



JALISCO

STATE ENERGY PLAN

I. Introduction

Energy constitutes a fundamental pillar for the development of any economy, it plays an essential role in the great challenges and opportunities that the world currently faces.

Daily life depends on reliable and affordable energy services to run smoothly and equitably.

The accelerated evolution in terms of diversity of sources and the dizzying pace of growth in energy consumption have impacted on the social, economic and political internalization of the consequences that the global energy model has had on the environmental balance and its sustainability.

In this context, initiatives are needed to ensure access to modern energy services, improve energy efficiency and increase the use of renewable sources to create more sustainable and inclusive communities, in a supportive environment for resilience against environmental problems such as climate change; prioritizing energy-efficient practices and adopting clean energy technologies and infrastructures.

The economic development of the state is closely linked to the energy sector, and the state government will exercise leadership focused on the strengthening and consolidation of an energy system that will meet the needs of a modern growing economy, such as Jalisco's.

In recent years, significant changes driven by the Energy Reform have had an impact the competitiveness of the sector, in terms of quality and cost of energy products and services. It will be necessary to focus on the optimal use of the scarce resources available with a sustainability approach that allows the transition to clean energy.

The adaptation and implementation of programs, knowledge, technologies, investments and other elements that allow to find an efficient balance between the energy requirements of the different actors and the optimal use of their energy resources are required.

It is a priority to implement a statewide strategic energy development program with a focus on short, medium and long term, to ensure that Jalisco's productive sectors have an economic and secure supply of energy that their value chains need, and in turn, promote a gradual decarbonization process that allows the transition from the use of petroleum products such as gasoline, diesel and fuel oil to the use of clean and renewable technologies that ensure sustainability and health of the people of Jalisco.

This document explains the state energy strategy that seeks to create the right environment for companies to maintain and protect ecosystems, encourage investment in sustainable energy services and promote savings in energy consumption.

The Jalisco State Energy Plan 2019-2034 considers the importance of the security and availability of energy resources in the stability, economic resilience and environmental issues of a region.

It establishes guidelines, initiatives and programs that incorporate the state government, local businesses and the general population. It promotes sustainability and the reduction of greenhouse gases that are implicit in the production and consumption of energy at all times, respecting the international commitments, agreements and treaties assumed by Mexico in this area.

Under this line, this document defines the elements that constitute important pillars for its achievement, such as the incorporation of new stakeholders who will attract financial resources, ensuring investment in the energy sector; an additional element will be the definition of savings opportunities in terms of energy intensity as well as the elements that help to achieve a change in the composition of the use of energy sources, gearing them towards the use of clean energies.

The State Energy Plan 2019-2034 seeks to develop a sustainable, avant-garde, flexible and agile energy sector for Jalisco, which incorporates elements of resilience to possible eventualities, adapting to national and international trends with quality, economically competitive and clean energy services and products.

Energy aspiration of the State of Jalisco

Based on the dialogues engendered in different working groups led by the Secretary of Economic Development and the Head of the Energy Agency of the State of Jalisco- in which experts, academics, businessmen, and representatives of various government agencies participated- a comprehensive diagnosis was obtained, as well as the different perspectives of the parties involved, which allows us to have a global vision for the decision making process.

Focusing efforts towards a long-term strategic vision may support the consolidation of energy policy that meets the needs and projections of the state.

In this sense, an energy aspiration is established as the guiding thread of the Jalisco 2019-2034 State Energy Plan, which flies this integral vision and directs all efforts towards: **Having a safe, quality, sustainable and competitively cost energy supply that is used efficiently to boost state development.**

This energy aspiration encompasses cutting-edge elements:

- **Stability and economic resilience:** Focus on productive processes that exert less pressure on the environment, associated with technologies with lower environmental impact that will strengthen a growing dynamic relationship between economic and ecological systems, ensuring sustainability from a balanced development perspective through the internalization of new criteria of environmental assessment.

- **Incorporation of the general population and companies in the technological, financial and service sectors:** From a global perspective, with an approach that promotes the participation of all sectors for an integrated management of the use and use of energy resources.
- **Protection of Regional Environment:** To guide policies towards the conservation of the regional ecology by minimizing the impact of activities related to the energy sector on the environment so that they do not exceed environmental limits and do not negatively impact the diversity, complexity and functions of ecosystems.
- **Reduction of greenhouse gases:** Subscribing to the commitment made in the United Nations Framework Convention on Climate Change (UNFCCC) to achieve stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system.
- **Sustainable, avant-garde, flexible and agile energy sector:** With a comprehensive and systematic approach, in which the interaction of people with technology and infrastructure through the rigorous use of innovative processes and best practices, respecting the environmental balance and oriented to the national development sustainability for the benefit of present and future generations, incorporating trends and best practices nationally and internationally.
- **Energy transition:** Through critical and creative approaches to underpin the development of the state in the optimal use of resources, to contribute to the pressing global need to cut the use of polluting fuels; reorienting the impulse to clean technologies, technological advances, cost-efficient renewable energy, digital development and risk management.

Under this perspective, the state of Jalisco aims to "Guarantee access to affordable, safe and sustainable energy for all", Mexico's commitment to the United Nations Organization.

State energy policy guidelines

The Jalisco State Energy Plan 2019-2034 recognizes and builds on Mexico's commitments in international agreements and treaties aimed at sustainable development and greater social inclusion that impact on the welfare of the population. The main international elements that frame the state energy policy are the following:

International Covenant on Economic, Social and Cultural Rights (ICESCR)

- The Covenant was approved on December 16, 1966; Our country joined on March 23, 1981 and entered into force on May 12 of that year. The ICESCR and its Optional Protocol are the international instruments of the United Nations System that regulate the protection of Economic, Social and Cultural Rights (ESCR).

- Article 11 recognizes the right of every person to an adequate standard of living for themselves and their family, including food, clothing, appropriate housing, and a continuous improvement of their current conditions.
- Access to energy is an essential element to achieve an adequate standard of living.

United Nations Framework Convention on Climate Change (UNFCCC)

- Mexico signed the agreement on June 13, 1992, which was then unanimously approved by the Senate on December 3 of the same year, and entered into force in 1993.
- The Convention has been ratified by 195 countries and its ultimate goal is to stabilize the concentrations of Greenhouse Gases (GHG) in the atmosphere, in order to prevent dangerous anthropogenic interference in the climate system.
- Such stabilization must be achieved within a sufficient period that allows ecosystems to adapt naturally to climate change, while ensuring that food production is not threatened and allows economic development to continue in a sustainable manner.

