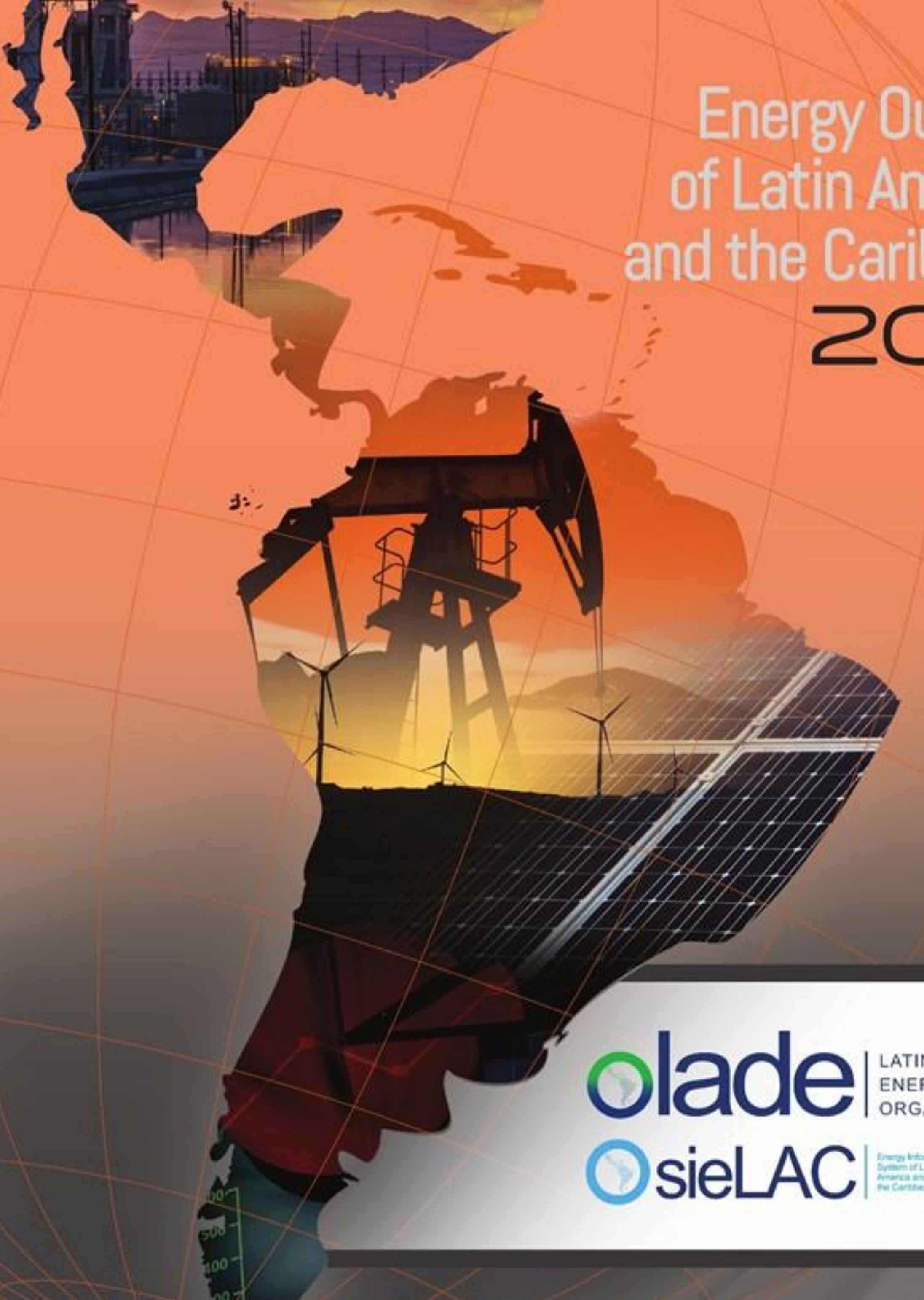
Energy Outlook of Latin America and the Caribbean 2019



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sieLAC | Energy Information System of Latin America and the Caribbean

Energy Outlook of Latin America and the Caribbean 2019

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Energy joins us

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Some of the information contained in this Latin America and the Caribbean Energy Outlook refers to prospective data based on the formulation of assumptions about future trends of various variables and the use of simulation models. Therefore, they involve a high degree of uncertainty. Consequently, the results presented do not imply any guarantee as to the accuracy of the forecasts, projections or predictive statements that are included.

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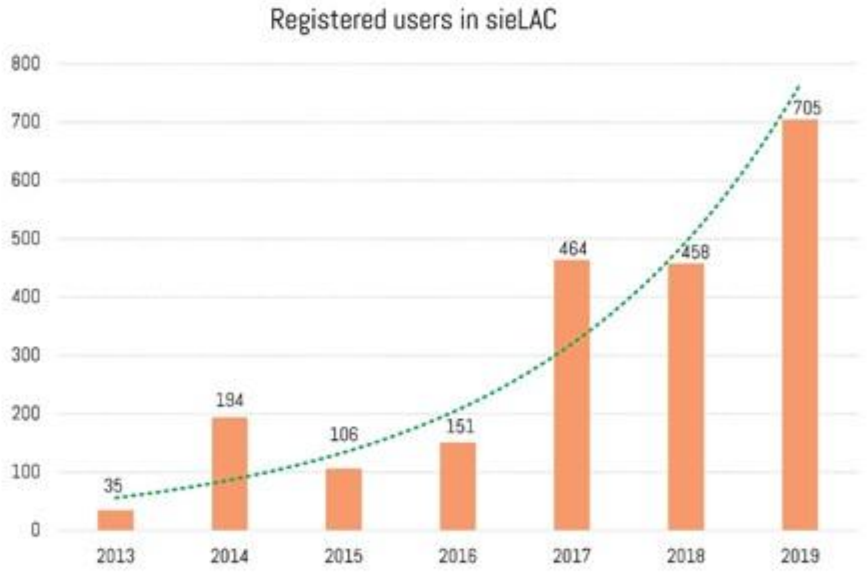
ALFONSO BLANCO BONILLA
Executive Secretary
OLADE

I am pleased to present the 2019 Latin American and the Caribbean Energy Outlook, which I hope will become a reference guide of high value to promote the debate on the present and future of energy in our region. Throughout the 2019 Latin American and the Caribbean Energy Outlook, a large amount of official statistical information and indicators are displayed graphically as of 2018, provided by our Member Countries.

The reason that has motivated us to adopt this way to present information, eminently graphic, lies in providing modern and open information that can be interpreted by all types of audiences. At the beginning of my management as Executive Secretary of OLADE, I decided to open our Energy Information System of Latin America and the Caribbean (sieLAC) and provide free access to all the information accumulated to the entire community of the energy sector in the region. For this reason, since 2017, anyone interested in using the information available in the system and perform the calculations and processing they want, has all the freedom to do so by accessing and registering on our information platform (http://sielac.olade.org/).

This strategy of opening information has certainly proved successful. If we observe the recent evolution of the number of registered users on the platform, the exponential growth we have achieved is evident.



The opening of our sieLAC is one of the great advances that we have made as an Organization towards promoting transparency of information by making it available in a free and accessible way. It is important to note that the information published in this Outlook, such as that available on the platform, has been the result of a joint effort with each of our member countries, and whose efforts have given us the opportunity to promote improvement in the quality, integrity and reliability of statistical data, as well as promoting the development of capacities in the collection and processing of information in our region.

Opening access to the sieLAC system has allowed us to identify opportunities for improvement in the platform, simplify content and improve indicators, as well as increase the reach to users and, therefore, generate new opportunities in the use of information. Thus, promoting greater collaboration between different stakeholders. Our platform has gone from being a restricted consultation tool, to an important reference point in the region as a source of information for the different decision makers in the Public and Private Sector, the Academy and the community of researchers and consultants who develop their activities in our region.

The next step we have considered is to move towards achieving a higher level of harmonization of our statistics in line with international recommendations, which will allow us to work with definitions common to other regions and have comparable quantitative information.

As an organization, we continue with the commitment to consolidate this content and encourage the exchange of knowledge, as well as strengthen relationships with our information providers. Thus, we are preparing the Manual of Good Practices of Energy Statistics in Latin America and the Caribbean, whose objective will be to contribute to the improvement of energy information, as well as the creation of inputs to have more reliable, complete and free availability data. Thus, promoting the quality of information by providing standards and knowledge that motivate those who are directly related to the compilation and production of information in our region.

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In this 2019 Energy Outlook, about 1,000 graphics are presented containing detailed information about the recent evolution of the energy matrices of the 27 Member Countries of the Latin American Energy Organization (OLADE). Likewise, a set of graphics is presented where the trends of the regional aggregates that the organization usually considers are expressed, namely: Central America, Brazil, the Caribbean, the Southern Cone, Mexico and the Andean Zone, as well as Latin America and the Caribbean in its entirety. In the case of hydrocarbons, regional trends are compared with global trends considering the regions of Africa, Latin America and the Caribbean, Asia and Australasia, Europe, the Commonwealth of Independent States (that is, some countries of the former Soviet republics), Middle East and North America. The information presented comes from the Energy Information System of Latin America and the Caribbean (sieLAC) managed by the OLADE information team.

Additionally, a global analysis for energy prospective is incorporated based on the information published in the outlooks by the different international and regional organizations for the period 2017-2040 developed by OLADE using the model for the Simulation and Analysis of the Energy Matrix (SAME).

The main objective of making multiple graphics available is to provide the Latin American and Caribbean community with the possibility of having a source of knowledge about the energy profiles of the countries of the region on a common basis, trying to provide as much detailed information as possible in a systematized, intelligible and concise way; as well as a trend in the energy sector within the next 20 years.

On the first page of each country, the values of the main energy indicators are presented to the year 2018 or the last available year according to each case, together with a summary version of the Sankey diagram of each one. The graphs presented contain information on reserves and production from various sources, energy supply and its flows, primary and final energy consumption, also considering their values at the sector level. An extensive set of indicators is then presented, including energy intensities of various kinds, renewable energy indexes, energy autarchy, avoided demands, per capita and per unit of added value indicators, evolution of the relative shares of various energy sources, etc. Then, some indicators that analyze the recorded trends of CO_2 emissions are presented. Finally, a summary chart is presented that shows the recent and comparative evolution of several energy and economic indicators.

Those indicators that do not turn out to be of habitual use are defined and described in the respective chapter of this Energy Outlook. To facilitate and make the visualization of the indicators more friendly, it was preferred to present the trend information as smoothed curves. Also, as can be seen, in some cases in addition to presenting the respective variables, the accumulated variation rates for five-year periods 2000 - 2004 / 2005 - 2009 / 2010 - 2014 and the annual rate for the period 2015 - 2018 were included in the right hand axis.

We hope that this Energy Outlook will become a common use and consultation tool that accounts for the evolution of trends in the region in the area of energy. Given that, as of 2017, the Energy Information System of Latin America and the Caribbean, sieLAC, is freely accessible and it is enough to register to have access to the entire database, we recommend and invite those interested in deepening the analysis and work with the information available to do so by visiting the website:

http://sielac.olade.org.

sieLAC | Energy Information System of Latin America and the Caribbean

simLAC | Energy Planning Tools for Latin America and the Caribbean

Relevant events

I INSTITUTIONAL, IMPLEMENTATION OF ENERGY PLANS AND POLICIES

Brazil approved the 2027 Decennial Energy Expansion Plan (PDE 2027), a document that consolidates the sector planning studies carried out and indicates that the internal energy supply (energy needed to boost the economy) will grow, on average, 2.3% per year, reaching 367.4 Mtoe in 2027. Of this amount, a 47% share of renewable sources is projected.

Chile presented the 2018-2022 Energy Route, an instrument that proposes the transition to a clean and renewable energy matrix through the implementation of seven axes: (1) energy modernization, (2) energy with a social seal, (3) energy development, (4) low emission energy, (5) sustainable transport, (6) energy efficiency and (7) energy education and training. In addition, the so-called 10 "Mega Commitments" are proposed, which consist of: (1) Raising a map of energy vulnerability in the country, identifying families that do not have electricity and other energy services, (2) increasing 10 times the electric vehicles existing in the country, (3) quadruple the small-scale renewable distributed generation, (4) establish a regulatory framework for energy efficiency, (5) modify the distribution law, (6) regulate firewood and its derivatives, (7) reduce the environmental processing times of energy projects by 25%, (8) start decarbonization of the energy matrix, (9) modernize the institutional framework and (10) train 6 thousand technical and professional operators in the use of Energy. On the other hand, the free mobile application "Online Heating" was launched, a useful tool for comparing prices of paraffin (or kerosene), liquefied petroleum gas and firewood, throughout the country and selecting the best option. Additionally, the Energy Access Fund was launched aimed at facilitating access to energy to community organizations in rural, isolated or vulnerable sectors through the financing of small-scale clean energy projects. Organizations may apply for two types of energy solutions: photovoltaic generation systems and battery storage for electricity, or solar thermal systems for domestic hot water.

Grenada reported conducting energy audits in 14 public buildings and receiving expressions of interest to occupy the management of phase two of the Sustainable Energy Program for the Eastern Caribbean (SEEC), a mechanism supported by a multi-donor trust fund for a term of four years, which involves the installation of intelligent infrastructure and the implementation of Energy Strategy Programs of the Caribbean Development Bank. The aforementioned program is designed to reduce dependence on imported fossil fuels in OECS participating countries, displacing fossil fuels in electricity generation with economically viable investments in renewable energy and energy efficiency.

The Ministry of Energy and Mines of Guatemala launched the project "Implementation of Energy Statistical Modules", based on the collection and storage of official information related to the energy sector. This platform, interactive and easily accessible, allows entry to updated statistical information that will facilitate the performance of statistical analyzes. The content includes statistics on: energy balances; Indicative Generation and Transportation Plans; greenhouse gas emissions and energy indicators; definitive authorizations; registration of generating plants less than or equal to 5 MW; socio-economic evaluation reports for electric power insertion projects; qualifications of renewable energy projects for the application of tax incentives; wind measurement results; electricity generation, installed capacity, power demand and Spot Price, among others.

The government of Mexico presented the National Plan for the Production of Hydrocarbons, aimed at raising national production to more than 2 Mbbl / day at the end of the sexennium, based on five strategic objectives and 16 lines of action, among which: ensure the increase in reserves through investment in the basins of the southeast of shallow waters and land, as well as in the conventional basins of the north; accelerate the development of discovered fields, guaranteeing the maximum recovery factor; incorporation of reserves of approximately 1,500 Mbbl / year, achieving a replacement factor of almost two; reactivate the production of Pemex, by increasing the drilling and repair of wells in fields in operation with 2P reserves; increase the recovery factor in mature fields; reduce the decline of the deposits in operation, applying technology and systematizing best practices of integrated deposit management and, mainly, in the timely development of new fields discovered with the new exploration strategy. Likewise, the National Refining Plan that involves the rehabilitation of the 6 refineries was presented, within a framework of the application of measures to increase production significantly, and by mid-2020 reach the final production target of 600 kbbl / day of gas. With aims of contributing to energy self-sufficiency, as a second strategy, the construction of the New Refinery in Dos Bocas, the 7th Pemex refinery, which will have a processing capacity of 340 kbbl / day, and will handle a 22ºAPI crude with high energy efficiency technology. Additionally, the National Electricity Program was presented, aimed at increasing the generation capacity of the CFE plants, making investments for the full use of the generation park and establishing an intelligent policy on the use of fuels, through the use of all primary sources. To fulfill the commitment to maintain a sustainable electricity, promotion of renewable energies is planned by programming mechanisms to take advantage of all the existing natural resources for the generation: hydraulic, geothermal, wind, photovoltaic and cogeneration with Pemex using steam from refineries at a minimum cost.

The Women Electricians project was presented in Uruguay , as part of the Social and Productive Complementarity Plan (CNPS) 2017-2019. The new program, developed by MIEM and UTE, together with INEFOP and Mides, is intended for women in the process of going out of gender-based violence situations or multiple discriminations and aims to promote their social inclusion paths and contribute to their economic autonomy, while articulating their training in electricity at the residential level, their labor insertion - particularly in the energy regularization plan of UTE - and the support for the formation of social cooperatives. The Women Electricians pilot plan has 45 participants over 18 years of age. The proposal is based on a training program with technical aspects, basic electricity and transversal dimensions, while promoting the formation of social cooperatives. It also includes agreements with the scope of the labour world, to promote the recruitment of participants, and their psychological support and legal advice, by the National Institute of Women (Inmujeres) of the Mides.

II HYDROCARBONS

2.1 Exploration and Exploitation

In October 2018, Argentina reported a total oil production of 498 kbbl / day, which represents an increase of 2% over the same period of the previous year. Meanwhile, total unconventional oil production (shale + tight) showed an annual growth of 15%. In particular, the production of shale oil was 66 kbbl / day (thousands of barrels per day) reaching a growth of 70% in annual terms. Regarding natural gas, total production grew interannually 7% with 132 Mm^3 / day. In particular, unconventional gas (shale + tight) showed an annual growth of 38% in October. The production of shale gas that was 25 Mm^3/ day stands out, growing 243% between October 2017 and October 2018. Additionally, Costa Afuera exploration was convened on the continental shelf, the exploration permits cover about 200,000 km^2 and represent a total of 38 blocks to be awarded concerning the Austral Marina, Malvinas Oeste and Argentina Norte basins.

In Brazil, the completion of the 6th Pre-Sal Distribution Round, the prospective studies for the 7th and 8th Production Tender Round, and the 16th Auction Round under concession in which blocks located in the basins will be selected are authorized Pernambuco-Paraíba, Jacuípe, Camamu-Almada, Campos and Santos, contemplating 42 blocks, distributed in seven sectors of five sedimentary basins, with a total area of 29,911.62 km^2. The Sixth Pre-Sal Distribution Round will include two new blocks: Southwest Sagittarius and North Brava. For Round 7, the Emerald, Agate and Aquamarine blocks will be recommended; and for Round 8, Tupinambá, Jade, Amethyst and Tourmaline. It was reported that the world's leading oil companies bought the four blocks offered at the auction of the 5th Pre-Sal Shared Production Round, held in Rio de Janeiro, in September 2018.

In Ecuador Petroamazonas EP, signed contracts that achieved a private investment of USD 1,622 million for the development of six fields in the provinces of Orellana, Napo and Sucumbíos. As part of the Oil & Gas 2018 process, the state oil company expects to obtain a private investment of USD 727 million for the Cuyabeno / Sansahuari fields; Bear, Yuralpa and Blanca / Vinita, located in the provinces of Orellana, Sucumbíos and Napo. The contracts were signed under the modality of Integrated Specific Services with contractor financing for the execution of drilling, reactivation and completion of wells, and construction and expansion of facilities required for oil fields. With this, an additional production of 77.29 Mbbl of oil is estimated for 10 years. The rates that Petroamazonas EP will pay contractors, for their services, will be established according to the international WTI crude oil marker, with an average rate of USD 18.41 considered for a WTI price of USD 60 per barrel. Additionally, Petroamazonas EP renegotiated the Integrated Specific Services contracts, signed in 2012, with the Shushufindi and Pardeliservices consortiums, which will allow an additional investment of USD 895 million for the development of the Shushufindi-Block 57 and Liberator-Block 58 fields, located in the province of Sucumbíos. Modifying contracts ensure rate reductions and transfer the risk of investments to the contractor, which for the provision of its services invoices based on a variable rate indexed to the crude WTI marker of USD 60. The agreements will allow an incremental production of 89 million barrels of oil, during the 15 years of validity, and it is expected to obtain about USD 1,800 million as additional income for the State, until 2032. Petroamazonas EP also reported the drilling of the Sacha-413D directional well located in Sacha, Block 60, Orellana province. These works are contemplated in an action plan developed by the state oil company that seeks to increase production in this Field, by at least 5,000 bbl / day, by drilling three new wells and five re-entry wells, with an approximate investment of USD 24.9 million. The Sacha field, considered one of the most important productive oil fields in the country, after Block 43-ITT, records a production of 67 kbbl / day of oil, with an operating cost until June 2018, of USD 3.8 per barrel. Its reserves are estimated at 350 Mbbl.

In March 2018 Grenada announced a significant discovery of gas and oil in its territorial waters. The drilling was done only in one well, and within the next 12 to 18 months, 3 more wells will be drilled and the samples analyzed. In April 2018, the National Gas Company of Trinidad and Tobago Limited announced the execution of a commercial agreement with Global Petroleum Group (GPG) that operated in Grenada. GPG was the oil and gas company that carried out exploration and evaluation activities off the south coast of Grenada, near the Patao / Dragon fields in Venezuela and the fields of the North Coast Marine Area (NCMA) in Trinidad in the middle of 2017. This agreement marks an important development in energy collaboration and cooperation between CARICOM countries and is an important pillar for the growth and strengthening of the region's economies. The relationship between the 2 companies is the result of the Energy Sector Development Framework Agreement signed between the Government of the Republic of Trinidad and Tobago (GORTT) and the Government of Grenada.

In Panama, within the framework of the Geophysical Survey Agreements signed in 2017 in the Multiclient modality, studies aimed at obtaining geophysical information on the country's oil potential began.

As a result of a tendering process, the Ministry of Energy of the Dominican Republic signed a consulting contract for the realization of an oil round for the promotion of hydrocarbon potential, in the modality of shared production prior to the auction of the blocks to grant exploration and exploitation rights. The blocks considered for the auction are Azua, Enriquillo, Bahía de Ocoa, San Pedro de Macorís, and Cibao Oriental, where there has been an emanation of a gas - presumably natural, specifically in the area of Villa Tapia. On the other hand, the Ministry of Energy and Mines presented the Hydrocarbon Exploration and Production Contract Model, based on the modality of shared production. The aforementioned document represents an essential step to tender or auction hydrocarbon blocks identified in the country. The model contract -which after being awarded and signed will have to be approved in the National Congress and promulgated by the Executive Power- contains the tax scheme that was already discussed with the Ministry of Finance and the General Directorate of Internal Taxes (DGII). It is a product resulting from the work carried out with the technical assistance and financial support of the Latin American Energy Organization (OLADE), with non-refundable Canadian cooperation funds.

In 2018, the Australian company BHP Billiton discovered offshore gas fields in Trinidad and Tobago. The exploration well where natural gas was found, Victoria-1, was drilled in June 2018 and is located about 200 km offshore from Mayaro. Additionally, in the same year, bpTT announced two new offshore natural gas projects that will allow access and production of low-pressure natural gas reserves from fields that are currently in operation.

2.2 Oil and derivatives

In 2018, proven oil reserves in Brazil reached 2,136 Mm^3, equivalent to 14 years of production, which means 102 million more compared to 2017. Oil production at sea accounts for 95.6% of total production. In 2018, oil production (with bituminous shale oil) decreased by 1.2% (minus 34,000 bbl / day) and natural gas production by 1.9% (plus 2.1 million m^3 per day). These levels of expansion, together with biodiesel, and the lower expansion of world energy demand, led to the first energy surplus in Brazil's history of 1.6% of the OIE. The volume of energy corresponding to 52.5% of oil surplus exceeded the sum of energy volumes corresponding to deficits in petroleum products (10.6%), natural gas (28.4%), coal (84.3%) and electricity (5.5 %).

In Colombia, oil production with an average of 883,239 barrels per day, in November 2018, grew 3.8% in relation to the same month of 2017, becoming the highest since June 2016. The increase is mainly due to the optimization of production in the Yarigui-Cantagallo, Tigana, Jacana, Akacias, Quifa, Castilla Norte, Chichimene SW, Acordionero fields and the reactivation of the Kona, Juglar and Jaspe fields. During the year, oil production stands at 862,924 barrels per day compared to 852,648, in the same period of 2017. Also, commercial gas production in November grew by 9.8% compared to the previous month, from 953 Mpc / day to 1,046 Mpc / day. The increase compared to November 2017 was 9.5% and was due to a higher demand for gas in Colombia, in the last month.

In Ecuador, crude oil from the Tambococha field was incorporated to the national production, with 2,700 barrels from the Tambococha 3 well, which is part of Block 43, formed by the fields: Ishpingo, Tambococha and Tiputini (ITT); located in the province of Orellana. The aforementioned field will add more than 35 kbbl to the national production. The average production of Block 43 ITT, as of February 2018, was 43,400 bbl / day. In July 2018, Block 43-ITT reached an oil production of 70 kbbl / day. This figure places the main Petroamazonas EP project, on fields such as Sacha, Shushufinfi and Auca. The Tiputini field has an oil daily production of 42,841 barrels, with 64 producing wells of which six are horizontal. Meanwhile, the Tambococha field reached a production of 27,165 bbl / day of oil, with 12 producing wells, of which six are horizontal. With the production achieved by Petroamazonas, national oil production exceeded 527 thousand barrels in July 2018. The Tortuga Field, of Block 61- Auca (province of Orellana), was incorporated into the national production with about 1,200 barrels per day. The oil production potential of the exploratory well is 1,200 bbl / day. Once the geological and reservoir analysis of three sands explored at different depths (Superior Soot, Napo T and Limestone M2) has been carried out, it is estimated that Tortuga has an OSI (Original Site Oil) of 10 million barrels. The drilling of the TTSA-001 well allowed the discovery of a new reservoir in the M2 Limestone, a calcareous body that presented 109 saturated feet of hydrocarbon.

Peru reported the Declaration of Commercial Discovery of the Brittany North reservoir of Lot 95, in the Loreto region, operated by the company PETROTAL PERU S.R.L. In such a scenario, the License Agreement for the Exploration and Exploitation of Hydrocarbons in Lot 95 passed to the operation phase since December 1, 2018. According to the Annual Book of Hydrocarbons Resources, as of December 31, 2017, for Lot 95, there are 39,759 Mbbl of oil as Contingent Resources.

2.3 Natural gas

A gas treatment plant in the vicinity of Añelo, Neuquén was inaugurated in Vaca Muerta, Argentina. This plant will allow the processing of unconventional gas produced in the Fortín de Piedra deposit of the Vaca Muerta formation. With an investment of more than USD 30 million, the plant has a treatment capacity of 6.5 Mm^3 / day of gas. The new facility will allow a production jump of 1.5 Mm^3 / day of gas to 6.5 million. In this way, the first phase of the Fortín de Piedra project, which foresees a total investment of USD 2,300 million until 2019, will be completed.

As part of the presentation of the Natural Gas Reserves Certification Report, with a cut-off as of December 31, 2017, Bolivia reported a historic increase in Proved Natural Gas Reserves amounting to 10.7 TCF's. The value of total proven reserves in the country is 10.7 TCF's, the most probable proved reserves is of 12.5 TCF's and the volume of proven, most probable, most possible remaining reserves is 14.7 TCF's. Certified and presented reserves guarantee the supply of the internal market, and export markets.

In 2018, proven reserves of natural gas in Brazil reached 368,911 Mm^3 equivalent to 9 years of production, which means 521 Mm^3 less than the amount of 2017. Natural gas production at sea represents 80.4% of total production.

El Salvador began the construction of its first natural gas plant, which will supply 30% of the electricity required by the country. The plant, which will be built on 20 blocks of land located in the port of Acajutla, Sonsonate, becomes the first of the so-called Northern Triangle of the Central American area (Guatemala-El Salvador-Honduras) and the second after another built in the canal from Panama. Initial work includes the dirt road, substitution of floors, access roads to the plant, construction of a perimeter wall, internal circulation areas and parking areas. A second component of the project involves the construction of the 45-kilometer transmission line that will connect Acajutla with Ahuachapán, from where the energy will be distributed throughout the country through the different electric power companies.

Panama announced the start of operations of the Fuel Free Zone of the company Costa Norte LNG Terminal, S. de R.L., terminal for the storage and regasification of natural gas.

In Peru, work began on the future Natural Gas Pressure Regulation Station that will take the service to thousands of Peruvians. Natural gas will arrive for the first time to 23,000 families in the district of Mi Peru and Ventanilla in early 2019. Likewise, with aiming to advancing progressively in the massification of natural gas, citizens were invited to participate in the financing program for vehicle conversions to natural gas with resources from the Social Energy Inclusion Fund (FISE). The program estimates initially to encourage the conversion of 15,000 vehicles per year in the regions of Lima, Callao, Ica, Lambayeque, Piura, Ancash, La Libertad, Junín, Cajamarca, Arequipa, Moquegua and Tacna. The signing of the agreement with the financial institution, which runs the program at its headquarters in Lima, Ica, Chiclayo, Trujillo and Piura, was reported in 2018.

The Ministry of Energy and Mines of the Dominican Republic issued the corresponding authorization for the start of the construction of a 45 km pipeline conceived by AES to take natural gas from its terminal in Andrés, Boca Chica, to San Pedro de Macorís. The aforementioned infrastructure will enable the conversion to natural gas of that 215 MW plant, which today operates with fuel oil, as well as the other plants for 900 MW that are in that demarcation. The pipeline must have sufficient capacity to eventually supply fuel to the rest of the Quisqueya park and the CESPM Combined Cycle units, thus adding a total generation capacity to natural gas of units benefiting from this conversion of more than 700 MW within the province of San Pedro de Macorís.

III ELECTRICITY

3.1 Generation, transmission, distribution and consumption

The Loma Campana Thermal Power Plant was inaugurated in Argentina, located in the area of the Vaca Muerta deposit in the province of Neuquén. This new thermal power plant demanded an investment of approximately 200 million dollars and is composed of two, last generation, GE LMS100PA + turbines, of 110 MW each.

In 2018, Barbados ranked as the third highest user of electric vehicles in the world in terms of electric vehicles per 1,000 people. The Ministry of Transportation, Works and Maintenance develops a hybrid / electric bus program that plays a fundamental role in the evolution of electromobility. The Government has bought more than eight electric vehicles, and encouraged an emerging electric vehicle sector that has generated more than 390 privately owned 100% electric vehicles.

In Brazil, in 2018, the indicator of households served with electric energy reached 99.74%, with 99.2% of the public network in full time, 0.25% of public network without integral time, and 0.3% of own generation systems (solar, wind and generators). The SIN expansion in 2018 was a total of 1,366 MW of installed generation capacity. As for the transmission, 536 km of transmission lines and connections to power plants in the basic network and 1,110 MVA of transformation in the basic network came into operation. The expansion of the system, until March 2018, was a total of 1,366 MW of installed generation capacity, 1,366 km of Basic Grid transmission lines and plant connections and 4,431 MVA of transformation in Basic Grid. The installed capacity of electricity generation reached 163,441 MW in 2018, with a net expansion of 3.7%, or 5,861 MW (expansion of 7,706 MW and demobilizations of 1,845 MW). The largest expansion was hydraulic, with 3,876 MW, with Belo Monte HPP having the largest participation in the indicator. The second corresponds to a wind source, with 2,107 MW of expansion, and the third to solar, with 1,199 MW of expansion. It should be noted that 95% of the total expansion was from renewable sources. The distributed micro and mini generation reached 691 MW in 2018, compared to 210 MW in 2017. At the end of 2018, the country already had more than 60 thousand installations, mostly photovoltaic solar. The installed capacity of the transmission lines was expanded by 3,970 km in 2018, reaching 145,500 km, with a voltage greater than or equal to 230 kV.

Within the framework of the National Electromobility Strategy, Chile reported, among others, the following advances made in 2018: presentation of the new fleet of six electric cars at the service of five State ministers and the Presidency of the Republic, the first electric truck of high tonnage of the country, arrival of 200 electric buses for the public transport system, incorporation of 15, 100% electric cars for the displacement of the officials of the Municipality of Vitacura, arrival in Santiago de Chile of the first fleet of electric taxis in the country, composed of 23 vehicles that are part of the 60 that will operate in the capital, announcement of 120 quotas for electric taxis in Valparaíso and Viña del Mar and in the province of San Antonio; inauguration of the first free charging point for electric cars in Osorno, the first of three free charging points for electric vehicles in the Santiago Metropolitan Park, the first charging point for electric cars in the English Quarter of Coquimbo, two charging stations in Viña del Mar, subscription of a public-private commitment with 38 companies and institutions to boost electromobility, launch of the EcoCarga application, which shows the online electrolineras available for Android in Play Store, and soon for IPhone in APP Store. On the other hand, "Energy Alert" was launched, a forest fire monitoring platform that detects threats to the electrical infrastructure. The Ancoa-Charrúa trunk transmission line, which is 200 kilometers long between 12 communes and three regions, was inaugurated in the Biobío Region, at a voltage level of 500kV. This project, which meant an investment of USD 175 million, strengthens the transmission capacity of the center-south of the country with 1,700 MVA. Additionally, the Smart Grid Energy Lab, the first Intelligent Electrical Networks Laboratory in the country, was inaugurated. It is a modern interconnected system that emulates the generation and storage of energy from different renewable sources.

The Ministry of Mines and Energy of Colombia officially convened the first long-term contracting electric power auction, which will be held on February 26, 2019 and seeks to diversify, complement and boost the competitiveness of the energy matrix, making it more resilient to climate variability, contributing to the reduction of carbon dioxide emissions and guaranteeing the country's energy security. This process will award 1,183,000 MWh per year, through long-term annual average energy contracts with a validity of 12 years. The start date of the obligations of the generation projects that are assigned will be December 1, 2021. On the other hand, the second Bolívar-Cartagena transmission line was inaugurated, which will benefit more than 2 million inhabitants of the department. The project goes through urban and rural areas of Cartagena, Turbaco and Santa Rosa de Lima and consists of the construction of a second 220 kV transmission line, from the Bolívar substation to the Cartagena substation, including the installation of a line module in each of the substations. The Bolívar-Cartagena line has a length of 20 km, of which four kilometers are underground. The Río Córdoba electrical project officially started operating in the municipality of Ciénaga, Magdalena, which will benefit a population of more than 3 million inhabitants in its area of influence. Río Córdoba included the construction of a 220kV substation, a transmission line of about 400 meters and transformers of 220 to 110 kV to connect the national network with the regional one.

With the aim of promoting the transition to zero-emission transport, in Costa Rica the ICE Group (Costa Rican Institute of Electricity) presented its fleet of 100 electric cars, which is expected to save up to 75% when passing fuel to electricity. In this context, it was announced the placement of 110 semi-fast loaders in ICE facilities located in Limón, Guápiles, Quepos, Puntarenas, Pérez Zeledón, Planta Garabito and Liberia. On the other hand, Correos de Costa Rica has launched a plan to replace its 348 combustion units with electric models in the next 5 years. From 2019, electric motorcycles will begin to be used for delivery of parcels nationwide. The plan called "Zero emission deliveries" will start with 18 electric motorcycles. Additionally, the National Consortium of Electrification Companies of Costa Rica RL (CONELECTRICAS R.L.), formed by the rural electrification cooperatives: COOPELESCA R.L., COOPESANTOS R.L., COOPEGUANACASTE R.L. and COOPEALFARORUIZ R.L. will begin using state-of-the-art electric meters consumption and management of electrical services remotely, for residential, industrial and commercial customers. From January 2019, the aforementioned cooperatives will begin the installation (at no cost to the user) of 249,300 smart meters that will gradually replace conventional or electromechanical ones in the regions where they are in charge of the electrical distribution. With this measure, associates will be able to know how much energy they consume in real time, at what time of day the greatest demand is given. The new meters are completely digital, contain electronic cards and communicate by PLC radio frequency, which gives them the ability to communicate remotely, process information, use it as its center and send it in real time to a central system. This connectivity allows more accurate and reliable consumption readings, energy theft detection, rapid system fault detection and permanent monitoring, among other advantages.

Ecuador inaugurated the Sacha Norte 2 power generation plant, using oil associated gas. The Central Sacha Norte 2, is the second plant that starts operation of a total of eight electricity generation infrastructures that produce energy from the residual gas from oil exploitation, using associated gas instead of diesel to produce up to 4 MW of power. Its operation allows fuel savings of about USD 5 million and reduces emissions by about 2,000 tons of CO_2 per year.

Guatemala's first electric bus started tests on the streets of the capital. If it enters circulation in the country's public transport, the vehicle would become the first of its kind in all of Central America. In this first phase, only seated passengers will be transferred. The ticket value would be Q2.50. The Costa Linda electricity substation was also inaugurated, which is part of the Energy Transportation Expansion Plan -PET- 2013-2019, which will allow the delivery of energy more efficiently to homes, businesses and industries of Escuintla. This project will benefit Escuintla customers with medium voltage feeders adapted to the coverage of that sector that allow a better load balance, decrease of energy losses of approximately 6,265 GWh per year, load segmentation, improvements in the quality of the supply of energy, operational safety, greater energy transformation capacity with loss reduction and efficient energy distribution.

In December 2018, the Minister of Foreign Affairs of Haiti made an official visit to Taiwan to sign a loan agreement of USD 150 million to be used for the restoration of the national electricity grid.

Panama announced the start of operations of the thermal plants, Barcaza Esperanza, Cobre Panamá and Costa Norte Gas Natural, with installed capacity of 92, 300, and 381 MW respectively.

Paraguay officially inaugurated the second work of the System in transmission in 500 kV, which links Yacyretá - Ayolas to the Villa Hayes Substation (YACAYO-VHA) aimed at increasing the levels of safety, reliability and optimization in the operation of the National Electric System. The Transmission Line, sectioned in the Ayolas Substation, has two sections, Yacyretá - Ayolas, with an approximate length of 17 km, and is a second interconnection with the Yacyretá Power Plant together with the existing one, both at 500 kV. With the interconnection of the second line (Yacyretá - Ayolas - Villa Hayes), the long-awaited interconnection operation between the ITAIPU and Yacyretá plants is completed, through the Chaqueña substation. These works will allow the use and transmission of all the energy generated in the Yacyretá Dam, with the aim of constituting an interconnection between the Itaipu and Yacyretá Hydroelectric Power Plants, in order to optimize the energy received from the binationals, in order to meet the demand. With the interconnection of both lines, in a single system, the highest levels of safety, reliability, operational flexibility and the realization of a true economic dispatch of loads will be achieved. On December 17, 2018, Itaipú Binacional generated 96,585,596 MWh (9.6 million MWh) of energy (50% corresponds to Paraguay), which represents its fourth best historical mark. The power supply by the ITAIPU hydroelectric power station accounted for about 80% of the total historical demand recorded by the Paraguayan National Interconnected System (SIN-PY) that same day, when a peak of 3,226 MW was recorded, which constitutes a new historical record. On the other hand, with a total investment of USD 8,365,000, the works of the new La Colmena Substation were completed in 66/23 KV and a 66 KV Transmission Line that will join the Paso Pe and La Colmena Substations, respectively, benefiting to several locations in the departments of Guaira and Paraguari. Additionally and in order to accompany the significant growth in demand for electricity supply in the department of Alto Paraná, especially in Ciudad del Este, through the signing of a Cooperation Agreement between the National Electricity Administration (ANDE) and the BINATIONAL ITAIPÚ Entity, the Microcentro Substation was inaugurated in 66/23 KV, of the sheltered type with output of 20 circuits of 23kV, totally underground and other complementary works for the reinforcement of the Eastern System.

The modern 220 kV electric transmission line Carhuaquero - Cajamarca - Cáclic and Moyobamba was inaugurated in Peru, which will benefit more than 200,000 families in the Cajamarca, Amazonas and San Martín regions. The work demanded an investment of more than USD 156 million and will strengthen the electrical connection in these regions at the same time that will allow generating more electrical capacity to meet future demand and boost its economic activities. It covers more than 370 km in 4 associated substations and its range of servitude crosses 3 regions, 6 provinces, 11 districts, 15 rural communities, 13 populated centers and more than 2,000 properties. With this new transmission line, the National Interconnected Electric System (SEIN) will be reinforced, improving the reliability and quality of the electrical system in Cajamarca, Amazonas and San Martín. It also includes a 220 kV stretch from Carhuaquero to Cajamarca Norte of approximately 98 kilometers, with a single circuit and 300 MVA capacity. It also includes the 220 MW sections, linking the Cajamarca Norte and Cáclic substations of approximately 161km, and the Cáclic-Moyobamba Nueva substations of approximately 142.5 km. The operations of the modern Santo Domingo de los Olleros combined cycle plant also started, built in Chilca (Cañete), with an investment of 180 million dollars. Thanks to the implementation of this important energy project, the power of the thermal power plant will go from 196 MW to 296 MW. With this expansion, the plant will generate up to 2,476.6 GWh / year, which represents approximately 4.5% of Peru's electricity demand. During the first half of 2018, the accumulated national electricity production in Peru reached 26,277 GWh, representing an increase of 3.2% over the same period of 2017. The technical report indicates that 63% was generated with water resources, 33% with natural gas and 4% with solar and wind energy. On the other hand, within the framework of the "E-motor 2018: Peru building the route to electromobility" fair, the Ministries of Energy and Mines, Environment and Transport and Communications, as well as the Protransporte and Global Sustainable Electricity Partnership institutions (GSEP); signed an agreement for two years to design the pilot project that will introduce an electric bus into the Public Transportation System in Lima. The electric bus will operate for 2 years under the responsibility of Protransporte. Once the first year of operation is finished, a replicability study will be prepared, which will be publicly accessible and part of the NAMA Energy Measurement, Reporting and Verification (MRV) system. After the second year, it is expected to generate information on the main technical components, in order to produce a thorough evaluation of the performance and maintenance needs of the bus.

In Uruguay, the first hybrid collective transport vehicle that will circulate around the city was officially presented. This bus marks a new instance in terms of sustainable development, being preceded only by the first electric bus and the taxi fleet launched during 2016. It is a hybrid bus (diesel - electric) that also has a low floor, with universal accessibility. The load is self-generated when the vehicle brakes or if it passes 20 km when the engine starts and can thus power the battery. It also has integral pneumatic suspension. The bus will be in operation in its different services to be tested in order to check the fuel economy that is estimated to reach between 25% and 30% savings. In this way, the unit will be working on the different transport lines of the company to be able to measure and evaluate its performance.

3.2 Universalization of energy

In May 2018, the system completion document was signed without connection to the La Gracia Smart network in Belize, proof of concept for the Ministry's rural electrification plans. The installation of the off-grid system was successfully completed in May of 2017 and a one-year pilot period was done to better understand the challenges of the system. The system has proven that a rural community can be served by a standalone smart renewable energy system. The Ministry plans to pattern its future micro grid based on this concept.

In Brazil, the Luz Para Todos Program celebrated 15 years of execution with 16 million Brazilians benefited. 3.4 million connections have been made in the country since the beginning of its implementation. In 2018 alone, more than 53,000 new home connections were made benefiting 212,000 people. During the execution of the Program, a large number of new families without electricity were identified, which led to the Program being extended until December 2022 to fully universalize access to energy at the national level.

Chile reported that in terms of access and improvement of the electricity supply for homes, contemplated in Axis 2 of the 2018-2022 Energy Route: "Energy with a Social Seal", during 2018, five rural electrification projects were inaugurated, both of network extensions and of isolated autogeneration systems.

As part of the Ilumina tu barrio program, Ecuador inaugurated public lighting works in several locations in the Sierra, Coast and Amazon, among which are: the delivery in the Cotopaxi province of integral electric power systems and public lighting for the Millennium Unit "Canchagua", a mobile power generation plant, the installation of public lighting equipment in the Ñampi and Agua Clara communities (belonging to the Chachi nationality). In the province of Esmeraldas, works in the South Guasmo of Guayaquil that benefit 600 families in the sector. Electrical works in the San Pablo, Ayangue and main roads of Capaes, Jambelí and Monteverde, in the province of Santa Elena that directly benefit 11,200 families in the sector with the installation of: 601 new luminaires, 333 reinforced concrete posts, 17 transformers and 7,050 meters of pre-assembled network, with an investment that exceeds 400 thousand dollars. Likewise, six electrification projects were inaugurated in the province of Esmeraldas for the Quinindé canton, which are part of the National Rural Electrification Plan that is carried out at the national level. In addition, the Loreto substation, located in the province of Orellana, was inaugurated, the operation of this substation benefits 13,000 inhabitants of the Loreto canton, and allows for a more optimal supply of the growing energy demand in the province of Orellana. The work, which involved an approximate investment of 11.7 million dollars, is considered a potential connection point between the state and private oil facilities, with the National Transmission System.

Nicaragua reached 95% of electricity coverage in August 2018, with the inauguration of four projects executed by the National Electric Transmission Company, ENATREL, in communities of San José de los Remates, Santa María de Pantasma and San Dionisio. By 2021, it is expected to reach 99% of electrical coverage.

In Peru, rural electrification works were inaugurated in the provinces of Padre Abad and Colonel Portillo that benefit more than 4,772 Peruvians. The work included the expansion of primary networks and home connections in a total of 1,193 homes. The development of this important project is part of the goal of the National Government to achieve by 2021, the anniversary of the Bicentennial of Independence, a 100% electrified Peru. Additionally, in the Neshuya district, the official delivery of the expansion and improvement works of the integral electrification system was carried out for the Populated Centers: Monte Alegre Neshuya, Alexander Von Humboldt and San Alejandro of the province of Padre Abad; as well as the Old Sector of Nueva Requena, province of Coronel Portillo. The execution of these works directly benefits 8,200 Peruvians. Also, within the framework of the electrified Peru Plan, photovoltaic electrification works were inaugurated in more than 80 communities in the Loreto region, providing for the first time the service of electrical energy to more than 4,000 families settled in hard-to-reach areas of the Amazon. Likewise, the electric power service that benefits more than 2,700 inhabitants of the towns of San Lorenzo, Alert, La Novia, Shiringayoc, La Merced, La Abeja, San Pedro and Santa María was inaugurated, belonging to the province of Tahuamanu, in Mother of God. Together, the work that benefits 107 towns in Cajamarca, one of the most productive regions of the country, was inaugurated. The project includes a laying of more than 155 km of primary line with concrete and wood posts, home connections, installation of energy meters, connection and support materials and accessories. On the other hand, it was reported that the school No. 60300 located in the town of Miraflores, district of Mazán, Loreto, became the first school in the Amazon to have a solar panel system that will allow it to supply electricity and this will enhance the educational development of its students.

3.3 Hydroelectricity

In Bolivia, on January 17, 2018, the commercial operations of the San José 1 Hydroelectric Power Plant, located in the department of Cochabamba in the Municipalities of Colomi and Villa Tunari, began. The Plant, located downstream of the Santa Isabel Hydroelectric Power Plant, has an installed capacity of 55 MW to generate 300 GWh / year and constitutes the first completed component of the San José waterfall hydroelectric power generation project. It is the third plant to continue with the use of the Corani - Santa Isabel waterfall, receiving the flows of the two hydroelectric plants of the same name, taking advantage of the flows of the Málaga, Santa Isabel and five tributaries of the right bank of the Paracti river. It has a fall of 370 m and has a time regulation reservoir called Aguas Claras, with an elevation of 1,728 masl, an approximate driving of 5,640 m in total length (tunnel, vertical well, forced pipe, sections and fork), leaving the axis of the turbine at the height 1,415 masl.

In Brazil, as a result of the low rainfall regime that affects the country since 2011, the hydraulic generation capacity factor reached about 42% in 2018, lower when compared with the historical measure of 55% indicator.

Chile inaugurated "La Mina", a run-of-river plant in San Clemente with the capacity to supply 86,000 people with an annual production of 191 GWh. The project meant an investment of USD 130 million and takes advantage of the hydraulic potential of the Maule River, restoring the waters to the natural channel in equal quantity and quality to which it was captured. The plant has an installed capacity of 34 MW, which represents 8% of the region's consumption. Its operation will prevent the emission of 100,000 tons of CO_2 annually.

IV ENERGY EFFICIENCY

Regarding Energy Efficiency, during 2018, Chile achieved significant progress through the implementation of the "Con Buena Energía" program, an initiative that involved raising awareness about the good use of energy for 680 families in the towns of Puerto Aysén, Lago Verde, Villa Amengual, Cochrane and Tortel, which also received a 9.5W LED bulb kit and door and window seals. For its part, the "Cambia el Foco" program, executed in the educational communities of the A-1 Polytechnic High School of Puerto Aysén, the Patagonia Agricultural High School, and the Argentine Republic High School, delivered a total of 4,000 LED bulbs, thus benefiting more than 1,000 families and allowing them to generate savings of up to 90.5% in their electricity consumption compared to the use of incandescent bulbs.

A program to reduce energy consumption was launched in Colombia by replacing 50,000 refrigerators in the Caribbean. The strategy will contribute to the protection of the environment with a decrease of 16,000 tons of CO_2 per year, equivalent to planting 32,000 trees. The "Construyendo País" workshop is part of the first phase of the program of this energy efficiency program that will be implemented in the departments of Atlántico, Magdalena, La Guajira, Bolívar, Córdoba, Sucre and Cesar. The Caribbean Region is the second with the highest consumption of electricity in Colombia, after the center of the country with about 24% of total consumption. While the increase in annual electricity consumption nationwide is on average 5%, in the Caribbean Region it is close to 9%.

During the first quarter of 2018, in El Salvador, under the Energía Mágica program, 13,500 children and 1,500 adults were trained on the efficient and safe use of electric energy, as well as the process of generation, transmission and distribution of electricity in the departments of Santa Ana, Usulután, Chalatenango and Sonsonate. During 2018, the educational program will reach 300 schools and 150 communities where it will benefit 45,000 children and 5,000 adults respectively. "Energía Mágica" will be aligned with the Sustainable Development Goals established by the United Nations Organization, contributing to the creation of a culture of responsible and safe use of this vital service in the new generations. In more than a decade of existence, the program has reached more than 570 thousand people in 2,972 schools and 1,390 communities. Additionally, the fourth edition of the National Energy Efficiency Award was held, an award established four years ago with the objective of promoting savings in supply consumption and recognizing companies, and institutions that promote Energy Efficiency measures. The prize, in addition to recognizing the efforts of public and private initiatives in that field, provides support with financing at special rates, economic contributions, strengthening the capacities of the entities, advice and equipment for the execution of such projects.

On May 30, 2018, the Jamaica Petroleum Corporation (PCJ) officially launched the USD 40 million Energy Management and Efficiency Program (EMEP), funded by the Inter-American Development Bank (IDB), through which energy efficiency interventions, aimed at reducing public spending will be implemented, in 80 government facilities. The primary objectives of EMEP are to reduce electricity and fuel consumption by improving energy efficiency in the public sector through retrofits at government facilities and the improvement of urban traffic management in order to shorten travel times. Additionally, the program plans to strengthen the technical capabilities of the Ministry of Science, Energy and Technology (MSET) to improve energy planning. Additionally, in 2018, the major intervention, executed under the PCJ's Energy Efficiency and Conservation Programme (EECP), involved a complete overhaul of the JCDC's air conditioning (AC) system and an upgrade of its electrical infrastructure.

Paraguay implemented a pilot energy efficiency project in four public buildings distributed in various points of the Central Department. On the other hand, in December 2018, the Letter Agreement was signed. It formalizes the "Non-Refundable Technical Cooperation" aimed at supporting the development of appropriate institutional environments of policies and regulatory frameworks for Energy Efficiency, as part of the "Promoting loan operation Private Sector Investments in Energy Efficiency in the Industrial Sector in Paraguay" (PR-L1146).

In Peru, in compliance with the provisions of the technical regulation on Energy Efficiency Labeling, the mandatory labeling of nine domestic energy equipment (refrigerators, clothes washers, clothes dryers, water heaters (thermal), air conditioners, lightbulbs and ballasts for fluorescent) and industrial (electric motors and boilers) became effective. In unison, the National Institute for the Defense of Competition and the Protection of Intellectual Property, INDECOPI, initiated actions to control compliance with the Energy Efficiency Labeling in the selected teams, in order to verify that the label is attached to the equipment mentioned above, correctly and visibly to the consumer. Additionally, in 2018, 54 events were held in different economic sectors, impacting 9,126 people on issues related to ISO 50001, Energy Efficiency Labeling, Approval Cards; among others. Likewise, awareness campaigns were carried out for the formation of a culture of efficient use of energy in the education sector, delivery of free distribution material and 1,336 teachers were trained. On the other hand, the first Energy Efficiency laboratory for electric water heaters was inaugurated, located in the Faculty of Electrical and Electronic Engineering (FIIE) of the National University of Engineering (UNI), in Rímac. With the installation of this laboratory, the first steps are taken to ensure the necessary conditions for the implementation of the Energy Efficiency Labelling Regulation at the national level, since it will allow private companies and public institutions to measure and verify the energy efficiency of electric water heaters both imported and manufactured nationwide.

The Ministry of Energy and Mines of the Dominican Republic presented the Rational Energy Use Campaign to reduce government consumption by 10%. With the slogan "Ahorra, es tu futuro", it is sought to raise awareness among institutions and public servants, through the dissemination of interactive videos and energy saving tips, as well as conducting talks, workshops and conferences to educate about economic benefits and environmentally efficient energy use.

The third call for Energy Efficiency Certificates was held in Uruguay. The annual energy savings of the MMEE amount to 4.1 ktoe / year, equivalent to the average annual electricity consumption of 17,663 households. The total amount of investments of the measures presented amounts to UYU 332 million and the total amount of EEC to be delivered amounts to UYU 25 million.

V RENEWABLE SOURCES

With the aim of tendering 400 MW of new installed power for generating electricity from renewable sources, the RenovAr Program in Argentina launched its round, which had as its main feature the use of the capacities available in medium voltage networks of 13.2 kV, 33 kV and 66 kV, the maximum power allowed per project was 10 MW, while the minimum of 0.5 MW. The distribution by technology was 350 MW for wind and photovoltaic solar, which competed together with quotas for regions and provinces; while 10 MW were available for Small Hydropower, 25 MW for biomass, 10 MW for biogas, and 5 MW for Biogas for Landfill, without region. It had a maximum quota of 20 MW per province, except for Buenos Aires where it was 60 MW. In this Round, extensions of existing plants were not allowed. The expansion works of the Rawson Wind Farm were also inaugurated in the province of Chubut. The expansion of the plant, with 12 new wind turbines, will increase its power to 101.4 MW to produce up to 410 thousand MWh per year, which is equivalent to the energy consumption of 137 thousand homes, preventing the release of 246 thousand tons of carbon dioxide per year. The Park, which required a private investment of almost 40 million dollars, is the largest in the country and is located on a 2,050-hectare site at kilometer 158 of Provincial Route No. 1. Likewise, the Mario Cebreiro Engineer Wind Farm was inaugurated, in the Buenos Aires municipality of Bahía Blanca, which, with 29 wind turbines, will provide 100 MW of renewable energy to the national system (an equivalent to the electricity requirement of 200,000 homes). Located in the town of Corti, next to Provincial Route 51 and about 20 kilometers from the city of Bahía Blanca, it is the first wind farm part of the RenovAr program. Additionally, the La Castellana Wind Farm was inaugurated, located in the Buenos Aires province of Villarino, which will provide 99 MW of renewable energy to the national system, equivalent to the electrical requirement of more than 115 thousand homes. The park has 32 wind turbines of 3.15 MW of unit power, and will reduce the emission of 375,000 tons of carbon dioxide (CO_2) per year. Likewise, the Caldenes del Oeste and La Cumbre Solar Parks were inaugurated, both located in the province of San Luis, which will provide 46.75 MW of renewable energy to the national system, equivalent to the electrical requirement of more than 30 thousand homes. Caldenes del Oeste has an installed capacity of 24.75 MW, and will provide electricity to power 17,000 homes. The project has installed 92,394 panels of an individual power of 325 Wp and involved an investment of 35 million dollars. For its part, La Cumbre, with an investment of $ 28,600,000, has 22 MW of installed capacity and capacity to supply 13,575 homes. In that place, 54,720 panels of 340 Wp of power and 27,360 panels of 345 Wp of power are installed. In addition, the Las Lomitas Solar Park was inaugurated in the province of San Juan. The infrastructure, which has 13.97 components of the national industry required an investment of USD 2,120,000, has an installed capacity of 1.7 MW and provides electricity to more than 1,000 homes.

Bolivia announced its entry into the era of green fuels since the entry into force of the Plant Additives Law, also known as the Ethanol Law. The aforementioned legal instrument will allow the gradual substitution of the import of inputs and additives for gasoline and diesel, the decrease of import costs and the reduction of subsidies. This new policy will allow the reduction of the import subsidy for an amount of more than USD 20 million in the first year, generating an accumulated savings of about USD 450 million until the year 2025. On the other hand, on November 12, 2018, the operations of the El Remanso Solar Hybrid Plant began in the Municipality of Baures, department of Beni. The referred project allows improving the quality of energy supply 24 hours a day, to the inhabitants of this community, promoting the generation of clean energy. The Plant bases its generation on photovoltaic solar energy, inverter technology, control interface and operation diagnostics. This design allows reliable operation over a minimum time horizon of 20 years. The final value to be delivered to the Electric System Operator is intended to meet the energy needs of its final consumers through a combination of efficient technology, responsible consumption and environmentally friendly generation, displacing thermal generation and CO_2 emissions.

Brazil reported that in 2018 renewable energy accounted for 45.3% of its Internal Energy Supply (OIE) matrix, a figure that shows considerable advantages in relation to the global indicator of 14.5%. Likewise, the internal electricity supply matrix (OIEE), with an amount of 636.4 TWh and with 83.3% of renewable energy, showed in 2018 a much higher indicator than the world-wide one of 26.0%. In the OIEE 2018 matrix, the 7.6% participation in wind generation stands out, compared to the 6.8% indicator in 2017 (an increase of 14.4% in the 2018 generation). Solar energy, although on a scale not yet representative, emerged with great expansion potential. In 2018, 3,461 GWh were generated, against 832 GWh in 2017 and 85 GWh in 2016. In liquid biofuels, biodiesel production was 5.35 Mm^3 in 2018, 24.7% more than in 2017, and ethanol production was 33.2 Mm^3, 19.9% more. The share of biofuels in transport energy consumption was 23.1%, when the global indicator is close to 3%. In relation to fuels derived from renewable raw materials in the last eight months of 2018, biodiesel production increased by 26% and automotive ethanol consumption increased by 14%. Brazil leads the second place as the largest producer of ethanol, until September 2018, about 164 million barrels were produced, especially in the states of São Paulo, Goiás and Minas Gerais. Rio Grande do Sul, Mato Grosso and Goiás lead the ranking of biodiesel production in the country, which produced 25 million barrels in the first nine months of 2018. In March 2018, biodiesel production reached 452 million liters, the highest volume in the last ten years.

In Chile, the following projects were inaugurated in 2018, among others, the following projects: Solar Roof in the Regional Hospital of Talca, with 604 photovoltaic modules and a power of 160 kW to generate 249,180 kWh per year, and avoid the emission of almost 98 tons of CO_2 per year; Public Solar Roof of 70 kWp of power in the Higher Industrial Lyceum of Talca, which will provide an estimated own energy generation of 106,330 kWh / year, equivalent to 142% of the establishment's self-consumption; Solar Roof of the Regional Hospital of Concepción Dr. Guillermo Grant Benavente, with 400 solar panels and a power of 100 kW; Public Solar Roof in the Municipality of Salamanca with 80 photovoltaic panels for a total of 20 kW capacity; Solar Roof of the O'Higgins Regional Hospital, which with 280 kW and a generation of 447 MWh / year constitutes the largest photovoltaic project installed by the Public Solar Roofs Program; 20 sheltered homes of Iquique Solar Thermal Systems that allow their residents to have sanitary hot water at zero cost; Public Solar Roof, in the Ministry of Social Development, which constitutes the first of its kind elaborated with the ESCO model, financing formula that avoids any type of expenses on the part of the entity, since the company designs, finances, installs, operates and it maintains the project for a period of 15 years and the institution buys all the energy generated by the solar panels at a lower rate; in this case, 14.1%. This system has 80 kW and is estimated to generate 119,500 KWh / year, at a rate of 75 USD / kWh, avoiding the emission of more than 41 tons of CO_2 per year; the Ernesto Torres Galdames Hospital in Iquique became one of the places that houses the largest solar plant in the region with 200 kWp. Additionally, the following solar energy projects were inaugurated: Tama te Ra'a, the first photovoltaic generation plant on Easter Island, with 400 solar panels for a total of 100 kW, which replaces 8% of diesel consumption of the current generation of the island; photovoltaic panels in 13 homes in Los Lagos that did not have electricity supply; in Valparaíso the first social condominium in height that incorporates solar thermal systems, Francisco I; first photovoltaic system in a high school in Valparaíso, with a capacity of 70 kW, which corresponds to 58% of the consumption of the educational establishment; the El Pelícano Solar Project, in the Commune of la Higuera, in the Coquimbo Region, which has 100 MW of installed capacity; the Santiago Solar Photovoltaic Park, the largest in the Metropolitan Region, with an investment of USD 146 million, has an installed capacity of 115 MW from approximately 400,000 photovoltaic modules, for an annual generation of up to 210 GWh. Likewise, a modern Photovoltaic Training Courtyard was opened in the Pablo Neruda High School premises, created with the objective of training qualified technicians in the installation, assembly and maintenance of this type of power generation systems. On the other hand, the first power generation plant based on biomass gasification in Chile was inaugurated, which produces, from forest and wood waste (biomass) the gas used to generate electrical and thermal energy in a cogenerator. The plant generates 30kW of electricity, used in commercial and industrial applications, as well as injection of the remnant to the Edelaysén network, generating 60kW thermal for heating. Also, with an investment of USD 140 million, the Punta Sierra wind farm in Ovalle was inaugurated, which will supply energy equivalent to 157 thousand homes, with an installed capacity of 82 MW and 32 turbines that will generate 282 GWh / year, offsetting 100 thousand tons of CO_2 per year.

Costa Rica closed the year 2018 with a 98.6% electricity generation produced with renewable sources. The data provided indicates that the country accumulated 312 days in which it generated 100% renewable energy. The last time Costa Rica used fuels to generate electricity was May 17, 2018. The highest production of clean energy came from water with 73.48%, followed by wind with 15.84% and geothermal energy with 8.52%. To a lesser extent was biomass with 0.67% and solar with 0.09%. In this context, the start of operations of the photovoltaic solar energy project, implemented at the Costa Rican North American Cultural Center (CCCN), in North Sabana, was announced. The 108 solar panel plant has an installed capacity of 35 kWp, which represents a 90% saving of the energy consumed at the headquarters, generating significant energy savings in its electricity grid and avoiding annual emissions of 36 tons of CO_2.

The Ecuadorian government carried out the technical tests of the Isabela hybrid project in the Galapagos Islands, a new energy system that takes advantage of solar irradiation and the use of biofuels for the generation of 100% renewable electricity. On September 1, during a period of 3 hours the continuous service was delivered to more than 2,500 inhabitants who used 1.7 MWh of electricity coming exclusively from the sun. The infrastructure has a construction cost of 14 million dollars covered by non-refundable financing agreements signed with the Government of Germany through the German Development Bank (KFW). The components that stand out in the hybrid system are: installation of a 0.92 MWp photovoltaic system, a new dual thermal infrastructure that uses biofuel, which replaces existing diesel generator sets, with dual 1,650 kW generators and an electrical substation. The hybrid system will have an installed capacity of 2.54 MW and will generate around 5.3 GWh per year, which will prevent the emission of 1,400 tons per year of CO_2, contributing to the "Zero Fossil Fuels for Galapagos" initiative, which seeks to eradicate the use of Petroleum-derived fuels on the islands. On the other hand, within the framework of the Rural Electrification Program promoted by the government, photovoltaic panels were installed that allow electricity to be brought to the communities of the provinces of Loja, Zamora Chinchipe and the Gualaquiza canton of Morona Santiago. This system implies the installation of a system per home; being able to use certain appliances. The investment for each photovoltaic system installed in a house is 4 thousand dollars and, so far, 169 panels have been installed.

El Salvador inaugurated at the Monseñor Óscar Arnulfo Romero International Airport, a solar energy system with more than 1,900 panels distributed in an area of more than 5,000 square meters on the roof of the airport parking lot. Each panel has a generation capacity of 275 W, with a general power of 531 Wp. On the other hand, in February 2018, the repowering of the Biomasa Jiboa plant (34.9 MW), with a final nominal capacity of 44.9 MW, entered into commercial operation in El Salvador's wholesale market. The photovoltaic solar plants, Pasaquina, Conchagua and El Carmen, also entered into commercial operation, with an installed capacity of 10 MW each. These 3 plants are part of the Bósforo project that, at the end of 2019, expects to end the construction of 10 plants with a capacity of 10 MW each, totaling 100 MW of solar energy. Additionally, the construction of a Biodigestor Pilot Project was reported in an agricultural educational institute located in the municipality of Chalatenango, where manure from cows, pigs, rabbits, chickens will be used for the production of biogas as a substitute for Liquefied Petroleum Gas (LPG). Additionally, the first plant of the Bósforo project was inaugurated in Pasaquina, department of La Unión, El Salvador, initiated in 2017 to generate 100 MW of energy with a photovoltaic solar source, which foresees with a total investment of USD 160 million, to build 10 plants that will be operating in full in the last quarter of 2019. Bosphorus is designed to help avoid emissions of more than 175 thousand metric tons of CO_2 per year. The plant has the capacity to supply the energy resource to approximately 33,000 homes connected to the distribution network of the Empresa Eléctrica de Oriente (EEO). Pasaquina, required an investment of USD 16 million and will produce 10 MW of energy power that will serve EEO customers in the eastern area. At the end of the first phase it is expected to generate enough energy to illuminate approximately 100,000 rural homes, and also prevent 52,000 tons of carbon dioxide from being released into the atmosphere.

The Grenada Photovoltaic Solar Demonstration Project received a USD 600,000 grant from the World Bank for the installation of a photovoltaic (PV) solar demonstration system, with a capacity of 200 kW. The aforementioned project also has a capacity development component in photovoltaic solar energy, for public servants, private sector professionals and students. On the other hand, the Solar Photovoltaic (PV) / Hybrid Battery Project was selected for grants from the Caribbean Renewable Fund (CREF), by the United Arab Emirates (UAE). This project will be established on Carriacou Island, in the Crown lands, in Limlair. The Energy Division advances the necessary procedures for the subscription of the corresponding financing agreement. It was also reported that St. Rose Modern Secondary School: The Caribbean Community Climate Change Center (5CS), has secured funds for the installation of a photovoltaic solar system, a biogas digester and a rainwater collection system for modern St. Rose. This school is a designated hurricane shelter, so it requires being equipped with such systems to improve its capacity and provide energy and water to the shelter during and after a disaster. On the other hand, and based on the technical assistance provided from 2014 by the governments of Japan and New Zealand for preliminary surface-based investigations of the geothermal energy potential of Grenada, progress was made in the implementation of a comprehensive geophysical research program that indicated the presence of a high temperature source (200-290 degrees Celsius) in the north of the island, enough to support a 15 MW geothermal power plant. To this end, an exploratory drilling campaign of two deep wells was developed to confirm the presence of a viable geothermal source, and with financial assistance from the Caribbean Development Bank, a Geothermal Project Management Unit was established to follow the national plan for geothermal energy development. At the end of 2018, the following activities were completed: hiring of the project coordinator, preparation of the geothermal drilling plan, completion of detailed viability of the site, start of the socio-environmental impact assessment process, evaluation of the entities invited to submit offers, choice of Community liaison officer and dialogue between stakeholders.

Guatemala announced the start of commercial operations of the following projects: wind power plant, Las Cumbres, in Jutiapa with 15 wind turbines and a power of 31.5 MW; Oxec II, Choliva and Hidrosan I hydroelectric plants with a power of 60.00 MW, 0.74 MW and 2.00 MW respectively; and the Hidroxocobil mini hydroelectric plant with 1.40 MW, which implies an addition to the nominal installed capacity of 95.64 MW, based on renewable resources.

Honduras inaugurated its first Geoplatanares geothermal plant located in the Platanares community of La Unión municipality, Copan department. With an investment of 127.29 million dollars, the plant will generate 35 MW to meet the demand for this fuel throughout the western region of the country. Additionally, the first regional laboratory for renewable energy studies was inaugurated in Siguatepeque, Comayagua, Honduras. The project in the hands of the University of Forestry Sciences (UNACIFOR) and with financing administered by the Central American Bank for Economic Integration (CABEI), will contribute to the sustainable development of the country with the conditioning, equipment and organization of seven laboratories, consolidating research capabilities. This laboratory will allow the specialization of energy and the strengthening of the new career of "Engineering in Sustainable Renewable Energies". Students, specialists and teaching staff will benefit directly, as well as families that use biomass material for heat generation, industrial companies with forest plantations certified by the Institute of Forest Conservation of Honduras. This project is part of the Social Development and Environmental Sustainability axes of the 2015-2019 CABEI Institutional Strategy, aimed at improving the quality of life of Central Americans.

The Villanueva Solar Plant in Coahuila was inaugurated in Mexico. With an investment of 650 million dollars, it is considered the largest photovoltaic plant in the Americas, it has an area of 2,400 hectares of construction, in which more than 2.3 million panels were installed, it has a capacity of 754 MW for a annual production of 1,700 GWh.

Geothermal energy reached a historical figure in Nicaragua with the San Jacinto-Tizate plant that achieved a significant rebound after the opening of new geothermal wells. More than USD 17.7 million in revenue was generated during the first six months of this year, representing an 11% growth over the amount recorded in the same period of 2017.

Panama announced the start of operations of the Ikako solar park that, with an investment of USD 48 million, will contribute 84.58 GWh to the country's energy matrix, energy that could cover the annual demand of 30 thousand homes. Additionally, the start of commercial operations of the Bejuco Solar and Estrella solar photovoltaic plants with 960 kW and 5,000 kW respectively were reported. Additionally, the beginning of the design and construction of the first solar vehicle in Panama that uses hybrid electric and solar energy technology for its operation was reported. The innovative vehicle, called Solar Uno, is a school project that seeks to make the general community aware of the importance of using renewable energy.

Paraguay formed the Inter-Institutional Working Table under Decree No. 4056/15 by which the Vice Ministry of Mines and Energy is authorized to establish Certification, Control and Promotion regimes for the use of Bioenergies that guarantee the sustainability of these resources. The aforementioned Working Table set out as a priority objective the elaboration of a regulation proposal that achieved the consensus of all the participating institutions and the different actors of the sector. The technical team responsible for the execution of the "Poverty, reforestation, energy and climate change (PROEZA)" Project, which has resources from the Green Climate Fund and aims to improve the resilience of 17,100 households highly vulnerable to impacts, was also formed of climate change (CC) in 66 municipalities located in 8 departments of the eastern region of Paraguay. The aforementioned project consists of three fundamental components: Monetary transfers conditional on reforestation for rural families in situations of poverty and extreme poverty; sustainable landscapes and responsible markets and Governance and law enforcement; and provision of technical assistance and institutional strengthening for the forestry, land, environmental and energy sector in support of the sustainable development of bioenergy.

The Rubí Photovoltaic Solar Power Plant was inaugurated, considered the largest in Peru with more than half a million photovoltaic panels that will produce 144.48 MW of effective power. The plant is located in the Moquegua district, Mariscal Nieto province, in the Moquegua region. With an investment of more than 165 million dollars, with the commencement of its commercial operations will exceed 240.8 MW which will strengthen the generation of energy in the south of the country. The modern Intipampa solar plant, which integrated into the National Interconnected Electric System (SEIN), will also provide electricity to thousands of homes in the south of the country. Its generation capacity of 40 MW is produced by 138,120 photovoltaic panels over an area of 322 hectares, located in Pampa Lagunas, Moquegua region. With an investment of more than USD 52.3 million, the plant will provide 108.40 GWh per year, which is equivalent to providing electricity to more than 90,000 homes in the south of the country. Intipampa will prevent the emission of 51,000 tons of CO_2 per year. In addition, the Wayra wind farm was inaugurated in Ica, considered the largest in the country, with an energy generation capacity equivalent to the consumption of 482,000 families. With an investment of USD 165 million, and an installed capacity of 132 MW, Wayra I will produce 605 GWh. The park has 42 wind turbines that will produce energy that will be supplied by Enel to the National Interconnected Electric System (SEIN). Wayra I, avoiding annually the emission of approximately 285,000 tons of carbon dioxide. Additionally, several photovoltaic systems (solar panels) were inaugurated in the Uros Island, in the middle of Lake Titicaca, in Puno, through which hundreds of inhabitants of this area far from the country can have electricity. In this context, the Ministry of Energy and Mines (MEM) of Peru installed a photovoltaic (solar) panel at its headquarters, which supplies electric power to different work areas of the Directorate General for Energy Efficiency (DGEE). The pilot project is replicated in seven universities in Lima and the interior of the country. On the other hand, the clean kitchens pilot plan was implemented that promotes the use of solar cookers and biomass cookers with fans, in 200 families in rural areas of 12 regions of the country. The pilot has the goal of generating information that can complement the current clean cooking programs of the State to close the access gap to clean fuels. This initiative is part of the Project "Appropriate National Mitigation Actions (NAMA) in the sectors of energy generation and its final use in Peru" which is implemented by the Ministry of Energy and Mines and the United Nations Development Program (UNDP), and financed by the Global Environment Facility (GEF).

In the Dominican Republic, the Montecristi Solar Photovoltaic Park started operations, with a capacity of 57.96 MW and 214,656 modules. Considered the largest photovoltaic energy project in the Caribbean, it has the capacity to generate 103,000 MW per year to bring electricity to more than 50,000 homes. The Larimar II Wind Farm also started operations, located in the city of Enriquillo in the department of Barahona, which has a capacity of 48.3 MW. With this new plant consisting of 14 Vestas V-117 wind turbines, with a height of 150 meters, the country's wind capacity is increased to 30%. Additionally, the announcement that the concessions for renewable energy generation projects will be made through a bidding process was made, leaving grade-to-grade delivery of the power purchase agreements (PPA). For this purpose, it will be the power of the Dominican State to determine the type of technology, quantity and other specifications prior to the tendering of the concessions. In the case of companies that are already in the process of installation, a protocol will be developed that, transparent and in compliance with laws and regulations, will define the treatment that will be given to them in tendering for PPAs, taking into consideration the status of each of them. This protocol will also detail what is the applicable procedure for companies that have been operating without having the corresponding energy purchase contracts.

In 2018, two women led a solar energy project in the Tepu community, an isolated indigenous village in southeastern Suriname. With support from the Electric Services Department of the Ministry of Natural Resources, part of the multilateral partnership, made up of community members, the UNDP-Japan-Caribbean Climate Change Partnership, the Suriname Government, and the Amazon Conservation Team, this goal was made a reality. For the first time in history, Tepu has electricity 24 hours a day. This new system is projected to reduce green-house gas emissions by 25 tons a year, proving that Suriname is making significant strides towards the Sustainable Development Goal of Affordable and Clean Energy in the 2030 Agenda.

At the Carrasco Airport in Uruguay, the installation of a photovoltaic solar generation plant with a power of 0.5 MWp was inaugurated, which in addition to energy efficiency measures allowed it to reduce the carbon footprint, also obtaining the environmental management certification. This work is part of the Energy Efficiency

Project that the air terminal carries out and includes the replacement of Led luminaires and the installation of heat pumps and free cooling for thermal conditioning. In its first stage, the solar park occupies an area of one hectare at the entrance of the terminal and is made up of 1,540 photovoltaic panels distributed in seven rows from north to south. Its metal structure has state-of-the-art solar tracking technology, which allows the movement of the panels during the day and improves the capture of the sun's energy to traditional fixed panels by 30%. The project is aligned with the goals set by the terminal in terms of sustainability and with the world order issued by the International Civil Aviation Organization (ICAO) to work to mitigate the carbon footprint and prevent pollution by 2030, year in which it is estimated that the number of aircraft passengers in the world will double. The Renewable Energy Maintenance and Operation Training Center (CEMOFER) was also inaugurated. The MIEM initiative will start operating after an investment of USD 1.4 million and it is proposed to develop local capacities to cover the operation and maintenance of renewable energy activities. CEMOFER has the backing of UTEC as academic responsible. There is also technical support from UTE, which has been exchanged with the Uruguayan Renewable Energy Association.

VI ENERGY AND ENVIRONMENT

In Brazil, CO_2 emissions, generated by the use of energy, decreased 4.9% in 2018. Taking into account that the OIE had the lowest reduction, the ratio between emissions and energy was 1.42 tCO_2 / toe, an indicator 4.3% lower than 2017 of 1.47 tCO_2 / toe. In the OECD block of countries, the indicator is 2.2 tCO_2 / toe and in the world, 2.33 tCO_2 / toe, which gives Brazil significant advantages.

The European Union launched the Green Fund Initiative for the Central American Integration System (SICA) region aimed at advancing mitigation and adaptation to climate change, which will provide resources for 88.1 million euros to promote programs aimed at generating renewable energy and the adoption of energy efficiency measures in micro, small and medium enterprises, as well as the availability of funds for investments in local areas to improve resilience to climate change in vulnerable areas. The initiative will have two components: the first, the so-called Green MIPYMES Initiative II, focused on reducing carbon dioxide (CO_2) emissions in Central America by generating renewable energy and adopting energy efficiency measures in Micro, Small and Medium Companies (MSMEs) and the second one called Green Development Fund and will provide resources for investments in local areas in order to improve resilience to climate change in vulnerable areas, through landscape restoration and ecosystem development integrated.

In Chile, the Government and the generators announced the commitment not to initiate new developments of coal projects that do not have carbon capture and storage systems or other equivalent technologies. On the other hand, the "Giro Limpio" Program aimed at advancing in efficient and sustainable transport was presented. The aforementioned initiative will certify those transport companies and load generators that are concerned about their energy performance and the environment.

The government of Costa Rica announced a new and ambitious plan to "decarbonize" the country, and rid it of carbon dioxide emissions, by 2021, in commemoration of the second centenary of independence. Costa Rica argues that such a plan can be allowed because its energy policy is already very "green." In 2017 the country survived more than 300 days without consuming electricity that did not come from renewable sources. During the last two years it has managed to produce 98% and 99% of its energy thanks to the country's hydroelectric infrastructure. The physical peculiarities of its territory (mountainous, very humid) and an ancient environmental policy have made Costa Rica come a long way towards decarbonization. With the slogan "Incentives vs. Prohibition" the plan does not imply the restriction to the use of fossil fuels, for this purpose the elimination of all taxes associated with electric vehicles is foreseen. It will also promote the creation of an infrastructure of charging stations throughout the country, hoping that the development of more autonomous and cheaper batteries do the rest. The goal is for Costa Rica to lead the Paris agreement on climate change and be a "global decarbonization laboratory" before the United Nations climate negotiations in 2020 (COP 26).

The project "Towards a sustainable and efficient urban mobility system in Uruguay" was launched. The initiative has the task of promoting an effective transition towards an urban mobility system that is inclusive, adaptable, efficient and with low carbon emissions. The transition will begin in the metropolitan area of Montevideo and will then be replicated in other cities of Uruguay. The project consists of the following lines: Regulatory framework for a low carbon transport system, Demonstration of technological options in Montevideo, Cultural change, dissemination and replication. Through the execution of these components, the project seeks to achieve a substantial reduction in carbon dioxide (CO_2) emissions, which is in line with the national commitments made in the Paris Agreement to face climate change, with the Development Objectives Sustainable United Nations and with the National Climate Change Policy.

VII INTEGRATION, COOPERATION AND ENERGY COMPLEMENTATION

Within the framework of the Protocol for the Agreement on the export, import, commercialization and transportation of electricity and natural gas, Argentina began a new cycle of natural gas export to Chile, which represents a milestone of binational energy integration. The corresponding maximum volume is 1,300,000 m^3 per day of natural gas of 9,300 kcal / m^3 with a term until 06:00 a.m. on May 1, 2019; with interruptible condition in case of need to guarantee the supply of the internal market. The resources will be used for power generation at the Nehuenco de Colbún SA Complex, located in the Valparaíso Region. The daily 1.3 million m^3 of gas will arrive through the GasAndes Pipeline, that is 463 kilometers long, located between the town of La Mora, in the province of Mendoza, Argentina, and San Bernardo, Metropolitan Region, Chile.

The Government of Ecuador signed a Memorandum of Understanding with the Korean Institute of Development and Technology KIAT; for the construction of a photovoltaic system on the San Cristóbal island of the Galapagos archipelago, a work that will be executed under the figure of donation with an amount that exceeds 5 million dollars. The signing of this non-refundable cooperation document that will support the "Zero Fossil Fuels in the Galapagos Islands" initiative implies the construction of a 1 MW photovoltaic system with a battery storage system of 1.4 MWh of energy on the island, which will prevent the emission of 948 tCO_2 / year.

In the first 5 months of 2018, Guatemala increased the sale of energy to Mexico, through a better use of the electrical interconnection maintained by these two countries, in operation since 2010, in that sense the export of energy to that destination increased 548% compared to as what was traded throughout 2017. Last year, the sale of this fluid represented USD 1 million 280 thousand, while as of May 2018 amount to USD 7 million 21 thousand (as of October 2017, between 80 and 90 MW are exported to southern Mexico, this although the original plan was to import this supply).

The government of Germany signed an agreement with the Dominican Republic aimed at contributing to climate protection and sustainable development through a cooperation of 4 million 800 thousand euros executable until June 2022, for technical support to the Ministry of Energy and Mines in a project of transition to renewable energy called "Support for the energy transition and the implementation of climate objectives in the energy sector of the Dominican Republic". With the launch of the initiative, measures will be promoted to mitigate greenhouse gas emissions.

Trinidad and Tobago and Guyana signed a Memorandum of Understanding on Energy Cooperation in the city of Georgetown on September 19, 2018. The aforementioned instrument establishes the process by which the parties agree to work with each other in the development of their energy sectors with emphasis on the promotion of joint hydrocarbon projects. On the other hand, the National Gas Company (NGC) of Trinidad and Tobago and the National Hydrocarbons Company (ENH) of Mozambique signed a Technical Services Agreement (TSA) in the framework of the Memorandum of Understanding that both companies signed in 2017. Under the aforementioned Agreement, ENH hires NGC to offer and provide technical, commercial and legal services for the development of the natural gas sector in Mozambique. The TSA covers the advice of the commercial framework in the entire value chain of the extractive, transport (LNG and gas pipeline networks) and domestic sectors.

VIII EVENTS AND CONVENTIONS

In the city of Bariloche, Argentina, the G20 Leaders Summit was held, a forum that represents more than 77% of energy consumption and more than 80% of the renewable energy capacity globally. During the meetings of this international event, the main energy authorities discussed energy transitions, access and affordability, as well as the role of technological innovation. The main energy policy makers of the participating countries, emphasized the transition to more flexible, transparent and clean energy systems, as well as affordable access to energy.

The first International Gas, Petrochemical and Green Fuels Forum 2018 was held in Bolivia, an event that concluded with new challenges for the hydrocarbons subsector, opening the way to the preparation of technical conditions for the development of biodiesel, the export of electricity to countries neighbors on the basis of the generation of thermoelectric plants that are going to demand greater volumes of gas and the start-up of LNG export plants by sea. During the development of the Forum, the signing of different agreements reached between the State and oil companies interested in investing in Bolivia materialized.

The I Forum of the World Energy Council was held in Paraguay , in charge of the Paraguayan Committee. In the aforementioned event, topics related to hydrocarbons, electricity, bioenergy, prospective consumption and trends for the future were discussed. Within the framework of the Forum, the official launch of the Paraguayan Committee, created by Decree No. 7418, of July 4, 2017, was announced and a presentation on the National Energy Policy was made.

The First Seminar on the Potential of Biomass was held in the Dominican Republic. In the event called "Potential, Use and Harnessing of Biomass", the results of the project to evaluate the energy potential of biomass and the importance of its development for the national economy were presented. In this meeting, in addition to MEM, the Partners of the Americas Foundation, the Global Environment Facility (GEF), the United Nations Industrial Development Organization (UNIDO), the Fernando Arturo de Meriño Agroforestry University, the Industrial Bioelectricity project, the Dominican Forest Chamber, the United States Agency for International Development and the Economic Commission for Latin America and the Caribbean participated.

In November 2018, the twentieth Ministerial Meeting of Gas Exporting Countries was held in Trinidad and Tobago, an event that included a Gas Symposium organized by the Ministry of Energy of this nation.

The Polish city of Katowice was the scene of the 24th United Nations Climate Summit (COP24). The meeting started with the challenge of specifying rules that allow the 2015 Paris Agreement to be operational, but, above all, to achieve more ambitious climate commitments taking into account the proximity of the planned date for the agreement to enter into force. After two long weeks of discussions, an extra day of negotiations was required to agree on a text that clarifies the "small print" of the Paris Agreement and allows its implementation in the face of 2020. The summit was sealed with a minimum agreement that, at least, makes it possible to make the commitment reached in Paris operational. The final commitment includes a reference to the scientific report of the Intergovernmental Panel on Climate Change (IPCC) that claims the need to undertake "urgent and unprecedented changes" to limit the increase in the temperature of the planet to 1.5 degrees.

Origin of the indicators and sources of information used

For the calculation of the indicators and the presentation of the graphs of this Energy Outlook, there are three types of sources of information corresponding to the producers or compilers› work scale who report the statistics and indicators. Generally, each type of information source responds to different user needs, of different scale, and presents specific advantages and disadvantages for analytical purposes.

Global Sources

They consist on databases that come from international organizations on a global scale, whose characteristic is to offer a high coverage of countries, sometimes resorting to estimates and imputations of data for countries that lack of national official data. Another characteristic is the usual transverse homogenization of calculation and estimation methods, without considering the differences in the statistical generation capacity of countries and regions. The main sources of global information used to prepare this Energy Outlook were the World Bank›s database, the World Development Indicators[1]; the last update of the database was used, consulted on July ,10 2019, and the BP Statistical Review of World Energy 2019[2].

Regional Events

These are databases and statistical information from regional organizations that, just like OLADE, have a partial coverage of the countries of the Latin American and Caribbean region. In this case, the statistical processing used allows regional comparability based on the national data that these agencies compile from their Member Countries. The economic and demographic indicators were obtained for this Energy Outlook, form the database of the Commission for Latin America and the Caribbean (ECLAC, UN) called CEPALSTAT[3].

Needless to say, the energy information from the Latin America and the Caribbean countries contained in the Energy Outlook comes from sieLAC (http://sielac.olade.org/), the Energy Information System which manages and updates OLADE on the basis of information officially supplied by Member Countries. The energy statistics presented and plotted in this document come from the most recent update of the information requested to the OLADE›s Member Countries through the OLADE SIE Advisers in the countries, who act as a link between the energy authorities in each country and OLADE and provide official information. In this sense, it is important to note that for the realization of this document, OLADE acts as a user and it does not constitute the producer or primary source of the energy information sector. The energy authorities in each country ore the one who provide this information and have the necessary resources and knowledge to collect and process the data with which this Energy Outlook was made, based on previously agreed methodologies. Likewise, aware of the relevance of the information used could have some discrepancies with the national data sources, particularly in the first years recorded in the time series, we have invited the energy community of the Member Countries to send us their comments and suggestions about the information provided and the contents of the Energy Outlook to the email address: sielac@olade.org.

National sources

In most cases, it was used official information provided by the SIE Advisors of each country. When no information is available for the Energy Balances of a given country, estimates are made with partial information that is usually obtained from official institutions (Ministries, Secretariats and National Energy Directorates, Sector Regulatory Agencies, National Commissions of Energy, etc.) Data from these sources usually have a lower scope and are not always comparable with other data in the region and are therefore used to estimate trends, particularly in the last reference year (in this case, 2018).

Given the dynamic nature of the statistical information presented in this Energy Outlook, the series included may not coincide with subsequent queries to the used databases.

1. http://databank.worldbank.org/wdi
2. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf
3. http://estadisticas.cepal.org/cepalstat

Timeline of the analysis and base year

The Energy Outlook presents information about the evolution and trends of numerous statistics and indicators that combine energy, economic and social information. Attempts have been made to make the most of the visual space in each graph so that in some cases, additional information is presented on the right axis. The information is displayed in the form of graphs covering a period between 2000 and 2018. The economic information refers to the base year 2011 in the case of GDP of Purchasing Power Parity and base 2010 for GDP at constant prices.

Country coverage

The information presented covers the 27 Member Countries of OLADE, where available data so allow it. These are: The Republic of Argentina, Barbados, Belize, the Pluri-national State of Bolivia, the Federative Republic of Brazil, the Republic of Chile, the Republic of Colombia, the Republic of Costa Rica, the Republic of Cuba, the Republic of Ecuador, the Republic of el Salvador, Grenada, the Republic of Guatemala, the Co-operative Republic of Guyana, the Republic of Haiti, the Republic of Honduras, Jamaica, the United Mexican States, the Republic of Nicaragua, the Republic of Panama, the Republic of Paraguay, the Republic of Peru, the Dominican Republic, the Republic of Suriname, the Republic of Trinidad and Tobago, the Eastern Republic of Uruguay and the Bolivarian Republic of Venezuela. In order to make the presentation of the indicators as user-friendly as possible, the short name of each country was used and it is presented in alphabetical order.

Discrepancies and statistical reconciliation

It is possible that when comparing indicators presented in this Energy Outlook with those published in other documents, there may be statistical discrepancies due to differences in the applied units systems and their conversion factors, conceptual definitions and methodological options used. These differences may be subtle, such as differences in the years or countries included, or more complex ones, such as the use of approximate indicators (proxies) or estimates of different nature, different geographic coverage (regional, national, local), differences in the databases updating periods consulted or the use of different population denominators and / or GDP. This Energy Outlook has sought to reconcile statistical data, presenting as explicitly and comprehensively as possible the conceptual and methodological definitions used.

About the population denominators and GDP

For all per capita indicators used in the Energy Outlook, the same database was used from the Latin American and Caribbean Demographic Center (CELADE, Population Division, ECLAC, and UN).

In order for comparability between countries to capture as effectively as possible the real effects of economic activity and to isolate, as much as possible, the exchange rate effects, the GDP values used in the Energy Outlook correspond to the annual statistical series of accounts expressed in purchasing power parity (PPP) and published by the World Bank in the base year 2011. The current series published by ECLAC were considered to carry out the sectorial weights, in the case of energy intensities and CO_2.

Methodology and definition of indicators

Reserves

These are the total amounts available in the deposits of fossil and mineral sources at a given date, within the national territory, which are feasible to be exploited to the short medium or long term. They are classified into proven, probable or possible reserves. The proven reserves are those that are economically extractable from existing wells or reservoirs with the country's available infrastructure and technology at the time of evaluation. Included are schemes of improved production, with a high degree of certainty in reservoirs that have demonstrated favorable performance in the exploitation. They are measured by exploratory studies.

Natural gas reserves represent the amount of natural gas that is found in the subsoil of all the deposits, whether associated or not associated with oil, at a certain date. Associated gas reserves are estimated as percentages of oil reserves.

Energy Sources

Primary energy sources

Defined as energy sources in their natural state; i.e., they have not undergone any physical or chemical transformation through human intervention. They can be obtained from nature, either directly as in the case of hydro, solar and wood energy and other plant fuels, or after an extraction process such as petroleum, coal, geothermal energy, etc.

Crude oil

A complex mixture of hydrocarbons of different molecular weights with a fraction, generally small, of compounds containing sulfur and nitrogen. The composition of crude oil is variable and can be divided into three classes according to its distillation residues: paraffin, asphalt or a mixture of both. In its natural state, it is in the liquid phase and remains in this stage under standard temperature and pressure conditions, although the field it may be associated with gaseous hydrocarbons. This category includes associated gas liquids that condense in production facilities when they reach the surface (petroleum condensates) or other liquid hydrocarbons that are mixed with the commercial flow of crude oil. Crude oil is the main feedstock for refineries that produce petroleum products and derivatives.

Natural Gas

Mixtures of gaseous hydrocarbons formed in sedimentary rocks and in dry deposits or together with crude oil. It consists mainly of methane (86%), liquefied petroleum gases, nitrogen and carbon dioxide. Due to its high caloric power and the almost total absence of contaminants, it is used in the generation of electric power and in domestic consumption for caloric uses.

Natural gas production refers to the sum of the production of the natural gas fields both associated and not associated with oil, including offshore production within national waters. Shale gas and gas obtained from coal mines is also added to the production. For gas associated with oil, this measurement is performed after the separation of the extraction fluid that contains crude oil, natural gas liquids, natural gas, and water. For free or non-associated gas, the measurement is taken directly from the wellhead.

Coal

It is the sum of the productions of the coal mines of the country. Coal has very different calorific power before and after washing. To avoid inconsistencies, coal is considered as washed coal, that is, without impurities. This coal is known as: anthracite, bituminous coal, lignite, and peat, which are the main varieties and possess precise calorific powers of between 4000 and 8000 kcal/kg. The production of coal can come from three sources: underground mines, surface mines, and recovery. The quantities used for the production process and those delivered to other energy producers are included.

Biomass

Plant and animal organic matter used for energy purposes. Biomass can be used directly as fuel or processed into liquid and gaseous products. The most widely used sources include wood, agricultural crops, municipal organic waste and manure.

Firewood

Energy that is obtained directly from forest resources. It includes tree trunks and branches but excludes logging waste, which is designated 'plant waste' used for energy purposes.

Sugarcane products

Products that are used for energy purposes. These include bagasse, cane juice and molasses. The latter two are the main feedstocks for ethanol production.

Other biomass

Organic materials obtained from biological and industrial processes that produced by various sectors such as agriculture, livestock, timber, etc. Depending on the sector where it originates, waste can be classified as a) animal waste, b) vegetable waste, c) industrial or recovered waste, d) urban waste.

Secondary energy sources

Energy sources obtained by processing primary sources or other secondary sources are called secondary energy sources. The sources and forms of secondary energy included in the energy balance are classified according to the primary source from which they were obtained.

Electricity

Energy transmitted by moving electrons. It includes electric power generated from any primary or secondary, renewable or nonrenewable resource in different types of power plants.

Oil derivatives

These are the products processed in a refinery that use oil as raw material. Depending on the composition of crude oil and demand, refineries can produce different oil products. Most of the crude oil is used as raw material for energy, for example, gasoline. They also produce chemical substances, which can be used in chemical processes to produce plastic and/or other useful materials. Since oil contains 2% sulfur, large amounts of sulfur are also obtained. Hydrogen and coal in the form of petroleum coke can also be produced as oil derivatives.

