GOBIERNO *de* GUATEMALA
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MINISTERIO DE ENERGÍA Y MINAS

INDICATIVE PLAN FOR RURAL ELECTRIFICATION

2020 - 2050

Guatemala City, April 2020

INDICATIVE PLAN FOR RURAL ELECTRIFICATION 2020-2050

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PRESENTATION

The Ministry of Energy and Mines, as the governing entity responsible for policies and plans related to electricity coverage in the Republic of Guatemala, in compliance with the General Government Policy 2020 - 2024 and the National Rural Electrification Policy 2020-2050, through the Unit of Mining Energy Planning, presents the updated Indicative Plan of Rural Electrification 2020 - 2050.

The country's electricity coverage rate has reached 91.23% (88.14% with conventional overhead networks and 3.06% with isolated renewable systems). These results were obtained from the XII Population and Housing Census conducted in 2018. This census provides a clearer picture of the current situation, enabling more precise planning and coordination of actions.

With the aim of fulfilling the goals set in the General Government Policy, a strategic and operational roadmap is developed below, enabling the achievement of established objectives.

The legal, institutional, technical, and financing framework needed to achieve the goals and objectives outlined in the policies are presented and elaborated in the proposals of this Plan. Furthermore, indicators are established for measurement, reporting, and verification regarding the fulfillment of this Plan, ultimately aiming for the electricity coverage indicator to reach 93.5% for the entire country by 2023.

Universal access to electricity service is one of the goals established in the United Nations Sustainable Development Goals (SDGs), particularly Goal 7, which focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all. Through this Plan, the aim is to facilitate the supply of electricity service, thereby fulfilling the functions and attributes of this Ministry.

Alberto Pimentel Matta
Minister of Energy and Mines

EXECUTIVE SUMMARY

The Ministry of Energy and Mines, with the aim of leading the path towards achieving the electricity coverage targets established in the General Government Policy 2020 - 2024 and the National Innovation and Development Plan, develops the guidelines in this plan to reach a 93.5% electricity coverage by 2023. In terms of execution and operation mechanisms, the "Rural Electrification Indicative Plan 2020 - 2050" is presented in this plan.

This plan conducts an analysis of the existing legal, technical, and financial framework for the execution of rural electrification projects, presenting the current electricity coverage situation of the country and the characterization of the population and patterns of final electricity usage.

Through this Plan, a methodology is developed to prioritize rural electrification in municipalities based on 7 variables: regulated user growth, access to the electricity transmission and distribution system, number of users in the country without access to electricity, human development index, multidimensional poverty index, percentage of people in poverty, electricity service quality, firewood consumption, proximity to existing grids, and population density.

Following the prioritization, technical mechanisms for rural electrification are described: connection to the grid, isolated systems and self-generating users, micro-substations, isolated micro-grids with the possibility of connecting to the grid, micro-generation, among others. It is specified that entities capable of developing electrification projects can be agents of the electricity sector or interested private entities.

Subsequently, responsibilities are assigned to the involved institutions by delineating specific actions through the establishment of procedures, all in congruence to achieve full coordination in goal attainment.

Finally, mechanisms allowing the financing of rural electrification projects are described, including Value Added Distribution, multilateral bank loans, Rural Electrification Subsidy, contributions from the central government, and self-initiatives by market agents. The Ministry will play an important role in coordinating efforts and centralizing information to efficiently execute projects and implement improvements.

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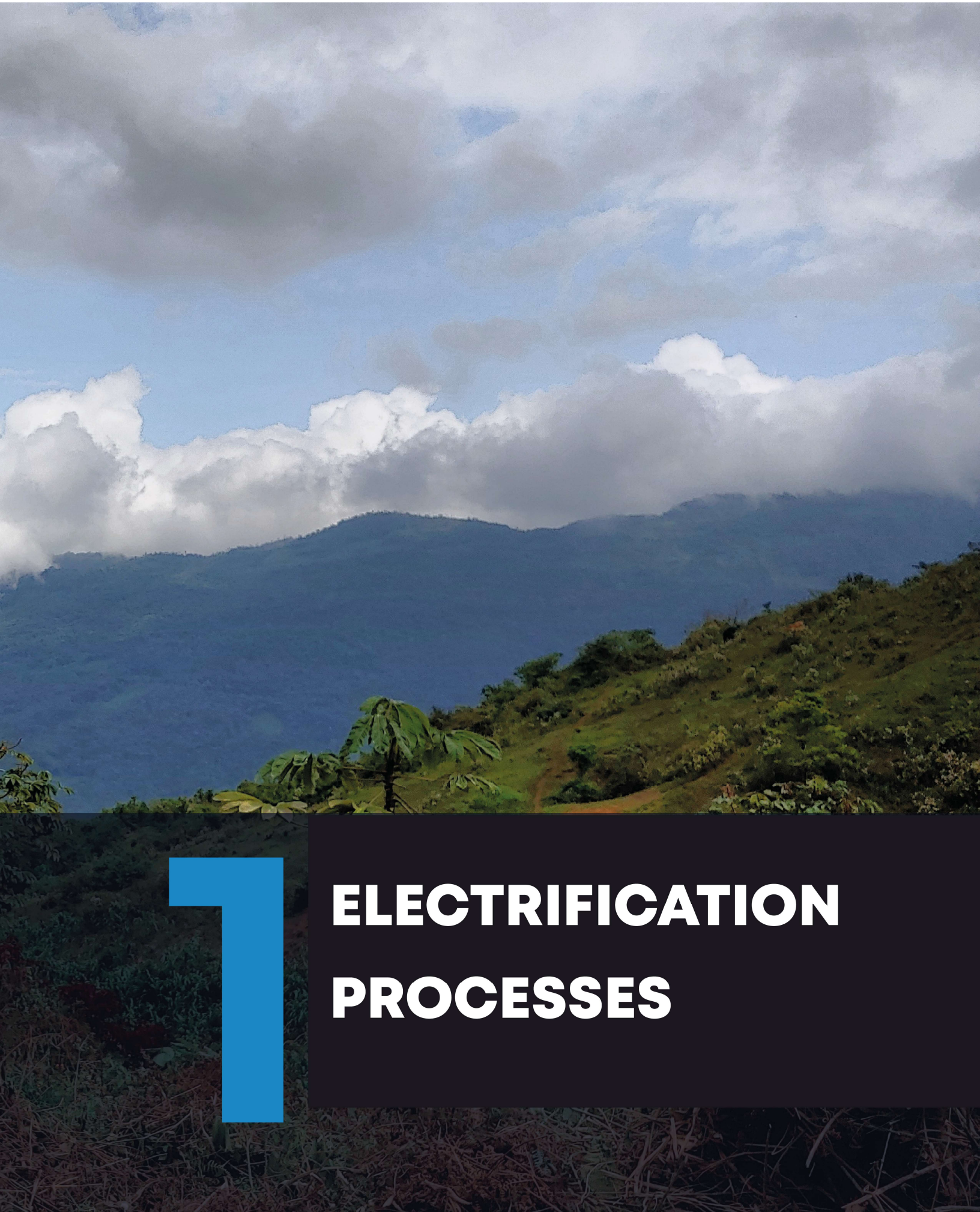


1 ELECTRIFICATION PROCESSES

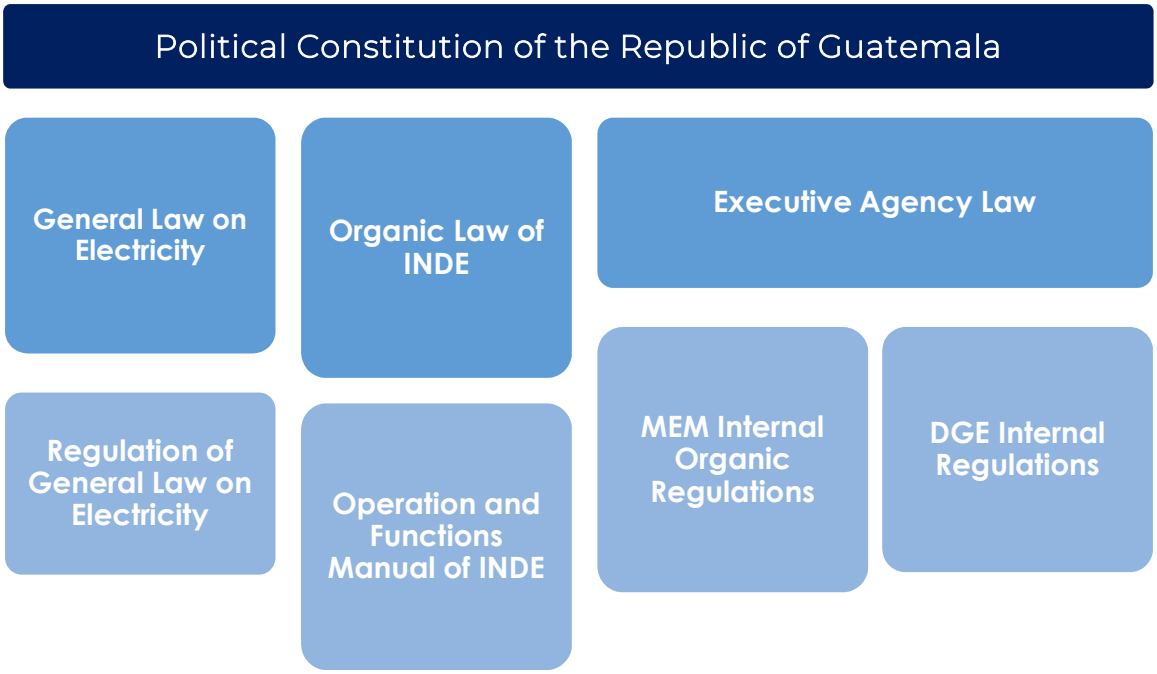
1. ACTORS IN THE ELECTRIFICATION PROCESS

This Plan is based on the current legal and institutional framework, in addition to the specific development policies of the electricity sector that will guide the implementation and achievement of the national rural electrification objectives. This Plan and its updates will establish for the actors involved the way in which it is intended to achieve in the first place the 93.5% established in the National Government Plan 2020 - 2024, 95% of the electricity coverage index in the year 2027, established in the Energy Policy 2013-2027, and at least 99.99% of electricity coverage before the year 2032.

1.1. LEGAL FRAMEWORK AND STRUCTURE OF THE ELECTRIC SUB-SECTOR

The development of this Plan is based on the current legal framework for rural electrification in the country, considering first the Constitution, secondly the laws currently in force, then the governmental agreements, and lastly the ministerial agreements and those of the Board of Directors of INDE. Illustration 1 shows the relationship between each one of them, and all of them related to the Constitution.

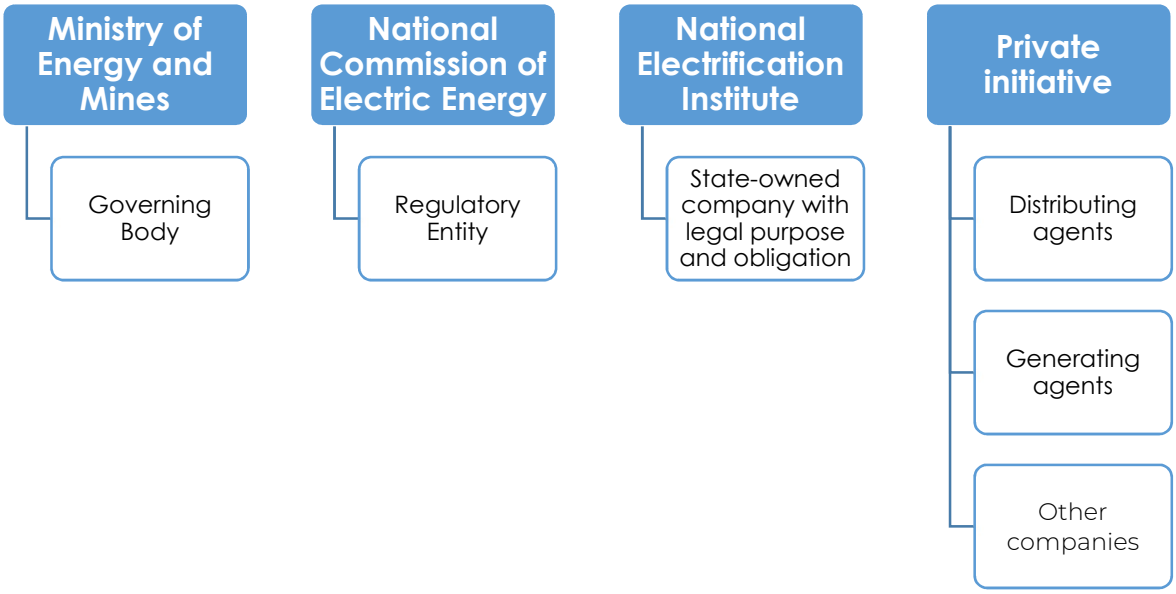
Illustration 1: Legal framework related to the electrification of the country.



Source: Unit of Mining Energy Planning, proprietary production.

The structure of the electricity subsector related to rural electrification is shown from the governing entity, the Ministry of Energy and Mines, to the executing institution or entities participating in it; however, it is INDE who is responsible for the responsibility established in Article 4 of its organic law, while the Constitution establishes the electrification of the country as a national urgency, allowing the participation of the private initiative.

Illustration 2: Institutional structure of the electric sub-sector related to the electrification of the country.



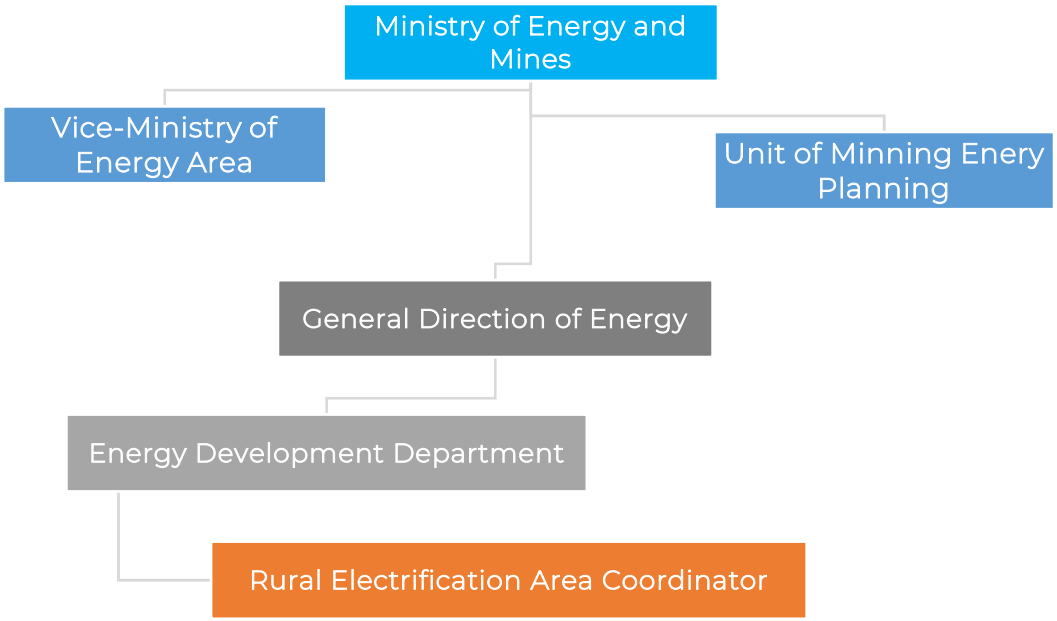
Source: Unit of Mining Energy Planning, proprietary production.

1.1.1. MINISTRY OF ENERGY AND MINES (MEM)

The Ministry, through the Energy Development Department of the General Direction of Energy, is in charge of carrying out the socioeconomic evaluations indicated in Article 47 of the General Law on Electricity, hereinafter referred to as LGE. Regarding the plans and policies related to the development of the national interconnected system and the coverage of the electricity distribution network, the Unit of Mining Energy Planning of the Ministry is in charge of developing the respective policies and plans.

In the Ministry, the current structure regarding compliance with Article 47 of the LGE and Articles 71, 72, 73, 74 and 77 of the Regulations of the LGE, according to Governmental Agreement 382-2006 and its reforms and Ministerial Agreement 178-2006, is the diagram detailed in Illustration 3.

Illustration 3: Institutional diagram of the Ministry of Energy and Mines involved with rural electrification and national electricity grid coverage according to the legal framework in force as of May 2019.



Source: Governmental Agreement No. 382-2006, amended by Governmental Agreement No. 631-2007, Ministerial Agreement No. 178-2006, and Manual of Functions and Job Descriptions of the General Direction of Energy.

1.1.2. National Commission of Electric Energy (CNEE)

The General Law on Electricity, through Article 4, establishes the National Commission of Electric Energy (CNEE) as a technical body of the Ministry. One of its functions is to issue regulations and norms to ensure the free access and use of transmission lines and distribution networks in accordance with the current legal and regulatory framework.

By legal mandate, the CNEE is responsible for granting recognition to final electricity distributors for the expansion of the distribution network in authorized areas, based on tariff studies that culminate in the determination of the Value Added for Distribution (VAD). In this way, the cost of expanding the distribution network to non-integrated users is recognized as a capital and operational cost of an efficient distribution network.

Article 85 of the Regulations of the General Law on Electricity states that for the calculation of Base Tariffs, the projected supply costs for the distributor over a period of five years will be considered. These cost projections consider the anticipated growth in electricity demand, expansion plans for the distribution network, and a series of indicators defined by the CNEE.

For isolated electrical systems, Article 100 of the Regulations of the General Electricity Law stipulates that the CNEE will issue resolutions to establish the necessary procedures for setting the prices of electric energy services. This would allow communities that are financially unviable to be connected to the National Interconnected System to receive electric energy services at a reasonable price regulated by the CNEE.

Illustration 4: Institutional diagram of the National Commission of Electric Energy involved with the expansion of distribution networks and the coverage of the national electricity grid according to the legal framework in place as of May 2019.

Source: Governmental Agreement No. 256-97, Governmental Agreement No. 68-2007, Governmental Agreement No. 145-2008, Agreement No. CNEE-98-2013 and Agreement No. CNEE-218-2015.

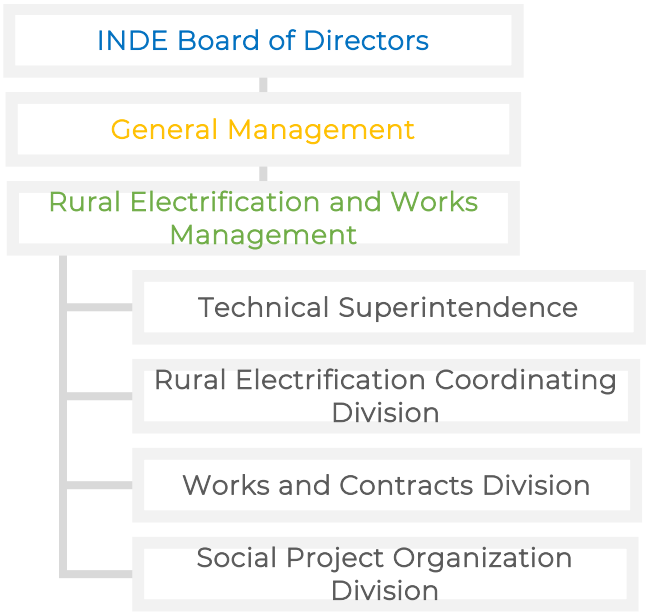
1.1.3. NATIONAL INSTITUTE OF ELECTRIFICATION

The National Electrification Institute - INDE for its acronym in Spanish- by legal mandate established in its Organic Law Decree 64-94, fulfills through the management of rural electrification, and works the task of executing projects that integrate communities or villages into the distribution network, provided they have the corresponding socio-economic study by the MEM. This allows for projects to be carried out if there are economic resources available.

Article 4 of the INDE Organic Law establishes as its primary purpose and obligation to undertake actions aimed at promoting the development of new industries and the use of electricity in rural regions. Electrical energy is correlated with the productive and industrial development of a community, as it makes production and transformation processes of raw materials into value-added products more efficient. Additionally, human development in conditions of lack of electricity service is considered a parameter to define poverty. For this reason, and in compliance with Article 23 and 24 of the same INDE Organic Law and Article 47 of the General Law on Electricity, INDE has executed the Rural Electrification Plan (PER for its acronym in Spanish).

In its Multi-Year Operational Plan 2018-2020, INDE has established an institutional outcome to contribute to the increase of the electricity coverage index in the rural areas of the country with 4,611 new users by the year 2020. Program 14 of INDE, related to rural electrification, provides the necessary electrical infrastructure to potential communities and inhabitants of rural areas, promoting economic growth, prosperity for all beneficiaries, and the expansion of the coverage of the national electric grid, through rural electrification programs in coordination with private entities, municipalities, and the government.

Illustration 5: Institutional diagram of the National Electrification Institute related to rural electrification and the coverage of the national electricity grid according to the current legal framework as of May 2019.



Source: Agreement GSC-11-2011 of the Management of Corporate Services of the INDE.

1.1.4. DISTRIBUTORS AND EEM'S AGENTS

Final electricity distribution agents duly authorized by the MEM, in accordance with the current legal framework, have the obligation to provide electricity service to users located within the compulsory strip that may not be less than 200 meters around their facilities (Article 65 of the Regulations of the General Law on Electricity).

If an end user of the distribution service is located outside the 200 meter band, it may reach the limit of the band using its own or third party electric service lines (Article 66 of the RLGE), and in the case of installations developed in accordance with Article 47 of the LGE, the connections within the obligatory band will be made by the distribution agents without requiring a reimbursable contribution from the users (Article 71 of the Regulations of the General Law on Electricity).

However, the distribution agents must also present to the CNEE in their five-year study their projections of supply costs for the calculation of the Base Tariffs, the plans for expansion of the distribution network, which may allow them to reach users that are outside the obligatory band, especially communities that may have many users even without electricity network coverage. The distribution network expansion plans included in the respective investment programs are verified by the CNEE and approved by the CNEE for inclusion in the investment cost projection.

The rural electrification process is also useful for increasing customer base and sales, and distributors can propose distribution network expansion plans to the CNEE for implementation in each distribution value-added stud

1.2. LEGAL BASIS

The following legal instruments were considered for the preparation of the following plan.

1.2.1. CONSTITUTION OF THE REPUBLIC AND THE LAW OF THE EXECUTIVE ORGANISM

Regarding national electrification:

- ✓ Article 129 of the Constitution of the Republic establishes: "The electrification of the country is declared a national urgency, based on plans formulated by the state and municipalities, in which private initiative may participate."

- ✓ The Constitutional Court has expressed its opinion on this matter as follows: "*The service of electrical energy constitutes an essential, obligatory, and regulated public service by the State. The Electric Company of Guatemala, Limited Company, is a private entity that provides an essential public service and, therefore, is endowed by law with certain powers, such as responding obligatorily and positively to a request for energy service installation, as long as legal requirements are met.*" Gazette 101. File 543-2011. Date of judgment: 20/07/2011. Gazette 117. File 1149-2012. Date of judgment: 10/09/2015. Gazette 107. File 4419-2011. Date of judgment: 05/02/2013.

Regarding State Investment and funds for economic and social development, the Constitution indicates:

- ✓ "Any law that implies investments and expenditures of the State must indicate the source from which the funds to cover them will be taken. If the investment or expenditure is not included and identified in the General Budget of Revenues and Expenditures of the State approved for the respective fiscal year, the Budget cannot be expanded by the Congress of the Republic without the favorable opinion of the Executive Organism.

If the opinion of the Executive Organism is unfavorable, the Congress of the Republic can only approve the expansion with the vote of at least two-thirds of the total number of deputies that make it up.

The Constitutional Court has pronounced on the application of this article as follows: "[...] this requirement tends to avoid estimating expenses without having resources for them. In other words, the constitutional norm obliges the State not to limit itself to assuming new expenses - which, it is worth mentioning, become necessary due to public needs - but to verify the existence of real sources to cover them beforehand, which must be detailed in the same norm that determines the expenditure. This not only ensures its financial capacity to meet this requirement, but also specifies, with general effects, the resources that will be prioritized to comply with the legal precept that so dictates, making feasible the achievement of the functions entrusted to it by the constitutional text. To build and sustain a democratic regime [...]." Gazette 113. File 5352-2013. Date of verdict: 11/07/2014.

"[...] by source, [...], it refers to the origin or origin of the financial resources to be used to cover a certain expense, i.e., the specific state income from which such resources will be taken. [...] by

source of investment or source of financing, one must understand the specific circumstance generating funds, from which the State will collect or receive the financial resources intended to fulfill its purposes. Now, these sources can be of a tax or non-tax nature, including under the former, different taxes, fees, or special contributions decreed in favor of the State, and under the latter, all income not generated from taxes, such as public credit operations, conceived as forms of state indebtedness to raise financing means - loans with national or international entities, issuance of securities, promissory notes, bonds, or obligations constituting loans and others -; charges for the provision of public services, or donations made in favor of the State, among others. [...] the constitutional norm obliges the State not to limit itself to assuming new expenses - which, it is worth mentioning, become necessary due to public needs - but to verify the existence of real sources to cover them beforehand, which must be detailed in the same norm that determines the expenditure. This not only ensures its financial capacity to meet this requirement but also specifies, with general effects, the resources that will be prioritized to comply with the legal precept that so dictates, making feasible the achievement of the functions entrusted to it by the constitutional text [...]." Gazette 85. File 1201-2006. Date of verdict: 27/09/2007.

- ✓ Artículo 242. Guarantee Fund. "In order to finance economic and social development programs carried out by legally recognized nonprofit organizations in the private sector in the country, the State will establish a specific fund of guarantee from its own resources, decentralized or autonomous entities, private contributions, or from international sources. A law will regulate this matter."

- ✓ Regarding the application of this article, the Constitutional Court has stated as follows: "Gazette 71. File 538-2003. Date of judgment: 15/01/2004."

Regarding the functions of the Ministry of Energy and Mines:

- ✓ Article 34. Ministry of Energy and Mines. "It is responsible for matters related to the legal regime applicable to the production, distribution, and commercialization of energy and hydrocarbons, and the exploitation of mining resources. Therefore, it has the following functions:

...

f) Provide opinions within its jurisdiction on policies or projects of other public institutions that impact the energy development of the country.

g) Exercise the regulatory, control, and supervisory functions in Electric Energy matters assigned to it by the laws..."

1.2.2. GENERAL ELECTRICITY LAW AND ITS REGULATIONS

Regarding the functions of the Ministry of Energy and Mines and the National Electricity Energy Commission, the General Electricity Law establishes:

- ✓ Article 3. "Except as expressed in this law, the Ministry of Energy and Mines, hereinafter referred to as the Ministry, is the state organ responsible for formulating and coordinating policies, state plans, indicative programs related to the electricity subsector, and applying this law and its regulations to fulfill its obligations."

Regarding the application of this article, the Constitutional Court has stated as follows: "[...] it must be concluded that the topic of electrical energy service is a matter of the unitary State and not of the entities that constitute it (municipalities). In this way, logically, everything related to decision-making regarding the electrification of the country corresponds to the Executive Organ, which finds the appropriate technical body for this purpose in the Ministry of Energy and Mines [...]." Gazette Jurisprudential No. 72, File No. 1063-2003, verdict: 18-05-20.

- ✓ Article 4. "The National Electricity Energy Commission is created, hereinafter referred to as the Commission, as a technical organ of the Ministry. The Commission will have functional independence for the exercise of its powers and the following functions: ...

e) Issue technical standards related to the electricity subsector and supervise their compliance in accordance with accepted international practices;

The Constitutional Court has pronounced on the application of this subparagraph as follows: "[...] with this basis, it cannot be affirmed that sanctioning non-compliance with the quality requirements of the technical resolutions issued by the Commission, or non-compliance with the submission of the necessary information to evaluate the quality of the service, is beyond the scope of the law that alters its spirit, or that it does not fit within the Commission's powers as per the Law. It is obvious that the Commission cannot fulfill these functions if, in addition to granting it the power to issue technical standards to regulate the actions of those involved in the electrical system, it is not authorized to ensure their compliance, empowering it to impose necessary sanctions; a situation that could not be otherwise in the light of the ordinary rule, which would fall into the absurdity of creating a Technical Commission to manage the electrical subsector with the power to issue technical standards but without sufficient power to ensure compliance with its own decisions. Such a situation would indeed be contrary to the spirit of the law." Gazette Jurisprudential No. 64, File No. 360-2002, verdict: 05-06-2002.

f) Issue provisions and regulations to guarantee free access and use of transmission lines and distribution networks, in accordance with this law and its regulations."

"(...) the National Electricity Energy Commission must comply with and enforce the law and its regulations, without prejudice to, regardless of the regulation, and in accordance with the aforementioned subparagraphs e) and f) of Article 4 of the Law, it (the Commission) may issue provisions based on the Law and the regulation that develop activities and decisions within its competence and that are not contained in it. Thus, there is a delegation of the law to the regulation on how the National Electricity Energy Commission should proceed, and

with this, no unconstitutionality of the attacked provision can be appreciated." Gazette Jurisprudential No. 67, File No. 1471-2002, verdict: 11-03-2003.

Regarding investment in rural electrification projects, the General Electricity Law establishes:

- ✓ Article 47. "The State may grant resources to fully or partially finance investment in rural electrification projects of social benefit or public utility, developed outside a delimited territorial zone. The resources granted by the State will be considered as a subsidy, which cannot be transferred as a cost to the user. The works built with these contributions will be administered and operated by the awardee, who is obligated to keep them in perfect working conditions.

The projects referred to in the preceding paragraph must have a favorable socio-economic evaluation report from the ministry."

Regarding the functions and attributions of the General Direction of Energy, the Internal Organizational Regulation of the Ministry of Energy and Mines establishes:

- ✓ Article 16. General Functions. "The General Direction of Energy shall have the following functions and powers: ...

d) Coordinate the identification, selection, competitions for socioeconomic evaluation, engineering studies, and construction of rural electrification projects for social benefit or public utility, as well as their supervision, in accordance with State policies;

..."

- ✓ Article 4 of Ministerial Agreement No. 178-2006, Internal Regulations of the General Direction of Energy, establishes the functions and powers of the Energy Development Department.

Regarding rural electrification projects, the RLGE stipulate:

- ✓ Article 77. Rural Electrification Projects. "For the application of Article 47 of the Law, the Ministry shall establish a procedure for the preparation of the economic and social evaluation report of the project, in order to determine the validity or invalidity of the request."

Concerning the recognition of distribution network expansion plans, RLGE establishes:

Article 85.- Cost Projection. "Supply costs for calculating Base Tariffs shall be representative average values of projected costs for a five-year period. Cost projections shall be determined at prices as of the date of the study, considering projected demand growth, expansion plans, and operation and unit cost indicators defined by the Commission.

The Expansion plans, including respective investment programs, shall be presented by the Distributor to the Commission, which shall verify their consistency and approve their inclusion in the investment cost projection..."

Regarding the price of electricity service for isolated systems, RLGE establishes:

- ✓ Article 100.- Isolated Systems. "The Commission, considering the specific characteristics of the operation of the respective Isolated System and applying, to the extent possible, the corresponding guidelines stipulated for the National Interconnected System, shall issue Resolutions establishing procedures to be followed in each specific case for setting prices."

1.2.3. INDE ORGANIC LAW

Regarding the Objectives and Obligations of INDE:

- ✓ Article 4. "The objectives and obligations of INDE are:

a) To carry out all actions aimed at quickly and effectively addressing the shortage of electricity in the country and ensuring that there is always available energy to meet the regular demand, to promote the development of new industries and the use of electricity in rural areas, in accordance with the policies defined by the State.

Regarding the financial policy of the use of INDE's surplus:

- ✓ Article 23. "INDE will have its own budget and private funds, and its financial policy will be to capitalize on the net profits obtained, allocating them to finance and execute its electrification plans."

- ✓ Article 24. "INDE is not a source of fiscal revenue and, therefore, will not contribute any of its profits to the State's common fund since its mission is to increase electricity production as a basic national industry. This is without prejudice to fulfilling the tax obligations established by the relevant laws. All revenues from electricity activities will form a fund of private availabilities for INDE, to be used exclusively in the fulfillment of its objectives. When INDE has a financial surplus, it must invest it primarily in rural areas, in line with the development plans established by the Ministry of Energy and Mines.

INDE's income will not depend on the Central Government, and it should receive payments from it for electricity and services provided at the corresponding rate.

INDE can also receive income from the Central Government in terms of subsidies granted to electricity rates for consumers and can also receive income from the Central Government for rural electrification."

Regarding the execution of plans, programs, and projects:

- ✓ Article 31. *"The INDE Board of Directors will authorize expansions, reductions, and transfers required for the proper execution of its plans, programs, and projects, following the procedure established in the initial approval of the same."*

- ✓ Article 45. *"The Ministry of Energy and Mines is the communication body between the Executive Organism and INDE...."*

1.2.4. NATIONAL DEVELOPMENT PLAN K'ATUN OUR GUATEMALA 2032

Within the National Development Plan K'atun Our Guatemala 2032, Chapter 10, as part of the guidelines of Goal 2 to meet the priority of comprehensive rural development, states:

"Reduce the impact of agricultural, mining-energy, industrial, and urban activities that occur in fragile ecosystems and/or heritage areas, thus mitigating the deterioration of natural forests, soil degradation, loss of biodiversity, contamination of water bodies, and loss of natural and cultural heritage."

From Chapter 12, Wealth for All, the infrastructure priority for development is highlighted, citing the following guideline of Goal 1:

"Communications infrastructure.

- *Access to telephony and the Internet.*
- *Access to electricity."*

From Chapter 13, Natural Resources Today and for the Future, the guideline of Goal 2, for the priority of adaptation and mitigation against climate change, states:

"Implement electrical connections through renewable energies (hydroelectricity, wind energy, solar)".

Similarly, from the priority of access to quality energy with national coverage, the following guideline is mentioned:

"Expand household electricity coverage in rural areas by strengthening the rural electrification program".

The development of rural electrification projects helps mitigate the uses of sensitive ecosystems for extracting energy supplies that meet basic needs in rural communities, such as firewood for cooking and heating in cold regions.

The Indicative Plan for Rural Electrification promotes the achievement of goals and guidelines proposed within the K'atun 2032 Plan, encouraging the use of renewable energies to provide electricity service to communities that, due to their geographical location, are difficult to connect to the network in the short term, thus contributing to the mitigation of GHG emissions produced by the energy sector.

The objectives of the K'atun 2032 Plan can be summarized as:

Objectives of the K'atun 2032 Development Plan.
Access to quality energy with national coverage.
Energy as a factor of social development is fundamental for the improvement of the population's living conditions. It favors the overcoming of poverty and the increase of family income, supports the development of social, productive, commercial and agricultural activities.
The living conditions of the rural population have improved with access to the services provided by electric power.
100% energy coverage in rural areas, for domestic use.
Quality energy throughout the country, for use in productive, industrial, commercial and agricultural activities.
Increasing the participation of renewable energy in the energy matrix, considering citizen participation and the participation of Mayan, Xinca, Garifuna, gender and age groups.

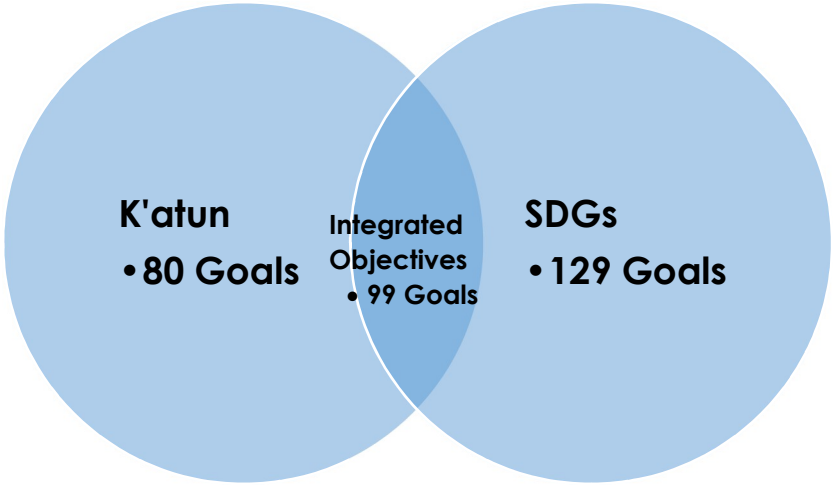
Source: Proprietary Production, K'atun 2032.

