PLANEE
PLAN NACIONAL DE EFICIENCIA ENERGÉTICA DEL ECUADOR

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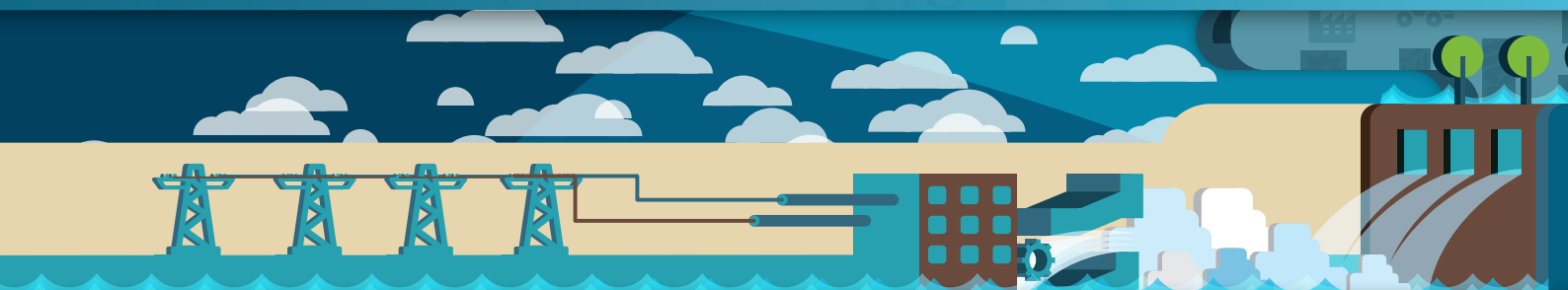
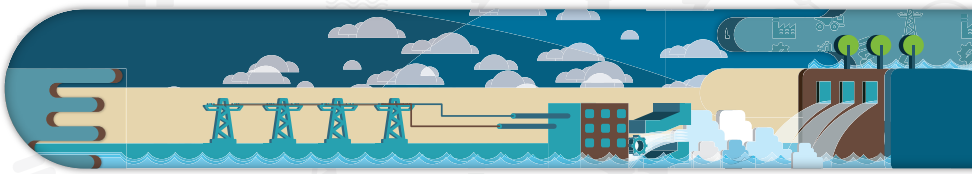
Ministerio de Electricidad y Energía Renovable

National Energy

Efficiency Plan 2016-2035



National Energy Efficiency Plan 2016-2035



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This document has been prepared with the support of the Inter-American Development Bank (IADB), which provided technical support in drafting the Ecuador National Energy Efficiency Plan (Projects EC-T1312 y EC-T1329).

It was reviewed by public officials in the Ministry of Electricity and Renewable Energy (Patricia Recalde, Alex Posso, Fernanda Valencia, Néstor Luna, Vinicio Carrión, Daniel Fierro, Luis Manzano, Andrés Sarzosa), under the supervision of Alfredo Samaniego, Deputy Minister; Adrián Moreno, Undersecretary of Renewable Energy and Energy Efficiency, and Carlos Dávila, National Director of Energy Efficiency. We take this opportunity to give thanks for the collaboration provided by the National Institute of Energy Efficiency and Renewable Energy (INER); Alfonso Blanco, Executive Secretary of the Latin American Energy Organization (OLADE), and Andrés Schuschny, expert from the Economic Commission for Latin America and the Caribbean (ECLAC); as well as the technical support provided by delegates of the Inter-Institutional and Multidisciplinary Technical Committee on Energy Efficiency, and finally, the consultant team.

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Presentation

Detailed, complete, timely and reliable planning is essential in anticipating future energy situations, given that efficient energy use is central in sustaining economic growth and providing quality of life.

On energy issues, Ecuador has been blessed with abundant natural resources, especially water. Such resources are both a source of life and a fundamental basis for development. The efficient use of energy resources is the most cost-effective measure in the short and medium term to care for the environment and preserve non-renewable resources, and at the same time to significantly reduce CO2 emissions, among other greenhouse gases.

Ecuador's sustainable development priorities have led to the development of a strategy that defends the rights of its people to live in a healthy environment, respect the rights of nature and have access to modern, renewable and energy efficient sources. These principles are enshrined in the Constitution of the Republic, which has the goal of achieving "Good Living".

Energy demand is characterized by the following: energy use, consumption schedules, prevailing uses and technologies, consumer diversity and share in the National Energy Balance, to name a few. These particularities lead to the need to define a strategy that encourages efficient energy use under the premise that efficient energy consumption does not mean reducing performance or productivity, but rather maintaining or improving conditions by reducing the amount of energy involved.

In this context, and as a contribution to the planning guidelines, which are the essential basis for strengthening or enhancing the energy sector in favor of the country's growth, I am pleased to present the ***National Energy Efficiency Plan 2016-2035 (PLANEE),*** which brings together the best applicable proposals that can realistically be applied in our country, based on international practices and applied technologies, as well as the experiences and lessons learned from the application of energy efficiency in Ecuador in the period of 2007-2015.

PLANEE also encourages the progressive substitution of fuels and energy sources with high environmental impact with others having low or no carbon content, including renewable energy sources. It also demonstrates the huge commitment that our country has to our planet by promoting concrete actions to guarantee sustainable economic development based on access to modern, clean and affordable energy, both for the people of today and future generations. This can be done by using the resources we have with intelligence, efficiency and environmental responsibility.

When talking about energy, it is not only a question of producing more, but consuming better.

Medardo Cadena Mosquera
Minister of Electricity and Renewable Energy

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LIST OF FIGURES

LIST OF ACRONYMS

AEADE	Ecuadorian Association of Automobile Companies
AIHE	Ecuadorian Hydrocarbon Industry Association
AME	Association of Ecuadorian Municipalities
AMT	Metropolitan Transit Agency
ANT	Ecuadorian National Transit Agency
ARCH	Hydrocarbon Control and Regulation Agency
ARCONEL	Electricity Control and Regulation Agency
BCE	Central Bank of Ecuador
CELEC EP	Strategic Public Company Ecuadorian Electrical Corporation
CENACE	National Electricity Operator
CFN	National Finance Corporation
CGREG	Galapagos Special Regime Government Council
CNEL EP	Strategic Public Company National Electrical Corporation
COMEX	Ministry of Foreign Trade
CTE	Ecuadorian Transit Commission
ELECGALAPAGOS	Galapagos Province Electrical Company
EP PETROECUADOR	Ecuadorian Public Oil Company
EPMMOP	Metropolitan Public Company for Mobility and Public Works
ESCO	Energy Services Companies
GADs	Decentralized Autonomous Government
INEC	National Institute of Statistics and Census
INEN	Ecuadorian Standardization Service
INER	National Institute of Energy Efficiency and Renewable Energy
MAE	Environmental Ministry
MAGAP	Ministry of Agriculture, Livestock, Aquaculture, and Fishing
MCPEC	Coordinating Ministry of Production, Employment and Competitiveness
MEER	Ministry of Electricity and Renewable Energy
MH	Hydrocarbons Ministry
MICSE	Coordinating Ministry of Strategic Sectors.
MIDUVI	Minister of Urban Development and Housing
MINFIN	Ministry of Finance
MIPRO	Ministry of Industries and Productivity
MTOP	Ministry of Transportation and Public Works
SAE	Ecuadorian Accreditation Service
SENAE	Ecuadorian National Customs Service
SENPLADES	National Secretary of Planning and Development
SERCOP	National Service of Public Procurement

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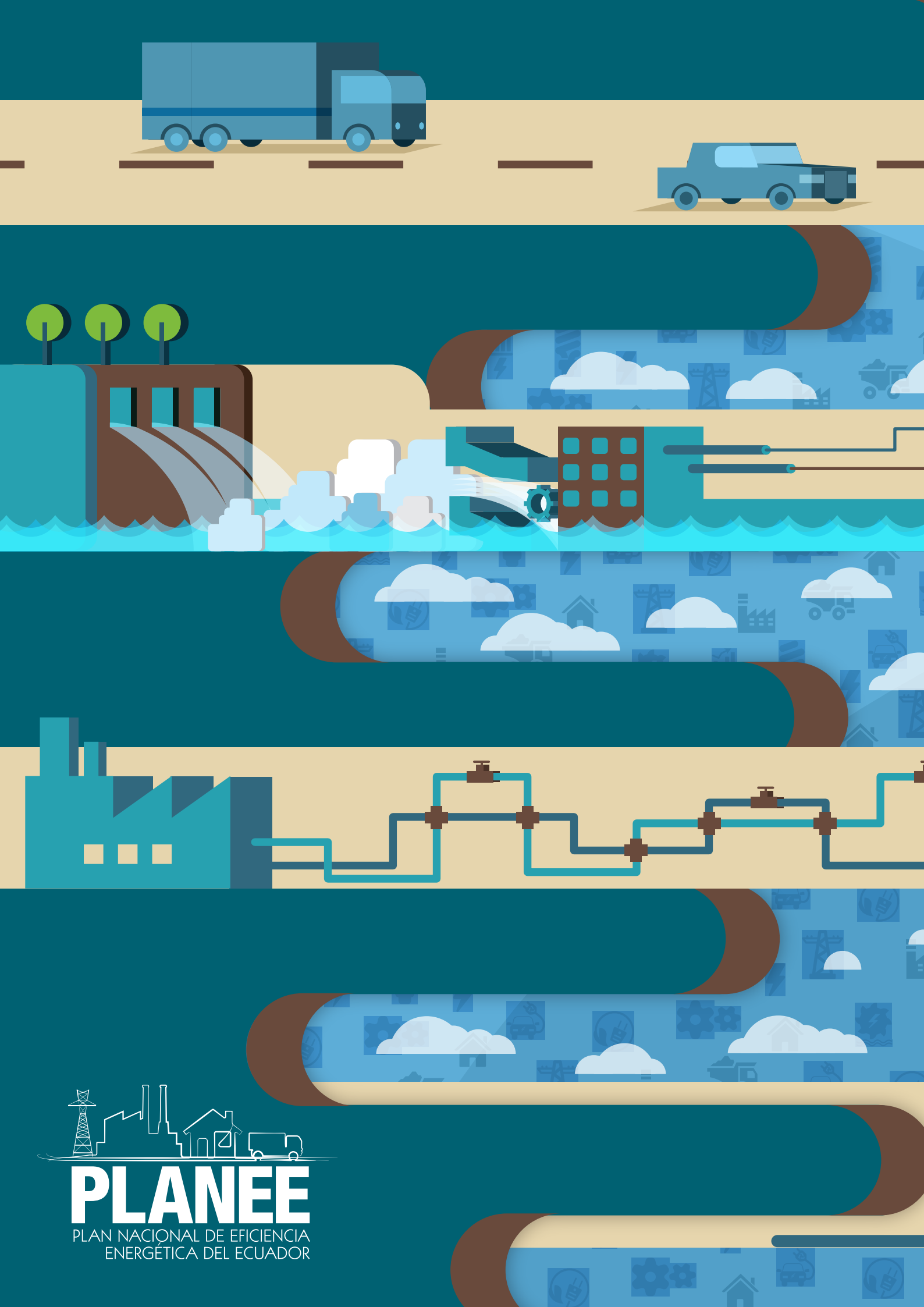

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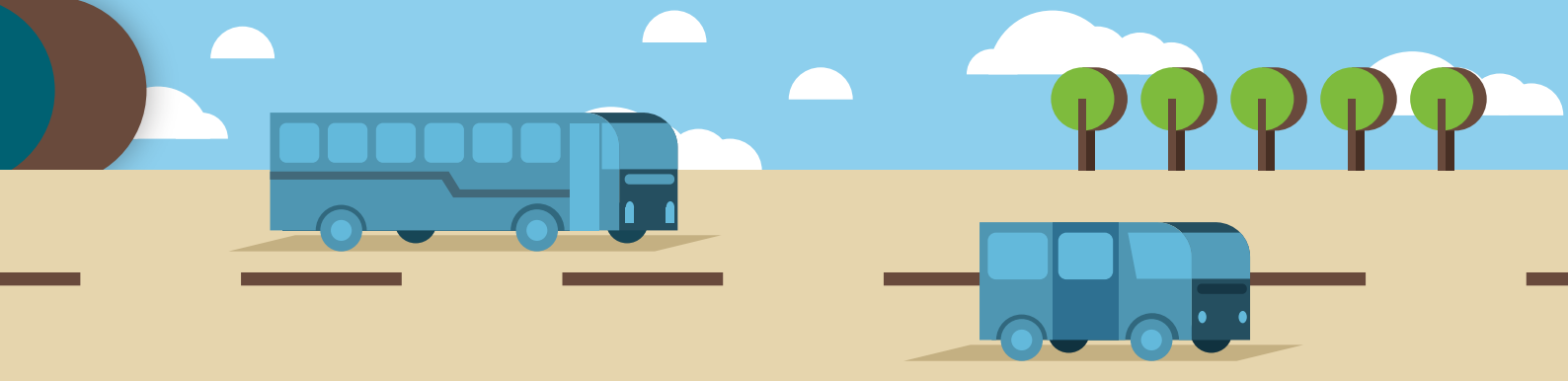


01.

INTRODUCTION

The Organic Law of Public Service for Electrical Energy establishes that MEER is the agency that governs and plans for the power sector and it is responsible creating the National Energy Efficiency Plan.

On July 9, 2007, through Executive Order No. 475, the Government of Ecuador split the Ministry of Energy and Mines into two ministries: the Ministry of Mines and Petroleum and the Ministry of Electricity and Renewable Energy (MEER).

The Constitution of the Republic of Ecuador, published in Official Gazette 449 on October 20, 2008, establishes the following in article 413: "The State shall promote energy efficiency, development and use of environmentally clean and healthy practices and technologies, as well as diversified, low-impact renewable energies that do not jeopardize food sovereignty, ecological balance of ecosystems and the right to water." This is reflected in objective 7 of the *National Plan for Good Living 2013-2017* (PNBV), specifically, in policies and strategic guidelines 7.7, 7.8 and 7.9, which discuss the need to "Implement technologies, infrastructure and tariff schemes to encourage energy efficiency in different sectors of the economy," and to "Promote conscious, sustainable and efficient consumption patterns based on sufficiency within the planet's limits."

The Organic Law of Public Service for Electrical Energy (LOSPEE) was published in Official Gazette No. 418 on January 16, 2015, and establishes that MEER is the governing and planning agency for the Power Sector and is responsible for defining and applying policies; its other duties involve verifying that regulation and control are performed to structure efficient public electricity services, identifying and monitoring project implementation, granting licenses, evaluating management of the Power sector, promoting and executing renewable energy plans and programs and mechanisms to achieve energy efficiency, in accordance with the Constitution and other laws. Likewise, Article 12, Chapter II, Title III of said law establishes creation of the National Plan of Energy Efficiency (PLANEE) as being part of the agency's duties and functions.

Meanwhile, Objective 4 of the *National Energy Agenda* (ANE), developed by the Coordinating Ministry of Strategic Sectors (MICSE), is to achieve "a country with efficient energy use," and establishes the following as part of its guidelines and actions to be taken: i) to maintain a strong institutional framework for energy efficiency to ensure it becomes a mainstream fixture, ii) to ensure the implementation of energy efficiency based on adequate planning, iii) to increase quality and optimize the management of information on energy uses, iv) to sustain energy efficiency on a sound regulatory framework, v) to encourage the creation of market mechanisms and promote the management of financing arrangements to achieve energy efficiency, vi) to promote the adoption of energy efficient behavior; and vii) to train and certify energy efficiency experts.

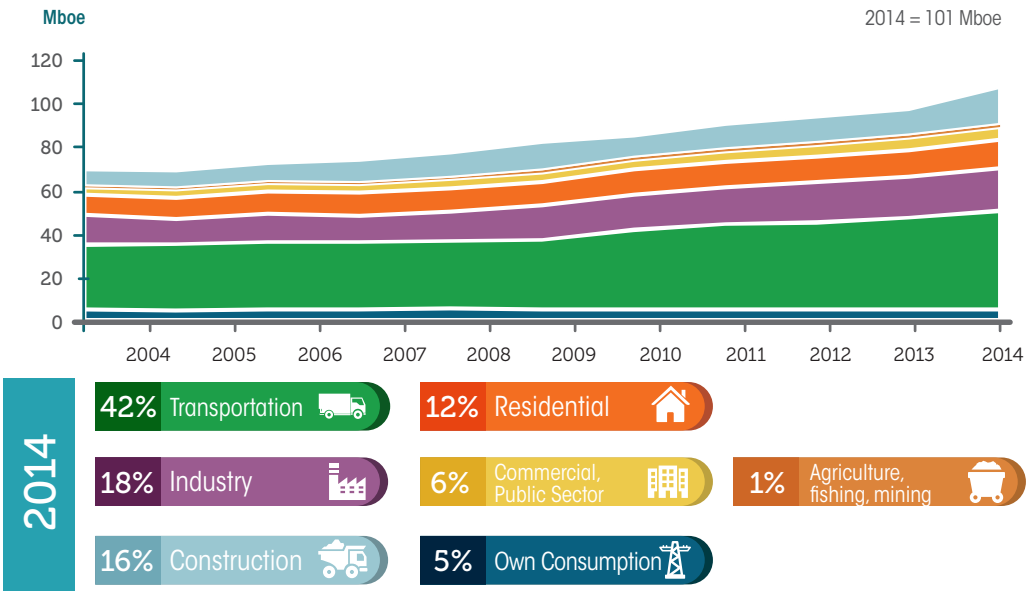
In compliance with the above, this ministry presents PLANEE as a public policy instrument that seeks to improve energy consumption habits by incorporating energy efficiency in sectors related to energy provision and use.

With the implementation of PLANEE, Ecuador will contribute with international initiatives aimed at "ensuring access to affordable, secure, sustainable and modern energy," a goal that was established by the United Nations in the 7th Sustainable Development Objective (ODS-7) and "double the global index of energy efficiency improvement," which is an essential objective of the *Sustainable Energy for All* initiative (SE4ALL).

1.1. Energy Sector Situation in Ecuador

According to the National Energy Balance 2015 (BEN) (base year 2014) final energy consumption reached 101 Mboe, representing an increase of 11% over the previous year. This made it possible to identify the sectorial energy consumption baseline, which was then used to present opportunities to apply energy efficiency mechanisms to moderate the growth rate without affecting the quality of life for the people.

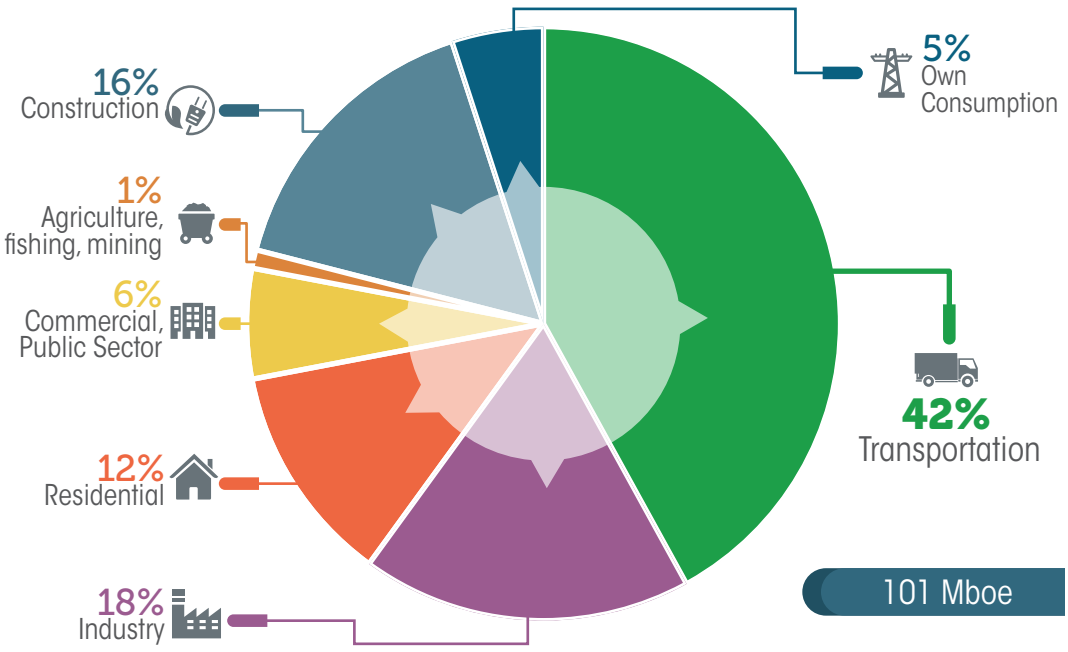
Figure 1. Evolution of Energy Consumption by Sector



Source: BEN (2015)

The main consumer sectors identified were: Transportation sector, corresponding to 42% of the total national energy consumption; Industrial sector (18%), Residential sector (12%), Commercial sector (5.68%), Agricultural, Fishing and Mining (0.94%), Construction and others (16.47%). Finally, own-consumption (own consumption) within the energy sector accounted for 5%.

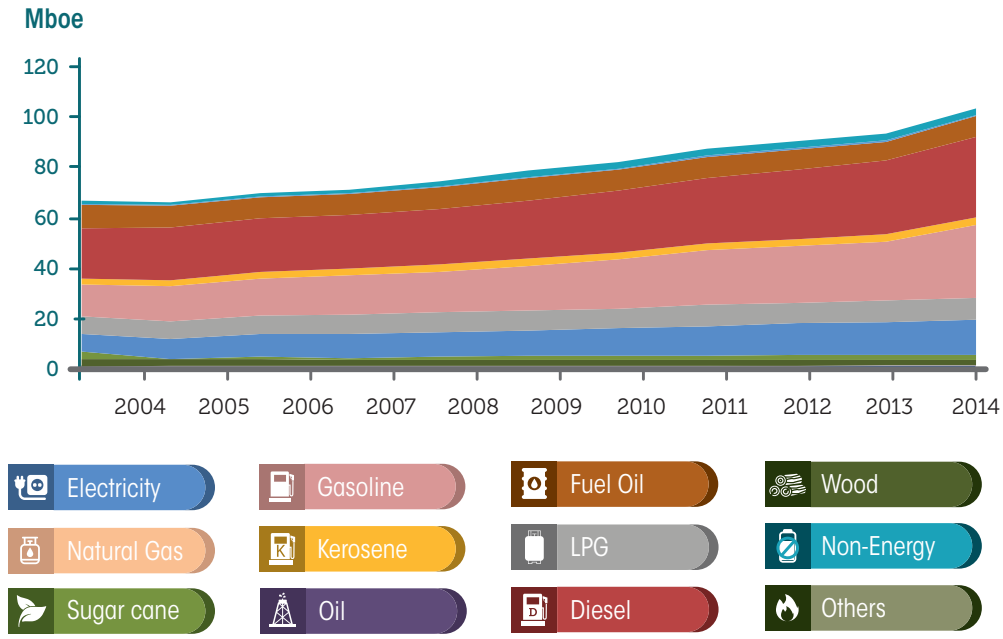
Figure 2. Structure of Energy Consumption by Sector



Source: BEN (2015)

On the other hand, the main types of energy consumed in the different sectors identified were: diesel (31%), gasoline and naphtha (28%), electricity (13.5%), liquefied petroleum gas (LPG) (8.5%) and *fuel oil* (8.1%).

Figure 3. Structure of Energy Consumption by Type of Energy



Source: BEN (2015)

1.2. The Need for an Energy Efficiency Policy

Energy efficiency plays an important role in competitiveness and social aspects, partly because it is one of the most effective ways to address climate change, but also because of its effects on the security of energy supply. However, there are serious obstacles that keep energy efficiency from achieving its full potential.

In Ecuador, these barriers or obstacles consist mainly of high initial investment, low stakeholder involvement, lack of information, limited access to efficient technologies, and the difficulty in quantifying and measuring the benefits associated with energy efficiency.

In this sense, it is a priority for the government to incorporate energy efficiency into public policy. To date, several actions and measures have been developed, including: limitations on the sale of inefficient equipment, replacement plans for residential appliances, tariff and tax measures to promote energy efficiency, preferential tariffs to promote the efficient use of energy, and mandatory technical regulations, etc.

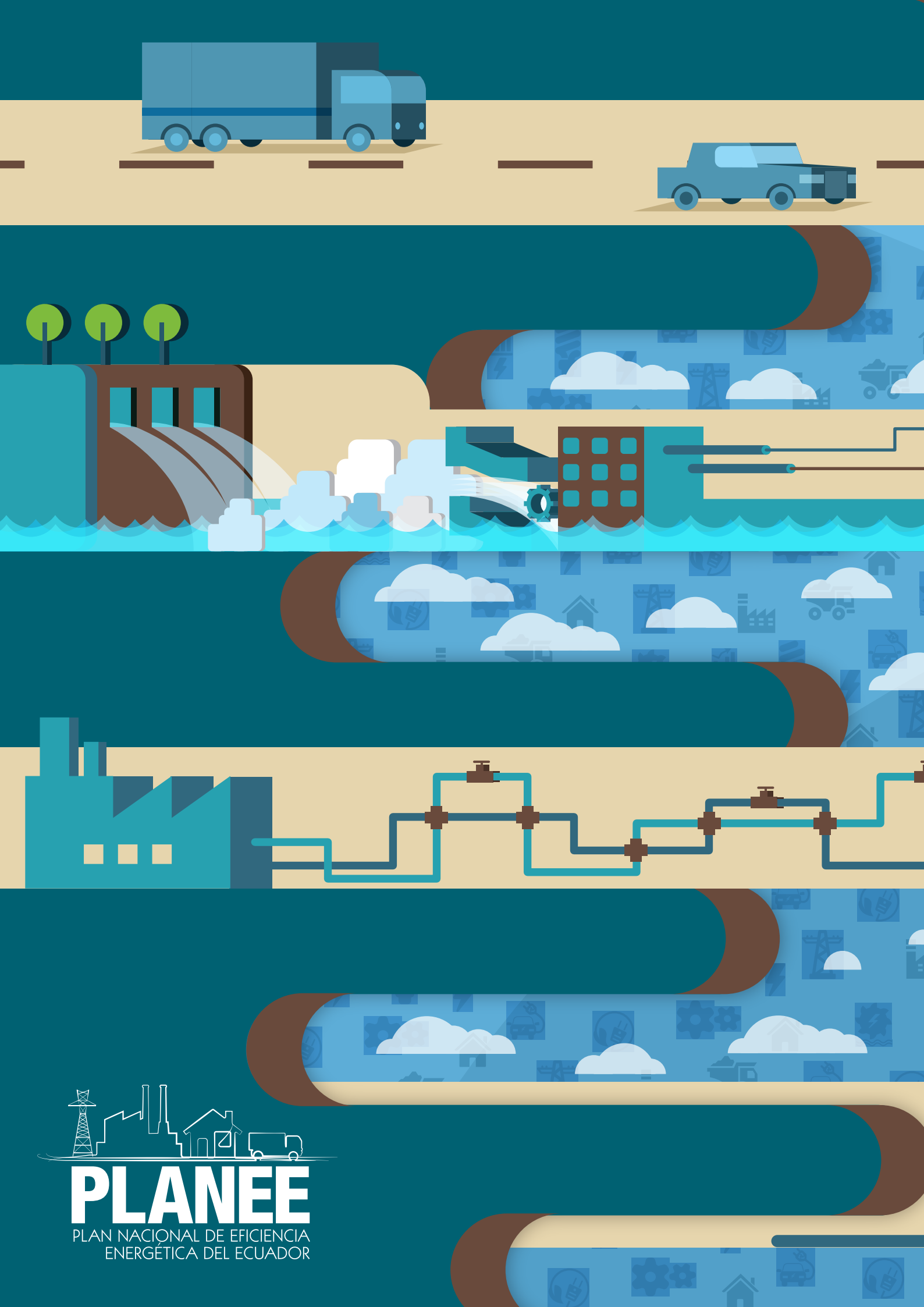
Ecuador has experienced economic growth that translates into improving its people's quality of life, and which has led to an increase in domestic energy demand. This increase in energy needs can be controlled through the implementation of energy efficiency programs that, in simple terms, consist of getting Ecuador to consume a smaller amount of energy to generate the same unit of product or service.

From a socio-economic standpoint, energy efficiency is a mechanism for generating highly specialized employment in the application of high-impact programs and projects. This allows for decentralized development and promotes research and the generation of local knowledge.

In terms of environmental management, energy production and consumption are the main causes of anthropogenic greenhouse gas (GHG) emissions, which accounted for 44.49% in 2010[1].