The production of oil products is broken down into fuel oil, diesel oil, LPG, kerosene, jet fuel, gasoline, alcohol, and others (non-energy plus other secondary and all energy that are not recorded individually).

Other energy Other Sectors

It corresponds to the grouping of the following energy: coke, fuel oil, gas, non-energy and other secondary.

Other energy Transport Sector

It mainly corresponds to the grouping of the following energy: natural gas and fuel oil.

Biofuels

Fuel from organic matter or biomass. It includes primary energy sources such as wood, as well as derived fuels such as methanol, ethanol, and biogas, from primary elements after undergoing biological conversion processes, i.e., fermentation or anaerobic digestion.

Energy aggregates

Production

It is considered the internal production of all primary energy source, extracted, exploited or harvested, in the national territory, that is important for the country.

Imports

It is the amount of primary and secondary energy sources, originated outside the borders and entering the country to form part of the total energy supply.

Exports

It is the quantity of primary and secondary energy sources that leave the territorial limits of a country and, therefore, are not destined to the supply of the domestic demand. This concept excludes the quantity of fuels sold to foreign air and sea ships.

Total Energy Supply

It is the sum of the total amount of energy, of both primary and secondary sources and, to avoid double accounting, in the case of Production, only the production of primary sources that is available for internal use is considered, either for input to transformation, for self-consumption of the energy sector or for final consumption. Part of this item is also covered by the losses that occur in the different stages of the energy chain. The total domestic supply is calculated using the following formula:

$$TPS_t = PP_t + IM_t - EX_t + SC_t - NU_t$$

Where:

$$\begin{aligned} TPS_t &= \text{Total power supply in } t \\ PP_t &= \text{Production of primary sources in } t \\ IM_t &= \text{Imports of primary and secondary energy in } t \\ EX_t &= \text{Exports of primary and secondary energy in } t \\ SC_t &= \text{Stock changes in } t \\ NU_t &= \text{Not used energy in } t \end{aligned}$$

Total energy supply by source

It is the quantity of energy of each source, which is available for internal use, either for input to transformation, for self-consumption of the energy sector or for final consumption. Part of this item is also covered by the losses that occur in the different stages of the energy chain. The total domestic supply by source is calculated using the following formula:

$$TPS_t^i = PP_t^i + IM_t^i - EX_t^i + SC_t^i - NU_t^i$$

Where:

$$\begin{aligned} TPS_t^i &= \text{Total power supply in } t \text{ of source } i \\ PP_t^i &= \text{Primary and secondary production in } t \text{ of source } i \\ IM_t^i &= \text{Primary and secondary imports in } t \text{ of source } i \\ EX_t^i &= \text{Primary and secondary exports in } t \text{ of the source } i \\ SC_t^i &= \text{Stock changes of primary and secondary energy} \\ &\quad \text{in } t \text{ of source } i \\ NU_t^i &= \text{Not used energy in } t \text{ of source } i \end{aligned}$$

Installed Capacity

It is the nominal capacity of supply of a generation plant by each type of technology. In the Energy Outlook , it is presented in aggregate form. It is expressed in Megawatts (MW) or Gigawatts (GW).

Electricity Generation

It is defined as the production of electricity from local generators, including self-producers. It is expressed in Megawatts hour (MWh) or Gigawatts hour (GWh).

Electrification rate

It is the percentage of inhabitants that have electric service versus the total number of inhabitants. It is obtained by dividing the total population served by the total population of the country, expressing the value in percentage.

Population without access to electricity service

It is an estimate of the number of people who do not have access to electricity services. It is defined by the expression:

$$PWAE = \text{Total Population} \cdot (1 - \text{Electrification rate})$$

Final energy consumption

It refers to all the energy delivered to the consumption sectors (total final consumption, of all productive sectors, final consumption by sector) for its use as useful energy. Excluded from this concept are the sources used as inputs or raw materials to produce other energy products, as this corresponds to the «transformation» activity.

Primary energy consumption

It refers to the consumption of natural resources available directly or indirectly that do not undergo any chemical or physical modification for their energy use. The main sources considered by the energy balances of the countries of Latin America and the Caribbean are oil, natural gas, mineral coal, hydroelectricity, firewood and other by-products of firewood, biogas, geothermal, wind, nuclear, solar and other primary such as bagasse and agricultural or urban waste.

Macroeconomic aggregates and social indicators

Added Value

It is the macroeconomic magnitude that measures the added value generated by the set of producers of the economy of a country. Gross Value Added (GVA) is the Gross Value of Production (GVP) (i.e. the value of all goods and services produced in a country) minus the Intermediate Consumption (IC) (i.e. the value of the inputs used in the production of non-durable goods and services). The GVA in a given period at constant prices of a given base year is estimated by valuing the quantities produced in that period at the prices of the base year considered. For more technical details it is recommended to consult the National Accounts System (UN, 2008).

Gross domestic product at constant prices

The Gross Domestic Product (GDP) is the macroeconomic magnitude that expresses the monetary value of a country's final set of goods and services over a specific period of time. It is published quarterly or annually. Annual values are used in this Energy Outlook. The sum of the Gross Aggregate Values (GVA) of all the economic sectors plus the net taxes of subsidies on the products, make up the Gross Domestic Product (GDP) of a country. Since national accounts are calculated in local currency, for international comparisons, GDP values are converted into dollars or expressed in Purchasing Power Parity (PPP). GDP can be expressed at current or constant prices. In the first case, the value is expressed at current market prices in the year of its calculation. For the GDP indicator to express the evolution of levels of economic activity in real terms, the distortion of price changes is eliminated and prices of a base year are taken as a reference. In this case, GDP is expressed at constant prices. To this end, GDP is accounted for by reference to a basket of prices (deflator) that refers to the base year considered.

GDP expressed in PPP constant dollars is an indicator that transforms the nominal value of local GDP to a valorization that is performed in relation to a weighted standardized price basket and that takes the United States of America as a reference for comparisons. The valorization of GDP and other macroeconomic aggregates to PPP, allows decoupling the results of the variations that may exist in the exchange rate between the local currency and the dollar from year to year. By eliminating the monetary illusion linked to the value of the dollar in each country and reflecting the purchasing power that this currency has in each of them, this valorization methodology, when used to compare the performance of the countries, reflects more accurately the real activity in the consumption and production of goods and services and therefore, of the final demand of the economy.

Private consumption

Household consumption expenditure, commonly referred to as private consumption, is the effective and imputed expenditure of households plus social in-kind transfers from non-profit institutions that serve the households.

Human Development Index (HDI)

It is a compound indicator, defined by the UNDP (United Nations Development Programme) that represents a measure of the progress achieved by a country in three basic dimensions of human development: (i) long and healthy life, (ii) access to education and (iii) decent standard of living, and it is estimated as a geometric mean, at equal weights, of the normalized indices of each of the three dimensions mentioned above. The variables used for each dimension are as follows:

(i) Life Expectancy Index: life expectancy at birth is used.

(ii) Education Index: It is a compound indicator that includes the adult literacy rate and the combined gross ratio of enrollment in primary, secondary and higher education, as well as the years of mandatory education.

(iii) Standard of living: Composed of GDP adjusted to purchasing power parity dollars per capita.

For the construction of the aggregate index, for each dimension, the results are normalized by taking the minimum and maximum values, so that values between 0 and 1 are obtained, in order to finally calculate the geometric average of the indices of the 3 dimensions to the same weight.

Energy Indicators

Energy intensity

It is an economic-energy indicator that allows aggregate quantification of the link between energy consumption and the production capacity of the economy. In general, it is calculated as the ratio between Energy Consumption and Gross Domestic Product (GDP). It allows a rough estimate for the level of efficiency in the use of the energy resources of the unit under analysis. Variations in the values of this relationship over time and across countries reflect changes in the economy and changes in the way energy is consumed in each country.

In order to establish cross-country comparisons, it can be calculated by using GDP values at constant prices in dollars of a base year or GDP at purchasing power parity (PPP) values. In the latter case, the valorization is performed in relation to a weighted standardized price basket, which takes the United States of America as a benchmark for comparisons. The valorization of GDP and other macroeconomic aggregates to PPP allows decoupling the results of the variations that may exist in the exchange rate between the local currency and the dollar from year to year. By eliminating the monetary illusion linked to the value of the dollar in each country and reflecting the purchasing power that this currency has in each of them, this valuation methodology, when used to compare the performance of the countries, reflects more accurately the real activity in the consumption and production of goods and services.

Primary Energy Intensity

It is defined as the ratio between the Primary Energy Consumption and the Gross Domestic Product in Purchasing Power Parity at a constant value of 2011 (GDP USD2011 PPP). It measures the total amount of energy needed to produce a unit of GDP. It is expressed in kilograms of oil equivalent per PPP constant dollar (koe / USD2011 PPP).

Final Energy Intensity

It is defined as the ratio between Final Energy Consumption and GDP USD2011 PPP. It is linked to final uses, that is, it is evaluated at the level of final consumption (excluding the production centers) and can be calculated at the sectorial level by taking values from the energy balances and the variables that make up the GDP. Among the factors that affect the intensity of the final energy we can name the following:

(i) Structure Effect: changes in the sectorial composition of GDP. For example, if the economy is outsourced, under equal conditions, the final energy intensity decreases, thus a decrease in the contribution of energy-intensive branches would lead to a decrease of the final energy intensity.

(ii) Efficiency Effect: the replacement of more efficient sources and generation technologies, the penetration of more efficient equipment, the implementation of energy saving techniques or the change of habits of the population, towards more rational consumption practices.

(iii) Activity Effect: Changes in the economic activity levels and the consequent changes in consumption patterns can obviously affect the evolution of final energy intensity.

(iv) Changes in patterns of consumption, for example, modal changes in the use of urban transport or social changes, like the increase of single-parent housing due to the increase in separations or divorces, or improvements in the living standards, which lead to a higher demand for devices in households.

It is expressed in kilograms of oil equivalent per PPP constant dollar (koe / USD2011 PPP).

Sectoral energy intensities

It is the relation between the Final Energy Consumption of each sector and the Sectoral Added Value expressed in PPP at constant value of the year 2011, corresponding to the same sector. For the specific case of the Residential sector, energy intensity is defined as the ratio between the final consumption of the sector and the PPP private consumption at a constant value.

$$EI_{it} = \frac{FC_{it}}{GVA_{it}}$$

Where:

$$\begin{aligned} EI_{it} &= \text{Energy intensity of sector } i \text{ in time } t \\ FC_{it} &= \text{Final consumption of sector } i \text{ in time } t \\ GVA_{it} &= \text{Gross value added of sector } i \text{ in time } t \\ i &= \text{Sectors: Industrial, Service, Transport,} \\ &\quad \text{Residential \& others} \end{aligned}$$

This Energy Outlook expresses the sectorial intensities in kilograms of oil equivalent per PPP constant dollar (koe / USD2011 PPA).

It is important to note that, since more detailed information on the transport sector is not available, the added value of the transport sector has been used as a proxy for the level of activity. In this case, the level of economic activity in this sector only computes activities related to passenger and cargo transportation (land, air and maritime), storage activities and communications. It should be borne in mind that self-transport by companies to distribute their products and households, is not part of this definition.

For this reason, the energy intensity of the transport sector tends to be underestimated, since the energy consumption of the sector also includes fuel consumption of the residential sector and companies.

Ratio between Final Intensity / Primary Intensity

It represents the relation between the Final Consumption and the Primary Consumption of Energy. In most countries, there is a slight decrease in this ratio indicating that, on average, more and more primary energy per unit of final energy consumption is needed. The losses in the transformations and the distribution of energy, and mainly in energy generation, where the majority of these losses are registered, are responsible for most of the differences between the primary and final energy consumption.

The variability of this relationship can be due to several factors (ECLAC, 2013):

(i) Changes in energy supply, particularly in the generation mix or in the technical and non-technical loss levels, will affect the relationship. For example, an increase in the share of thermal energy generation increases the gap between the two intensities; in contrast, an increasing share of hydropower or wind energy reduces this gap.

(ii) Changes in the efficiency of the transformations: for example, a higher efficiency of thermal power plants (for example, by the development of combined cycle gas plants) reduces the relationship between final and primary intensity.

(iii) Changes in the share of secondary energies (mainly electricity) in the final consumption.

(iv) The change in the percentage of energy for non-energy uses decreases the value of the relation since these consumptions are included in the primary intensity but are excluded from the final intensity.

(v) Changes in the proportion of imported secondary energies, for example, the increase in electricity imports will reduce the transformation losses and, therefore, will reduce the gap between the two intensities.

Intensity of final energy at constant structure

It serves to analyze the effect of the structural changes in the GDP on the energy intensity by facilitating the comparison of the Final Energy Intensity with an estimate of the Final Energy Intensity calculated on the assumption that the economic structure remained unchanged with respect to a base period. The Energy Intensity at Constant Structure is then a theoretical intensity that results from assuming that all sectors grow at the same rate as GDP (i.e. the structure of GDP remains constant with respect to the base year). It is estimated using the actual values of the sectorial intensities. The calculation is made considering the main sectors (industry, tertiary, transport and residential).

$$EICS_t = \frac{\left[\frac{VA_{t_o}^{Ind}}{VA_t^{Ind}}\right] \cdot FC_t^{Ind} + \left[\frac{VA_{t_o}^{Serv}}{VA_t^{Serv}}\right] \cdot FC_t^{Serv} + \left[\frac{GDP_{t_o}}{GDP_t}\right] \cdot FC_t^{Trans} + \left[\frac{C_{t_o}^{Resid}}{C_t^{Resid}}\right] \cdot FC_t^{Resid}}{GDP_{t_o}}$$

Where:

$EICS_t$ = Energy intensity at constant structure in time t
VA = Value added: industrial (Ind) y Service (Serv)
t_o = Reference or base period: 2000
FC = Final consumption of energy: Industrial (Ind), Service (Serv), Transport (Trans), Residential (Resid)
C^{Resid} = Household final consumption expenditure
GDP = Gross Domestic Product

Avoided energy demand due to changes in energy intensity

The elasticity of a "y" magnitude respect of another "x", that is the Elasticity (y, x) , tells in what percentage does "y" vary, when "x" increases by 1%. Since it is a ratio between 2 rates of variation, it can be represented as:

$$Elasticity(y,x) = \frac{x}{y}\frac{dy}{dx} = \frac{d\ln(y)}{d\ln(x)} \approx \frac{\Delta\ln(y)}{\Delta\ln(x)}$$

Similarly, if we take the Energy Intensity and the Final Energy Consumption of the sector i, the value of:

$$\frac{\ln(EI_t) - \ln(EI_{t-1})}{\ln(FC_t) - \ln(FC_{t-1})}$$

It represents the percentage that varies the Energy Intensity between t and t-1 of sector i, when the final energy consumption varies by 1%. We can then use this value to weight the variation in the final consumption and calculate the avoided energy demand in the period t of the sector i, that is:

$$AED_t^i = \left(FC_t^i - FC_{t-1}^i\right)\cdot\left(\frac{\ln(EI_t^i) - \ln(EI_{t-1}^i)}{\ln(FC_t^i) - \ln(FC_{t-1}^i)}\right)$$

This indicator estimates the variation of the final energy weighted by the changes in the Energy Intensity due to the changes in the final energy. For this reason, it is a good approximation of the avoided demand by improvements in energy efficiency. In this case the value is negative. Conversely, when its value is positive, it accounts for the final energy demand induced by increases in inefficiency (increase in intensity) in the use of energy.

This same indicator could be calculated at the level of the economic sectors, thus computing the energy avoided demands in each sector. In the graphs published in this Energy Outlook, and to better capture the evolution of the ongoing avoided (or induced) demands, given due to the changes that occur over time in energy intensity and in final energy consumption, the evolution of avoided energy demand is calculated by setting 1999 as the base year (World Bank, 2015).

Analysis of the structural decomposition based on the Logarithmic Mean Divisia Index (LMDI)

It is an index developed by François-Jean-Marie Divisia in the 1920s, designed to analyze changes of a magnitude over time from subcomponents that are measured in different units. The resulting series is dimensionless. It started to be used in the 1970s, in the energy scope to break down the causal factors of the changes in energy consumption, allowing to disaggregate the activity effect (due to the aggregate change in economic activity), the structure effect (due to changes in the structural composition of the economy, i.e. changes in the relative shares of the activity's branches) and efficiency effect (due to the energy savings generated) (Ang and Liu, 2006).

Since we are processing time series, we used the multiplicative version of the Logarithmic mean divisia Index of the changes in the Final Consumption between the instant t and a reference instant to, are decomposed into the 3 effects mentioned:

$$\frac{FC_t^{Tot}}{FC_{to}^{Tot}} = D_t^{Tot} = D_t^{act}\cdot D_t^{str}\cdot D_t^{eff}$$

With:

$$D_t^{act} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i}\cdot\ln\left(\frac{Q_t}{Q_{t_o}}\right)\right]$$

$$D_t^{str} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i} \cdot \ln\left(\frac{P_t^i}{P_{t_o}^i}\right)\right]$$

$$D_t^{eff} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i} \cdot \ln\left(\frac{EI_t^i}{EI_{t_o}^i}\right)\right]$$

Being:

$$\widetilde{w_t^i} = \frac{\left[\frac{FC_t^i - FC_{t_o}^i}{\ln(FC_t^i) - \ln(FC_{t_o}^i)}\right]}{\left[\frac{FC_t^{Tot} - FC_{t_o}^{Tot}}{\ln(FC_t^{Tot}) - \ln(FC_{t_o}^{Tot})}\right)\right]}$$

Where:

FC_t^{Tot} = Final consumption of all sectors in time t

FC_t^i = Final consumption of sector i in t

t_o = Reference or base time period: 2000

D_t^{act} = Decomposition factor that explain activity effect in t

D_t^{str} = Decomposition factor that explain structure effect in t

D_t^{eff} = Decomposition factor that explain efficiency effect in t

Q_t = Total activity level (i.e the sum of sectoral value added) in t

P_t = Share of sector i in t

EI_t^i = Energy intensity of sector i in t

i = Represents sectors: industrial, service, transport and others

The year 1999 was considered as a reference year in this Energy Outlook, and only the productive sectors were used to analyze the evolution of the explanatory factors of the changes that occurred in the final energy consumption.

Efficiency in the transformation processes

It is defined as the relation between the Final Energy Consumption and the Total Energy Supply. This indicator, when presented as a time series, accounts for the aggregate performance of the transformation centers that convert primary energy into secondary energy regardless of the source.

Efficiency of the electricity sector

It is the relationship between the production of electricity and the inputs required in its generation. In this case, and taking into account that the indicator refers to the processes of transformation of the electricity sector, the inputs must be taken from the transformation centers (including self-producers) and not from the consumer sectors as in the latter case that considers the transformation process as a whole (including, for example the refining processes). As for the hydroelectricity, wind and solar generation, the value of the inputs is equal to the amount of electricity produced, thus it is assumed that the efficiency is 100%.

Ratio between Losses / Electricity supply

Losses in the electricity transmission and distribution systems are the sum of the technical or non-technical inefficiencies that occur in a given time frame.

The technical losses are related to the energy lost during transportation and distribution within the network as a result of the natural heating of transformers and conductors that transport electricity from the generation plants to the customers. According to the second principle of thermodynamics, the technical losses cannot be eliminated completely, although it is possible to reduce them through improvements in the network.

Non-technical losses represent the remaining balance of energy losses and constitute the energy consumed that has not been billed due to technical or administrative errors, measurement anomalies, self-connecting customers or energy thefts.

Since increasing levels of losses in the system result in lower availability of installed capacity, decrease, in turn, revenues from unbilled consumptions; this can lead to increases in electricity rates due to the waste of energy generated and increases the costs of maintenance of the distribution networks. It becomes important to establish quantitative measures that allow to evaluate the evolution of the levels of the losses and, therefore, of the efficiency of the electrical system. The relationship between losses and the electricity supply is the appropriate indicator to measure and evaluate the state of electricity losses over time.

Renewability index of primary energy supply

It is defined as the percentage that represents the renewable primary energy supply with respect to the total energy supply. The total supply of renewable primary energy can be considered as the total renewable energy entering the transformation centers plus the final consumption of that energy. The total energy supply has been defined in a previous section. This indicator measures the degree of penetration of renewable resources in the country's energy matrix. In combination with emission factors, it can also assess the mitigation of the environmental impact that takes place in the energy sector.

Energy External Dependency Index

Se It is defined as the ratio of total energy imports minus total exports divided by total primary energy supply.

Hydrocarbon autarky index

It is defined as the primary production of hydrocarbons (oil and natural gas) divided for the total supply of these same sources plus the supply of oil products minus the production of derivatives (to avoid double accounting). When the index is greater than the unit, the country is self-sufficient, while if it is less than 1, the country is dependent on imports of crude oil, natural gas or oil products.

Index of biomass residential consumption

It is defined as the ratio between the sum of fuelwood and charcoal consumption in the residential sector divided by the final consumption of the residential sector.

Participation of hydroenergy in the renewable primary supply

It defines the proportion of hydroelectricity in the renewable supply. It is calculated by dividing the total supply of hydro-energy by the primary supply of renewable energies.

Participation of dendroenergy in the total renewable supply

It is defined as the amount of dependence on energy produced after the combustion of wood fuels such as firewood, charcoal, pellets, etc. It is calculated dividing the total supply of firewood and charcoal by the primary supply of renewable energy.

Energy path

It is a graphical representation that attempts to briefly summarize the link between the evolution of the levels of development of a country or sub-region, expressed in a very simplified way by GDP per capita, and the quality of its energy performance, represented by changes in the Energy final intensity. By combining both variables in a single graph it is possible to identify periods of time that have a virtuous or desirable performance, since the per capita GDP levels increase and, therefore, the path shifts to the right, while the energy intensity decreases, moving the energy path downwards. On the contrary, if at some period of time the energy path shifts to the left, this would mean that a contraction of economic activity has taken place; whereas if it moves upward, energy intensity would be increasing over previous periods, for which the energy performance would be, in aggregate terms, more inefficient. Given this combination of variables expressed in the figure, it is also possible to represent a set of level curves that represent the possible combinations of GDP per capita and Energy Intensity that maintain a constant value of the final energy consumption per capita. In this sense, if a sub-region or country has an energetic path whose trajectory moves through different level curves, that is crossing them, it means that the final consumption per capita is changing and, therefore, the patterns in which the energy demand is generated have been modified.

This may be due for example, to a greater provision of electronic devices in households or a substantial growth in the vehicle fleet. Likewise, it could happen that the energy path moves to the right and up, which could mean not a growth of energy inefficiency but a change in the productive structure that, in particular, happens in the industrial sector. Clearly, the analysis of the energy paths should be complemented by a more detailed analysis of how the economic activity and the productive matrix evolved, as well as to know the how and why of the changes that took place in the energy matrix.

Indicators of CO_2 emissions

CO_2 emissions derived from the combustion of fossil fuels, unlike other greenhouse gases, can be calculated with an acceptable degree of accuracy from the calculation of the amounts of carbon contained in fuels, while the volume of the other emissions depends on the technologies and the combustion conditions.

The most important source of CO_2 emissions in the Energy Sector is the carbon oxidation that takes place during the combustion process of fossil energy sources and represents between 70% and 90% of total anthropogenic emissions. The rest is emitted in the form of carbon monoxide (CO), methane (CH_4) and another form of compound hydrocarbons, that, in the time frame from a few days to 10 or 11 years, oxidizes in the atmosphere to become CO_2.

In this Energy Outlook, the method of estimation of emissions by technologies was applied. According to the IPCC (Intergovernmental Panel on Climate Change), this method consists of estimating the CO_2 emissions depending on the activity and technology under which the energy is used. It is about quantifying the emissions that occur along the energy chains, from the use of primary energies, through the processes of transformation, losses due to transportation and distribution, until the final use of energy. CO_2 emissions of the sector i during the time t, are calculated using the expression:

$$Emissions_t^i = \sum_{j=1}^{\text{Source}} EF_j^i \cdot FC_{jt}^i$$

Where:

$$EF_j^i = \text{Emission factor of source } j \text{ of sector } i$$
$$FC_{jt}^i = \text{Final consumption of energy of source } j \text{ of sector } i \text{ in } t$$

Thus the total emissions during time t are:

$$Total\ Emissions_t = \sum_{i-1}^{Sectors} Emissions_t^i$$

This Energy Outlook not only presents total CO_2 emissions by sectors of final consumption, but it shows total emissions per capita and per unit of GDP in dollars as of 2011, expressed in purchasing power parity.

It is worth mentioning that the emission values presented do not strictly correspond to the national official greenhouse gas inventory reports, according to the 2006 IPCC guidelines.

The Carbon Dioxide Emission factors used as reference for the calculations can be consulted in the sieLAC option Energy Statistics - Environmental Impact.

CO_2 emissions index per energy consumed

It is defined as the ratio of total CO_2 emissions divided by the final consumption of energy.

CO_2 emissions index in the electric generation

It is defined as CO_2 emissions produced by electricity generation divided by total electricity production.

Generic formulas

Variation rates

It is defined as a variation of an amount relative to its previous value in relative terms, that is, as the rate of change of it. It is expressed as a percentage. The rate of change can be "punctual" when comparing data from two periods or maybe a "cumulative average variation rate" when calculated based on the initial and final data of a series of values.

Formula of the percentage change rate:

$$VR_t = \frac{M_t - M_{t-1}}{M_{t-1}} \cdot 100$$

Where:

$$\begin{aligned} VR_t &= \text{Percentage change rate in } t \\ t &= \text{Period of time} \\ M_t &= \text{Amount or value in time } t \\ M_{t-1} &= \text{Amount or value in previous time } t-1 \end{aligned}$$

Formula of the cumulative average variation rate:

$$\overline{VR_{t+n}^t} = \left[\left(\frac{M_{t+n}}{M_t}\right)^{\frac{1}{n}} - 1\right] \cdot 100$$

Where:

$$\begin{aligned} \overline{VR_{t+n}^t} &= \text{Average accumulated variation rate} \\ &\quad\ \text{between } t+n \text{ and } t \\ M_t &= \text{Amount or value in time } t \\ M_{t+n} &= \text{Amount or value in time } t+n \end{aligned}$$

Statistics and aggregate energy indicators of Latin America and the Caribbean and the World

LATIN AMERICA AND THE CARIBBEAN

General Information 2018

Population (thousand inhab.)	635,194
Area (km²)	20,397,602
Population Density (inhab./km²)	31
Urban Population (%)	80
GDP USD 2010 (MUSD)	5,710,111
GDP USD 2011 PPP (MUSD)	9,430,332
GDP per Capita (thou. USD 2011 PPP/inhab.)	15

Energy Sector

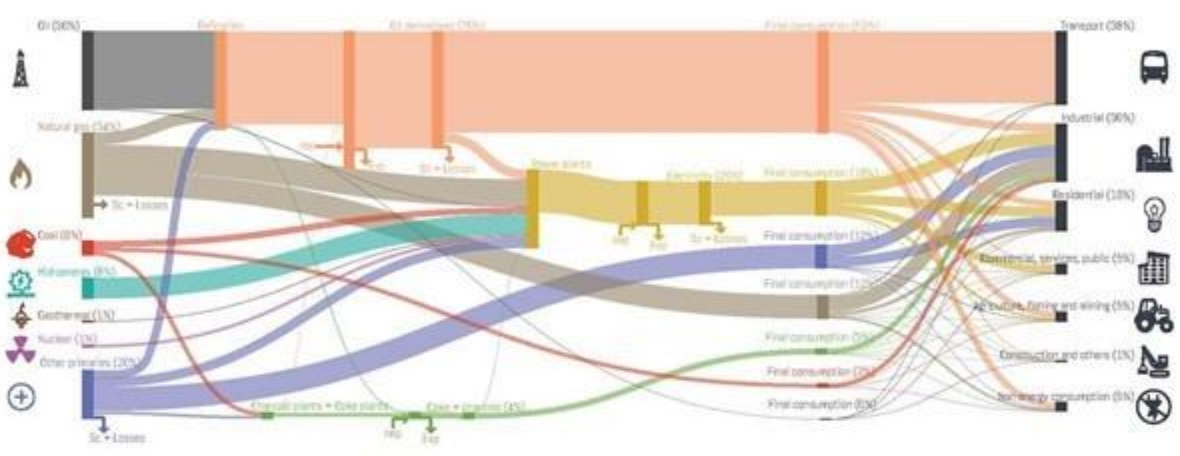
Final consumption in the Transport Sector	Mtoe 238
Final consumption in the Industrial Sector	Mtoe 189
Final consumption in the Residential Sector	Mtoe 98.76
Final consumption in the Commercial and Service Sector	Mtoe 33.46
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 67.89

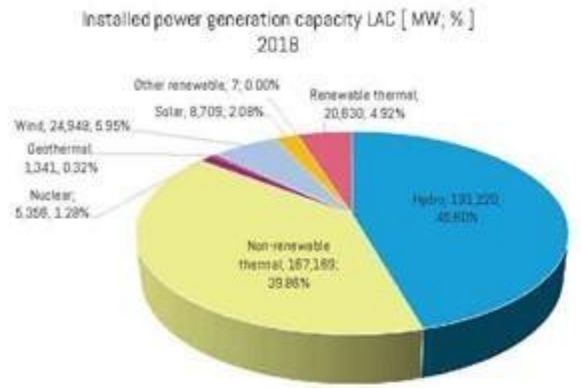
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 334,513	Gm³ 7,825	Mt 16,253

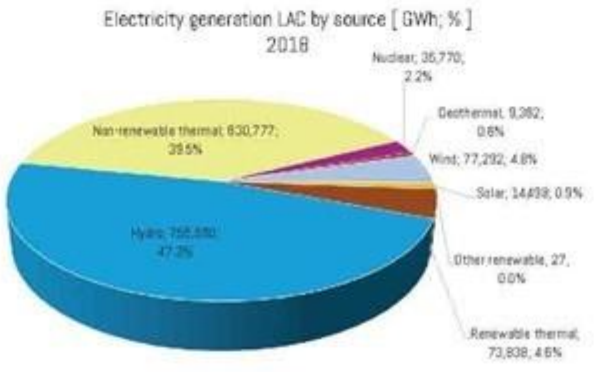
[1] It includes non-energy consumption.
[2] Does not include consumption of the energy sector.
Note: The 2018 supply and demand data for Mexico correspond to estimates made by OLADE.

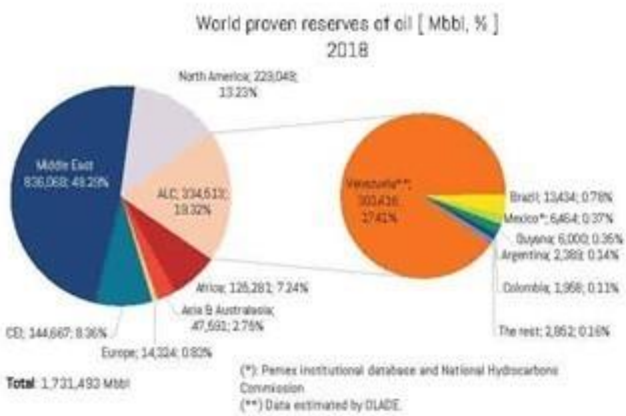
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,056	0.99	97	886	1,048	290	425	627 [2]	7,442	419	0.09 / 0.07

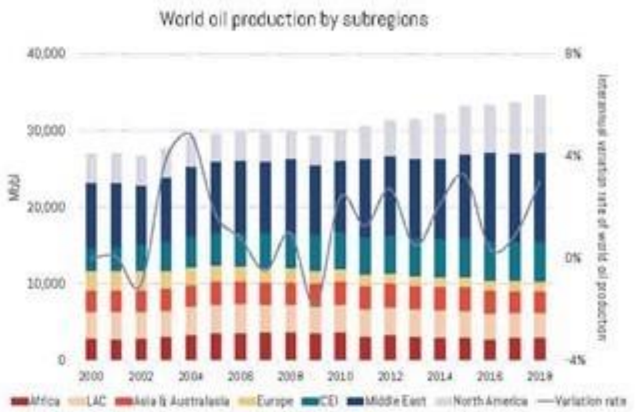
Summarized energy balance 2018

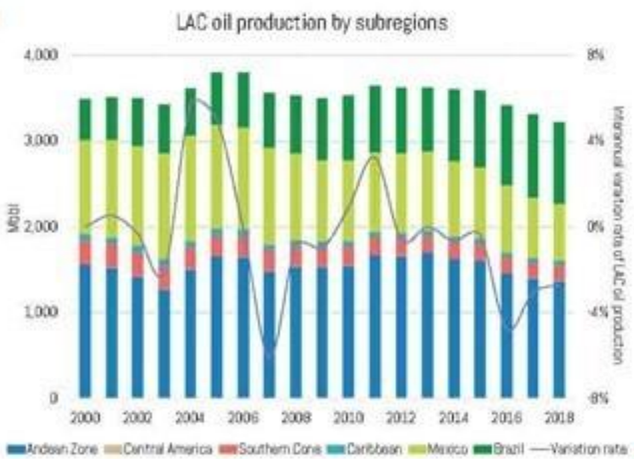


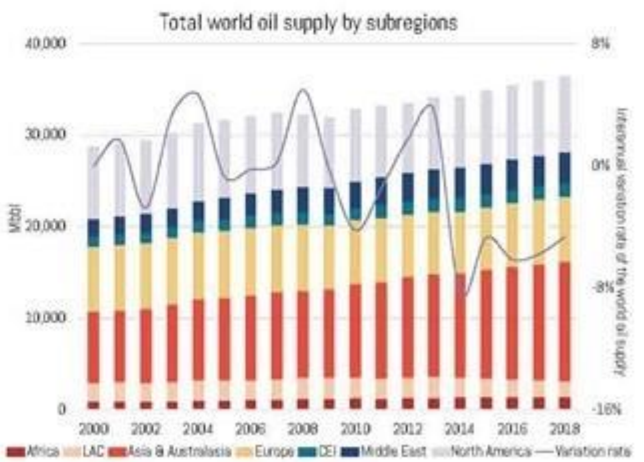

Installed power generation capacity LAC [MW; %]
2018
Other renewable; 7; 0.00%
Renewable thermal; 20,830; 4.92%
Solar; 8,709; 2.08%
Wind; 24,949; 5.95%
Geothermal; 1,341; 0.32%
Nuclear; 5,356; 1.28%
Non-renewable thermal; 167,169; 39.86%

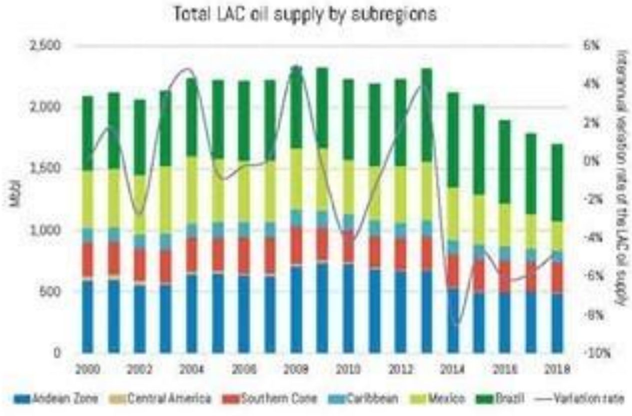

Electricity generation LAC by source [GWh; %]
2018
Nuclear; 35,770; 2.2%
Geothermal; 9,362; 0.6%
Non-renewable thermal; 630,777; 39.5%
Wind; 77,292; 4.8%
Solar; 14,499; 0.9%
Other renewable; 27; 0.0%
Renewable thermal; 73,838; 4.6%

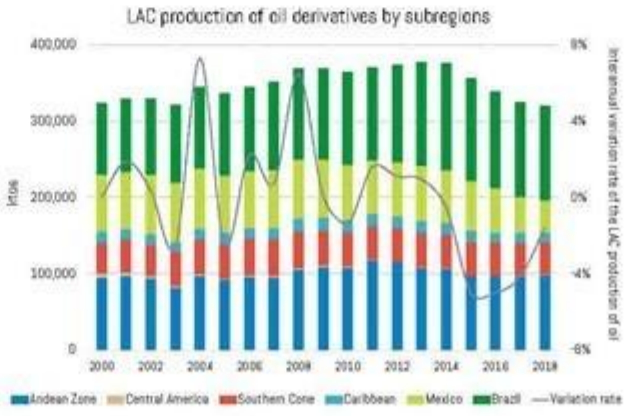

World proven reserves of oil [Mbbl, %]
2018
North America; 229,049; 13.23%
Middle East 836,068; 49.29%
ALC; 334,513; 19.32%
Brazil; 13,434; 0.78%
Mexico*; 6,464; 0.37%
Guyana; 6,000; 0.35%
Argentina; 2,389; 0.14%
Africa; 125,281; 7.24%
Colombia; 1,958; 0.11%
Asia & Australasia; 47,691; 2.75%
CEI; 144,667; 8.36%
The rest; 2,852; 0.16%
Europe; 14,324; 0.83%
Total 1,731,493 Mbbl
(*): Pemex institutional database and National Hydrocarbons Commission
(**) Data estimated by OLADE

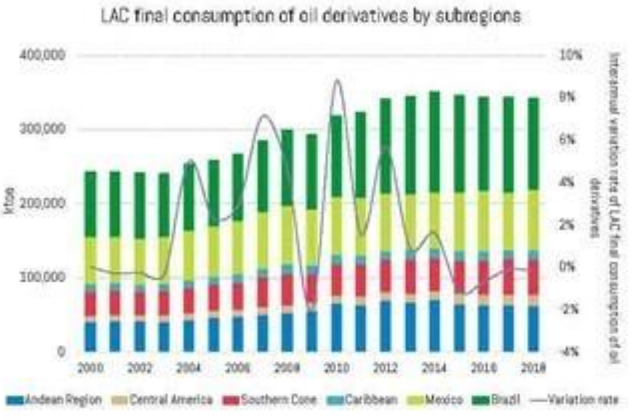

World oil production by subregions
Mbbl
Interannual variation rate of world oil production
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

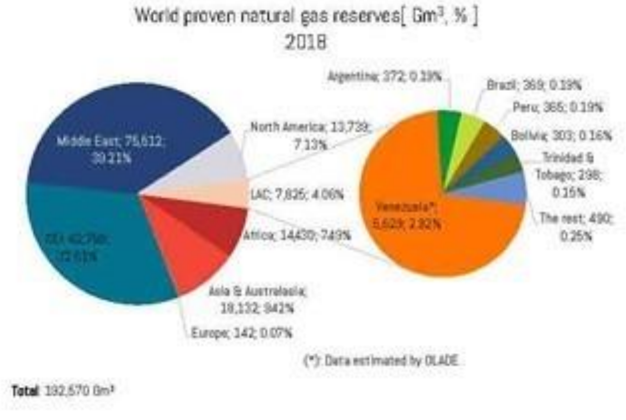

LAC oil production by subregions
Mbbl
Interannual variation rate of LAC oil production
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

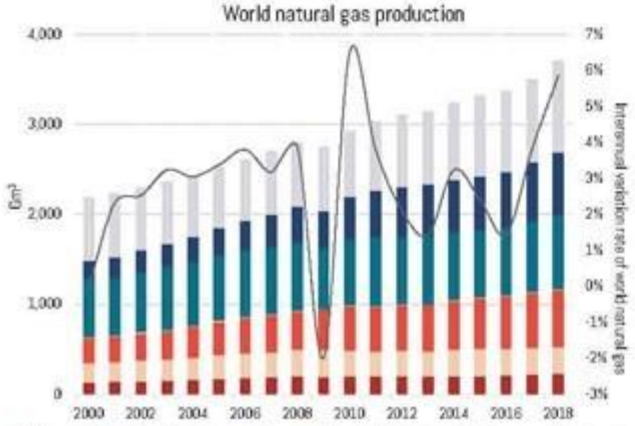

Total world oil supply by subregions
Mbbl
Interannual variation rate of the world oil supply
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

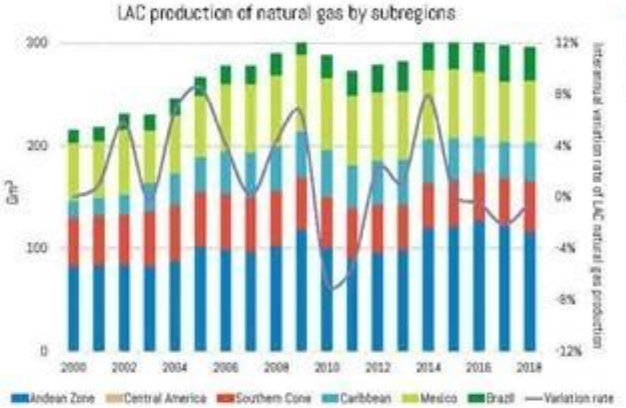

Total LAC oil supply by subregions
Mbbl
Interannual variation rate of the LAC oil supply
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

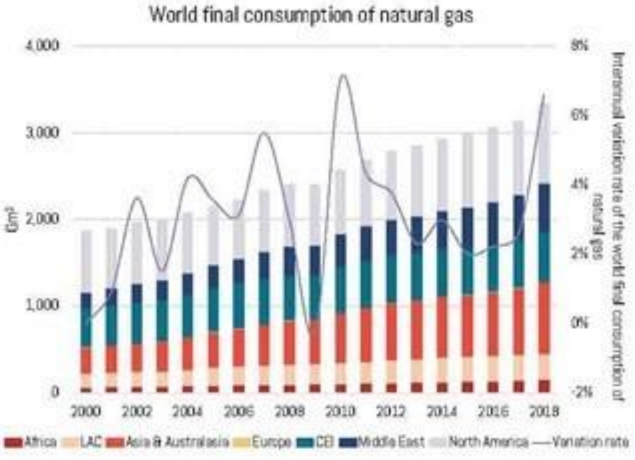

LAC production of oil derivatives by subregions
ktoe
Interannual variation rate of the LAC production of oil
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

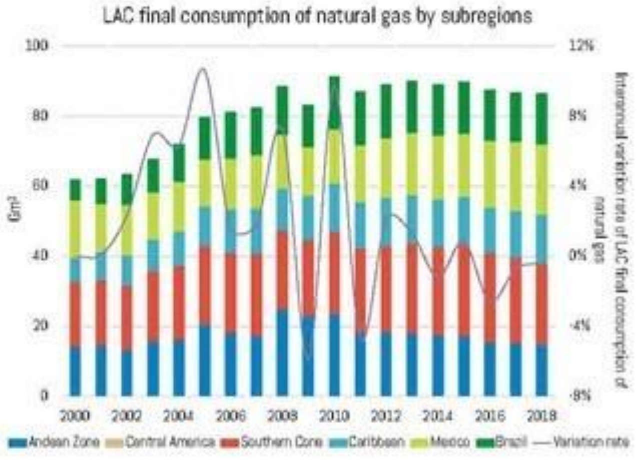

LAC final consumption of oil derivatives by subregions
ktoe
Interannual variation rate of LAC final consumption of oil derivatives
Andean Region
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

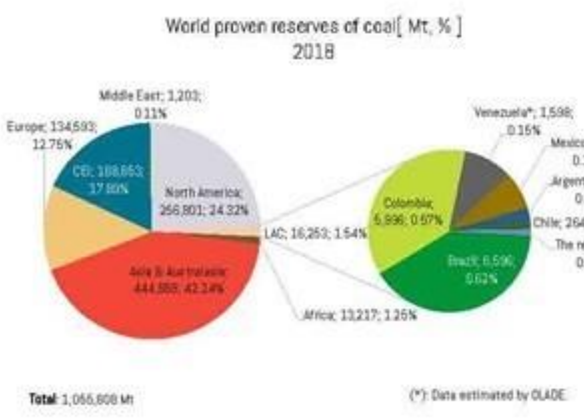

World proven natural gas reserves[Gm³, %]
2018
Middle East; 75,612; 39.21%
North America; 13,739; 7.13%
LAC; 7,826; 4.06%
Africa; 14,430; 7.49%
Asia & Australasia; 18,132; 9.42%
Europe; 142; 0.07%
Argentina; 372; 0.19%
Brazil; 369; 0.19%
Peru; 365; 0.19%
Bolivia; 303; 0.16%
Trinidad & Tobago; 298; 0.15%
The rest; 490; 0.25%
Venezuela*; 5,629; 2.92%
(*): Data estimated by OLADE
Total: 192,570 Gm³

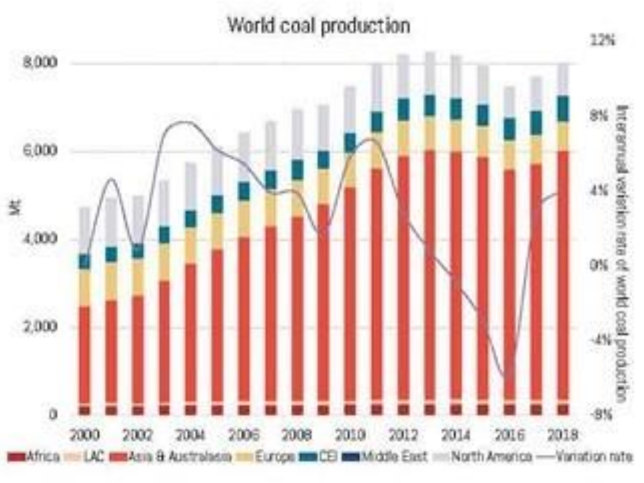

World natural gas production
Gm³
Interannual variation rate of world natural gas
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

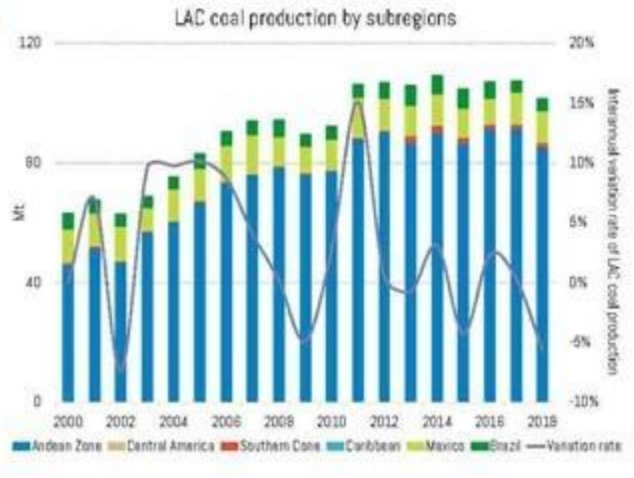

LAC production of natural gas by subregions
Gm³
Interannual variation rate of LAC natural gas production
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

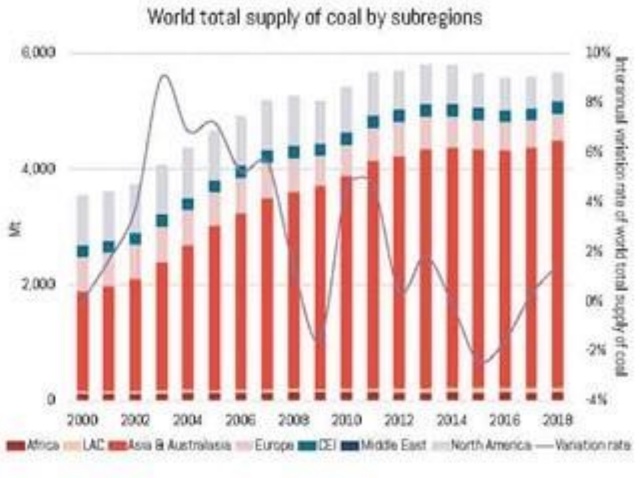

World final consumption of natural gas
Gm³
Interannual variation rate of the world final consumption of natural gas
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

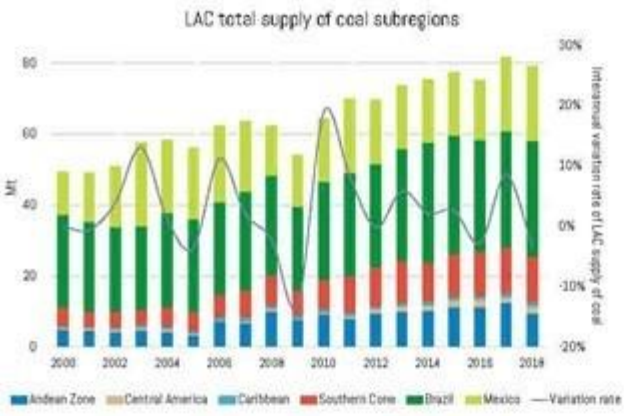

LAC final consumption of natural gas by subregions
Gm³
Interannual variation rate of LAC final consumption of natural gas
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

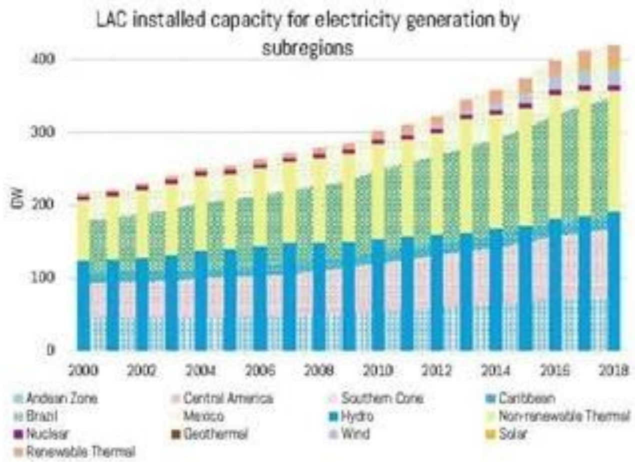

World proven reserves of coal [Mt, %]
2018
Middle East; 1,203; 0.11%
Europe; 134,593; 12.75%
CEI; 188,853; 17.88%
North America; 256,801; 24.32%
LAC; 16,253; 1.54%
Asia & Australasia; 444,555; 42.14%
Africa; 13,217; 1.25%
Venezuela*; 1,598; 0.15%
Mexico; 1,211; 0.11%
Argentina; 421; 0.04%
Chile; 264; 0.03%
The rest; 167; 0.02%
Colombia; 5,996; 0.57%
Brazil; 6,596; 0.62%
Total: 1,055,608 Mt
(*): Data estimated by OLADE.

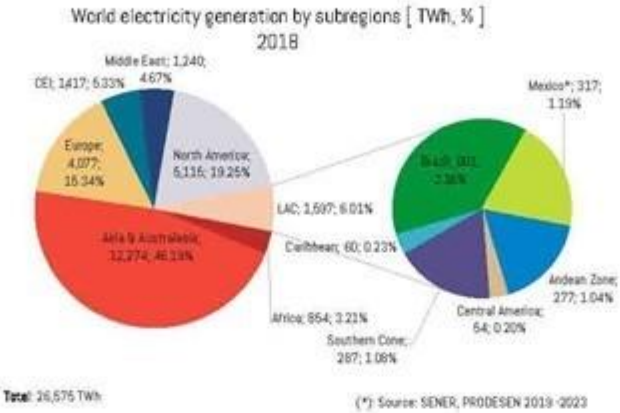

World coal production
Mt
Interannual variation rate of world coal production
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

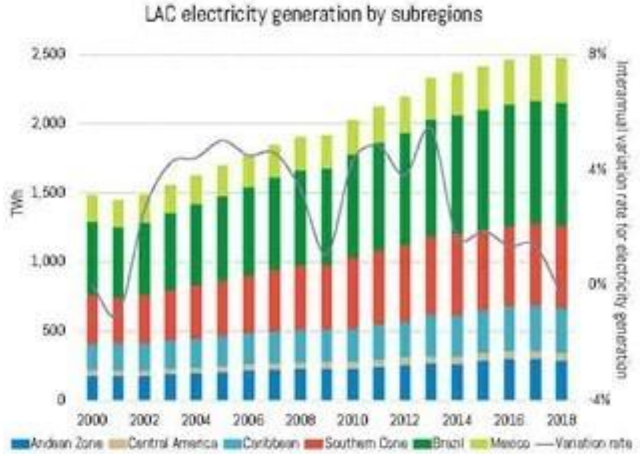

LAC coal production by subregions
Mt
Interannual variation rate of LAC coal production
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

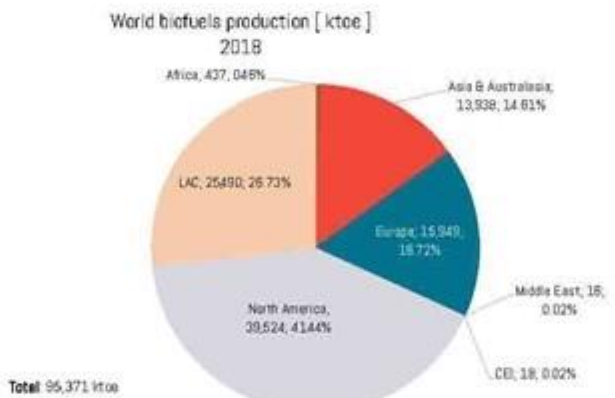

World total supply of coal by subregions
Mt
Interannual variation rate of world total supply of coal
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

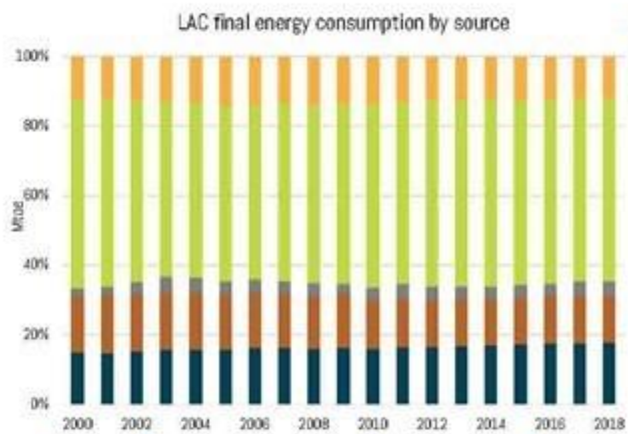

LAC total supply of coal subregions
Mt
Interannual variation rate of LAC supply of coal
Andean Zone
Central America
Caribbean
Southern Cone
Brazil
Mexico
Variation rate


LAC installed capacity for electricity generation by subregions
GW
Andean Zone
Central America
Southern Cone
Caribbean
Brazil
Mexico
Hydro
Non-renewable Thermal
Nuclear
Geothermal
Wind
Solar
Renewable Thermal


World electricity generation by subregions [TWh, %]
2018
Middle East; 1,240; 4.67%
CEI; 1,417; 5.33%
Europe; 4,077; 15.34%
North America; 5,115; 19.25%
LAC; 1,597; 6.01%
Asia & Australasia; 12,274; 46.19%
Caribbean; 60; 0.23%
Africa; 854; 3.21%
Mexico*; 317; 1.19%
Andean Zone; 277; 1.04%
Central America; 54; 0.20%
Southern Cone; 287; 1.08%
Total: 26,575 TWh
(*) Source: SENER, PRODESEN 2019 -2023

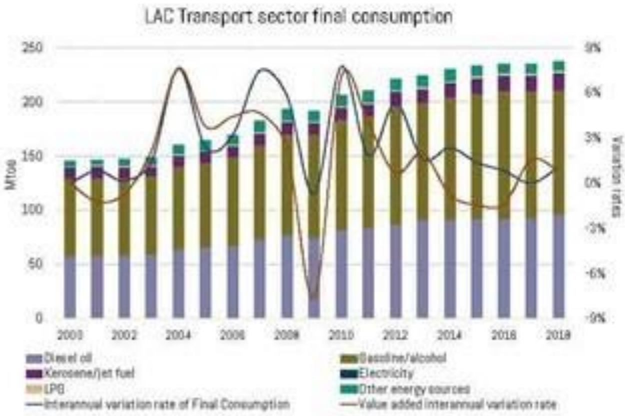

LAC electricity generation by subregions
TWh
Interannual variation rate for electricity generation
Andean Zone
Central America
Caribbean
Southern Cone
Brazil
Mexico
Variation rate


World biofuels production [ktoe]
2018
Africa; 437; 0.46%
Asia & Australasia; 13,938; 14.61%
LAC; 25490; 26.73%
Europe; 15,949; 16.72%
Middle East; 18; 0.02%
North America; 39,524; 41.44%
CEI; 18; 0.02%
Total: 95,371 ktoe


LAC final energy consumption by source
Mtoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas

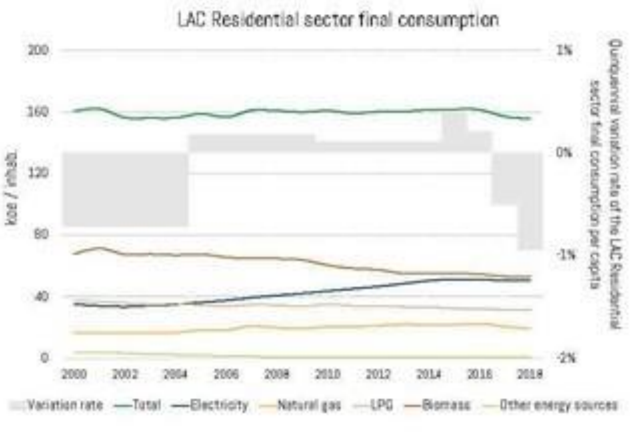

LAC Industrial sector final consumption
Mtoe
Variation rates
Biomass
Coal and coke
Natural gas
Final consumption interannual variation rate
Oil and derivatives
LPG
Electricity
Value added interannual variation rate

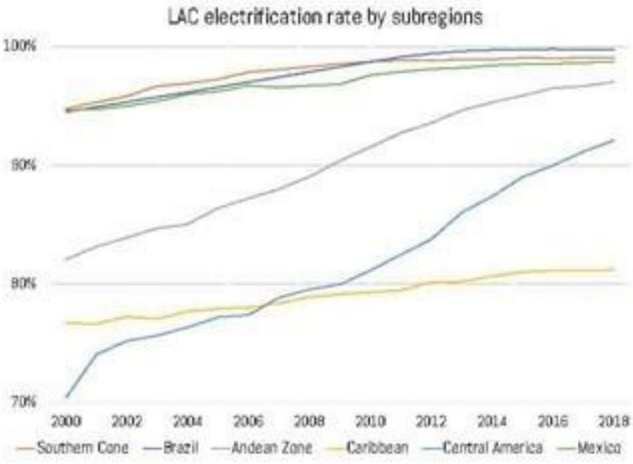

LAC Commercial sector final consumption
Mtoe
Variation rates
Biomass
LPG
Electricity
Value added interannual variation rate
Oil and derivatives
Natural gas
Final consumption interannual variation rate

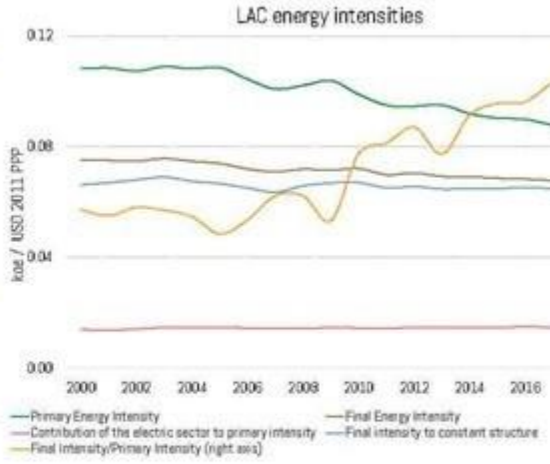

LAC Transport sector final consumption
Mtoe
Variation rates
Diesel oil
Kerosene/jet fuel
LPG
Interannual variation rate of Final Consumption
Gasoline/alcohol
Electricity
Other energy sources
Value added interannual variation rate

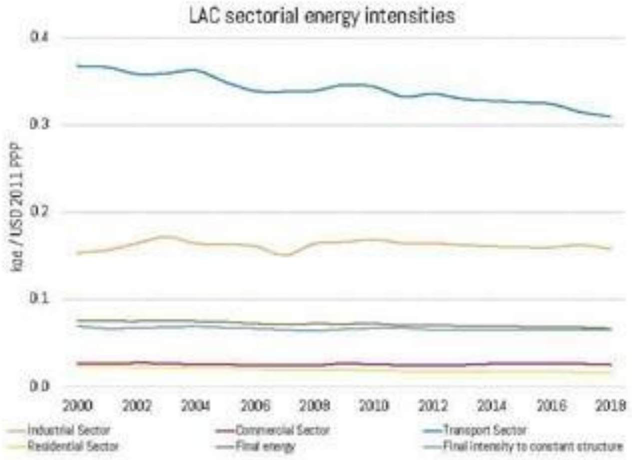

LAC Other sector final consumption
Mtoe
Variation rates
Biomass
Gasoline/alcohol
Coal and coke
Natural gas
Final consumption interannual variation rate
Oil and derivatives
Diesel oil
LPG
Electricity
Value added interannual variation rate

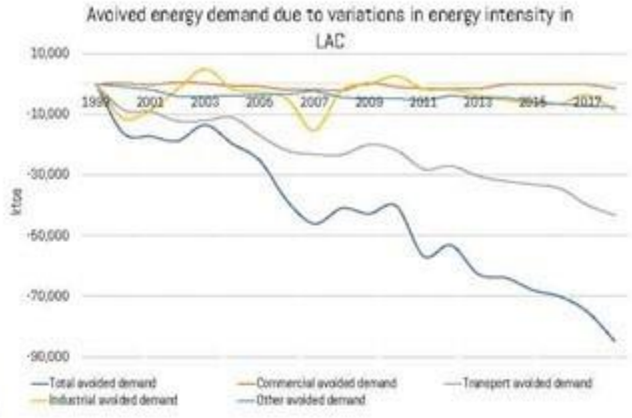

LAC Residential sector final consumption
Mtoe
Variation rates
Electricity
LPG
Biomass
Household consumption variation rate
Natural gas
Oil and derivatives
Final consumption interannual variation rate

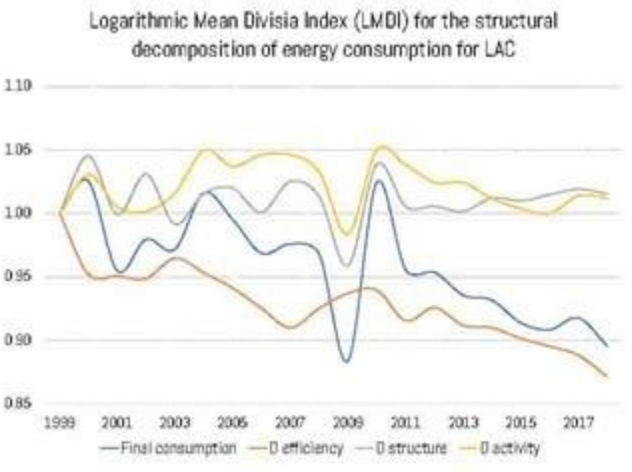

LAC Residential sector final consumption
koe / inhab.
Quinquennial variation rate of the LAC Residential sector final consumption per capita
Variation rate
Total
Electricity
Natural gas
LPG
Biomass
Other energy sources

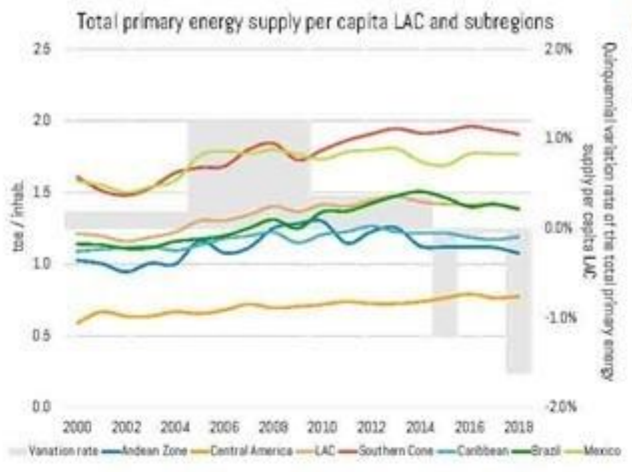

LAC electrification rate by subregions
100%
90%
80%
70%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Southern Cone
Brazil
Andean Zone
Caribbean
Central America
Mexico

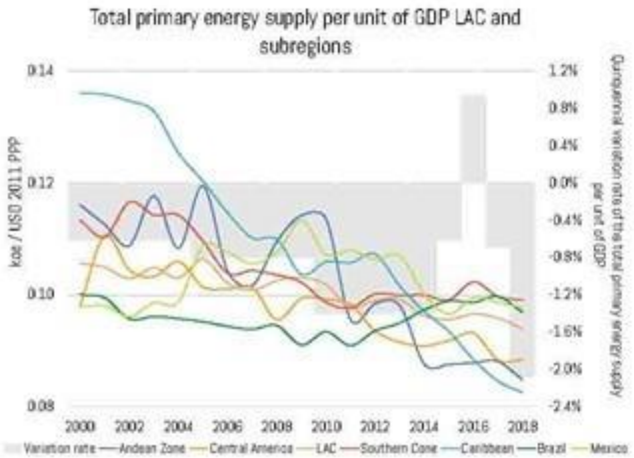

LAC energy intensities
koe / USD 2011 PPP
0.12
0.08
0.04
0.00
0.80
0.76
0.72
0.68
0.64
0.60
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Primary Energy Intensity
Final Energy Intensity
Contribution of the electric sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

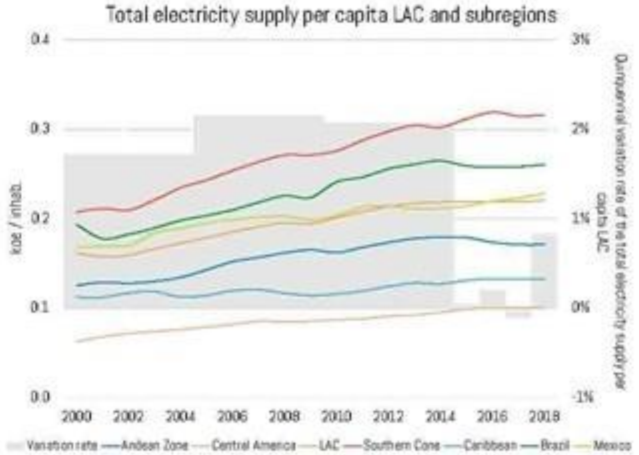

LAC sectorial energy intensities
koe / USD 2011 PPP
0.4
0.3
0.2
0.1
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Industrial Sector
Commercial Sector
Transport Sector
Residential Sector
Final energy
Final intensity to constant structure

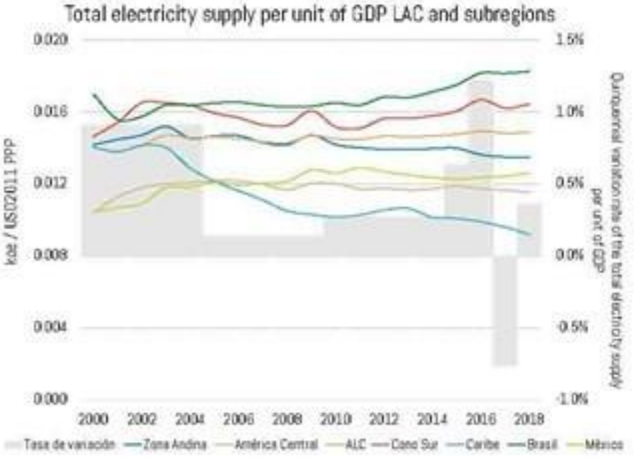

Avoived energy demand due to variations in energy intensity in LAC
ktoe
10,000
-10,000
-30,000
-50,000
-70,000
-90,000
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Total avoided demand
Commercial avoided demand
Transport avoided demand
Industrial avoided demand
Other avoided demand

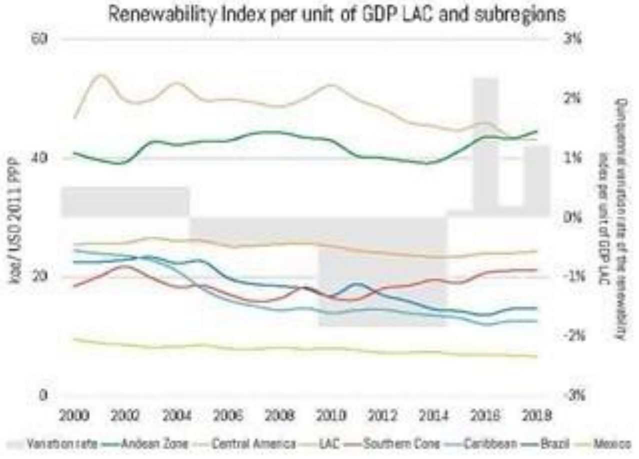

Logarithmic Mean Divisia Index (LMDI) for the structural decomposition of energy consumption for LAC
1.10
1.05
1.00
0.95
0.90
0.85
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Final consumption
D efficiency
D structure
D activity


Total primary energy supply per capita LAC and subregions
toe / inhab.
2.5
2.0
1.5
1.0
0.5
0.0
2.0%
1.0%
0.0%
-1.0%
-2.0%
Quinquennial variation rate of the total primary energy supply per capita LAC
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico

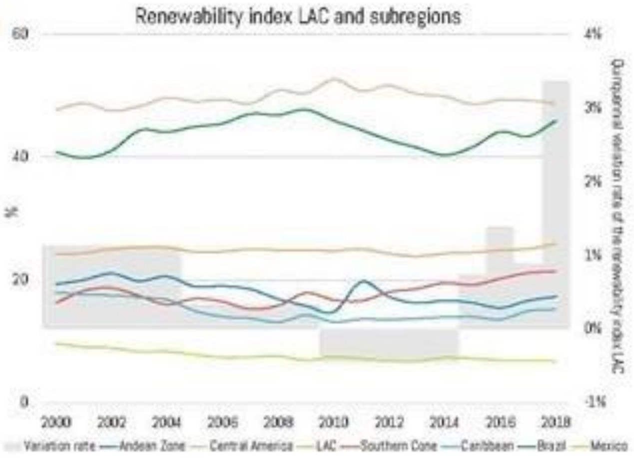

Total primary energy supply per unit of GDP LAC and subregions
koe / USD 2011 PPP
Quinquennial variation rate of the total primary energy supply per unit of GDP
Variation rate — Andean Zone — Central America — LAC — Southern Cone — Caribbean — Brazil — Mexico

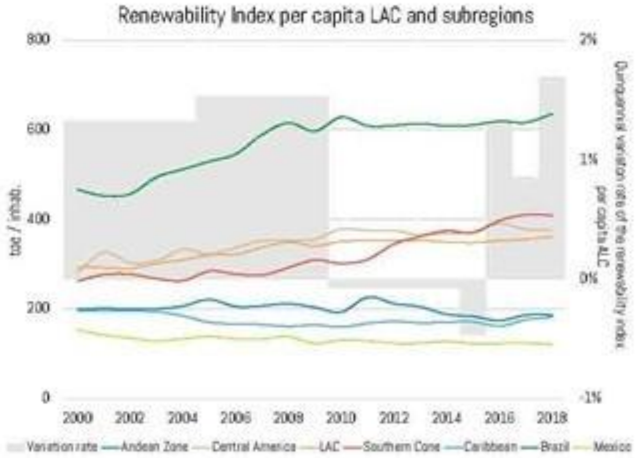

Total electricity supply per capita LAC and subregions
koe / inhab.
Quinquennial variation rate of the total electricity supply per capita LAC
Variation rate — Andean Zone — Central America — LAC — Southern Cone — Caribbean — Brazil — Mexico


Total electricity supply per unit of GDP LAC and subregions
koe / USD2011 PPP
Quinquennial variation rate of the total electricity supply per unit of GDP
Tasa de variación — Zona Andina — América Central — ALC — Cono Sur — Caribe — Brasil — México

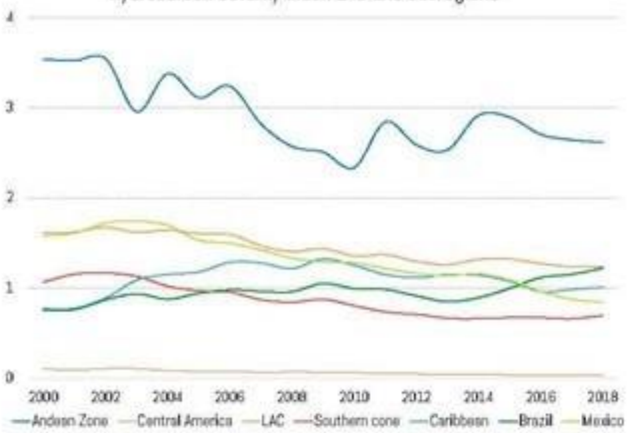

Renewability Index per unit of GDP LAC and subregions
koe / USD 2011 PPP
Quinquennial variation rate of the renewability index per unit of GDP LAC
Variation rate — Andean Zone — Central America — LAC — Southern Cone — Caribbean — Brazil — Mexico

LAC

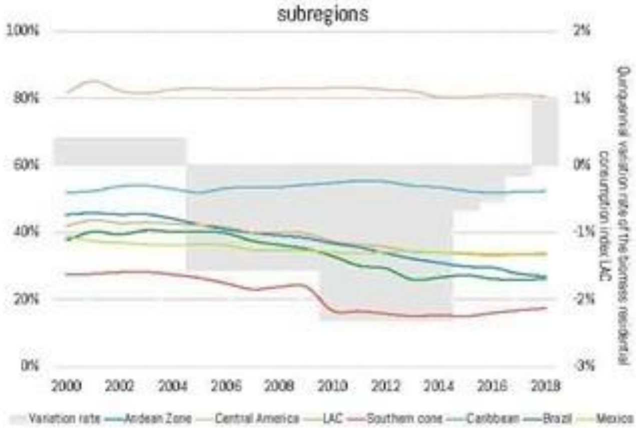

Renewability index LAC and subregions
%
Quinquennial variation rate of the renewability index LAC
Variation rate — Andean Zone — Central America — LAC — Southern Cone — Caribbean — Brazil — Mexico


Renewability Index per capita LAC and subregions
toe / inhab.
Quinquennial variation rate of the renewability index per capita ALC
Variation rate — Andean Zone — Central America — LAC — Southern Cone — Caribbean — Brazil — Mexico

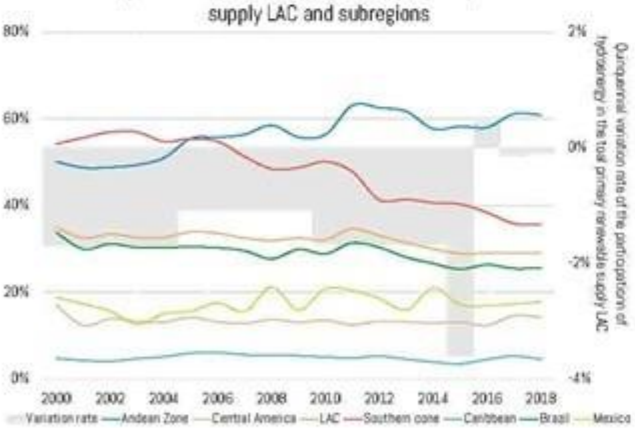
Hydrocarbon autarky index LAC and subregions



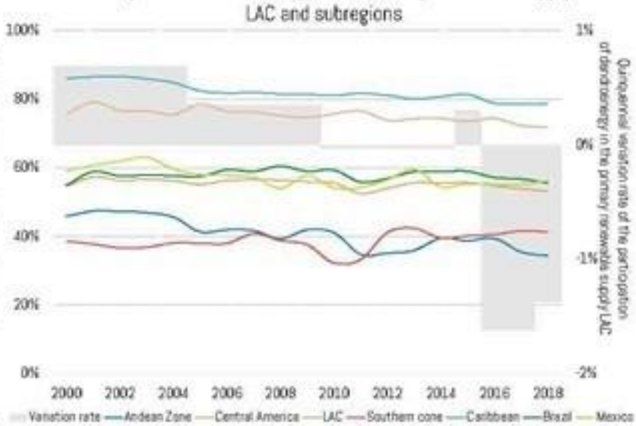
Biomass residential consumption index LAC and subregions



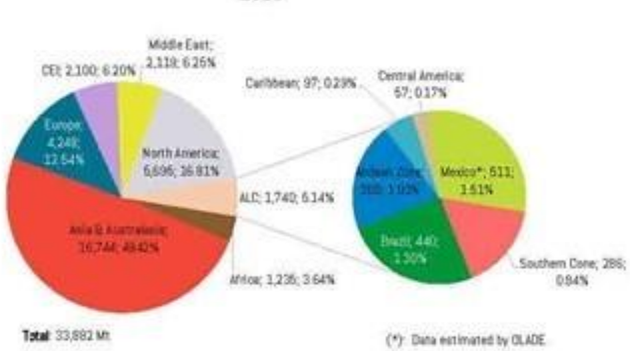
Participation of hydroenergy in the total primary renewable supply LAC and subregions



Participation of dendroenergy in the primary renewable supply LAC and subregions



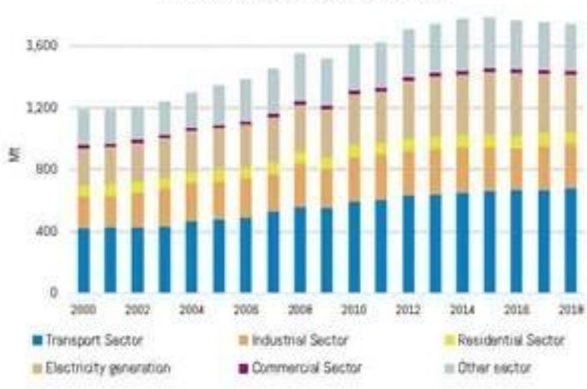
Global CO_2 emissions by subregions[Mt; %]
2018



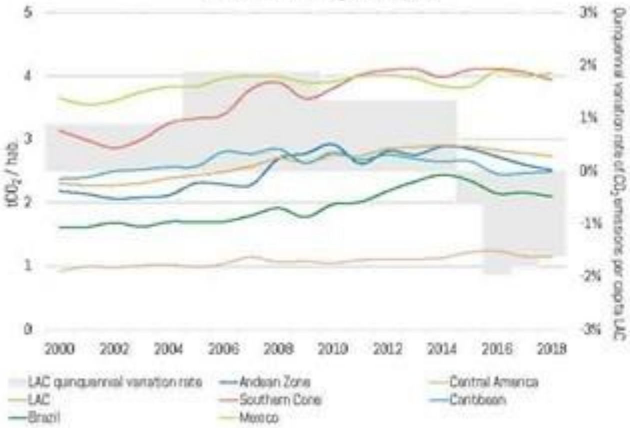
Total 33,882 Mt

(*): Data estimated by OLADE

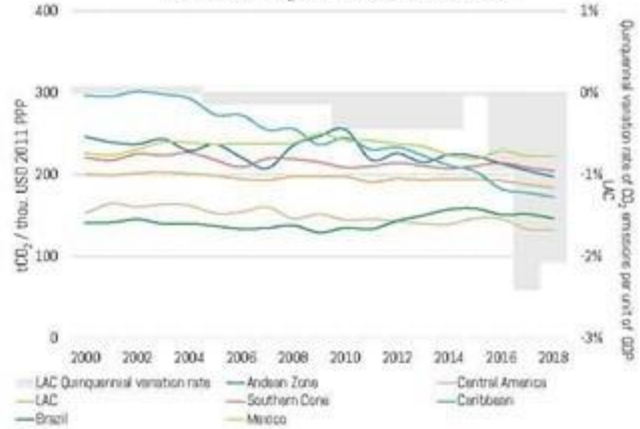
Evolution of CO_2 emissions by sector



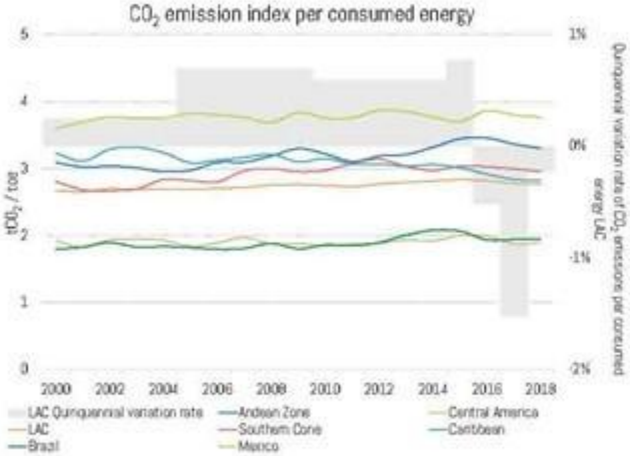
Evolution of CO_2 per capita



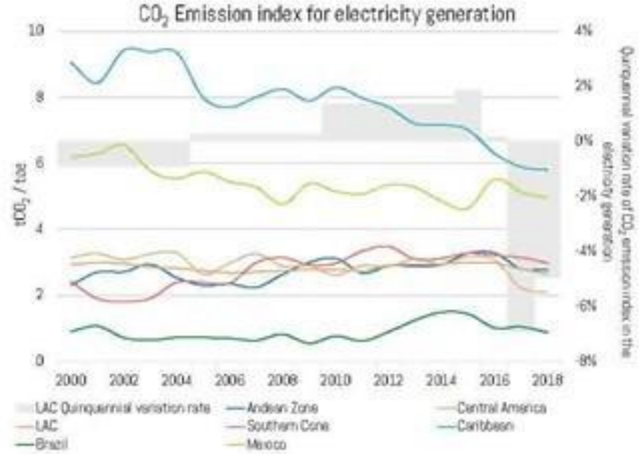
Evolution of CO_2 emissions per unit of GDP



CO_2 emission index per consumed energy

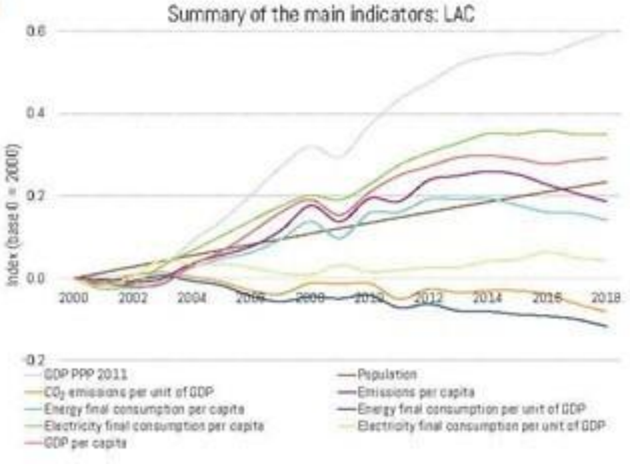


CO_2 Emission index for electricity generation

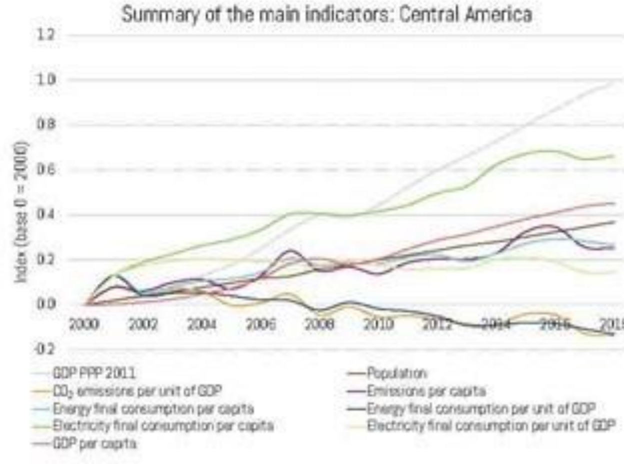


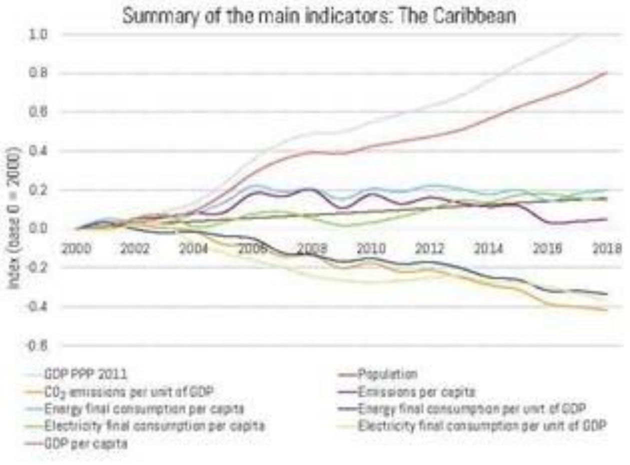
LAC

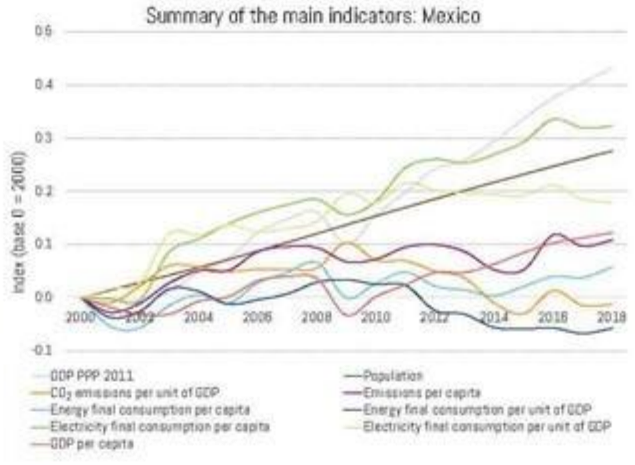
Summary of the main indicators: LAC

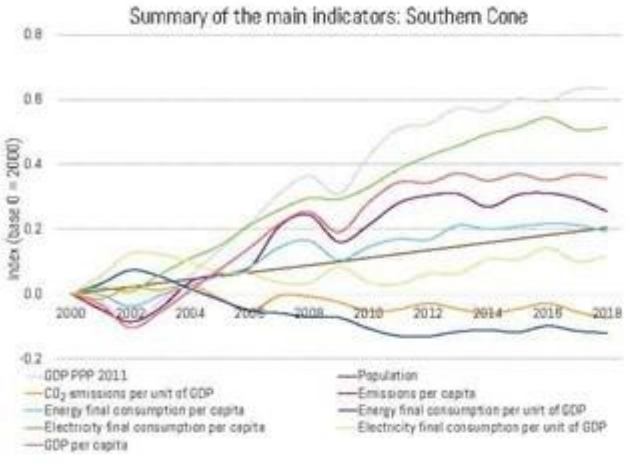


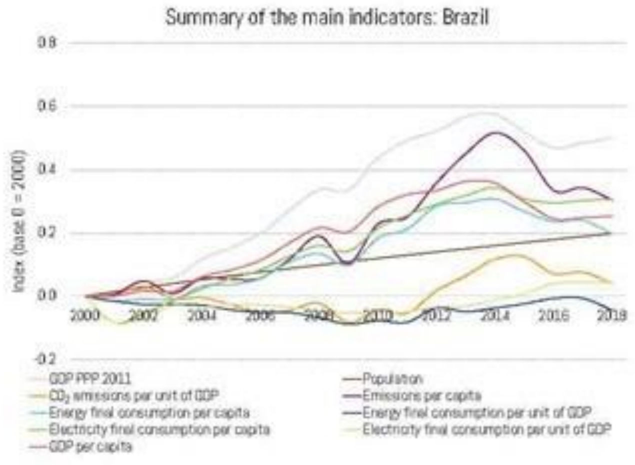
Summary of the main indicators: Central America

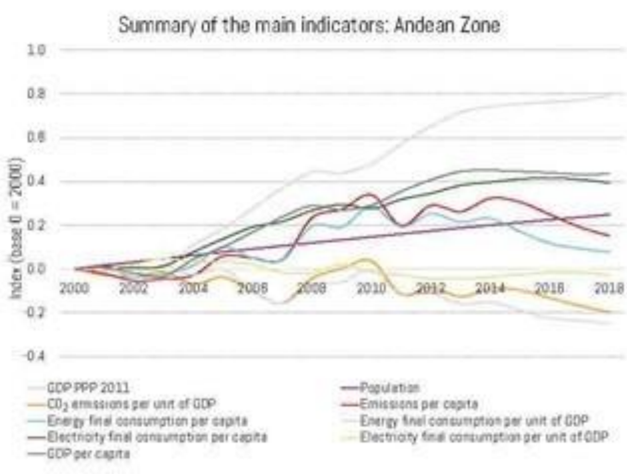



Summary of the main indicators: The Caribbean
Index (base 0 = 2000)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

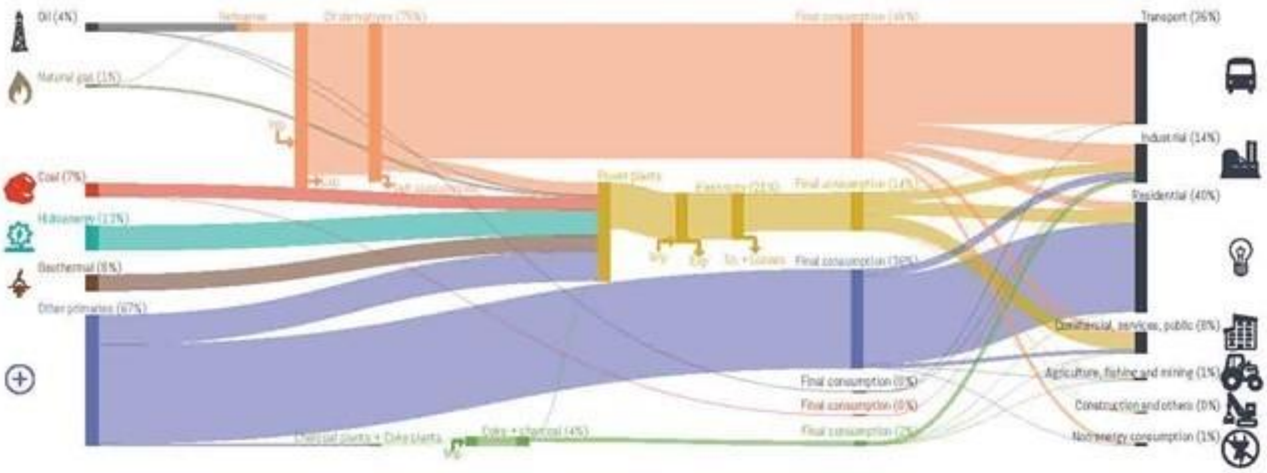

Summary of the main indicators: Mexico
Index (base 0 = 2000)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP


Summary of the main indicators: Southern Cone
Index (base 0 = 2000)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

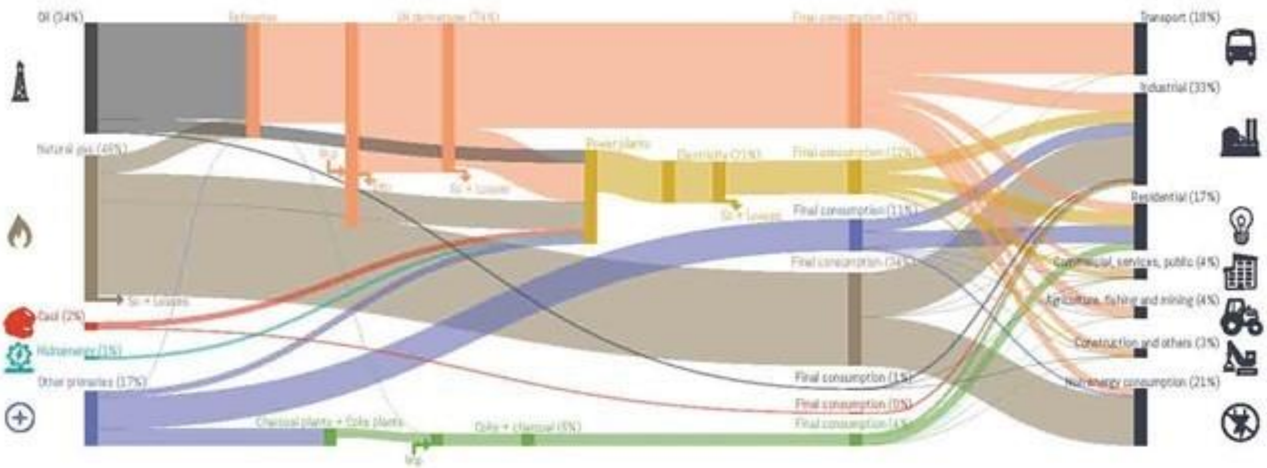

Summary of the main indicators: Brazil
Index (base 0 = 2000)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP


Summary of the main indicators: Andean Zone
Index (base 0 = 2000)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

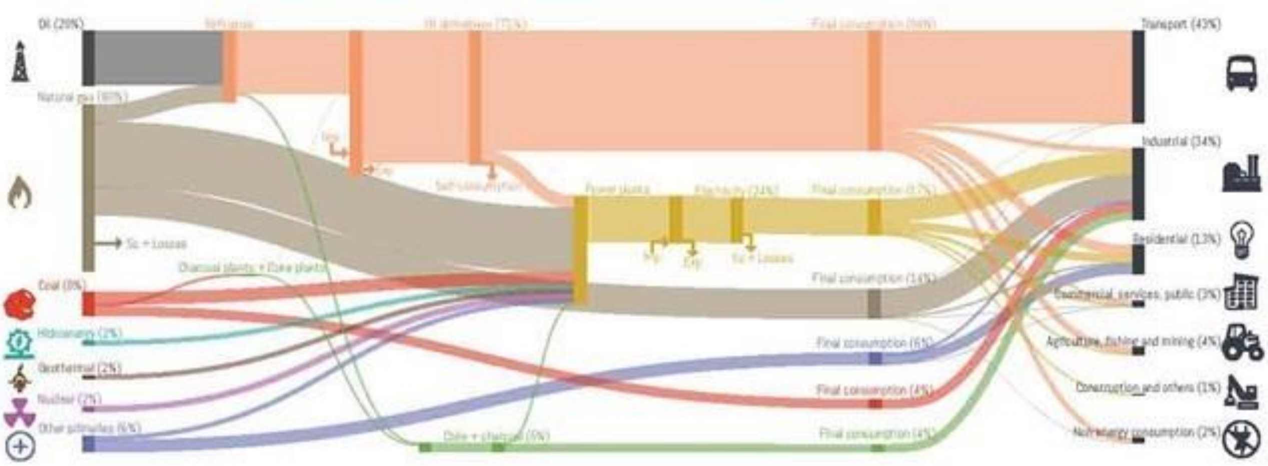
Summarized energy matrix: Central America - 2018 | Total energy supply: 37,903 ktoe



