



SUSTAINABLE ENERGY FOR ALL

Rapid Assessment
Gap Analysis
Nicaragua



Nicaragua

Rapid Assessment and Gap Analysis



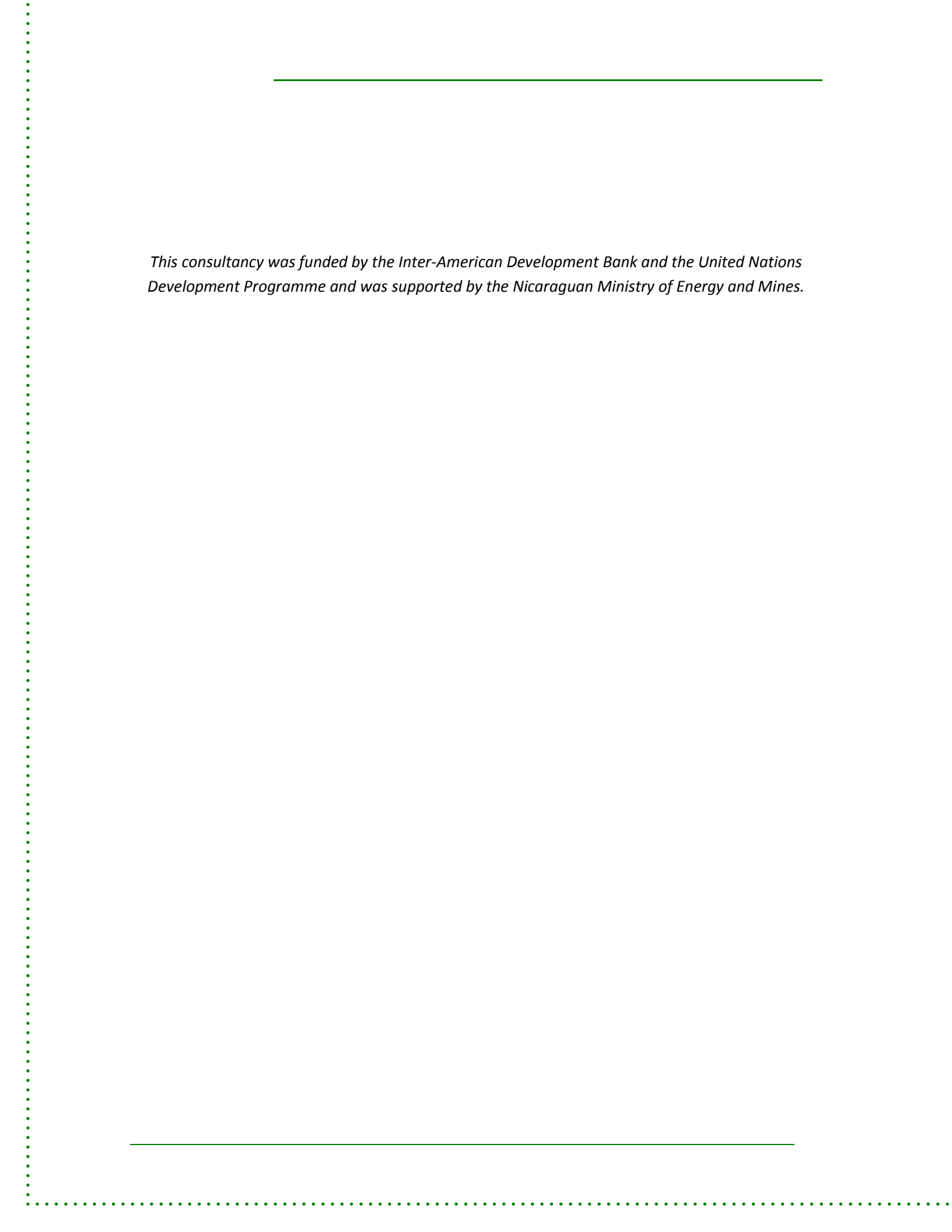
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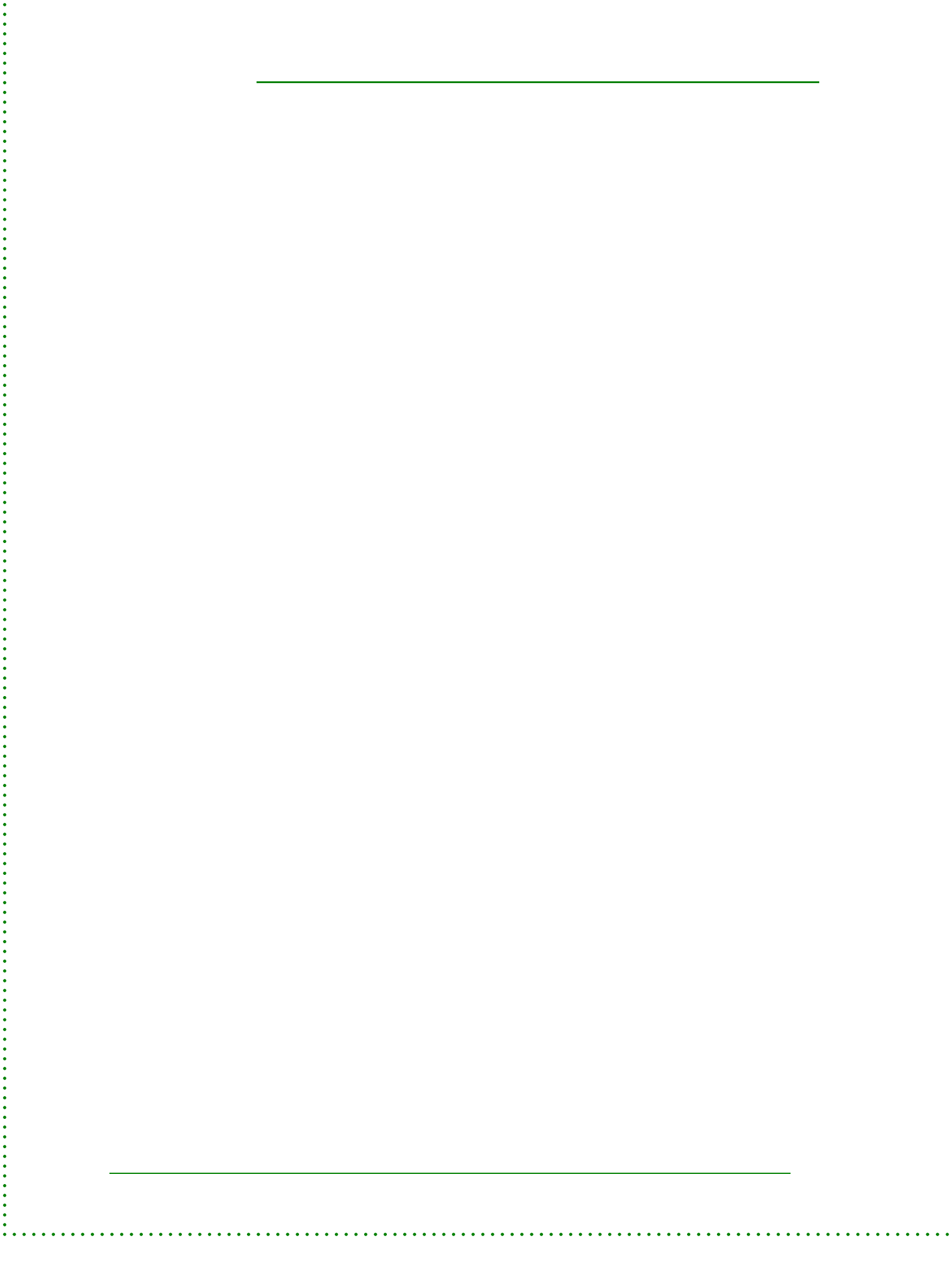
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Acronyms

ABC	Brazilian Cooperation Agency
ALBA	Bolivian Alliance for the Americas
ALBANISA	ALBA of Nicaragua, S.A.
ARI	Acute Respiratory Infections
BCIE	Central American Bank of Economic Integration
CDM	Clean Development Mechanism
CIDA	Canadian International Development Agency
CEPAL	Economic Commission for Latin America and the Caribbean
CER	Certified Emissions Reductions
CL	Local operator
CNI	National Industry Confederation
CSR	Corporate Social Responsibility
DAI	Import Tariff
DC	Developing Country
DISNORTE	North Distributor (Nicaragua)
DISSUR	South Distributor (Nicaragua)
DN-DS	DISNORTE-DISSUR
EE	Energy efficiency
EIB	European Investment Bank
ENATREL	National Electricity Transmission Company (Nicaragua)
ENEL	Nicaraguan Electricity Company (Nicaragua)
ESMAP	Energy Sector Management Assistance Program
EU	European Union
FDI	Foreign direct investment
FISE	Emergency Social Investment Fund (Nicaragua)
FODIEN	Development Fund for the National Electricity Industry (Nicaragua)
GDN	Government of Nicaragua
GDP	Gross Domestic Product
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GHG	Greenhouse Gas Effect
GIE	Inter-Institutional Expert Group
GIS	Geographic Information System
IDB	Inter-American Development Bank
IEA	International Energy Agency
IMF	Microfinance Institution
INE	Nicaraguan Energy Institute (Nicaragua)
INEC	National Institute of Statistics and Census (Nicaragua)
INETER	Nicaraguan Institute of Territorial Studies (Nicaragua)
INIDE	National Institute of Development Information (Nicaragua)
INTN	National Institute of Standards and Technology (Nicaragua)

IPCC	Intergovernmental Panel on Climate Change Panel
IRENA	International Agency for Renewable Energy
IRR	Internal Rate of Return
JICA	Japanese International Cooperation Agency
KEXIM	Bank of Korea
LAIF	Latin American Investment Facility (UE)
LAC	Latin America and the Caribbean
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goals
MEM	Ministry of Energy and Mines (Nicaragua)
MDG	Millennium Development Goals
MIPYMES	Mini, small, and mid-sized companies
NBI	Unsatisfied basic needs
NBS	Satisfied basic needs
NDF	Nordic Development Fund
NGO	Non-governmental Organization
OAS	Organization of American States
OLADE	Latin American Energy Organization
PC	Small Operator
PDMS	Development Program for the Solar Market
PERZA	Rural Electrification Project in Isolated Areas
PLANER	National Rural Electrification Plan
PLANERAC	National Rural Electrification Plan in Concession Areas Plan
PMP	MDL Programmatic Project (see POA)
PNDH	National Plan for Human Development (Nicaragua)
PNESER	National Program for Sustainable Electrification and Renewable Energy
POA	Program of Activities (MDL Programming)
PPA	Power Purchase Agreement
PYMES	Small and Medium Companies
RAAN	Autonomous Region of the Northern Atlantic
RAAS	Autonomous Region of the Southern Atlantic
SE4ALL	Sustainable Energy for All (<i>Sustainable Energy for All</i>)
SDC	Swiss Agency for Development and Cooperation
SHP	Small Hydropower Plant
SICA	Central American Integration System
SIEE	System of Economic Energy Information
SIMERNIC	System of Information to Monitor and Evaluate Renewable Energy in Nicaragua
SIN	National Interconnected System (Nicaragua)
SPV	Solar Photovoltaic System
SREP	Program for Small Renewable Energy Projects

TCV	Housing Growth Rate
TIC	Information and Communication Technology
UNDP	United Nations Development Programme
VAT	Value Added Tax
WB	World Bank
ZC/DN-DS	Concession area granted to DISNORTE - DISSUR
ZCPCI	Concession area granted to small interconnected licensees
ZCI	Interconnected concession areas
ZAD	Isolated Areas Served
ZTA	Totally Isolated Areas

Abbreviations (Units)

bbbl	Barrel
bbbl/d	Barrels per day
BOE	Barrel of Oil Equivalent
Cu ft	Cubic foot
EUR	Euro
Gg	Gigagram
LPG	Liquefied Petroleum Gas
LV	Low Voltage
GW	Gigawatt
GWh	Gigawatt hour
ha	Hectares
hab	Inhabitants
mboe	Thousands of barrels of oil equivalent
kg	Kilogram
km ²	Kilometer squared
ktoe	Thousands of tons of oil equivalent
kWh	Kilowatt hour
m ³	Cubic meter
Mbbl	Million barrels
MEUR	Million Euros (M€)
Mt	Million tons
MV	Medium Voltage
MUSD	Millions of United States Dollars (M\$)
MW	Megawatt
MWh	Megawatt hour
NIO	Nicaraguan Córdoba (C\$)
Prelim	Preliminary data
t	Tons
tce	Ton of coal equivalent
Tj	Terajoule
Tmt	Thousands of tons
toe	Ton of oil equivalent
TWh	Terawatt-hour
USD	United States Dollars

Important note: for the decimal notation we adopted North American typography

Examples: ten thousand : 10,000
 Five point seven: 5.7

Introduction to the SE4ALL Initiative

The Inter-American Development Bank (IDB) and the United Nations Development Programme (UNDP) support the implementation of the Sustainable Energy for All Project (SE4ALL) in Latin America. It was launched by the United Nations Secretary-General (SGUN) in 2012, which was declared the “Year of Sustainable Energy for All.” The objective of SE4ALL is to increase the use of renewable energy, to create more detailed policies for energy efficiency in various sectors of the economy, and promote unrestricted access to energy. The IDB proposes to support all Latin American and Caribbean countries in evaluating available information to collaborate and improve existing programs that promote these goals.

In late December 2012, the General Assembly of the United Nations unanimously declared the decade 2014-2024 as the “Decade of Sustainable Energy for All,” which highlights the importance of energy questions for sustainable development and for setting the agenda for post-2105 development.

In adopting the resolution, the General Assembly reaffirmed its determination to make sustainable energy a reality. The text calls member states to “drive efforts to make universal access to modern sustainable energy a priority and noted that 1.3 billion people lack electricity and 2.6 billion people in developing countries depend on traditional biomass for cooking and heating. It expresses concern that even when energy services exist, millions of poor people can’t pay for them.”

Developed countries face the challenge of renewing, transforming, and expanding the existing infrastructure, while developing countries have the opportunity to adopt clean technology and more efficient processes of economic development and social inclusion, including decreasing poverty and existing inequalities.

Therefore, the three following objectives were raised by the SE4ALL Initiative:

- a) universal access to modern energy services;
- b) increasing energy efficiency; and
- c) greater integration of renewable energy into the energy matrix.

These three objectives reinforce each other and together provide the opportunity to maximize the benefits of development and to face the global challenge that would allow us to stabilize the climate change phenomenon.

Sustainable development isn't possible without a sustainable energy sector. One person out five on the planet lacks electricity to light their homes and carry out their work or profession. Nearly 40% of the world population still uses firewood, charcoal, or animal remains for cooking food. They use rudimentary equipment that causes toxic smoke and is responsible for lung diseases and the death of nearly 2 million people per year, mostly women and children, who die of diseases related to these issues.¹

It has been established that **access to modern energy services** facilitates economic and social development and provides the opportunity to improve society and create economic progress.

- Electricity provides children with the opportunity to study after dark, pumps water for food and for daily activities, and refrigerates food and medicine
- Modern fuels for cooking and heating allow women to not invest time in going long distances to search for firewood that they need for the home, an activity that also puts them at risk.
- Energy can be used to support economic activities and family businesses and achieve greater general prosperity.

In this sense, public-private investment is key for those markets. Greater prosperity means more disposable income and new markets for consumer goods. Through innovation in energy products and investment in their diffusion, it is possible to create new jobs and provide millions of people with the necessary tools to improve their lives.

Without access to modern and sustainable energy services, it isn't possible to reach the Millennium Development Goals (MDG) which relate to the eight point global agenda adopted by the United Nations in 2000. Among those we could highlight are poverty reduction, improvements in health for women and children, and the extended reach of education.

Energy efficiency, whose increase is another project objective, improves the global productivity of natural resources. Increases in energy efficiency support economic growth and help reduce the cost of energy in general.

Investment in efficiency is critical to satisfy future energy demands and to mitigate the effects of climate change by reducing greenhouse gas emissions and improving global productivity.

¹ United Nations Secretary-General: "Sustainable Energy for All – Objectives." <http://www.sustainableenergyforall.org/objectives>

Investment in energy efficiency creates employment, promotes growth, and reduces energy vulnerability in countries that depend on imports of fossil fuels like oil, oil products, and natural gas.

Of the three goals outlined in the SE4ALL Initiative, the improvement in energy efficiency is the one that has the clearest impact in terms of monetary savings, improved commercial results and greater diversity of services for consumers – better freezers and refrigerators that cost approximately the same and use much less energy, new designs of cars that travel farther with the same amount of fuel, and buildings that require less energy for air conditioning and own consumption.

By reducing the demand for energy, energy efficiency measures allow us to move toward a sustainable and efficient energy system, which is a contribution to the global economy that has many resource restraints.

Adopting cost effective standards for a wide range of technologies could, by 2030, reduce projected electricity consumption in buildings and industry by 14% avoiding the construction of nearly 1,300 new power plants of medium power. Between 1990 and 2006, the increase in energy efficiency in the manufacturing sector of the 21 member countries of the International Energy Agency (IEA) resulted in a 21% reduction of energy consumption per product unit (Consumption/GDP). To share and adopt these practices more widely among countries and industries will make energy more reliable and less expensive for homes and for production.

Finally, the third objective of the project, the **increase in the participation of renewable energy in the energy matrix** – wind, hydro, solar, biomass, and geothermal – offers access to a clean and sustainable resource. Currently renewable energy constitutes 13% of the Global Supply.² The products and services associated with renewable energy have grown rapidly in the international market.

The costs of these technologies continue to drop rapidly and being to appear, under certain conditions, to be competitive with other fossil resources. They also reduce GHG emissions and contribute to the global effort to combat climate change, as well as the national effort to promote economic and social development.

² Source: International Energy Agency, 2012.

Reaching the objectives proposed by the Secretary-General of the United Nations means doubling the percentage of renewables in the energy balance by 2030, which requires the support of all social sectors, including individuals.

Investments in wind, solar, tidal, and biomass grew 187 billion USD in 2011, more than the 157 billion USD invested in oil, gas, and coal. The total investment in new energy reached 260 billion USD in 2011.³ Recent scenarios estimate that renewable energy will contribute to the energy supply with low carbon content and with greater energy than nuclear energy or technology that captures and stores carbon.⁴

Hydropower, geothermal, and bioenergy are competitive when the resources are available, and solar energy and wind energy begin to be attractive in many areas. If there is strong support that starts with the design of public policy and provides fertile investment terrain for the private sector, renewable energy could satisfy a greater portion of the world energy requirements in 2030.

³ Source: United Nations Secretary-General

⁴ International Energy Agency (IEA): "Tracking Clean Energy Progress." Energy Technology Perspectives 2012 excerpt as IEA input to the Clean Energy Ministerial, June 2012, Paris.

Executive summary

Current and future development in Nicaragua and the Central American region is absolutely connected to the stable supply and efficient use of energy, which is necessary to improve daily life, including transport and the production of primary, secondary, and tertiary energy. Beyond supply, the nexus between energy access, climate, and poverty was recognized on the international agenda as a central subject to take into account when creating public strategies at a national and multilateral level for the long term.

This document presents a rapid analysis of the current situation in Nicaragua up to 2012 including challenges to the energy sector in the framework of the “SE4ALL” Initiative (Sustainable Energy for All).

The first section presents a summary of the energy situation in the country with the socioeconomic context; the second section analyzes the position of the country in relation to the three goals of the SE4ALL Initiative; and the third section concludes with an approach to the challenges and opportunities to reach the suggested goals and a proposal that could serve as the foundation for an action plan to help Nicaragua reach the final three objectives of the SE4ALL Initiatives:

- a) universal access to modern energy services access;
- b) increase in energy efficiency; and
- c) greater use of renewable energy in the energy matrix.

In section 1, we detail the general situation in the Republic of Nicaragua at the end of 2012. The Republic of Nicaragua had 5.5 million inhabitants according to the last census from 2005, and it is estimated to have a population of 5.8 million at the end of 2012 in a territory of 130,373.4 km.² The Central Bank of Nicaragua (BCN) considers that the growth of the economy in 2011 was 4.7% with a GDP of 7,297.5 million USD⁵ (range 138 to 195⁶). The country occupies the 129th position out of 194 countries on the Human Development Index,⁷ mainly impacted by the levels of poverty.

⁵ (BCN, 2011b)

⁶ <http://unstats.un.org/unsd/snaama/dnltransfer.asp?fid=2>

⁷ <http://hdrstats.undp.org/en/countries/profiles/NIC.html>

The share of the energy sector in the GDP has varied between 2009 and 2011 from 2.7% to 2.9% without including the mining sector.⁸ This share has remained stable in recent years. However, the asymmetry between important energy imports and the almost current lack of energy exports continues to be a source of vulnerability, dependence, and impoverishment in Nicaragua with the “oil bill” representing more than 55% of the FOB value of exports in 2011. These variables are important in the current context of Nicaragua, which continues to be the poorest country in the western hemisphere, excluding Haiti.

⁸ Mining represented 1.8% off the GDP in 2011, (BCN, 2011b)

Section 2 describes the position of the country related to the three goals of the SE4ALL Initiative. In the first place, we propose the following analysis of the current situation in Nicaragua related to universal access to modern energy services:

more than 1,500,000 inhabitants, mainly rural, don't have access to electricity. A majority of the population depends on inefficient energy that is harmful to health, such as firewood, which represents 87.9% of the final consumption of primary energy in the residential sector. In urban areas, its participation is reduced due to the availability of liquefied gas; the development of electricity infrastructure is still insufficient and leaves Nicaragua with a global coverage rate of 73.7% in 2012. Note that the overall rate hides great variations in coverage among urban and rural areas depending on if it is a concession area or is an area under the responsibility of ENEL or if it is an area totally isolated from electricity service; the nominal installed capacity for national generation at the end of 2011 is 1,116.80 MW, and peak demand is estimated to be 617 MW in 2012, which allows it to have a sufficient power reserve;

the growth of electricity demand in the next decade will require an increase of 896 MW in installed capacity (medium demand scenario) and up to 1,038.5 MW additional by 2026 (high demand scenario). This means that a huge effort is required in public and private investment to expand and densify transmission lines and distribution and to maintain and improve the quality and reliability of the current National Interconnected System (SIN);

in 2005 (the last national global census), of the 308,630 homes that didn't have access to electricity, almost 30% were in a situation of extreme poverty;

the goal of PNER is to allow, by the end of 2016, access to electricity service to 117,390 homes in 3,666 communities in rural areas that form part of the almost 310,000 homes that today don't have electricity out of a total of 1,100,000 occupied homes. In addition, it seeks to normalize service in 648 settlements;

the small interconnected rural providers serve approximately 9,500 clients located in the center of the country and the autonomous regions RAAN and RAAS. These companies are in difficult situations and require immediate attention from the authorities;

the Nicaraguan Electricity Company (ENEL) guarantees access to electricity (generation, distribution, commercialization) in the North Atlantic, Central and South regions of the country (22 sites). ENEL doesn't guarantee service to all the isolated zones. The total number of clients in January 2013 reached 47,214 (Source: ENEL);

In the Autonomous Region of the Atlantic North (RAAN) and the Autonomous Region of the Atlantic South (RAAS) there are Small Hydroelectric Plants (PCH) and Micro Hydroelectric Plants (MCH) run by private or joint ventures; in February 2012 there were 7 PCH and 11 MCH in operation;

Non-concession areas and particularly areas that are totally isolated coincide with the areas of greatest poverty in the country, directly influencing the level of economic and social development of its inhabitants, in particular in areas with the severest and highest levels of poverty;

There is great potential that has yet to be taken advantage of to develop green fuels like biogas for the rural residential sector and small producers and biofuels for the transport sector;

In the productive sector in relation to electricity, the frequent blackouts that Nicaragua experienced before 2007 and energy prices that continue to be very high in comparison to other countries in the region have been serious obstacles;

The development of access to commercial electricity in Nicaragua can be described as a pending task in the last few decades, but there has been an acceleration and concrete and significant improvements in the last five years.

In second place, we propose the following analysis of the current situation in Nicaragua in relation to energy efficiency measures:

Energy efficiency is still an emerging issue in Nicaragua. It has been institutionalized in recent decades;

The rational and efficient use of energy is currently one of the strategic priorities of the energy sector and focuses particularly on the electricity sector. The idea is to promote a National Energy Savings Plan that takes into account all the types of final users and to do it via the PNER Program. This plan will be translated into public energy efficiency policies and the Law of Energy Efficiency;

There is the need to review the respective responsibilities of the public and private sector in meeting these new guidelines;

The energy intensity of the economy of the Republic of Nicaragua allows a measurement of the development of energy efficiency measures as necessary energy units consumed to obtain a unit of product: in comparison with the average of Honduras and Guatemala, Nicaragua has an energy intensity that is 30% less favorable on average in the past five years.

In third place, we propose to analyze the following current situation in Nicaragua related to the role of renewable energy sources:

The participation of renewable energy sources in the global energy matrix is probably, of the three SE4ALL objectives, the subject which Nicaragua can be most proud of in terms of current results and future plans. During the last five years, it has promoted a great variety of renewable energy projects at the scale of interconnected generation plants;

However, Nicaragua still takes advantage of only a small part of its renewable energy potential, less than 10% of the total estimated potential at 5,500 MW in this study;

In 2011, we can see that generation from renewable fuels in the SIN reached 34.4% of the gross energy total. In 2012 it reached almost 44%;

The 2012 – 2026 expansion Plan estimates that it will be necessary to add 896 MW of renewable generation plants to compensate for the growth in demand that is estimated at 887 MW by 2026 (medium demand scenario, and maximum demand scenario 915 MW);

Given the recent development of various projects based on renewable sources and the interest in continuing with these developments, strong growth is expected in the renewable energy supply in Nicaragua. Considering the low level of energy absorption in the SIN mainly during the night, it is extremely important that SIEPAC can start operating at full capacity so that investments in renewable energy projects interconnected to the SIN aren't suspended with a few years. Energy transactions via SIEPAC are currently on the spot market; long term transactions don't yet exist given that there isn't any coordinated regional planning; each country plans for energy self-sufficiency and in this scenario the economic development of renewable energy projects for export is not viable;

Official statistics don't measure the total contribution of renewable sources in isolated electricity generation (private) to the national matrix;

There are still no provisions for integrated generation distributed by favorable tariffs with the goal of connecting small scale renewable energy systems to distribution lines (*feed in tariffs*) and to pay consumers the surplus generated with renewable energy (*net metering*);

The potential biogas market for productive use is estimated at a total of 80,902 between medium and large producers and a grand total of 839,906 homes in Nicaragua;

The self-producers, in general the large farmers who convert their surplus biomass into electricity, have an important role in the matrix: this market also has huge potential for growth.

Given this situation, the government of Nicaragua is implementing an energy strategy aligned with the Central American Strategy 2020, approved by the governments in the region and perfectly aligned with the objectives of the SE4ALL Initiative. To contribute to reaching the goals of the initiative of SE4ALL by 2030, the government of Nicaragua and its institutions need to develop and implement a strategy on various fronts. To do this, a series of goals has been proposed for 2015, 2020, and 2030 with clear performance indicators. The goals are presented by year and by objective according to the following proposed central strategies:

Objective 1: rational use of firewood; increased use of solar collectors for heating water; use of biodigesters in the rural residential sector; global electricity coverage; electricity coverage by type of geographic area (5 levels studied: ZC, ZCPCI, ZCI, ZAD, ZTA); extension of the SIN; price of electricity for vulnerable users; production and use of biofuels.

Objective 2: efficient use of firewood; efficient use of fuels; energy intensity; energy efficiency in the residential sector; energy efficiency in the commercial and industrial sector; energy efficiency in the public sector and electricity systems.

Objective 3: use of renewable sources for electricity generation; electricity generation from renewable sources for gross energy; distributed generation; program to promote rural interconnected generation (PC, PCH and local concessionary); program to promote isolated generation in totally isolated zones; energy infrastructure strategies for sustainable energy; use of biodigestors in the PYMES; program to encourage the self-producing sector.

Section 3 describes the relevant institutional framework for each strategic concept and the current or future public policies of the sector, such as programs being carried out or potential sources of financing. The most important is PNESER which is currently being carried out for the amount of 418,700,000.00 USD. PNESER seeks to have a transformational effect on electricity coverage at a national level by significantly increasing the rate of electricity service coverage while taking into account the increased use of Renewable Energy (RE) and the promotion of Energy Efficiency (EE).

In conclusion, based on an analysis of the current situation in Nicaragua made in section 2, and looking at the goals proposed to reach the objectives of SE4ALL discussed in section 3, this study proposes a rapid analysis of the gaps and barriers presented to the SE4ALL objectives and makes proposals for confronting them. Briefly, the barriers fall in the following categories:

Barrier 1. Access to financing for the intermediate market (lack of credit supply adapted for the residential and commercial sector)

-
- Barrier 2. Management capacity of public authorities (lack of planning and follow-up)
 - Barrier 3. Development of technical abilities in Nicaragua (lack of technical personnel trained in management, operation, and maintenance of renewable energy systems)
 - Barrier 4. Perception of Nicaragua as a high risk country (it is necessary to continue changing this perception of Nicaragua as a high risk country for investment)
 - Barrier 5. Database of generation potential and public access to information (there is only one known estimate of generation potential from renewable sources)
-

In a complimentary manner, the following recommendations were also presented:

- Recommendation 1. To make the baseline and projections for universal access to energy services
- Recommendation 2. To agree on a definition for modern electricity services
- Recommendation 3. To develop and implement a System of Information and Energy statistics for the country
- Recommendation 4. To make the baseline and projections for energy efficiency
- Recommendation 5. To establish a model of organization for the promotion and development of renewable energy and energy efficiency
- Recommendation 6. To complete knowledge of the potential of renewable sources in Nicaragua
- Recommendation 7. To create a Single Window for Renewable Energy Projects (VUPER)
- Recommendation 8. To adapt the rules for small producers and concessionaries
- Recommendation 9. To establish MEM as a focal point (monitoring authority)
- Recommendation 10. To include energy information in the next General Census (2015)

This consultancy has been financed by the Inter-American Development Bank and the United Nations Development Programme and supported by the Ministry of Energy and Mines of Nicaragua.

The consultant would like to thank the valuable help and information received from MEM and the collaboration with ENEL and ENATREL without which this study would not have been possible.

Section 1: Introduction

Main Indicators of the Republic of Nicaragua 2012

Total Population (2012 ⁹):	5,991.7 (thousands of hab)
Rate of Population Growth (2012 ¹):	1.46% annual accumulated
Total area (land ¹⁰ , including islands):	130,373.4 km ²
Population Density (2011 ¹):	45 hab/km ²
Urban Population (2011 ^{1,3}):	58.3%
Gross Domestic Product (2012 ²): 2005)	8,088.2 million USD (M\$ equiv.
GDP/inhabitant(2012 ²):	1349.89 USD/hab
Participation of the goods producing sector (2011 ²):	56.2%
Participation of the services sector (2011 ²):	24.7%
Total Final Energy Consumption (2012 ¹¹):	2,180.5 ktoe
Final Energy Consumption per Inhabitant (2011 ³):	0.356 toe/hab
Growth Rate of Final Energy Consumption:	3.4% annual (2010 a 2011)
Energy Intensity (CEF/PIB, 2012 ¹²):	2.71 boe/miles USD de PIB (0.37 toe)
Electricity Consumption (2012)	3,040.38 GWh
Electricity Consumption per Inhabitant (2012):	500.8 kWh/hab
Growth Rate of Electricity Consumption (2012 ¹³):	7.8% (2012 vs. 2011)

⁹ Census Data (INIDE / INEC, 2005) and official estimates (CEPAL, 2011a), World Bank 2012.

¹⁰ World Bank 2012.

¹¹ (MEM, 2012a)

¹² (OLADE, 2012)

Number of Households (2012 ¹²):	1,065,100 Households
Inhabitants per household (2011 ¹⁰):	5.7 inhabitant/household
Households with water available from network (2011 ⁴):	65.9%
Households with sewer available (2010 ⁴):	23.3%
Residential Consumption of LPG (2012 ¹²):	395.4 thousands of barrels, residential use
Households with electricity available (2012 ³):	73.7%
Inhabitants without electricity service (2012 ¹²):	1,596 (thousands of hab) - estimate

¹³ INE : growth in gross generation in 2011

Current Situation of the Energy Sector in the Republic of Nicaragua

Energy supply, energy matrix, and trade

Primary Energy Production

The production of primary energy in the Republic of Nicaragua in 2012, according to the National Energy Balance Report (MEM, 2012b) was 1,547.3 ktoe which represented a growth of 3.4% with respect to 2011. Using the names adopted by the MEM (Nicaragua), we present the distribution of this offering based on the respective energy sources:

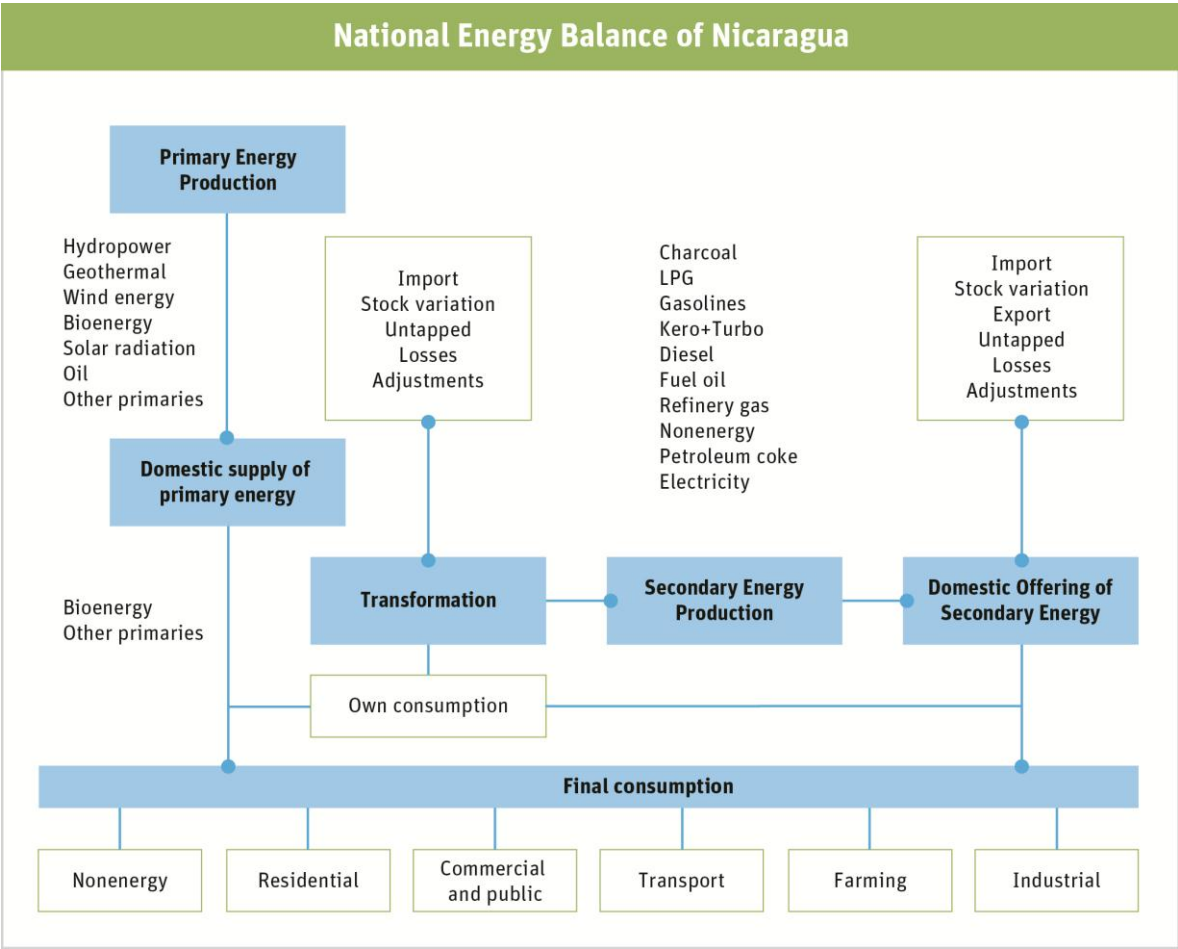
Fuentes	2012		Variation 2011 / 2010
	ktoe	% total produced	%
Hydro Energy	62.5	4.1	(23.5)
Geothermal Energy	114.2	7.4	52.3
Wind Energy	28.3	1.8	56.4
Bioenergy	1,342.3	86.7	1.6
Solar Radiation	Unknown ¹⁴	N/A	N/A
Total:	1,547.3	100.0	3.4

Table Error! No text of specified style in document.-1 Production of primary energy by source, 2012

Source: (MEM, 2012a), own elaboration

The internal gross supply of primary and secondary energy comes from primary energy production according to the following graphic:

¹⁴ The contribution of solar photovoltaic panels (SPV) to energy generation in Nicaragua is not measured satisfactorily yet. It is expected that the commissioning of 2 SPV projects by MEM in 2011 and 2012 will change this situation.



Graphic Error! No text of specified style in document.–1 **Diagram of the flow showing the components that make up the National Energy Balance of Nicaragua and the interrelations among the components. Source: Own elaboration.**

Below we describe the gross internal supply of primary and secondary energy.