At the international level, energy efficiency has been incorporated into public policy with an energy and environmental focus, with the goal of being used as an industrial-sector planning tool. At the regional level, Brazil, Chile and Mexico can be mentioned as successful cases where dedicated agencies were incorporated into government, achieving important results including optimization of energy resources, increased competitiveness of strategic sectors, access to sources of international financing and the promotion of new local capacities and activities with high added value.

[1] *First Biennial Update Report on Ecuador* in the United Nations Framework Convention on Climate Change (UNFCCC), MAE, 2016.



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02.

CONCEPTUAL AND STRATEGIC FRAMEWORK

PLANEE preparation began with the revision of international energy efficiency plans and programs and previous experiences in the country.

According to LOSPEE, "the general objective of energy efficiency is to obtain the same service or product with the lowest energy consumption." To achieve this objective, below are some actions that have been identified: a) promote efficiency in the economy and society, b) promote the rational use of electrical energy and the reduction of fossil fuels, c) reduce production costs, and d) reduce environmental impacts.

As a result of implementing energy efficiency measures, unused or saved energy can be made available to produce more units of products or services and thus ensure greater competitiveness.

2.1. Methodology

PLANEE preparation began by reviewing international energy efficiency plans and programs and previous experiences in the country. This information was used to analyze the main barriers and prerequisites and create a stakeholder's map.

After breaking down each of the identified barriers, a cause and effect analysis was performed for each sector, followed by the creation of an action-result tree. This then led to the first intervention strategies, which were analyzed with representatives of the ministries involved, choosing the most feasible options to achieve the desired results.

This document provides a summary of the legal and institutional factors required to implement PLANEE, the general objective, industry-sector objectives and their corresponding lines of action.

2.2. PLANEE General Objective

To increase the efficient use of energy resources by implementing energy efficiency programs and projects according to energy supply and demand, in order to reduce the import of petroleum products, contribute to mitigate climate change and to create a culture of energy efficiency backed by a solid legal and institutional framework.

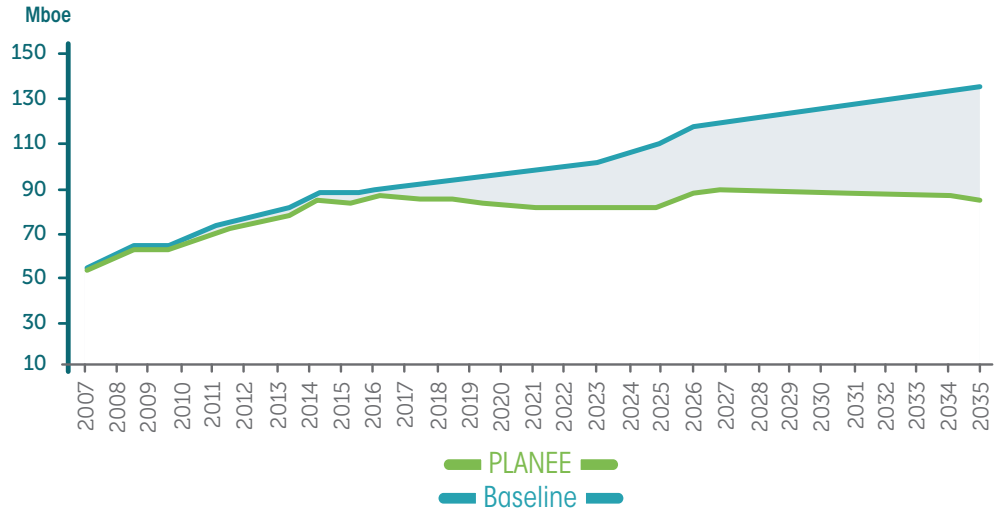
2.3. Goal

During the 2016-2035 period, the minimum threshold of energy saved in the sectors analyzed under PLANEE is expected to be around 543 Mboe. These savings will represent approximately USD 84 131 billion[2], with an estimated reduction of 65 $MtCO_2e$ in GHG emissions.




[2] Amount calculated from figures projected by the US Energy Information Administration (2015) (diesel, fuel oil and LPG).

Figure 4. Total energy saved by implementing PLANEE



Source: Prepared by PLANEE

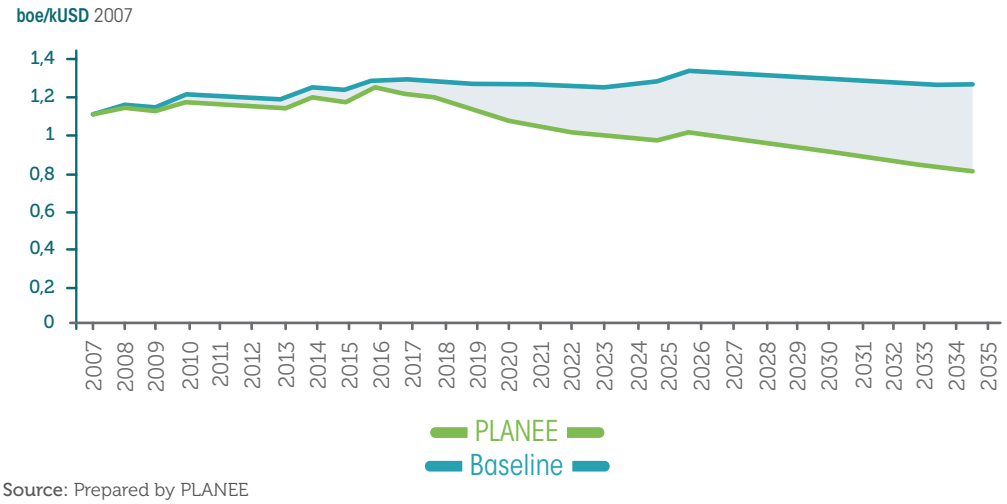
The total amount of saved energy is the result of energy efficiency projects and programs applied in the sectors of energy supply and demand.

It should be mentioned that energy efficiency scenario modeling began in 2007, which was the year in which the government prioritized implementing energy efficiency plans, programs and projects in the country. However, savings during the 2007-2016 period are not representative compared to those expected with PLANEE.

In order to demonstrate the effect on the reduction of energy consumption, this report presents both the baseline and PLANEE scenario graphs, which include all energy efficiency programs and projects. For analysis of these previous graphs, a GDP growth rate of between 2% and 2.5% has been considered, which is calculated based on mathematical models of annual GDP data provided by the Central Bank of Ecuador (ECB).

Meanwhile, energy intensity allows us to measure the relationship between global energy consumption and economic activity, as well as other indicators at industry-sector levels (Figure 5).

Figure 5. Evolution of total energy intensity



Source: Prepared by PLANEE

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03.

NATIONAL ENERGY EFFICIENCY PLAN

PLANEE coordinates stakeholders, identifying and incorporating programs and projects that will be implemented nationwide to increase efficient energy use.

This document covers, as relevant issues, the legal and institutional factors required to implement PLANEE, the specific objectives of the Residential, Commercial and Public sectors, along with Industry, Transportation and own consumers of the Energy sector, and its corresponding lines of action. Due to specific nature, a special section has been included for the Galapagos Islands.

In addition, the programs and projects considered within PLANEE have been included as Annexes, with further detail, specifications, and financial estimates for each of the energy supply and demand sectors.

3.1. Legal and Institutional Factors, Access to Information

Diagnosis of the Current Situation

Energy efficiency needs to be based on a legal and institutional framework to become a long-term government policy. Institutional arrangement or coordination is a critical factor in establishing an intervention strategy to increase the permeation of energy efficiency measures in the market and to encourage stakeholder participation. Institutional arrangements generally operate in three areas: program supervision, administration and services and implementation of measures [3].

Central governments (supervisory bodies) work to define the country's vision and to plan industry-sector policies. They also design, draft and pass the laws, norms and decrees necessary for the sector to develop strategically. In the case of energy efficiency, the governing body responsible for formulating strategies and policies is MEER.

The managing agencies are those that implement energy efficiency initiatives. They aim to generate additional savings by developing interventions that produce both a direct impact (additional energy efficiency measures versus the baseline scenario) and market transformation (changes in business practices that are persistent and long-term). Generally, the administration includes regulatory, control and industry oversight agencies.

Finally, at the third level are public and private organizations that are involved as service providers in the energy efficiency programs.

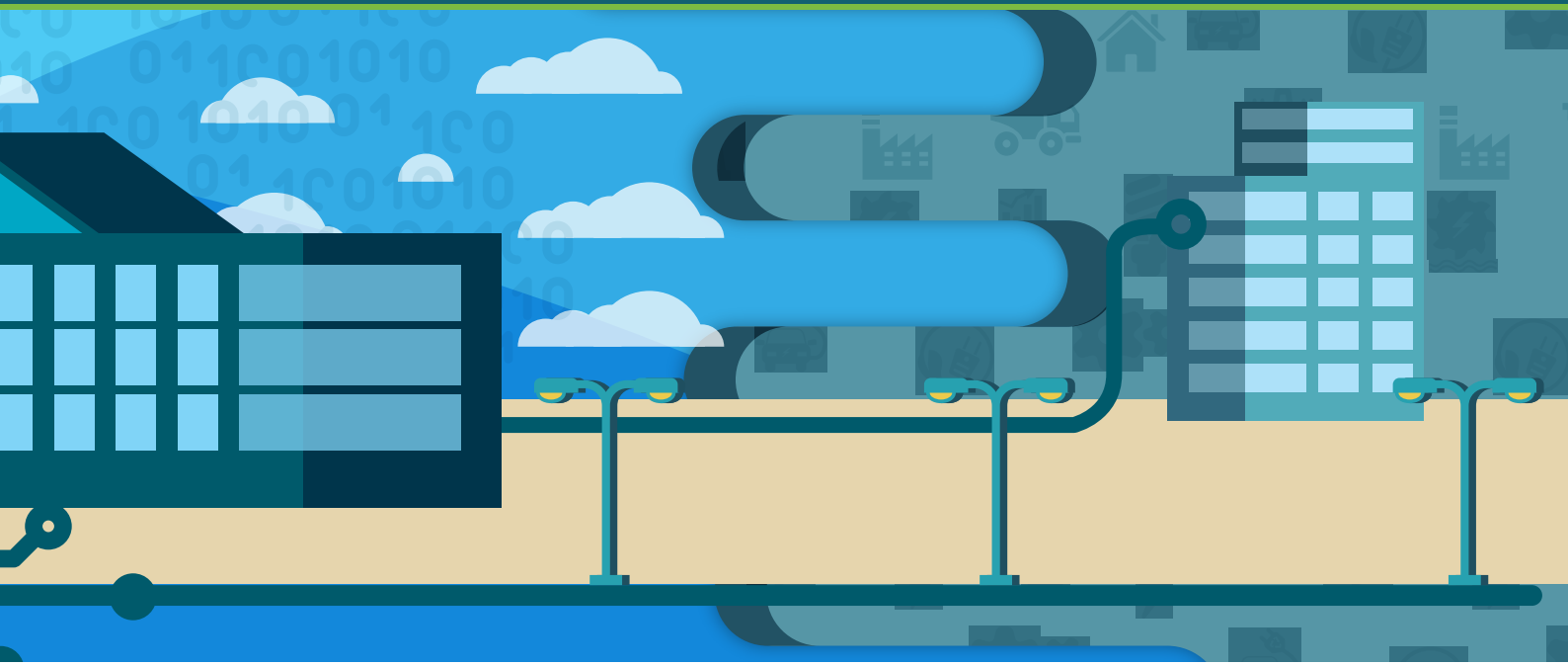
3.1.1. Sector Objective

To ensure the stability and continuance of energy efficiency policies, plans and projects in the long term, by strengthening existing legal and institutional frameworks.

Goal:
By 2020, have a strengthened legal framework and solid institutions directed at promoting energy efficiency.

To meet this industry-sector goal, the following specific objectives are proposed.

[3] Inter-American Development Bank (IADB), 2016.



3.1.2. Specific Objective 1: To strengthen existing legal and institutional frameworks to promote energy efficiency in Ecuador

Goal:
At the end of three years, to have stronger legal and institutional instruments to allow for implementation of programs and projects identified in PLANEE.

To achieve this objective, design and execution of the following lines of action are proposed:

Line of action 1: *Project to Reinforce the Regulatory Framework to Promote Energy Efficiency in the Country*

A project will be developed to consolidate the legal framework, allowing for promotion and development of energy efficiency in the country, and providing investment security to the industrial sectors involved.

Line of action 2: *Project to Strengthen the Institutional Framework to Promote Energy Efficiency in the Country*

The proposal is to strengthen the following:

a. **Undersecretary of Renewable Energy and Energy Efficiency:** the agency's functions will be consolidated and reinforced to provide the technical support required to implement PLANEE.

a. **Interinstitutional Committee on Energy Efficiency4:** this collective agency will be coordinated by the Undersecretary of Renewable Energy and Energy Efficiency, and its functions will be to coordinate, articulate, and formulate energy efficiency policies and actions. It is made up of governing bodies from different sectors related to energy production and consumption.

[4] Committee created in early 2016, presided by MEER and including MICSE, the Ministry of Industries and Productivity (MIPRO), the Ministry of Hydrocarbons (MH), the Ministry of Transportation and Public Works (MINTOP), the Ministry of Urban Development and Housing (MIDUVI), the Ministry of the Environment (MAE), the Association of Ecuadorian Municipalities and the National Institute of Energy Efficiency and Renewable Energy (INER).

3.1.3. Specific Objective 2: To communicate the results of energy efficiency actions implemented nationwide

Goal:
Communicate at least 80% of the energy efficiency projects.

To generate a cultural change in the Ecuadorian population regarding efficient energy use so that a multiplier effect is created that allows people to become part of the various government and private initiatives.

To achieve this objective, design and execution of the following lines of action are proposed:

Line of action 1: *Project to Create a National Energy Efficiency Indicators System (SINEE)*

This system will make it possible to manage information involving energy efficiency projects and design indicators to monitor the actions carried out, which will then facilitate decision-making by the corresponding entities.

Actions to be taken:

a) Identify existing energy information systems and indicators.

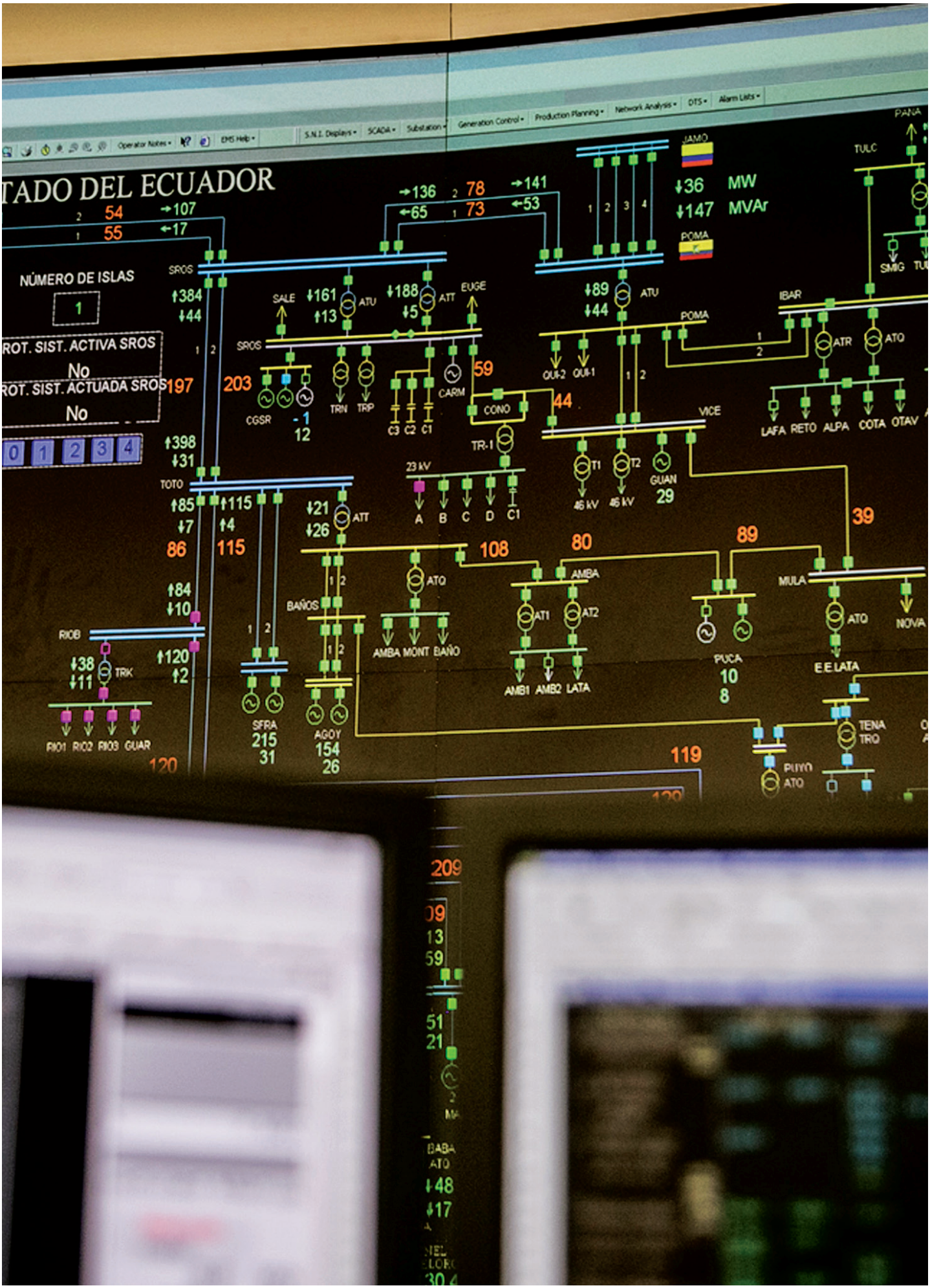
b) Consolidate existing information systems through a platform to manage energy efficiency.

c) Collect, store and systematize information on energy efficiency projects regarding stakeholders in energy supply and demand.

d) Create repositories with professionals in energy efficiency and energy services companies, to create work networks.

Line of action 2: *Program to Communicate Energy Efficiency Best Practices*

The communication program will incorporate communication campaigns, workshops and other mechanisms to promote regulations, incentives, an energy saving culture and recognition of best practices. Several media will be used, both conventional media (radio and television) and digital media, to promote the internalization of energy efficiency in the supply and demand sectors.



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3.2. Residential, Commercial, and Public Sectors.

Diagnosis of the Current Situation

The Residential, Commercial and Public sectors are responsible for 18% of total energy consumption and 57% of electricity consumption, according to BEN 2015. In this document, these sectors were taken as a whole because of the similarities in their energy consumption patterns; therefore, the programs and projects are considered common to all three.

MEER has developed several regulatory instruments and tax incentives in accordance with the national energy policy, and has promoted various initiatives related to energy efficiency in these sectors, including the following:

Regulatory instruments. Beginning in 2007, in coordination with the Ecuadorian Standardization Service (INEN), 11 Energy Efficiency Standards were developed to promote energy management and efficient construction, along with 23 Technical Regulations for Energy Efficiency to guarantee that equipment/appliances sold for use in homes and industry offer maximum efficiency.

Technological Restructuring in Residential Lighting. Through this initiative, between 2008 and 2014, 16 million incandescent light bulbs were replaced by energy saving light bulbs in the residential and craft sectors, as well as in public sector agencies, which represented approximately three million beneficiaries. This initiative, developed by MEER, prompted a resolution from the Foreign Trade Secretary (COMEX), suspending imports of incandescent light bulbs for residential use, ranging from 25 to 100 W, beginning in January 2010. This measure achieved an estimated reduction of 287,000 MWh/year and 263 MW of power.

Efficient Public Lighting. Between 2012 and 2014, 61,610 mercury vapor 175-watt lamps were replaced by 100 W sodium vapor lamps, resulting in an approximate annual electrical energy reduction of 20,037 MWh and 4.6 MW of power.

Program to Replace Inefficient Energy Consumption Equipment. Project *No. 1 Refrigerator Replacement*, implemented during 2012-2016, was focused on substituting inefficient (high energy consumption) appliances with new and efficient equipment manufactured in the country. On December 31, 2016, through the Electricity Distribution Companies, 95,652 refrigerators were replaced nationwide, generating an approximate reduction of 38,200 MWh/year of electricity and 5.53 MW of power.

Energy Efficiency Program for Electrical Induction Cooking and Electrical Water Heating (PEC). Underway since August 2014, this program aims to replace the use of LP gas with electricity for cooking food and water heating in the residential sector. As of December 2016,

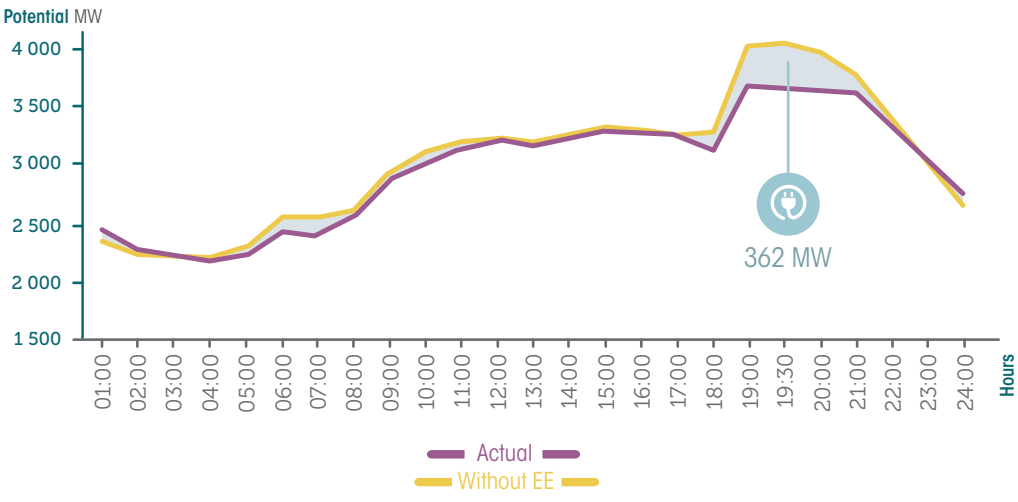
579,637 families used the program and benefited from the tariff incentive. 80% of the involved users obtained government financing to purchase induction stoves.

Ensuring Energy Efficiency in the Public and Residential Sectors of Ecuador (SECURE). Applied by MEER since 2015, this initiative seeks to increase the number of efficient electrical appliances in the Residential and Public sectors by promoting the Maximum Energy Efficiency Emplem (DMEE), which recognizes appliances that have been laboratory tested as providing the highest energy efficiency levels.

Meanwhile, MEER has proposed actions and strategies focused on energy efficiency in buildings; a specific energy efficiency chapter was included in the Ecuadorian Construction Standard (NEC).

In summary, the implementation of the energy efficiency programs led to a significant reduction in electricity consumption nationwide. During the hours of maximum demand (7 P.M. to 10 P.M.), it was possible to reduce around 362 MW of power, which represented a savings of more than USD 720 million for the country due to costs saved in the installation of new infrastructure needed to meet demand.

Figure 6. Energy saved due to projects executed (2015)



Source: Prepared by MEER

3.2.1. Sector Objective

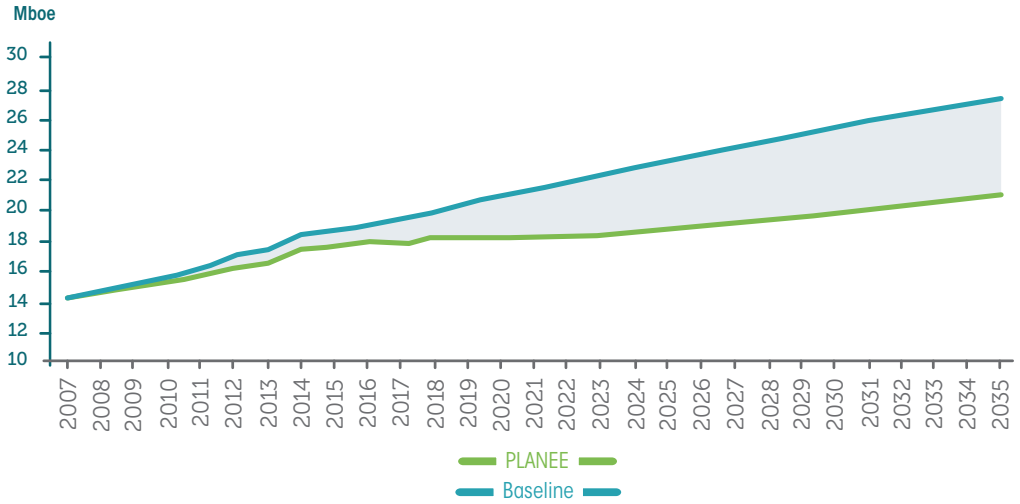
To increase the efficient energy use in residential, commercial and public buildings and establish a regulation on building habitability.

Indicator: Percentage reduction in energy consumption in comparison with the baseline.

Goal:

By 2035, reduce cumulative energy consumption in the residential, commercial and public sectors by at least 88.8 Mboe as a result of energy efficiency measures implemented.

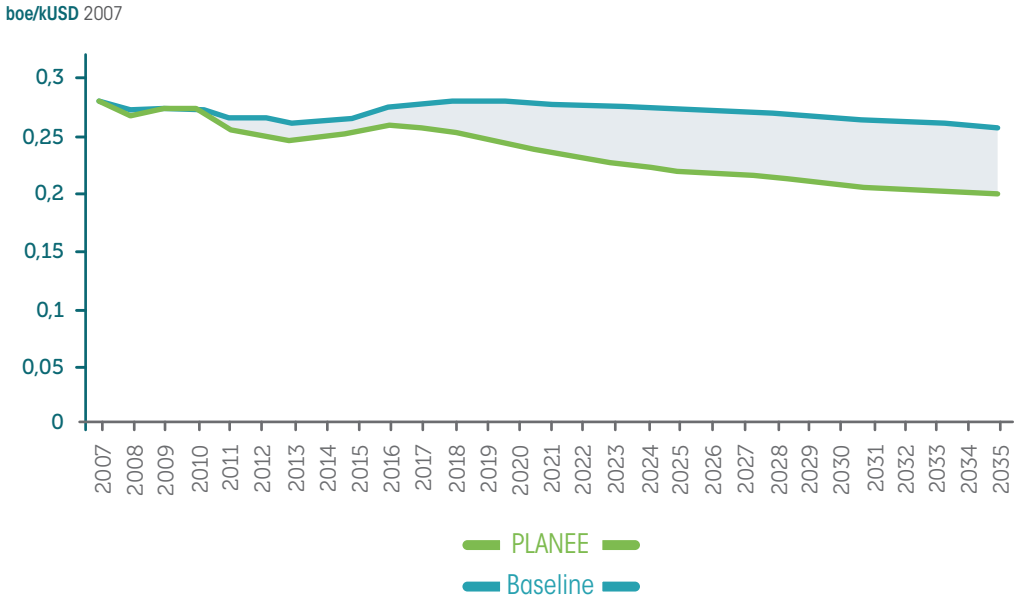
Figure 7. Energy saved in Residential, Commercial, and Public Sector



Source: Prepared by PLANEE

The purpose is to demonstrate that the reduction in energy consumption is not related to an economic downturn, but rather a change in the energy intensity, which relates the amount of energy consumed and the GDP.

Figure 8. Evolution of Energy Intensity in Residential, Commercial, and Public Sectors



Source: Prepared by PLANEE

To meet this sector goal, the following specific objectives are proposed.

3.2.2. Specific Objective 1: To strengthen programs for replacement and labeling of high energy consuming home appliances and equipment

Indicator: High energy consumption appliances and electrical equipment sold in the country having a national energy efficiency emblem (DMEE).

Goal:
By 2035, there will be a savings of 88.8 Mboe after replacing inefficient equipment and labeling high energy consumption equipment in the market with a national energy efficiency emblem DMEE.

Energy consumption in the Residential, Commercial and Public sectors is mainly influenced by the use of electrical equipment and/or home appliances. This is why it is important to implement measures aimed at efficient energy consumption, and to do so, the following lines of action need to be developed:

Line of action 1: *Project to Identify End-Use of Energy in Residential, Commercial and Public Sectors*

The technical statistics on energy uses in the country will be consolidated and updated on an ongoing basis, fed with economic, social and demographic information compiled by the competent agencies to update and create key indicators to monitor and evaluate the results achieved through adopting energy efficiency measures in these sectors.