1.2.5. NATIONAL AND DEVELOPMENT PRIORITIES AND STRATEGIC GOALS

The various state powers, civil society, the private sector, and international organizations have committed to the National Sustainable Development Agenda and how it can be articulated to the National Development Plan K'atun 2032.

The establishment of national priorities aims to seek integrated goals among the 80 goals set in the K'atun development plan and the 129 Goals set in the SDGs, determining that between the two plans, there are 99 integrated goals.

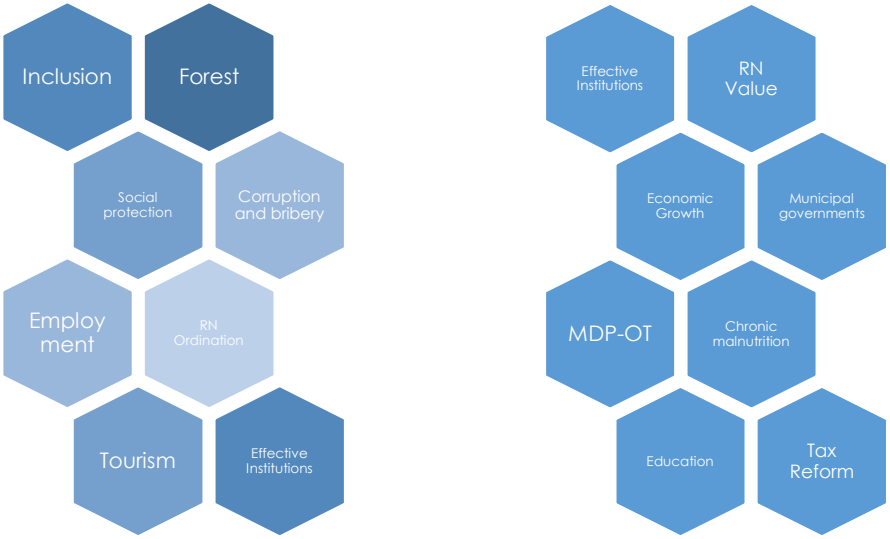
Illustration 6: Integrated Goals K'atun 2032 and SDGs.



Source: Proprietary Production, Segeplan.

The integration of these objectives was summarized in 16 MED objectives, which are cross-cutting for both the K'atun Development Plan and the sustainable development objectives.

Illustration 7: Strategic Development Goals.



Source: Proprietary production, Segeplan

1.2.6. GENERAL GOVERNMENT POLICY 2020-2024

The Government of Guatemala, committed to the fulfillment of national and international agreements acquired throughout the diplomatic history of the country, has presented the General Government Policy, with a horizon of 2020 to 2024. Considering that all actions and efforts for the country are focused on improving the living conditions of the Guatemalan population, in its social, political, economic and environmental environment, this policy presents five strategic pillars.

Illustration 8: Strategic pillars of the General Government Policy 2020 - 2024.

General Government Policy
Economy, Competitiveness and Prosperity
Social Development
Governance and Security in Development
Accountable, Transparent and Effective State
World Relations

Source: Proprietary Production, with information from the General Government Policy 2020- 2024.

Identifying the country's commitments and the current context of Guatemalan society, country solutions are formulated, which contain goals, actions, and indicators. Regarding the energy sector and rural electrification, the following points are emphasized.

Illustration 9: Interaction of Government Policy with rural electrification in Guatemala.

4.1 Economy, competitiveness and prosperity	**Strategic Objective:** to promote economic growth and sustainable employment growth	**Sectorial objective:** Promote the development of renewable and non-renewable energy sources compatible with environmental conservation.	**Strategic action:** to expand the coverage of electricity service to the Guatemalan population, with emphasis on the population living in rural areas.
	Strategic goal: by 2023, the proportion of the population with access to electricity will have increased to 93.50%.	**Indicator for measurement:** proportion of the population with access to electricity **Baseline:** 88.14 % (2018) **Directly responsible:** MEM	

Source: Proprietary production, with information from the General Government Policy 2020 - 2024.

Illustration 9, shows the objectives and the goal formulated by the current General Government Policy regarding rural electrification in Guatemala, deducing the direct responsibility of the Ministry of Energy and Mines; the creation of this document provides the guidelines and roadmaps that will allow the fulfillment of this General Government Policy.

Illustration 10: Guidelines of the National Innovation and Development Plan for rural electrification.

Source: Proprietary production, PLANID

1.2.7. ENERGY POLICY 2013 - 2027

The first core concept of the 2013-2027 energy policy, Security of electricity supply at competitive prices, establishes the following in terms of electricity coverage, Illustration 8, details this policy.

Illustration 11: Detail of the objective established in the Energy Policy 2013-2027, Governmental Agreement No. 80-2013.

Operational Objectives	•Extending electricity coverage nationwide
Long Term Goals	•Achieve 95% electricity coverage index
Actions	•Implement a strategic rural electrification plan in synergy with the actions developed by Inde. •Strengthen the actions of Inde's Rural Electrification Plan. •Develop rural electrification programs that use supply options for isolated systems and in which renewable energies are prioritized. •Improve inter-institutional procedures associated with rural electrification requests.
Related public and private institutions	•MEM, INDE, CNEE, AMM, distribution companies and municipal electric companies. Organized private sector.

Source: Energy Policy 2013-2027, page 39.

1.2.8. ENERGY POLICY 2019 – 2050

La actualización de la Política Energética establece para el eje de abastecimiento y uso final de electricidad del sector de la industria energética, el objetivo detallado en la Ilustración 9. En este eje, establece lo siguiente:

"The Government of Guatemala, through the institutions that must enforce the General Electricity Law, will face the challenge of increasing electricity coverage in the country, guaranteeing the quality of electricity service throughout the national territory, supplying this energy at the most competitive price for regulated and non-regulated users, in addition to generating electricity efficiently by means of various technologies that guarantee the coverage of the daily demand curve of our country; ..."

Illustration 12: Detail of the objective established in the Energy Policy 2019-2050.

Electricity Supply and End-Use of the Power Industry Sector *Energy Industry*		
3. Objective: National Electric Coverage	✓ Actions o Elaborate the National Rural Electrification Plan 2020 - 2050 to reach 99% electricity coverage by 2032. o Incorporate in the Transportation System Expansion Plan the infrastructure that will allow for the adaptation of the network to facilitate the incorporation of electrification projects.	*Actors:* *UPEM and DGE (for its acronym in Spanish)*

Source: Energy Policy 2019-2050, page 54.

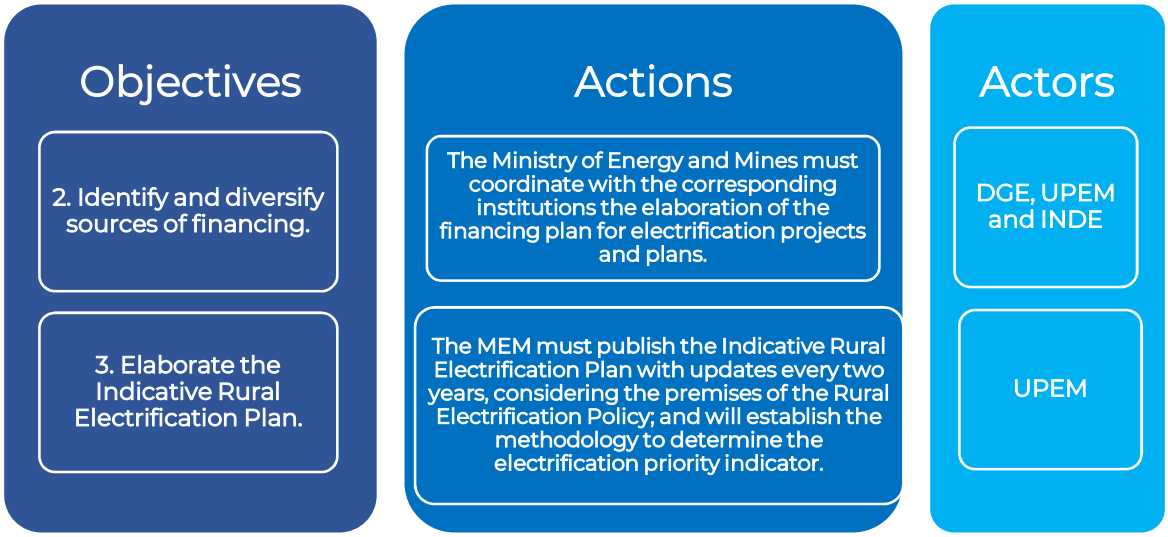
1.2.9. RURAL ELECTRIFICATION POLICY 2020 - 2050

The National Rural Electrification Policy 2020-2050 is necessary to guide the principles and guidelines that underpin the plans, strategies and actions that will be carried out to ensure electricity supply to nearly 388,675 thousand Guatemalan households that currently do not have this service.

This policy establishes the following principles for future rural electrification plans:

- ✓ Security of energy supply
- ✓ Strategic planning
- ✓ Sustainable development

Illustration 13: Detalle de los objetivos planteados en la Política Nacional de Electrificación Rural 2020 - 2050.



Source: National Rural Electrification Policy 2020-2050, page 52.

The main lines of action of this policy are aimed at improving the living conditions and productivity of Guatemalan communities that currently do not have electricity service. This mission is pursued from two different fronts: the technical front through the Rural Electrification axis, and the social front with the Productive Development axis.

The sectors involved in this policy were considered according to the area of influence and relationship with the objectives: the community sector addresses the need to involve Guatemalans affected by the lack of electricity service, with the purpose of integrating them into the network and the chain of production and use of electricity. The institutional sector involves public and private entities, both from the central government and municipalities, such as INDE and distribution agents, whose institutional and legal framework obliges them or allows them to promote the growth of the coverage of the electricity distribution network.

In this policy, all objectives and operational actions are related to the goal of reaching 93.5% of the population with access to electricity by 2023. Specifically of the Rural Electrification Plan, Illustration 13 contains the objectives and actions that this Plan intends to achieve.

✓ PREMISES OF THE RURAL ELECTRIFICATION POLICY

The fourth chapter of the National Rural Electrification Policy 2020-2050 establishes the premises for the preparation of the Indicative Plan for the objective of increasing the electricity coverage index. In the first place, it is necessary to establish an indicator that allows prioritizing the communities in which efforts should be focused to allow them access to electricity, since the construction and assembly of a distribution network that allows increasing electricity coverage is only one part and is related to the productive development of the communities for the use of electricity.

The identification of each of the variables related to the priority indicator will determine the approach for the optimization of technical resources, considering the social and development needs of the communities' inhabitants. Those communities whose self-determination is not to be incorporated into the distribution network, and those whose development plans are intrinsically related to this Plan, will be heard, and taken into account.

✓ MUNICIPALITIES PRIORITY INDICATOR

This indicator will allow establishing the necessary communities to reach the first rural electrification goal of 93.5% by 2023, which will be executed in the next two years until this Plan is updated; the identified variables are nine, four of them are technical premises and five are socioeconomic premises.

The weighting of the premises for the preparation of the Plan will be in accordance with Table 1.

Tabla 1: Valorization of the technical and socioeconomic premises.

Premises	*%*
Socioeconomic	*70*
Techniques	*30*

Source: National Rural Electrification Policy 2020 - 2050, page 56.

1.3. SOCIO-ENVIRONMENTAL CONSIDERATIONS

The following is a description of the set of commitments and socio-environmental plans considered in the preparation of this plan.

1.3.1. AGENDA 2030 AND SUSTAINABLE DEVELOPMENT GOALS (SDGs)

The Sustainable Development Goals (SDGs), a project that has been presented within the framework of the United Nations, sets forth as Goal 7: "Affordable and Clean Energy", which presents the following goals:

- *"7.1 Ensuring universal access to affordable, reliable and modern energy services by 2030*
- *7.2 By 2030, significantly increase the share of renewable energy in the overall energy mix*
- *7.3 Doubling the global rate of energy efficiency improvement by 2030*
- *7.a By 2030, increase international cooperation to facilitate access to clean energy research and technology, including renewables, energy efficiency and advanced and*

cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean technologies.

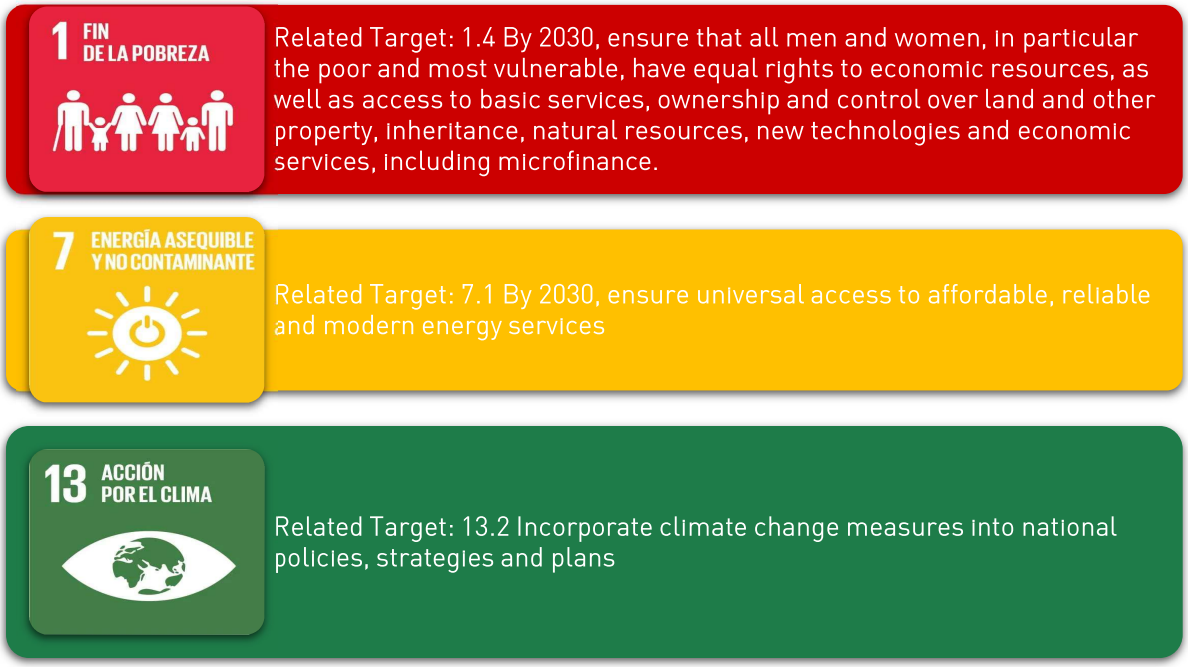
- *7.b By 2030, expand infrastructure and improve technology to provide modern and sustainable energy services for all in developing countries, in particular the least developed countries, small island developing States and landlocked developing countries, consistent with their respective support programs."*

Promoting rural electrification projects within the national territory contributes to the fulfillment of the goals presented by SDG 7.

The 2030 Agenda for Sustainable Development with its 17 Sustainable Development Goals (SDGs), was approved in September 2015 by the United Nations General Assembly, establishing a transformative vision towards economic, social and environmental sustainability of the 193 Member States, to which Guatemala belongs.

The management and implementation of projects that allow bringing electric power to those communities isolated from the national electricity system, allows contributing to the fulfillment of three SDGs in direct and indirect ways. The following figure shows how rural electrification can contribute to the fulfillment of various SDGs.

Illustration 14: Sustainable Development Goals linked to rural electrification in Guatemala.



Source: Proprietary production, with information from the United Nations.

Illustration 14 shows the impact that meeting the Guatemalan government's target would have on SDGs 1, 7 and 13, related to rural electrification. Electricity provides opportunities for community development, improved living conditions, energy transition in domestic activities, as well as an indirect contribution to the mitigation of greenhouse gas emissions by avoiding the use of fossil fuels for lighting and the use of firewood for cooking.

1.3.2. NATIONAL STRATEGY FOR LOW GREENHOUSE GAS EMISSIONS DEVELOPMENT

Among the options prioritized for the energy sector, the report published by USAID, in its Low Emissions Development project, identifies the following option as a nexus for supporting rural electrification projects:

SE-21/E-5. Development of mini and micro hydroelectric plants

This is a highly relevant option for bringing electricity supply to rural communities that have access to rivers, but not close access to the SNI power grid.

2

HISTORICAL CONTEXT

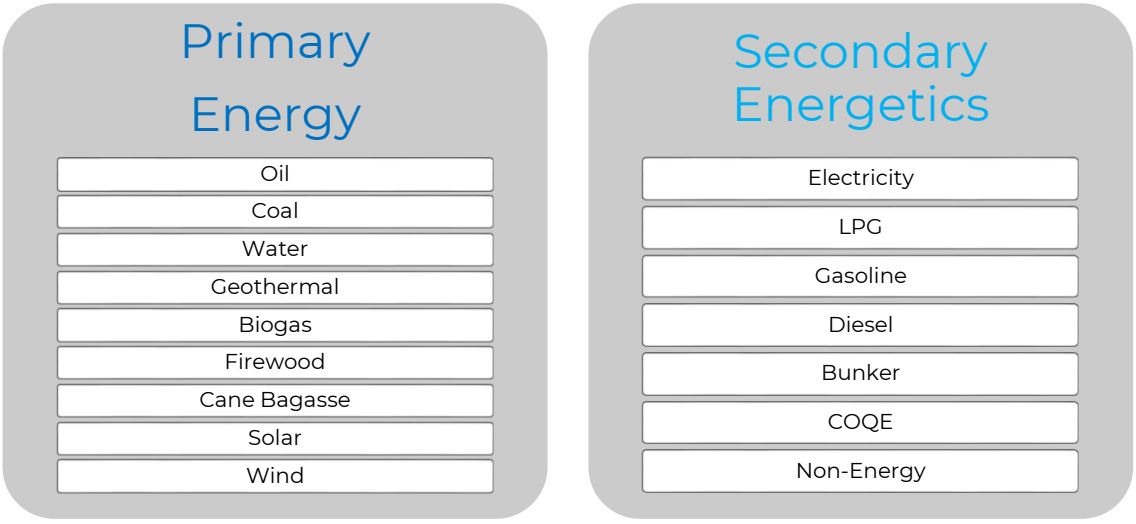
2. HISTORICAL CONTEXT

A fundamental part of determining future actions is to understand the historical characteristics, ranging from ethnic distribution, income, investments made, as well as approximate electricity coverage data.

2.1. ENERGY CONSUMPTION IN RURAL AREAS

Historically, energy uses have been classified into primary energy and secondary energy. Primary energy is all energy extracted from natural and unprocessed energy resources, while secondary energy is all energy extracted from energy conversion processes.

Illustration 15: Description of energies accounted for in the national energy balances.



Source: Ministry of Energy and Mines.

The applications of primary energy resources are diverse. The following are the most important ones: Generation of electric power, where the following energy sources are used: Oil, Coal, Water, Geothermal, Biogas, Cane Bagasse, Solar and Wind. Depending on the recovery capacity of each energy source and the amount of greenhouse gas emissions they produce during their application, they are classified as renewable and non-renewable.

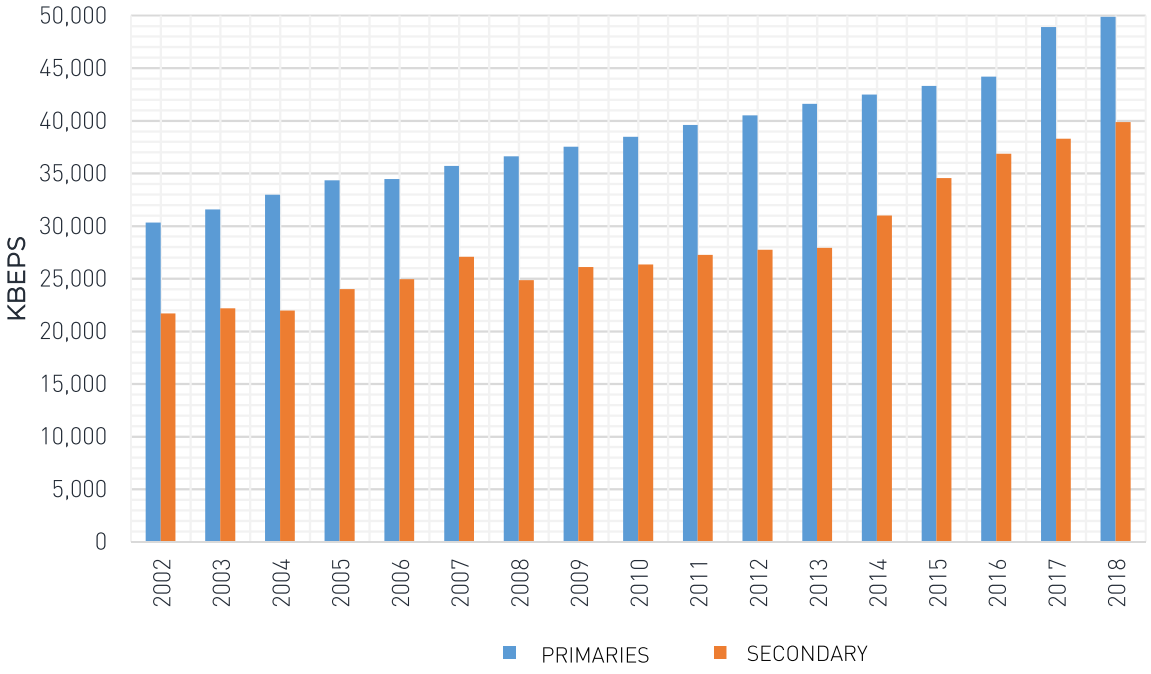
Among consumer sectors, firewood consumption has historically been the most demanded primary energy through the residential sector.

Secondary energy sources have a greater diversity of applications within the national energy balance; therefore, more consumption sectors require them. Such is the case of the land transportation sector, which demands gasoline and diesel in large proportions; during the last few years it has demanded electricity and Liquefied Petroleum Gas (LPG), due to the incursion of new technologies in the national vehicle fleet.

The Non-Energy category defines products that are derived from primary energy sources and whose purpose is not to generate electricity or other types of energy for final consumption. This group includes petroleum derivatives used to create asphalt.

In contrast to the case of non-energy products, there are secondary energy products: COQE and bunker, which are derived from primary energy products and are used to generate electricity.

Graph 1: Annual consumption of primary and secondary energies.



Source: Ministry of Energy and Mines.

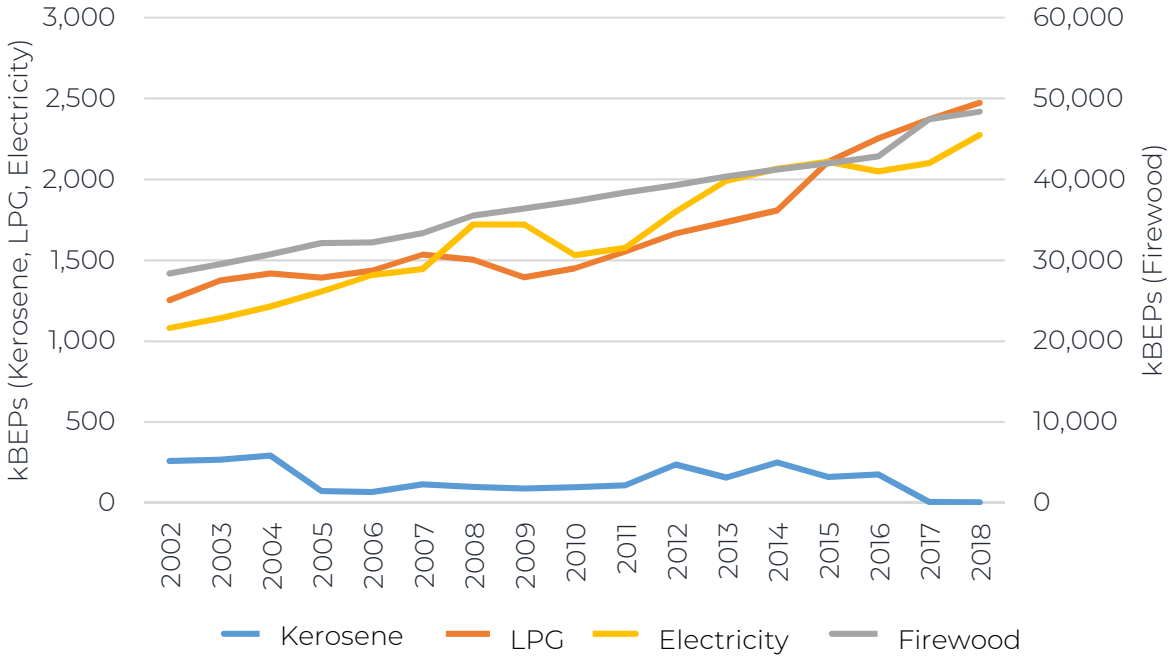
Graph 1 shows how, historically, the consumption of primary energy has been increasing. The largest proportion of this demand belongs to the residential sector, where firewood is used for various purposes.

In addition, the annual historical demand for secondary energy is shown. This figure shows that the growth in demand for these resources has not been under a linear trend, because the consumption of these resources is influenced by events and situations that directly or indirectly affect the country's economic growth capabilities.

2.1.1. HISTORICAL ENERGY BALANCE IN THE RESIDENTIAL SECTOR

The residential sector is classified into two characteristic subgroups: urban residential and rural residential.

Graph 2: Historical Energy Balance in the Residential Sector.



Source: Ministry of Energy and Mines.

Graph 2 shows the energy consumption of the residential sector by type of energy in annual periods, with firewood being the most demanded energy source.

2.1.2. ELECTRICITY CONSUMPTION IN RURAL AREAS

Electricity consumption in the residential sector ranges from 0 kWh to 300 kWh per month, with a small part of the population consuming more than 301 kWh per month.

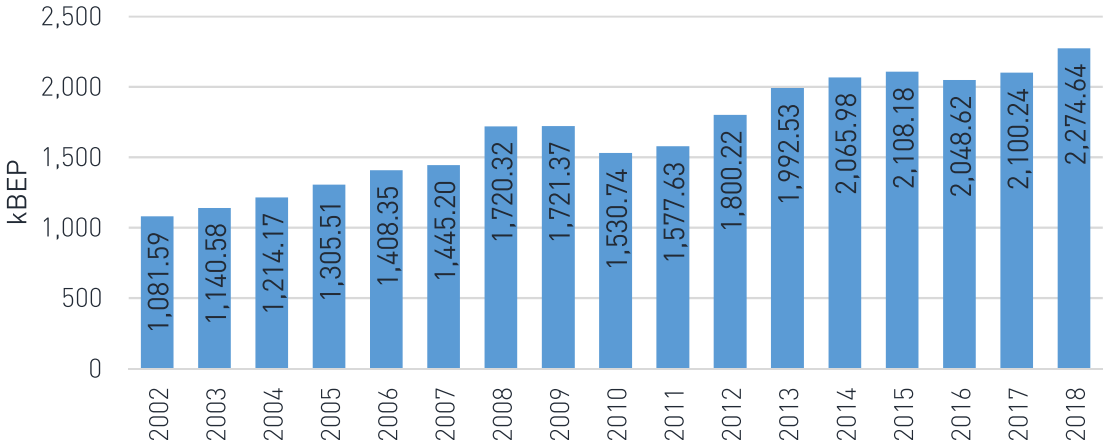
Table 2: Relative frequencies of monthly electricity consumption, residential sector.

Department	0 to 10 kWh	11 to 100 kWh	101 to 200 kWh	201 to 300 kWh	Over 301 kWh	TOTALS
Alta Verapaz	21.8%	61.7%	13.5%	2.9%	0.1%	100.0%
Baja Verapaz	23.9%	61.5%	12.1%	2.4%	0.0%	100.0%
Chimaltenango	11.7%	65.6%	20.2%	2.5%	0.0%	100.0%
Chiquimula	18.6%	62.0%	15.8%	3.5%	0.0%	100.0%
El Progreso	15.6%	64.2%	17.5%	2.6%	0.1%	100.0%
Escuintla	9.5%	45.8%	40.8%	3.8%	0.1%	100.0%
Guatemala	10.1%	39.7%	43.0%	7.0%	0.2%	100.0%
Huehuetenango	20.9%	70.2%	7.6%	1.2%	0.0%	100.0%
Izabal	18.6%	54.8%	21.0%	5.5%	0.1%	100.0%
Jalapa	13.8%	70.3%	13.5%	2.4%	0.0%	100.0%
Jutiapa	14.3%	67.8%	15.4%	2.5%	0.1%	100.0%
Petén	15.5%	60.6%	19.5%	4.3%	0.1%	100.0%
Quetzaltenango	15.5%	67.8%	14.4%	2.3%	0.0%	100.0%
Quiche	22.0%	66.7%	9.6%	1.6%	0.0%	100.0%
Retalhuleu	13.0%	63.0%	20.6%	3.4%	0.1%	100.0%
Sacatepéquez	7.6%	41.0%	46.7%	4.6%	0.1%	100.0%
San Marcos	19.8%	66.8%	11.2%	2.2%	0.0%	100.0%
Santa Rosa	13.7%	63.1%	20.1%	3.1%	0.0%	100.0%
Sololá	12.3%	69.6%	15.3%	2.7%	0.1%	100.0%
Suchitepéquez	11.7%	65.2%	19.8%	3.2%	0.1%	100.0%
Totonicapán	17.8%	69.3%	11.1%	1.8%	0.0%	100.0%
Zacapa	19.6%	57.7%	16.8%	5.8%	0.1%	100.0%

Source: Ministry of Energy and Mines.

Table 2 shows the distribution of relative frequencies of users of electricity services in the residential sector, which is an average over the previous 2 years. It can be observed that in all departments most of the population is concentrated in consumption ranging from 11 to 100 kWh per month.

Graph 3: Electricity consumed by the residential sector.



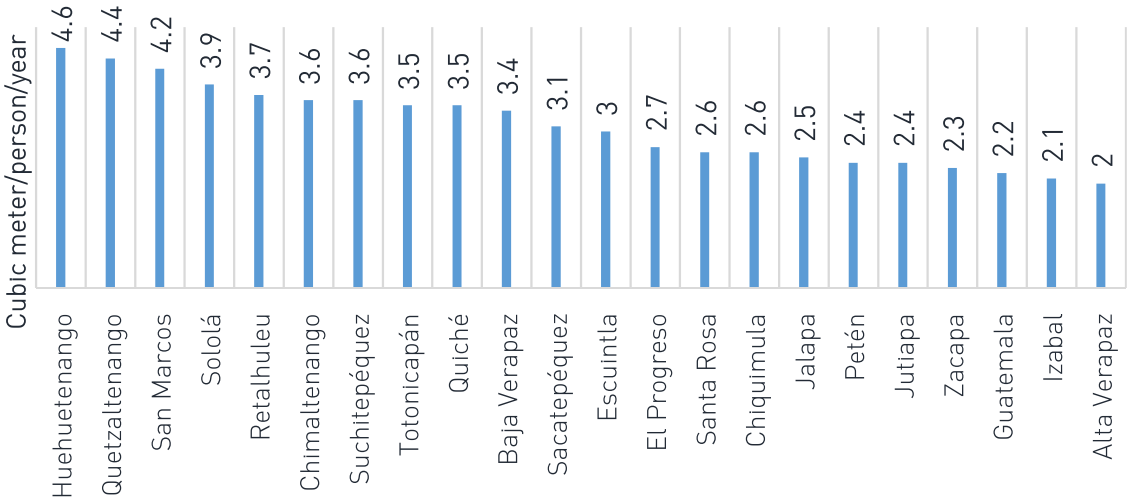
Source: Ministry of Energy and Mines.

Graph 3 represents the historical data of electric energy consumed by the residential sector at the national level; from this information it can be observed that the trends of electric energy consumption at the national level are always growing, considering that in some typical years there are lower consumptions with respect to previous years. On the other hand, although the demand for electricity continues to grow within the residential sector, the blocks represented in Table 2 will rarely present significant changes.

2.1.3. FIREWOOD CONSUMPTION

Firewood has presented an average participation of 92% in the energy demand matrix of the residential sector, this percentage of participation is due to the dependence on this energy source in rural areas, being the non-electrified communities the ones that present the highest demand for firewood to cover basic needs such as cooking, home heating, and space heating.

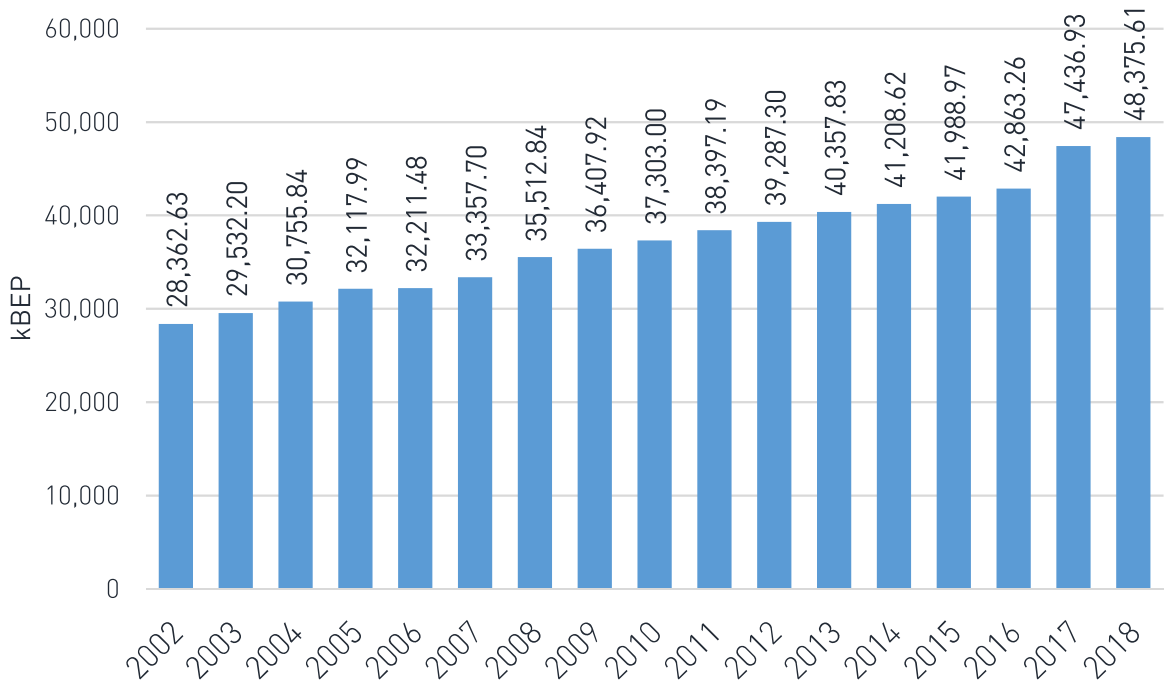
Graph 4: Per capita demand for firewood in rural areas at the departmental level.



Source: Proprietary production, with information from IARNA and INAB (for its acronym in Spanish).

Graph 4 shows the demand for firewood that each person living in rural areas represents, counted in cubic meters of dry firewood per year; it can be observed that the departments that represent the highest demand for firewood per capita are located in the western part of the country, within the coldest regions; in these regions the demand for firewood is greater, because the energy needs that are supplied through firewood not only cover the cooking of food, but also heating systems and water heating.

Graph 5: Wood energy demand of the residential sector.



Source: Ministry of Energy and Mines.

Graph 5 represents the energy demand for firewood in the residential sector, which, like electricity consumption, shows a trend growth. It is important to highlight that the per capita consumption represented in Graph 4, combined with population growth, represents the growth of wood fuel energy demand at the national level; the levels of wood fuel demand per person can be reduced if there are possibilities of accessing electric energy sources that supply the same needs that wood as an energy source supplies.