Gross Internal Supply of Primary and Secondary Energy

Taking into account the production of primary energy and adding imports – mainly crude oil – and subtracting exports – mainly biomass – thus reflecting losses, untapped energy, and changes in inventory, the Gross Internal Supply of Energy in 2012 reached 2,947.7 ktoe. Of this, primary energy (not transformed) and secondary energy (with the transformation process) were divided in the following way:

	2012		Variation 2012 / 2011
Sources	ktoe	% of the total supply	%
Primary Energy	2,028.8	68.9	(7.2)

Hydro Energy	42.8	2.1	(12.1)
Geothermal Energy	72.8	2.5	(6.1)
Wind Energy	28.3	1.4	56.4
Bioenergy	1,3209	44.8 ¹⁵	(17.2)
Solar Radiation	Unknown	N/A	N/A
Oil	525.6	25.9	(33.3)
Secondary Energy	918.9	31.1	32.3
Vegetable coal	0.0	0.0	0.0
LPG	83.0	2.8	32.3
Gasolines	184.1	6.2	36.9
Kero+Turbo	3.3	0.1	291.0
Diesel	314.3	10.7	33.8
Fuel oil	297.9	10.1	26.0
Refinery gas	0.0	0.0	0.0
Non-energetics	12.3	0.4	67.0
Petroleum coke	22.6	0.8	(0.6)
Electricity	1.4	0.1	154.9
Total:	2,947.7	100.0	2.3

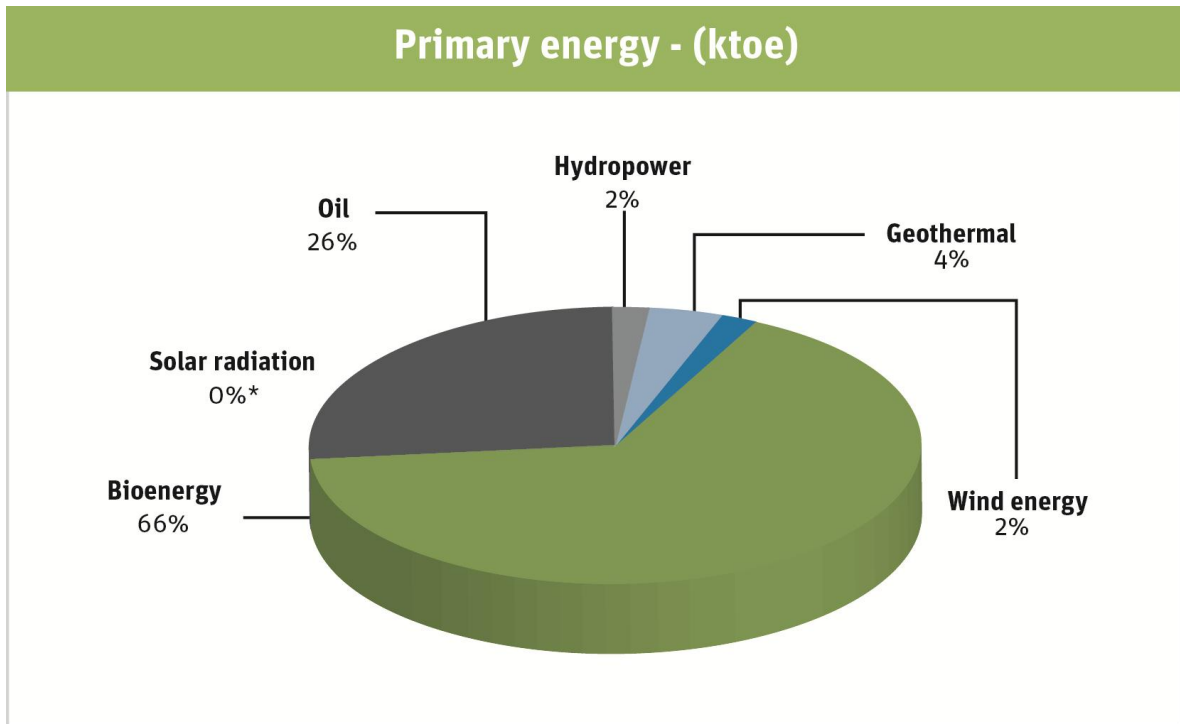
Table Error! No text of specified style in document.-2 Gross Domestic Product of Energy, 2012

Source: (MEM, 2012a), own elaboration

The composition of this supply shows the strong predominance of fossil fuels, essential diesel, and fuel oil with 20.8% and petroleum with almost 26% of the total offering.

¹⁵ Firewood alone represented 34.1% of the Gross Domestic Supply of total energy.

Primary energy sources



Graphic Error! No text of specified style in document.–2 Participation by Source in the Internal Offering of Primary Energy in the Republic of Nicaragua (2012)

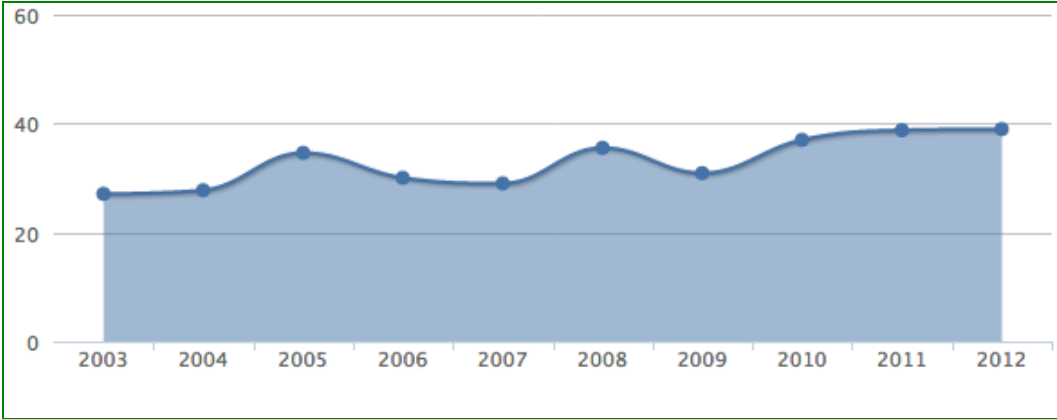
(*) solar energy is not measured by the National Energy Balance/ Source: (MEM, 2012a), own elaboration

Primary energy supply in 2012 totaled 2,028.8 ktoe (MEM, 2012a) with the two main sources being firewood (49.5%) and oil (25.9%).

The strong dependence on the petroleum products has been characteristic of the Nicaraguan energy system structure in the last decades. The current strategy of the government of Nicaragua and the Ministry of Energy and Mines is to achieve systematic change in the energy matrix to favor renewable fuels as is described in 2.3.4.

However, observing the distribution of Internal Primary Energy Supply by source in 2012, we can appreciate that even more than petroleum, unlike many other countries in Latin America, the most important source is firewood and other biomass residues, with an incidence of 65.1% of the total of primary sources (with firewood at 49.5% of that figure). This is a characteristic specific to Nicaragua, and its consequences will be described in 3.1.2.

Finally, to a lesser extent, other renewable energy sources such as conventional ones like hydropower and non-conventional ones like wind, geothermal, and solar (photovoltaic and thermal) energy, which can't be measured, have an increasingly important global role. In total, renewables account for around 74% of the primary energy supply in the national energy balance and, in reality, in particular in the electricity subsector, as will be described in detail in 3.3.



Graph Error! No text of specified style in document.–3 Percentage of gross energy generated with renewable sources in Nicaragua in total (electricity and thermal uses).

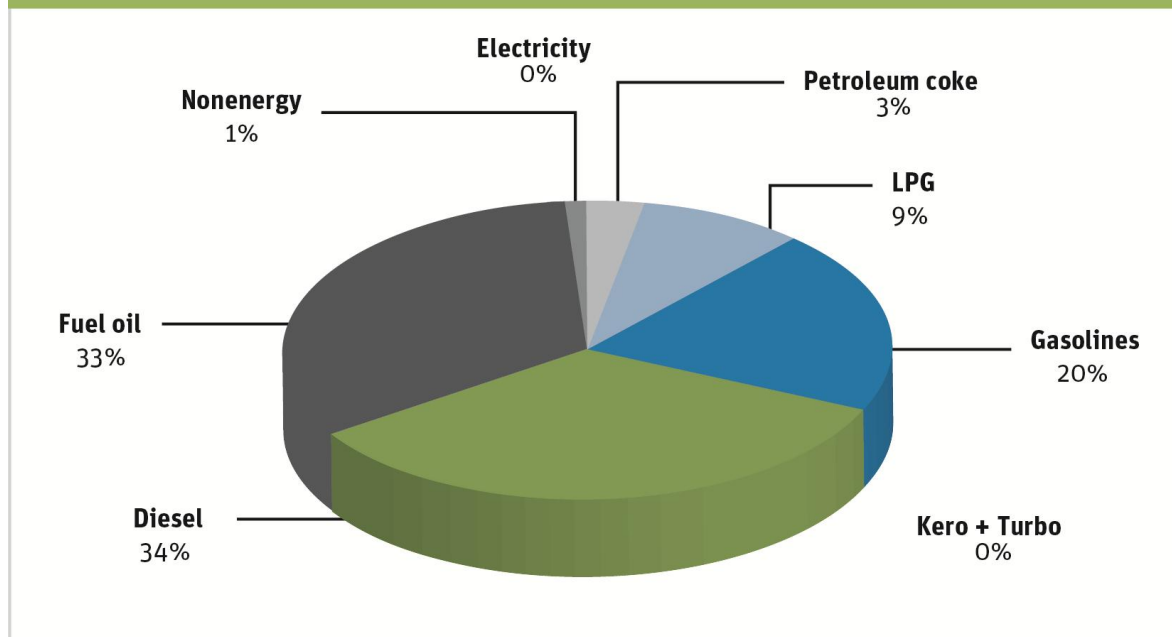
Source: Renewables Association, System SIMERNIC¹⁶

Secondary sources of energy

Secondary energy supply in 2012 totaled 918.9 ktoe, mostly petroleum products.

¹⁶ www.renovables.org.ni/simernic

Secondary energy - (ktoe) 2012



Graph Error! No text of specified style in document.–4 Participation by Source in Internal Secondary Energy Supply in the Republic of Nicaragua (2012)

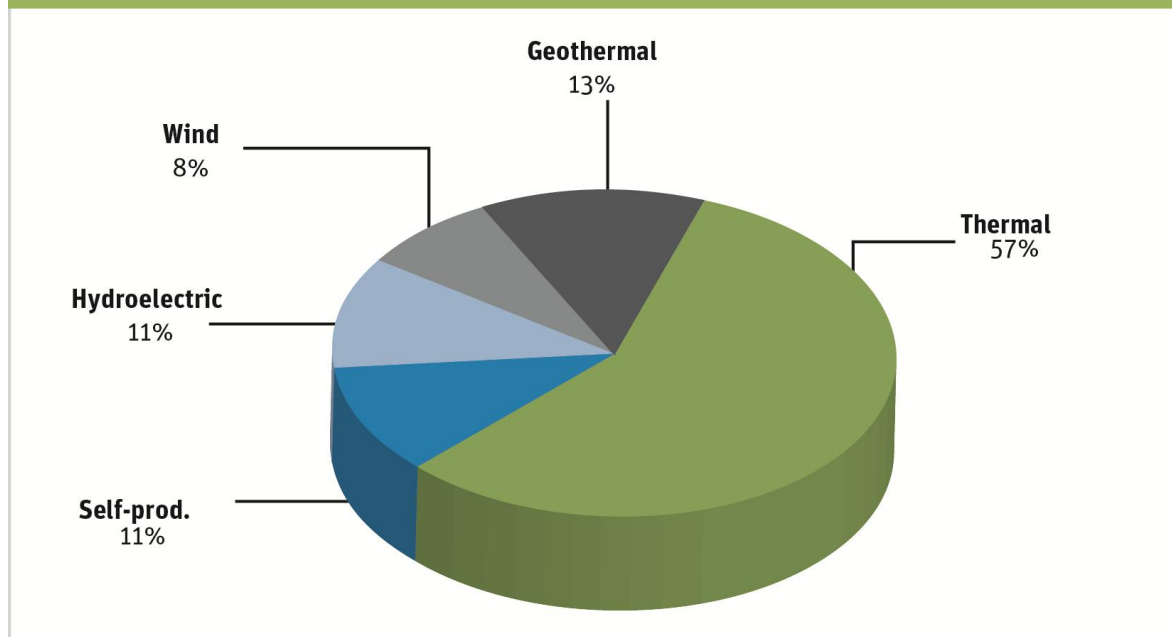
Source: (MEM, 2012a), own elaboration

Focus on the electricity subsector

The electricity subsector in Nicaragua has undergone huge changes since 2007. The government of Nicaragua via MEM, ENATREL and ENEL has made significant advances. It has guaranteed the stability of the national electricity system with a more secure and reliable electricity supply and greater access in vulnerable zones, achieving greater investment and positioning Nicaragua as the 2nd country to receive the largest Direct Foreign Investment (per capita) for renewable energy projects in Latin America in 2011 (IDB-FOMIN / Bloomberg, 2012). It carried out important changes in the electricity grid and widened the coverage area.

In 2012, MEM evaluated that gross generation in the national electricity subsector reached 4,018.2 GWh, which corresponded to 57.1% of the thermal plants, 13.0% geothermal energy, 10.4% hydroelectricity, 11.3% produced by auto-producers mainly based on plant residues (bagasse) and finally 8.2% wind energy.

Gross generation of electricity (by source) 2012



Graph Error! No text of specified style in document.—5 Electricity subsector: gross electricity generation

Source: (MEM, 2012a), own elaboration

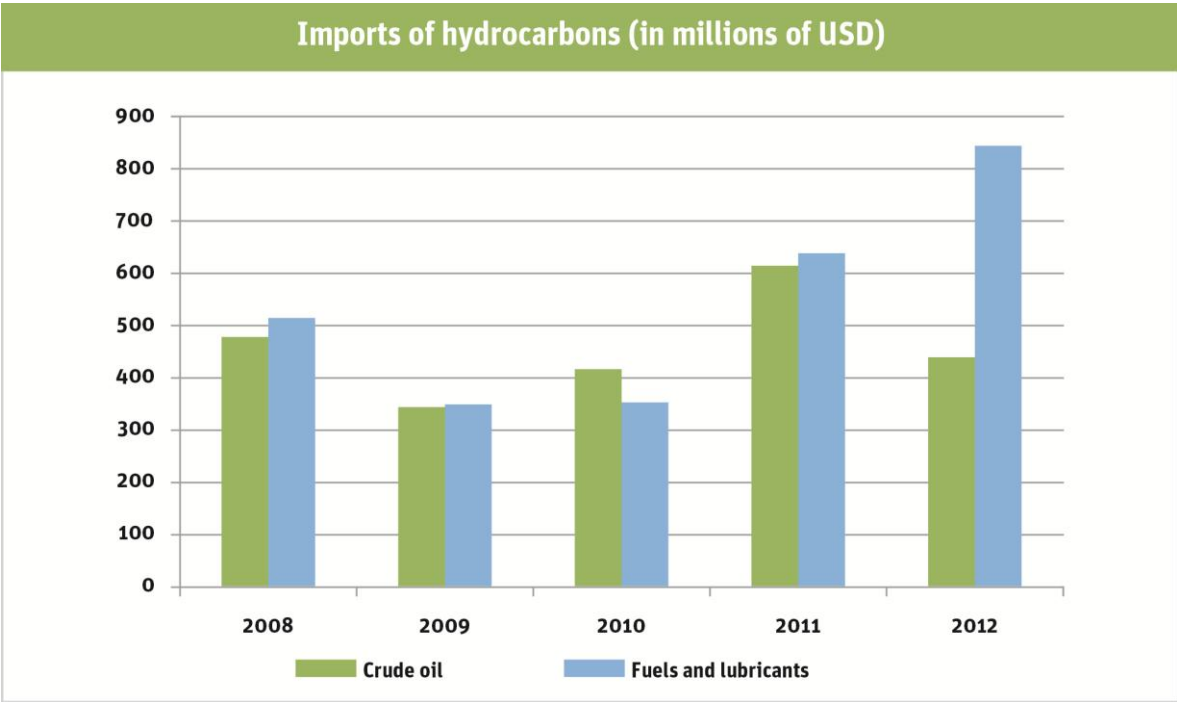
Energy exports and imports

a) Imports

Nicaragua is a country that is highly dependent on hydrocarbon imports which represent a significant economic burden. In 2011, the country's oil bill reached 1,256.4 million USD (including oil, by-products, and lubricants), which meant an increase of 61.9% compared to 2010, which was 776 million USD due mainly to the upward trend in oil prices in the international markets (MEM, 2012b). In 2012 crude oil imports reached 580.2 thousand toe, which is equivalent to 4,174.3 thousand barrels, and the country of origin of 100% of the crude oil is Venezuela. The imports represent a reduction of 29% compared to 2011.

The composition of oil imports indicates that 38% of crude oil and the remaining finished products necessary to meet the demand include: Fuel Oil (19.1% of the total imported), Diesel (21.1%) and gasoline's (12.6%) (MEM, 2012a).

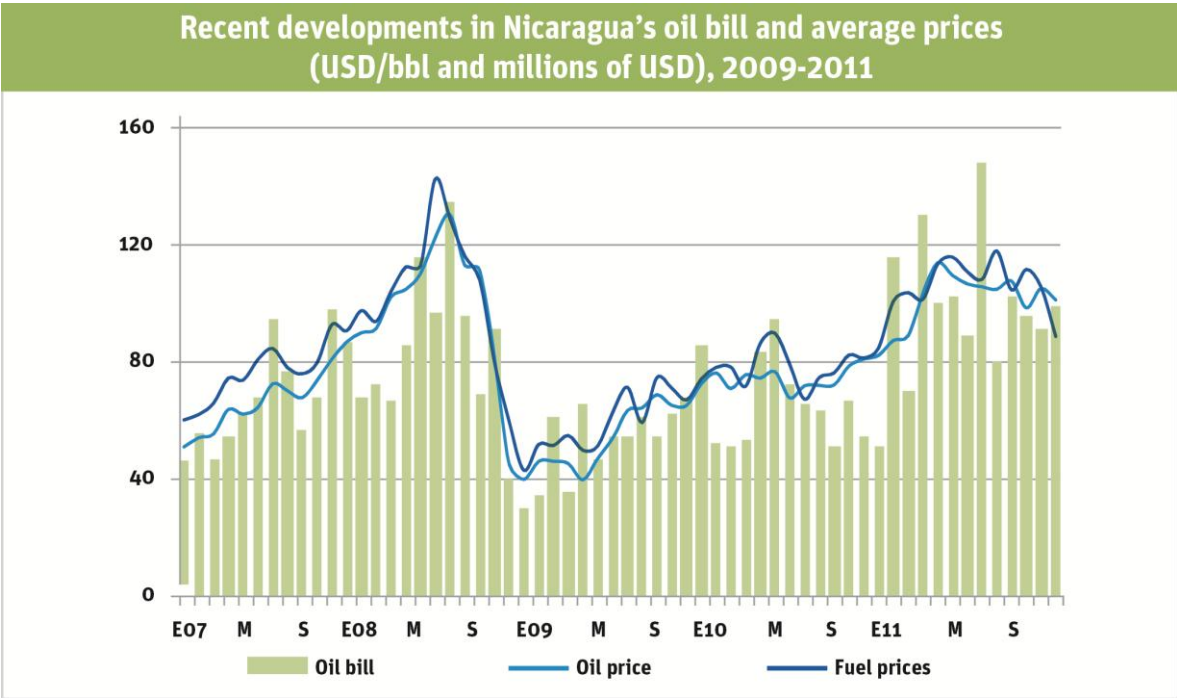
Venezuela is the main supplier of hydrocarbons with 82.6% of the total which includes 100% of the required crude oil. These imports are made via a commercial supply agreement signed between ALBANISA and PDVSA in mid 2008 (MEM, 2012b).



Graph Error! No text of specified style in document.–6 Imports (in millions of USD) of petroleum by-products in Nicaragua, 2008 to 2012

Source: (BCN, 2011a), own elaboration

The cost of these strategic imports puts great stress on the Nicaraguan economy; the two following graphs allow us to visualize the impact. In the past three years, Nicaragua’s oil bill has varied between 40 and 160 million USD per month depending on the price of oil and other fuels on the international market. (BCN, 2011a).

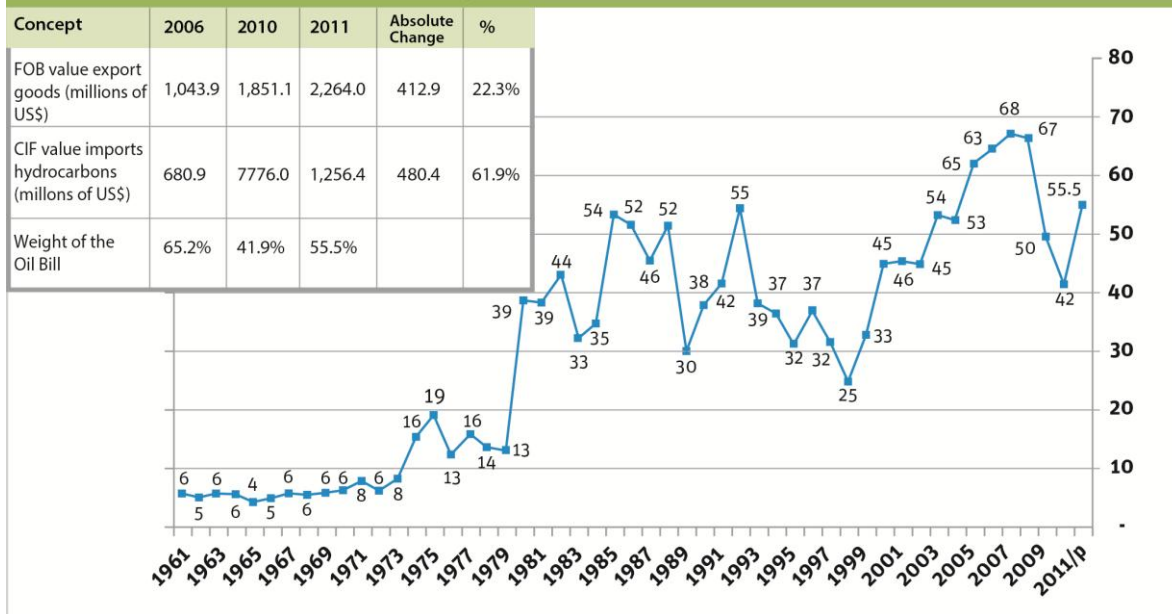


Graph Error! No text of specified style in document.–7 Recent developments in Nicaragua's oil bill and average prices (USD/bbl and millions of USD), 2009-2011

Source: (BCN, 2011a), MEM and DGA.

In 2011, this situation caused the weight of the “oil bill,” which represented 55.5% of the FOB value of exports despite the high growth that exports registered that year (MEM, 2012b): see the following graph.

**Development of the Stress of the Oil Bill 1961 to 2011 vs. Exports
(Imports CIF Hydrocarbon vs. Exports FOB Total).**



Graph Error! No text of specified style in document.—8 Development of the Stress of the Oil Bill 1961 to 2011 vs. Exports

(Imports CIF Hydrocarbon vs. Exports FOB Total). Source: BCN, 2011 (preliminary)

Note that Nicaragua is not a natural gas importer mainly due to the lack of adequate infrastructure. Only liquefied petroleum gas (LPG) is consumed in the country. There are two LPG importers: Tropigas and Zeta Gas and four marketers of the product: Tropigas, Zeta Gas, PETRONIC, and ESSO. (MEM, 2012b)

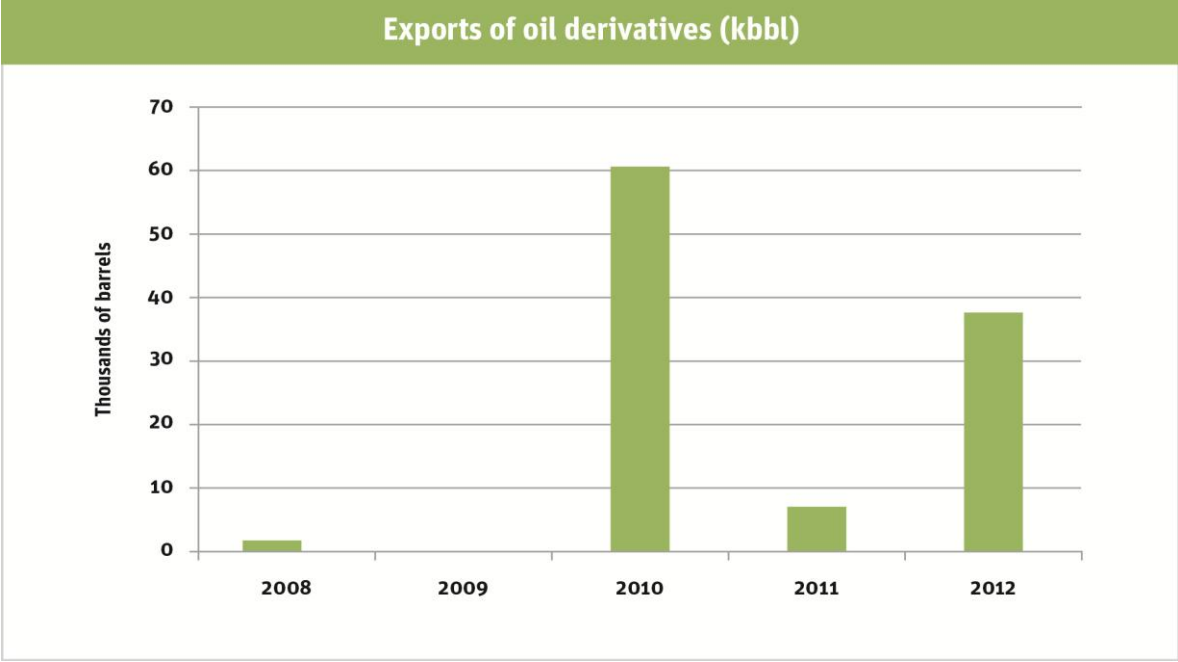
b) Exports

In early 2010 the storage capacity in Corinto increased due to the construction of the facilities “Benjamín Zeledón” with 200 thousand barrels of Fuel Oil for import, property of ALBANISA and “Germán Pomares,” property of DNP, with a capacity of 180 thousand barrels of Diesel and 90 thousand barrels of Gasoline (MEM, 2012b).

Domestic production of petroleum products reached 5,616 thousand barrels in 2011 which represented an increase of 0.80% from the 5,572 thousand barrels produced during 2010. In 2012, it dropped to 9.1% compared to 2011.

The main products in 2012 were: Fuel Oil (44.2%), Diesel (30.5%) and Gasolines (13.7%) which together reached 88.4% of the total production of petroleum products (MEM, 2012a). But the vast majority of these products were consumed on the domestic market.

The volume of exports of transformed petroleum products in Nicaragua is not significant. The figures for the last five years are represented in the following graph.



Graph Error! No text of specified style in document.—9 Exports (in thousands of barrels) of petroleum products (mainly diesel oil), 2008 to 2012

Source: (OLADE, 2012) and (MEM, 2012a), own elaboration

Exports of electricity in 2012 were 3.2 GWh which represented less than 0.1% of the total electricity production in 2011: it is not significant. However, as we will explain in Section 2, paragraph 3.3.2.1, Nicaragua has huge export potential in electricity given that SIEPAC is entering operation and given the current tendency to invest in generation projects in the country based on renewable fuels. To date, long-term transactions don't exist given that there is no joint regional planning: each country plans energy self-sufficiently and in this scenario it isn't economically viable to develop renewable projects for export.

Energy demand

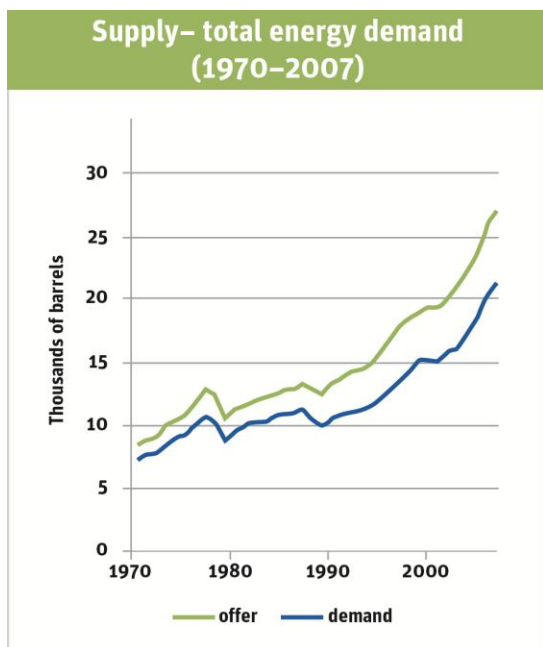
Final energy consumption in different sectors of the economy in 2012 was 2,180.5 millions of toe. The residential sector is responsible for 46.3% of all energy consumed in Nicaragua (final energy consumption), followed by the transport sector with 26.2%, industry with 12.8%, and the commercial/public and services with 10.5% (MEM, 2012a), with a cumulative annual growth rate between 2000 and 2012 of 1 to 2% per year which will be kept around 1.6% for the next ten years (CEPAL, 2011b). The most dynamic sectors whose annual growth rate exceeds the average are the industrial sector with 4.8%, the transport sector with 4.6%, and the agricultural sector with 40.4% (CEPAL, 2011b).

Sources	2012		Variation 2012 / 2011 (%)
	ktoe	% total consumed	
Residential	1,009.1	46.3	1.7
Commercial, public, and services	229.7	10.5	1.9
Industrial	278.9	12.8	4.8
Transport	570.9	26.2	4.6
Agriculture	51.7	2.4	40.4
Others	40.2	1.8	24.5 ¹⁷

Table Error! No text of specified style in document.-3 Final consumption by energy sector, 2011

Source: (MEM, 2011a), own elaboration

¹⁷ The "others" sector is not detailed in the Report on the national energy balance and its contribution is smaller.



Graph Error! No text of specified style in document.–
10 Supply- total energy demand (1970-2007)

In thousands of boe. Source: (CEPAL, 2011b)

Country	2010-2025
Costa Rica	2,8
El Salvador	1,6
Guatemala	0,5
Honduras	2,7
Nicaragua	1,6
Panama	3,2
Belize	4,9
Central American Average	2,5

Graph Error! No text of specified style in document.–
11 Rate of growth of energy demand .

Scenario based on 2010 A. Source: (CEPAL, 2011b)

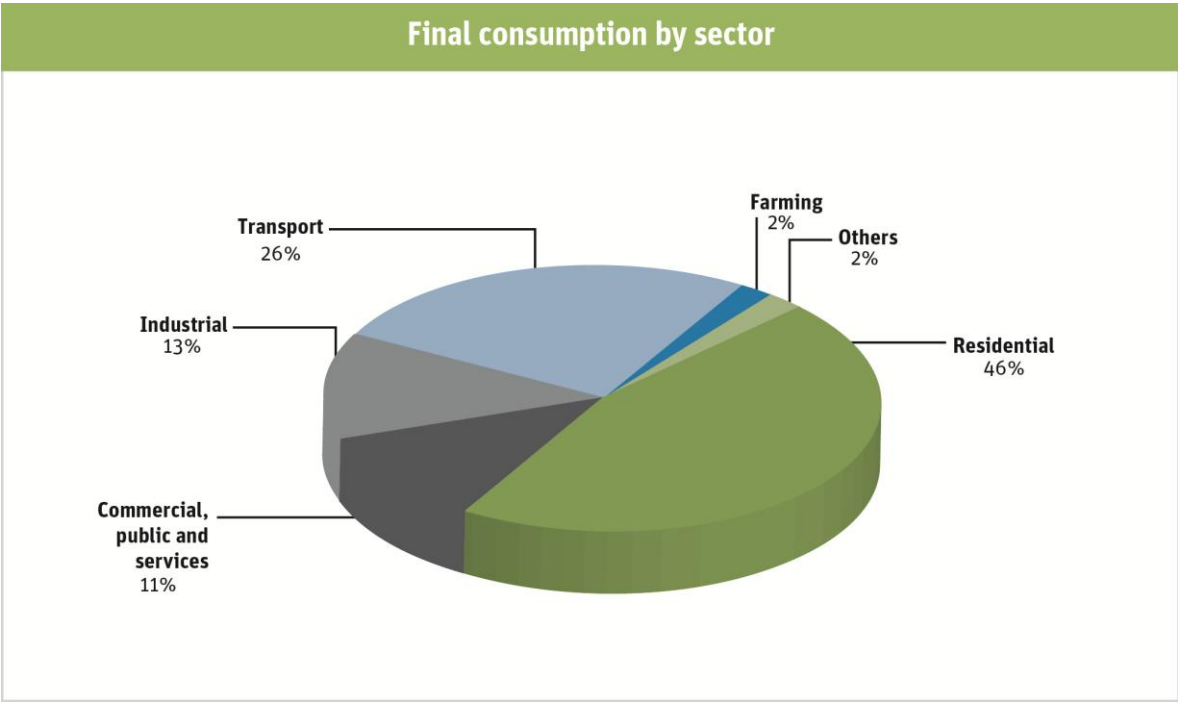
The residential sector consumes 1009.1 ktoe with an increase over 2011 of 1.7% due mainly to the consumption of firewood, which represented 87.1%, followed by electricity with 8.5% (MEM, 2012a).

The commercial, public, and services sectors consume 10.5% of the final demand which is equal to 229.7 ktoe, which represents an increase of 1.9% over 2011. The participation of petroleum products and electricity are 53.5% and 31.7% respectively, with firewood 13.7% and coal 1.1% (MEM, 2012a).

The industrial sector consumes 278.9 ktoe, which represents 12.8% of final consumption. It was a 4.8% increase over 2011. The structural percentage of this sector corresponds to 46.1% of petroleum products, 18.5% firewood, 31.6% electricity (MEM, 2012a).

The transport sector held a 26.2% share of the final energy consumption which in energy value equals 570.9 ktoe, a growth of 4.6% over 2011. Diesel Oil represents 54.8% of the total followed by gasoline with 41.4% and kero-turbo with 3.8% (MEM, 2012a).

The agricultural sector represents 2.5% of final consumption, i.e. 51.7 ktoe and reflects a growth of 40.4% over 2011. Its structure was 47.6% obtained from vegetable waste, 21.5% from petroleum products, 15.7% from electricity, and 13.3% from firewood (MEM, 2012a).



Graph Error! No text of specified style in document. –12 Final energy consumption by sector.

Source: (MEM, 2012a), own elaboration

Energy and economic development

The world economy in 2012 was affected by a number of factors including: the persistence of high levels of unemployment in advanced economies, the crisis of sovereign debt in the Euro zone, the deterioration of global financial conditions, the volatility of commodity prices, geopolitical instability including various key elections around the world, and the consequences of the earthquake, tsunami, and nuclear crisis in Japan in 2011. In this difficult context, Nicaragua suffered a further increase in the price of oil products which contributed to the fact that the total import bill of goods was 5,203.7 USD in 2011, equivalent to a growth of 24.7%.

The largest absolute increase in imports relative to exports led to the current account deficit which represented 17.8% of the GDP in 2011 (13.5% of the GDP in 2010). This increase was partially offset by an increase in family remittances that grew 10.8% to reach 911.6 million USD in 2011 (BCN, 2011a).

The current account deficit was financed mainly by foreign direct investment (FDI), followed by public and private external borrowing and grants. The FDI received during 2011 reached 967.9 million USD registering a growth of 90.5% over 2010 (BCN, 2011a), and the most important investments were directed to the energy and mining sector, adding more than 255 million USD to this sector in 2011 (MEM, 2011c).

The share of the energy sector in the GDP has varied between 2009 and 2011 between 2.7% and 2.9% excluding the mining sector.¹⁸ This share has remained stable in recent years. However, the asymmetry between major energy imports and the almost complete current lack of energy exports continues to be a source of vulnerability, dependence, and impoverishment for Nicaragua with the “oil bill” representing more than 55% of the FOB value of exports in 2011 (see 0).

These variables take on great importance in the current context of Nicaragua which continues to be the poorest country in the western hemisphere excluding Haiti, (CEPAL, 2012). More than 1,150,000 homes, in their great majority rural, don't have access to electricity and depend on firewood which is inefficient and harmful to the health. (see 3.1.3).

Thus, current and future development in Nicaragua are absolutely tied to the stable supply of efficient energy which is necessary to improve daily life, transport and the production of primary, secondary, and tertiary energy.

Energy strategy and relevant objectives

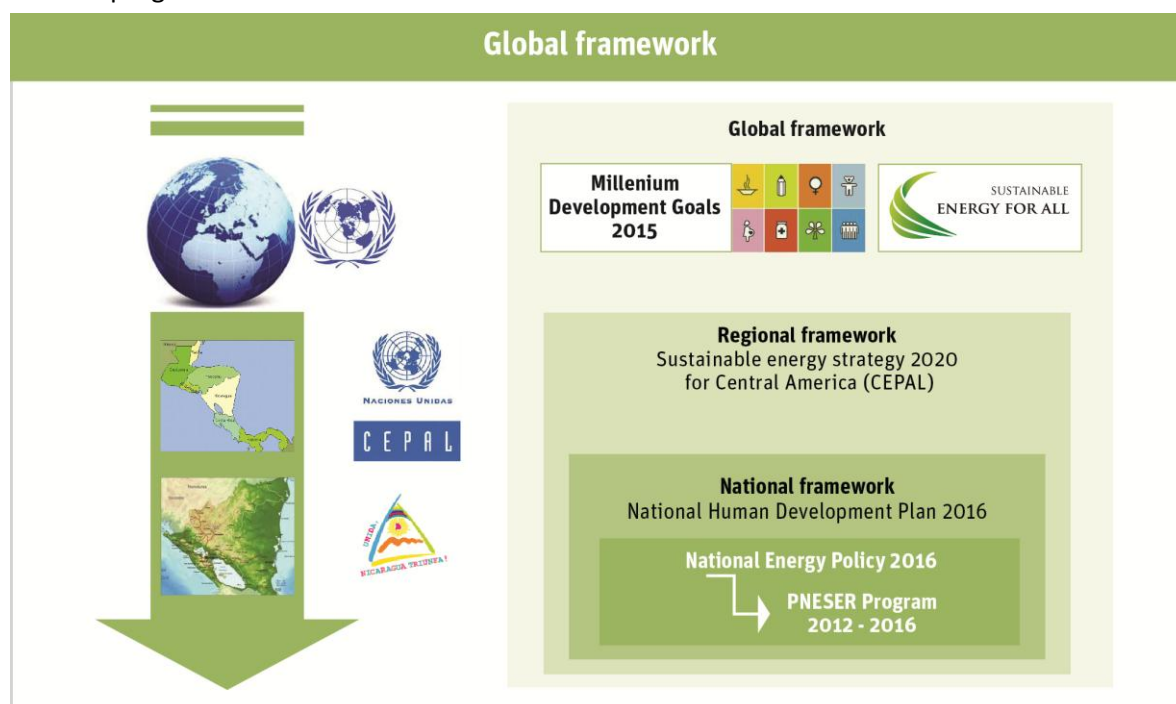
Energy has an indispensable influence on development and is a fundamental task of the strategies for fighting poverty and reaching greater levels of equality in accessing basic services. Nicaragua is a country with low wages in Latin America and the Caribbean (LAC) and it has one of the lowest

¹⁸ Mining represented 1.8% of the GDP in 2011, (BCN, 2011b)

levels of electricity service coverage in the region, which is represents an important barrier to its socioeconomic development.