Actions to be taken:

a) Apply final-use energy surveys.

b) Gather statistics.

c) Feed the statistics in to SINEE.

Line of action 2: *Program for Standardization and Labeling of Energy Consuming Equipment*

Standards and technical specifications will be updated and developed, as required, to classify the energy consuming products and equipment according to their efficiency levels.

Strengthening quality infrastructure is key when implementing this type of programs (energy efficiency laboratories, conformity assessment bodies, market surveillance, etc.).

Actions to be taken:

a) Review and update the regulations.

b) Strengthen the quality structure of national testing laboratories.

c) Strengthen quality evaluation agencies.

d) Implement the energy labeling program (DMEE).

e) Coordinate the incorporation of energy labeling in goods purchasing within the public sector, inside of the corresponding government offices.

f) Perform market surveillance.

g) Develop a training program based on standards and labeling.

h) Coordinate trainings with the corresponding authorities.

Line of action 3: *Program to Replace High Energy Use Residential Appliances*

Obsolete technologies with high energy consumption will be replaced with new, more efficient equipment. This program will include the scrapping and replacement of appliances that, according to the standardization and labeling program, do not operate at acceptable levels of energy efficiency, according to the latest technological developments.

Actions to be taken:

a) Continue the voluntary replacement programs for refrigerators, stoves, and lights.

b) Broaden the scope of equipment replacement programs.

3.2.3. Specific Objective 2: To establish oversight and control mechanisms to implement and apply NEC chapters on Energy Efficiency, Air Co ditioning and Renewable Energy at the GAD level

Indicator:	Number of Decentralized Autonomous Governments (GADs) that implement and apply the NEC (chapter on energy efficiency, air conditioning and renewable energy) satisfactorily within their city limits.

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Goal:

By 2020, 20% of GADs will have successfully implemented and applied the NEC (chapter on energy efficiency, air conditioning and renewable energy) satisfactorily.

An initiative to include the energy efficiency chapter in the current NEC became popular in recent years. To verify compliance, it is necessary to establish mechanisms for oversight and control of regulations. To this effect, the following lines of action have been proposed:

Line of action 1: *Project to Define Control and Oversight Mechanisms for the Implementation and Continuous Improvement of the NEC Standard - Energy Efficiency, Air Conditioning and Renewable Energy*

Adequate oversight and control mechanisms will be established. To achieve this goal, it is fundamental that the MIDUVI, the MEER and the Association of Ecuadorian Municipalities (AME) work together and proactively to create and apply regulations, along with control and oversight mechanisms that promote or require compliance with the rule.

Actions to be taken:

a) Create and apply control and oversight mechanisms to aid GADs in adopting the NEC.

b) Carry out campaigns to inform people about the mechanisms.

c) Put together a catalog of thermal, surface and optical characteristics/properties of the building materials used in Ecuador (under development by INER).

d) Create a country climate zoning map.

3.3. Industrial Sector

Diagnosis of the Current Situation

Public policy in the sector is aimed at changing the productive matrix, and there has been progress both in regulations, with the issuance of the Organic Code of Production, Trade and Investments (COPCI), and in infrastructure, through increased connectivity, telecommunications, highways, and renewable energy.

National industry has developed to produce efficient equipment, a process that began in 2012, with a program to replace inefficient energy consumption equipment: ***P****roject No. 1: Replacement of Refrigerators and the Energy Efficiency Program for Electrical Induction Cooking and Water Heating Using Electricity (PEC)*, in coordination with MIPRO.

From 2012 to 2015, MEER, with the support of the United Nations Industrial Development Organization (UNIDO), implemented the *Energy Efficiency for Industry (EEI)* project, successfully implemented Energy Management Systems (SGEn) in 39 companies and trained 2,000 technicians nationwide who are prepared to identify energy improvements in electric and steam power systems. The project resulted in a reduction in consumption of 13,400 MWh/year in electricity and 57,272 boe/year in fuels.

Meanwhile, the industrial sector, which is focused on the efficient use of resources, has implemented cogeneration projects in a more limited way. To date, only three sugar mills supply electricity from cogeneration, with a total capacity of 136.4 MW.

3.3.1. Sector Objective

To reduce energy consumption per unit of physical production in the industry sub-sectors.

Indicator:	Energy consumption in each industrial subsector indexed to the physical production units for the industries that implement energy efficiency measures.

Goal:

At 2035, there will be savings of at least 29.9 Mboe thanks to the energy efficiency actions implemented in the sector.

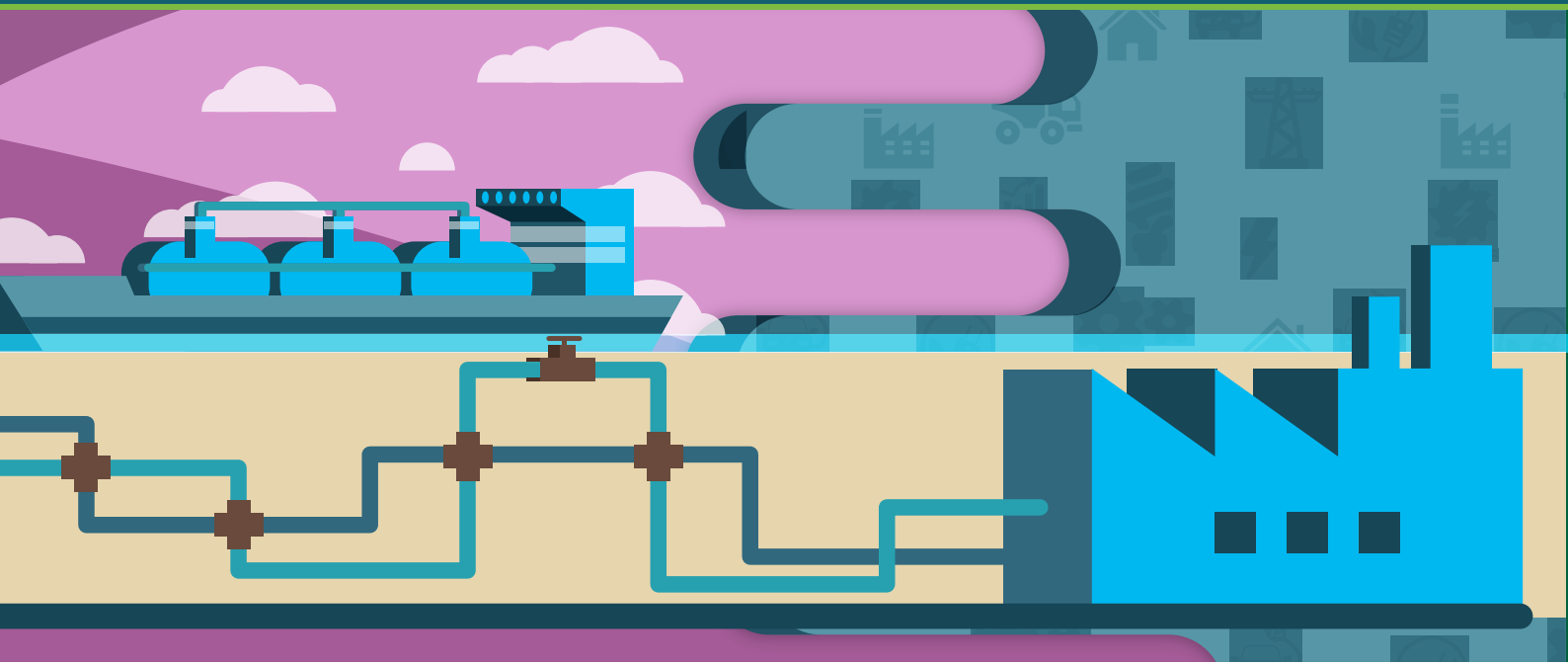
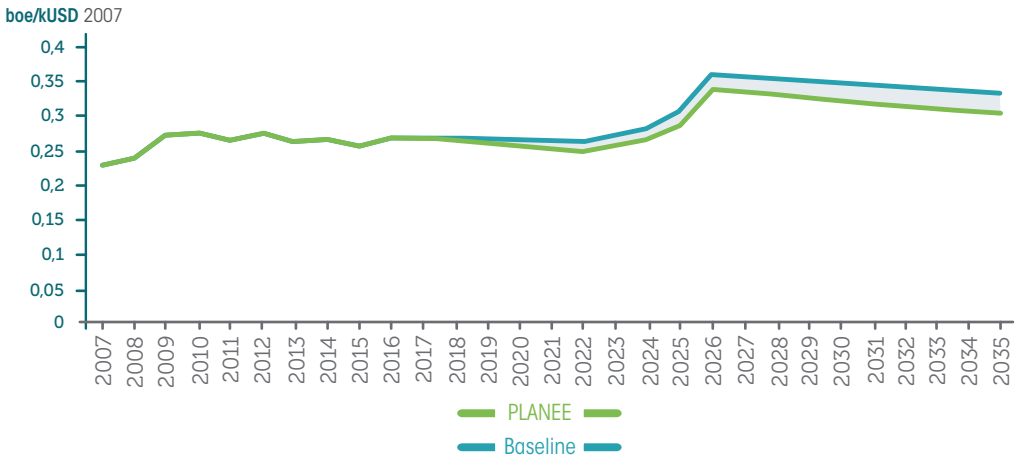


Figure 9. Energy Saved in the Industrial Sector

Source: Prepared by PLANEE

The evolution of the energy intensity for the Industrial Sector during the study period is shown below:

Figure 10. Evolution of Energy Intensity in the Industrial Sector



Source: Prepared by PLANEE

To meet this objective, the following specific objectives are proposed.

3.3.2. Specific Objective 1: To replace inefficient equipment, apply cogeneration systems and adopt ISO 50001 in energy-intensive industries

Indicator: Energy saved per unit of physical production in comparison with the base year.

Goal:
By 2035, energy-intensive industries that implement SGEn, cogeneration and replacement of inefficient equipment will reduce energy consumption by 29.9 Mboe.

Energy management and efficiency will be institutionalized throughout energy-intensive industries by adopting the ISO 50001 standard, replacement of equipment and the implementation of cogeneration systems, as well by reporting energy consumption to SINEE. To achieve this goal, design and execution of the following lines of action are required:

Line of action 1: *Program to implement the ISO 50001 standard in the energy-intensive industries.*

This program will allow the implementation of SGEn in energy-intensive industries by developing mechanisms to promote the adoption of ISO 50001, and coordinate with SINEE for reporting of industry indicators.

Actions to be taken:

a) Identify energy-intensive industries to implement the ISO 50001 standard.

b) Develop a training and certification program in energy efficiency and best practices.

c) Coordinate SGEn training and optimization of systems with specialized institutions.

d) Follow up on SGEn implementation in energy-intensive industries.

e) Monitor and prepare a SGEn report for SINEE to manage energy efficiency programs.

f) Create a network of professionals trained in SGEn and systems optimization.

g) Prepare a database of professionals trained in SGEn and systems optimization, which will be widely communicated.

Line of action 2: *Cogeneration program in industry*

This program will motivate industries to implement cogeneration systems by creating a favorable environment.

Actions to be taken:

a) Determine nationwide cogeneration potential.

b) Promote pilot case studies.

c) Promote the implementation of cogeneration systems in industries.

d) Follow-up on, monitor and communicate best practices.

Line of action 3: *Program to replace engines, pumps, boilers and water heaters in industries*

This program will focus on developing projects to replace inefficient equipment including pumps, motors, boilers and water heaters in the industrial sector. The government will promote it through incentives and will be implemented by the private sector, which will benefit from the energy savings generated replacing the equipment.

Actions to be taken:

a) Conduct an information survey about inefficient equipment in the industries participating in the program.

b) Evaluate the selection criteria of participating equipment/industries.

c) Define incentives to promote private sector participation.

d) Implement inefficient equipment replacement.

e) Follow-up on, monitor and communicate best practices.

3.3.3. Specific Objective 2: To promote the development of an Energy Services Companies (ESCOs) market in the country

Indicator:	Percentage of energy-intensive companies that implement energy efficiency projects through ESCOs.

Goal:
By 2035, 80% of energy-intensive companies will have implemented energy efficiency programs with the support of ESCOs.

An energy efficiency market will be developed through the creation of ESCOs, which will implement improvement measures in the Industrial sector and benefits will be derived from the savings obtained through reducing energy consumption over a certain time or amount established by the ESCOs and industry.

To achieve this goal, design and execution of the following lines of action are required:

Line of action 1: *Program for the development and promotion of an ESCOs market in Ecuador*

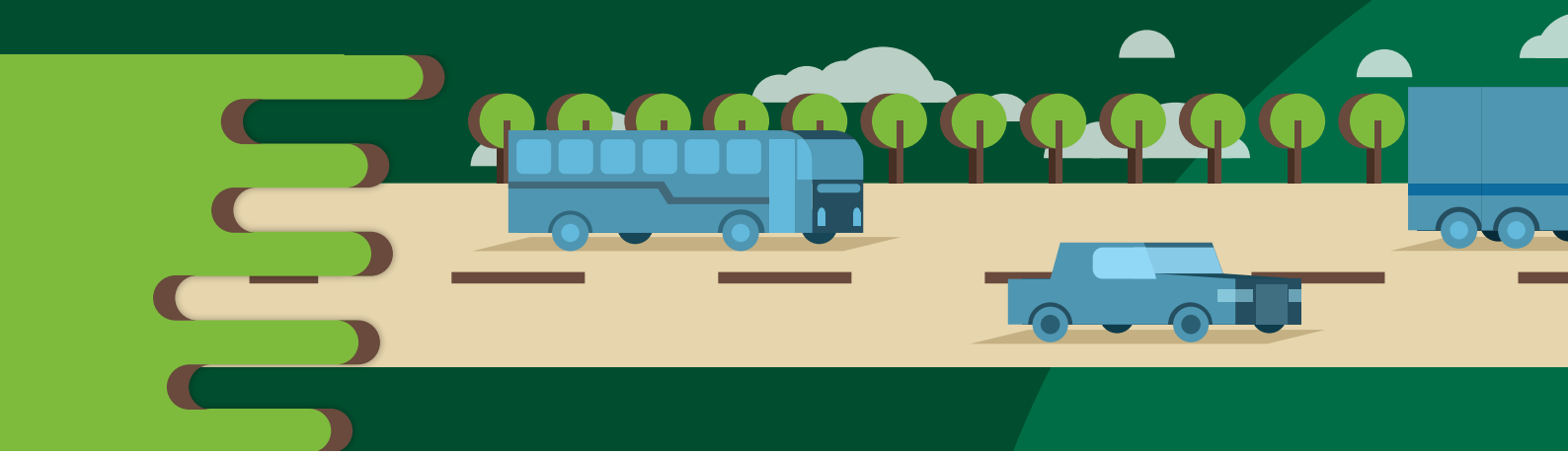
This program will aid in developing the prerequisites to create ESCOs. Financial institutions will be trained, and technical assistance will be provided for energy diagnostics; the results will be communicated to motivate the private sector to implement energy efficiency measures under this scheme.

Actions to be taken:

a) Define incentives for ESCOs to operate in the country.

b) Promote and communicate an ESCOs database.

3.4. Transportation Sector



Diagnosis of the Current Situation

Energy consumption by this sector represents 42% of the national total. The main fuels in demand are: diesel (45%), gasoline (41%) and fuel oil (7%). Electricity use in transportation is minimal.

According to Objective 7 of the PNBV (Strategic Guideline 7.7 (c)), the government will promote a gradual reduction in the use of fossil fuels in transportation and replacement of conventional vehicles by promoting sustainable mobility.

During 2007-2015, the infrastructure of roads, airports and sea ports was improved to transport cargo and passengers, contributing to a reduction in fuel use and optimization of travel times. According to the *Report to the Nation 2016*, USD 8.9 billion were invested in roads.

Beginning 2008, hybrid and electric vehicle purchases have been encouraged through the tariff exemptions. Through December 2014, a total of 4,055 hybrid and 35 electric units were registered.[5]

Also in 2008, the National Government implemented the *Vehicles Replacement Plan (RENOVA)* to replace public and commercial transportation units. By 2014, 16,123 units were scrapped and 19,614 new units were added.

Beginning in 2010, *the Ecopaís Biofuel Production* Project (production of "extra" gasoline with 5% anhydrous ethanol) has been launched, which aided in the development of an important agricultural industry sector and contributed to the reduction of high octane naphtha imports and GHG emissions. According to ANE 2016-2040, Ecopaís gasoline consumption represents 9% of the nation's use.

In terms of fuel quality, starting in 2011, EP Petroecuador reduced the diesel sulfur content from 7,000 ppm to less than 500 ppm, leading to the import of better quality vehicles.

It is important to mention that the *Metro de Quito* project is underway, which began construction of its second phase (tunnel and intermediate stations) on January 19, 2016; In Guayaquil, the *Metrovía* system was expanded, and in Cuenca the *Cuatro Rios Tram* is under construction.

[5] *Transport statistics 2014,* National Institute of Statistics and Census (INEC).

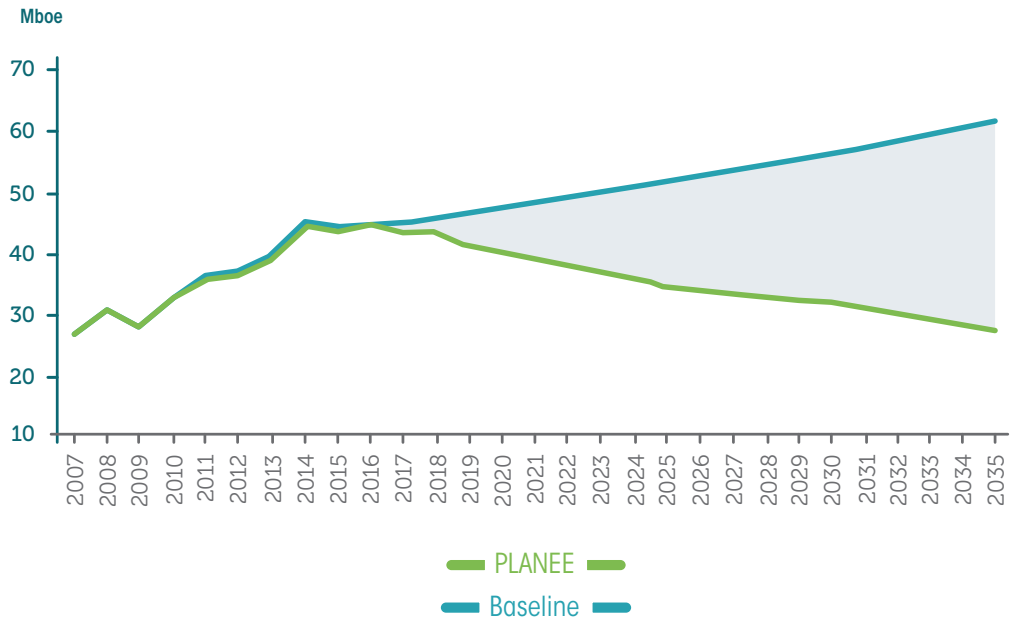
3.4.1. Sector Objective

To optimize energy consumption in cargo and passenger transport in comparison with the industry baseline scenario by carrying out energy efficiency projects that generate benefits in the sector.

Indicators[6]: Energy consumed per unit of cargo transported.
Energy consumed per passenger transported.

Goal:
By 2035, the Transportation sector will have generated an accumulated savings of 339.6 Mboe.

Figure 11. Energy Saved in the Transportation Sector

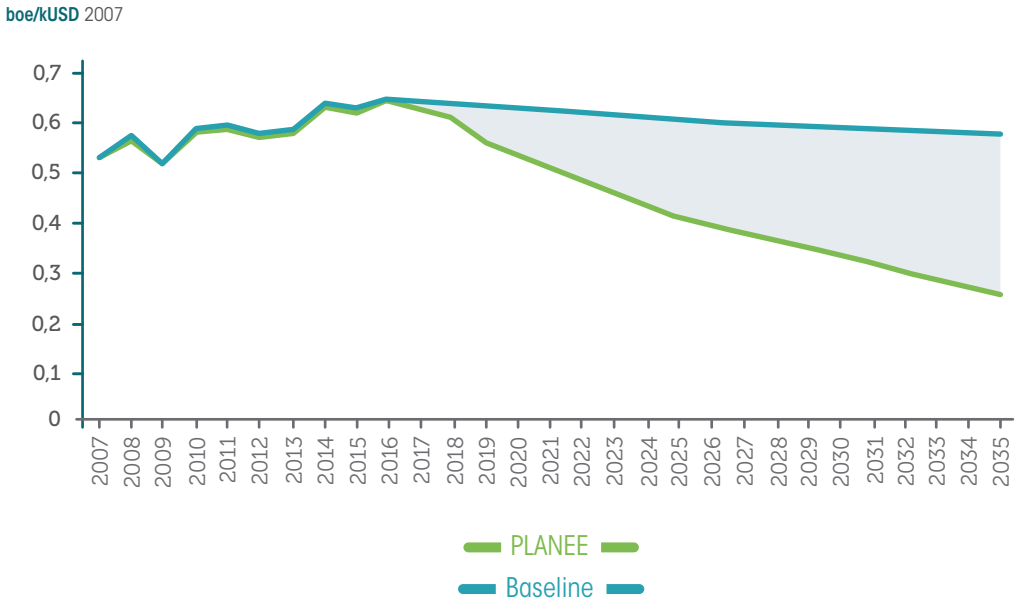


Source: Prepared by PLANEE

[6] These indicators are recommended by the International Energy Agency.

The evolution of the energy intensity for the Transportation Sector during the study period is shown below:

Figure 12. Evolution of Energy Intensity in the Transportation Sector



Source: Prepared by PLANEE

The objectives and lines of action described below are based mainly on the Public Policy Proposal and its regulations on sustainable land transport, which was drafted by the MTOP.

3.4.2. Specific Objective 1: To optimize transportation infrastructure to contribute to a reduction in fuel consumption

The planning and structuring of vehicular flow in cities makes it possible to optimize the time involved in point-to-point transfer and fuel consumption, resulting in financial benefits for consumers.

Indicator: Energy saved by implementing actions involving optimization of infrastructure in comparison to the base year.

Goal:
By 2035, there will be a cumulative savings of 12.1 Mboe, thanks to the application of measures to optimize transportation infrastructure.

To achieve this objective, design and execution of the following line of action is proposed:

Line of action 1: *Program to Improve Transportation Infrastructure and Operation*

Regulations will be developed and implemented to result in creating integrated mobility systems within cities by improving infrastructure (road networks, mass transit stops) and traffic operation to make efficient use of energy resources.

Actions to be taken:

a) Review and update transportation regulations to include energy efficiency criteria.

b) Expand and maintain roads and complementary infrastructure, such as public transportation stops.

c) Implement comprehensive mobility systems that allow for intelligent traffic planning and control in cities.

d) Promote the implementation of mass public transport systems within cities, along with the incorporation of exclusive lanes, more units, construction of electrically-run subway systems.

e) Implement vehicle review systems in all cities.

f) Carry out training and information campaigns.

3.4.3. Specific Objective 2: To replace inefficient transportation technologies, implement energy labeling and hold training on efficient driving techniques

The implementation of these measures will generate savings in fuel consumption in vehicles currently circulating within the country. The savings will be oriented towards the use of efficient technologies and will be complemented by establishing an efficient driving culture.

Indicator: Energy saved in the transportation sector in comparison with the base year.

Goal:
By 2035, the energy consumption in the sector will be reduced by 135.5 Mboe.

To achieve this objective, design and execution of the following lines of action are proposed:

Line of action 1: *Energy Performance Labeling Project for New Vehicles*

This project will provide actual information on fuel efficiency and associated CO_2 emissions, which will be a tool for users to prioritize the use of efficient vehicles.

Actions to be taken:

a) Identify the baseline.

b) Implement the labeling program.

c) Perform outreach campaigns.

d) Follow-up on, monitor and oversee the sale of labeled vehicles.

Line of Action 2: *Project to Reactivate, Reconfigure and Expand the RENOVA Vehicle Plan*

This project will reconfigure and reactivate the RENOVA Plan, which is focused on modernizing the automobiles in the country through the removal of inefficient and poorly equipped vehicles that currently provide transportation services. Such vehicles will be involved in a scrapping process in which their owners will receive a financial incentive that will allow them to purchase a new national vehicle at preferential price and/or with the exemption of tariffs on imported vehicles.

Actions to be taken:

a) Reconfigure the RENOVA plan and review incentives.

b) Perform outreach campaigns.

c) Conduct monitoring and follow-up to verify the impact.

Line of action 3: *Efficient Driving Techniques Training Project*

In collaboration with the coordinating agencies, MTOP, ANT and others, MEER will work to create a legal regulatory framework for compulsory training in efficient driving as a requirement to obtain type C, D, and E drivers' licenses. It will also incorporate topics on efficient driving to renew other types of drivers' license.

Actions to be taken:

a) Create regulatory framework for mandatory training in efficient driving to obtain type C, D, and E drivers licenses.

b) Carry out a training program in efficient driving techniques (Eco Driving).

c) Coordinate the training sessions with driving schools and specialized centers.

d) Coordinate the incorporation of questions on efficient driving into the evaluations for all types of driver's licenses.

3.4.4. Specific Objective 3: To replace energy sources used as fuels, improve its quality and introduce new technologies

Indicator:	Energy saved by the substitution of energy sources in comparison with the base year.

Goal:
By 2035, accumulated savings of 191.9 Mboe will have been generated through the application of these measures.

To achieve this objective, design and execution of the following lines of action are proposed:

Line of action 1: *Project to Incorporate Hybrid, Electric and New Technology Vehicles to be commercially available in the Future*

Se establecerán mecanismos para incentivar la importación/fabricación nacional de vehículos híbridos, eléctricos o de nuevas tecnologías, que sean más eficientes, reduzcan o eliminen las emisiones derivadas de su uso y utilicen combustibles producidos en el país.

Line of action 2: *Partial Replacement of Fossil Fuels by Mixture with Biofuels*

Coordination with the Coordinating Ministry of Production, Employment and Competitiveness (MCPEC); MEER; the Ministry of Hydrocarbons (MH); the Ministry of Agriculture, Livestock, Aquaculture and Fisheries (MAGAP); PETROECUADOR and the National Biofuels Committee, to implement a

national program for the use of diesel-biodiesel and extra-ethanol gasoline blends, using surplus African palm vegetable oil and the nation's sugar industry as raw materials.

Experiences from the City of Guayaquil will be used to extend the project nationwide.

3.5. Energy Sector Own Consumption Sector

Diagnosis of the Current Situation

Own consumption is the energy used by the energy sector for its operation in the stages of production, transformation, transportation, distribution and storage. According to BEN 2015, Ecuador's own energy consumption was 3,861 kboe, which represents approximately 5% of total energy consumption, a percentage that has remained constant over the last 10 years and mainly covers consumption by the Electric and Hydrocarbons sectors.

Current situation of the Power sector

The document entitled *The Ecuadorian Power Sector 2007-2016,* published by MEER, reports that the installed capacity of electricity generation has evolved in the last decade, from 4,070 MW in 2006 to 8,089 MW in 2016, and is expected to reach 8,569 MW by 2017.

This increase in the supply of electricity was made possible by investment in new hydroelectric plants that were incorporated into the National Interconnected System (SNI). The Coca Codo Sinclair (1,500 MW), Sopladora (487 MW), Manduriacu (65 MW), Minas San Francisco (275 MW) and Mazar (160 MW) increased hydroelectric generation, reduced thermal generation and increased electricity coverage from 92.89% to 97.18%, which resulted in more than 900,000 additional households with access to electricity between 2007 and 2015.

During this same period, the *Loss Reduction Program* was implemented, which reduced electricity distribution losses from 22.25% to 12.11%, representing an accumulated monetary saving of more than USD 1.2 billion. The percentage of non-technical losses dropped from 56% to 33% as a result of improved administrative actions.

Regarding thermoelectric power plants, according to the *Electricity Master Plan 2013-2022*, there are 43 plants generating a total net energy of 6,944.68 GWh/year. These plants have internal combustion generators, steam and gas units.

Current Situation of the Hydrocarbons sector

Based on information from the World Bank's *Gas Global Flaring Reduction,* it is estimated that the burning and release of gas associated with oil in the Amazon district over the last 30 years amounts to approximately 180 Mboe.