Kyoto Protocol

- On December 11, 1997, industrialized countries made a commitment in Kyoto to a set measures to reduce greenhouse gas emissions. The Governments of these countries agreed to a reduction of at least 5% on average in greenhouse gas emissions to be achieved between 2008 and 2012, taking 1990 levels as a reference.
- The United Nations Framework Convention on Climate Change was signed by the Government of Mexico in 1992 and ratified before the United Nations Organization in 1993. The Kyoto Protocol entered into force on 16 February 2005.
- It strives to reduce emissions of six greenhouse gases that cause global warming: carbon dioxide, methane gas, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. At the same time, the Kyoto Protocol seeks to promote sustainable growth in developing countries.
- The Protocol has enacted a series of market-based mechanisms to facilitate the compliance of industrialized countries with their mitigation commitments and to promote sustainable growth in developing countries, such as the provision of financing and supporting technology, the implementation of National Adaptation Action Plans in developing countries and programs to develop skills through climate change education and training.
- The Clean Development Mechanism (CDM) is a procedure under the Kyoto Protocol in which developed countries can finance projects to mitigate greenhouse gas (GHG) emissions in developing countries, and receive in return Emission Reduction Certificates applicable to meet their own reduction commitment. Mexico has the

fifth place worldwide in the development of CDM projects in methane recovery, renewable energy, energy efficiency, industrial processes and waste management.

COP 21 (Paris Agreement)

- The Agreement was adopted at the Paris Climate Conference (COP21), held in December 2015, and signed by 195 countries. Mexico signed in April 2016 and ratified the agreement in September of the same year.
- It is an instrument that seeks to face climate change globally by reorienting the development of countries towards a more sustainable world, with lower emissions and with the capacity to adapt to a more extreme climate, through mitigation, adaptation and resilience of ecosystems to fight Global Warming.
- The agreement urges the nations involved to limit the increase in global temperature below 1.5 ° C.
- Each Party should undertake planning processes for adaptation to climate change and adopt its own measures. This includes the formulation or improvement of relevant plans, policies and contributions, implementation of national adaptation plans, monitoring and evaluation of such plans, as well as adaptation measures and programs.

2030 Agenda for Sustainable Development

- The 2030 Agenda for Sustainable Development was approved in September 2015 by the United Nations General Assembly. The 193 member countries approved a resolution in which they recognize that the greatest challenge in the world today is the eradication of poverty, an essential element for achieving sustainable development.
- The agenda establishes a work guide towards economic, social and environmental sustainability for the next 15 years. Seventeen objectives of an integrated and indivisible nature are proposed, in particular, the seventh objective of the Agenda focuses on affordable, safe, sustainable and modern energy for all.
- It is proposed to substantially increase the use of renewable energy by 2030, to double the global rate of improvement in energy efficiency, to increase international cooperation aimed at facilitating access to clean energy research and technologies, and to promote investment in infrastructure and technology.

Intergovernmental Panel on Climate Change (IPCC)

- Created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), it assesses scientific information on climate change and its potential environmental and socio-economic impacts.

- Its main activity focuses on the reviewing and evaluating of research reports on climate change as well as preparing technical documents to consolidate the most up-to-date scientific information for high-level decision-making.

These are the main agreements and treaties that support the international commitments entered by Mexico aimed at sustainable development and greater social inclusion.

At the national level, following the amendment to articles 25, 27 and 28 of the Constitution in 2013 that resulted in Mexico's Energy Reform, the country has undergone a profound transformation process; since then, constitutional amendments and secondary legislation significantly reorganized the country's energy governance and institutional structure in this area.

Among its fundamental objectives and premises, the Energy Reform considers maintaining the country's ownership of the hydrocarbons found in the subsoil, as well as modernizing and strengthening, without privatizing, Petróleos Mexicanos (Pemex) and the Federal Electricity Commission (CFE) as State Productive Companies. It seeks to attract greater investment to the Mexican energy sector to impact on a greater supply at better prices.

Table 1.- Constitutional amendments in the field of electric power and hydrocarbons

Electric Power	Hydrocarbons
CFE and PEMEX become State Productive Companies, with a specific mandate to generate value	
The operation of the transmission and distribution network is reserved to the State.	The State regulates and supervises the activities of the hydrocarbon sector. The Executive Branch manages the oil resources.
Electricity generation is open to free competition. The participation of individuals in the generation of electricity and selling in the wholesale market is allowed.	Oil extraction and transformation is open to individuals, as well as natural gas processing, import and export of crude oil, natural gas and petroleum products.
Restrictions for self-suppliers are eliminated, for selling to third parties.	Individuals can participate in transportation, storage and sale of refined hydrocarbons.
	New tax regime for hydrocarbon exploration and production. The Mexican Petroleum Fund receives resources derived from Rights and Considerations and is channeled to the Income Stabilization Fund of the Federal entities.
Tax benefits for renewable energy	

Source: Own report, with SENER information

We have moved from a centralized energy sector controlled by parastatal companies, to a more competitive sector, with possibilities of being more modern and efficient, enabling society to benefit by opening up to private participation. The incorporation of various industries into the energy value chain has increased significantly, which in turn has impacted on the generation of new markets related to the supply of goods and services for the sector.

The restructuring of the Mexican energy sector is supported by two independent regulatory bodies: The National Hydrocarbons Commission (CNH) and the Energy Regulatory

Commission (CRE). CNH regulates *upstream*¹ activity, holds bids and manages contracts, as well as having the authority to supervise and promote oil activities; CRE is responsible for regulating electricity and *midstream* and *downstream*² hydrocarbon operations.

The Secondary Legislation of the Reform created the National Center for Natural Gas Control (CENAGAS) and the National Center for Energy Control (CENACE), responsible for ensuring the technical functioning of the energy market. CENAGAS is the independent operator of the gas pipeline network; administers and supervises the operations, transportation and storage of natural gas in the country; it is responsible for overseeing the bidding process for investment in the natural gas pipeline network in Mexico. CENACE exercises the operational control of the national electricity system, supervises the operation of the wholesale electricity market to ensure that open and non-discriminatory access to the national grid and general distribution lines prevails.

The Energy Reform, with its regulatory branches, opens the opportunity for the country's states to play an active role in the energy sector. The State Energy Plan contemplates the opportunities provided by the Reform as an important point of support to face the challenges of the energy sector in Jalisco, through an effective coordination that fosters the active participation of society and the productive sector of the state.

While seeking to promote investment in the sector to increase energy infrastructure based on state potential, Jalisco's energy policy is framed within a criterion of sustainability, promoting the efficient use of energy resources through a change in consumption habits of all stakeholders.