In order to better situate the Nicaraguan energy strategy, it is necessary to examine the situation in the Republic of Nicaragua within the framework of relevant world energy strategies relevant to this study and the regional strategy and country plan. We will describe the following five levels:

- Millennium Development Objectives and SE4ALL;¹⁹
- Sustainable Energy Strategy for Central America SICA / CEPAL 2020;
- National Human Development Plan for Nicaragua 2012-2016;
- National energy policies; and
- The program framework for PNER 2012-2016



Graphic Error! No text of specified style in document.–13 Levels relevant to energy strategies

Source: own elaboration

Millennium Development Objectives for Nicaragua

The document Country Objectives for the Millennium of Development (MDG) for Nicaragua does not identify sustainable energy (SE4ALL Initiative) as a particular objective but rather as a subject that is related to various objectives.

¹⁹ See <http://www.sustainableenergyforall.org/>

However, Objective No. 7, “Sustainability of the environment,” stipulates that Nicaragua should: “reduce the number of people without access to a source of potable water and basic sanitation services. Nicaragua needs to accelerate its efforts to reduce by half the number of people without access to a sustainable source of potable water by 2015” (UNDP, 2007). It lists the following goals and indicators, of which we should observe No. 3, No. 4 and No. 5, which set high level energy goals for environmental sustainability for Nicaragua and the state of advancement of the project at the date mentioned:

#	Indicator	Unit	Year	Value	Year	Value
No.3	Use of energy per 1,000 USD of Gross Domestic Product (GDP)	toe per 1,000 dollars of GDP	2006	0.4	2011	0.37 toe²⁰
No.4	Carbon dioxide emissions per capita	ton/hab	2000	2.64	2011	0.73²¹
No.5	Per capita biomass consumption (firewood + cane products + other primary resources)	toe/hab	2006	174.6	2012	214.2

Table Error! No text of specified style in document.-4 Goals No. 3,4 and 5 of MDG N°7, with values from the UNDP 2007 report and current data

Source: (PNUD, 2007) y (MEM, 2011a)

If we analyze these indicators as were provided in 2000 and at their current level (2011 or 2012), we can observe that they reflect three essential tendencies:

- a) a better use of energy reflected in energy intensity, but limited by a very low progression
- b) the change in the energy matrix causes a reduction in carbon dioxide emissions per capita
- c) the growth of the population causes greater consumption of biomass per capita

The following table, more detailed and integral, shows us that energy, even though it is a cross-cutting issue, is not explicitly mentioned in the objectives and goals of the MDG. However, its

²⁰ See 0

²¹ 4,281 Gg in 2011 equivalent 4,281 kt, source (OLADE, 2012)

presence is essential to achieve the development commitments as described in the productivity columns, coverage, basic energy necessities, and participation in renewable energy.

No.	Millennium Objectives	#	Millennium Goals	Productivity	Coverage	Basic Energy Necessities	Participation in Renewable Energy
1	Eradicate extreme poverty and hunger	1.1	Reduce by half between 1990 and 2015 the percentage of people whose earnings are below \$1 dollar per day	Increase energy productivity which reduces costs and generates more employment	To provide electricity services to allow improved information opportunities and quality of life	To access modern energy sources makes domestic productivity more efficient	
		1.2	To reduce by half between 1990 and 2015 the percentage of people who suffer from hunger	To increase energy productivity which allows increased production			
2	To achieve universal primary schooling	2.1	To ensure that by 2015 all children can complete a full course of primary schooling		To provide electricity service to allow better information opportunities for children	To count on higher levels of comfort in areas that are extremely cold or extremely hot	Electricity service with renewable energy
3	To promote gender equality and empower women	3.1	To eliminate gender disparity in primary and secondary school preferably by 2005 and in all levels of schooling by 2015		To provide electricity services in homes to allow better information opportunities for children	To cover energy necessities like heat for cooking frees up time for the children and women who have to collect firewood	Electricity services with renewable energy
4	To reduce infant mortality	4.1	To reduce the mortality rate of children under 5 years by two thirds between 1990 and 2015		To provide health services in rural areas with basic equipment to care for children	To have refrigeration and heating processes for instrument sterilization processes in rural health centers	
5	To improve maternal health	5.1	To reduce maternal mortality by three fourths between 1990 and 2015		To make sure health services in rural areas have basic equipment for health care	To have refrigeration and heating processes for sterilization in rural health centers	Electricity services with renewable energy
6	To combat HIV/AIDS, malaria and other diseases	6.1	To halt and begin to reduce the spread of HIV/AIDS by 2015		To make sure health services in rural areas have basic equipment for health care	To have refrigeration and heating processes for sterilization in rural health centers	Electricity services with renewable energy

		6.2	To halt and begin to reduce the spread of malaria and other serious diseases by 2015		To make sure health services in rural areas have basic equipment for health care	To have refrigeration and heating processes for sterilization in rural health centers	
7	To ensure environmental sustainability	7.1	To incorporate the principles of sustainable development into national policies and reverse the loss of environmental resources	To increase productivity to generate more employment without damaging the environment		To avoid the predation of plant species used for fuel	To carry out sustainable management in rural wooded areas
		7.2	To reduce the percentage of people who lack sustainable access to potable water by half by 2015				Water pumping services with renewable energy
		7.3	To have considerably improved life for at least 100 million inhabitants of villages by 2020		To provide electricity services to improve life quality, information, and entertainment	To provide distribution systems for commercial energy to cook	

Table Error! No text of specified style in document.-5 Poverty and Energy, objectives and millennium goals (MDG, MDM).

Source: (FICHTNER, 2011a)

Initiative Objectives “Sustainable Energy for All”SE4ALL”

Just as we explained in the Introduction, the objectives of the Initiative “Sustainable Energy for All” “SE4ALL” are easy to summarize and present:

1 ENSURE
universal access
TO MODERN ENERGY SERVICES.

2 DOUBLE THE GLOBAL RATE OF IMPROVEMENT IN
energy efficiency

3 DOUBLE THE SHARE OF
renewable energy
IN THE GLOBAL ENERGY MIX.

Sustainable energy strategy 2020

An important reference at the regional level is the “Central American Sustainable Energy Strategy 2020”, approved by the ministers of energy at the end of 2007 and later by the Presidents of SICA (CEPAL, 2007). Its goal is to establish clear directives to achieve sustainable development in the sector. In order to do this they carried out prospective studies that considered, among other factors, the energy sources available worldwide, international commitments from the World Summit on Sustainable Development in Johannesburg, the sustainability of the sector, the

socioeconomic situation, the existing energy system, GHG emissions, and the institutional environment in the region.

This strategy provides countries with a common vision of development and energy integration, establishing goals to:

- i) reduce the dependence on hydrocarbons;
- ii) increase the participation of renewable sources;
- iii) reduce GHG emissions;
- iv) increase electricity coverage and
- v) increase energy supply and demand efficiency

See the following table for more details:

Sustainable energy strategy for Central America 2020 (SICA / CEPAL)	
1) General objective	
	To ensure the energy supply in Central America in terms of the quality, quantity, and diversity of sources necessary to guarantee sustainable development, taking into account questions of social equality, economic growth, and governance and environmental compatibility according to international environmental commitments.
2) Specific objectives	
☐	To reduce the growth rate for demand of petroleum by-products (for electricity consumption and generation sectors).
☐	To reduce energy dependence on imported sources increasing the supply of renewable energy sources.
☐	To improve efficiency and promote the rational use of energy in both the demand and supply sectors.
☐	To incorporate new technologies and energy sources that contaminate less
☐	To increase energy services access to low earning and isolated populations.
☐	To mitigate the effects of the use and production of energy on the environment.
3) Goals of the sustainable energy strategy for 2020	

a- Access to energy by populations with scarce resources

- To achieve at least 90% electricity coverage in each country.

b- Rational and efficient use of energy

- To reduce the use of firewood for cooking by 10% by using more efficient stoves in one million rural homes.
- To reduce the use of electricity by 12% in the residential, commercial, industrial, and public lighting sectors via the introduction of efficient lighting systems (24 million CFL)
- To reduce the use of electricity for refrigeration in the residential sector by substituting outdated refrigerator models for more efficient units in 2.7 million homes.
- To reduce the use of electricity in the industrial sector by 10% by using efficient motors.
- to reduce energy loss in electricity systems in the countries by at least 12%.
- To reduce the consumption of petroleum by-products in public and private transport by efficient management measures and the implementation of rules for importing vehicles and promoting public transport, among others.

c- Renewable energy sources

- To increase the participation of renewable sources of electricity by 11% mainly via hydroelectric plants.

Biofuels for the transport sector

- Substitute 15% of the consumption of petroleum by-products in public and private transport with biofuels.

d- Climate change

- To reduce GHG emissions by 20% compared to the baseline scenario in 2020, maximizing the implementation of carbon reduction certificates.

Table Error! No text of specified style in document.-6 Summary presentation, Sustainable energy strategy for Central America 2020 (SICA /CEPAL)

Source: (CEPAL, 2007), (CEPAL, 2011b), own elaboration

Important note: on a regional level, on the specific subject of energy efficiency, the Policy Strategy in Energy Efficiency for the Electricity Sector in Central America and the Dominican Republic should also be taken into account (USAID, PNUD, GEF et Al., 2007). We will provide details on this subject in the analysis presented in 0

Country Plan 2012 - 2016

The framework at the country level is the National Human Development Plan (NHDP). According to (Government of Nicaragua, 2012), said document lists as a priority “economic growth with an increase in jobs and a reduction of poverty and inequality, the recovery of values, the return of the economic, social, environmental, and cultural rights of the people, above all the sectors that have historically been excluded and an increase in the capabilities of Nicaraguan families.”

According to (Government of Nicaragua, 2012), “The advance in the reduction of poverty and inequality in the context of economic growth, macroeconomic growth and social stability, despite the international economic and financial crisis, the rise in fuel and food prices, the impact of climate change on the country, are the main results of NHDP 2007-2011. It established the basis for an even greater transformation between 2012-2016.”

Below we present a summary of relevant subjects for energy issues:

National Human Development Plan 2012-2016

Policies of energy infrastructure

The main purpose of the energy policies implemented since 2007 is expanding the supply of power generation with renewable resources and changing the generation matrix, such as rural electrification. In the past few years significant advances have been made in strengthening the electricity sector. The capacity for installed generation has been expanded over peak demand, the transformation of the energy matrix with renewable resources has advanced, and the performance of the distribution sector has improved via measures aimed at reducing electricity fraud and giving stability to the regulatory framework.

1) Transformation of the energy matrix

The 2012-2016 period includes plans to continue the transformation of the energy matrix from 25% renewable in 2007 to 94% renewable in 2017 with the development of hydroelectric, geothermal, wind, biomass, and solar projects involving the private, public, and joint investment included in the Electricity Generation Expansion Plan (2007-2025).

2) Increased power generation to reduce the deficit

During the 2012-2016 period the electricity supply will be expanded by 614 MW of additional capacity from mainly renewable sources, which will drive productive capacity in the country and improve life conditions for the population.

3) Expansion of the power transmission and distribution network and power distribution on a national level

The project will continue to expand power transmission and distribution networks on a national level, will develop rural electrification, and will support generation from renewable energy sources in remote rural communities (micro-hydroelectric and photovoltaic).

During this six year period, 1,463 new kilometers of transmission will be installed, and the transformation capacity will be increased to 1,248 MVA.

4) Expanding the network of rural and urban electrification

It will continue to expand the network of national electrification, thus bringing electrification to urban and rural homes. The PNER-FODIEN Project will increase the rural electrification index from 72.4% in 2011 to 85% in 2016. The National Program for Sustainable Electrification and Renewable Energy (PNER) drives energy generation via projects like micro hydroelectric dams and photovoltaics with the rural electrification network and improves life conditions for families in isolated communities. The PNER Program 2012-2016, with the support of the Inter-American

Development Bank (IDB) and other financial institutions, estimates investment needs at US\$ 404.0 million.

The goal is to bring electrification to 164,046 urban homes and 146,643 rural homes for a total of 310,689 new homes in the rural and urban sector. It is estimated that 1.7 million people will be the new beneficiaries of the expanded electrification network.

5) Electrification on the Caribbean Coast

The goal for the Caribbean Coast is to increase electricity coverage to 95.0% of the communities with special attention on the regions with the greatest deficit: Bilwi, Waspam, El Tortuguero, La Cruz del Río Grande, which means 142,264 families served by 2016.

6) Savings and energy efficiency

During the 2012-2016 period, the effort to produce savings and energy efficiency in the country will continue what was begun in 2007 with the enactment of the 13 Nicaraguan Mandatory Technical Standards (NTON) of Energy Efficiency (normalizing 5 equipments) i.e. to restrict the introduction into the country of equipment that did not meet the efficiency specifications for electricity consumption. It will also strengthen the legal framework for EE and promote implementation projects in various sectors.

7) To drive hydrocarbon industrialization

To continue driving the construction of El Supremo Sueño de Bolívar refinery, the expansion of storage capacity with the Miramar and Piedras Blancas and Benjamín Zeledón plans, as well as the LPG project on the Caribbean Coast.

8) To drive oil exploration

In the 2012-2016, the on-shore exploration and development of hydrocarbons on the continental shelf of the Nicaraguan Caribbean and the Pacific coast with the objective of determining the existence of hydrocarbons and the eventual ability to use them.

Table Error! No text of specified style in document.-7 Summary Presentation of the Politics of Energy Infrastructure of Nicaragua 2012-2016

Source: (Government of Nicaragua, 2012), own elaboration

In the longer term, we can consider that the National Energy Strategy executed by MEM will follow the long-term guidelines established in the energy strategy document (MEM, 2009) based on the following three central guidelines: (1) widening electricity coverage , (2) promoting energy efficiency and (3) increasing the contribution of renewable energy to the national grid.

PNESER Program

Context of the PNESER Program

In support of the strategy being implemented by the government of Nicaragua to achieve sustainability in the energy sector, consolidate economic growth in the country, and reduce poverty, a group of bilateral and multilateral organizations headed by the Inter-American Development Bank (IDB) decided to support authorities in implementing the National Program of Sustainable Electrification and Renewable Energy (PNESER) that was officially launched in 2011. Below the contributor and their level of investment are detailed.

Investment Category	Total 2012-2016 (MUSD)										
	BID	FND	KEXIM	LAIF	BEI	BCIE	JICA	OFID	Thirds	GDN	Total
ENATREL Sub-program Components 1, 2, 6	59.7	-	72.2	9.6	70	64.5	-	9.9	36.1	24.1	346
Sub-program MEM Components 3 al 5	18.2	5.9	0	-	-	10.6	12	10.2	-	6.1	63
Subprogram ENEL Components 7	9.7	-	0	-	-	-	-	0	-	0	9.7
Total	87.5	5.9	72.2	9.6	70	75	12	20	36.1	30.3	418.7

Table Error! No text of specified style in document.-8 Contributors to the PNESER Program

Source: BID, own elaboration

The PNESER, currently in operation, is supported by the efforts of the government of Nicaragua to provide access to efficient and sustainable electricity to an important segment of the population. It generates conditions that drive change in the energy grid and allows a reduction in Greenhouse Gas Emissions (GHG), which contributes to improved conditions that mitigate climate change in Nicaragua.

The PNESER seeks to have a transformational effect on electricity coverage on a national level by significantly increasing the rate of electricity service coverage while taking into account the increased use of Renewable Energy (RE) and promoting Energy Efficiency (EE) in Nicaragua.

Components of PNESER

The seven components of the PNESER program are:

PNESER Program – Components

Component 1 – Rural Electrification by the Extension of Networks

(PNESER US\$106.0 million).

The goal of PNESER is to provide access to electricity service to 117,390 households in 3,666 communities in rural areas, which form part of the 310,000 households that today don't have electricity of the total 1,100,000 households occupied.

Component 2 – Standardization of Service in Settlements

(PNESER US\$42.3 million).

This component will allow the standardization of 164,000 households located in 648 identified settlements and including an improvement in the distribution networks, the connections, and the meters. Of these 164,000 households, some 124,000 are clients of the distributors and 39,000 are illegal users, but, in general, they all receive deficient service given the lack of standardized networks that increase technical and non-technical (theft overloading the networks) losses, the lack of investment, and energy losses.

Component 3 – Expansion into Isolated Areas with Renewable Energy

(PNESER US\$16.5 million)

This component includes the development of micro projects and/or small hydroelectric projects, wind plants, and other sources of RE like photovoltaic solar energy, which are oriented at promoting sustainable development and improving the sustainability of the electricity supply to approximately 10,000 households of the 310,000 that don't have service in Nicaragua.

Component 4 – Pre-investment and Studies of Generation Projects and Renewable Energy

(PNESER US\$19.1 million).

Pre-investment studies and projects that demonstrate the possibility to increase the use of renewable energy sources, mainly hydroelectricity, geothermal, biomass, wind, and solar will be funded. Nicaragua has high potential to use (geothermal 1500 MW, hydroelectric 2000 MW, wind 800 MW, and biomass 200 MW), of which it has only developed 5.2% given the lack of basic studies. Implementing this component will contribute to generating conditions to change the energy grid which currently depends highly on oil. This component includes RE projects focused on:

- i) studies and optimization of alternatives,
- ii) design of structures and equipment for the alternatives selected,
- iii) analysis of the economic, financial, environmental, and social feasibility of hydroelectric projects,
- iv) installation of a project that demonstrates solar generation connected to the SIN, and
- v) finalizing the geologic map of the pre-feasibility stage of the Volcán Cosigüina geothermal project. At the same time, it includes other investments in wind and solar studies.

Component 5 – Energy Efficiency Programs

(PNESER US\$20 million).

This component will support the implementation of EE programs aimed at reducing power demands and current energy consumption in Nicaragua, fundamentally in refrigeration and illumination in various consumption sectors. It includes the following indicated measures:

- i) the substitution of at least 2 million glow plugs for compact fluorescents in the residential sector;
 - ii) the substitution of at least 20 million 40 W fluorescent magnetic lamps for electronic 32 W ones in the government sector;
 - iii) the replacement of at least 25 thousand mercury lamps with sodium vapor lamps and other efficient technology in public lighting in the country;
 - iv) the installation of at least 13 solar hot water heating systems in 5 hospitals, 3 hotels, and 5 industrial installations;
 - v) carrying out engineering and development for solar thermal energy application in refrigeration and temperature control; and
 - vi) the installation of more than 750 solar photovoltaic systems for productive use in Nicaragua.
-

Component 6 – Strengthening the Transmission System in Rural Areas

(PNESER US\$161.8 million)

This component will finance the sub-stations and transmission lines required to improve the EE of the electricity transmission system, provide reliable supply to new users who will receive electrification and to users who currently have service in program areas, and to incorporate new sources of RE into the Nicaraguan system. Initially, it was identified that in order to expand coverage, construction, remodeling, and the widening seven sub-stations was necessary, including the lines of transmission and other connected works, which would be used to power charges in its areas of direct influence.

Component 7 – Sustainability and Isolated ENEL Systems

(PNESER US\$9 million)

This component includes resources for:

- i) “Institutional strengthening of agencies,” that seek to strengthen managing and operational capacity of the agencies of isolated systems through the acquisition of equipment, goods, trainings, and services that increase the skills and operating capacities of ENEL agencies on the Caribbean coast of Nicaragua;
- ii) ii) “The formulation of pre-investment studies in isolated systems,” which will support the creation of pre-investment studies in the area where it is potential to develop renewable energy projects which, in the medium term, will replace fossil-fuel generation;

iii) “Investment projects with renewable sources” that support renewable and alternative investments that replace fossil-fuel generation in areas of influence in Isolated Systems.

Table Error! No text of specified style in document.-9 Summary presentation of the components of the PNESER Program

Source: (FICHTNER, 2011b) and IDB, own elaboration

Note (Source: ENATREL): the costs only include direct costs and not financial, engineering, supervision, or administration costs.

These components are summarized in the context of other support programs in section 5.

Expected Results of PNESER

The expected results of the project are presented as a summary below according to the estimates of the government of Nicaragua (MEM, 2011c):

Expected results/year	Base: 2009	2010	2011	2012	2013	2014	2015
Increase in electricity coverage in the country (%)	64.4	66.5	70.1	72*	75.9*	80.9*	83.1* ²²
Households occupied (thousands)	1104	1119	1133	1148	1162	1177	1177
Households occupied with electricity access (thousands)	711	744	794	871	940	1008	1008
Proportion of electricity from renewable sources (%)	35.0	36.3	42.4	55.4	62.0	76.3	76.3
Total generation (GWh)	3100	3322	3456	3584	3710	3835	3835
Generation from renewable sources (GWh)	1085	1207	1467	1985	2301	2927	2927
Reduction in consumption by energy efficiency programs (GWh/year)	0	0	0	130	160	190	221
Reduction of electricity losses in settlements (%)	0	0	0(* ²³)	0.53*	1.78*	3.11*	4.56
Number of problems in transmission lines. (Decrease in the number of interruptions by SIN reinforcements)	139	125	122	111	100	89	78

Table 2-Error! No text of specified style in document.-10 Summary presentation of the results of the PNESER Program, MEM: 2010-2015

Source: (MEM, 2011d), ENATREL, own elaboration

The program really started running in 2012 and the IDB updated the following table to show the expected results:

²² (*) datos corregidos en 2013 por ENATREL

²³ (*) datos actualizados en abril 2013 por el BID y ENATREL

Expected result	Important portion of the population with access to reliable electricity								
Indicator / year	Unit of measure	Baseline	Base year	2012	2013	2014	2015	2016	End of project
Electricity service coverage in the country	Percent	66.7	2009	77.7	79.2	80.8	82.3	83.8	83.8
Reliability of electricity service in the transmission system associated with the index of failure	Index of failure	6.42	2009		6.3			6.1	6.1
Reduction in consumption by energy efficiency programs	GWh/a		2009			90	180	221	221
Reduction of non-technical electricity losses in settlements	%		2009		0.56	1.86	3.26	4.56	4.56
Expected result	Modified energy matrix								
Proportion of electricity generation from renewable sources	%	27.9	2009	34.8	40.5	42.9	43.3	44.1	44.1

Table 2-Error! No text of specified style in document.-11 Presentation summary of the results of the PNESER Program, IDB: 2012-2016

Source: (IDB, 2012), own elaboration

In conclusion, it can be seen that in terms of country strategy, the National Human Development Plan (NHDP 2012-2016) (government of Nicaragua, 2012) shows that Nicaragua is on a parallel route and is in line with SE4ALL Initiative objectives.

The national energy strategy derived from the NHDP and driven by the Ministry of Energy and Mines (MEM), provides the following eight priorities (see 0):

- Transformation of the energy grid
- Increase in electricity generation to decrease the deficit
- Expansion of the electricity transmission network on a national level
- Expansion of the urban and rural electrification network and the one on the Caribbean Coast
- Savings and energy efficiency
- Driving the industrialization of hydrocarbons and oil exploration

We compare the objectives of the SE4ALL Initiative in the table presented below.


 SUSTAINABLE ENERGY FOR ALL	Energy Policies in Nicaragua 2012 - 2016	Contributing PNER component 2012 - 2016
To ensure universal access to modern energy services	Expansion of electricity transmission networks and electricity distribution on the national level	Component 1 Component 6
	Expansion of the network of rural and urban electrification	Component 1 Component 2
	Electrification on the Caribbean Coast	Component 3 Component 7
To double the rate of energy efficiency improvement	Savings and energy efficiency	Component 5
Double the participation of renewable energy sources in the energy matrix	Transformation of the energy matrix	Component 3 Component 4
N/A	Increase the generation of electricity to decrease the deficit	N/A
	The industrialization of hydrocarbons	N/A
	To drive oil exploration	N/A

Table Error! No text of specified style in document.-12 Objectives of SE4ALL and Energy Policies in Nicaragua

Source: SE4ALL²⁴, (Government of Nicaragua, 2012), own elaboration

²⁴ <http://www.sustainableenergyforall.org/objectives>

This alignment is almost a perfect copy of the list of three strategic priorities of the Action Plan 2012 – 2017 (MEM, 2012) of MEM:

Action Plan 2012 – 2017, MEM

Strategic priorities 1 to 3

1) Universal access to energy

It aims to improve the quality of life of a segment of the population that has historically been denied the right to conditions to achieve a dignified and productive life and that have been without access to basic services. For example, they have not had access to electricity or the benefits that it offers. Universal access to energy means reaching the national human development goals, thus improving the quality of life of the population, creating new productive opportunities, and contributing to the protection of the local and global environment.

2) Energy Efficiency

This represents a cross-cutting priority in energy politics that seeks to develop the culture and habits of rational and efficient energy use among the entire population and companies and institutions in the country. The goal is to reduce final energy consumption (gallons of fuel, kWh, firewood, etc), without decreasing the comfort level of the activity and to thus contribute to decreasing the energy intensity in the country and preserving the local environment in the country and the region.

3) Diversification of the energy matrix

This priority takes different forms in different sectors: electricity, oil, and other energies. In the case of electricity, it seeks to transform the generation matrix based mainly on oil to one based on renewable energy like hydroelectric, geothermal, biomass, wind, and solar energy.

Table Error! No text of specified style in document.-13 Strategic priorities 1, 2, 3 Action Plan MEM 2012-2017

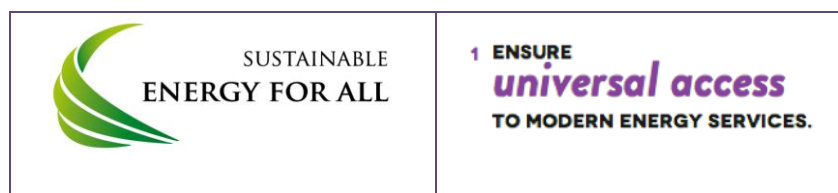
Source: (MEM, 2009), own elaboration

The PNESER Program, with an estimated amount of above \$400 million USD is the most important and relevant embodiment of what will allow Nicaragua to progress towards the SE4ALL Initiative objectives.

Section 2: The Situation of Nicaragua related to the SE4ALL Objectives

Access to energy in Nicaragua in relation to objective No. 1 of SE4ALL

General vision and evaluation

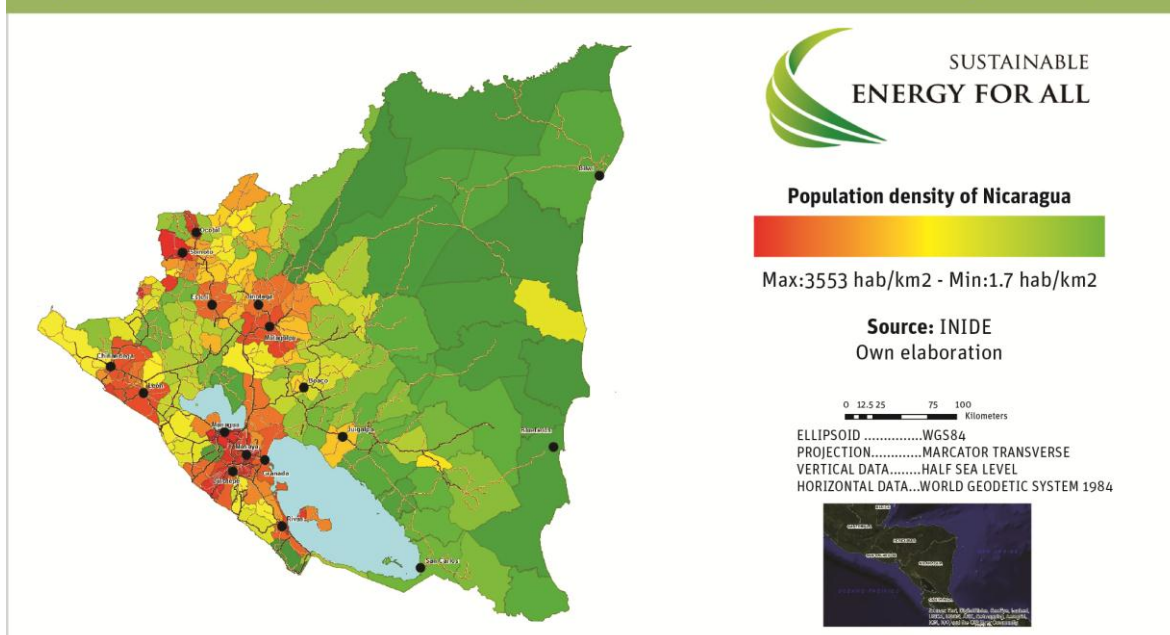


Access to modern energy services in Nicaragua at the end of 2012 was far from being universal. Three issues take precedence:

- i) lack of access to modern services for cooking food
- ii) lack of access to electricity
- iii) the dependence of the energy matrix on fossil fuels and its negative impact on the productive sector.

These three issues occur in the context of a country that is mainly rural in which the population distribution over territory is not very dense with road transportation networks that are limited.

Rapid Evaluation Analysis of the Energy Sector of the Republic of Nicaragua 2012/2013



Graphic Error! No text of specified style in document.–14 Map of population density by municipality and road networks in Nicaragua

Source: (INIDE / INEC, 2005), own elaboration

This section provides details about access to modern energy services in the following aspects:

- Access to energy for thermal uses: 0;
- Access to electricity: 0; and
- Access to energy for the productive sector: 0.

Access to energy for thermal uses is very different in rural areas than in urban ones. In rural areas, firewood is the main fuel used, mostly for cooking in the residential sector. More than 94% of Nicaraguan homes use firewood according to the most recent National Firewood Survey (MEM, 2007) and this represents 87.9% of final energy consumption in the residential sector (as much urban as rural) according to the National Energy Balance 2011 (MEM, 2011a). In urban areas, the use of firewood has been reduced by the availability of liquefied gas. We will describe this situation in 3.1.2.

The development of **access to commercial electricity** in Nicaragua can be described as a pending task in the past decades, but the past five years have seen an acceleration and concrete and significant improvements. Despite recent advances in the field, Nicaragua continues to be one of the Latin American countries with the lowest level of electricity coverage.

The development of electricity infrastructure is still very insufficient, and it left Nicaragua with an electricity coverage rate of nearly 72% in 2012 (MEM, 2012b). Note that this overall rate hides huge variations in coverage between urban and rural zones if it is not a concession area, whether it is or is not an area under the responsibility of ENEL, or if it is an area totally isolated from electricity service. We will describe this situation in 0

Finally, the situation of energy access for the productive sector suffers from high generation costs caused by the Nicaraguan energy matrix, which is still primarily based on fossil fuels. However, the situation varies a lot among types of production. We will describe this situation in 0.

Access to modern energy services is not a sudden event but rather a process of continual improvement. Thus, any definition of minimum threshold of access to energy is in a certain way arbitrary. However, if we aim to achieve universal energy access by 2030 according to what was

proposed by the Secretary General of the UN and the SE4ALL Initiative, ideally we need to define recognizable milestones along the way, indicators of if we have met the goal.

Some experts argue that:

In the case of energy for cooking, the step from biomass (firewood, coal) to LPG (gas) and;
In the case of electricity, the step of connecting to the national network for all energy necessities

They must be defined as the threshold for access.

However, as is easily seen in practice, many poor homes with electricity from the network don't have other uses aside from the light of a few light bulbs for a few intermittent hours per night, which leaves the majority of supposed beneficiaries of development out of reach.

In addition, the use of biomass as fuel for cooking in an efficient stove that vents smoke outside has very different implications for health, dignified daily life, and the environmental impact of cooking over an open fire in the kitchen.

A variety of methods have been proposed to establish a minimum level of access to energy based on the average measures in kWh or barrels of oil equivalent consumed by households, even commercial measures of energy consumption (Columbia University, 2010).

However, these approaches work with averages that tend to dilute the information obtained which is why it is very difficult to note the difference between true access by someone who consumes X kWh or Y kWh, outside of the context of services that they are enjoying.

The Index of Access to energy developed by *Practical Action*²⁵ to indicate the progress of the supply towards the standards of energy service mentioned measure three main dimensions of supply of energy supply, domestic fuels, electricity, and mechanical energy. By assigning a number value to the qualitative dimensions (1 is the lowest and 5 is the highest level of access) it proposes

²⁵ <http://practicalaction.org/total-energy-access-standards>

to cover a true variety of experiences related to energy supply and overcome the binary difference between having it and not having it.

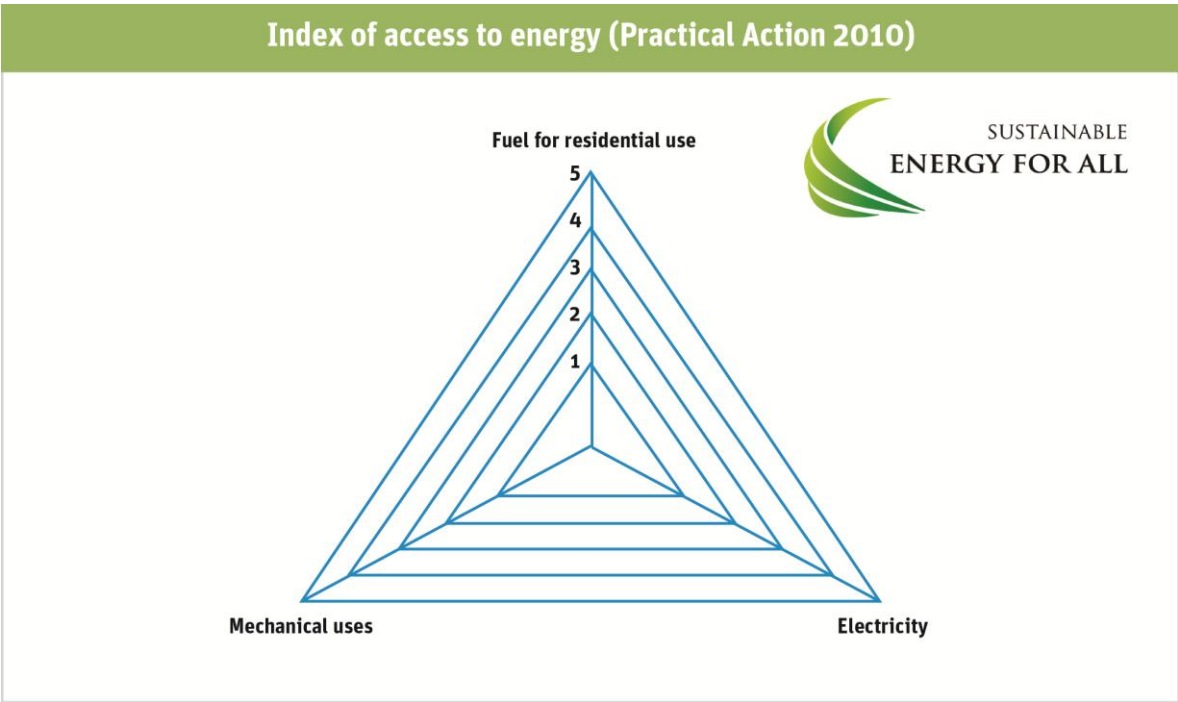
Type of energy	Level	Minimum standard
Fuels for residential use	1	Collecting firewood or dung and using a three stone fire
	2	Collecting wood and using an improved stove
	3	Buying wood and using an improved stove
	4	Buying charcoal and using an improved stove
	5	Use of modern, clean fuel with an improved stove
Electricity	1	Absolutely no access to electricity
	2	There is access to battery charging by a third party
	3	Owner of a low voltage DC circuit that supplies access to domestic applications
	4	An AC connection exists, but the quality is bad and the supply is intermittent
	5	A reliable AC connection exists for all uses
Mechanical and productive uses	1	There is no access to mechanical energy. Manual force with basic tools is the only source of power.
	2	There are mechanical devices available to increase human advantage/ animal effort
	3	There are mechanical devices available (with renewable or fossil fuel sources) for some tasks
	4	There are mechanical devices available (with renewable or fossil fuel sources) for the majority of tasks
	5	Mainly buying processed mechanical services

Table Error! No text of specified style in document.-14 Levels of energy access by type

Source: Practical Action, Energy Access Index (EAI) 2010

We agree with the *Practical Action* Report on the energy situation of the poorest citizens (“Poor people’s energy outlook (PPEO),” 2012)) that we should take into account the number and quality of energy services that people enjoy and the quality of energy supply that people have to produce these services.

To understand the methodology presented in more detail in the following graphs, please refer to the modeling of energy access developed by *Practical Action* (“Poor people’s energy outlook (PPEO),” 2012) and *Practical Action*, Energy Access Index (EAI) 2010.



Graph Error! No text of specified style in document.–15 **Representation of energy access by type (EIA)**

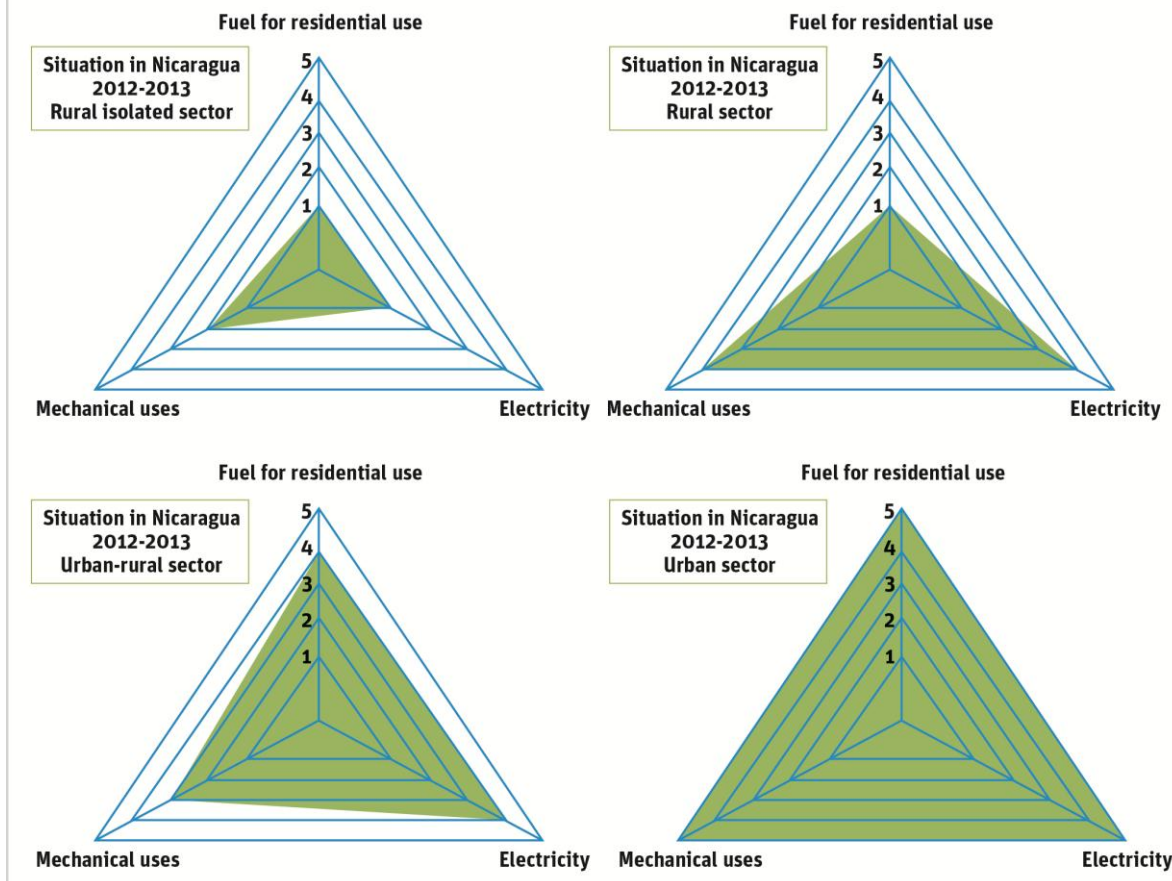
Source: Practical Action, Energy Access Index (EAI) 2010, own elaboration

Below we describe the index of access graphically and the situation in Nicaragua in 4 different contexts: isolated rural, rural, urban-rural, and urban.