Within the PNBV, Change of the Productive Matrix, Change of the Energy Matrix and as one of the policies in ANE 2016-2040, since 2008, Petroamazonas EP has been carrying out the *Optimization of Power Generation and Energy Efficiency* Project (OGE&EE), whose objective is to improve the use

of existing energy resources in oil sectors through the implementation of a system of collection, transport and associated gas management, along with more efficient electrical generation and distribution systems.

Thanks to this project, net savings of USD 607 million were recorded in 2016, using associated gas to produce LPG, natural gas, and to generate electricity, thus reducing diesel consumption and GHG emissions (up to 937,511.73 tons of CO_2 per year).

Similarly, the *Interconnection of Sectors and Petroleum Facilities in the Amazon District through a Petroleum-Extended Electrical Interconnected System (SEIP-E)* project consists of developing about 500 km of underground power lines with voltages of 15 kV, 35 kV and 69 kV distributed throughout the Amazon district, 400 km of overhead and buried cables with 138 kV, and connect the SEIP-E with the SNI.

Meanwhile, in 2015, EP PETROECUADOR completed the emblematic project to *Rehabilitate and Repower the Esmeraldas Refinery,* which had the objective of recovering its 110 kbod processing capacity. This increased the process efficiency and continuity, generating savings of USD 300 million in imported petroleum by-products.

That same year, EP PETROECUADOR modernized the Esmeraldas-Quito pipeline pump stations, which consisted basically of replacing obsolete diesel engines with electric engines. This increased the transportation capacity of petroleum by-products by 72 kbod in the Esmeraldas-Santo Domingo and Santo Domingo-Quito sections, which represented savings in diesel and a reduction of GHG emissions.

It is also important to mention the construction of the Pascuales-Cuenca pipeline, which has increased the capacity and efficiency in transporting clean products to meet the demand for Super and Extra diesel, diesel and LPG in the country's central and southern provinces.

In terms of to the sector's infrastructure, the Hydrocarbons Regulation and Control Agency (ARCH) is working to equip the hydrocarbons laboratory to strengthen its control activities and to optimize the control of remnants by using automated measurement of the processes of reception, storage and dispatch of LPG in the Lojagas and Austrogas plants.

Finally, efforts have been made to coordinate information on the hydrocarbon sector. Such is the case of the implementation of ARCH's Center for Hydrocarbons Monitoring and Control, which supports the continuous improvement of sector stakeholders. This project, currently underway, includes achievements such as integration of 30% of control subjects in all processes in the hydrocarbon chain.

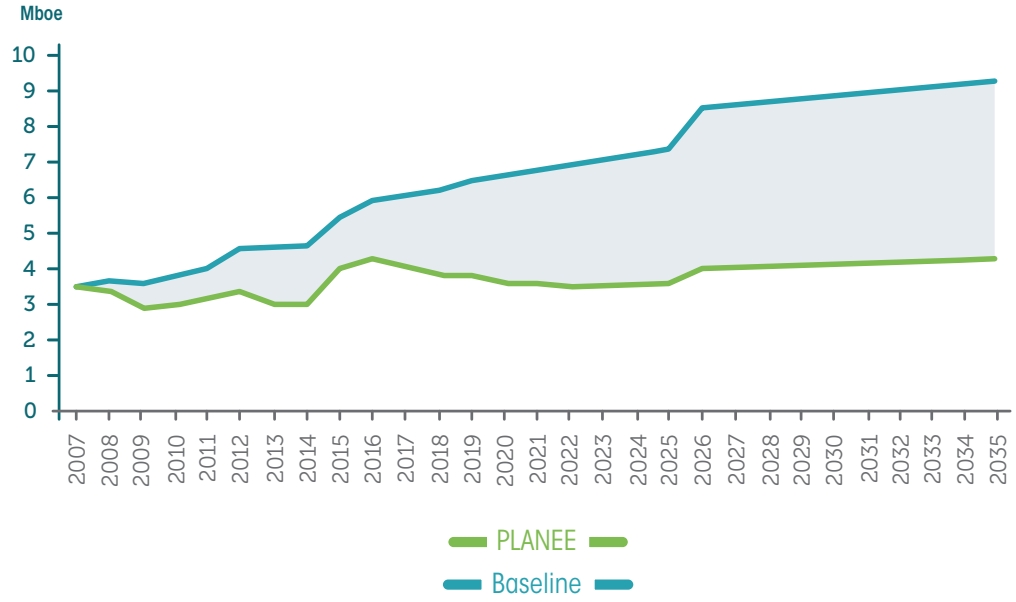
3.5.1. Sector Objective

To reduce the energy consumption per unit of physical production in the corresponding value chain.

Indicator: Energy consumption of the sector per unit of physical product.

Goal:
By 2035, companies in the country's energy industry that participated in energy efficiency projects will have achieved an 83.7 Mboe reduction in own consumption, as compared to the baseline scenario.

Figure 13. Energy Saved in the Energy Sector Own Consumption Sector

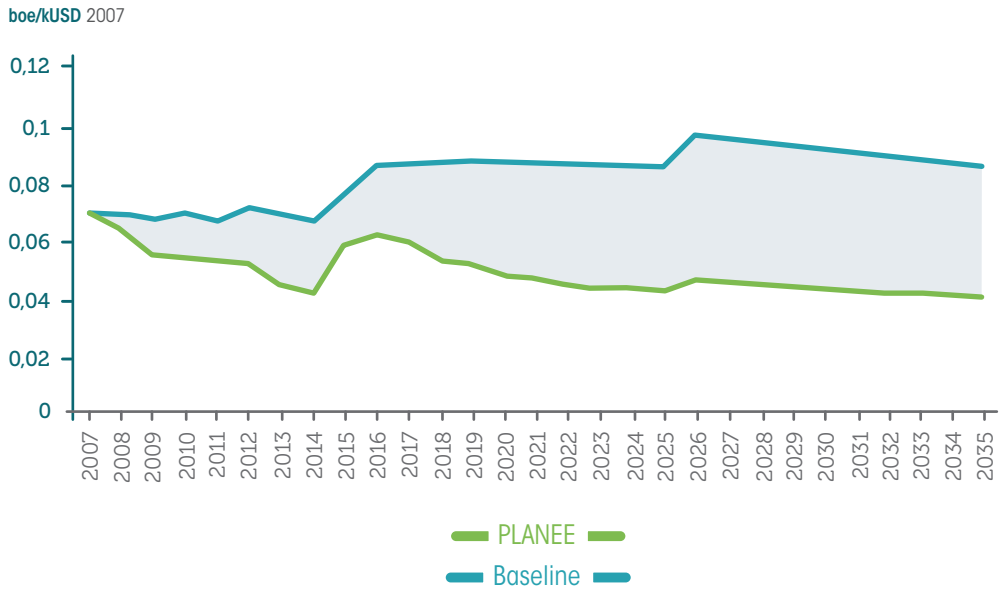


Source: Prepared by PLANEE

www.flickr.com/photos/eppetroecuador/20660229485

The evolution of the energy intensity for the Own Energy Consumption Sector for the study period is shown below:

Figure 14. Evolution of Energy Intensity in the Energy Sector Own Consumption Sector



Source: Prepared by PLANEE

To meet this industry-sector goal, the following specific objectives are proposed.

3.5.2. Specific Objective 1: To reduce energy own-consumption per physical production unit in the Power sector

The Power supply sector is committed to the sustainable use of energy resources in electrical generation, distribution and transmission. By 2035, the sector will have implemented energy efficiency measures, actions and programs that will contribute to the optimization of its operations and to the fulfillment of its sectoral objectives.

Indicator: Electrical Sector Energy Consumption.

Goal:
By 2035, there will be savings by reducing losses in electricity distribution and implementing SGEn, equivalent to 64.1 Mboe.

To meet the specific objective, the following lines of action are proposed:

***Line of action 1**: Program to Reduce of Energy Losses in the Electricity Distribution System*

Improvements in infrastructure and technical management of distribution companies will continue, reducing technical losses in the system, in accordance with the planning established for 2017-2025 in the *Electrification Master Plan.*

In 2015, there were 12.11% of losses, of which 67% correspond to technical losses.

Actions to be taken:

a) Conduct feasibility studies to reduce losses at cost-efficient levels.

b) Expand distribution networks and implement equipment to improve technical operations.

c) Implement a smart measurement at the distribution network and user levels *(Smart grids)*.

Line of action 2: *Project Implement Energy Management Systems based on ISO 50001 in Thermal Generation Plants*

Although much of the electrical generation comes from water sources, there is some contribution from thermoelectric plants, which will maintain operating conditions to guarantee the best standards of energy efficiency and environmental performance.

Actions to be taken:

a) Evaluate the current situation with an orientation to diverse actions that include the implementation of combined cycles, cogeneration, making an inventory of inefficient equipment in the value chain, etc.

b) Develop a program for the implementation of energy management systems by applying the ISO 50001 standard in thermal generation plants.

c) Implement a program to replace inefficient equipment with high energy consumption like engines, pumps, heat exchangers, etc.

3.5.3. Specific Objective 2: To reduce energy own-consumption per physical production unit in the hydrocarbon sector.

Energy consumption by the oil industry is intense. It is mainly concentrated in exploitation, production, transport, refining and distribution activities; specifically, in the following processes: extraction of oil and associated gas, secondary transportation of oil to production facilities, water separation and injection systems; processing centers, and transportation, storage and marketing of refined products.

The demand for electrical energy for production processes depends on the volume of hydrocarbons being handled and processed.

Indicator:	Energy consumption of the hydrocarbon sector per unit of physical product.

Goal:
By 2035, public companies and private companies belonging to the country's hydrocarbon industry will be carrying out energy efficiency projects to achieve a cumulative reduction of at least 19.6 Mboe.

To meet this objective, the following lines of action are proposed:

Line of action 1: *Project to Supply Electricity to Oil Facilities*

The oil electricity generation facilities will be connected to the SNI to optimize the use of energy in the hydrocarbon sector, since, on the one hand, energy will be used from the emblematic hydroelectric projects, substantially reducing the use of diesel or crude oil, and on the other hand, applying own

www.flickr.com/photos/energiaecuador/32494161661/

generation schemes (OGE&EE) to use associated gas volumes and crude oil that were not used until recently.

Guaranteeing the supply of electricity to oil facilities will increase operational safety and the ability to perform substantive tasks more efficiently.

Actions to be taken:

a) Support the implementation of projects associated with optimizing electrical power generation and energy efficiency.

b) Interconnect the oil industry's power generation facilities to SNI.

Line of action 2: *Project to Improve the Supply of High-Quality Oil By-Products*

Fuels with better physical and chemical characteristics will be placed on the market, leading to the entry of new and more efficient technologies, mainly in the transportation and industrial sectors.

Actions to be taken:

a) Update regulations governing the production and commercialization of fuels in matters related with sulfur and particles content.

b) Design and develop a continuous fuel improvement plan.

Line of action 3: *Project to train Evaluators, Managers and Auditors on Energy Management Projects*

By strengthening technical capabilities in energy efficiency, including SGEn, the hydrocarbon industry will have qualified personnel to optimize energy consumption.

Actions to be taken:

a) Develop training and certification programs in energy efficiency and best practices.

b) Implement Energy Management Systems.

Line of action 4: *Project to Implement Energy Efficiency Actions in the Transportation, Storage and Commercialization of Petroleum By-Products Infrastructure*

Given that the Hydrocarbons sector is a high-energy consumption industry, all production, transportation, storage and distribution infrastructure can be replaced by more efficient technologies; therefore, replacement and technological modernization actions will be implemented.

Actions to be taken:

a) Make an inventory of inefficient equipment within the sector's value chain.

b) Implement programs to replace inefficient equipment with high energy consumption like engines, pumps, heat exchangers, etc.

3.6. Galapagos Sector

Diagnosis of the Current Situation

The National Government, being concerned about the ecological, economic and social feasibility of activities in the Galapagos Islands, has expressed the need to adopt measures and implement actions to prevent habitat degradation and ecological impact on the delicate balance of species that coexist in the Galapagos National Park and the Galapagos Marine Reserve.

As part of this commitment, energy planning in the islands is done considering the *Zero Fossil Fuels in Galapagos* Initiative, which aims at eradicating the use of oil-derived fuels in the archipelago by developing non-conventional renewable energy projects and the rational use of energy.

Some of the renewable resource development projects are:

Baltra photovoltaic plant and energy accumulation (65 kWp, 4MWh acid lead and 268 kWh lithium ion). It contributes to the system with average annual production of 136 MWh, representing diesel consumption reduction of approximately 12 thousand gallons, equivalent to the non-emission of 81.6 Tons of CO_2/year.

Baltra-Santa Cruz wind farm (2.25 MW). It contributes to the system with average annual production of 5,800 MWh, representing diesel consumption reduction of approximately 480 thousand gallons, equivalent to the non-emission of 3,600 Tons of CO_2/year.

Puerto Ayora Photovoltaic plant (1.5 MW). It contributes to the system with average annual production of 2,430 MWh, representing diesel consumption reduction of approximately 194 thousand gallons, equivalent to the non-emission of 1,475 Tons of CO_2/year.

San Cristóbal wind farm (2.4 MW). It contributes to the system with average annual production of 4,000 MWh, representing diesel consumption reduction of approximately 300 thousand gallons, equivalent to the non-emission of 2,070 Tons of CO_2/year.

Floreana Island hybrid system (20.6 kWp, 138 kW dual thermal and 192 kWh lead acid). It contributes to the system with average annual production of 93 MWh, representing diesel consumption reduction of approximately 7,700 thousand gallons, equivalent to the non-emission of 56 Tons of CO_2/year.

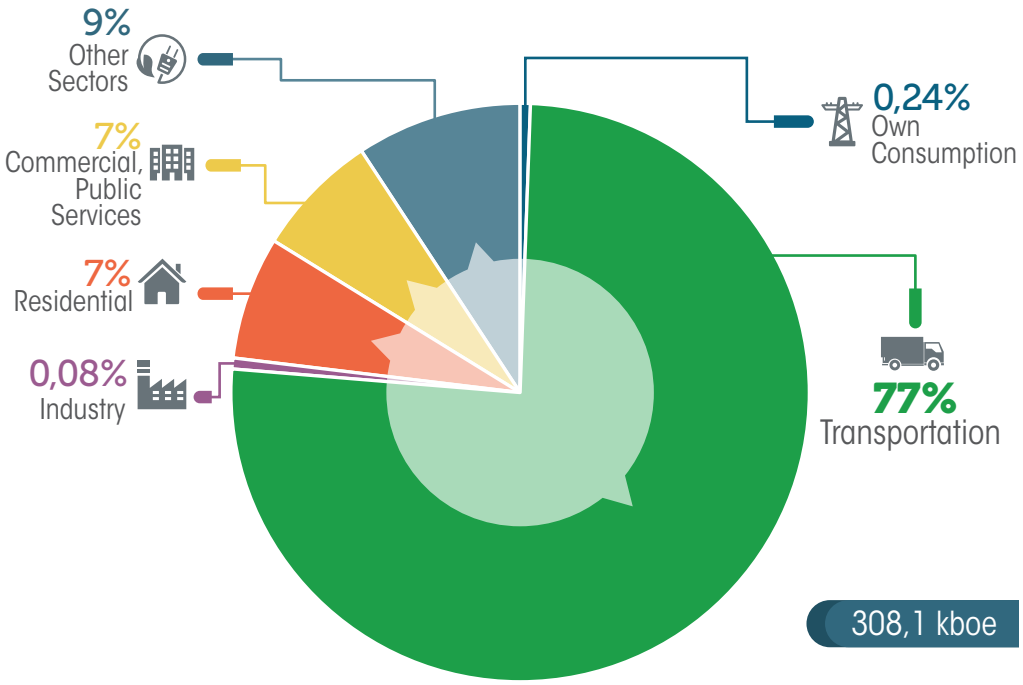
Isabela hybrid project (922 kWp, 1,62 MW dual thermal and 305 kWh in storage). It contributes to the system with average annual production of 3,600 MWh, representing diesel consumption reduction of approximately 300 thousand gallons, equivalent to the non-emission of 1,870 Tons of CO_2/year.

According to the Energy Balance of Galápagos Province 2015, prepared by INER, primary energy production is 3 kboe, which is generated mainly by unconventional renewable energy sources; specifically, wind and solar power.

Meanwhile, secondary energy is generated in transformation centers, mainly in thermal power plants. In 2014, secondary energy production was 29 kboe. Of this value, 89% of the electricity was produced in thermal generators.

The islands recorded 308.1 kboe of energy consumption. The transportation sector has the highest energy consumption, with a 77% share, followed by the Commercial sector, with 7% of total consumption.

Figure 15. Structure of consumption by energy sector



Source: Galapagos Province Energy Balance (2015)

In terms of energy efficiency, the following are the results of several initiatives that promote the rational use of energy:

Replacement of incandescent light bulbs with energy-saving light bulbs: between 2008 and 2013, 25,000 units were replaced, achieving energy savings of 400 MWh/year, saving total emissions of 268 Ton CO_2/year.

RENOVA Refrigerators Program - Phase I, 1,109 refrigerators were replaced between 2012 and 2016, which represented an energy saving of 137.71 MWh/year and 602.67 tons of CO_2 emissions not released into the air.

Public lighting: in 2012, 1,250 inefficient street lamps were replaced with induction lights, creating a benefit of 109.50 MWh/year of saved energy and emissions reduced by 73.36 Ton CO_2/year.

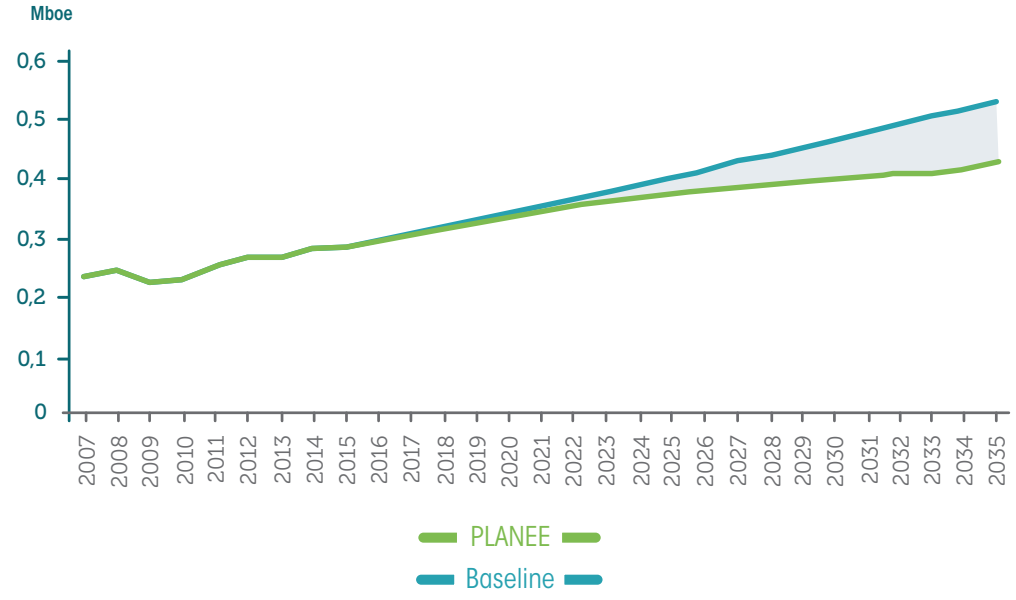
3.6.1. Sector Objective

To establish and implement energy efficiency actions that help to optimize the use of fossil fuels in the Galapagos Islands, targeted at sustainable energy production and consumption in the different sectors.

Indicator:	Percentage reduction in energy consumption in the Galapagos Islands in comparison with the baseline.

Goal:
By 2035, the accumulated consumption of fossil fuel origin energy in the Galapagos Islands will be reduced by 0.36 Mboe, while the share of sustainable energy will have increased by 0.5 Mboe.

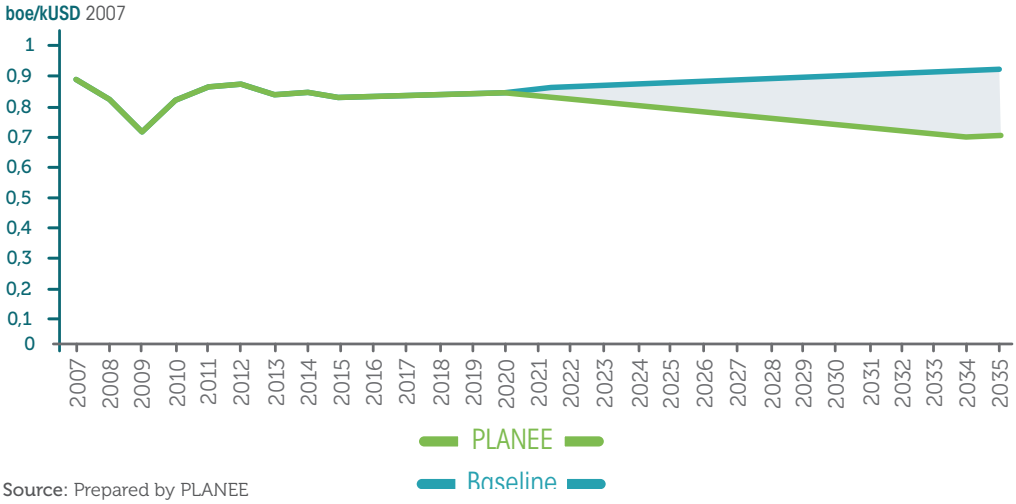
Figure 16. Energy Saved in Galapagos



Source: Prepared by PLANEE

To demonstrate that the reduction in energy consumption is not related to an economic downturn, the following figure relates the amount of energy consumed to the GDP.

Figure 17. Evolution of Energy Intensity in Galapagos



Source: Prepared by PLANEE

To meet this industry-sector goal, the following specific objective is proposed:

3.6.2. Specific Objective 1: To implement projects that encourage efficient energy consumption

Indicator:	Energy saved through energy efficiency actions implemented in Galapagos.

Goal:
By 2035, cumulative energy consumption savings will reach 0.78 Mboe.

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To achieve this objective, design and execution of the following lines of action are proposed:

Line of action 1: *Adoption of the NEC's Galapagos Implementation Project*

In collaboration with the coordination agencies and MIDUVI, MEER will work to define policies that incorporate and guarantee the use of renewable energy and energy efficiency, focused on promoting the updating and application of the NEC in the Residential, Commercial and Public sectors on the islands, taking into consideration their climatic peculiarities and the fragility of their ecosystems.

Actions to be taken:

a) Prepare a regulation proposal for to implement the NEC standard, which will be applied by the GADs.

b) Apply and oversee the catalog on thermal characteristics and thermal, surface and optical properties of construction materials in Galapagos.

Line of action 2: *Program to Replace High Energy Use Equipment*

In cooperation with the coordination entities and MIPRO, MEER will work to define a program focused on promoting the updating and application of energy labeling standards for equipment used in the Residential, Commercial and Public sectors of the islands, taking into consideration their climatic peculiarities and the fragility of their ecosystems.

Actions to be taken:

a) Implement energy efficiency labeling schemes, such as DMEE, on equipment sold on the islands.

b) Replacement of equipment that requires more energy (air conditioners, refrigerators and lighting) in the Residential, Commercial and Public sectors.

c) Implement a plan for replacing and maintaining efficient lighting.

Line of action 3: *Program to Implement Energy Management Systems Based on ISO 50001 in the Islands' Public Institutions and Commercial Sector*

The energy management will be implemented in public institutions and the Commercial sector, through the adoption of ISO 50001.

Actions to be taken:

a) Implement the training and technical assistance programs necessary to implement the SGEn with identified stakeholders.

b) Evaluate and follow-up on SGEn implementation.

c) Integrate information from the island's consumption sectors with the SINEE.

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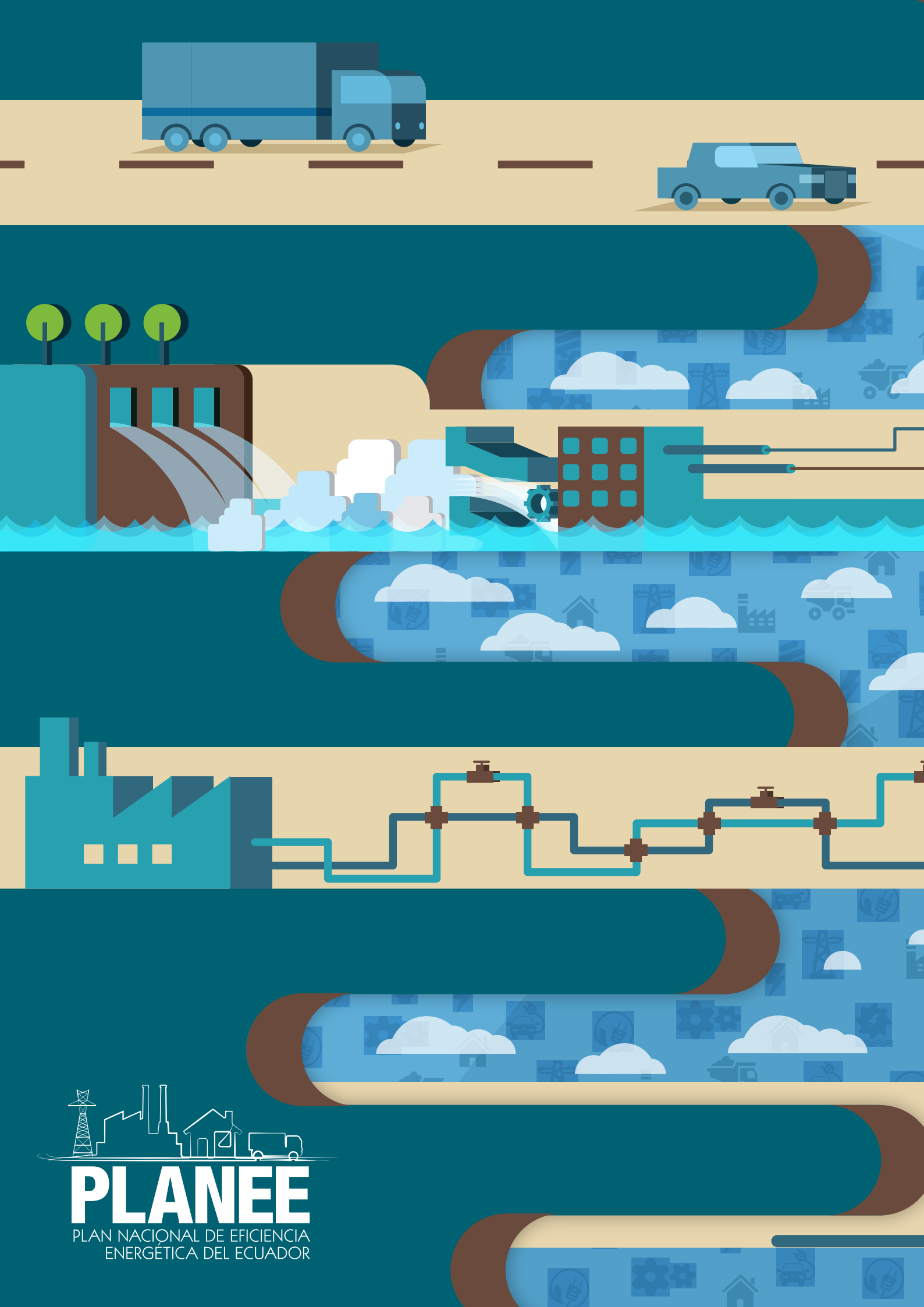

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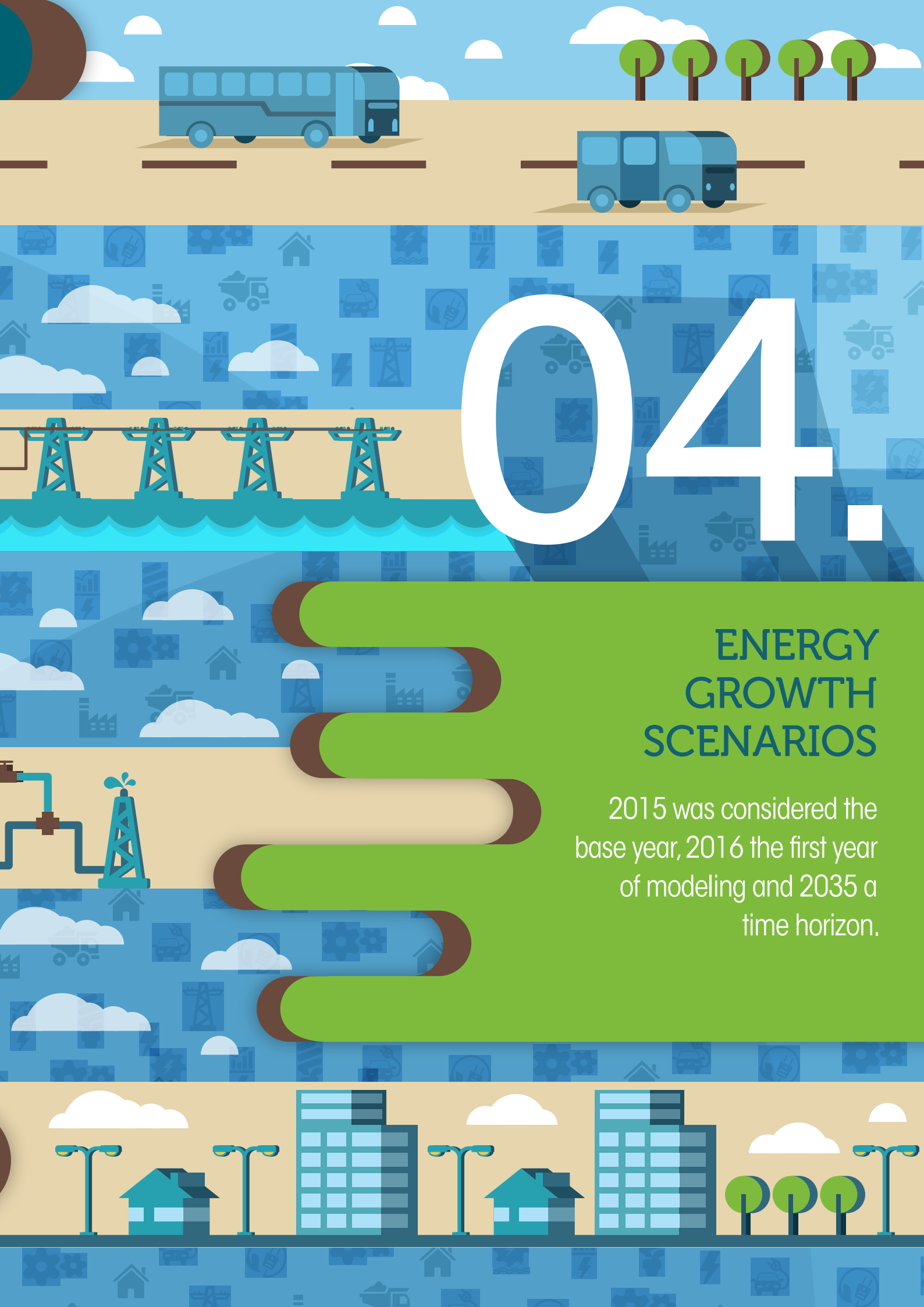


04.