Globally, accelerated population growth and climate change -a consequence of current consumption patterns- pose global challenges that compromise future food and energy sovereignty, as well as water supply. In a context of limited and degraded natural resources, the need to consider the nexus between water, energy and food ³(WEF) becomes more relevant for decision making from a global approach that allows issues to be addressed in a more sustainable and integrated manner.

The topic has been discussed since the Bonn Conference “The Nexus between Water, Energy and Food Security. Solutions for the Green Economy” (2011). It recognizes that, in the current conditions of intensive use, the decisions adopted in one sector affect the others, so it is necessary to formulate public policies aimed at minimizing conflicts and maximizing synergies between the three sectors. It is based on three guiding principles: 1) Place people and their basic human rights as the main priority of this nexus. 2) Create public

¹*Upstream*: It refers to extraction and exploration.

²*Midstream*: Transportation, storage and marketing. *Downstream*: Oil refining and gas processing

³ WEF (Water, Energy, Food)

awareness and political will for a successful implementation. 3) Involve local communities in the planning and implementation processes in order to create a sense of participation and ownership.

On the other hand, the State Energy Plan considers the use of bioenergies and biofuels with a second generation approach. In one way, their large contribution to substitute fossil energy sources (without increasing emissions that directly affect climate change), and on the other, they allow the elimination of considerable amounts of rural and urban organic waste. Its development must be done by reconciling land use conflicts, changing land use and food production, rehabilitating soils, and promoting development and social equity; involving local communities in order to create a sense of participation and ownership. This approach contributes to sustainable development, and has a direct effect on the growth of small and medium industries impacting on job creation.

Sustainability is a fundamental element in the State Energy Plan, since it represents the basis to determine the guidelines of the state energy policy, showing the government's interest and commitment to the comprehensive approach. It considers mitigation, adaptation and resilience projects in the face of climate change, linking with the objectives of the National Development Plan and the Sustainable Development Goals, as well as the objectives of the Jalisco State Governance and Development Plan.

The current environment opens the possibility to the development of sustainable energy projects at the regional level, allowing state governments to find a development trigger in this sector by promoting investment in infrastructure for transport, storage and distribution of energy, among others. In recent years, significant investments have been made in the Jalisco energy sector, especially in activities aimed at generating electricity through renewable sources.

The Jalisco State Governance and Development Plan 2018-2024, includes all these elements and marks the general guidelines of state energy policy. The Sustainable Development of the Territory constitutes one of the five thematic axes of the Plan, which includes adaptation to the negative effects of climate change and the reduction of GHG emissions. The Plan marks the state's energy policy that aims to achieve maximum energy sufficiency in Jalisco by attracting investment, increasing energy efficiency, reducing costs, increasing network coverage, strengthening infrastructure and promoting alternative, clean and renewable energies.

In summary, the principles supporting the state energy policy are framed in the commitments of our country at the international level and in the opportunities derived from the Energy Reform, under principles of sustainability, and are aligned with the State Plan for Governance and Development of Jalisco 2018-2024, which guides the vision of the Institutional Plan of the State Energy Agency and the implementation of programs and projects at the municipal level.

The guidelines of the State Energy Plan will be used to facilitate access to modern energy services, improve energy efficiency, increase the use of renewable energy and protect the environment.

II. Current situation

The Gross Domestic Product generated by the energy sector⁴ in Jalisco represented in 2016 5.56% of the national's energy GDP; at a state level, it is one of the most important productive sectors.

Currently, most of the demand for energy at the national level is met through hydrocarbons, particularly petroleum products, a situation that is also observed in Jalisco. The state generates a minimal proportion of the energy it consumes, and largely depends on fossil fuels.

The highest consumption of gasoline and diesel nationwide occurs in the Central and Western regions of the country. The consumption of fuels such as gasoline and diesel is key in sectors that play fundamental roles in the economic development of Jalisco such as transportation -both passenger and cargo- and industry. Gasoline and diesel consumption in the state represents 5.34% and 4.81% nationwide, respectively.

The state's vehicle fleet has tripled since 2000, going from one million 300 thousand registered motor vehicles (including cars, trucks, motorcycles and passenger trucks), to 3.6 million vehicles in 2017 according to data from INEGI. Specifically, the number of cargo trucks increased from 511 thousand 440 to 1 million 43 thousand during the period. The growth in the air transport sector has also generated a significant increase in the consumption of jet fuel.

The recent liquid hydrocarbons demand in the state shows the growing risks in terms of emissions to the atmosphere and economic dependence, with an associated social impact.

The dynamics that follow the demand of energy in the state and the way in which it is satisfied has a strong relation with the price of these.

Energy supply and demand

In order to explain the current situation, supply and demand are presented by type of fuel, that is, electricity, natural gas, LP gas, and liquid fuels.

⁴ Sector 22: Generation, transmission and distribution of electricity, water and gas by pipelines, to the final consumer INEGI

1. Electricity

Jalisco is one of the states with the highest electricity consumption nationwide. According to data from the Federal Electricity Commission (CFE), it reached a level of 13,476 GW / h during 2018, surpassed only by Nuevo León and the State of Mexico, representing 6.2% of national consumption.

The consumption of energy in Jalisco is directly related to the preponderant activities of the state; More than 60% of the electricity consumed in the state is concentrated in the municipalities of Guadalajara, Zapopan, El Salto, Tlajomulco, Puerto Vallarta and Tlaquepaque, municipalities with high industrial and tourist activity. Only the first three aforementioned municipalities consumed half of the state's energy during 2018.

The degree of urbanization in the municipalities is also reflected in the levels of consumption; the vast majority of energy consumption is in urban areas (only 13% of electricity consumption in rural areas).

As a consequence, the highest concentration of energy consumption occurs in the industrial sector, followed by residential consumption and far below the agricultural and services sector.

With regard to the supply of electricity, the national electrical system (SEN) is made up of nine regional control centers and a small electrical system. Guadalajara is the control center hub of the western region. Jalisco consumes a significant proportion of national electricity generation, which contrasts with very low energy generation in the state. Jalisco is the state that presents the greatest imbalance in terms of generation and consumption, which puts it in a vulnerable position.

This implies that 99% of the energy that was consumed inside the state during 2017 was generated in other regions. The state of Colima plays a very important role in this regard given its adjacency with Jalisco, as well as its large electricity generation capacity.

Despite having installed capacity in the state of Jalisco for the production of electricity, there are areas in the state that do not have access to power distribution networks. An example of this is the Costalegre area, where the municipalities of Cabo Corriente and Tomatlán do not have access to the national transmission network.