Indexes of energy access in Nicaragua by sector



SUSTAINABLE
ENERGY FOR ALL



Graph Error! No text of specified style in document.–16 Indexes of energy access in Nicaragua by sector.

Source: own elaboration

Access to energy for thermal uses

In this paragraph we describe the energy access situation for thermal uses which we understand as technologies for cooking, heating, and heating water. As noted in the distribution description for Internal Primary Energy offering by source in 2011, we have found that, unlike many other countries in Latin America, the most important source is firewood, and then other waste like biomass, with an order of incidence of 57.7% of the total of primary sources. Firewood alone represented 46% of the Internal Primary Energy offering in 2011 (MEM, 2011a). The majority of firewood is consumed in rural homes. The total quantity of energy consumed produced by firewood was 1,005 ktoe in 2011 according to the 2011 National Energy Balance (MEM, 2011a), of

which only 43.4 ktoe (el 4%) were transferred to transformation centers to be converted into charcoal.

The last complete census was carried out in 2005²⁶ (INIDE / INEC, 2005), and it allowed us to measure that, of the total population of 5.143 million inhabitants, 59% were urban and 41% were rural. It is estimated that in 2011 these statistics were similar. See the table:

	2005	%	2011	%
Rural population (hab)	2,108,630	41%	2,524,000	43%
Urban population (hab)	3,034,370	59%	3,365,000	57%
Total population (hab)	5,143,000		5,888,900	

Table Error! No text of specified style in document.-15 Population of Nicaragua and rural-urban distribution (2005 – 2011)

Source: (INIDE / INEC, 2005), own elaboration

a) Rural area

i) Firewood

In rural areas, firewood is the main fuel used for cooking in the residential sector, which uses firewood more than 90% (MEM, 2007).

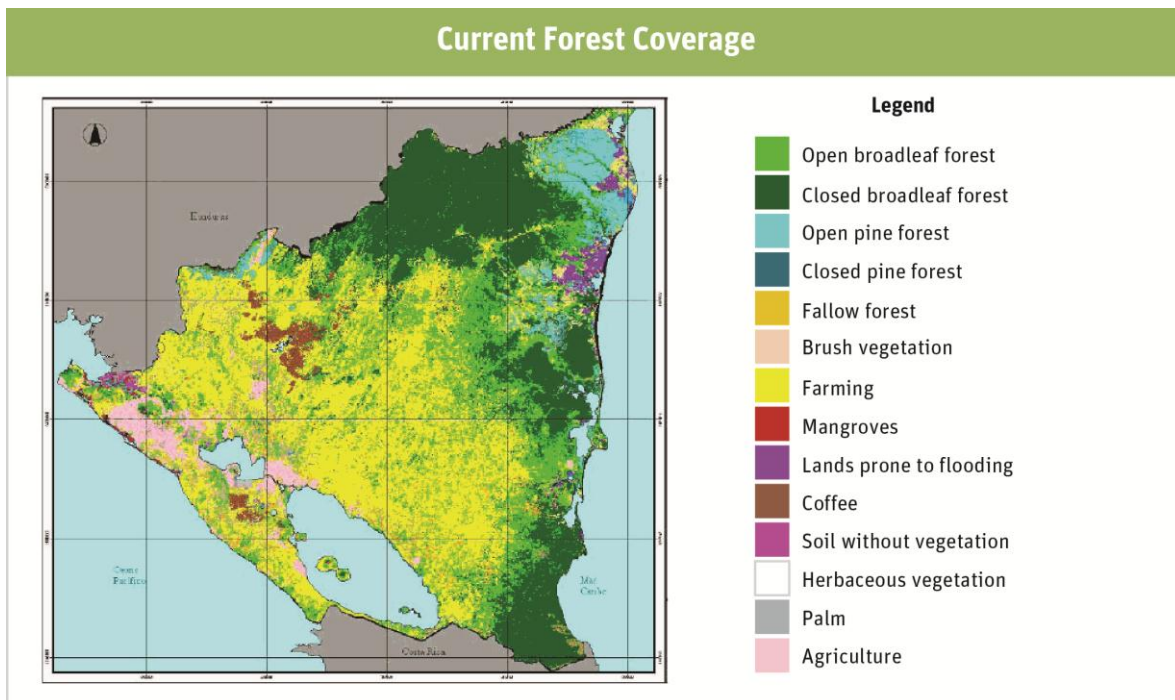
Historically, firewood and charcoal, like other biomass derivatives, has played an important role in meeting basic energy needs like cooking the food of Nicaraguans. The use of firewood for heating also exists but it is much less important and it hasn't been measured in a form in which we can differentiate it from the present study.

In 1990, according to the National Firewood Survey conducted in 2007 (MEM, 2007), firewood represented 55% of net final energy consumption; charcoal 1% and oil by-products 27%. According to this study, consumption of firewood is estimated between 1,500,000 and 1,800,000 metric tons (MT). 89% was consumed in residential and commercial areas, 5% in the industrial sector, and the remaining 6% in the production of charcoal. It also indicated that 1.8 million people (nearly 350,000 households) used firewood as their main fuel (MEM, 2011b).

²⁶ The next national census is scheduled for 2015.

In 2011, in the absence of updating the National Firewood Survey, we can consider that these statistics have changed very little in proportion, and have only increased in volume due to population growth.

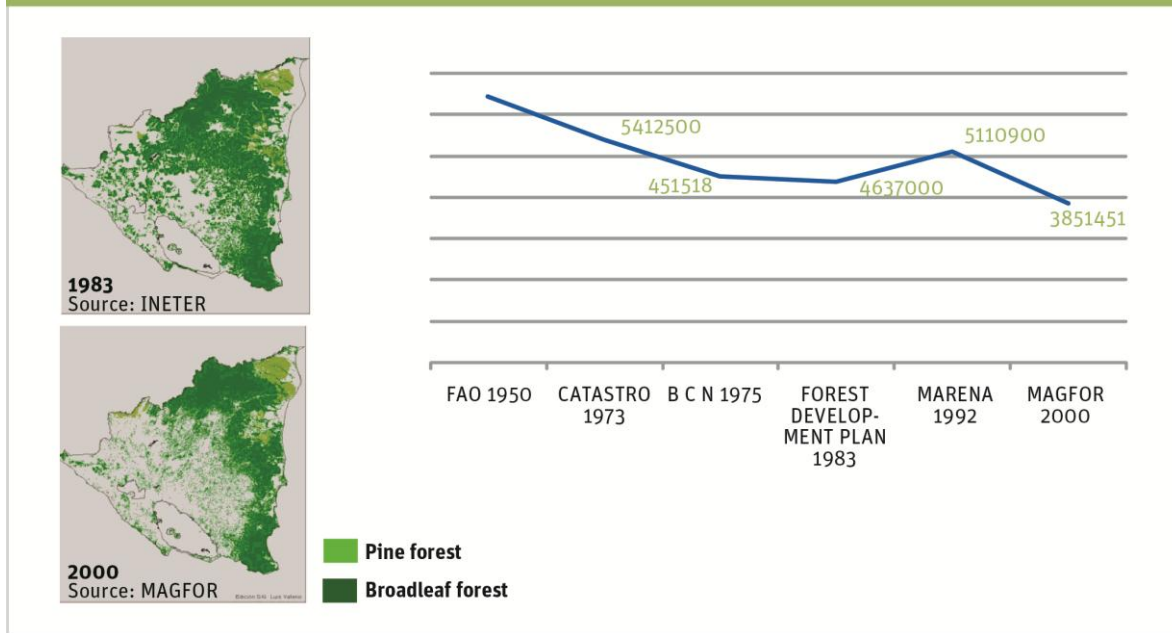
The automatic consequence of this consumer pressure contributes to the reduction in forest coverage in Nicaragua. Obviously, the impact of firewood consumption for domestic uses is considerably less than the impact of the progression of the agricultural frontier in the eastern part of the country (mainly the autonomous regions RAAN and RAAS). Based on the land area of the country (13,000,000 ha), forest coverage is estimated at 3,254,145 ha, that is to say 25% of the national territory. Of this, 3,180,466 ha (98%), correspond to natural forest and 73,679 ha (2%) are planted forests (INAFOR, 2008).



Graphic Error! No text of specified style in document.–17 Forest Coverage in Nicaragua, 2002

Source: MARENA

Historic evolution of forest coverage in Nicaragua, 1950 to 2000.



Graph Error! No text of specified style in document. –18 Historic evolution of forest coverage in Nicaragua, 1950 to 2000.

Source: INAFOR (INAFOR, 2008)

Most of the firewood consumers acquire it by buying it, and in many cases the firewood is illegally obtained. Many actors in the forestry sector don't carry out their activities in accordance with the legal and technical framework about forest and park management. As a consequence, they can't assure sustainable production and conservation of resources.

On the other hand, a minority of homes that collect firewood directly have had the same access to wood near their homes as in previous years and in general dedicate less than an hour per day per person to collect it.

A low transformation efficiency of 8% in firewood and 14% in charcoal is observed during the use of the heating power of wood, which is even worse due to the persistence of inefficient heat transformation systems like the use of open fire, semi-open fire with a chimney, ovens with obsolete technology, and heat leaks among others.

These obsolete technologies have an impact on the health of final consumers by causing acute respiratory infections (ARI) in the population (mainly infants), irritating eyes, lowering the intrauterine growth of the fetus, and eventually causing lung cancer.²⁷

More than 90% of the homes that consume firewood haven't changed fuel in the last five years and nearly 80% of those don't have a perspective on how to do it, mainly because they consider fuel cheap and available. The homes that replaced firewood in the last five years replaced it with mostly liquefied gas and, those that are thinking of replacing it, nearly 20%, would do it mainly with liquefied gas (MEM, 2007).

In addition, firewood is used for industrial and commercial activities, mainly for drying beans for coffee and a certain amount is employed in the manufacture of mud bricks and also for lime production for the construction and agricultural sectors.

Note that this economic activity generates employment for some 250,000 people who live permanently dedicated to the extraction of these, and 75% are small and medium rural producers. It is the main source of energy production in homes, in small and medium producers, and recently in large industry (MEM, 2011b).

ii) Biogas

From 1992 to 2006, according to the IDB/FOMIN-SNV (IDB, 2010) Study, around 500 biodigesters have been constructed and installed in Nicaragua sporadically and on a small scale mainly on a domestic level and in small coffee and cattle ranches. In 2007 the subject was taken up by the government via the productive food program "Zero Hunger," which installed 800 biodigesters as part of an aid package for poor families at the household level. This effort was complemented by the account Millennium Challenge (CRM) which has installed 260 biodigesters.

Year	Agency/Executor	Location	Quantity	Technology	Current State
1985-1989	FAO, Program PER-INE	Matagalpa, Carazo	62	Hindu	Some function
1995-1999	CIPRES	Estelí, Pueblo Nuevo,	600	Plastic bag	100 to 200 operating

²⁷ Ver <http://www.sustainableenergyforall.org/objectives/universal-access>

		Chinandega			
2007-2010	MAGFOR (Program Zero Hunger)	Nueva Segovia, RAAN	550	Taiwan, plastic bag	50 to 60 operating
2007-2010	CRL	León, Chinandega	300	Taiwan, plastic bag	100 to 150 operating

Table Error! No text of specified style in document.-16 Inventory of biodigesters installed in Nicaragua by Programs (1985 – 2010)

Source: (SNV / HIVOS, 2010), own elaboration

To date, most of these rural biodigesters don't work. A recent diagnosis supported by SNV²⁸ and HIVOS²⁹ concluded that fewer than 400 are in operational status in the whole country (SNV / HIVOS, 2010).

b) Urban areas

In urban areas, firewood plays a role just as it does in rural areas, but to a lesser extent. The thermal use of firewood for cooking is progressively being substituted for liquefied petroleum gas. Consumption of LPG by the residential sector in 2011 was 34.7 ktoe (MEM, 2011a).

The urban sector is distinguished by much more frequent use of electric water heating devices in the residential sector. In relation to modern technology for thermal applications, one of the immediate opportunities that the country can take advantage of is the development of markets for solar collectors to heat water that can replace electric heaters, which will contribute to lowering the maximum SIN load in peak hours in the morning. It will also strengthen national industry given that the heaters could be produced locally by national companies.

This presents an opportunity in the energy matrix of Nicaragua given that the residential sector accounted for 896.8 GWh (CEPAL, 2011a) of a total 2820.4 GWh (MEM, 2011a) of national electricity consumption in 2011, 32% of the total.

²⁸ www.snvworld.org

²⁹ www.hivos.nl

In 4.4.1.1 we will summarize the barriers and gaps to achieve the goals proposed in the objectives of SE4ALL set out in 0.

Access to electricity

In this paragraph we will describe the situation of access to electricity, i.e. electricity coverage in the following dimensions of analysis: the National Interconnected System of Nicaragua (SIN), its historical context and current trends, concession zones and small actors and the most disadvantaged areas.

We want to clarify that access to modern energy services takes into account several types of service. It is important to define precisely where this concept leads considering, for example, a minimum of kWh per person/month or a defined price that represents a % of average national income or a similar criteria to the proposed categories in graph **Graph** Error! No text of specified style in document.–15.

We also want to clarify that the statistics presented are the result of data and calculations that involve various actors in the country, among others: the INIDE for households, families, and energy census, the INE and the Distributors for the number of clients, ENATREL for the characteristics of the SIN, and MEM for preparing the official statistics.

Coverage data is global, outdated, and based on official projections. The data doesn't take into account the relationship between access to electricity and urban or rural location. In fact, the distributors don't link their records (NIS numbers) to the situation of the households. This produces the following consequences:

- Since there is no coordinating body to establish a single concept of electricity information coverage, there are various statistics and discrepancies exist among them (see MEM and CEPAL, 3.1.3.5);

- The data is outdated and doesn't reflect the current situation;

- We don't have an urban index and a rural index.

The electricity system context

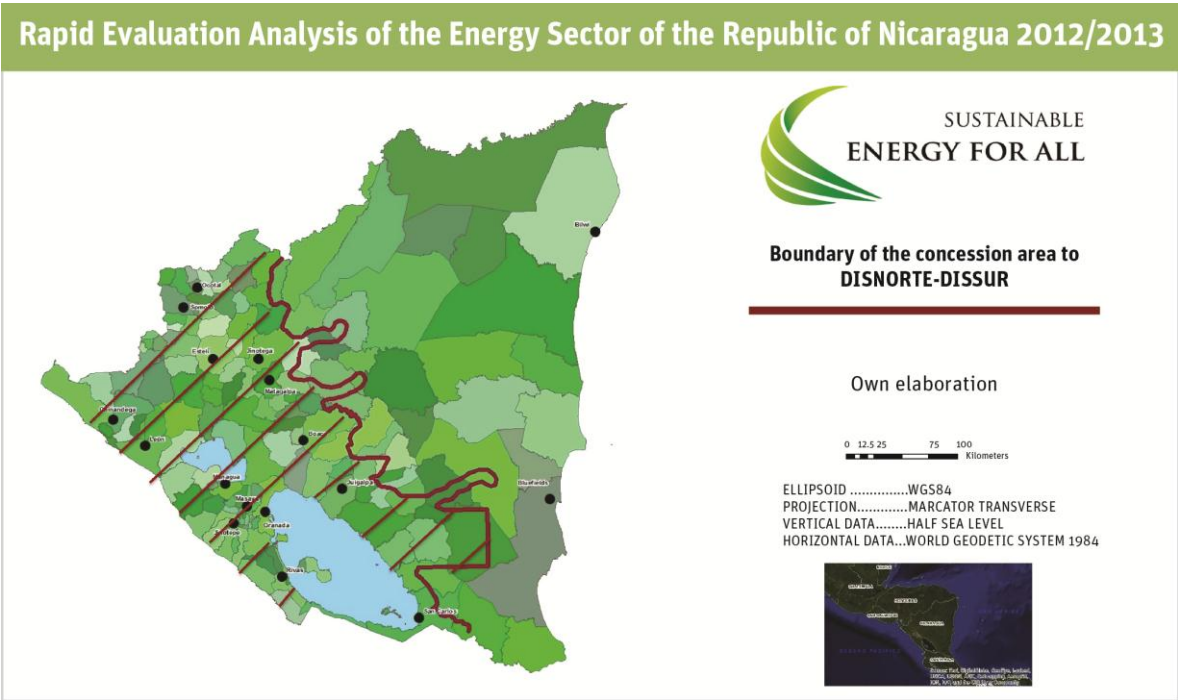
Until 1998, the entire electricity system was property of the State. After the Law of the Electricity Industry 272 was passed in 1998 (Government of Nicaragua, 1998, p. 272), ENEL was divided into several generation companies, a transmitter, and two distribution companies that proceeded to

be privatized. The restructuring of ENEL initially had the goal of privatizing separately each of the generation, transmission, and distribution companies.

However, in agreement with Law No. 272, later reformed in 2004, the State has responsibility and the commitment to develop electrification in rural and low populated areas where distribution companies haven't developed an interest in participating.

Distribution Concessions

In the area of distribution, the main result of this privatization was the signing of the sales distribution concessions to various companies, mainly to DISNORTE-DISSUR in the whole western Pacific of Nicaragua representing more than 90% of energy sales.



Graph Error! No text of specified style in document.–19 Location of the DISNORTE-DISSUR concession area - 2012

Source: own elaboration

Later the distribution concession was made to Bluefields (RAAS). However, there are several small concessionaries who are: ATDER-BL (El Cuá – Jinotega), APRODELBO (San José de Bocay), ZELAYALUZ, S.A. y HISMOW, S.A. (RAAS). We will describe these institutions more in 0.

Two important changes that happened recently:

- i) the Government proposed the constitutional reform of ENEL to congress. Via this reform ENEL lost character as a corporation and transformed into a Decentralized Body of the Executive Branch under the direction of the Ministry of Energy and Mines, which could not be an object of privatization.
- ii) On the other hand, after a year and a half of negotiations that began in 2010, no agreement was reached between the Government of Nicaragua and Natural Gas (previously Unión Fenosa) a majority shareholder (84%) of DISNORTE – DISSUR, in relation to the terms and deadlines to resolve the problem of electricity losses and the percentage of rate adjustment required to stabilize the distribution system. When the negotiations failed, Natural Gas decided to leave Nicaragua and sold all of its shares (86%) to a new Spanish operator, TSK Electronics and Electricity, S.A., associated with the company Melfosur, who had a close relationship with ALBANISA. The Government of Nicaragua kept 16% of the shares of the energy distributor.

Distribution system and customer service in concession areas

According to the inventory network report presented by the distributors DISNORTE and DISSUR (in December 2011) the distribution system on a national level has 15,477.50 km of distribution networks broken down into three levels of voltage 4.16kV, 13.2kV and 24.9kV, 37,575.00 transformation centers and 48,667.00 transformers, with a capacity of 1,916,151.20 kVA, as can be seen in the following table (MEM, 2012b):

Company	Lines (km)	Transformation Centers	Transformers	Capacity (KVA)
DISNORTE	9,231.45	20,726	27,053	988,446.20
DISSUR	6,246.05	16,849	21,614	927,705.00
Total	15,477.50	37,575	48,667	1,916,151.20

Voltage (kV)	Line area (km)	Subterranean line (km)
4.16	23.8	0

13.2	5,422.6	65.04
24.9	9,930.5	35.63
Total	15,376.9	100.67

Table Error! No text of specified style in document.-17 Physical elements of the distribution system in DISNORTE-DISSUR concession areas – December 2011

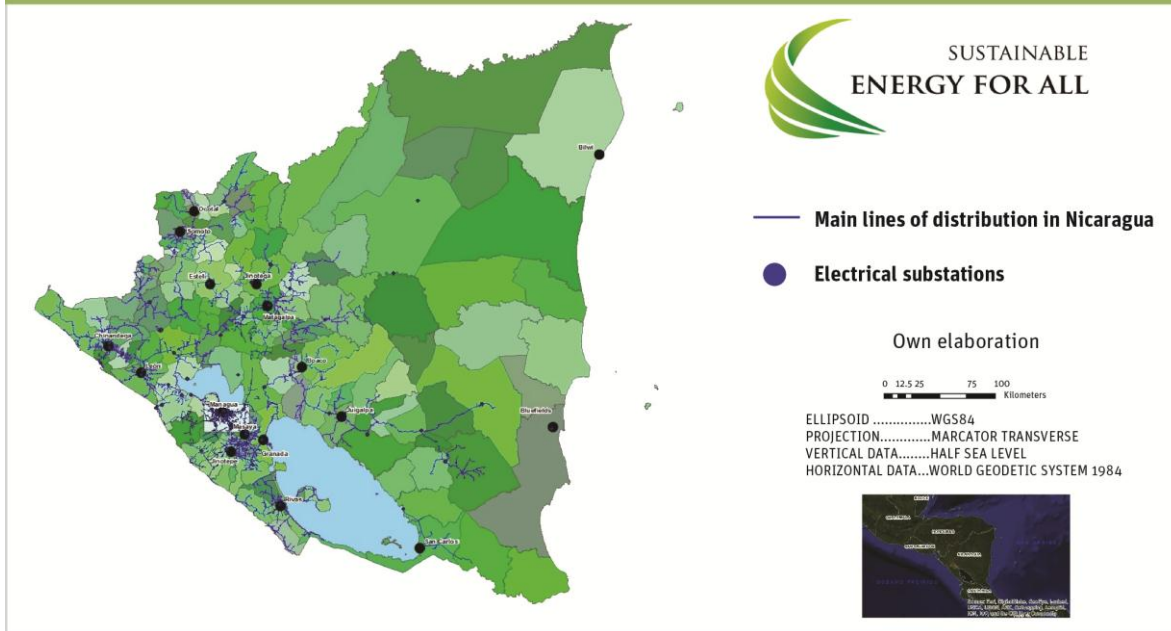
Source: DISNORTE – DISSUR, (MEM, 2012b), own elaboration

Location of client attention centers in DISNORTE-DISSUR concession areas 2011						
MANAGUA DISTRICT			NORTH DISTRICT			
Region	Attention center	Type of company	Region	Attention center	Type of company	
Managua	Central	Disnorte	Jinotega	Jinotega	Disnorte	
Managua	Occidental	Disnorte	Esteli	Esteli	Disnorte	
Managua	San Rafael del Sur	Disnorte	Madriz	Somoto	Disnorte	
Managua	Ciudad Sandino	Disnorte	Nueva Segovia	Ocotal	Disnorte	
Managua	Sur	Dissur	Nueva Segovia	Jalapa	Disnorte	
Managua	Oriental	Dissur	Matagalpa	Matiguás	Disnorte	
Managua	Norte	Dissur	Matagalpa	Matagalpa	Disnorte	
Managua	Tipitapa	Dissur	Matagalpa	Sébaco	Disnorte	
Managua	Ticuantepe	Dissur	Matagalpa	La Dalia	Disnorte	
WEST DISTRICT			SOUTH DISTRICT			
Region	Attention center	Contact	Region	Attention center	Type of company	
León	León	Disnorte	Masaya	Masaya	Dissur	
León	Nagarote	Disnorte	Masaya	La Concepción	Dissur	
León	La Paz Centro	Disnorte	Masaya	Masatepe	Dissur	
León	El Sauce	Disnorte	Granada	Granada	Dissur	
León	Malpaisillo	Disnorte	Granada	Nandaime	Dissur	
Chinandega	Chinandega	Disnorte	Carazo	Diriamba	Dissur	
Chinandega	El Viejo	Disnorte	Carazo	Jinotepe	Dissur	
Chinandega	Somotillo	Disnorte	Rivas	Rivas	Dissur	
Chinandega	Corinto	Disnorte	Rivas	San Juan del Sur	Dissur	
Chinandega	Chichigalpa	Disnorte	Rivas	Isla de Ometepe	Dissur	
EAST DISTRICT			DISNORTE: 23 attention centers DISSUR: 21 attention centers Total: 44 attention centers			
Region	Attention center	Type of company				
Boaco	Boaco	Disnorte				
Chontales	Juigalpa	Disnorte				
Santo Tomás	Santo Tomás	Disnorte				
RAAS	Rama	Disnorte				
RAAS	Nueva Guinea	Disnorte				
Río San Juan	Río San Juan	Disnorte				

Table Error! No text of specified style in document.-18 Location of client attention centers in DISNORTE-DISSUR concession areas 2011

Source: DISNORTE – DISSUR, (MEM, 2012b)

Rapid Evaluation Analysis of the Energy Sector of the Republic of Nicaragua



Graph Error! No text of specified style in document.—20 Representation of the main distribution lines in the DISORTE-DISSUR concession area 2012

Source: own elaboration

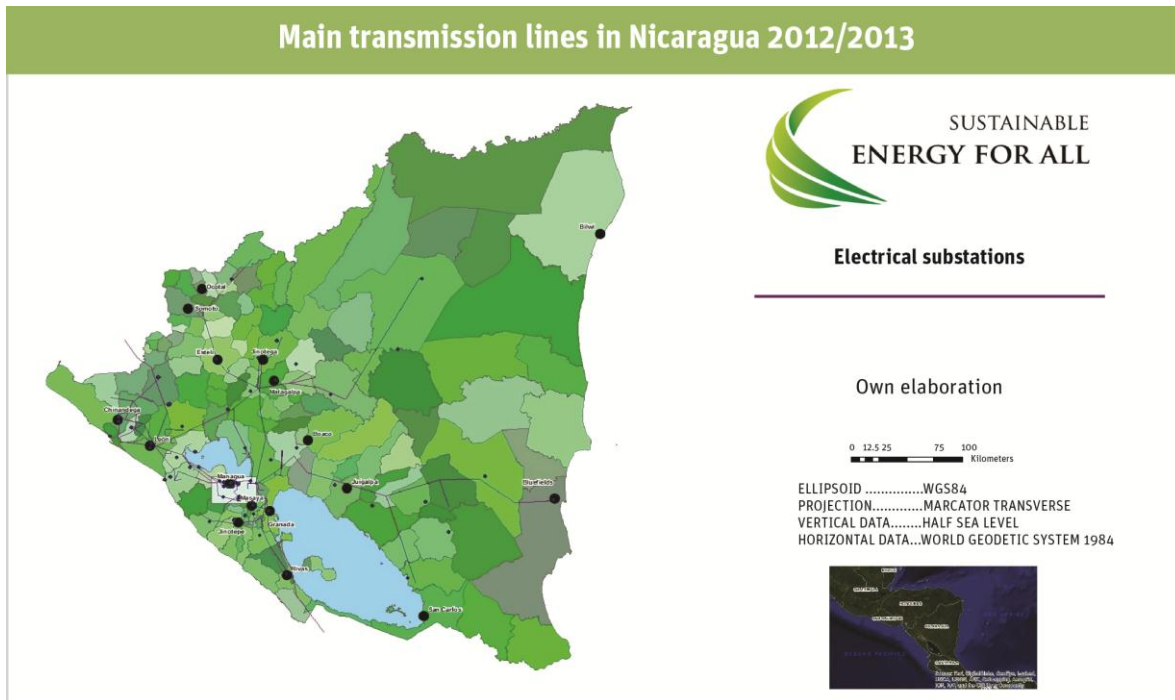
National Interconnected System (SIN)

Transmission in the National Interconnected System (SIN) is from a state company, ENATREL (National Company of Electricity Transmission). The National Interconnected System (SIN) is a set of power plants and distribution systems that are interconnected by the National Transmission System. The National Transmission System in 2013 is made up of 2,515 km of lines and 80 electricity substations, of which 2,072 km of lines and 62 substations belong to ENATREL and the rest to agents of the Electricity Market of Nicaragua (ENATREL, 2013).

The SIN serves the entire pacific region, the central and north area of the country, in which more than 90% of the country's population is found. However, of this percentage only a little more than 70% have regular electric service (see 3.1.3.5). In the rest of the country, some areas are served by ENEL which recently interconnected the majority of its isolated distribution networks with small interconnected dealers and isolated systems.

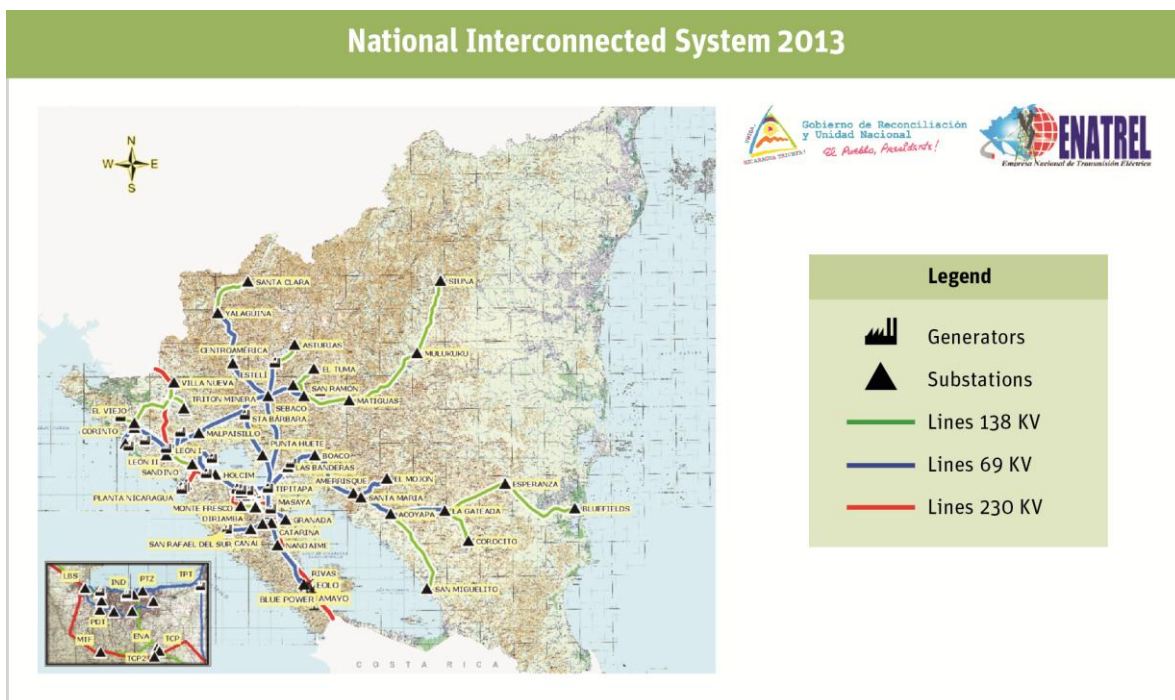
The nominal installed capacity of the national generation park in late 2011 is 1108.29 MW, the highest demand being estimated at 617 MW (according to CNDC data the maximum demand in 2012 was 609.9 MW) which allows more than 130 MW of power reserve (MEM, 2012d).

Below we describe the regions served by 69 kV, 138 kV and 230 kV transmission lines.



Graph Error! No text of specified style in document. -21 Representation of the main transmission lines in Nicaragua - 2012

Source: own elaboration



Graph Error! No text of specified style in document.–22 **Detail of the main transmission lines in Nicaragua - 2013**

Source: ENATREL

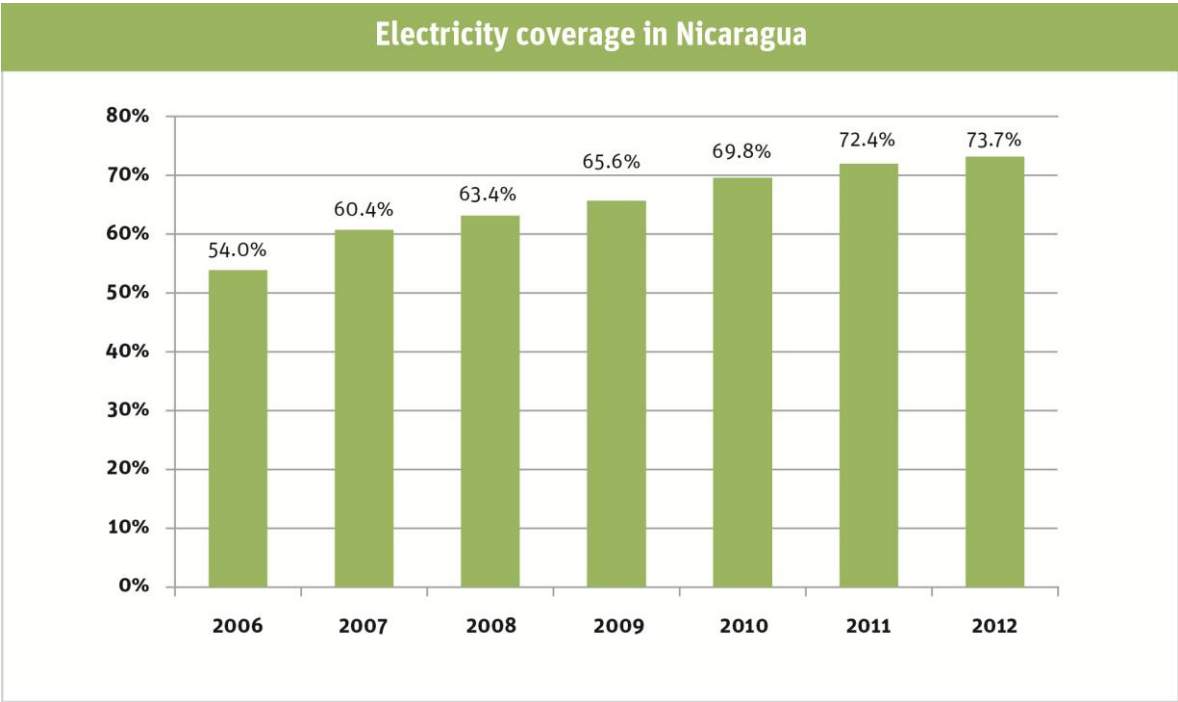
Current state of global electricity coverage

Access to commercial electricity in Nicaragua is an objective that can be described as a failed state policy that has been developing unsatisfactorily during the past thirty years, but that has seen an acceleration and concrete and significant improvements in the past five years. However, despite the progress made in this field in the past years, Nicaragua continues to be one of the countries in Latin America with the lowest level of electricity coverage.

The development of electricity infrastructure is still insufficient and leaves Nicaragua with a rate of electricity coverage, as we will see, near 73.7% in 2012 (MEM, 2012b). In this sense, under the administration of the MEM, during the period between 2007 and 2011, 54,772 households were electrified, restoring the right to electricity to 328,632 people via the construction of 2,462 kilometers of electricity networks. Between 2007 and 2010 on a national level 6,907 individual photovoltaic systems were financed by MEM which benefited an equal number of households.

In the period between 2006 and 2011 there was an increase of 18.4% in the rate of rural electricity coverage, which in this last year reached 72.4% (MEM, 2012b) and 73.7% in 201 (MEM, 2013) which means that still nearly 310,000 households don't have access to electricity in 2012.

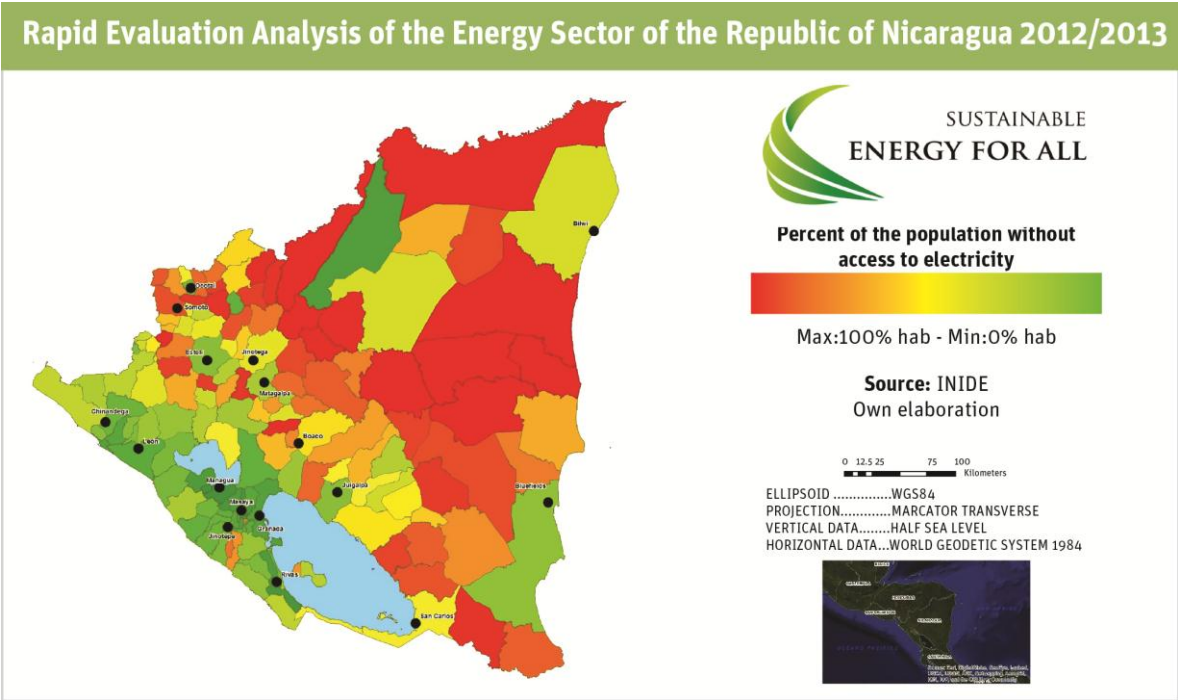
Note: CEPAL has a different figure for electricity coverage, 77.9% in 2011 (CEPAL, 2011a). This discrepancy is based on the recommendation about statistics presented in 0.