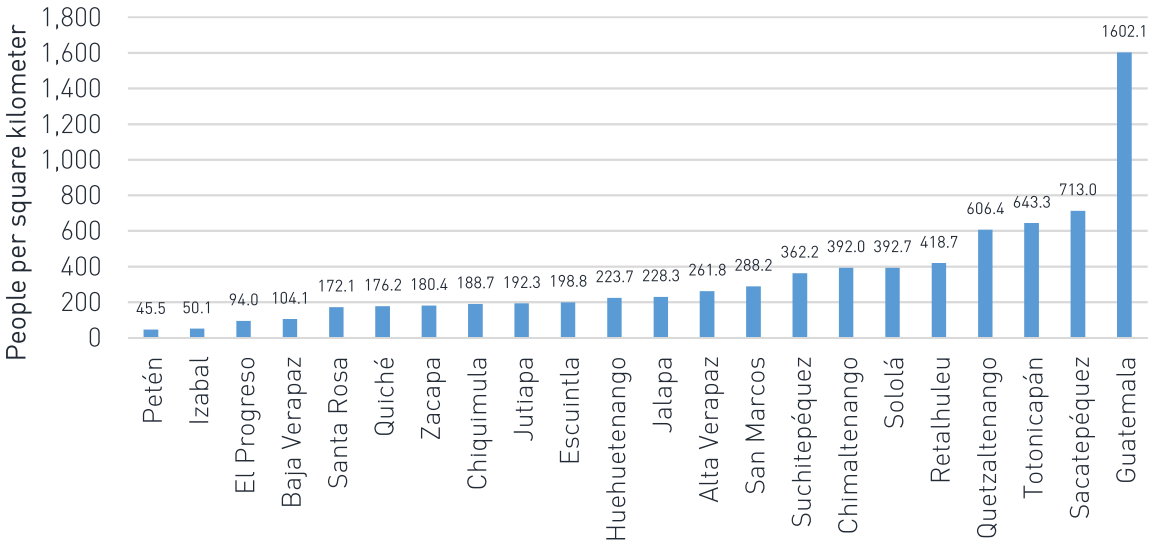
2.2. SOCIOECONOMIC ENVIRONMENT IN RURAL AREAS

Guatemala is diverse in social and economic aspects. Knowing the socioeconomic characteristics of each department allows guiding strategies to adapt projects for access to electricity in an efficient way. The following is a description of the most important socioeconomic variables to be analyzed in terms of electrification.

2.2.1. POPULATION DENSITY

Population density measures the number of people per square kilometer in each area. This is important in electrification projects, since it can be used as an initial indicator of the existing dispersion in the departments, an important characteristic since it influences the technical and economic feasibility of electrification projects. Graph 6 shows the population density by department, with Guatemala being the department with the highest population density, doubling the value of Sacatepéquez, the second most densely populated department. Petén has the lowest population density, with 45.5 people per square kilometer.

Graph 6: Population density.



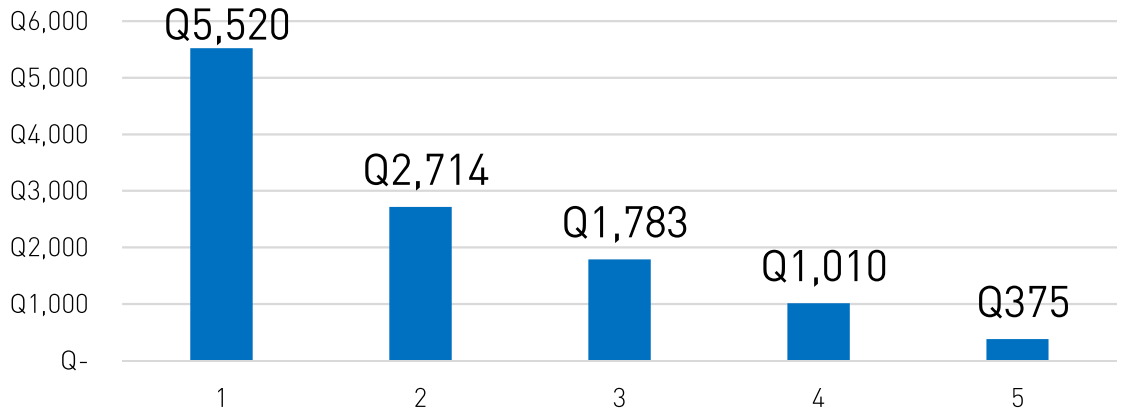
Source: National Institute of Statistics.

2.2.2. ECONOMIC INCOME

The National Institute of Statistics defines labor income as income from salaried employment plus income related to self-employment for profit or gain in the main agricultural and non-agricultural occupation.

Graph 7 presents monthly labor income by quintiles. It shows that 20% of the workers in the first quintile earn an average of Q375.00, the quintile with the lowest income. On average, the 20% of workers with the highest income earn Q 5,520.00 per month.

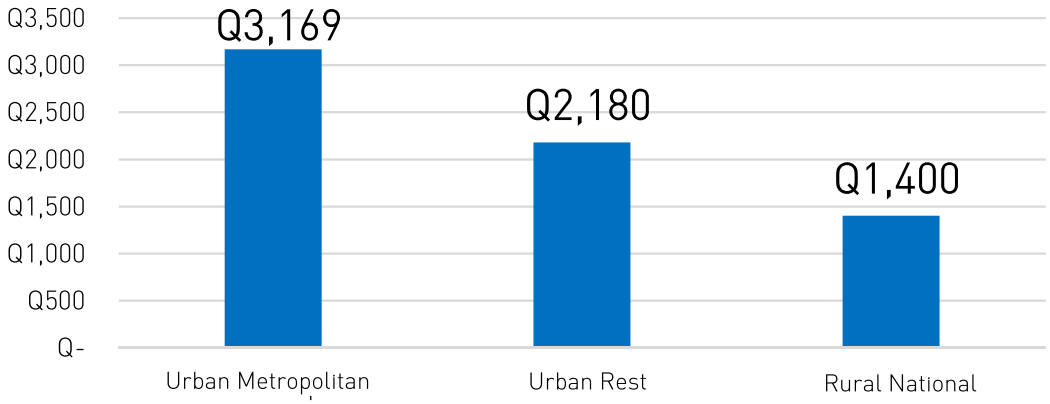
Graph 7: Monthly labor income.



Source: ENEI 1-2017, National Employment and Income Survey, INE (for its acronym in Spanish).

Graph 8 shows the income separated into three areas: Urban Metropolitan, Rest of Urban and Rural National. The urban metropolitan area represents 22.6% of the average monthly income of the rural area. In electrification projects this influences the economic feasibility of the project since it limits the possibility of the end user to cover the supply itself or any additional cost to have access to electricity.

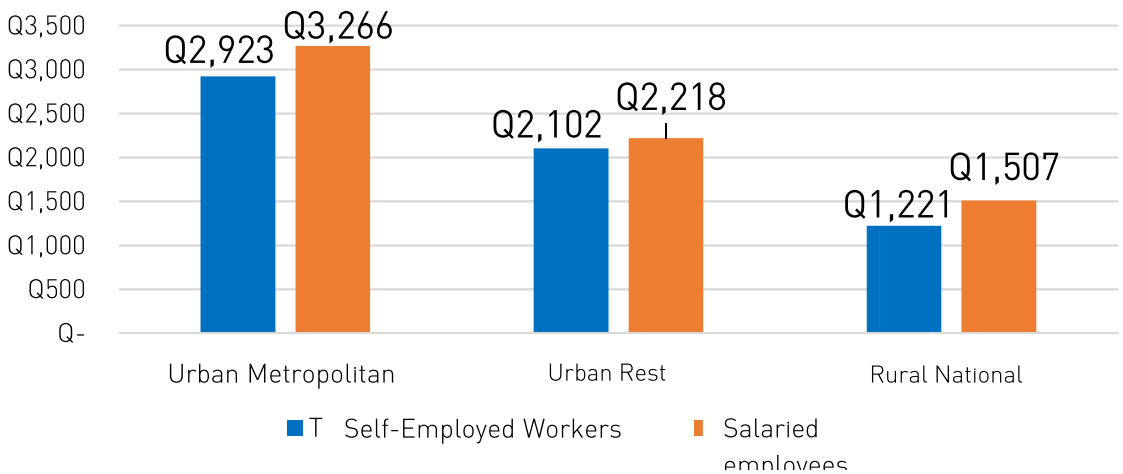
Graph 8: Average monthly labor income.



Source: ENEI 1-2017, National Employment and Income Survey, INE.

As described in Graph 9, in general for all divisions, a salaried worker earns, on average, a better income than the self-employed.

Graph 9: Comparison of monthly income.

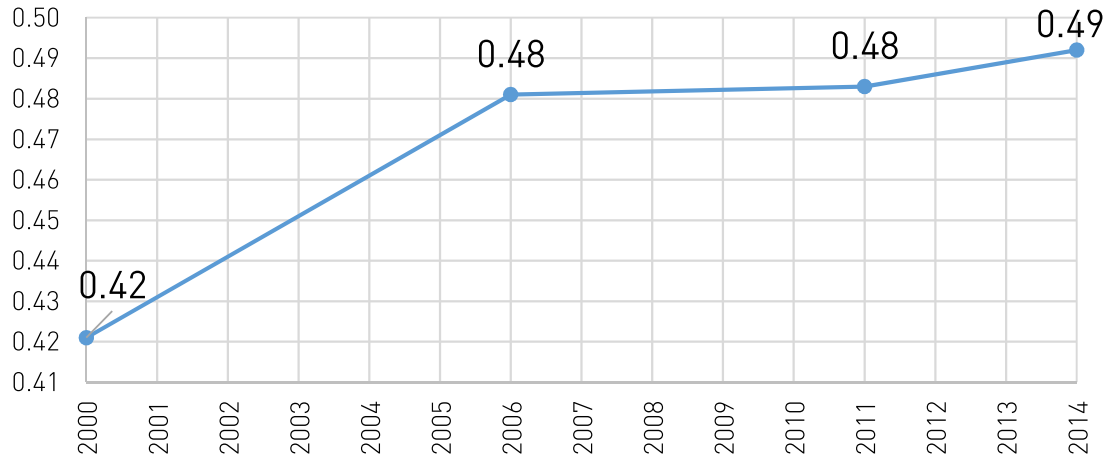


Source: ENEI 1-2017, National Employment and Income Survey, INE.

2.2.3. HUMAN DEVELOPMENT INDEX

The human development index is defined within three basic dimensions: health, education and income. It is based on measuring development in terms of increased opportunities for human development. For Guatemala, the Human Development Index increased by 17% from 2000 to 2014, however, from 2011 to 2014 it increased by only 2%, the largest increase is between 2000 and 2006 with an increase of approximately 14%. The evolution of the Human Development Index can be seen in Graph 10.

Graph 10: Human Development Index.



Source: National Human Development Report Guatemala, UNDP.

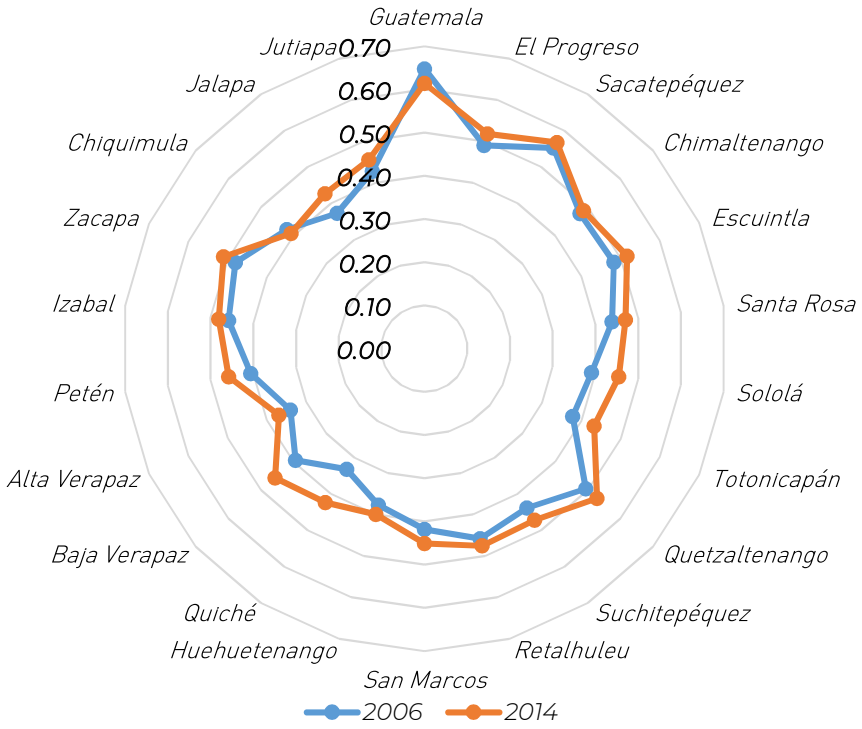
Con el apoyo del diagrama de caja de la Graph 11 es posible observar que el 25% de los departamentos con mayor IDH se encuentran por encima de 0.5115, además puede inferirse que un 50% de los departamentos tiene un IDH inferior al 0.4641 y que el 25% de los departamentos con menores índices se encuentran por debajo de un IDH de 0.4318.

Graph 11: Distribución del índice de desarrollo humano.

Source: Informe Nacional de Desarrollo Humano Guatemala, PNUD.

Graph 12 shows the human development indexes broken down by department for 2006 and 2014. This graph shows the evolution of the HDI of each department, Guatemala is the department with the highest HDI for both 2006 and 2014, at the other extreme for 2014 Alta Verapaz has the lowest Human Development Index.

Graph 12: Departmental human development index.



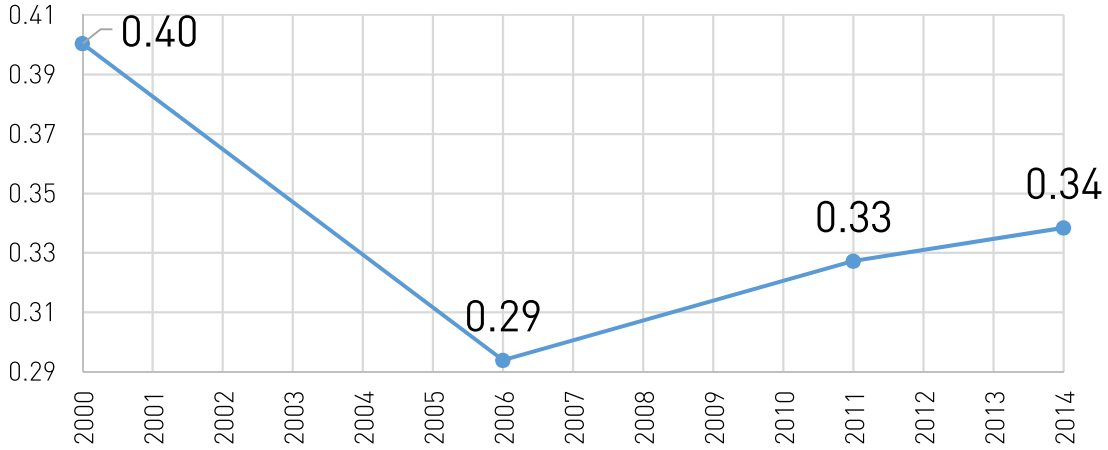
Source: National Human Development Report Guatemala, UNDP.

2.2.4. MULTIDIMENSIONAL POVERTY INDEX

The multidimensional poverty index is an indicator developed by the United Nations Development Program. This index reflects poverty conditions composed of different aspects, weighted according to their impact on people's quality of life. This index is a composite of 10 parameters: Years of Schooling, Children in School, Infant Mortality, Nutrition, Electricity, Sanitation, Drinking Water, Soil, Household Fuel and Assets. Lack of access to electricity supply contributes 0.055 to the multidimensional poverty index.

Graph 13 shows the development of Guatemala's multidimensional poverty index; the last estimate presented a country MPI of 0.338.

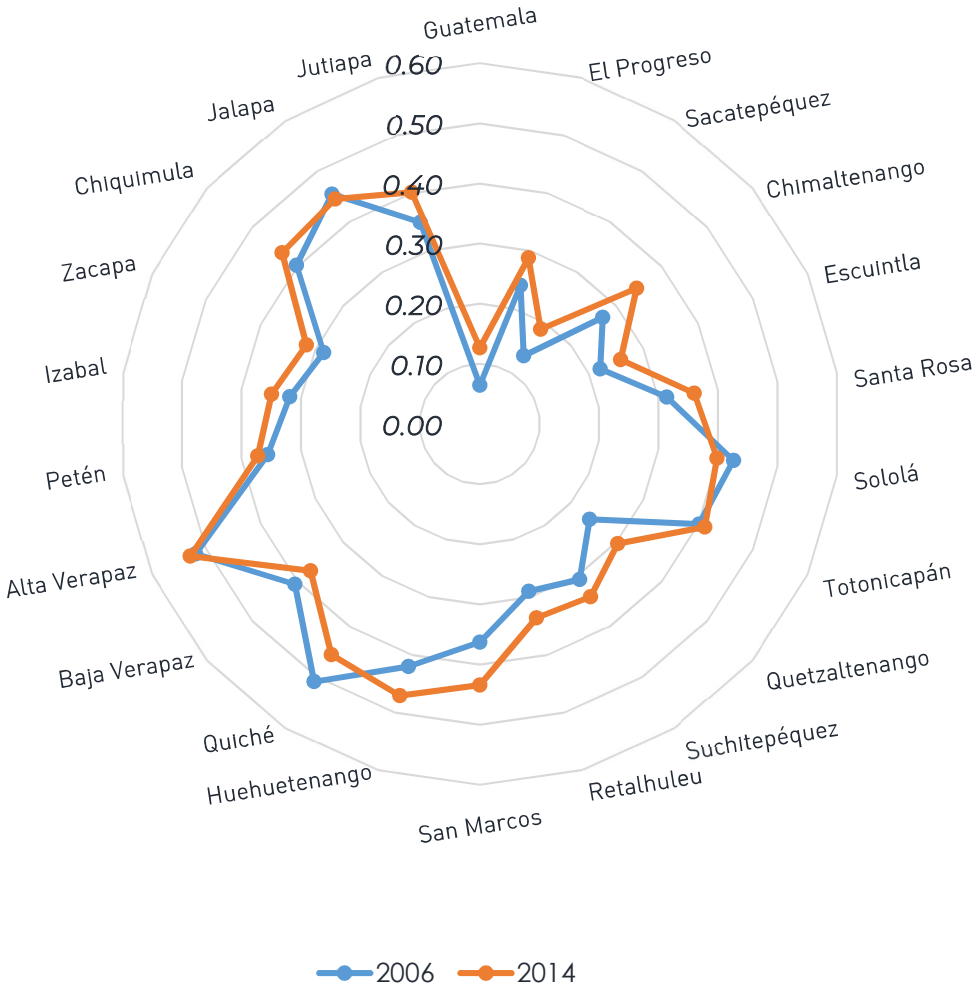
Graph 13: Multidimensional poverty index.



Source: National Human Development Report Guatemala, UNDP.

Graph 14 shows the Multidimensional Poverty Indexes for each department, from which it can be quickly inferred that the Department of Guatemala has the lowest index (0.127) while Alta Verapaz has the highest multidimensional poverty index (0.529).

Graph 14: Multidimensional poverty index by department.



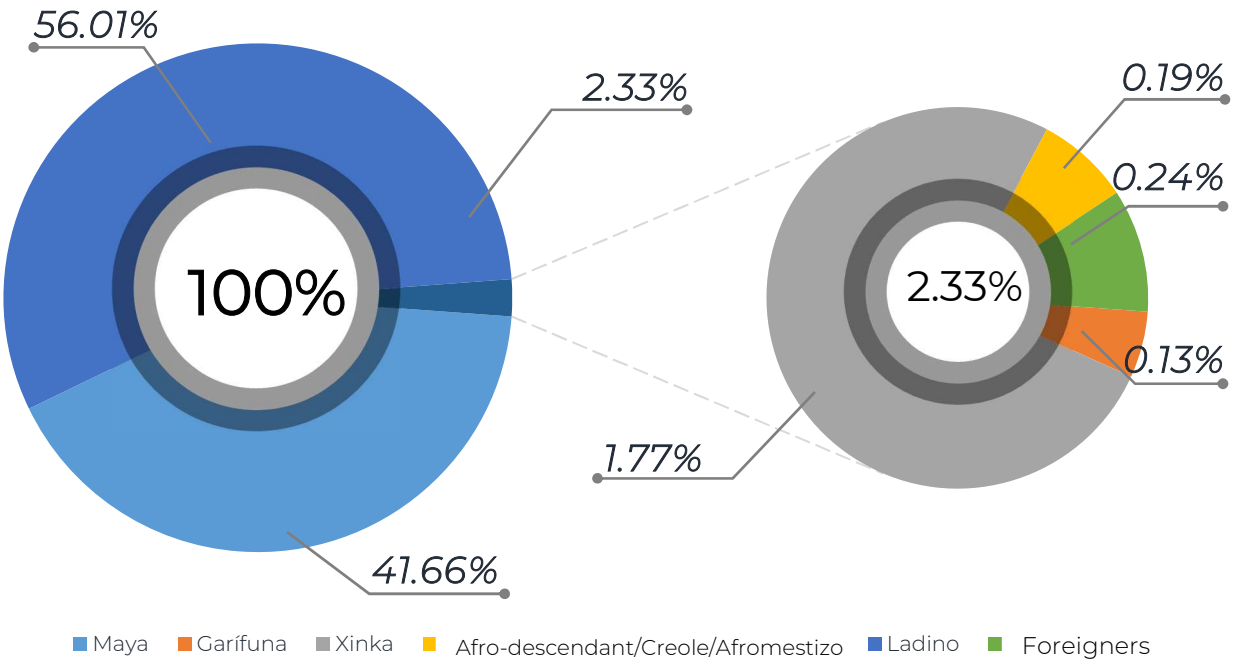
Source: National Human Development Report Guatemala, UNDP.

In general, access to electricity has a cross-cutting influence on the basic dimensions of a country's human development. Access to electricity supply allows for nearby hospital facilities, access to sanitation and water services, technological access in education applications, and economic development, facilitating improved productivity and therefore improved income and job opportunities. The above shows the importance of access to electricity service in the quality of life of the country's inhabitants and the need to provide access to electricity to the nation's inhabitants.

2.3. ETHNIC CHARACTERISTICS IN RURAL AREAS

Guatemala is a multicultural, pluricultural and multilingual country. Graph 15 shows the distribution of Guatemalan ethnic groups. The largest population is conglomerated in the group of Ladinos (56.01%) and Mayas (41.66%). A small percentage corresponds to the Xinka population (1.77%); Garifuna (0.13%); Afro-descendant/Creole/Afromestizo (0.19%) and foreigners (0.24%).

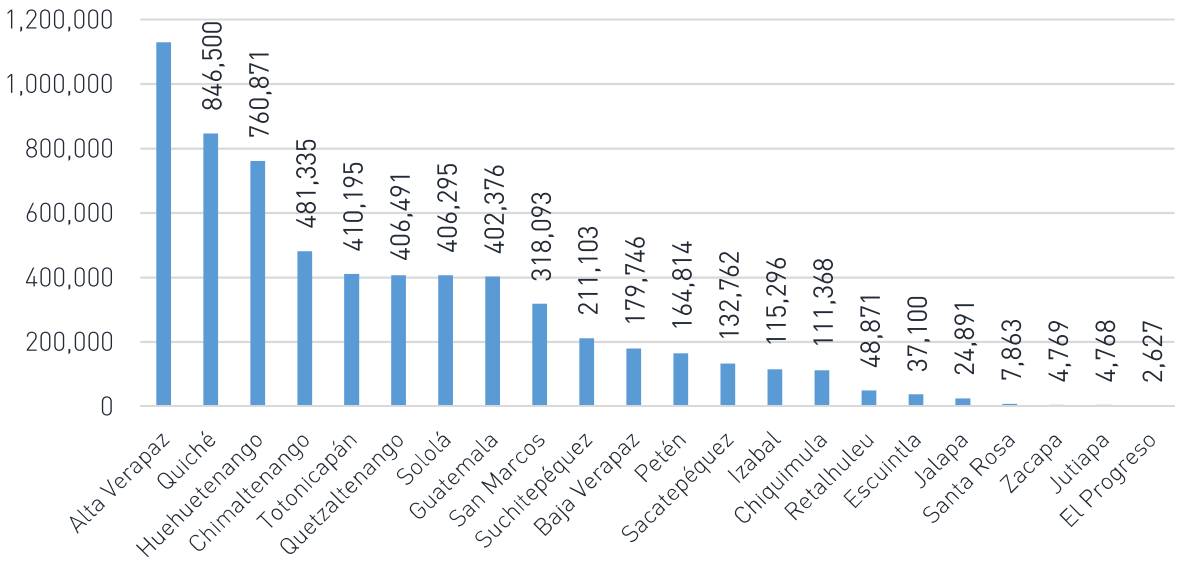
Graph 15: Ethnic distribution.



Source: Proprietary production based on information from SEGEPLAN

Graph 16 shows the distribution of the Mayan population over the 22 departments. The highest concentration is in the departments of Alta Verapaz, Quiché, and Huehuetenango; however, the rest of the departments show a significant amount of Mayan population.

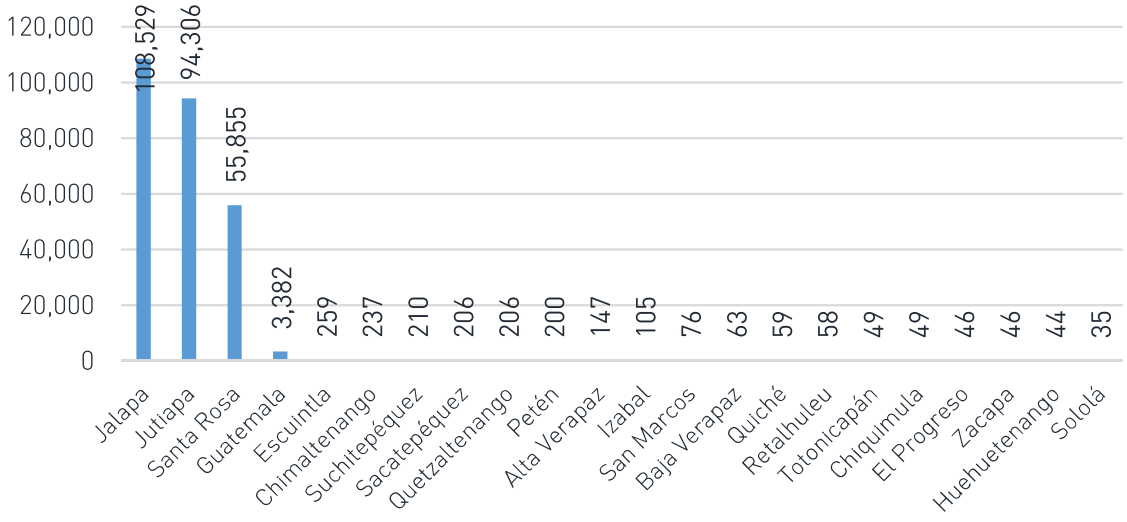
Graph 16: Distribution of the Mayan population by department.



Source: Census 2018 results.

Graph 17 shows that the Xinka population is concentrated in the departments of Jalapa, Jutiapa and Santa Rosa, and to a lesser extent in the department of Guatemala.

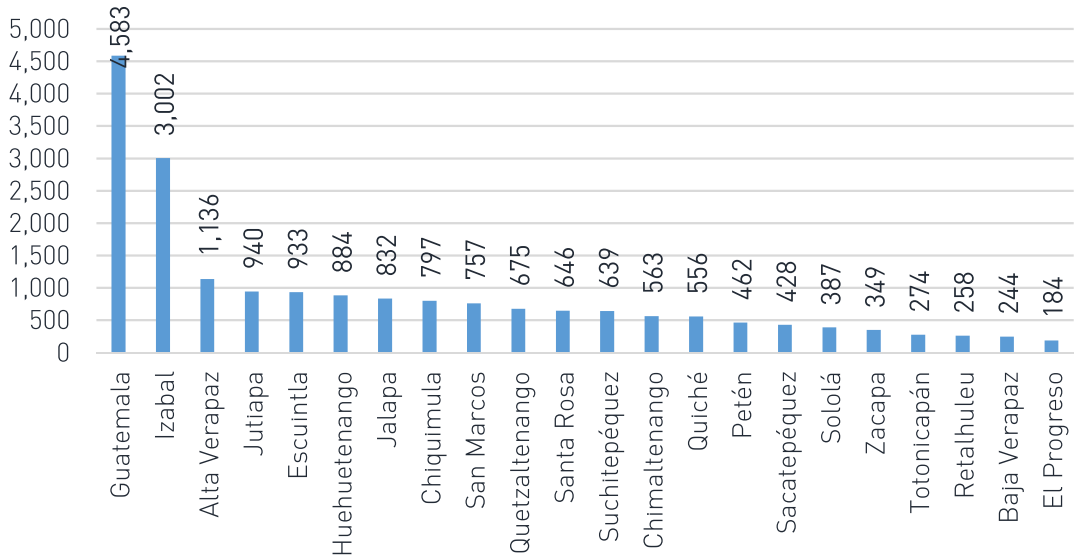
Graph 17: Distribution of the Xinka population by department.



Source: Census 2018 results.

The Garifuna population is concentrated in the departments of Guatemala, Izabal and Alta Verapaz. They are also present in smaller numbers in the rest of the departments.

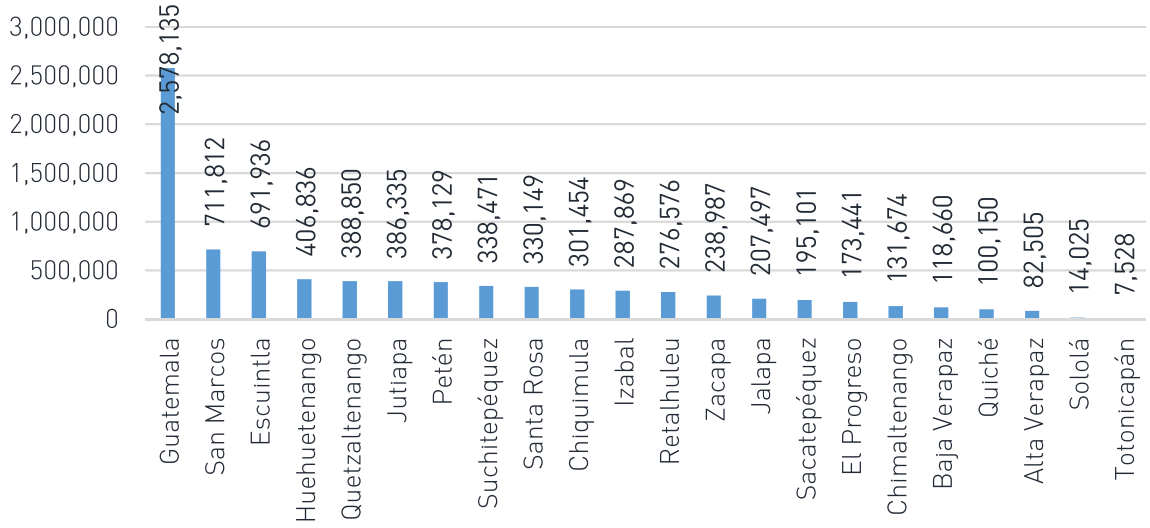
Graph 18: Distribution of the Garifuna population by department.



Source: Census 2018 results.

The Ladino population makes up 56.01% of the population, Graph 19 describes how it is distributed in the 22 departments. Guatemala has the largest number of Ladinos, approximately 30% of the country's entire Ladino population.

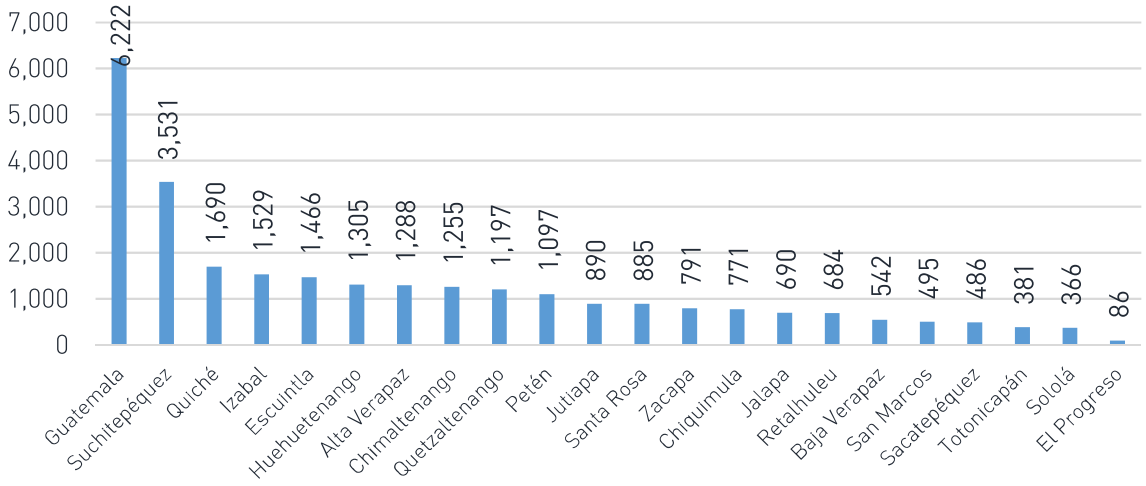
Graph 19: Distribution of the ladino population by department.



Source: Census 2018 results.

Graph 20 shows the departments in which the Afro-descendant/Creole/Afro-mestizo population is distributed. The largest population is distributed in the departments of Guatemala and Suchitepéquez, as well as in the rest of the departments.

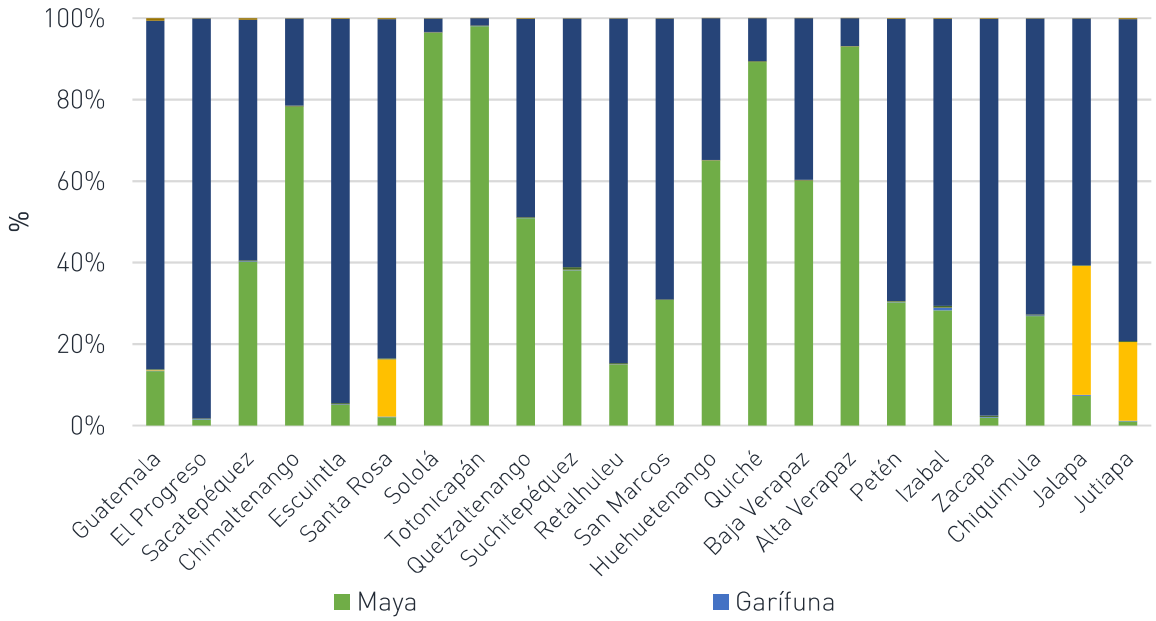
Graph 20: Distribution of the Afrodescendant/Creole/Afromestizo population by department



Source: Census 2018 results.

A visual appreciation of the distribution of ethnicities in each department is provided in Graph 21, which shows the percentage composition of ethnicities in the different departments, reflecting the multi-ethnic characteristic of the country.

Graph 21: Departmental ethnic composition.