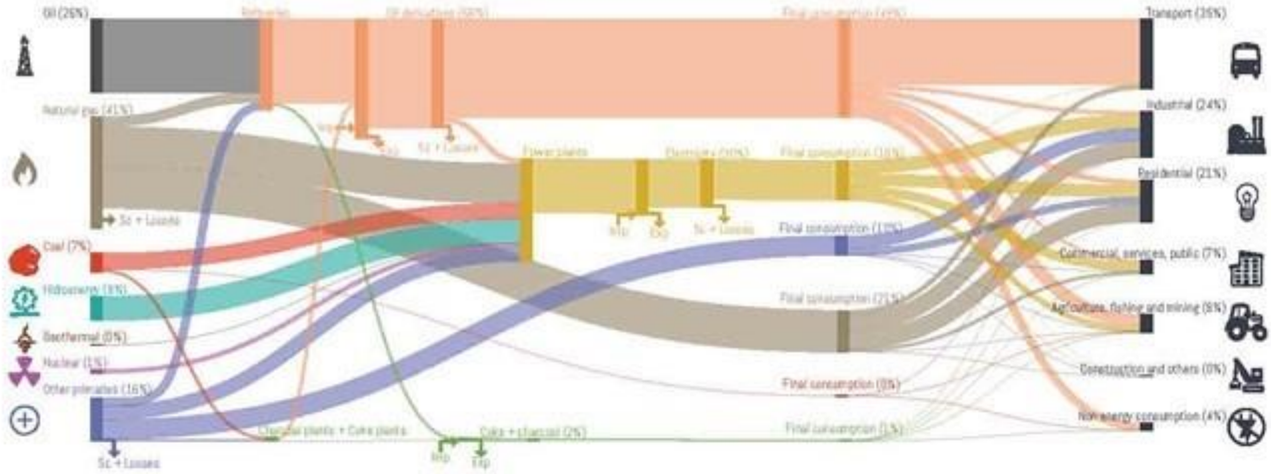
Summarized energy matrix: Caribbean - 2018 | Total energy supply: 46,240 ktoe



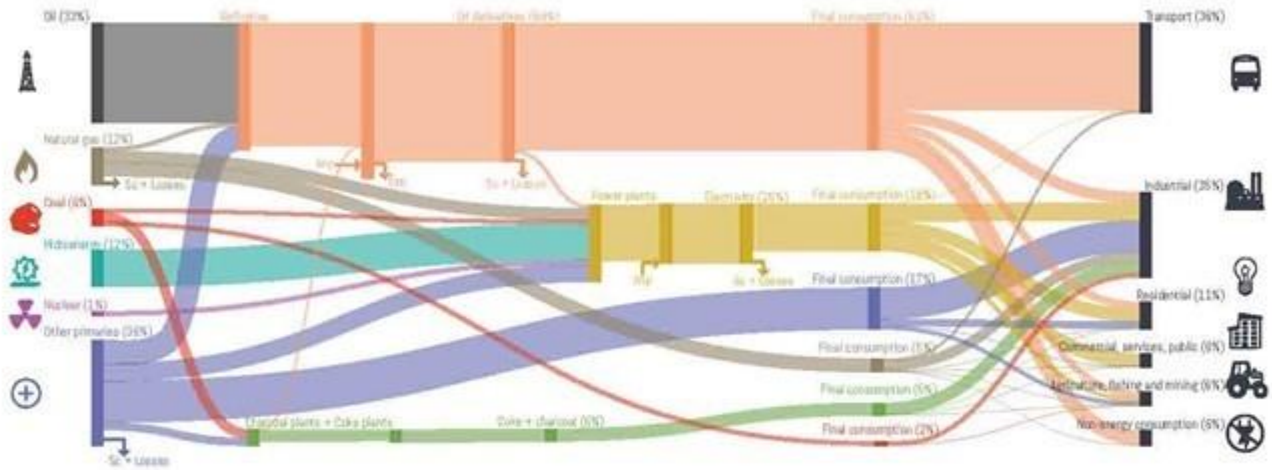
Summarized energy matrix: Mexico - 2018 | Total energy supply: 223,241 ktoe



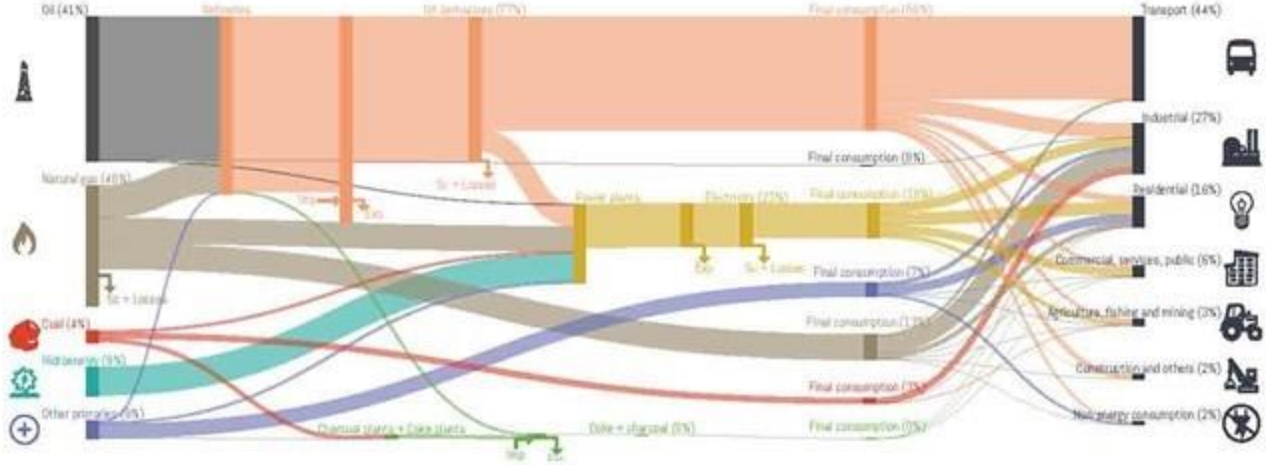
Summarized energy matrix: Southern Cone - 2018 | Total energy supply: 138,536 ktoe

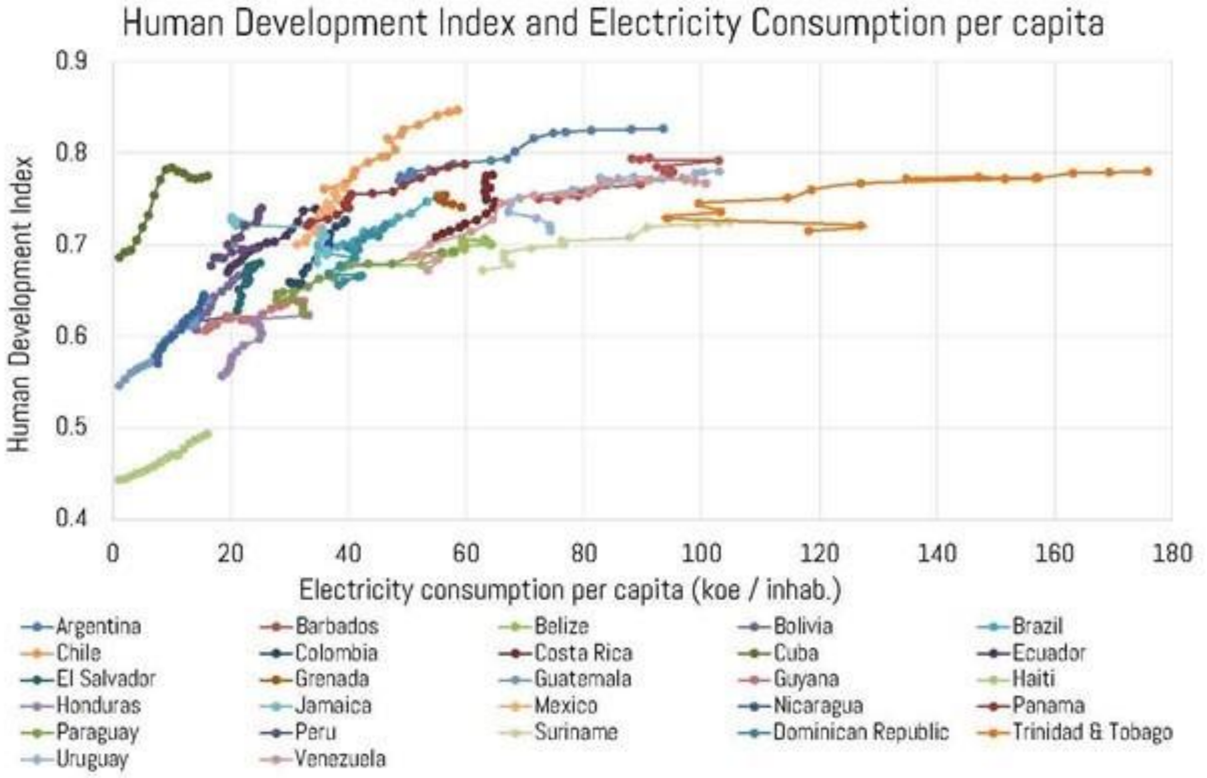


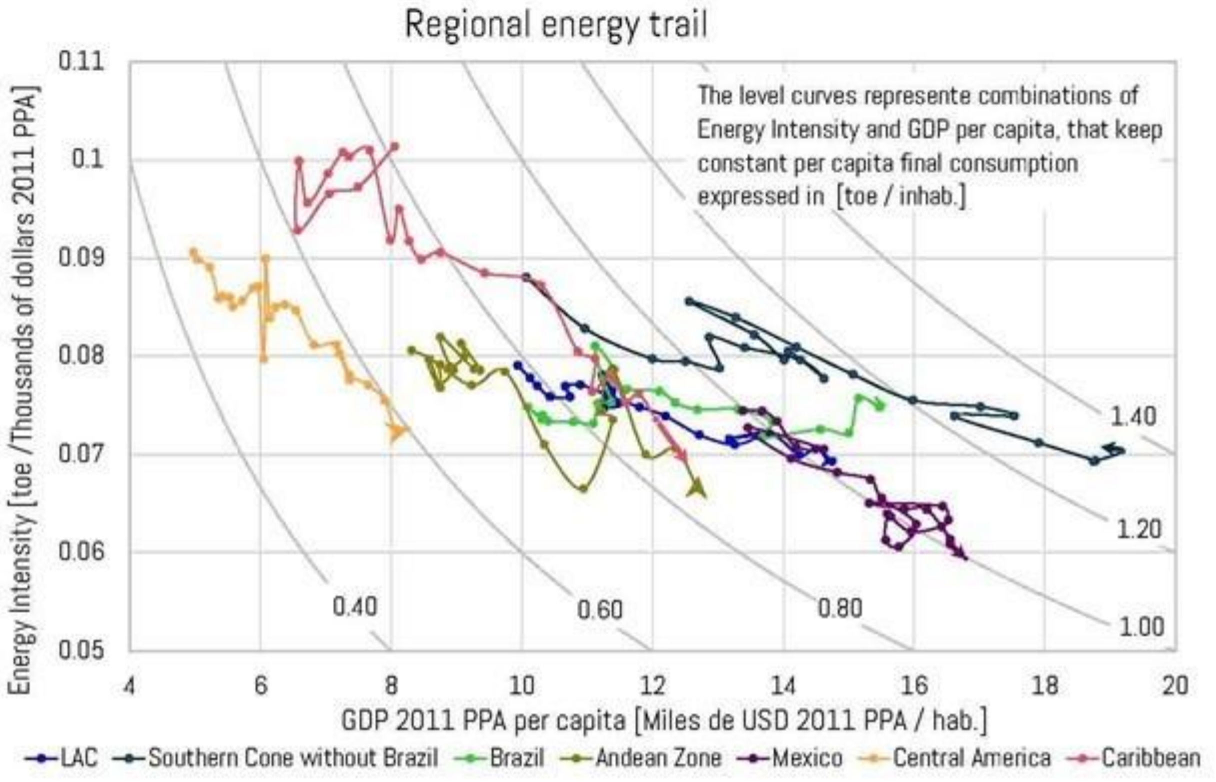
Summarized energy matrix: Brazil - 2018 | Total energy supply: 289,845 ktoe



Summarized energy matrix: Andean Zone - 2018 | Total energy supply: 149,904 ktoe




Human Development Index and Electricity Consumption per capita
Human Development Index
Electricity consumption per capita (koe / inhab.)
Argentina
Barbados
Belize
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Ecuador
El Salvador
Grenada
Guatemala
Guyana
Haiti
Honduras
Jamaica
Mexico
Nicaragua
Panama
Paraguay
Peru
Suriname
Dominican Republic
Trinidad & Tobago
Uruguay
Venezuela


Regional energy trail
The level curves represente combinations of Energy Intensity and GDP per capita, that keep constant per capita final consumption expressed in [toe / inhab.]
Energy Intensity [toe /Thousands of dollars 2011 PPA]
GDP 2011 PPA per capita [Miles de USD 2011 PPA / hab.]
0.40
0.60
0.80
1.00
1.20
1.40
LAC
Southern Cone without Brazil
Brazil
Andean Zone
Mexico
Central America
Caribbean

Energy profile of Member Countries

ARGENTINA

General Information 2018

Population (thousand inhab.)	44,361
Area (km²)	2,780,400
Population Density (inhab./km²)	16
Urban Population (%)	92
GDP USD 2010 (MUSD)	449,898
GDP USD 2011 PPP (MUSD)	813,453
GDP per Capita (thou. USD 2011 PPP/inhab.)	18

Energy Sector

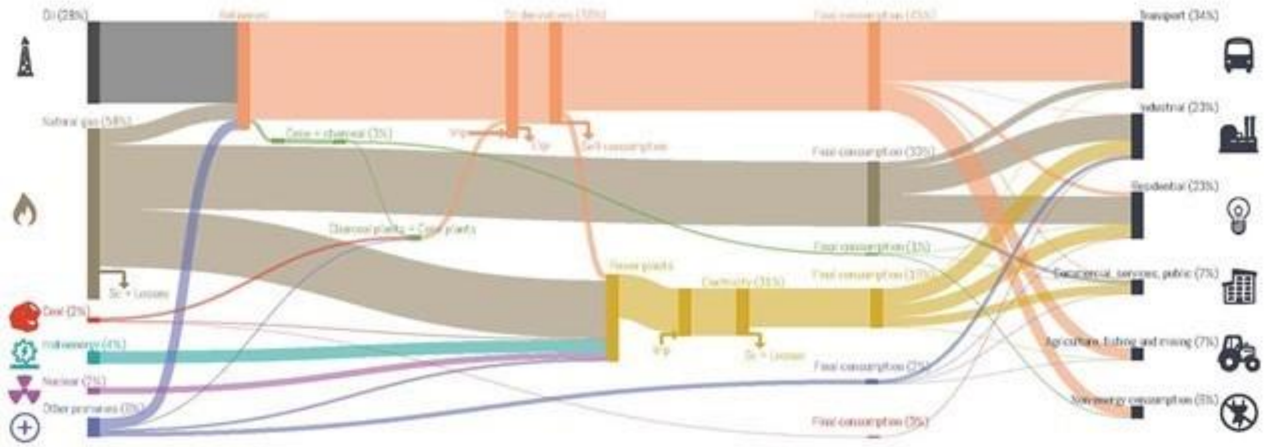
	Mtoe
Final consumption in the Transport Sector	19.12
Final consumption in the Industrial Sector	13.06
Final consumption in the Residential Sector	13.24
Final consumption in the Commercial and Service Sector	4.25
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	7.12

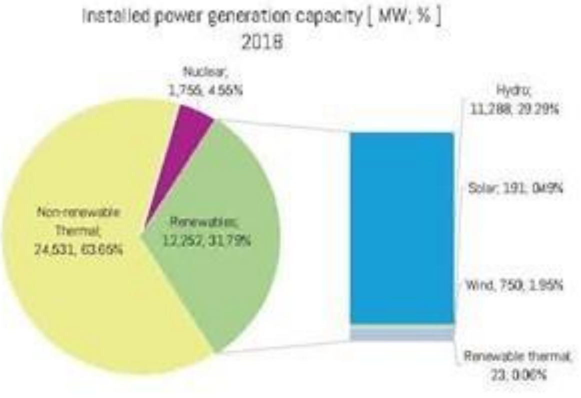
Oil reserves	Natural gas reserves	Coal reserves
2,389 Mbbl	372 Gm³	421* Mt

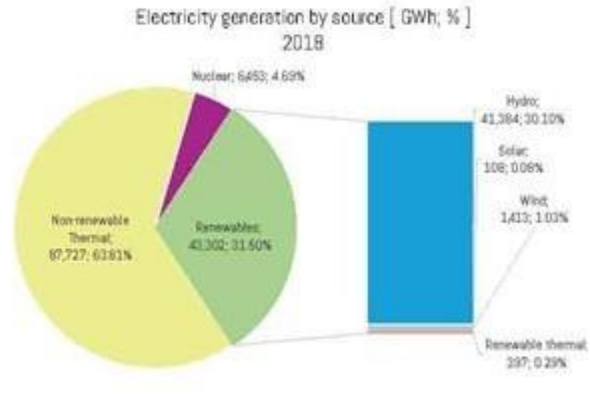
* Data corresponding to the year 2017.

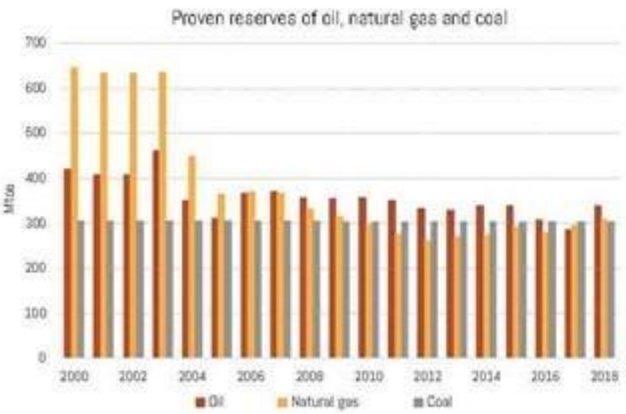
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,902	1.28	98.79	84.33	75.51	16.52	7.42	56.79	612	38.54	0.10 / 0.07

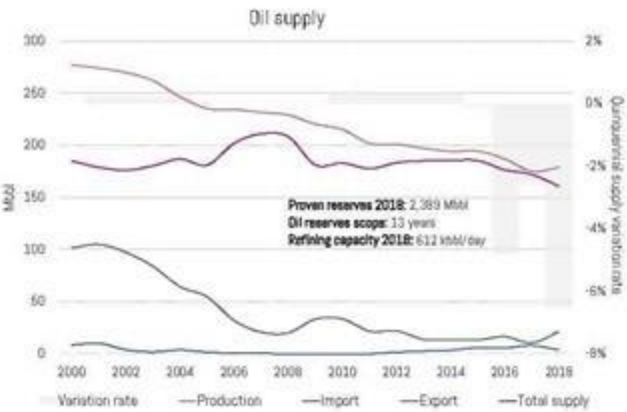
Summarized energy balance 2018

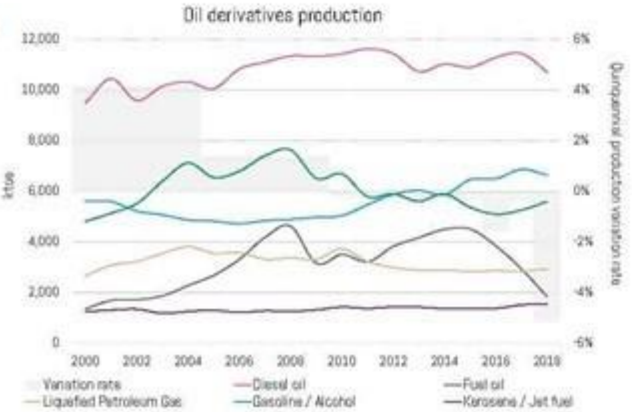


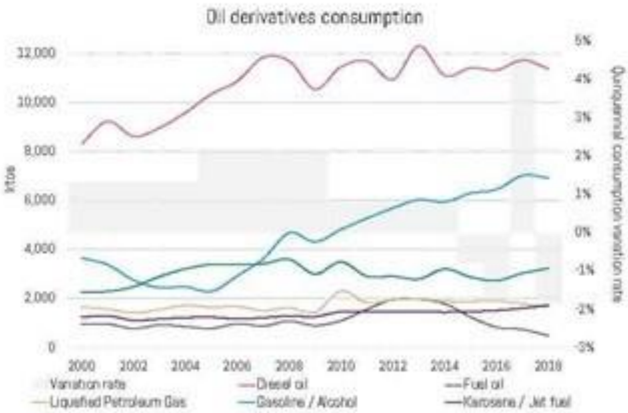

Installed power generation capacity [MW; %]
2018
Nuclear; 1,756; 4.56%
Non-renewable Thermal; 24,531; 63.65%
Renewables; 12,252; 31.79%
Hydro; 11,288; 29.29%
Solar; 191; 0.49%
Wind; 750; 1.95%
Renewable thermal; 23; 0.06%

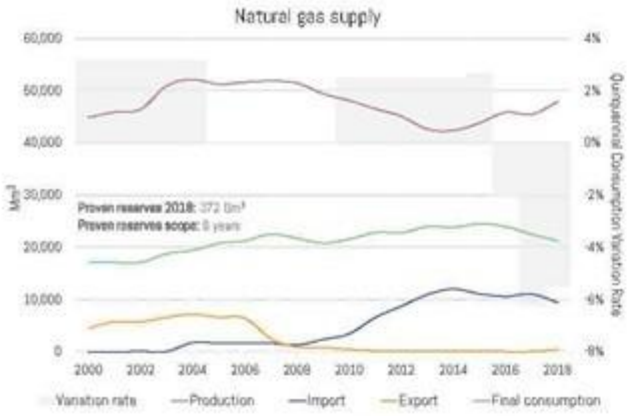

Electricity generation by source [GWh; %]
2018
Nuclear; 6,453; 4.69%
Non-renewable Thermal; 87,727; 63.81%
Renewables; 43,302; 31.50%
Hydro; 41,384; 30.10%
Solar; 108; 0.08%
Wind; 1,413; 1.03%
Renewable thermal; 397; 0.29%

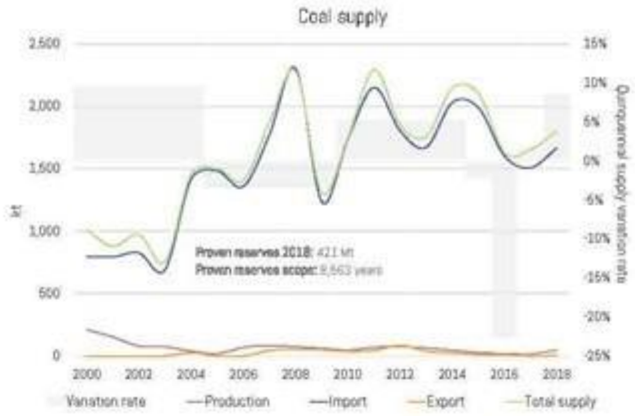

Proven reserves of oil, natural gas and coal
Mtoe
Oil
Natural gas
Coal

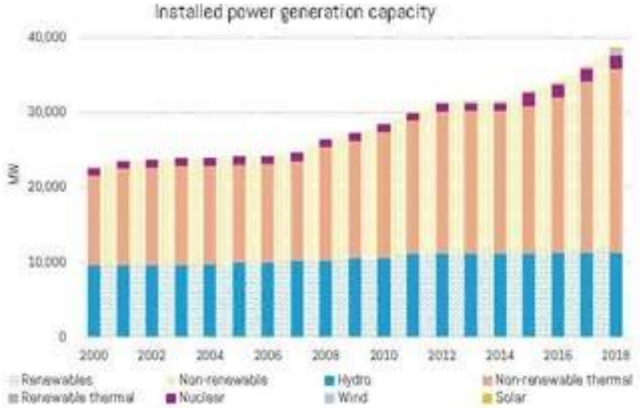

Oil supply
Mbbl
Quinquennial supply variation rate
Proven reserves 2018: 2,389 Mbbl
Oil reserves scope: 13 years
Refining capacity 2018: 612 kbbl/day
Variation rate
Production
Import
Export
Total supply

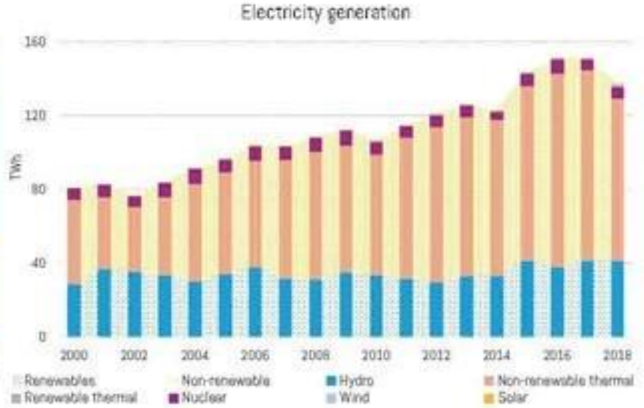

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Liquefied Petroleum Gas
Diesel oil
Gasoline / Alcohol
Fuel oil
Kerosene / Jet fuel

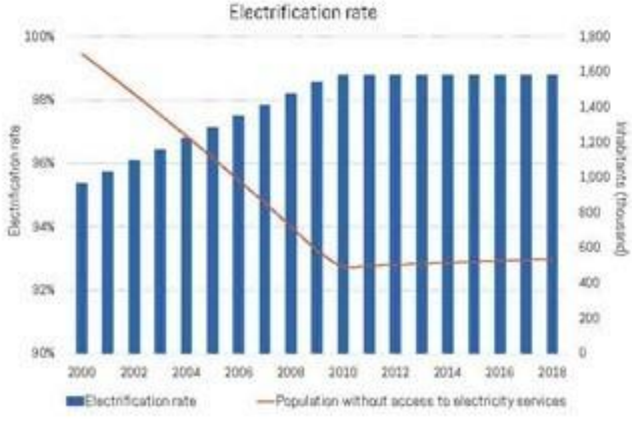

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Liquefied Petroleum Gas
Diesel oil
Gasoline / Alcohol
Fuel oil
Kerosene / Jet fuel

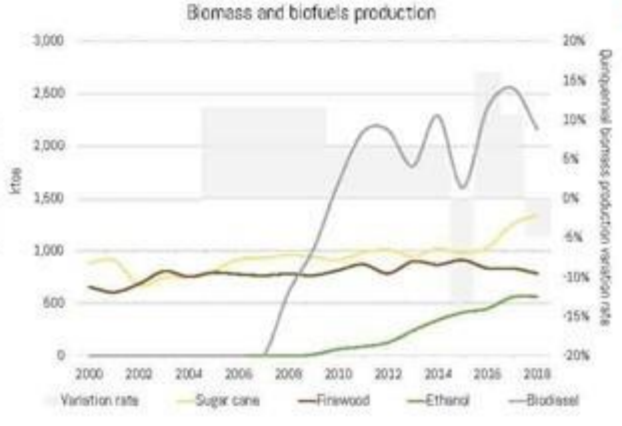

Natural gas supply
Mm³
Quinquennial Consumption Variation Rate
Proven reserves 2018: 372 Gm³
Proven reserves scope: 8 years
Variation rate
Production
Import
Export
Final consumption


Coal supply
kt
Quinquennial supply variation rate
Proven reserves 2018: 421 Mt
Proven reserves scope: 8,563 years
Variation rate
Production
Import
Export
Total supply

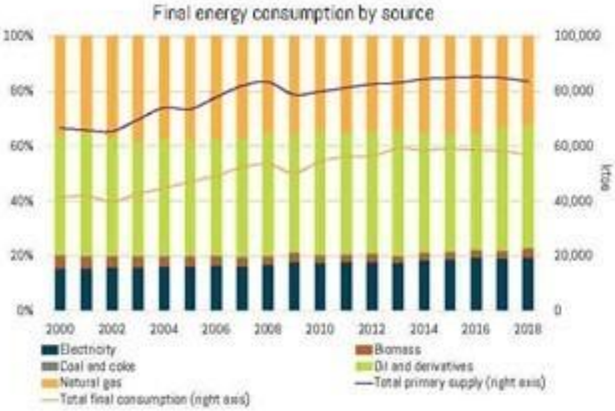

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Nuclear
Wind
Solar

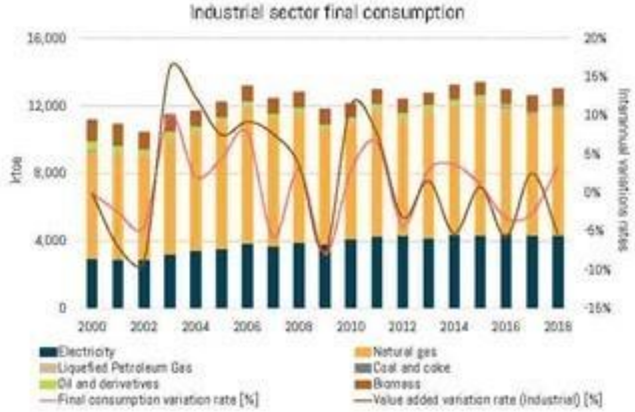

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Nuclear
Wind
Solar

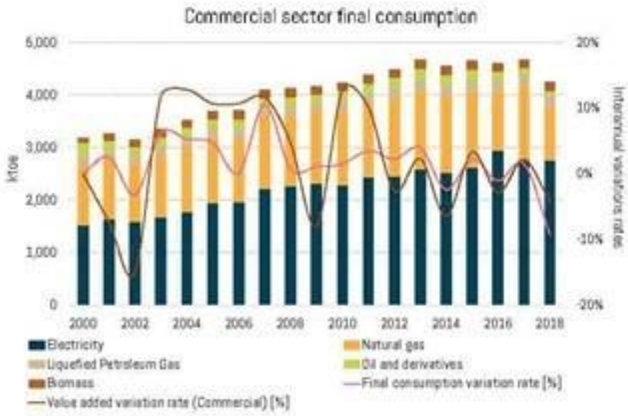

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services

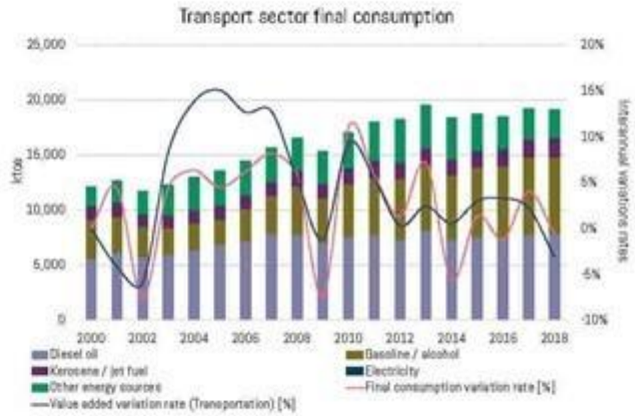

Biomass and biofuels production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood
Ethanol
Biodiesel

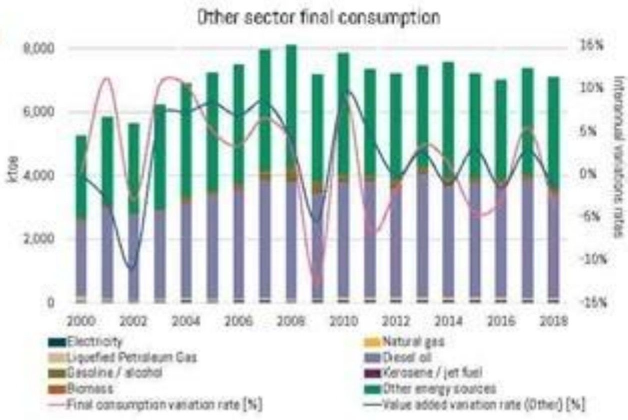
ARGENTINA

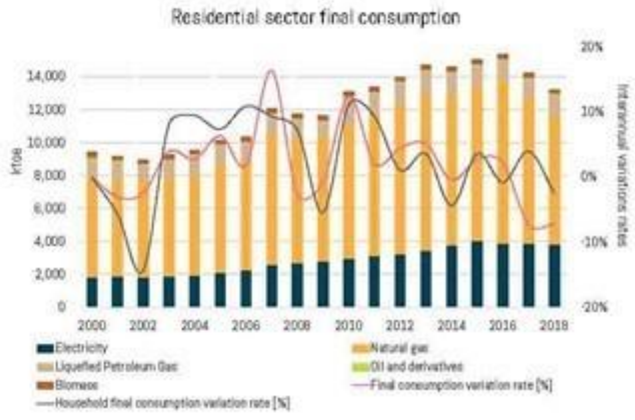

Final energy consumption by source
ktoe
Electricity
Coal and coke
Natural gas
Total final consumption (right axis)
Biomass
Oil and derivatives
Total primary supply (right axis)

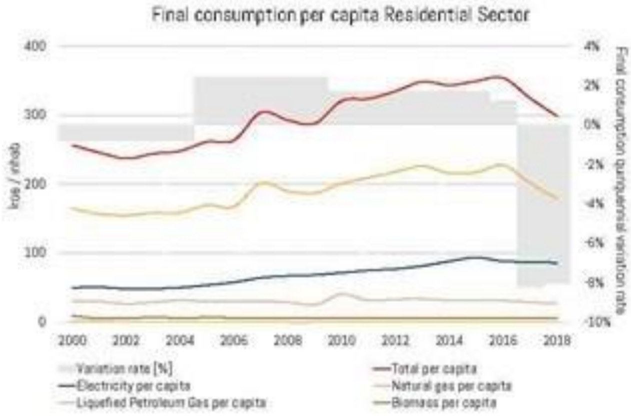

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]

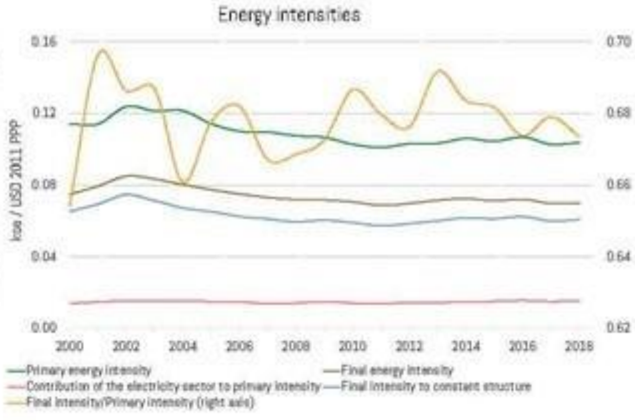

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

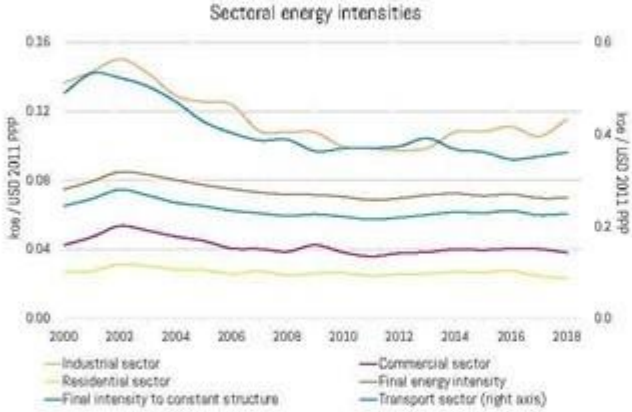

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Other energy sources
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

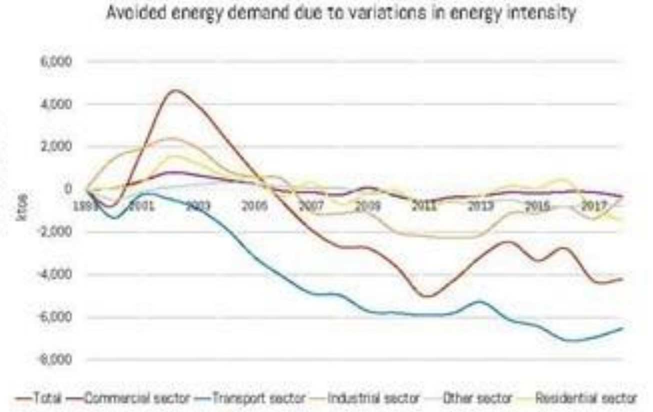

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Gasoline / alcohol
Biomass
Final consumption variation rate [%]
Natural gas
Diesel oil
Kerosene / jet fuel
Other energy souices
Value added variation rate (Other) [%]

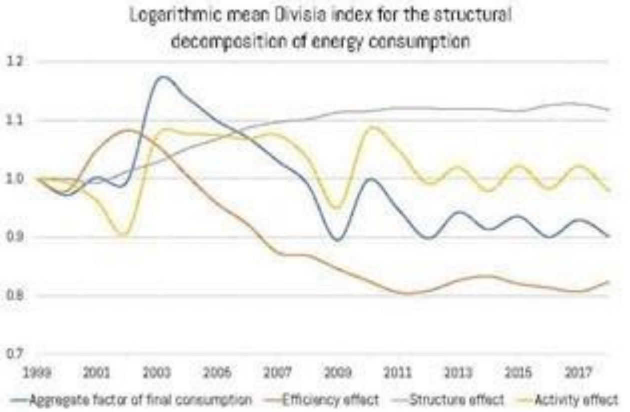

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

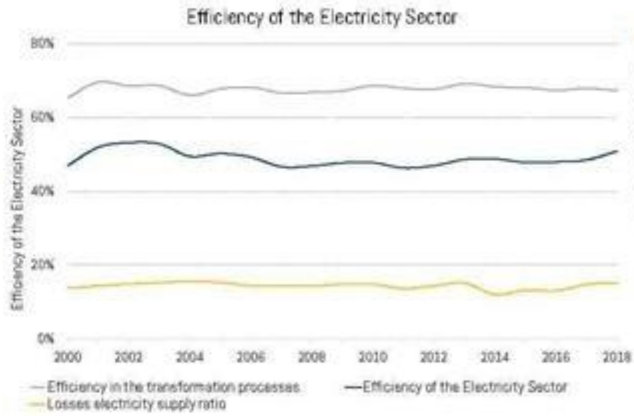

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Total per capita
Natural gas per capita
Biomass per capita

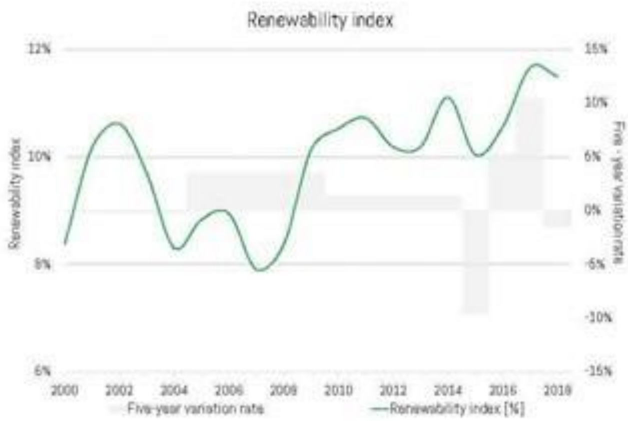

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

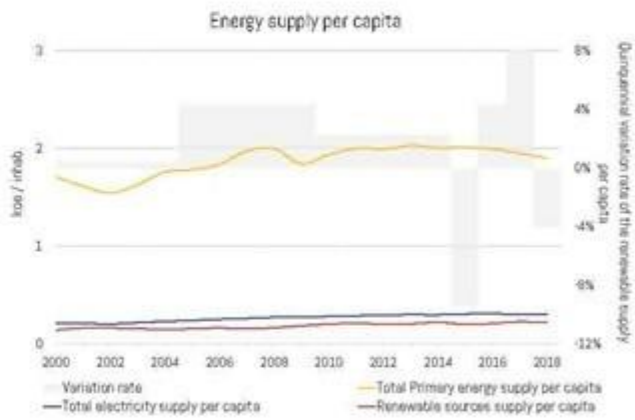

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

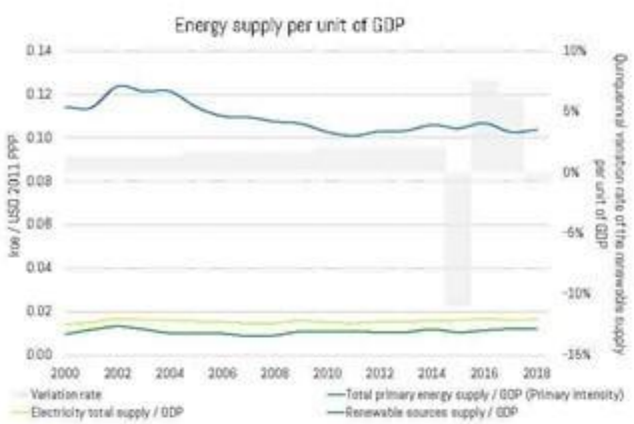

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

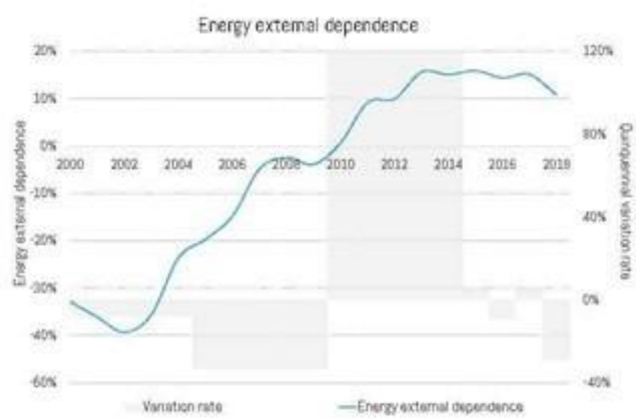

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

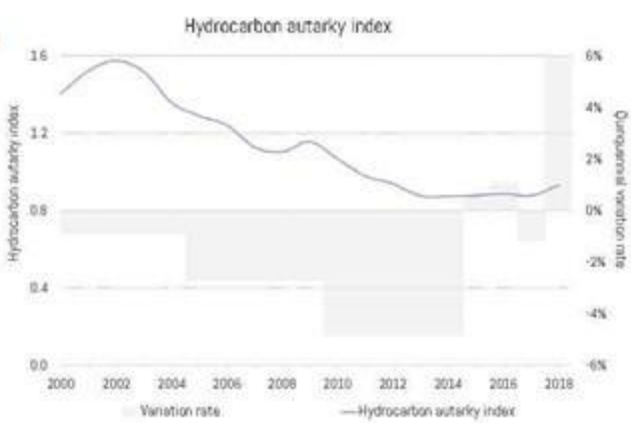

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

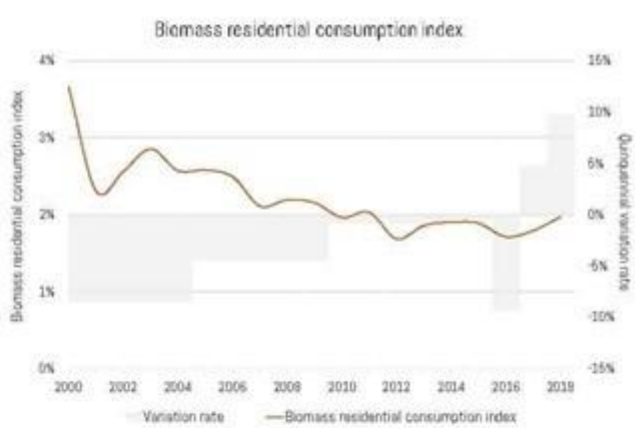

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

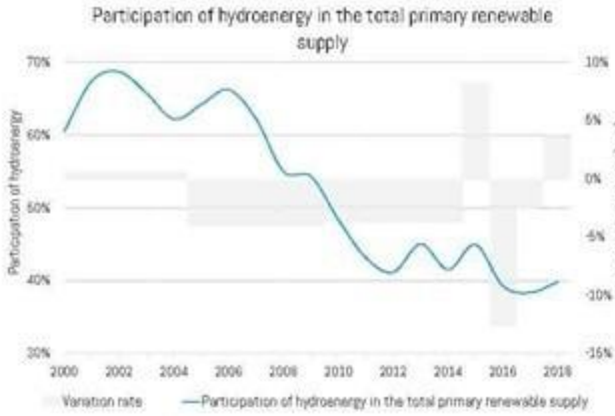

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

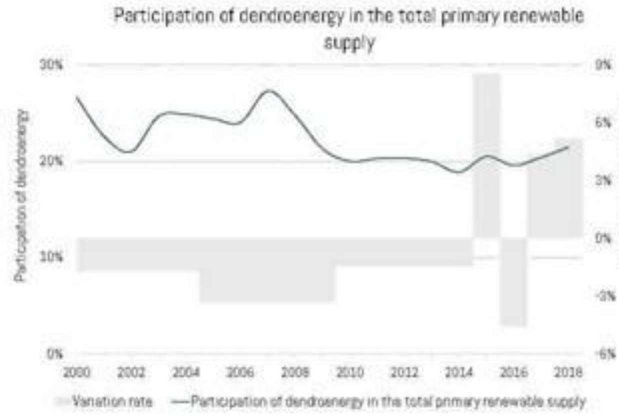

Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

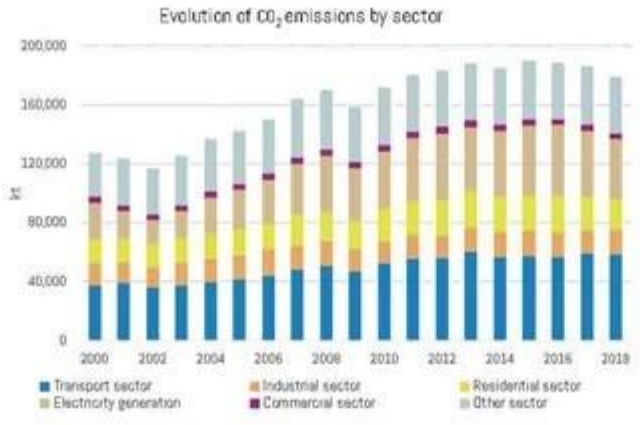

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

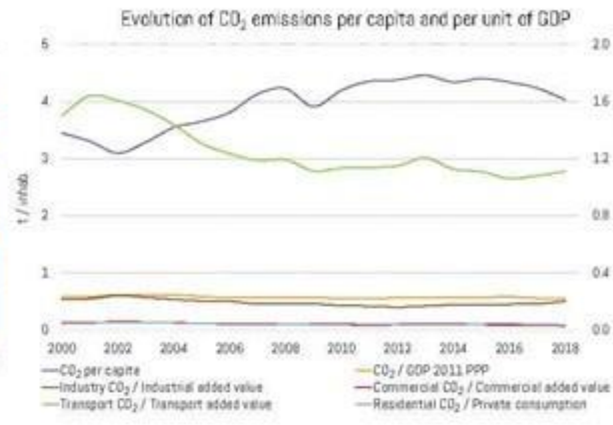

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

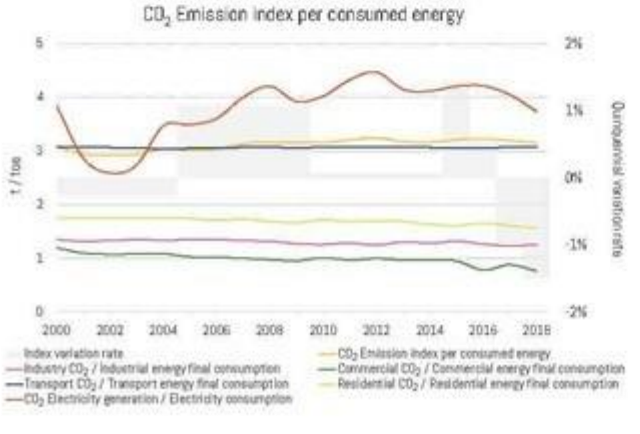

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

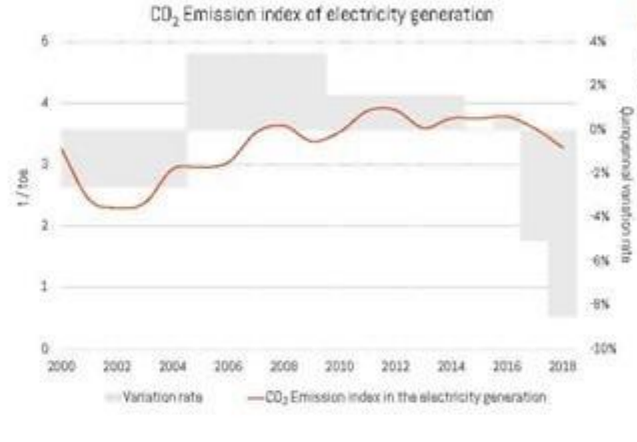

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

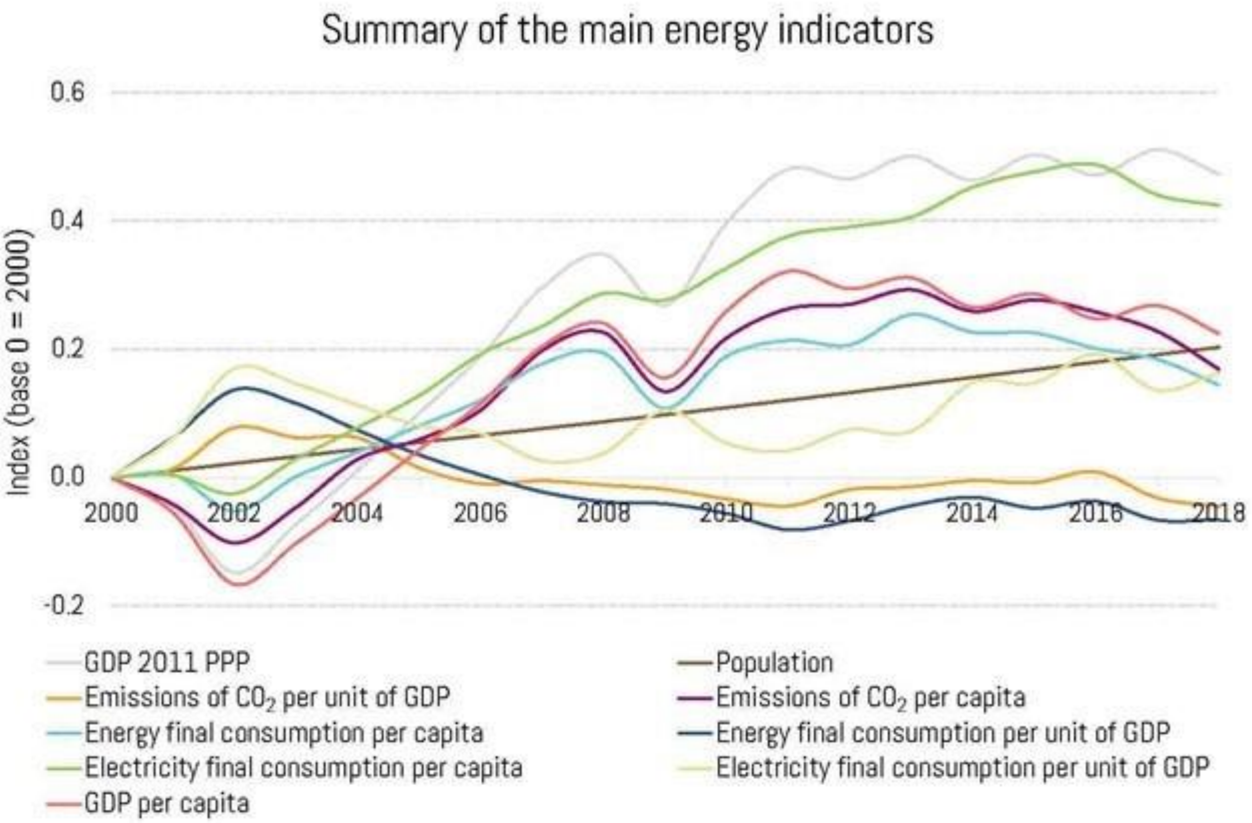

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO2 per capita
CO2 / GDP 2011 PPP
Industry CO2 / Industrial added value
Commercial CO2 / Commercial added value
Transport CO2 / Transport added value
Residential CO2 / Private consumption


CO2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO2 Emission index per consumed energy
Industry CO2 / Industrial energy final consumption
Commercial CO2 / Commercial energy final consumption
Transport CO2 / Transport energy final consumption
Residential CO2 / Residential energy final consumption
CO2 Electricity generation / Electricity consumption


CO2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

BARBADOS

General Information 2018

Population (thousand inhab.)	287
Area (km²)	430
Population Density (inhab./km²)	667
Urban Population (%)	69
GDP USD 2010 (MUSD)	4,828
GDP USD 2011 PPP (MUSD)	4,868
GDP per Capita (thou. USD 2011 PPP/inhab.)	17

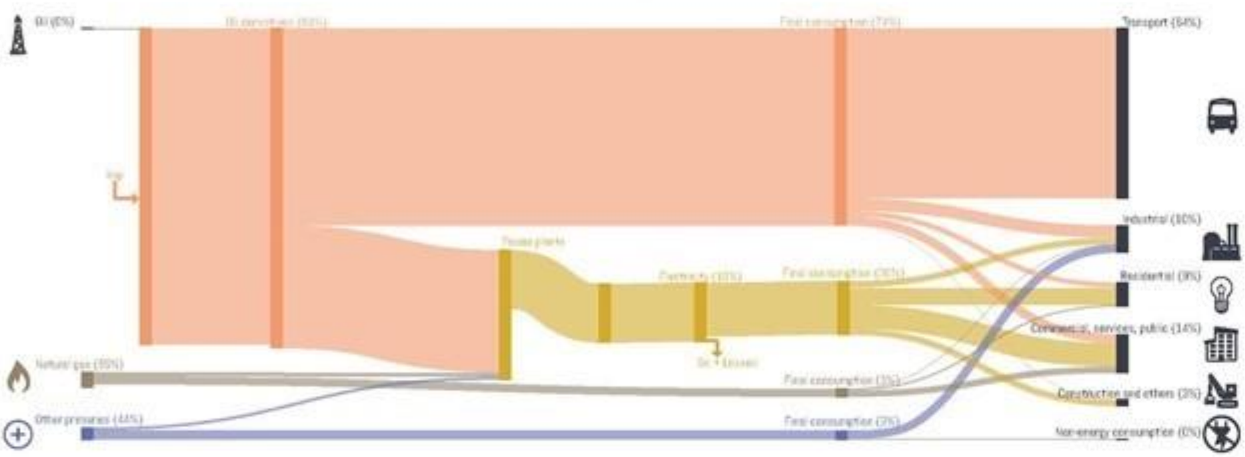
Energy Sector

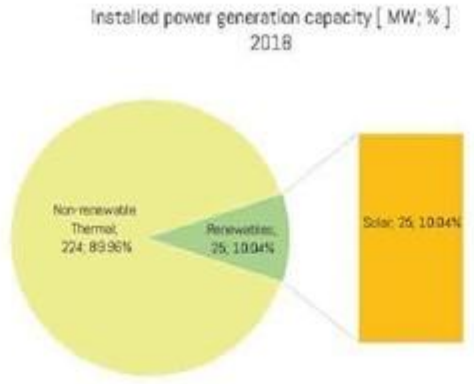
Final consumption in the Transport Sector	Mtoe 0.28
Final consumption in the Industrial Sector	Mtoe 0.04
Final consumption in the Residential Sector	Mtoe 0.04
Final consumption in the Commercial and Service Sector	Mtoe 0.06
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.01

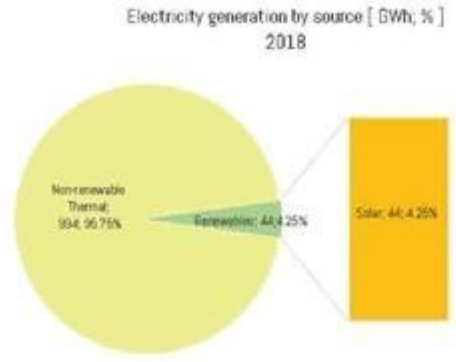
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 2.2	Gm³ 0.14	Mt n.a.

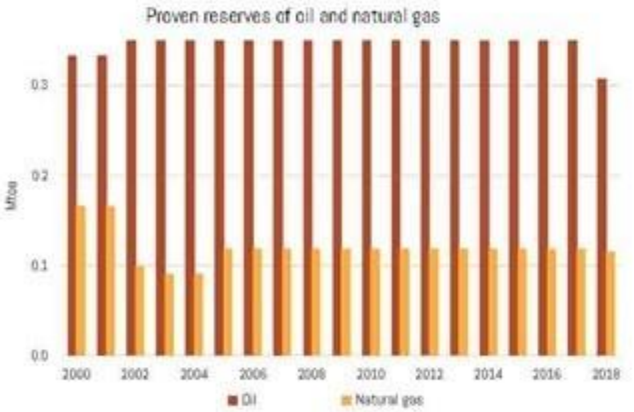
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
3,288	1.41	99.80	0.52	0.07	0.48	0.03	0.40	0.6	0.25	0.11 / 0.08

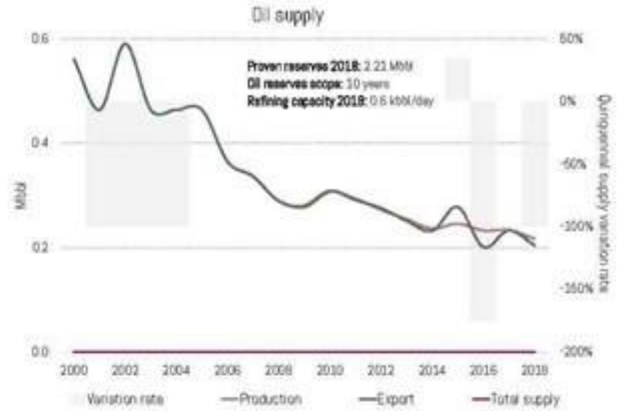
Summarized energy balance 2018

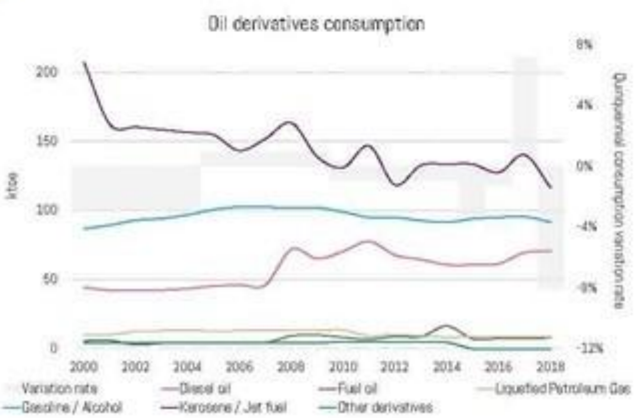


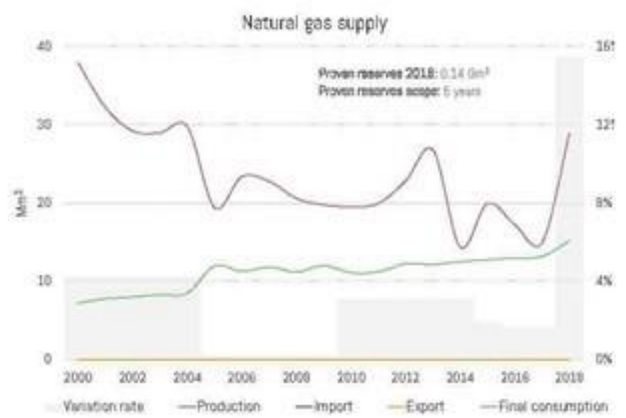

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 224; 89.96%
Renewables; 25; 10.04%
Solar; 25; 10.04%

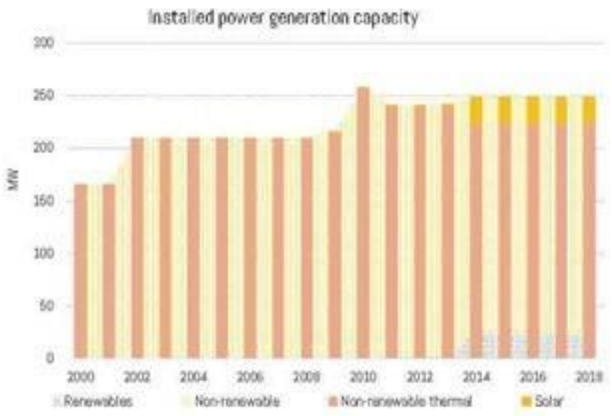

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 994; 95.75%
Renewables; 44; 4.25%
Solar; 44; 4.25%

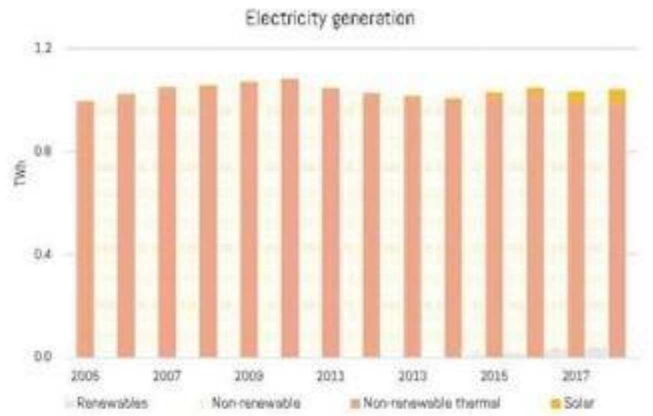

Proven reserves of oil and natural gas
Mtoe
Oil
Natural gas

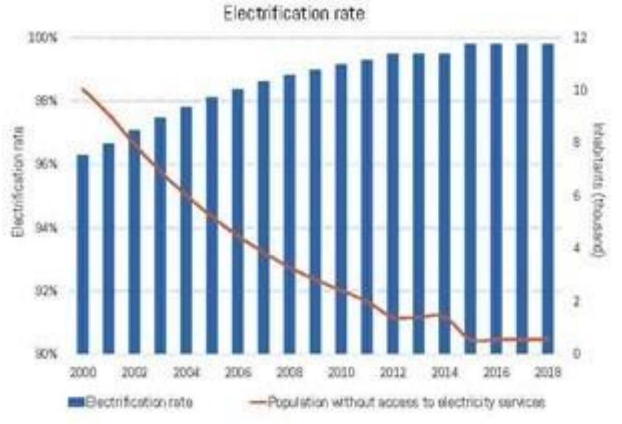

Oil supply
Mbbl
Proven reserves 2018: 2.21 Mbbl
Oil reserves scope: 10 years
Refining capacity 2018: 0.6 kbbl/day
Quinquennial supply variation rate
Variation rate
Production
Export
Total supply

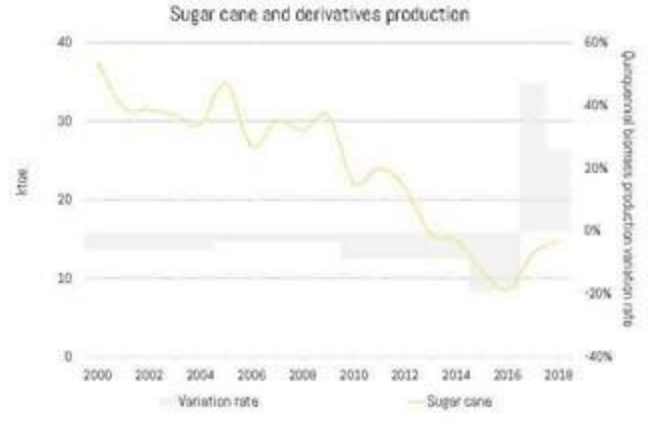

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

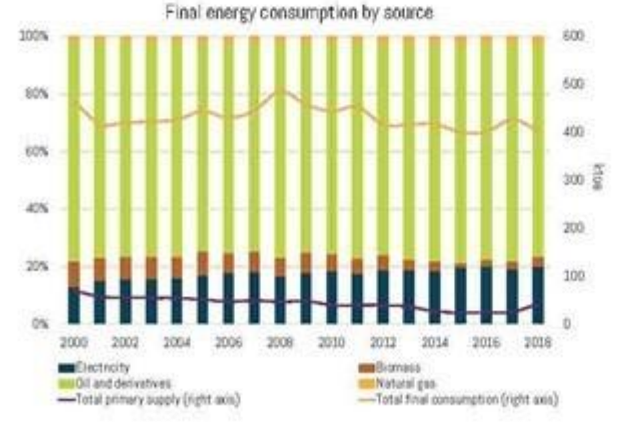

Natural gas supply
Mm³
Proven reserves 2018: 0.14 Gm³
Proven reserves scope: 6 years
Variation rate
Production
Import
Export
Final consumption

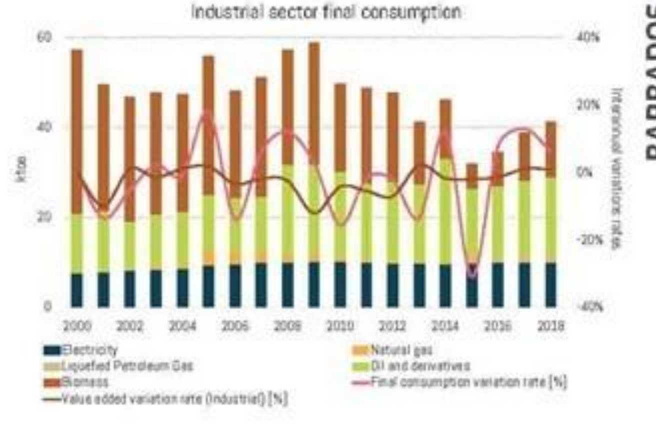

Installed power generation capacity
MW
Renewables
Non-renewable
Non-renewable thermal
Solar

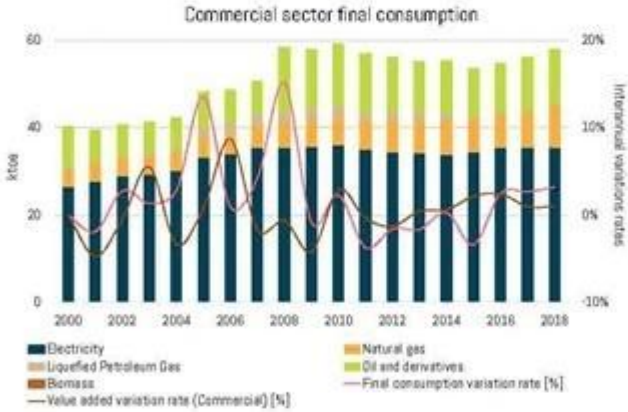

Electricity generation
TWh
Renewables
Non-renewable
Non-renewable thermal
Solar

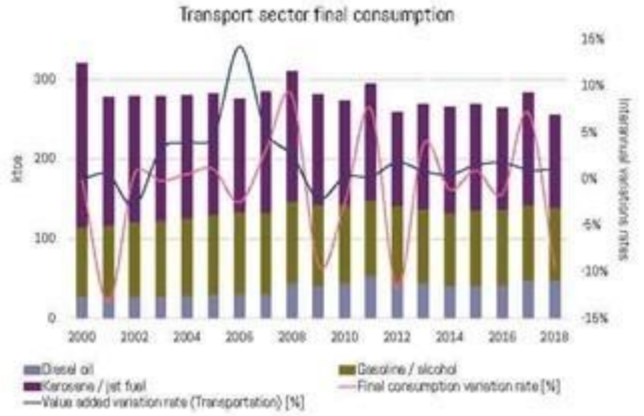

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services


Sugar cane and derivatives production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane

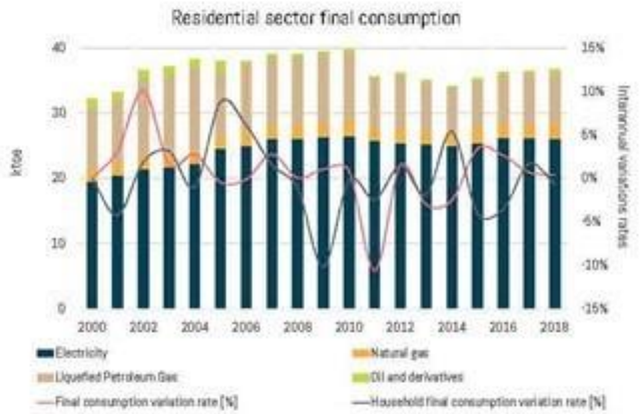

Final energy consumption by source
ktoe
Electricity
Oil and derivatives
Total primary supply (right axis)
Biomass
Natural gas
Total final consumption (right axis)


Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

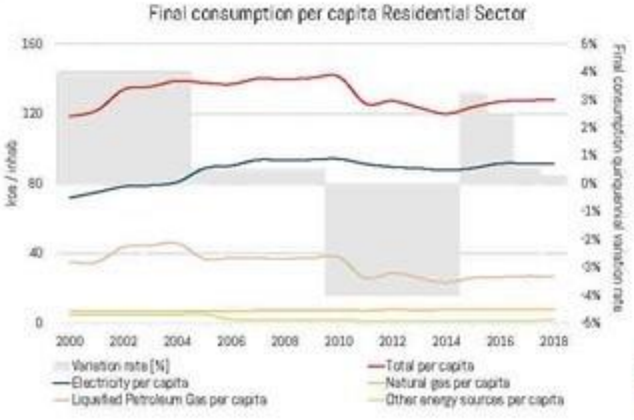

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

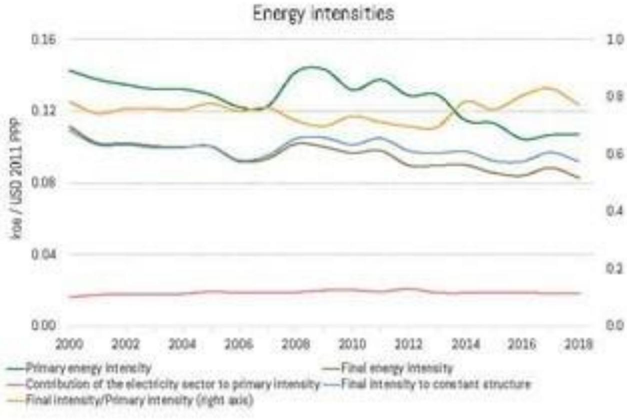

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Final consumption variation rate [%]

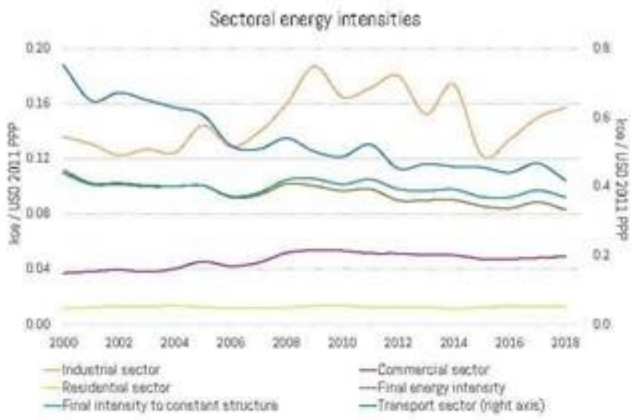

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Fuel oil
Value added variation rate (Other) [%]
Diesel oil
Final consumption variation rate [%]

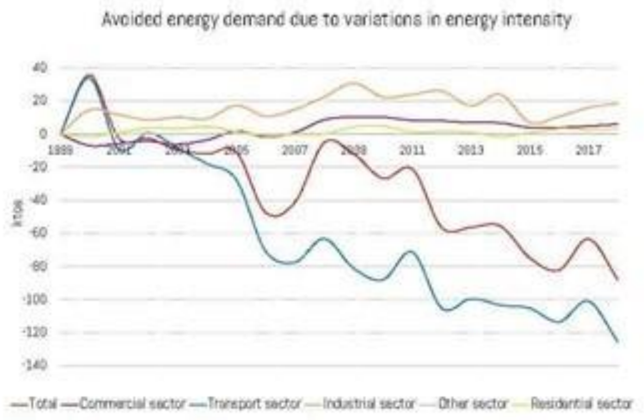

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Natural gas
Oil and derivatives
Household final consumption variation rate [%]

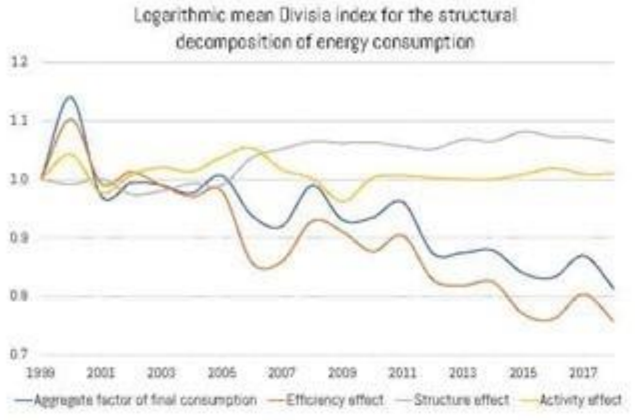
BARBADOS

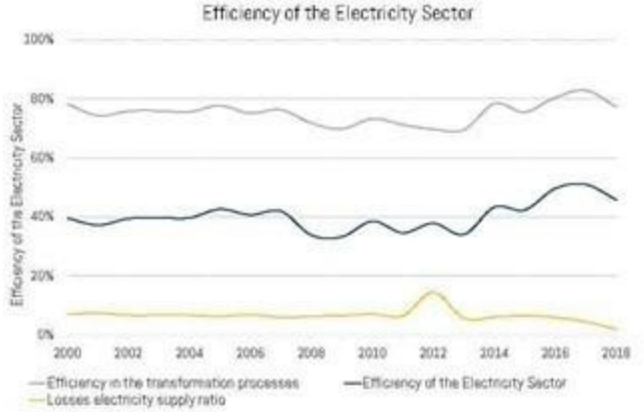

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Total per capita
Natural gas per capita
Other energy sources per capita

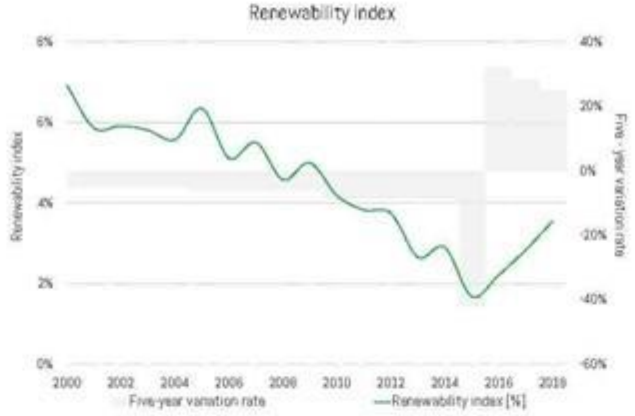

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Contribution of the electricity sector to primary intensity
Final intensity/Primary intensity (right axis)
Final energy intensity
Final intensity to constant structure

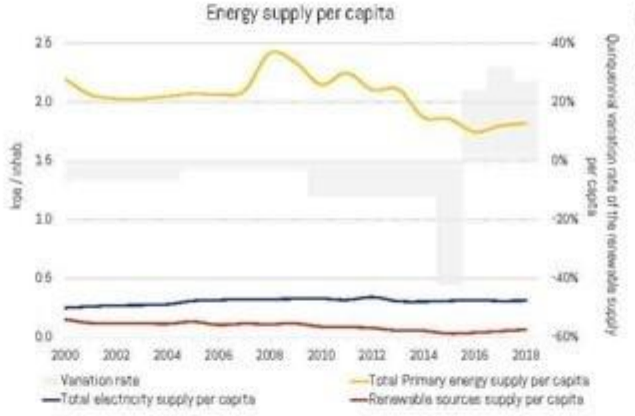

Sectoral energy intensities
toe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

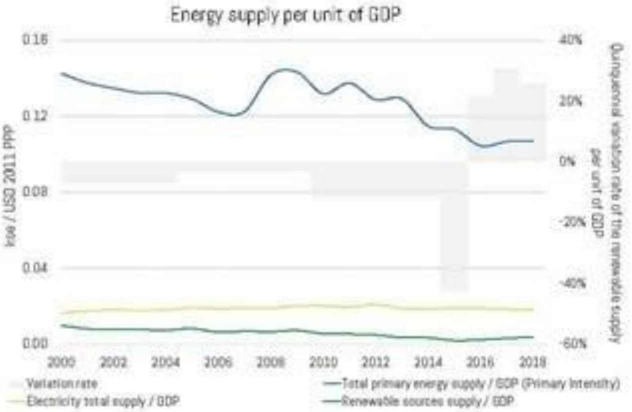

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

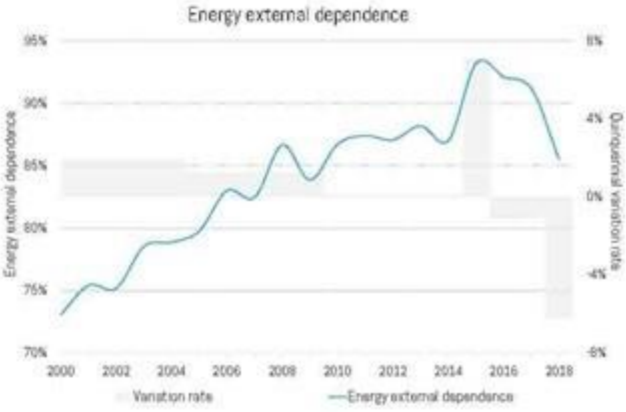

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

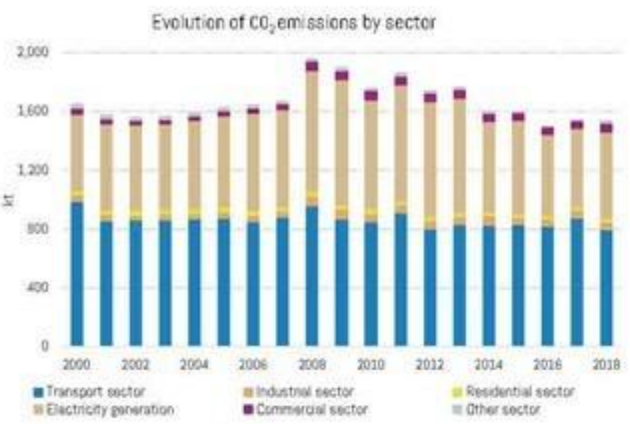

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

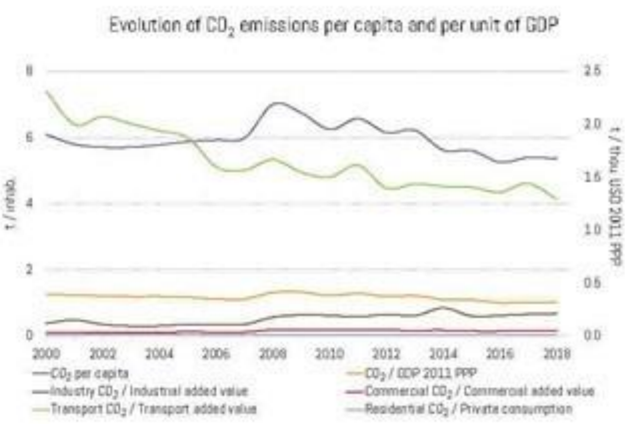

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

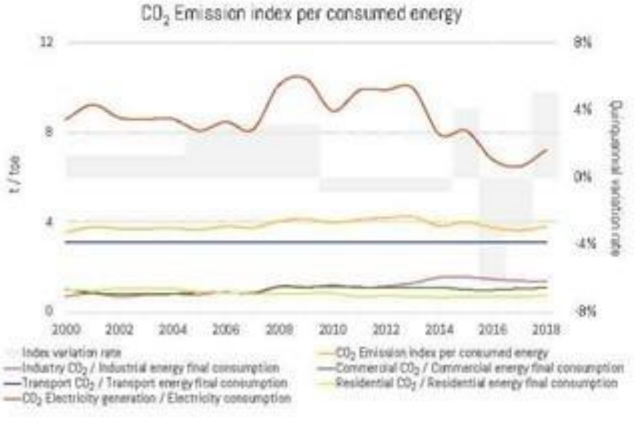

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total electricity supply per capita
Total Primary energy supply per capita
Renewable sources supply per capita

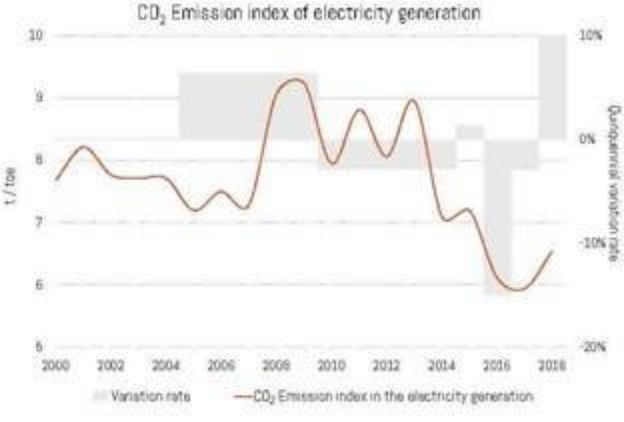

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Electricity total supply / GDP
Total primary energy supply / GDP (Primary Intensity)
Renewable sources supply / GDP

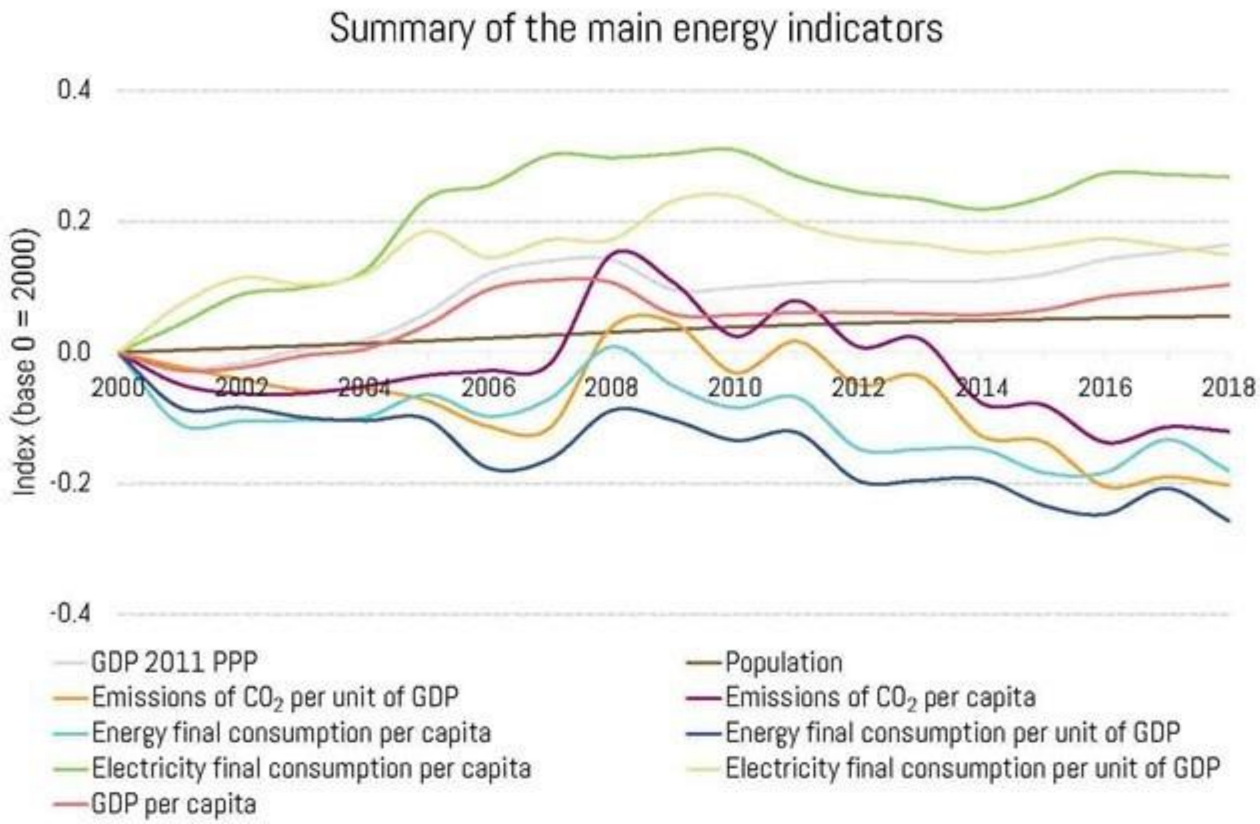

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence


Evolution of CO_2 emissions by sector
kt
Transport sector
Electricity generation
Industrial sector
Commercial sector
Residential sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO_2 per capita
Industry CO_2 / Industrial added value
Transport CO_2 / Transport added value
CO_2 / GDP 2011 PPP
Commercial CO_2 / Commercial added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
0.4
0.2
0.0
-0.2
-0.4
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

BARBADOS

BELIZE

General Information 2018

Population (thousand inhab.)	398
Area (km²)	22,970
Population Density (inhab./km²)	17
Urban Population (%)	45
GDP USD 2010 (MUSD)	1,651
GDP USD 2011 PPP (MUSD)	2,992
GDP per Capita (thou. USD 2011 PPP/inhab.)	8

Energy Sector

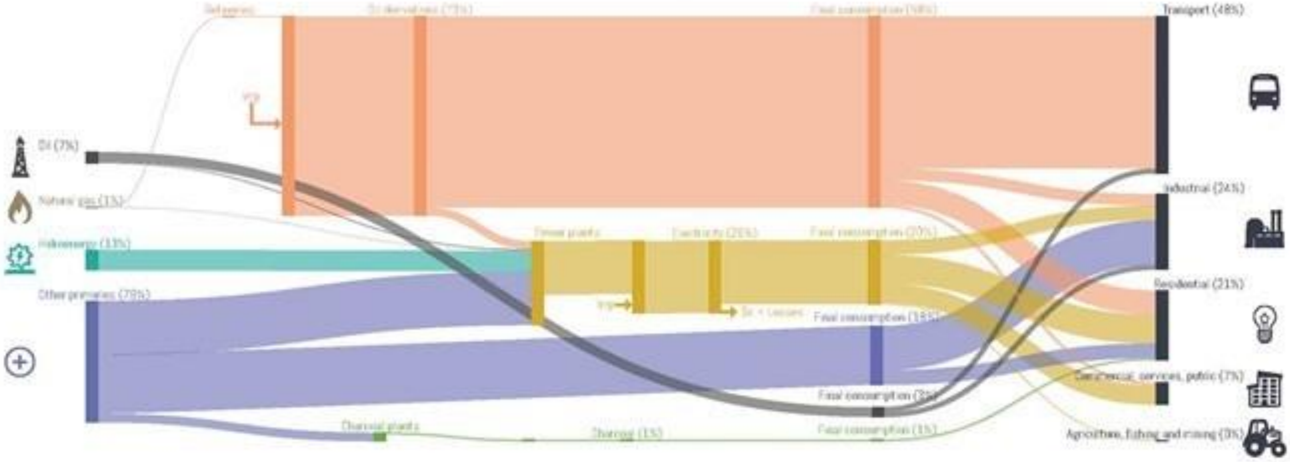
	Mtoe
Final consumption in the Transport Sector	0.16
Final consumption in the Industrial Sector	0.08
Final consumption in the Residential Sector	0.07
Final consumption in the Commercial and Service Sector	0.02
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.00

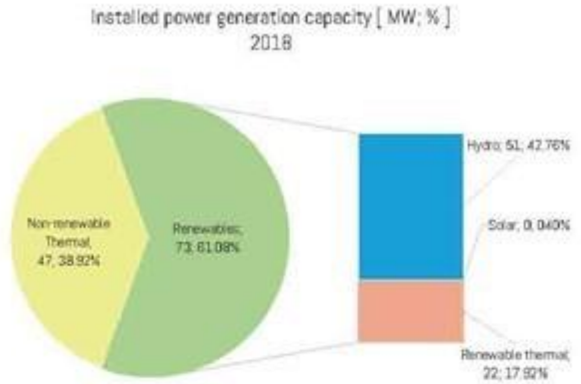
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
8	n.a.	n.a.

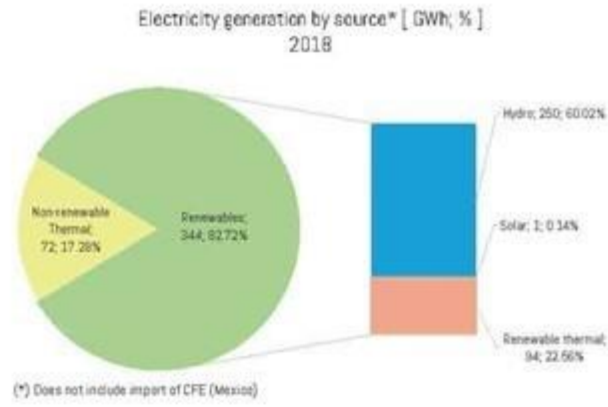
Note: The supply and demand data are presented for the 2013-2018 period because for previous years the data is being reviewed by the country.