Graph Error! No text of specified style in document.–23 Indicators for global electricity coverage 2006 to 2012

Source: (MEM, 2012b), own elaboration

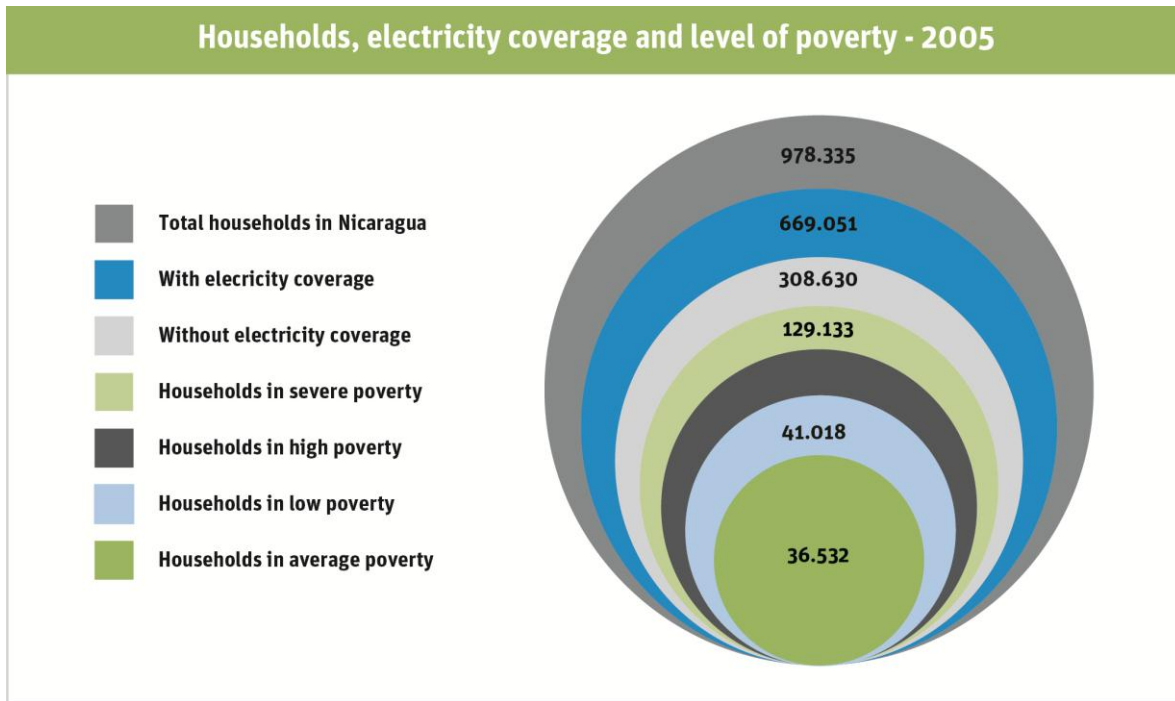
The global rate of electricity coverage hides huge variations in coverage between urban and rural areas as is demonstrated in the following graph.



Graph Error! No text of specified style in document.–24 Map of the proportion of the population without access to electricity - 2005

Source: (INIDE / INEC, 2005), own elaboration

Changes in the distribution of electricity coverage conditions



Graph Error! No text of specified style in document.–25 Diagram of households, electricity coverage and level of poverty - 2005

Source: (FICHTNER, 2011a)

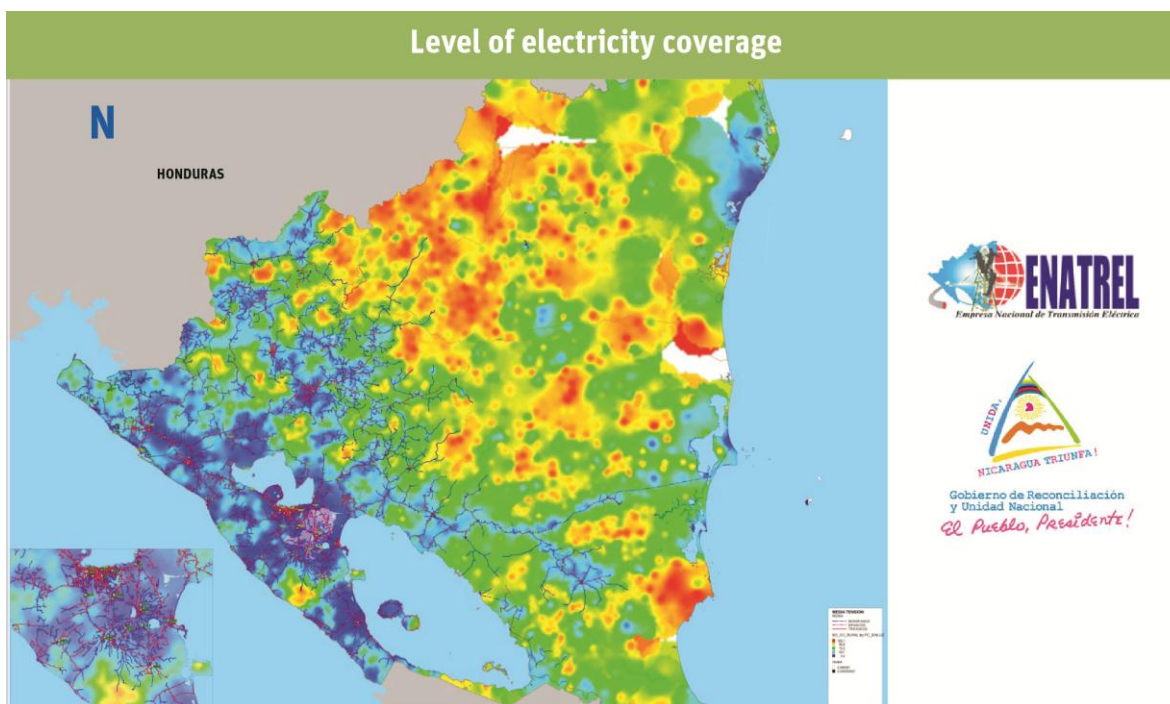
As we can see in graphs Graph Error! No text of specified style in document.–24 and Graph Error! No text of specified style in document.–25, the global rate of electricity coverage hides large variations in coverage among urban and rural zones and the vulnerability of the populations. In 2005, of 308,630 households that didn't have access to electricity, almost 30% were in a situation of extreme poverty according to the Census (INIDE / INEC, 2005). A large majority of these households were found in rural areas.

It should be noted that neither DISNORTE-DISSUR nor ENEL identify the area (urban or rural) where their clients are, which prevents calculating the exact rate of users without access to electricity service by rural or urban category.³⁰ However, ENATREL has made a current 2013 model

³⁰ The NIS (User identification) of DN-DS and of ENEL is not connected to the rural or urban location of the household.

based on geo-location of transformers and it can propose an approximation of what the index of rural/urban electricity coverage in Nicaragua would be.

The following graphic illustrates this mapping at the regional level. In the recommendations (see 0), it is proposed that MEM will coordinate the effort to transform the initiative into an official statistic.



Graphic Error! No text of specified style in document.–26 **Map of electricity coverage at the regional level - 2013**

Source: ENATREL, 2013

The following table presents the demographic data and the lists of users that were used by ENATREL to create this type of map.

Department	Population INIDE urban 2013	Population INIDE rural 2013	Urban households 2013	Rural households 2013	Households Electrified by the PELNICA project in 2013	Households electrified by the PNER Project in 2013	Total urban users in 2013	Total rural users in 2013	% urban electricity coverage 2013	% rural electricity coverage 2013	% municipal electricity coverage 2013
Boaco	58 196	117 788	11 068	22 637	129	923	9 626	11 692	87%	52%	63%
Carazo	120 648	67 544	24 060	13 626	39	2 352	18 936	17 146	79%	100%	96%
Chinandega	267 559	157 690	47 230	26 919	859	4 514	39 692	39 756	84%	100%	100%
Chontales	108 726	75 123	21 620	14 408	212	1 821	20 365	8 897	94%	62%	81%
Estelí	136 001	85 889	27 670	17 229	1 018	1 002	29 464	14 515	100%	84%	98%
Granada	135 493	67 172	25 853	12 946	132	1 648	22 600	12 304	87%	95%	90%
Jinotega	97 314	326 967	17 983	58 552	20	2 921	13 106	15 724	73%	27%	38%
León	252 069	154 552	50 993	31 051	177	3 036	46 840	29 896	92%	96%	94%
Madriz	51 809	108 233	9 885	20 234	234	1 972	8 011	11 935	81%	59%	66%
Managua	1 348 760	111 471	259 934	22 667	419	8 635	231 200	53 758	89%	100%	100%
Masaya	207 112	146 386	39 233	28 012	99	884	31 586	28 489	81%	100%	89%
Matagalpa	218 535	330 130	41 817	61 433	591	5 834	35 071	39 644	84%	65%	72%
Nueva Segovia	109 842	136 631	22 160	26 164	211	2 025	15 075	15 915	68%	61%	64%
RAAN	145 392	317 061	23 993	52 331	0	30	1 214	249	5%	0%	2%

RAAS	156 807	217 590	29 349	37 977	0	300	6 931	7 886	24%	21%	22%
Río San Juan	32 709	91 448	6 161	17 011	0	956	3 176	7 085	52%	42%	44%
Rivas	85 766	89 856	17 853	18 291	93	953	15 008	17 907	84%	98%	91%
Total general	3 532 740	2 601 531	676 861	481 488	4 233	39 806	547 901	332 798	81%	69%	76%

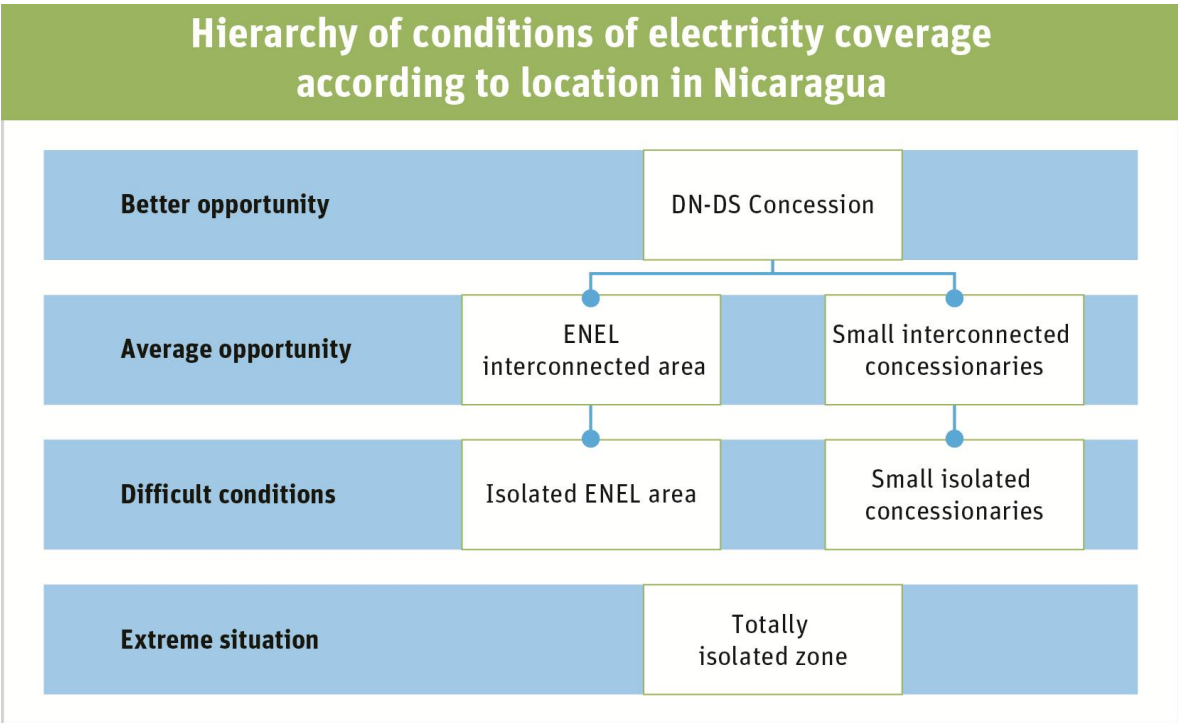
Table Error! No text of specified style in document.-19 Estimated electricity coverage in the country by region with urban and rural levels

Source: ENATREL (2013), own elaboration

It can be estimated from the various figures presented previously that coverage on a national level at the end of 2012 is a bit above 70%. The official figure from MEM estimates global coverage at 72.4% in 2012 based on the 2005 census (INIDE / INEC, 2005) and the official population projections of INIDE.

Based on the 2005 figures, 42% of unattended households are situated in areas of severe poverty and almost 20% are in areas of high poverty which indicates that more than 60% of the households are in areas of low economic and social development, especially the Autonomous Regions of the Atlantic North and Atlantic South.

In addition to this vulnerability, there are fundamental differences in rates, quality, and opportunity to having access to electricity service depending on the location of the user: if he/she is in a DISNORTE-DISSUR concession area or a small concession area, in an area under the responsibility of ENEL is interconnected or isolated or, in the worst of the cases, in an area totally isolated from electricity service.



Graph Error! No text of specified style in document.–27 **Diagram of the hierarchy of conditions of electricity coverage according to location in Nicaragua**

Source: own elaboration

Below we describe the differences in situation among different categories of attention areas for electricity service in Nicaragua.

a) DISNORTE - DISSUR (ZC/DN-DS) concession areas



Graphic Error! No text of specified style in document.–28 Sales made in 2011 by DISNORTE-DISSUR

Source: DISNORTE-DISSUR

The average coverage in municipalities located in DN-DS concession areas is 99% (urban dense areas) and 35% (in municipalities near the concession border). These areas have the highest increase in the rate of coverage.

In terms of relative poverty according to (INIDE / INEC, 2005), houses located in the concession areas of the distributors DISNORTE and DISSUR in the Central and Pacific area of the country are in a situation of average³¹ and low³¹ poverty given that these regions are relatively more developed fundamentally.

In addition to the benefits mentioned previously, the rates in these areas are the lowest in Nicaragua and, from 2005 to the present, they have had a subsidy provided by Law 554 of Energy Stability (Government of Nicaragua, 2005b), which benefits users with residential consumption of up to 150 kWh/month.

Clients in DISNORTE - DISSUR (ZC/DN-DS) concession areas are structured in the following way:

³¹ See definitions of categories of poverty in INIDE / INEC, 2005.

Consumption sector	Number of clients 2011	Average consumption (MWh/client/year) 2011
Total S.I.N.	864,184	3.03
Residential	775,806	1.12
Commercial	48,495	13.32
Industrial	7,065	88.68
Public lighting * ¹	606	126.49
Irrigation	1,032	71.8
Government	* ²	* ¹
Pumping	1,007	190.86
Unregulated rate (large consumers)	9	142.57
Use of networks	7	591.24

Table Error! No text of specified style in document.-20 Number of clients and average consumption in DISNORTE-DISSUR concession areas in 2011

Source: (INE, 2011a), (INE, 2011c), own elaboration. Note: a client is a home with a contract.

(*¹) Note: this figure only takes into account public lighting circuits measured by distributors.

(*²) Note: Since 2003, the distributors DISNORTE and DISSUR haven't reported to the Government Sector because they distribute to other categories of consumption.

Programs to extend the networks in these areas are most favored by PELNICA projects and other support projects (see 0), and currently the PNESER Program that is presented in 0.

The current diagnosis is as follows:

The quality of service improved considerably between 2007 and 2012 (few blackouts, short lived)

Many rural distribution lines continue to be monophasic;

Many rural lines lack adequate maintenance (transformers, hot spots, etc.)

There are still many segments in the terminal sections of distribution lines where voltage drops cause harmful effects to electronics in homes and small businesses;
The necessary substations required to continue building rural distribution lines are lacking.

Vision of the Future of ENATREL from 2020 -2030

ENATREL, by special mandate of the Presidency, is a company committed to the human and economic development of the country and to performing tasks that enable human development. Among those are:

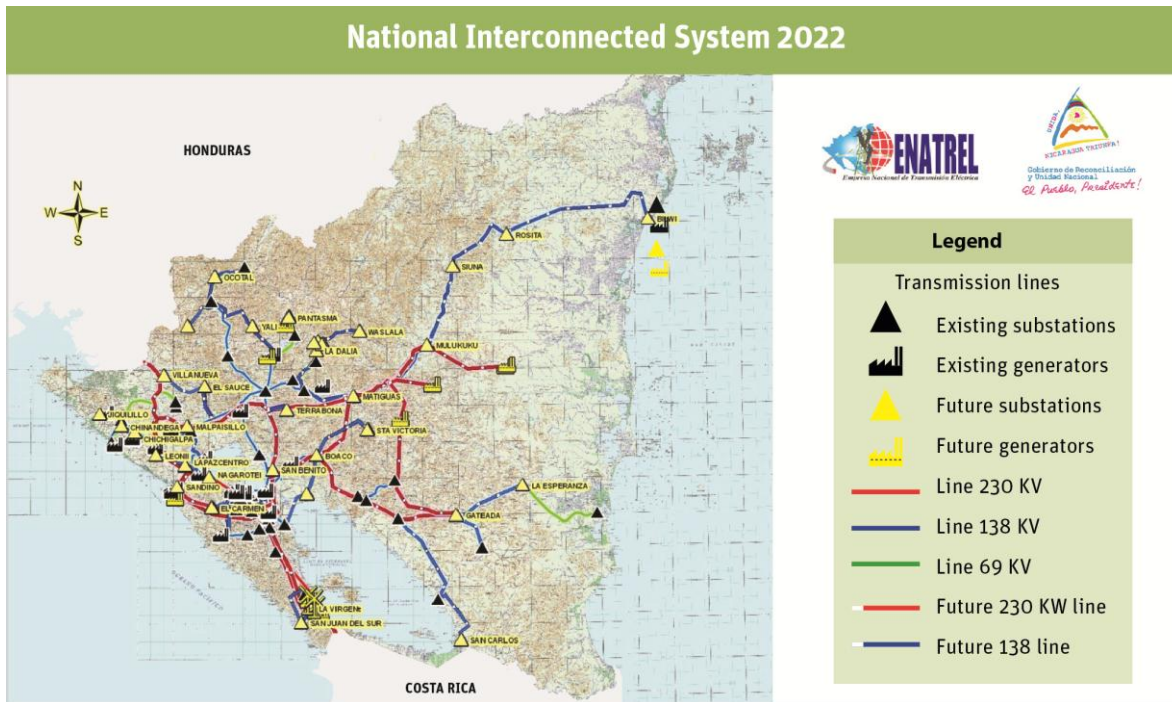
- 1) Increasing electricity coverage to the greatest number of households in the country with the available resources.
 - 2) To strengthen sports centers for the healthy development of the population.
 - 3) To strengthen public education centers in areas where electrification coverage is carried out.
 - 4) To expand ENATREL communication services from their area of influence to the whole country.
 - 5) To strengthen the small and medium sized productive sectors of the country.
 - 6) To strengthen pumping systems that supply drinking water in places where ENATREL provides rural electrification.
 - 7) To carry out public lighting plans on a national level where the distributor doesn't provide this service to the population of the country.
 - 8) To expand the SIN to connect renewable energy generation projects.
 - 9) To expand the SIN to satisfy the electricity demand.
 - 10) To respect the environment by complying with regulations in the area.
 - 11) To promote the development of generation distributed within a framework of responsibility shared with municipal governments.
 - 12) To establish 5 regional offices in the country with the goal of strengthening maintenance and improving emergency care.
 - 13) To promote energy savings and efficiency.
-

14) To promote Regional Electricity Integration via the participation of regional organizations created for that purpose.

15) To provide communications service to the public sector of the country.

Table Error! No text of specified style in document.-21 Vision of the future of ENATREL from 2020 -2030

Source: (ENATREL, 2013), own elaboration



Graphic Error! No text of specified style in document.-29 Projection of the main transmission lines in Nicaragua - 2022

Source: ENATREL

b) Concession areas to small interconnected dealers (ZCPCI)

Small rural interconnected dealers serve approximately 9,500 clients located in the center of the country and the autonomous regions RAAN and RAAS, of which 5,228 are on the Island of Ometepe which is technically isolated but under the concession regime DN-DS.

Areas served by small rural licensees	Number of clients	Average consumption (MWh/client/year)
	2011	2011

APRODELBO	864	0.72
ATDER - BL	2,381	0.56
ZelayaLuz, S.A.	278	0.15
HISMOW, S.A.	737	Not available
EMEAW	Not in service	Not in service
Ometepe ³²	5,228	Not available
Total	9,488	N/A

Table Error! No text of specified style in document.-22 Number of clients and average concession areas granted to small operators.

Source: (INE, 2011a), (INE, 2011c), own elaboration. Note: a customer is a home under contract.

These companies face a difficult situation, and their biggest challenges are the following

(Renewable Association / ATDER-BL / Aprobello, 2010):

There are constant blackouts, fluctuations in voltage and reclosers in DISNORTE and DISSUR (DN-DS) medium voltage networks which are connected to (small operators) PC and small hydroelectric plants (PCH). This greatly affects the amount of energy that hydroelectric generators can sell. The projects don't meet their generation goals given that there is "not a line" to receive energy, and this results in important economic losses and affects the sustainability of the projects.

The small renewable energy generators sell their energy to DISNORTE and DISSUR for very low prices without being able to negotiate given their legal and real disadvantage. This price doesn't allow the recuperation of investments and doesn't take into account the financial costs of renewable energy projects during their first years of operation. The INE is currently limiting the sale price of energy from small hydroelectric plants that are interconnected to the DISNORTE and DISSUR networks to the maximum value of the "Price Bands for Renewable Energy on the Spot Market. This "band" of the Spot Market is currently set by the INE at between 90-100 USD/MWh. This ban can be used by renewable generators that do sell on the Spot Market and are interconnected directly to an ENATREL substation. However, the sale in medium voltage of a renewable generator to DISNORTE or DISSUR is not a sale on the spot market. Rather, it is a purchase/sale transaction via a contract. Thus, there isn't a law or a regulation that limits the price of a contract to the "band" on the Spot Market.

Given that these small generators of renewable energy located in rural zones lose approximately 25% (Renewables Association/ATDER-BL/Aprobello, 2010) of their generation due to blackouts, voltage fluctuations, imbalances between phases and reclosers in the distribution circuits of DISNORTE and DISSUR.

³² The island of Ometepe is inside the DN-DS concession area but is technically isolated from the SIN.

We present what was previously mentioned because there is no legal or regulatory framework in the country that establishes technical and commercial responsibilities among the largest players and operators and the small operators with their own private generation. This framework would avoid the setbacks caused by the imbalance between large and small players.

For example, we can describe some of those imbalances:

The lack of relevant authority or the definition of processes, to obtain the granting of titles to inhabitants for the use of water is cumbersome and arbitrary, which produces setbacks in implementing projects.

Four small operators currently buy energy from DISNORTE-DISSUR (DN-DS) at prices ranging from the PMC plus 2% to a rate T-4D which is equivalent to approximately the PMC plus 35%. The small operators provide utilities of up to 30% to DN-DS when they buy energy. However, the large companies don't take into account that the energy is used to provide services in rural areas that are made up of users with consumption less than 300kWh/month. This makes the cost of energy higher for final users of the small operators.

The small operators can't get back the IVA paid in the purchase of energy to DISSUR and/or DISNORTE because the majority of users are consumers of less than 300 kWh/month to whom the cost can't be passed on.

The economic cost of the process of legalization of the small operators or generators of hydroelectric energy is very high due to the mandate of the law and regulations of the LIE.

Fires and deforestation are produced in the drainage basin of small hydroelectric plants. The owner, licensee or operator of the hydroelectric plant denounces the environmental damage to MARENA and the National Police. Those authorities carry out inspections and write reports, but no sanction, fine, or punishment is applied nor do they require the responsible party to compensate or repair the environmental damage. The damage continues as if the laws didn't exist.

c) Interconnected concession areas (ZCI), the service area of ENEL

The Nicaraguan Electricity Company (ENEL) provides distribution service in concession sectors located in the Atlantic North, Central, and South regions of the country (23 sites). These regions have many uncovered areas where distribution service still isn't provided or administered by any entity (See ZTA). If we only analyze the sites interconnected to the SIN, we can see that ENEL attends to 14 settlements representing almost 27,000 clients (in interconnected areas), among which are found government entities, touristic centers, and schools.

The total of ENEL clients, including those clients in isolated areas (see d.), reached 47,214 in January 2013, while sales of energy reached 5,809.36 MWh in January 2013. The extension of service anticipates the growth of both figures.

The Directorate of Operation of Isolated Systems (DOSA), is the area that supplies this electricity service.

Interconnected areas with distribution ENEL	Number of clients 2012 ³³	Average consumption (MWh/client/year) 2011 ³⁴
Bluefields (SIN)	9,418	2.45
El Bluff (SIN)	483	1.58
Siuna (SIN)	4,593	1.03
Rosita (SIN)	4,520	1.06
Bonanza (SIN)	3,811	0.79
Mulukuku (SIN)	3,980	0.86
El Ayote (SIN)	1,114	Not available
Wiwilí	2817	0.6
Plan de grama	461	Not available
Wamblam	305	Not available
Kukra Hill (SIN)	1417	0.85
Laguna de perlas	922	1.29
Tasbapownie	246	Not available

³³ ENEL 2012, Universe of clients by supply source.

³⁴ (INE, 2011a), (INE, 2011c)

Karawala	532	Not available
Total	26,969	N/A

Table Error! No text of specified style in document.-23 Number of clients and average consumption in areas with interconnected ENEL distribution. Source: (ENEL, 2012), (INE, 2011a), (INE, 2011c), own elaboration. Note: a client is a household with a contract.

Classification by rate 2013	Rate	Clients	Consumption (kWh)
Total	T0	45 234	3,839,627
	T1	1 271	836,083
	T1A	14	54,798
	T2	35	275,179
	T2D	4	81,005
	T3	4	3,159
	T4	118	287,736
	T5	1	120,200
	T5D	0	0
	T7	37	126,870
	T8	25	95,113
	T9	122	28,653
	TJ	310	40,965
	T3T	28	13,855
TR	11	6,115	
Total		47,214	5,809,358

Table Error! No text of specified style in document.-24 Number of clients and consumption by ENEL rate in January 2013

Source: ENEL 2013, own elaboration.

Below we present the vision of the future of ENEL for the next five years.

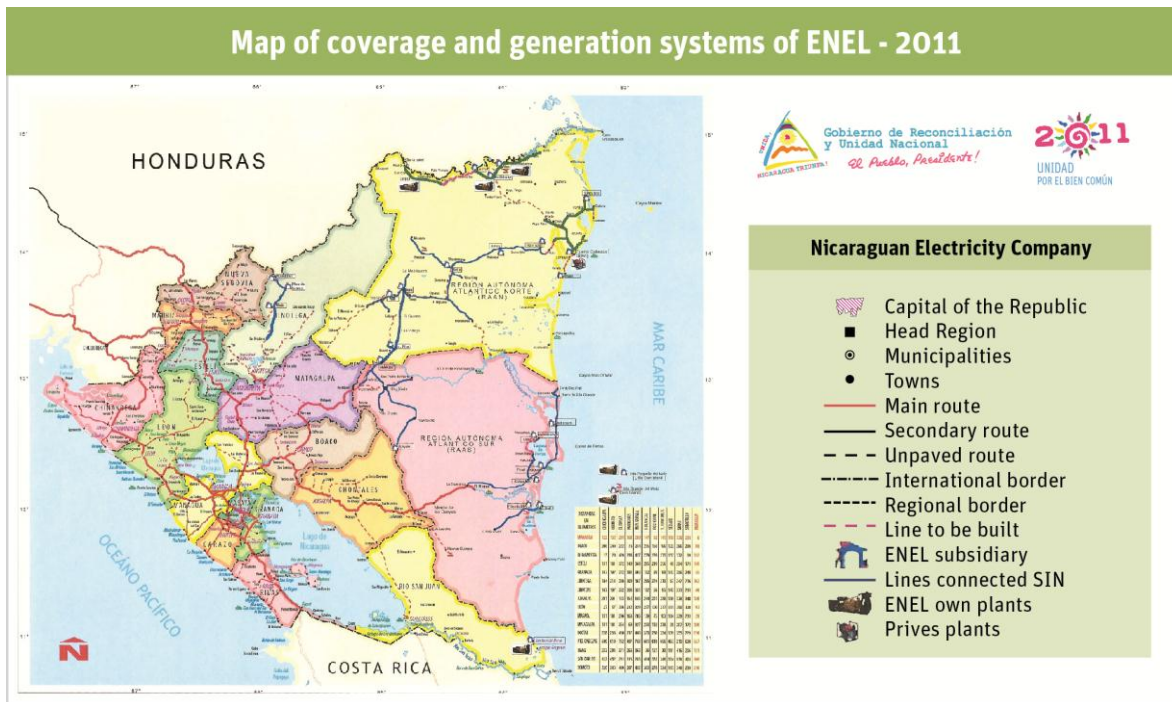
The challenges of ENEL for the 2013-2018 period

- 1) Reduction of technical losses and non-technical losses in areas, concessionary or not, served by ENEL.

-
- 2) Extension of service coverage in areas, concessionary or not, served by ENEL.
 - 3) The substitution of generation sources that burn fossil fuels via the extension of transmission and sub-transmission networks and generation with primary sources of renewable energy in areas, concessionary or not, served by ENEL.
 - 4) The legalization and/or updating of concessions where ENEL provides distribution services.
 - 5) Improve the business management system.
 - 6) Systematic training of personnel and the implementation of Employee Job Manuals.
 - 7) To commit actively to reducing poverty and improving health and education via the introduction of generation systems that use renewable energy in inaccessible areas (mini hydroelectric, solar, wind, or biomass plants).
 - 8) To incorporate a program of energy efficiency that includes the extension of service coverage.
 - 9) To ensure financial sustainability via adequate rates for the sale of energy to distribution companies and for energy directly marketed.
 - 10) Creation and Development of a Unit for the Management of Drainage Basins.
 - 11) The extension of production capacity to supply the national network via the development of projects with renewable energy (hydroelectric, geothermal).
 - 12) To manage and obtain financing for the development of generation and distribution projects.

Table Error! No text of specified style in document.-25 Vision of the future of ENEL to 2018

Source: ENEL, own elaboration



Graphic Error! No text of specified style in document.–30 Map of coverage and generation systems of ENEL - 2011

Source: ENEL, DOSA³⁵.

d) Isolated areas served (ZAD): in ENEL concession areas, small concessions, or local concessions

Other ENEL clients make up almost 9,000, and they are the ones that belong to the seven following disconnected settlements of the SIN:

Isolated areas with ENEL distribution	Number of clients 2012 ³⁶	Average consumption (MWh/Client/Year) 2011 ³⁷
Puerto Cabezas (Bilwi)	7,892	Not available
Waspam	1,870	Not available

³⁵ DOSA: Dirección de Operación de los Sistemas Aislados

³⁶ ENEL 2012, Universo de clientes por fuente de suministro

³⁷ (MEM, 2012b)

Bulkiamp	39	Not available
Corn Island (Big Corn)	1,480	Not available
San Juan de Nicaragua	351	Not available
Pueblo Nuevo	122	Not available
Orinoco	194	Not available
Total	8,933	N/A

Table Error! No text of specified style in document.-26 Number of clients and average consumption in areas with isolated ENEL distribution

Source: (ENEL, 2012), (INE, 2011a), (INE, 2011c), own elaboration. Note: a client is a household with a contract.

In the Autonomous Region of the Atlantic North (RAAN) and the Autonomous Region of the Atlantic South (RAAS) there are also Small Hydroelectric Plants (PCH) and Micro Hydroelectric Plants (MCH) run by private companies but developed with the support of the MEM and international cooperation (see 0 y 0). At the end of 2012 7 PCH and 11 MCH were in operation, with local concession, and they can be seen in the following table:

Isolated areas, local concessions	Number of clients 2012 ³⁸	Average consumption (MWh/client/year) 2011 ³⁹
PCH Río Bravo, Puerto Viejo	380	Not available
PCH Las Nubes El Naranjo	770	Not available
PCH Bilampí-Musún	540	Not available
PCH Salto Negro-La Unión	378	Not available
PCH Kublalí La Florida	360	Not available
PCH San José-El Malacate	720	Not available
PCH Salto Mollejones	737	Not available
MCH Malacatoya	32	Not available

³⁸ ENEL 2012, Universo de clientes por fuente de suministro

³⁹ (MEM, 2012b)

MCH La Laguna	40	Not available
MCH El Roblar	30	Not available
MCH El Zompopo	35	Not available
MCH Kuskawás	75	Not available
MCH Ocote Tuma	46	Not available
MCH Kasquita	50	Not available
MCH Los Milagros	24	Not available
MCH La Samaria	23	Not available
MCH Aguas Rojas	11	Not available
MCH Castillo Súr	65	Not available
Total	3,579	N/A

Table Error! No text of specified style in document.-27 Number of clients in local concession areas

Source: (MEM, 2012b), FODIEN, own elaboration. Note: a client is a household with a contract.

These small concessionary companies located in rural areas, especially in isolated areas, face many operation difficulties. It is complicated to get and train technical personnel, and for them it is difficult to maintain agile business operations. Furthermore, they are subject to an isolation that increase their difficulties with low communications coverage due to the lack of basic tools like an Internet or cell phone signal, which hinders them from identifying actions that can be taken to strengthen their business. Finally, small concessionaries spontaneously drive rural electrification projects in their areas of influence, providing photovoltaic solar systems via a micro credit or donation payment system. For example:

APRODELBO (Jinotega, San José de Bocay)

APRODELBO was a pioneer in this type of projects and obtained solar panels for families in the basin Los Ángeles in Bocay, with the support of the UNDP – Small Donations Program 2009. In the Bocay basin, all of the demand was met because there weren't many families. In El Bote there are more families in the basin, and it is necessary to consider another idea for the future to finish the PV systems for homes located in the basin area.

ATDER-BL (Jinotega, El Cuá)

En 2010, ATDER-BL received a donation of US\$ 25,000 from the UNDP Small Donations Program to cover the full costs of buying, transporting, and installing 25 PV panels for families that live in the El Bote basin. They are families that work with a program to improve agriculture, and forest, land, and water conservation. There are approximately 150 families in the basin that participate in

program conservation activities, and the electricity lines can't be extended to these houses due to the distance, the low density of population, and the lack of roads. The families receive a PV system and pay 50% of the value in dues, like a credit. With the money made from the payments of those families, in addition to the 25 original panels, 22 more have been installed. In the El Bote river basin 47 families now use PV systems, but 100 families still don't have them yet.

HISMOW, S.A. (RAAS)

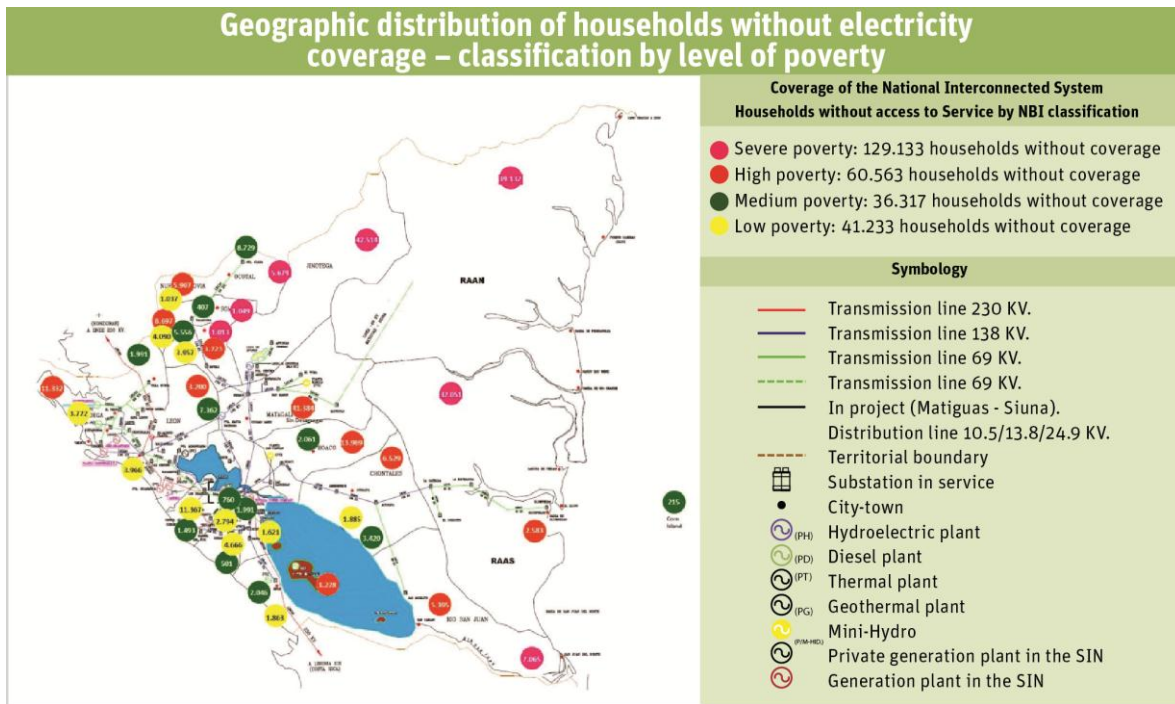
In 2012, 50 sola panels were given to an equal number of families in the basin area that forms part of the concession area. Currently no funds have been obtained to carry out another project for them even though the majority of families in these remote communities don't have access to energy.