ENERGY GROWTH SCENARIOS

2015 was considered the base year, 2016 the first year of modeling and 2035 a time horizon.

The quantitative determination of saved energy in each sector of PLANEE analysis was carried out using the modeling technique of energy scenarios for the period 2016-2035.

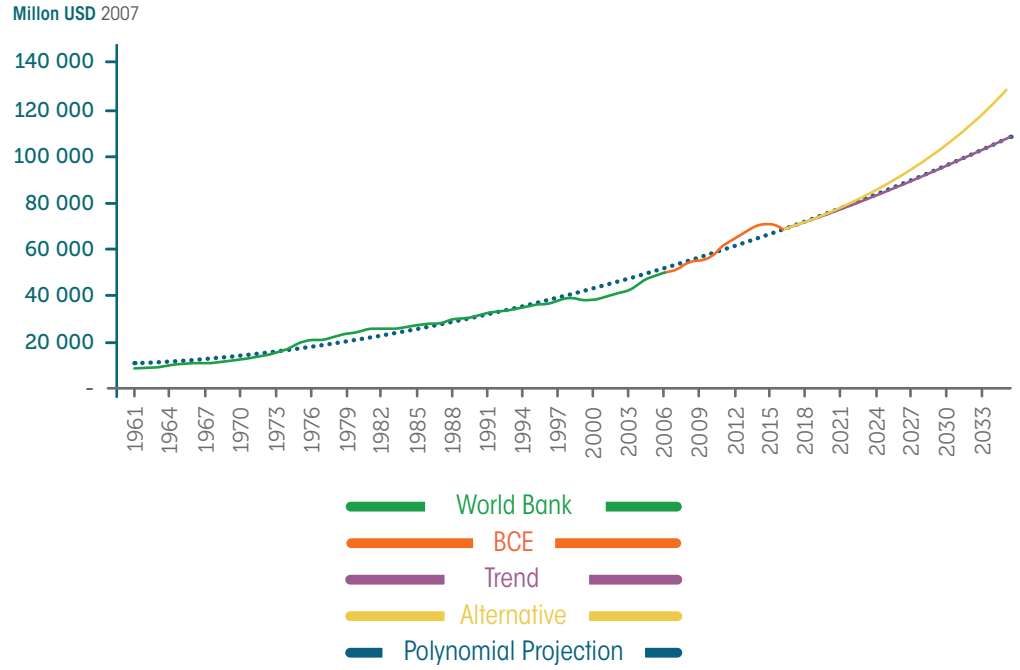
According to the data from the BCE regarding the GDP projection, two economic scenarios denominated "Trend" and "Alternative", were built. In both, the year 2015 was considered the base year, the year 2016 the first year of modeling and the year 2035 a time horizon. Although they differ in the future evolution of GDP, they consider energy growth as a result of policies to improve the performance of refineries in the country, implementation of strategic industrial projects such as steel, aluminum, copper and petrochemical industries, and incentives to mining. They also consider that in the commercial sector, agriculture, tourism and construction will be promoted.

The basis for the information to obtain GDP projections is the gross aggregate value per industry from the BCE.

World Bank data from 1961 to 2006 and BCE data from 2007 to 2015 were used for the "Trend Scenario"[7]. This information was applied to mathematical models based on historical GDP growth and projections from 2 to 2.5 %, from 2016 to 2035; while for the "Alternative" scenario GDP growth was considered from 3.5% to 4% for the same period.

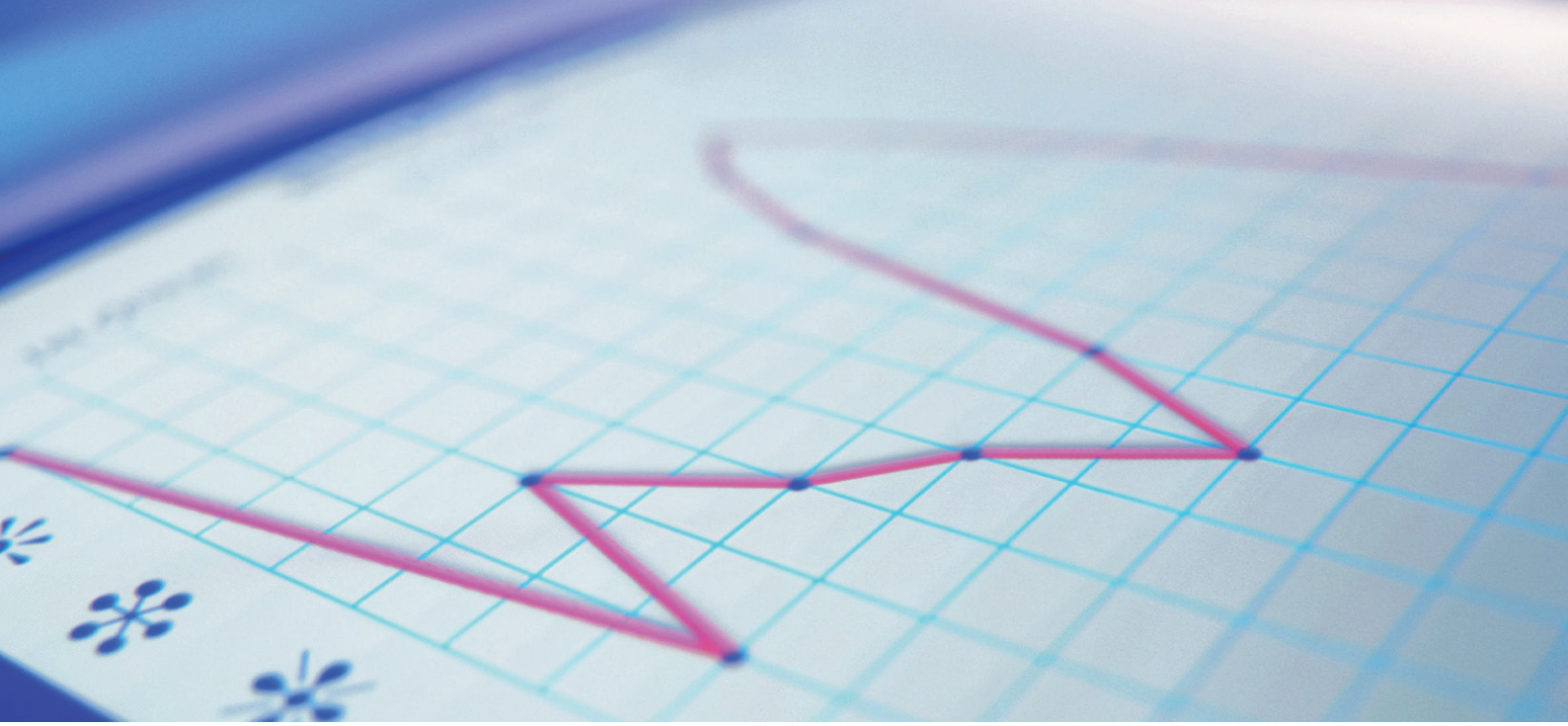
The simulation of the programs and projects showed a non-representative difference in the economic scenarios mentioned above, so that, for the energy projections of PLANEE, only the Trend scenario was used, because it was more conservative.

Figure 18. Economic Scenarios – GDP growth



Source: Prepared by PLANEE

[7] In 2007 dollars



4.1. Methods and Information Collection

For the development of energy projections, the LEAP (Long-range Energy Alternatives Planning Systems) program is used, it was developed by the Stockholm Institute of Environment. This tool is widely used worldwide for the analysis of energy policies, through the development of prospective scenarios of energy supply and demand, as well as GHG emissions.

The sources of information were: Trend Economic Scenario; *National Strategy for the Change of the Productive Matrix,* published by the Vice-Presidency; National Energy Balances prepared by MICSE; Study of the energy prospects of the country prepared by MEER; *Master Plan of Electrification 2013-2022* and statistics of the Ecuadorian Power sector, published by ARCONEL; *Petroecuador EP Strategic Plan;* energy scenarios developed by INER; *Strategic Mobility Plan developed by the MTOP;* among others.

4.2. Characterization of the Scenarios

The main objective of the energy scenarios is to enable the work of prospective energy and of the indicative planning of the energy system, considering a greater energy efficiency. The proposed indicators give an approximate scenario until 2035, including the interaction between the various dimensions of sustainable development, and show the implications of current decisions and behaviors in the long term.

For the development of these scenarios, we started with an initial modeling that includes the data of demand by sector, sources and supply of energy with installed capacities of generation of electricity by type of plant; supply and equipment in oil and natural gas; scenarios of oil production, natural gas and biofuels, and, in general, the entire energy structure of the country. Modifications were made based on this, in accordance with the needs of PLANEE and the following scenarios were developed:

- **Baseline scenario.** It represents the continuity of the inertial situation of the historical period in the future and does not contemplate any policy of energy management in both supply and demand.
- **PLANEE scenario.** It considers the results of the implementation of the programs and projects that are constant in the planning of the different governing bodies in the period 2007-2015, for instance: hydroelectric plants, induction stoves and energy saving light bulbs. As of 2016, simulations of the natural market behavior and the quantifiable programs and projects of PLANEE are carried out for each sector of analysis.

Table 1. Characterization of the historical period 2007-2015

Analysis Sector	Situation prior to 2007	Situation 2007-2015
Own consumption		
Public electricity generation service.	Configuration prior to changing the energy matrix.	Emblematic hydroelectricity plants and change of the energy matrix.
Self-production in generation.	Diesel and crude oil consumption for generation in oil production.	Project OGE&EE of PAM.
Supply management.	Level of losses according to the historical trend (prior to 2007).	Reduction of distribution losses.
Residential, Commercial and Public		
Residential demand management.	Cooking with LPG, penetration of refrigerators of low efficiency, continuity of lighting with incandescent light bulbs.	Induction stoves program, RENOVA refrigerators plan, change of incandescent lamps by LCF.
Public demand management.	Low-efficiency street lamps in public lighting.	Changing street lamps in public lighting.
Industrial		
Industrial demand management.	No energy efficiency intervention in this sector.	Energy efficiency project in the industry.
Transportation		
Demand of transportation management.	No energy efficiency intervention in this sector.	RENOVA Plan for public service vehicles.

The following is a sectoral summary of the specific objectives, lines of action and indicators considered in PLANEE. Currently, some are unquantifiable, since they require previous studies for their modeling.

4.2.1. Residential, Commercial and Public Sector

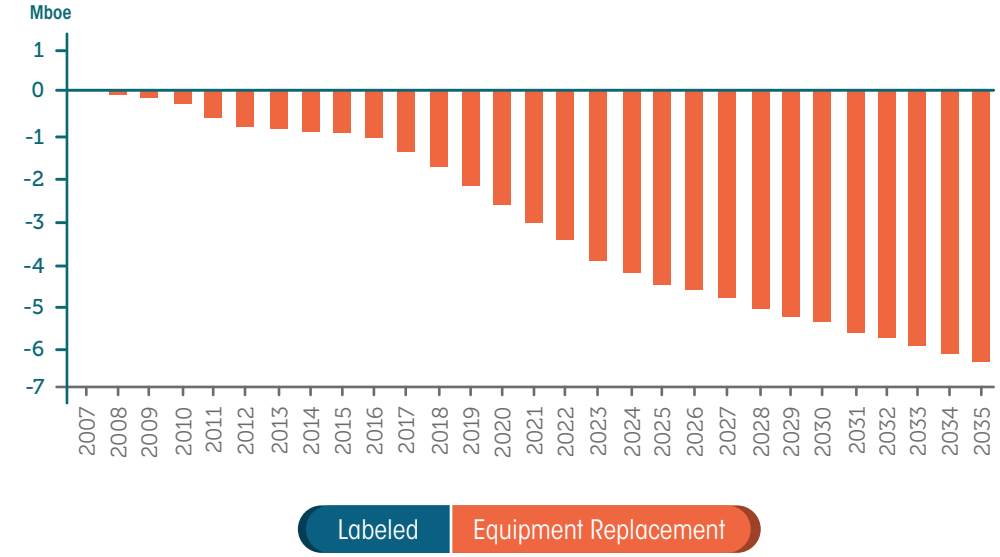
In the Residential, Commercial and Public sectors, the potential of energy saved is mainly based on the labeling, the replacement of inefficient electrical appliances and public lighting.The PEC remains as a project in the energy efficiency baseline scenario.

Table 2. Specific objectives, lines of action and indicators in the Residential, Commercial and Public Sector

RESIDENTIAL, COMMERCIAL AND PUBLIC SECTOR	
Sectoral Objective:	To reduce the average annual growth rate of energy consumption in residential, commercial and public buildings, and establish a regulation on building habitability.
Indicator:	Percentage of reduction in energy consumption with respect to the baseline.
Goal:	In the year 2035, the cumulative energy consumption of the residential, commercial and public sector will be reduced by at least 88.8 Mboe, due to the energy efficiency measures implemented.

Specific objective	Lines of action	Estimate of the reduction of energy consumption
To strengthen programs for the replacement and labeling of electric appliances and high energy consumption equipment.	Project for the identification of final uses of energy in the Residential, Commercial and Public sectors.	Not quantifiable.
	Program for the standardization and labeling of energy-consuming equipment.	Reduction of **70 837 boe**, from 2016 to 2035. Estimated reduction from 25% by 2035, of energy intensity; however, because the growth of electrical appliances is very similar to the reduction of energy intensity, the final result is that there is no reduction of Boe.
	Replacement program of greater energetic consumption equipment for residential use.	Reduction of **88.8 Mboe**, from 2016 to 2035. Improvement of energy efficiency in residential equipment. Replacement in the commercial sector to achieve a reduction of 10% of energy intensity by 2035. Continuation of the massive introduction of induction stoves
To establish oversight and control mechanisms for the implementation and application of the NEC (chapters of energy efficiency, air conditioning and renewable energy) at the GAD level.	Project for the definition of oversight and control mechanisms for the implementation and continuous improvement of the NEC standard - Energy Efficiency, Air Conditioning and Renewable Energy	Not quantifiable.

Figure 19. Energy saved in Residential, Commercial and Public Sector

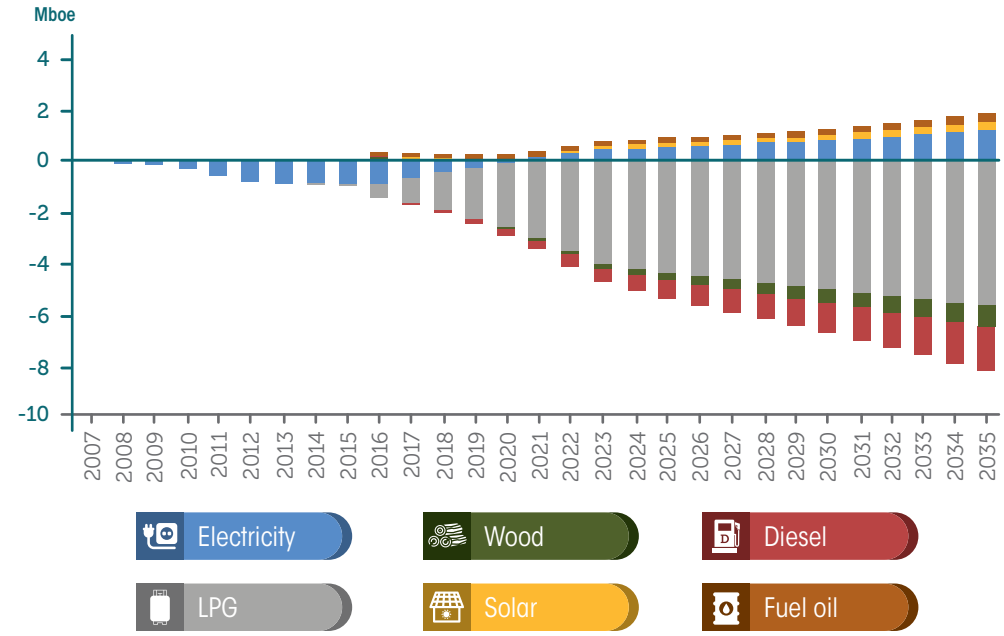


Source: Prepared by PLANEE

The energy saved in this sector reaches 88.8 accumulated Mboe, when the base scenario is compared with the PLANEE scenario.

In this sector, LPG is the energy source with the greatest reduction in consumption, due to the massive introduction of induction stoves. The following is diesel, as shown below.

Figure 20. Consumption variation by energy source in the Residential, Commercial and Public Sector



Source: Prepared by PLANEE

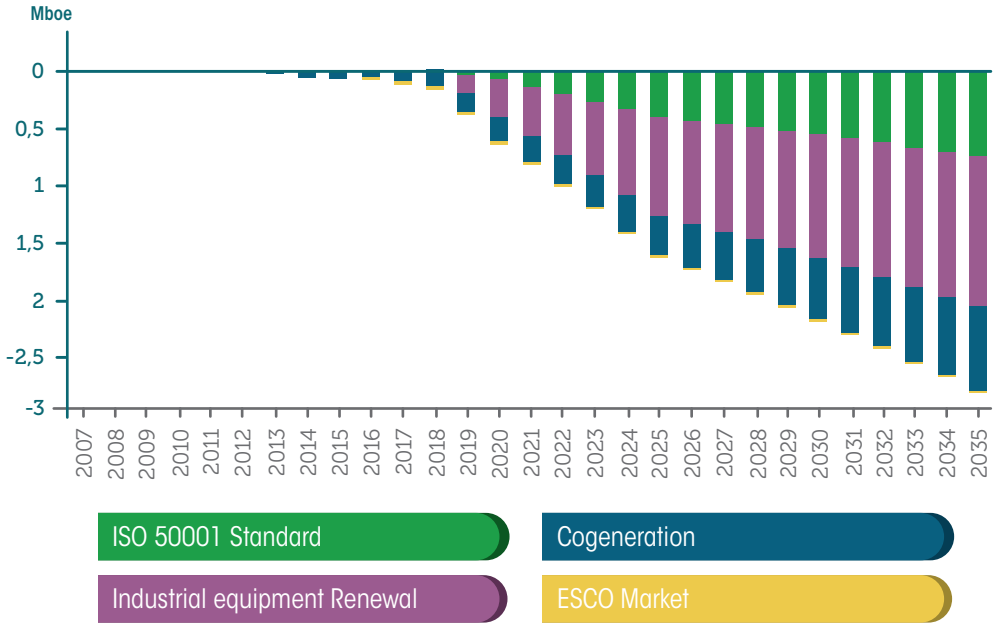
4.2.2. Industrial Sector

The industrial sector has an interesting potential for saving, especially in the case of an alternative behavior of the economy, according to which, the entrance of heavy industry with high energy intensity is expected. The reduction is mainly due to the renewal of industrial equipment and the introduction of ISO 50001 in the processes of greater consumption.

Table 3. Specific objectives, lines of action and indicators in the Industrial Sector

INDUSTRIAL SECTOR		
Sectoral Objective:	To reduce energy consumption per unit of physical production in the sub sectors of the industry.	
Indicator:	Energy consumption in each industrial sub sector indexed to physical production units for industries implementing energy efficiency measures.	
Goal:	By 2035, there will be a saving of at least 29.9 Mboe, thanks to the energy efficiency actions implemented in the sector.	
Specific objective	Line of action	Estimate of the reduction of energy consumption
Reemplazar equipos ineficientes, aplicar sistemas de cogeneración y adoptar la norma ISO 50001 en las industrias energo-intensivas	Program for the implementation of the ISO 50001 standard in energy-intensive industries	Reduction of **7.4 Mboe**, from 2007 to 2035. Reduction of energy intensity considering 100 energy-intensive industries.
	Cogeneration program in the industry.	Reduction of **7.75 Mboe**, from 2007 to 2035. Improvement of energy efficiency by 10%.
	Replacement program for engines, pumps, boilers and heaters in industries.	Reduction of **14.7 Mboe,** from 2007 to 2035. Estimated reduction of 10% of energy intensity by 2035.
Impulsar el desarrollo de un mercado de Empresas de Servicios Energéticos (ESCOs) en el país	Program for the development and promotion of an ESCO market in Ecuador.	Not quantifiable.

Figure 21. Energy saved through Energy Efficiency in the Industrial Sector

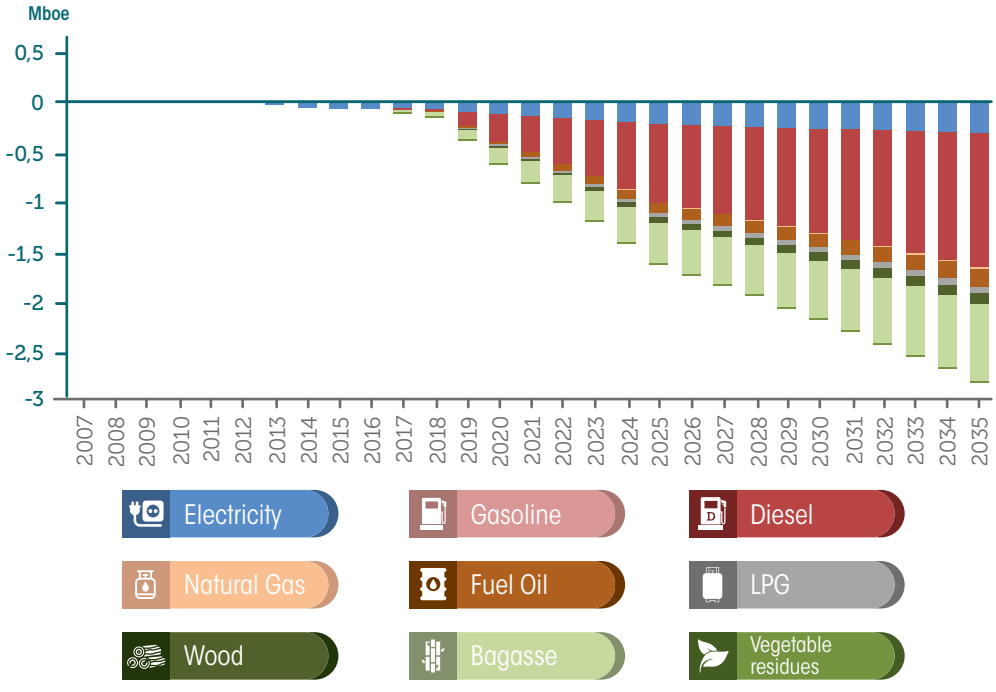


Source: Prepared by PLANEE

Regarding the energy saved, a reduction of 29.9 Mboe is achieved, when comparing energy efficiency and baseline scenarios.

In the industrial sector, energy sources with the greatest reduction in demand are expected to be diesel, bagasse, fuel oil and electricity.

Figure 22. Consumption variation by energy source in the Industrial Sector



Source: Prepared by PLANEE

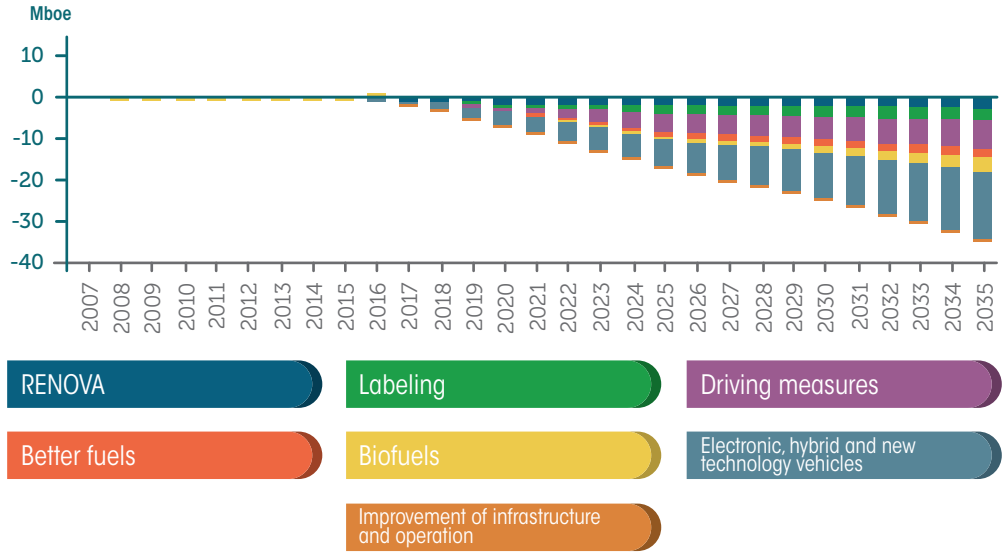
4.2.3. Transportation Sector

It is the sector with the greatest potential for energy saving, mainly due to the scrapping of vehicles, the entry of new technologies and efficient driving habits.

Table 4. Specific objectives, lines of action and indicators in the transportation Sector

TRANSPORTATION SECTOR		
Sectoral Objective:	To optimize energy consumption in freight and passenger transportation, in relation to the sectoral baseline scenario, through the execution of energy efficiency projects that generate benefits in the sector.	
Indicators:	Energy consumed per unit of transported cargo. Energy consumed per transported passenger.	
Goal:	By the year 2035, the transportation sector will generate accumulated savings of 339.6 Mboe.	
Specific objective	Base line	Estimate of the reduction of energy consumption
To optimize the infrastructure for the circulation of transportation, contributing to the reduction of fuel consumption.	Program of improvement of the Transportation Infrastructure and Operation.	Reduction of **12.2 Mboe**, from 2007 to 2035. In mass transportation, a reduction of 10% of cars and SUVs is considered, due to the replacement of buses.
To replace inefficient transportation technologies, implement energy labeling and conduct training in efficient driving techniques	Energy efficiency labeling project for new vehicles.	Reduction of **28.6 Mboe** from 2007 to 2035. Estimated reduction of 5% in energy intensity by 2035.
	Project to reactivate, reconfigure and expand the RENOVA Vehicle Plan.	Reduction of **35.3 Mboe**, from 2007 to 2035. Scrapping of 2,000 vehicles per year.
	Training project in efficient driving techniques.	Reduction of **71.6 Mboe**, from 2007 to 2035. Estimated reduction of 12.5% of energy intensity by 2035.
To replace energy used as fuel, improve quality and new technologies	Project to incorporate hybrid vehicles, electric vehicles and new technologies to be commercially available in the future	Reduction of **144.8 Mboe,** from 2007 to 2035. Reduction based on Blue Map Scenario Ecuador
	Project of partial replacement of fossil fuel by biofuel blending.	Reduction of **26.0 Mboe**, from 2007 to 2035. Achievement of 5% biodiesel blending, and 10% ethanol, by 2025.