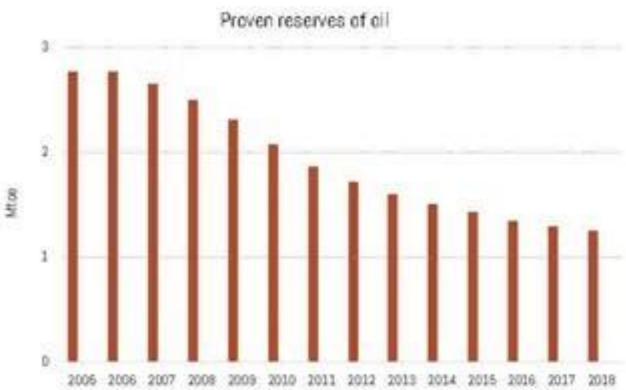
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,957
Final consumption per capita	toe/inhab.	0.86
Electrification rate	%	91.30
Total energy supply	Mtoe	0.39
Total energy production	Mtoe	0.19
Total energy imports	Mtoe	0.23
Total energy exports	Mtoe	0.03
Total final energy consumption	Mtoe	0.34
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	0.12
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.13 / 0.11

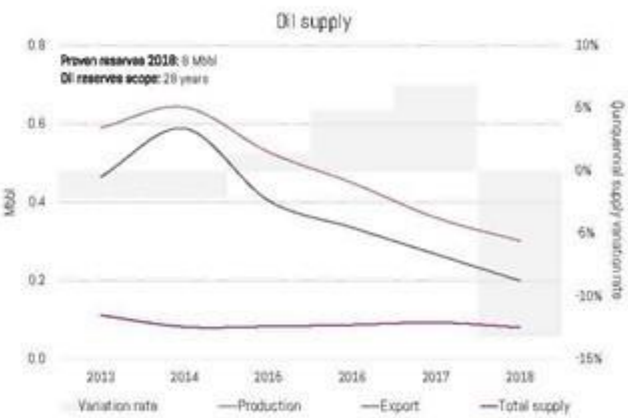
Summarized energy balance 2018

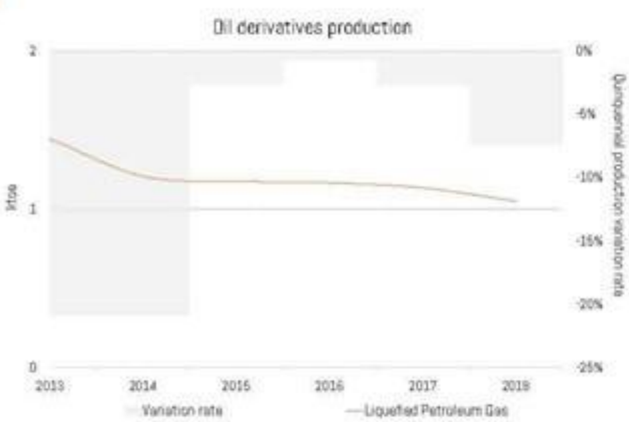


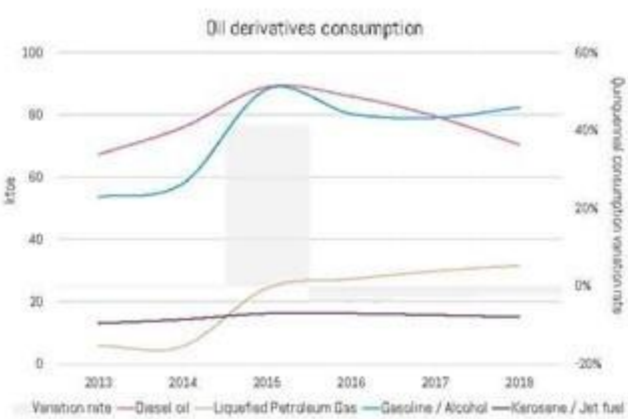

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal 47; 38.92%
Renewables; 73; 61.08%
Hydro; 51; 42.76%
Solar; 0; 0.40%
Renewable thermal; 22; 17.92%

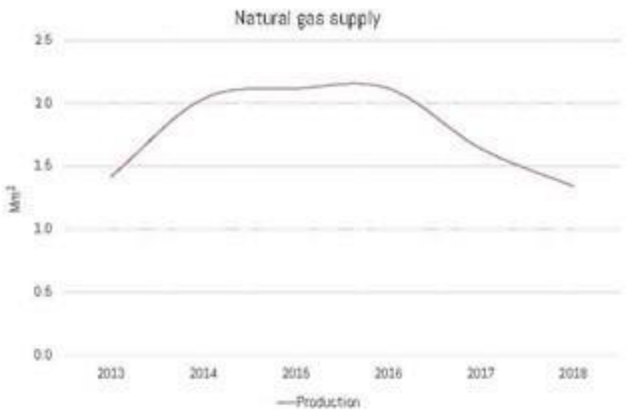

Electricity generation by source* [GWh; %]
2018
Non-renewable Thermal; 72; 17.28%
Renewables; 344; 82.72%
Hydro; 250; 60.02%
Solar; 1; 0.14%
Renewable thermal; 94; 22.56%
(*) Does not include import of CFE (Mexico)


Proven reserves of oil
Mtoe

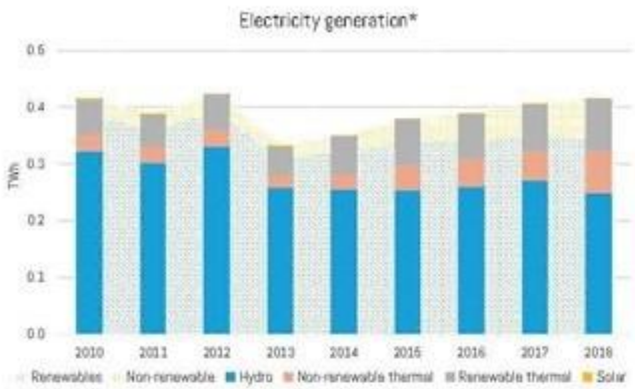

Oil supply
Proven reserves 2018:
Oil reserves scope:
Mbbl
Quinquennial supply variation rate
Variation rate
Production
Export
Total supply


Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Liquefied Petroleum Gas

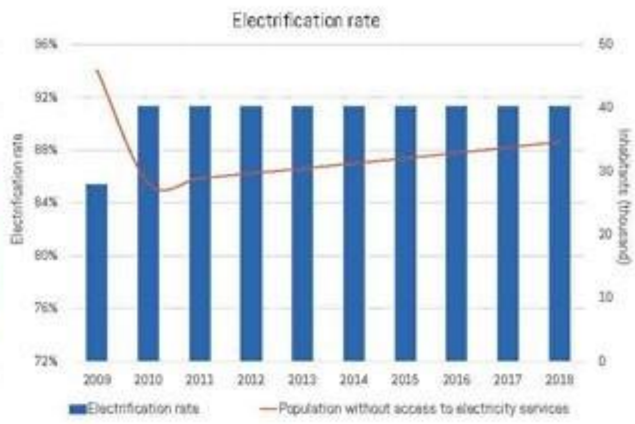

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel

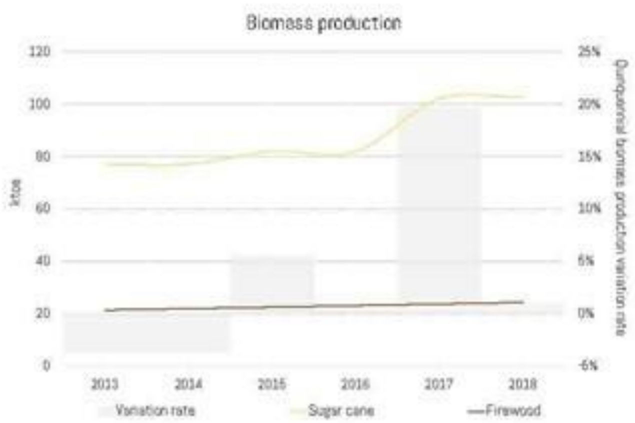


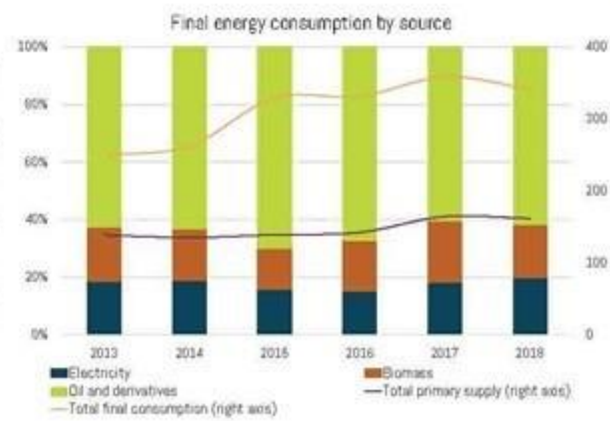
(*) Data for the 2009 - 2015 period are subject to review by the country



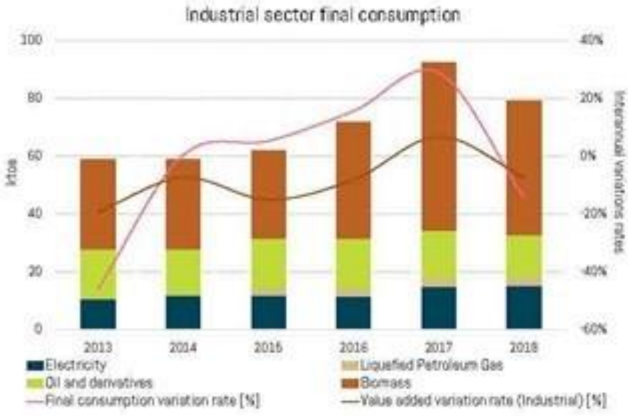
(*) Corresponds to gross generation and does not include import of CFE (Mexico)

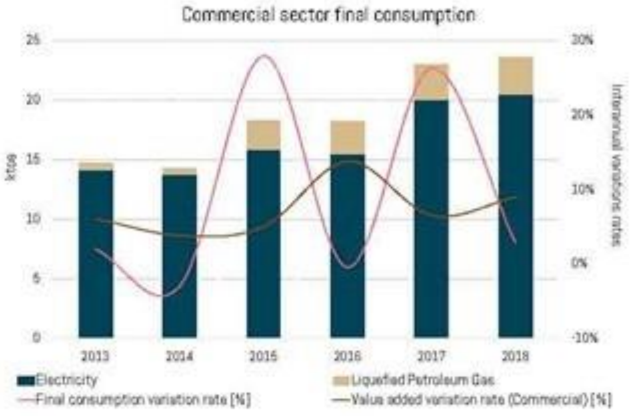


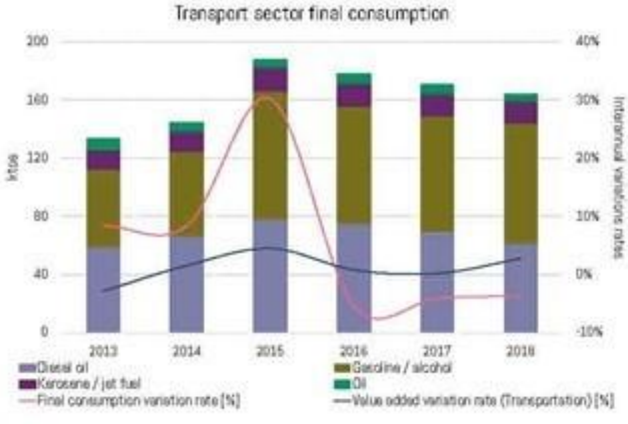


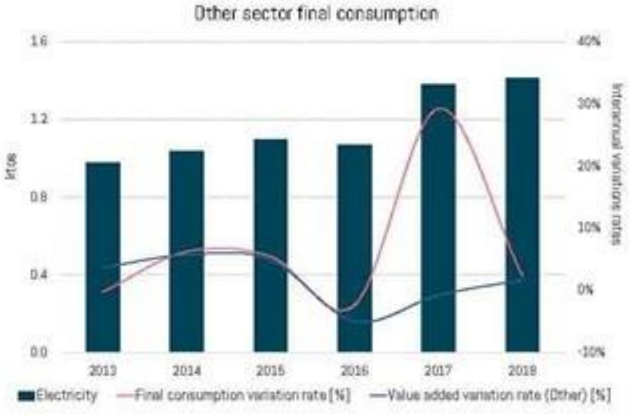


BELIZE

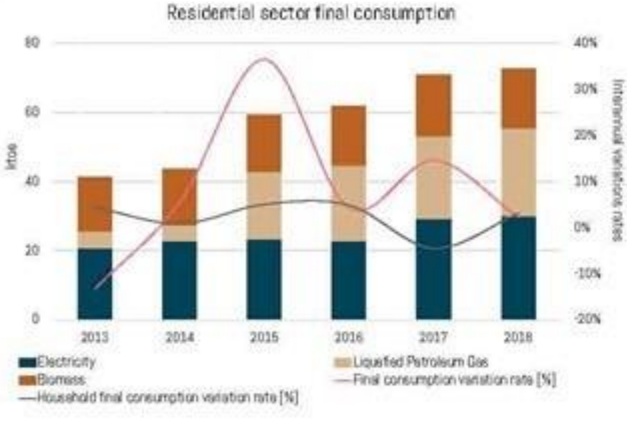

Industrial sector final consumption
ktoe
Interannual variations rates
100
80
60
40
20
0
40%
20%
0%
-20%
-40%
-60%
2013
2014
2015
2016
2017
2018
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

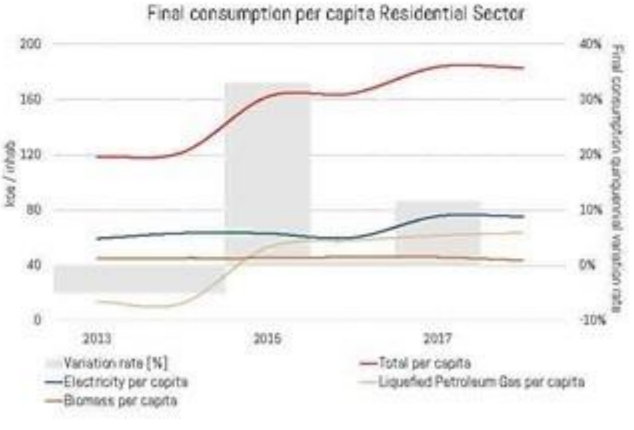

Commercial sector final consumption
ktoe
Interannual variations rates
25
20
15
10
5
0
30%
20%
10%
0%
-10%
2013
2014
2015
2016
2017
2018
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

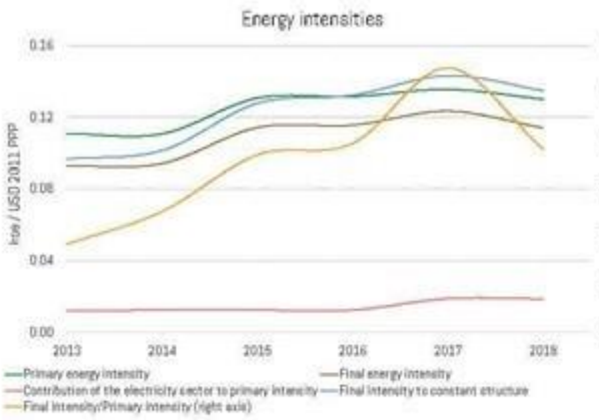

Transport sector final consumption
ktoe
Interannual variations rates
200
160
120
80
40
0
40%
30%
20%
10%
0%
-10%
2013
2014
2015
2016
2017
2018
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Oil
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

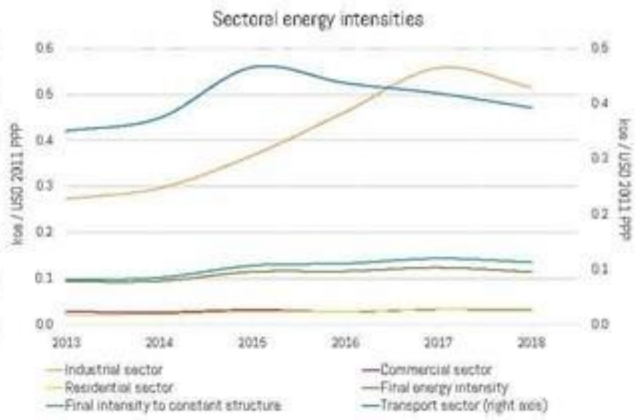

Other sector final consumption
ktoe
Interannual variations rates
1.6
1.2
0.8
0.4
0.0
40%
30%
20%
10%
0%
-10%
2013
2014
2015
2016
2017
2018
Electricity
Final consumption variation rate [%]
Value added variation rate (Other) [%]

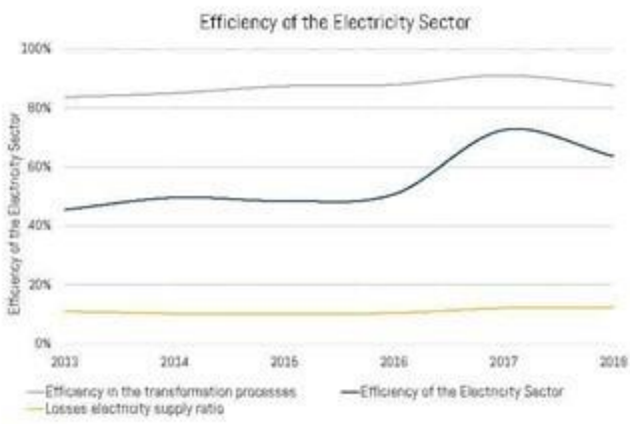
BELIZE

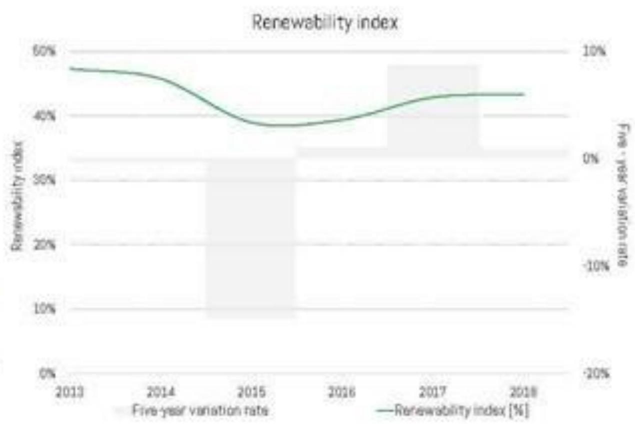

Residential sector final consumption
ktoe
Interannual variations rates
80
60
40
20
0
40%
30%
20%
10%
0%
-10%
-20%
2013
2014
2015
2016
2017
2018
Electricity
Liquefied Petroleum Gas
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

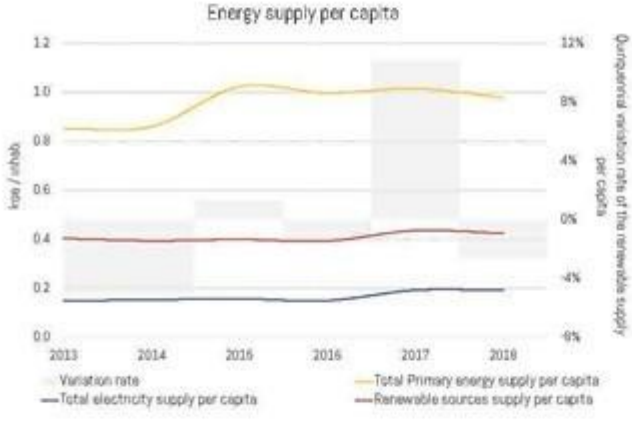

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
200
160
120
80
40
0
40%
30%
20%
10%
0%
-10%
2013
2015
2017
Variation rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita

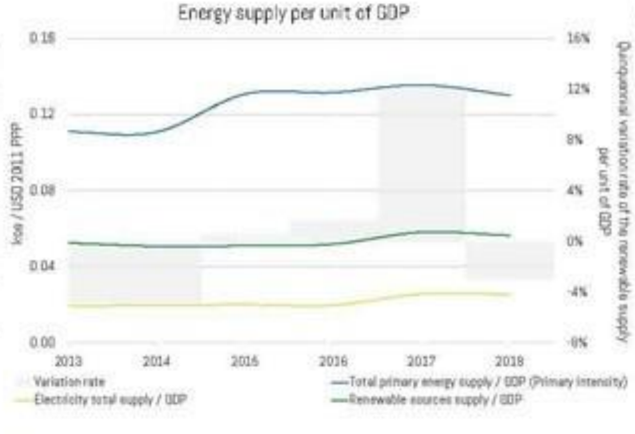

Energy intensities
koe / USD 2011 PPP
0.16
0.12
0.08
0.04
0.00
0.92
0.90
0.88
0.86
0.84
0.82
0.80
2013
2014
2015
2016
2017
2018
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

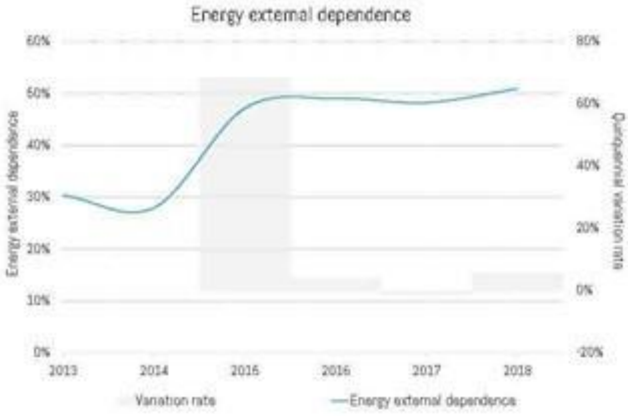

Sectoral energy intensities
koe / USD 2011 PPP
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2013
2014
2015
2016
2017
2018
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

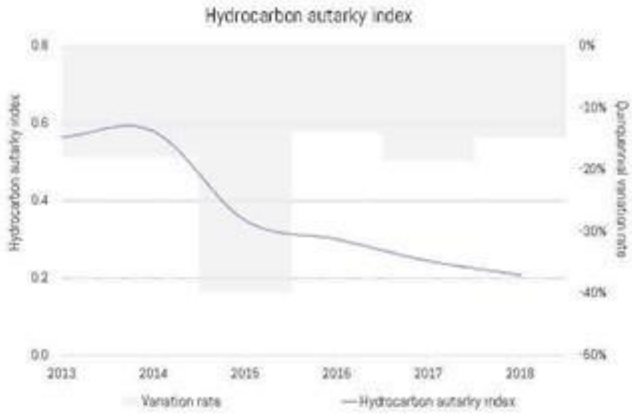

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
100%
80%
60%
40%
20%
0%
2013
2014
2015
2016
2017
2018
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

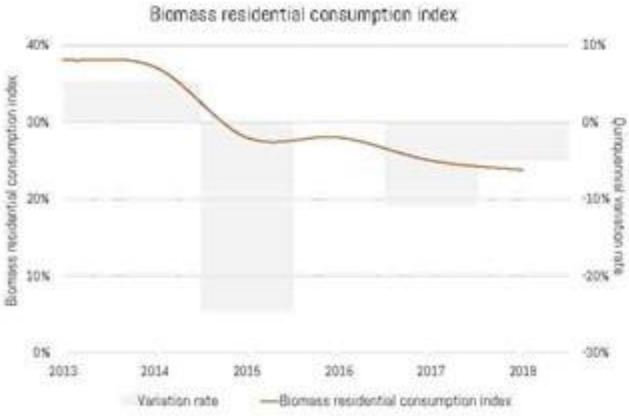

Renewability index
Renewability index
60%
40%
30%
20%
10%
0%
10%
0%
-10%
-20%
Five - year variation rate
2013
2014
2015
2016
2017
2018
Five-year variation rate
Renewability index [%]


Energy supply per capita
koe / inhab.
1.2
1.0
0.8
0.6
0.4
0.2
0.0
12%
8%
4%
0%
-4%
-8%
Quinquennial variation rate of the renewable supply per capita
2013
2014
2015
2016
2017
2018
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


Energy supply per unit of GDP
koe / USD 2011 PPP
0.16
0.12
0.08
0.04
0.00
16%
12%
8%
4%
0%
-4%
-8%
Quinquennial variation rate of the renewable supply per unit of GDP
2013
2014
2015
2016
2017
2018
Variation rate
Electricity total supply / GDP
Total primary energy supply / GDP (Primary intensity)
Renewable sources supply / GDP

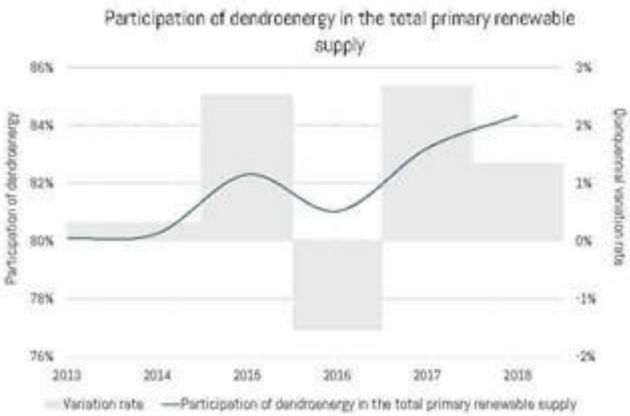

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

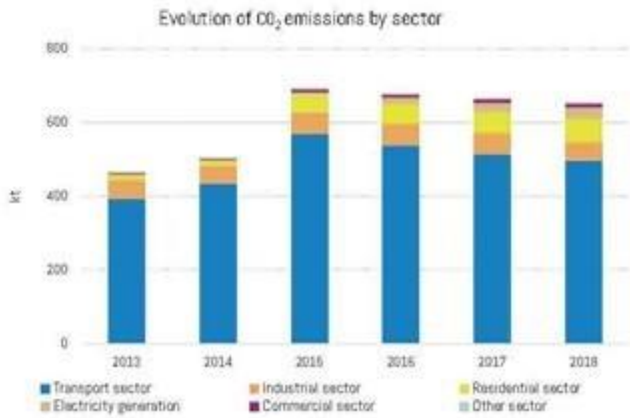

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

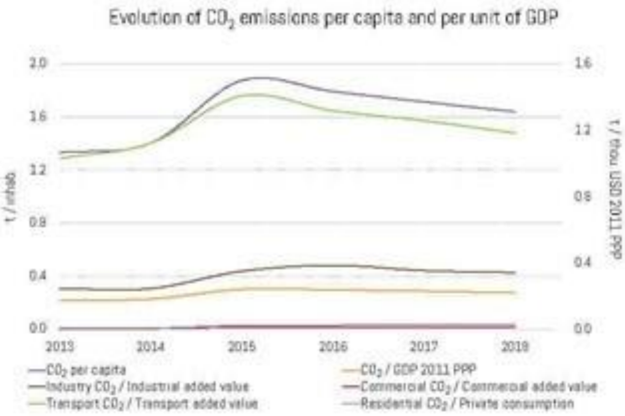

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

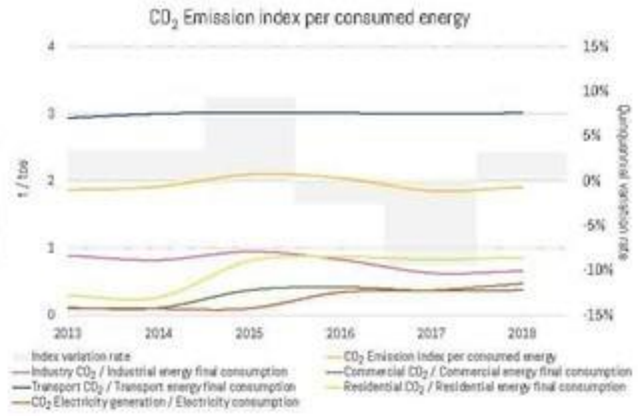

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

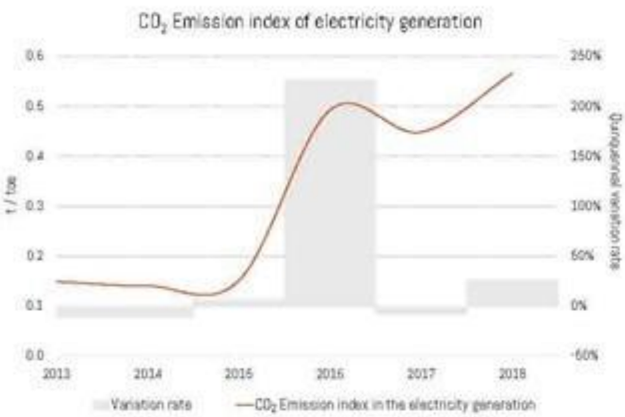
BELIZE


Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply

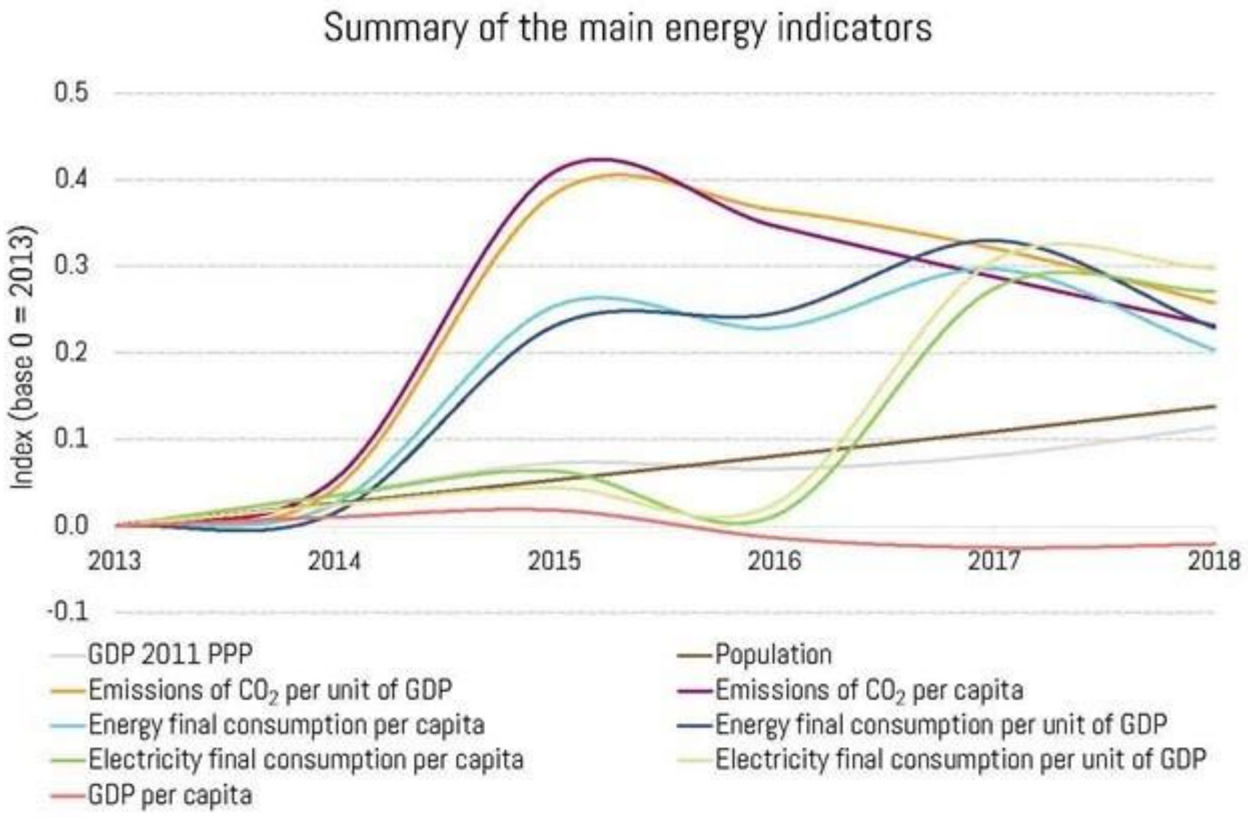

Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou. USD 2011 PPP
CO_2 per capita
Industry CO_2 / Industrial added value
Transport CO_2 / Transport added value
CO_2 / GDP 2011 PPP
Commercial CO_2 / Commercial added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation

BELIZE


Summary of the main energy indicators
Index (base 0 = 2013)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
2013
2014
2015
2016
2017
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

BOLIVIA

General Information 2018

Population (thousand inhab.)	11,307
Area (km²)	1,098,581
Population Density (inhab./km²)	10
Urban Population (%)	70
GDP USD 2010 (MUSD)	29,059
GDP USD 2011 PPP (MUSD)	79,314
GDP per Capita (thou. USD 2011 PPP/inhab.)	7.0

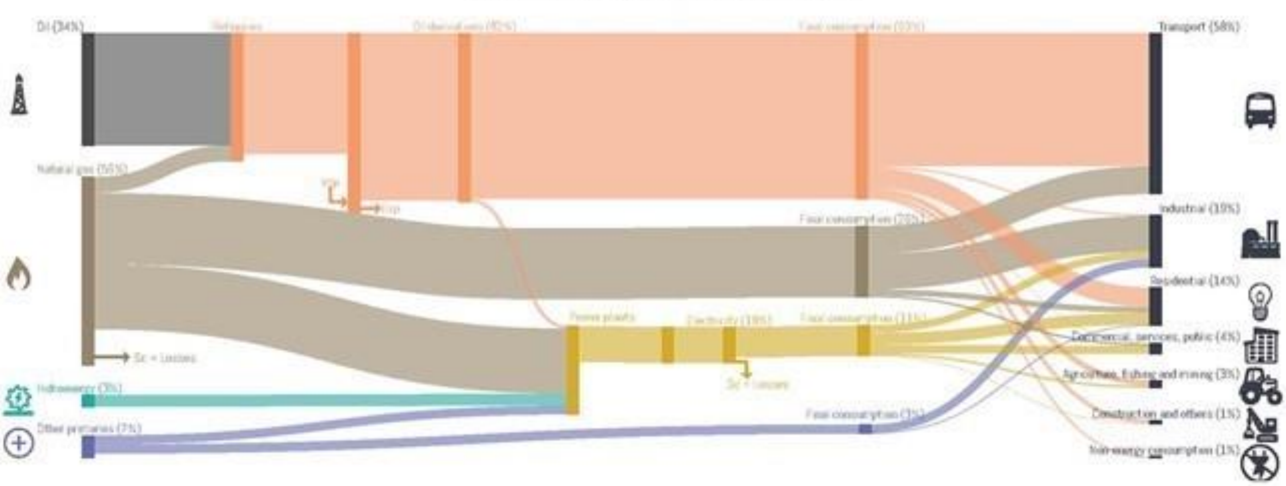
Energy Sector

	Mtoe
Final consumption in the Transport Sector	3.79
Final consumption in the Industrial Sector	1.25
Final consumption in the Residential Sector	0.91
Final consumption in the Commercial and Service Sector	0.25
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.33

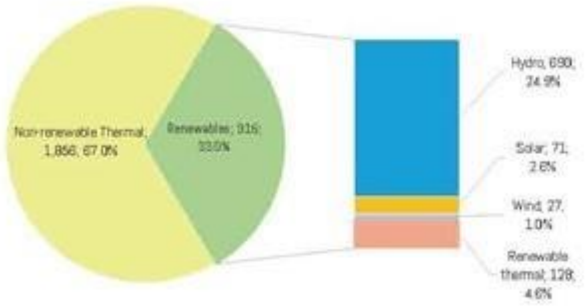
Oil reserves	Natural gas reserves	Coal reserves
241 Mbbl	303 Gm³	n.a. Mt

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	747
Final consumption per capita	toe/inhab.	0.58
Electrification rate	%	93.06
Total energy supply	Mtoe	9.02
Total energy production	Mtoe	19.44
Total energy imports	Mtoe	1.39
Total energy exports	Mtoe	11.78
Total final energy consumption	Mtoe	6.53
Refining capacity	kbbl/day	68.05
Installed power generation capacity	GW	2.77
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.11 / 0.08

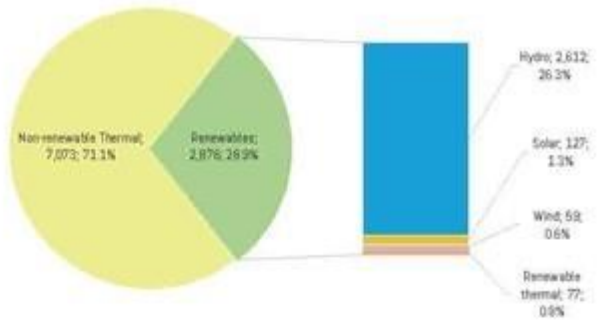
Summarized energy balance 2018



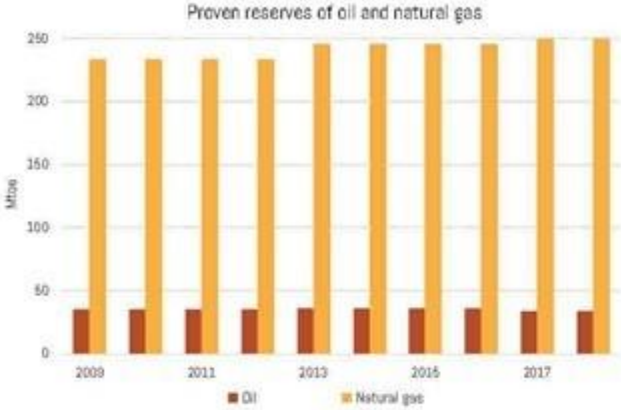
Installed power generation capacity [MW; %]
2018



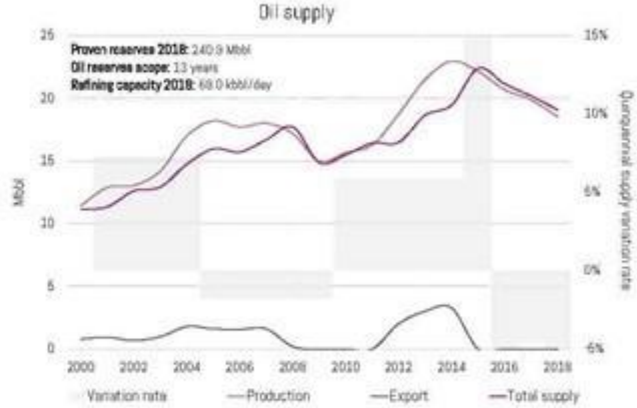
Electricity generation by source [GWh; %]
2018



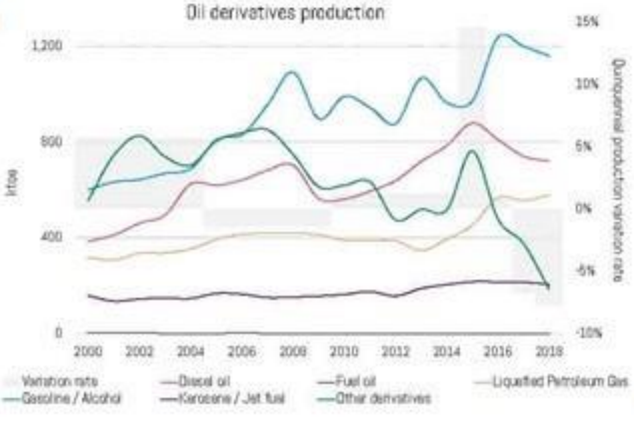
Proven reserves of oil and natural gas



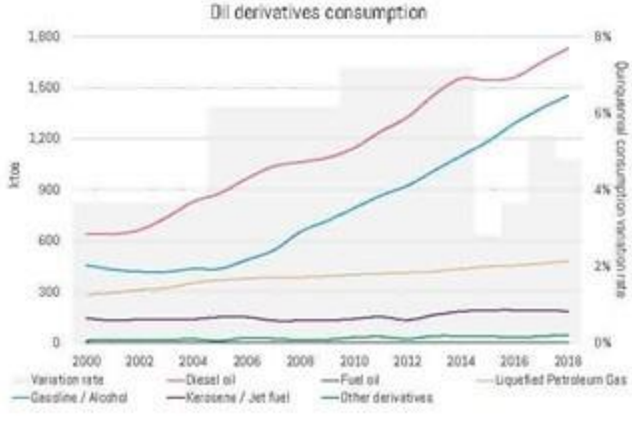
Oil supply

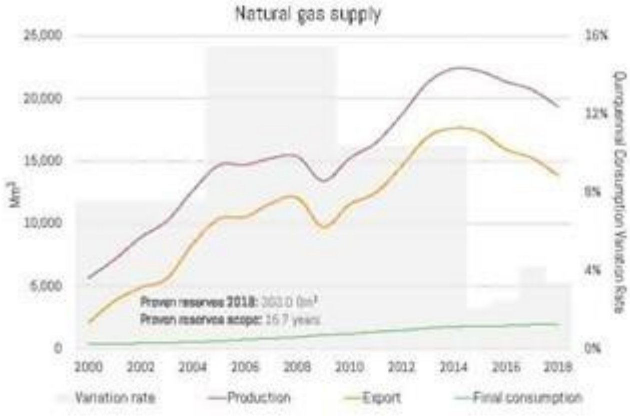


Oil derivatives production

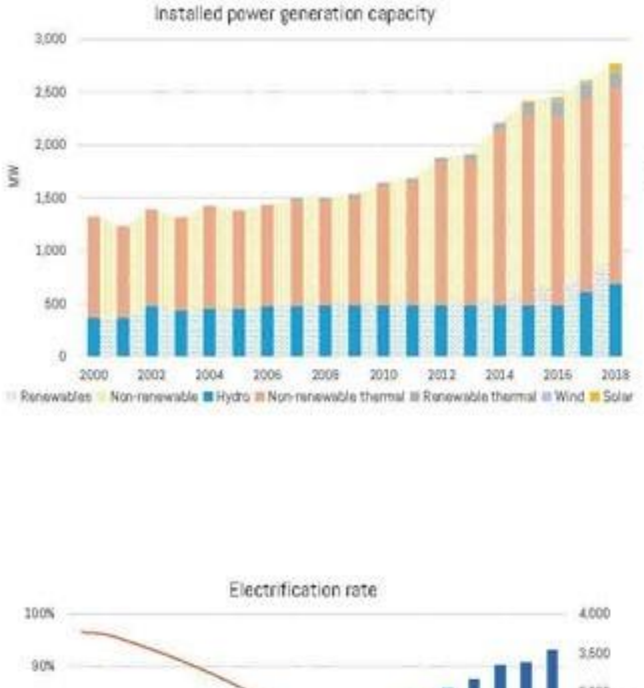


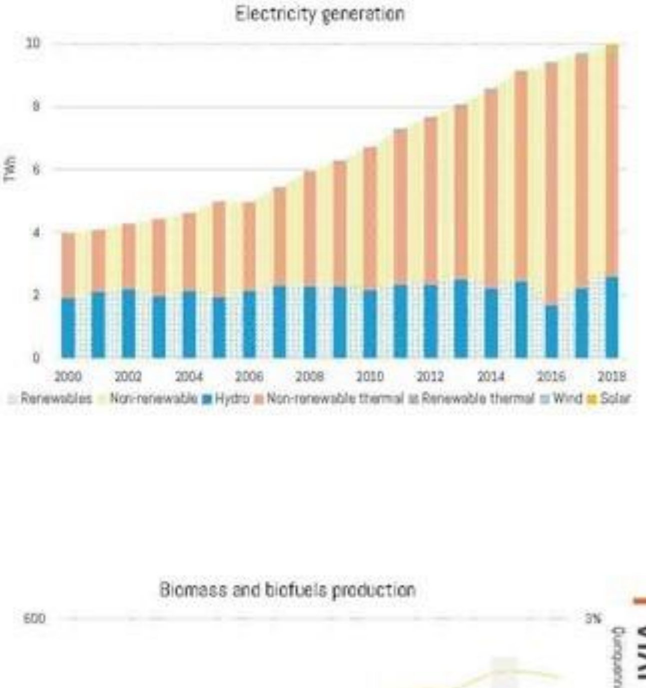
Oil derivatives consumption

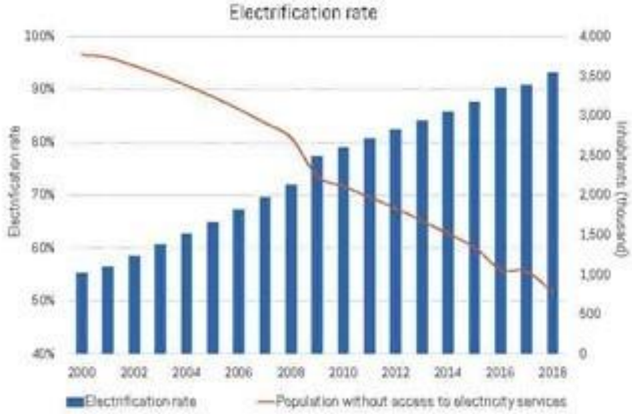


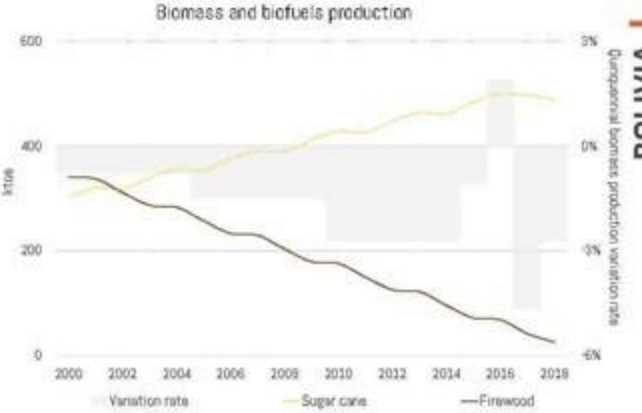


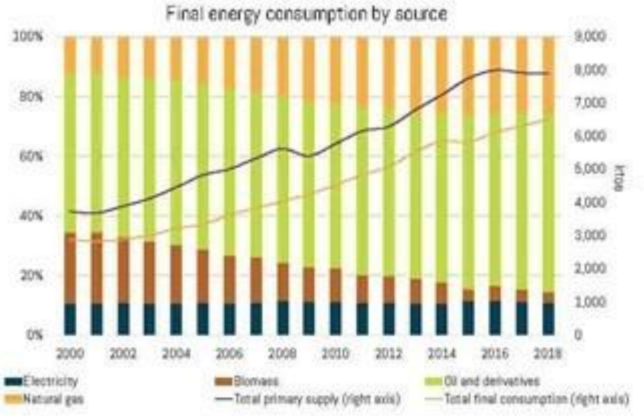
On September 8, the Photovoltaic Solar Plant was inaugurated in Uyuni with a capacity of 60 MW, becoming the largest in the country. The new plant is located in the province of Antonio Quijarro, Potosí and its annual production is estimated to reach 123,000 MWh/year, allowing to cover 50% of the energy demand of the department of Potosí.

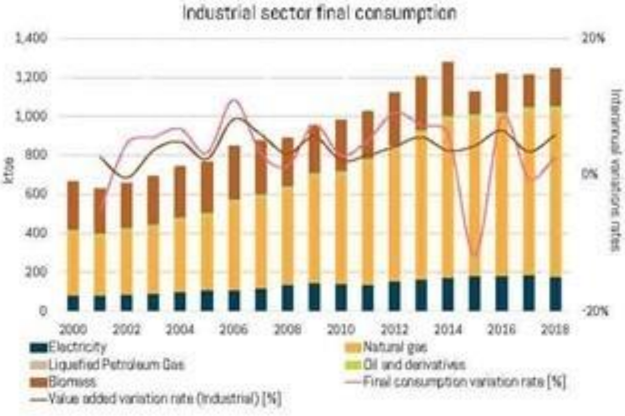


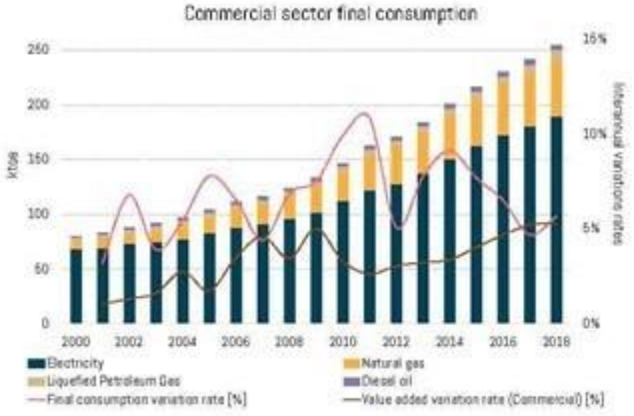


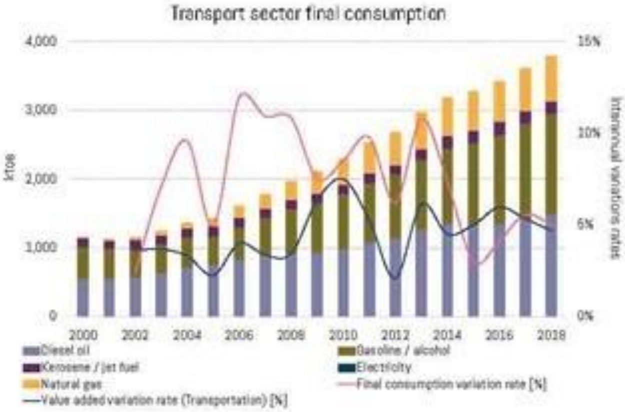


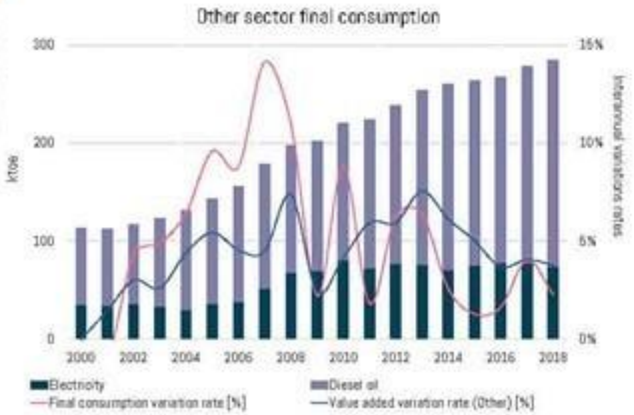


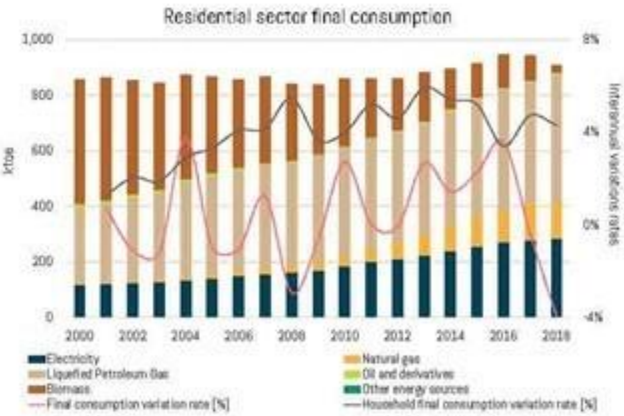

Final energy consumption by source
ktoe
Electricity
Natural gas
Biomass
Total primary supply (right axis)
Oil and derivatives
Total final consumption (right axis)

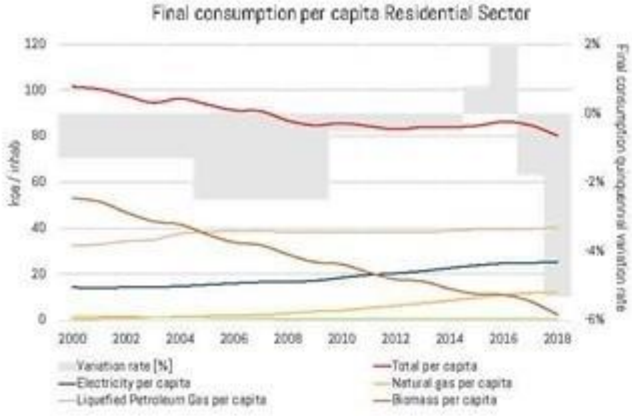

Industrial sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

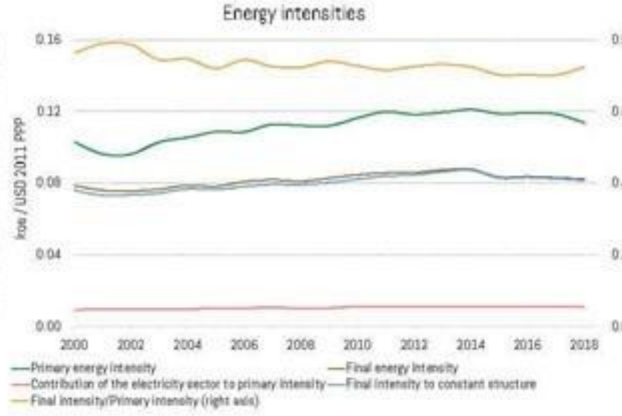

Commercial sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Natural gas
Diesel oil
Value added variation rate (Commercial) [%]

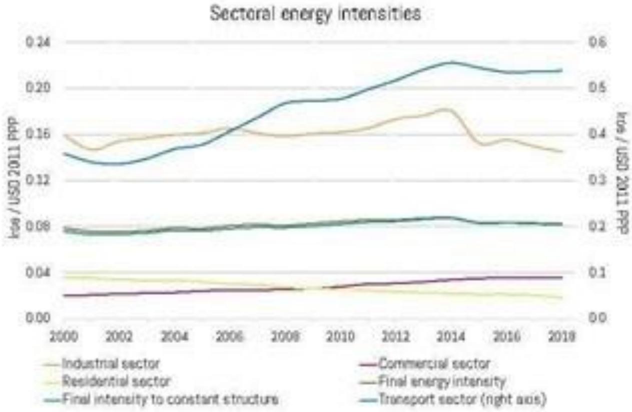

Transport sector final consumption
ktoe
Interannual variation rates
Diesel oil
Kerosene / jet fuel
Natural gas
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

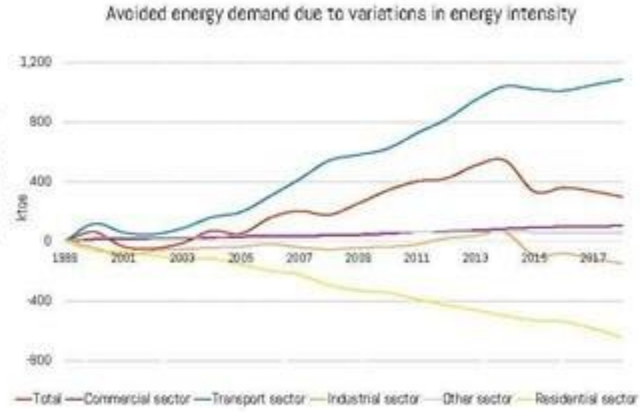

Other sector final consumption
ktoe
Interannual variation rates
Electricity
Final consumption variation rate [%]
Diesel oil
Value added variation rate (Other) [%]

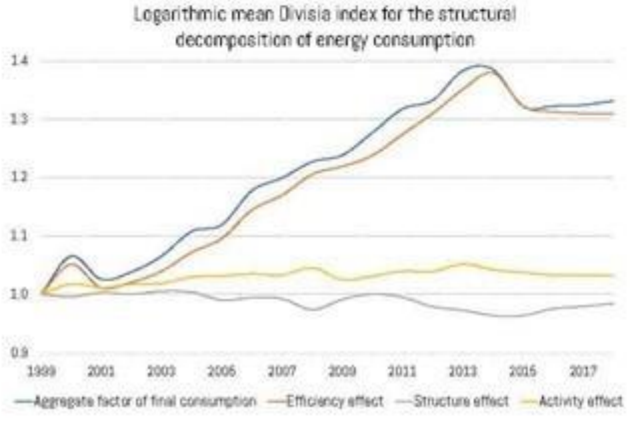

Residential sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Biomass
Final consumption variation rate [%]
Natural gas
Oil and derivatives
Other energy sources
Household final consumption variation rate [%]

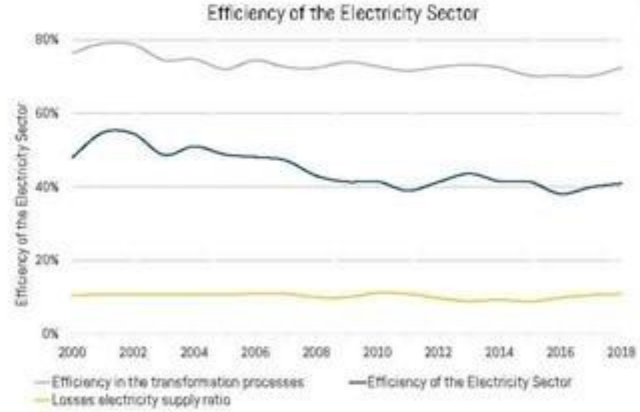

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Total per capita
Natural gas per capita
Biomass per capita


Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

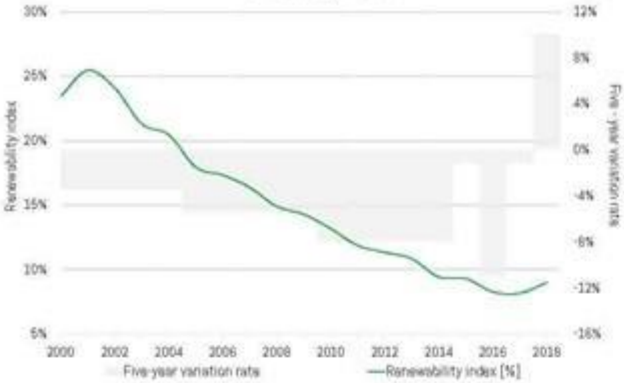

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)


Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

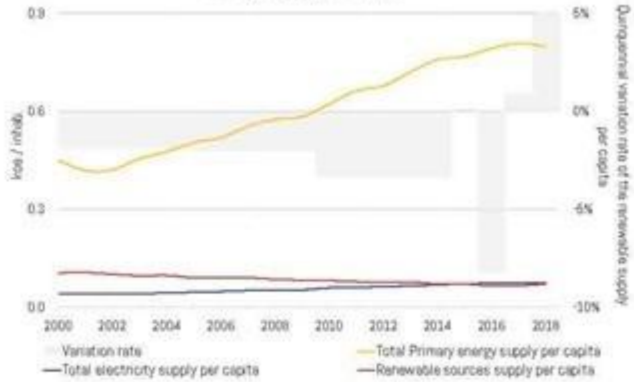

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

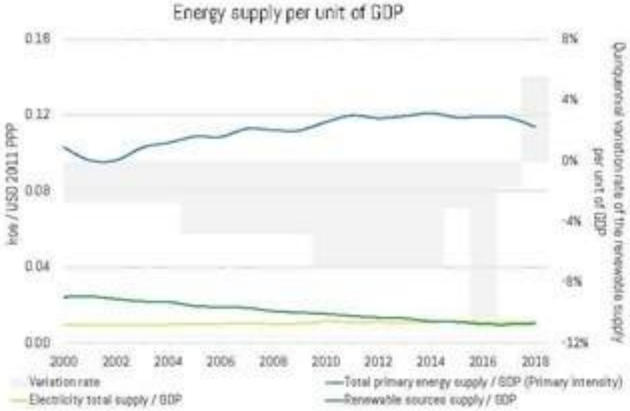
Renewability index



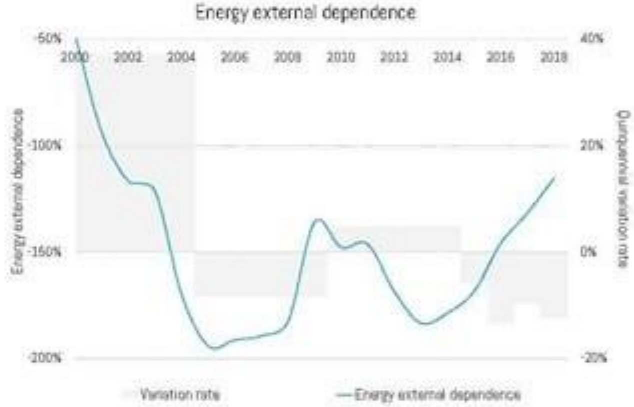
Energy supply per capita



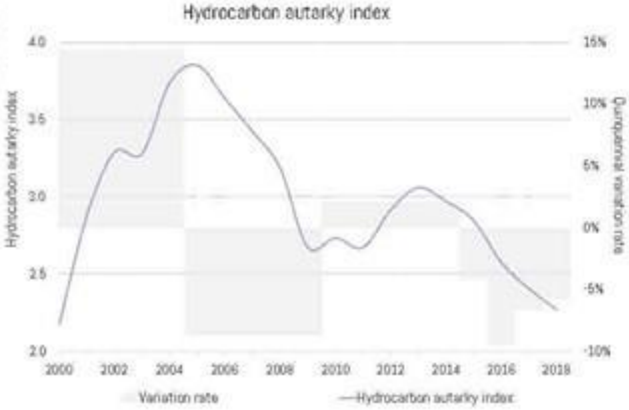
Energy supply per unit of GDP



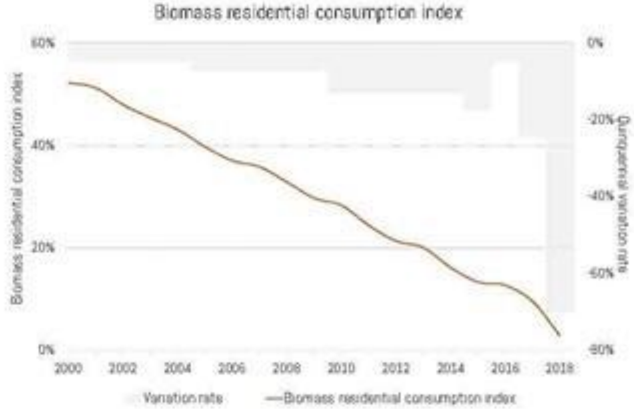
Energy external dependence

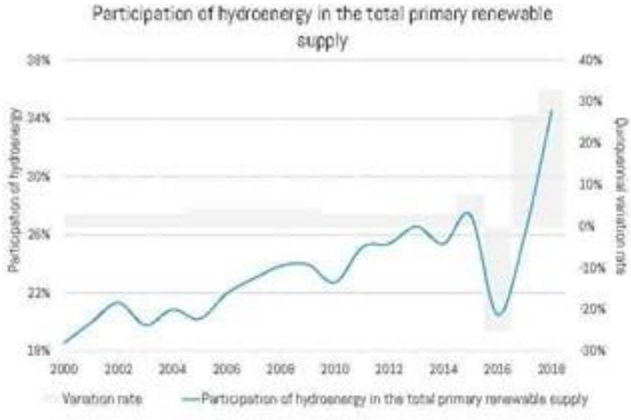


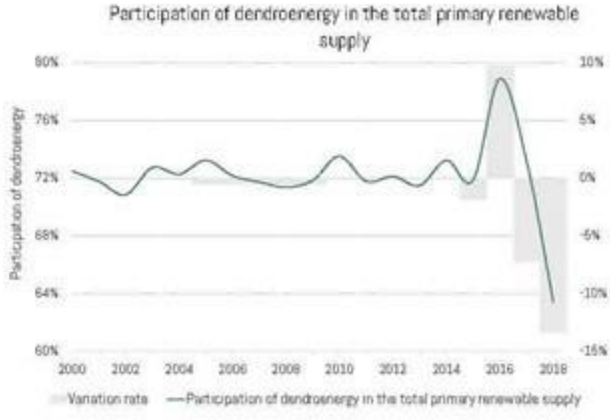
Hydrocarbon autarky index

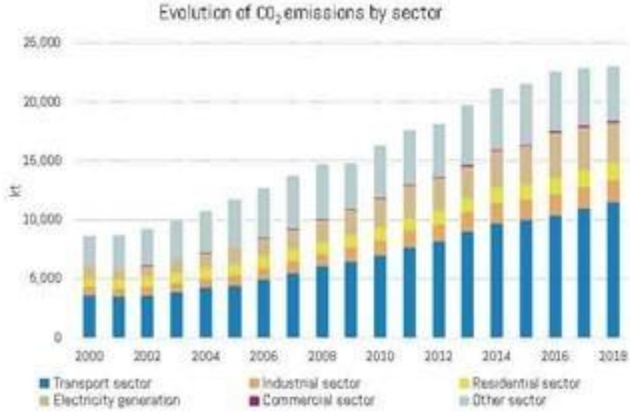


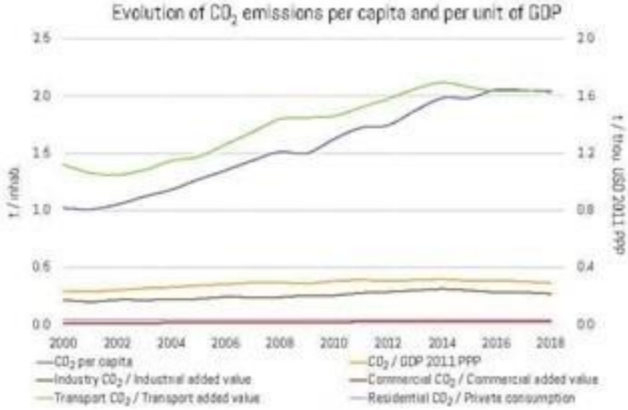
Biomass residential consumption index

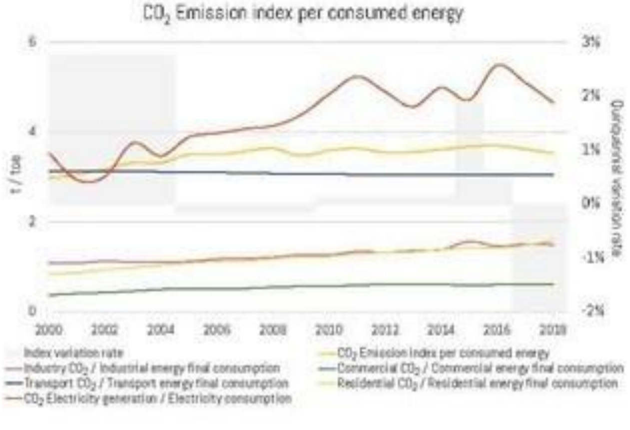


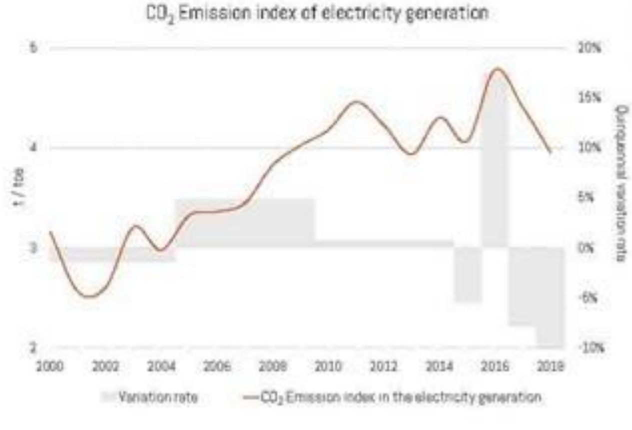

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply


Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector

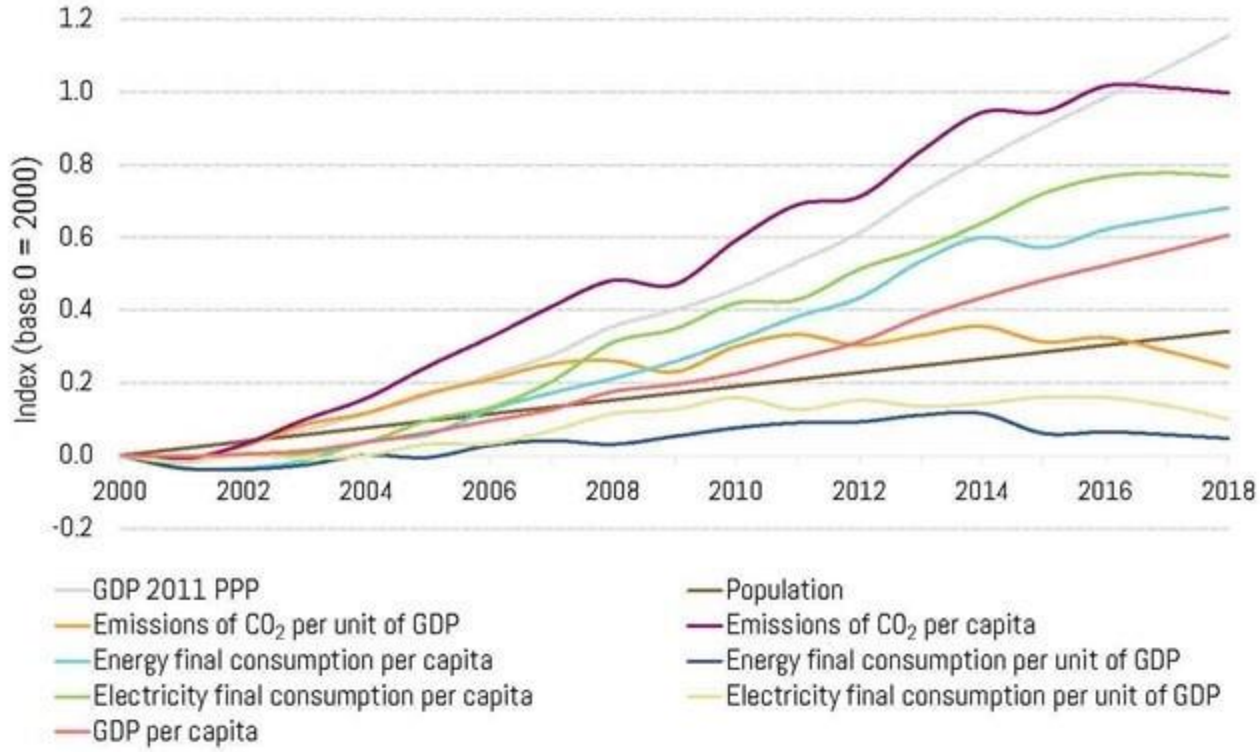

Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation

BOLIVIA

Summary of the main energy indicators



BRAZIL

General Information 2018

Population (thousand inhab.)	209,469
Area (km^2)	8,515,759
Population Density (inhab./km^2)	25
Urban Population (%)	86
GDP USD 2010 (MUSD)	2,309,623
GDP USD 2011 PPP (MUSD)	2,991,792
GDP per Capita (thou. USD 2011 PPP/inhab.)	14

Energy Sector

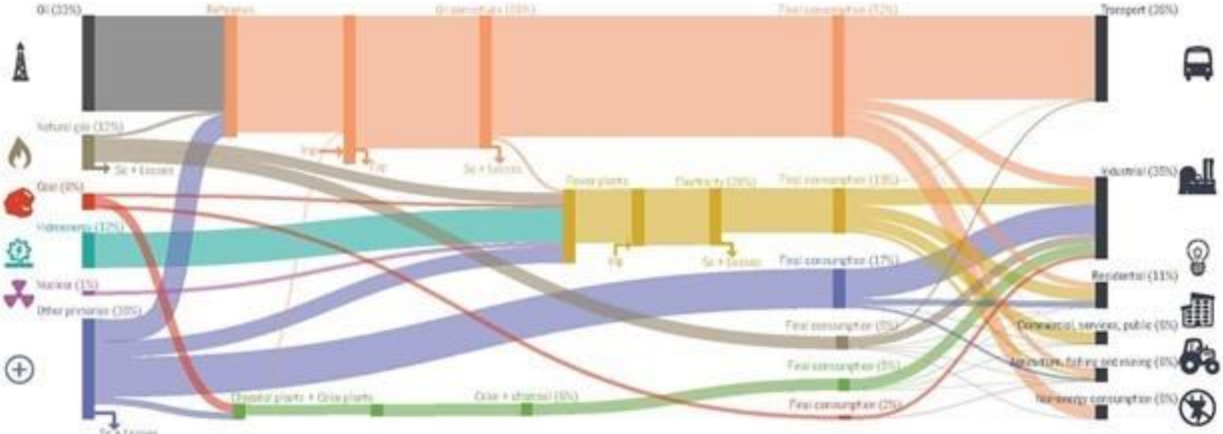
Final consumption in the Transport Sector	Mtoe 82.12
Final consumption in the Industrial Sector	Mtoe 78.05 [3]
Final consumption in the Residential Sector	Mtoe 25.18
Final consumption in the Commercial and Service Sector	Mtoe 12.58
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 27.10

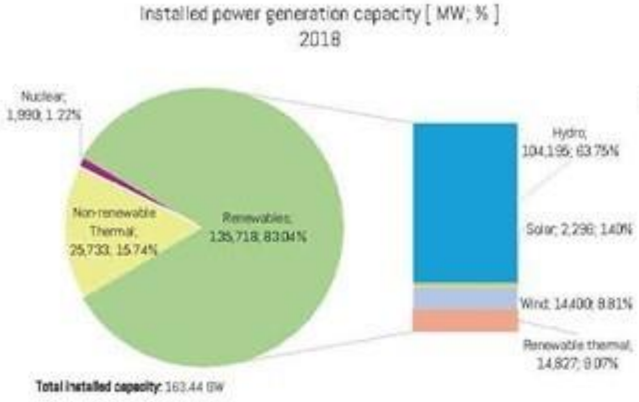
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 13,434	Gm³ 369	Mt 6,596 [2]

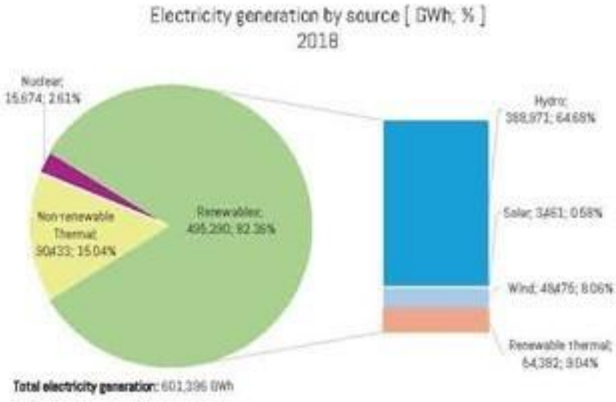
[1] Does not include own consumption of the energy sector.
[2] Data estimated by OLADE.
[3] Does not include Mining and Pelletization.

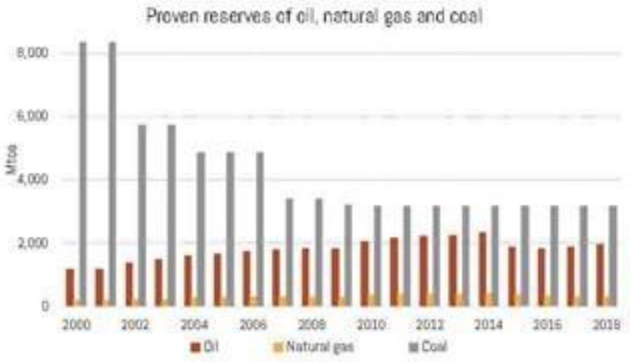
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,4016 [1]	1.07 [1]	99.73	289.85	303.08	63.16	72.68	255.02 [1]	2,405	163.44	0.10 / 0.08

Summarized energy balance 2018

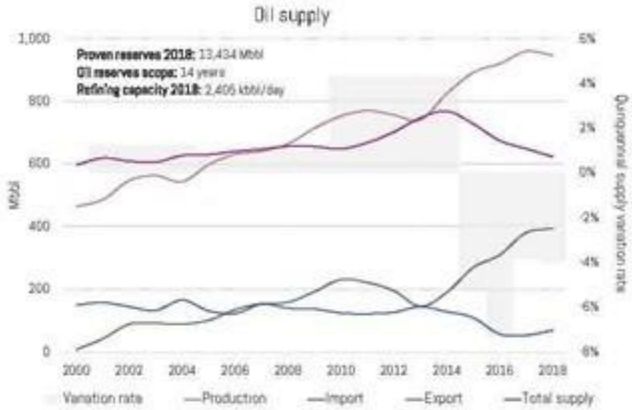


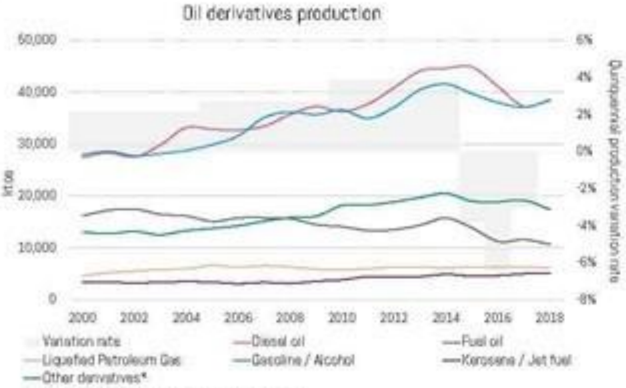




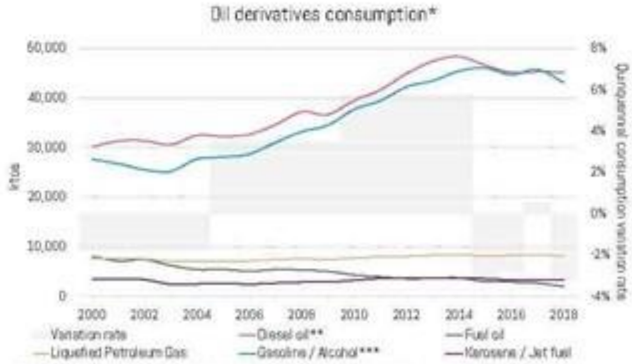


Coal reserves data estimated by OLADE.
For the 2000-2007 period, coal values include probable reserves.

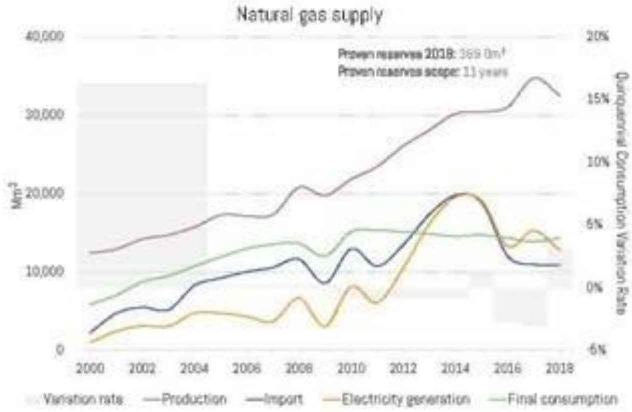


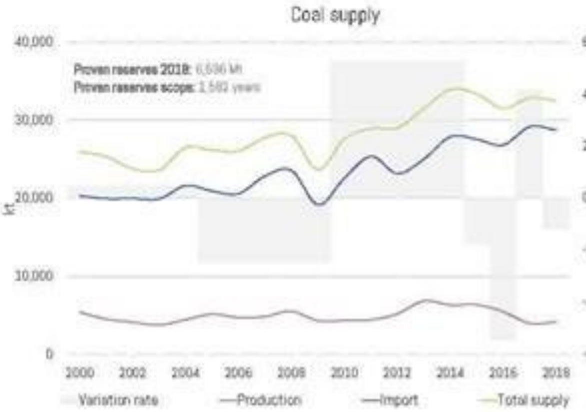


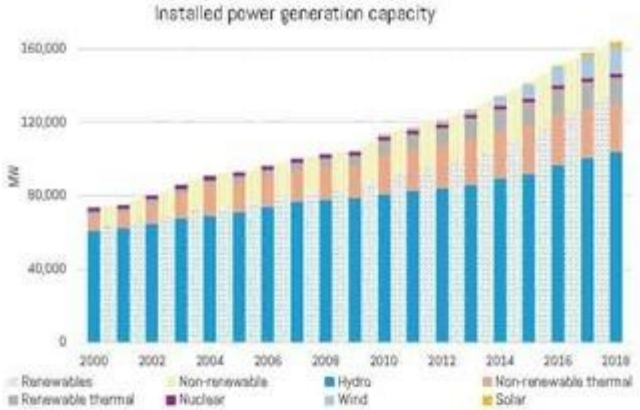
(*): Includes non-energy, other secondary and gases.

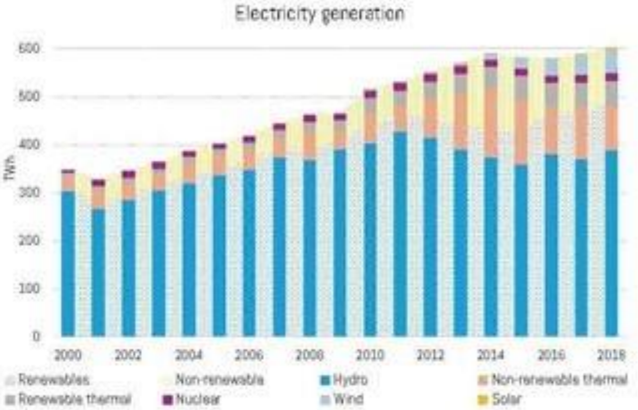


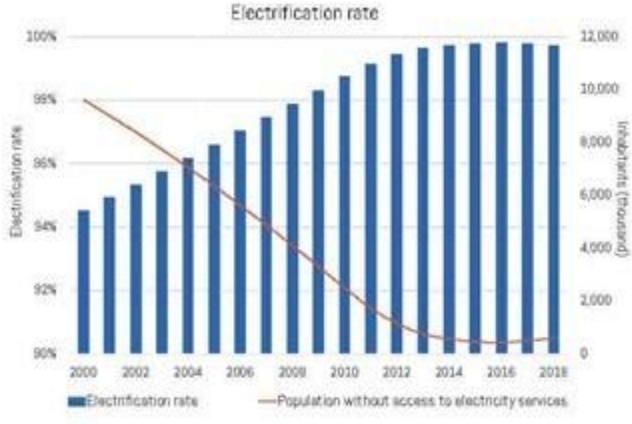
(*): Excludes consumption in transformation centers and the energy sector.
(**) Includes biodiesel
(***): Includes petrochemical naphtha

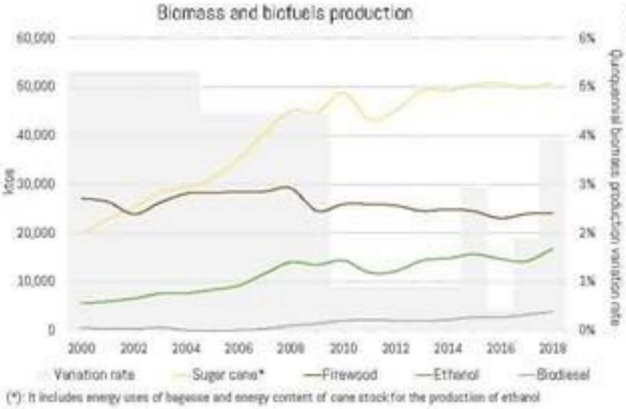






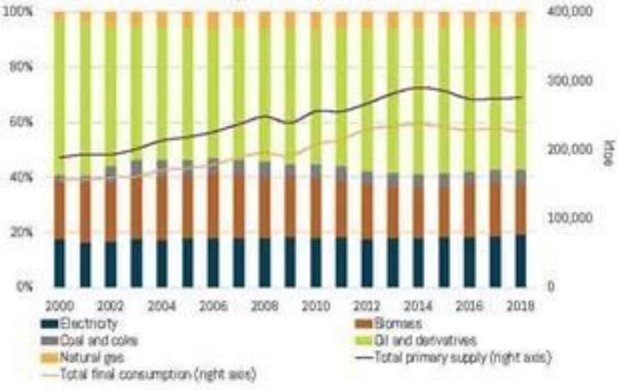




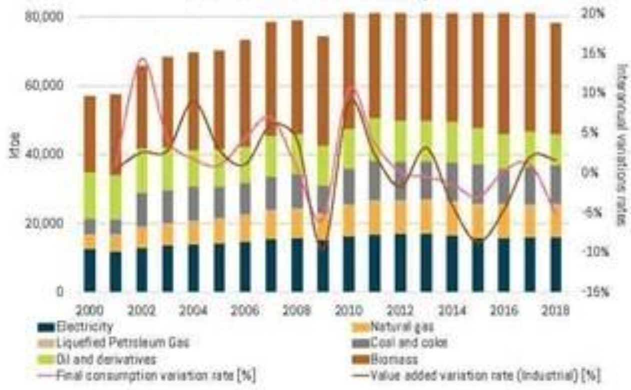


(*): It includes energy uses of bagasse and energy content of cane stock for the production of ethanol

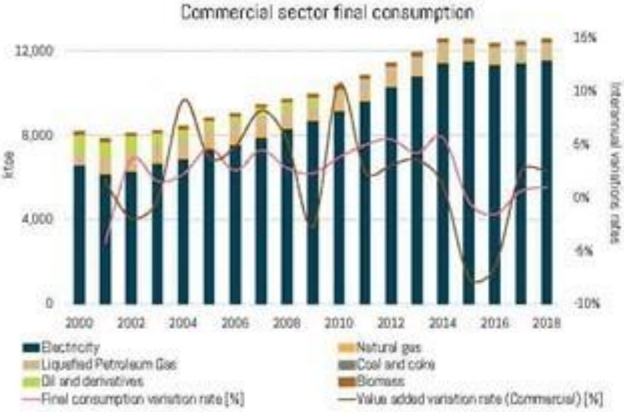
Final energy consumption by source



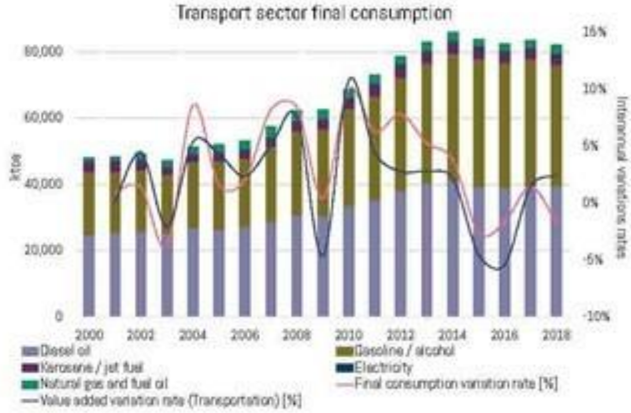
Industrial sector final consumption



Commercial sector final consumption



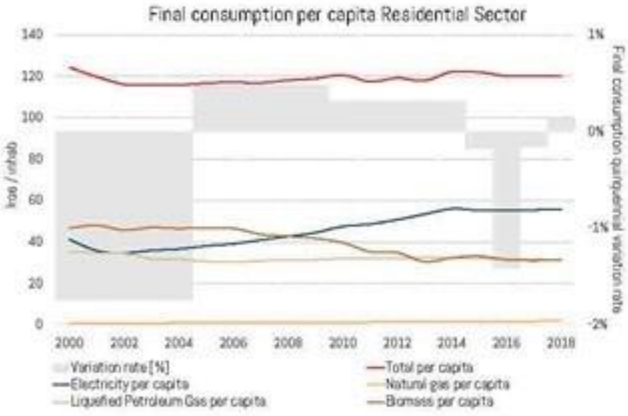
Transport sector final consumption

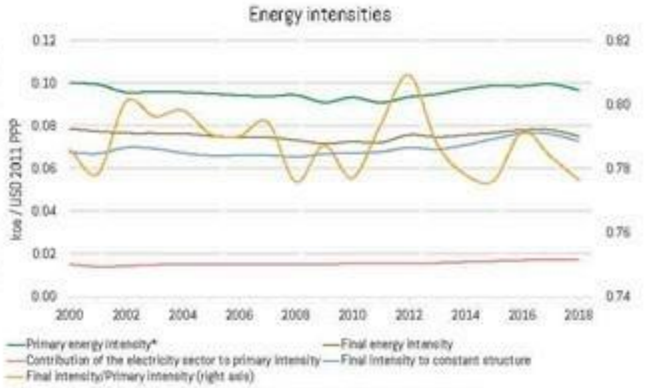


BRAZIL

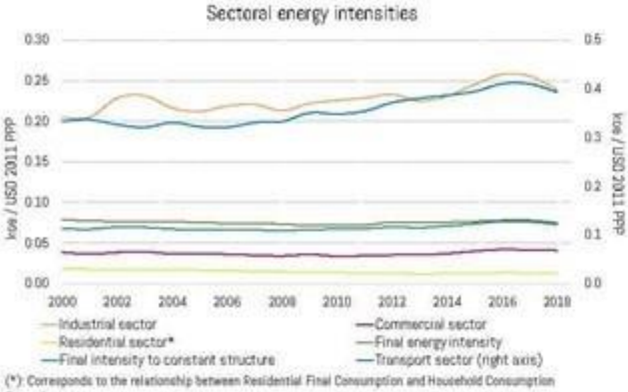
Other sector final consumption

Residential sector final consumption

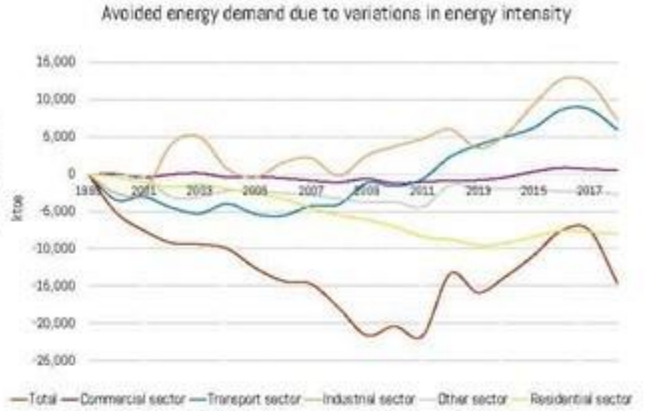


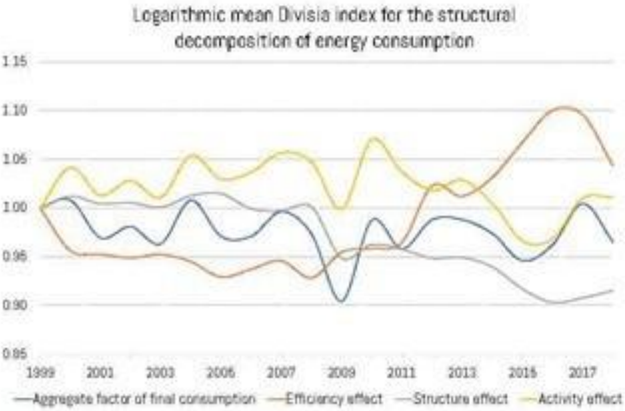


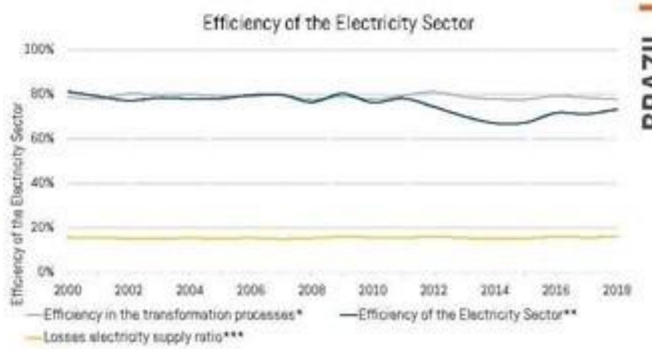
(*): Includes own consumption of the energy sector and liquid foreign trade of derivatives.



(*): Corresponds to the relationship between Residential Final Consumption and Household Consumption Expenditure.

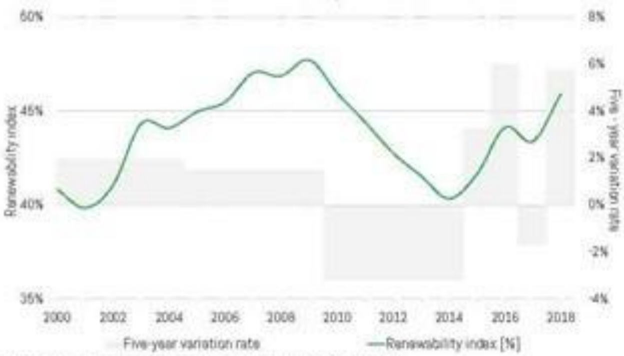






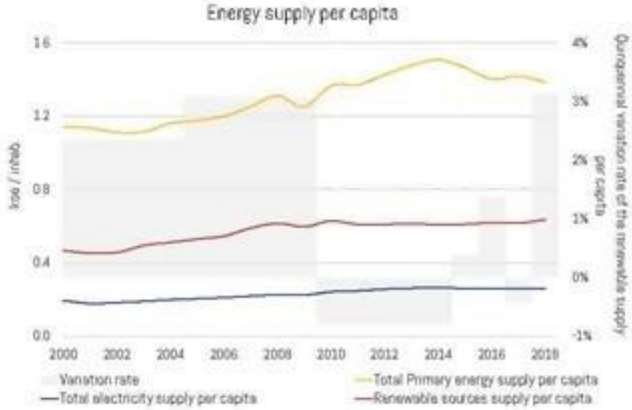
(*): Relationship between Final Energy Consumption and Total Energy Supply. The final consumption does not include own consumption of the energy sector.
(**): Relationship between the production of electricity and the inputs required for its generation. In caloric units.
(***): Relationship between the losses of electricity and the supply of electricity.

Renewability index*

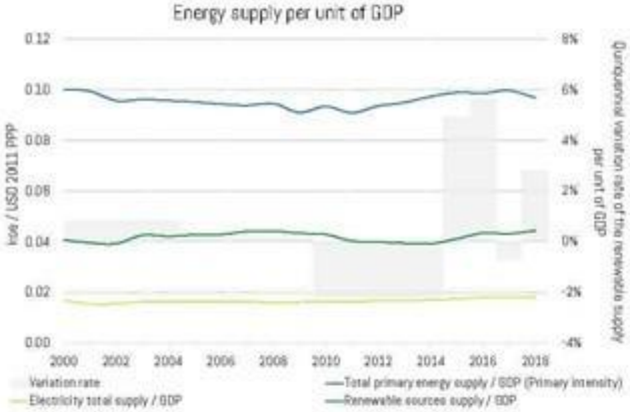


The calculation is based on the Internal Energy Supply Matrix (Energy Matrix).

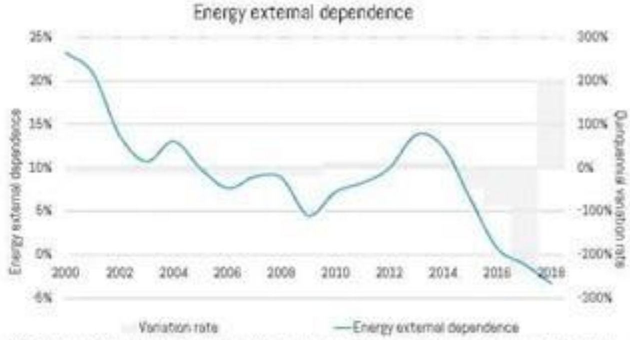
Energy supply per capita



Energy supply per unit of GDP



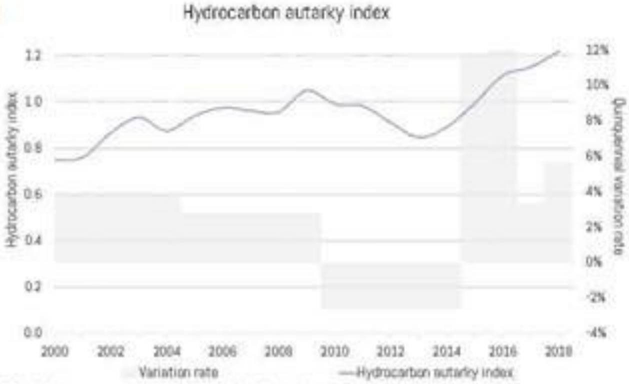
Energy external dependence



Note: For the year 2017 according to Olade's methodology there is an export, however, in the balance sheet prepared for the Ministry of Mines and Energy of Brazil it is identified that the country still has an external energy dependence. These differences are due to the fact that in Brazil's BEN there is a significant import of uranium which is not being accounted for in the OLADE BEN because there is no transformation center for the "Nuclear Combustion Cycle"

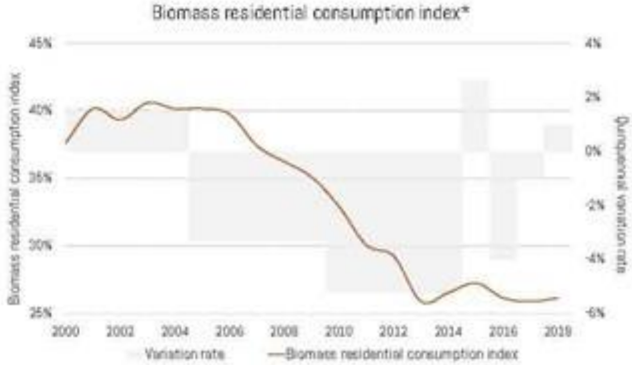
BRAZIL

Hydrocarbon autarky index



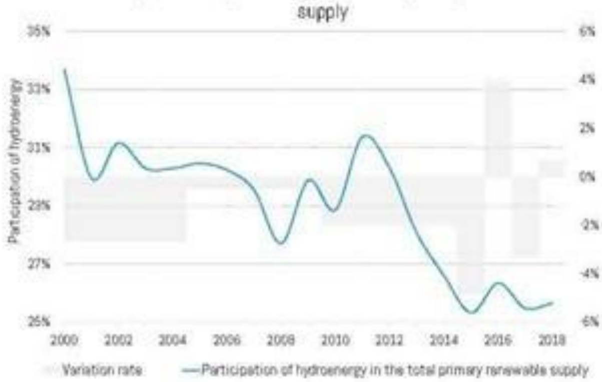
Note: Values greater than 1 represent that there is a surplus and less than 1 deficit.