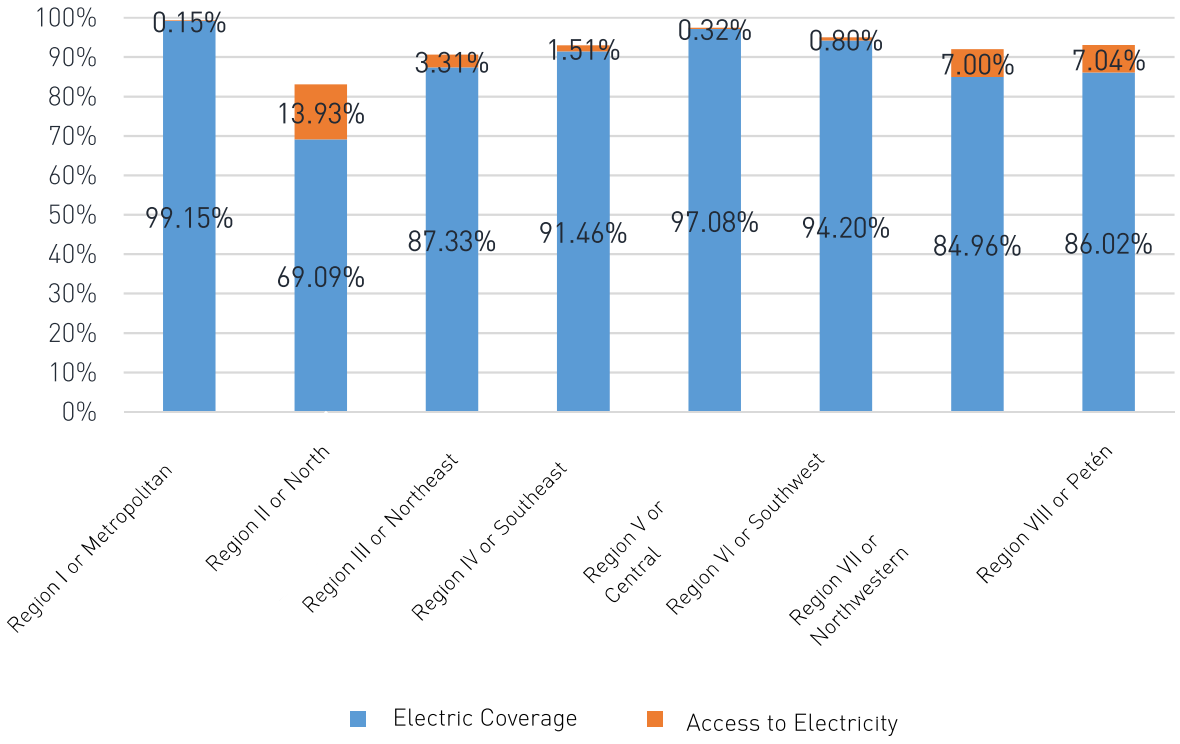


Source: Census 2018 results.

2.4. ELECTRICITY COVERAGE INDEX

The electricity coverage index represents the proportion of users that have electricity supply. For the year 2018, Guatemala presented an overall coverage index of 91.23%. Graph 22 shows the coverage index and access to electricity by region. Among them, the Petén Region (VIII), the Northern Region (II) and the Northwestern Region (VII) are the ones with the lowest electricity coverage and access index.

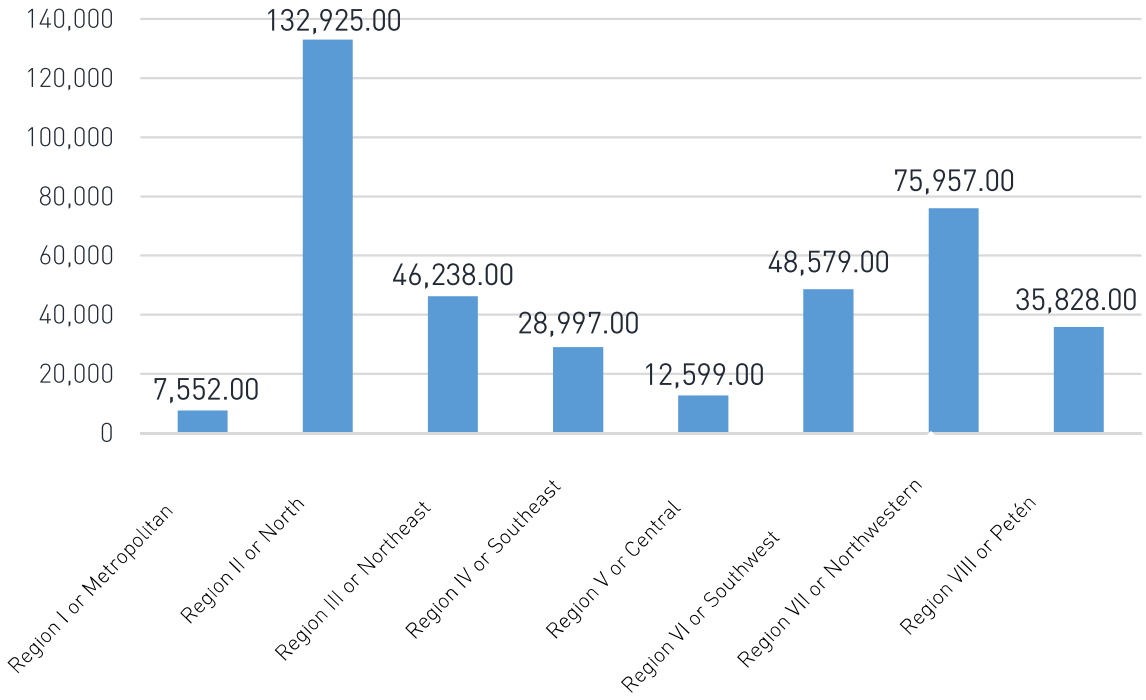
Graph 22: Electricity access index by region.



Source: Proprietary production from Census 2018 results.

However, the highest concentration of users without supply is in the Northern Region of the country, as shown in Graph 23. The Northern Region accounts for approximately 32% of users without coverage.

Graph 23: Users without electrification.

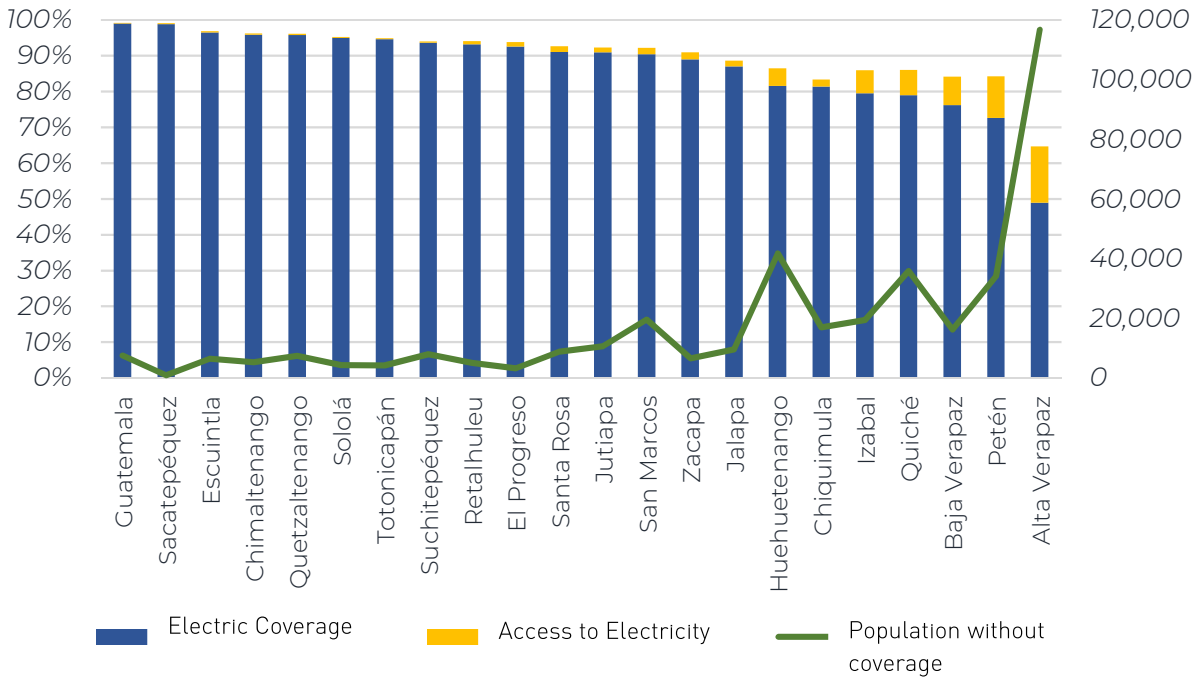


Source: Proprietary production from Census 2018 results.

2.5. ELECTRICITY COVERAGE BY DEPARTMENT

Graph 24 presents the coverage and access to electricity indexes for each department of the country and the number of users without electrification as a secondary axis. Alta Verapaz has the lowest rate of access to electricity, at 64.61%. At the other extreme, Guatemala is the department with the highest electricity coverage, reaching more than 99%. It can be observed that the volume of users without supply is considerably higher in the department of Alta Verapaz.

Graph 24: Access rate and number of users without supply by department.

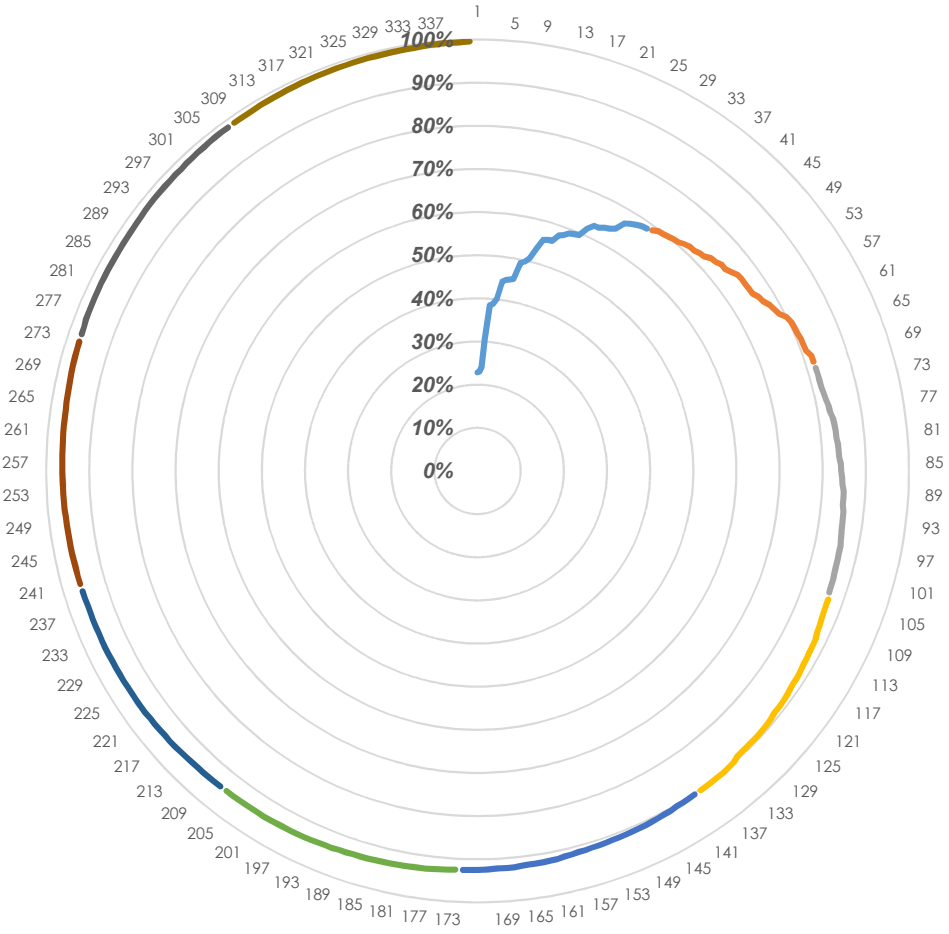


Source: Ministry of Energy and Mines.

2.6. ELECTRIC COVERAGE BY MUNICIPALITY

Guatemala has 340 municipalities distributed over the 22 departments. Graph 25 shows the distribution of the electricity coverage indexes of each municipality in ascending order and separated by deciles, which allows for a simplified visual appreciation of the distribution and location of the electricity coverage indexes of the municipalities. From this graph it can be inferred that 10% of the municipalities with the lowest index have a coverage lower than 68.58% and that more than 50% of the municipalities have a coverage index higher than 92.46%.

Graph 25: Electricity coverage index by municipality.



Source: Ministry of Energy and Mines

Table 3: Electricity coverage index by deciles.

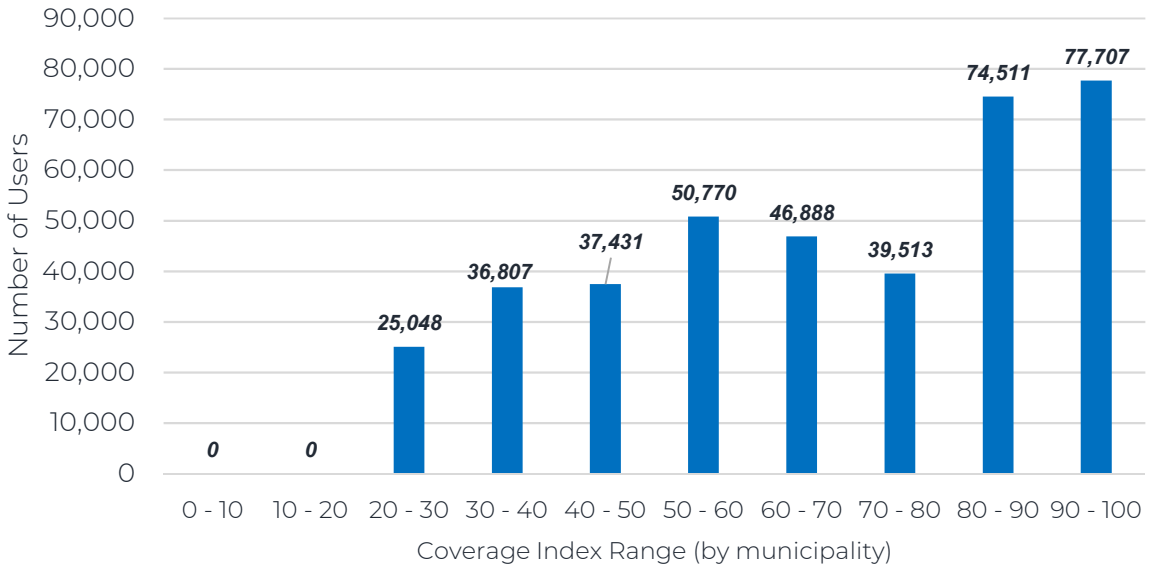
D1	68.90 %
D2	81.94 %
D2	86.29 %
D4	90.30 %
D5	92.53 %
D6	94.30 %
D7	95. 73 %
D8	97.07 %
D9	98.44 %
D10	99.58 %

Source: Ministry of Energy and Mines.

2.7. USERS WITHOUT SUPPLY

An important aspect to consider is the distribution of users without electricity supply, whose analysis can be supported by Graph 26, from which it can be determined that 77.53% of the users without electricity coverage are distributed in municipalities with coverage rates below 90% and the rest of the users are distributed over municipalities with coverage rates above 90%.

Graph 26: Number of users without electricity coverage.



Source: Ministry of Energy and Mines.

It is important to mention that the electrification projects previously executed were developed in locations with economically feasible aptitudes and with sustainable projections of the project.

This has an important implication in achieving access to electricity service for users without supply, given that there are communities with technical and economic characteristics that make the execution of electrification projects difficult, so their future development must be integrally conformed, facilitating the necessary financing mechanisms for the expansion of the coverage index.

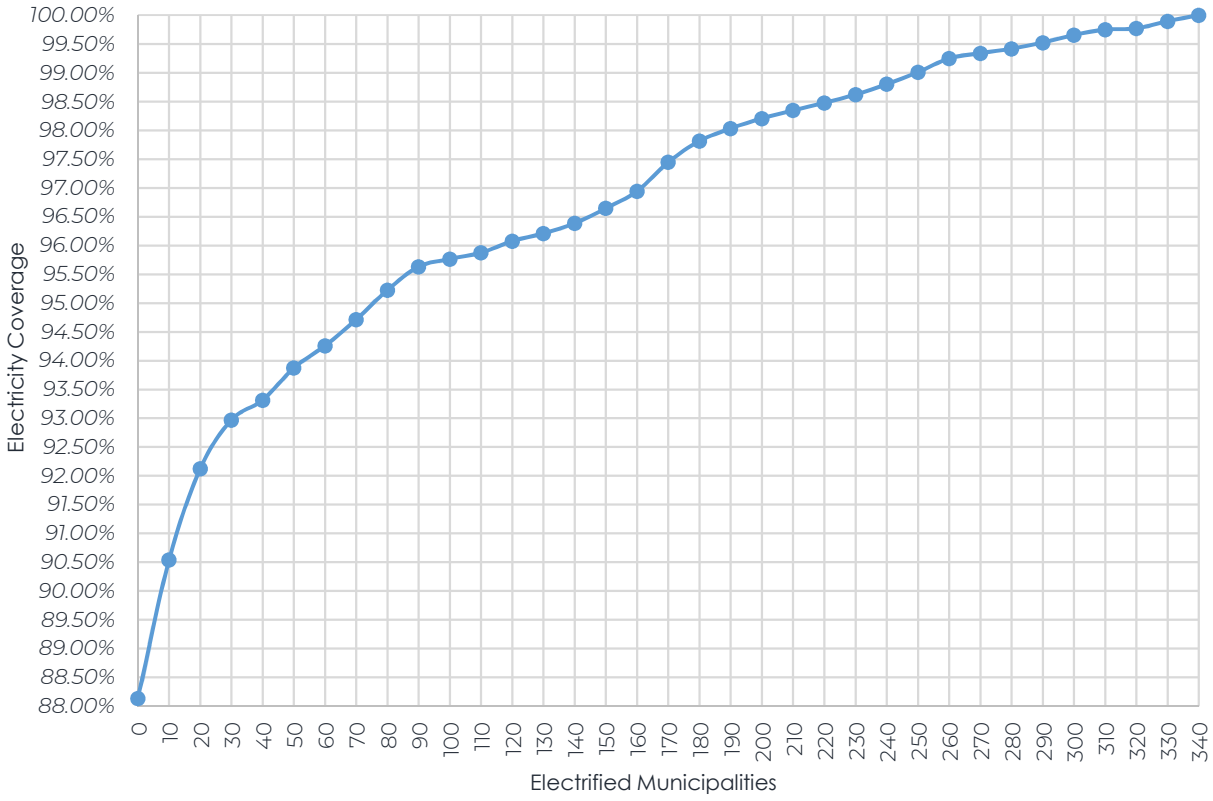
2.8. IMPACT OF ELECTRIFICATION

Next, the impact of electrification is evaluated in accordance with the provisions of section 3.2 of this same plan.

It can be estimated that electrifying the 20 municipalities prioritized in the ranking of item 3.2 will increase the electricity coverage index by approximately 3.47%.

Graph 27 shows the evolution of the coverage index as access to electricity is provided to each municipality.

Graph 27: Impact of electrification by municipality



Source: Ministry of Energy and Mines.

2.9. HISTORICAL ELECTRIFICATION PROJECTS

During the period from 1998 to 2018, the National Electrification Institute has invested Q. 1,423.87 million in electrification projects, these projects were divided into 3 forms of financing.

- ✓ Investment in the Rural Electrification Plan: It was financed through the administration trust INDE Obras Rurales de Occidente y Oriente, funds that came from the sale of INDE's distributors, INDE's own funds and IDB loan.

- ✓ Investment in isolated systems: Loan from the Inter-American Development Bank.

- ✓ Institutional Plan Investment: Institution's own funds, as well as state contributions (as of 2017).

These investments can be seen broken down by year and by type of investment in Table 4.

Table 4: Investment and beneficiary users of electrification projects

Year	Rural Electrification Policy		Isolated Systems		Institutional Plan	
	Users	Investment [Q]	Users	Investment [Q]	Users	Investment [Q]
1998					717	Q 2,566,547.00
1999	703	Q 3,317,539.10			5,400	Q 19,329,646.00
2000	87,038	Q 382,897,810.22			1,776	Q 6,357,306.00
2001	16,487	Q 78,042,169.26			289	Q 1,034,494.00
2002	42,176	Q 199,774,135.11			1,892	Q 6,772,535.00
2003	25,010	Q 126,719,312.28			4,690	Q 16,788,155.00
2004	12,742	Q 63,737,793.75			4,677	Q 16,741,621.00
2005	1,703	Q 8,689,279.48			2,010	Q 7,194,924.00
2006	734	Q 3,363,357.33			605	Q 2,165,636.00
2007	5,145	Q 26,204,294.53			880	Q 3,150,016.00
2008	10,357	Q 58,762,031.05			360	Q 1,288,643.00
2009	4,483	Q 26,603,631.40			233	Q 834,038.00
2010	5,848	Q 35,926,224.81			280	Q 1,002,278.00
2011	7,745	Q 47,471,251.51			493	Q 1,764,725.00
2012	9,335	Q 60,646,846.55			95	Q 340,059.00
2013	8,909	Q 59,093,230.60			657	Q 2,351,774.00
2014	3,993	Q 26,591,368.04	335	Q 3,203,536.57	866	Q 3,099,902.00
2015	10,465	Q 75,867,232.95	3,045	Q 25,786,898.04	282	Q 1,009,437.00
2016					175	Q 1,516,250.00
2017					198	Q 2,816,930.00
2018					1,385	Q 13,047,444.00
Total	252,873	Q1,283,707,507.97	3,380	Q 28,990,434.61	27,960	Q 111,172,360.00

Source: National Institute of Electrification.

During the previous 20 years, as shown in Table 5, 284 thousand users have benefited from electrification projects, investing a total of 1,423 million Quetzales.

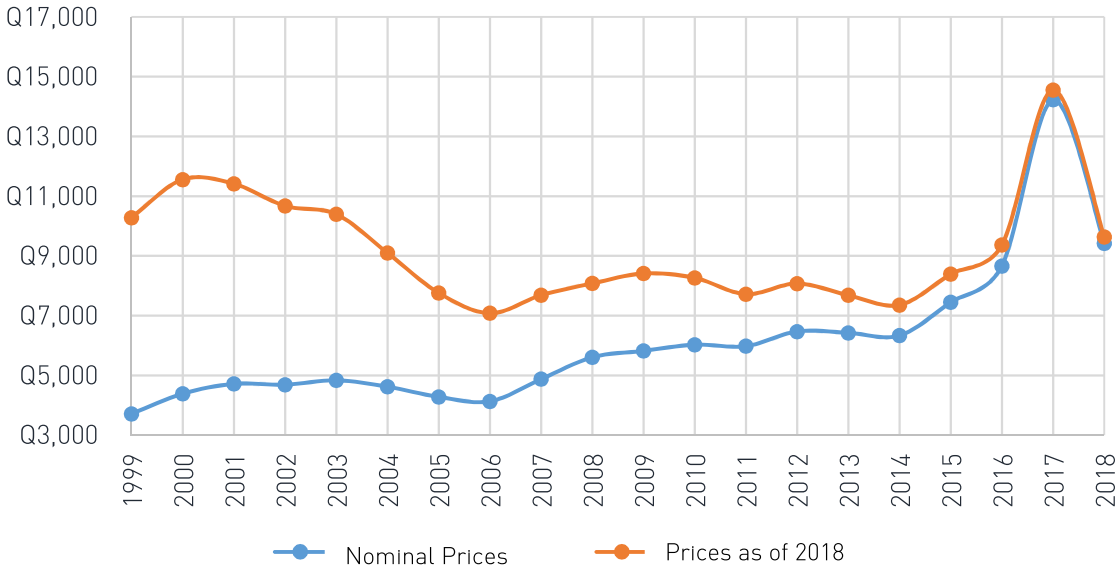
Table 5: Usuarios, comunidades eUsers, communities and annual investment in electrification projects.

Year	Benefited Communities	Total Users	Total Investment [Q]
1998	8	717	Q 2,566,547.00
1999	76	6,103	Q 22,647,185.10
2000	418	88,814	Q 389,255,116.22
2001	483	16,776	Q 79,076,663.26
2002	446	44,068	Q 206,546,670.11
2003	347	29,700	Q 143,507,467.28
2004	238	17,419	Q 80,479,414.75
2005	43	3,713	Q 15,884,203.48
2006	21	1,339	Q 5,528,993.33
2007	98	6,025	Q 29,354,310.53
2008	129	10,717	Q 60,050,674.05
2009	55	4,716	Q 27,437,669.40
2010	78	6,128	Q 36,928,502.81
2011	74	8,238	Q 49,235,976.51
2012	145	9,430	Q 60,986,905.55
2013	163	9,566	Q 61,445,004.60
2014	94	5,194	Q 32,894,806.61
2015	117	13,792	Q 102,663,567.99
2016	3	175	Q 1,516,250.00
2017	5	198	Q 2,816,930.00
2018	20	1,385	Q 13,047,444.00
Total	3,061	284,213	Q 1,423,870,302.58

Source: National Institute of electrification.

A notable improvement in electricity coverage can be seen in Graph 28, which shows an increase in the average cost of electrification per user as electricity coverage increases.

Graph 28: Average cost invested to electrify a user.



Source: Proprietary production, National Institute of Electrification.

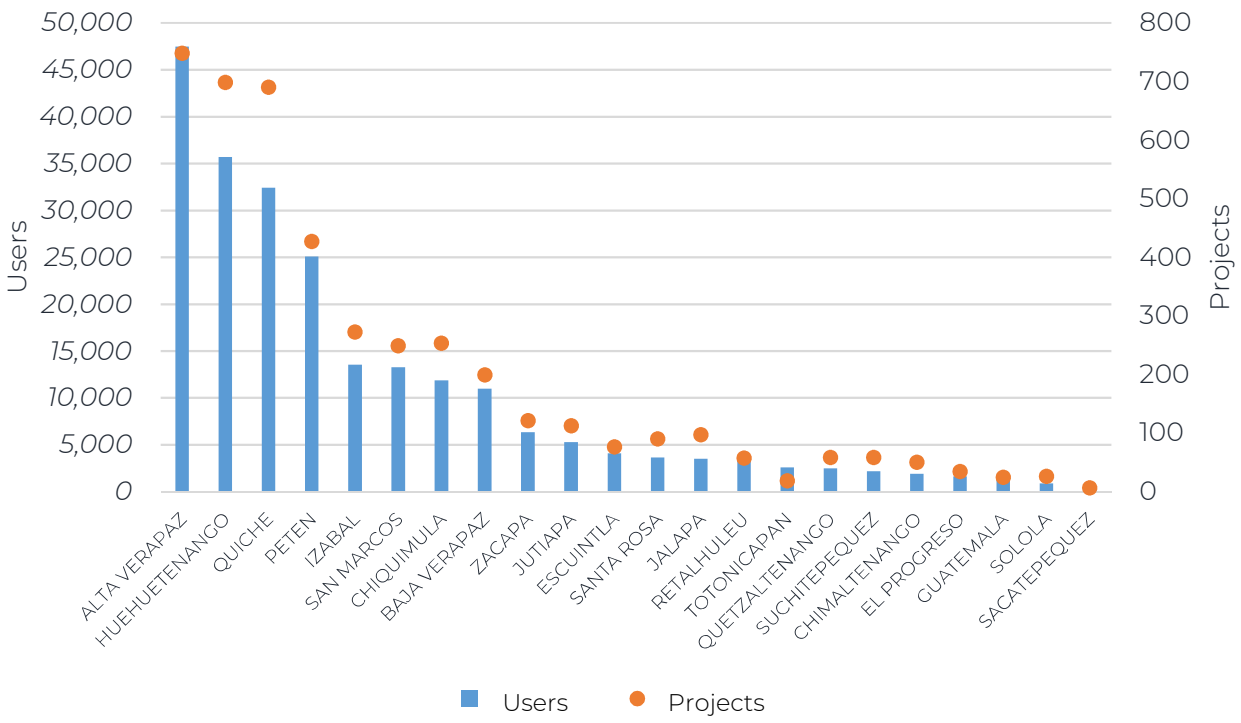
The information presented in this section reflects the investments and execution of projects carried out by INDE through the Rural Electrification and Works Management, which is presented in this Plan as a reference, since the investment costs related to the necessary infrastructure must be defined in detail prior to the request for resources from the General Budget of the Nation.

2.10. INVESTMENT PORTFOLIO

The NSDI has a portfolio of projects evaluated since 1999, each project is organized according to the village and municipality to which it belongs; and each one includes several users ranging from a few to 720 users per project, the latter is in the village of Pajom de San Mateo Ixtatan, Huehuetenango.

Graph 29 illustrates, in descending order and by department, the number of users that have been identified through the NSDI for the projects in the portfolio. The first ten departments account for about 88% of the identified users, totaling 3,769 projects. The department with the highest number of users identified for electrification is Alta Verapaz, with a share of 20.7%; in projects it represents 17.1%.

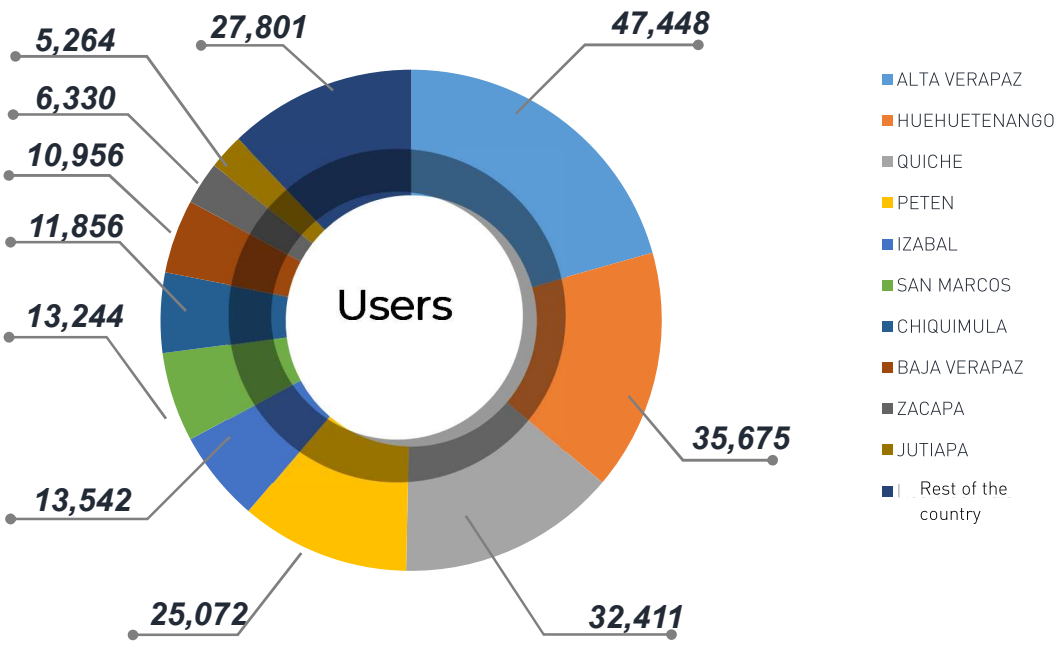
Graph 29: Users and Projects identified by department.



Source: INDE, Rural Electrification and Works Management.

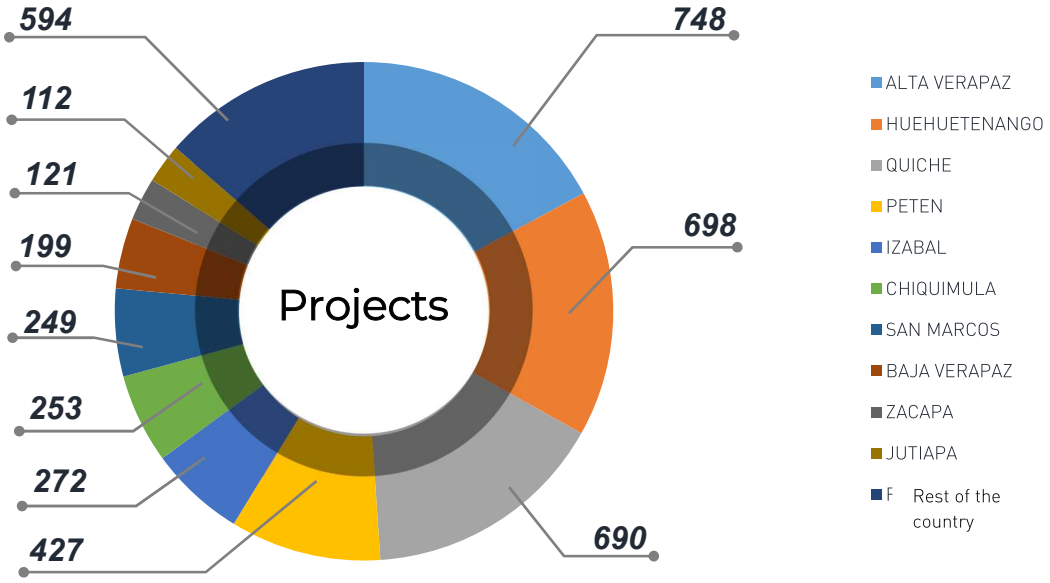
Graphs 30 and 31 show the distribution of the projects in the portfolio and the scope of users to be electrified, some departments in contrast with others, for example, Alta Verapaz, Huehuetenango and Quiché are the departments that stand out in the number of identified users, followed by Petén, Izabal and San Marcos. Some departments, such as Sacatepéquez, Sololá, Totonicapán, and Guatemala, have less than 100 identified projects. There are at least 60 projects in the investment portfolio that would benefit no more than 10 users, unlike the aforementioned project in Aldea Pajom that would benefit 720 users with a single project.

Graph 30: Users identified in the INDE's project portfolio, by department.



Source: INDE, Rural Electrification and Works Management.

Graph 31: Identified INDE projects, by department.

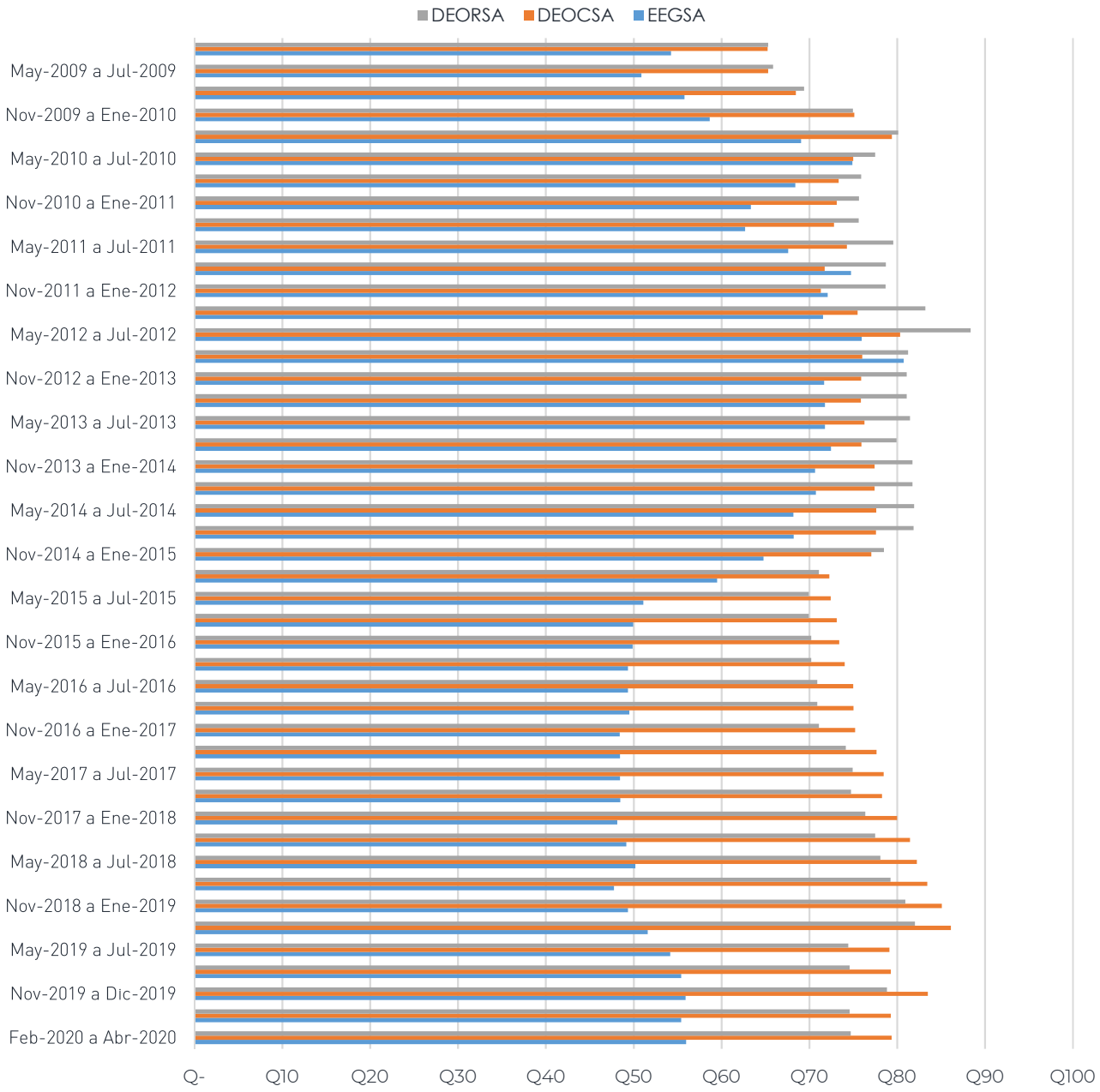


Source: INDE, Rural Electrification and Works Management.