However, it should be noted that the beneficiaries of solar panels and other technologies, due to the fact that they are outside the coverage area of the SIN in concession areas, regardless of their source of supply (solar, biomass, hydroelectricity or thermal) don't benefit from the subsidy mentioned in 0 a), which doesn't help to guarantee the sustainability of these initiatives.

e) Completely isolated areas (ZTA)

Non-concession areas are also the areas of greatest poverty in the country, directly influencing the level of economic and social development of the inhabitants, in particular in areas of severe poverty and high poverty.

These areas are characterized by, among other things, not having access to electricity service.



Graphic Error! No text of specified style in document.–31 Geographic distribution of households without electricity coverage – classification by level of poverty

Source: (FICHTNER, 2011a)

Where information about electricity coverage and the degree of development intersect (INIDE / INEC, 2005), it can be seen that the most neglected regions are found, especially:

Jinotega (32,045 households without access to electricity and 54% in a situation of extreme poverty);

Río San Juan (12,568 households without access to electricity and 53% in a situation of extreme poverty);

And the following autonomous regions:

RAAN (40,818 households without access to electricity and 65% in a situation of extreme poverty);

RAAS (89,430 households without access to electricity and 68% in a situation of extreme poverty).

Clearly a major effort should be undertaken in those municipalities to address the 174,861 households without access to electricity and in a situation of extreme poverty or high poverty.

Department	Area (km2)	# Households without electricity	% electricity coverage	% Population in situation of poverty	% Population in situation of extreme poverty

RAAS	26,020	40,818	65,18%	25,30%	65,10%
RAAN	32,601	89,430	67,67%	22,97%	67,87%
Rio San Juan	7,527	12,568	68,52%	28,72%	53,82%
Jinotega	15,630	32,045	61,91%	26,09%	54,10%

Table Error! No text of specified style in document.-28 Households without access to electricity and poverty in completely isolated areas sin - 2005

Source: (INIDE / INEC, 2005), own elaboration

Important note: in this category of “Completely isolated areas,” we are not considering a number of households without access to electricity that are found in concession areas where lack of access to electricity service is due to fundamentally socio-economic barriers of the rural populations that live in those areas.

If we focus on the two autonomous regions that have the greatest quantity of households without access to electricity, we can confirm the following:

RAAN

In the RAAN it was established that of the 8,678 households (79 counties, plus the neighborhoods of the Waspam capital) without access to electricity, just over 50% can be addressed with strategies that involve market mechanisms, while the balance, 47%, require strategies where the State intervenes with 100% of the investment. The strategies of the Waspam and Prinzapolka municipalities are described below (FICHTNER, 2011c).

RAAS

On the other hand, in the RAAS, of the 16,870 households (65 counties) without access to electricity (practically double that of the RAAN), 67% of those require strategies where the State participates with 100% of the investment while the remaining 33% of the households can be served with mechanisms that require the participation of the user and market practices. Strategies are described for the municipalities of Desembocadura del Río Grande, El Tortuguero, Paiwas, and La Cruz del Río Grande (FICHTNER, 2011c).

Additionally, in our review of the study (FICHTNER, 2011c), we consider that because it is based in analysis at the level of municipality about the Census figures (INIDE / INEC, 2005), part of the reality is lost from the indigenous territories where the Municipality is a concept that covers very

different realities. In addition to the groupings made for projects in the RAAN and RAAS, we recommend that some municipalities that weren't taken into account be reviewed.

A striking example is the municipality of Bluefields (RAAS) that appears with a coverage rate of 82% overall (1,596 homes without electricity of the total 10,759), but in almost all of the communities outside of the regional capital we find rates between 30% and 0% with 23 communities below 20% coverage with an average coverage of less than 2% (data from 2005).

Example of the municipality of Bluefields, RAAS	Households occupied	Households without electricity	With a distance of C/S greater than 5 km	% Electricity coverage
TOTAL /% Average	1,135	1,107	775	1.9%
Mahagani	30	28	17	6.7%
Caño Negro	22	22	17	0.0%
San Mariano	50	50	45	0.0%
Alrededores de Bluefields	40	39	35	2.5%
Musalaine	34	33	15	2.9%
Las Pavas	25	24	24	4.0%
Kukra River ⁴⁰	146	134	99	8.2%
Monkey Point ^(*)	43	40	9	7.0%
Punta Águila ^(*)	18	18	15	0.0%
Monte Cristo	82	81	29	1.2%
S. Thomas de Masayón	133	131	133	1.5%
El Guapote	25	25	25	0.0%

⁴⁰ (*) Desde el 2007, la ONG blueEnergy ha instalado sistemas aislados FV y eólicos para atender a estas comunidades.

Atlanta	32	32	15	0.0%
Masayón	18	18	17	0.0%
El Guineo	48	48		0.0%
El Diamante	25	25	2	0.0%
Salto León	17	17	17	0.0%
La Gloria	34	30	29	11.8%
San Sebastián	38	38	37	0.0%
San Francisco de Agua Fría	38	38	37	0.0%
Santa Lucía	24	24	24	0.0%
El Delirio	17	17	17	0.0%
Guásimo	179	178	102	0.6%
El Encanto	17	17	15	0.0%

Table Error! No text of specified style in document.-29 Communities with less than 20% coverage in the municipality of Bluefields - Figures 2005

Source: (INIDE / INEC, 2005), own elaboration

Access to energy for the productive sector

The situation of lack of energy infrastructure such as port terminals to received natural gas, gas pipelines for piping the gas, and strong electricity transmission and distribution networks has historically made access to energy a competitive disadvantage in Nicaragua to attract foreign investment in the Latin American context and to promote the productive sector.

According to the National Energy Balance (MEM, 2011a), the industrial sector consumed 266.1 ktoe which represents 12.7% of final consumption that year. An increase of 3.6% is observed compared to 2010, and the percentage structure of this sector is 45.3% oil derivatives, 20.4% firewood, and 30.1% electricity.

The agricultural sector accounted for 1.8% of final consumption, i.e. 36.9 ktoe, an increase of 3.9% over 2010. Its structure was 42.8% obtained from vegetable waste, 29.6% from oil derivatives, 17.3% electricity, and 9.5% firewood (MEM, 2011a).

In relation to fuels (firewood, other biomass residues and hydrocarbons) in terms of access, service, and prices, the same commentary made in paragraph 0 is relevant, with the following clarification: except for the large agricultural producers (cane sugar, peanuts, rice, and coffee mainly) the agriculture and livestock and industrial sectors don't have the terms given to residential users related to prices. Thus, in the firewood sector and often the LPG sector, they are required to negotiate their supply with producers and distributors.

Regarding biofuels for the transport sector, in 2008 the MEM finalized the process for formulating a biofuel and agro-energy policy. The report indicated the following potential:

Sugar cane: 513,000,000 liters of ethanol obtained from a maximum of 60,000 hectares (ha) under irrigation provided that all the production becomes ethanol. The cost of production is estimated at USD 0.60/liter. The total potential available is 777,000 ha.

Palm oil: 662,000,000 liters of biodiesel if all production becomes biodiesel and is from 200,000 ha of fields. The estimated cost of production is USD 0.72/liter. The total potential available is 1,440,000 ha.

Yuca: 420,000,000 liters of ethanol based on 75,000 ha under cultivation. The estimated cost is USD 0.80/liter. The total potential available is 1,440,000 ha.

Calabash: 447,500,000 liters of ethanol and 137,500,000 liters of biodiesel based on 500,000 combined ha with ranching. The estimated cost of both biofuels is USD 0.40/liter. The total potential available for production is 3,282,000 ha.

Jatropha and fig trees: relatively small areas between 2,500 ha monoculture and 8,000 ha for each one, combined with other yearly crops. Given their low current yields the price of biodiesel from both is above USD 1.00/liter. The total potential available is 236,000 ha for Jatropa and 306,000 ha for fig trees.

Regarding electricity, the frequent blackouts in Nicaragua that occurred before 2007 and energy prices that continue to be high in comparison to other countries in the region have proved important barriers to the productive sector.

Rates for distribution service to final clients are established by the INE via requests to distributors. Both the methodology for calculation and the structure of the rates are approved for 5 year periods. According to Nicaraguan legislation, there are two ways to buy electricity: the free price regime (unregulated market) and the regulated price regime (rates of the regulated market). In the free price regime (unregulated) transactions are made without the intervention of the state and include transactions between the following agents (BCIE, 2011):

between generators, co-generators, self-producers, distributors and large consumers,

plus imports and exports of electricity and power.

In the regulated price regime, transactions are paid through tariff schedules approved by the Regulatory Entity which is the INE and they include the following transactions:

- the sale of energy and power from distributors to final consumers,
- the transport (toll) of energy and power in the transmission and distribution system and other positions.

Large consumers in the industrial sector (agents with voltage concentrated above 1,000 kW) can make transactions in any of the regimes mentioned as long as they meet the current regulations.

The evolution of prices in past years in the productive sector was:

Year	Average prices commercial sector (\$/kWh)	Average prices industrial sector (\$/kWh)
2008	0.242	0.150
2009	0.211	0.143
2010	0.238	0.160
2011	0.241	0.162

Table Error! No text of specified style in document.-30 Average price of access to electricity for the productive sector – 2008 to 2011

Source: (CEPAL, 2011a), own elaboration

However, the real cost of energy for the final consumer can be up to 100% higher depending on the quantity of energy consumed. For example, in the residential sector, users that consume less than 150 kWh/month are subsidized while users that consume more than 150 kWh/month are charged more according to the following system regulated by the INE:

Description	C\$/kWh (September 2013)	USD/kWh (September 2013)
First 25 kWh	2,405	0,0962
Next 25 kWh	5,1811	0,207244
Next 50 kWh	5,4264	0,217056

Next 50 kWh	7,1716	0,286864
Next 350 kWh	6,6889	0,267556
Next 500 kWh	10,6242	0,424968
All kWh > 1000 kWh	11,9083	0,476332

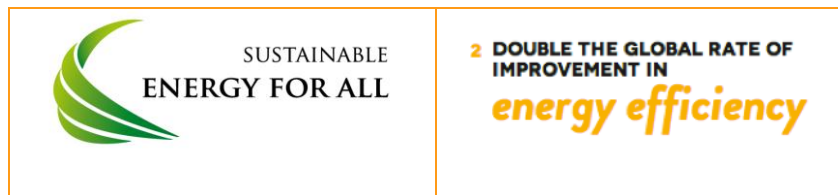
Table Error! No text of specified style in document.-31 Residential rate T-0 for use of urban and rural houses

Source: (INE, 2013), Own elaboration. Note C\$25 / 1 USD

In general, in respect to opportunity to access and quality service, the same commentaries are pertinent to the productive sector that were made in the previous paragraph 0, and there are large variations among regions. (See Graphic **Graph Error! No text of specified style in document.-24**)

Energy efficiency in Nicaragua related to SE4ALL objective No. 2

General vision and evaluation



Energy efficiency is still a new subject in Nicaragua. Within the framework of the Central American sustainable energy strategy 2020 (CEPAL, 2007) and the Strategy of Policies and Energy Efficiency for the Central American and Dominican Republic Electricity Sector (USAID, PNUD, GEF et Al., 2007), Presidential Decree 13-2004 has become institutionalized in the “Establishment of a National Energy Policy” published in La Gaceta No. 45 on March 4, 2004, and more recently in Decree No. 2-2008, Approved January 30, 2008 (Government of Nicaragua, 2008) and the National Human Development Plan (NHDP 2012-2016) (Government of Nicaragua, 2012).

Specifically, on the subject of energy efficiency, Energy Policy aims (MEM, 2011e):

- To promote the establishment of energy efficiency goals along the entire production chain of the electricity and oil industry.
- To promote the efficient use of energy for all types of final consumers.
- To promote incentives that favor the import of energy efficient electricity equipment.
- To promote the identification (labeled) of energy efficiency in all electricity equipment that enters the country.
- To establish a legal framework that requires maximum efficiency for all new equipment used in new projects or expansion projects for electricity generation.
- To foster work with corresponding institutions that evaluate and establish measures for the efficient use of fuels in public and private transport.
- To promote regulations that incentivize the creation of energy audits in private companies and public institutions to improve energy efficiency, support and incentivize the formation of private companies that specialize in the service of energy efficiency.
- To promote, through programs and energy projects, the efficient use of firewood and the promotion of energy nurseries.
- To facilitate and maximize the reach of renewable energy in the national energy system, particularly related to its contribution to the security of supply and the stability of the system.

In compliance with energy policy, the rational and efficient use of energy is actually one of the central strategies of the energy sector, with a specific focus on the electricity sector. The idea is to

promote a National Energy Savings Plan that takes into account all kinds of final consumers via the PNESER Program (MEM, 2011d). This plan will be translated into an Energy Efficiency Law that intends to achieve:

- The fulfillment of national objectives related to savings, energy efficiency, the participation of renewable energy in consumption and energy generation;
- To orient public policies in this area via a Regulation that guarantees the fulfillment of commitments, obligations, and agreements;
- To provide security to companies in different investment sectors related to this subject and to investors in renewable energy;
- To promote energy efficiency in all sectors;
- To establish mechanisms of cooperation and coordination; and
- To eliminate institutional, economic, environmental and other barriers

However, one should not lose sight of the importance of the use of firewood in the residential sector or the use of fuels in the transport sector, which have equal or more importance than the electricity sector in achieving this goal.

Energy intensity

The energy intensity of the Republic of Nicaragua allows us to have a measure for the evolution of energy efficiency necessary units of energy consumed to produce one unit of product.

In the following graph, you can see its evolution between 2007 and 2011. Observe the progressive decrease in performance.

Year	2007	2008	2009	2010	2011
Energy intensity (toe/MC\$)	0.059	0.057	0.058	0.056	0.056

Table Error! No text of specified style in document.-32 Evolution of energy intensity in toe per million cordobas – 2007 to 2011

Source: (MEM, 2011a), own elaboration

In 2011, final energy consumption per inhabitant grew 2.09% over 2010 (MEM, 2011a). The energy intensity in Nicaragua reached 2.71 boe (0.37 toe)/thousands USD of GDP 2005 (OLADE, 2012) and according to (MEM, 2011a) 2.2 Barrels of Oil Equivalent – boe – for each 1,000 USD of GDP in 2010), which represents the quantity of energy consumed for each unit of gross domestic product produced. This indicator stayed the same compared to 2010.

A hypothesis can be presented that the downward trend can be explained by the performance of the GDP, which seems to be determinant in the evolution of this indicator. In periods of recession and economic crisis, it tends to grow (2009), and in periods of the economic growth, it experiences the opposite effect, as has been the case since 2010.

It is also important to put Nicaragua in the Central American context and to look at the tendencies of the past five years compared to two other countries in similar situations (Honduras and Guatemala).

It is important to note that energy intensities should be bought in comparable terms including only the part of production in the GDP and/or the part from exports.

Year	2007	2008	2009	2010	2011
Energy Intensity Nicaragua (boe / 1,000 USD de PIB, USD del 2005)	2.79	2.71	2.73	2.67	2.71
Average energy intensity of Guatemala and Honduras (boe / 1,000 USD of GDP, USD 2005)	2.08	1.98	2.12	2.21	2.10
Energy intensity gap (supplement to consumption in Nicaragua)	34%	37%	29%	21%	29%

Table Error! No text of specified style in document.-33 Comparative evolution of the energy intensity in Nicaragua – 2007 to 2011

Source: (OLADE, 2012), own elaboration

In comparison with the average of Honduras and Guatemala, Nicaragua has had an energy intensity 30% less favorable on average over the last five years.

Recent steps towards energy efficiency

Through MEM, energy efficiency programs have been promoted with the objective of raising awareness about the importance of rational and efficient use of energy. These include:

Distribution via the Nicaraguan Institute of Social Security (INSS) of 1.2 million high efficiency bulbs between 2008 and 2010 allowing an estimated savings of 43,776 MWh per year, equivalent to saving 62,182 barrels of fuel oil for electricity generation and not producing 249,593 tons of CO₂. In 2012 36,000 additional FCLs were distributed to Masaya and San Jacinto.

The educational campaign “Efficient Energy Use” 2008-2009, directed at elementary school teachers and students in Managua managed to involve 200 public educational centers and 50,000 students.

The educational campaign “Efficient Energy Use” 2010-2011, directed at elementary school teachers and students in 14 departments of the country. They managed to involve 1,098 public education centers, 12,050 students and 42,000 students and to introduce the subject as required subject matter for academic curriculum in the fifth grade.

Period 2008-2010: energy audits conducting 20 audits in the Public Sector (Government, Hospitals, and Schools) and 28 energy audits in the industrial, commercial, and service

sectors. During 2011-2012 there were 15 audits of which 8 were in the private sector and 7 in the public sector.

Training via workshops and fairs in energy efficiency for entrepreneurs, businessmen, government officials, and the general public.

Period 2008-2010: formation of the Energy Efficiency Committee in 38 government institutions.

Preparation and publication of the 13 Nicaraguan Mandatory Technical Standards (NTON) during the period from 2007-2011 (MEM, 2011g) which established minimum standards and procedures for labeling energy efficiency that should be met by equipment imported and marketed in the country.

Renewable energy in Nicaragua in relation to objective No. 3 of SE4ALL

General vision and evaluation



The participation of renewable sources in the global energy matrix is probably, of the three SE4ALL objectives, the topic that Nicaragua should be most proud of in terms of current results and future plans.

Nicaragua has an estimated generation potential based very diversely on renewable energy sources, and is well above the current demand. It is believed that generation plants interconnected to the SIN totaling 5,500 MW could be installed with wind parks, hydroelectric plants, geothermal plants, solar gardens, and generation from biomass – all this without taking into account the potential of marine energy (currents, waves, or tides).

At the end of 2012, electricity generation was over 40% based on renewables, and the current plans point in the direction of 85% and even possibly, within 15 to 20 years will reach almost 100% (minus the emergency thermal reserves). However, at the level of the private sector, there is still a large market that needs to be driven, via actions to promote distributed generation and rate plans that encourage the performance of small and medium clean energy producers, both of electricity and of thermal energy and in the transport sector.

Renewable energy interconnected to the system and isolated generation

Renewable energy interconnected to the (SIN) grid

According to the National Human Development Plan (Government of Nicaragua, 2012) and the MEM Action Plan (MEM, 2012b), during the past five years, a large variety of renewable energy projects at the scale of interconnected generation plants have been promoted.

However, Nicaragua still only takes advantage of a small part of its renewable energy potential – in fact, less than 10% of its total potential.

In the following table we detail this estimate.

Renewable source	Estimated potential (MW)	Study or source	Installed capacity at the end of 2012 (MW)	Percent utilized 2012 (%)
Hydroelectric generation	2,000	Master Plan of electricity development in Nicaragua 1977-2000 (IECO-LAHMAYER), 1980	98	4.90%
Geothermal generation	1,500	Master Plan for the geothermal sector (CNE), 2001.	66	4.40%
Wind generation	800	SWERA	143 ⁴¹	17.88%
Biomass generation	200	Silvio Binato, 2003-2004	120	60.00%
Solar generation	1,000	Own calculation, considering that it takes up 1% of national territory (houses and lands without productive use)	2	0.20%
Total	5,500	N/A	429	7.80%

Table Error! No text of specified style in document.-34 Estimate of the potential of renewable energy available by source and current state - 2012

Source: (MEM, 2011a), own elaboration

The gross generation produced in 2011 was the following:

Type of source or fuel / year	2008	2009	2010	2011	2012
Non-renewable : thermal plants - Bunker (GWh)	2,055.1	2,295.15	2,246.69	2,463.39	2,245.59
Non-renewable : thermal plants - Diesel (GWh)	63.84	48.65	14.48	14.32	3.42
Renewable : thermal plants - Bagazo (GWh)	337.83	362.56	384.65	372.75	453.96

⁴¹ Asumiendo Amayo (63MW), EOLO (40MW), and BLUE POWER (40MW) in testing at the time othis report was written.

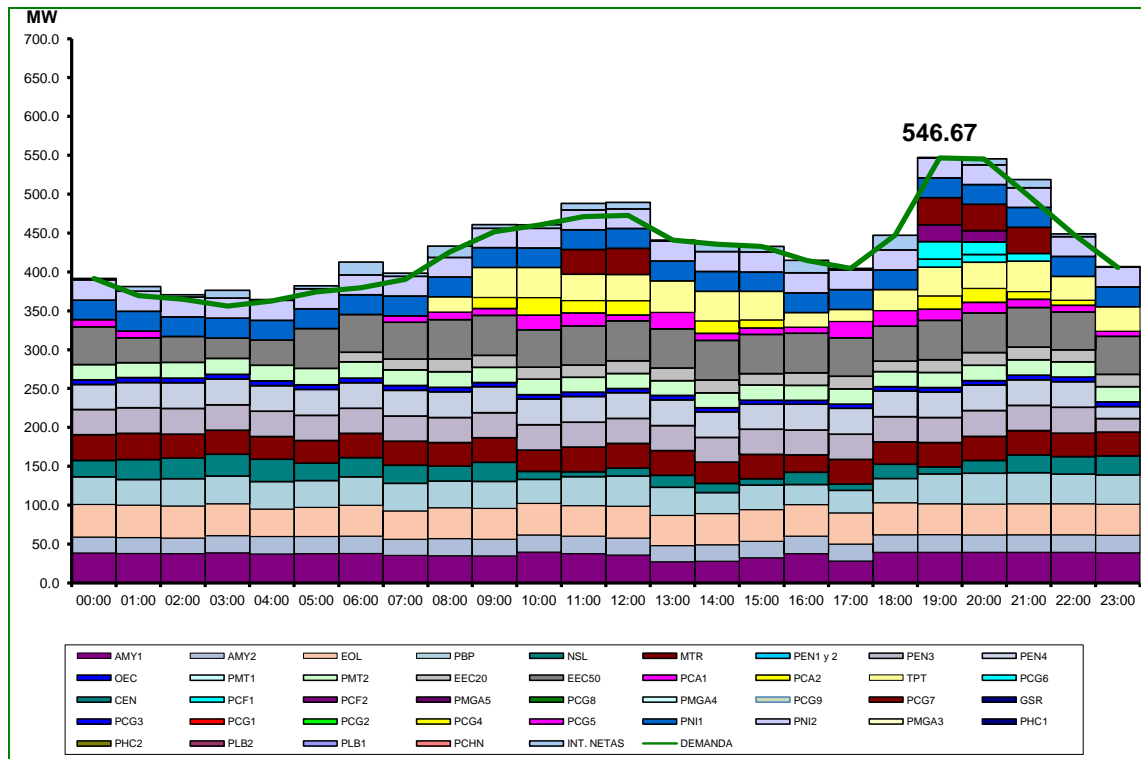
Renewable : hydroelectric plants (GWh)	534.45	296.72	503.15	443.7	417.18
Renewable : geothermal plants (GWh)	322.14	296.53	302.11	272.85	532.32
Renewable : wind plants (GWh)	0	112	163.39	210.66	329.55
Total gross generation S.I.N. (GWh)	3,313.36	3,411.6	3,614.47	3,777.67	3982.02

Table Error! No text of specified style in document.-35 Evolution of the contribution to the SIN of renewable sources in gross electricity generation in Nicaragua – 2008 to 2012

Source: (INE, 2011b), own elaboration

In 2011, we can confirm that generation based on renewable sources in the SIN reached 34.4% of the total of gross energy. The preliminary figures in 2012 are nearly 43.5%.

For example, the profile of daily generation and provision of energy in the SIN on February 9, 2013 was the following, where it reached a peak demand of 564.67 MW at 7:00pm:



Graph Error! No text of specified style in document.-32 Profile of load dispatch by interconnected generation plant – February 9, 2013

Source: (CNDC, MEM, 2013)

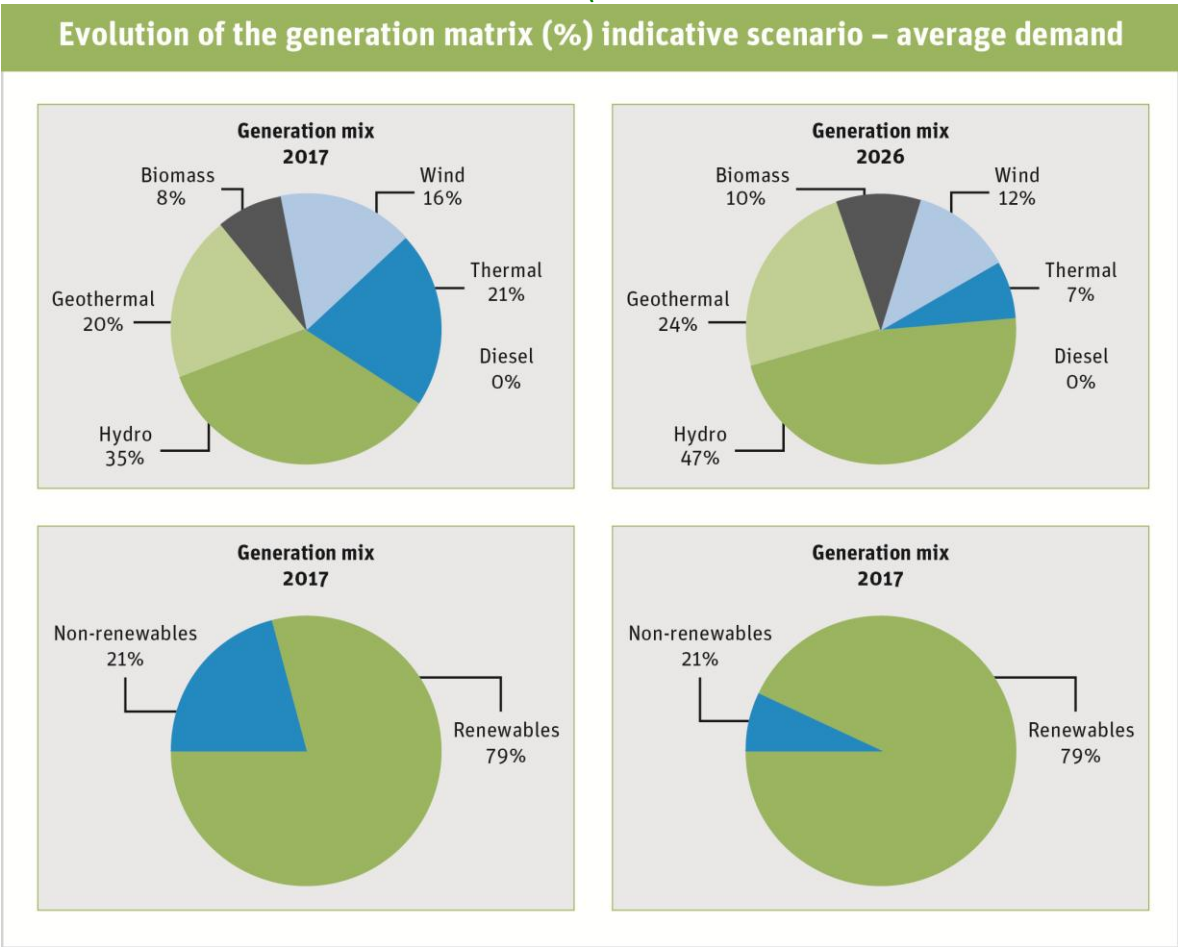
In this graphic, the renewable plants are AMY1 and AMY2 (Amayo 1 and 2 / wind), EOL (EOL / wind), PBP (BLUE POWER / wind), NSL (Ingenio San Antonio / sugar cane), MTR (Ingenio Monte

Rosa/ sugar cane), (PENSA / geothermal plants) , (ORMAT / geothermal plants) and the hydroelectric plants of ENEL: PCA and PLB.

As you can see, after 8pm and during the night, more than half of electricity generation in Nicaragua is renewable, and during a 24-hour period, 68.3% of the national demand was supplied based on renewable generation sources.

The Expansion Plan 2012 - 2026 (MEM, 2012d) has estimated that it will be necessary to add 896 MW in renewable generation plants in order to compensate for the growth of demand that is estimated at 887 MW for 2026 (scenario of medium demand, 915 MW in the maximum demand scenario).

Graphic Error! No text of specified style in document.–33 Evolution of the generation matrix



%) indicative scenario – average demand

Source: (MEM, 2012d)

It is very important to note this tendency, and we need to value that in the next few years the supply of renewable energy in Nicaragua will have to exceed the total electricity demand, at least at night. Thus, it is extremely important that the SIEPAC begin operation at least minimally so that investments aren't halted in interconnected renewable energy projects with a few years.

Renewable energy for isolated generation

Type of source or fuel / year	2008	2009	2010	2011	2012
Thermal plants (Fuel Oil)	24.54	26.09	29.43	31.06	31.31
Thermal plants ENEL (Diesel)	23.05	16.37	15.17	15.7	15.68 ⁴²
Hydroelectric plants (INE Report)	0	0	0	0	1.46
Isolated PCH Hydroelectric Plants	Not available	Not available	Not available	Not available	Not available
Isolated wind plants	Not available	Not available	Not available	Not available	Not available
Isolated solar PV generation	Not available	Not available	Not available	Not available	Not available
Total of isolated systems	47.59	42.46	44.6	46.77	48.44

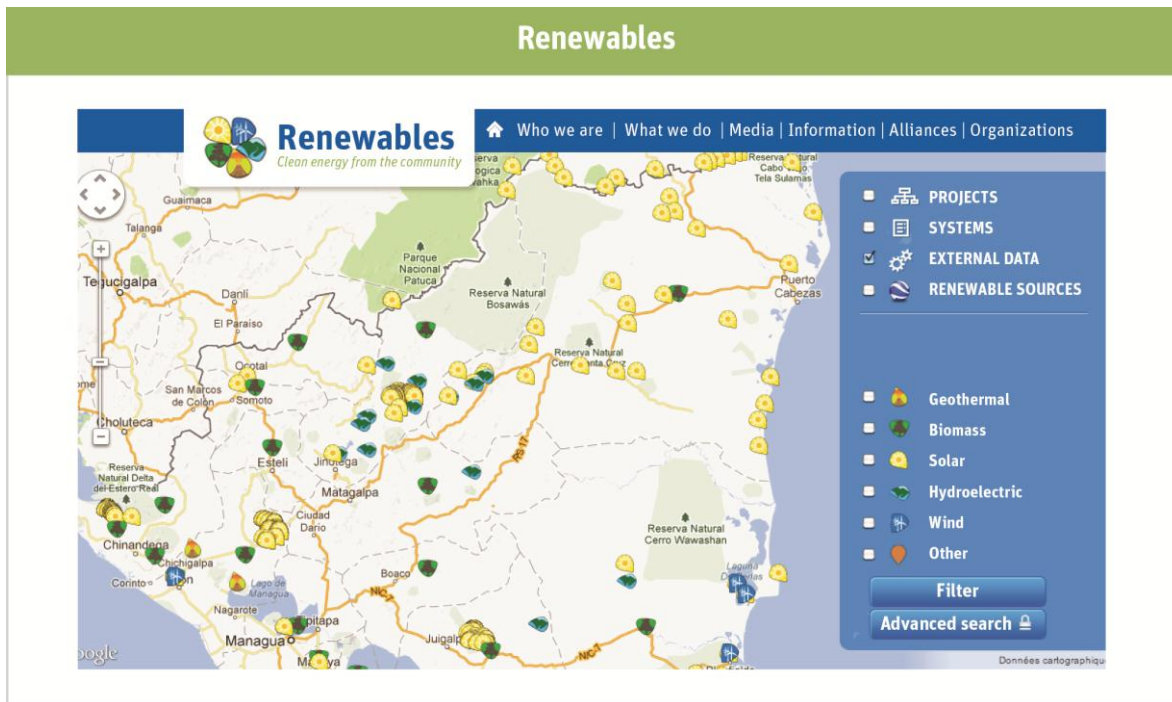
Table Error! No text of specified style in document.-36 Evolution of the contribution of renewable sources in the isolated gross generation of electricity in Nicaragua – 2008 to 2012

Source: (INE, 2011b), own elaboration

In terms of the participation of renewable sources in isolated electricity generation, what we can confirm is that official statistics can't measure its contribution (0% in 2011 according to the INE report). However there is an effort on the part of the Renewables Association of Nicaragua⁴³ to measure the electricity contribution of its members who are spread across the country:

⁴² Private plants (7.94 GWh and ENEL 7.74 GWh)

⁴³ www.renovables.org.ni



Graphic Error! No text of specified style in document.–34 Location of isolated registered systems – 2013

Source: Renewables Association, SIMERNIC⁴⁴

In the private sector, although there are no provisions to integrate distributed generation by favorable tariffs with the goal of connecting small scale renewable energy systems to lines of distribution (*feed in tariffs*) and to pay consumers the excess that is generated with renewable energy (*net metering*). But in 2012, via PNESE, the MEM promoted the first step with the consultancy of Planning for Distributed Electricity Generation (MEM, 2011f). We will describe this in further detail in 4.3.2.

Sources of renewable energy in thermal applications

Solar thermal energy and biodigestors, like other forms of renewable energy for thermal applications, have not been commercially exploited in Nicaragua satisfactorily, and they represent an important market in the years to come. For more details about aspects of access in the residential sector, please refer to 0.

To encourage these uses in all sectors – residential, commercial, and industrial – via the MEM Nicaragua followed the Global Methanol Initiative in September 2010. In its action plan for biogas

⁴⁴ www.renovables.org.ni/simernic

(MEM, 2012c), the MEM takes into account that biogas could be a substitute in the residential firewood and Liquefied Petroleum Gas (LPG) sector for cooking food, as well as providing lighting.

According to a Feasibility study carried out by HIVOS and SNV⁴⁵ (MEM / SNV, 2010) about the experience related to the use of biodigestors, it was established that between 1985 and 2010 1,512 biodigestors were constructed, of which we know that between 300 and 400 still work today.

This same study determined that the technical and economic potential for implementing biogas plants for domestic use in Nicaragua from bovine manure is 55,000 units nationally, considering farms with more than seven cows born on average.

Furthermore, in 2010, the Multilateral Investment Fund (FOMIN/BID) together with the SNV carried out a study evaluating the potential of biogas in BID/FOMIN projects, including the strategy to implement a biogas program in Nicaragua (BID, 2010). According to the latter study, in the case of the domestic potential of biogas, the total segment potential for those projects is 3,209 units between small production farmers, coffee farmers, and hotel owners located in the regions of Matagalpa, Jinotega, Boaco, Chontales, the RAAN, the RAAS, and the island of Ometepe.

According to this study, in the case of the segment potential of the biogas market for productive uses, there are an estimated total of 80,902 medium and large producers: farmers, coffee farmers, and hotel owners and a grand total of 839,906 households in Nicaragua (IDB, 2010).

Renewable energy sources in the industrial sector and productive activities

The industrial sector and productive activities are mostly connected to the SIN. Thus they operate under the same conditions described in 0.

However, it is important to highlight the prominent role of the self-producers, in general the large agricultural producers who transform their biomass excess into electricity. Generation projects from biomass residues are maintained as good level projects in terms of cost (BCIE, 2011), especially when the costs related to managing the resources are not directly related to the project of exporting electricity and are really more business components like the production of sugar


⁴⁵ www.snvworld.org

(Ingenios Monte Rosa with 20 MW to sell to the SIN , San Antonio with 22 MW, and the future CASUR⁴⁶ project with 17MW planned). This report hasn't dedicated specific attention to wood farm generation from plantations committed to the production of electricity.

Summary of the rapid analysis

The problems highlighted related to energy access, energy efficiency, and renewable energy will be developed in greater detail in this report. Here are some of the most important issues.

Based on the analysis of the current situation in Nicaragua discussed in 0, this study proposes the following rapid analysis of the subject of universal access to modern energy services. The No. 1 objective of SE4ALL is universal access to modern services. A more detailed analysis of the gaps and barriers and respective energy strategies to confront them is presented in 0.

 <p>SUSTAINABLE ENERGY FOR ALL</p>	<p>1 ENSURE <i>universal access</i> TO MODERN ENERGY SERVICES.</p>
<p>Access to energy for thermal uses</p>	<p>In rural areas, firewood is the main fuel (90%) used for cooking in the residential sector.</p> <p>The majority of rural households use inefficient stoves that are harmful to health.</p> <p>Firewood made up 46% of the Internal Primary Energy offering in 2011.</p> <p>This economic activity generated employment for 250,000 people.</p> <p>The sale of firewood in many cases is illegal, and consumer pressure contributes to the reduction of forest coverage in Nicaragua (- 40% in the past 40 years).</p> <p>In urban areas, firewood is progressively substituted by the use of LPG.</p> <p>Solar collectors for heating water are not sufficiently distributed in the country despite the technical and economic potential that they represent.</p>
<p>Access to electric energy</p>	<p>Statistics are not currently coordinated among the various actors in the sector. There are discrepancies which is why we</p>

⁴⁶ CASUR: Sugar Company of the South.

(electricity)	<p>rely on data from the MEM.</p> <p>In the period from 2006-2011, there was an increase of 18.4% in the index of rural electricity coverage, which reached 72.4% in 2011.</p> <p>It is estimated that 310,000 households didn't have access to electricity service in 2012.</p> <p>There are huge variations in coverage between rural and urban areas.</p> <p>There are fundamental differences in rates, quality, or the opportunity to one day have access to electricity service depending on the geographic location of the user.</p> <p>The small concessionaries confront various difficulties that impede their sustainability and capacity to reach more users.</p> <p>Isolated small Hydroelectric Plants (PCH) and Micro Hydroelectric Plants (MCH) run by private companies encounter many systemic difficulties.</p> <p>Many rural users suffer from the absence of adapted tariffs and don't receive the same subsidies that SIN users do.</p> <p>ENEL serves as a distributing entity to the majority of the population of RAAN and RAAS. It has managed to interconnect the majority of its networks to the SIN in recent years.</p> <p>The rest of the non-concessionary areas coincide with the areas of greatest poverty in the country, which directly influences the level of economic and social development of its inhabitants, in particular in areas of severe and high poverty. These include the RAAN, the RAAS, the areas of Río San Juan and Jinotega totaling 174,861 households without access to electricity (2005)</p>
Access to energy for the productive sector	<p>The situation of lack of energy infrastructure (port terminals, pipelines for gas, electricity grids) has historically made energy access a competitive disadvantage in Nicaragua to attract foreign investment.</p> <p>The industrial sector consumed 266.1 ktoe in 2011, which represented 12.7% with respect to final consumption that year. The agricultural sector corresponded to 1.8% of final consumption. In Nicaragua there is huge potential for the use of biogas, the production and use of biofuels, and agro-energy (generation and wood farms)</p>

Table Error! No text of specified style in document.-37 Summary of the situation in Nicaragua vs. objective No. 1 of SEALL

Source: own elaboration

Based on the analysis of the current situation in Nicaragua made in 0, this study proposes the following rapid analysis on the subject of energy efficiency regarding objective No. 2 of SE4ALL for doubling the global rate of energy efficiency. A more detailed analysis of the gaps and barriers and respective strategies to confront them is presented in 0.