Biomass residential consumption index*

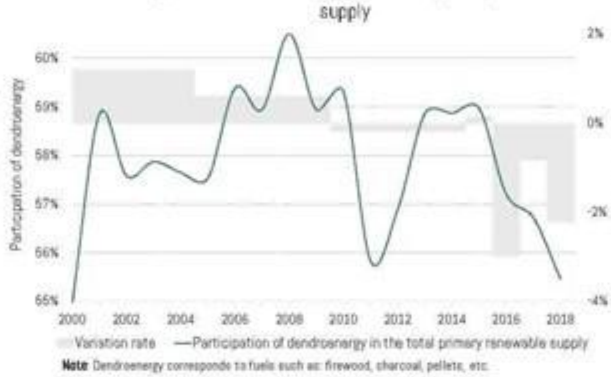


Defined as the ratio between the sum of the consumption of firewood and charcoal in the residential sector divided for the final consumption of the residential sector

Participation of hydroenergy in the total primary renewable supply

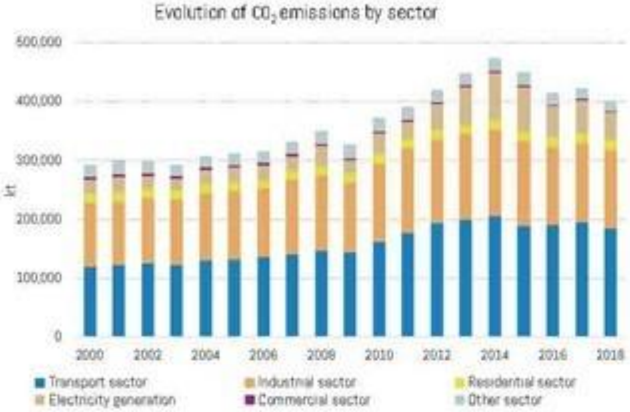


Participation of dendroenergy in the total primary renewable supply

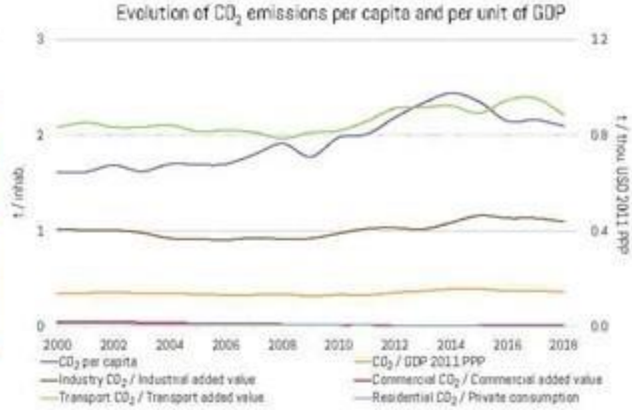


Note: Dendroenergy corresponds to fuels such as: firewood, charcoal, pellets, etc.

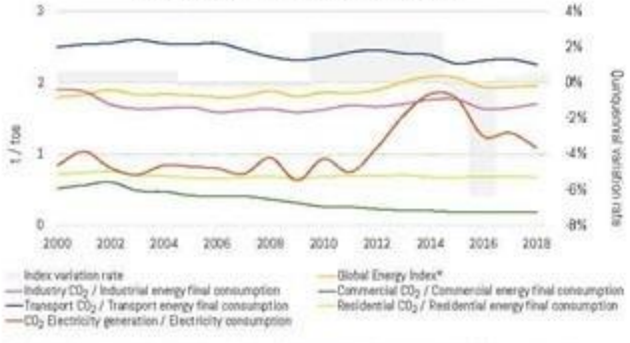
Evolution of CO_2 emissions by sector



Evolution of CO_2 emissions per capita and per unit of GDP

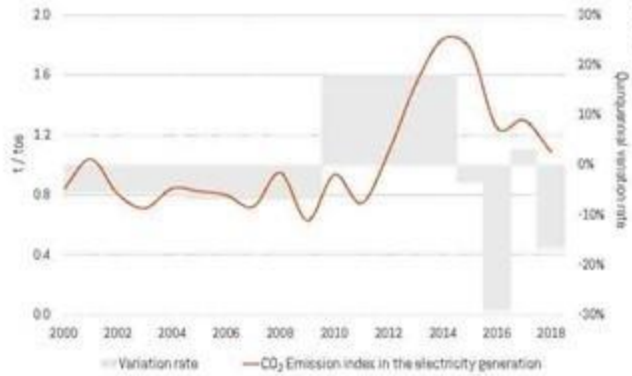


CO_2 Emission index per consumed energy

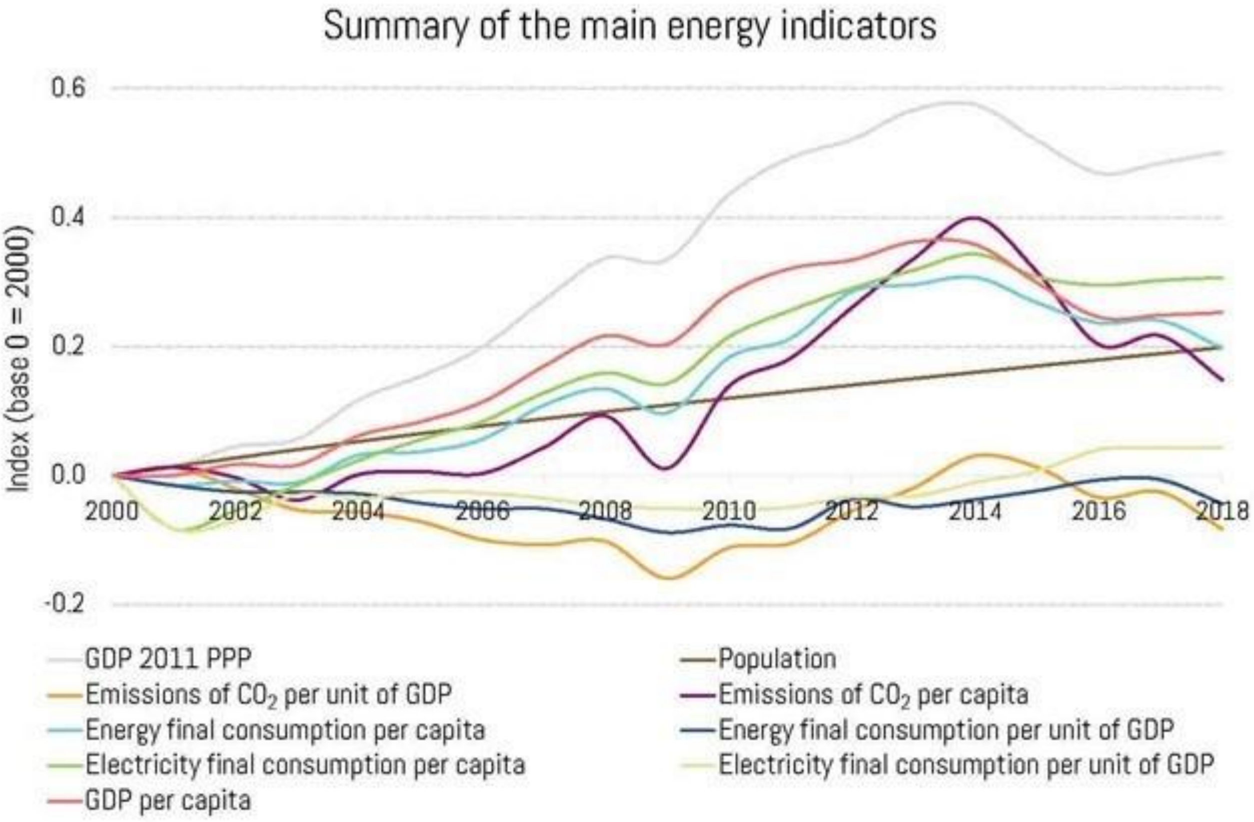


(*) Internal energy supply that includes total losses, final consumption and own consumption of the energy sector

CO_2 Emission index of electricity generation



BRAZIL


Summary of the main energy indicators
Index (base 0 = 2000)
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

CHILE

General Information 2018

Population (thousand inhab.)	17,715
Area (km²)	756,096
Population Density (inhab./km²)	23
Urban Population (%)	89
GDP USD 2010 (MUSD)	283,375
GDP USD 2011 PPP (MUSD)	428,407
GDP per Capita (thou. USD 2011 PPP/inhab.)	24

Energy Sector

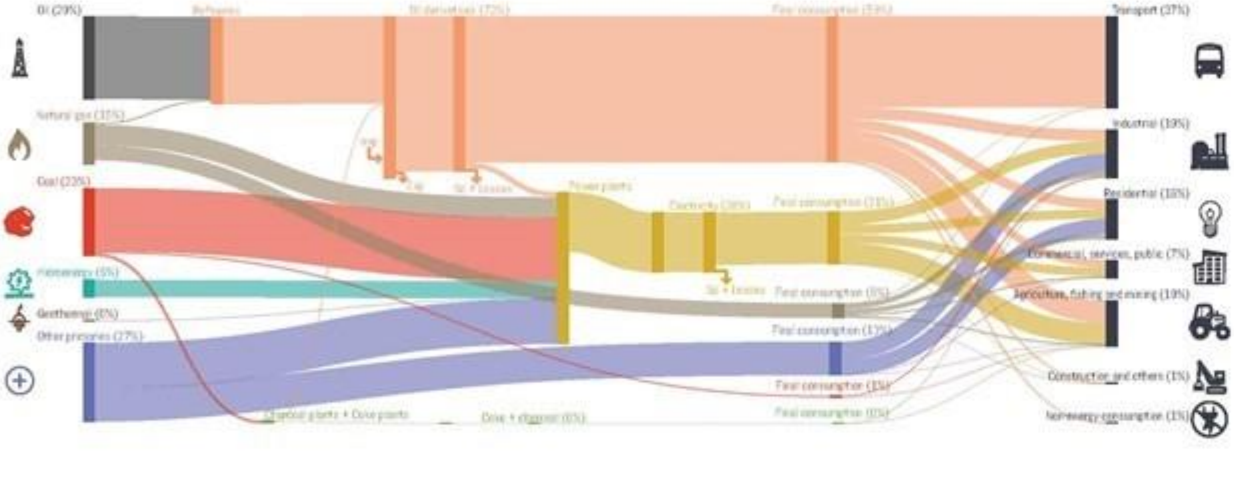
Final consumption in the Transport Sector	Mtoe 10.55 [1]
Final consumption in the Industrial Sector	Mtoe 5.57 [1]
Final consumption in the Residential Sector	Mtoe 4.62 [1]
Final consumption in the Commercial and Service Sector	Mtoe 2.12 [1]
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 5.77 [1]

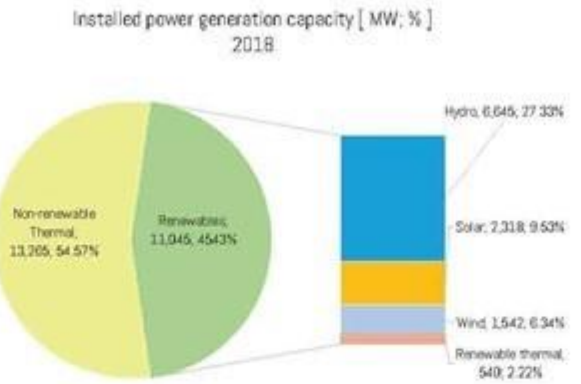
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 6	Gm³ 7	Mt n.d.

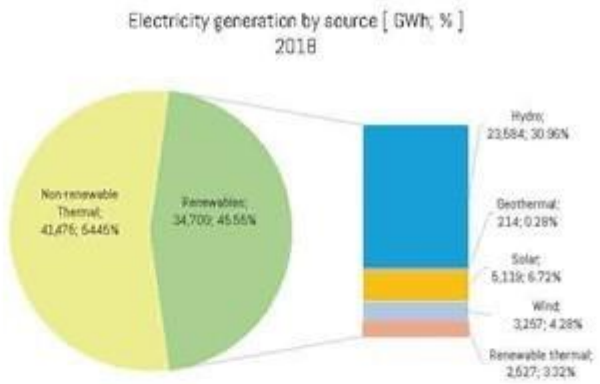
[1] Supply and demand data for the year 2018 estimated by OLADE.
[2] It includes non-energy consumption.
[3] Does not include consumption of the energy sector.

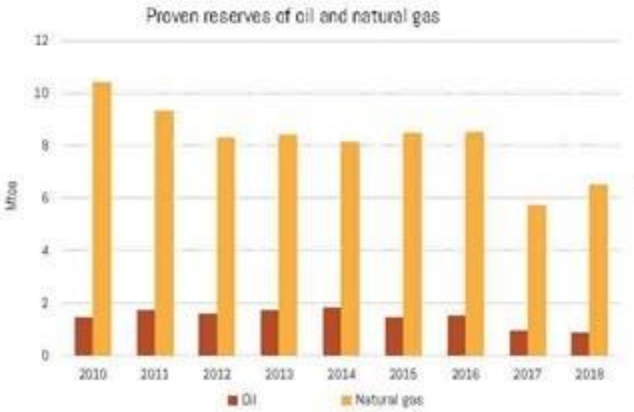
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
3,990	1.62 [1]	99.63	40.43 [1]	13.39 [1]	28.64 [1]	1.42 [1]	28.63 [2]	220	24.31	0.09 / 0.07

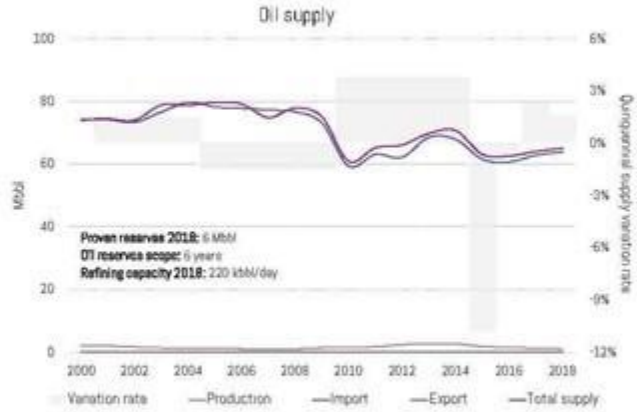
Summarized energy balance 2018



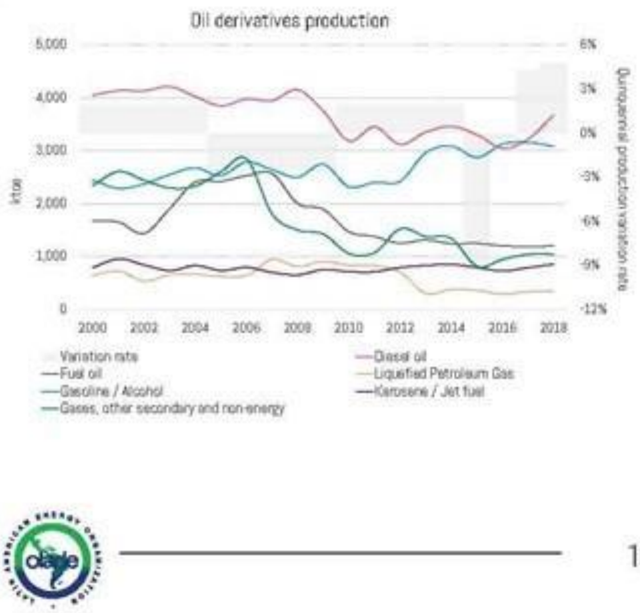

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal, 13,205; 54.57%
Renewables; 11,045; 4543%
Hydro, 6,645; 27.33%
Solar; 2,318; 9.53%
Wind; 1,542; 6.34%
Renewable thermal; 540; 2.22%

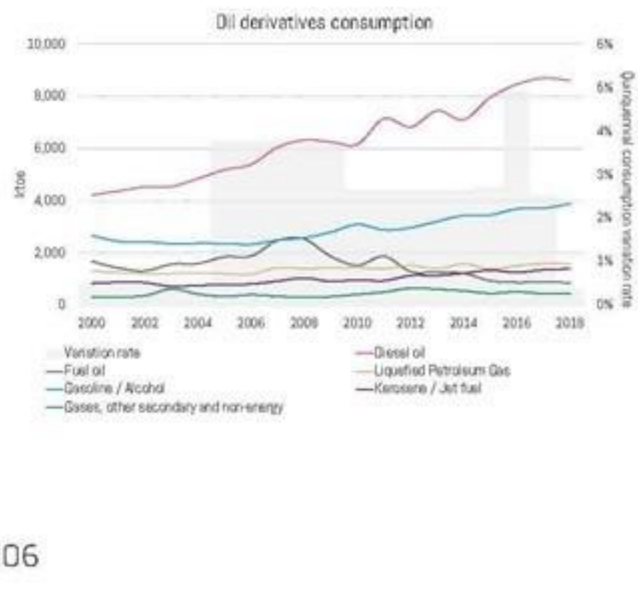

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 41,476; 5445%
Renewables; 34,700; 45.55%
Hydro; 23,584; 30.96%
Geothermal; 214; 0.28%
Solar; 5,119; 6.72%
Wind; 3,257; 4.28%
Renewable thermal; 2,627; 3.32%

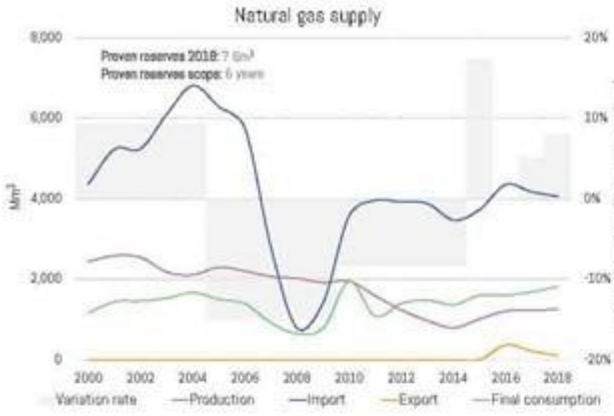

Proven reserves of oil and natural gas
Mtoe
Oil
Natural gas

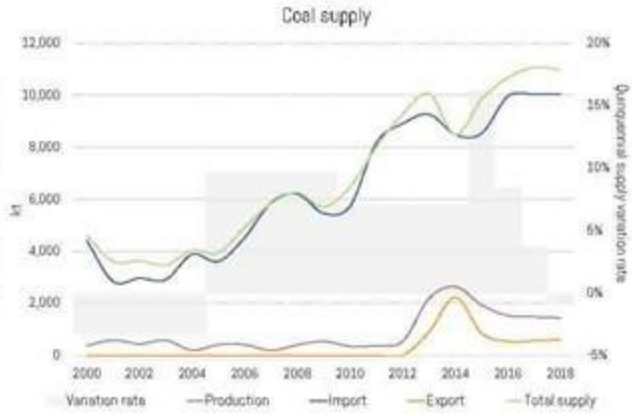

Oil supply
Mbbl
Proven reserves 2018: 6 Mbbl
Oil reserves scope: 6 years
Refining capacity 2018: 220 kbbl/day
Quinquennial supply variation rate
Variation rate
Production
Import
Export
Total supply

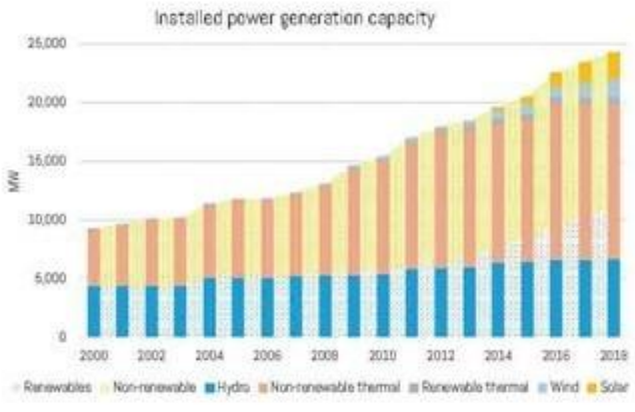
CHILE

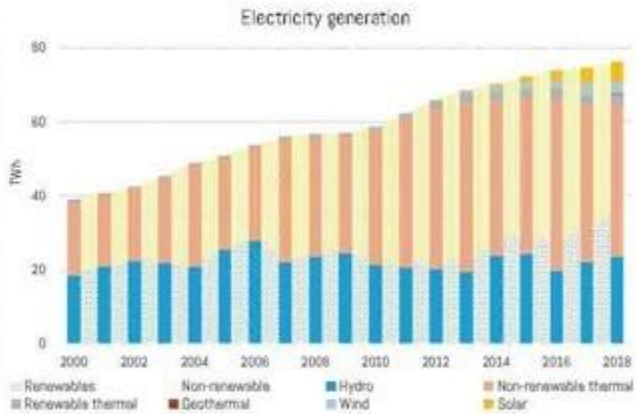

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Fuel oil
Gasoline / Alcohol
Gases, other secondary and non-energy
Diesel oil
Liquefied Petroleum Gas
Kerosene / Jet fuel

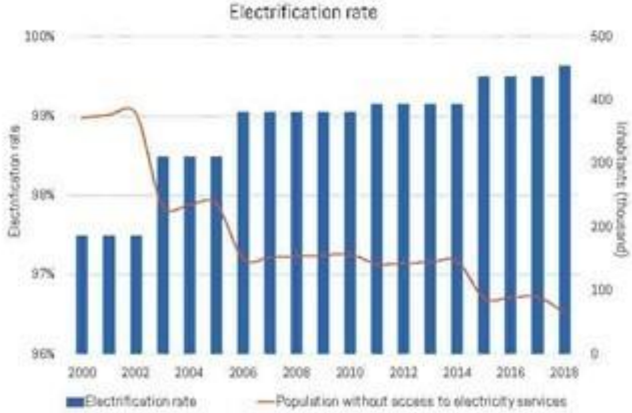

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Fuel oil
Gasoline / Alcohol
Gases, other secondary and non-energy
Diesel oil
Liquefied Petroleum Gas
Kerosene / Jet fuel

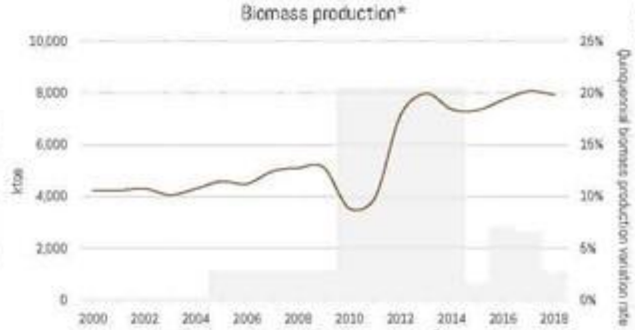






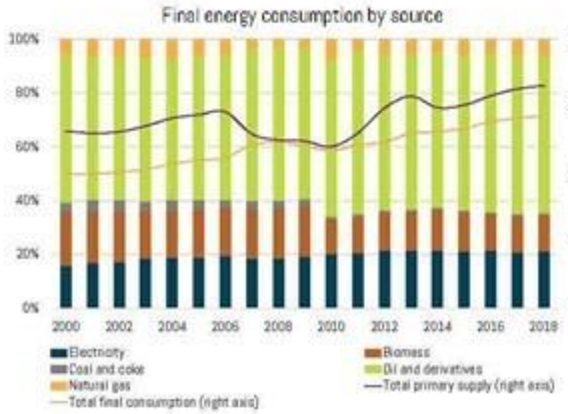




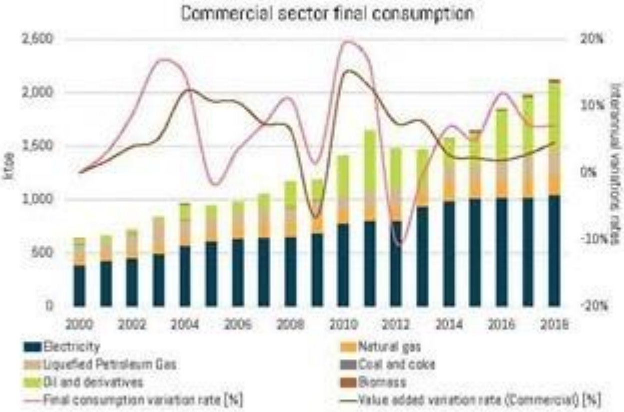


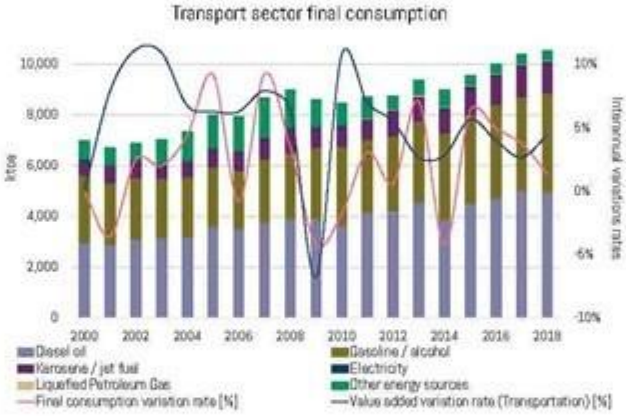
(*): Includes firewood, black liquor, biomass pellets and charcoal.

Note: The fall between 2009 and 2010 corresponds to a methodological change made by the country in the National Energy Balance

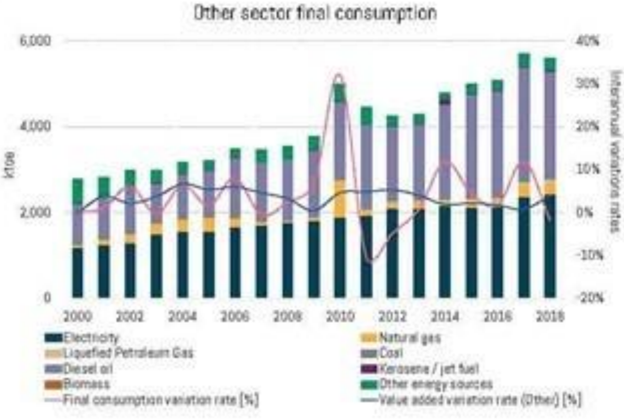

Final energy consumption by source
ktoe
Electricity
Coal and coke
Natural gas
Total final consumption (right axis)
Biomass
Oil and derivatives
Total primary supply (right axis)


Industrial sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]

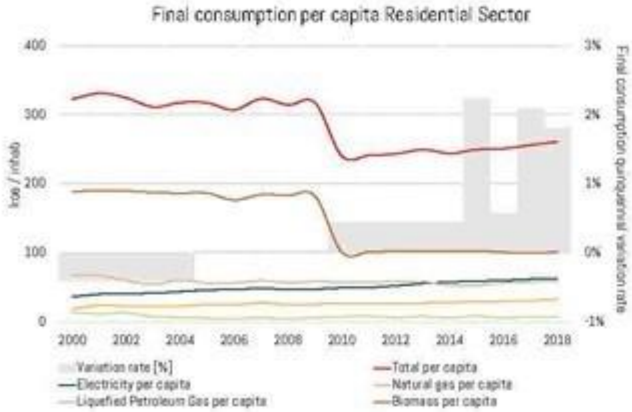

Commercial sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Commercial) [%]

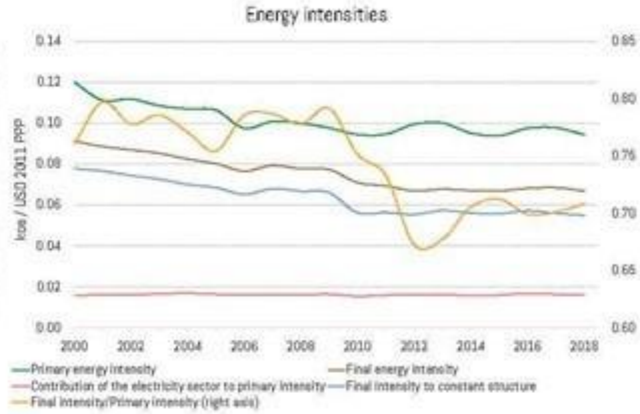

Transport sector final consumption
ktoe
Interannual variation rates
Diesel oil
Kerosene / jet fuel
Liquefied Petroleum Gas
Final consumption variation rate [%]
Gasoline / alcohol
Electricity
Other energy sources
Value added variation rate (Transportation) [%]

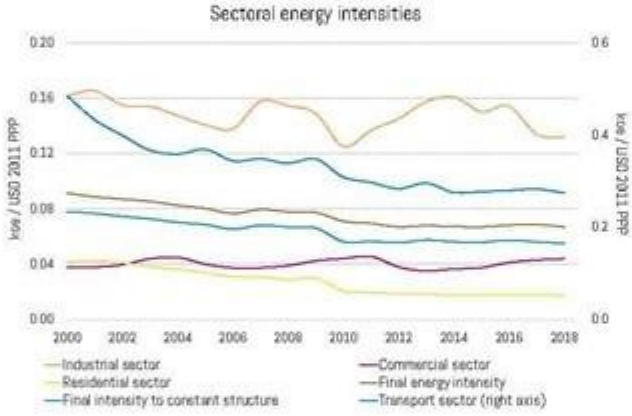
CHILE

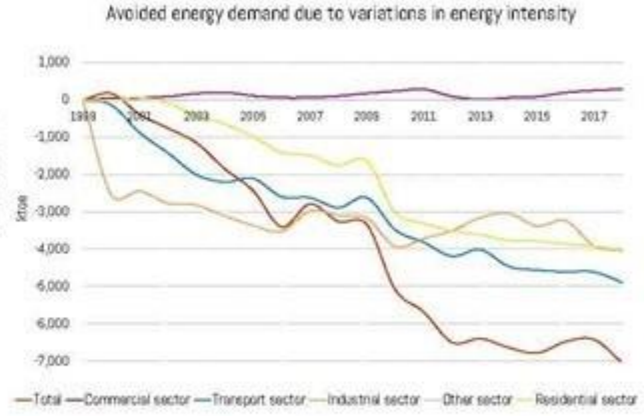

Other sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Diesel oil
Biomass
Final consumption variation rate [%]
Natural gas
Coal
Kerosene / jet fuel
Other energy sources
Value added variation rate (Other) [%]

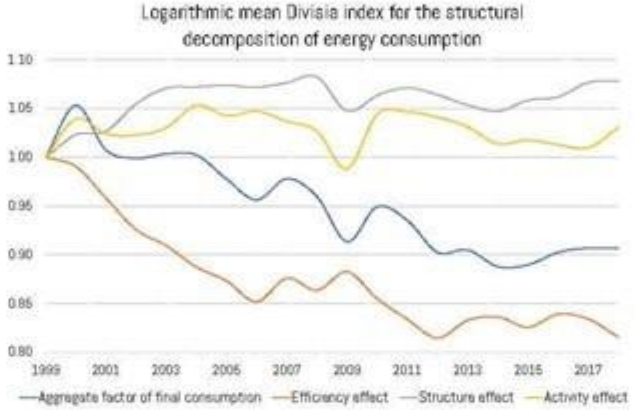

Residential sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

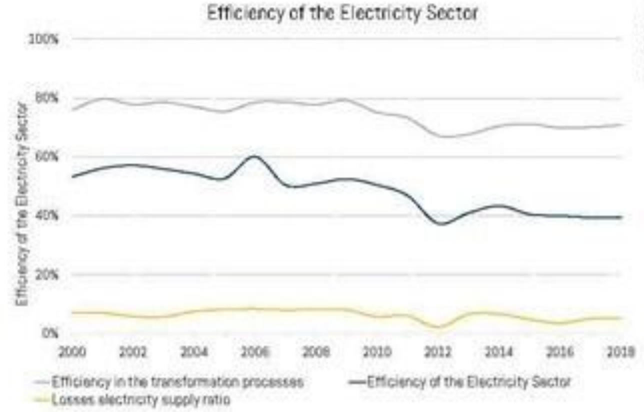

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Total per capita
Natural gas per capita
Biomass per capita

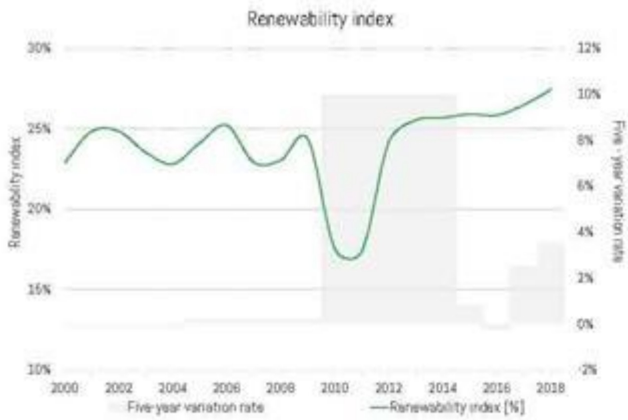

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

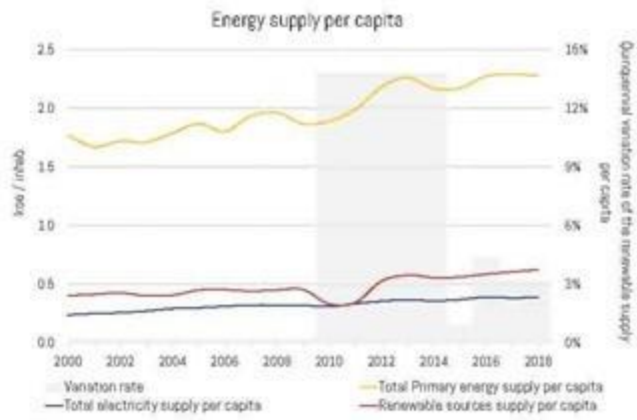

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

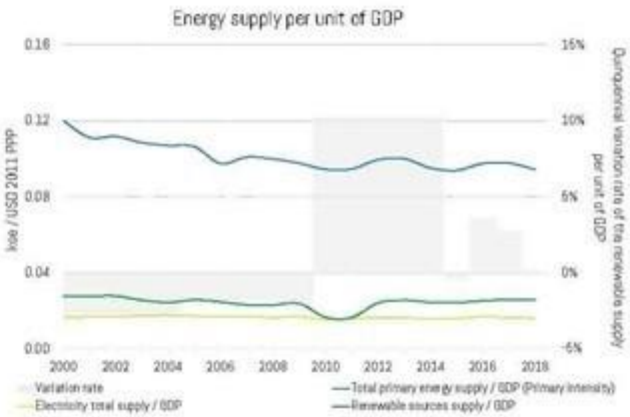

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

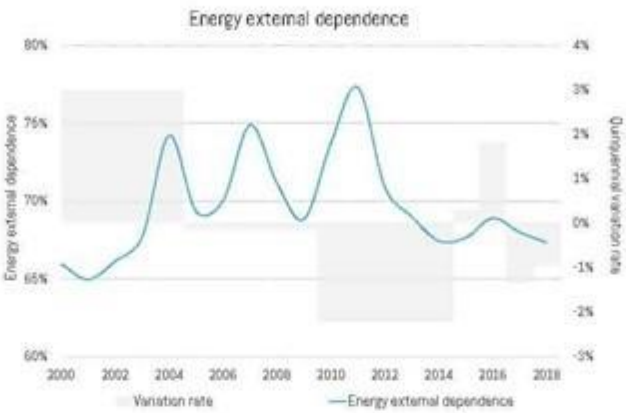

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

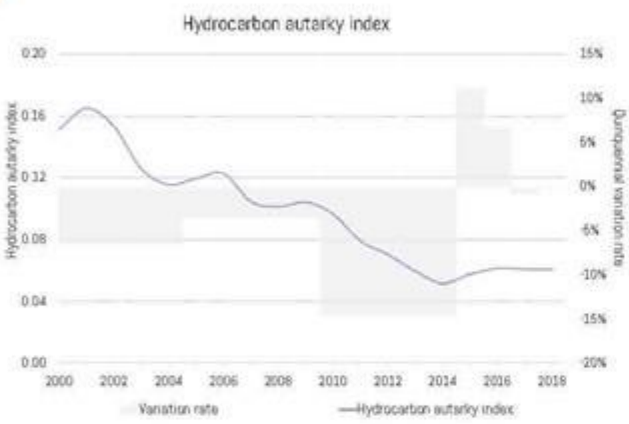

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

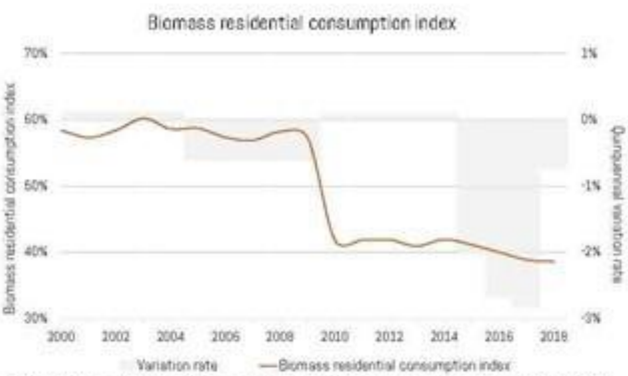




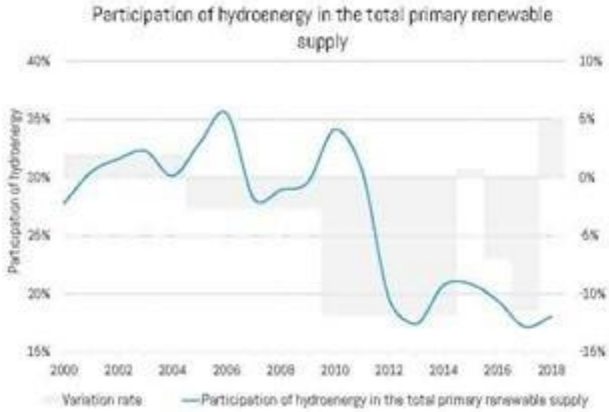


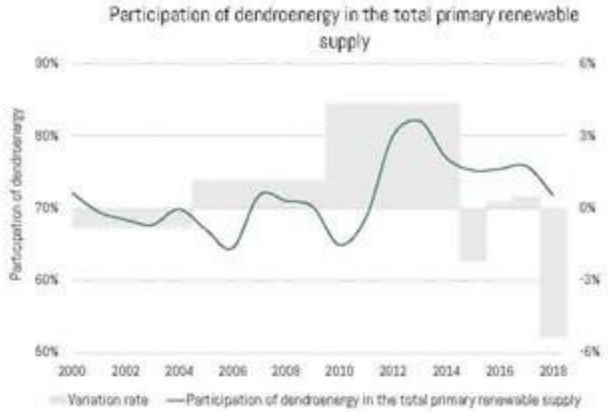


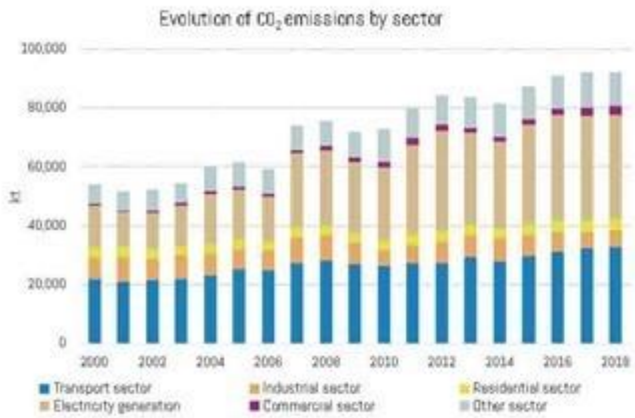


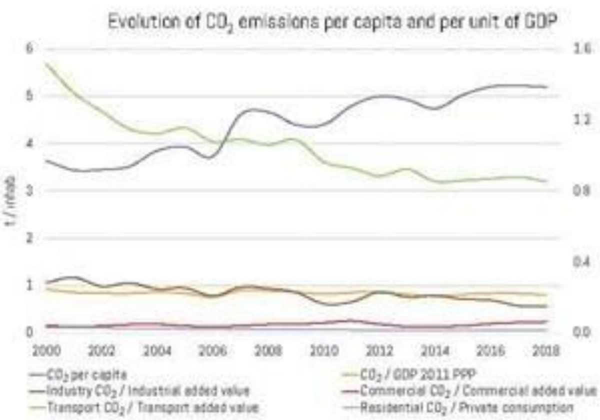


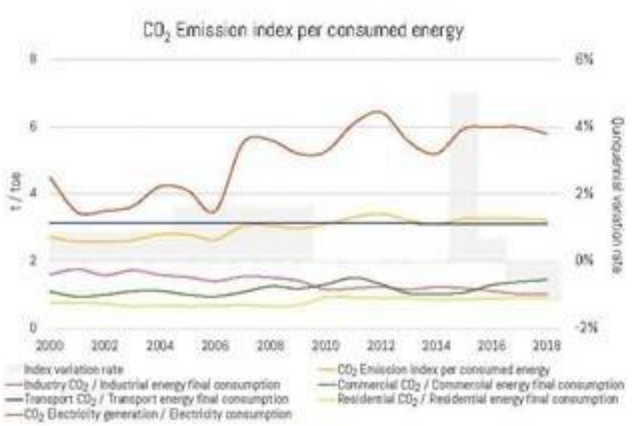
Note: The fall between 2009 and 2010 corresponds to a methodological change made by the country in the National Energy Balance.

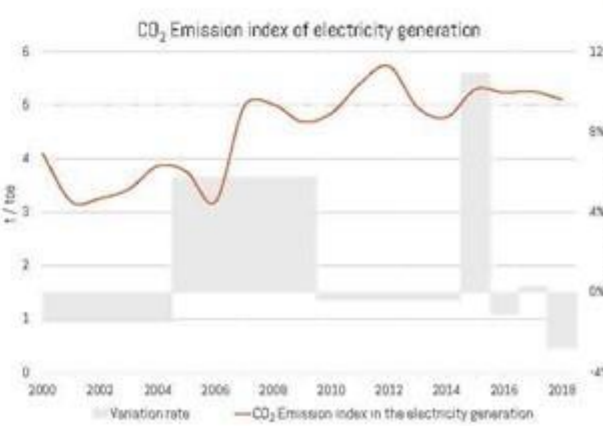

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Participation of hydroenergy in the total primary renewable supply

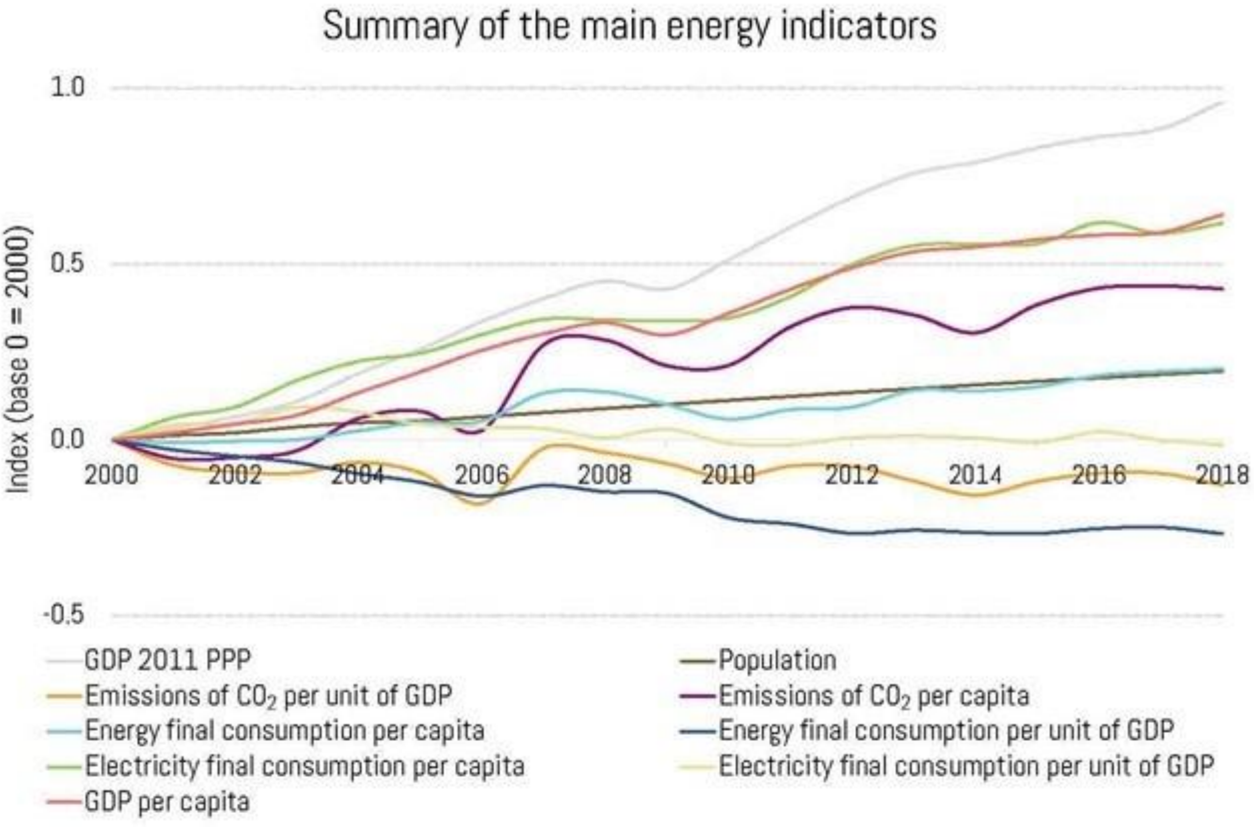

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
90%
80%
70%
60%
50%
6%
3%
0%
-3%
-6%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
100,000
80,000
60,000
40,000
20,000
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou. USD 2011 PPP
6
5
4
3
2
1
0
1.6
1.2
0.8
0.4
0.0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
8
6
4
2
0
6%
4%
2%
0%
-2%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
6
5
4
3
2
1
0
12%
8%
4%
0%
-4%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
1.0
0.5
0.0
-0.5
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

COLOMBIA

General Information 2018

Population (thousand inhab.)	49,661
Area (km²)	1,141,749
Population Density (inhab./km²)	43
Urban Population (%)	80
GDP USD 2010 (MUSD)	381,885
GDP USD 2011 PPP (MUSD)	661,960
GDP per Capita (thou. USD 2011 PPP/inhab.)	13

Energy Sector

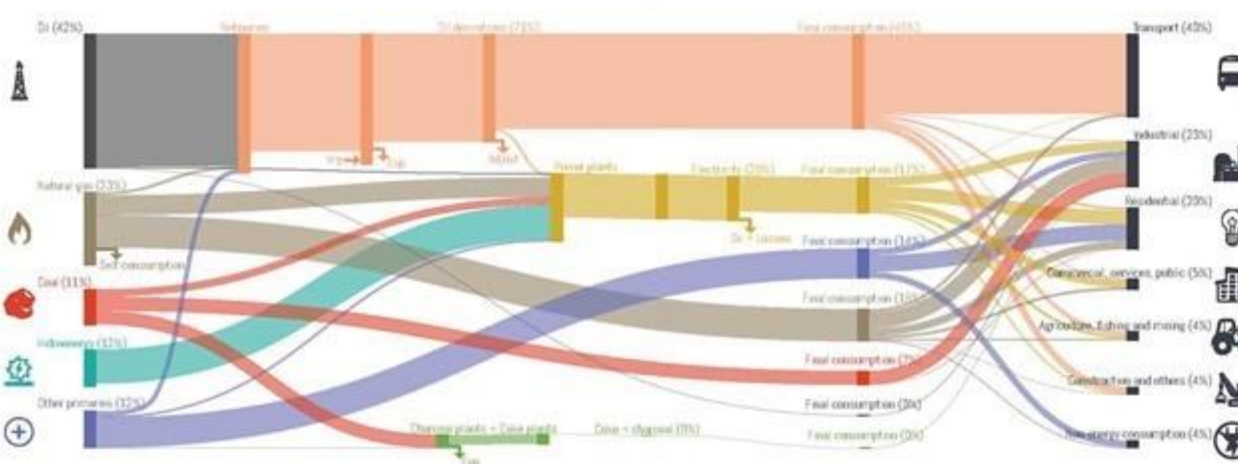
- Final consumption in the Transport Sector — Mtoe 12.52
- Final consumption in the Industrial Sector — Mtoe 6.99
- Final consumption in the Residential Sector — Mtoe 6.28
- Final consumption in the Commercial and Service Sector — Mtoe 1.70
- Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption — Mtoe 3.76

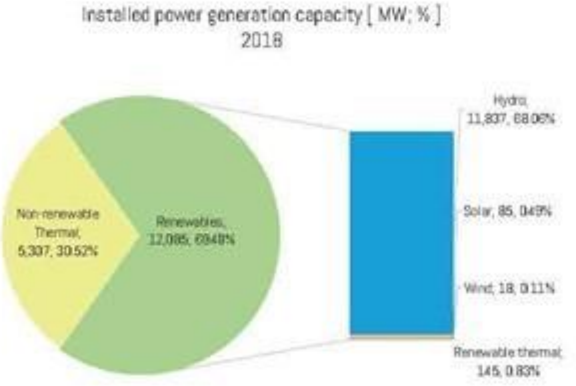
- Oil reserves — Mbbl 1,958
- Natural gas reserves — Gm³ 107
- Coal reserves — Mt 5,996 [2]

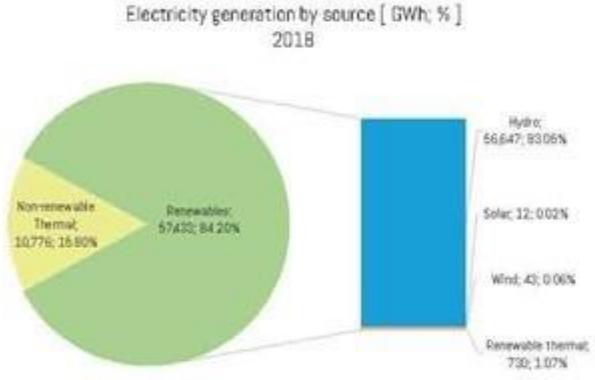
[1] Data corresponding to the year 2017.
[2] Estimated data by OLADE.

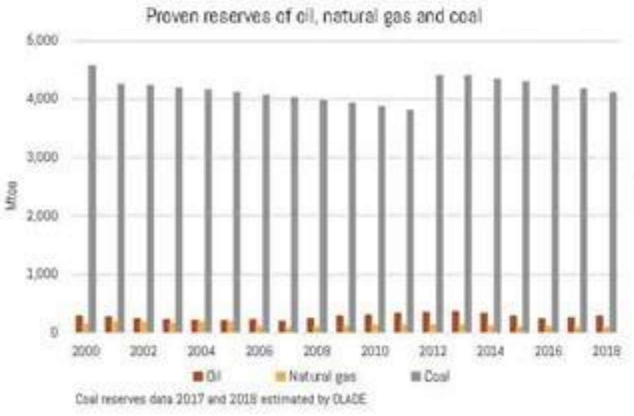
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,264	0.63	96.89 [1]	44.99	134.95	1.97	93.99	31.25	348	17.39	0.07 / 0.05

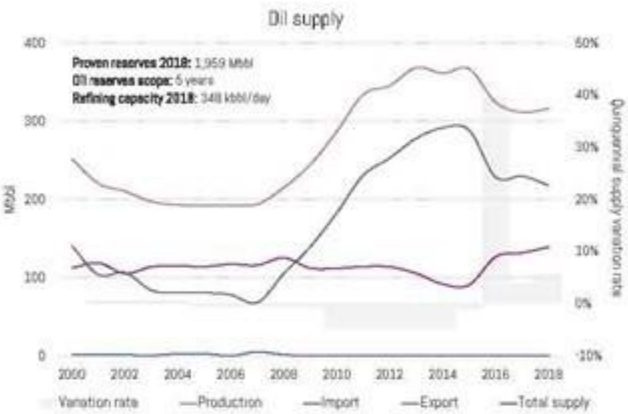
Summarized energy balance 2018



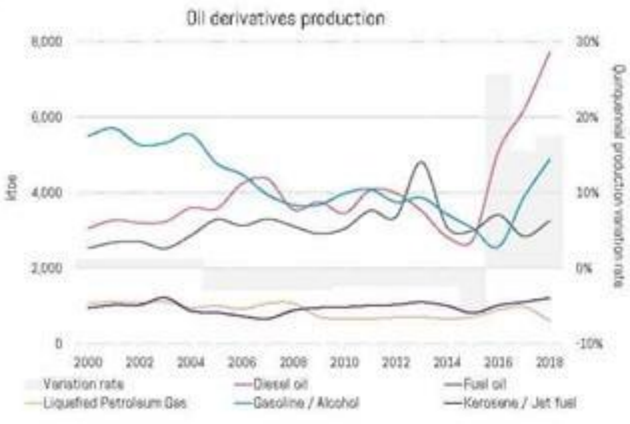

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 5,307; 30.52%
Renewables; 12,085; 69.48%
Hydro; 11,837; 68.06%
Solar; 85; 0.49%
Wind; 18; 0.11%
Renewable thermal; 145; 0.83%

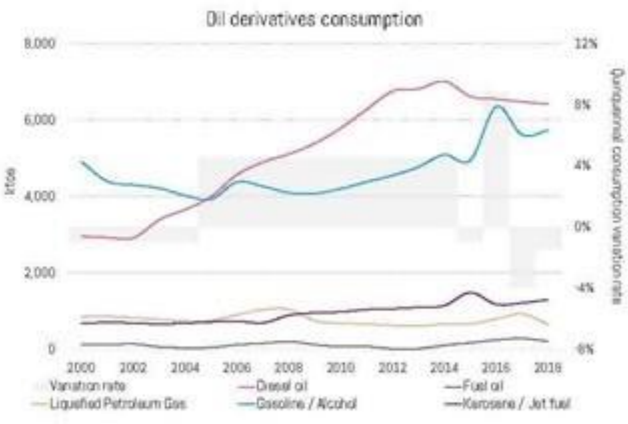

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 10,776; 15.80%
Renewables; 57,433; 84.20%
Hydro; 56,647; 83.06%
Solar; 12; 0.02%
Wind; 43; 0.06%
Renewable thermal; 730; 1.07%

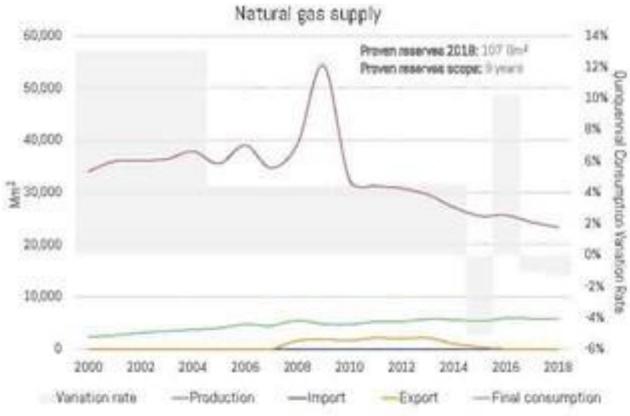

Proven reserves of oil, natural gas and coal
Mtoe
Oil
Natural gas
Coal
Coal reserves data 2017 and 2018 estimated by OLADE

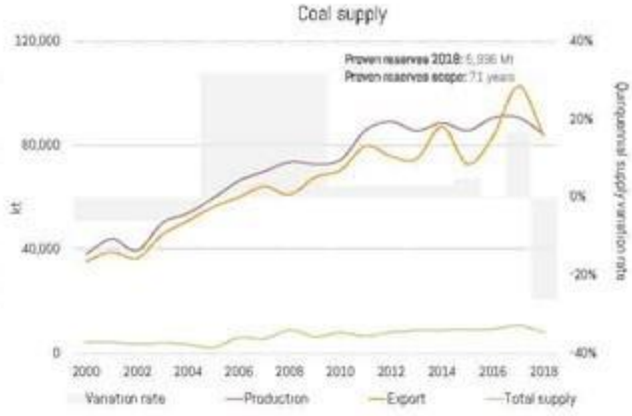

Oil supply
Proven reserves 2018: 1,959 Mbbl
Oil reserves scope: 5 years
Refining capacity 2018: 348 kbbl/day
Mbbl
Quinquennial supply variation rate
Variation rate
Production
Import
Export
Total supply

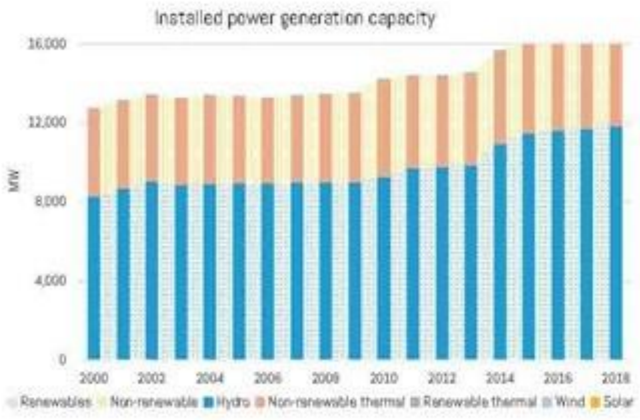
COLOMBIA

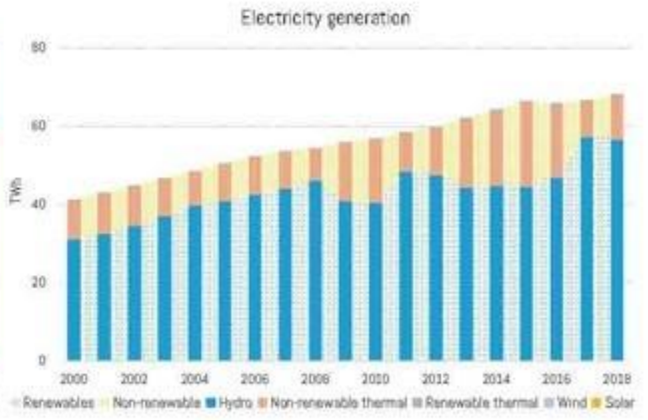

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel

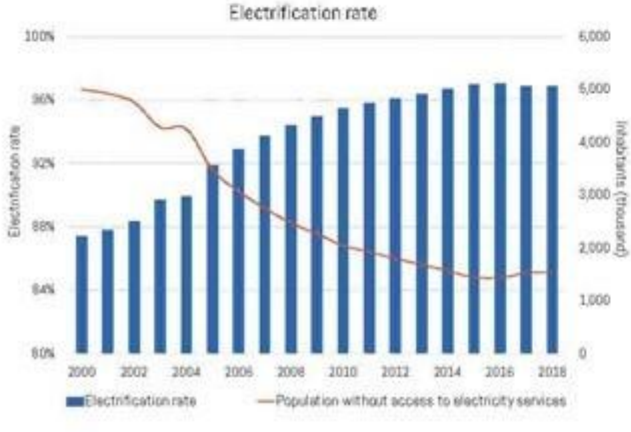

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel

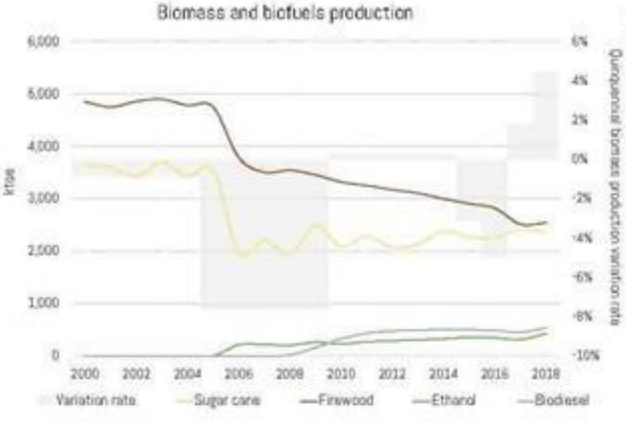

Natural gas supply
Proven reserves 2018: 107 Bm³
Proven reserves scope: 9 years
Mm³
Quinquennial Consumption Variation Rate
Variation rate
Production
Import
Export
Final consumption

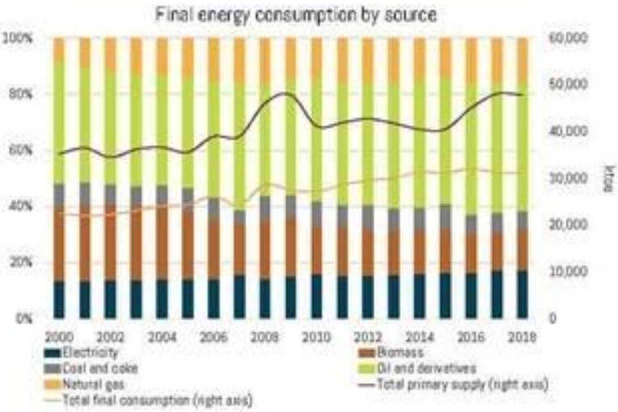

Coal supply
Proven reserves 2018: 5,996 Mt
Proven reserves scope: 71 years
kt
Quinquennial supply variation rate
Variation rate
Production
Export
Total supply

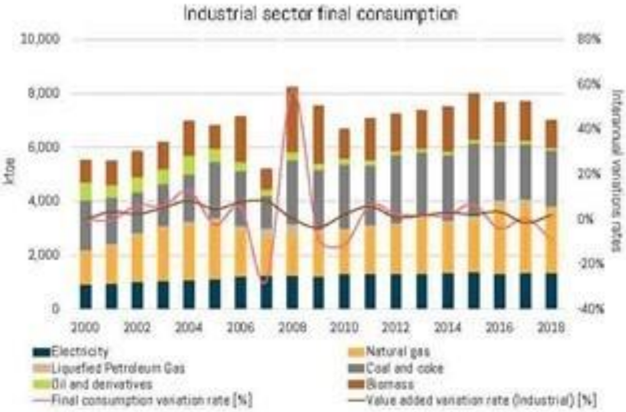

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

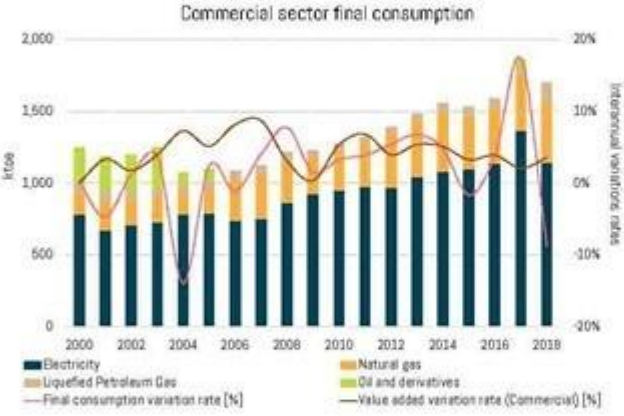

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

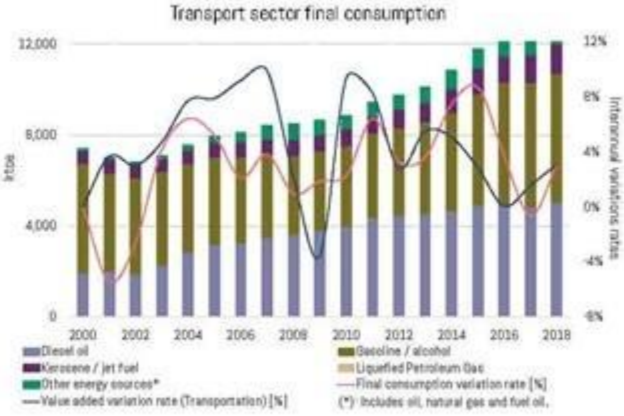

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services

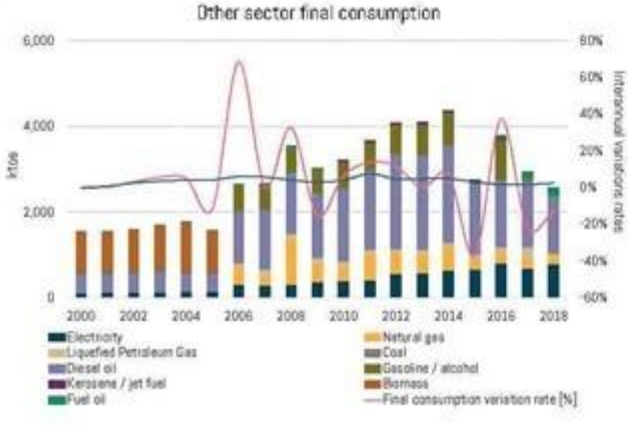

Biomass and biofuels production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood
Ethanol
Biodiesel

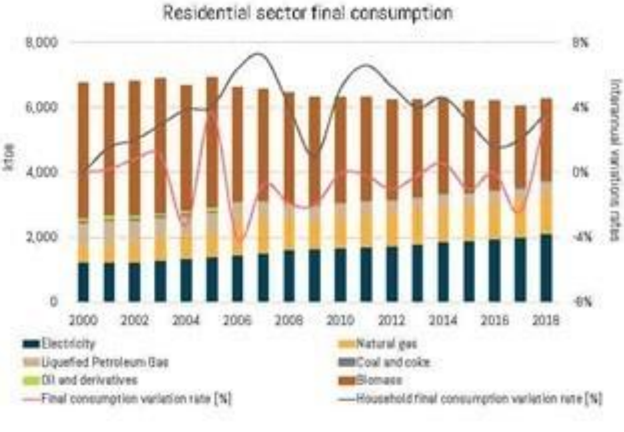

Final energy consumption by source
ktoe
Electricity
Coal and coke
Natural gas
Total final consumption (right axis)
Biomass
Oil and derivatives
Total primary supply (right axis)


Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]

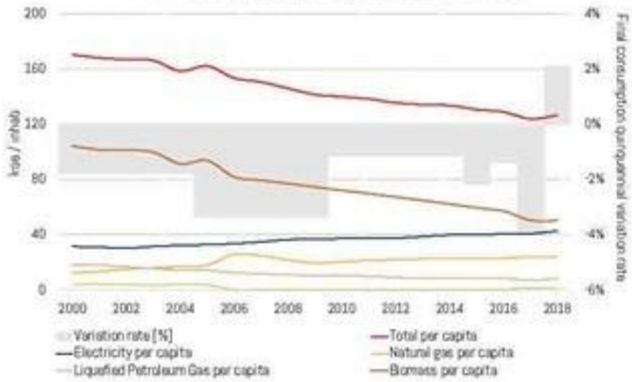

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Natural gas
Oil and derivatives
Value added variation rate (Commercial) [%]


Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Other energy sources*
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Liquefied Petroleum Gas
Final consumption variation rate [%]
(*): Includes oil, natural gas and fuel oil.

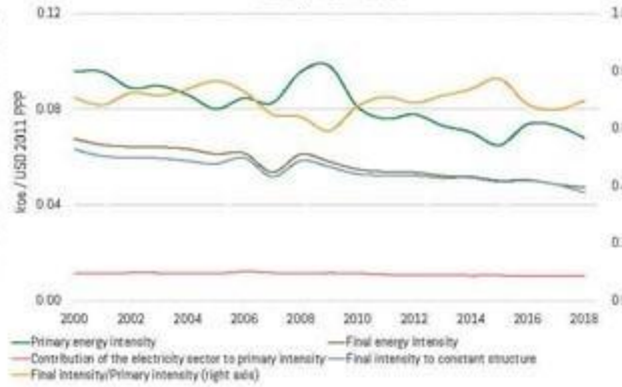

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Diesel oil
Kerosene / jet fuel
Fuel oil
Natural gas
Coal
Gasoline / alcohol
Biomass
Final consumption variation rate [%]


Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Household final consumption variation rate [%]

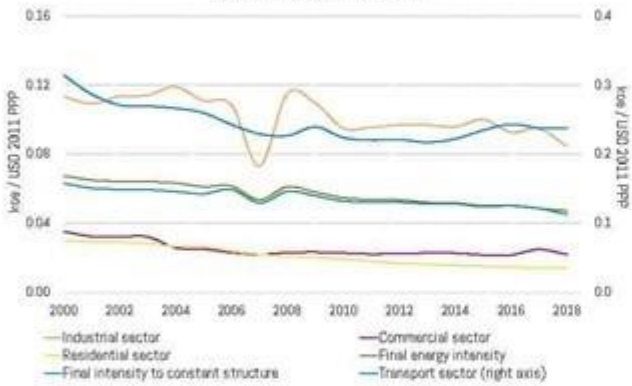
Final consumption per capita Residential Sector



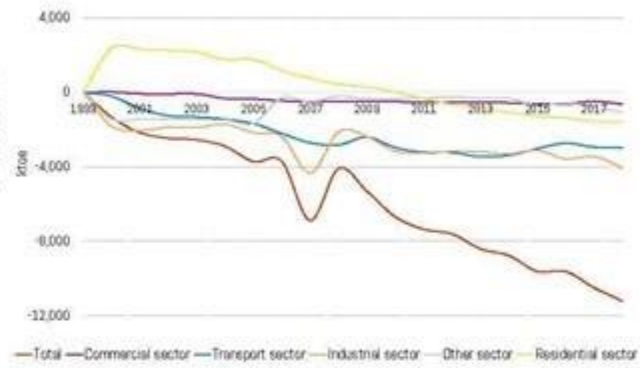
Energy intensities



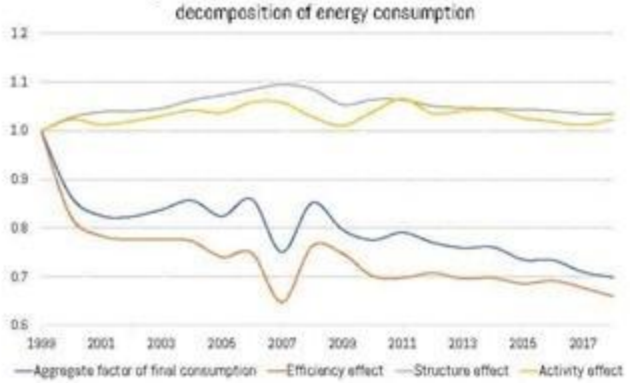
Sectoral energy intensities



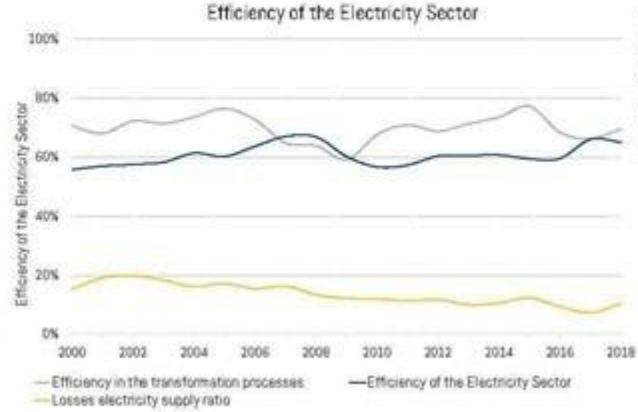
Avoided energy demand due to variations in energy intensity



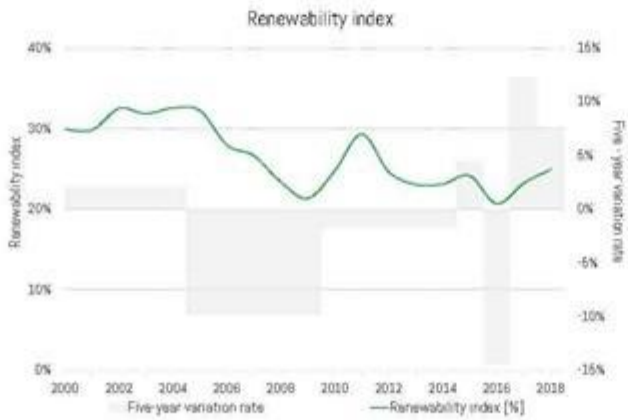
Logarithmic mean Divisia index for the structural decomposition of energy consumption

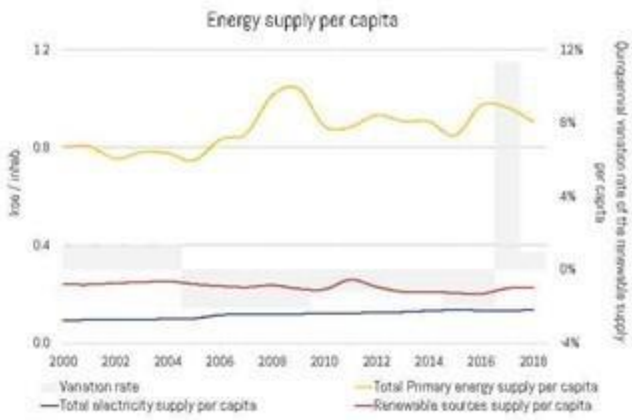


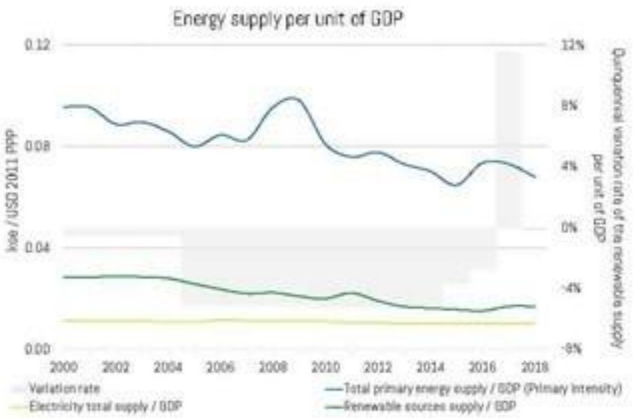
Efficiency of the Electricity Sector

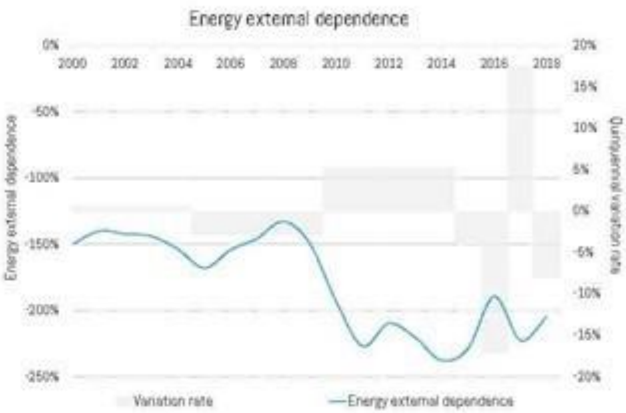


COLOMBIA

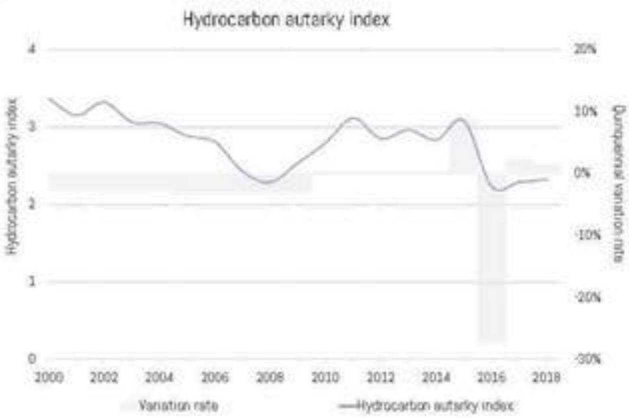

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

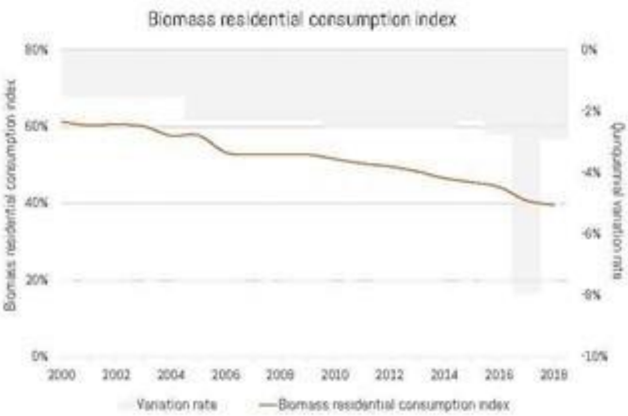

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

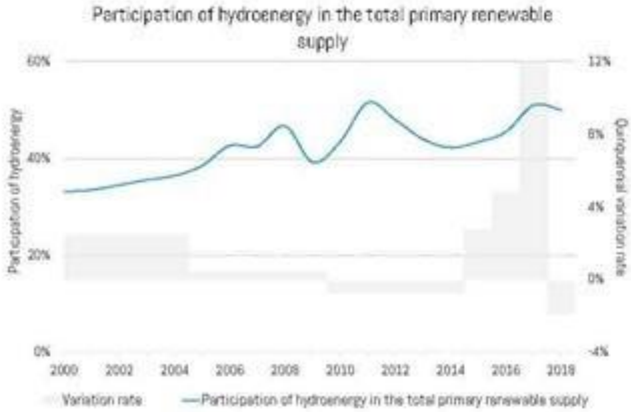

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

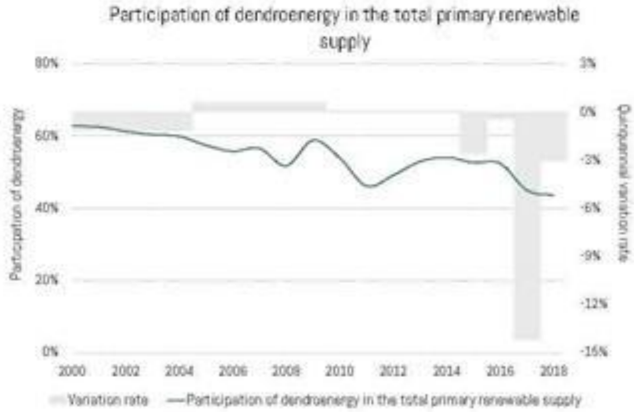

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

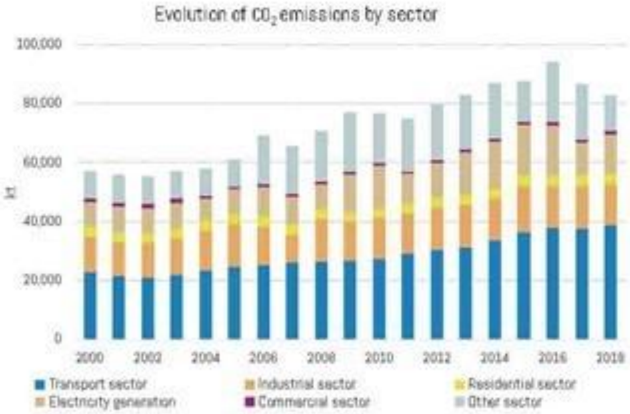
COLOMBIA

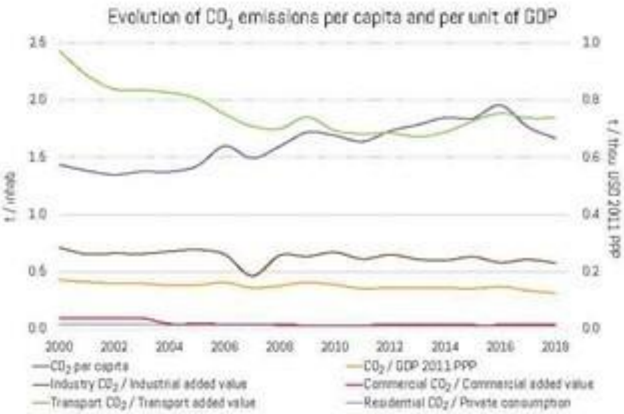

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

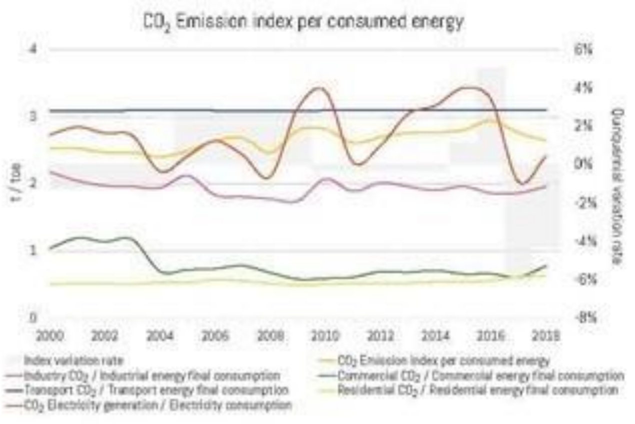

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

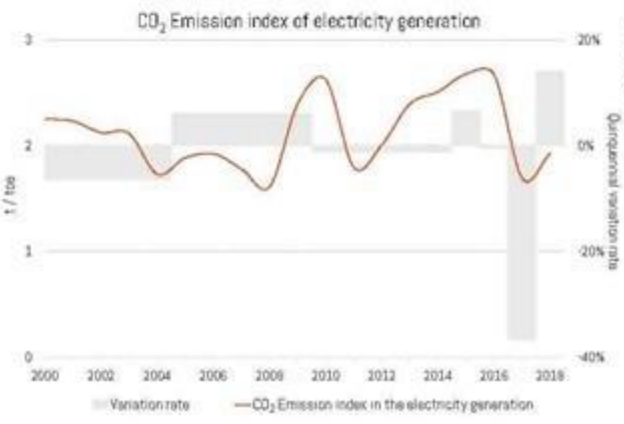

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

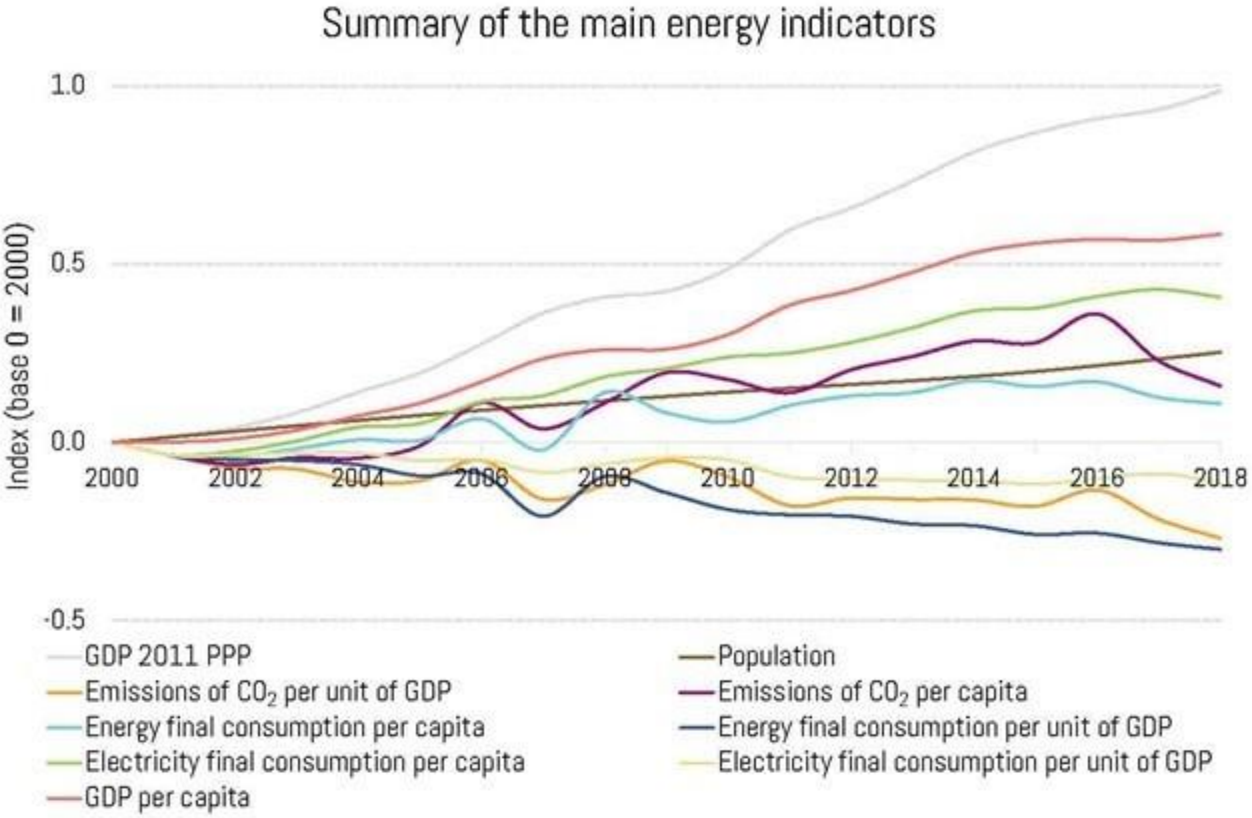

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO2 emissions per capita and per unit of GDP
t / inhab
t / thou. USD 2011 ppp
CO2 per capita
CO2 / GDP 2011 PPP
Industry CO2 / Industrial added value
Commercial CO2 / Commercial added value
Transport CO2 / Transport added value
Residential CO2 / Private consumption


CO2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO2 Emission index per consumed energy
Industry CO2 / Industrial energy final consumption
Commercial CO2 / Commercial energy final consumption
Transport CO2 / Transport energy final consumption
Residential CO2 / Residential energy final consumption
CO2 Electricity generation / Electricity consumption


CO2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.0
0.5
0.0
-0.5
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

COSTA RICA

General Information 2018

Population (thousand inhab.)	4,999
Area (km²)	51,100
Population Density (inhab./km²)	98
Urban Population (%)	79
GDP USD 2010 (MUSD)	49,443
GDP USD 2011 PPP (MUSD)	78,414
GDP per Capita (thou. USD 2011 PPP/inhab.)	16

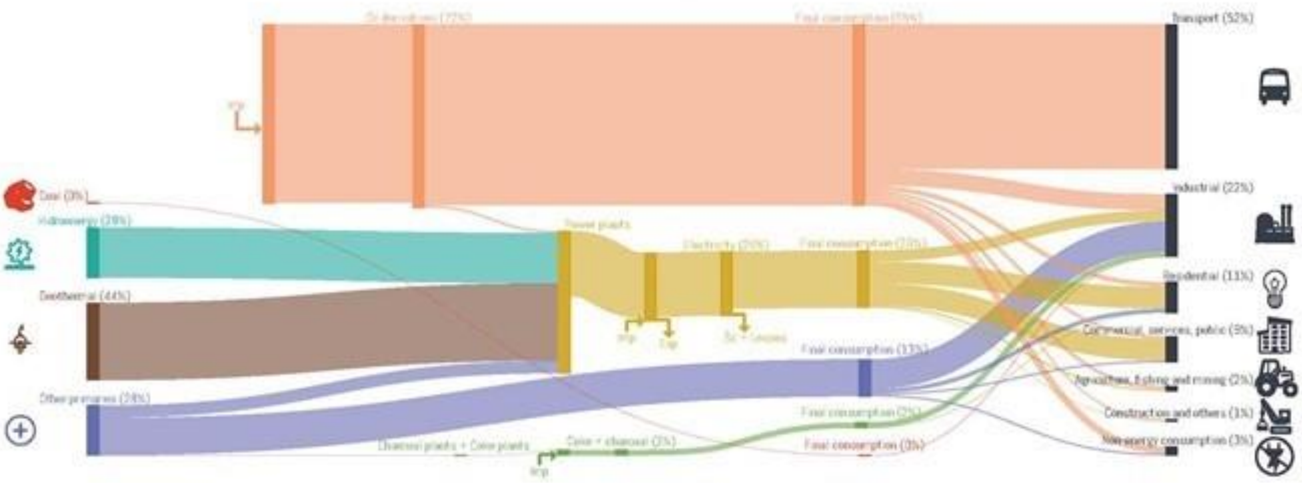
Energy Sector

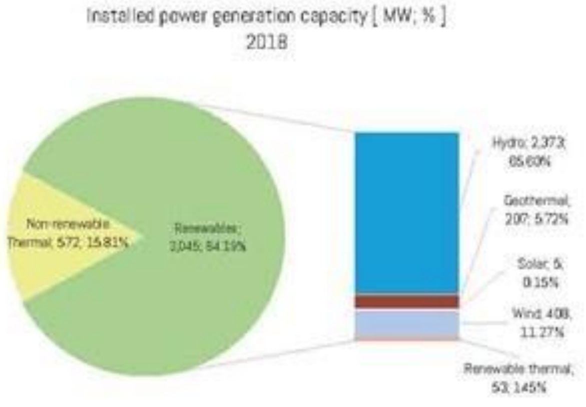
Final consumption in the Transport Sector	Mtoe 2.18
Final consumption in the Industrial Sector	Mtoe 0.94
Final consumption in the Residential Sector	Mtoe 0.46
Final consumption in the Commercial and Service Sector	Mtoe 0.40
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.25

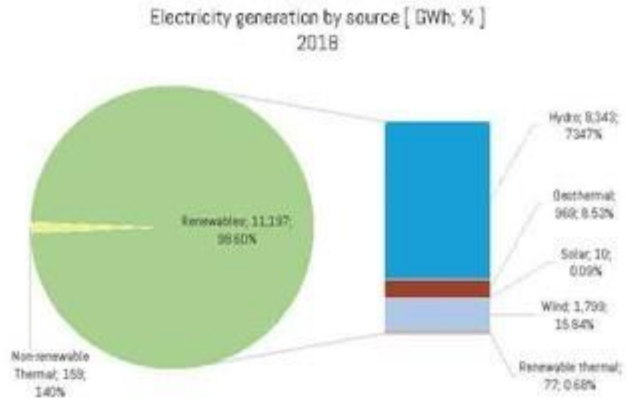
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	32.80

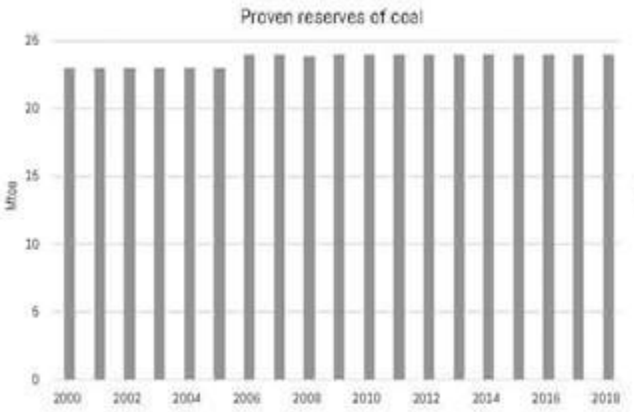
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,998	0.85	99.40	5.46	3.10	2.81	0.08	4.23	n.a.	3.62	0.07 / 0.05

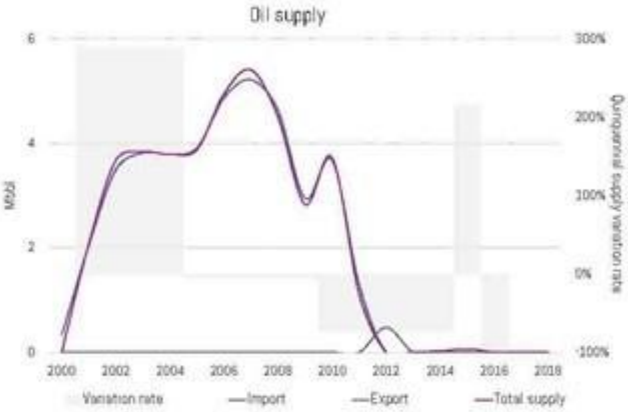
Summarized energy balance 2018

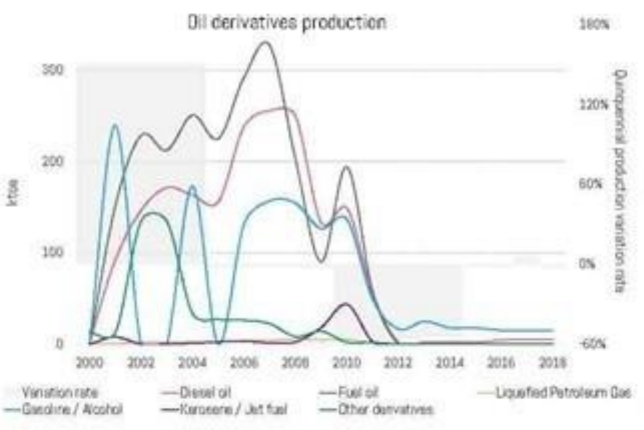


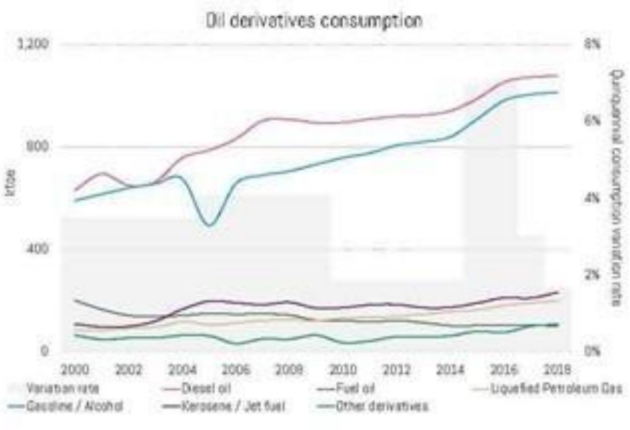

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 572; 15.81%
Renewables; 3,045; 84.19%
Hydro; 2,373; 65.60%
Geothermal; 207; 5.72%
Solar; 5; 0.15%
Wind; 408; 11.27%
Renewable thermal; 53; 1.45%


Electricity generation by source [GWh; %]
2018
Renewables; 11,197; 98.60%
Non-renewable Thermal; 159; 1.40%
Hydro; 8,343; 73.47%
Geothermal; 968; 8.53%
Solar; 10; 0.09%
Wind; 1,799; 15.84%
Renewable thermal; 77; 0.68%

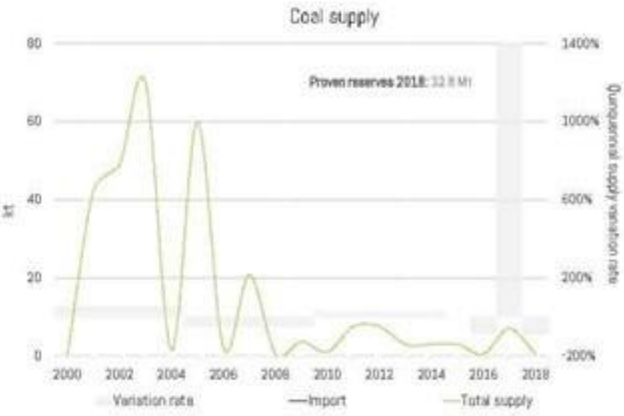

Proven reserves of coal
Mtoe

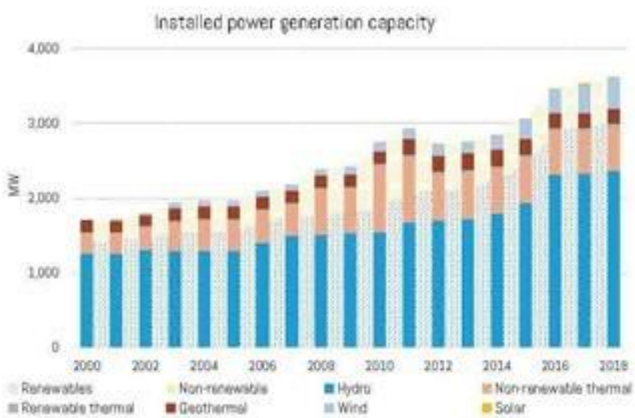

Oil supply
Mbbl
Quinquennial supply variation rate
Variation rate
Import
Export
Total supply

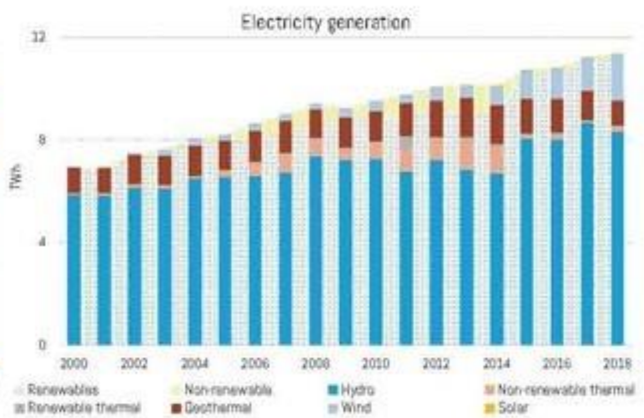

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

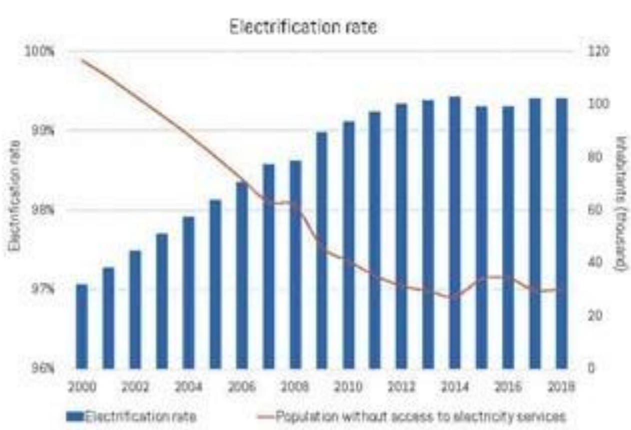

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

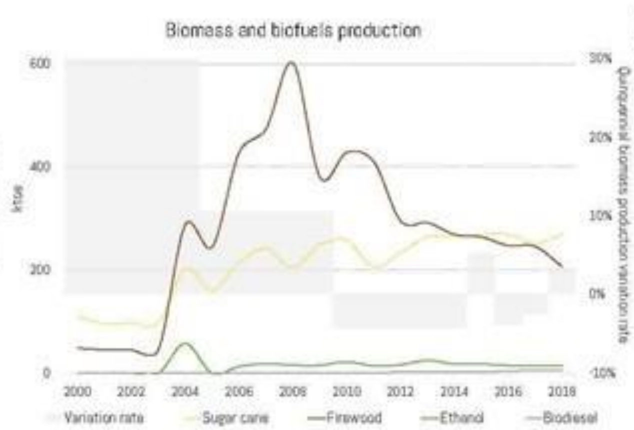
Costa Rica closed the year 2018 with an electricity generation of 98.6% produced from renewable sources, as confirmed by the Costa Rican Institute of Electricity (ICE).