The type of electricity that has shown the greatest average price increase from 2006 to date is commercial energy, which grew more than 20% between 2016 and 2017. The sectors mostly affected by the increase in the cost of electric energy are commercial and services.

In the last year, the rates of CFE Basic Services Provider for the commercial and industrial sector increased on average by 30%.

The cost of power generation depends on the node of the National Electric System (SEN) used for its distribution. Local marginal prices are established from the node. There are more than 2,000 nodes in the SEN.

Jalisco is the state with the highest cost of electricity for household use in most residential rates; with the exception of the high medium voltage demand (HMVD) rate, which is highest in the East and South Central zones.

The cost of electricity in different sectors has a strong impact on the general economic activity of the state.

Source: Own report, with CFE information

2. Natural and LP Gas

The use of gas is a short-term alternative that has a significant impact on the emissions produced by liquid hydrocarbons. Currently, two types of gas are used: Liquefied Petroleum Gas (LPG, a mixture of butane and propane) and natural gas (mainly methane).

Table 8.- Comparison between natural gas and LP gas

	Natural gas	LP Gas
Compound and properties	Mainly methane CH ₄ , lighter than air.	Butane and propane (C ₃ H ₈ and C ₄ H ₁₀) heavier than air (tends to accumulate).
Distribution	Underground pipelines in compliance with NOM-003-ASEA-2016.	Through pipes or cylinders transported by motor vehicles.
Safety	Transport and distribution networks monitored and with rulings issued by verification units.	High number of stationary tanks or cylinders operating beyond the useful life established in the standard.

Price	From 15% to 54% cheaper compared to LP gas.	30 KG cylinder - \$ 585 MXN
Circulating Gas	One household has the equivalent energy to 10 kcal.	Between 308 and 1,905 Mcal per house (when using 30 kg cylinders up to 300 lt stationary tank).
Environment	It mainly generates carbon dioxide and water vapor. Non-renewable resource.	Since it is a petroleum product, it contains sulfur and other contaminants. Non-renewable resource.

Due to its calorific value (2.5 times higher than natural gas), high portability and relative environmental efficiency, LP Gas is one of the top five products on the basic basket.

It is an indispensable fuel in the daily life of Mexican homes, since nationally 76% of households use it as the main fuel for cooking food and water heating. On the other hand, natural gas has important advantages as it turns out to be cleaner and cheaper compared to LP gas, in addition to being safer.

The national demand for natural gas has maintained an increasing rate during last the two decades, although in comparison with the national behavior, the dynamism in the increase in the consumption has been lower in Jalisco.

Jalisco consumes 7.2% of the national total of LP gas and more than half is for residential use. The state holds the twentieth national position in terms of consumption.

Graph 2.- Natural gas consumption by state

According to the prospective carried out by the Ministry of Energy, the consumption of natural gas will have an increase of 66.8% between 2013 and 2028, which represents an average annual growth rate of 3.5% during the prospective period. In 2028 the largest demand for natural gas will be in the Northeast region with a share of 29.9%, followed by the Center-West region with 23.1%, the South-Southeast region with 21.2%, the Center region with 13.5%, Northwest with 9.7% and finally territorial waters with 2.6%.

Currently, more than 50% of the gas consumed in the country is imported.

Natural gas is 35% cheaper than diesel and emits 80 percent less pollutants. In the residential sector, Jalisco only has 35,500 natural gas users, who have an economic saving of up to 25% with respect to the use of gas LP.

For the industrial sector, the access to the natural gas distribution sector allows savings for up to 54\$, compared to other hydrocarbons. Despite the above, Jalisco only has about 300 industrial users of natural gas.

The supply of natural gas comes from two different sources: domestic production through Pemex and other marketers, and import (through internment pipelines and ships). The commercialization is carried out through Pemex, CFE and private companies. Currently, more than 50% of the gas consumed in the country is imported.

The gas consumed in the state is imported and supplied through the National Integrated Natural Gas Transportation and Storage System (SISTRANGAS).

Two different systems are used for the internment of the hydrocarbon: the FERMACA System ⁵, in its section from Waha to Guadalajara and along the South Texas-Tuxpan-Tula-Villa de Reyes-Guadalajara route. The FERMACA system can carry approximately 0.5 billion cubic feet per day to Jalisco. The construction of the Laguna-Durango-Aguascalientes-Guadalajara gas pipeline will facilitate the transfer of Natural Gas to the state. Access to the Waha basin should improve efficiency.

The closest compression stations are in Valtierra, in the state of Guanajuato and El Sauz in Querétaro. There is the construction project for the compression station in Pátzcuaro.

On the other hand, with the release of the natural gas market, the variation in available rates is very high. The cost, when users are directly connected to the transportation system, is based on the cost of acquiring the molecule and the cost of transportation. When purchased through a distributor, the cost depends on the service, use, volume and capacity.

Jalisco is located in the region IV from the reference index of natural gas prices. There was a decrease in price and volume traded in the region from 2018 to 2019. In the neighboring states, higher prices were observed in Colima, San Luis Potosí and Aguascalientes than in Jalisco; in the other states the price is lower.

Despite the subsidies that LP gas receives, it is more expensive than natural gas; Therefore, the use of the natural gas distribution network allows savings of up to 54% with respect to the use of other hydrocarbons.

⁵Fermaca, a Mexican private company, is the second operator of natural gas transport infrastructure in the country.

Nationally, these markets are characterized by high levels of concentration with the consequent influence on the price level as of their release in January 2017. This generates a strong impact on the most vulnerable population, since the poorest 10% allocates 9% of their income to the purchase of LPG.

The natural gas transport network in Jalisco is approximately 750 km; of which 419.03 kilometers are owned by CENAGAS and 330 km are of private property. The Gas Pipeline operated by CENAGAS crosses the regions Altos Norte (north highlands), Altos Sur (south highlands), Southeast, Lagunas, Valles and South.

With the support of TransCanada, liquefied natural gas is transported from the city port of Manzanillo to the metropolitan area of Guadalajara; where it is expected to consolidate an interconnection that connects the two currently existing pipelines and a pipeline from Aguascalientes, which is under construction⁶.