 <p>SUSTAINABLE ENERGY FOR ALL</p>	<p>2 DOUBLE THE GLOBAL RATE OF IMPROVEMENT IN <i>energy efficiency</i></p>
<p>Energy efficiency in Nicaragua</p>	<p>Energy efficiency is still an emerging issue in Nicaragua: the first structural advances were made beginning in 2008.</p> <p>We should not lose sight of the importance of the residential sector and the use of firewood or the transport sector and the use of fuels that are equally or more important than the electricity sector to reaching this goal.</p> <p>The intensity of energy in Nicaragua reached 2.71 boe in 2011 (0.37 toe) /thousands USD of GDP 2005 according to OLADE, 2012.</p> <p>Recently several important steps were taken toward the market of energy efficiency which were strengthened by the PNESER project.</p>

Table Error! No text of specified style in document.-38 Summary of the situation in Nicaragua vs. objective No. 2 of SEALL

Source: own elaboration

Based on the analysis of the current situation in Nicaragua made in 0, this study proposes the following rapid analysis on the subject of greater participation of renewable sources in the SIN and in isolated areas relative to objective No. 3 of SE4ALL and doubling renewable energy sources in the global energy matrix. A more detailed analysis of the gaps and barriers and respective strategies to confront them is presented in 0.



SUSTAINABLE
ENERGY FOR ALL

3 DOUBLE THE SHARE OF
renewable energy
IN THE GLOBAL ENERGY MIX.

Renewable energy
interconnected to the system
and isolated generation

In 2011, we can see that generation from renewable sources in the SIN totaled 34.4% of the gross energy total. The preliminary figures from 2012 are near 38%.

Nicaragua is still only taking advantage of a small part of its renewable energy potential (less than 10%)

The supply of renewable energy in Nicaragua will exceed the total electricity demand, at least during the night. This is why it is extremely important that the SIEPAC begin to operate, at least nominally, so that investment in renewable energy projects interconnected to the SIN aren't suspended in a few years.

In the private sector, although there are no provisions to integrate distribution via favorable tariffs with the goal of connecting small scale renewable energy systems to lines of distribution (*feed-in tariffs*).

In terms of the participation of renewable sources in isolated electricity generation, what we can see is that the official statistics can't measure its contribution (0% in 2011 according to an INE report).

However, there is an effort on the part of the Renewables Association of Nicaragua to measure the electricity contribution of its members spread around the country.

Renewable energy sources in
thermal applications

Apart from solar thermal energy and biodigestors, other forms of renewable energy for thermal applications haven't been commercially exploited in Nicaragua.

In Nicaragua there is the potential to use biogas as a substitute for firewood in the residential sector and Liquefied Petroleum Gas (LPG) for cooking food.

Between 1985 and 2010 1,512 biodigestors were constructed, of which between 300 and 400 currently function. There is great potential for the widespread use of this technology in the rural residential sector and in rural PYMES.

A total of 839,906 households in Nicaragua could benefit from this technology.

Sources of renewable energy in
the industrial sector and

Self-producers have a predominant role (large agricultural producers) in transforming their excess of biomass into electricity.

productive activities	There is also the potential for generation from tree farms dedicated to producing electricity.
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Table Error! No text of specified style in document.-39 Summary of the situation in Nicaragua vs. objective No. 3 of SEALL

Source: own elaboration

Goals of SE4ALL for Nicaragua

In order to contribute to reaching the goals of the SE4ALL initiative, the Government of Nicaragua and its institutions need to develop and implement actions on various fronts. To support the creation or adaptation of a global strategy for reaching the objectives of SE4ALL, the following goals have been proposed for 2015, 2020 and 2030, with their main indicators.

In part 0, we will describe specific strategies for reaching these goals in the context of existing programs, and we will identify the gaps and barriers that currently impede us from achieving these goals.

Access to energy

<small>1 ENSURE</small> universal access <small>TO MODERN ENERGY SERVICES.</small>	SE4ALL goals for Nicaragua in 2015	SE4ALL goals for Nicaragua in 2020	SE4ALL goals for Nicaragua in 2030
Regularized use of firewood	10% of households and 20% of PYMES using firewood with access to legal firewood or legal charcoal	20% of households and 40% of PYMES using firewood with access to legal firewood or legal charcoal	100% of homes and PYMES using firewood with access to legal firewood and legal charcoal
Justification/Assumption: it is estimated that by the end of 2012, more than 350,000 households will use firewood as their main fuel for cooking (see 0). However, there is no baseline regarding legal and illegal use of this resource. The goal is to slowly substitute firewood as a fuel with charcoal and to regularize the sources of supply of the fuel. We would like to clarify that the term “regularize” means establishing a legal and regulatory framework for marketing firewood.			
Widespread use of solar collectors for water heating	Doubling the current use of solar thermal collectors in households, the tourist sector, and public services.	10% of urban and/or rural households equipped, 30% of hotels, 50% of hospitals and health centers	30% of urban and/or rural households, 50% of hotels, and 100% of hospitals and health centers
Justification/Assumption: we haven’t found a baseline for 2012. The products are already on sale on the market and there have been awareness programs to PYMES.			

The use of biodigestors in the rural residential sector	Launching pilot projects to promote the diffusion of biodigestors in the rural households sector	10,500 rural households equipped	200,000 rural households equipped (25% of the market total)
Justification/Assumption: it is estimated that at the end of 2012, less than 400 rural biodigestors will be functioning (see 0). However, it is projected that the market total in Nicaragua is 80,902 between medium and large producers and 839,906 households in total (see 0). The HIVOS project foresees the installation of 8,000 new biodigestors by 2016.			
Global electricity coverage	75% of households with access to electricity	85% of households with access to electricity	95% of households with access to electricity
Justification/Assumption: current coverage at a global level is at 72,4% (MEM, see 0). The objective of PNER (see 0) is to reach 82.8 (IDB) or 85.6% (MEM) in 2015. The projection leaves at least 170,000 households without access, of which 15,000/ year until 2030 could be electrified. The Central American strategy 2020 (SICA/CEPAL, see 0) proposes the goal of reaching at least 90% electricity coverage in the country.			
Electricity coverage in rural concession areas DN-DS	75% of households with access to electricity	85% of households with access to electricity with modified tariffs	95% of households with access to electricity
Justification/Assumption: see above			
Electricity coverage in rural interconnected areas served by ENEL	50% of households with access to electricity with modified tariffs	60% of households with access to electricity with modified tariffs	90% of households with access to electricity with modified tariffs
Justification/Assumption: we didn't have access to precise data. These are general estimates.			
Electricity coverage in rural areas served by interconnected PC ⁴⁷	50% of households with access to electricity with modified tariffs	60% of households with access to electricity with modified tariffs	90% of households with access to electricity with modified tariffs
Justification/Assumption: we didn't have access to precise data. These are general estimates.			
Electricity coverage in rural isolated areas in ENEL areas of influence or PC	40% of households with access to electricity with modified tariffs	50% of households with access to electricity with modified tariffs	60% of households with access to electricity with modified tariffs

⁴⁷ PC: small concessionaries

Justification/Assumption: we didn't have access to precise data. These are general estimates.			
Electricity coverage in totally isolated rural areas	10% of households with access to electricity and access to subsidies	20% of households with access to electricity and access to subsidies	50% of households with access to electricity and access to subsidies
Justification/Assumption: we based this on case studies of the RAAS (municipality of Bluefields) where there are rates of 0 to 10% coverage.			
Extension of the SIN	6,500 km of distribution lines and 2953 km of transmission, with a 20% decrease in the number of failures.	9,000 km of distribution lines and 4,513 km of transmission, with a decrease of 25% in the number of failures.	13,900 km of distribution lines and 5,067 km of transmission, with a decrease of 30% in the number of failures.
Justification/Assumption: the objective of the PNESER (see 0) is to have 7400 km of lines of distribution in operation by 2016 and 2,953 km of transmission lines by 2015, with a progressive decrease in the number of failures. Distances are projected through 2030.			
Electricity prices for vulnerable users	Regulations for the most vulnerable users (income < 40% of the median income)	Subsidies for the most vulnerable users (income < 40% of the median income)	Rates for the most vulnerable users (income < 40% of the median income)
Justification/Assumption: the price of energy for the final user is a key issue for energy access. There are conditions of costs, subsidies, technical losses, etc. that are so different between different classes of users that we propose to focus on the most vulnerable users, defined as those households whose income is lower than 40% of the median income of the country.			
Production and use of biofuels	Doubling the current use of biofuels	Substitute the consumption of 10% of all the fuels used in Nicaragua	Substitute the consumption of 20% of all the fuels used in Nicaragua
Justification/Assumption: the Central American strategy 2020 (SICA/CEPAL, see 0) proposes the goal of reducing the consumption of petroleum derivatives by 10% in public and private transport.			

Table Error! No text of specified style in document.-40 Goals proposed for Nicaragua to reach objective No.1 SEALL

Source: own elaboration

Energy efficiency

2 DOUBLE THE GLOBAL RATE OF IMPROVEMENT IN <i>energy efficiency</i>	SE4LL goals for Nicaragua in 2015	SE4ALL goals for Nicaragua in 2020	SEALL goals for Nicaragua in 2030
Efficient and sustainable use of firewood	10% of homes and 20% of PYMES use firewood with the use and appropriation of efficient technologies that use firewood or charcoal. A 3% reduction in the consumption of firewood.	30% of homes and 50% of PYMES use firewood with the use and appropriation of efficient technologies that use firewood or charcoal. A 5% reduction in the consumption of firewood.	100% of homes and PYMES use firewood with the use and appropriation of efficient technologies that use firewood and charcoal. A 10% reduction in the consumption of firewood.
<p>Justification/Assumption: it is estimated that by the end of 2012, more than 350,000 households will use firewood as their main fuel for cooking (see 0). According to the Renewable Association of Nicaragua and the MEM, more than 15,000 improved stoves have already been distributed on the market. We propose to double this quantity by 2015, with a rate of annual growth of 20%. The Central American strategy 2020 (SICA/CEPAL, see 0) proposes to reduce firewood consumption for cooking by 10% by using more efficient stoves in a million rural households in the region.</p>			
Efficient use of fuels (baseline 2012)	Reduce consumption in public and private transport by 5% (per capita)	Reduce consumption in public and private transport by 10% (per capita)	Reduce consumption in public and private transport by 20% (per capita)
<p>Justification/Assumption: the Central American strategy 2020 (SICA/CEPAL, see 0) proposes the goal of reducing by 10% the consumption of oil derivatives in public and private transport. We propose to double this rate by 2030.</p>			
Energy intensity	Reduce by 2% the electricity intensity based on the 2012 scenario.	Reduce by 5% the electricity intensity based on the 2012 scenario.	Reduce by 10% the electricity intensity based on the 2012 scenario.
<p>Justification/Assumption: macroeconomic calculation beyond the reach of this study. The idea would be to put Nicaragua progressively in line with the Central American rates and to create an indicator based on the cost of the oil bill (see Error! Reference source not found.).</p>			
Energy efficiency in the residential sector (baseline 2012)	Pilot project of 1,000 homes with smart meters and incentives for energy efficiency in 100% of the imported appliances related to the NTONs	5% of urban homes with smart meters and incentives for energy efficiency. Substitute 50% of the refrigerators. Campaigns for energy efficiency in rural areas	30% of urban households with smart meters and energy efficiency incentives. Substitution of 100% of refrigerators. Campaigns for energy efficiency in rural areas

		(ENEL, PC): 30% of households educated	(ENEL, PC): 80% of households educated
<p>Justification/Assumption: the Central American strategy 2020 (SICA/CEPAL, see 0) proposes the goal of reducing by 12% the use of electricity in the residential sector via the introduction of efficient lighting systems and by 35% the use of electricity for refrigeration in the residential sector.</p>			
<p>Energy efficiency in the commercial and industrial sector (baseline 2012)</p>	<p>By consumption range:</p> <p>>1GWh/a: 80% of companies with plans for energy efficiency</p> <p>1MWh/a – 1GWh/a: 40% of companies with plans for energy efficiency</p> <p><1MWh/a: 10% of companies with plans for energy efficiency</p> <p>Substitution de 5% of refrigerators and A/C systems</p> <p>Substitution of 5% of regulated motors⁴⁸</p>	<p>By consumption range:</p> <p>>1GWh/a: 100% of companies with plans for energy efficiency</p> <p>1MWh/a – 1GWh/a: 50% of companies with plans for energy efficiency</p> <p><1MWh/a: 20% of companies with plans for energy efficiency</p> <p>Substitution of 50% of refrigerators and A/C systems</p> <p>Substitution of 50% of regulated motors</p>	<p>By consumption range:</p> <p>1MWh/a – 1GWh/a: 80% of companies with plans for energy efficiency</p> <p><1MWh/a: 50% of companies with plans for energy efficiency</p> <p>Substitution of 100% of refrigerators and A/C systems</p> <p>Substitution of 100% of regulated motors</p>
<p>Justification/Assumption: the Central American strategy 2020 (SICA/CEPAL, see 0) propose the goal to reduce the use of electricity in the commercial and industrial sectors by 12% via the introduction of efficient lighting systems, and by 10% in electricity use in the industrial sector via efficient motors.</p>			
<p>Energy efficiency in the public sector and electricity systems (baseline 2012)</p>	<p>80% of the buildings and infrastructure of public institutions with plans for energy efficiency</p>	<p>100% of the buildings and infrastructure of public institutions with plans for energy efficiency. A 12% reduction in energy loss in the SIN, ENEL and PC networks (lighting and components)</p>	<p>20% reduction in energy losses in the SIN, ENEL and PC networks (lighting and components)</p>

⁴⁸ Motors with alternate current, three phase induction, squirrel cage type, nominal potential 0.746 to 373 kW, NTON (MEM, 2011g)

Justification/Assumption: the Central American strategy 2020 (SICA/CEPAL, see 0) proposes the goal of reducing by 12% the use of electricity in public lighting via the introduction of systems of efficient illumination and by 12% energy losses in the electricity systems of those countries.

Table Error! No text of specified style in document.-41 Goals proposed for Nicaragua to reach objective No.2 of SEALL

Source: own elaboration

Renewable Energy

<small>3</small> DOUBLE THE SHARE OF renewable energy <small>IN THE GLOBAL ENERGY MIX.</small>	SE4LL Goals for Nicaragua in 2015	SE4ALL goals for Nicaragua in 2020	SEALL Goals for Nicaragua in 2030
To take advantage of renewable sources for electricity generation (Estimation 5.5GW)	To take advantage of 10% of the renewable potential in Nicaragua to generate electricity from renewable sources	To take advantage of 15% of the renewable potential in Nicaragua to generate electricity from renewable sources	To take advantage of 30% of the renewable potential in Nicaragua to generate electricity from renewable sources
<p>Justification/Assumption: in 2012 it is estimated that at least 10% of the renewable potential will be used (see 3.3.1). Based on the MEM expansion plan, to satisfy the demand it would be necessary to install 900 MW –medium demand- until 2026, of which almost 100% would be plants based on renewable sources totaling 300 MW current renewables (hydro, geothermal, wind). Total installed potential would be 2000MW. But with the potential that Nicaragua has, 30% in 2030 would mean installing at least 500 MW additional for exportation.</p> <p>Note ENEL: “the criteria for incorporating renewable energy should go hand in hand with aspects of operational security (controlling the frequency, power, and reactive energy, among others); exports to the region can’t justify the current scenarios; the MER only has transactions on the spot market and not contracts.”</p>			
Electricity generation based on renewable sources (gross energy)	Reaching 45% of the total of gross energy produced annually	Reaching 75% of the total of gross energy produced annually	Reaching 95% of the total of gross energy produced annually
<p>Justification/Assumption: The objective of the PNESER (see 2.3.5.3) is to reach 2015 with 76.3% of generation based on renewables. The MEM estimates that in 2026, 5427 GWh will be produced based on renewable sources in a medium demand scenario (6,229 GWh in high demand). The demand covered by fossil fuel sources would be 405 GWh, which represents 7.5%, which we propose to reduce to 5% in 2030.</p>			
Distributed generation	To launch distributed generation pilot projects to perfect the technical and economic requirements that allow individual users to sell excess energy to the SIN	To have established legal, technical, and commercial mechanisms so that all Nicaraguans can sell their excess energy to the SIN	10% of Nicaraguan homes are equipped with gauges for <i>net metering</i>
<p>Justification/Assumption: we don’t have precise data, we are waiting on the results of the Consultation about this subject by the PNESER (see 0, e). They are general proposals.</p>			
Program to promote	To implement a support	To double the quantity of	30 PCH and 30 companies

rural interconnected PC, PCH and local concessionary (CL) generation	pricing policy plan to promote the sector PC, PCH and CL.	PCH and create 10 additional companies (solar, wind, biomass) for isolated generation (>1MW)	working (solar, wind, biomass) for isolated generation (>1MW)
Justification/Assumption: we don't have precise data. These are general proposals based on the recommendations of the report (FICHTNER, 2011c).			

Program to promote generation in isolated and totally isolated areas	To implement a plan of tariff and subsidy support for totally isolated areas	Creation of 10 companies (solar, wind ⁴⁹ , biomass) for isolated generation (<1MW)	30 companies working (solar, wind, biomass) for isolated generation (<1MW)
Justification/Assumption: we don't have precise data. These are general proposals based on the recommendations of the report (FICHTNER, 2011c).			
Strategic energy infrastructure for sustainable energy	SIEPAC working	Strategic infrastructure to be defined	Strategic infrastructure to be defined
Justification/Assumption: the SIEPAC is technically connected but still lacks full legal integration. It also lacks economic integration via coordinated planning with the goal of signing long-term sales contracts rather than restricting them to the spot market.			
Note ENEL: "also suggests as a condition for introducing renewable sources that they meet the requirements of the MEN and the MER related to operational security and without which the projects would not meet the required conditions in either of the markets. Additionally, it continues to be valid that due to lack of coordinated regional planning, energy sales are on the spot market and not the contract market, which could justify investment for exportation."			
Use of biodigestors in the PYMES	To launch pilot projects to distribute biodigestors in the small production sector	5,000 small and medium rural producers equipped	20,000 small and medium rural producers equipped
Justification/Assumption: it is estimated that in late 2012, at least 400 rural biodigestors are functioning (see 0). However, it is projected that the total market in Nicaragua is 80,902 between medium and large producers (see 0). We propose a growth rate of 1,000 / year, in reference to programs already carried out in this area see 0).			
Program to promote the self-production sector (baseline 2012)	Double the quantity of self-producers and create a favorable rate plan to permit smaller companies to be viable when the generate using renewable fuels	To reach 100 MW of the generation capacity of self-producers	To reach 200 MW of the generation capacity of self-producers

⁴⁹ For more details about the potential of small isolated wind power in Nicaragua, see (Marandin / Craig / Casillas / Leary, 2013)

Justification/Assumption: we don't have precise data. These are general proposals.

Table Error! No text of specified style in document.-42 Goals proposed for Nicaragua to reach objective No. 3 of SEALL

Source: own elaboration

Section 3: Challenges and opportunities to reach the objectives of SE4ALL

Institutional framework and policy design

Energy and development

The current regulatory framework in the energy sector has its legal basis in the Constitution of Nicaragua (CPE) that specifies responsibilities for the development of the sector, recognizing the duty of the State to promote social progress including energizing isolated areas to guarantee the development of citizens under dignified conditions. This includes avoiding discrimination against citizens with respect to electricity and energy in general.

At the institutional level, for the sector of firewood and agricultural fuels, the primary role of MARENA and MAGFOR/INAFOR is evident.

In relation to rural electrification, institutional matters and policy design are two essential subjects. First, the need to regulate all activity related to rural energy supply, public or private, of any energy or population size (commercial, charitable, promotional, etc.). Second, the necessity to make current regulations more flexible in the sense of allowing electricity supply entities to participate in other activities related to the provision of services and supply of equipment for productive, social, or domestic energy use, actions that should be taken care of by the INE and the MEM according to their competences (FICHTNER, 2011a). Other relevant actors are the FODIEN (ENATREL) and ENEL.

The distortions and failures of the market and of public policies on rural energy issues are known factors and they have already had disappointing effects on the process of widening the energy frontier in Nicaragua. Levels of energy consumption in the country are generally so low that there is no way to achieve a minimum administrative rationality if their various activities are not brought together under single management, for example, different services or related services and supplies.


The institutional framework and design policies of energy efficiency are concentrated in the MEM for the creation of technical rules (Office of Energy Efficiency), the proposal of strategy and public

policies, and the measurement of results. The MEM has received support from international cooperation in this area as has been the case with USAID, GEF, BUN-CA.⁵⁰

Finally, the institutional framework and design of policies to promote renewable sources is also concentrated in the MEM (General Office of Renewable Energy Resources) for proposed strategy and public policy performance measurement.

Thermal energy for residential uses

Based on the goals proposed by the SE4ALL initiative in 0, we will describe the relevant institutional framework for each strategic area and existing or planned public policies for thermal energy for residential uses.

	Legal-institutional framework	Relevant plan(s)
Rational use of firewood	MARENA MAGFOR INAFOR	National survey on firewood (MEM, 2007) Strategy for firewood (MEM, 2011b)
Use of biodigestors in the rural residential sector	MEM: Law 532 (Government of Nicaragua, 2005) MARENA	Biogas plan (MEM, 2012c)
Mass use of solar collectors for water heating	MEM / Law 532 (Government of Nicaragua, 2005) MHCP /Finance law	There are no specific plans In general: the MEM Action Plan (MEM, 2012b)

⁵⁰ www.bun-ca.org

Table Error! No text of specified style in document.-43 Institutional and legal framework for strategic areas SEALL, objective No. 1 – thermal residential energy

Source: own elaboration





 	Legal-institutional framework	Relevant plan(s)
Efficient and sustainable use of firewood	See Table Error! No text of specified style in document.-43	See Table Error! No text of specified style in document.-43
Efficient use of fuels	MEM, Government decree 2008 (Government of Nicaragua, 2008)	Hydrocarbon strategy In general: the MEM action plan (MEM, 2012b)

Table Error! No text of specified style in document.-44 Institutional and legal framework for strategic areas SEALL, objective No.2 – residential thermal energy

Source: own elaboration


Electricity sector

 	Legal-institutional framework	Relevant plan(s)
Global electricity coverage	MEM, INE : Law 272 (Government of Nicaragua, 1998) Law 532 (Government of Nicaragua, 2005) Law 554 (Government of Nicaragua, 2005b)	MEM Action Plan (MEM, 2012b) PNESER Program (MEM, 2011d)
Electricity coverage in rural concession areas DN-DS	MEM, FODIEN / ENATREL	MEM Action Plan (MEM, 2012b) PNESER Program (MEM, 2011d)

Electricity coverage in rural interconnected areas served by ENEL	MEM, ENEL, INE	Strategic Plan PNESER (FICHTNER, 2011c)
Electricity coverage in rural interconnected areas served by PC	MEM, INE, FODIEN	Strategic Plan PNESER (FICHTNER, 2011c)
Electricity coverage in rural isolated areas, areas of influence ENEL or PC	MEM, ENEL, INE, FODIEN	PLANER Strategic Plan PNESER (FICHTNER, 2011c)
Electricity coverage in totally isolated rural areas	MEM, FODIEN	PLANER
Strategic energy infrastructure for sustainable energy	MHCP, MEM	PNDH (Government of Nicaragua, 2012)
Price of electricity	MEM, INE. Law 272 (Government of Nicaragua, 1998) Law 532 (Government of Nicaragua, 2005) Law 554 (Government of Nicaragua, 2005b)	PNDH (Government of Nicaragua, 2012)

Table Error! No text of specified style in document.-45 Institutional and legal framework for the strategic areas of SEALL, objective No. 1 – electricity sector

Source: own elaboration

	Legal-institutional framework	Relevant plan(s)
Energy efficiency in the residential sector	MEM, Decree 2008 (Government of Nicaragua, 2008)	Component 5 PNESER (MEM, 2011e)

Energy efficiency in the commercial and industrial sector	Decree 2008 (Government of Nicaragua, 2008)	Component 5 PNESER (MEM, 2011e)
Energy efficiency in the public sector	Decree 2008 (Government of Nicaragua, 2008)	Component 5 PNESER (MEM, 2011e)

Table Error! No text of specified style in document.-46 Legal and institutional framework for the strategic idea SEALL, objective N°2 – electricity sector

Source: own elaboration


	Legal-institutional framework	Relevant plan(s)
Take advantage of renewable energy sources for electricity generation (Estimate 5.5GW)	MEM, INE : Law 272 (Government of Nicaragua, 1998) Law 532 (Government of Nicaragua, 2005)	MEM Action Plan (MEM, 2012b) PNESER (MEM, 2011e)
Generation based on renewable sources for gross energy	MEM, INE : Law 272 (Government of Nicaragua, 1998) Law 532 (Government of Nicaragua, 2005)	MEM Action Plan (MEM, 2012b) PNESER (MEM, 2011e)
Distributed generation	MEM/ Doesn't exist	MEM Action Plan (MEM, 2012b) PNESER (MEM, 2011e) y (MEM, 2011f)
Program to promote rural interconnected generation by PC, PCH and local concessionaries (CL)	MEM/ Doesn't exist	Doesn't exist
Program to promote isolated generation in totally isolated areas	MEM/ Doesn't exist	Doesn't exist

Table Error! No text of specified style in document.-47 Legal and institutional framework for the strategic idea SEALL, objective N°3 – electricity sector

Source: own elaboration

Commercial energy for productive sectors



 	Legal-institutional framework	Relevant plan(s)
Production and use of biofuels	MEM: Law 532 (Government of Nicaragua, 2005) MARENA Executive Decree No. 42-2006	Biogas plan (MEM, 2012c) and Firewood and Biofuels Strategy (MEM, 2011b)

Table Error! No text of specified style in document.-48 Legal and institutional framework for the strategic idea SEALL, objective No. 1 – productive sector

Source: own elaboration

 	Legal-institutional framework	Relevant plan(s)
Use of biodigestors in the productive rural sector (PYMES)	MEM: Law 532 (Government of Nicaragua, 2005) MARENA	Plan de biogas (MEM, 2012c)
Program to promote the self-producing sector (baseline 2012)	MEM: Law 532 (Government of Nicaragua, 2005)	The date is not yet available

Table Error! No text of specified style in document.-49 Legal and institutional framework for the strategic goal SEALL, objective No. 3 – productive sector

Source: own elaboration

National Auditing Framework for SE4ALL

The Ministry of Energy and Mines (MEM) has taken the lead in implementing the SE4ALL Initiative in Nicaragua, and is currently in the process of regularizing their role as the focal point of the initiative.

The institution in the Nicaraguan institutional framework that will have the mission to audit the objectives of the SE4ALL Initiative hasn't been identified yet, although the most natural candidate would be the MEM:

The Directorate General of Renewable Energy Resources; and

The Directorate of Energy Efficiency;

given that they are the ones who carry out initiatives related to energy efficiency and renewable energy programs.

Programs and financing

Below in chronological order we present a selection of the programs and opportunities for financing for Nicaragua in recent years:

Thermal energy

FOMIN / SNV / HIVOS

The Study of evaluation of biogas potential in IDB/FOMIN projects and the implementation strategy for the biogas program in Nicaragua were carried out in 2010 (BID, 2010). According to the study, from 1992 to 2006, around 500 biodigestors were constructed and installed in Nicaragua sporadically and on a small scale, mainly for domestic use and in small coffee and livestock farms. In 2007, the subject was taken up by the government via the productive food program “Zero Hunger,” and it installed 800 biodigestors as part of an aid package for poor families on a domestic level. This effort has been complemented by the program account Millennium Challenge (CRM), that has installed 260 biodigestors. The sources of external financing that have supported this effort are mainly: GTZ, OLADE, NOVIB, SNV, AID and the United States with the CRM.

The results of this study contain the basis for developing an initiative to promote the birth of a market for the production of biogas in Nicaragua, which they recommend be addressed in two ways: domestic and productive.

PREPCA

The Regional Program for Energy and Poverty in Central America (PREPCA⁵¹) is part of the Renewable Energy Program of HIVOS during the 2011-2015 period. It is oriented to maximize and manage resources with a multi-stakeholder approach and the goal of achieving greater integration in energy management in productive processes. Its execution is part of the HIVOS Renewable Energy Program.

The General Objective is to develop sustainable energy markets (low voltage) to improve the quality of life for the most vulnerable populations in Central America with an emphasis on Nicaragua and Guatemala. Among its objectives for productive uses of energy is a program to support the diffusion of biodigestors and eco-stoves (improved stoves). At this date, the amounts available for this activity aren't known.

ECPA

The *Energy and Climate Partnership of the Americas* (ECPA⁵²) Program was launched in 2009 under the initiative of the Obama administration and the United States. In 2012, and via a project run by

⁵¹ <http://programaprepca.wordpress.com/>

⁵² <http://www.ecpamericas.org/>

the NGO Tress Water & People, Power Mundo, it began an initiative with the objective of creating synergies in learning and fighting against deforestation, which allowed it to contribute to an increase in the use of eco-stoves in Central America. In Nicaragua, these activities are channeled through the NGO Proleña.⁵³ At this date, the amounts available for these activities aren't known.

Electricity sector: programs and financing for improved access, energy efficiency, and renewable energy

PERZA

The World Bank and the Swiss Corporation financed the Rural Electrification Program in Isolated Areas (PERZA) in Nicaragua. The project, which cost 19 million USD, was financed with 12 million USD from the Bank during the initial period from 2003 to 2008, but it was extended and then ended on December 31, 2011.⁵⁴ The main objective of the project was to support the sustainable supply of electricity service and the social and economic benefits associated with it to select rural sites in Nicaragua and to consolidate the institutional capacity of the government to implement a national strategy for rural electrification. It was carried out via FODIEN and resulted in the creation of several PCHs, see 0 c) y d).

PELNICA

The Canadian Agency for International Development (CIDA) has allocated financial resources of approximately 18,950,000 dollars and the government of Nicaragua contributed \$ 1,500,000 to carry out the electrification project in Nicaragua (PELNICA) to promote the Government of Reconciliation and National Unity via the Ministry of Energy and Mines. The objective of this project is to electrify rural communities that historically haven't had electricity service, mainly those in areas in the north of the country.

The project, carried out by the Ministry of Energy and Mines of the Government of Nicaragua, is expected to be implemented between 2009 and 2014, and its objective is to facilitate access to electricity for approximately 102,000 people in more than 650 communities. The results obtained since March 2012 include: 14,367 homes have been connected to the electricity network and 86,202 men, women, and children have access to electricity in 293 communities. In addition to providing electricity, this project offers training and technical assistance related to gender equality and developing a business plan. A total of 1,960 participants (1,445 women and 515 men) have participated in these workshops to date. The project coordinates its efforts with local actors via

⁵³ <http://www.prolenaecofogon.org/>

⁵⁴

<http://web.worldbank.org/external/projects/main?Projectid=P073246&theSitePK=2748767&piPK=64624214&enabledHL=TRUE&pagePK=64283627&menuPK=2804981&Type=Overview&hIPK=2810751>

the creation of a network of more than 40 members to support economic development in the beneficiary communities.

MASRENACE

The Program for the Sustainable Management of Natural Resources and the Development of Business Skills (MASRENACE) is driven by different Nicaraguan organizations in the Environment and Rural Development sectors with assistance from the German Cooperation (GIZ). It aims to help the rural population manage its natural resources sustainably in and around forests. MASRENACE promotes the development and strengthened capacity of public and civil society institutions in Nicaragua and provides training, technical assessment, and support to implement measures in different municipalities and indigenous territories. The program entered its third and final phase of implementation (April 2011 - December 2013). The main challenge of this phase consisted of guaranteeing the sustainability of those efforts during the last years. During the first half of 2011, the Program shut down its activities in the southeastern region and concentrated on RAAN and institutions at a central level.⁵⁵

PCH Program

The project “Productive uses of small-scale hydroelectricity,” more commonly known as “Small Hydroelectric Plants PCH” began in 2003 at the initiative of the Government of Nicaragua and with the support of the Global Environment Fund (GEF), the United Nations Development Programme (UNDP) and the Swiss Cooperation. The World Bank and the Government of Holland joined the program too. Throughout the project, the Swiss Cooperation has become one of the main donors and has pledged approximately 5.8 million dollars between 2003 and 2008, for a total investment of 19 million USD (Swiss Cooperation, 2009). From 2005 to 2010 the use of electric lighting by families increased 445%. The commercial sector increased 200% and welding and metal working 800% during the same period. The project has contributed to the improvement and/or construction of eight Small Hydroelectric Plants PCH: El Bote, Wanawas, Rió Bravo and El Naranjo. In total they have benefited some 10,000 families.

EnDev Program

The EnDev⁵⁶ program is financed by a number of European countries, Australia, and the European Union and is managed by the German Cooperation (GIZ) and the Holland Agency for Development (Dutch NL Agency). Globally, 181 million Euros have been committed. Its main objective is to provide access to energy for homes, social institutions, and small and medium sized companies in developing countries in Africa, Asia, and Latin America via the creation of sustainable and economic energy solutions and distribution patterns mainly in rural communities. It is in progress, and it has mainly provided funding grants for isolated photovoltaic projects in Nicaragua.

⁵⁵ <http://masrenace.wikispaces.com/>

⁵⁶ <http://endev.info/>

European Union Programs

The Delegation in Nicaragua hasn't currently defined any type of Plan or concrete Strategy related to the energy sector or climate change in Nicaragua. Currently it is defining the Strategic Country Report for the 2014-2020 period where it will be specific about the field of Climate Change. This document is still in a draft version. However, it should be clarified that the EU has a clear and strong commitment at the global level and especially in Latin America when confronting climate change.⁵⁷ With the clear objective of seeking sustainable economic development, among other issues, actions have been developed in different areas such as: promoting the use of renewable energy (see the example of the regional program EUROSOLAR), the improvement in energy infrastructure (security, energy efficiency, energy savings, etc.) and protection of the environment including the promotion of technologies to adapt to climate change (see the LAIF program), the development of specialized expertise in climate change (EUROCLIMA program), etc.

Project EUROSOLAR (2008-2012) is in the process of ending in Nicaragua, which has contributed 1,767,517 EUR for Nicaragua. The main objective of the project was to provide a source of renewable electricity strictly for community use to rural communities that lacked access to the electricity grid. In each community they installed a standard kit made up of photovoltaic panels and an aerogenerator to produce energy. The system also included systems for telecommunications, community lighting installations, computer equipment, a refrigerator for vaccines, a battery charger, and a water treatment system. In Nicaragua they carried out 42 installations in an equal number of communities in the RAAN in the municipalities of Siuna (7), Rosita (3), Bonanza (3), Puerto Cabezas (3), Waspán (22) and Prinzapolka (4).

The PNER – LAIF is being implemented (a program for sustainable electrification and renewable energy in Nicaragua) with the support of 7 MEUR to PNER in the 2013 to 2015 period. LAIF's grant supports the strengthening the transmission system in rural areas and the connection to electricity produced from renewable energy.

AEA

The Alliance for Energy and Environment with Central America is an initiative that began in 2002 with the objective of promoting renewable energy in Central American countries to contribute to sustainable development and mitigate global climate change. This effort began with the Ministry of External Affairs of Finland in coordination with the Central American Integration System, (SICA) and the Central American Commission for Environment and Development (CCAD) and since February 2007, the incorporation of the Austrian Cooperation and the European Union. It offers support mainly for generation projects of solar energy, wind, small hydroelectric plants, bioenergy and geothermal energy; and to accomplish this it collaborates with governmental institutions, NGOs, and the private sector. The program is projected to end June 30, 2013, and its global contribution was 19.5 MEUR (the contribution of the EU was 1.5 MEUR).

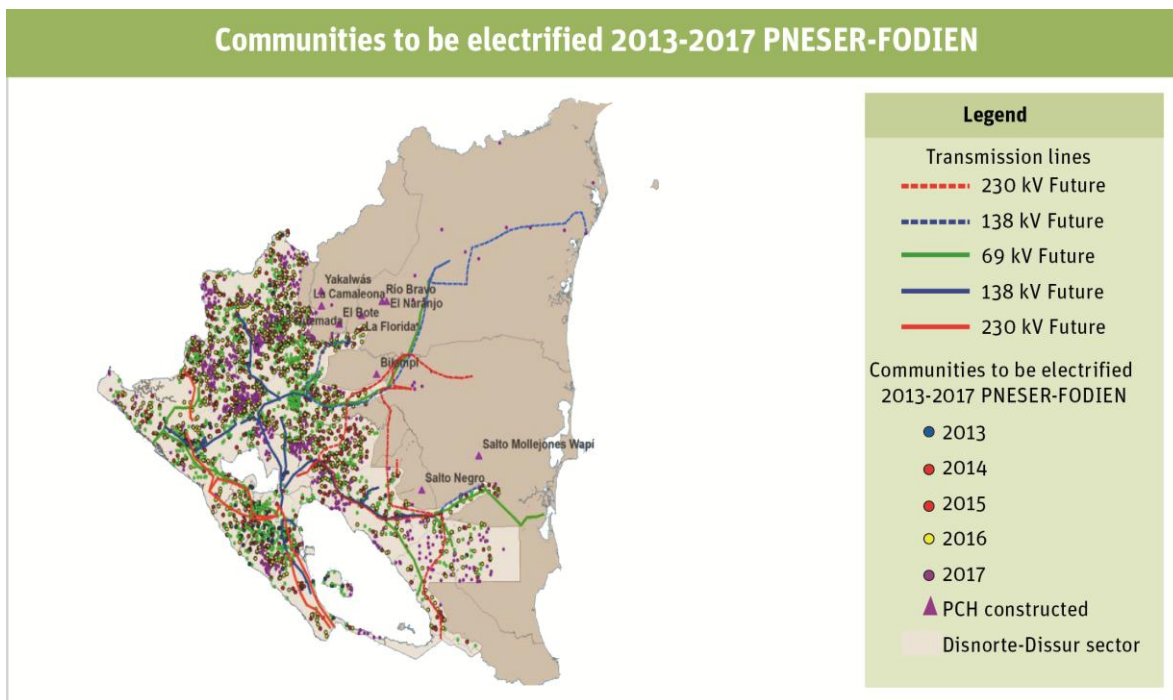
⁵⁷ http://ec.europa.eu/europeaid/news/agenda_for_change_en.htm

USAID

As of this date, we have not been able to obtain any information. See ECPA.