Figure 23. Energy saved through energy efficiency in the Transportation Sector

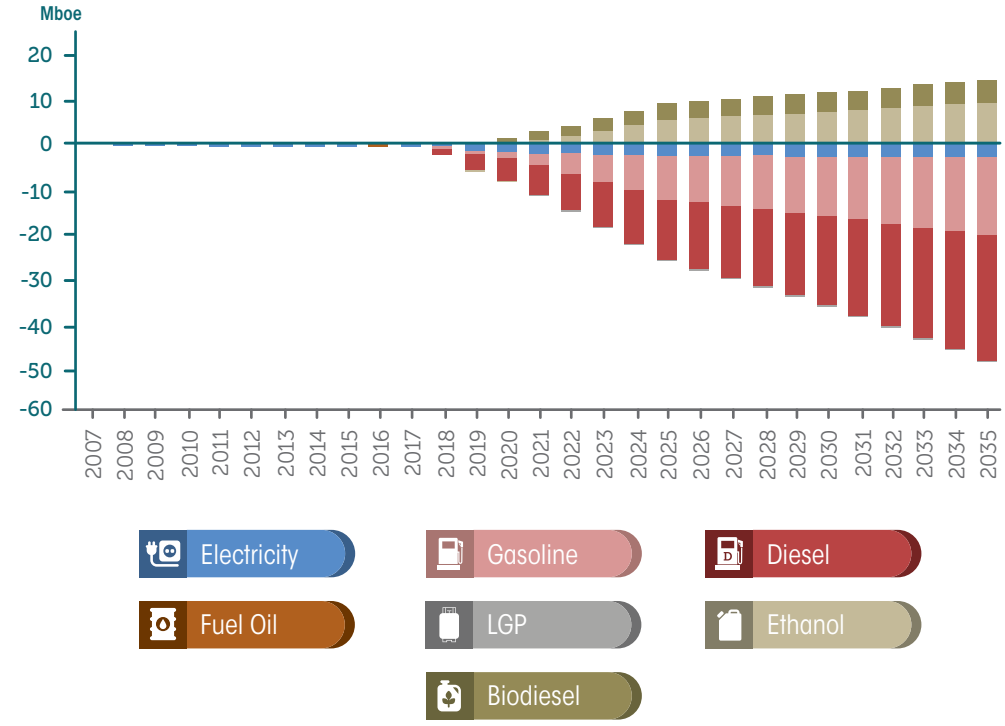


Source: Prepared by PLANEE

A cumulative amount of energy of 339.6 Mboe is expected to be saved on this sector, when baseline and energy efficiency scenarios are compared.

Fuels, mainly diesel and gasoline, specially imported and subsidized, are the energy source with the greatest reduction in consumption in this sector.

Figure 24. Consumption variation by energy source in the Transportation Sector



Source: Prepared by PLANEE

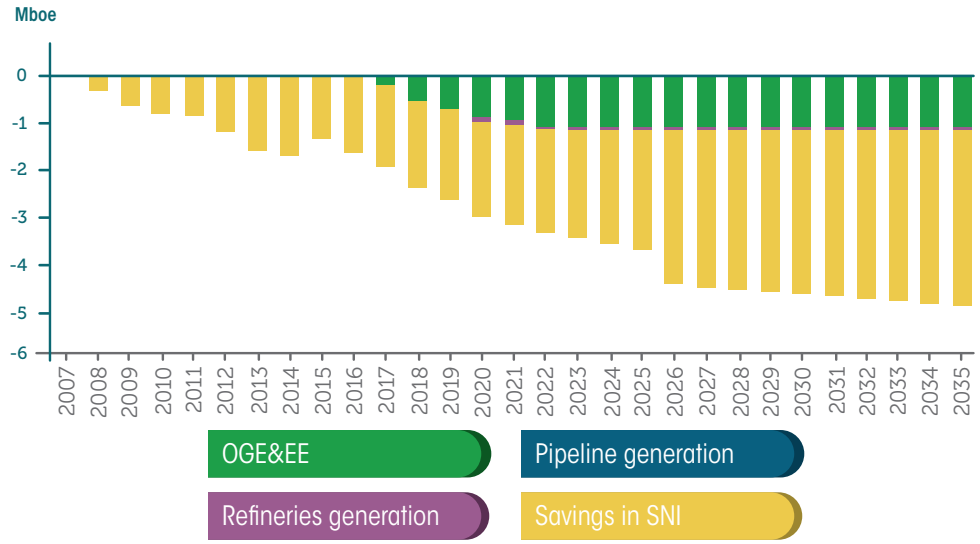
4.2.4. Energy sector own consumption Sector.

In this sector, the country's energy industries carry out energy efficiency projects by 2035, to achieve a reduction in own consumption, as shown below.

Table 5. Specific objectives, lines of action and indicators in the Own Consumption Sector

ENERGY SECTOR OWN CONSUMPTION SECTOR			
Sectoral Objective:	To reduce the energy consumption per unit of physical production in the corresponding value chain.		
Indicator:	Energy consumption of the sector per unit of physical product.		
Goal:	By 2035, companies that belong to the country's energy industry, and carry out energy efficiency projects, will achieve a reduction of 83.7 Mboe in own consumption, compared to the baseline scenario.		
Specific objective		Base line	Estimate of the reduction of energy consumption
To reduce energy own-consumption per physical unit of production in the electricity sector.		Program to reduce energy losses in the electricity distribution system	Reduction of **64.13 Mboe**, from 2007 to 2035. Loss reduction is 21.4%, in 2007, to 8.3%, in 2035.
		Project for the implementation of energy management systems based on ISO 50001 in thermal generation plants	The ISO 50001 management systems must be carried out in both hydroelectric and thermal generation. No analysis has been made in this regard.
To reduce energy own-consumption per physical unit of production in the hydrocarbon sector		Project to supply electricity to oil facilities.	Reduction of **18.5 Mboe**, from 2007 to 2035. Replacement of diesel by associated gas in the OGE and the use of SNI.
		Project to improve the supply of high quality derivatives.	Not quantifiable.
		Project to train evaluators, administrators and auditors of energy management projects.	Not quantifiable.
		Project to implement energy efficiency actions in the transportation, storage and commercialization of derivatives	Reduction of **0.08 Mboe**, from 2007 to 2035, in pipelines by the replacement of crude oil by electricity from SNI in 2014 - 2024, and from **1.0 Mboe**, from 2007 to 2035 in refineries, by replacement of fuel oil by electricity from SNI, in 2020.

Figure 25. Energy saved through energy efficiency in the Energy Sector own consumption Sector

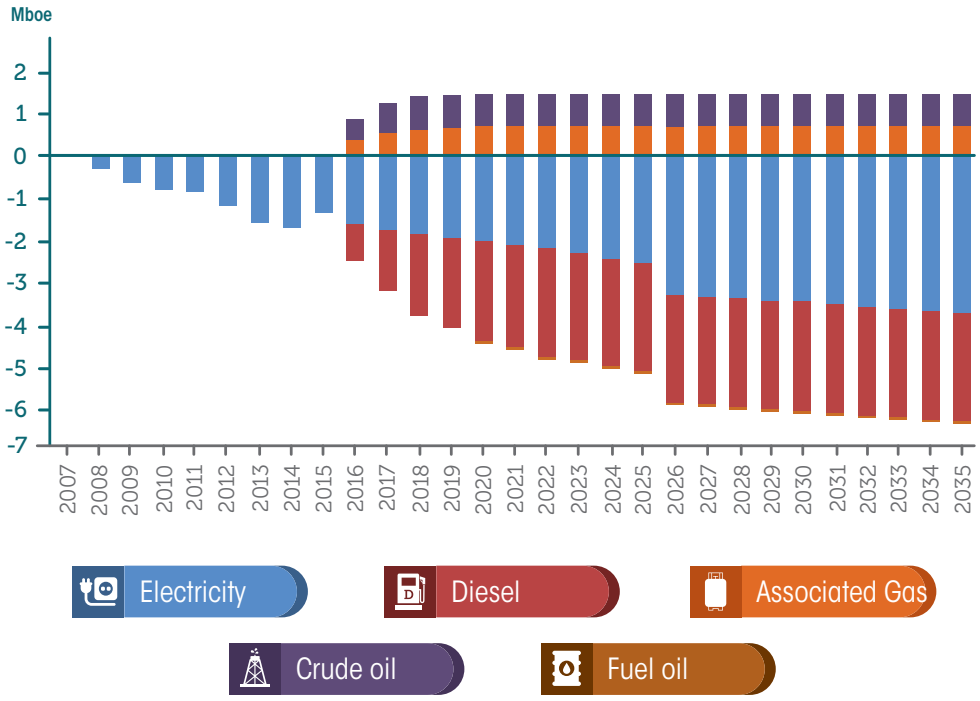


Source: Prepared by PLANEE

When baseline and energy efficiency scenarios (PLANEE) are compared, it is expected to save an accumulated energy amount of 83.7 Mboe.

The energy source with the greatest reduction in consumption will be electricity, with approximately 64.1 Mboe, followed by diesel with 46.9 Mtep.

Figure 26. Consumption variation by energy source in the Energy sector own consumption Sector



Source: Prepared by PLANEE

4.2.5. Galapagos Sector

In this sector, it is expected to implement 100% of energy efficiency actions by 2035, which are detailed below.

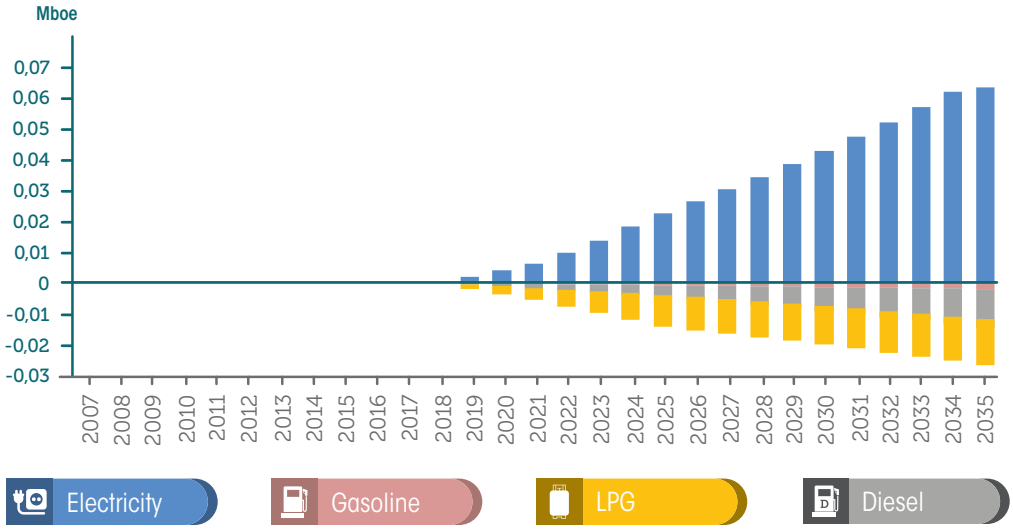
Table 6. Specific objectives, lines of action and indicators in Galapagos

GALAPAGOS SECTOR		
Sectorial Objective:	To establish and implement energy efficiency actions that help to optimize the use of fossil fuels in the Galapagos Islands, guiding the production and sustainable consumption of energy in different sectors.	
Indicator:	Percentage reduction in energy consumption in the Galapagos Islands compared to the baseline.	
Goal:	By the year 2035, the cumulative consumption of energy of fossil origin in the Galapagos islands will be reduced in 0.36 Mboe. On the other hand, the share of sustainable energy will increase by 0.5 Mboe.	
Specific objective	Base line	Estimate of the reduction of energy consumption
To execute projects that encourage efficient energy consumption	Adoption of the NEC's implementation project in Galapagos	Not quantifiable.
	Program of replacement of equipment of greater energy consumption.	Reduction of **0.098 Mboe**, from 2007 to 2035. Efficiency improvement by equipment replacement.
	Program for the implementation of energy management systems based on ISO 50001 in public institutions and the commercial sector of the islands	Reduction of **0.112 Mboe**, from 2007 to 2035. Reduction of 10% of energy intensity by 2035, mainly by optimal consumption of energy in the tourism sector.

The largest decrease due to energy efficiency measures is recorded in the transportation sector, which is the highest fossil fuel consumer.

The following is the decrease in the consumption of fossil fuels and the increase in the consumption of electricity.

Figure 27. Consumption variation by energy source in the Galapagos

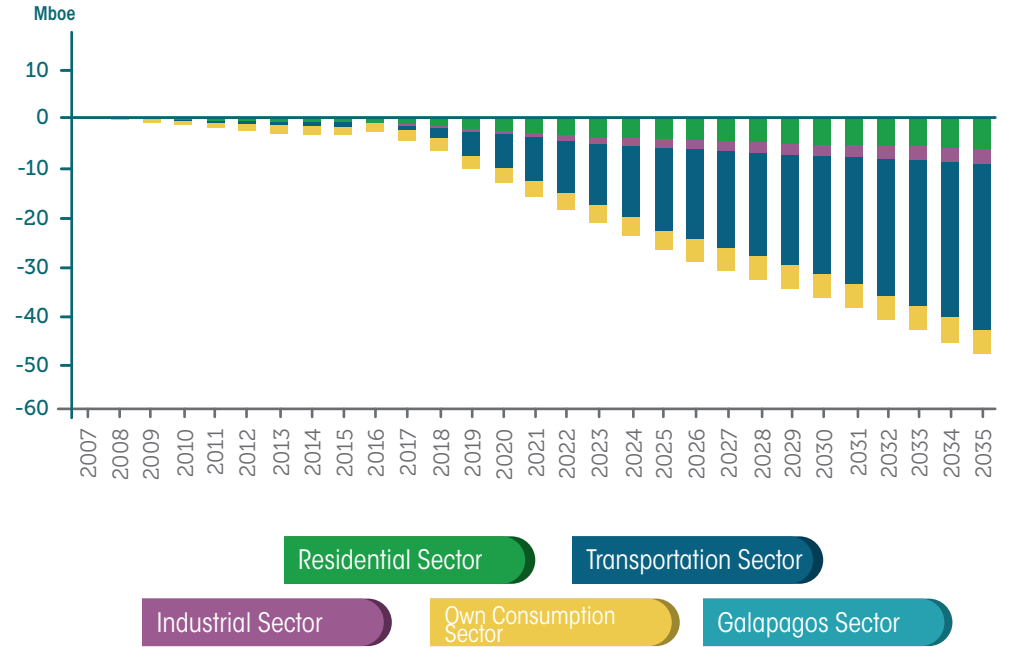


Source: Prepared by PLANEE

4.3. Analysis of results

The amount of energy saved due to the implementation of the energy efficiency measures proposed in PLANEE is 543 Mboe, with a trend in GDP growth. This amount results from the aggregation of sectorial net values of saved energy, as shown below.

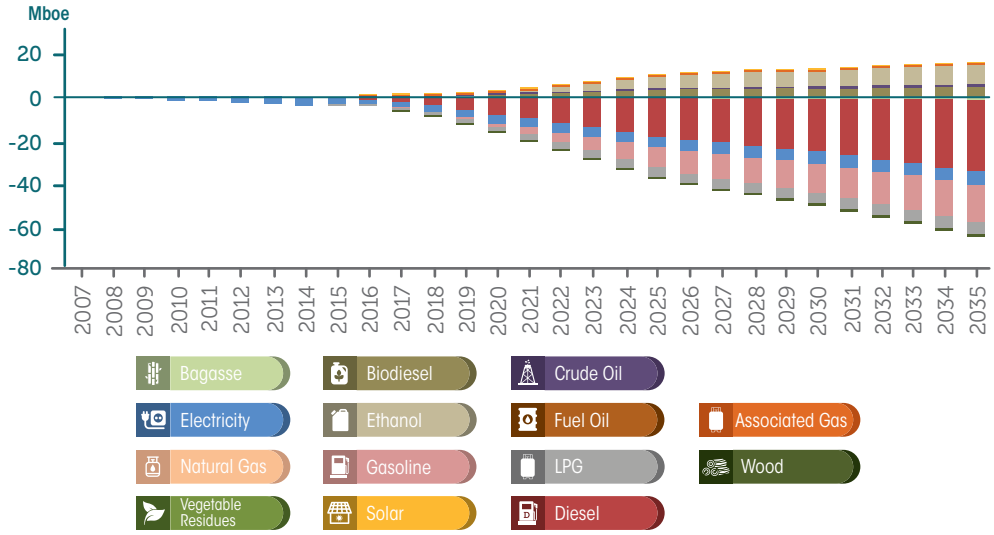
Figure 28. Total energy saved - PLANEE



Source: Prepared by PLANEE

From the perspective of energy sources, the reduction of diesel followed by gasoline stands out, while an increase in the demand for electrical energy is expected.

Figure 29. Total Consumption variation by energy source

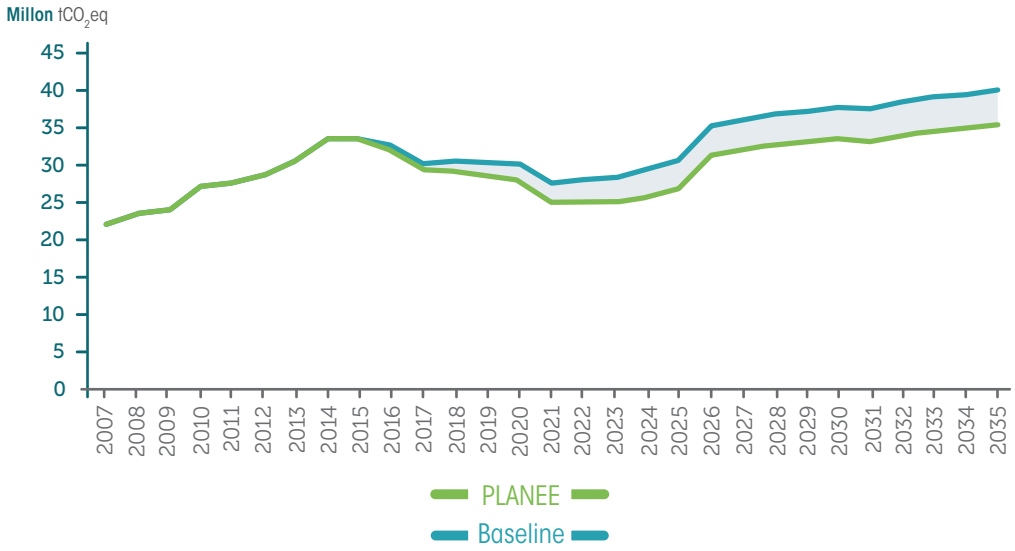


Source: Prepared by PLANEE

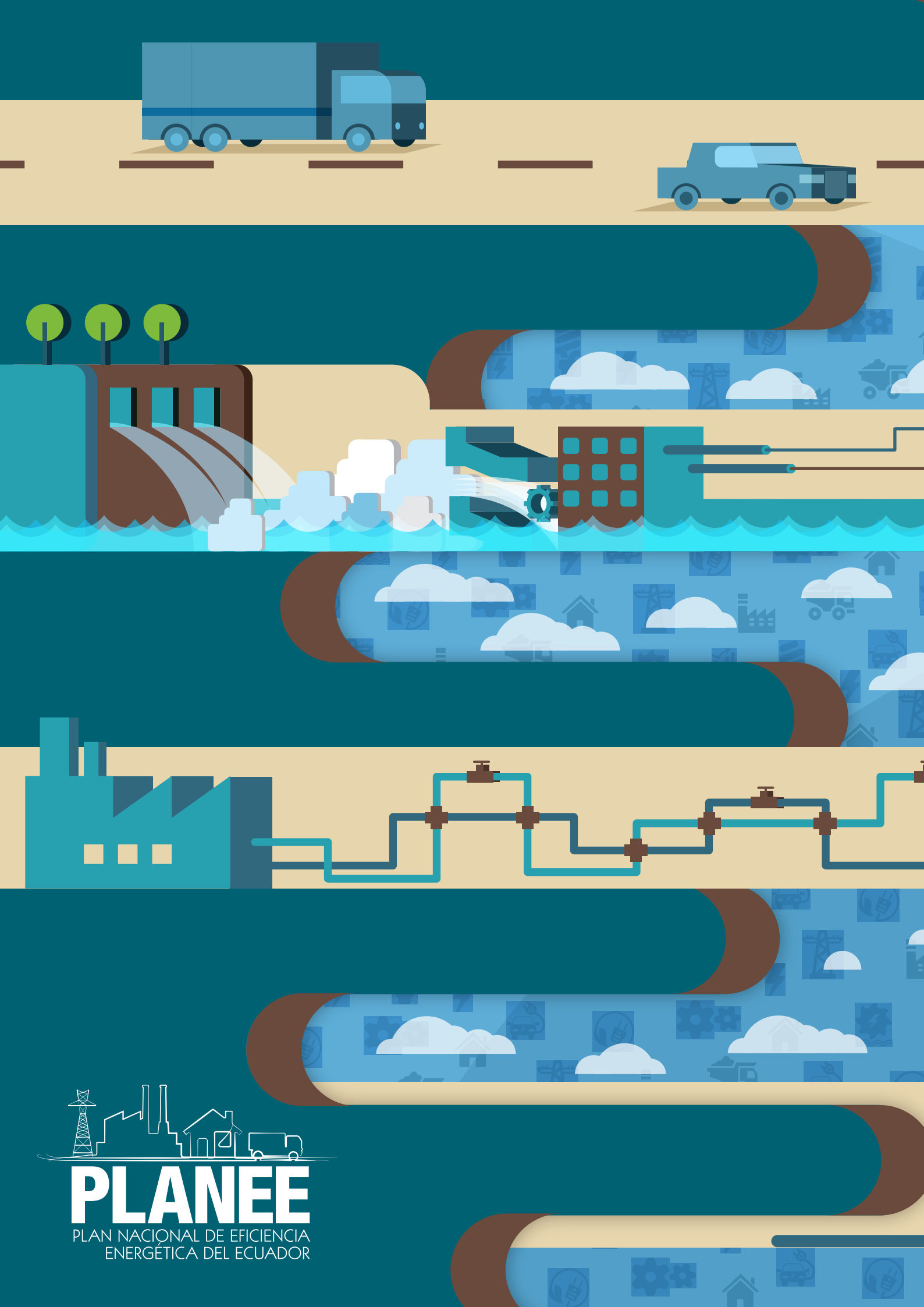
The reduction in the demand for fossil fuels because of greater energy efficiency in sectors analyzed, reflects in the reduction of GHG emissions according to the following distribution.

Comparing the baseline scenario with the PLANEE scenario, a GHG emission reduction of 65 $MtCO_2eq$ is recorded.

Figure 30. Total GHG emissions

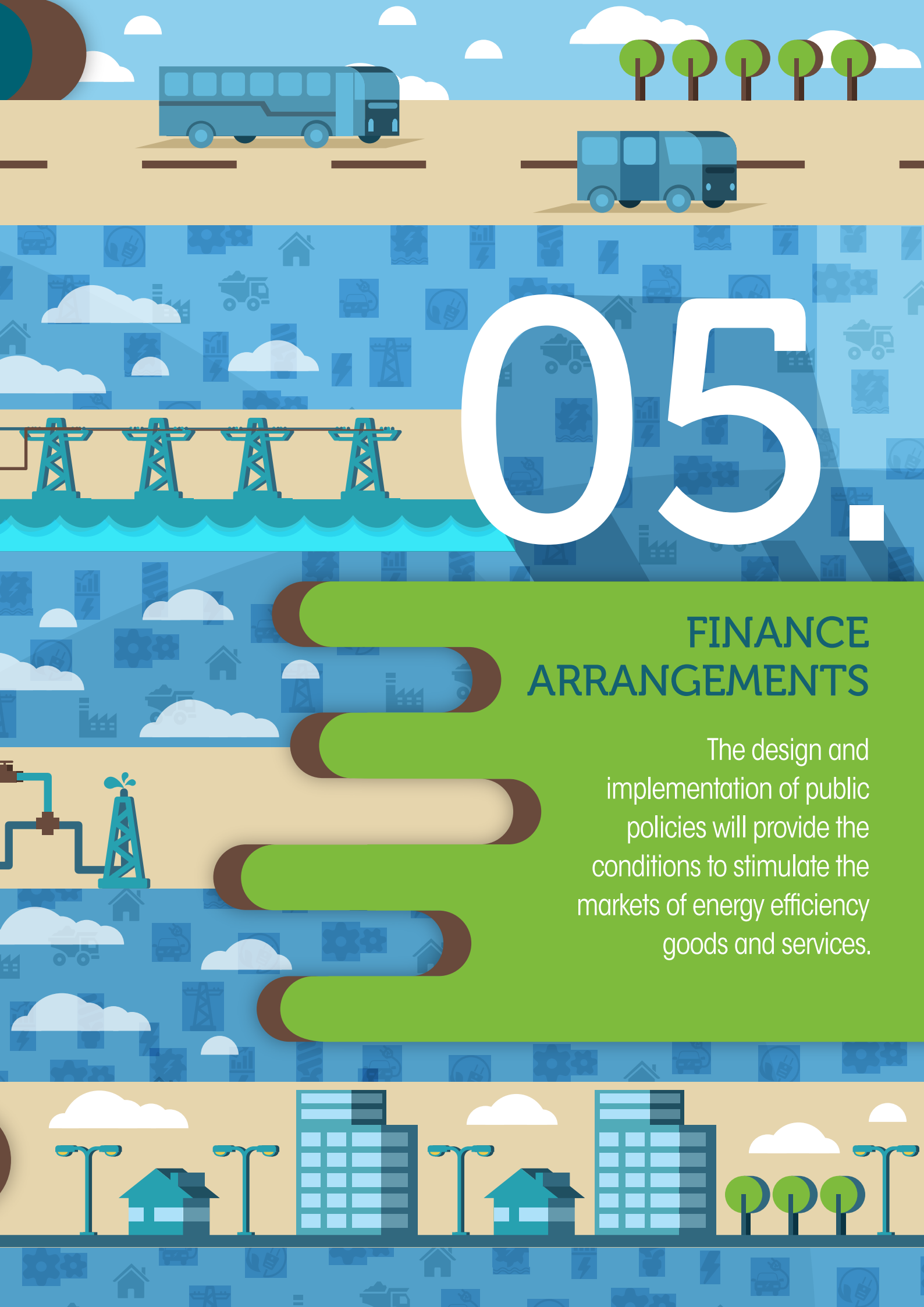


Source: Prepared by PLANEE



PLANEE

PLAN NACIONAL DE EFICIENCIA ENERGÉTICA DEL ECUADOR



05.

FINANCE ARRANGEMENTS

The design and implementation of public policies will provide the conditions to stimulate the markets of energy efficiency goods and services.

PLANEE must identify the economic resources required to meet the objectives set. The design and implementation of public policies will provide the conditions to stimulate the markets for energy efficiency goods and services. For this, it is necessary to consider two financing schemes for:

- Public and sectoral programs of government agencies in energy efficiency.
- Private investment projects.

In the case of programs developed by the government, the operational costs associated with their maintenance and continuity must be considered.

This section presents estimates of public resource requirements for PLANEE; however, the importance of the private sector counterpart is emphasized, whose estimates will be adjusted during the implementation of each line of action.

5.1. The National Financial System

Ecuador has a financial system made up of public and private stakeholders that operate in the different market segments and potentially could handle an offer of financial products aimed to covering the programs and projects identified in PLANEE.

Therefore, the role of the local financial sector should focus on identifying business opportunities in energy efficiency issues, which could be financed by own lines of credit, bilateral or multilateral agencies, from international initiatives on energy efficiency, mitigation and adaptation to climate change.

To date, financial sector investments are channeled through the supply of instruments that respond to the needs of the different economic sectors, so it is necessary to strengthen their internal capacities in the following areas:

- Improvement of liquidity of the financial sector that can be covered with funds created for a specific purpose.
- Diversification of the credit supply at different market segment levels.
- Reduction of companies´ financial costs, mainly SMEs.