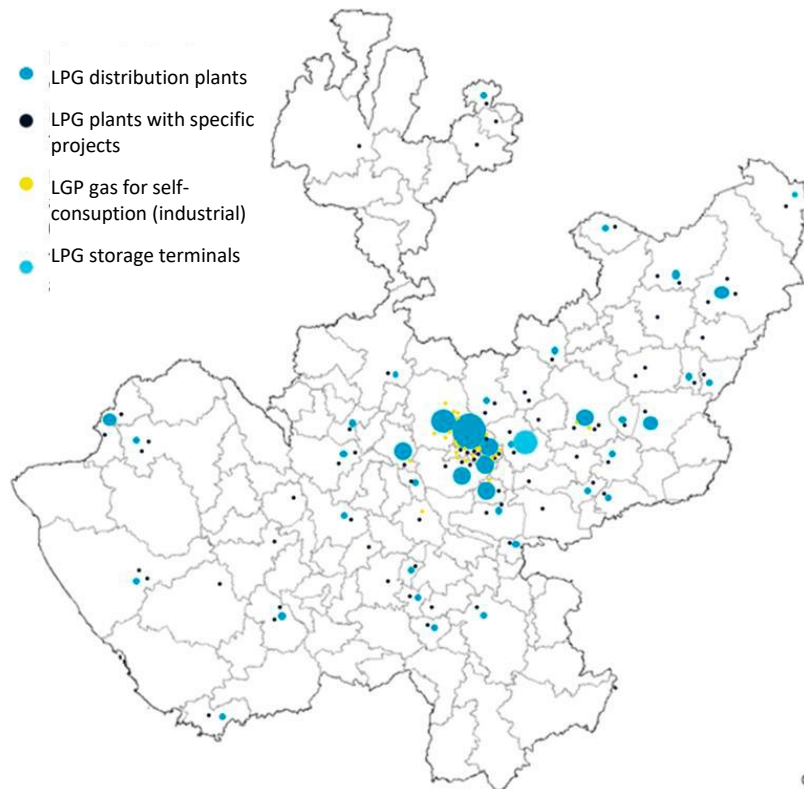
SISTRANGAS has an injection and extraction point in El Castillo and an extraction point in El Salto. The flow of the system goes from El Castillo to the junction of the pipelines that go Salamanca, Morelia and Aguascalientes.

In Jalisco, the networks for the distribution of natural gas at low pressure (up to 21 kg / cm²) -aimed to directly supply the end user (residential, commercial or industrial)- are mainly concentrated in the municipalities of the metropolitan area of Guadalajara, and to a lesser extent in the area of Lagos de Moreno. Currently, the network has an extension of 1,200 kilometers and is operated by different distributors.

Jalisco has LP Gas distribution plants, stations for specific purposes, self-consumption (industrial) stations and storage terminals. Map 3 shows how these are distributed throughout the state, focusing mainly on the municipalities comprising the Guadalajara metropolitan area.

⁶ SENER 2019

Map 3.- State Gas Infrastructure LP



3. Liquid fuels

As a result of a growing demand for energy at the national level, the composition of supply has undergone important changes; the production of petroleum products of the National Refining System has shown continuous declines in recent years, so that fuel imports have increased to meet demand.

In 2017, the national production of gasoline, diesel, jet fuel and fuel oil accounted for 42% of the national supply, the remaining 58% was covered by imports. From 2011 to 2017, gasoline imports increased by 41%, from 405 Mbd to 572 Mbd; at the same time, production decreased 36%, from 400 Mbd to 257 Mbd ⁷.

The state of Jalisco does not have power generation capacity of this type. By not having oil fields or refineries, Jalisco depends entirely on the logistics infrastructure of hydrocarbons to meet its demand of 94,340 barrels per day (equivalent to 15 million liters), of which 53% is consumed at the metropolitan area of Guadalajara ⁸.

⁷ SENER Information

⁸ Information provided by the Mexican Association of Gasoline Entrepreneurs (AMEGAS).

The main source of supply for Jalisco is the Salamanca refinery in Guanajuato, which sends product to the Zapopan and El Castillo terminals via pipelines. Salamanca is interconnected with the Tula refinery by two pipelines. The supply terminal of Manzanillo, in Colima, and Lázaro Cárdenas, in Michoacán, also supply part of the state fuel.

The western region has an inventory on demand days of 4.3 for Gasoline, 5.4 for Diesel and 7.7 for jet fuel.

The National Refining System is made up of six refineries, all of them belonging to Pemex. The State of Jalisco has no participation in the production and transformation of fuels, making it fully dependent on the existing infrastructure and logistics for its transportation and storage.

The supply network used in the western region is part of the South-Gulf-Central-West Zone system, and has a total length of 990 kilometers and an operational capacity of 453 TBD.

There are currently three storage and dispatch (TAR) terminals in the state, two owned by PEMEX and one by the private sector. The terminal of El Castillo has a capacity of 220 thousand barrels (TB), while the Zapopan terminal has a storage capacity of 281.2 TB; both connected to the pipeline that comes from the Salamanca refinery. The TAR located in Lagos de Moreno is private and has an estimated capacity of 300 TB. Like the two PEMEX terminals, the Lagos de Moreno terminal has access through roads and railways, which allows the transport of fuels by autotank and tanker.

Airports and Auxiliary Services (Aeropuertos y Servicios Auxiliares) operates a significant capacity of fuel barrels. The Guadalajara terminal is the largest in the western region, with a storage capacity of 84.3 Mb of Jet Fuel and 0.6 Mb of ATF (aviation turbine fuel). The second most important ASA storage terminal is that of Puerto Vallarta, with a capacity of 28.3 Mb of jet fuel and 0.4 Mb of ATF.

At the end of 2018 Jalisco reached a nominal storage capacity of 82 TB in 21 facilities owned by distribution licensees.

There are approximately 1,110 km of railways in the state of Jalisco. Ferromex is the only concessionaire that operates in Jalisco, but rents part of its tracks to other companies, allowing the transfer of petrochemicals from the border into the interior of the state.

Another part of the fuel consumed in the state arrives through tankers to the Manzanillo terminal.

Map 4.- Infrastructure for hydrocarbons in Jalisco



Source: Own report, with PEMEX information

In terms of infrastructure for reaching the final consumer, there are more than 75 brands of private gas stations and 12,285 service stations nationwide. Jalisco is the second state with the highest concentration of service stations per person, making it crucial to ensure the supply of these stations to meet the consumption needs of the population.

The state has 917⁹ petrol and diesel service stations with a valid and operational permit. All sell regular gasoline, and of those, 95% and 79% sell Premium gasoline and diesel, respectively. Of the total service stations that the state has, 51% is located in the municipalities that make up the metropolitan area of Guadalajara.

⁹ Information as of June 2019.

The price of gasoline in Jalisco is one of the highest in the country. In July 2019, Jalisco's premium and regular gasoline prices were the third and second highest in Mexico, respectively. Prices vs. national average are shown.