PNESER

For the next five years, the PNESER Program, currently being implemented, will support the efforts of the Government of Nicaragua to give access to efficient electricity service to a significant portion of the population. Its cost reaches 418,700,000 USD. PNESER seeks to have a transformation effect on electricity coverage on a national level by significantly increasing the rate of electricity service coverage while also taking into account the scarcity of the use of Renewable Energy (RE) and the promotion of Energy Efficiency (EE) in Nicaragua. The program is financed by a group of bilateral and multilateral organizations led by the Inter-American Development Bank (IDB) and including FND, KEXIM, LAI, BEI, BCIE, JICA, OFID and the Government of Nicaragua, among others. In terms of increased electricity coverage, the following graph shows the goals to be achieved representing 117,390 households in 3,666 communities in rural areas.



Graphic Error! No text of specified style in document.–35 Communities slotted for electrification projects in the 2017 expansion plan

Source (MEM, 2012b)

For more information about the PNESER Program, see 0 .

Commercial energies for productive uses: programs and financing to improve access, energy efficiency, and renewable energy

Program for Energy Efficiency and Renewable Energy in Central America (LAIF)

The program (EEERC / LAIF) has been designed to facilitate PYME access to sources of financing to carry out investment projects related to the reduction of energy consumption, efficient energy systems, and technology to produce energy from renewable sources. This is currently being implemented at a total cost of 36.3M€, under the leadership of KfW.⁵⁸

National program for energy efficiency (PNESER Component 5)

Component 5 of PNESER supports the implementation of energy efficiency destined to reduce the demand for power and current energy consumption in Nicaragua, fundamentally in refrigeration and lighting in various consumption sectors.

It has 17.2 million USD assigned to PNESER, of which 2.6 million are provided by the IDB.

It is currently implementing a consultancy focused on elaborating policies for the final use of electricity and points to (MEM, 2011e):

- i) institutional strengthening of public entities that implement actions in this area and to different consumption sectors;
- ii) the transformation of the technological park (the introduction of efficient electric equipment);
- iii) the promotion and strengthening of capacity for users to select efficient equipment; and
- iv) the promotion of investment in the area of energy efficiency.

In addition, the formulation of a National Program for Energy has been proposed. It would encourage savings and the efficient use of energy in different consumption sectors.

Program CPmL

The Center for Cleaner Production of Nicaragua (CPmL-N⁵⁹) promotes sustainable development. It established the National University of Engineering (UNI) in 1998, on the initiative of the United Nations Industrial Development Organization (UNIDO) as part of the Program “Center for Cleaner Production.” It recently implemented an auditing project in the private sector, and it estimates the following margins of potential savings, by use:

⁵⁸ <http://www.kfw-entwicklungsbank.de/>

⁵⁹ <http://www.pml.org.ni/>

Potential savings in the private sector, use - 2012

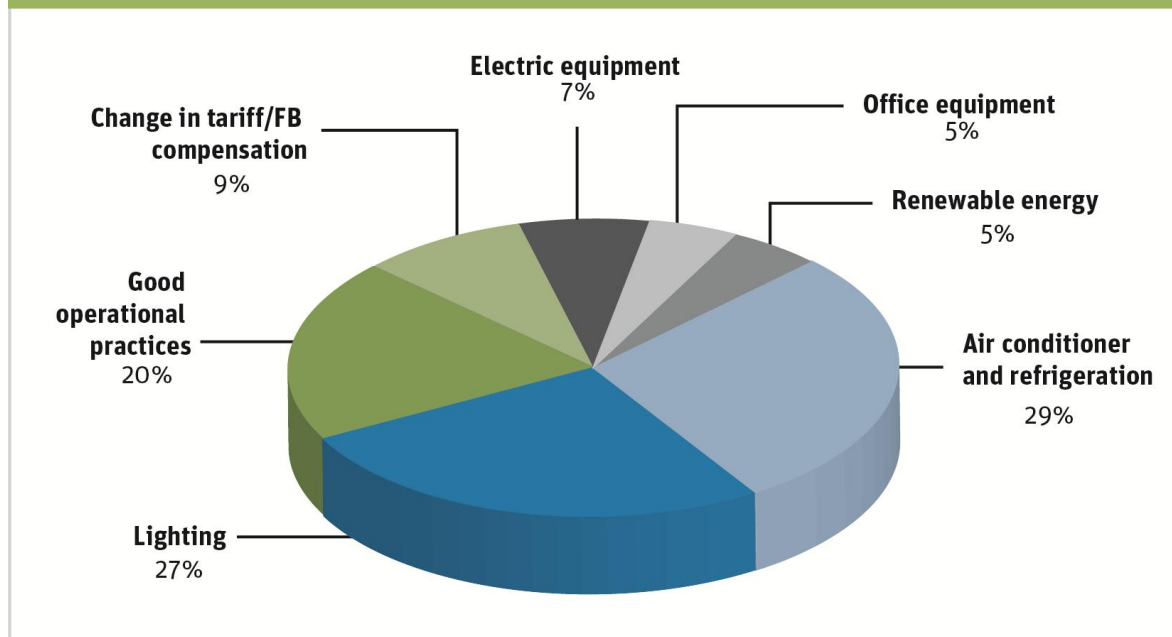


Gráfico Error! No text of specified style in document.-36 Potencial de ahorro en el sector privado, por uso - 2012

Fuente: CPmL⁶⁰

The CPmL is not a financing entity, but it can support processes and offer services for future energy efficiency projects.

Program 4E

The objective of this program of the Renewable Energy and Energy Efficiency in Central America Program (4E⁶¹) is to improve the implementation of strategies for the diffusion of renewable energy (RE) and energy efficiency (EE) measures, and to increase investment in ER and EE.

The focus of the program during the first phase (2010 -2013) centers on El Salvador, Costa Rica and Honduras. According to identified demand, the measures carried out will be replicable in the region. At this date it still hasn't begun in Nicaragua.

Private investment and business environment

Thermal energy in the residential sector

The ECPA Program mentioned proposes subsidies of up to 25% for the sale of improved stoves in Nicaragua.

⁶⁰ CPmL: Center for Cleaner Production, Nicaragua.

⁶¹ <http://www.energias4e.com/elprograma.php>

The PREPCA – HIVOS Program is in the stage of designing its strategies to improve the markets for better stoves and biodigesters in Nicaragua.

Electricity sector

Distributed generation

Via PNER, there is currently a consultancy being carried out under the control of the MEM that has the objective of modeling and proposing a rule or standard for technical, commercial, and administrative conditions, which allows the implementation of a blueprint for Distributed Generation in Nicaragua (MEM, 2011f).

This initiative includes electricity generation systems that expand coverage, self-consumption or an increase in energy efficiency based on natural renewable resources with a nominal potential of less than 1 MW connected to the national electricity system via distribution networks of concessionary companies. The expected result would be an increase in the creation of sources for economic development that contribute to the growth of electricity demand in the country affecting the social environment and changes in the national energy matrix to reduce the high dependency on electricity generation from fossil fuels.

In the case of Nicaragua, in particular for Isolated Areas, this method is not yet considered viable given the low earnings of the population in said regions (FICHTNER, 2011a). However, for urban users with greater buying power, the implementation of energy credits is being considered and could spark the photovoltaic solar market and other distributed generation technologies (micro hydroelectric plants in some cases, small-scale wind turbines).

SIEPAC

The infrastructure of the SIEPAC⁶² Project consists in implementing the First System of Regional Electricity Transmission to reinforce the electricity network in Central America (Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panamá). The promised current cost of the project reaches 494,000,000 USD. Financing for this program comes from a Technical Cooperation of the Inter-American Development Bank (IDB) and complimentary financing from BCIE.

⁶² <http://www.eprsiepac.com/>

Commercial energies for productive uses

Among the supply of credit to support renewable energy for the productive sector, we can list the following opportunities to date:

At a regional level:

BID / FOMIN

BCIE / Program of MIPYMES Green

At the level of the national bank:

ProCREDIT / Fund for green credits

LAFISE / Unit for renewable energy projects

BANPRO / Unit for renewable energy projects

At the level of national micro-financers:

ASOMIF

PRODESA

FODENIC

Asociación Alternativa

Caritas Estelí

CEPRODEL

Cooperativa 20 de Abril

Fondo de Desarrollo Local

FUNDENUSE

FUNDESER

MiCredito

Prestanic

Barriers and gaps that separate us from the SE4ALL objectives

Objective SE4ALL No. 1: access to universal energy

Access to thermal energy in the residential sector

Based on an analysis of the current situation in Nicaragua made in 0 and looking toward the goals proposed to achieve the SE4ALL objectives displayed in 0, this study proposes the following rapid analysis of the barriers and gaps to energy access for thermal uses (cooking, heating, heating water) in Nicaragua concerning the No. 1 SE4ALL objective of universal access to modern energy services and related to strategies for confronting them.

1 ENSURE universal access TO MODERN ENERGY SERVICES.		1.1 / To ensure universal access to modern energy services-thermal uses: cooking, heating, and heating water		
Relevant subjects		Gap/Barrier	Strategy	Actors
Rural area - firewood	Access to legal and sustainable fuel	Gap: a lot of wood is sold in an illegal and unsustainable manner Barrier: no legal framework has been adopted	Organize and regulate the supply chain	MEM, MARENA private sector
	Access to technologies that don't harm health	Gap: there is very little introduction of improved stoves in rural areas. Barrier: incentives adapted for this subsector	To promote and incentivize improved stoves. See the proposal of Reform to law 532 (Renewable Association of Nicaragua, 2012)	MEM, MHCP, NGOs, private sector
Rural and urban area - firewood	Improve the productive chain of firewood and charcoal - Line 1 (MEM, 2011d)	Gap: the charcoal sector is new Barrier: the sector of firewood sales is informal and disorganized	To form integrated and responsible organizations in the value chain. To organize women to form firewood and charcoal associations.	MAGFOR, INAFOR MARENA, MEM, NGOs, private sector
Rural	Mass use of	Gap: many rural	To select the areas with the	MAGFOR,

area – biogas	biogestores for the residential sector in rural areas	biogestores have been abandoned for a lack of models that are technically reliable and economically viable Barriers: there is not much local expertise to universalize its use. There is still not a functional value chain.	greatest potential for the conditions of the number of homes-farms available, firewood consumption, and capacity to produce milk. Then impact neighboring households of the poorest to encourage and incorporate that segment. (SNV / HIVOS, 2010)	INAFOR MARENA, MEM, NGOs, private sector
Urban area - GLP	Urban planning for the LPG supply	Gap: the supply of LPG, carried out by the private sector, operates without planning or coordination	To promote urban planning in the large urban centers for the supply of LPG including the potential of constructing dedicated infrastructure	Government, MEM, AMUNIC
Rural and urban area – thermal solar	Universalization of the use of solar thermal collectors in the residential sector and PYMES	Gap: there has been very little penetration of collectors in the market Barriers: the current legal framework does not exonerate this technology. There are no other types of subsidies or incentives to promote its diffusion.	To include a strategy to promote the use of solar thermal devices in future reforms of law 532 (Government of Nicaragua, 2005b)	MEM, MHCP, private sector

Table Error! No text of specified style in document.-50 Rapid analysis of the gaps and barriers to access to energy for thermal uses vs. objective No. 1 of SE4ALL

Source: own elaboration

Access to electricity

Based on the analysis of the current situation in Nicaragua made in 0 and looking at the goals proposed to reach the objectives of SE4ALL discussed in 0, this study proposed the following rapid analysis of the gaps and barriers to electricity access in Nicaragua concerning objective No. 1 of SE4ALL, universal access to modern services, and the respective strategies to face them.

1 ENSURE universal access TO MODERN ENERGY SERVICES.	1.2 / To ensure universal access to modern energy services – electricity
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Relevant subjects		Gap/Barrier	Strategy	Actors
ZC / DN - DS	Electricity coverage	Gap: average electricity coverage varies between 30% and 99% Barrier: private investment	Extension and densification, via loans	MEM Distributors
ZCPCI	Electricity coverage	Gap: average electricity coverage is between 40% and 50% Barrier: private and public investment	To establish incentives for rural electrification via the establishment of a Rural Electrification Bond and a Fund for Equality, to open the rules of the electricity sector up to different categories of providers and users of electricity. To strengthen all the PC, including the central role of ENEL for the RAAN and RAAS. (FICHTNER, 2011c)	MEM, ENEL, private sector, Beneficiary communities
ZCI	Electricity coverage	Gap: average electricity coverage is between 40% and 50% Barrier: public investment		
ZAD	Electricity coverage	Gap: average electricity coverage is below 30% Barrier: public investment		
All areas with networks	Distribution service	Gap: the quality of distribution networks affects rural users Barrier: the lack of application of penalties for not respecting regulations about the quality of service	Massive investment in improved rural distribution networks Implementation of penalties for not complying with quality of service	MEM Distributors
ZTA	Electricity coverage	Gap: average electricity coverage is below 20% and in many cases is 0% Barrier: the absence of universal social programs	Massive support program with technical solutions adapted for the socio-economic reality. They can be SFV, MCH or biodigesters. State subsidies will be necessary. To establish complimentary rural regulations for Isolated Areas.	MEM, NGOs, private sector, Beneficiary communities

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Table Error! No text of specified style in document.-51 Rapid analysis of the gaps and barriers to electricity access vs. objective No. 1 of SE4ALL

Source: Own elaboration

Energy access in the productive sector

Based on the analysis of the current situation in Nicaragua made in 0 and looking at the goals proposed to reach the SE4ALL objectives shown in 0, this study proposes the following rapid of the gaps and barriers to energy access for use in the productive sector in Nicaragua concerning SE4ALL objective No. 1 of universal access to modern services, and the respective strategies to confront them.

1 ENSURE universal access TO MODERN ENERGY SERVICES.		1.3 / To ensure universal access to modern energy services – uses of the productive sector		
Relevant subjects		Gaps and Barriers	Strategy	Actors
Biogás	Universalization of the use of biodigestors for rural PYMES	See Table Error! No text of specified style in document.-50.		
Electricity Prices	Price of electricity	Gap: the average price for rural users is higher than in other Central American countries Barrier: current dependence on fossil sources, limited generation capacity	Change in the energy mix, promotion of long-lasting and worthwhile projects Possibly energy bids based on production prices	MEM, INE
Bio - combustibles	Production and use of biofuels and agroenergy	Gap: there is very little production and diffusion of biofuels Barrier: there is not a value chain for the universalization of its use	To establish and launch a National Plan for Biofuels and Agroenergy	MEM

Table Error! No text of specified style in document.-52 Rapid analysis of the gaps and barriers to energy access for productive uses vs. objective No. 1 of SE4ALL

Source: own elaboration

Objective SE4ALL N°2: energy efficiency

Based on the analysis of the current situation in Nicaragua made in 0 and looking at the goals proposed to reach the objectives of SE4ALL seen in 0, this study proposes the following rapid analysis of the gaps and barriers to improving energy efficiency concerning objective No. 2 of SE4ALL of doubling the rate of improvement in global energy efficiency and the respective strategies to confront them.

2 DOUBLE THE GLOBAL RATE OF IMPROVEMENT IN <i>energy efficiency</i>		2 / Double the global rate of improvement in energy efficiency		
Relevant subjects		Gaps and barriers	Strategy	Actors
Rural area - firewood	Efficient use of fuel	Gap: almost nonexistent value chain for charcoal Barrier: Financing for programs to promote it	To promote the creation of production companies of charcoal, to support incentives and technical training	MEM, Private sector
	Efficient use of cooking devices	Gap: little diffusion of improved stoves Barrier: financing of universalization programs	To promote and incentivize improved stoves	MEM, MHCP, NGOs, private sector
Multi-Sector - firewood	Improvement of energy efficiency and the use of firewood and charcoal in homes and industries - Line 4 (MEM, 2011d)	Gap: there is no systematic practice of energy efficiency in the use of biomass fuels in productive sectors Barrier: nonexistent value chain and adopted legal framework	To increase the current level of efficiency to reduce energy consumption by 2020 by 10% in cooking food and 3% in artisanal industries	MEM, Academy, NGOs, private sector
Multi-Sector - firewood	Research for the sustainable development of production, sale, and transformation of efficient firewood and charcoal - Line 6 (MEM, 2011b)	Gap: there is not sufficient management of technologies and practices for the efficient use of biomass Barrier: financing research programs	To improve knowledge and promote information to increase the productive base of the biological capital of forests and related technologies to promote energy efficiency in the use of firewood	INTECFOR, INATEC, MEM, CONICYT, Academy, NGOs, private sector
Sector	Efficient use of water	Gap: the urban sector,	Incentivize the progressive	MEM, private

urban - solar	heating devices	there is not much diffusion of solar thermal collectors despite their savings advantage Barrier: the cost of initial investment	substitution of electric devices with solar thermal collectors	sector
EE residential sector	Change the habits of residential users	Gap: there isn't a culture of EE in households Barrier: financing programs for education	To implement campaign activities of the National Plan for Energy Efficiency just as foreseen in the PNER. To distribute smart meters.	MEM, private sector, end users
EE private sector	To improve the practices of productive users (PYMES)	Gap: there is no culture of EE in the PYMES Barrier: subsidies, financing programs to replace equipment	To implement campaign activities of the National Plan for Energy Efficiency just as foreseen in the PNER. To establish incentives. To distribute smart meters.	MEM, private sector, IMFs, Banks
EE public sector	To improve the practices of public users	Gap: the savings plan has not been implemented in rural municipalities, health centers, etc. . Barrier: education programs, subsidies, financing programs to replace equipment	To implement campaign activities of the National Plan for Energy Efficiency just as foreseen in the PNER. To distribute smart meters.	MEM, public sector
Public sector	Application	Gap: there are technical regulations but they aren't respected Barrier: the lack of equipment and ability to check actual consumption of equipment	To establish a national center of expertise and verification	MEM
Transpo	National plan for energy efficiency for the	Gap: there is not a frame of reference for	To launch a program for new regulation for	MEM

rt	transport sector	EE in the transport sector and to impose per vehicle consumption characteristics Barrier: established policies and capacity to confirm the real consumption of vehicles	imported vehicles. Taking into account the need to replace the fleet. To coordinate with the national center of experts and verification (see above)	
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Table Error! No text of specified style in document.-53 Rapid analysis of the gaps and barriers to energy efficiency vs. SE4ALL objective No. 2

Source: own elaboration

Objective SE4ALL No. 3: renewable energy

SIN and isolated areas

Based on the analysis of the current situation in Nicaragua made in 0, and looking at the goals proposed to reach the SE4ALL objectives seen in 0, this study proposes the following rapid analysis of the gaps and barriers to the greater participation of renewable sources in the SIN and in isolated areas concerning SE4ALL objective No. 3 of doubling renewable energy sources in the global energy mix and the respective strategies to confront these.

3 DOUBLE THE SHARE OF renewable energy IN THE GLOBAL ENERGY MIX.		3.1 / Double the participation of renewable energy sources in the global energy mix – SIN and isolated areas		
Relevant subjects		Gaps and barriers	Strategy	Actors
Renewable sources	Take advantage of the potential	Gap: only take advantage of 8% of renewable sources in Nicaragua Barrier: projects, foreign investment	To keep the current direction of the PNDH steady and with the Energy Strategy to cultivate and maintain a favorable environment for the IED.	MEM, INE, MHCP, private sector
Large scale projects	Generation from large projects	Gap: renewable generation reaches less than 40% of the electricity of Nicaragua Barrier:	To continue with current incentives policies at the IED for renewable energy projects. To practice legal security and in particular to	MEM, INE, MHCP, private sector

			practice legal security, especially maintaining stable law 532 Institutionalizing Security Investment	
PC, PCH, CL	Rural interconnected generation PC, PCH and local concessionaries (CL)	Gap: environment unfavorable for businesses PC, PCH and PC. Barriers: lack of regulations adapted to the reality of PC and PCH. Lack of adapted incentives and subsidies. Very limited negotiation power in front of the DN-DS.	To launch a program to promote rural interconnected generation PC, PCH and local concessionaries (CL)	MEM, INE, MHCP, Private sector
ZTA	Isolated generation in totally isolated areas	Gap: there is no ecosystem for sustainable businesses Barriers: Lack of basic infrastructure, lack of technical and managerial capabilities and very low socio-economic characteristics y	To launch a program to promote isolated generation in totally isolated areas including subsidies for the management of systems including subsidies like the integration of local communities into management	MEM, INE, MHCP, private sector, NGOs, communities
Private sector	Distributed generation	Gap: there is no reference framework for small producers (>100kW) to connect to the network. Barrier: Lack of regulations adapted to promote distributed generation.	To put the conclusions of the current Consultancy into practice to create a Law of distributed generation. To consult with the private sector and sector representatives (Renewable Association of Nicaragua) to finalize technical rules.	MEM, INE, Trade associations
SIEPAC	Toll contracts	Gap: there is still not a legal framework to sign multi-year toll contracts Barrier: international	To promote the efficient function of the SIEPAC to facilitate the installation of new projects in Nicaragua where the supply could	SICA, MEM

		political process	rapidly outpace the energy demand	

Table Error! No text of specified style in document.-54 Rapid analysis of the gaps and barriers to promoting renewable energy in the SIN and isolated areas vs. objective No. 3 SE4ALL

Source: own elaboration

Thermal applications

Based on the analysis of the current situation in Nicaragua made in 0, and looking at the proposed goals to reach the SE4ALL objectives seen in 0, this study proposes the following rapid analysis of the gaps and barriers to the greater participation of renewable sources in thermal applications concerning SE4ALL objective No. 3 regarding doubling renewable sources in the global energy mix and respective strategies for confronting them.

3 DOUBLE THE SHARE OF renewable energy IN THE GLOBAL ENERGY MIX.		3.2 / Double the participation of renewable sources in the global energy matrix – thermal applications		
Relevant subjects		Gaps and barriers	Strategy	Actors
Sector rural - Biogas	Universalization of the use of biodigesters for PYMES in rural areas	Gap: there is not much local expertise in universalizing its use. Barriers: there is still not a functional value chain.	To select areas with the greatest potential for their conditions of number of households-farms available, consumption of firewood, and capacity for milk production. (SNV / HIVOS, 2010)	MAGFOR, INAFOR MARENA, MEM, NGOs, private sector
Urban sector - solar	Efficient use of water heating devices	See Table Error! No text of specified style in document.-53Table Error! No text of specified style in document.-1		

Table Error! No text of specified style in document.-55 Rapid analysis of the gaps and barriers to promote thermal renewable energy applications in isolated areas vs. objective No. 3 SE4ALL

Source: own elaboration

Industrial sector and productive activities

Based on an analysis of the current situation in Nicaragua made in 0, and looking at the proposed goals to reach the SE4ALL objectives seen in 0, this study proposes the following rapid analysis of the gaps and barriers to the greater participation of renewable sources in the productive sector

concerning objective No.3 SE4ALL of the duplication of renewable sources in the global energy matrix and respective strategies for confronting them.

3 DOUBLE THE SHARE OF renewable energy IN THE GLOBAL ENERGY MIX.		3.3 / To double the participation of renewable sources in the global energy mix – industrial sector and productive activities		
Relevant subjects		Gaps and barriers	Strategy	Actors
Industry	Self-producers	<p>Gap: the number of companies participating as self-producers is still limited.</p> <p>Barrier: as of yet, there is no support plan in negotiating PPA with distributors for the authorities. The procedures also complicate the management of new projects.</p>	To launch a program of promotion for the auto-producer sector with the goal of multiplying the quantity of companies participating, with adapted tariffs and easy processes for obtaining a generation license and other permissions	MEM, INE, private sector
Trade industry	Price of electricity	See Table Error! No text of specified style in document.-52		
Generators	Forest energy generation	<p>Gap: almost nonexistent value change for generation from biomass as a main activity</p> <p>Barrier: financing development programs</p>	To promote the creation of companies for forest energy and to support them with incentives and technical training.	MEM, private sector

Table Error! No text of specified style in document.-56 Rapid analysis of the gaps and barriers to promoting renewable energy in the productive sector vs. objective No. 3 SE4ALL

Source: own elaboration

Short summary

Conclusions

To date, in the energy environment of Nicaragua, there are many gaps still in the current situation of the country and the objectives proposed by the SE4ALL initiative. Among those, we have found that Nicaragua continues to be a country that is highly dependent on firewood and fossil fuels with lower electricity coverage than its neighbors.

The energy intensity of the country is the highest in the region, and energy efficiency is still a nascent subject. However, there have been positive developments in the last few years, among them the importance given to renewable sources.

The current energy strategies on a regional, nation, and program level are perfectly aligned with the objectives of SE4ALL and with the PNESER Program currently being implemented we expect great advances looking towards 2020.

However, a series of barriers must be faced in order to achieve the goals of the SE4ALL initiative by 2030. Of the most important, we would like to highlight the following:

Barrier 1. Access to financing for the medium market

Despite being the country to receive the second largest quantity of Direct Foreign Investment for large renewable energy projects in Latin America in 2011, access to capital for commercial actors and the residential sector continues to be an important barrier to the development of the energy sector in Nicaragua. The average level of poverty doesn't give hope that the private sector can make the necessary investment in the next 15 years. In this national market of a smaller size for the subject of distributed generation and energy efficiency, there are financial limitations due to the actual absence of an offering of sufficient credits adapted for individual or commercial users such as leasing or "green credits." It also requires a relevant legal framework permitting and incentivizing these investments.

Management training for public authorities

There is a clear political decision to maintain an electricity generation plan based on the exploitation of domestic natural resources and promoting the rational and efficient use of energy. To carry out this plan, the heavy involvement of public authorities is necessary to maintain obligations related to quality of service, energy efficiency, and the levels of investment necessary to obtain them from all the actors in the sector, and in particular the electricity distribution companies with measureable results and concrete goals. It requires strengthening the capacity of public authorities at the level of planning and monitoring adapted tools.

Development of Technical Capacity in Nicaragua

At a national level, the supply of technicians trained in the management, operation, and maintenance of renewable energy systems and a wide range of technologies installed in the country should be strengthened. The country should have an integrated plan for the development

of human capacity coordinated by the technical institutions (INATEC, IPLS) and the universities that promote this subject (among others: UNI, UCA, UNAN, ULSA). An interesting initiative in this direction is the Educational Platform for Renewable Energy of the Renewable Association of Nicaragua that also recommends linking said entity to the efforts of SE4ALL in Nicaragua. Additionally, it recommends supporting the institutional strengthening of the MEM to accompany these measures.

The perception of Nicaragua as a high risk country

In order to achieve financing for the MEM 2026 Expansion Plan, it is necessary to maintain the current direction established by the UNDP and the Energy Strategy of cultivating and maintaining an environment favorable for reaching high levels of foreign direct investment.

This is why the current policy of incentives to the IED for renewable energy projects, and the institutionalization of the security of investment should be followed to continue changing the perception that Nicaragua is high risk country for investment. It is also necessary to continue with current legal security that has allowed the current results of the IED, in particular to keep the benefits granted in law 532 stable.

Database for generation potential and public access to information

Precise knowledge of the generation potential based on renewable sources in Nicaragua is not well known, and only an estimation can be provided. It is necessary to continue measuring this potential (solar, wind, geothermal, hydroelectric – including marine energy – and biomass) in the country and establishing public maps of potential that will be shared with the public.

Recommendations

Based on the analysis of the current situation in Nicaragua made in section 2 and looking at the goals proposed to reach the SE4ALL objectives discussed in section 3, this study proposes a rapid analysis of the gaps and barriers that the SE4ALL objectives face and proposes how to confront them. Among the most important, we would like to highlight the following:

Objective SE4ALL 1

Recommendation 1. Create a baseline and projections for universal access to energy services

We recommend conducting a detailed study in coordination with the PNER Program on baselines and estimating the state of the SE4ALL indicators until 2016 (expected completion date of PNER) and the gaps for reaching the goals proposed in this report (see 0). This study should focus on the accurate measure and in depth study of information, and should make sustained estimates in the current plans to update the proposed goals and establish the levels of investment

necessary to achieve them. The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

To agree on a definition of modern energy services

The modern energy services discussed in the SE4ALL initiative consider several categories of services. It is important to precisely define this concept (for example, a minimum kWh per person/month, a defined price in % of the average national earnings). The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

To develop and implement an Information System for Energy Statistics in the country

Within the institutional framework for the management of systems of Public Information under the Department of Technology and Information of the MHCP, it was recommended that a coordinating mechanism be established with relevant authorities in the energy sector (MEM, MARENA, INE, ENATREL, ENEL, INIDE and Distributors) for the development of an Information System for statistics in the energy environment of the country (balances, coverage, etc.). The development of this system will permit, among other things, being able to disaggregate the index of global coverage into rural and urban. In particular, it recommends the establishment of a strategy to specifically measure the quantity of renewable energy produced at a country level in the SIN, in isolated systems, auto-producers, and soon via distributed generation. It can strengthen, for example, the SIMERNIC system of the Renewables Association of Nicaragua. We also recommend strengthening the MEM with some or various systems of integrated geographic information to be able to represent the estimated generation potential (see the initiative of the OLADE Observatory), effective generation (see SIMERNIC), and planning public investment in infrastructure and in energy efficiency programs to meet the SE4ALL objectives. The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

Objective SE4ALL 2

Make a baseline and energy efficiency projections

We recommend a detailed study in coordination with the DGEE and the MEM of the baseline and an estimate of the state of indicators of Energy Efficiency in the SE4ALL Initiative for 2016 (expected completion date of PNESER) and the gaps to reach the goals proposed in the present report (see 0). Once the legal framework of EE proposed under PNESER is established, the study should focus on defining baseline and measurement indicators to achieve the proposed goals, such as establishing the levels of investment necessary to achieve them. The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

Establish a model of organization for the promotion and development of renewable energy and energy efficiency

Based on the current state of development, we recommend studying what would be the best model of organization for the promotion and development of renewable energy and energy efficiency:

To continue with the actual structure of the MEM, coordinating with public authorities and the private sector, or:

To create an agency that specifically is dedicated, within the existing institutional structure, to renewable energy and energy efficiency, like the types of agencies that exist in other Latin American countries or in developed countries (i.e. ADEME, France, IDEA, Spain).

The goal is to unify different areas of public administration that carry out energy efficiency and renewable energy projects, respective rules and regulations and the generation of projects and incentives that channel sources of funding for these type of projects. In this way it will overcome certain identified regulatory and technological barriers. At the same time, it could perform the function of the Control and Validation Center to ensure that equipment and programs meet technical norms (NTON). The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

Objective SE4ALL 3

To complete knowledge of the potential of renewable sources in Nicaragua

Studies are needed of the measurement and extrapolation potential of generation based on renewable sources (solar, wind, geothermal, hydroelectric – including marine energy – and biomass) throughout the entire territory of the country. It is recommended that maps that show potential generation be established or updated and shared with the public via INETER and an adapted electronic portal. The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

Create a Single Window for Renewable Energy Projects (VUPER)

To simplify the permits and reduce the time needed to develop renewable energy projects, we recommend starting a debate about the creation of a Single Window for Renewable Energy Projects (VUPER) in accordance with the recommendations of the Renewables Association of Nicaragua.

Adapt the regulations for small producers and operators

We recommend modifying the regulations for the sector so that they include small producers and operators. This requires adapting the regulations that were designed for large generators so that the smaller ones can receive equal and non-discriminatory treatment.⁶³ The MEM could be the coordinating institution for this activity in its role as the regulating body of the energy sector.

Monitoring SE4ALL

Establish the MEM as the focal point (authority for monitoring)

With the MEM as the coordinating institution, we recommend establishing it as the focal point of the SE4ALL Initiative for Nicaragua. Its team could have the following structure: a representative (executive director) from the superior office; a general coordinator (technical area); a Technical Group made up of representatives from the DGRER, DORR, DGPP, Electricity Market and DGEE. This internal MEM structure would coordinate, with the rest of institutions pertinent or related to the energy sector, the implementation, monitoring, and national evaluation of the SE4ALL Initiative in Nicaragua.

Include energy aspects in the next General Census (2015)

We recommend a detailed revision of the questionnaires for the next general census (2015) to integrate energy aspects that could be lacking to help measure the SE4ALL indicators.

⁶³ See the recommendations established by the Renewables Association 2012.

Annexes

Annex 1.1: Description of the programs being implemented by the Government and other partners in subjects relevant to the SE4ALL Initiative

Program Title	Leading Institution	Financers	Objective SEALL	Description and Chronology	Amount (USD/EUR)
Program BID/FOMIN - SNV	BID/FOMIN	BID SNV	Objective 1 Objective 3	The results of the study carried out contain the basis for developing an initiative that will drive the birth of a market for the production of biogas in Nicaragua, which should be approached in two ways: the domestic and the productive.	Not defined
PREPCA	BUN-CA	HIVOS	Objective 1 Objective 2 Objective 3	The Regional Program of Energy and Poverty in Central America (PREPCA) forms part of the HIVOS Renewable Energy Program for the period 2011-2015. It is oriented towards maximizing and managing resources with a multi-actor focus and achieving a greater integration of energy management in productive processes.	Not defined
ECPA	TPA Proleña	US State Department	Objective 1 Objective 2 Objective 3	ECPA began in 2009, and its period is open. In 2012, via the Project managed by the NGOs Trees Water & People - Power Mundo, another initiative was created that aimed at creating synergies in learning and in fighting against deforestation, and it contributes to the increase in the use of eco-stoves in Central America.	Defined annually
PELNICA	MEM	ACDI	Objective 1	The Electrification Project of Nicaragua , implemented by the Government of Nicaragua and Ministry of Energy and Mines,	18,950,000

				plans to implement the program from 2009 to 2014 and aims to facilitate access to electricity for approximately 102,000 people in more than 650 communities.	USD
MASRENACE	GIZ	GIZ	Objective 1	The Program for Sustainable Management of Natural Resources and Promoting Business Skills helps the rural population manage natural resources in and around forests in a sustainable manner. The Program entered its third and last phase of implementation (April 2011 - December 2013	4 th phase: 4,000,000 EUR
EnDev	GIZ	Several European countries, GIZ, Dutch NL Agency, Australia	Objective 1 Objective 3	The Energy Program for Development (EnDev) has the main objective of providing energy access for households, social institutions and small and medium sized companies. The timeframe of the program is open.	On a global level: 181,000,000 EUR
LAIF - PNER	FODIEN	LAIF, UE	Objective 1	The Program PNER – LAIF (program for sustainable and renewable energy electrification in Nicaragua) will be implemented between 2013 and 2015. The subsidy from LAIF supports the reinforcement of the transmission system in rural areas and the connection to electricity generated from renewable energy.	7,000,000 USD
PNER	ENATREL MEM	BID + a group of bilateral and multilateral	Objective 1 Objective 2 Objective 3	The PNER Program, currently being implemented, seeks to have a transformational effect on electricity coverage on a national level by significantly increasing the level of electricity service coverage considering both increased use of Renewable Energy (RE) and the promotion of Energy	408,000,000 USD

		organizations		Efficiency (EE) in Nicaragua.	
EEERC / LAIF	KfW	LAIF, UE	Objective 2	The Program for Energy Efficiency and Renewable Energy for Central America has been designed to facilitate the access to PYMEs to sources of financing in order to carry out investment projects related to reducing energy consumption, efficient energy systems, and production technologies for energy from renewable sources.	36,300,000 EUR
4E	GIZ	GIZ	Objective 2 Objective 3	The focus of the program during the first phase (2010 -2013) was on El Salvador, Costa Rica, and Honduras. Nicaragua is not included at this date.	Not defined

Table Error! No text of specified style in document.-57 Programs being implemented by the Government and other partners in issues related to the SE4ALL initiative.

Source: own elaboration

Annex 1.2 Description of programs and initiatives proposed to reach the objectives of the SE4ALL Initiative

Strategic plans	Estimated amount (USD)	Assumptions
Program SE4ALL	2013 - 2018: 1 MUSD	Baseline study of SE4ALL issues and projections for goals. Participation in relevant international forums, including IRENA.
National biogas plan	2012 - 2014: 2.7 MUSD	National biogas program (SNV / HIVOS, 2010).
	2014 - 2030: 20 MUSD	Division of the first two years with progressive participation of the private sector.
National plan for firewood and charcoal	2011- 2025: 39.8 MUSD	Amount projected in the plan (MEM, 2011b).
Universal access to electricity – generation subsector	2012 - 2026: 2,700 MUSD	According to the Expansion Plan of the MEM, the will install 900MW (3USD/W) during the 2012 – 2026 period.
Expansion plan of the SIN for universal access to electricity – transmission subsector	2012 - 2030: 936 MUSD	According to the Plan of Expansion of Transmission of ENATREL 2994 km de of lines and 43 substations should be constructed during the 2013 to 2022. Of the total, 453 million are without defined financing.
Expansion Plan for the SIN for universal access to electricity – distribution subsector	2012 - 2030: 350 MUSD	An estimated 7,400 km by 2016, projecting growth by 2030 of 6,500 km of distribution lines (25 KUSD/Km single phase, 20 KUSD/Km conversion, 35 KUSD/km tri phase)
Electrification plan in isolated areas	2013 – 2030: 84 MUSD	It is estimated that 3,200 km of distribution lines will be constructed (25 kUSD/km single

(ZCPC, ZACI)		phase, 20 KUSD/Km conversion, 35 KUSD/km tri phase)
Plan to access energy for all in completely isolated areas	2013-2018: 30,000,000 2018-2025: 20,000,000 2025-2030: 10,000,000	Dissemination of SFV and other adapted technologies (MCH, biodigesters, small wind turbines). Cost/person in 2012 is \$200 for access to minimum services. It is estimated that 30,000 households in completely isolated areas and 5 hab./household. The technology requires investments every five years, but the subsidies can be progressively assumed by end users.
National plan for energy efficiency	Amount to be defined	A first estimation for the activities foreseen for the Plan would be proposed in the results of the consultation that is in progress.
National plan for distributed generation		A first estimation for the activities foreseen for the Plan will be proposed in the results of the consultation that is in progress.
Strategic infrastructure	Amount to be defined	Depends on political decisions

Table Error! No text of specified style in document.-58 Programs and initiatives proposed to reach the objectives of the SE4ALL Initiative

Source: own elaboration

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