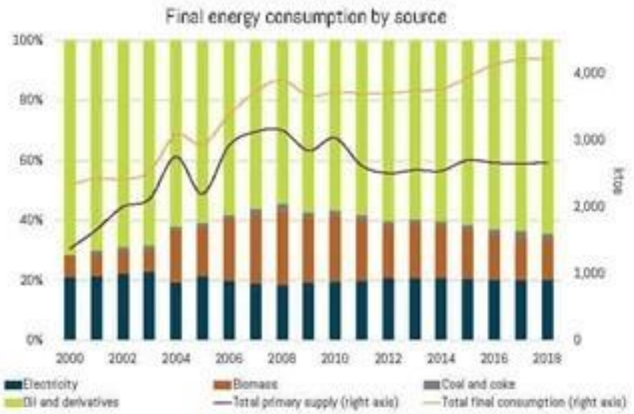


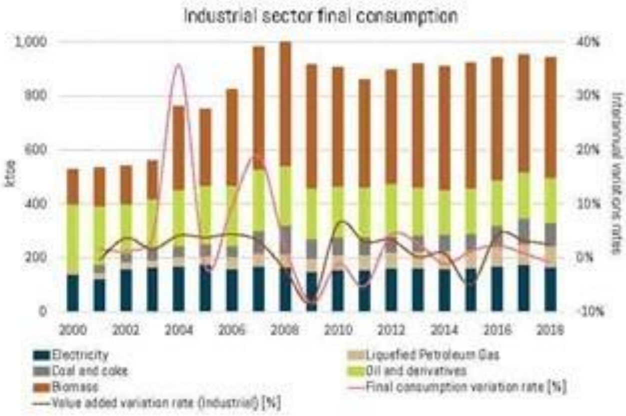


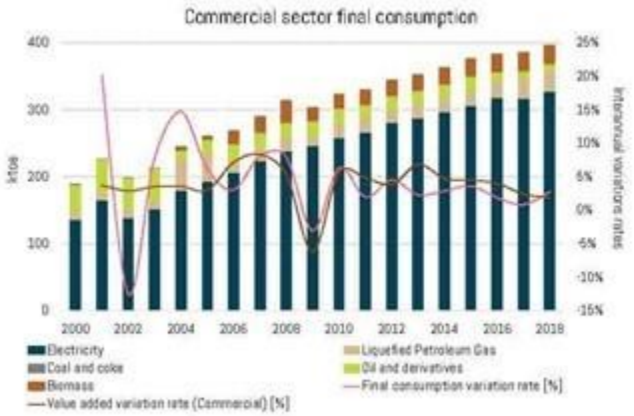


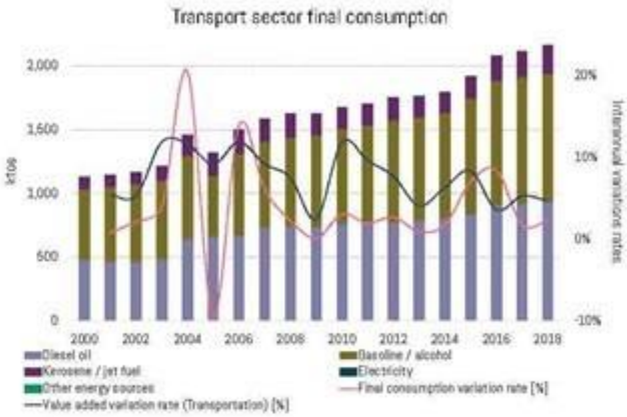




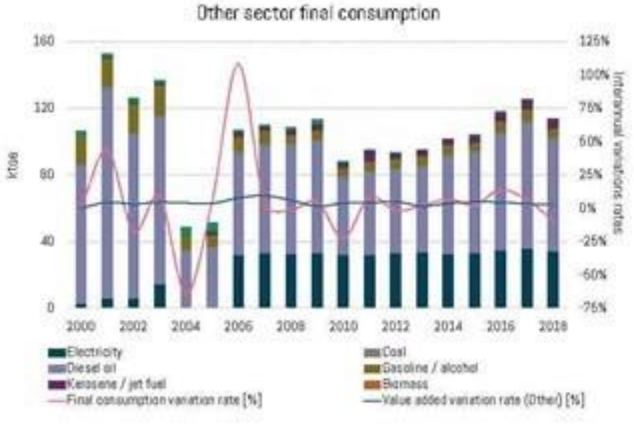

Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

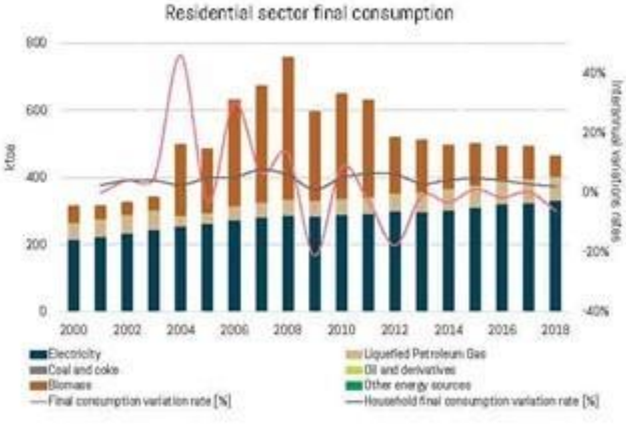

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]


Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]

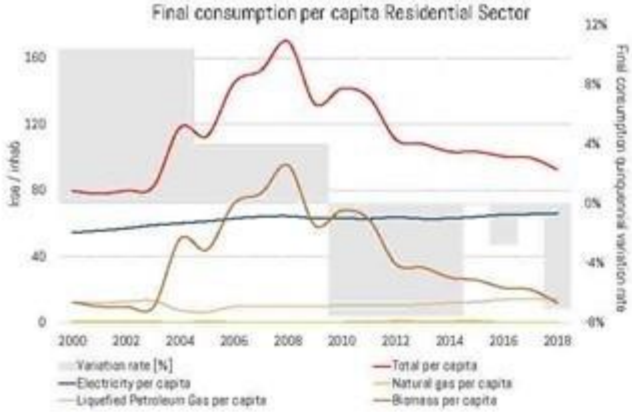

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Other energy sources
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

COSTA RICA

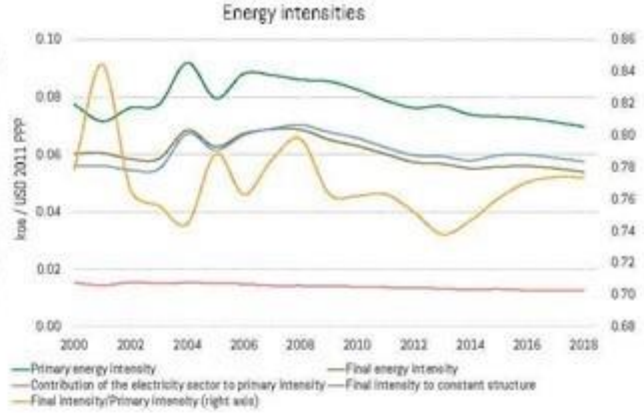

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Coal
Gasoline / alcohol
Biomass
Value added variation rate (Other) [%]


Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Final consumption variation rate [%]
Liquefied Petroleum Gas
Oil and derivatives
Other energy sources
Household final consumption variation rate [%]

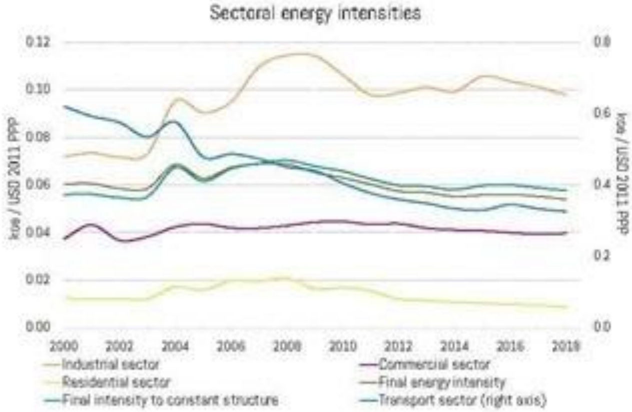
Final consumption per capita Residential Sector



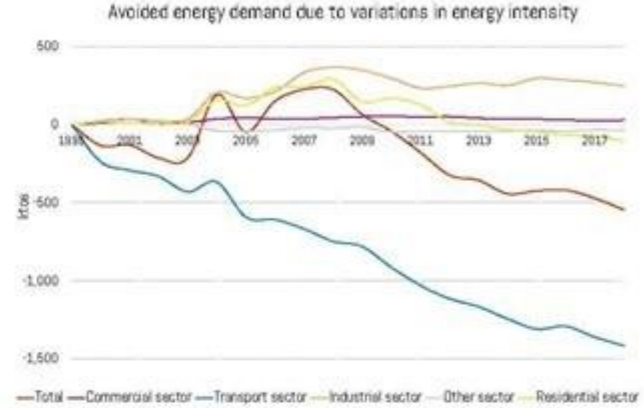
Energy intensities



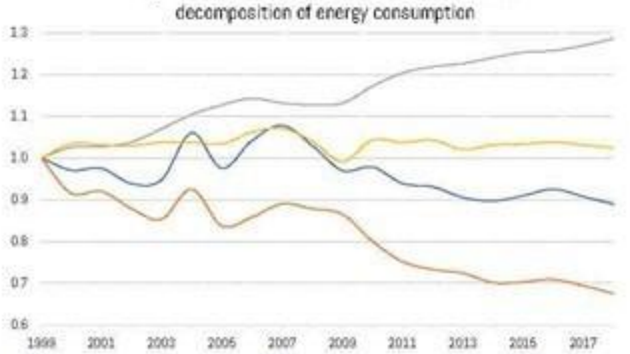
Sectoral energy intensities



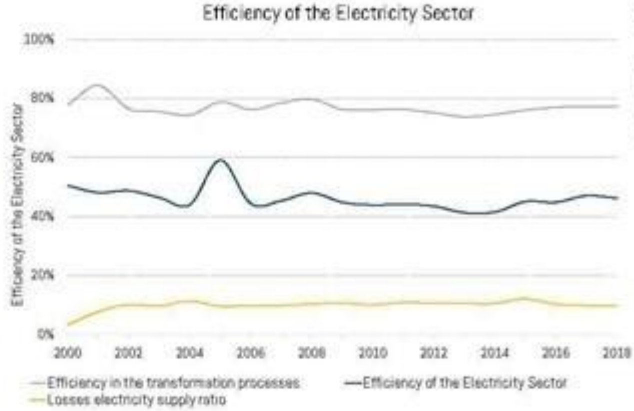
Avoided energy demand due to variations in energy intensity

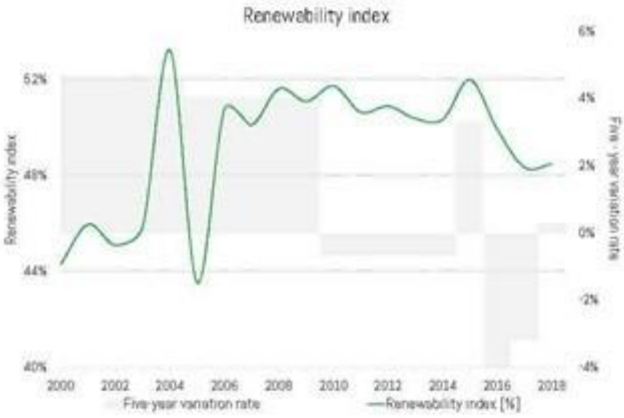


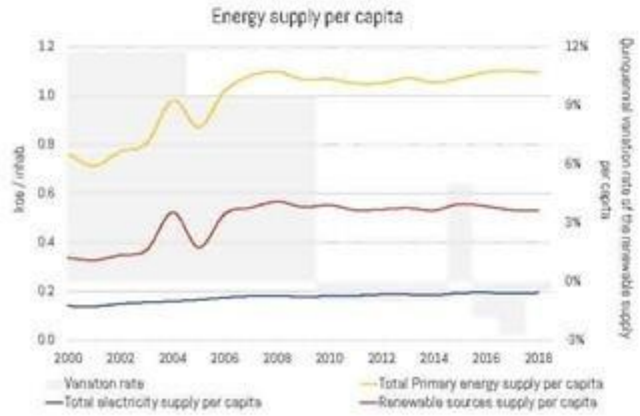
Logarithmic mean Divisia index for the structural decomposition of energy consumption

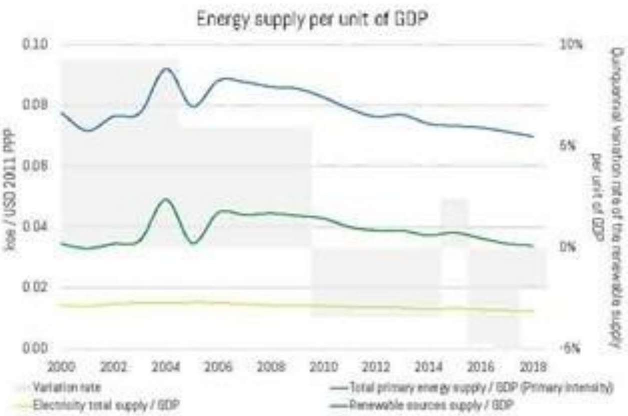


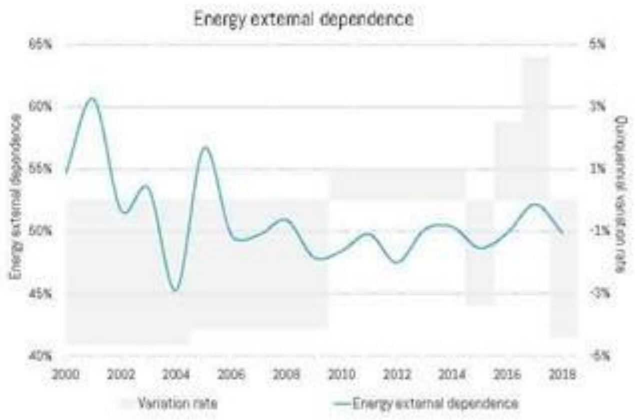
Efficiency of the Electricity Sector



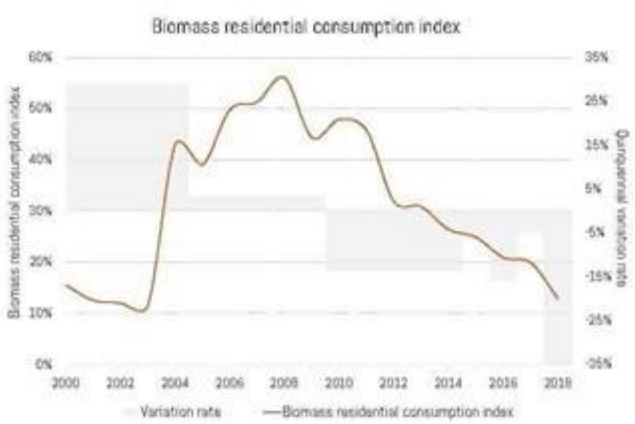


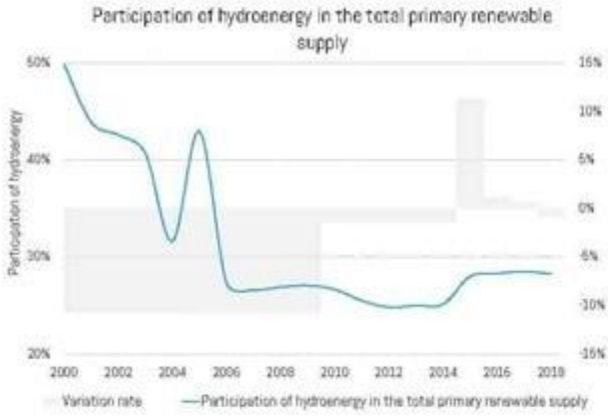


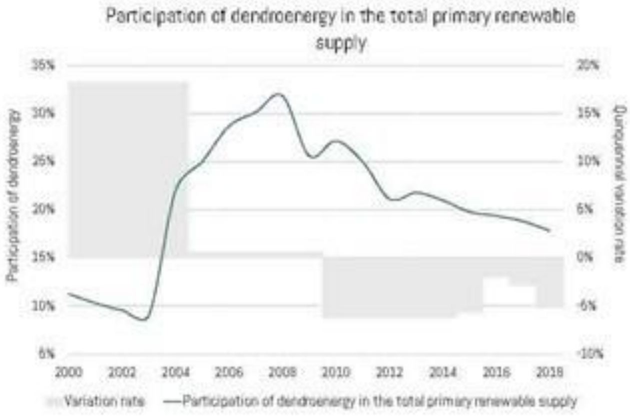


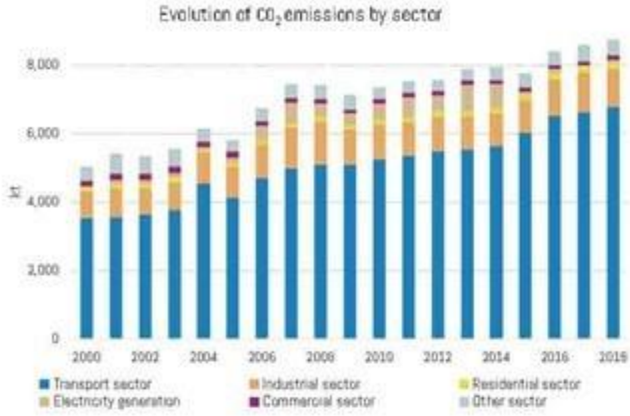


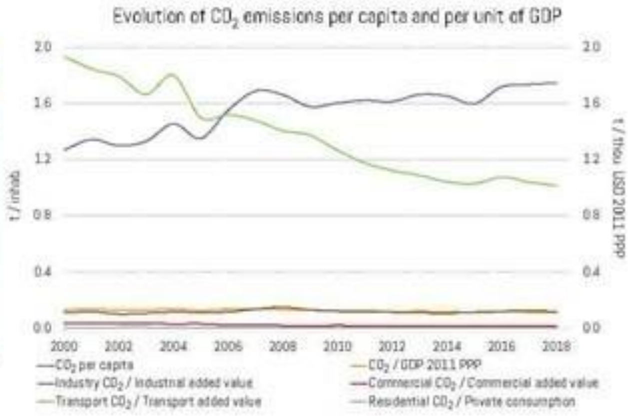
The data provided indicates that the country accumulated 312 days in which it generated 100% renewable energy. The last time Costa Rica used fuels to generate electricity was May 17, 2018.

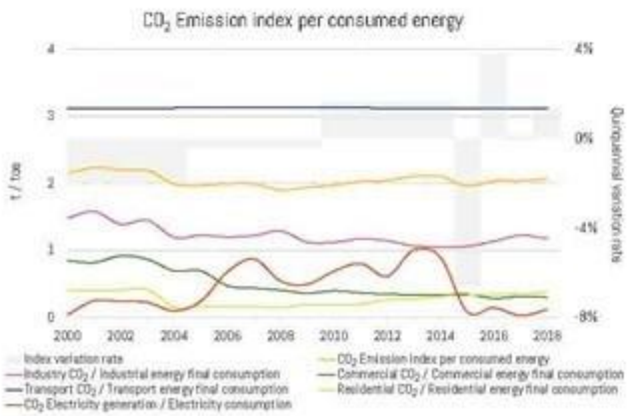


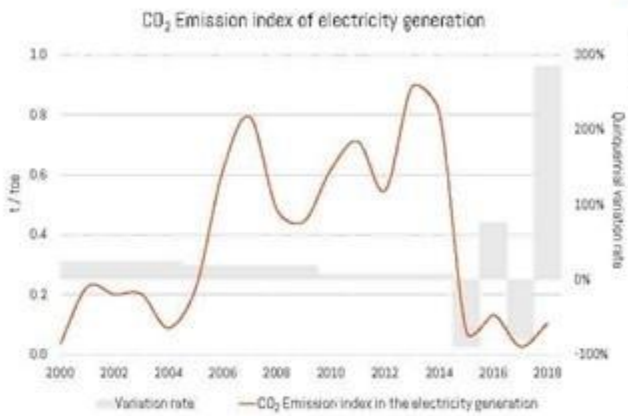

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

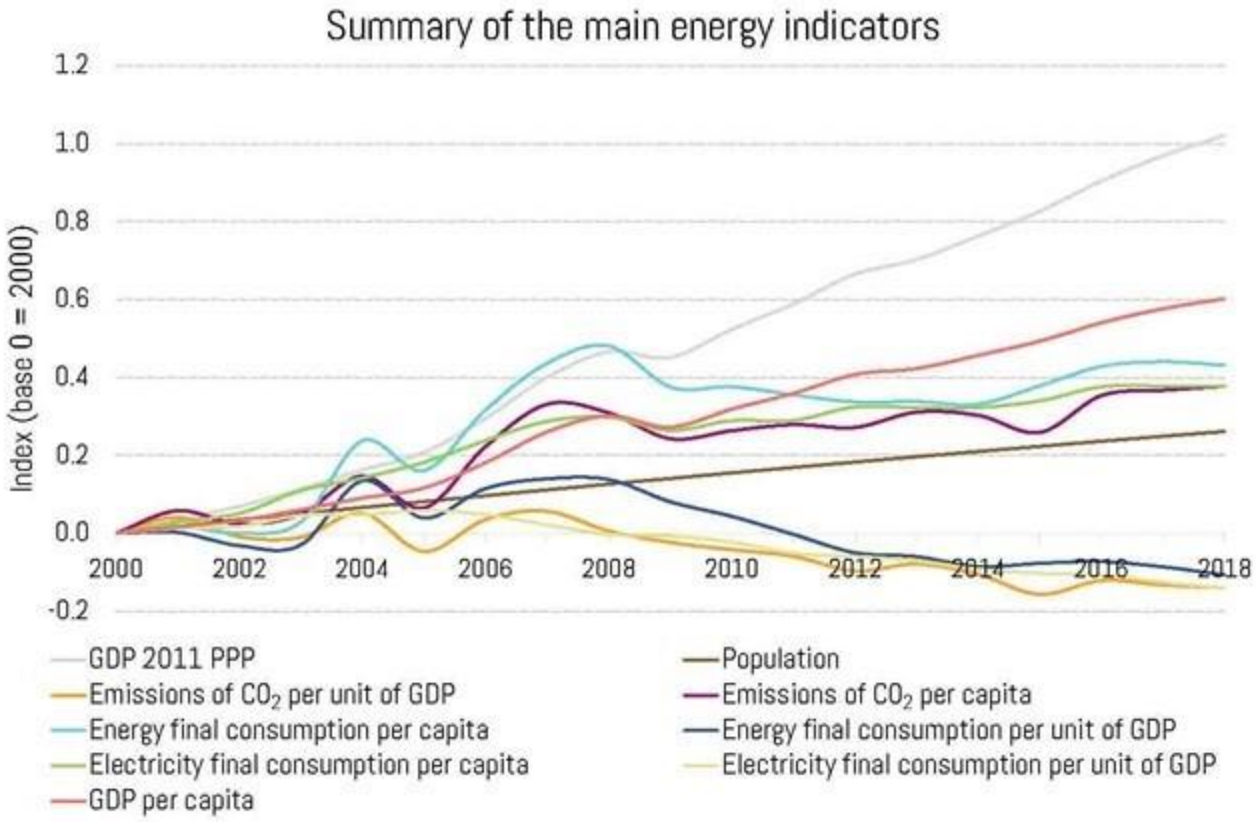

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

CUBA

General Information 2018

Population (thousand inhab.)	11,338
Area (km²)	109,884
Population Density (inhab./km²)	103
Urban Population (%)	77
GDP USD 2010 (MUSD)	77,294
GDP USD 2011 PPP (MUSD)	289,314
GDP per Capita (thou. USD 2011 PPP/inhab.)	26

Energy Sector 2017

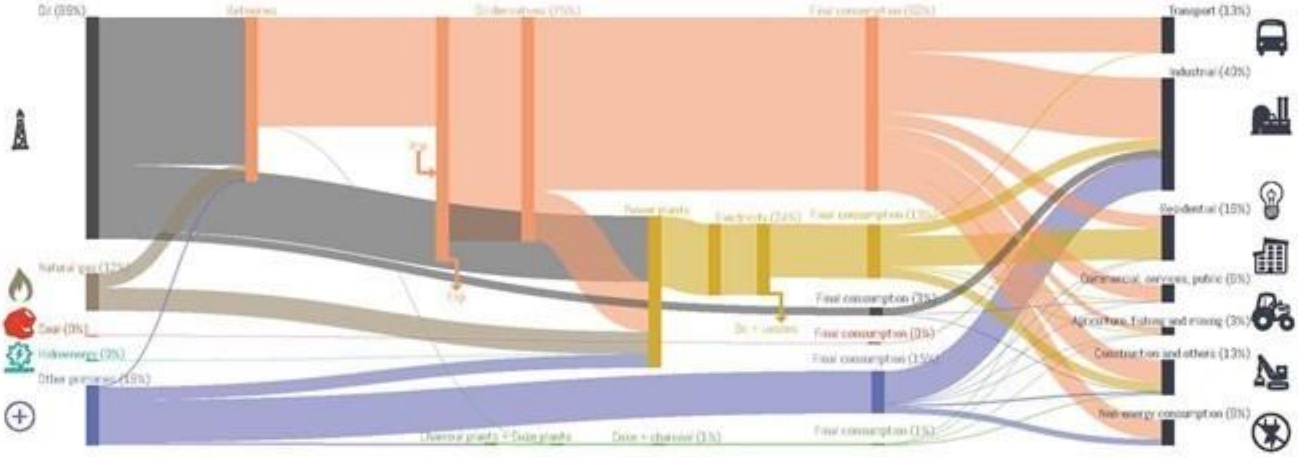
Final consumption in the Transport Sector	Mtoe 0.89
Final consumption in the Industrial Sector	Mtoe 2.78
Final consumption in the Residential Sector	Mtoe 1.12
Final consumption in the Commercial and Service Sector	Mtoe 0.43
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 1.71

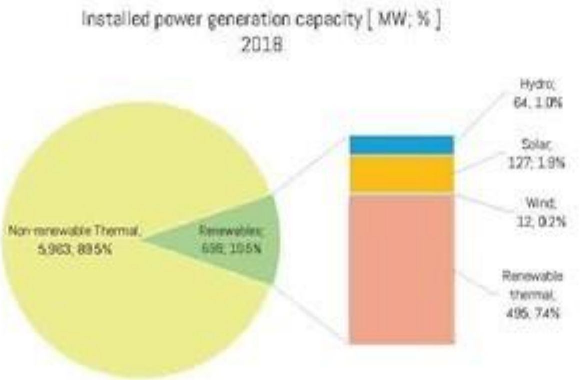
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 106 [2]	Gm³ 70 [2]	Mt n.a.

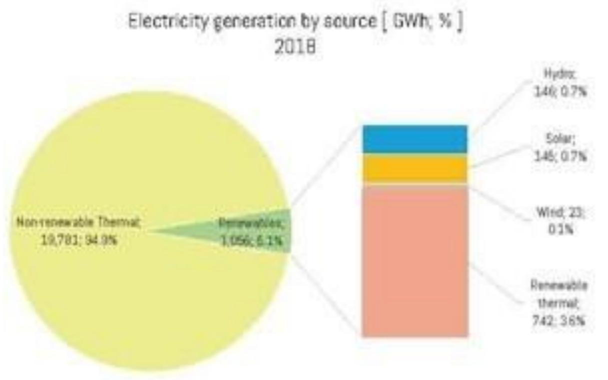
[1] Data 2018.
[2] Data estimated by OLADE.

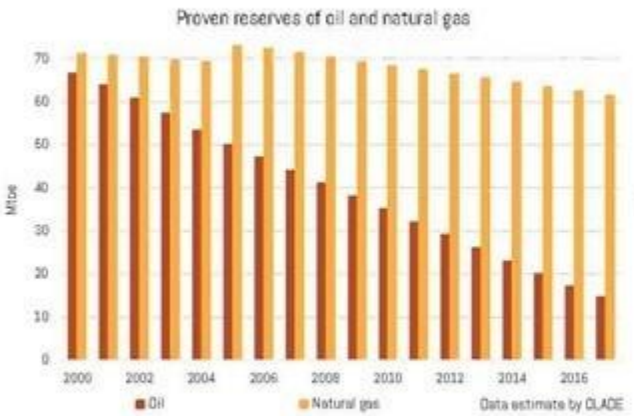
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,375 [1]	0.61	100.00 [1]	10.76	5.01	6.27	0.51	6.94	123	6.66 [1]	0.04 / 0.03

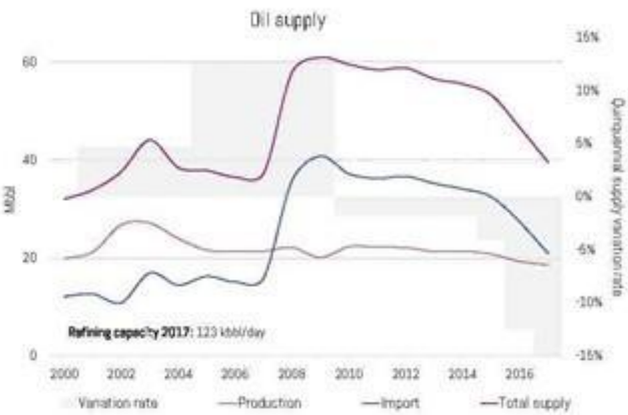
Summarized energy balance 2017

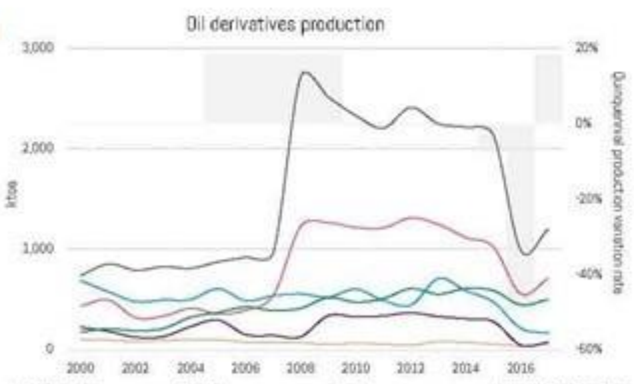


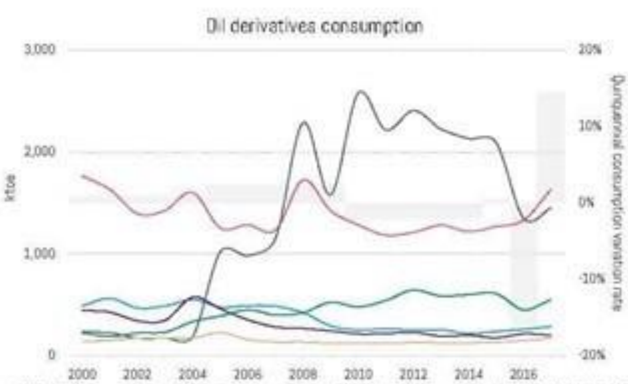

Installed power generation capacity [MW; %]
2018
Hydro; 64; 1.0%
Solar; 127; 1.9%
Wind; 12; 0.2%
Renewable thermal; 495; 7.4%
Non-renewable Thermal; 5,963; 89.5%
Renewables; 698; 10.5%

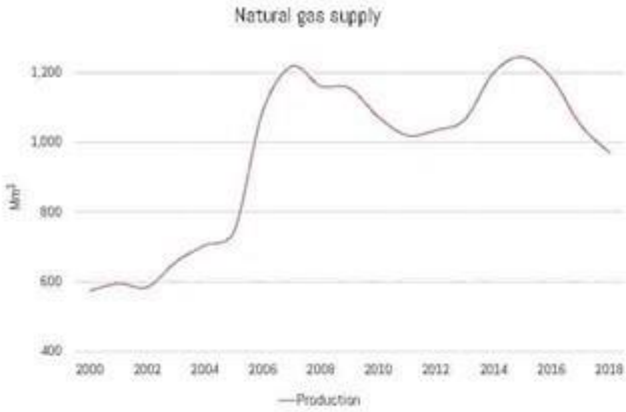

Electricity generation by source [GWh; %]
2018
Hydro; 146; 0.7%
Solar; 145; 0.7%
Wind; 23; 0.1%
Renewable thermal; 742; 3.6%
Non-renewable Thermal; 19,781; 94.9%
Renewables; 1,056; 5.1%

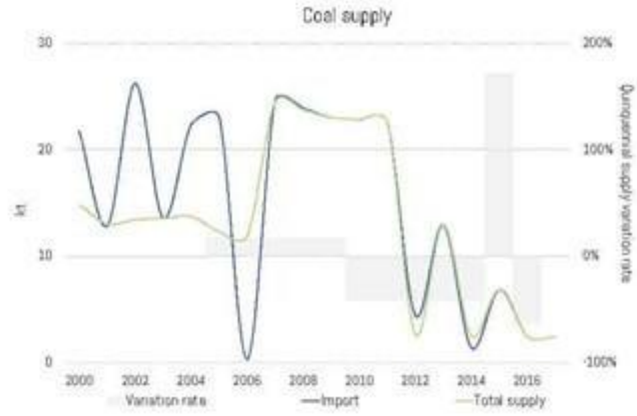

Proven reserves of oil and natural gas
Mtoe
Oil
Natural gas
Data estimate by OLADE

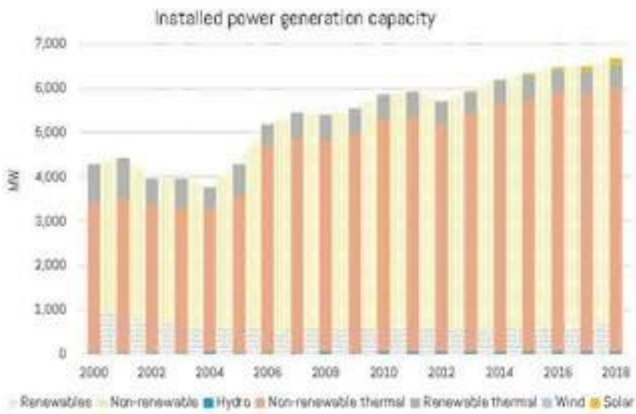

Oil supply
Mbbl
Quinquennial supply variation rate
Refining capacity 2017: 123 kbbl/day
Variation rate
Production
Import
Total supply

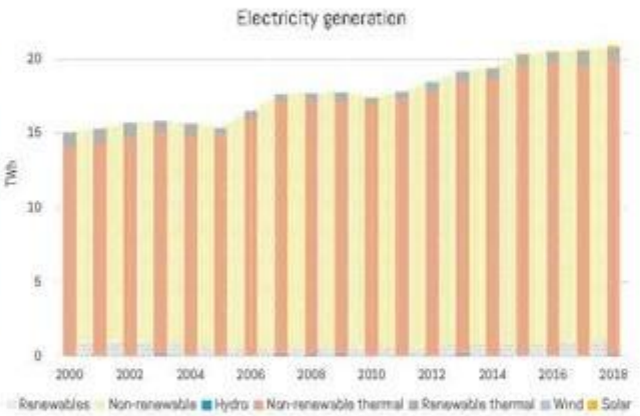

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

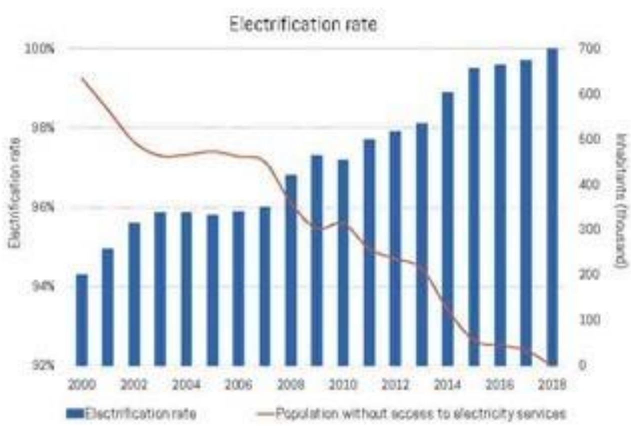

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

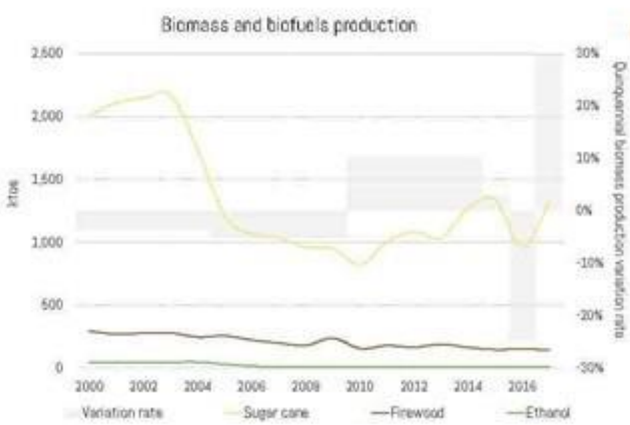

Natural gas supply
1,200
1,000
800
600
400
Mm³
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Production

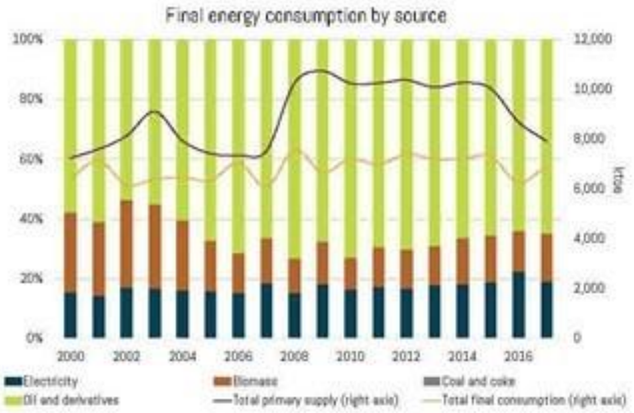

Coal supply
30
20
10
0
kt
200%
100%
0%
-100%
Quinquennial supply variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016
Variation rate
Import
Total supply

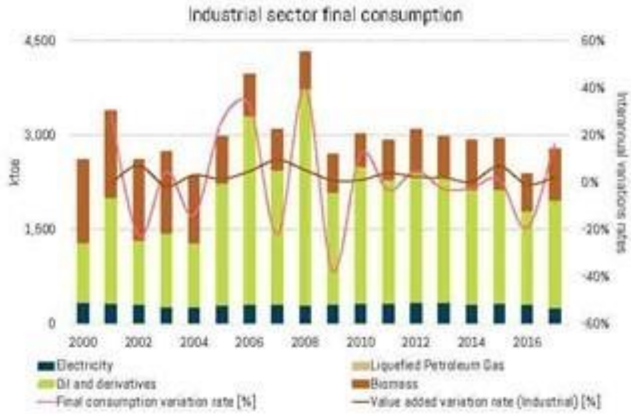

Installed power generation capacity
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
MW
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables Non-renewable Hydro Non-renewable thermal Renewable thermal Wind Solar

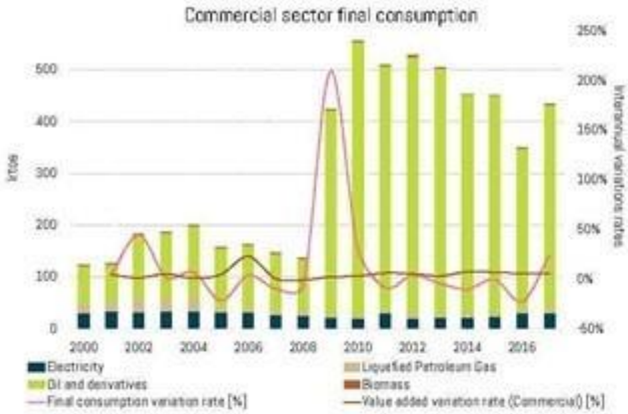

Electricity generation
20
15
10
5
0
TWh
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables Non-renewable Hydro Non-renewable thermal Renewable thermal Wind Solar

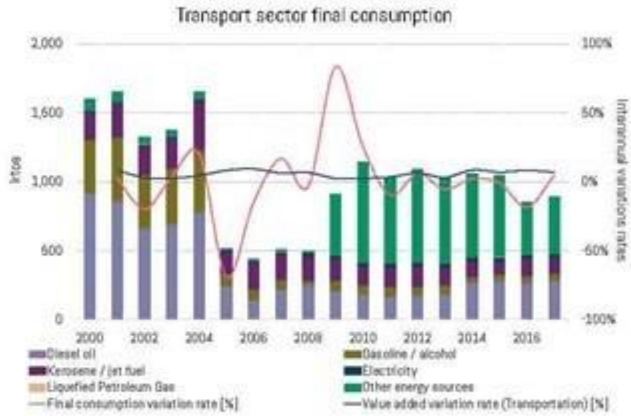

Electrification rate
100%
98%
96%
94%
92%
Electrification rate
700
600
500
400
300
200
100
0
Inhabitants (thousand)
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Electrification rate
Population without access to electricity services

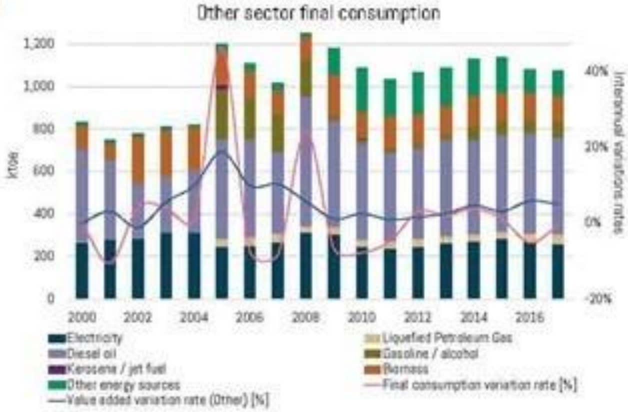

Biomass and biofuels production
2,500
2,000
1,500
1,000
500
0
ktoe
30%
20%
10%
0%
-10%
-20%
-30%
Quinquennial biomass production variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016
Variation rate
Sugar cane
Firewood
Ethanol

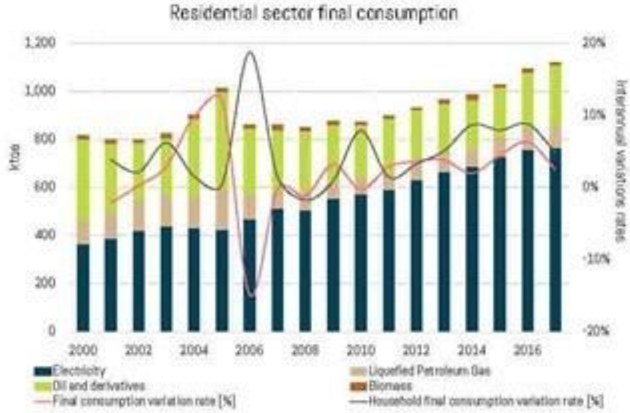

Final energy consumption by source
100%
80%
60%
40%
20%
0%
12,000
10,000
8,000
6,000
4,000
2,000
0
ktoe
2000
2002
2004
2006
2008
2010
2012
2014
2016
Electricity
Biomass
Coal and coke
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

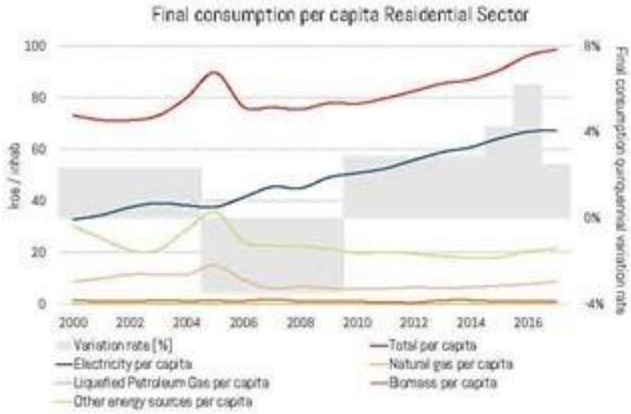

Industrial sector final consumption
4,500
3,000
1,500
0
ktoe
60%
40%
20%
0%
-20%
-40%
-60%
Interannual variations rates
2000
2002
2004
2006
2008
2010
2012
2014
2016
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

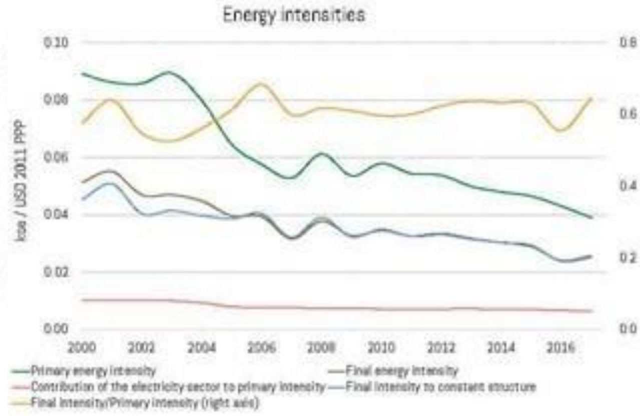

Commercial sector final consumption
500
400
300
200
100
0
ktoe
250%
200%
150%
100%
50%
0%
-50%
Interannual variations rates
2000
2002
2004
2006
2008
2010
2012
2014
2016
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

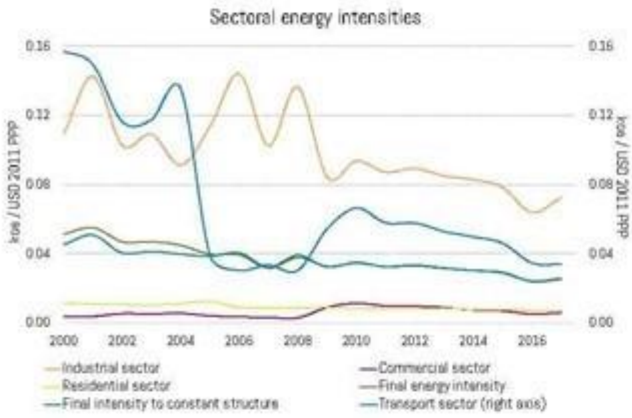

Transport sector final consumption
2,000
1,500
1,000
500
0
ktoe
100%
50%
0%
-50%
-100%
Interannual variations rates
2000
2002
2004
2006
2008
2010
2012
2014
2016
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied Petroleum Gas
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

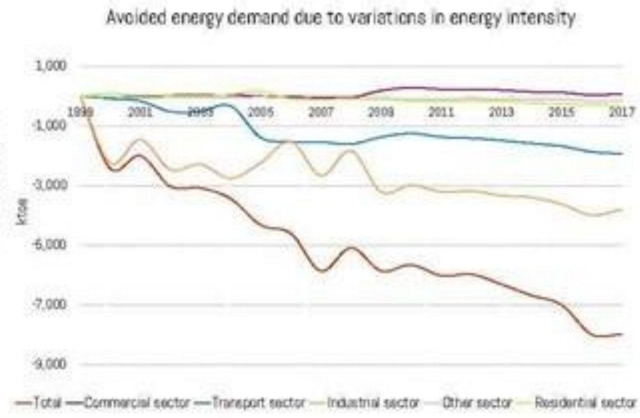

Other sector final consumption
1,200
1,000
800
600
400
200
0
ktoe
40%
20%
0%
-20%
Interannual variations rates
2000
2002
2004
2006
2008
2010
2012
2014
2016
Electricity
Liquefied Petroleum Gas
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Biomass
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Other) [%]

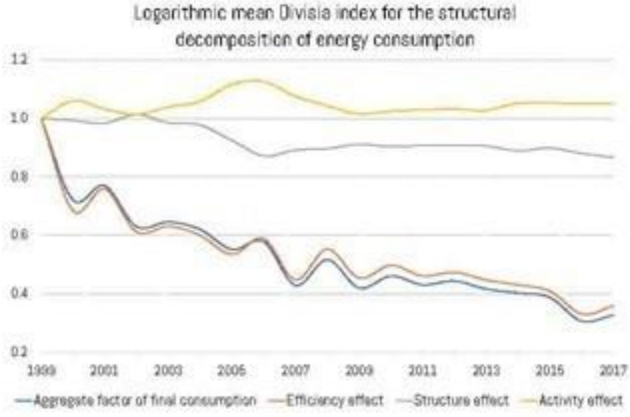

Residential sector final consumption
1,200
1,000
800
600
400
200
0
ktoe
20%
10%
0%
-10%
-20%
Interannual variations rates
2000
2002
2004
2006
2008
2010
2012
2014
2016
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

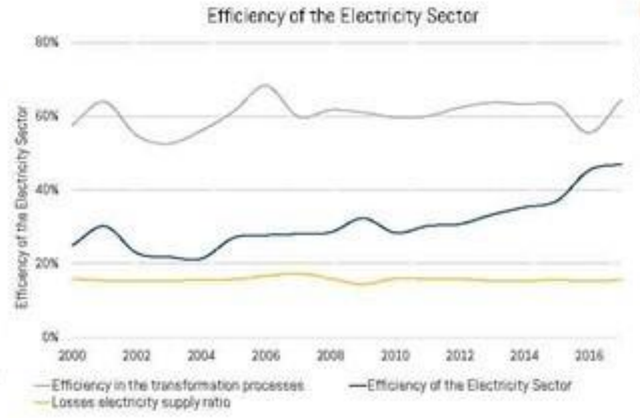

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Other energy sources per capita
Total per capita
Natural gas per capita
Biomass per capita


Energy intensities
kep / USD 2011 PPP
Primary energy intensity
Contribution of the electricity sector to primary intensity
Final intensity/Primary intensity (right axis)
Final energy intensity
Final intensity to constant structure

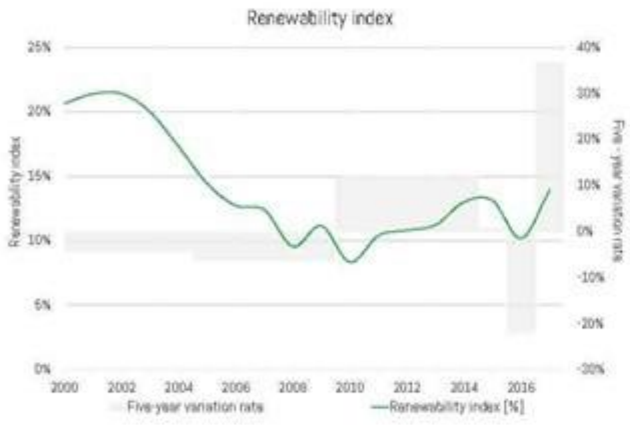

Sectoral energy intensities
kep / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

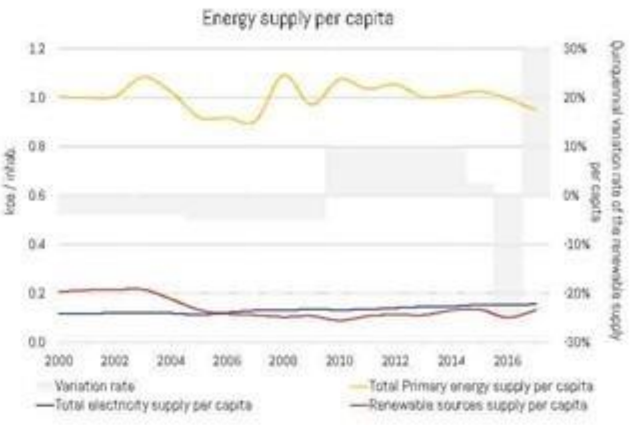

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

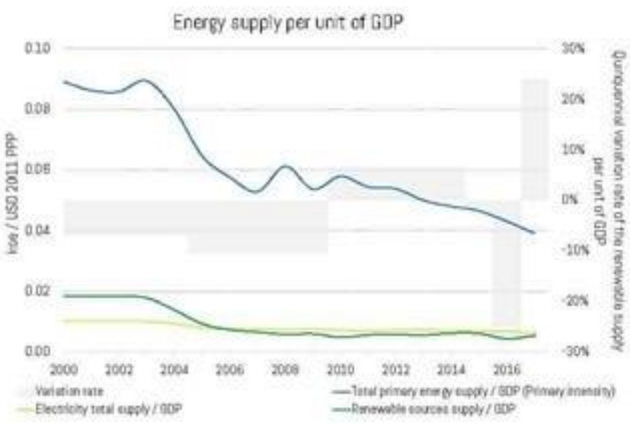

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

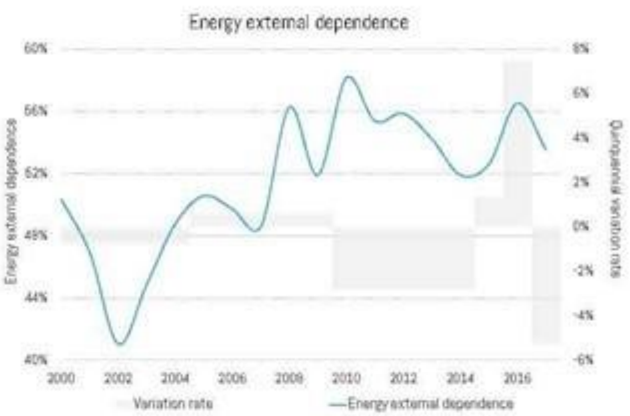

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

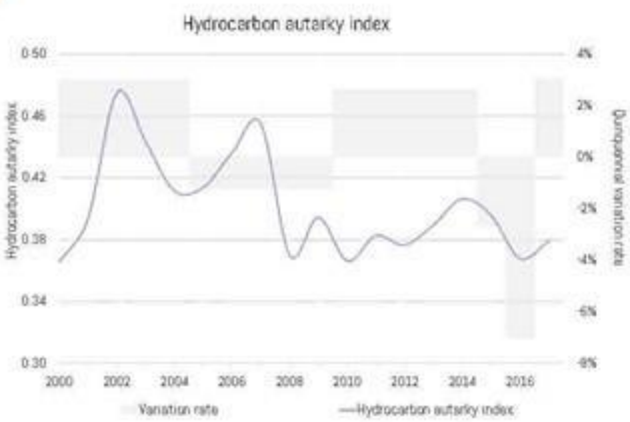
CUBA

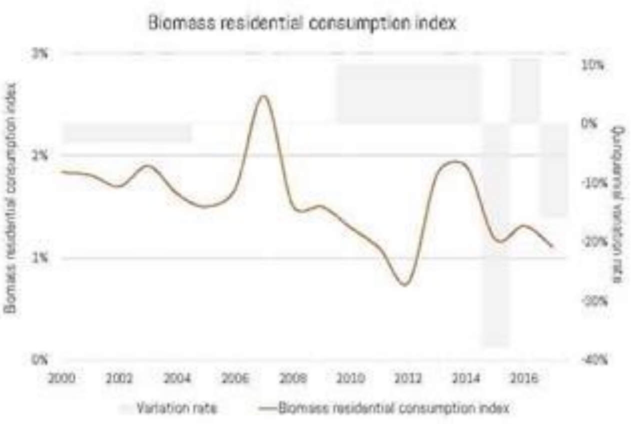

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

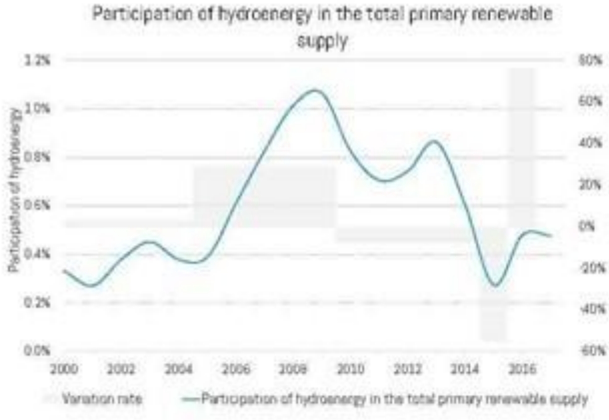

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

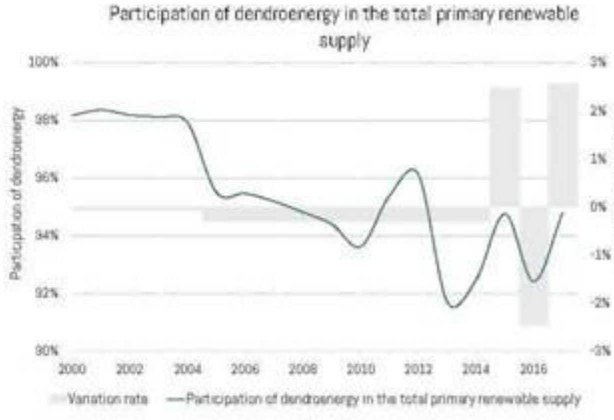

Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

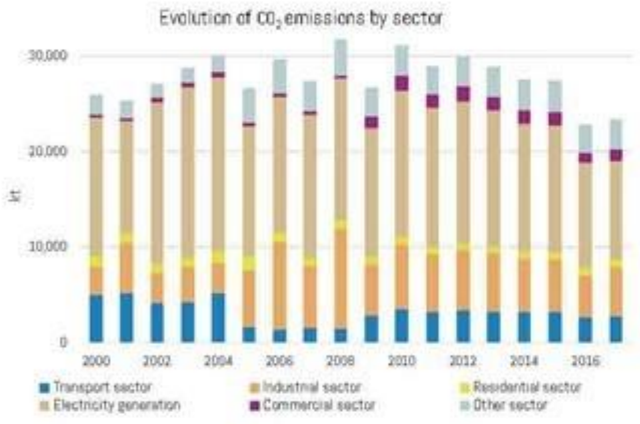

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

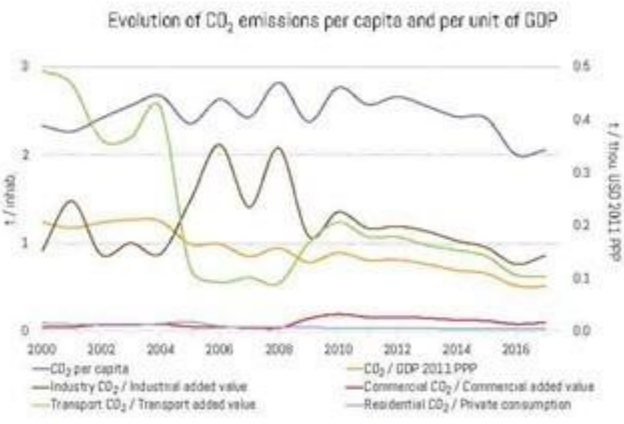

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

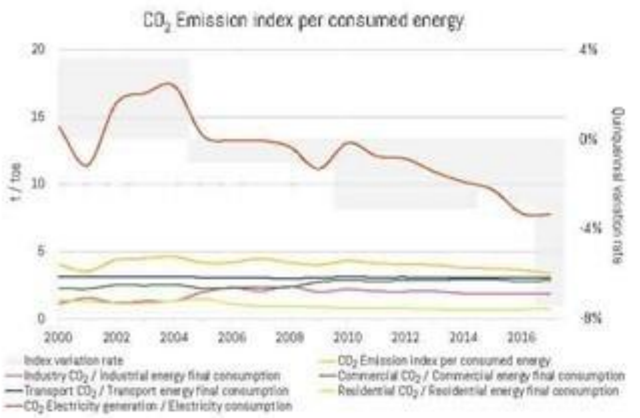

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

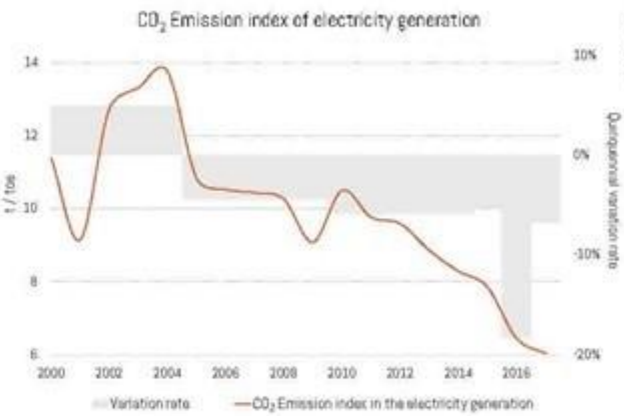

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

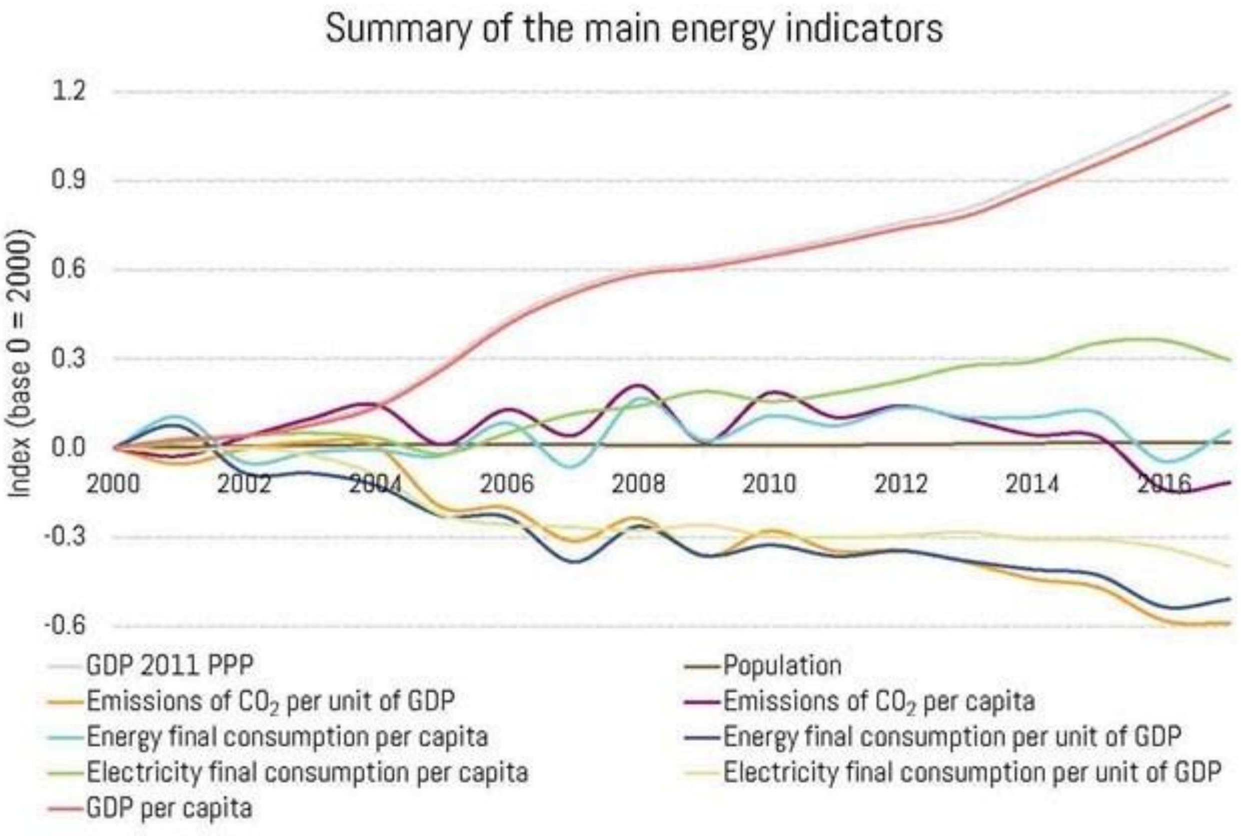

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Electricity generation
Industrial sector
Commercial sector
Residential sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO_2 per capita
Industry CO_2 / Industrial added value
Transport CO_2 / Transport added value
CO_2 / GDP 2011 PPP
Commercial CO_2 / Commercial added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
2000
2002
2004
2006
2008
2010
2012
2014
2016
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

DOMINICAN REPUBLIC

General Information 2018

Population (thousand inhab.)	10,266 [1]
Area (km^2)	48,442
Population Density (inhab./km^2)	212
Urban Population (%)	81
GDP USD 2010 (MUSD)	81,685
GDP USD 2011 PPP (MUSD)	168,135
GDP per Capita (thou. USD 2011 PPP/inhab.)	16

Energy Sector

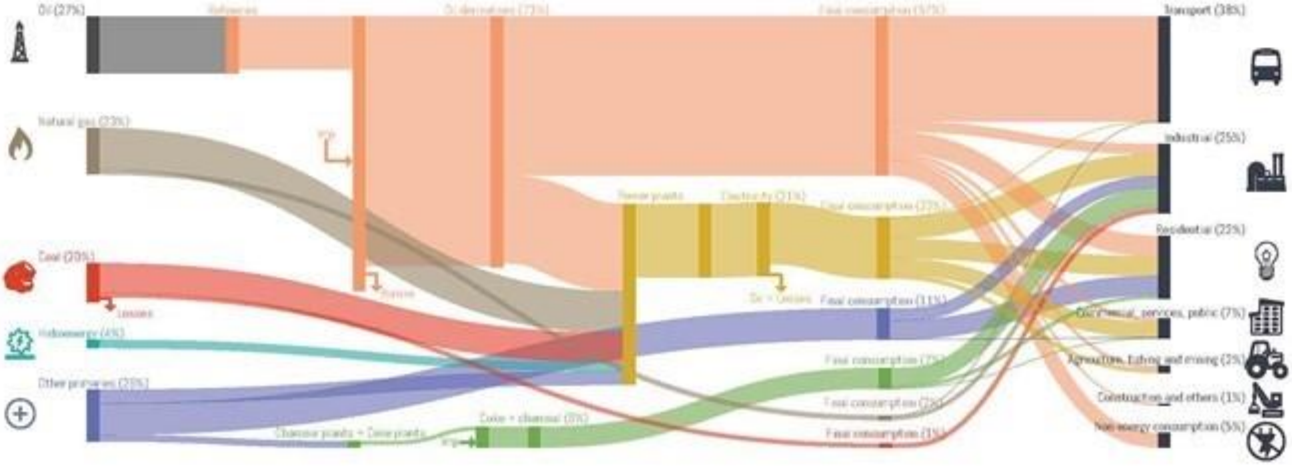
Final consumption in the Transport Sector	Mtoe 2.43
Final consumption in the Industrial Sector	Mtoe 1.59
Final consumption in the Residential Sector	Mtoe 1.44
Final consumption in the Commercial and Service Sector	Mtoe 0.46
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.54

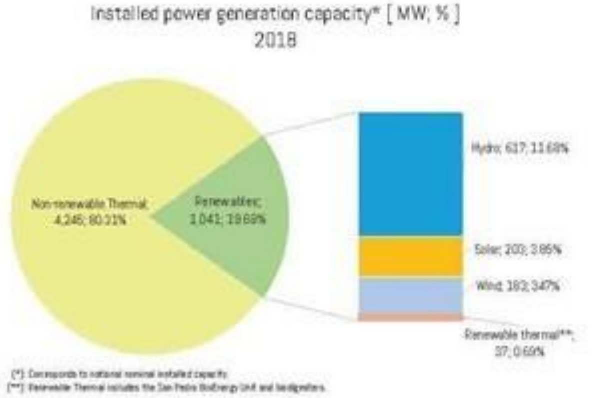
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm^3	Mt
n.a.	n.a.	n.a.

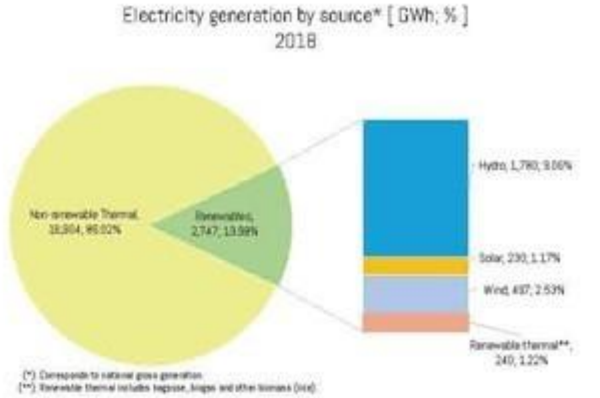
[1] CNE's own estimates.
[2] Exports include vegetable coal, AVTUR bunker and natural gas re-export.
[3] It includes non-energy consumption.

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,598	0.63	97.39	9.52	1.38	8.70	0.59 [2]	6.46 [3]	34	5.29	0.06 / 0.04

Summarized energy balance 2018

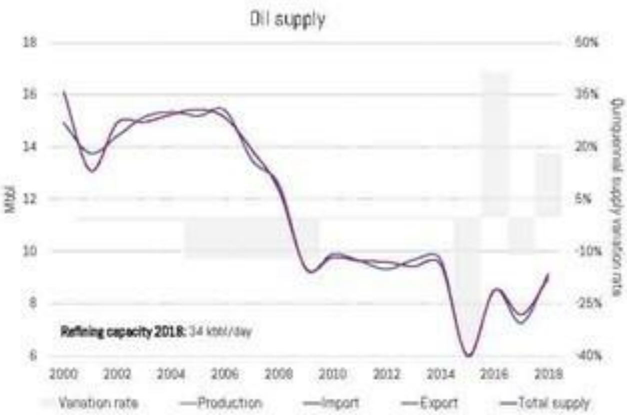


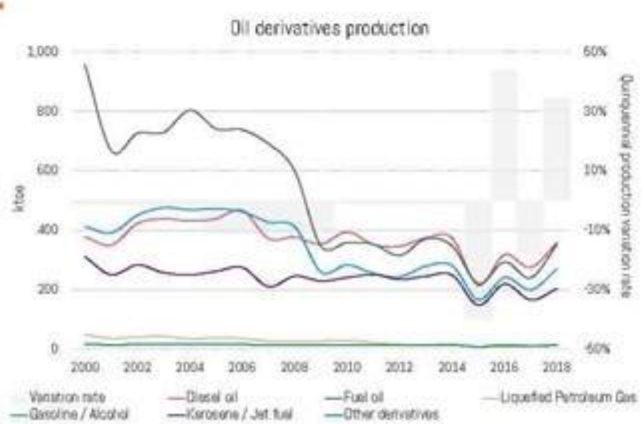


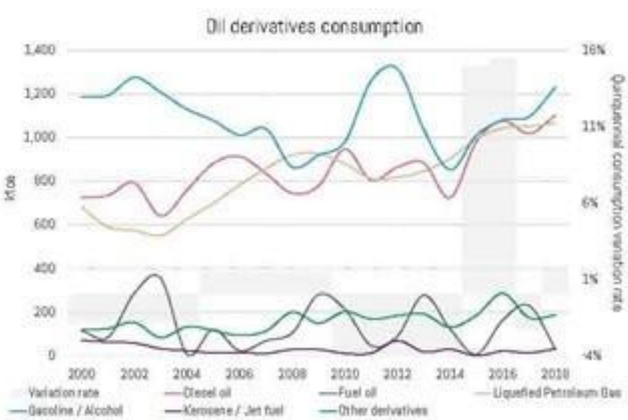


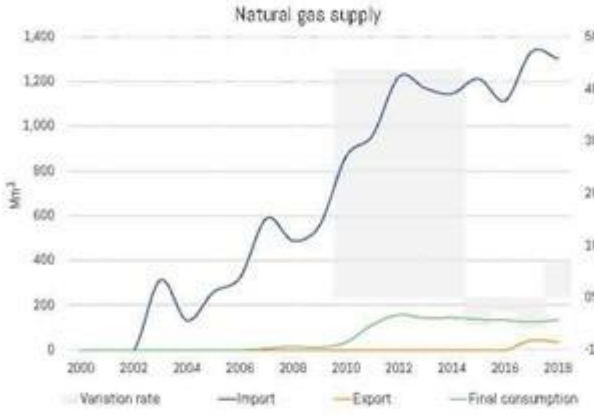
In August 2018, the Montecristi Solar Photovoltaic Park started operations, with an installed capacity of 57.96 MW, which is the largest photovoltaic energy project in the Caribbean, with an investment of 100 million dollars.

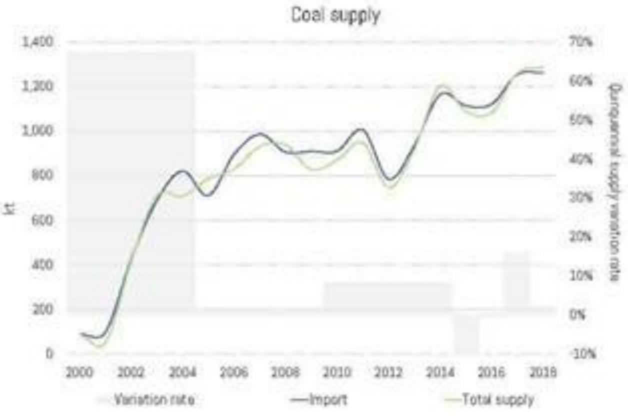
In October 2018, Larimar II Wind Farm started operations, with an installed capacity of 48.3 MW and an investment of 103 million dollars.

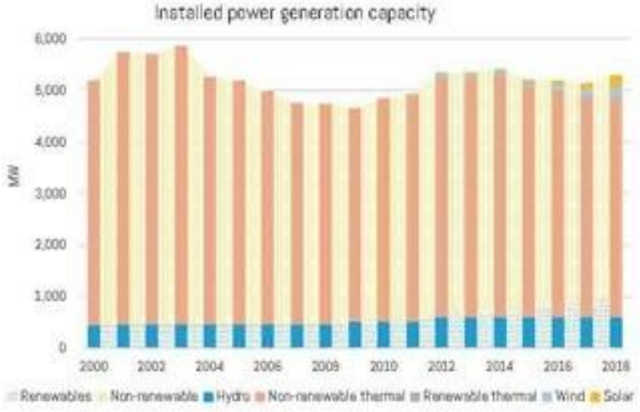


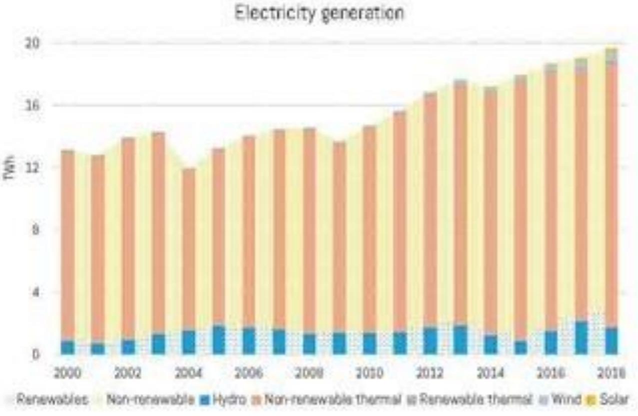


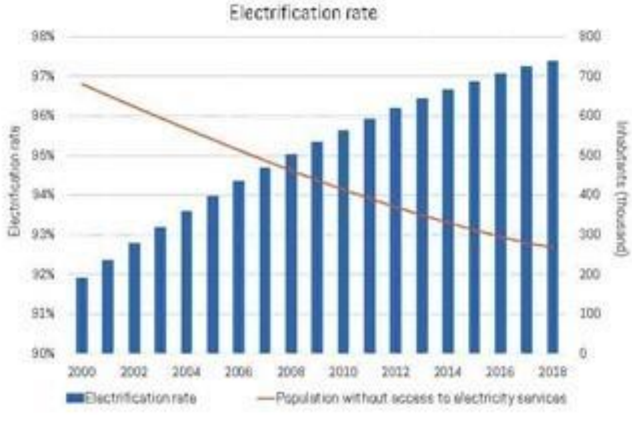


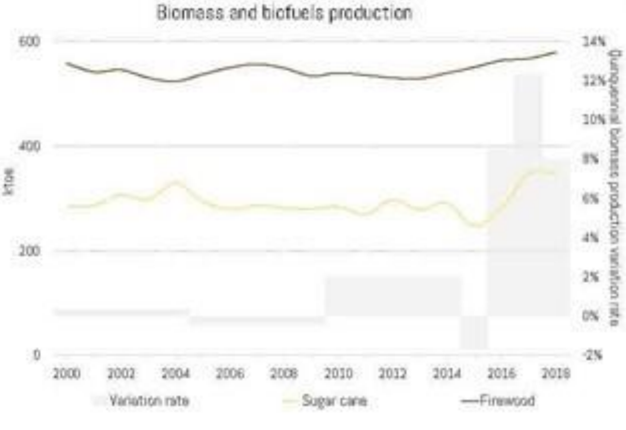




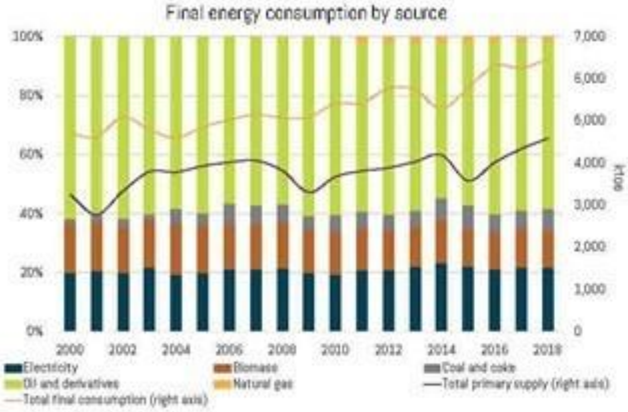


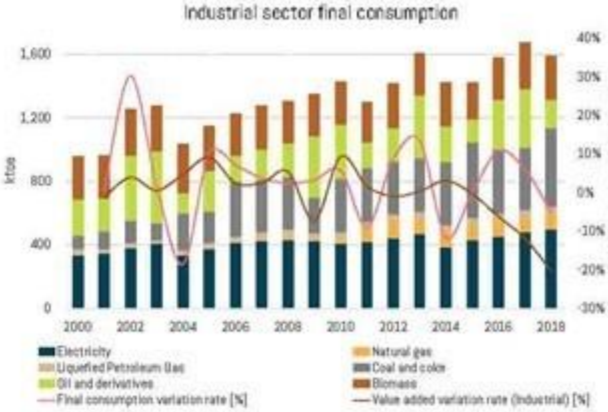


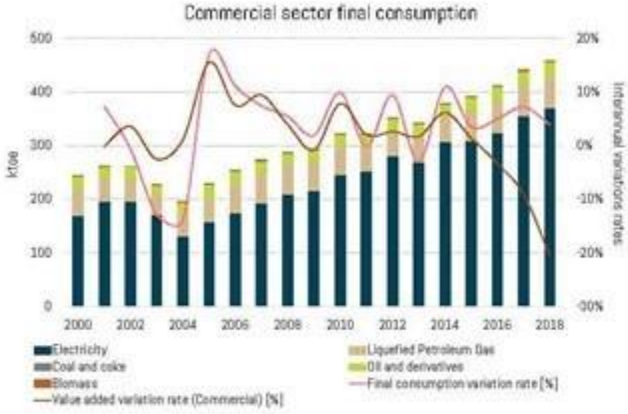




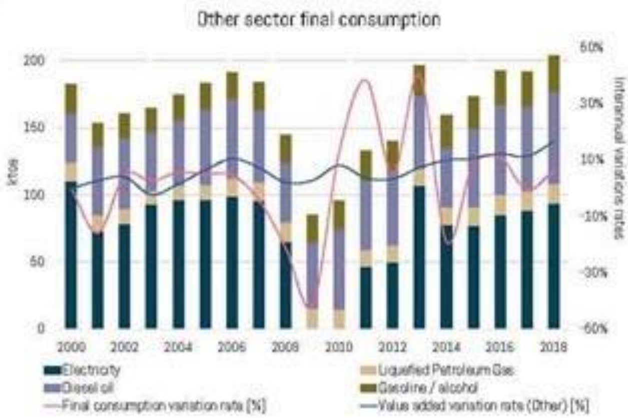
DOMINICAN REPUBLIC

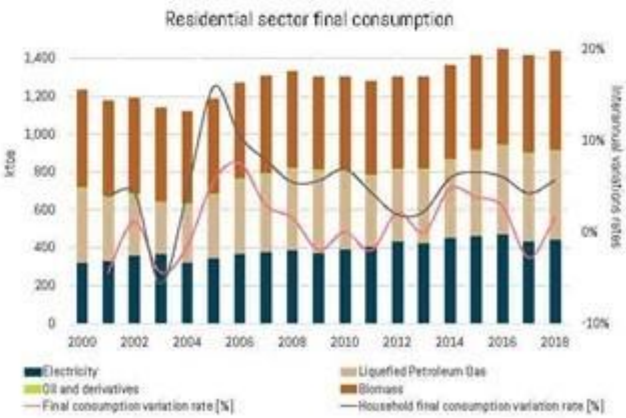

Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)


Industrial sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]

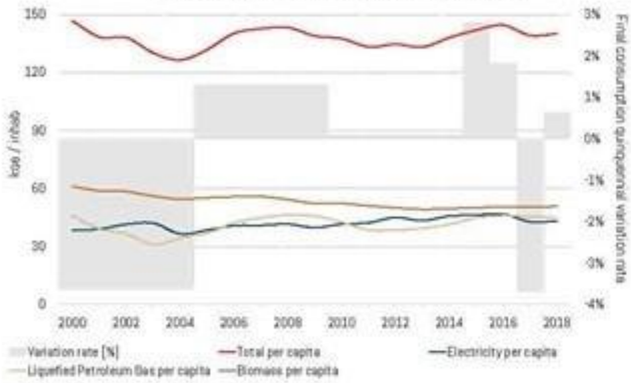

Commercial sector final consumption
ktoe
Interannual variation rates
Electricity
Coal and coke
Biomass
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]


Transport sector final consumption
ktoe
Interannual variation rates
Diesel oil
Kerosene / jet fuel
Liquefied Petroleum Gas
Final consumption variation rate [%]
Gasoline / alcohol
Electricity
Other energy sources
Value added variation rate (Transportation) [%]

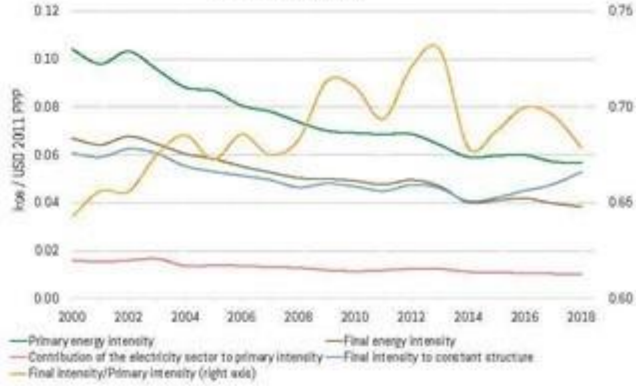

Other sector final consumption
ktoe
Interannual variation rates
Electricity
Diesel oil
Final consumption variation rate [%]
Liquefied Petroleum Gas
Gasoline / alcohol
Value added variation rate (Other) [%]


Residential sector final consumption
ktoe
Interannual variation rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]

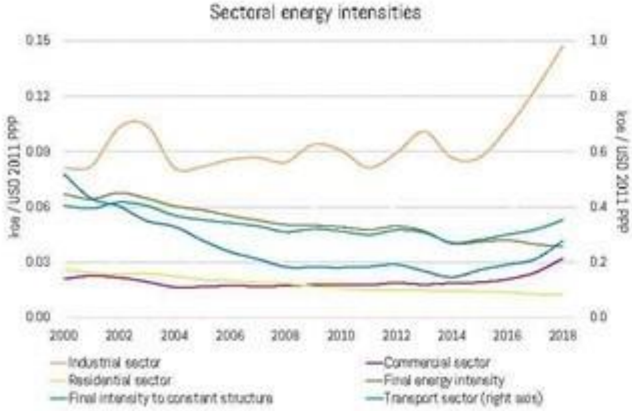
Final consumption per capita Residential Sector



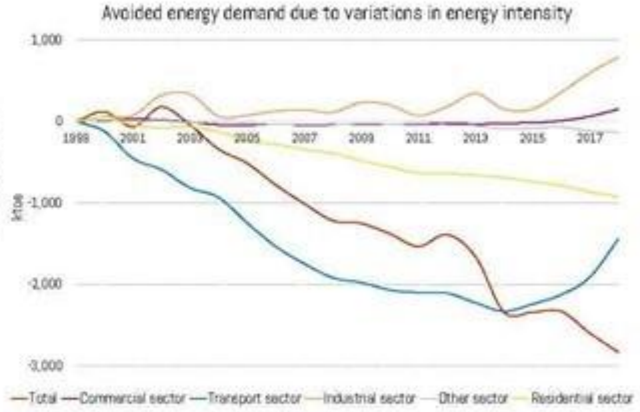
Energy intensities



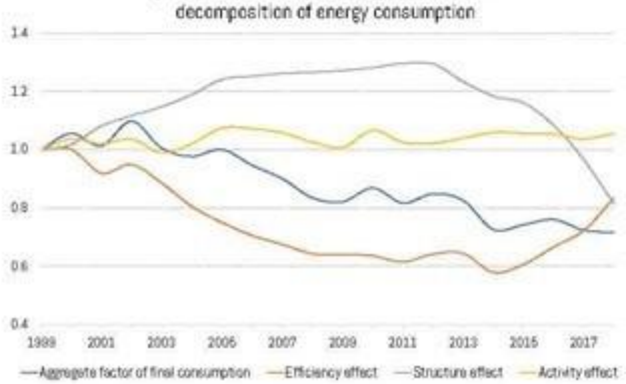
Sectoral energy intensities



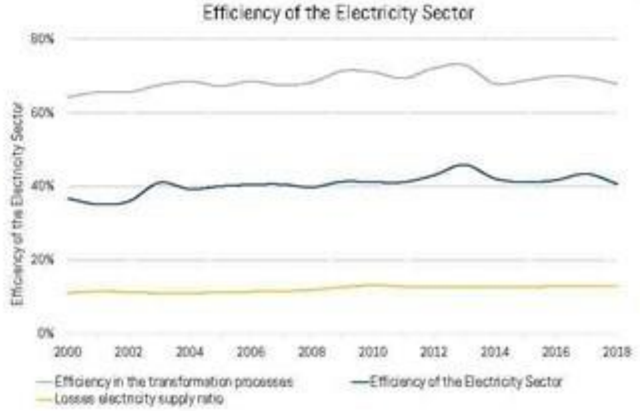
Avoided energy demand due to variations in energy intensity

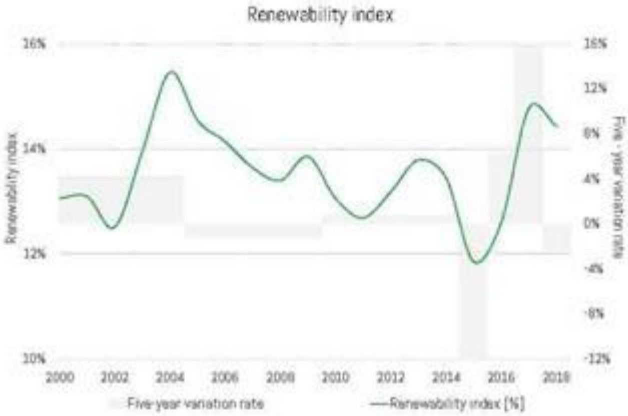


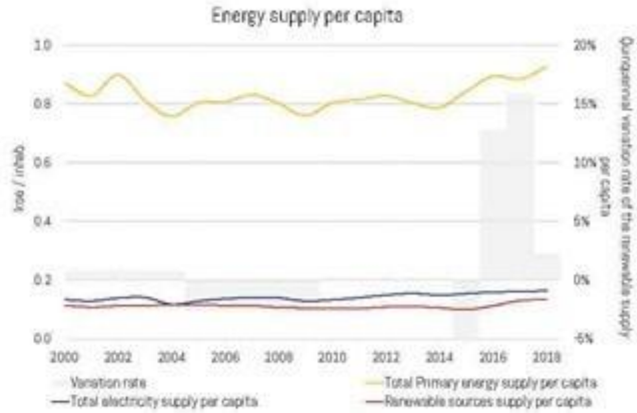
Logarithmic mean Divisia index for the structural decomposition of energy consumption

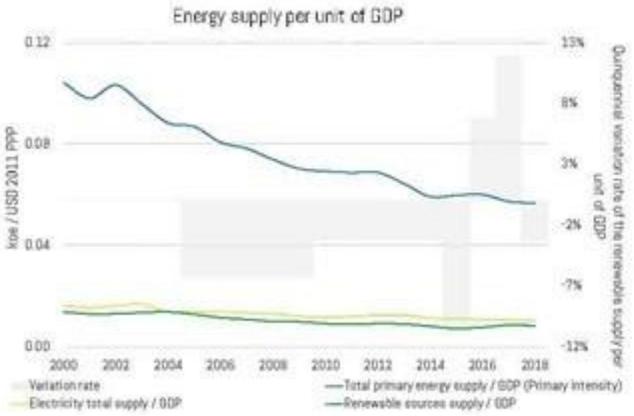


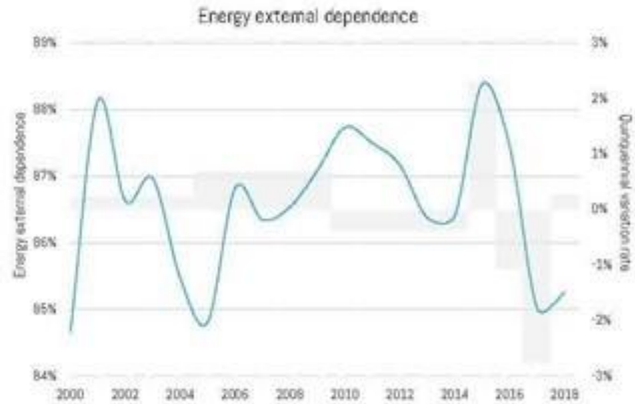
Efficiency of the Electricity Sector

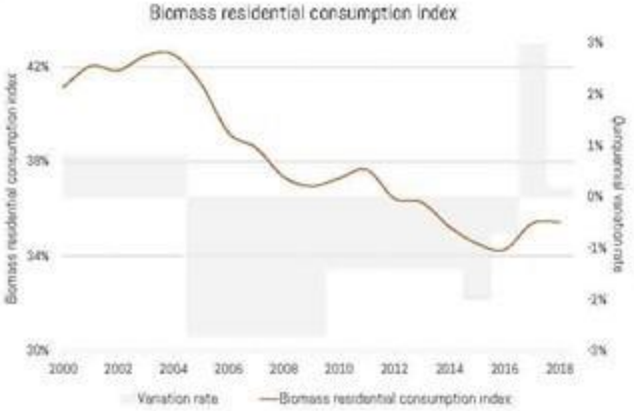


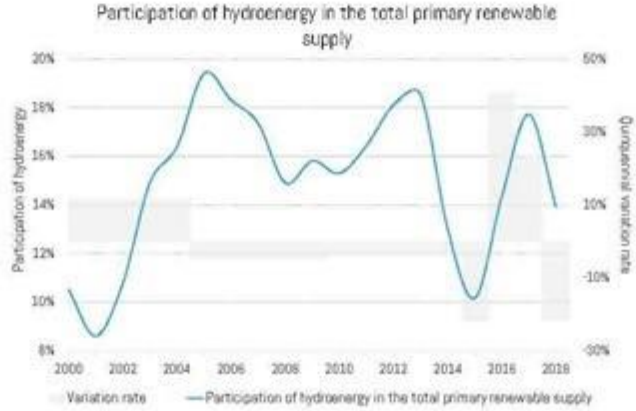

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

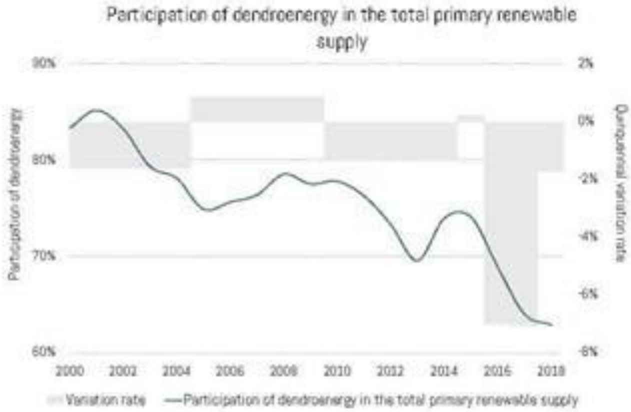

Energy supply per capita
koe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

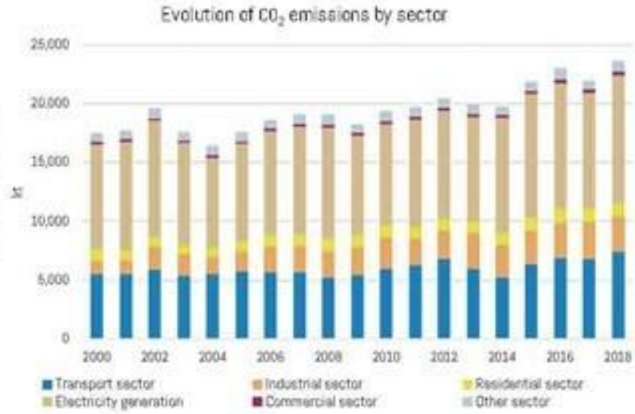

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

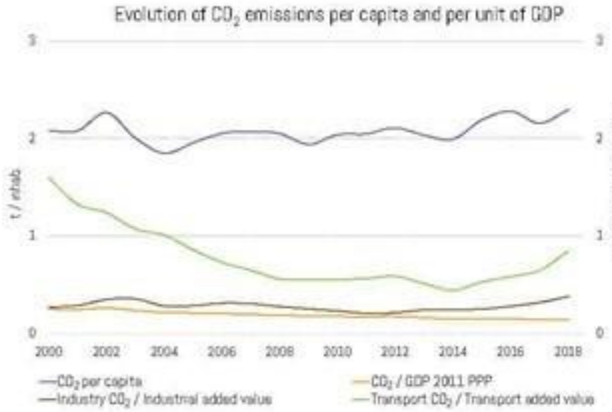

Energy external dependence
Energy external dependence
Quinquennial variation rate

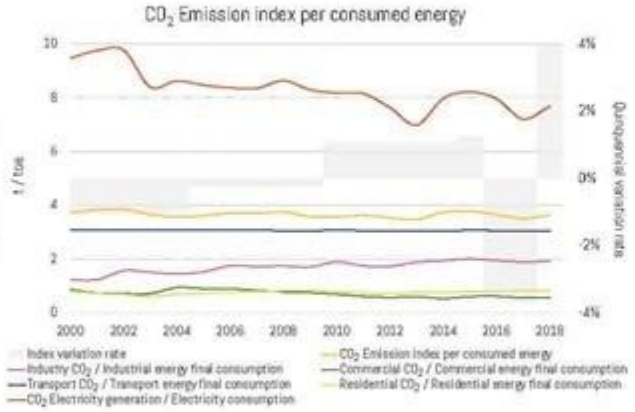

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

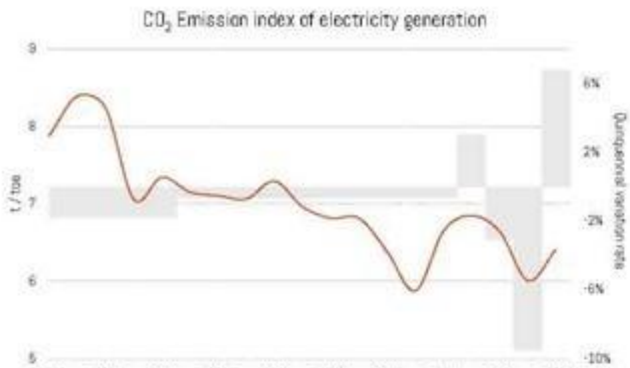

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

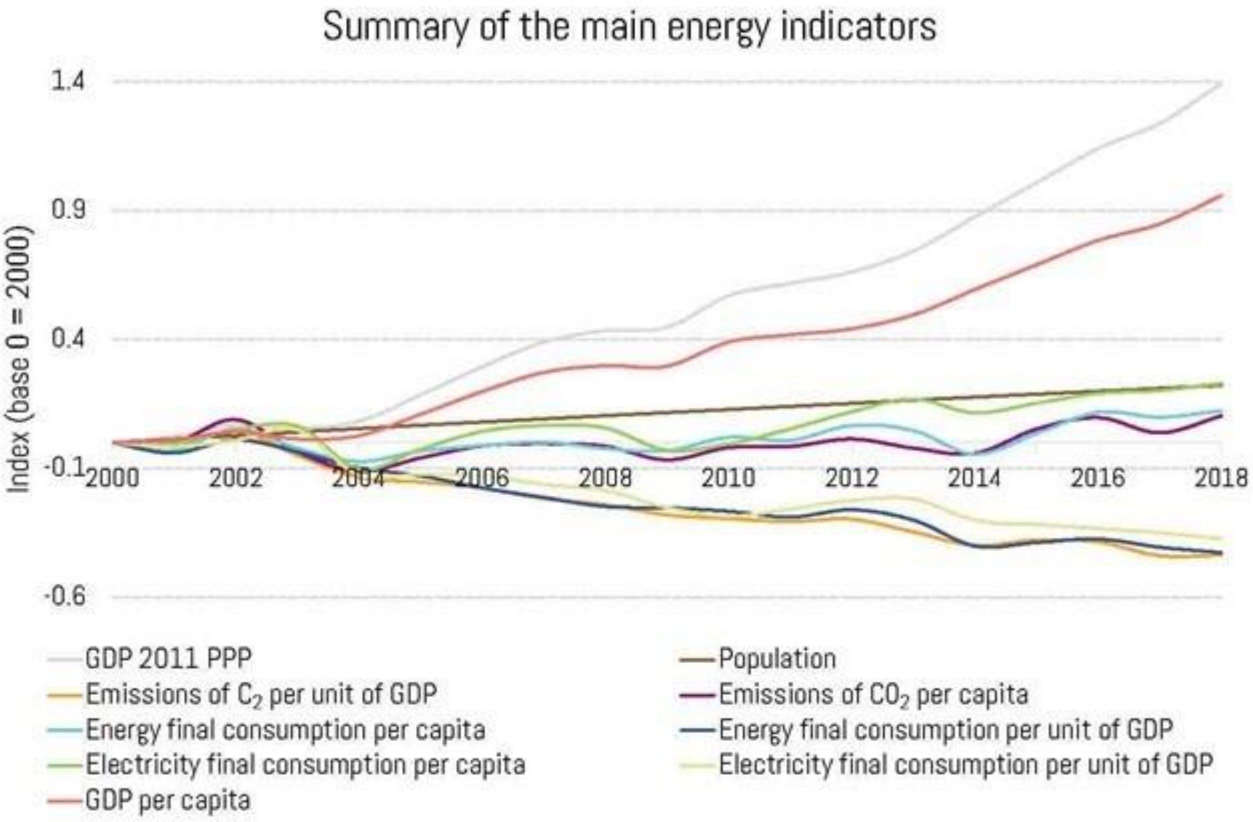

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Transport CO_2 / Transport added value


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
1.4
0.9
0.4
-0.1
-0.6
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of C_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

ECUADOR

General Information 2018

Population (thousand inhab.)	17,084
Area (km^2)	256,370
Population Density (inhab./km^2)	67
Urban Population (%)	65
GDP USD 2010 (MUSD)	88,584
GDP USD 2011 PPP (MUSD)	177,886
GDP per Capita (thou. USD 2011 PPP/inhab.)	10

Energy Sector

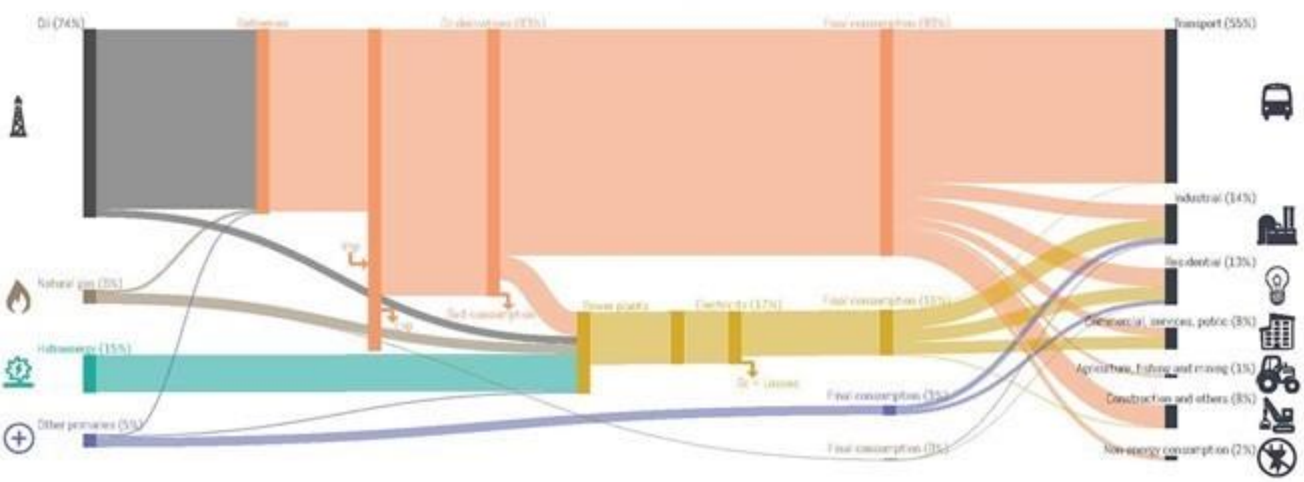
	Mtoe
Final consumption in the Transport Sector	7.29 [2]
Final consumption in the Industrial Sector	1.88
Final consumption in the Residential Sector	1.72
Final consumption in the Commercial and Service Sector	1.02
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	1.47

Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm^3	Mt
1,632 [1]	4.7 [1]	n.a.