Use of natural resources and the environment

The scenario facing the Jalisco energy market in terms of demand and supply is intimately linked to the infrastructure available, both in terms of production and transformation of fuels and their storage, transport and distribution, as well as for electricity transmission and distribution.

In summary, it is evident the dependence of Jalisco in terms of supply of gas hydrocarbons and liquid fuels and its impact on costs, which makes the state vulnerable to economic activity, impacting the entire population. This is aggravated if natural phenomena that impact the flow of energy products to the state that impact on all sectors are considered.

The effects of natural phenomena can be enhanced as a result of climate change. In addition, it should not be forgotten that, in most energy generation processes, water is a key element. Energy production represents about 15% of global water consumption, and it is estimated that 11% of it does not return to its source of origin.

Jalisco has made progress towards cleaner energy sources, increasing the energy potential of the state.

The use of natural resources and the use of clean technologies from the exploration of geothermal resources and the production of bioenergy are currently being promoted. Nowadays, the installed capacity in the state for bioenergy production is 88 MW and with a generation of 187 GWh, according to PRODESEN figures.

The mills in Jalisco generate bioenergy for self-consumption. The Melchor Ocampo mill has a total capacity of 6 MW and a Gross Generation of 15 GWh; The San Francisco Ameca mill has a slightly lower capacity (5 MW and 13 GWh respectively). However, the Tala and Tamazula mills have a greater capacity.

There are three cogeneration plants located in El Ahogado, Atenquique and Tala. Altogether they have a total capacity of 44 MW and a gross capacity of 122 GWh. Finally, the company Renova Atlatec has the capacity to generate a total of 11 MW (not for self-consumption).

In addition to the bioenergy that can be produced in the state, Jalisco has an important potential as a solar power generator. The average daily solar radiation is 5.6 kWh / m²; One of the places with the highest solar collection in the world. This is reflected in the number of small and medium scale contracts in the state. Jalisco is the state with the largest number of contracts (8,589); It has an installed capacity of 40,832 kW.

In addition, it should not be forgotten that, in most energy generation processes, water is a key element. Energy production represents about 15% of global water consumption, and it is estimated that 11% of it does not return to its source of origin.

To generate a cubic meter of drinking water, between 0 and 8.5 kWh of energy are required, which is a function of the characteristics of the place where the water is obtained and the treatment it requires.

Opportunities after the Energy Reform

There is still a long way to go and the Energy Reform opens opportunities in this regard. The bases and guidelines under which the new Wholesale Electricity Market (MEM) operates were created, providing an open, competitive and deregulated market that offers cheaper supply alternatives for large consumers with respect to the regulated rates offered by CFE SSB (users with demand greater than 1 MW).

The National Energy Control Center (Cenace) is responsible for operating the MEM. The creation of the MEM allows large buyers and generators to carry out transactions of electrical energy and associated products such as power, Clean Energy Certificates (CEL), financial transmission rights, related services and controllable demand.

The MEM allows grouping loads with demands greater than 25 kW to be supplied through Qualified Service Providers (SSC), providing the possibility of accessing more competitive electricity rates for small and medium-sized industries that are integrated into a cluster.

It is estimated that the savings margins that large users can obtain by migrating to an SSC are 20% to 40% compared to CFE SSB rates, which means potential savings for the State Government of between 174 and 348 million pesos.

Exploiting the possibilities offered by the MEM will not only bring savings to the state, but will also increase Jalisco's energy competitiveness, attracting investment in important generation projects and allowing it to offer cheap and clean energy to its industries. Accelerating the growth of installed capacity in the entity is especially important to ensure resilience, reduce congestion in transmission and distribution networks, as well as obtain lower Local Margin Prices (PML).

The Energy Reform also offers opportunities in terms of natural gas by opening the possibility for industries to set up cogeneration systems, which allows them to generate energy at low cost and sell their possible surpluses.

In addition to the bioenergy that can be produced in the state, Jalisco has an important potential as a solar power generator. The average daily solar radiation is 5.6 kWh / m²; One of the places with the highest solar collection in the world. This is reflected in the number of small and medium scale contracts in the state. Jalisco is the state with the largest number of contracts (8,589); It has an installed capacity of 40,832 kW.

In addition, the new policies for the commercialization of petroleum products allow greater competition among licensees, which will facilitate access to points of sale and generate greater dynamism in the market. The opening to new brands will allow the generation of a more competitive market.

III. Strategic points, programs and indicators

The general scenario of the Jalisco energy sector, in terms of supply and demand, as well as in logistical terms, together with the use of natural resources and the state environment, allows us to identify the main areas of opportunity to which this Plan must be oriented in order to achieve the state's energy aspiration, in the light of the guidelines described and taking advantage of the opportunities opened up by the Energy Reform.

In this sense, the approach to energy efficiency in different fields becomes more pressing, as well as attention to the supply of energy in general. In terms of electricity, including generation, transmission, distribution and costs. In terms of fuels, in relation to Natural Gas, LP Gas and Petroleum Products.

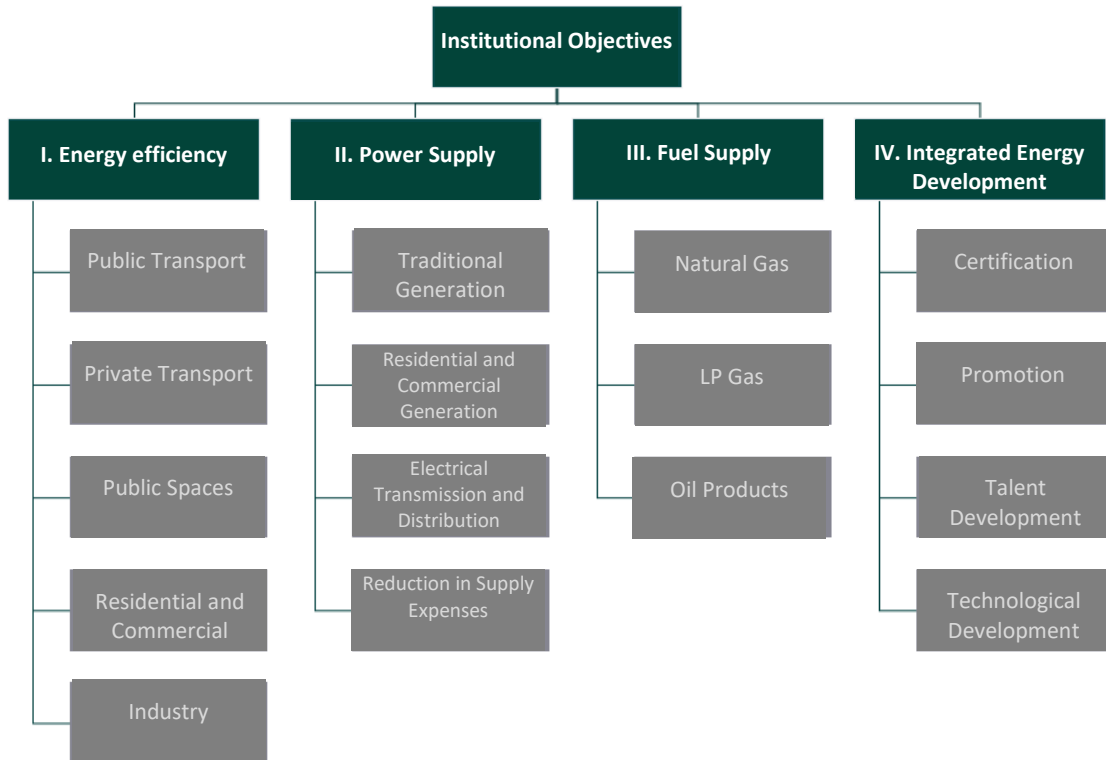
Under these premises, four major strategic points are identified, which constitute the institutional objectives of the Jalisco State Energy Plan for the period 2019-2034:

- I. Energy Efficiency
- II. Power Supply
- III. Fuel Supply
- IV. Integrated Energy Development

The latter gives a global orientation to the Plan by promoting regional development in the medium and long term, based on an approach to the promotion of training, research and certification programs, from a sustainability and efficiency perspective.

To achieve the four institutional objectives, 16 initiatives are identified that will support the strategy.

Figure 1.- Institutional Objectives and Initiatives



For these initiatives, specific programs and indicators have been established to cover specific objectives, establishing short, medium and long-term goals that impact each of the institutional objectives.

I. Energy Efficiency

Energy efficiency is the fundamental basis and the first step towards a rational use of energy, allowing the same process to be carried out at a lower cost compared to the investment involved in developing generation projects, as well as contributing to reducing pollutant and Greenhouse Gases emissions, and to mitigate climate change. It is a field that applies in all energy users, applying techniques and technologies resulting in savings of up to 50% ¹⁰.

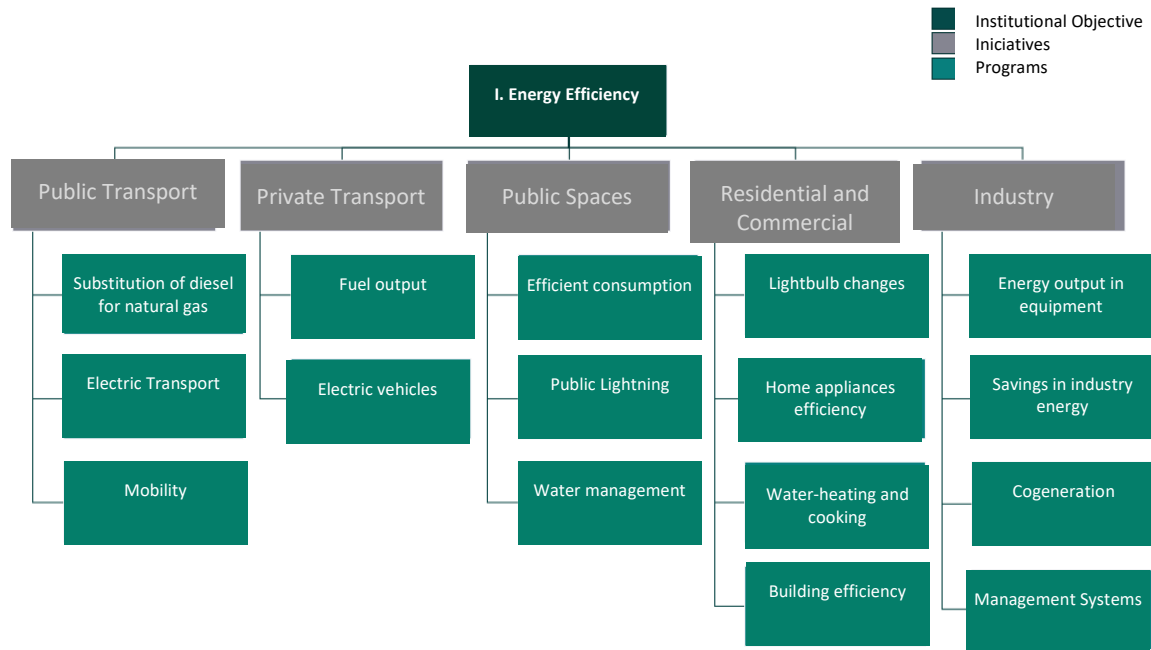
The State Energy Plan identifies five important initiatives to cover areas of opportunity in energy efficiency:

¹⁰ SENER, CONUEE.

1. **Public Transportation:** This program is oriented to the use of natural gas in public vehicles, modification of the public transport fleet and the improvement of routes.
2. **Private transport:** Focused on the use of vehicles with better fuel efficiency, the usage of one vehicle to move around more people and the incorporation of electric vehicles into the vehicle fleet.
3. **Public spaces:** Looks for more efficient standards in facilities, energy consumption in transported water and municipal public lighting.
4. **Residential and Commercial:** The approach of the programs is oriented to low-power consumption lightning systems, household-electric economizers of energy, options of heating of smaller power consumption and reduction of power losses.
5. **Industry:** The programs are focused on energy efficiency in equipment and processes, and efficient cogeneration schemes.

The institutional objective of Energy Efficiency includes 16 programs, which are:

Figure 2.- Energy Efficiency - Initiatives and Programs



II. Power Supply

The electricity supply is one of the basic services for the daily life of any society, coverage and quality in the service is required to underpin economic growth and social development.

Jalisco suffers an important imbalance between generation and consumption of electricity, which may affect the competitiveness of the state, so it seeks an efficient and quality supply leveraged in taking advantage of the enormous and diverse potential of the state in terms of clean energy, basically solar energy, biomass, hydraulic and wind.

The State Energy Plan identifies four important initiatives to cover areas of opportunity in energy supply:

1. **Traditional generation:** The focus of the programs is oriented to plants of the National Electric System Development Program (Prodesen) and generation plants with renewable energies.
2. **Generation in homes and businesses:** Focused on solar power generation.
3. **Electrical Transmission and Distribution:** The approach of the programs is oriented to the repowering of CFE transmission lines, intelligent networks, loading sites, micro networks.
4. **Reduction of supply costs:** Focused on electrical storage and consolidated purchases.