- Incorporation of structured financing mechanisms.

5.2. Financing needs: PLANEE

The resources required to implement the various lines of action of PLANEE have been estimated in US $116 million during the first five years of implementation, representing an annual average investment of USD 23.2 million.

On the other hand, it would be expected that the investments of the private counterpart, supported by the existing regulatory framework and the institutionality, will be of the same level or higher.

5.3. Financing of Public Programs

In addition to the institutional will and the development of mandatory regulations, it is important to establish the financial conditions that allow the market to internalize these regulations and their mandatory nature.

Often, energy efficiency programs are linked to projects with external sources and cannot continue when these resources are not available. External sources for specific projects are important drivers of the market, but do not ensure the follow-up and permanence of actions.

The financing of public programs must be aimed at covering the cost of public policy instruments to break the barriers and flaws in the market, that the market itself, cannot solve. The budgetary sources that enable the implementation of public policy instruments at both the supply and demand of energy can have different origins, including:

5.3.1. Donation funds and non-refundable technical cooperation funds.

International cooperation agencies or multilateral agencies have funds to support energy efficiency programs and projects, which can be delivered as grants or non-refundable technical cooperation.

Ecuador has signed international treaties and agreements and established channels of cooperation to strengthen such projects.

5.3.2. Sovereign Debt

The structure of the national budget includes financing mechanisms such as the contracting of debt with multilateral agencies, this is an alternative to partially cover the financial requirements of the programs and projects of PLANEE.

5.3.3. Budget allocations

Part of the budget required for the implementation of energy efficiency programs and projects may be covered by fiscal resources.

5.3.4. National Sustainability Fund

The possibility of establishing a tax on energy sales will be analyzed in detail, which will capitalize a national sustainability fund that will allow the partial development of PLANEE programs and projects. The rate to be considered for the establishment of this fund has been estimated at 0.2% of total energy sales (electricity and fossil fuels).

5.4. Financing of Private Investment Projects

This refers to the financing of projects aimed at the implementation of energy efficiency measures for energy final consumers; for example, technological replacement. In this sense, the financing schemes are oriented to overcome the barriers in the different markets.

One of the main challenges is the development of adequate financial instruments to boost investment projects. Some alternatives for financing will be described below.

5.4.1. Technical Assistance Line

.International cooperation agencies or multilateral agencies have funds to support studies and diagnosis of energy efficiency for the private sector, which can be delivered as a seed fund.

5.4.2. Energy efficiency guarantee fund

The Government could create an energy efficiency guarantee fund as financial instrument to guarantee the credit lines offered by Intermediate Financial Institutions (IFIs) which are hired by final energy users. The Guarantee Fund supports the corporate credit operations offered by the banks, reducing the risk of the loans and, therefore, the cost of financing.

5.4.3. Credit line for project financing

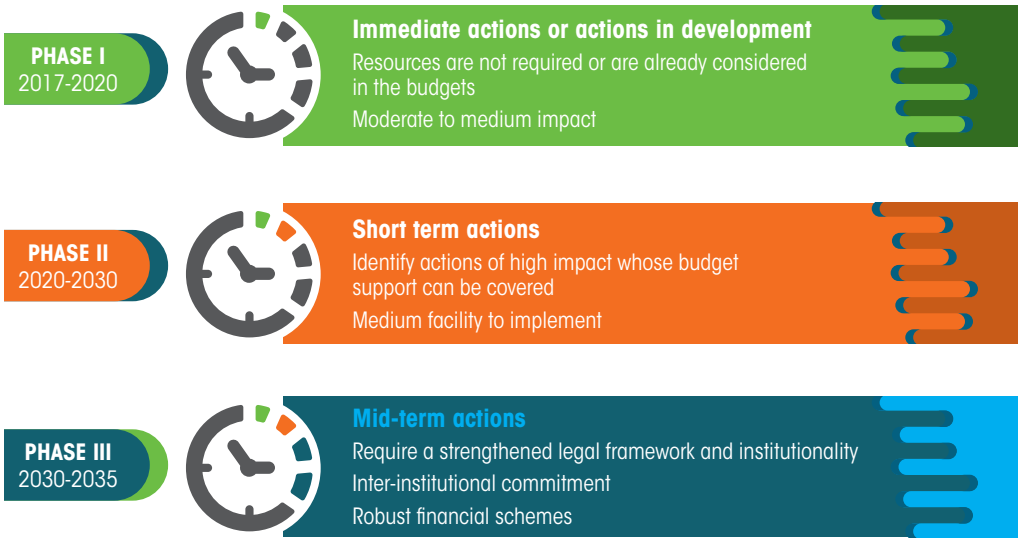
It is proposed that IFIs establish specific credit lines for financing energy efficiency projects, for which they must work on financing schemes. This will reduce risk and provide more accessible interest rates.

5.4.4. Revolving fund for private investment.

A percentage of the sustainability fund will be destined for the creation of a revolving fund to enable the private sector to develop energy efficiency initiatives. It is recommended that this fund be managed by a public financial institution.

5.5. PLANEE IMPLEMENTATION SCHEME

In an execution plan, it is important to establish the resources and to program the activities to be developed. The main actions were prioritized in three stages, which are described below:



5.5.1. Phase I: Immediate Actions

This includes all actions, programs and projects that are currently being developed at the national level. These actions do not represent, to a large extent, the need for financial resources; or, resources are provided by each state agency or by private agents.

The impacts envisaged for this stage can be moderate to medium.

Programs and projects

- Project to Consolidate the Regulatory Framework to Promote Energy Efficiency in the country.
- Project to Strengthen the Institutional Framework to Promote Energy Efficiency in the Country.
- Project to Create a System of National Energy Efficiency Indicators (SINEE).
- Program to Communicate Best Practices of Energy Efficiency in the Residential, Commercial and Public sectors.
- Project to Identify Final Energy Users in the Residential, Commercial and Public sectors.
- Program to Standardize and Label Energy Consuming Equipment.
- Project to Train in Efficient Driving Techniques.

- Project to Define Oversight Mechanisms for the Implementation and Continuous Improvement of the NEC Standard - Energy Efficiency, Air Conditioning and Renewable Energy.

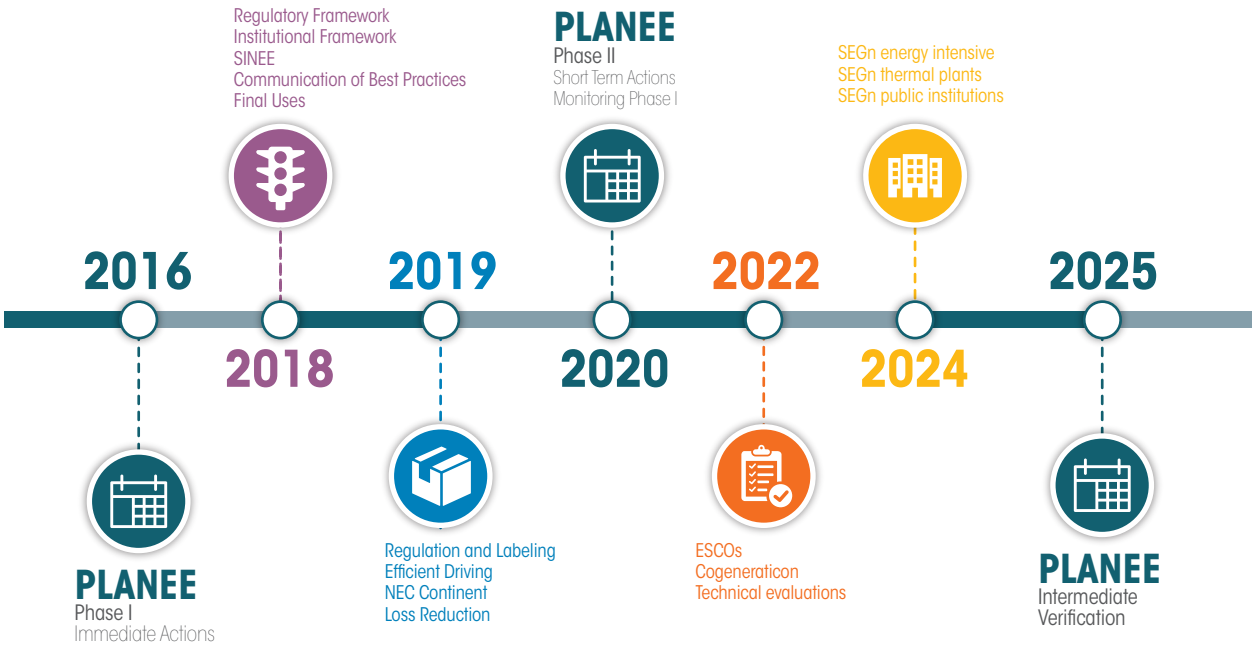
At the same time, the implementation processes of Stages II and III must be initiated, in order to have an enabling scheme that allows meeting the established goals.

5.5.2. Stage II: Short-term actions

This includes all actions, programs and projects that are not difficult to implement: identification of the stakeholders responsible for executing them and the resources needed to do so. It should be noted that the aim is to promote measures that have the greatest impact on the efficient use of energy.

Programs and projects

- Program for replacement of residential equipment of greater energetic consumption.
- Program for the Implementation of the ISO 50001 Standard in Energy-intensive Industries.
- Cogeneration Program in the industry.
- Replacement Program for engines, pumps, boilers and heaters in the industries.
- Program for the Development and Promotion of a Market of ESCOs in Ecuador.
- Energy Performance Labeling Project for New Vehicles.
- Project to Reactivate, Reconfigure and Expand the RENOVA Vehicle Plan.
- Incorporation Project of Hybrid, Electric Vehicles and New Technologies to be Commercially available in the Future.
- Project for Partial Replacement of Fossil Fuel by Mixture with Biofuels.
- Project for Implementation of Energy Management Systems based on the ISO 50001 Standard in Thermal Generation Plants.
- Project to Supply Electricity to Oil Facilities.



- Project to Improve the Supply of High Quality Derivatives.
- Training Project for Evaluators, Managers and Auditors of Energy Management Projects.
- Project to Implement Energy Efficiency Actions in the Infrastructure of Transportation, Storage and Commercialization of Derivatives.
- Program for Replacement of Equipment of Greater Energy Consumption.
- Program for the Implementation of Energy Management Systems Based on the ISO 50001 Standard in Public Institutions and the Commercial Sector of the Islands.

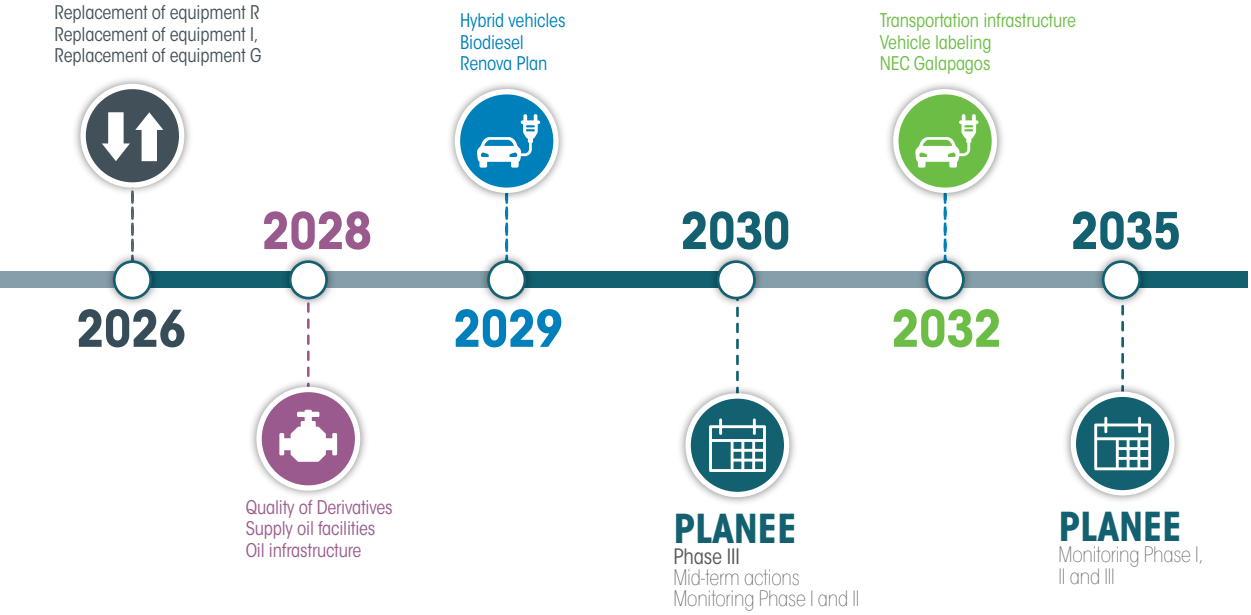
It should be noted that, at this stage, it is necessary to develop the enabling conditions for Stage III and to carry out sustainability actions of the previous stage in parallel. Therefore, it is necessary to carry out a technical-financial follow-up of the fulfillment of the established objectives.

5.5.3. Stage III: Medium-term actions

It considers those actions that require inter-institutional support, financial support; and, above all, the consolidation of previous actions of energy efficiency. Furthermore, there is the need for changes in the institutional structures and changes in the legal framework, in the information system, in the identification of final uses, etc.

Programs and projects

- Project to Improve Transportation Infrastructure and Operation.
- Project to Define Oversight Mechanisms for the Implementation and Continuous Improvement of the NEC Standard - Energy Efficiency, Air Conditioning and Renewable Energy (Galapagos).



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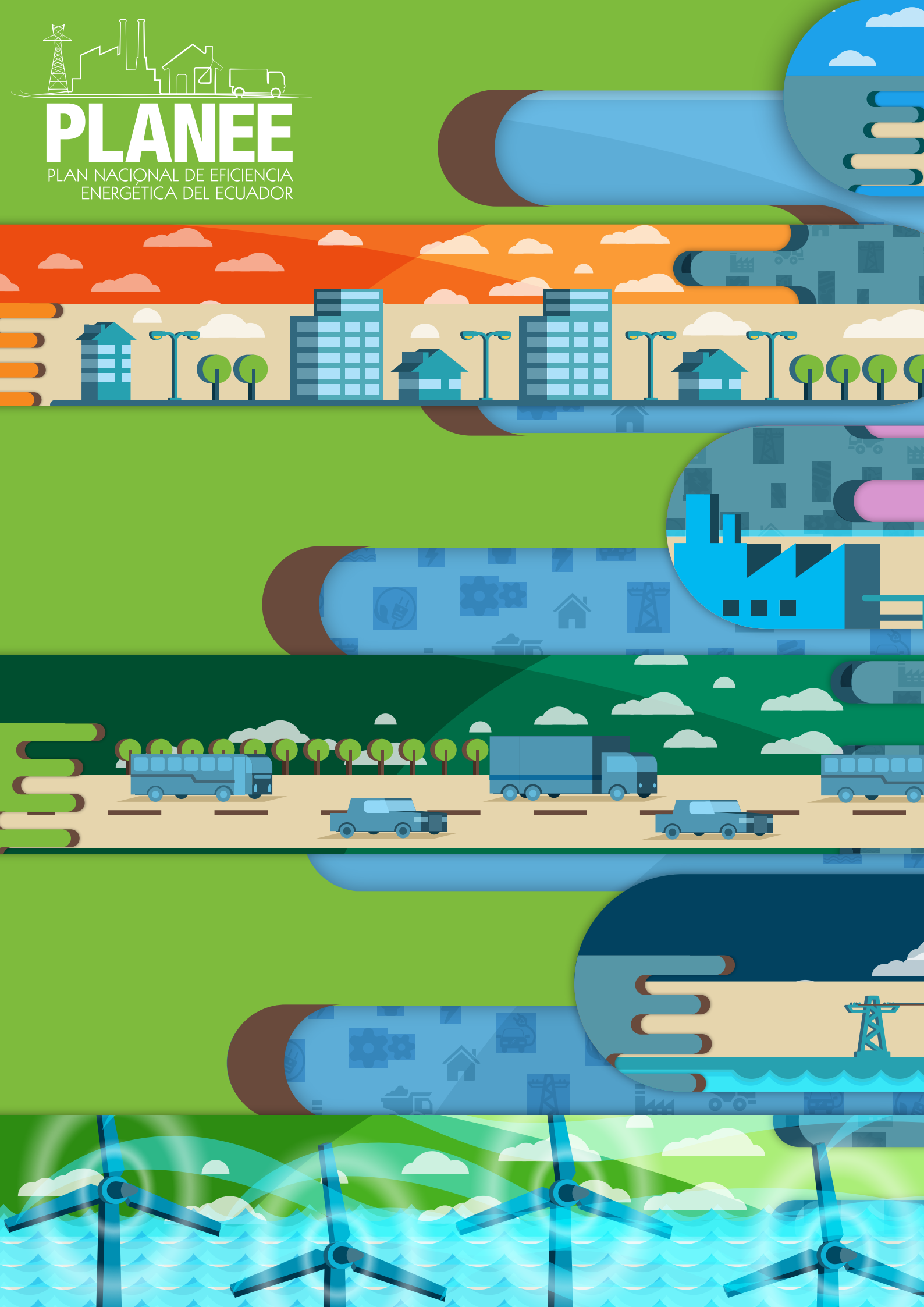


ANNEXES

ANNEX 1. LINES OF ACTION BY SECTOR

LINES OF ACTION	
Juridical, Institutional and Access to Information Sector	
PLANEE-CANV-01	Consolidation Project of the Regulatory Framework to Promote Energy Efficiency in the Country
PLANEE-CANV-02	Project to Strengthen the Institutional Framework to Promote Energy Efficiency in the Country
PLANEE-CANV-03	Project for the Creation of a System of National Energy Efficiency Indicators (SINEE)
PLANEE-CANV-04	Program to Communicate Best Practices in Energy Efficiency
Residential, Commercial and Public Sector	
PLANEE-CANV-05	Project to Identify Final Uses of Energy in Residential, Commercial and Public Sectors
PLANEE-CANV-06	Program for the Standardization and Labeling of Energy Consumption Equipment
PLANEE-CANV-07	Program for Replacement of Equipment of Residential Use of Greater Energy Consumption.
PLANEE-CANV-08	Project to Define Control and Oversight Mechanisms for the Implementation and Continuous Improvement of the NEC Standard - Energy Efficiency, Air Conditioning and Renewable Energy
Industrial Sector	
PLANEE-CANV-09	Program for the Implementation of the ISO 50001 Standard in Energy-Intensive Industries
PLANEE-CANV-10	Cogeneration program in the industry
PLANEE-CANV-11	Replacement Program for Engines, Pumps, Boilers and Heaters in Industries.
PLANEE-CANV-12	Program for the Development and Promotion of an ESCOs Market in Ecuador

Transportation Sector	
PLANEE-CANV-13	Program for the Improvement of Transportation Infrastructure and Operation
PLANEE-CANV-14	Energy Performance Labeling Project for New Vehicles
PLANEE-CANV-15	Project to Reactivate, Reconfigure and Expand the RENOVA Vehicle Plan
PLANEE-CANV-16	Training Project in Efficient Driving Techniques.
PLANEE-CANV-17	Project to Incorporate Hybrid and Electric Vehicles and New Technologies that will be commercially available in the future
PLANEE-CANV-18	Project for Partial Replacement of Fossil Fuel by Biofuels blending.
Energy sector own consumption Sector	
PLANEE-CANV-19	Program for Reduction of Energy Losses in the Electricity Distribution System
PLANEE-CANV-20	Project to Implement Energy Management Systems based on ISO 50001 in Thermal Generation Plants
PLANEE-CANV-21	Project to Supply electricity to Oil Facilities
PLANEE-CANV-22	Project to Improve the Supply of High-Quality Derivatives
PLANEE-CANV-23	Training Project for Evaluators, Managers and Auditors of Energy Management Projects
PLANEE-CANV-24	Project to Implement Energy Efficiency Actions in the Infrastructure of Transportation, Storage and Commercialization of Derivatives
Galapagos Sector	
PLANEE-CANV-08	Adoption of the NEC's implementation project in Galapagos
PLANEE-CANV-07	Program for Replacement of Equipment of Greater Energy Consumption
PLANEE-CANV-09	Program for the Implementation of Energy Management Systems Based on the ISO 50001 Standard in Public Institutions and the Commercial Sector of the Islands

Code:	PLANEE-CANV-01
Line of action:	Consolidation Project of the Regulatory Framework to Promote Energy Efficiency in the Country
Type of measure / sector:	Juridical, Institutional and Access to Information Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MICSE, MAE, MIPRO, MIDUVI, MTOP, MH, SENPLADES, INER, ARCH, ARCONEL, GADs, professional associations, Cleaner Production Center, academia, association or consumer´s guild.	• Form an inter-institutional and multidisciplinary technical committee. • Analyze legal, regulatory, administrative and organizational barriers. • Establish the proposal of the legal and regulatory framework for the promotion of energy efficiency in Ecuador, aimed at removing the barriers identified. • Establish the proposal for monitoring and control mechanisms. • Issue, through the corresponding legal figure, the regulatory framework to promote energy efficiency in the country. **Key Resources** • Inter-institutional and multidisciplinary technical team made up of key partners and led by MEER. • Referential regulatory frameworks from different countries regarding energy efficiency.	Legal framework that allows the promotion and development of energy efficiency in Ecuador. **Channels** • Energy efficiency committees. • Physical and electronic communications.	• Based on a dialogue that includes key political stakeholders, scholars and consumers, the parties will work on an Energy Efficiency Law Draft aimed at promoting energy efficiency in Ecuador.	• Final Energy Users • The population.

Referential Costs	Benefits
Total CAPEX	• An incentive scheme for energy efficiency is generated. • Barriers to energy efficiency are removed. • It generates a discussion that involves society. • Cultural change is promoted. • Strategic allies are generated.
Total OPEX	

Code:	PLANEE-CANV-02
Line of action:	Project to Strengthen the Institutional Framework to Promote Energy Efficiency in the Country
Type of measure / sector:	Juridical, Institutional and Access to Information Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MICSE, MAE, MIPRO, MIDUVI, MTOP, MH, SENPLADES, INER, ARCH, ARCONEL, MINFIN, GADs.	• Strengthen and reform the institutional structure around the different energy efficiency actions identified in PLANEE for the sectors of energy supply and demand. • Define managers and institutional focal points (upper hierarchical level). • Define clear institutional roles and responsibilities without duplicating actions. • Define follow-up, monitoring and evaluation managers. • Provide objective trainings in energy efficiency to the different key partners. • Issue, under the corresponding legal figure, the responsibilities of the different state agencies. **Key Resources** • Inter-institutional technical team made up of key partners and led by MEER. • Institutional regulatory frameworks of key partners (ex. LOSPEE).	Strengthen and reform the institutional framework that allows the promotion and development of energy efficiency in Ecuador to coordinate and articulate the participation of internal and external stakeholders in the implementation, monitoring and evaluation of PLANEE. Consolidate and increase the powers of the Undersecretariat of Renewable Energy and Energy Efficiency, in order to provide technical support for the implementation of PLANEE. Strengthen and restructure the responsibilities of the members of the Interministerial Committee on Energy Efficiency. **Channels** • Energy efficiency committees. • Physical and electronic communications.	• Based on a dialogue that includes institutional stakeholders, work will be done to strengthen the institutional structure for coordinating energy efficiency actions in Ecuador for different sectors of energy supply and demand.	• Final Energy Users • The population.

Referential Costs	Benefits
Total CAPEX	• Barriers to energy efficiency are removed. • It generates a discussion that integrates the institutional managers. • Cultural change is promoted. • Strategic allies are generated.
Total OPEX	

Code:	PLANEE-CANV-03
Line of action:	Project for the Creation of a System of National Energy Efficiency Indicators (SINEE)
Type of measure / sector:	Juridical, Institutional and Access to Information Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, ARCONEL, MIPRO, MAE, MH, MTOP, CGREG, ARCH, INEC, financial entities, chambers of industry and Cleaner production centers, academia, international cooperation agencies.	• Establish indicators for the measurement and verification system. • Establish a sectoral baseline scenario in order to quantify the impacts of energy efficiency initiatives, against which the required impact parameters can be measured. • Prepare a measurement and verification plan, which will include procedures and requirements by sector. • Prepare a technological tool that allows to enter, store, process data and prepare reports. • Establish agreements with companies in each sector to achieve the integration of the information. **Key Resources** • Methodology for the collection and verification of information. • Technical capacity to generate sectoral information for each control subject.	Information on the baseline of variables and energy indicators that monitor the efficiency of different sectors. Measurement and verification plan. IT system for the monitoring of energy efficiency measures by sector. Standardization of energy variables and EE indicators. **Channels** • Information systems of control subjects. • Monitoring systems.	• Periodic reports of the energy variables for analysis and decision making.	• Sectoral decision makers. • Users from the consumption sectors. • Professionals in energy efficiency.

Referential Costs		Benefits
Development of a computer system for monitoring energy efficiency indicators, training on the use of the IT system, hardware and software updates for monitoring center, dissemination of the project.		• Consolidation of a database to simulate future scenarios of energy demand. • Database improvement for decision-making. • Transparency in the information of the operation.
Total CAPEX	USD 250,000	
Total OPEX	USD 440,000	

Code:	PLANEE-CANV-04
Line of action:	Program to Communicate Best Practices in Energy Efficiency
Type of measure / sector:	Juridical, Institutional and Access to Information Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MIPRO, MAE, MH, chamber of industry, media, efficient technology vendors, ESCOs, academia	• Collect information about programs and projects implemented. • Define the target audience. • Produce material. • Create communication campaigns. **Key Resources** • Human and economic resources for the development of communication campaigns, through newsletters, workshops and recognition activities.	Achieve a culture of energy efficiency in the sectors of energy supply and demand, based on the dissemination of successful cases and the acknowledgment of best practices. **Channels** • Government platforms. • Institutional emails. • Radio and television campaigns. • Public dissemination events. • Digital media. • Social media.	• Dissemination of energy efficiency actions, implemented by the energy supply and demand sectors, within the framework of PLANEE. • Acknowledgment of best energy efficiency practices in the demand sector.	• Users from the consumption sectors. • General public.

Referential Costs		Benefits
Monthly newsletters, media campaign design, Activities and events of recognition, social media, maintenance of the dissemination campaign		• Encouragement for the participation of a greater number of companies and institutions in energy efficiency initiatives. • Improvement of the corporate image, through the promotion of energy efficiency practices.
Total CAPEX	USD 162,000	
Total OPEX	USD 1,600,000	

Code:	PLANEE-CANV-05
Line of action:	Project for the Identification of Final Uses of Energy in the Residential, Commercial and Public Sectors
Type of measure / sector:	Residential, Commercial and Public Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, INEC, MH, electricity distribution companies, academia, international cooperation agencies	• Update the cadaster of users of Residential, Services and commercial sectors. • Set a sample to conduct surveys nationally. • Design the survey to identify the final uses of energy. • Conduct surveys nationally to identify the equipment used and different consumption habits. • Enter, process information and run reports. • Establish a plan of action and measures for energy saving with the final uses defined per each sector analyzed. • Disseminate the results. • Design a training program on standards and labeling. **Key Resources** • Institutions responsible for gathering information in the Sector. • Monitoring and support personnel for electric companies.	Matrix of the final uses of energy and energy sources by sector, location and consumption strata, that allow decision making and establishing policies for energy efficiency. Load curve of the analyzed sectors. Analysis of impacts on the demand matrix of the current technological substitutions. **Channels** • Interviews. • Surveys.	• Periodic reports. • Follow up to the data collection, entry and processing, to obtain optimal results.	• Sectoral decision makers. • Residential, public and commercial services users.