2.11. COST OF ELECTRICITY

From 2012 to the present, the tariff has been reduced considerably, as shown in Graph 32 where the electricity bill is simulated with a consumption of 30 kWh.

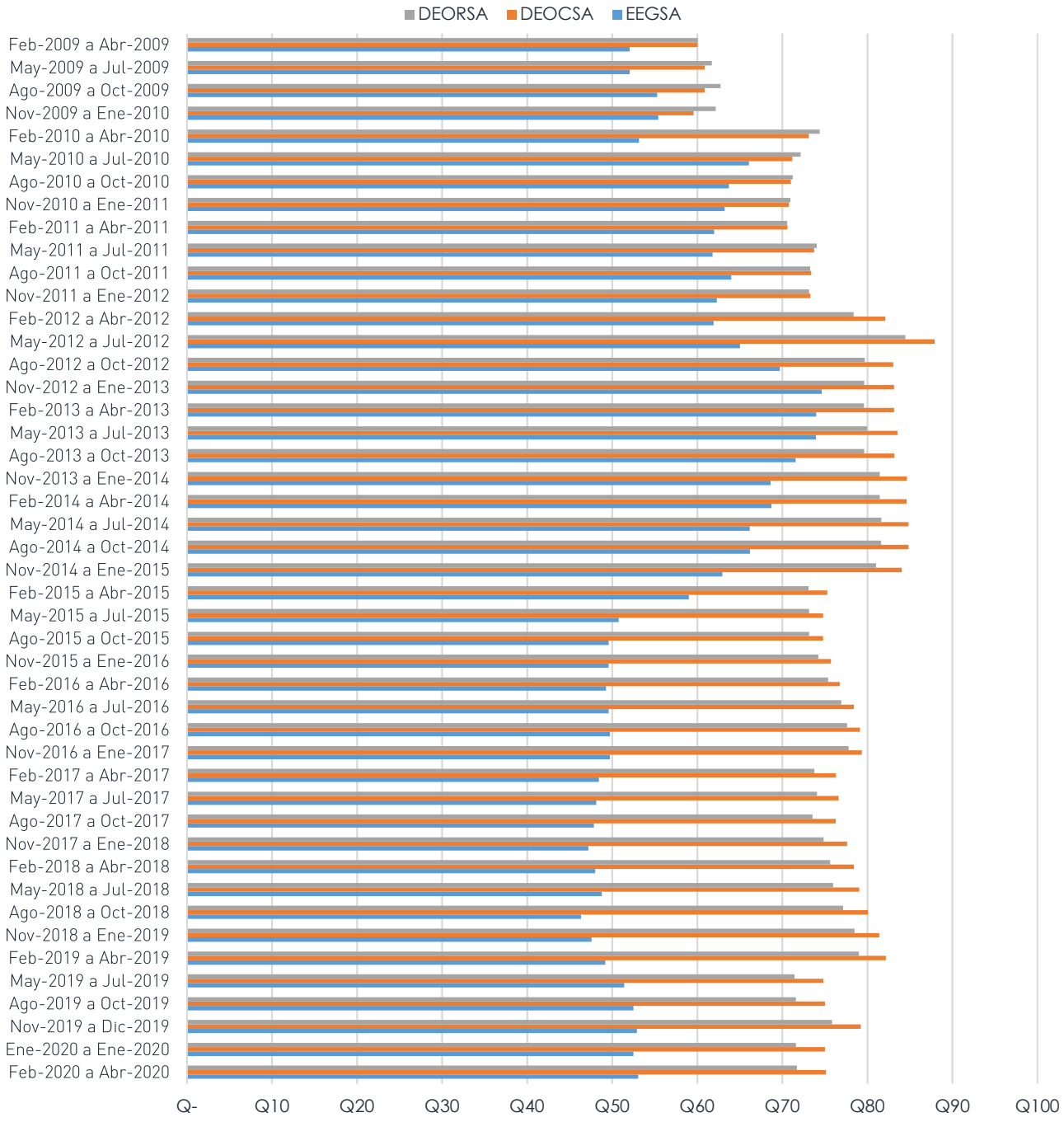
Graph 32: Simulation of the cost of the electric bill for Simple Low Voltage.



Source: Proprietary production, with data from the National Commission of Electric Energy.

Similarly, in Graph 33 and when simulating the social tariff at 30 kWh, we obtain the following results.

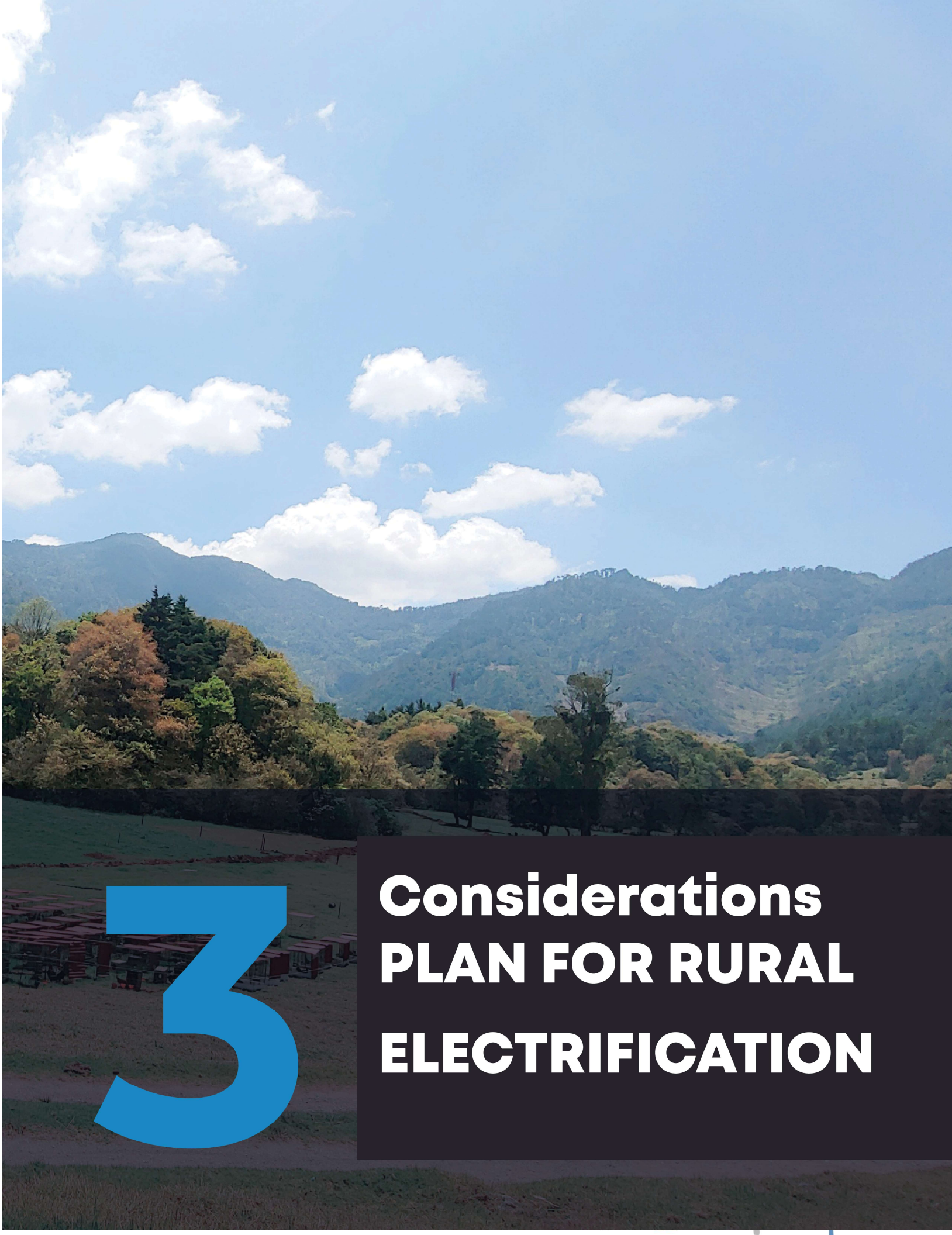
Graph 33: Simulation of the cost of the electricity bill for the Social Tariff.



Fuente: Proprietary production, with data from the National Commission of Electric Energy.

Perspective of the Indicative Plan for Rural Electrification

SECTION 2



3

Considerations PLAN FOR RURAL ELECTRIFICATION

3. RURAL ELECTRIFICATION PLAN CONSIDERATIONS

In the development of the electrification plan strategy, a series of premises were considered, as well as the development of a methodology to focus institutional resources on alleviating the situation of the most disadvantaged communities. Therefore, taking into consideration the General Government Policy 2020, the following objectives are considered:

- ✓ By 2023 increase the proportion of the population with access to electricity to 93.50%.
- ✓ Increase domestic and foreign direct investment.
- ✓ Generate employment in the areas of influence.
- ✓ Improve the quality of electric power service to end users.
- ✓ Promote the generation of geographically located electric energy.
- ✓ Encourage health, tourism, education, and security through the electric power service.
- ✓ Improve quality of life indexes.
- ✓ Support for the economic wall on the border with Mexico, promoting business investment in the area, and bilateral trade.
- ✓ Promote business investment in the border with El Salvador and Honduras, and bilateral trade.
- ✓ Promote regional electricity exports and imports to Central America, Mexico and in the future Belize.

3.1. PREMISES OF THE INDICATIVE PLAN FOR RURAL ELECTRIFICATION

Next, the premises considered in the development of the plan were defined as the technical and socioeconomic variables that would allow us to determine where to concentrate institutional efforts.

✓ ACCESS TO ELECTRIC POWER TRANSMISSION AND DISTRIBUTION SYSTEMS.

The distance that exists between the communities without electricity and the distance to the nearest electrical distribution network impacts the cost necessary to provide access to electricity service, and there is a legal obligation to provide the service if the communities are within 200 meters of the distribution network (at no cost to the user).

In the electric transmission and distribution networks, there is a difference between voltage levels, so it is necessary, in addition to power transformers, the installation and assembly of grounding systems, control systems and protections, which allow the transmission and distribution companies to guarantee the quality of service, whose limits are established by the National Commission of Electric Energy in the Technical Standards for Distribution Service (NTSD for its acronym in Spanish) and the Technical Standards For Access And Use Of Transport Capacity (NTAUCT for its acronym in Spanish).

Therefore, establishing the technical criteria for access to the energy transmission and distribution networks is a variable that is considered within the priority indicator.

- ✓ HUMAN DEVELOPMENT INDEX (HDI)

The HDI measures a country's progress in three basic dimensions of human development: enjoying a long and healthy life, access to education, and a decent standard of living. Health, education, and level of opportunity.

Access to electricity is considered fundamental for human development, as it allows the substitution of inefficient or polluting energy sources, such as kerosene and firewood for cooking and heating in homes. By allowing the opportunity to use electric energy to supply the energy demands of households.

This index is an important variable to consider in the prioritization of municipalities to be electrified, since it favors those municipalities, whose human development is deficient.

- ✓ MULTIDIMENSIONAL POVERTY INDEX (MPI)

The Multidimensional Poverty Index (MPI) is a measurement tool, also developed by UNDP, in collaboration with the Oxford University Poverty and Human Development Initiative (OPHI). Since 2010, this indicator replaces human poverty indices, including income parameters along with other types of deprivations that affect people's lives.

The MPI weights education, healthcare or health, and quality of life. The last dimension considers access to electricity and cooking fuels, which could be categorized as indicators of energy poverty.

The multidimensional poverty index makes it possible to place those municipalities whose deprivations do not exceed the minimum threshold. This indicator is important because it integrates the lack of services such as access to drinking water, health care and sanitation, whose access can be enhanced and made viable when electricity service is available.

- ✓ PERCENTAGE OF PEOPLE LIVING IN POVERTY (%)

The percentage of people living in poverty according to each department in Guatemala will be considered to assess the priority that productive development programs related to access to electricity service will have.

- ✓ RELATIVE FIREWOOD CONSUMPTION INDEX

In Guatemala, this variable is related to energy poverty due to the lack of access to electricity or other energy services. Firewood consumption is used in a higher percentage in rural communities and as useful energy for cooking and heating. This index will be valued for its importance in the sustainable development of those communities that are consuming the most forest resources.

- ✓ POPULATION DENSITY

This variable is updated with data from the XII National Population Census and VII Housing Census conducted in 2018, by means of this indicator the number of inhabitants per kilometer can be determined, thus facilitating the determination of which municipalities can be prioritized.

3.2. METHODOLOGY FOR PRIORITIZATION OF RURAL ELECTRIFICATION PROJECTS

The Ministry, when designing the rural electrification policy, considered it appropriate to include a series of technical and socioeconomic variables that will allow prioritizing and orienting institutional efforts; the indicators described in this paragraph will be updated every year and will be the responsibility of the Ministry of Energy and Mines.

For these municipalities to be considered within the methodology, it is appropriate that at least the following can be guaranteed:

- ✓ The safety of the technicians in the work regions is guaranteed.
- ✓ The infrastructure projects are accepted by the communities and local authorities.
- ✓ There is political will on the part of the local authorities to implement the plan.
- ✓ There is a high risk of non-payment by the beneficiary communities.

These points will be institutionalized in Illustration 15.

If the points mentioned above are met, the municipalities priority indicator will be considered, which will be developed below.

Table 6: Weight of socioeconomic and technical indicators.

No.	Indicator	Weight
Socioeconomic indicators		70%
1	Relative index of firewood consumption	5%
2	Percentage of people living in poverty	20%
3	Human development index	15%
4	Multidimensional poverty index	15%
5	Population density	15%
Technical indicators		30%
6	Electricity coverage index	20%
7	Access to electricity transmission and distribution systems	10%
Total		100%

Source: Proprietary production.

Each of the indicators will be adjusted to prioritize the municipalities with the worst indicators, using the following equation for the variables where the ascending indicators are prioritized.

$$I_j = P_i * \frac{I_{Vmax} - I_{real}}{I_{Vmax} - I_{Vmi}}$$

Or the following equation for variables where top-down values are prioritized:

$$I_j = P_i * \frac{I_{Vmin} - I_{real}}{I_{Vmin} - I_{Vmax}}$$

I_j: Adjusted indicator.
P_i: Weight of the indicator.
I_{Vmax}: Maximum indicator for the country.
I_{Vmin}: Minimum indicator for the country.
I_{real}: Municipality indicator.

By evaluating these indicators in each of the municipalities, we were able to determine which municipalities would be prioritized, based on the weighting established in Table 6, also in the annexes section of this document you will find the complete list of municipalities.

Table 7: Prioritized municipalities.

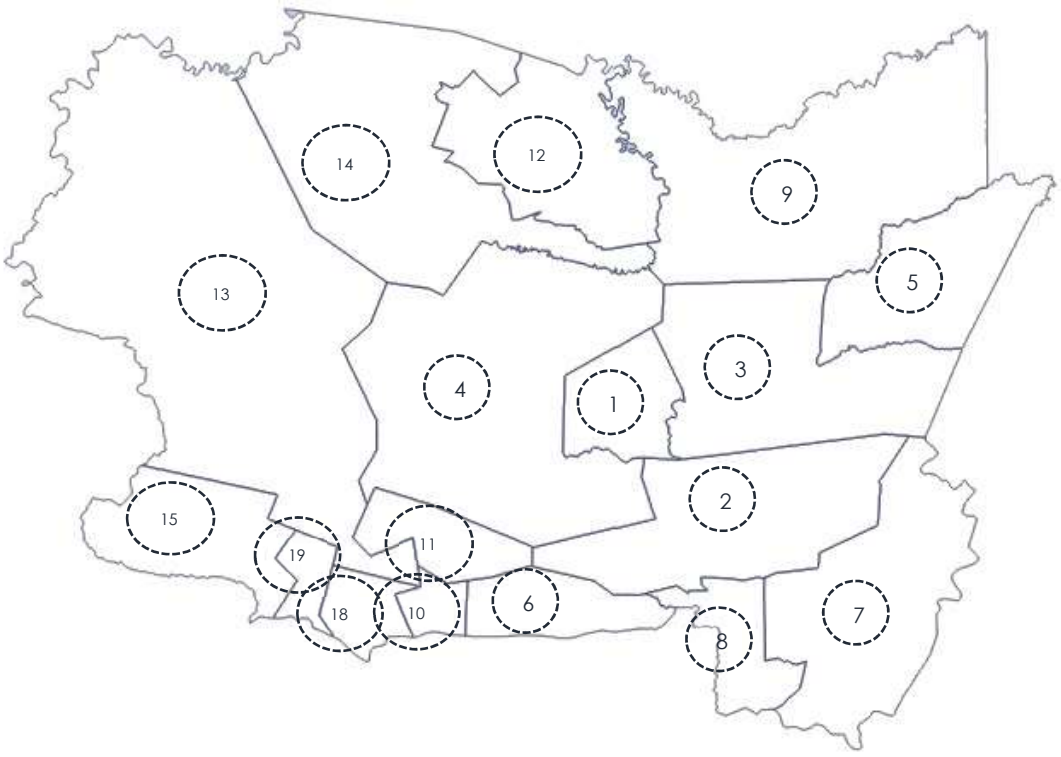
No.	Department	Municipality	Accumulated Electricity Coverage	Users Without Coverage	Estimated Investment[1] [USD]
1	Alta Verapaz	San Agustín Lanquín	88.23%	3,372	$ 5,867,724
2	Alta Verapaz	Senahú	88.62%	12,784	$ 22,245,842
3	Alta Verapaz	Santa María Cahabón	88.90%	8,892	$ 15,473,250
4	Alta Verapaz	San Pedro Carchá	89.71%	26,629	$ 46,337,964
5	Alta Verapaz	Chahal	89.81%	3,493	$ 6,078,280
6	Alta Verapaz	San Miguel Tucurú	89.94%	4,248	$ 7,392,079
7	Alta Verapaz	Panzós	90.18%	7,814	$ 13,597,388
8	Alta Verapaz	Santa Catalina La Tinta	90.28%	3,156	$ 12,057,372
9	Alta Verapaz	Fray Bartolomé de Las Casas	90.49%	6,929	$ 5,491,855
10	Alta Verapaz	Tamahú	90.54%	1,509	$ 2,625,859
11	Alta Verapaz	San Juan Chamelco	90.69%	5,163	$ 8,984,299
12	Alta Verapaz	Raxruhá	90.78%	2,948	$ 5,129,908
13	Alta Verapaz	Cobán	91.34%	18,241	$ 31,741,740
14	Alta Verapaz	Chisec	91.53%	6,066	$ 10,555,638
15	Alta Verapaz	San Cristóbal Verapaz	91.62%	2,956	$ 5,143,829
16	Quiché	San Miguel Uspantán	91.82%	6,709	$ 11,674,543
17	Huehuetenango	San Gaspar Ixchil	91.85%	818	$ 1,423,428
18	Alta Verapaz	Tactic	91.89%	1,401	$ 2,437,924
19	Alta Verapaz	Santa Cruz Verapaz	91.92%	1,097	$ 1,908,924
20	Huehuetenango	Santa Cruz Barillas	92.12%	6,430	$ 11,189,046

Source: Proprietary production.

[1] Assuming a price of Q 13,225.00 corresponding to the construction of single-phase lines, provided by INDE.

The infrastructure needed to increase electricity coverage in the prioritized municipalities should also consider those communities or villages that are nearby, especially if it is more economically efficient to serve this community from another municipality. There is no limitation or circumscription to the prioritized municipalities since the infrastructure should be used to serve as many users as possible.

Map 1: Prioritized location of the municipalities of Alta Verapaz.



Source: Proprietary production, UPEM.

3.3. ESTIMATION OF ENERGY DEMAND AND UNSUPPLIED POWER

Until 2016, the Ministry of Energy and Mines identified 272,139 homes that still did not have electricity service within the national territory; each non-electrified home represents a block of power and energy to be considered within a rural electrification project, now with the support of the data collected through the National Census 2018, the new results of estimated energy and power not supplied by municipality and by department are presented; likewise, the prices for energy not supplied in a year.

Table 8: Estimated energy and power not supplied by department.

Department	Annual energy not supplied (GWh)	Maximum power (MW)	Department	Annual energy not supplied (GWh)	Maximum power (MW)
Alta Verapaz	146.21	25.67	Jalapa	11.94	2.10
Petén	45.86	8.05	Santa Rosa	11.10	1.95
Huehuetenango	42.91	9.46	Suchitepéquez	9.99	1.75
Quiché	37.38	8.24	Zacapa	8.23	1.44
Izabal	24.36	4.28	Quetzaltenango	7.77	1.71
Chiquimula	21.22	3.73	Chimaltenango	5.46	1.20
Baja Verapaz	20.33	3.57	Retalhuleu	5.29	1.17
San Marcos	20.26	4.47	Totonicapán	5.24	0.92
Guatemala	16.36	2.57	Sololá	4.55	1.00
Escuintla	13.99	2.20	El Progreso	4.12	0.72
Jutiapa	13.29	2.33	Sacatepéquez	1.97	0.31

Source: Ministry of Energy and Mines.

Table 8 represents the estimated energy (GWh) and power (MW) not supplied to the non-electrified communities in each department; the estimate of total energy not supplied amounts to 447.83 GWh per year, while the estimate of power not supplied within the entire national territory is 88.85 MW in peak demand.

3.3.1. COST OF ENERGY NOT SUPPLIED

Unsupplied energy represents an attractive economic flow opportunity for the energy industry, in addition to new community development possibilities for connected users.

Table 9 represents the estimated cost of unsupplied energy in one year for each department, in millions of Quetzals; the estimated total cost of unsupplied energy in the country amounts to 5,856.68 million Quetzals, in current currency.

Table 9: Estimated cost of energy not supplied by department.

Department	Millions of GTQ	Department	Millions of GTQ
Alta Verapaz	Q 1,792.04	Jalapa	Q 146.33
Petén	Q 562.16	Santa Rosa	Q 136.06
Huehuetenango	Q 525.94	Suchitepéquez	Q 122.50
Quiché	Q 458.17	Zacapa	Q 100.81

Izabal	Q 298.62	Quetzaltenango	Q 95.28
Chiquimula	Q 260.07	Chimaltenango	Q 66.92
Baja Verapaz	Q 249.19	Retalhuleu	Q 64.86
San Marcos	Q 248.30	Totonicapán	Q 64.19
Guatemala	Q 200.52	Sololá	Q 55.72
Escuintla	Q 171.45	El Progreso	Q 50.54
Jutiapa	Q 162.90	Sacatepéquez	Q 24.14

Source: Proprietary production, with information from the Wholesale Market Administrator

Table 10 represents the ten municipalities with the highest proportions of energy and power not supplied, these being in the northern part of the country.

Table 10: Estimates of energy and power not supplied by municipality, and prices of energy not supplied in a year.

No.	Municipality	Energy not supplied in a year (GWh)	Power not supplied (MW)	Price of energy not supplied (Millions of GTQ)
1	San Pedro Carchá	91.40	5.86	Q 408.92
2	Cobán	62.61	4.01	Q 280.11
3	Senahú	43.88	2.81	Q 196.31
4	Santa María Cahabón	30.52	1.96	Q 136.55
5	Panzós	26.82	1.71	Q 119.99
6	El Estor	23.89	1.53	Q 106.86
7	Fray Bartolomé de Las Casas	23.78	1.52	Q 106.40
8	Purulhá	22.95	1.47	Q 102.66
9	Sayaxché	21.01	1.35	Q 94.01
10	Chisec	20.82	1.33	Q 93.15
11	Other municipalities	941.42	65.28	Q 4,211.71

Source: Ministry of Energy and Mines.

3.4. ELECTRIFICATION COST ESTIMATE

Based on the historical information provided by the Rural Electrification and Works Management of INDE reflected in Tables 4 and 5 of this Plan, an estimate of the costs of electrification can be made, obviously this estimate may be different from the real values, but it can allow us to have a general idea of the amount of investment needed.

Considering the pre-established goals in the General Government Policy 2020 - 2024, Energy Policy 2013 - 2027, as well as in the Rural Electrification Policy 2018 - 2032 and the SDGs, an estimate has been made of the minimum investment needed per year, which would allow us to meet each of the following goals.

Table 11: Estimated minimum investment per year.

Year	Number of Families	Electrical Coverage	Electricity Coverage Goal	Population Growth Rate	Target number of users to be electrified	Estimated Investment USD
2018	3,275,931	2,887,256	88.14%	1.61%		
2019	3,327,449	2,968,362	89.21%	1.57%	29,588	$ 51,487,442
2020	3,378,412	3,050,073	90.28%	1.53%	30,748	$ 53,504,982
2021	3,428,795	3,132,348	91.35%	1.49%	31,891	$ 55,495,211
2022	3,478,523	3,215,097	92.43%	1.45%	33,022	$ 57,462,965
2023	3,527,530	3,298,240	93.50%	1.41%	34,136	$ 59,401,279
2024	3,575,766	3,356,750	93.88%	1.37%	10,274	$ 17,877,676
2025	3,623,196	3,414,863	94.25%	1.33%	10,682	$ 18,587,877
2026	3,669,802	3,472,550	94.63%	1.29%	11,082	$ 19,284,020
2027	3,715,573	3,529,794	95.00%	1.25%	11,473	$ 19,964,909
2028	3,760,505	3,622,620	96.33%	1.21%	47,893	$ 83,340,897
2029	3,804,610	3,715,836	97.67%	1.17%	49,111	$ 85,459,545
2030	3,847,895	3,809,416	99.00%	1.14%	50,295	$ 87,520,395
2031	3,890,378	3,868,981	99.45%	1.10%	17,082	$ 29,724,714
2032	3,932,073	3,928,141	99.90%	1.07%	17,465	$ 30,391,406

General Government Policy 2020 - 2023

Energy Policy 2013 - 2027

SDGs

Katun 2032

Source: Proprietary production, with information from INDE.

The investment shown in Table 11 does not include adjustments and extensions to the high voltage network, so it can be considered that these amounts are the minimum that should be invested to achieve the proposed goals.

3.5. RECOGNIZED ELECTRIFICATION PROCESSES

The following is a description of the different electrification methods, which are composed as follows.

3.5.1. LEGAL FRAMEWORK FOR MICROGRIDS

In Guatemala, the General Law of Electricity (Decree 93-96) indicates the separation of functions in the electrical activity in Article 7, however, it also establishes that the final distribution service providers may be owners of generation plants of up to 5 MW without prejudice to the above. In addition, companies with installed generation power of up to 5 MW will be able to carry out electric distribution activities without the need for separation of functions. In the case of municipal electric companies, it is not necessary to carry out the separation of functions of generation and distribution except in the case of investments with non-municipal resources.

This article establishes that electricity companies cannot operate through monopolies, where the activity of generation, transmission and distribution is carried out through different companies and each company must respond in accordance with the regulatory framework that corresponds to it. In

the case of distribution companies, the National Electric Energy Commission establishes a tariff which includes the payment for this service, in addition to the payment for the generation and transportation of electricity. However, the law also establishes that distribution companies may invest in small-scale generation plants, if needed, and generation companies (up to 5 MW) may provide the distribution service. In the case of microgrids, whether isolated or connected to the distribution grid, the generation plants that supply them are considered micro plants since they do not exceed this limit.

3.5.2. TECHNICAL ASPECTS OF MICROGRIDS

Microgrids are commercially operated facilities for a variety of applications, from supplying electricity to remote communities, isolated grids, grid support, and industrial research centers. It is the technological outcome of a series of opportunities with distribution grids and renewable electricity generation, as well as economic priorities due to the volatility of petroleum product prices and environmental considerations related to greenhouse gas emissions.

In an electric power system, there is a balance between demand and generation that is carried out with operational coordination regulations to guarantee the quality of supply. This system coordination is carried out in Guatemala through the AMM, which manages the transportation system between generation plants and demand nodes for Large Users or Distributors. At the distribution network level, the companies authorized to provide the service in Guatemala have their own unit in charge of managing the network that corresponds to them.

Microgrids are electrical systems useful for managing a network of a few kilometers, in which small-scale generation plants are integrated, these are operated or managed by automatic control equipment (microgrid management systems), they may have electrical energy storage systems and may also operate in isolation from the national grid.

3.5.3. ISOLATED MICROGRIDS

An isolated system is a short-range electrical network, which directly interconnects generation systems to specific electrical loads. This type of system has a centralized control of dispatch, transport, and supply of electric energy the control systems are not sectioned as in the SNI.

Illustration 16: Basic energy supply scheme.

Source: Proprietary production.

Isolated microgrids have socio-environmental benefits, since they can use generation systems from renewable energy sources such as solar, wind and water, encouraging the population to use electricity as a clean energy source to cover needs such as lighting and thermal services (i.e. refrigeration, air conditioning systems, heating).

It is advisable to make use of isolated microgrid systems when a non-electrified community is extremely remote from the National Interconnected System, and where its geoGraphic conditions make it impossible in the medium term to create expansions in the transmission networks.

Isolated microgrid systems that make use of renewable energy sources must generally implement energy management systems using battery banks, which must guarantee the supply of voltage and electrical power and the quality of supply. The electricity generation that supplies the demand of the microgrid can come from renewable or non-renewable sources; in the case of micro hydroelectric plants, hydroelectric dam systems can even be used to store energy for use according to the demand of the microgrid.

3.5.4. MICROGRIDS IN DISTRIBUTION SYSTEMS

The distribution networks in Guatemala cover extensive rural areas, with various types of demand, mostly residential. In the urban area, the distribution network covers a smaller extension, but the demand is much higher, for example, the maximum demand between 18.00 and 21.00 hours in Guatemala City is more than 100 MW, while the maximum demand in that same period in Dolores, Petén, is approximately 0.8 MW. In both cases, Guatemalans have the same right to the electricity distribution service they are paying for, and in both cases microgrids can be a technological solution.

The integration of micro and small generation plants in the network has allowed reducing energy losses in transmission and distribution lines and has also led to an improvement in voltage and current quality indicators, however, the administration of the distribution network is still centralized and the balance between supply and demand of electricity is often done by interrupting the supply of demand circuits when there are failures in other sections of the network. Microgrids make it possible to manage the demand circuits and the generation connected to that circuit, to optimize and guarantee the supply of electricity. This reinforces distribution networks, reduces losses, and optimizes the management of extensive distribution networks.

In the case of Guatemala City, microgrids allow optimizing the management of a network with industrial and commercial demand, by including energy storage systems it is possible to reduce energy transportation costs in peak demand periods by transporting electricity in periods of minimum demand. This benefits both residential users and generating agents.

This community was benefited by the California Energy Commission through the EPIC program, with the installation of a microgrid. Due to the geoGraph location, there were disconnections from the community to the rest of the distribution network of the distributor (in California Pacific Gas & Electric) due to natural disasters, for example, forest fires. The microgrid consists of a battery energy storage system (500 kW, 950 kWh), a micro-PV power plant (420 kW), a backup diesel generator (1 MW), and the microgrid management system. Because of the microgrid, the community was declared by the Red Cross as a natural disaster rally point in Humboldt Bay, California.

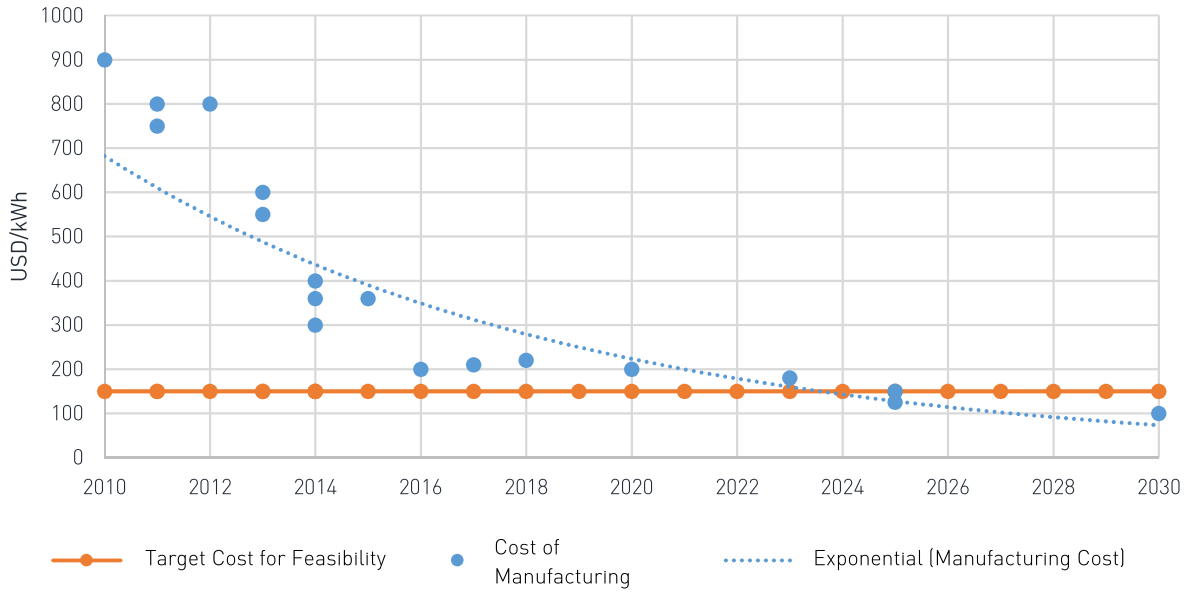
3.5.5. MICROGRID MANAGEMENT SYSTEM

The management of a microgrid is done through specialized electronic controllers, known as MGMS (microgrid management system), currently all suppliers of electrical equipment have lines of controllers for microgrid management. There are suppliers that offer computer simulation of the microgrid, software for remote management of the operation, and data analysis integrated into the controller; others offer an energy storage system through batteries, therefore this type of MGMS offers resilience and quality of supply, optimizing the stored resources and resources from the distribution network or from a generation plant, and are automatically synchronized with the distribution network at 60 Hz.

Microgrid management systems can have PCC (point of common coupling) relays when they are part of a distribution network, thus interconnecting between the microgrid and the main distribution network and disconnecting from the grid during a power failure. Operators can manually operate a microgrid through the MGMS to isolate it from the system in case of distribution circuit maintenance or for safety reasons. In general, the benefits of these management systems are highlighted in resilience, energy and power quality, and reduction of environmental impacts when the microgrid is connected to the distribution grid, in addition to access to electricity, quality of supply and a lower economic and environmental impact in the case of isolated or hybrid grids.

An important component of the management systems of isolated or hybrid microgrids is the electricity storage system, by means of batteries. The cost of investment in batteries is the main stumbling block during the technical and economic analysis of these systems. The cost of batteries has been decreasing since 2010, and it is expected that by the end of 2020 there will be a commercial battery at the limit of 150 USD/kWh, this is necessary to make this technology competitive. Graph 35 illustrates the historical trend and the projection to 2030.