The institutional objective of Electric Supply includes nine programs, which are:

III. Fuel Supply

The availability of fuels plays a very important role in the economic activity of the state. Jalisco depends entirely on the logistic infrastructure of hydrocarbons and, although the current storage capacity is sufficient to supply the demand, the deficiencies in the transport and distribution networks bottlenecks the flow¹¹. It is also necessary to strengthen the energy transition to cheaper sources with less impact on the atmosphere.

The State Energy Plan identifies three important initiatives to cover areas of opportunity in fuel supply:

1. **Natural Gas** The programs are focused on the coverage of distribution networks, purchase conditions and second generation biogas.
2. **LP Gas:**The program is focused on competition in the supply of LP Gas.
3. **Oil products:**The programs are focused on logistics infrastructure, cost of supply and second generation biogas.

The institutional objective for Fuel Supply includes seven programs, which are:

¹¹ Jalisco State Governance and Development Plan 2018 - 2024; pp. 149

IV. Integrated Energy Development

Moving the state of Jalisco towards achieving energy aspiration requires the integration of a set of actions and skills focused on reaching the maximum energy sufficiency of the state in a clean, sustainable and resilient energy ecosystem.

The Integral Energy Development as an institutional objective, establishes mechanisms between the different stakeholders and public and private units, allowing a multidisciplinary vision that gives permanence to the State Energy Plan.

The State Energy Plan identifies five important initiatives to cover areas of opportunity in terms of Integrated Energy Development:

1. **Certification:** The program approach is oriented towards certification schemes in energy efficiency.
2. **Promotion:** The programs are aimed at making energy efficiency services companies more visible and promoting this new sustainable vision from basic levels of education.
3. **Talent Development:** The programs are focused on training in energy efficiency and environmental protection, scholarship programs and certifications.
4. **Technological development:** The programs are focused on the development of low-cost solutions to improve energy efficiency and environmental protection.

The institutional objective of Integrated Energy Development includes nine programs, which are:

In summary, the State Energy Plan is comprised by four institutional objectives, supported by 16 initiatives integrated by 41 programs:

Figure 6.- Institutional objectives, initiatives and programs

Institutional Objectives (4)	Initiatives (16)		Programs (41)
I. Energy Efficiency	Public Transport	Substitution of diesel with natural gas Electric transportation	Mobility
	Private Transport	Fuel output	Electric vehicles
	Public Spaces	Efficient Consumption Public lightning	Water management
	Residential and Commercial	Lightbulb substitution	Water-heating and cooking
		Home appliance output	Building efficiency
Industry	Equipment energy output Industry energy savings	Cogeneration Management systems	
II. Power Supply	Traditional Generation	<i>Prodesen</i> plants	Additional renewable generation
	Residential and Commercial Generation	Solar generation in households and shops	
	Power transmission and distribution	Line re-powering and installation	Smart networks
		Public space electric vehicles power supply	Micro networks in remote areas
Supply cost reduction	Power storage	Usage of Large-scale power market	
III. Fuel Supply	Natural Gas	Increase of distribution networks Consolidated Purchases	Production of Biogas
	LP Gas	Competitive LP Gas supply	
	Oil Products	State logistics infrastructure	Infrastructure for state fuel supply
Biodiesel production			
IV. Integrated Energy Development	Certification	Facilities certification	
	Promotion	Promotion to companies with energy efficiency	Innovation contests
	Talent Development	Universities and technical schools	Professional Certifications
		Industrial Practices	
Technological Development	International Network Knowledgebase Research Institutions	Jalisco Energy Information System	

IV. Requirements

From the perspective of the Jalisco State Governance and Development Plan 2018-2024, in which citizen participation is considered as a key element for development, the execution of the Jalisco State Energy Plan considers the “new way of governing where the citizenship is responsible for decisions, jobs and results”.

In order to achieve the energy aspiration of the state, the participation of the different stakeholders is required; there is a need to carry out concrete actions in different spheres to ensure the correct execution of the programs described above.

The adequacy of public policy and regulation is required through the definition of new standards and the establishment of improvement schemes. Also of baselines and requirements, simplification of procedures and permits.

In one hand, the state government will need to reallocate resources for promotion, as well as the characterization of variables, the conduct of censuses, integration of directories, consolidated purchases and promotional activities.

It is also necessary to promote new skills for a more efficient operation, the dissemination of requirements and the facilitation in participation schemes to different sectors.

Commitment to the purchase of stored energy, development of business cases, supply contracts and a scheme that guarantees the security of the logistics infrastructure.

The Jalisco State Energy Plan also contemplates one of the fundamental aspects that will contribute to the state's energy development and that will allow the state to remain one of the competitive relays in the domestic energy market, through the introduction and implementation of policies and programs that support private initiative and the population in general and through them obtain better energy efficiency.

It also requires investment in pipeline infrastructure, supply contracts will be signed with government facilities, and programs will be developed to promote the interaction of railway and logistics companies for the further implementation of infrastructure projects, as well as the interaction of railway companies with potential terminal developers, and with several suppliers and customers in the market.

Promotion of private investment and financing for the use of clean energy, as well as linking schemes between sectors.

The Jalisco State Energy Plan 2019-2034 is conducted by the State Government, however, it requires the concurrence of the entire population to maximize the impact of the initiatives that comprise it. Government, industry, companies and the general population must have an active and responsible participation aligned with the actions proposed in the Plan.

In the particular case of the general population, it is required that they gradually become aware of the individual and collective benefits implied by the Plan's proposals, and therefore join in.

On the other hand, the participation of the industrial sector is required in investment in services and products with lower energy consumption, investment in efficient cogeneration plants and the development of relevant infrastructure.

The State and the state energy policy institutions will need to allocate budgets for the promotion of programs, dissemination of long-term cost advantages and initiatives.

A sustainable energy policy is not only dependent on programs, resources and data; it is essential to have professionals specialized in the field, who actively participate since the design up to the measurement of the impact of such programs and, for this purpose, the state of Jalisco must address the need from the beginning in collaboration with educational institutions. For this, it is necessary to work with universities, institutes, schools and other educational entities to adapt academic, technical and professional programs, and to include an approach to energy efficiency and environmental protection.

The participation of all stakeholders, focused on achieving the Jalisco State Energy Plan will be a determining factor in obtaining the maximum energy sufficiency of the state to underpin development.