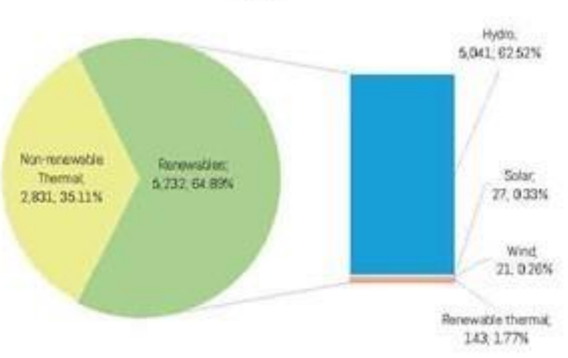
[1] The figures presented correspond only to the proved reserves and not to the total reserves.
[2] Includes bunker.

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,458	0.78	97.05	15.79	30.03	6.63	20.64	13.38	175	8.06	0.09 / 0.08

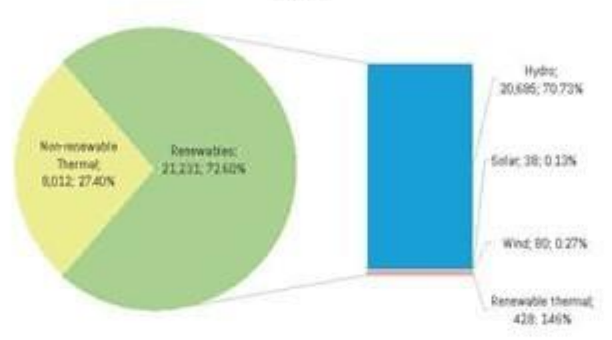
Summarized energy balance 2018



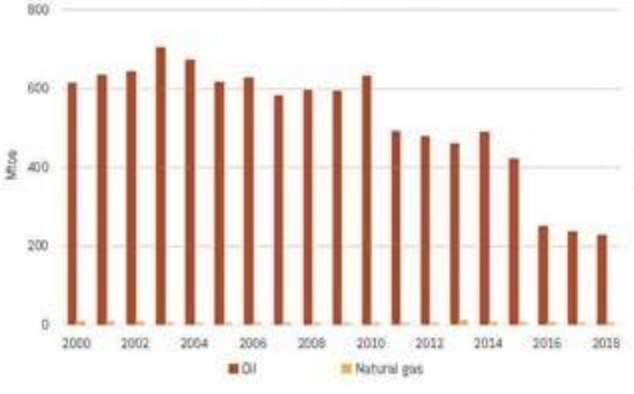
Installed power generation capacity [MW; %] 2018



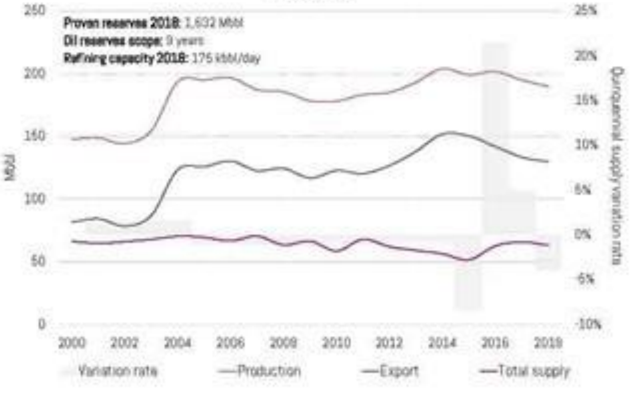
Electricity generation by source [GWh; %] 2018



Proven reserves of oil and natural gas



Oil supply



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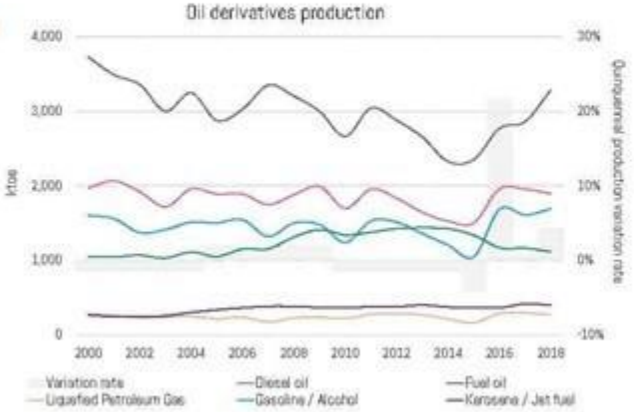
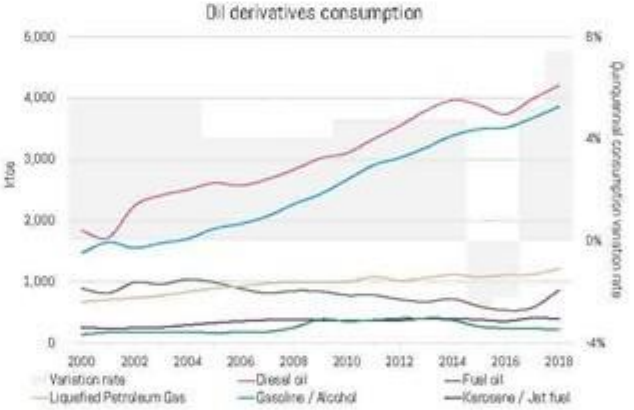
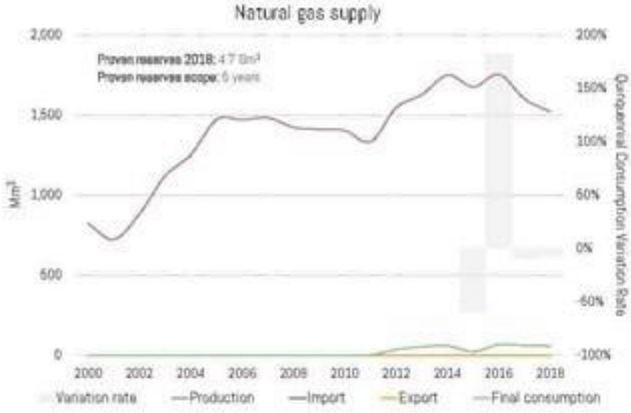
Oil derivatives production

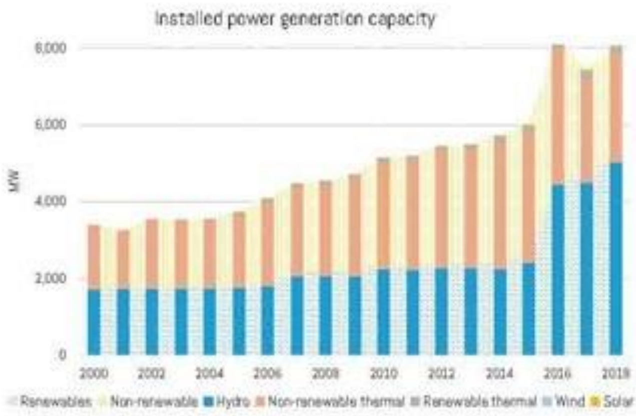


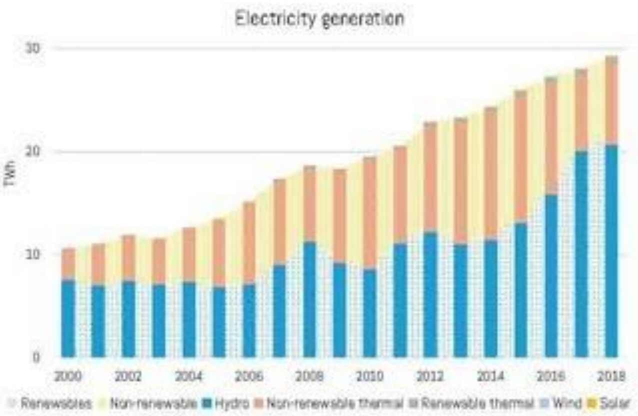
Oil derivatives consumption

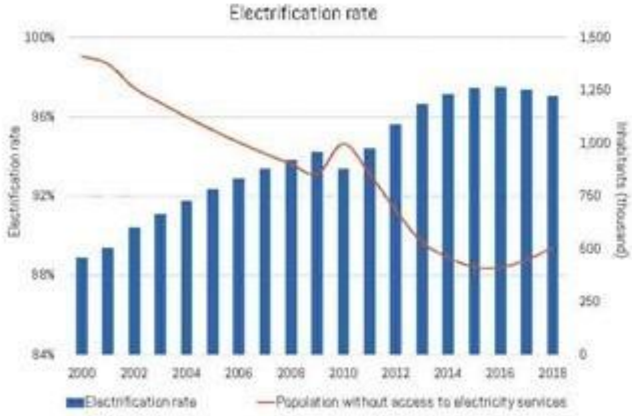


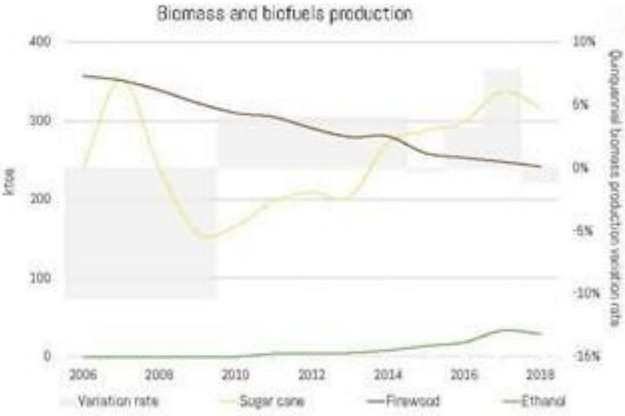


On April 5, 2018, the Sacha Norte 2 power generation plant was inaugurated, using the oil associated gas. The Central Sacha Norte 2, is the second plant that enters into operation of a total of eight electricity generation infrastructures that produce energy from the residual gas from oil exploitation, using associated gas instead of diesel to produce up to 4 MW of power. Its operation allows fuel savings of about USD 5 million and reduces emissions by about 2,000 tons of CO_2 per year.









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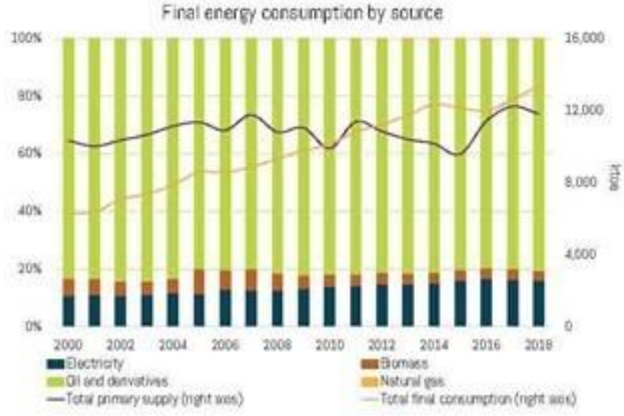
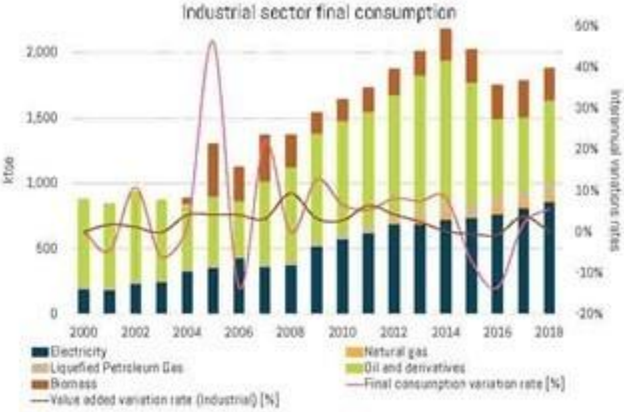
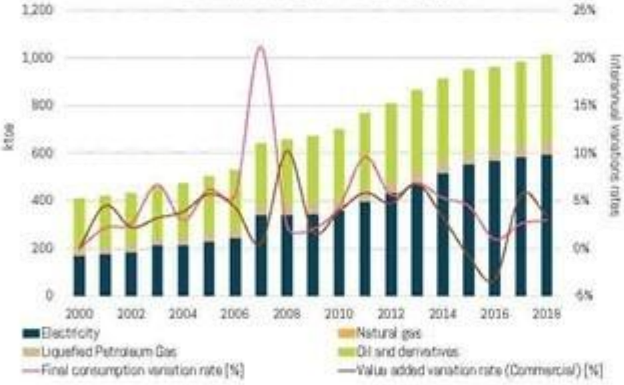
Final energy consumption by source



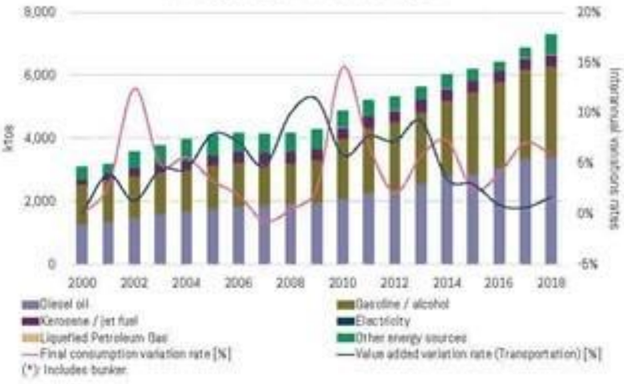
Industrial sector final consumption



Commercial sector final consumption

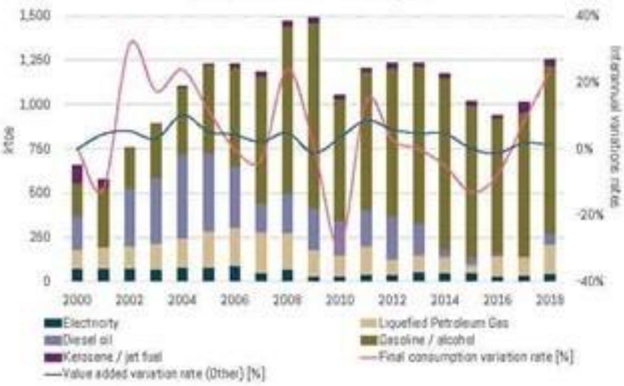


Transport sector final consumption*

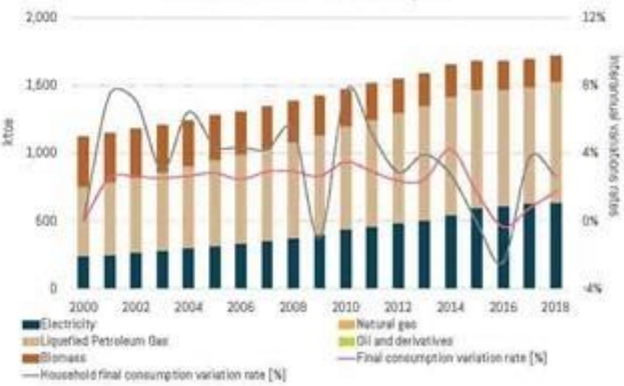


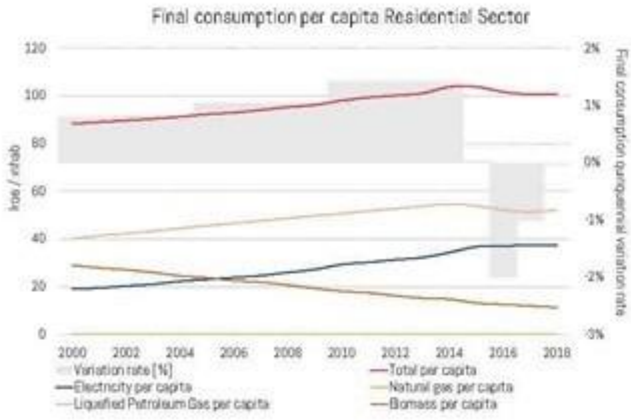
(*): Includes bunker.

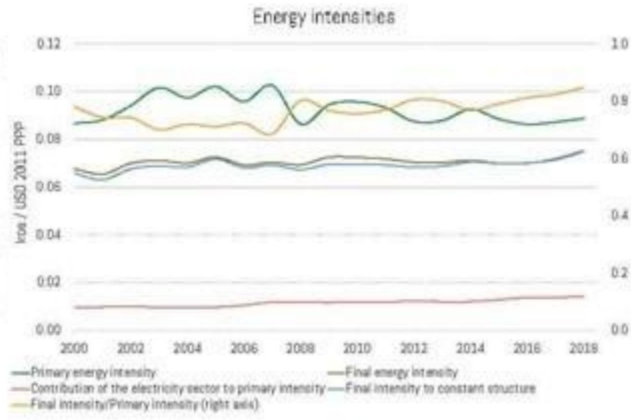
Other sector final consumption

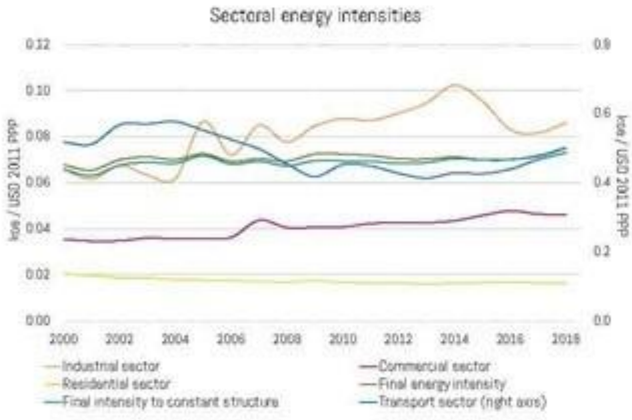


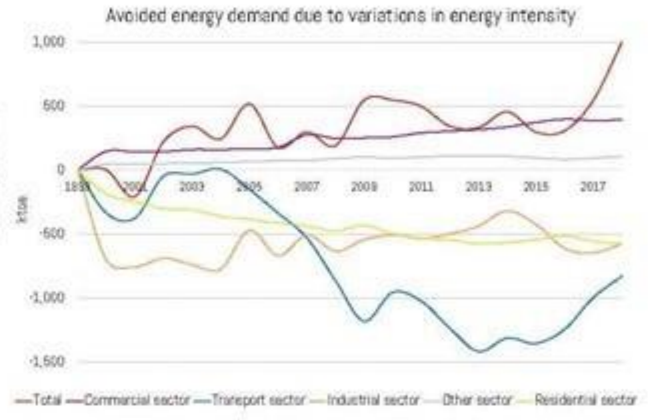
Residential sector final consumption

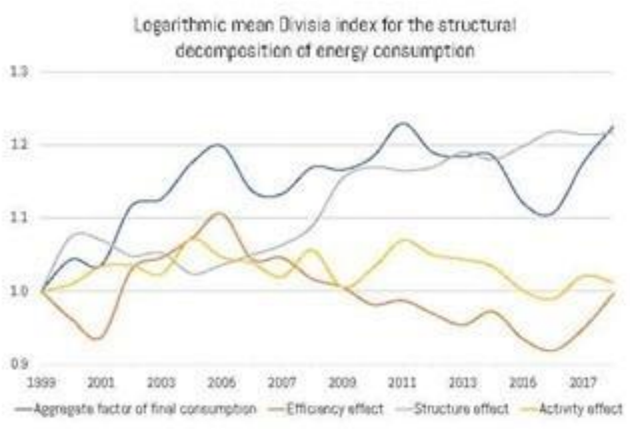


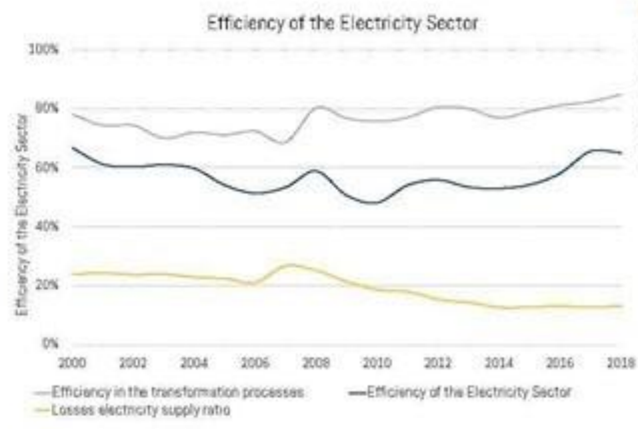

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita


Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)


Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)


Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector


Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

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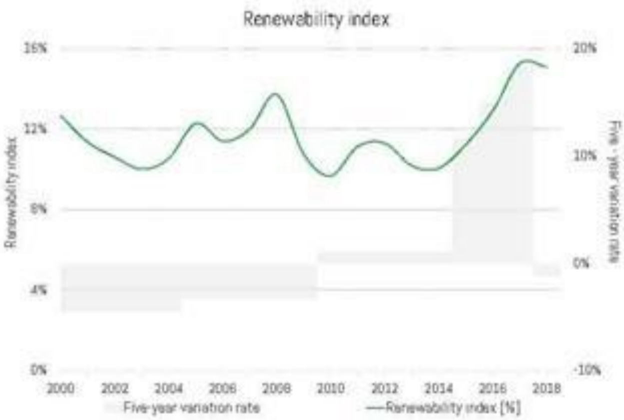
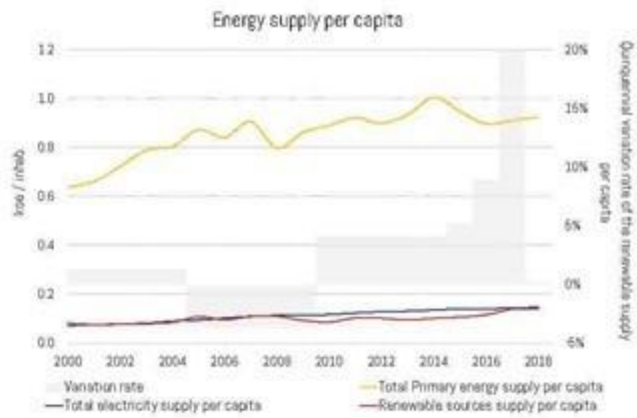
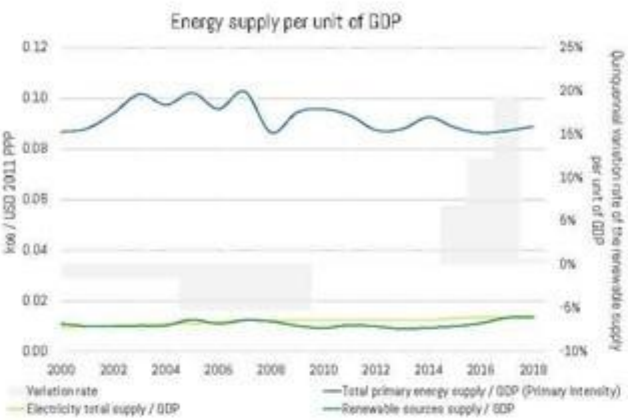
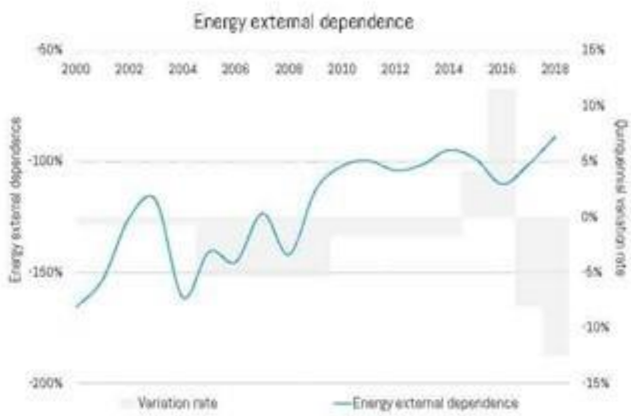
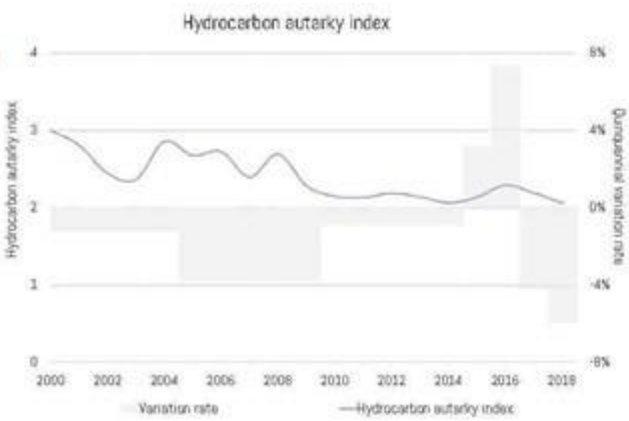
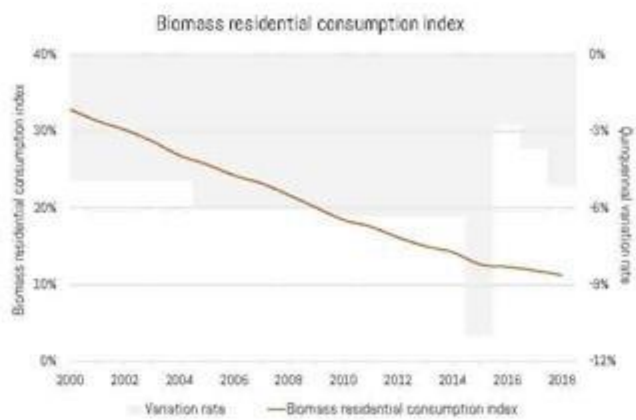

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

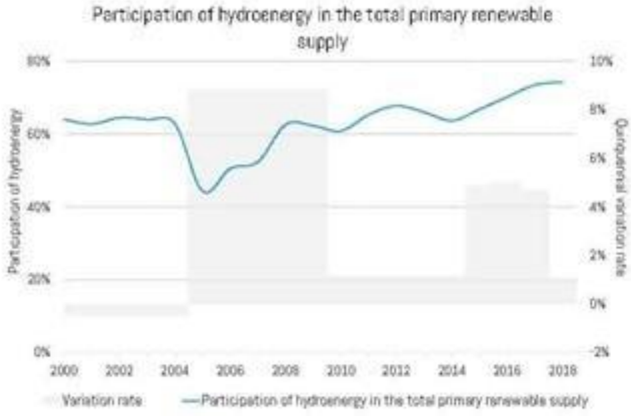

Energy supply per capita
koe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

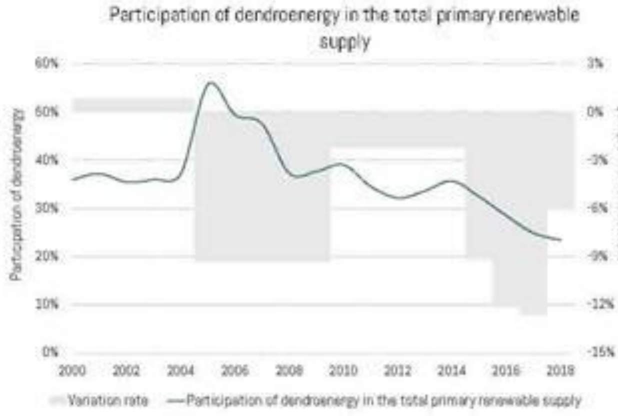

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary Intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

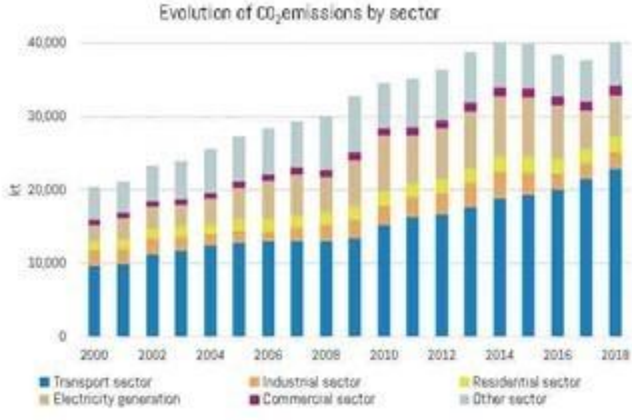

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

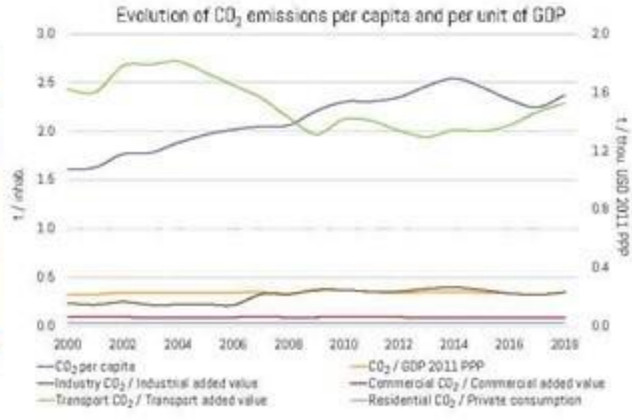

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

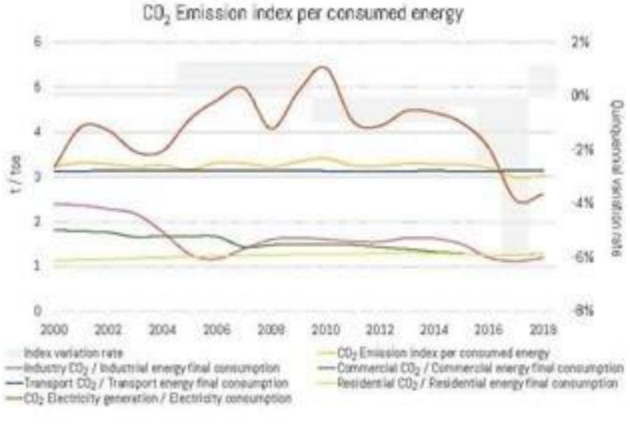

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

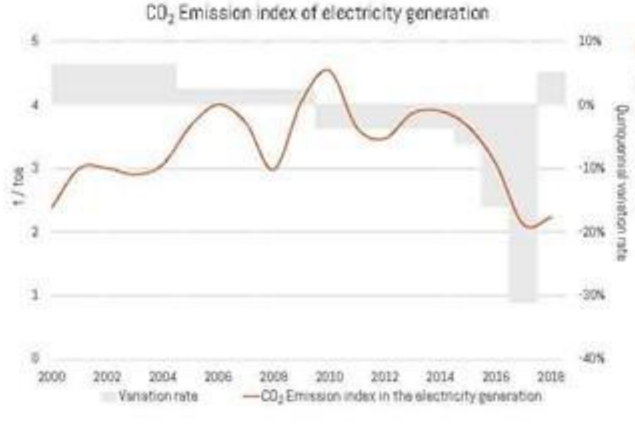

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

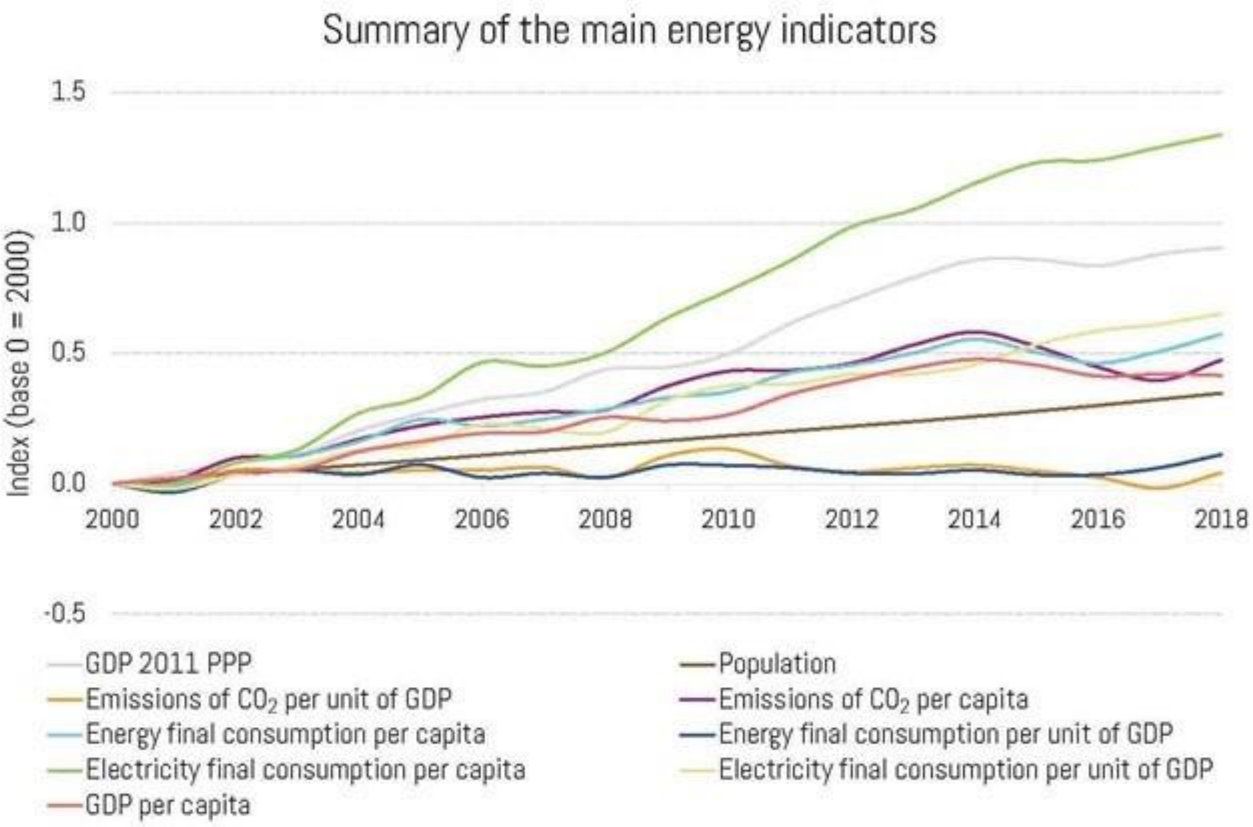

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
1.5
1.0
0.5
0.0
-0.5
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

EL SALVADOR

General Information 2018

Population (thousand inhab.)	6,643 [1]
Area (km²)	21,041
Population Density (inhab./km²)	316
Urban Population (%)	62
GDP USD 2010 (MUSD)	22,545
GDP USD 2011 PPP (MUSD)	47,468
GDP per Capita (thou. USD 2011 PPP/inhab.)	7

Energy Sector

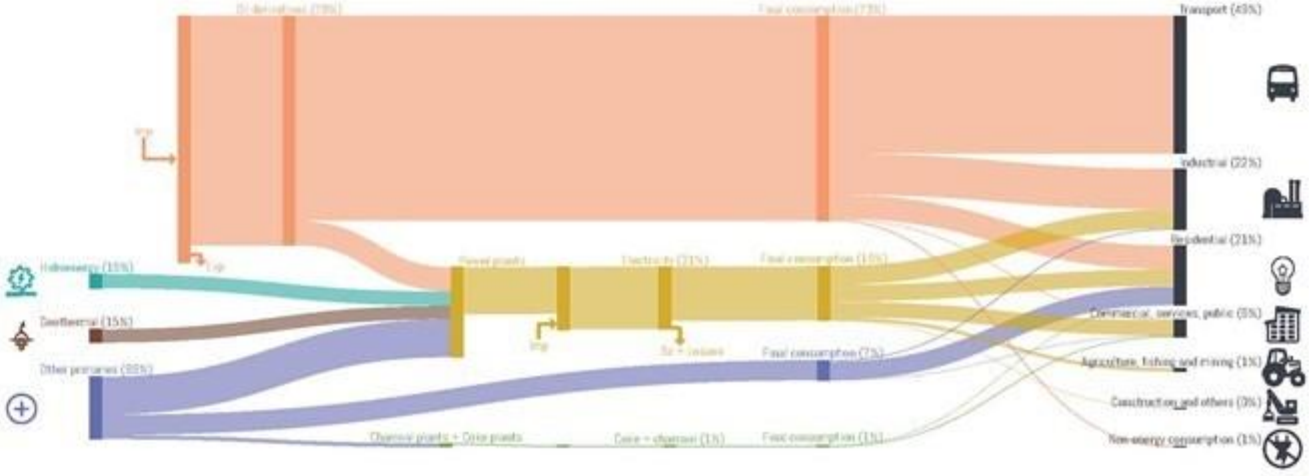
	Mtoe
Final consumption in the Transport Sector	1.35
Final consumption in the Industrial Sector	0.60
Final consumption in the Residential Sector	0.58
Final consumption in the Commercial and Service Sector	0.18
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.05

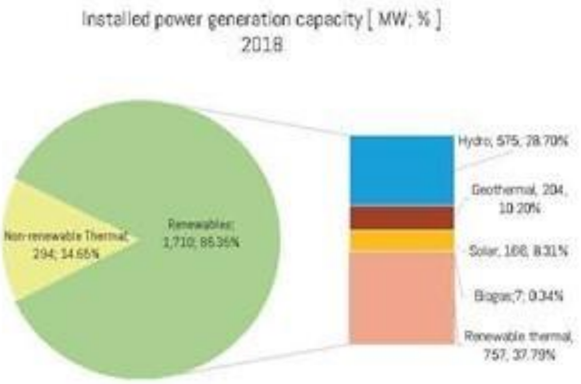
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

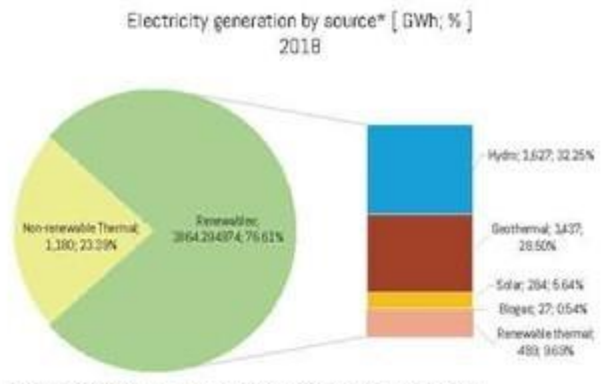
[1] General Directorate of Statistics and Census - El Salvador.

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
937	0.42	97.00	3.29	0.88	2.58	0.18	2.76	n.a.	2.00	0.07 / 0.06

Summarized energy balance 2018

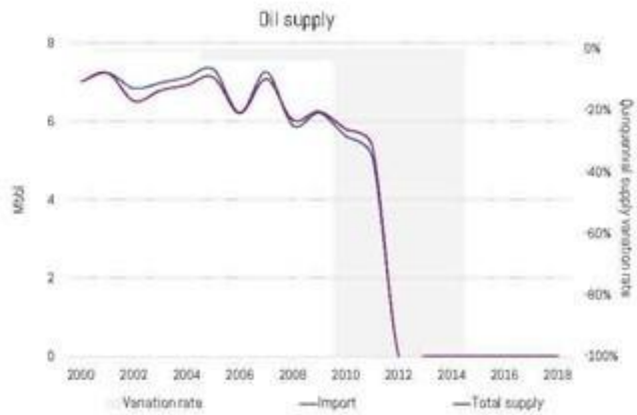


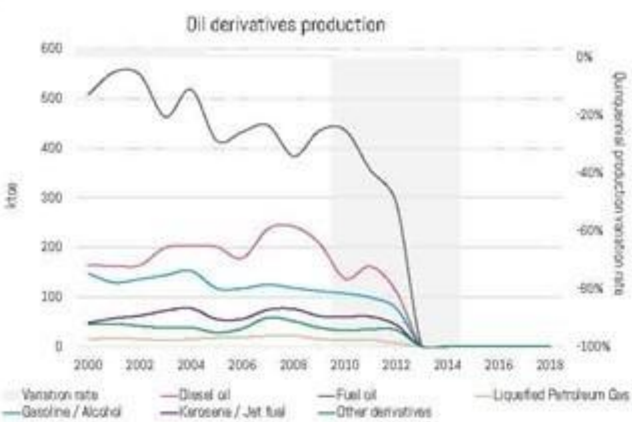


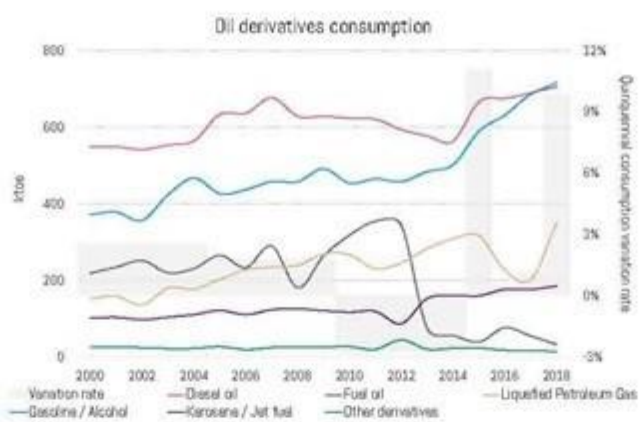


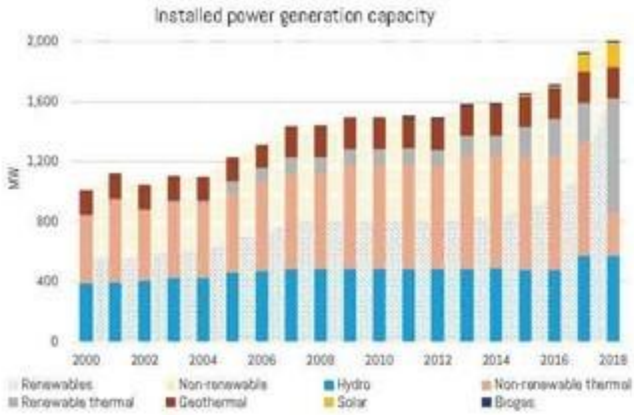
(*) Source: SIGET 2018, Newsletter and own elaboration CNE (distributed generation included)

In September 2012, the Salvadoran Refinery (RASA) in Acajutla closed its operations.







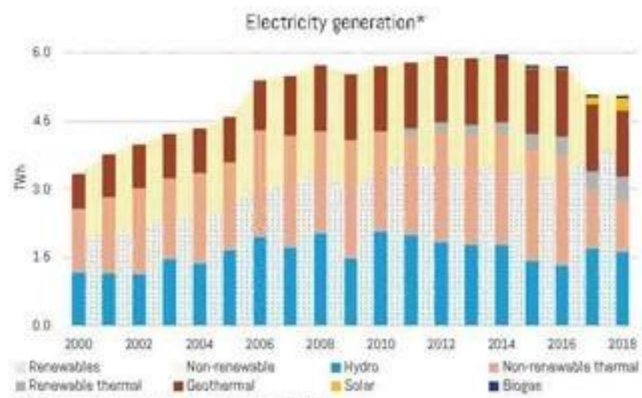


In February 2018, the repowering of the Jiboa Biomass plant (34.9 MW) entered into commercial operation in the wholesale market of El Salvador. Owned by Sociedad Ingenio Central Azucarero Jiboa, S.A., the final nominal capacity of the plant is 44.9 MW.

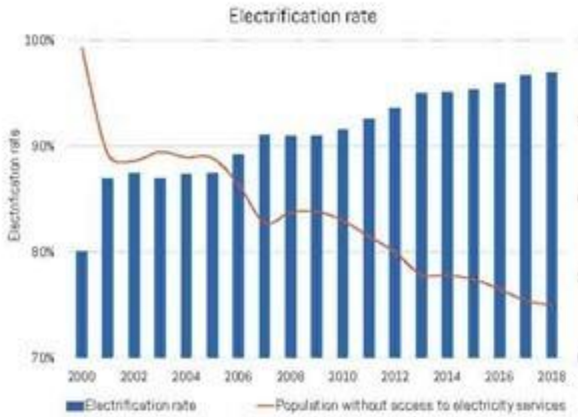
In December 2018, the construction of three photovoltaic plants, interconnected to the national transmission system, with a total of 34 MW, was completed. The same were awarded in July 2014 in a tendering process and a total of 47 MW of interconnected photovoltaic plants to the distribution network.

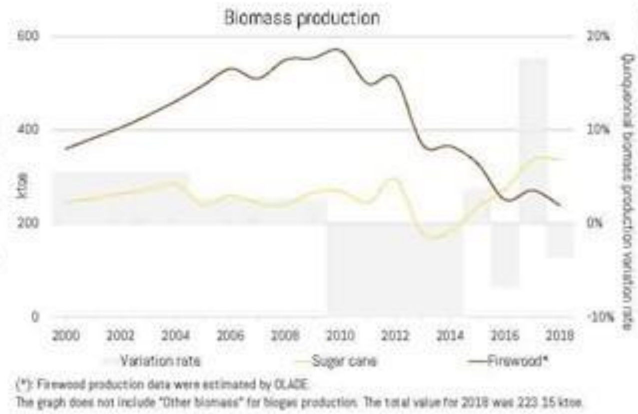
In April, June and September 2018, the photovoltaic solar plants, Pasaquina, Conchagua and El Carmen respectively, owned by the Company BÓSFORO, LTDA, entered into commercial operation. Of C.V., with an installed capacity of 10 MW each.

There are 3 plants that are part of the Bosphorus project for the construction of 10 plants with a capacity of 10 MW each, totaling 100 MW.



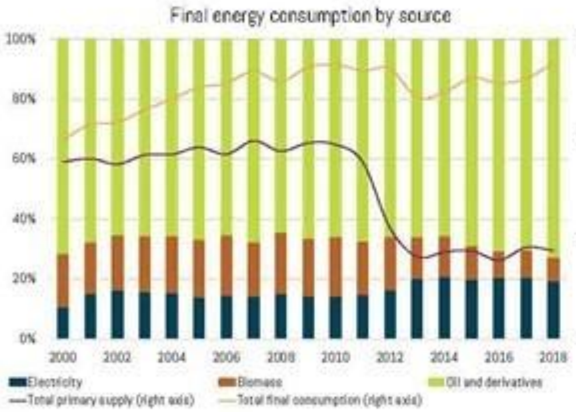
(*): Corresponds to gross generation of electricity - SIGET

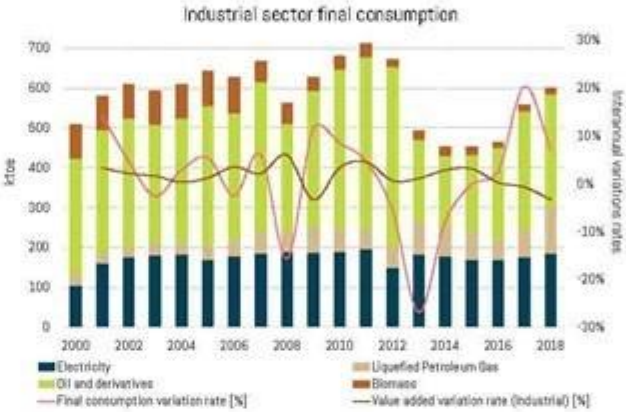


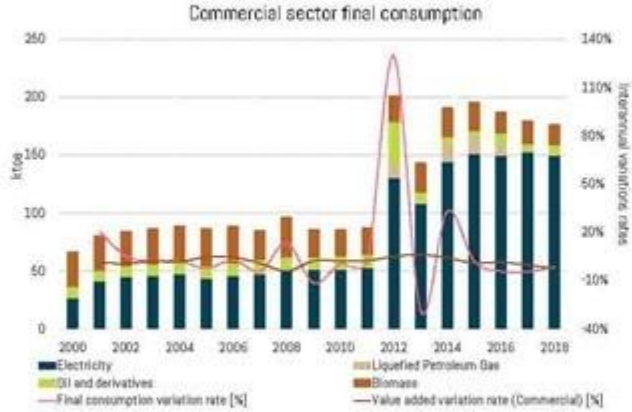


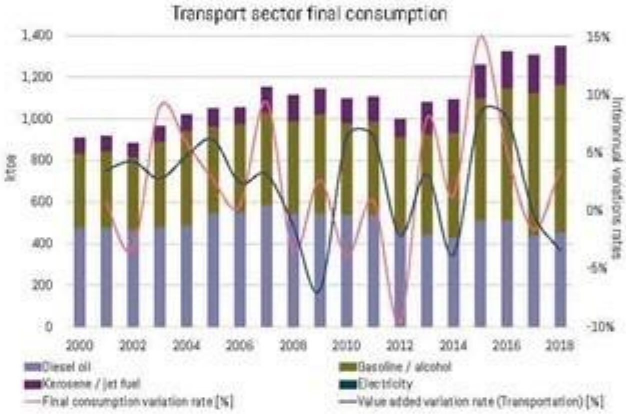
(*): Firewood production data were estimated by OLADE.
The graph does not include "Other biomass" for biogas production. The total value for 2018 was 223.15 ktoe.

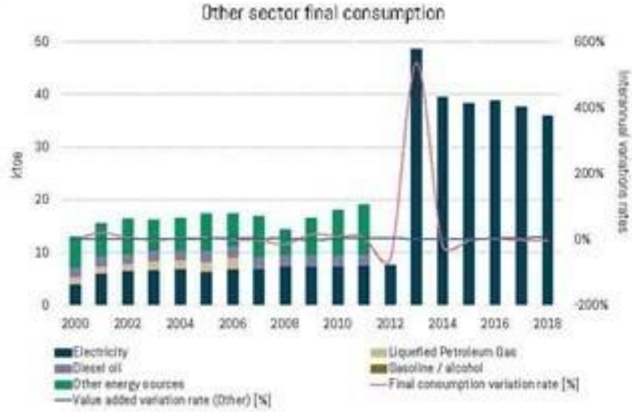
EL SALVADOR


Final energy consumption by source
ktoe
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

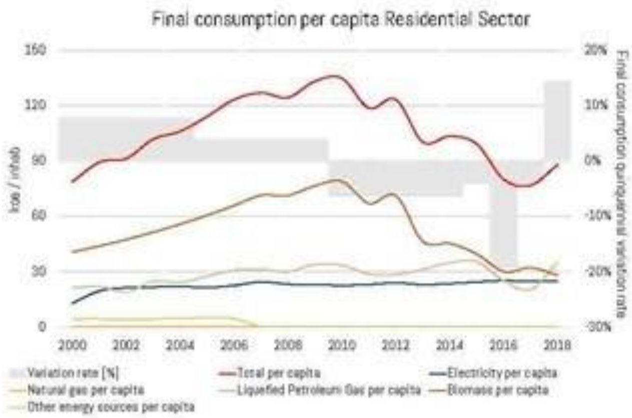

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

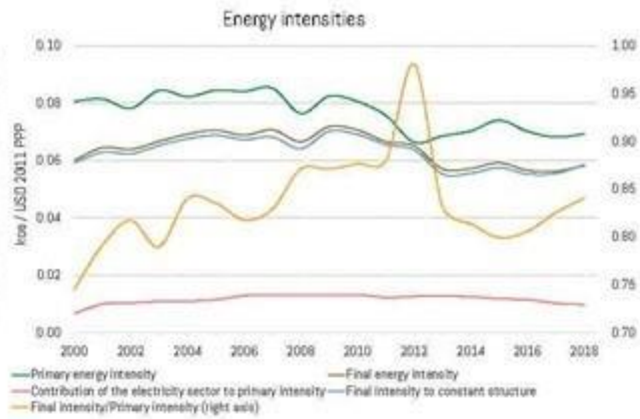

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

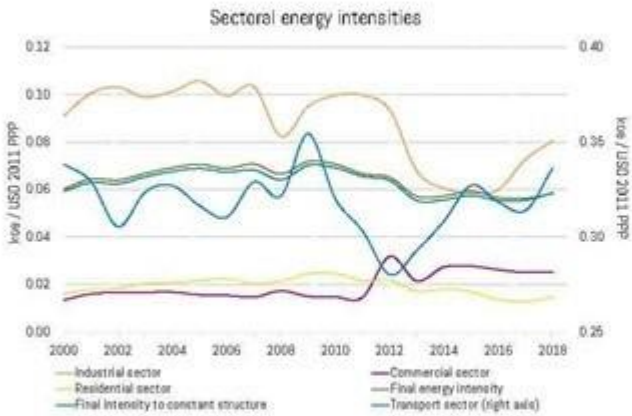

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

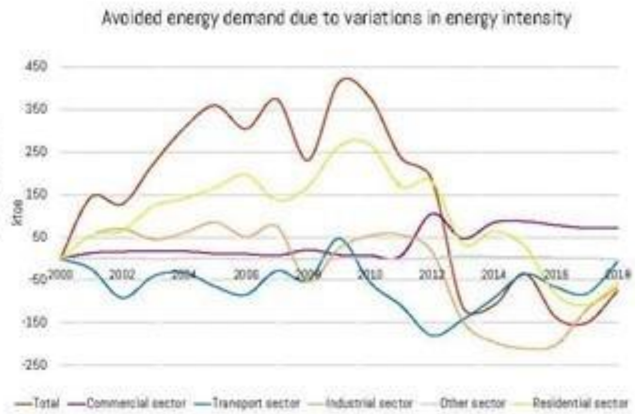

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Diesel oil
Gasoline / alcohol
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Other) [%]

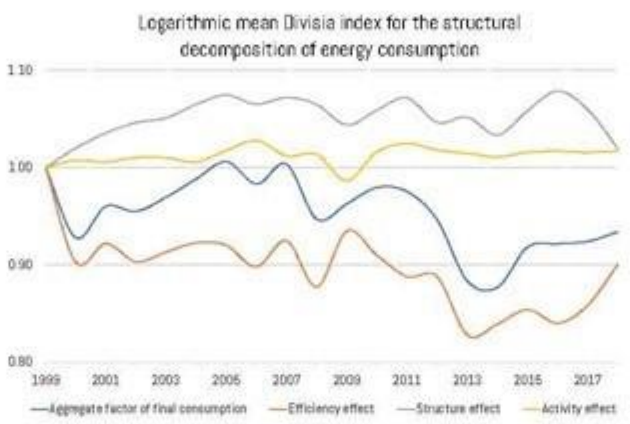

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

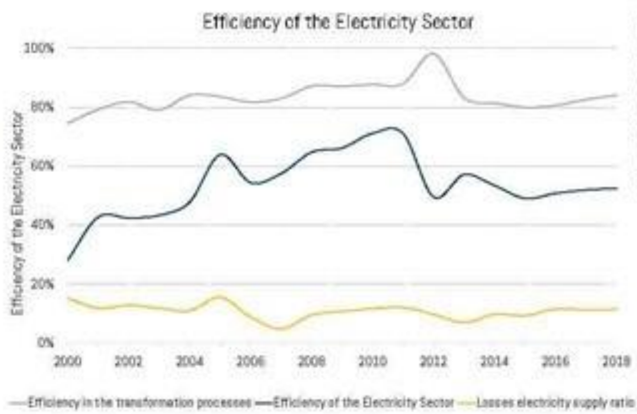

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

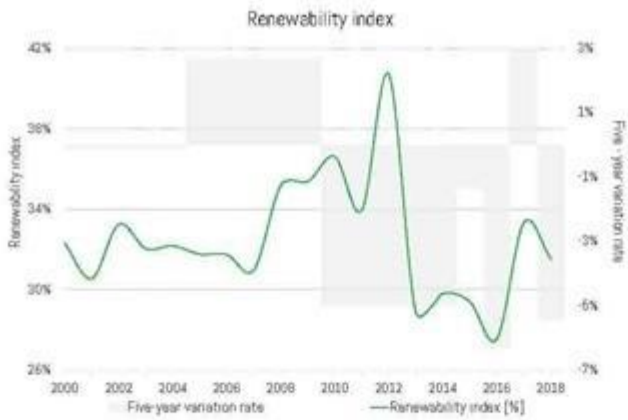

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

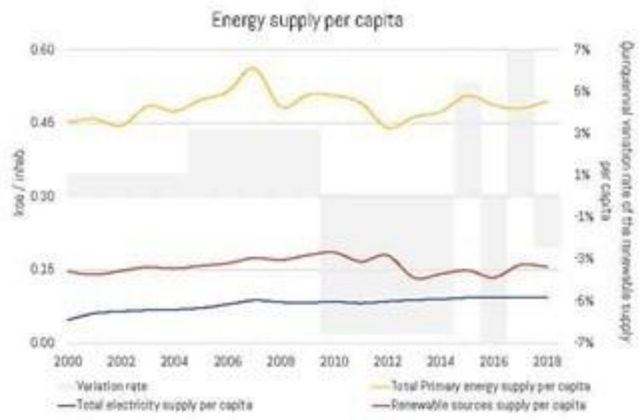

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

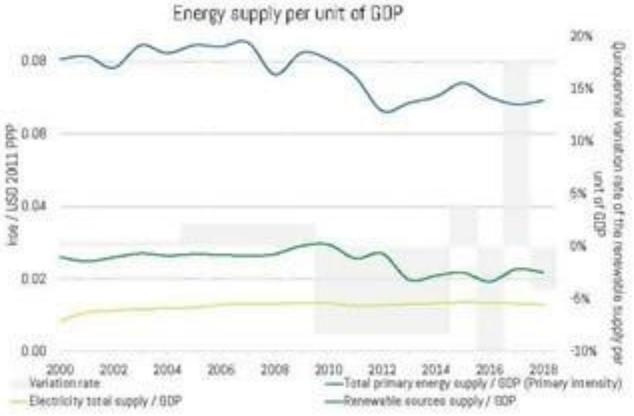

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

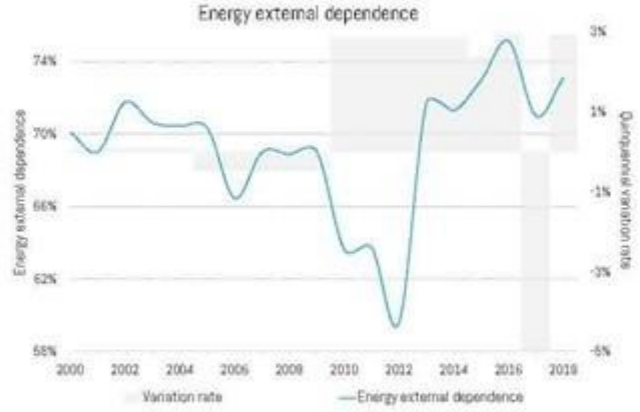

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio


Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

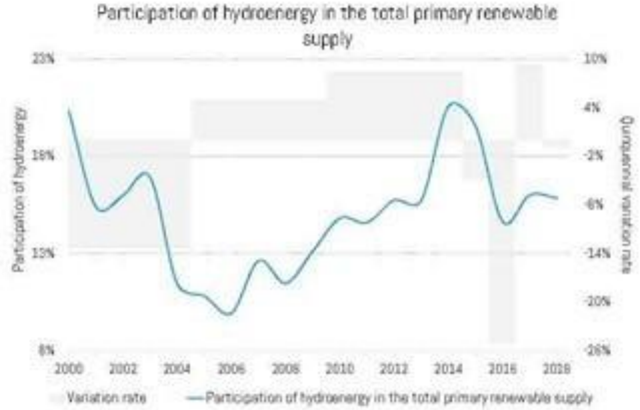

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

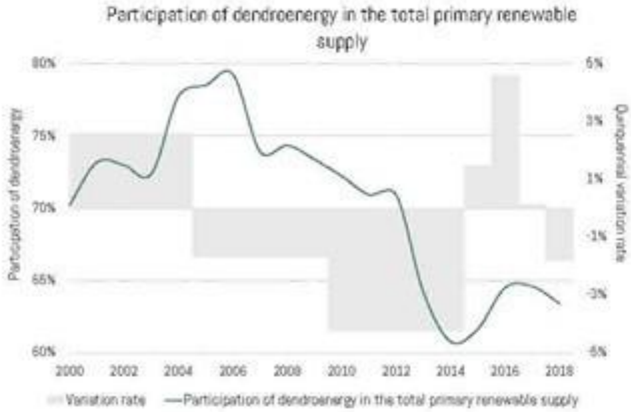

Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

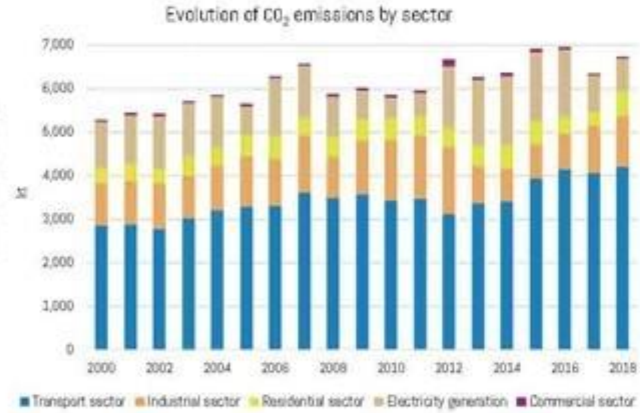

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

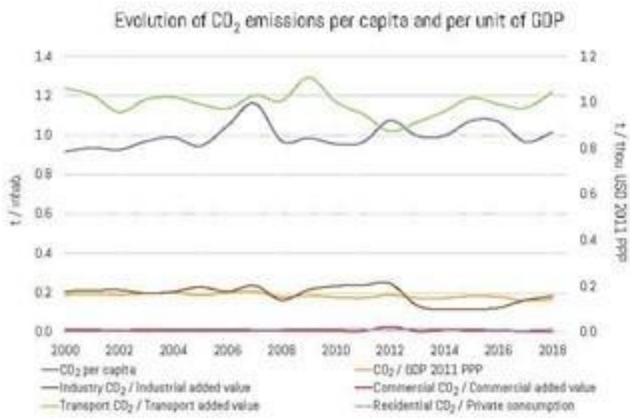
EL SALVADOR

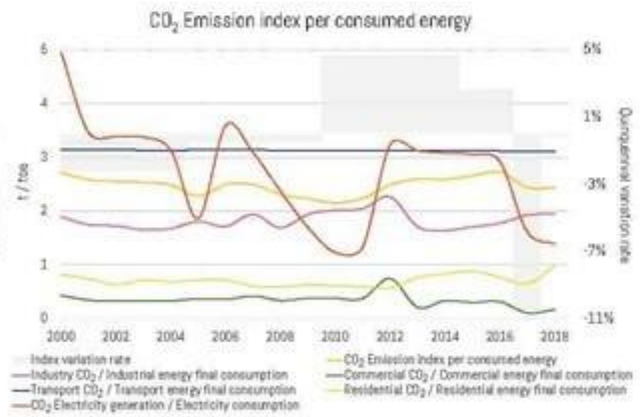

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

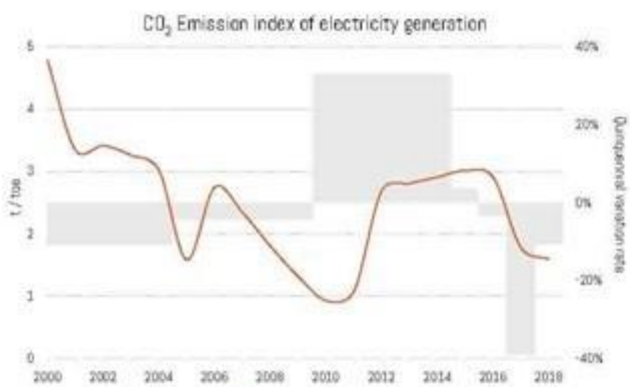

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

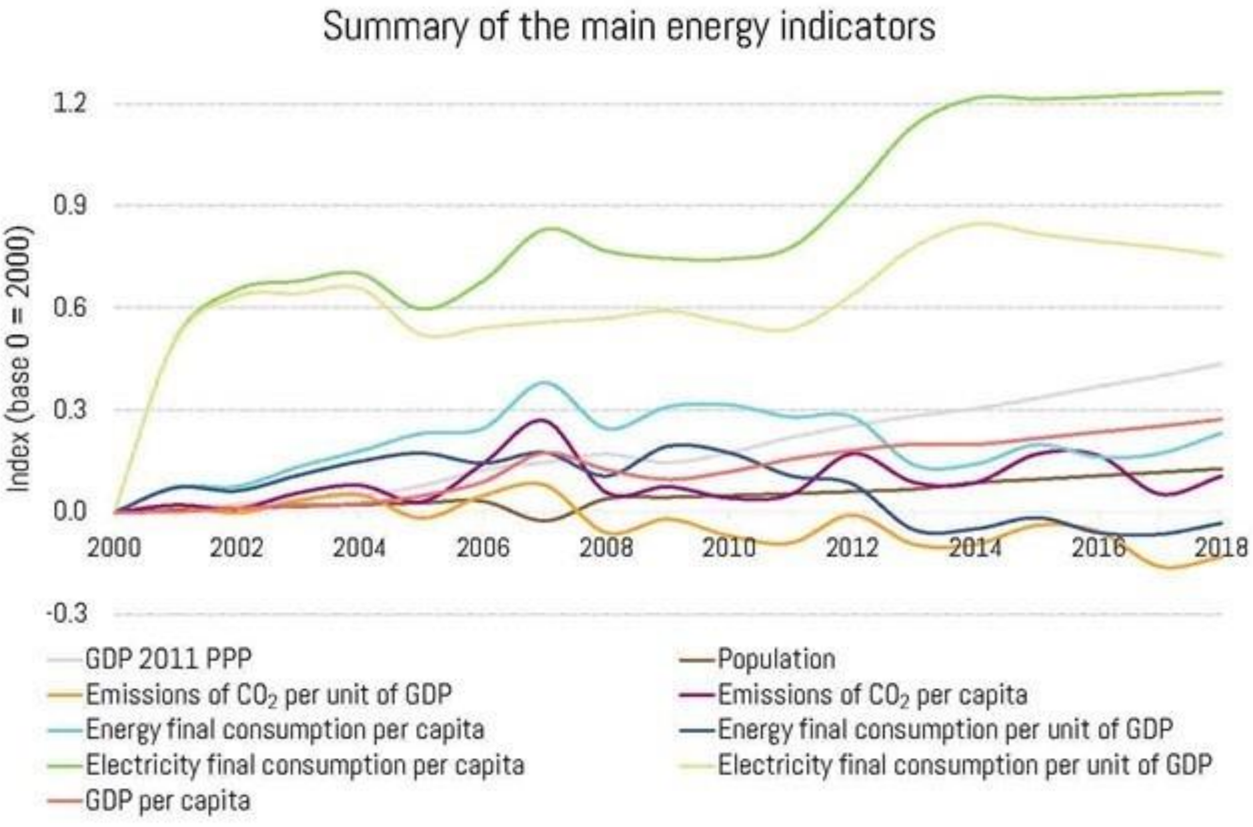

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
80%
75%
70%
65%
60%
5%
3%
1%
-1%
-3%
-5%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
5
4
3
2
1
0
5%
1%
-3%
-7%
-11%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
5
4
3
2
1
0
40%
20%
0%
-20%
-40%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.2
0.9
0.6
0.3
0.0
-0.3
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO2 per unit of GDP
Emissions of CO2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

GRENADA

General Information 2018

Population (thousand inhab.)	111
Area (km^2)	340
Population Density (inhab./km^2)	328
Urban Population (%)	36
GDP USD 2010 (MUSD)	1,013
GDP USD 2011 PPP (MUSD)	1,557
GDP per Capita (thou. USD 2011 PPP/inhab.)	14

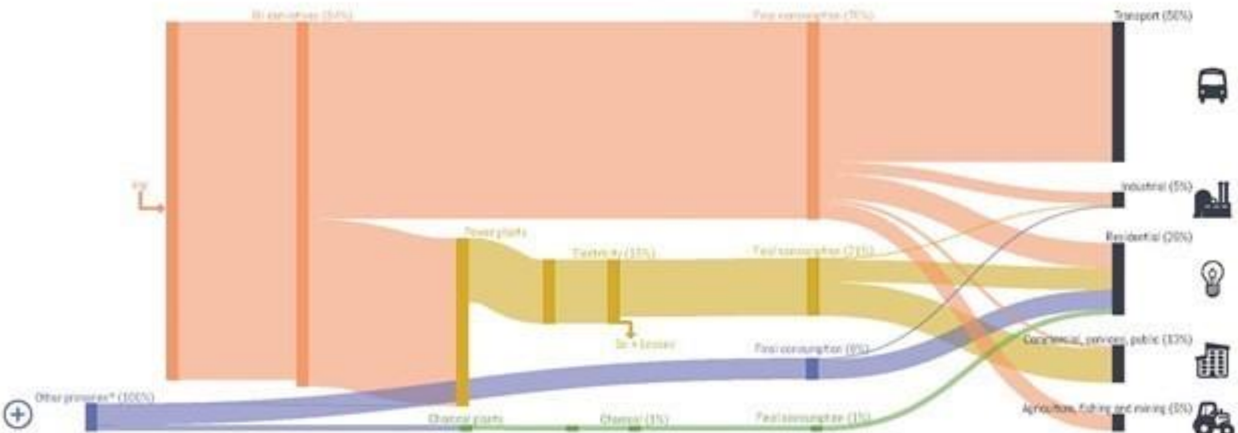
Energy Sector

	Mtoe
Final consumption in the Transport Sector	0.04
Final consumption in the Industrial Sector	0.00
Final consumption in the Residential Sector	0.02
Final consumption in the Commercial and Service Sector	0.01
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.01

Oil reserves (Mbbl)	Natural gas reserves (Gm^3)	Coal reserves (Mt)
n.a.	n.a.	n.a.

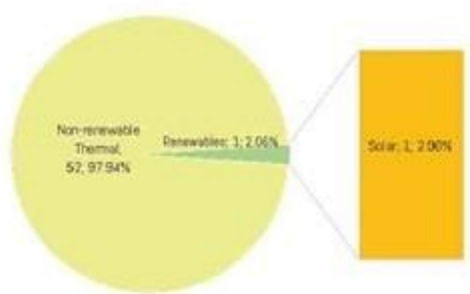
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,867
Final consumption per capita	toe/inhab.	0.78
Electrification rate	%	94.70
Total energy supply	Mtoe	0.12
Total energy production	Mtoe	0.01
Total energy imports	Mtoe	0.11
Total energy exports	Mtoe	0.00
Total final energy consumption	Mtoe	0.09
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	0.05
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.08 / 0.06

Summarized energy balance 2018

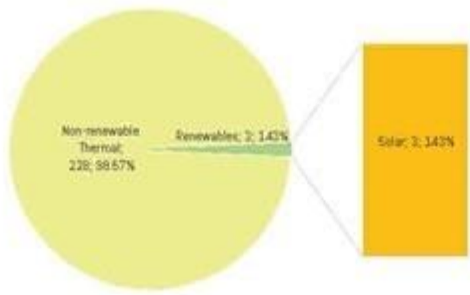


* Corresponds to firewood + sugarcane and derivatives

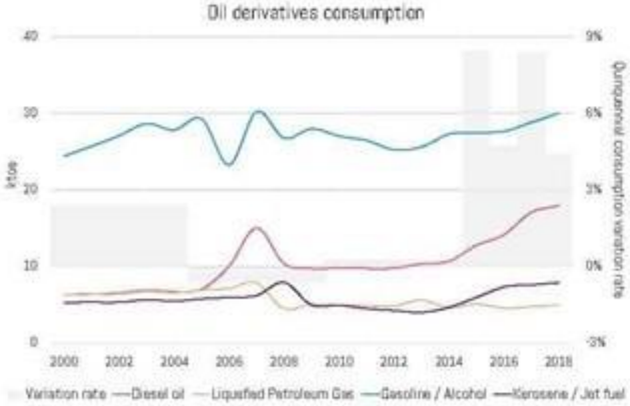
Installed power generation capacity [MW; %]
2018



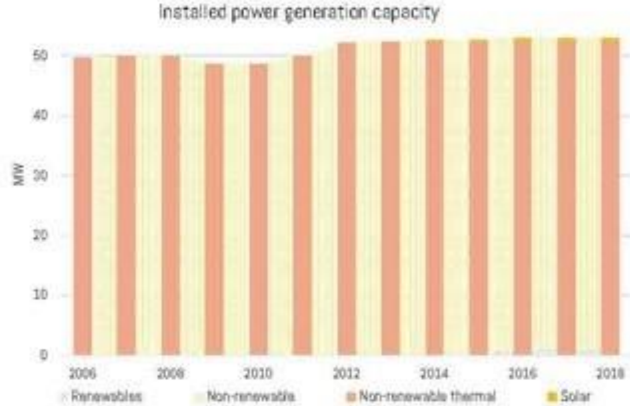
Electricity generation by source [GWh; %]
2018



Oil derivatives consumption



Installed power generation capacity



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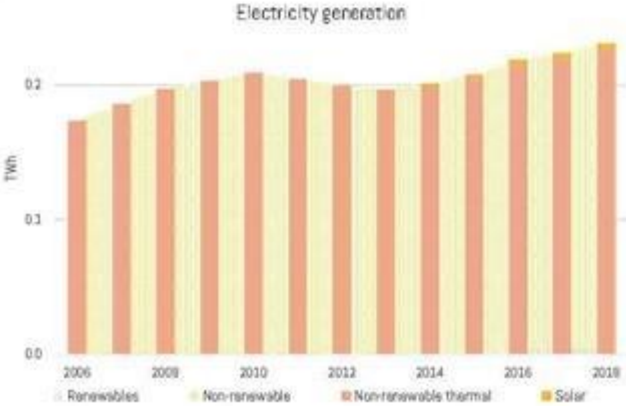
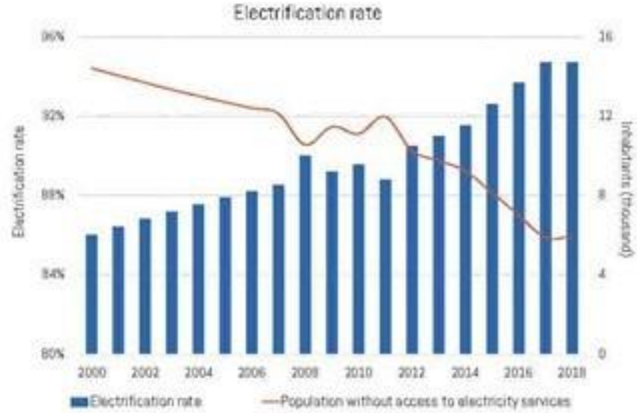
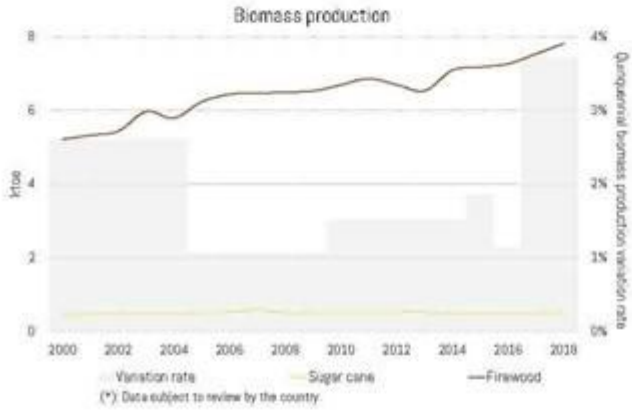
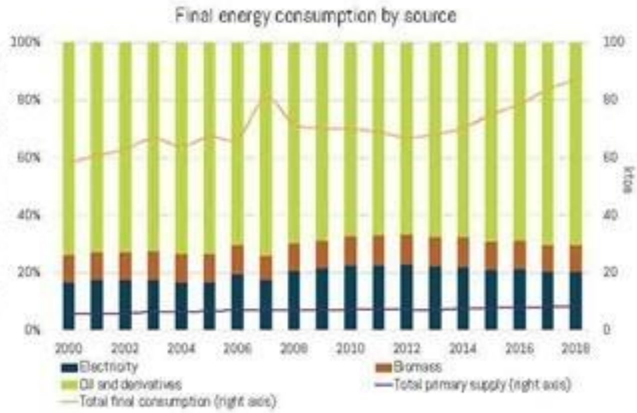
Electricity generation

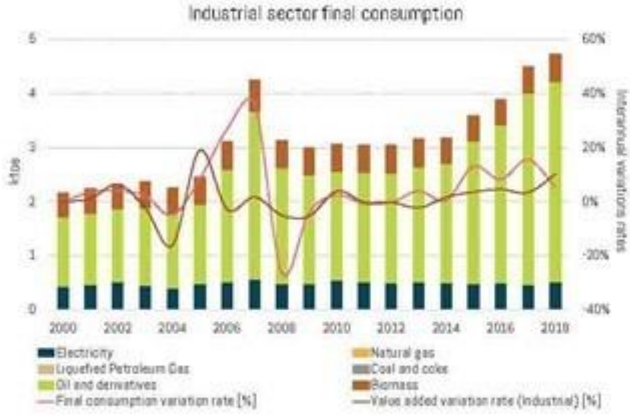


Electrification rate

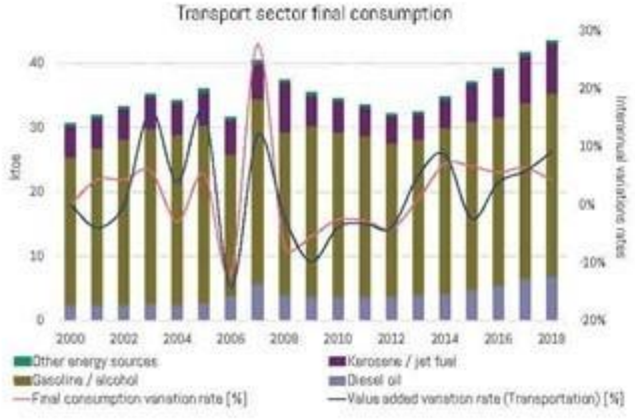


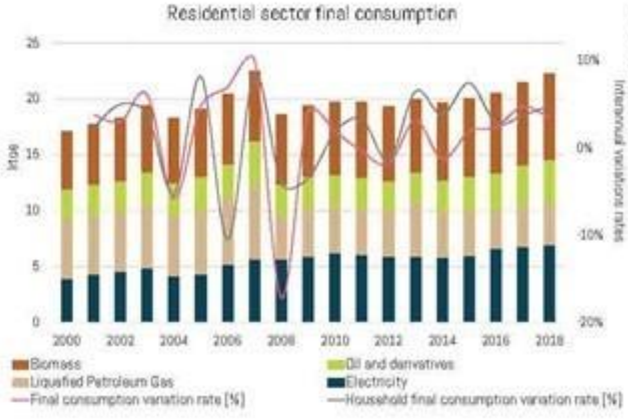

Biomass production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood
(*): Data subject to review by the country


Final energy consumption by source
ktoe
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

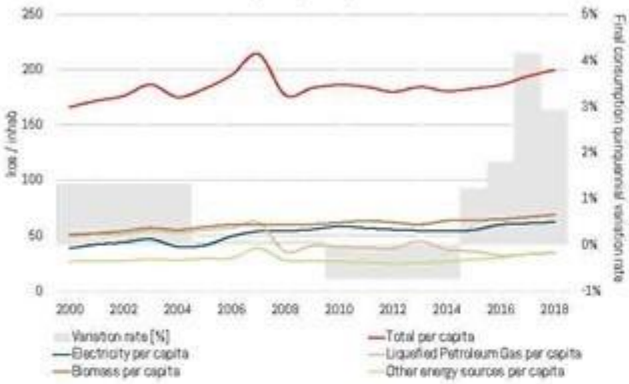

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied Petroleum Gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]


Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

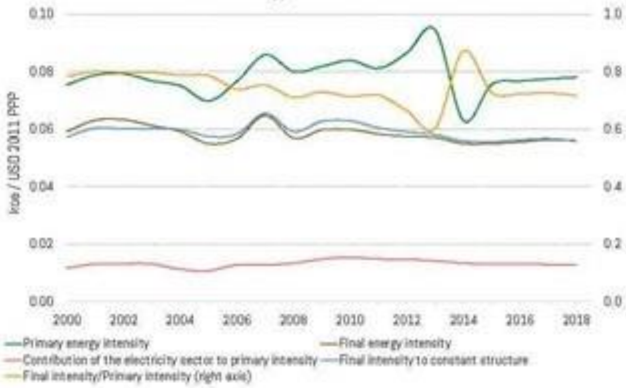

Transport sector final consumption
ktoe
Interannual variations rates
Other energy sources
Kerosene / jet fuel
Gasoline / alcohol
Diesel oil
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]


Residential sector final consumption
ktoe
Interannual variations rates
Biomass
Oil and derivatives
Liquefied Petroleum Gas
Electricity
Final consumption variation rate [%]
Household final consumption variation rate [%]

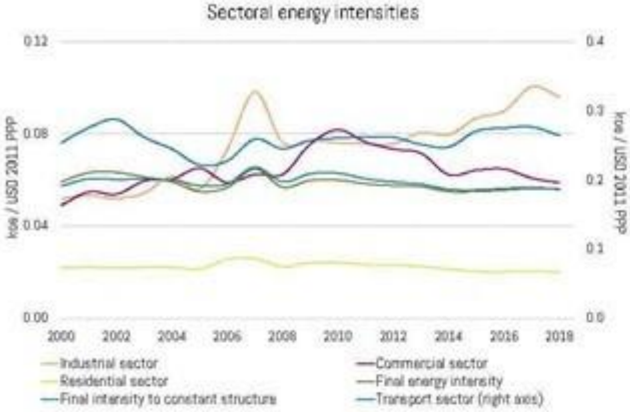
Final consumption per capita Residential Sector



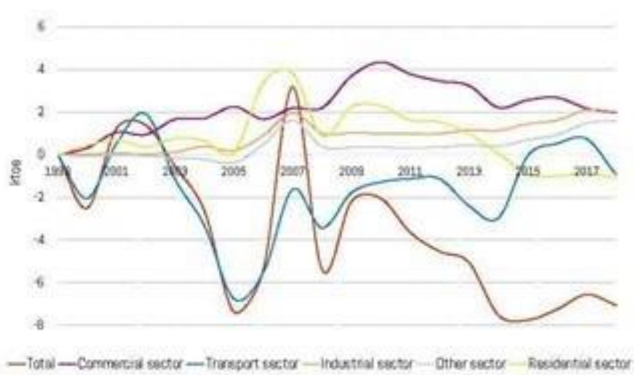
Energy intensities



Sectoral energy intensities

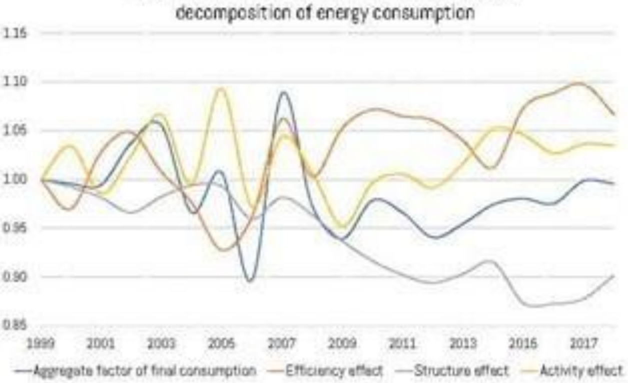


Avoided energy demand due to variations in energy intensity

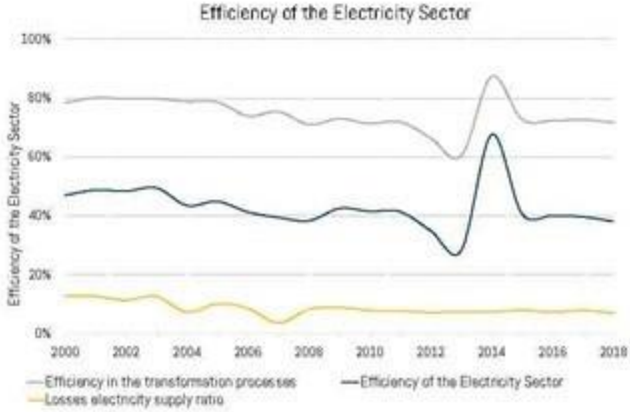


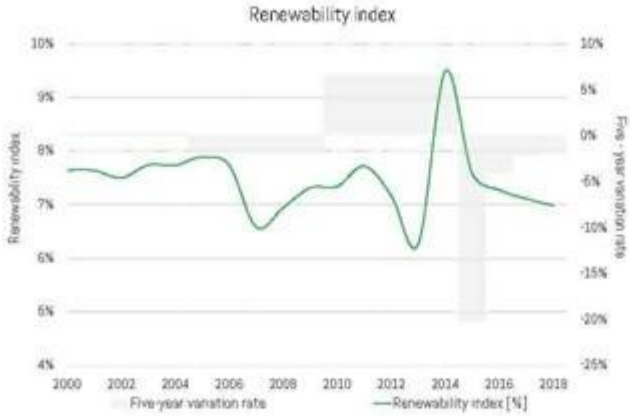
GRENADA

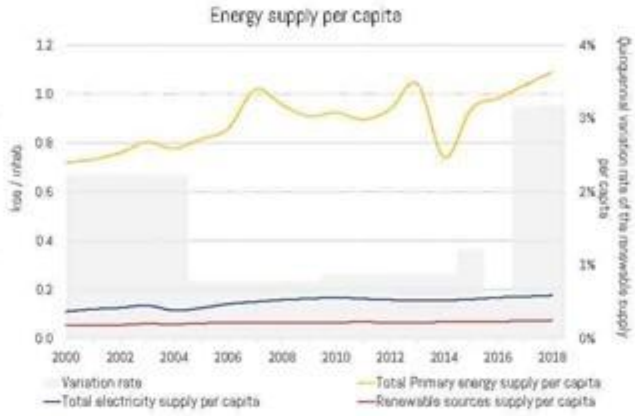
Logarithmic mean Divisia index for the structural decomposition of energy consumption

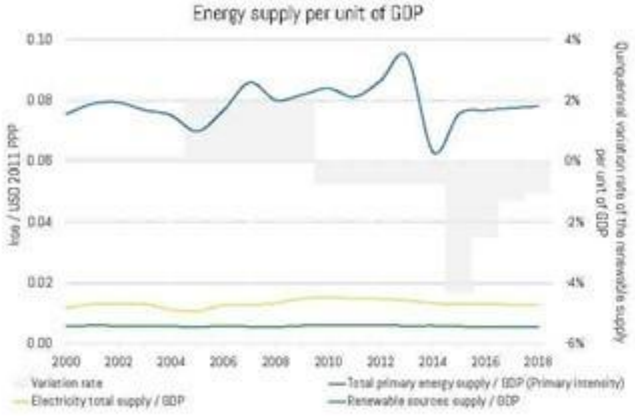


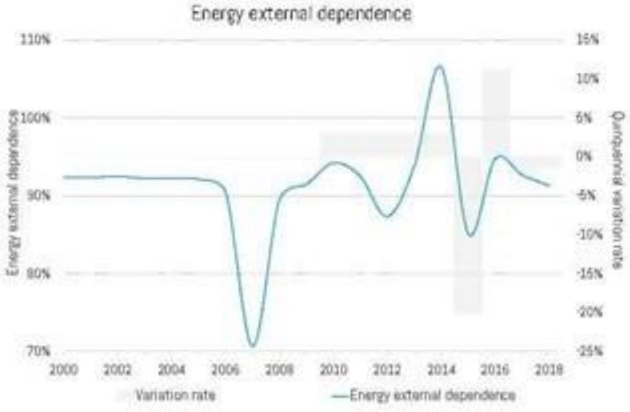
Efficiency of the Electricity Sector



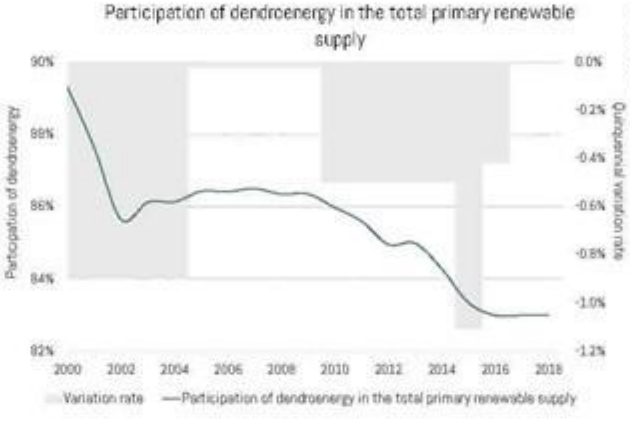

Renewability index
Five-year variation rate
Renewability index [%]


Energy supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

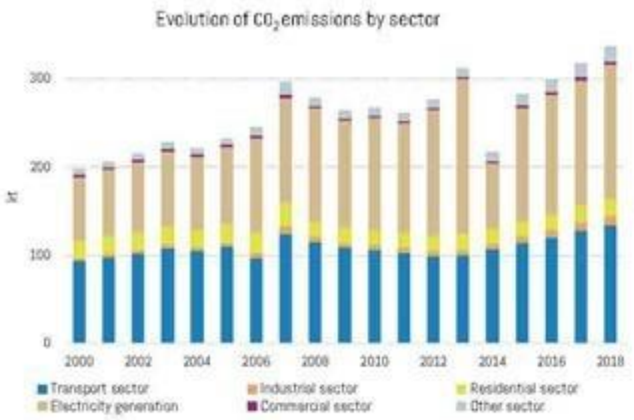

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

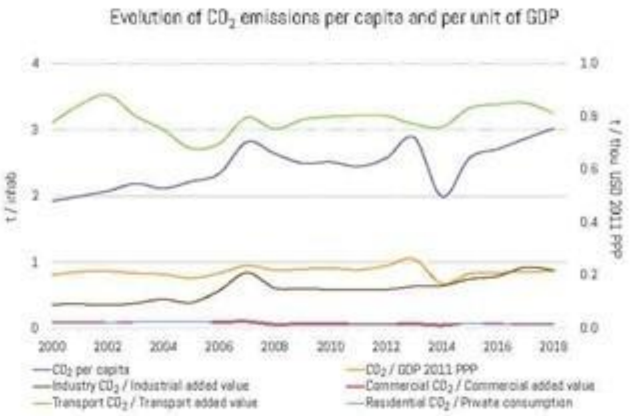

Energy external dependence
Variation rate
Energy external dependence

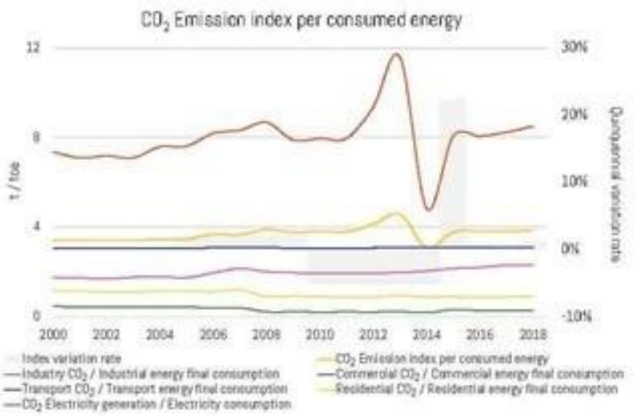

Biomass residential consumption index
Variation rate
Biomass residential consumption index

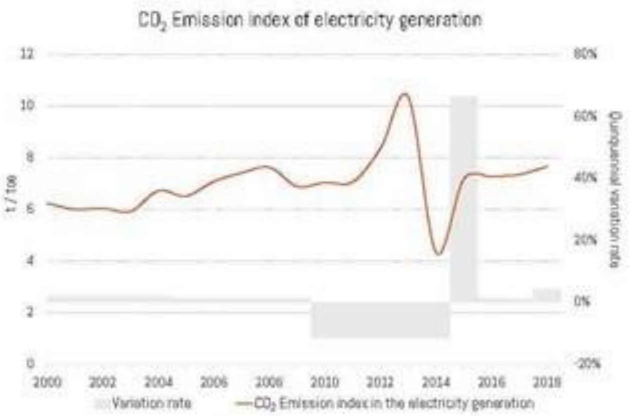

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply

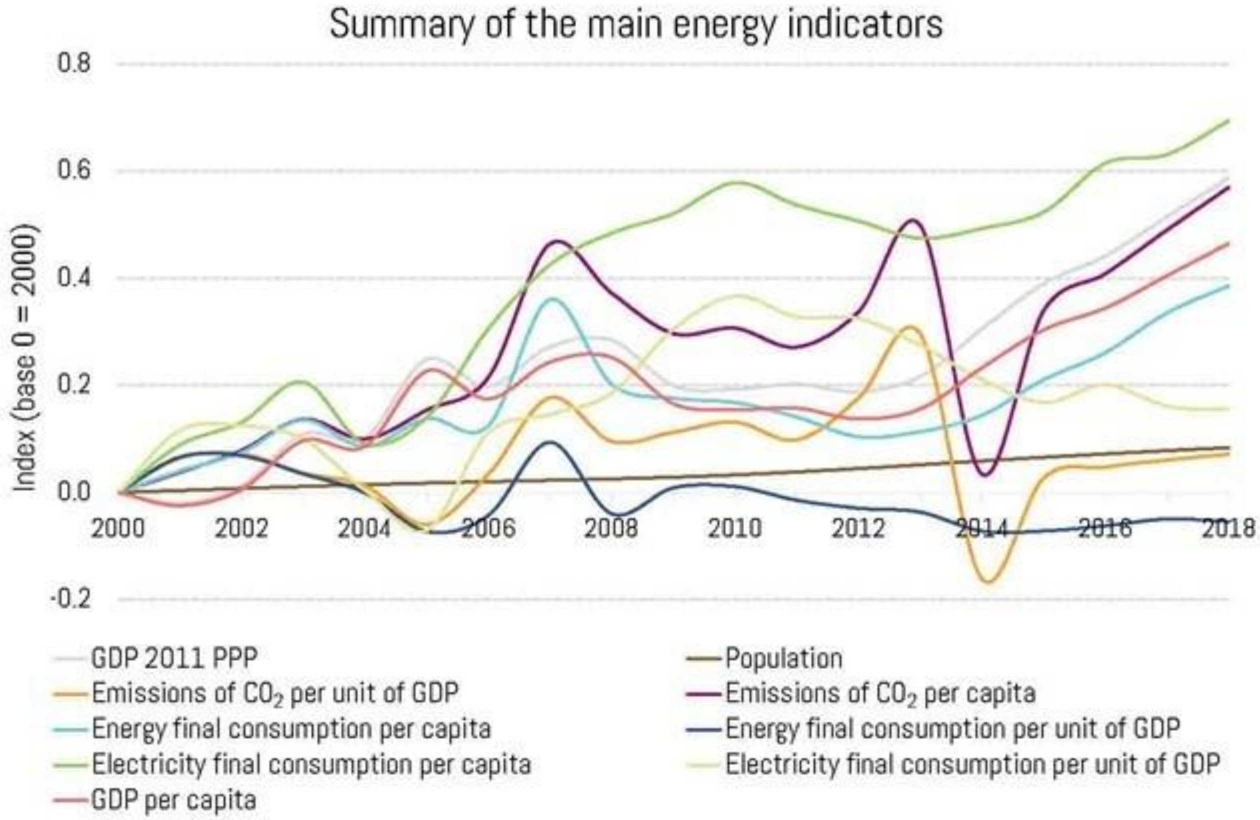
GRENADA


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
0.8
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

GUATEMALA

General Information 2018

Population (thousand inhab.)	17,302 [2]
Area (km²)	108,889
Population Density (inhab./km²)	159
Urban Population (%)	58
GDP USD 2010 (MUSD)	54,503
GDP USD 2011 PPP (MUSD)	129,511
GDP per Capita (thou. USD 2011 PPP/inhab.)	7.5

Energy Sector

	Mtoe
Final consumption in the Transport Sector	3.33
Final consumption in the Industrial Sector	0.90
Final consumption in the Residential Sector	7.41
Final consumption in the Commercial and Service Sector	0.49
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.08

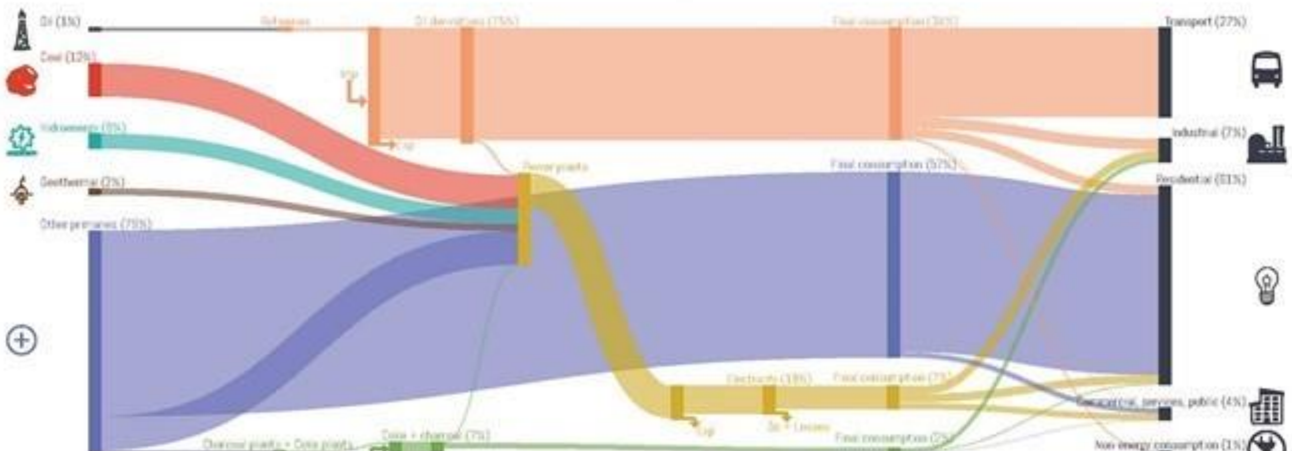
Oil reserves	Natural gas reserves (Amargo)	Coal reserves
Mbbl 86	Gm³ 0.52 [1]	Mt n.a.