Referential Costs		Benefits
Studies of demand and final uses of energy, Sector data collection.		• Improved decision making. • Improvement on availability of information about the habits of energy consumption and characterization of the demand curve per final uses.
Total OPEX	USD 2,500,000	

Code:	PLANEE-CANV-06
Line of action:	Program for the Standardization and Labeling of Energy Consumption Equipment
Type of measure / sector:	Residential, Commercial and Public Sector

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Proposition</th><th>Relationship with beneficiaries</th><th>Beneficiaries</th></tr>
<tr>
<td rowspan="2">MEER, MIPRO, COMEX, INEN, SAE, SENAE, SERCOP, national testing laboratories, quality assessment bodies, chambers of industry and commerce, manufacturers, traders and importers</td>
<td>• Review and update the regulations.
• Strengthen the quality structure of national testing laboratories.
• Strengthen quality assessment bodies.
• Implement the energy labeling program.
• Incorporate energy labeling in the procurement of goods in the public sector.
• Surveil the market.</td>
<td rowspan="2">Guarantee the energy efficiency of the electrical equipment sold in the country.
Encourage the commercialization of high energy efficiency equipment.
Fostering competitiveness among domestic producers.
Provide energy information to consumers when purchasing appliances and other equipment.
Channels
• Communication campaigns that integrate manufacturers and market players.
• Information available and mandatory in all points of sale
• Oversight and control by recognized market agents.</td>
<td rowspan="2">• Labeling is easy to interpret and provides clear and standardized energy information.
• Improve the supply of efficient products for consumers.</td>
<td rowspan="2">Direct:
• Energy consumers from the Residential, Commercial and Public Services sector.
• Equipment manufacturers and importers.
• Electric companies.</td>
</tr>
<tr>
<td>Key Resources
• Technical standardization committees.
• Legal resources for regulation.
• Equipment testing capabilities.
• Technical bodies for control and oversight.
• Certification and accreditation bodies.</td>
</tr>
</table>

<table>
<tr><th colspan="2">Referential Costs</th><th>Benefits</th></tr>
<tr><td colspan="2">Market studies, laboratory capacity development, testing costs, control and oversight costs</td><td rowspan="2">• Penetration of efficient equipment.
• Creation of energy awareness in users.</td></tr>
<tr><td>Total OPEX</td><td>USD 5,000,000</td></tr>
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Code:	PLANEE-CANV-07
Line of action:	Program of Replacement of Residential Equipment of Greater Energy consumption Program of Replacement of Equipment of Greater Energy Consumption
Type of measure / sector:	Residential, Commercial and Public Sector Galapagos Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER; MIPRO; CGREG; electricity distribution companies; Manufacturers, assemblers, importers and distributors of appliances; environmental manager	• Enroll users who voluntarily accept the change of equipment. • Confirm compliance with applicable requirements. • Replace the equipment at the address of the applicant. • Remove obsolete equipment and deliver it to the environmental manager for scrapping and recovery of refrigerant gases (if applicable). • Collect the financial incentive (credit) granted through the electricity invoices or through the mechanism chosen by the beneficiary. **Key Resources** • Technical Management Committee. • IT systems developed. • Customer service personnel (sales). • After-sales service personnel (technicians).	Replace older technologies with newer and more energy-efficient equipment. Replace and scrap appliances that are not in acceptable levels of energy efficiency, according to standardization and labeling program. **Channels** • Institutional web portals. • Flyers, spots, social media. • IT systems. • Institutional Infochannels.	• The user receives a permanent monitoring if he must make the payment of the incentive given by the State. • Manufacturers, assemblers, distributors will provide after sales technical service to ensure proper equipment operation. • The energy consumption of participating households will be monitored randomly to verify that the objectives are met.	• Families that opt for the replacement of inefficient appliances. • National manufacturers and assemblers of equipment, commercial distributors that participate in sales and different jobs at national level. • Environmental managers to recover scrap that is reused in other national or international production processes.

Referential Costs	Benefits
Payments to manufacturers or commercial distributors, payments to electricity distribution companies, transportation and logistics.	• Savings in the energy consumption of clients. • Energy saving • Employment generation. • Promotion of the domestic appliances industry.
Total CAPEX	
Total OPEX	

Code:	PLANEE-CANV-08
Line of action:	Project to Define Monitoring and Oversight Mechanisms for the Implementation and Continuous Improvement of the NEC Standard - Energy Efficiency, Air Conditioning and Renewable Energy. Adoption of the NEC Implementation Project in Galapagos.
Type of measure / sector:	Residential, Commercial and Public Sector Galapagos Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MIDUVI, MEER, CGREG, GADs, Chamber of Construction, professional associations, manufacturers and traders of construction materials	• Form a technical committee to establish regulatory framework and oversight mechanisms for the adoption of the NEC. • Approve the regulatory framework of the NEC at the juridical level. • Identify GADs to implement pilot plan and scale it at the national level. • Conduct training campaigns. • Apply and supervise a catalog on thermal, superficial and optical characteristics and properties of construction materials at the national level.	Compliance with the NEC (chapter EE, ER and CyC) throughout the country. Determine a methodology for the approval of plans and construction permits, including energy calculation reports for the building, materials to be used and their thermal transmittance values. Galapagos Chapter: Coordination in the definition of policies that incorporate and guarantee the use of renewable energy and energy efficiency, focused on promoting the updating and application of the NEC standard in the islands, considering their particular climatic conditions and the fragility of the ecosystem. **Channels** • Campaigns to disseminate the regulatory framework to construction professionals through their respective professional associations.	• Provide clear and standardized information to builders and users. • Control and oversight of blueprints and construction. • Mechanisms that expedite the approval of plans based on NEC standards.	• Construction professionals. • The population.
	Key Resources • Standardization Technical Committees and minimum standards of consumption. • Legal Resources for Regulation. • Equipment testing capabilities. • Technical Organizations for control and oversight. • Certification and Accreditation Bodies.			

Referential Costs		Benefits
Organization and logistics, development of regulations, training, dissemination campaigns, oversight and control costs		• Design and construction of comfortable buildings with low energy consumption.
Total CAPEX	USD 150,000	
Total OPEX	USD 1,000,000	

Código:	PLANEE-CANV-09
Línea de acción:	Program for the Implementation of the ISO 50001 Standard in the Energy-Intensive Industries Program for the Implementation of Energy Management Systems Based on the ISO 50001 Standard in Public Institutions and the Commercial Sector of the Islands
Tipo de medida/sector:	Industrial Sector Galapagos Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MIPRO, CGREG, chambers of industry, professional associations, international cooperation agencies, academia	• Develop the legal-regulatory framework necessary for the implementation of the standard. • Identify energy-intensive industries. • Implement, monitor and evaluate the SGEn in the management platform. • Design incentive instruments to promote ISO 50001 implementation. • Disseminate successful experiences involving local and international experiences. • Develop and articulate a training and certification program in energy efficiency and best practices. • Form a network of trained professionals. **Key Resources** • Trainers in ISO 50001. • Training institutions. • Support platform. • Monitoring and support personnel for companies.	Obtain long-term energy characterization of productive processes per subsector. Increase the local technical knowledge regarding systems of energy management and optimization of steam and electric systems. Offer of specialized professionals that provide their services to the national industry. Galapagos Chapter: Implement SGEn in public institutions and clients from the commercial sector. **Channels** • Energy efficiency committees. • Database of trained professionals. • Training courses. • Web Channels.	• Quarterly reports on the platform for energy efficiency management. • Implementation follow -ups. • Development of professional networks.	• Energy-intensive industries. • Hospitals. • Hotels. • Large commercial areas.

Referential Costs		Benefits
Studies and investments in SGEn for the industry, training program and certification in energy management.		• Alignment with international standards. • Capacity building at the customer level and improvement of competitiveness. • Engagement of senior management in energy issues.
Total CAPEX	USD 6,500,000	
Total OPEX	USD 60,000	

Code:	PLANEE-CANV-10
Line of action:	Cogeneration program in the industry
Type of measure / sector:	Cogeneration program in the industry

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MIPRO, MAE, MAGAP, chambers of industry, hotels association, AIHE (Association of Hydrocarbon Industry in Ecuador), academia, international cooperation agencies	• Count with a study of cogeneration potential in Ecuador. • Develop an applicable legal and regulatory framework. • Develop pre-feasibility studies for the application of cogeneration models. • Elaborate and evaluate projects, in feasibility phase, basic and detailed engineering of cogeneration projects. • Select replicable models in different sectors. **Key Resources** • Trainers in cogeneration. • Training institutions. • Monitoring and support personnel for industries. • Pre-feasibility studies. • Funds to finance projects. • Agreement with international cooperation agencies. • Regulatory • Framework.	Develop replicable models of cogeneration as an alternative to improve energy use in the industrial sector. Train people from different sectors about the benefits of cogeneration. Enhanced efficiency in fuel consumption. Electrical losses reduction in the process of energy distribution in the SNI. Increase of competitiveness in the industry by reducing operating costs. **Channels** • Web of cogeneration of public access. • Programs and training courses • Communication material for best practices in cogeneration. • Database of trained professionals. • Guides and manuals for the implementation of cogeneration projects.	• Network development: • Of professionals to collaborate in the development of projects. • Of adequate businesses to undertake cogeneration projects and purchase surplus energy produced through this technology. • Of learning skills for the transfer of technical capacities in the cogeneration Sector.	• Industries. • Hotels. • Public and private hospitals. • Agricultural sector.

Referential Costs		Benefits
Training of personnel in different sectors on cogeneration and selection of projects, salary of monitoring personnel, competitive funds		• Reduction of fuel use. • Capacity building at the customer level and improvement of its competitiveness. • Reduction of GHG emissions. • Local development and creation of new jobs.
Total CAPEX	USD 1 120 000	
Total OPEX	USD 3 700 000	

Code:	PLANEE-CANV-11
Line of action:	Replacement Program for Engines, Pumps, Boilers and Heaters in Industries.
Type of measure / sector:	Industrial Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MIPRO, chambers of industry, professional associations, international cooperation agencies, academia	• Collect information of inefficient equipment of the industries that participate in the program. • Set incentives to promote private sector intervention. • Run the program to replace inefficient equipment. • Follow up and monitoring, as well as communication of best practices.	Creation of a revolving fund to finance projects for the replacement of inefficient equipment such as pumps, engines, boilers and water heaters for the industrial sector. Capacity building in the industrial sector to propose projects of technological change. Increase the available knowledge about final uses and useful energy outcomes in the industrial sector.	• Network of trained professionals. • Equipment renovation follow-up. • Application to the replacement incentive. • Reports of energy reduction.	• Industries. • Hotels. • Public and private hospitals.
	Key Resources • Personnel for project evaluation, qualification and monitoring. • Definition of a financial mechanism to fund projects. • Support platform for dissemination of results.	**Channels** • Energy efficiency platform. • Physical and electronic communications. • Maximum energy efficiency label. • Incentives to promote the replacements.		

Referential Costs		Benefits
Financing of pilot projects, specific studies and monitoring, seed capital for revolving fund, guarantee fund		• Increased productivity. • Modernization of equipment. • Access to soft credits for technological reconversion.
Total CAPEX	USD 44 600 000	
Total OPEX	USD 160 000 000	

Code:	PLANEE-CANV-12
Line of action:	Program for the Development and Promotion of an ESCOs Market in Ecuador
Type of measure / sector:	Industrial Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, MIPRO, MAE, chambers of industry and commerce, efficient technology suppliers, cleaner production center, universities, IDB, CAF, European Union, UNIDO and related international organizations	• Establish and implement the legal and regulatory framework for the promotion of ESCOs in Ecuador. • Define incentives for the operation of ESCOs in the country. • Train managers and officials in charge of credit assistance in banks, cooperatives and national credit agencies, regarding the mechanisms of investment recovery based on ESCOs. • Disseminate the methodology of ESCO-type programs in the main chambers of industry and commerce at the national level. • Implement an assistance line for energy diagnosis. • Form a network of national and international ESCOs. **Key Resources** • Resources for revolving funds. • Incentive program for private banking. • Development of ESCOs. • Fund management personnel. • Personnel for management of funding program for pilots.	Promote the development of a market of energy service enterprises (ESCOs) in Ecuador. **Channels** • Private banking. • State revolving fund. • ESCOs. • Institution/program for pilots.	• Monthly discussion with the beneficiaries of the financing.	• Energy-intensive industries. • Hotels. • Hospitals (public and private). • SMEs. • Large commercial areas. • Community.

Referential Costs		Benefits
Subsidies for Technical Assistance Line (studies and diagnosis), financing for the initial evaluations for ESCOs training programs		• Communication of best practices. • Remodeling of the industrial park / hospitals / hotels. • Local capacity-building. • Employment generation.
Total CAPEX	USD 2 100 000	
Total OPEX	USD 50 000	

Code:	PLANEE-CANV-13
Line of action:	Program for the Improvement of Infrastructure and Operations of Transportation
Type of measure / sector:	Transportation Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
Metropolitan Public Passengers Transportation Company, AME, GADs, AMT, ANT, National Police, MTOP, EPMMOP	• Design Comprehensive Vehicle Mobility Plans in cities. • Expand the public transportation offer in operations and infrastructure. **Key Resources** • Standardization Technical Committees. • Legal resources for regulation. • Control and oversight technical bodies. • Certification and accreditation bodies.	Cultural change in citizens, transporters and control bodies. Reduction of traffic of private vehicles in the city. Traffic management, with the possibility to extend it nationally. Reduction in commute times within the city. Ensure constant flow of vehicles with few interruptions. **Channels** • Campaigns to promote the use of mass transportation systems. • Bus stops infrastructure. • Security and punctuality depend on the culture.	• Reliability in the mass transportation system. • Control and oversight of the transportation system. • Encourage multi modal mobility in the city and create the necessary infrastructure.	• GADs. • Mass transportation users. • Drivers. • Transit control bodies.

Costos referenciales	Beneficios
	• Increase in number of people using the mass transportation system. • Reduction of private vehicles on the streets. • Less accidents between private vehicles and buses. • Centralized mass transportation service.

Code:	PLANEE-CANV-14
Line of action:	Energy Performance Labeling Project for New Vehicles
Type of measure / sector:	Transportation Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MTOP, INEN, SENAE, SAE, ANT, MEER, GADs, automotive industry, chambers of industry, chambers of commerce, dealers, manufacturers / assemblers, importers, international cooperation agencies, academia, driving schools, transportation cooperatives	• Vehicle labeling based on recognized international systems. • Establish agreements with manufacturers, assemblers and importers. • Regulate and implement the program. • Carry out dissemination campaigns. • Monitor and surveil of the commercialization of labeled vehicles. **Key Resources** • Technical standardization committees. • Legal resources for regulation. • Control and oversight technical bodies. • Certification and accreditation bodies.	Have a tool for users to give priority to the use of efficient vehicles. **Channels** • Dealers, points of sale. • Consumer information campaigns and vendor training. • Inspection of agents.	• Have a simple system to interpret information on energy consumption. • Encourage cultural change regarding the availability of energy resources and the environmental implications. • Regulation for the sale of new vehicles.	• Vehicle owners. • Dealers, • Manufacturers, assemblers and Importers

Costos referenciales		Beneficios
System design and market research, creation of monitoring platform, information and teaching campaigns, costs of control and oversight, monitoring and market control		• Technological renovation in transportation.
Total CAPEX	USD 350 000	
Total OPEX	USD 350 000	

Code:	PLANEE-CANV-15
Line of action:	Project to Reactivate, Reconfigure and Expand the RENOVA Vehicle Plan
Type of measure / sector:	Transportation Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, ANT, MTOP, SENAE, CFN, automotive industry, transportation cooperatives, GADs	• Identify potential vehicles for vehicle renovation, market characterization. • Design financing scheme. • Analyze tax regimes. • Establish agreements with financial institutions. • Identify potential scrap companies. • Communicate and disseminate the system. **Key Resources** • Standardization Technical Committees and minimum standards of consumption. • Legal resources for regulation. • Equipment testing capabilities. • Control and oversight technical bodies. • Certification and accreditation bodies.	Promote the renovation of the inefficient automotive fleet through replacement and scrap processes, with more efficient and cleaner technologies. **Channels** • Dealers. • Information campaigns • Institutions of financial intermediation. • Networks and business associations. • Related state institutions.	• Renewal of the automotive fleet. • Better performance levels and safety. • Provide solutions aimed at providing access to financing for fleet renewal.	• Vehicle owners. • Dealers. • Manufacturers, assemblers and Importers. • Scrapping companies

Referential Costs		Benefits
CAPEX: automotive fleet survey, design of financing system and tax scheme analysis, communication and dissemination, credit lines for renovation OPEX: Information campaigns, subsidies, monitoring and market control		• Renovation of the automotive fleet.
Total CAPEX	USD 40 130 000	
Total OPEX	USD 10 070 000	

Code:	PLANEE-CANV-16
Line of action:	Training Project in Efficient Driving Techniques.
Type of measure / sector:	Transportation Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MTOP, ANT, AMT, CTE, MEER, INER, driving schools, academia, transportation cooperatives	• Elaborate regulatory framework for mandatory training in efficient driving. • Identify segments for training. • Design course / module for each type of training segment. • Train instructors. • Execution of pilot plan. • Implement the training program in efficient driving. • Communicate and disseminate the system. **Key Resources** • Trainers in efficient driving techniques. • Media. • Information manuals. • Technological infrastructure for training and testing.	Adoption of driving techniques that benefit the efficient use of energy resources. **Channels** • Driving schools. • Dissemination campaigns.	• Awareness raising for efficient driving. • Knowledge of efficient driving as a requirement for obtaining a driver's license.	• Awareness raising for efficient driving. • Knowledge of efficient driving as a requirement for obtaining a driver's license.

Referential Costs		Benefits
CAPEX: Training of trainers / instructors, organization and logistics, pilot plan development, communication campaign, support personnel OPEX: Students training		• Increase in the operating life of vehicles. • Improved safety.
Total CAPEX	USD 130 000	
Total OPEX	USD 400 000	

Code:	PLANEE-CANV-17
Line of action:	Project for the incorporation of Hybrid, Electric and New Technologies Vehicles to be commercially available in the future
Type of measure / sector:	Transportation Sector

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Proposition</th><th>Relationship with beneficiaries</th><th>Relationship with beneficiaries</th></tr>
<tr>
<td rowspan="2">MCPEC, MTOP, AME, GADs, electricity distribution companies, AEADE, COMEX, CGREG</td>
<td>• Promote the import / domestic manufacture of hybrid, electric or new technology vehicles.
• Establish agreements with manufacturers, assemblers and importers.
• Develop regulations for new vehicle technologies, including monitoring and surveillance.
• Dissemination campaigns.</td>
<td rowspan="2">Issue an incentive regulation for the import / domestic manufacture of hybrid, electric or new technology vehicles, with more efficient characteristics compared to internal combustion vehicles.
Encourage key strategies to guide the transition towards sustainable transportation.
Channels
• Dealers.
• Information campaigns.
• Institutions of financial intermediation.
• Networks and business associations.
• Related state institutions.</td>
<td rowspan="2">• Simple regulation to interpret clear and standardized information.
• Provide solutions aimed at providing access to financing for the renovation.
• Efficient transportation that contributes with environmental protection.</td>
<td rowspan="2">• GADs.
• Vehicle owners.
• Transportation companies.
• Dealers, importers, assemblers, manufacturers.</td>
</tr>
<tr>
<td>Key Resources
• International benchmark experiences.
• Studies and regulations for the optimal transition of vehicles with new technologies.</td>
</tr>
<tr><th colspan="2">Referential Costs</th><th colspan="3">Benefits</th></tr>
<tr>
<td colspan="2"></td>
<td colspan="3" rowspan="2">• Renewal of the automotive fleet.
• Better performance levels and safety.</td>
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Code:	PLANEE-CANV-18
Line of action:	Project of Partial Replacement of Fossil Fuel by Biofuels blending.
Type of measure / sector:	Transportation Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Relationship with beneficiaries
MCPEC, MEER, MH, EP Petroecuador, MAGAP, producers of ethanol and biodiesel, MAE, transporters' association	• Strengthen the National Biofuels Committee. • Update the legal framework for the use of biofuel blending. • Adapt the infrastructure of fuel dispatch centers. • Encourage agricultural production to obtain raw materials. • Strengthen the infrastructure to produce biofuel to guarantee its supply. **Key Resources** • Existing biofuel infrastructure. • Available agricultural areas. • National testing laboratories.	Reduction of imports of high octane naphtha and diesel. Purchase of product in the domestic market to avoid capital outflow. Reformulation of biofuel blending for use in internal combustion engines. Promotion of agricultural research and development. **Channels** • Service stations. • Network of professionals. • Dissemination campaign.	• Access to quality fuels that contribute to environmental protection.	• Agricultural producers. • Biofuels producing companies. • Fuel trading companies. • Vehicle owners. • Community.

Referential Costs	Benefits
Implementation of biofuel refining infrastructure. Marketing and distribution network. Socialization campaign. Agricultural development.	• Renewal of the automotive fleet. • Better performance levels and safety.

Code:	PLANEE-CANV-19
Line of action:	Project of Partial Replacement of Fossil Fuel by Biofuels blending.
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiarios
MCPEC, MEER, MH, EP Petroecuador, MAGAP, producers of ethanol and biodiesel, MAE, transporters association	• Strengthen the National Biofuels Committee. • Update the legal framework for the use of biofuel blending. • Adapt the infrastructure of fuel dispatch centers. • Encourage agricultural production to obtain raw materials. • Strengthen the infrastructure to produce biofuel to guarantee its supply.	Improve quality of service and expand coverage. Losses (PLANREP). Plan for distribution improvement Programs of rural energization and urban-marginal electrification. Increase the supply of electric generation and transmission. **Channels** **Own resources:** • State financing. **External resources:** • Management with multilateral and private entities to obtain financing underpinning social, environmental and economic benefits.	• The savings will be invested in infrastructure, maintenance and training. • Improvement of the distribution infrastructure in the rural and urban sector. • Supply of quality energy. • Increased efficiency in the management of electric companies. • Energy coverage to all sectors of the country.	• Residential users. • Public services. • Local industry. • Businesses. • Electricity distribution companies.
	Key Resources • Existing biofuel infrastructure. • Available agricultural areas. • National testing laboratories.			

Referential Costs	Benefits
Maintenance of overhead and underground power distribution lines. Programs to reduce energy losses in electricity distribution companies. • Distribution improvement plan. • Programs of rural energization and urban-marginal electrification. • Increase the supply of electric generation and transmission.	**Social benefits:** • Social benefits of providing quality electricity with a 100% of energy coverage. **Economic benefits:** • The savings will allow investing in infrastructure, maintenance and training.

Code:	PLANEE-CANV-20
Line of action:	Project for the Implementation of Energy Management Systems based on ISO 50001 in Thermal Generation Plants
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiarios
MEER, CENACE, CELEC EP international cooperation agencies, academia	• Evaluate the current situation of the thermal electricity stations, aimed to various actions such as the implementation of combined cycles, cogeneration, inventory of inefficient equipment within the value chain, among others. • Apply the program for the implementation of energy management systems, through the application of ISO 50001. • Carry out a program of replacement of inefficient equipment of high energy consumption like engines, pumps, heat exchangers, among others. • Track the SGEn implementation. • Monitor and elaborate the SGEn report on the platform for the management of energy efficiency programs. **Key Resources** • Technicians trained in ISO 50001. • Training institutions. • Support platform (web). • Energy efficiency. • Monitoring and support personnel for companies. • Agreement with universities.	Implement energy management systems in thermoelectric plants to guarantee the best energy efficiency and environmental performance standards. **Channels** • Web Channels. • Training courses. • Communication of best practices. • Database of trained professionals. • Monitoring and control platform.	• Quarterly reports. • Implementation follow -ups. • Input of information to the monitoring and control platform.	• Private generators. • Public generators. • Community.

Referential Costs		Benefits
SGEn implementation in thermal electricity plants and implementation of proposals.		• Alignment with international standards. • Capacity building at the customer level and improvement of its competitiveness. • Senior management engagement in energy issues.
Total CAPEX	USD 1 515 000	
Total OPEX	USD 60 000	

Code:	PLANEE-CANV-21
Line of action:	Project to Supply electricity to Oil Facilities
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MICSE, MINFIN, MH, MEER, MAE, public companies of the energy sector, oil operators, communities and local entities within the area of influence of the program, international cooperation agencies	• Extend low and medium voltage power lines distributed in the Amazonian district. • Develop the interconnection of the SEIP-E with the SNI. • Support the implementation of associated projects. **Key Resources** • Availability of human and economic resources. • Evaluation, analysis and approval of models and contractual and external financing schemes.	Guarantee the electricity supply to the oil Sectors and facilities in the Amazon District through a SEIP-E to share resources of electricity generation capacity, improve the reliability and availability indexes of the interconnected electricity system. Create and fulfill an electrical demand from communities within the area of influence of SEIP-E. **Channels** • Own resources: financing from the Ecuadorian state through the Ministry of Finance. • External resources: negotiations with multilateral and private entities to obtain external financing.	• Communities close to the area of influence will have modern energy services. • The State will be able to efficiently articulate the sectors of supply and demand of electricity in the oil sector. • Oil companies will receive security in the supply of electricity, which leads to greater efficiency.	• Communities. • Ecuadorian State. • Oil operators.

Referential Costs		Benefits
Overhead and underground power lines, substations for 138 kV subsystems		• Reduction of environmental impact in the communities surrounding the area of influence of the project. • Possibility of providing electricity to isolated areas. • Saving on fuel consumption.
Total CAPEX	USD 305 000 000	

Code:	PLANEE-CANV-22
Line of action:	Project to Improve the Supply of High-Quality Derivatives
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MH, ARCH, MTOP, MIPRO, MAE, COMEX, Hydrocarbon companies (Refineries), international cooperation agencies	• Update the regulations regarding fuel production and commercialization. • Strengthen fuel refining infrastructure. • Design and develop a continuous fuel improvement plan. **Key Resources** • Refining capacity, in terms of volumes of production and quality of the derivatives. • Capacity of the control and oversight bodies.	Having fuels commercialized in the country that meet international quality standards will allow the introduction of more efficient and less polluting technologies for industry and transportation. **Channels** • Information campaigns for users.	• Access to quality fuels that contribute to environmental protection.	• Fuel trading companies. • Vehicle owners. • Vehicle dealers. • Community.

Referential Costs	Benefits
	• Technological renewal in industry and transportation. • Reduce dependence on imported fuels.

Code:	PLANEE-CANV-23
Line of action:	Training Project for Evaluators, Managers and Auditors of Energy Management Projects.
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MEER, professional associations, academia, certification bodies, public research institutes, international cooperation agencies, AIHE	• Develop a training and certification program in energy efficiency and best practices. • Implement SGEn with certified technicians. **Key Resources** • Certification bodies. • Academic material. • Communication and dissemination campaigns. • Training institutions. • Support platform.	Strengthen technical capacities in energy efficiency such as SGEn to have qualified personnel to optimize energy consumption. **Channels** • Online platform (web page of energy efficiency, training history, webinars). • Training and certification courses. • Database of certified professionals.	• Follow-up to participating companies and certified technicians. • Transfer of knowledge. • Network of certified professionals. • Energy efficiency platform.	• Hotels. • Hospitals. • Large commercial areas. • Oil companies. • Industries.

Costos referenciales		Beneficios
CAPEX: Training and certification program in energy management (ISO 50001 - USD 90,000; EUREM - 2 editions 60 professionals USD 60 000; organization and logistics, support personnel and infrastructure, printed material, media campaign online platform 3.1 Reinforcement of guidelines and regulation		• Strengthening local capacities. • Energy saving. • Communication of best practices • Reduction of GHG emissions.
Total CAPEX	USD 270 000	
Total OPEX	USD 50 000	

Code:	PLANEE-CANV-24
Line of action:	Project to Implement Energy Efficiency Actions in the Transportation, Storage and Commercialization of Derivatives Infrastructure
Type of measure / sector:	Energy Sector Own Consumption Sector

Key Partners	Key Activities	Value Proposition	Relationship with beneficiaries	Beneficiaries
MH, ARCH, MINFIN, SENPLADES, MICSE, MEER, MAE, EP of the Hydrocarbons sector, traders of derivatives	• Create an inventory of inefficient equipment in the sector's value chain. • Document existing installed capacity • Conduct a program to replace inefficient equipment. • Perform the monitoring, follow up and evaluation of the energy consumption of the replaced equipment.	Incorporate energy efficiency in the transportation, storage and commercialization of oil derivatives, through the increase and optimization of existing infrastructure. **Channels** • Energy efficiency platform. • Physical and electronic communications. • Maximum energy efficiency label. • Incentives to promote the replacements.	• Improvement of productivity and management indicators.	• Companies in the hydrocarbons sector.
	Key Resources • Updated inventory of the hydrocarbon sector. • Access to financial resources.			

Costos referenciales		Beneficios
CAPEX:		• Reduction of operating costs
Inventory of inefficient equipment	USD 200 000	
Pilot Projects for Equipment Replacement	USD 1 000 000	
Feasibility studies	USD 200 000	
Seed capital for revolving fund	USD 40 000 000	
Total CAPEX	USD 41 400 000	

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