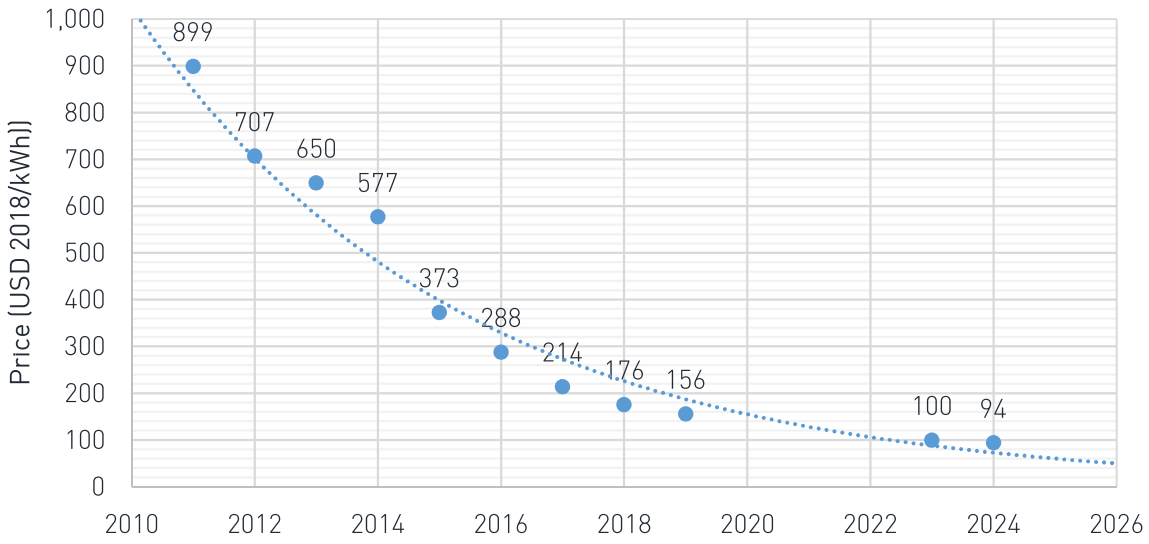
Graph 34: Battery manufacturing cost benchmark.



Source: Union of Concerned Scientists, Political briefs 2017.

Bloomberg New Energy Finance (BNEF) conducts an annual survey and market analysis of lithium-ion battery prices. Due to the investment in electric vehicles (cargo, passenger, buses, etc.) prices have been reduced annually by an average of 21%, and the prices of the necessary metals, i.e. lithium, cobalt and nickel, would only affect the future price by an increase of 18.8% for nickel, 2.4% for cobalt and 5.6% for lithium, therefore, in the worst scenario the trend of battery prices would be 26.8% higher than predicted. Figure 3 presents the information resulting from the market research done by BNEF, which reflects the price of storing electricity in batteries in the world market as of 2018 with the trend until 2026.

Graph 35: Analysis of the global electric battery market.



Source: Bloomberg NEF, March 5, 2019.

In summary, the investment cost of using battery electricity storage systems is no longer an impediment or a disadvantage when implementing microgrid management systems, therefore, the technological solution related to off-grid microgrids should be evaluated due to the probable feasibility.

It is remarkable the case of two companies, among many others, that have invested in isolated microgrids especially for rural electrification. These cases are Siemens in Ethiopia, a country with a much lower income level than Guatemala, and General Electric in India. In the case of Ethiopia, there is an Investment Commission in charge of solving the challenges of the energy and infrastructure sector in that country, it is worth mentioning that as of April 2019, 56% of the population of Ethiopia does not have access to electricity. The government's plan has the ambitious goal of achieving 100% access to electricity by 2025, and to achieve this goal they have signed memorandums of understanding with various private or international cooperation entities for technical assistance through the expansion of the distribution network or solutions with isolated systems, which can be microgrids for communities or island systems for industrial centers; it is in this plan of the Ethiopian government that cooperation with Siemens is agreed.

In the case of General Electric, one of the largest companies in the world with investments in aeronautics, nuclear energy, electrical equipment, among others, it has invested in efficient technologies to get involved in Sustainable Development Goal 7: universal access to energy. The solution they have provided to communities in Nepal and India has been modules installed inside 20-foot, plug-and-play containers that provide 15 kW of power through a set of solar panels (15 kW peak), 100 Ah capacity batteries, and an 18.75 kVA diesel generator. These micro generation plants are connected to the microgrid and have integrated MGMS, therefore, the cost of the microgrid is reduced by integrating many of the components needed for a microgrid. General Electric offers 30, 40 and 250 kW containers with the appropriate parameters according to each power rating.

3.5.6. ELECTRICITY GENERATION FOR MICROGRIDS

The power generation required for a microgrid can serve two functions:

- Microgrid and distribution circuit backup.
- Reduction of transmission and distribution losses.

To participate as a generator in a distribution circuit, the current legal framework authorizes renewable distributed generators and self-producing users with energy surpluses, the latter can inject their generation directly into the distribution network and a subtraction is made between the energy consumed and the energy generated by the user.

A user can generate the electric energy it consumes and operate in a system isolated from the distribution circuits owned by the Distribution Agents. However, this type of user does not currently have a legal or regulatory framework on the technical or economic decisions necessary to be used in proposals or projects, they are users that can exist under the premise of freedom in the generation of electric energy. The legal and regulatory framework in force until 2019 only contemplates in the Technical Norm of Renewable Distributed Generation the figure of Self-producing Users with energy surplus (UAEE for its acronym in Spanish), this is a user of the distribution system that injects electric energy to such system, produced by generation with renewable energy sources located within its consumption facilities, and that does not receive remuneration for such surplus.

Self-producing users isolated from the grid are those who produce and consume electricity without being connected to a distribution system, unlike isolated systems or microgrids, this system is completely independent of any distribution system.

This type of users has important differences, first, the generation of electric energy can happen by means of renewable or non-renewable energies (generation plants by means of diesel, gasoline, natural gas, LPG). In the case of intermittent renewable energies (solar, wind and hydro) it is necessary to add an electric energy storage system by means of batteries. Finally, the electricity is converted into useful energy, which is what we need for lighting, heating, cooking or cooling systems. Figure 14 shows the relationship between the systems required for an off-grid renewable energy autoproducer.

Illustration 17: Self-producer user with renewable energies isolated from the grid.

Source: Mining Energy Planning Unit, Proprietary production.

Unlike Self-producing Users with Energy Surplus (hereinafter UAEE), self-producing users isolated from the grid do not have a distribution system at a reasonable distance to interconnect; in addition, these users decided to have their own generation system, either renewable or non-renewable, to supply electricity to those electrical and electronic equipment necessary for comfort, health and safety, such as refrigerators and lighting systems.

In summary, microgrids can obtain a source of electricity generation either by means of a renewable distributed generator, a UAEE, or an autoproducer. In any of the above cases, the technical analysis must prevail to establish which would be the most convenient legal figure, since in the case of an isolated system it could even be convenient to present a new regulatory framework that promotes the administration of the microgrid by the users to be electrified.

The technologies that can be used for micro power generation plants are divided according to the energy resource they use, into renewable and non-renewable. The renewable ones are micro hydroelectric power plants, micro photovoltaic power plants and wind turbines. The non-renewable ones are gasoline, natural gas or diesel reciprocating engines.

3.5.7. MICROHYDROELECTRIC

A micro hydroelectric power plant is a type of hydroelectric power plant that produces between 5 to 100 kW, useful for supplying energy to small communities, about 2400 kWh per day if the plant factor of a 100 kW plant is 100%. These plants have now been developed all over the world, both in developing and industrialized countries, as they can complement distribution systems, microgrids, photovoltaic or wind power plants through an economical option both in investment and operating costs.

The installation required for a micro hydroelectric plant depends on two variables: water fall and water flow. Most micro-hydro plants use Pelton turbines because of the steep drop despite low flow, although many of these installations use small dams or ponds to maximize the potential. Microhydro plants that do not use dams are more economical, however they can only generate between 5 to 15 kW in low flow basins, although a minimum drop of 1 meter is required. The installation and construction details depend on the site where it is convenient, however there are some important components for these plants: water intake, canalization, pressure chamber, piping to the turbine, turbine and discharge or spillway channel.

The potential energy that could be generated, in kW, from a micro hydroelectric power plant can be estimated using the following equation:

$$Power = \left(\frac{QH}{k}\right) * \eta = \left[\frac{(gal/min)(ft)}{(gal/min)/(ft/kW)}\right]$$

Where:

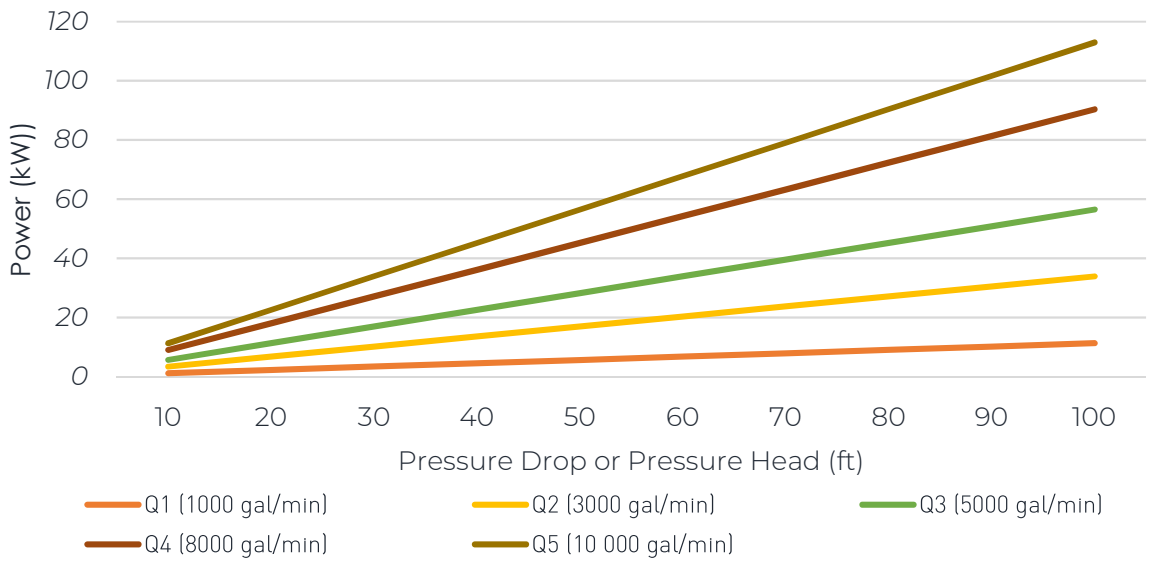
- Q: is the flow rate in gallons per minute.

- H: is the pressure head, static pressure head or drop, in feet.

- k: constant 5 310 gallons per minute per foot per kW.

- η: is the system efficiency, considering turbine efficiency and pipe friction (Hazen Williams equation).

Graph 36: Graph of Micro Hydroelectric Generation, efficiency of 60%.



Source: Mining Energy Planning Unit, Proprietary production.

Considering a micro hydroelectric plant with 60% efficiency in the conversion of water potential, Graph 36 illustrates the possible generation power for different flows, in this case, falls in the range between 10 and 100 ft (3.05 and 30.5 meters) are used. Micro-hydro plants must consider the seasonality of the water resource in addition to the ecological or through flow, this flow does not enter the water intake, therefore, it is not turbined, in larger hydroelectric plants a minimum range of 10% of the flow is considered responsible for this non-turbine flow. Currently, there are options for micro-hydropower plants using plug and play turbines, but they only exist in the 5 to 15 kW range.

In Guatemala there are two examples of micro hydropower plants operating in isolated systems: El Chel village micro hydro (Asociación hidroeléctrica Chelense) and Batzchocolá micro hydropower plant. The Batzchocolá micro hydro provides electricity service to the communities of Batzchocolá, Laguna Batzchocolá and Visquichum, supported through MEM, OLADE and other NGOs, the communities were advised to form and manage a rural energy company, registered as Asociación Hidroeléctrica de Desarrollo Integral Norte de Quiché (ASHDINQUI). The project included the construction of the micro-hydro, the distribution circuit, technical assistance and training for the administration and operation of the isolated system, and social works. The investment in the 90 kW micro-hydro plant was 2.3 million Quetzals (US$294,000), which was provided by Energia Limpia of Guatemala and through international cooperation from the Netherlands (Hivos). The distribution network to the communities was provided by INDE and had a value of 908,000 Quetzals (US$117,000) and was intended to provide electricity coverage to 160 users. In total, the rural electrification project had a cost of 3.2 million Quetzals (US$410,000), which, when distributed among 160 users, gives an estimated cost per user of approximately 20,000 Quetzals.

The Batzchocolá micro-hydro has 126 meters of gross drop or pressure head, and a minimum flow of 102 liters per second, a design flow of 120 liters per second (1900 gal/minute) during 10 months of the year, a normal flow of 367 liters per second, and a maximum flow of 700 liters per second in the

heaviest month of the year. Maintenance is planned, with daily cleaning of the grate and every two days cleaning of the sand trap. This project is currently in operation and has enabled three communities located in Nebaj and Chajul, Quiché, to have electricity service through this isolated system.

3.5.8. INTERMITTENT RENEWABLE ENERGY MICROGRIDS

Intermittent renewable energy micro plants have solar and wind power as their primary source of energy. They are known as intermittent because the maximum or peak power they can supply is possible only under conditions that cannot be controlled, in the case of solar energy there must be direct irradiation, in a range close to 90 degrees with respect to the surface of the cell, and at an ambient temperature not exceeding 35°C, they must also receive continuous preventive maintenance to prevent dust films or debris from decreasing the efficiency of electrical generation of the cells. In any case, operating with maintenance and solar radiation monitoring schemes, the generation capacity decreases due to meteorological causes specifically related to the amount of clouds over the plant.

Wind turbines also depend on the weather conditions of the wind, therefore, there are periods where it is possible to generate electricity at maximum capacity, however, this is not common. Since there are no costs associated with primary energy sources, the intermittency or lack of regulation of these technologies is compensated by a very low variable cost of generation.

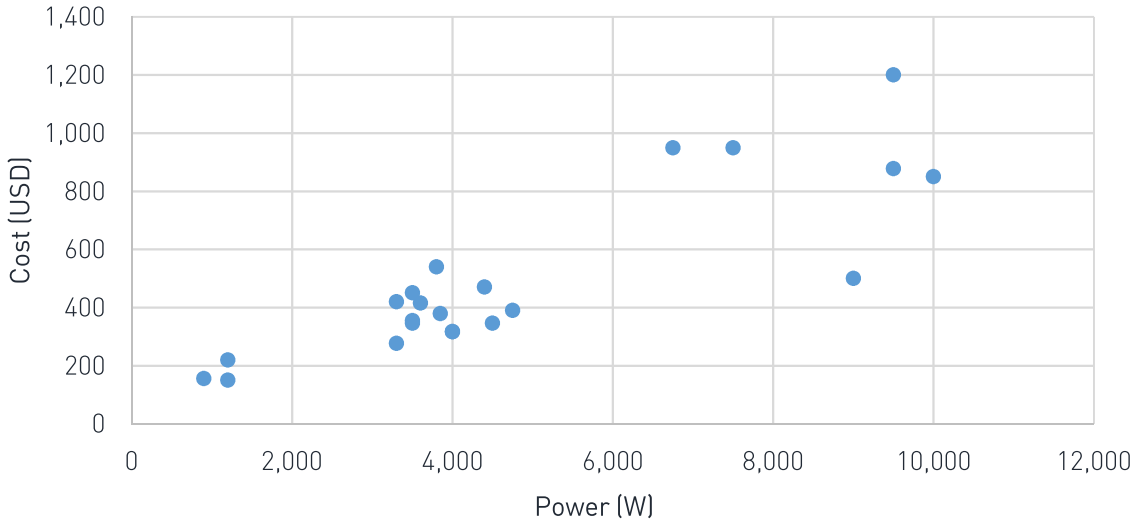
However, for isolated systems, the investment cost is associated with a battery storage system since the primary energy from the sun, wind or rivers cannot be regulated or modified depending on whether electricity is needed or not. Therefore, the cost of batteries is the main stumbling block during the technical and economic analysis for their application in off-grid systems. As mentioned above, battery systems are currently available at around USD 150/kWh, so the analysis must consider the existence of the solar or wind resource and its storage in lithium batteries to guarantee the quality of the supply.

3.5.9. GENERATION PLANTS WITH NON-RENEWABLE RESOURCES

In Guatemala it is common to find diesel or other non-renewable fuel generation plants for emergency plants, for example, in hospitals or shopping malls. These plants have a diesel cycle reciprocating engine, connected to an electric generator and with their respective protection and starting equipment.

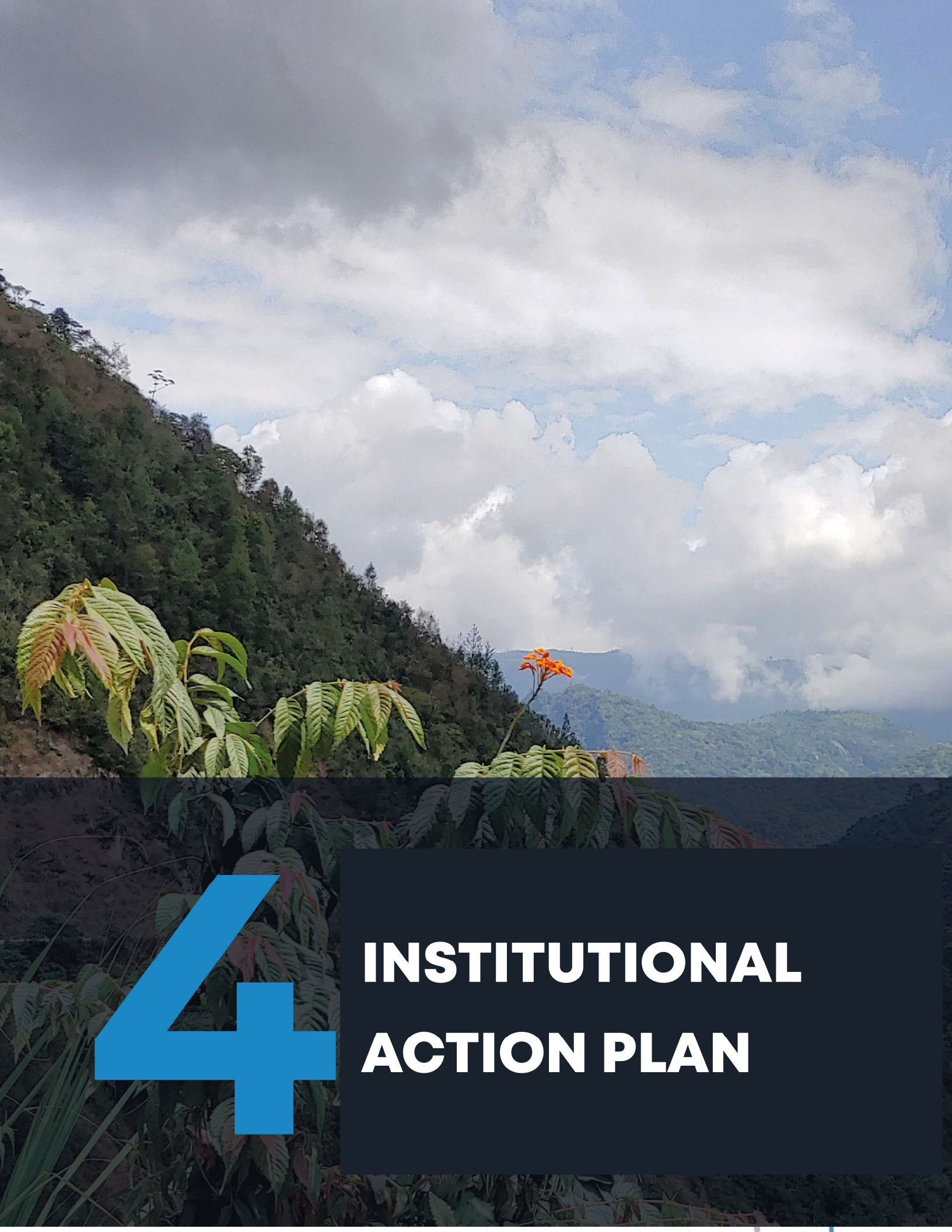
The cost required to implement a generation plant in an off grid microgrid is related to the generation system to be implemented. In the case of non-renewable fuels, plants can start up in a matter of minutes, and keep generating electricity for as long as needed. However, the cost is associated with the fuels for the power plant; Graph 37 illustrates the relationship between the cost of a power plant and the power it provides.

Graph 37: Investment cost of non-renewable energy generating plants.



Source: Amazon.com, accessed February 2020.

It is advisable to integrate several generation sources in a microgrid, in addition to a micro hydro or photovoltaic plant, it is possible to integrate a plant using diesel, natural gas, LPG or gasoline, as it is part of the premises of energy planning at the level of a power system: diversification of supply. Hybrid microgrids, operating grid-connected or stand-alone, also benefit from having the black start feature, this property of non-renewable power plants allows them to re-establish a power system with the nominal frequency of the system (60 Hz). The disadvantage of using non-renewable resources is precisely the volatility of fuel prices, in addition to greenhouse gas emissions.



4 INSTITUTIONAL ACTION PLAN

4.INSTITUTIONAL ACTION PLAN

The following are the specific procedures and actions to be developed by the institutions involved to make the financing of electrification projects feasible.

4.1. INSTITUTIONAL ACTIONS

The actions necessary for the fulfillment of the rural electrification policy are described, these actions will be shown by institution and the Ministry of Energy and Mines will be responsible for verifying their fulfillment.

4.1.1. GENERAL DIRECTION OF ENERGY

The main responsibility of the General Direction of Energy is to carry out the socioeconomic evaluation studies, as well as to gather the information deemed necessary to identify the communities and users without electricity coverage.

- Expand the staff of the Rural Electrification Unit, reaching at least a minimum of 5 technicians working in the field, dedicating 3 technicians to the prioritized areas.
- Coordinate with the mayors to obtain information on the communities in the municipalities.
- Budgetary adjustment to ensure funding for the performance of all functions

4.1.2. MINING ENERGY PLANNING UNIT

The Mining Energy Planning Unit is responsible for coordinating, designing, and proposing the necessary electricity infrastructure to enable the electrification of the country, as well as coordinating and reviewing the progress of the Plan.

- To have at least 2 specialized technicians who are permanently designing infrastructure to guarantee electrification.
- Acquisition of the necessary software for the technical-economic evaluation for the design of electrical infrastructure.
- Control and update of indicators.
- Necessary management for the implementation of the plan.
- Manage for the approval of regulations necessary for the use of any type of technology established in 3.5.

The UPEM will submit for approval of the superior office the technical infrastructure proposals it prepares for rural electrification projects.

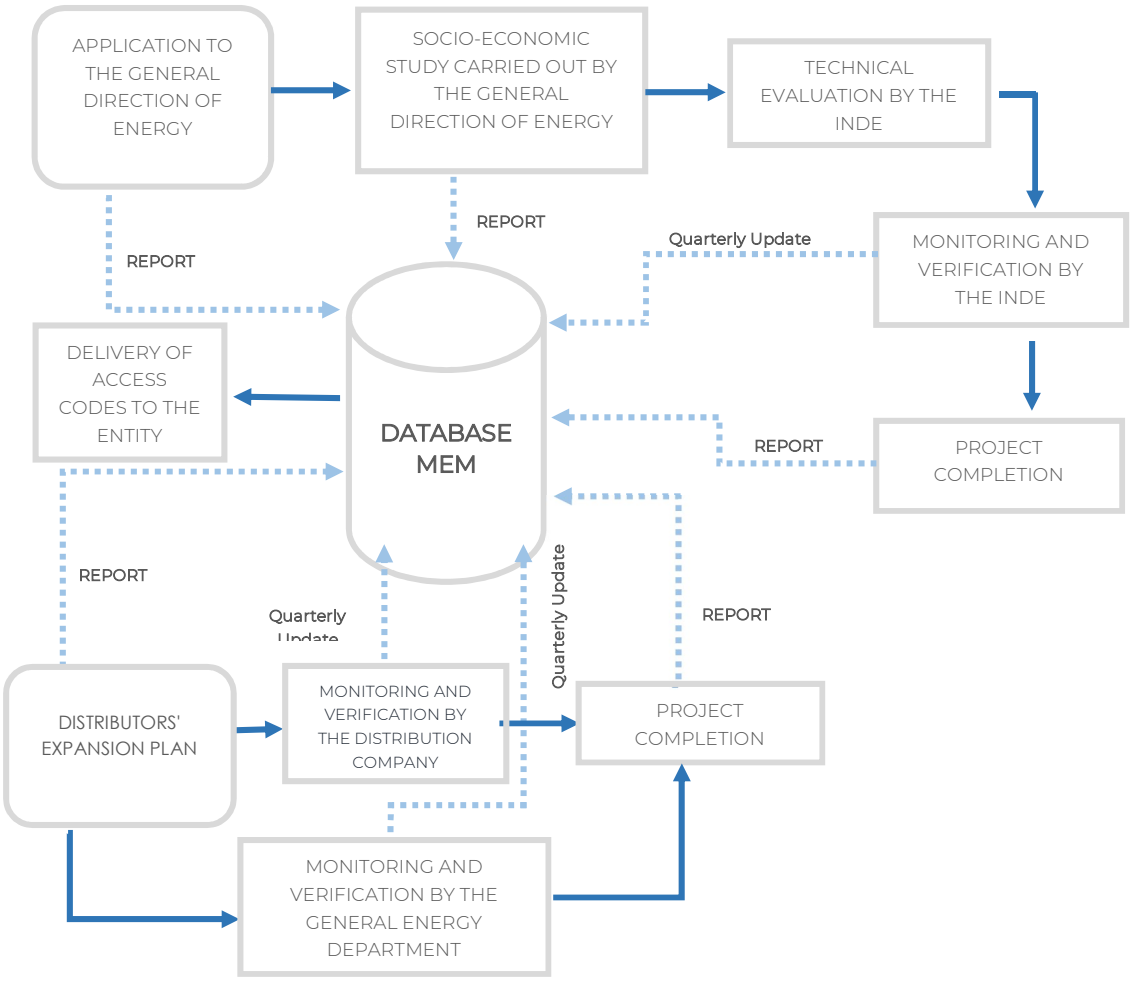
4.2. INFORMATION MANAGEMENT SYSTEM

All the actors that generate or use information will be integrated into a single system that will centralize the information and will be easily accessible to those interested in executing any type of electrification project.

For the control, monitoring and follow-up of electrification projects, a database will be created, which will be fed with information from institutions and agents of the electricity sub-sector or entities related to the subject.

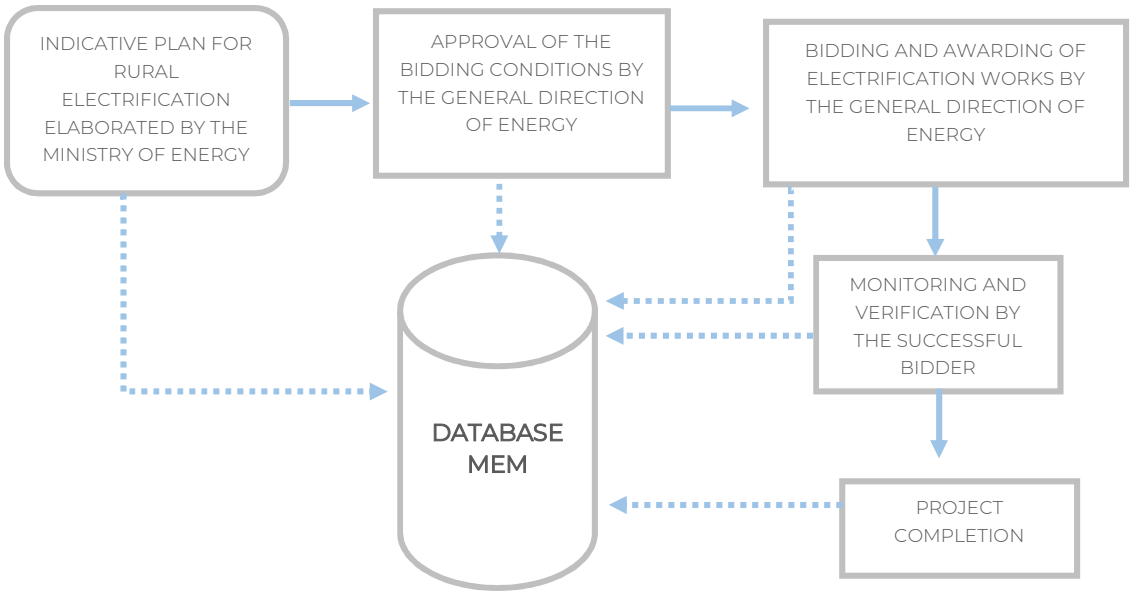
- CONSIDERATIONS
  - The database must be updated and integrated with the official cadastre information.
  - The database must be coordinated and managed with the different actors in the electrification processes.
  - The information previously collected prior to the publication of this plan will be unified and managed by the Mining and Energy Planning Unit.

Illustration 18: Electrification project management and monitoring system.



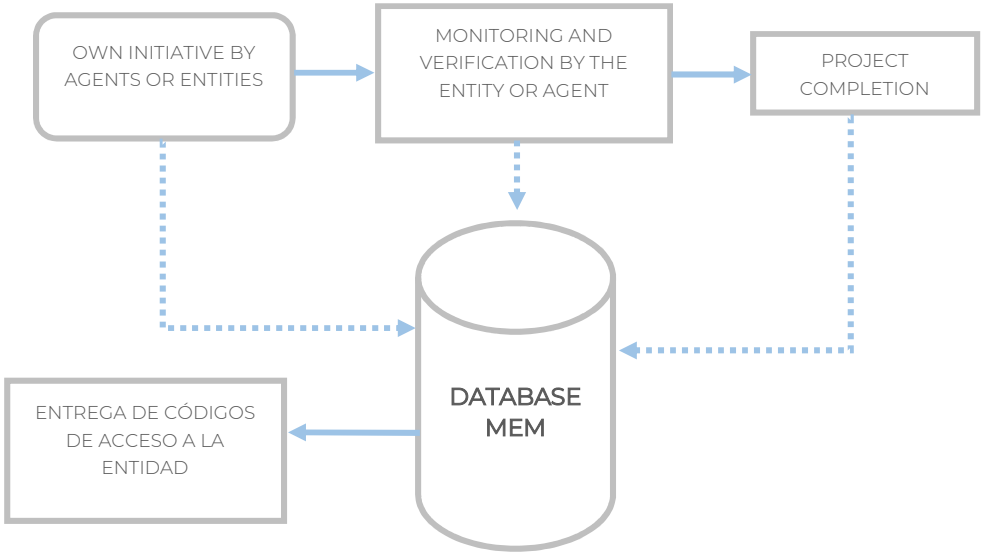
Source: Proprietary production.

Illustration 19: Management and monitoring system for works proposed by the state.



Source: Proprietary production.

Illustration 20: Management and monitoring system for works proposed by the private sector.

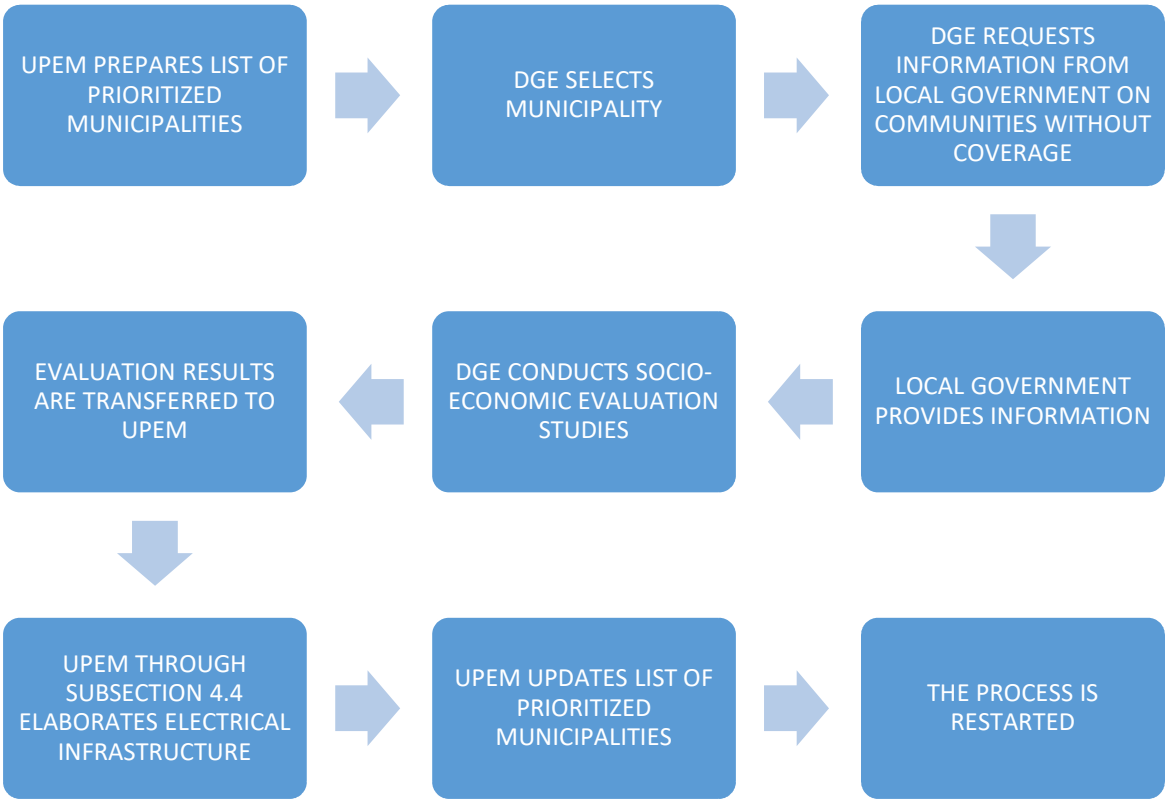


Source: Proprietary production.

4.3. IDENTIFICATION AND SOCIO-ECONOMIC ASSESSMENT OF NON-ELECTRIFIED USERS

Next, the institutional roadmap will be established to articulate the actions based on established timeframes and goals.

Illustration 21: Socioeconomic identification and evaluation system.

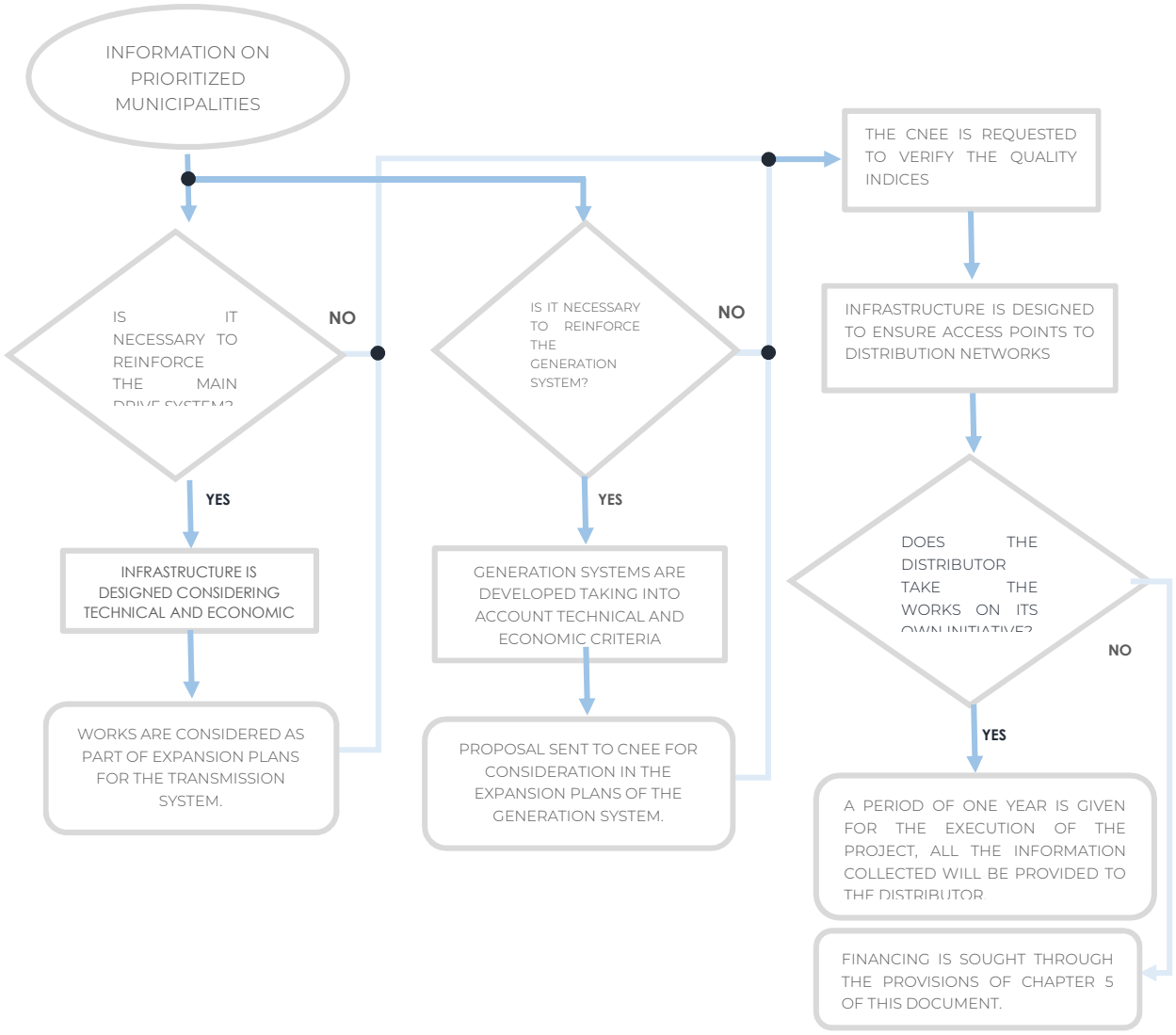


Source: Proprietary production.

4.4. PREPARATION OF THE INDICATIVE PLAN FOR RURAL ELECTRIFICATION

The flow chart below details the procedures considered necessary for the awarding of the electrification works.

Illustration 22: Design of the indicative plan for electrification.



Source: Proprietary production.

4.5. INTER-INSTITUTIONAL MANAGEMENT OF PRODUCTIVE SUPPORT

To develop rural development plans whose main mission is to understand and analyze the main causes that impede the development of families in rural areas, the following premises are considered pertinent.

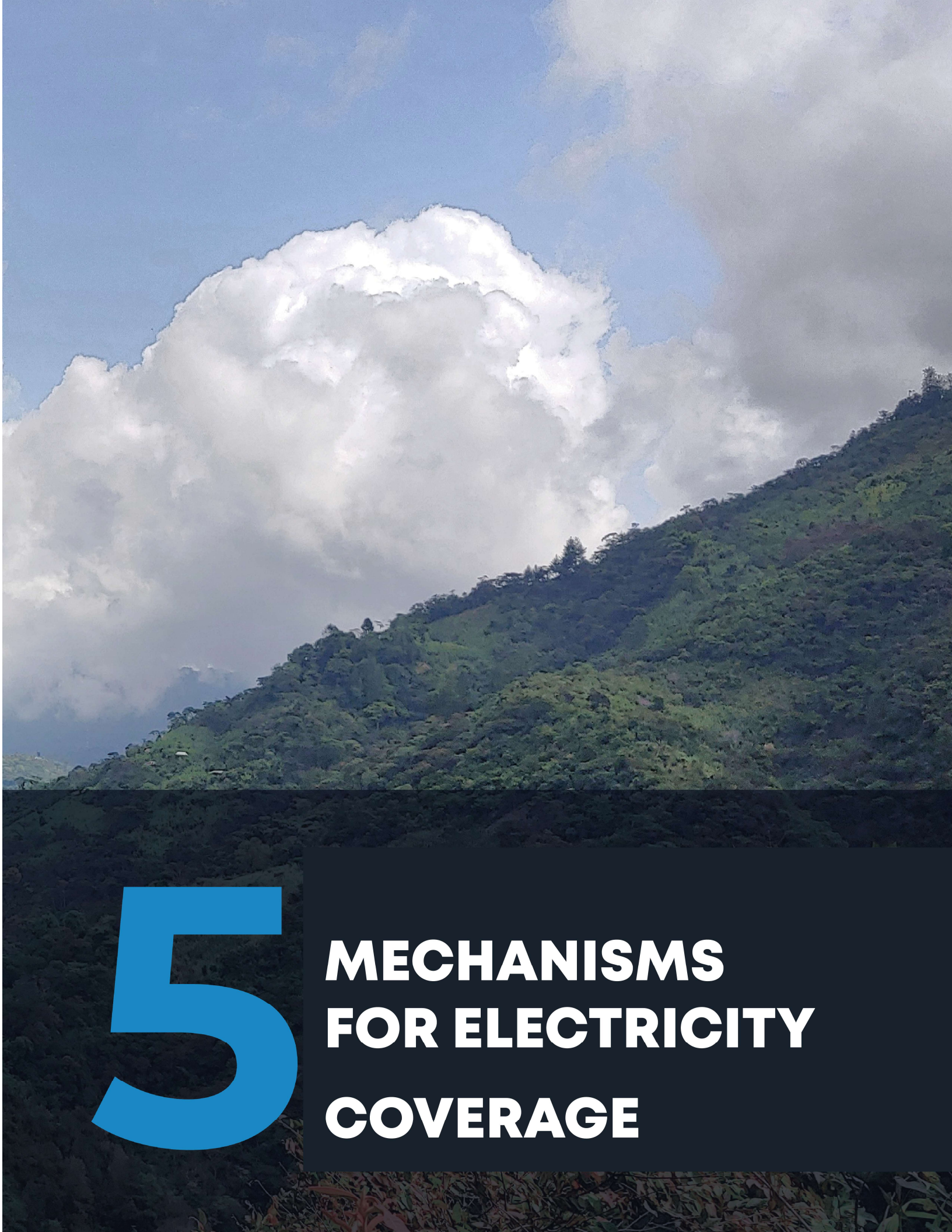
Table 12: Premises of the development plan.

Premise	Description
Short Term	Combat the most basic needs of the communities, guaranteeing access to health, drinking water, drainage, food, among others.
Medium Term	Ensure increased productivity and efficiency in the use of local resources, as well as the formation of human capital to improve the income of families in the project's areas of influence.
Long Term	To guarantee that the younger generations can have access to education and adequate food that allows for the proper development of all their capabilities.

Source: Proprietary production.

To guarantee support to the communities, the Ministry, through the Mining Energy Planning Unit, will seek to form alliances with the General Secretariat of the Presidency, the Ministry of Economy, the Ministry of Public Health and Social Assistance, and the Ministry of Social Development, seeking to coordinate the preparation of a development plan, which will have a long-term vision, establishing at least an 8-year horizon.

This plan must include the actions considered convenient to guarantee the development of the communities together with the accessibility to the electric energy service, which through time will be updated with the results obtained. For its supervision, the Ministry of Energy and Mines will coordinate with the institutions that it considers convenient the generation of socioeconomic and technical indicators that allow to periodically evaluate the effectiveness of the strategies used.

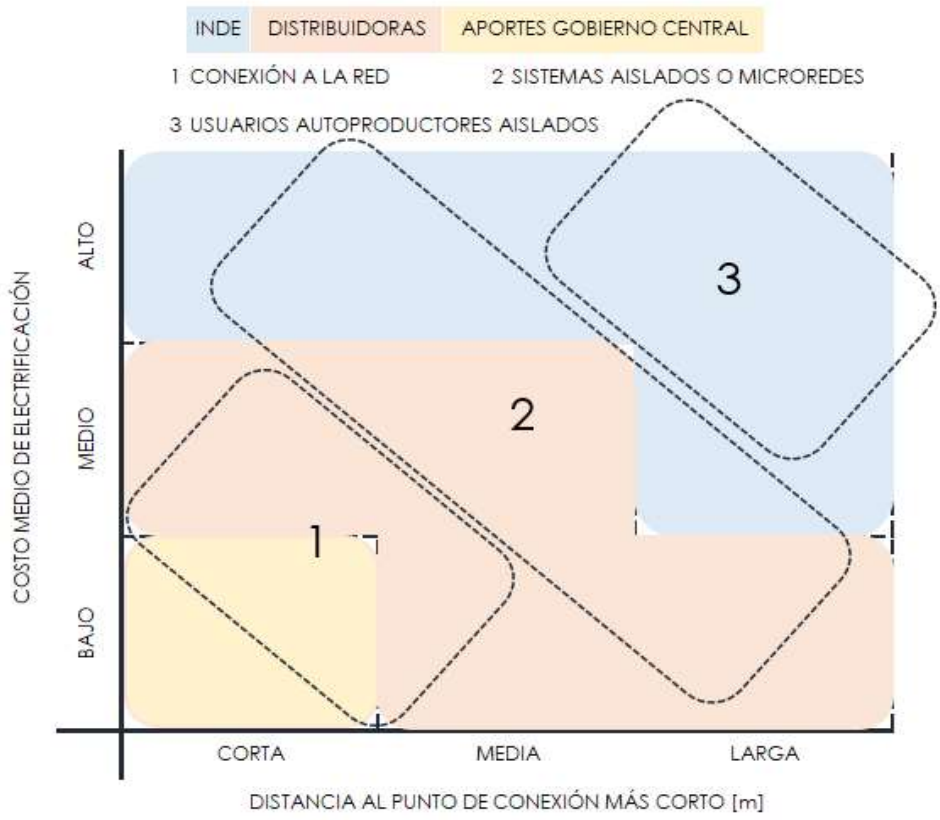


5 MECHANISMS FOR ELECTRICITY COVERAGE

5. MECHANISMS TO EXPAND THE COVERAGE OF THE ELECTRIC POWER SERVICE

The following is a description of the institutional management that would make it possible to guarantee funds for electrification projects, involving the institutions and entities interested in each process.

Illustration 23: Focusing resources and types of systems used in each segment.



Source: Proprietary production.

In Illustration 23, a sketch has been established on the relationship that will exist between the funds obtained and the type of technology that could be used in each segment, this type of technology is the strategy used in the technical/economic evaluation used by the UPEM, to determine what type of technology is considered most appropriate to supply electricity, as well as a general indication of the form of financing that would be used to meet the works.

5.1. NATIONAL ELECTRIFICATION INSTITUTE

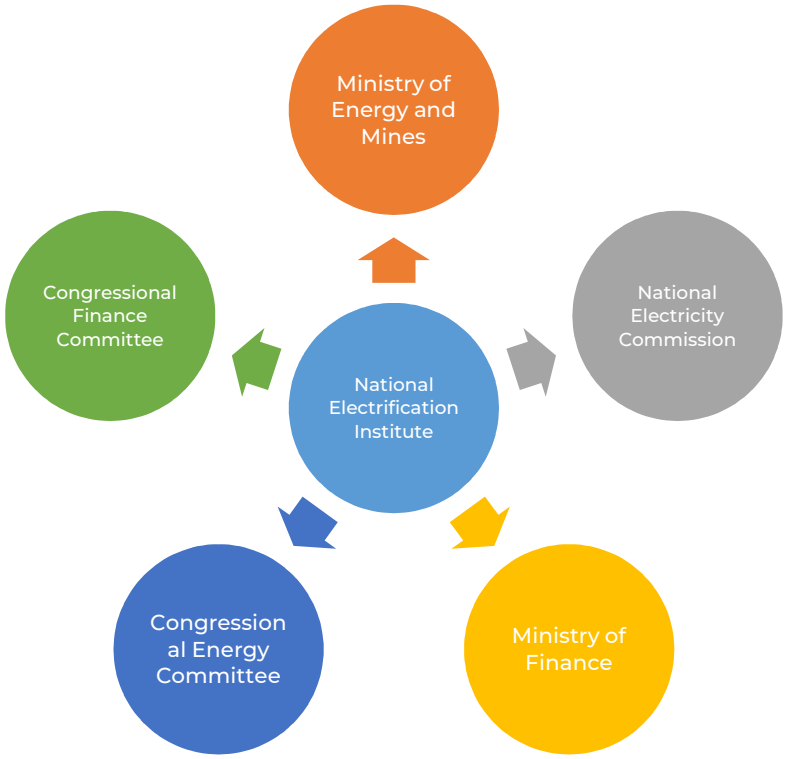
INDE has so far been one of the major financiers of electrification projects, but in recent years, due to various circumstances, the institution has not been able to release funds for the construction of new projects.

To guarantee funds for the construction of electrification projects, it is considered necessary to implement the following:

- INTER-INSTITUTIONAL COORDINATION

The National Electrification Institute together with the Ministry of Energy and Mines will coordinate through the institutions indicated in Illustration 24, where consensus will be sought in order to reach a common agreement, which would allow the creation of a common front between different institutions which would facilitate the obtaining of funds.

Illustration 24: Institutions involved in the coordination of fundraising support for the INDE.



Source: Proprietary production.

- ANNUAL PUBLICATIONS

    - Report on political agreements: This should express the positions of each of the institutions, as well as the agreements reached.
    - Anual de inversión y uso del gasto: Se indique el estado de avance de las obras de electrificación que se encuentre ejecutando.
    - Investment plan and use of expenditure: indicating investments in electrification projects in the following year, as well as other projects of social benefit.

5.2. MULTILATERAL BANKING

Multilateral banks can provide important resources for the construction of electrification projects. In the past, international loans have been used to finance electrification projects, which allowed a considerable increase in the penetration of electricity services.

Currently, a loan is being considered to finance a considerable group of electrification projects, and the impact of obtaining these resources will be analysed below.

Table 13: Funding proposal.

Source of Funding	Amount
Inter-American Development Bank	USD 100,000,000.00

Source: National Electrification Institute.

5.3. INVESTMENT PROGRAMMES FOR RURAL ELECTRIFICATION SET OUT IN THE TARIFF SCHEDULES ISSUED BY THE CNEE

The distributors, in accordance with what has been established in their specific tariff schedule, may execute rural electrification plans, which will be approved by the CNEE and considered in the tariff calculation in accordance with the procedures established in their respective tariff schedules.

The request for inclusion of infrastructure or rural electrification works by the distributors will be governed by the guidelines established in each tariff schedule approved for them.

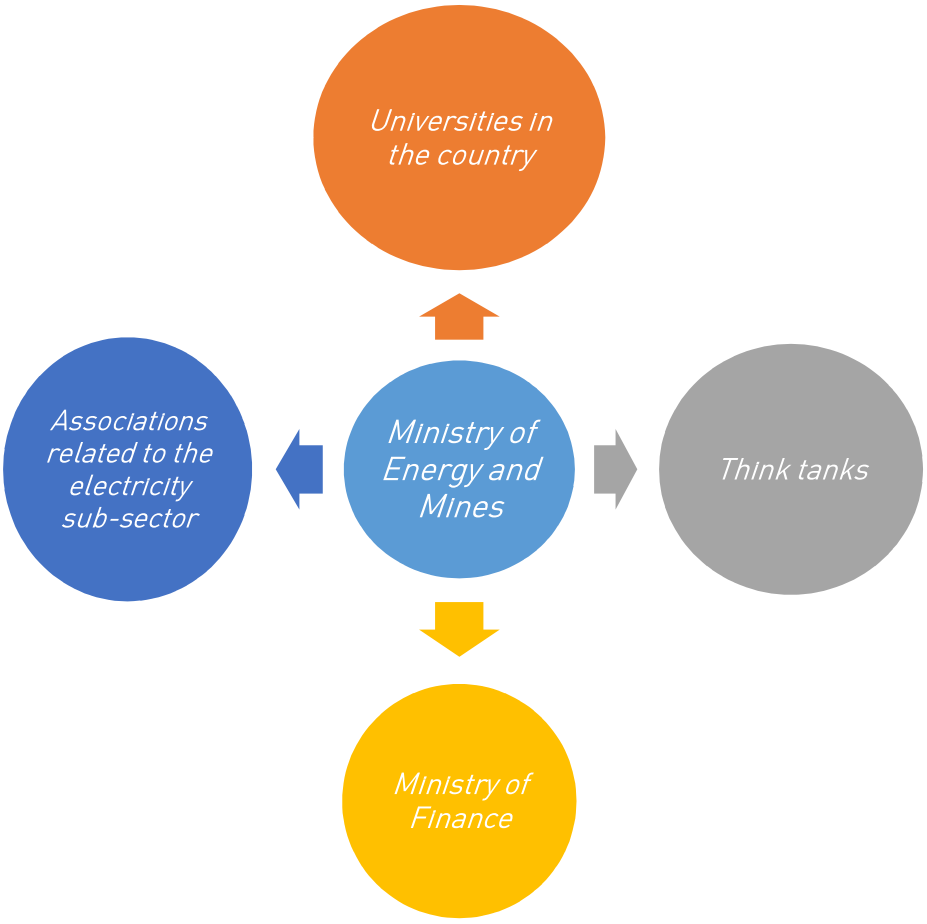
5.4. CENTRAL GOVERNMENT CONTRIBUTIONS

The electrification subsidy is a financial method which allows to incentivise the construction of electrification projects by establishing a single payment for each electrified user.

This strategy will seek to be financed through public resources, since there is currently no real financing scheme, the first part of the plan will consist of making this strategy institutionally viable, considering the following:

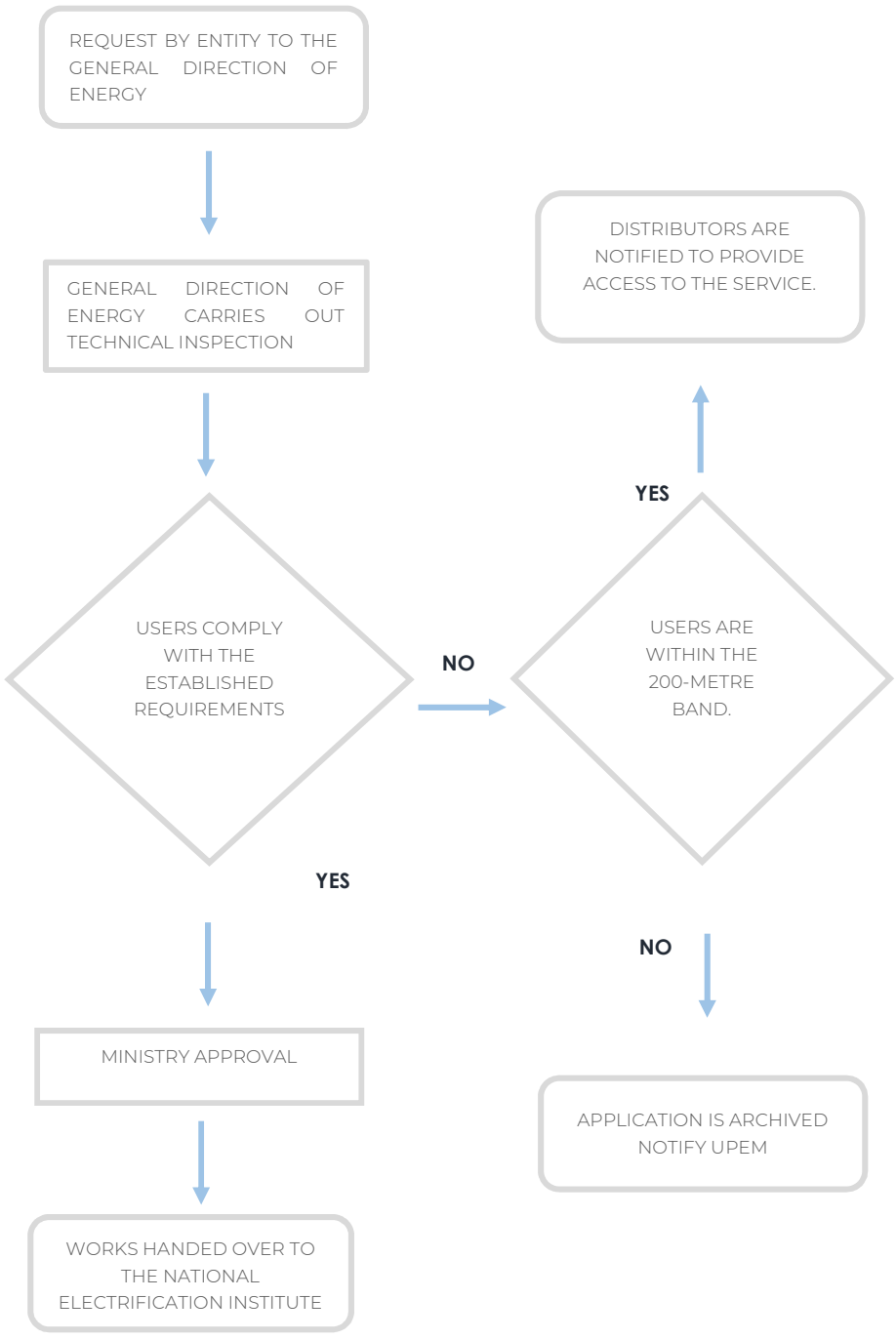
The scheme of operation is set out below:

Illustration 25: Institutions involved in the implementation of the electrification contribution.



Source: Proprietary production.

Illustration 26: System of contributions for electrification.



Source: Proprietary production.

5.4.1. SUBSIDY CONSIDERATIONS

A. A one-off payment is made to the project-executing agency.
B. The works are verified by the MEM.
C. The beneficiary users must not be within 200 metres.
D. The amount per subsidy is defined under the following premises:

a. A technical team should be created between the National Commission of Electrical Energy and the Ministry of Energy and Mines, where the value of the first amount of the subsidy should be sized, and then be subject to the rules established in the following paragraph.

b. The increase of the subsidy must be subject to the following conditions:

i. There can be no more than one annual increase.
ii. The increase cannot exceed more than 20% of the annually recognized value.
iii. The targets set out in Table 14 are not met.

Table 14: Electricity coverage targets.

YEAR	Percentage of Coverage Electricity
2018	91.26%
2019	92.71%
2020	92.16%
2021	92.60%
2022	93.05%
2023	93.50%
2024	93.88%
2025	94.25%
2026	94.63%
2027	95.00%
2028	96.33%
2029	97.67%
2030	99.00%
2031	99.45%
2032	99.90%

Source: Proprietary production.

5.5. INTERNATIONAL COOPERATION

The Government of Guatemala actively participates in regional and international strategies related to access to electricity, therefore, this means of obtaining technical or financial resources would ultimately be appropriate if the support to the State is not conditional. It is one of the objectives of this Plan to make the process of increasing electricity coverage economically efficient; at the Central American level there are examples of economic efficiency due to the work that was carried out jointly through regional frameworks, therefore, this means is optional only if it is attached to the interests of the State of Guatemala.

6. RECOMMENDATIONS

A. The plan should be updated annually, based on updated information, integrating the works that are being designed, as well as presenting a summary of the information gathered in the field.

B. The results of the meetings with the institutions involved should be integrated into the plan, with the MEM trying in good faith to seek consensus that will allow it to make the financing of electrification projects viable.

ANNEXES

A – REFERENCES

1. Wholesale Market Administrator, Annual Statistical Reports 2010-2016.
2. Bank of Guatemala, Economic Statistics
3. National Institute of Statistics of Guatemala, ENCOVI.
4. Association of Renewable Generators of Guatemala.

B – Acronyms, Multiples and Units of Measurement

ACRONYMS	
MEM	Ministry of Energy and Mines
UPEM	Mining Energy Planning Unit
DGE	General Direction of Energy
CNEE	National Commission of Electric Energy
INDE	National Electrification Institute
NDC's	*"National Determined Contributions"*, Nationally Determined Contributions in the Paris Agreements

UNITS OF MEASUREMENT		MAGNITUDE
BTU	British Thermal Unit	Energy
CO_2	Carbon Dioxide	Mass
GWh	Gigawatt hour	Energy
Kg	Kilogram	Mass
kV	Kilovolt	Electrical Voltage
MVA	Mega volt-ampere	Apparent Power
MW	Megawatt	Electrical Active Power
TJ	Terajoule	Energy
BEP	Barrel of oil equivalent	Energy

MULTIPLE		
Prefix	Symbol	Factor
Kilo	k	1,000
Mega	M	1,000,000
Giga	G	1,000,000,000
Tera	T	1,000,000,000,000

C – DEFINITIONS

Based on Article 6 of the General Law on Electricity, the following definitions are taken into consideration for the purposes of this plan:

Autoproducer: This is the person, individual or legal entity, owner or holder of an electricity generation plant, whose production is intended exclusively for its own consumption.

Access to Electricity: It is the service provided to a user through any type of technology without the need to have a connection to the National Interconnected System.

Awardee: The individual or legal entity to whom the Ministry grants an authorisation for the development of electricity transmission and distribution works, and is subject to the regime of obligations and rights established in this law.

Generator: The person, individual or legal entity, owner or possessor of an electricity generation plant, who commercialises all or part of its electricity production.

Electricity Coverage: The service provided to a user through an electricity network connected to the National Interconnected System.

Distributor: The person, individual or legal entity, owner or possessor of installations intended for the commercial distribution of electrical energy.

Private Distribution Service: The supply of electrical energy that is provided to the consumer, through distribution networks and under conditions freely agreed, on a case-by-case basis, between the user and the distributor, and which does not use public property.

Final Distribution Service: The supply of electricity to the population, through distribution networks, under conditions of service quality and prices approved by the Commission.

Easements: All those easements that need to be constituted for the construction of works and facilities for the generation, transmission and distribution of electricity will be considered as legal easements of public utility.

Transmission system: The set of transformation substations and transmission lines between the generator's delivery point and the distributor's or large users' reception point, comprising a main system and secondary systems.

Main System: This is the transmission system shared by the generators. The Commission will define this system, in accordance with the report submitted to it by the wholesale market manager.

Secondary System: This is the system that is not part of the main system. The private and final distribution systems are not part of the secondary system.

Distribution Systems: The set of electricity transformation lines and substations, intended to carry out the distribution activity and which operate at the voltages specified in the regulations.

National Electrical System: The set of installations, generating plants, transmission lines, electrical substations, distribution networks, electrical equipment, load centres and in general all the electrical infrastructure intended for the provision of the service, whether interconnected or not,

within which the different transfers of electrical energy are carried out between different regions of the country.

National interconnected system: The interconnected portion of the National Electric System.

Transmission: The activity whose purpose is to transport electrical energy through the transmission system.

Transporter: The person, individual or legal entity, owning installations intended to carry out the activity of transmission and transformation of electricity.

User: The owner or holder of the real estate that receives the electricity supply.

D – FULL LIST OF PRIORITISED MUNICIPALITIES

Ranking	Department	Municipality	Users Total	Population with Electricity Coverage	Adjusted Electricity Coverage Index	Adjusted Human Development Index	Adjusted Multidimensional Poverty Index	Adjusted Rural Poverty Incidence Index	Adjusted Relative Fuelwood Consumption Index	Adjusted Transport Access Index	Adjusted Population Density Index	Score
324	Guatemala	Guatemala	243,014	241,689	0.03	0	0.00	0.00	0.19	10.0	11.20	21.4
329	Guatemala	Santa Catarina Pinula	20,064	19,900	0.10	0	0.00	0.00	0.02	10.0	3.36	13.5
338	Guatemala	San José Pinula	19,608	19,358	0.22	0	0.00	0.00	0.04	10.0	0.83	11.1
340	Guatemala	San José del Golfo	1,913	1,855	0.68	0	0.00	0.00	0.01	10.0	0.18	10.9
333	Guatemala	Palencia	17,411	16,672	1.00	0	0.00	0.00	0.12	10.0	0.86	12.0
328	Guatemala	Chinautla	28,077	27,650	0.29	0	0.00	0.00	0.07	10.0	3.26	13.6
331	Guatemala	San Pedro Ayampuc	14,121	13,802	0.48	0	0.00	0.00	0.05	10.0	1.74	12.3
327	Guatemala	Mixco	118,506	117,830	0.04	0	0.00	0.00	0.10	10.0	7.87	18.0
339	Guatemala	San Pedro Sacatepéquez	11,041	10,909	0.20	0	0.00	0.00	0.02	10.0	0.82	11.0
330	Guatemala	San Juan Sacatepéquez	45,416	44,639	0.34	0	0.00	0.00	0.14	10.0	2.19	12.7
337	Guatemala	San Raymundo	7,065	6,927	0.40	0	0.00	0.00	0.02	10.0	0.84	11.3
336	Guatemala	Chuarrancho	2,626	2,509	1.05	0	0.00	0.00	0.02	10.0	0.27	11.3
334	Guatemala	Fraijanes	13,615	13,372	0.36	0	0.00	0.00	0.03	10.0	1.28	11.7
335	Guatemala	Amatitlán	28,919	28,574	0.20	0	0.00	0.00	0.05	10.0	1.31	11.6
326	Guatemala	Villa Nueva	109,133	108,540	0.03	0	0.00	0.00	0.09	10.0	8.25	18.4
332	Guatemala	Villa Canales	37,768	36,665	0.65	0	0.00	0.00	0.17	10.0	1.44	12.3
309	Guatemala	San Miguel Petapa	34,546	34,400	0.00	0	0.00	0.00	0.02	10.0	15.00	25.0
280	El Progreso	Guastatoya	6,619	6,454	0.54	6	6.01	11.66	0.03	10.0	0.28	34.4

268	El Progreso	Morazán	3,229	2,980	1.90	6	6.01	11.66	0.04	10.0	0.07	35.6
258	El Progreso	San Agustín Acasaguastlán	10,581	9,090	3.56	6	6.01	11.66	0.30	9.1	0.27	36.8
307	El Progreso	San Cristóbal Acasaguastlán	1,890	1,713	2.33	6	6.01	11.66	0.03	0.0	0.12	26.0
272	El Progreso	El Jícaro	3,456	3,232	1.58	6	6.01	11.66	0.04	10.0	0.11	35.3
271	El Progreso	Sansare	3,233	3,034	1.49	6	6.01	11.66	0.03	10.0	0.24	35.3
303	El Progreso	Sanarate	9,941	9,548	0.92	6	6.01	11.66	0.07	5.5	0.32	30.3
266	El Progreso	San Antonio La Paz	5,264	4,871	1.84	6	6.01	11.66	0.07	10.0	0.21	35.7
319	Sacatepéquez	Antigua Guatemala	11,131	11,033	0.12	3	2.24	5.68	0.02	10.0	1.26	22.2
313	Sacatepéquez	Jocotenango	5,319	5,275	0.11	3	2.24	5.68	0.01	10.0	1.99	22.9
311	Sacatepéquez	Pastores	4,331	4,280	0.20	3	2.24	5.68	0.01	10.0	2.38	23.4
315	Sacatepéquez	Sumpango	8,192	8,067	0.29	3	2.24	5.68	0.03	10.0	1.49	22.6
322	Sacatepéquez	Santo Domingo Xenacoj	2,778	2,741	0.24	3	2.24	5.68	0.01	10.0	0.74	21.8
308	Sacatepéquez	Santiago Sacatepéquez	6,583	6,520	0.14	3	2.24	5.68	0.01	10.0	4.37	25.3
310	Sacatepéquez	San Bartolomé Milpas Altas	1,839	1,820	0.16	3	2.24	5.68	0.00	10.0	2.65	23.6
312	Sacatepéquez	San Lucas Sacatepéquez	5,937	5,900	0.05	3	2.24	5.68	0.00	10.0	2.06	22.9
316	Sacatepéquez	Santa Lucía Milpas Altas	3,863	3,843	0.02	3	2.24	5.68	0.00	10.0	1.77	22.6
325	Sacatepéquez	Magdalena Milpas Altas	2,593	2,565	0.17	3	2.24	5.68	0.00	10.0	0.30	21.3
317	Sacatepéquez	Santa María de Jesús	4,316	4,257	0.25	3	2.24	5.68	0.01	10.0	1.48	22.5
318	Sacatepéquez	Ciudad Vieja	8,027	7,968	0.08	3	2.24	5.68	0.01	10.0	1.56	22.4
321	Sacatepéquez	San Miguel Dueñas	3,013	2,966	0.30	3	2.24	5.68	0.01	10.0	0.81	21.9
320	Sacatepéquez	San Juan Alotenango	5,384	5,221	0.68	3	2.24	5.68	0.04	10.0	0.62	22.1
314	Sacatepéquez	San Antonio Aguas Calientes	2,674	2,633	0.29	3	2.24	5.68	0.01	10.0	1.58	22.7
323	Sacatepéquez	Santa Catarina Barahona	987	969	0.37	3	2.24	5.68	0.00	10.0	0.31	21.5
234	Chimaltenango	Chimaltenango	20,939	20,629	0.28	8	8.13	14.59	0.09	10.0	1.12	42.0
292	Chimaltenango	San José Poaquil	5,230	4,928	1.40	8	8.13	14.59	0.09	0.0	0.59	32.6
240	Chimaltenango	San Martín Jilotepeque	14,764	13,660	1.84	8	8.13	14.59	0.34	7.5	0.63	40.8
209	Chimaltenango	San Juan Comalapa	9,983	9,543	1.04	8	8.13	14.59	0.14	10.0	1.47	43.1

235	Chimaltenango	Santa Apolonia	3,339	3,199	0.98	8	8.13	14.59	0.05	10.0	0.44	42.0
243	Chimaltenango	Tecpán Guatemala	16,625	15,881	1.06	8	8.13	14.59	0.27	7.4	1.05	40.3
222	Chimaltenango	Patzún	12,245	11,752	0.94	8	8.13	14.59	0.15	10.0	1.06	42.7
270	Chimaltenango	San Miguel Pochuta	1,907	1,563	4.59	8	8.13	14.59	0.11	0.0	0.12	35.3
221	Chimaltenango	Patzicía	7,337	7,188	0.42	8	8.13	14.59	0.04	10.0	1.79	42.8
225	Chimaltenango	Santa Cruz Balanyá	2,019	1,905	1.36	8	8.13	14.59	0.03	10.0	0.53	42.4
224	Chimaltenango	Acatenango	4,987	4,673	1.53	8	8.13	14.59	0.09	10.0	0.31	42.4
232	Chimaltenango	San Pedro Yepocapa	7,219	6,891	1.07	8	8.13	14.59	0.10	10.0	0.37	42.1
230	Chimaltenango	San Andrés Itzapa	6,652	6,439	0.72	8	8.13	14.59	0.06	10.0	0.87	42.2
207	Chimaltenango	Parramos	3,541	3,455	0.52	8	8.13	14.59	0.02	10.0	2.28	43.3
237	Chimaltenango	Zaragoza	5,578	5,470	0.39	8	8.13	14.59	0.03	10.0	0.95	41.9
239	Chimaltenango	El Tejar	4,438	4,394	0.15	8	8.13	14.59	0.01	10.0	0.30	41.0
290	Escuintla	Escuintla	39,403	38,510	0.48	6	4.85	10.10	0.19	10.0	1.06	32.7
294	Escuintla	Santa Lucía Cotzumalguapa	26,815	25,981	0.70	6	4.85	10.10	0.18	10.0	0.57	32.4
298	Escuintla	La Democracia	5,949	5,683	1.06	6	4.85	10.10	0.05	10.0	0.16	32.2
296	Escuintla	Siquinalá	5,507	5,277	0.98	6	4.85	10.10	0.05	10.0	0.27	32.3
291	Escuintla	Masagua	11,692	11,026	1.37	6	4.85	10.10	0.13	10.0	0.19	32.7
301	Escuintla	Tiquisate	14,640	14,277	0.54	6	4.85	10.10	0.07	10.0	0.34	31.9
295	Escuintla	La Gomera	11,790	11,234	1.12	6	4.85	10.10	0.11	10.0	0.16	32.4
265	Escuintla	Guanagazapa	3,574	2,930	4.59	6	4.85	10.10	0.15	10.0	0.15	35.9
300	Escuintla	San José	17,161	16,756	0.51	6	4.85	10.10	0.07	10.0	0.57	32.1
297	Escuintla	Iztapa	4,897	4,717	0.85	6	4.85	10.10	0.03	10.0	0.40	32.2
289	Escuintla	Palín	16,023	15,846	0.18	6	4.85	10.10	0.04	10.0	1.68	32.9
288	Escuintla	San Vicente Pacaya	4,280	3,982	1.71	6	4.85	10.10	0.06	10.0	0.15	32.9
299	Escuintla	Nueva Concepción	18,358	17,661	0.88	6	4.85	10.10	0.14	9.9	0.29	32.1
293	Escuintla	Sipacate	4,185	3,937	1.43	6	4.85	10.10	0.05	10.0	0.13	32.6
242	Santa Rosa	Cuilapa	10,065	9,479	1.41	9	8.73	14.32	0.11	6.7	0.25	40.4

204	Santa Rosa	Barberena	14,248	13,627	1.03	9	8.73	14.32	0.12	10.0	0.46	43.5
203	Santa Rosa	Santa Rosa de Lima	4,982	4,683	1.45	9	8.73	14.32	0.05	10.0	0.32	43.7
195	Santa Rosa	Casillas	6,088	5,617	1.91	9	8.73	14.32	0.08	10.0	0.29	44.2
187	Santa Rosa	San Rafael Las Flores	3,111	2,697	3.36	9	8.73	14.32	0.07	10.0	0.33	45.6
185	Santa Rosa	Oratorio	6,248	5,369	3.56	9	8.73	14.32	0.16	10.0	0.25	45.8
178	Santa Rosa	San Juan Tecuaco	2,117	1,708	4.93	9	8.73	14.32	0.09	10.0	0.28	47.2
213	Santa Rosa	Chiquimulilla	13,834	12,360	2.67	9	8.73	14.32	0.25	8.0	0.23	43.0
229	Santa Rosa	Taxisco	7,524	6,608	3.06	9	8.73	14.32	0.16	7.1	0.14	42.3
205	Santa Rosa	Santa María Ixhuatán	5,912	5,214	2.97	9	8.73	14.32	0.13	8.0	0.46	43.4
191	Santa Rosa	Guazacapán	4,575	4,190	2.08	9	8.73	14.32	0.07	10.0	0.24	44.3
196	Santa Rosa	Santa Cruz Naranjo	4,116	3,847	1.59	9	8.73	14.32	0.05	10.0	0.62	44.1
184	Santa Rosa	Pueblo Nuevo Viñas	6,199	5,297	3.68	9	8.73	14.32	0.17	10.0	0.19	45.9
190	Santa Rosa	Nueva Santa Rosa	9,273	8,736	1.40	9	8.73	14.32	0.10	10.0	1.22	44.6
128	Sololá	Sololá	14,799	14,365	0.65	10	10.15	18.68	0.18	8.8	2.10	50.3
148	Sololá	San José Chacayá	745	715	0.94	10	10.15	18.68	0.01	10.0	0.19	49.7
153	Sololá	Santa María Visitación	548	537	0.41	10	10.15	18.68	0.00	10.0	0.22	49.2
131	Sololá	Santa Lucía Utatlán	4,701	4,581	0.56	10	10.15	18.68	0.03	10.0	1.02	50.2
170	Sololá	Nahualá	14,721	13,253	2.49	10	10.15	18.68	0.51	5.4	0.76	47.8
156	Sololá	Santa Catarina Ixtahuacán	11,509	10,394	2.42	10	10.15	18.68	0.37	7.0	0.57	49.0
112	Sololá	Santa Clara La Laguna	2,112	2,042	0.75	10	10.15	18.68	0.02	10.0	1.72	51.1
150	Sololá	Concepción	947	920	0.63	10	10.15	18.68	0.01	10.0	0.35	49.6
147	Sololá	San Andrés Semetabaj	2,648	2,583	0.53	10	10.15	18.68	0.02	10.0	0.59	49.7
130	Sololá	Panajachel	3,689	3,653	0.14	10	10.15	18.68	0.01	10.0	1.46	50.2
108	Sololá	Santa Catarina Palopó	741	690	1.68	10	10.15	18.68	0.01	10.0	0.89	51.2
121	Sololá	San Antonio Palopó	3,268	3,115	1.11	10	10.15	18.68	0.04	10.0	0.93	50.7
136	Sololá	San Lucas Tolimán	6,402	6,159	0.88	10	10.15	18.68	0.07	10.0	0.53	50.1
109	Sololá	Santa Cruz La Laguna	1,163	1,088	1.57	10	10.15	18.68	0.02	10.0	0.97	51.2

114	Sololá	San Pablo La Laguna	1,730	1,656	1.00	10	10.15	18.68	0.02	10.0	1.42	51.0
152	Sololá	San Marcos La Laguna	545	534	0.42	10	10.15	18.68	0.00	10.0	0.47	49.5
133	Sololá	San Juan La Laguna	2,633	2,538	0.83	10	10.15	18.68	0.03	10.0	0.71	50.2
145	Sololá	San Pedro La Laguna	2,632	2,595	0.26	10	10.15	18.68	0.01	10.0	0.94	49.8
142	Sololá	Santiago Atitlán	10,074	9,832	0.52	10	10.15	18.68	0.07	10.0	0.70	49.9
143	Totonicapán	Totonicapán	22,860	22,399	0.42	11	10.60	16.84	0.13	10.0	0.70	49.9
96	Totonicapán	San Cristóbal Totonicapán	7,441	7,157	0.88	11	10.60	16.84	0.08	10.0	2.14	51.7
127	Totonicapán	San Francisco El Alto	10,726	10,362	0.77	11	10.60	16.84	0.11	10.0	0.94	50.5
92	Totonicapán	San Andrés Xecul	5,214	5,076	0.58	11	10.60	16.84	0.04	10.0	3.15	52.4
110	Totonicapán	Momostenango	17,439	16,395	1.45	11	10.60	16.84	0.35	10.0	0.70	51.1
78	Totonicapán	Santa María Chiquimula	8,711	7,435	3.71	11	10.60	16.84	0.49	10.0	0.57	53.4
91	Totonicapán	Santa Lucía La Reforma	3,183	2,757	3.38	11	10.60	16.84	0.18	10.0	0.35	52.5
72	Totonicapán	San Bartolo Aguas Calientes	1,956	1,769	2.38	11	10.60	16.84	0.06	10.0	2.90	54.0
260	Quetzaltenango	Quetzaltenango	42,642	42,056	0.25	5	6.60	11.01	0.19	10.0	3.25	36.5
257	Quetzaltenango	Salcajá	4,716	4,639	0.32	5	6.60	11.01	0.02	10.0	3.63	36.8
267	Quetzaltenango	San Juan Olintepeque	7,892	7,698	0.53	5	6.60	11.01	0.07	10.0	2.21	35.7
279	Quetzaltenango	San Carlos Sija	6,638	6,325	1.12	5	6.60	11.01	0.11	10.0	0.44	34.5
281	Quetzaltenango	Sibilia	1,910	1,862	0.54	5	6.60	11.01	0.01	10.0	0.66	34.1
302	Quetzaltenango	Cabricán	4,385	3,963	2.40	5	6.60	11.01	0.17	5.2	0.84	31.5
275	Quetzaltenango	Cajolá	2,916	2,783	1.08	5	6.60	11.01	0.05	10.0	0.92	34.9
274	Quetzaltenango	San Miguel Siguilá	1,475	1,389	1.41	5	6.60	11.01	0.03	10.0	0.63	34.9
261	Quetzaltenango	San Juan Ostuncalco	10,074	9,629	1.04	5	6.60	11.01	0.16	10.0	2.45	36.5
283	Quetzaltenango	San Mateo	1,809	1,792	0.13	5	6.60	11.01	0.00	10.0	0.91	33.9
282	Quetzaltenango	Concepción Chiquirichapa	3,549	3,493	0.30	5	6.60	11.01	0.02	10.0	0.81	34.0
304	Quetzaltenango	San Martín Sacatepéquez	5,898	5,597	1.22	5	6.60	11.01	0.12	5.0	0.67	29.8
276	Quetzaltenango	Almolonga	3,515	3,478	0.16	5	6.60	11.01	0.01	10.0	1.86	34.9
249	Quetzaltenango	Cantel	9,035	8,661	0.97	5	6.60	11.01	0.15	10.0	4.70	38.7

306	Quetzaltenango	Huitán	2,489	2,076	4.22	5	6.60	11.01	0.17	0.0	1.87	29.1
286	Quetzaltenango	Zunil	3,335	3,297	0.19	5	6.60	11.01	0.01	10.0	0.33	33.4
305	Quetzaltenango	Colomba Costa Cuca	10,103	9,392	1.72	5	6.60	11.01	0.25	4.5	0.49	29.8
277	Quetzaltenango	San Francisco La Unión	1,616	1,527	1.33	5	6.60	11.01	0.03	10.0	0.56	34.8
287	Quetzaltenango	El Palmar	6,103	5,794	1.21	5	6.60	11.01	0.11	8.8	0.38	33.3
273	Quetzaltenango	Coatepeque	23,422	22,157	1.30	5	6.60	11.01	0.42	10.0	0.52	35.1
284	Quetzaltenango	Génova	7,996	7,044	2.99	5	6.60	11.01	0.35	7.5	0.22	33.9
269	Quetzaltenango	Flores Costa Cuca	4,760	4,437	1.66	5	6.60	11.01	0.11	10.0	0.78	35.4
278	Quetzaltenango	La Esperanza	5,196	5,135	0.20	5	6.60	11.01	0.02	10.0	1.56	34.6
263	Quetzaltenango	Palestina de Los Altos	3,356	3,155	1.45	5	6.60	11.01	0.07	10.0	1.64	36.0
227	Suchitepéquez	Mazatenango	18,322	17,865	0.54	9	7.99	14.47	0.12	10.0	0.46	42.3
217	Suchitepéquez	Cuyotenango	7,749	7,317	1.34	9	7.99	14.47	0.12	10.0	0.31	43.0
216	Suchitepéquez	San Francisco Zapotitlán	5,311	5,106	0.90	9	7.99	14.47	0.05	10.0	0.84	43.0
192	Suchitepéquez	San Bernardino	3,578	3,311	1.84	9	7.99	14.47	0.07	10.0	1.12	44.2
220	Suchitepéquez	San José El Ídolo	2,362	2,232	1.32	9	7.99	14.47	0.03	10.0	0.25	42.8
201	Suchitepéquez	Santo Domingo Suchitepéquez	9,603	8,835	1.97	9	7.99	14.47	0.22	10.0	0.40	43.8
246	Suchitepéquez	San Lorenzo	3,066	2,710	2.92	9	7.99	14.47	0.09	4.2	0.48	38.9
186	Suchitepéquez	Samayac	5,807	5,601	0.81	9	7.99	14.47	0.05	10.0	3.57	45.7
194	Suchitepéquez	San Pablo Jocopilas	4,800	4,579	1.09	9	7.99	14.47	0.06	10.0	1.83	44.2
188	Suchitepéquez	San Antonio Suchitepéquez	12,285	11,481	1.60	9	7.99	14.47	0.25	10.0	2.10	45.2
248	Suchitepéquez	San Miguel Panán	2,135	1,961	2.01	9	7.99	14.47	0.05	4.9	0.58	38.8
208	Suchitepéquez	San Gabriel	1,714	1,638	1.05	9	7.99	14.47	0.02	10.0	1.04	43.3
236	Suchitepéquez	Chicacao	12,027	10,746	2.67	9	7.99	14.47	0.42	7.0	0.64	41.9
285	Suchitepéquez	Patulul	9,238	8,587	1.73	9	7.99	14.47	0.19	0.0	0.27	33.4
193	Suchitepéquez	Santa Bárbara	5,725	5,178	2.38	9	7.99	14.47	0.16	10.0	0.47	44.2
189	Suchitepéquez	San Juan Bautista	1,784	1,562	3.13	9	7.99	14.47	0.06	10.0	0.34	44.7
223	Suchitepéquez	Santo Tomas La Unión	2,640	2,523	1.05	9	7.99	14.47	0.03	10.0	0.35	42.6

233	Suchitepéquez	Zunilito	1,849	1,810	0.44	9	7.99	14.47	0.01	10.0	0.36	42.0
210	Suchitepéquez	Pueblo Nuevo	2,533	2,443	0.82	9	7.99	14.47	0.02	10.0	1.08	43.1
202	Suchitepéquez	Río Bravo	6,396	5,817	2.25	9	7.99	14.47	0.15	10.0	0.19	43.8
212	Suchitepéquez	San José La Máquina	5,302	4,947	1.64	9	7.99	14.47	0.10	10.0	0.14	43.1
244	Retalhuleu	Retalhuleu	21,293	20,058	1.40	8	7.80	14.41	0.33	7.4	0.24	40.0
200	Retalhuleu	San Sebastián	6,502	6,285	0.76	8	7.80	14.41	0.06	10.0	2.32	43.8
219	Retalhuleu	Santa Cruz Muluá	3,085	2,847	1.90	8	7.80	14.41	0.07	10.0	0.24	42.9
214	Retalhuleu	San Martín Zapotitlán	2,733	2,602	1.14	8	7.80	14.41	0.04	10.0	1.16	43.0
211	Retalhuleu	San Felipe	5,371	5,207	0.69	8	7.80	14.41	0.05	10.0	1.70	43.1
228	Retalhuleu	San Andrés Villa Seca	10,538	9,739	1.87	8	7.80	14.41	0.24	9.1	0.42	42.3
215	Retalhuleu	Champerico	7,729	7,105	1.99	8	7.80	14.41	0.16	10.0	0.18	43.0
206	Retalhuleu	Nuevo San Carlos	8,491	7,539	2.81	8	7.80	14.41	0.29	8.2	1.38	43.3
198	Retalhuleu	El Asintal	7,970	7,258	2.22	8	7.80	14.41	0.21	10.0	0.73	43.9
122	San Marcos	San Marcos	10,056	9,797	0.56	10	11.46	17.72	0.08	10.0	0.83	50.7
123	San Marcos	San Pedro Sacatepéquez	17,738	17,273	0.57	10	11.46	17.72	0.15	10.0	0.68	50.6
103	San Marcos	San Antonio Sacatepéquez	4,087	3,817	1.61	10	11.46	17.72	0.09	10.0	0.51	51.4
60	San Marcos	Comitancillo	10,147	7,693	6.19	10	11.46	17.72	1.03	8.5	0.92	55.9
159	San Marcos	San Miguel Ixtahuacán	8,146	6,868	3.98	10	11.46	17.72	0.54	4.3	0.56	48.6
79	San Marcos	Concepción Tutuapa	11,995	8,593	7.28	10	11.46	17.72	1.35	4.7	0.81	53.3
140	San Marcos	Tacaná	13,180	12,023	2.18	10	11.46	17.72	0.49	7.5	0.55	49.9
95	San Marcos	Sibinal	2,464	1,931	5.53	10	11.46	17.72	0.24	6.6	0.18	51.8
141	San Marcos	Tajumulco	9,265	7,878	3.79	10	11.46	17.72	0.55	6.0	0.36	49.9
146	San Marcos	Tejutla	7,335	6,646	2.34	10	11.46	17.72	0.26	7.4	0.59	49.8
120	San Marcos	San Rafael Pie de la Cuesta	3,759	3,622	0.84	10	11.46	17.72	0.04	10.0	0.65	50.7
135	San Marcos	Nuevo Progreso	6,268	5,702	2.24	10	11.46	17.72	0.20	8.0	0.47	50.1
126	San Marcos	El Tumbador	9,000	8,227	2.13	10	11.46	17.72	0.29	7.7	1.20	50.5
241	San Marcos	San José el Rodeo	3,725	3,573	0.95	10	11.46	17.72	0.05	0.0	0.48	40.7

151	San Marcos	Malacatán	18,307	17,324	1.29	10	11.46	17.72	0.36	7.7	0.98	49.5
106	San Marcos	Catarina	6,715	6,385	1.17	10	11.46	17.72	0.10	10.0	0.85	51.3
138	San Marcos	Ayutla	8,685	8,513	0.41	10	11.46	17.72	0.05	10.0	0.39	50.0
144	San Marcos	Ocós	2,573	2,529	0.34	10	11.46	17.72	0.01	10.0	0.32	49.9
197	San Marcos	San Pablo	9,898	9,379	1.26	10	11.46	17.72	0.19	2.6	0.87	44.1
98	San Marcos	El Quetzal	4,633	4,297	1.78	10	11.46	17.72	0.12	10.0	0.59	51.7
117	San Marcos	La Reforma	3,688	3,295	2.67	10	11.46	17.72	0.14	8.4	0.41	50.8
238	San Marcos	Pajapita	4,723	4,428	1.52	10	11.46	17.72	0.10	0.0	0.57	41.4
171	San Marcos	Ixchiguán	4,226	3,816	2.42	10	11.46	17.72	0.16	5.7	0.26	47.7
180	San Marcos	San José Ojetenam	3,153	2,936	1.68	10	11.46	17.72	0.08	5.2	0.65	46.8
107	San Marcos	San Cristóbal Cucho	3,424	3,229	1.37	10	11.46	17.72	0.07	10.0	0.62	51.2
66	San Marcos	Sipacapa	3,550	2,427	8.14	10	11.46	17.72	0.46	7.0	0.28	55.1
102	San Marcos	Esquipulas Palo Gordo	2,629	2,531	0.86	10	11.46	17.72	0.03	10.0	1.37	51.4
116	San Marcos	Río Blanco	1,124	1,061	1.35	10	11.46	17.72	0.02	10.0	0.32	50.9
87	San Marcos	San Lorenzo	2,506	2,283	2.21	10	11.46	17.72	0.08	10.0	1.17	52.6
93	San Marcos	La Blanca	6,695	6,076	2.30	10	11.46	17.72	0.20	10.0	0.67	52.4
52	Huehuetenango	Huehuetenango	26,994	26,648	0.22	13	12.84	18.63	0.12	10.0	1.25	56.2
67	Huehuetenango	Chiantla	16,920	13,721	4.82	13	12.84	18.63	1.35	3.7	0.39	54.9
70	Huehuetenango	Malacatancito	4,017	3,461	3.50	13	12.84	18.63	0.20	6.1	0.14	54.6
41	Huehuetenango	Cuilco	11,367	9,208	4.84	13	12.84	18.63	0.89	6.8	0.21	57.4
43	Huehuetenango	Nentón	8,523	5,876	7.99	13	12.84	18.63	1.13	3.3	0.12	57.2
37	Huehuetenango	San Pedro Necta	7,097	5,812	4.61	13	12.84	18.63	0.53	7.9	0.67	58.4
44	Huehuetenango	Jacaltenango	9,328	8,657	1.77	13	12.84	18.63	0.22	10.0	0.39	57.0
81	Huehuetenango	San Pedro Soloma	8,913	7,898	2.86	13	12.84	18.63	0.45	4.7	0.40	53.1
24	Huehuetenango	San Ildefonso Ixtahuacán	7,984	5,635	7.56	13	12.84	18.63	1.01	7.8	0.50	61.5
28	Huehuetenango	Santa Bárbara	5,689	3,969	7.77	13	12.84	18.63	0.74	6.3	0.50	60.0
40	Huehuetenango	La Libertad	7,261	5,953	4.59	13	12.84	18.63	0.54	6.9	0.78	57.4

51	Huehuetenango	La Democracia	11,101	9,645	3.31	13	12.84	18.63	0.55	7.0	0.84	56.3
23	Huehuetenango	San Miguel Acatán	4,430	3,310	6.48	13	12.84	18.63	0.54	9.5	0.38	61.5
38	Huehuetenango	San Rafael La Independencia	2,311	2,029	3.07	13	12.84	18.63	0.14	10.0	0.49	58.4
56	Huehuetenango	Todos Santos Cuchumatán	6,034	5,161	3.66	13	12.84	18.63	0.34	7.2	0.24	56.1
29	Huehuetenango	San Juan Atitán	4,163	3,448	4.37	13	12.84	18.63	0.26	10.0	0.65	59.9
39	Huehuetenango	Santa Eulalia	6,559	4,742	7.11	13	12.84	18.63	0.76	4.9	0.25	57.7
58	Huehuetenango	San Mateo Ixtatán	7,015	5,195	6.65	13	12.84	18.63	0.86	3.6	0.16	55.9
21	Huehuetenango	Colotenango	5,977	4,526	6.22	13	12.84	18.63	0.67	10.0	1.07	62.6
31	Huehuetenango	San Sebastián Huehuetenango	5,722	4,320	6.28	13	12.84	18.63	0.62	7.4	0.64	59.6
32	Huehuetenango	Tectitán	1,824	1,500	4.52	13	12.84	18.63	0.15	9.6	0.33	59.2
33	Huehuetenango	Concepción Huista	3,545	3,026	3.71	13	12.84	18.63	0.21	10.0	0.29	58.9
46	Huehuetenango	San Juan Ixcoy	4,279	3,013	7.60	13	12.84	18.63	0.49	4.0	0.20	57.0
35	Huehuetenango	San Antonio Huista	3,948	3,397	3.53	13	12.84	18.63	0.18	10.0	0.23	58.6
48	Huehuetenango	San Sebastián Coatán	4,141	3,504	3.90	13	12.84	18.63	0.24	7.4	0.25	56.5
20	Huehuetenango	Santa Cruz Barillas	17,678	11,248	9.37	13	12.84	18.63	2.87	7.6	0.19	64.7
47	Huehuetenango	Aguacatán	9,941	8,304	4.18	13	12.84	18.63	0.65	6.7	0.36	56.5
22	Huehuetenango	San Rafael Petzal	2,170	1,670	5.90	13	12.84	18.63	0.20	10.0	0.97	61.7
17	Huehuetenango	San Gaspar Ixchil	1,469	651	14.41	13	12.84	18.63	0.36	6.1	0.57	66.1
54	Huehuetenango	Santiago Chimaltenango	2,529	2,245	2.82	13	12.84	18.63	0.07	7.6	1.07	56.2
45	Huehuetenango	Santa Ana Huista	2,334	2,133	2.13	13	12.84	18.63	0.06	10.0	0.14	57.0
104	Huehuetenango	Unión Cantinil	3,420	3,159	1.88	13	12.84	18.63	0.10	3.9	0.81	51.3
34	Huehuetenango	Petatán	1,346	1,173	3.24	13	12.84	18.63	0.06	10.0	0.77	58.7
62	Quiché	Santa Cruz del Quiché	15,277	13,794	2.42	12	12.28	17.78	0.44	9.8	1.29	55.7
132	Quiché	Chiché	4,913	4,221	3.56	12	12.28	17.78	0.26	4.1	0.46	50.2
55	Quiché	Chinique	2,191	1,837	4.10	12	12.28	17.78	0.11	9.6	0.60	56.1
64	Quiché	Zacualpa	5,706	4,722	4.39	12	12.28	17.78	0.35	8.5	0.21	55.2
27	Quiché	Chajul	8,416	4,722	11.33	12	12.28	17.78	1.26	5.5	0.17	60.0

125	Quiché	Santo Tomás Chichicastenango	22,786	21,771	1.05	12	12.28	17.78	0.37	6.6	0.75	50.6
84	Quiché	Patzité	1,065	1,024	0.89	12	12.28	17.78	0.01	10.0	0.20	52.9
176	Quiché	San Antonio Ilotenango	4,251	4,049	1.13	12	12.28	17.78	0.08	3.6	0.73	47.3
115	Quiché	San Pedro Jocopilas	4,623	4,003	3.39	12	12.28	17.78	0.25	5.5	0.11	51.0
59	Quiché	Cunén	6,687	5,822	3.26	12	12.28	17.78	0.33	10.0	0.54	55.9
76	Quiché	San Juan Cotzal	5,624	4,029	7.28	12	12.28	17.78	0.55	3.5	0.38	53.4
61	Quiché	Joyabaj	14,815	12,603	3.78	12	12.28	17.78	0.73	8.9	0.58	55.8
63	Quiché	Santa María Nebaj	14,708	11,452	5.66	12	12.28	17.78	0.99	7.0	0.26	55.7
50	Quiché	San Andrés Sajcabajá	5,185	3,690	7.41	12	12.28	17.78	0.41	6.7	0.11	56.4
16	Quiché	San Miguel Uspantán	12,267	5,558	14.15	12	12.28	17.78	2.21	8.5	0.16	66.8
73	Quiché	Sacapulas	8,904	7,343	4.46	12	12.28	17.78	0.56	6.5	0.54	53.9
69	Quiché	San Bartolomé Jocotenango	1,980	1,179	10.44	12	12.28	17.78	0.32	1.9	0.22	54.7
53	Quiché	Canillá	2,703	1,882	7.81	12	12.28	17.78	0.22	6.2	0.21	56.2
36	Quiché	Chicamán	7,451	3,778	12.74	12	12.28	17.78	1.22	2.5	0.17	58.4
49	Quiché	Playa Grande Ixcán	18,651	15,047	4.93	12	12.28	17.78	1.18	8.4	0.13	56.4
74	Quiché	Pachalum	2,239	2,088	1.65	12	12.28	17.78	0.03	10.0	0.31	53.7
181	Baja Verapaz	Salamá	15,726	14,144	2.51	10	9.14	15.94	0.40	9.0	0.18	46.8
226	Baja Verapaz	San Miguel Chicaj	7,289	6,106	4.12	10	9.14	15.94	0.34	2.9	0.25	42.3
158	Baja Verapaz	Rabinal	9,462	8,161	3.47	10	9.14	15.94	0.35	10.0	0.18	48.7
155	Baja Verapaz	Cubulco	12,445	8,451	8.26	10	9.14	15.94	1.11	4.8	0.28	49.2
218	Baja Verapaz	Granados	3,603	3,086	3.63	10	9.14	15.94	0.11	4.4	0.12	42.9
174	Baja Verapaz	Santa Cruz El Chol	2,453	2,214	2.43	10	9.14	15.94	0.05	10.0	0.15	47.4
166	Baja Verapaz	San Jerónimo	6,151	5,425	2.97	10	9.14	15.94	0.18	10.0	0.12	48.0
25	Baja Verapaz	Purulhá	10,874	4,189	15.92	10	9.14	15.94	2.19	8.0	0.53	61.3
13	Alta Verapaz	Cobán	43,165	24,924	10.91	15	15.00	20.00	3.11	5.0	0.21	69.3
19	Alta Verapaz	Santa Cruz Verapaz	6,066	4,969	4.60	15	15.00	20.00	0.20	8.9	1.46	65.2
15	Alta Verapaz	San Cristóbal Verapaz	12,172	9,216	6.22	15	15.00	20.00	0.60	9.4	0.80	67.0

18	Alta Verapaz	Tactic	7,802	6,401	4.57	15	15.00	20.00	0.24	10.0	0.99	65.8
10	Alta Verapaz	Tamahú	3,614	2,105	10.78	15	15.00	20.00	0.30	10.0	0.40	71.5
6	Alta Verapaz	San Miguel Tucurú	8,375	4,127	13.11	15	15.00	20.00	0.79	10.0	1.02	74.9
7	Alta Verapaz	Panzós	13,066	5,252	15.48	15	15.00	20.00	1.50	6.6	0.24	73.9
2	Alta Verapaz	Senahú	16,573	3,789	20.00	15	15.00	20.00	2.49	5.8	0.60	78.9
4	Alta Verapaz	San Pedro Carchá	43,589	16,960	15.82	15	15.00	20.00	5.00	4.9	0.47	76.2
11	Alta Verapaz	San Juan Chamelco	11,064	5,901	12.06	15	15.00	20.00	0.94	6.1	1.58	70.7
1	Alta Verapaz	San Agustín Lanquín	4,382	1,010	19.95	15	15.00	20.00	0.65	8.5	0.25	79.3
3	Alta Verapaz	Santa María Cahabón	11,707	2,815	19.69	15	15.00	20.00	1.72	7.1	0.15	78.7
14	Alta Verapaz	Chisec	14,919	8,853	10.49	15	15.00	20.00	1.19	7.3	0.16	69.1
5	Alta Verapaz	Chahal	5,029	1,536	18.00	15	15.00	20.00	0.65	7.2	0.17	76.0
9	Alta Verapaz	Fray Bartolomé de Las Casas	12,554	5,625	14.28	15	15.00	20.00	1.26	6.4	0.11	72.0
8	Alta Verapaz	Santa Catalina La Tinta	7,710	4,554	10.56	15	15.00	20.00	0.58	10.0	1.06	72.2
12	Alta Verapaz	Raxruhá	6,659	3,711	11.43	15	15.00	20.00	0.57	7.2	0.15	69.3
179	Petén	Flores	10,321	9,192	2.74	10	9.18	15.41	0.17	10.0	0.01	47.1
113	Petén	San José	1,443	1,060	6.81	10	9.18	15.41	0.07	10.0	0.00	51.1
172	Petén	San Benito	11,419	10,369	2.29	10	9.18	15.41	0.17	10.0	0.89	47.5
42	Petén	San Andrés	7,189	3,235	14.23	10	9.18	15.41	0.73	8.2	0.00	57.4
163	Petén	La Libertad	15,909	12,728	5.10	10	9.18	15.41	0.62	8.5	0.02	48.5
105	Petén	San Francisco	3,525	2,581	6.87	10	9.18	15.41	0.18	10.0	0.10	51.3
111	Petén	Santa Ana	4,997	3,700	6.66	10	9.18	15.41	0.23	10.0	0.04	51.1
82	Petén	Dolores	5,895	3,636	9.88	10	9.18	15.41	0.44	8.4	0.01	52.9
149	Petén	San Luis	15,470	10,005	9.10	10	9.18	15.41	1.06	5.4	0.05	49.7
75	Petén	Sayaxché	19,461	13,339	8.09	10	9.18	15.41	1.27	10.0	0.05	53.6
161	Petén	Melchor de Mencos	6,822	5,231	5.97	10	9.18	15.41	0.27	8.1	0.02	48.6
90	Petén	Poptún	11,894	8,017	8.39	10	9.18	15.41	0.71	9.2	0.06	52.6
168	Petén	Las Cruces	7,049	5,342	6.20	10	9.18	15.41	0.33	7.2	0.03	47.9

183	Petén	El Chal	3,256	2,050	9.55	10	9.18	15.41	0.21	2.1	0.03	46.0
256	Izabal	Puerto Barrios	26,612	25,543	0.94	8	8.32	12.13	0.14	7.3	0.16	37.2
175	Izabal	Livingston	15,934	10,187	9.29	8	8.32	12.13	0.95	8.4	0.08	47.3
162	Izabal	El Estor	13,845	6,886	12.99	8	8.32	12.13	1.34	5.5	0.05	48.5
251	Izabal	Morales	24,458	21,026	3.55	8	8.32	12.13	0.51	5.5	0.16	38.4
231	Izabal	Los Amates	13,937	11,698	4.08	8	8.32	12.13	0.36	8.9	0.08	42.1
245	Zacapa	Zacapa	15,235	13,863	2.24	6	7.09	12.02	0.21	9.5	2.65	40.0
264	Zacapa	Estanzuela	2,518	2,478	0.30	6	7.09	12.02	0.00	10.0	0.22	35.9
259	Zacapa	Río Hondo	5,825	5,558	1.08	6	7.09	12.02	0.03	10.0	0.10	36.6
247	Zacapa	Gualán	10,927	9,425	3.47	6	7.09	12.02	0.25	9.6	0.14	38.9
262	Zacapa	Teculután	4,459	4,304	0.80	6	7.09	12.02	0.02	10.0	0.18	36.4
254	Zacapa	Usumatlán	3,069	2,839	1.84	6	7.09	12.02	0.03	10.0	0.10	37.4
253	Zacapa	Cabañas	3,351	3,058	2.17	6	7.09	12.02	0.04	10.0	0.21	37.8
252	Zacapa	San Diego	1,686	1,521	2.44	6	7.09	12.02	0.02	10.0	0.05	37.9
199	Zacapa	La Unión	6,756	4,732	7.70	6	7.09	12.02	0.40	10.0	0.34	43.8
250	Zacapa	Huité	2,714	2,379	3.11	6	7.09	12.02	0.05	10.0	0.04	38.6
255	Zacapa	San Jorge	2,892	2,710	1.53	6	7.09	12.02	0.03	10.0	0.33	37.3
89	Chiquimula	Chiquimula	25,038	23,040	1.97	13	11.49	15.90	0.41	9.4	0.78	52.6
94	Chiquimula	San José La Arada	2,232	2,043	2.10	13	11.49	15.90	0.03	10.0	0.12	52.3
68	Chiquimula	San Juan Ermita	3,677	2,899	5.41	13	11.49	15.90	0.16	8.9	0.40	54.9
26	Chiquimula	Jocotán	12,551	7,032	11.35	13	11.49	15.90	1.36	6.9	1.01	60.6
30	Chiquimula	Camotán	10,763	6,779	9.54	13	11.49	15.90	0.96	8.8	0.54	59.9
88	Chiquimula	Olopa	5,679	4,598	4.85	13	11.49	15.90	0.24	7.1	0.39	52.6
71	Chiquimula	Esquipulas	12,578	10,695	3.79	13	11.49	15.90	0.37	9.9	0.22	54.4
97	Chiquimula	Concepción Las Minas	3,106	2,917	1.48	13	11.49	15.90	0.03	10.0	0.15	51.7
85	Chiquimula	Quezaltepeque	6,688	5,978	2.66	13	11.49	15.90	0.13	9.6	0.26	52.7
77	Chiquimula	San Jacinto	2,876	2,552	2.83	13	11.49	15.90	0.06	10.0	0.48	53.4

101	Chiquimula	Ipala	5,729	5,448	1.17	13	11.49	15.90	0.05	10.0	0.21	51.5
119	Jalapa	Jalapa	33,416	30,135	2.45	12	11.87	16.95	0.71	6.6	0.66	50.8
57	Jalapa	San Pedro Pinula	12,101	8,728	7.16	12	11.87	16.95	0.77	7.4	0.25	56.0
99	Jalapa	San Luis Jilotepeque	6,107	5,623	1.96	12	11.87	16.95	0.09	9.0	0.19	51.6
80	Jalapa	San Manuel Chaparrón	2,205	1,968	2.69	12	11.87	16.95	0.04	10.0	0.14	53.2
65	Jalapa	San Carlos Alzatate	3,572	3,020	3.92	12	11.87	16.95	0.13	9.1	1.71	55.2
83	Jalapa	Monjas	6,625	6,044	2.18	12	11.87	16.95	0.11	10.0	0.24	52.9
137	Jalapa	Mataquescuintla	9,442	8,421	2.71	12	11.87	16.95	0.20	6.4	0.33	50.0
177	Jutiapa	Jutiapa	32,507	30,115	1.81	10	10.26	16.51	0.45	8.0	0.51	47.3
169	Jutiapa	El Progreso	5,729	5,578	0.58	10	10.26	16.51	0.02	10.0	0.72	47.8
167	Jutiapa	Santa Catarina Mita	7,609	7,305	0.93	10	10.26	16.51	0.05	10.0	0.48	48.0
173	Jutiapa	Agua Blanca	4,353	4,189	0.87	10	10.26	16.51	0.02	10.0	0.10	47.5
182	Jutiapa	Asunción Mita	12,705	12,255	0.81	10	10.26	16.51	0.07	8.8	0.22	46.4
129	Jutiapa	Yupiltepeque	3,962	3,543	2.65	10	10.26	16.51	0.07	10.0	1.05	50.3
164	Jutiapa	Atescatempa	4,942	4,694	1.20	10	10.26	16.51	0.04	10.0	0.60	48.3
157	Jutiapa	Jerez	1,869	1,720	1.97	10	10.26	16.51	0.02	10.0	0.23	48.7
134	Jutiapa	El Adelanto	1,474	1,292	3.11	10	10.26	16.51	0.03	10.0	0.46	50.1
118	Jutiapa	Zapotitlán	2,049	1,726	4.00	10	10.26	16.51	0.06	10.0	0.24	50.8
100	Jutiapa	Comapa	7,086	5,900	4.25	10	10.26	16.51	0.23	10.0	0.55	51.5
154	Jutiapa	Jalpatagua	7,091	6,448	2.25	10	10.26	16.51	0.11	10.0	0.31	49.2
86	Jutiapa	Conguaco	4,491	2,998	8.56	10	10.26	16.51	0.34	6.8	0.41	52.7
139	Jutiapa	Moyuta	9,589	8,011	4.18	10	10.26	16.51	0.28	8.7	0.23	49.9
124	Jutiapa	Pasaco	2,143	1,725	4.97	10	10.26	16.51	0.07	9.0	0.05	50.6
165	Jutiapa	San José Acatempa	3,580	3,399	1.21	10	10.26	16.51	0.03	10.0	0.43	48.2
160	Jutiapa	Quesada	5,588	5,261	1.42	10	10.26	16.51	0.05	10.0	0.61	48.6

GOBIERNO *de*
GUATEMALA
DR. ALEJANDRO GIAMMATTEI