[1] Data 2017.

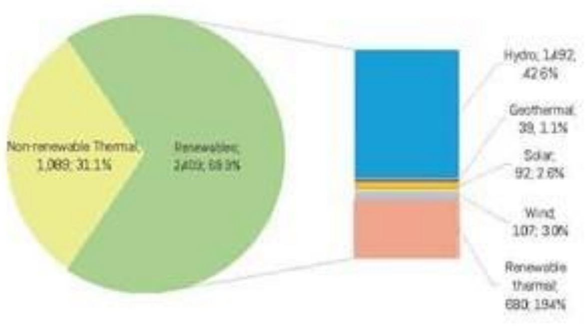
[2] According to the 2002 Census Data Projection.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	591
Final consumption per capita	toe/inhab.	0.70
Electrification rate	%	92.39 [1,2]
Total energy supply	Mtoe	14.88
Total energy production	Mtoe	9.60
Total energy imports	Mtoe	6.00
Total energy exports	Mtoe	0.78
Total final energy consumption	Mtoe	12.20
Refining capacity	kbbl/day	6
Installed power generation capacity	GW	3.50
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.11 / 0.09

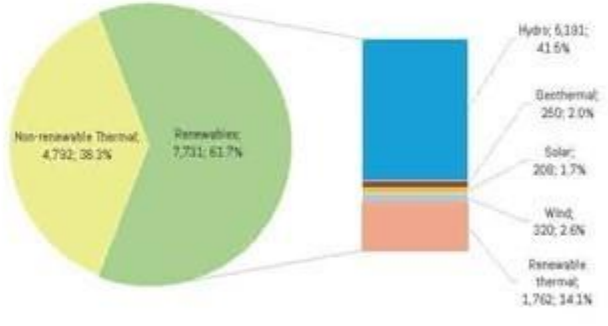
Summarized energy balance 2018



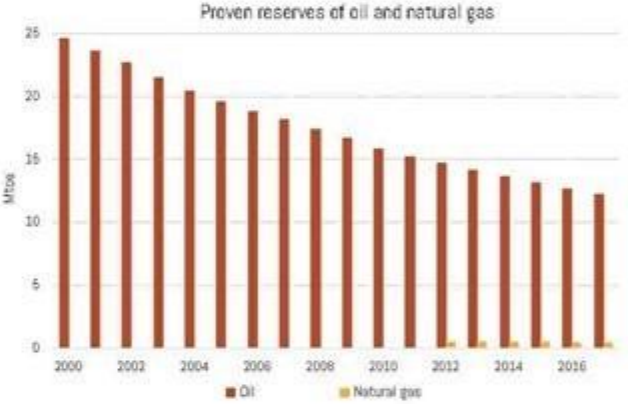
Installed power generation capacity [MW; %]
2018



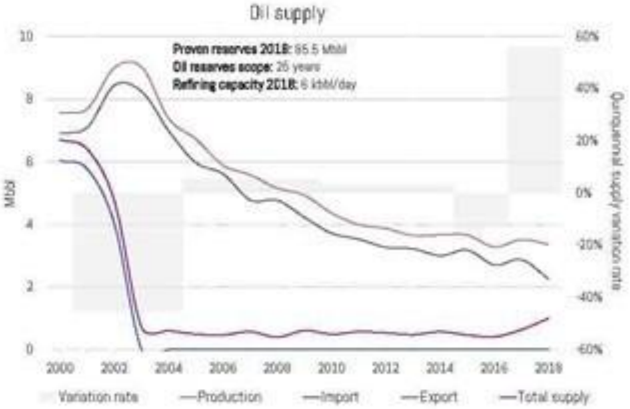
Electricity generation by source [GWh; %]
2018



Proven reserves of oil and natural gas



Oil supply



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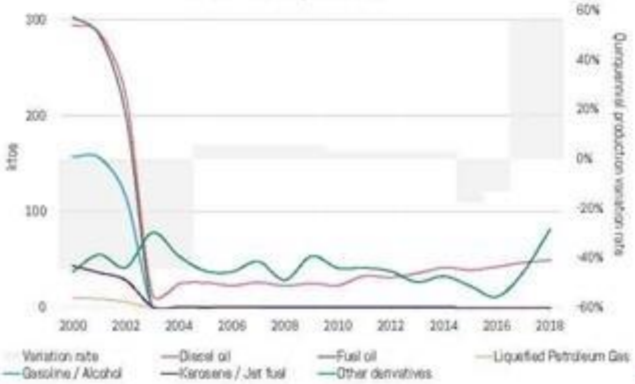
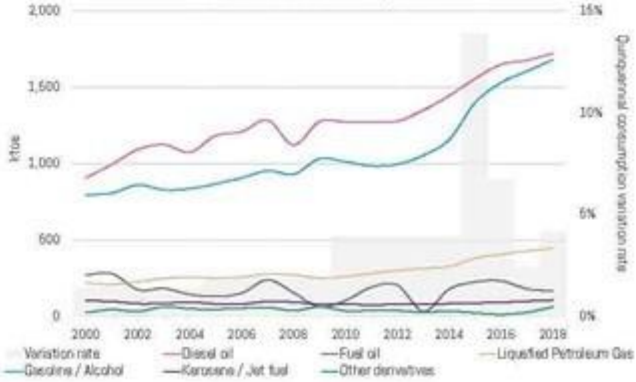
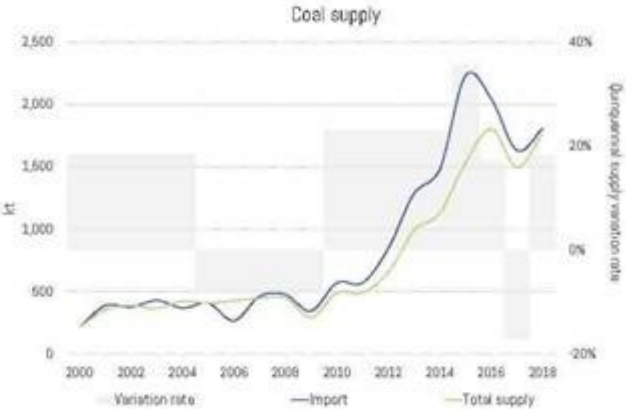
Oil derivatives production

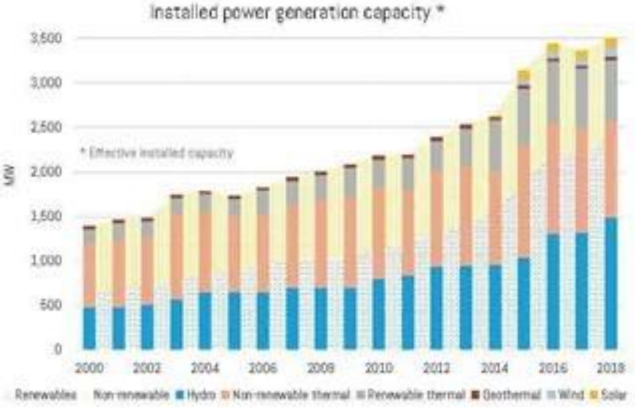


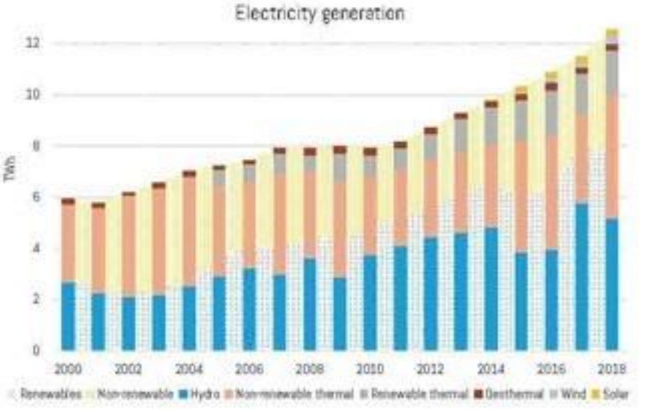
Oil derivatives consumption

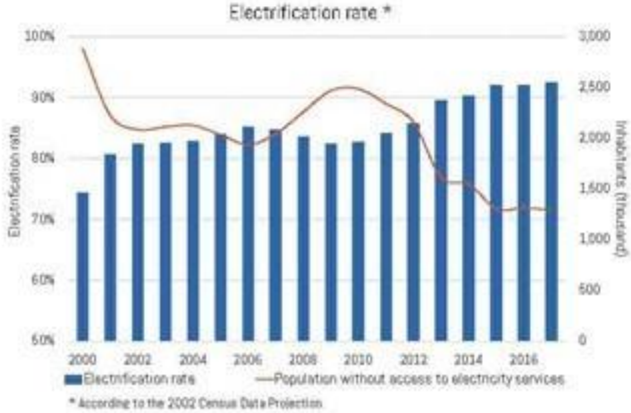


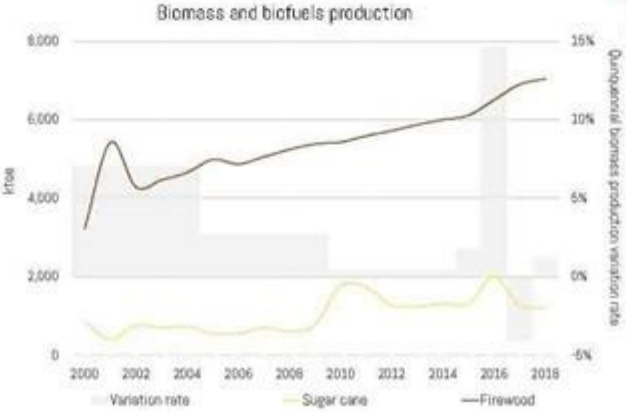
In the new installed capacity in 2018, it is important to mention that only plants with renewable resources started to operate, where hydroelectric generation represents 64.59% with 60.00 MW, wind plants with 31.50 MW that represents 33.91%, and the plants of distributed generation based on renewable resources adhere only 1.4 MW representing 1.51%. It is also important to mention that no generation plant based on non-renewable resources was installed this year.

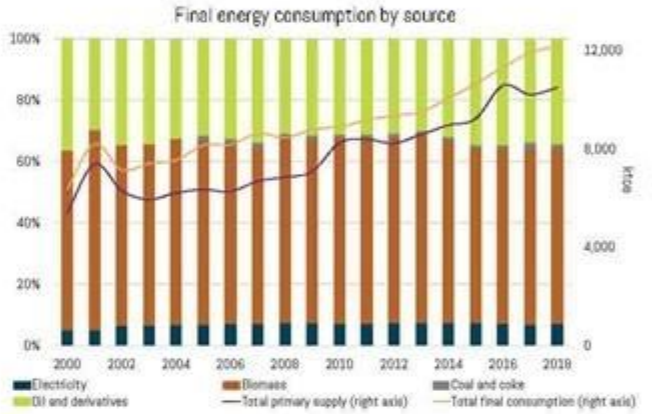


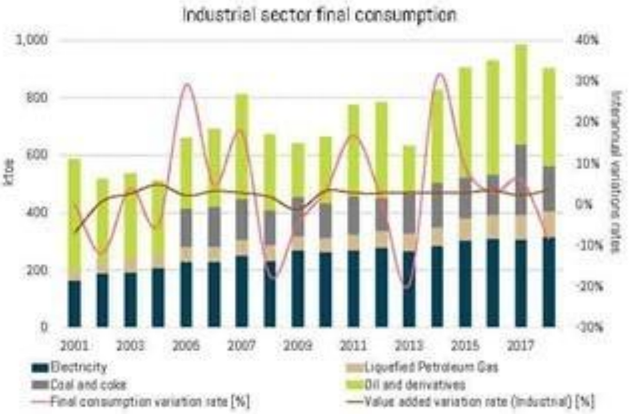


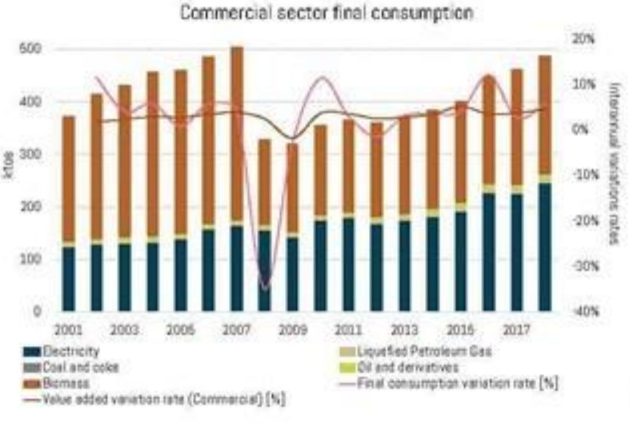


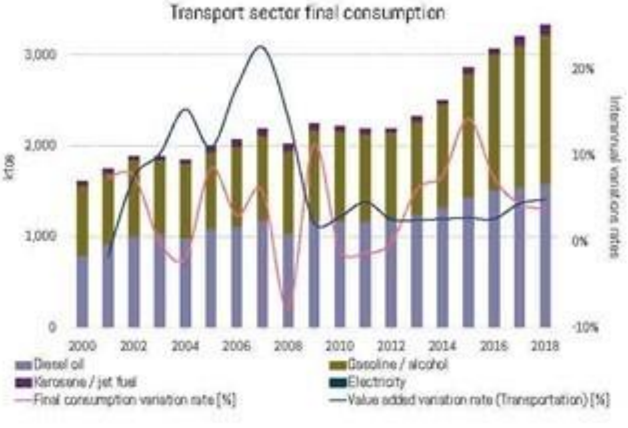












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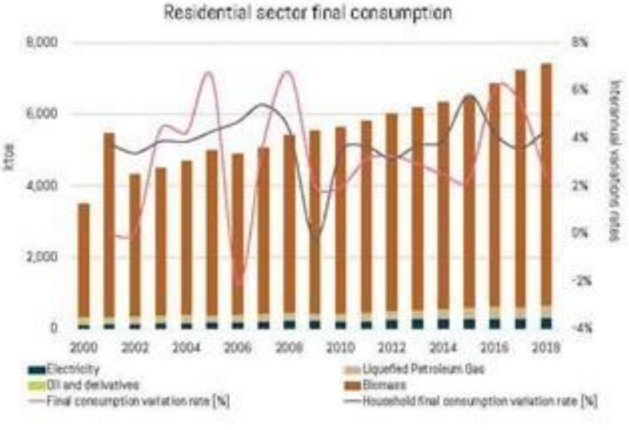
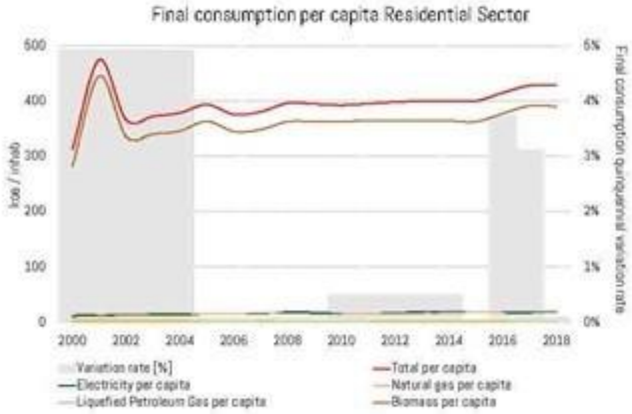
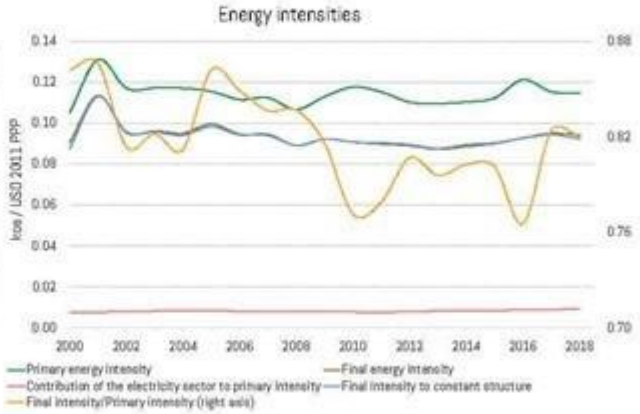
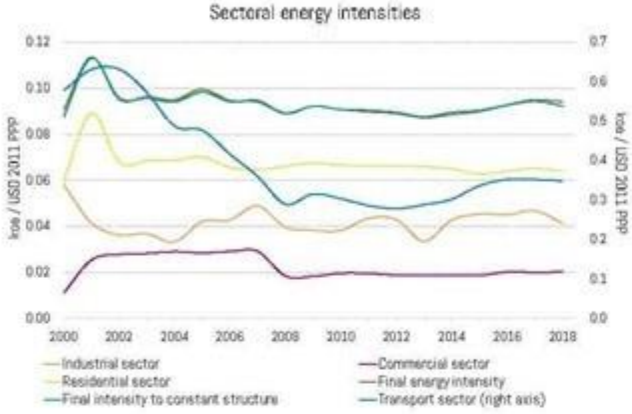
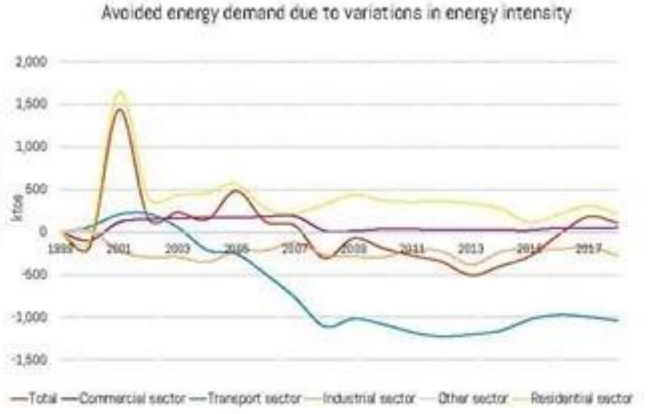
The important thing about the new installed capacity for 2018 is that 100% corresponds to the base generation of renewable resources, where the wind power plant "Las Cumbres" began operating with a power of 31.5 MW, it consists of 15 machines Model G114 of Gamesa and phase II of Oxec.

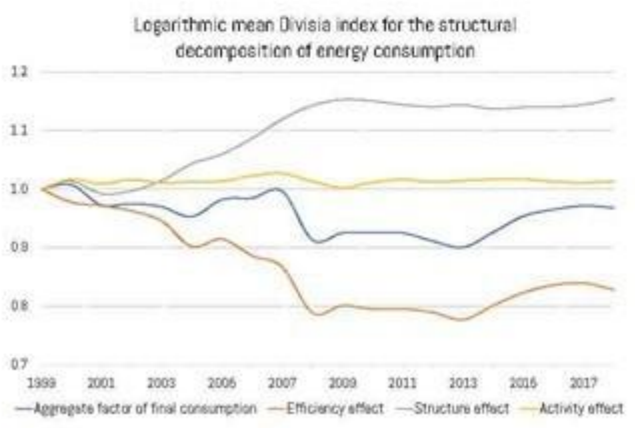


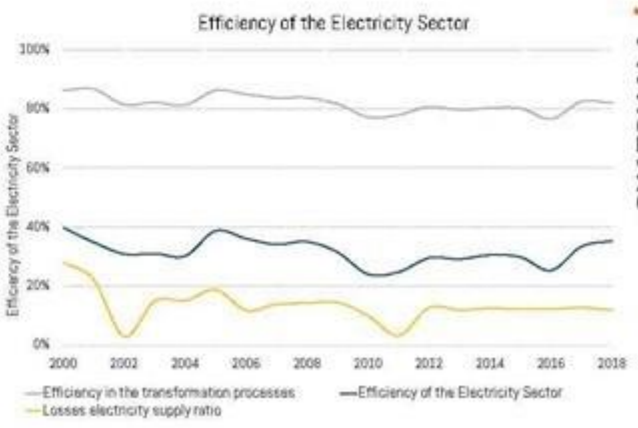

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Total per capita
Natural gas per capita
Biomass per capita

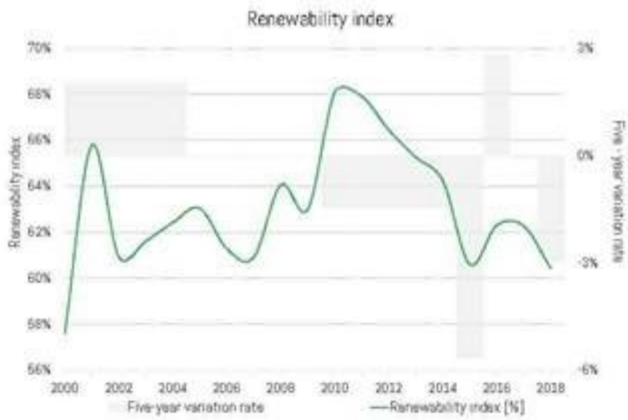

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

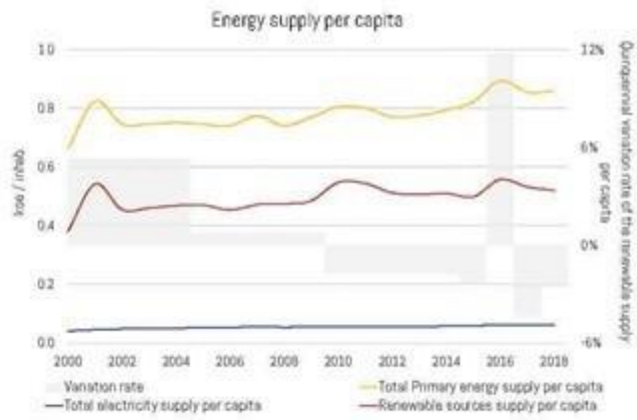

Sectoral energy intensities
koe / USD 2011 PPP
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

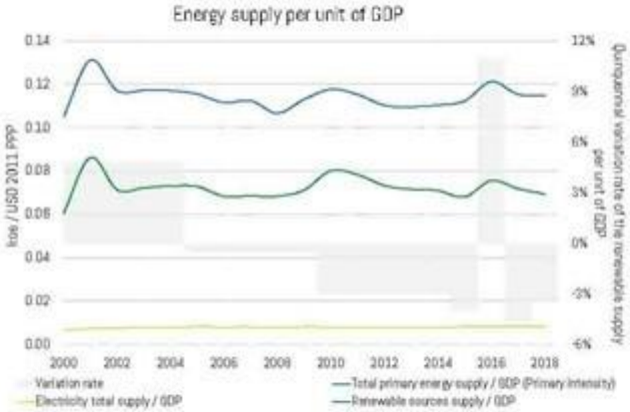

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

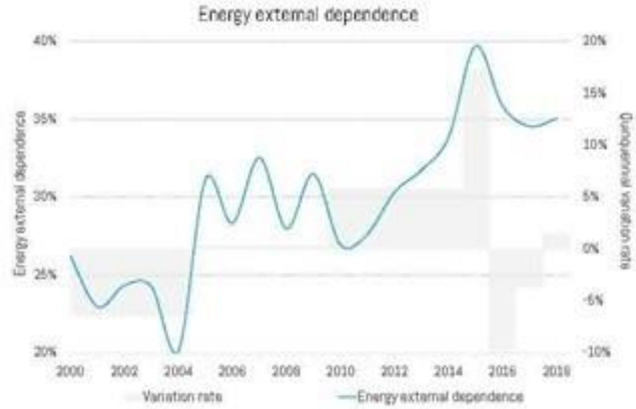

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

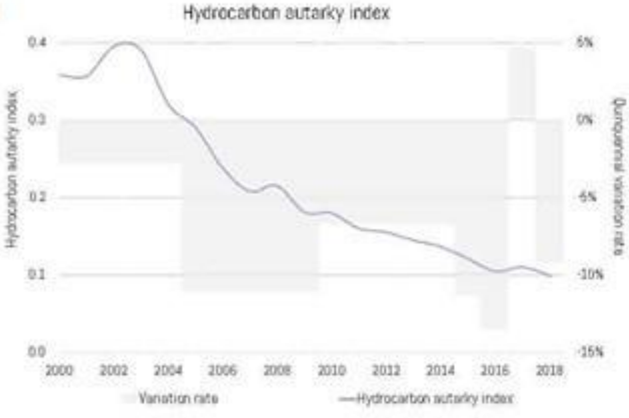

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

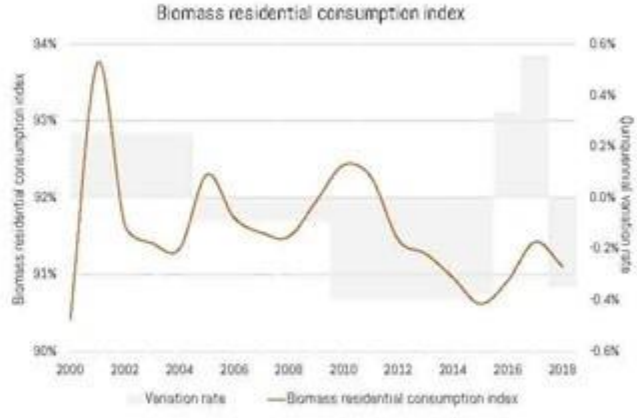

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

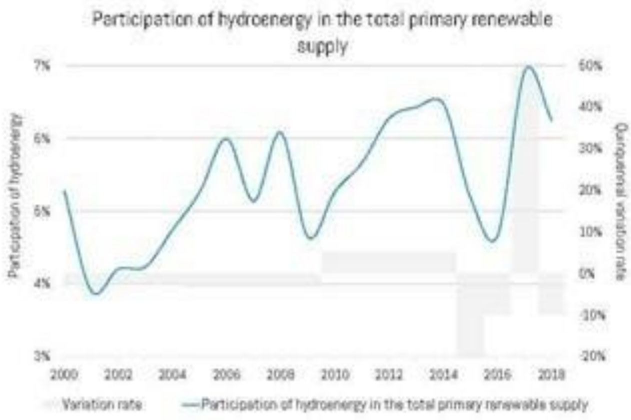

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

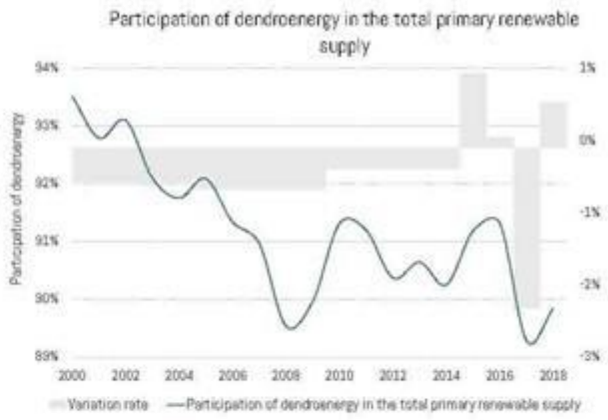

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence


Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

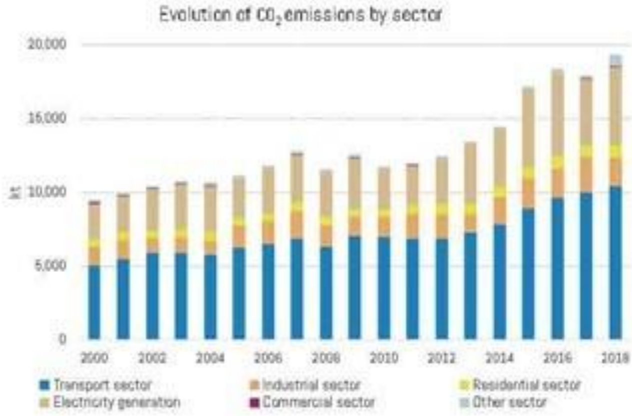

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index



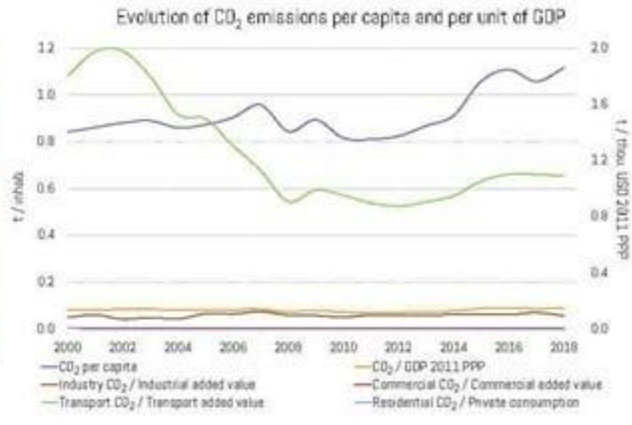
Participation of hydroenergy in the total primary renewable supply



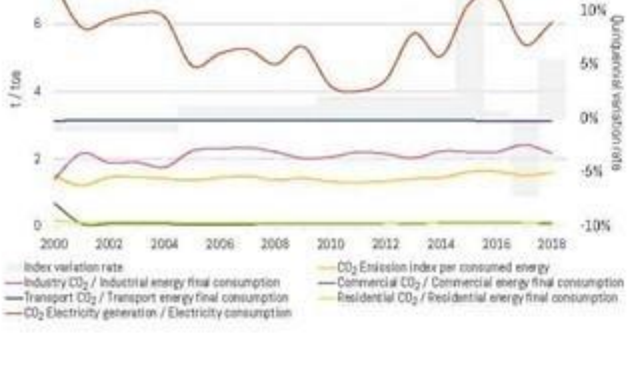
Participation of dendroenergy in the total primary renewable supply



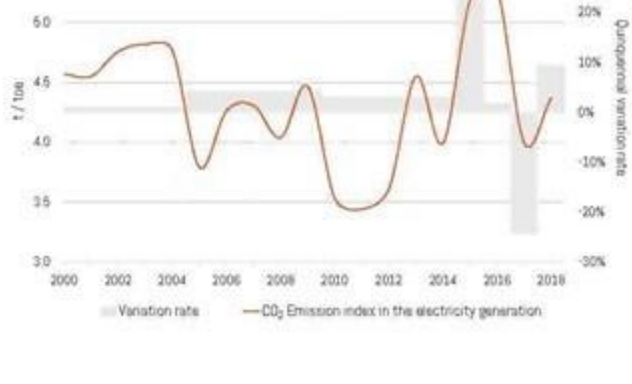
Evolution of CO_2 emissions by sector



Evolution of CO_2 emissions per capita and per unit of GDP

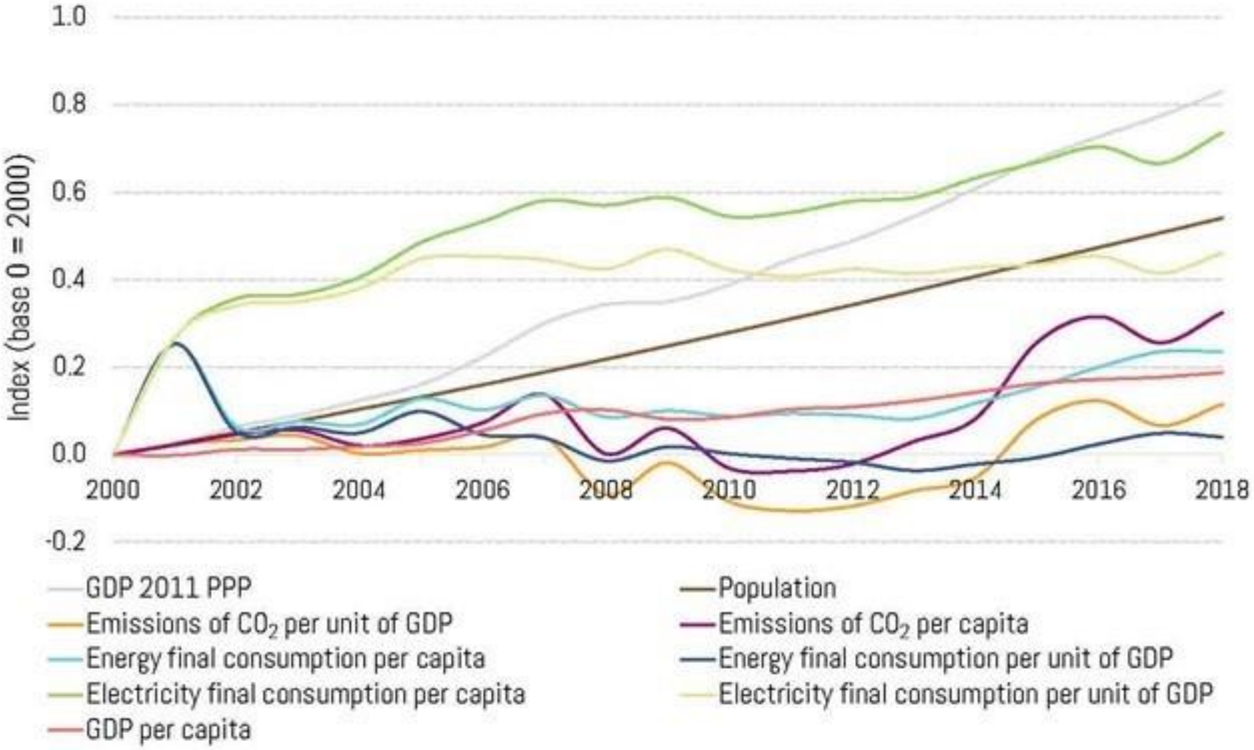


CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation

Summary of the main energy indicators



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General Information 2018

Population (thousand inhab.)	779
Area (km²)	214,970
Population Density (inhab./km²)	4
Urban Population (%)	29
GDP USD 2010 (MUSD)	3,112
GDP USD 2011 PPP (MUSD)	5,933
GDP per Capita (thou. USD 2011 PPP/inhab.)	8

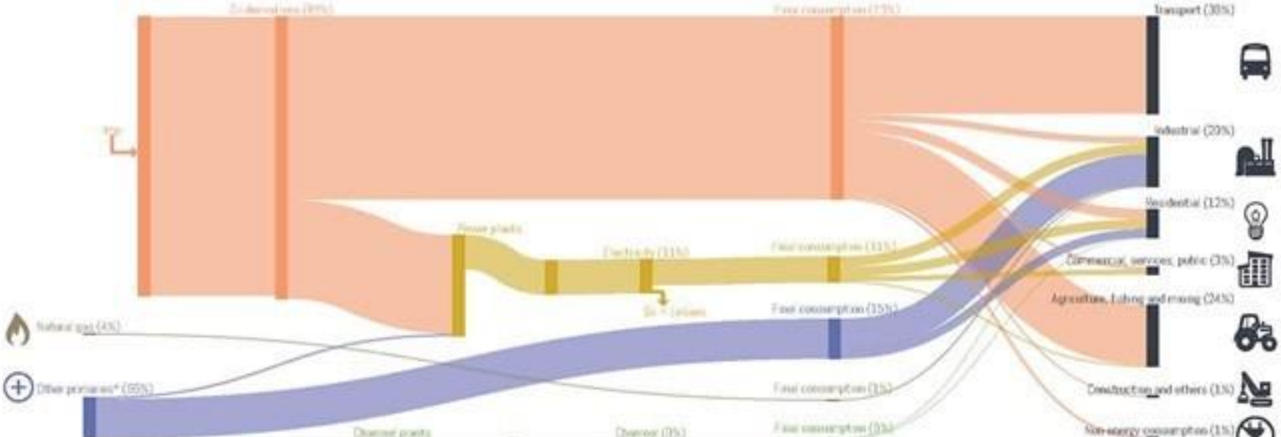
Energy Sector

	Mtoe
Final consumption in the Transport Sector	0.28
Final consumption in the Industrial Sector	0.14
Final consumption in the Residential Sector	0.08
Final consumption in the Commercial and Service Sector	0.02
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.19

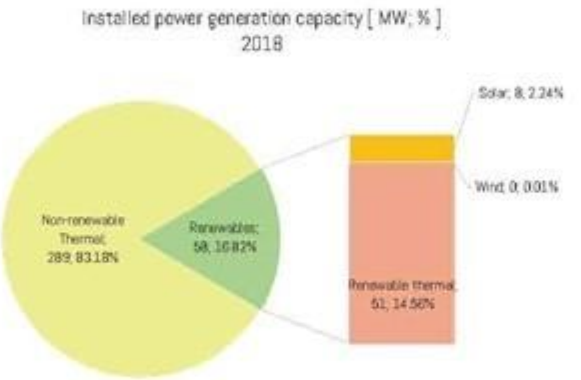
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
6,000	18	n.a.

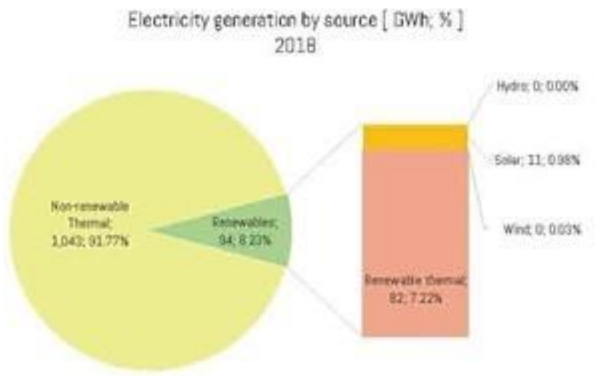
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,115	0.91	90.76	0.92	0.12	0.79	0.00	0.71	n.a.	0.35	0.16 / 0.12

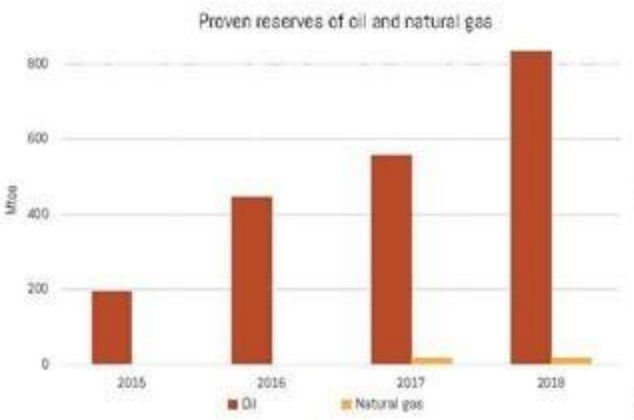
Summarized energy balance 2018

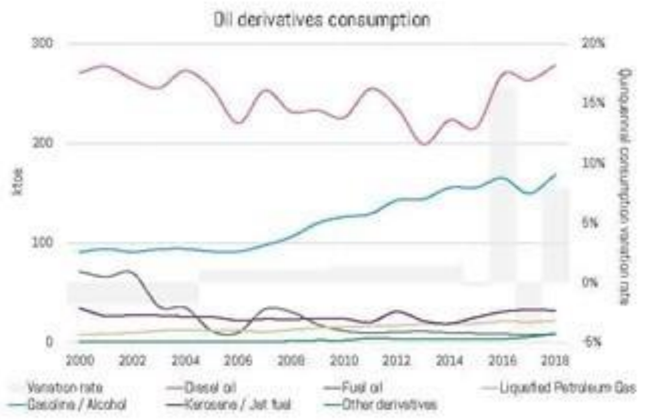


* Corresponds to firewood + sugarcane and derivatives

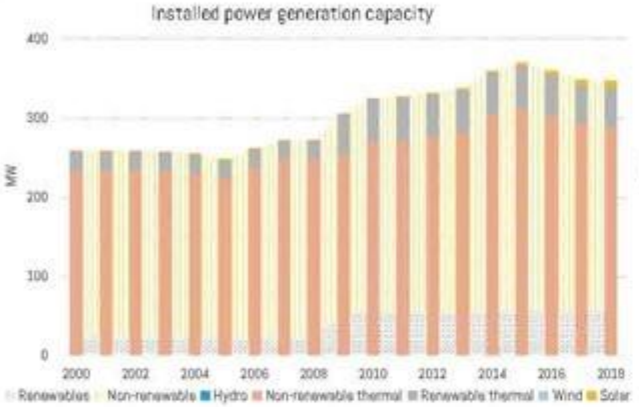

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 289; 83.18%
Renewables; 58; 16.82%
Solar; 8; 2.24%
Wind; 0; 0.01%
Renewable thermal; 51; 14.56%

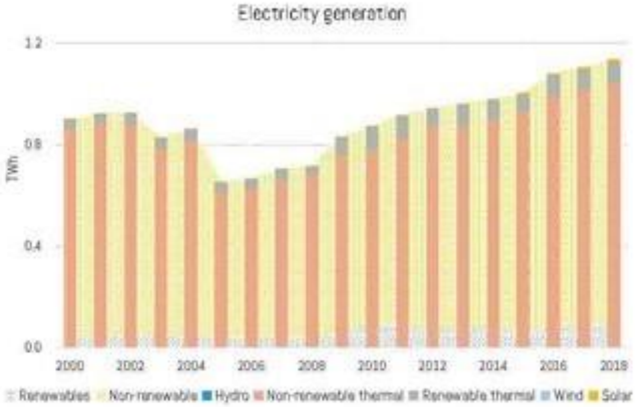

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 1,043; 91.77%
Renewables; 94; 8.23%
Hydro; 0; 0.00%
Solar; 11; 0.98%
Wind; 0; 0.03%
Renewable thermal; 82; 7.22%

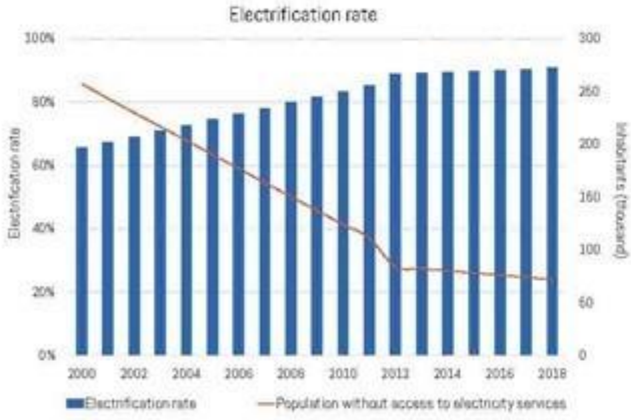

Proven reserves of oil and natural gas
Mtoe
Oil
Natural gas

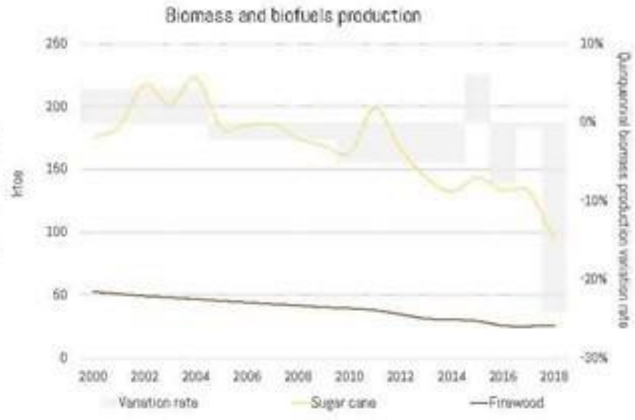

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

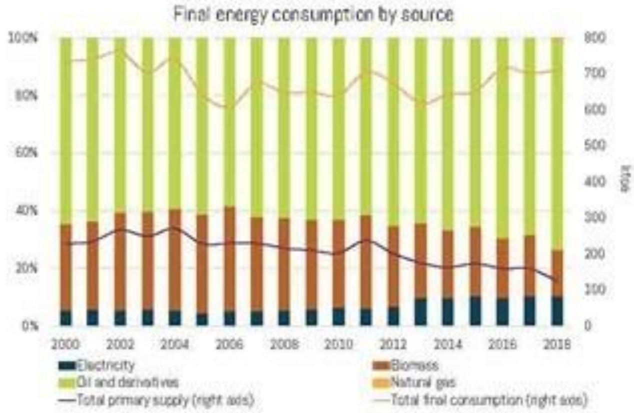
GUYANA

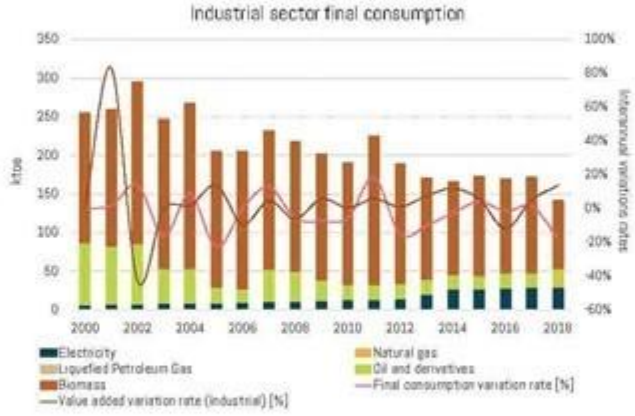

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

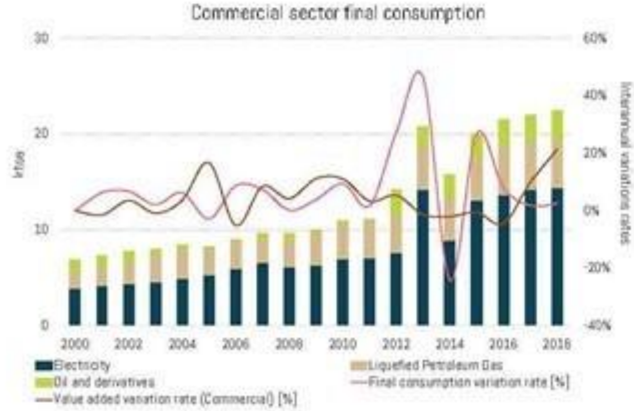

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

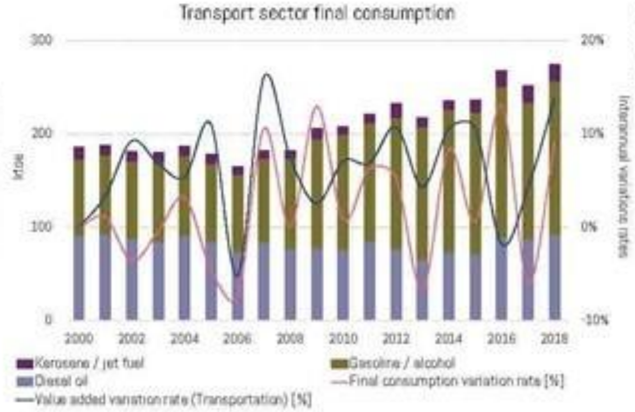

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services


Biomass and biofuels production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood

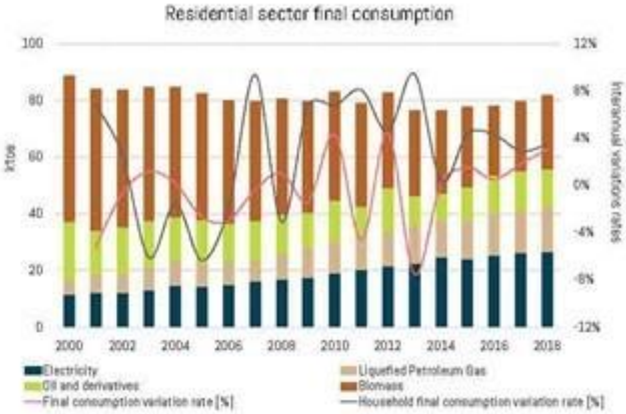

Final energy consumption by source
ktoe
Electricity
Oil and derivatives
Total primary supply (right axis)
Biomass
Natural gas
Total final consumption (right axis)

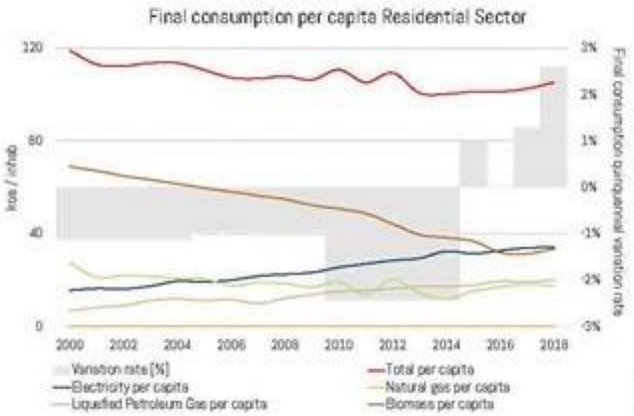

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

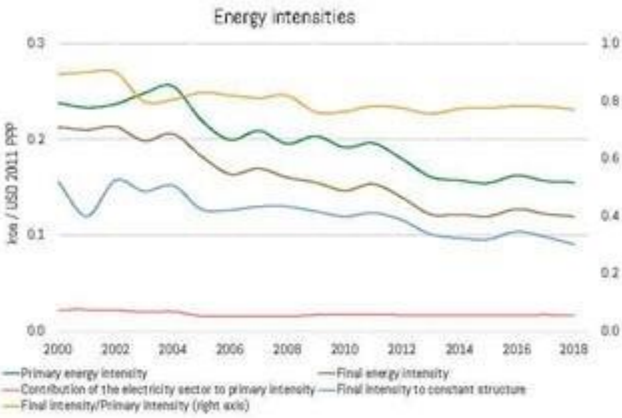

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Final consumption variation rate [%]


Transport sector final consumption
ktoe
Interannual variations rates
Kerosene / jet fuel
Diesel oil
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Final consumption variation rate [%]

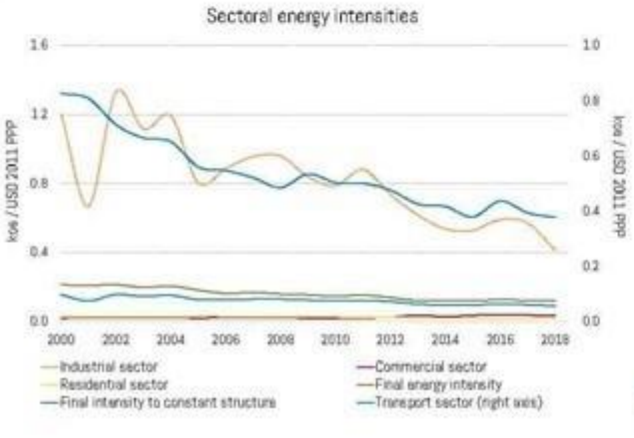

Other sector final consumption
ktoe
Interannual variation rates
Electricity
Diesel oil
Gasoline / alcohol
Final consumption variation rate [%]
Value added variation rate (Other) [%]

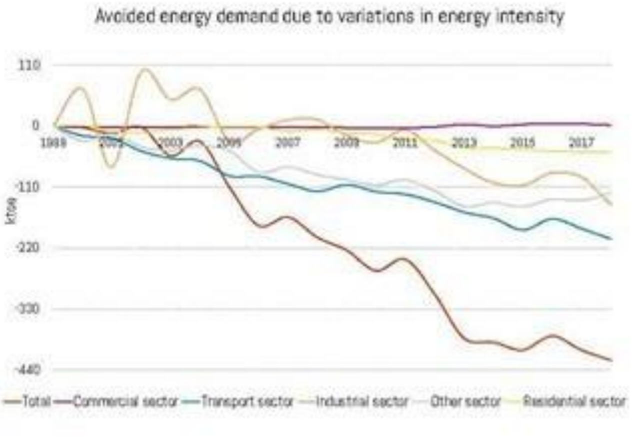

Residential sector final consumption
ktoe
Interannual variation rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

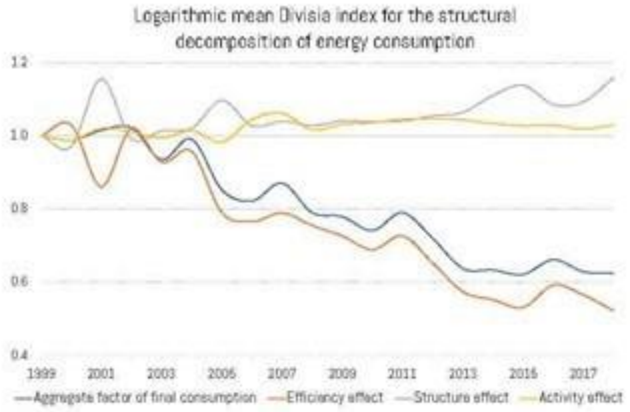

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita

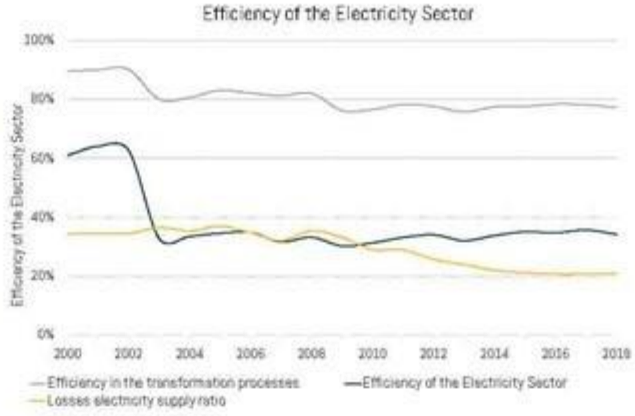

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

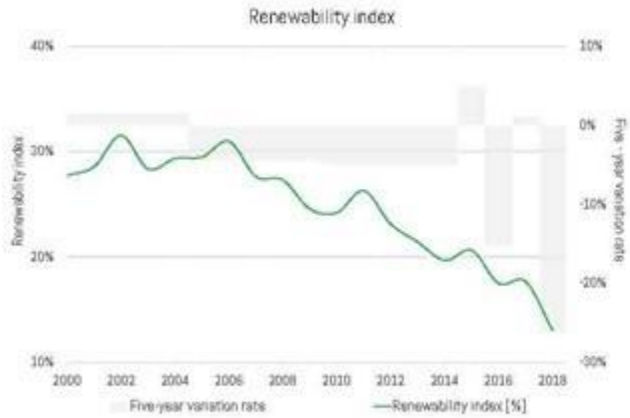
GUYANA

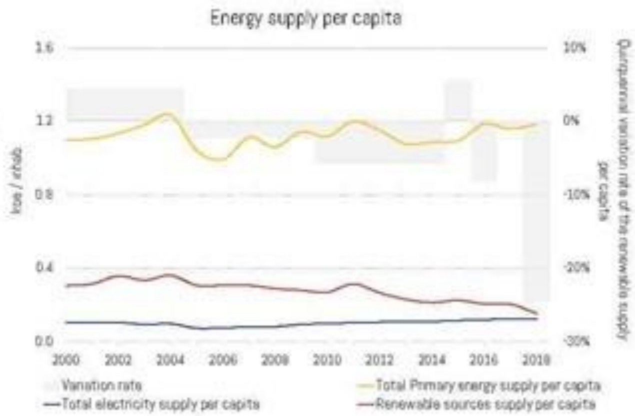

Sectoral energy intensities
koe / USD 2011 PPP
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

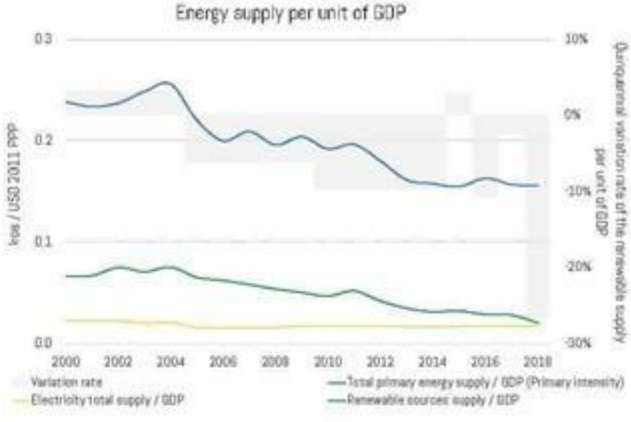

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

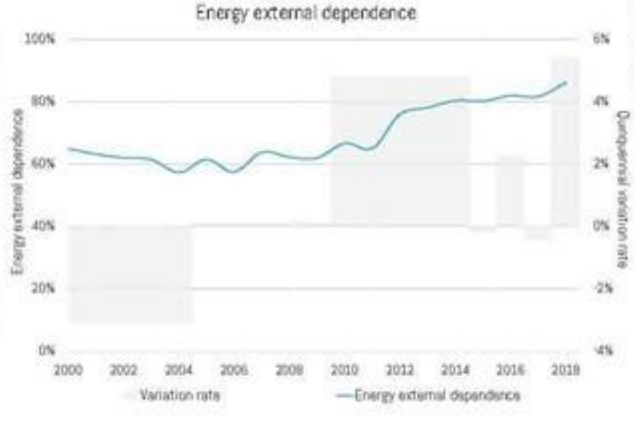

Logarithmic mean Divisia index for the structural decomposition of energy consumption
1.2
1.0
0.8
0.6
0.4
1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

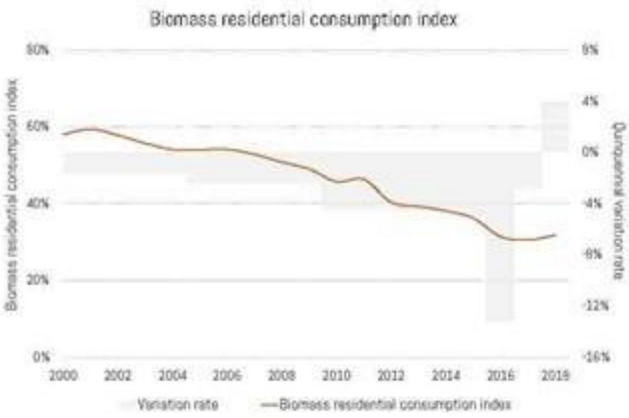

Efficiency of the Electricity Sector
100%
80%
60%
40%
20%
0%
Efficiency of the Electricity Sector
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

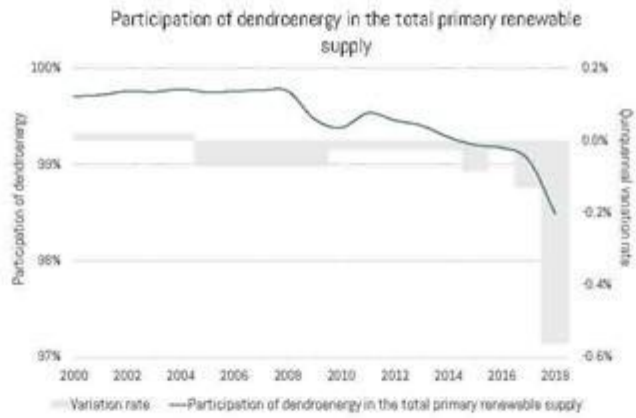

Renewability index
40%
30%
20%
10%
Renewability index
10%
0%
-10%
-20%
-30%
Five - year variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Five-year variation rate
Renewability index [%]

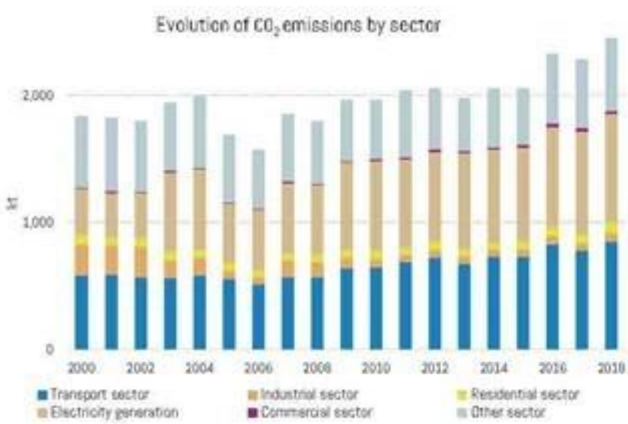

Energy supply per capita
1.6
1.2
0.8
0.4
0.0
toe / inhab
10%
0%
-10%
-20%
-30%
Quinquennial variation rate of the renewable supply per capita
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

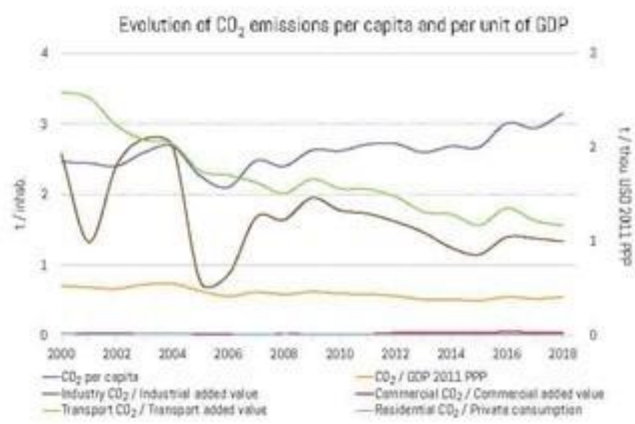

Energy supply per unit of GDP
0.3
0.2
0.1
0.0
kep / USD 2011 PPP
10%
0%
-10%
-20%
-30%
Quinquennial variation rate of the renewable supply per unit of GDP
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Electricity total supply / GDP
Total primary energy supply / GDP (Primary intensity)
Renewable sources supply / GDP

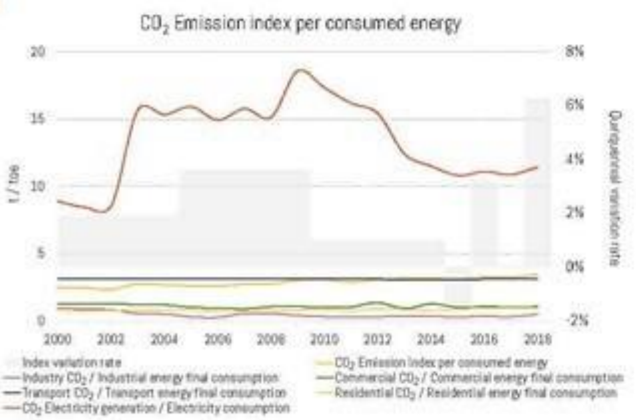

Energy external dependence
100%
80%
60%
40%
20%
0%
Energy external dependence
6%
4%
2%
0%
-2%
-4%
Quinquennial variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Energy external dependence

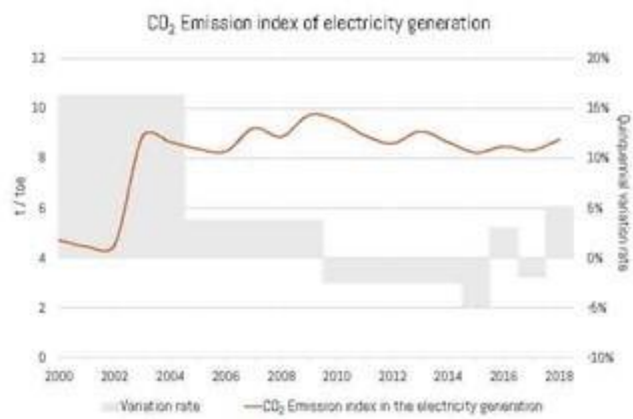

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
80%
60%
40%
20%
0%
8%
4%
0%
-4%
-8%
-12%
-16%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Biomass residential consumption index

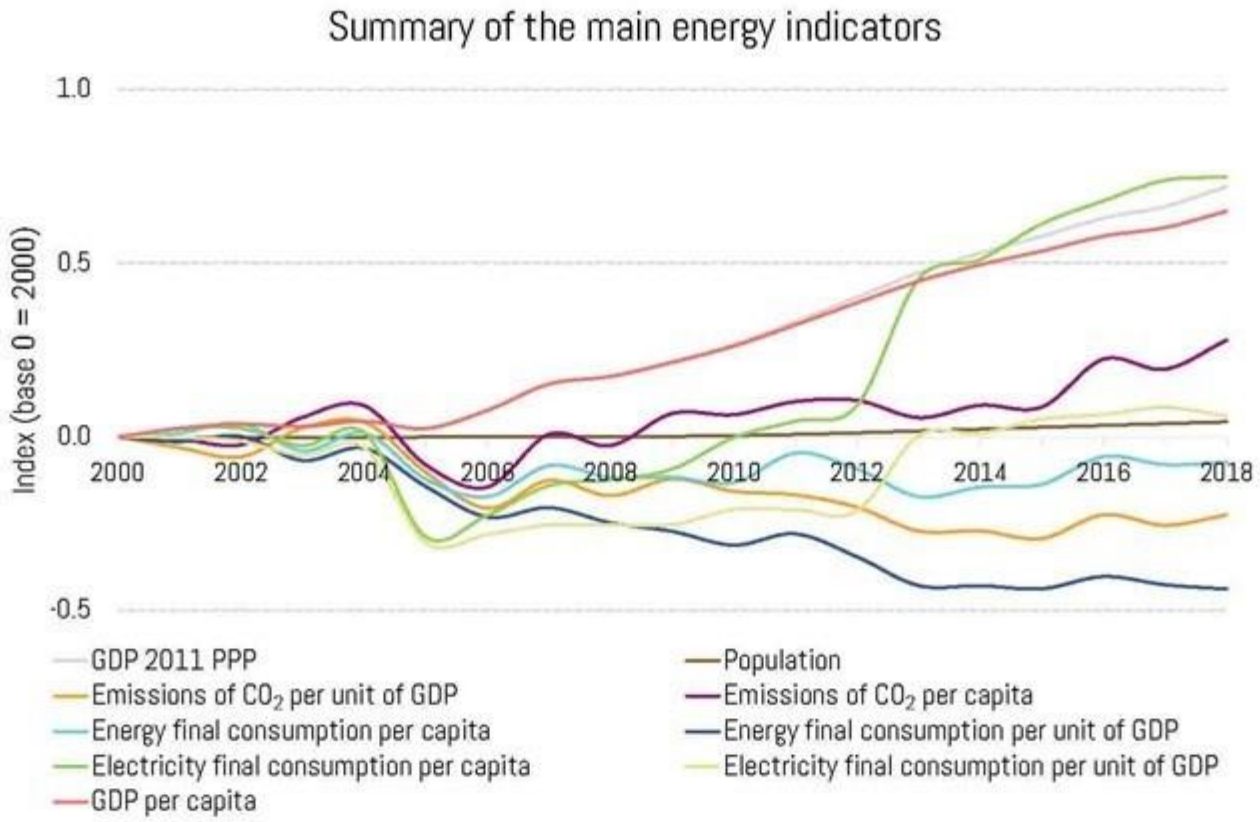

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
100%
99%
98%
97%
0.2%
0.0%
-0.2%
-0.4%
-0.6%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
2,000
1,000
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab.
t / thou USD 2011 PPP
4
3
2
1
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
20
15
10
5
0
8%
6%
4%
2%
0%
-2%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
12
10
8
6
4
2
0
20%
15%
10%
5%
0%
-5%
-10%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
1.0
0.5
0.0
-0.5
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

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General Information 2018

Population (thousand inhab.)	11,123
Area (km²)	27,750
Population Density (inhab./km²)	401
Urban Population (%)	55
GDP USD 2010 (MUSD)	8,228
GDP USD 2011 PPP (MUSD)	18,423
GDP per Capita (thou. USD 2011 PPP/inhab.)	2

Energy Sector

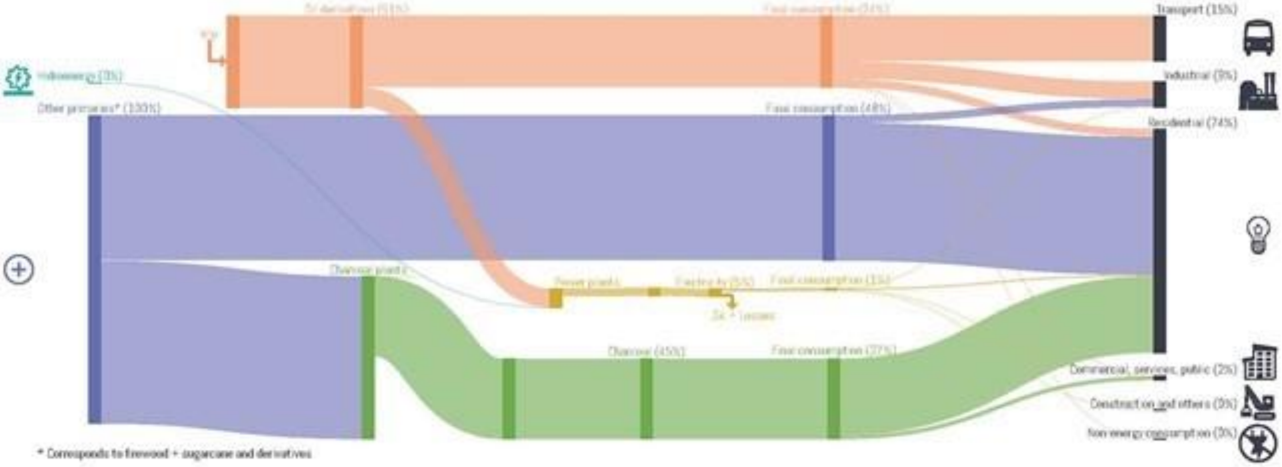
Final consumption in the Transport Sector	Mtoe 0.51
Final consumption in the Industrial Sector	Mtoe 0.29
Final consumption in the Residential Sector	Mtoe 2.50
Final consumption in the Commercial and Service Sector	Mtoe 0.05
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.01

Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	9

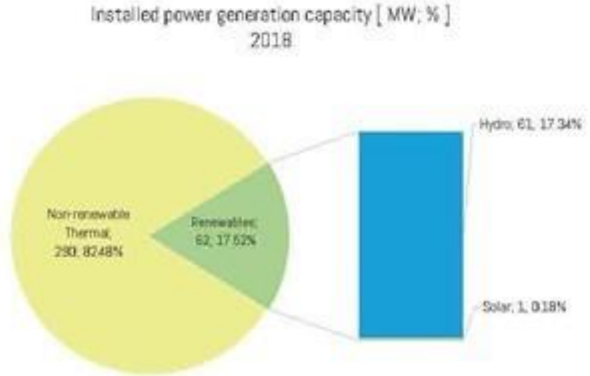
*Data corresponding to the year 2017.

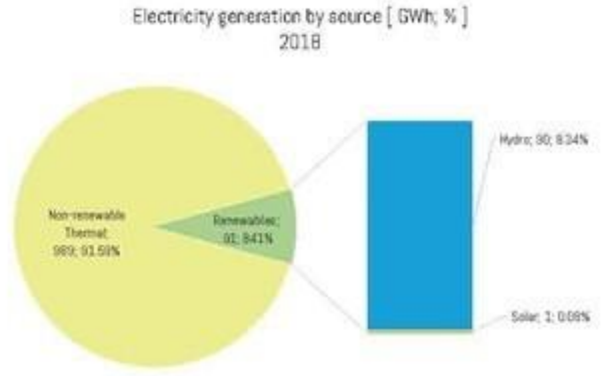
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
38	0.30	38.69 *	4.48	3.51	1.02	0.00	3.37	n.a.	0.35	0.24 / 0.18

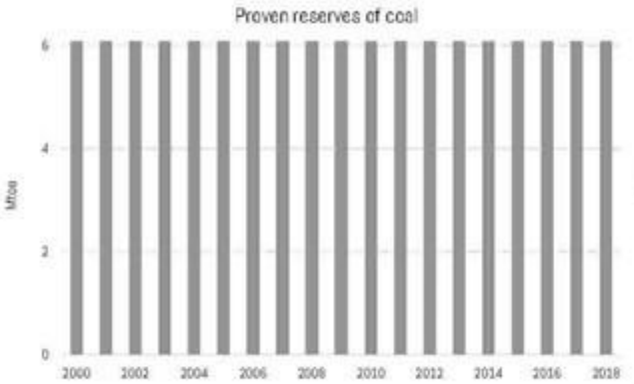
Summarized energy balance 2018

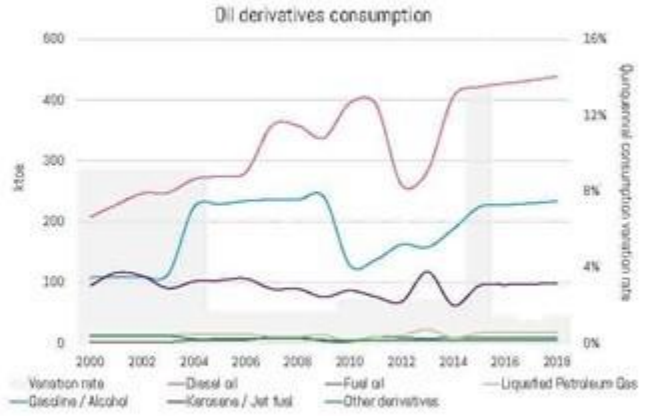


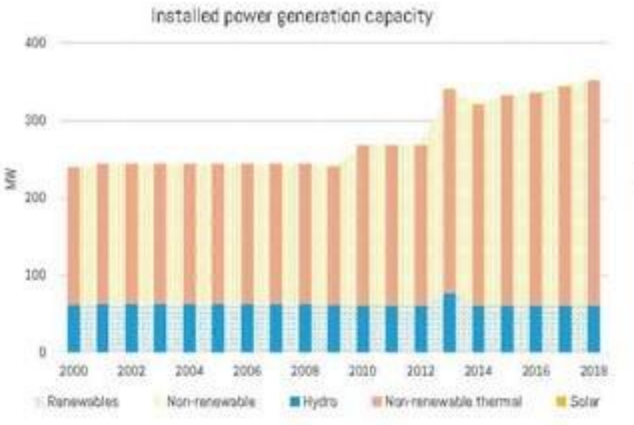
* Corresponds to firewood + sugarcane and derivatives

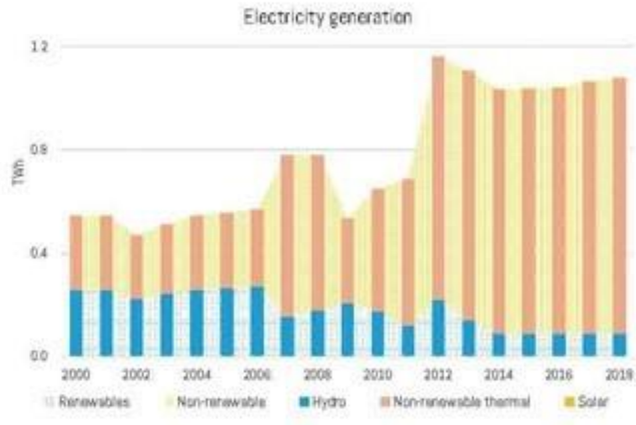

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 290; 82.48%
Renewables; 62; 17.52%
Hydro; 61; 17.34%
Solar; 1; 0.18%

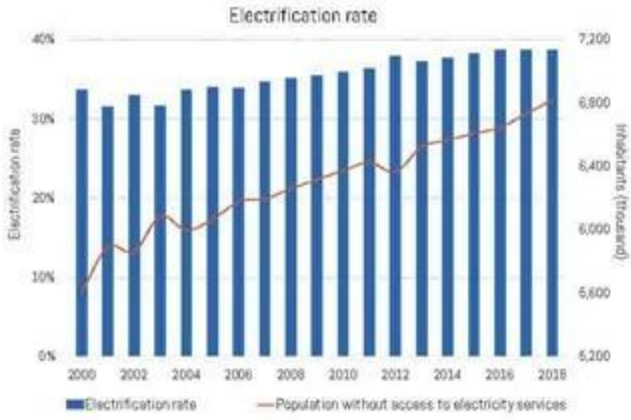

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 989; 91.59%
Renewables; 91; 8.41%
Hydro; 90; 8.34%
Solar; 1; 0.08%

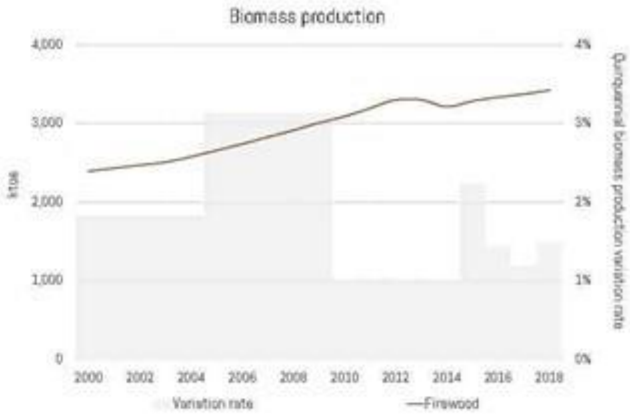

Proven reserves of coal
Mtoe

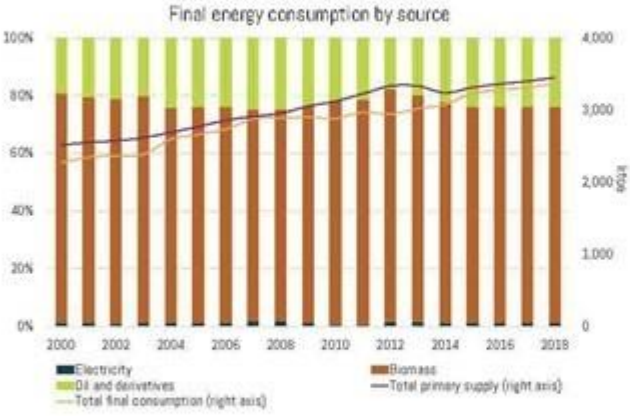

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

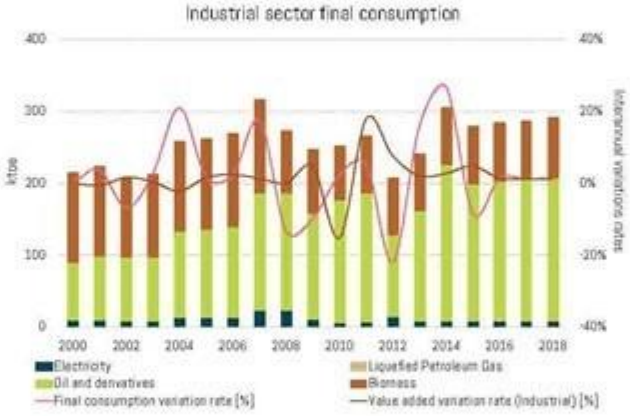

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Solar

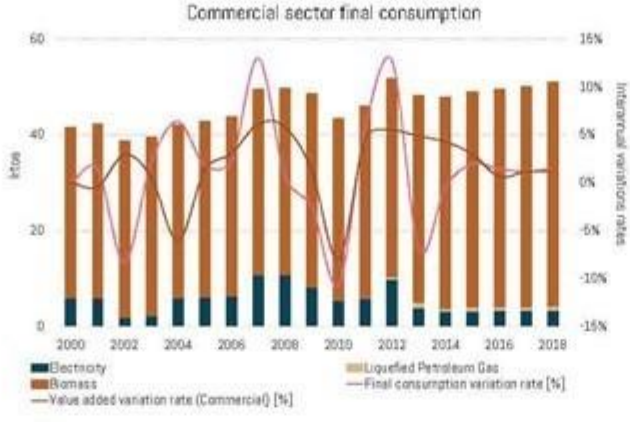

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Solar

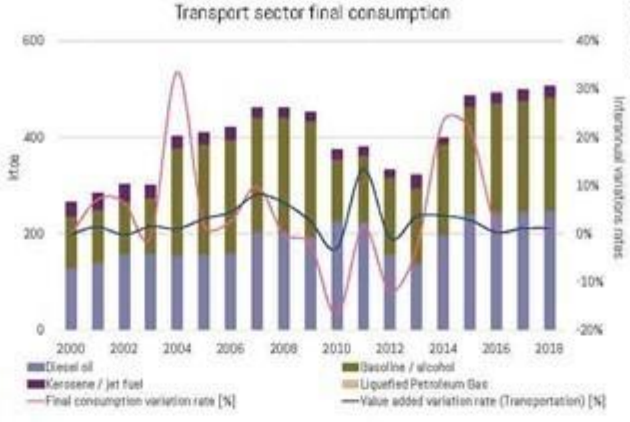

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services


Biomass production
ktoe
Quinquennial biomass production variation rate
Variation rate
Firewood

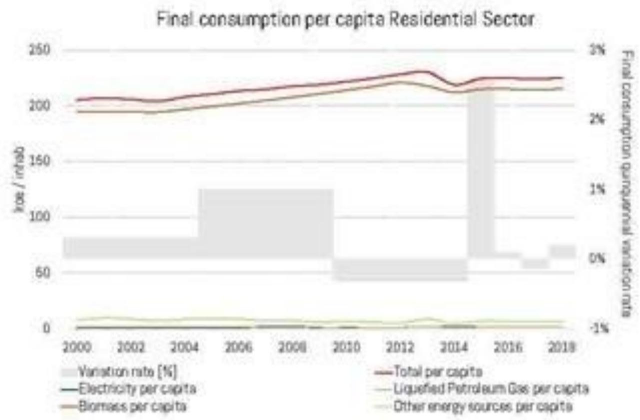

Final energy consumption by source
ktoe
Electricity
Oil and derivatives
Total final consumption (right axis)
Biomass
Total primary supply (right axis)

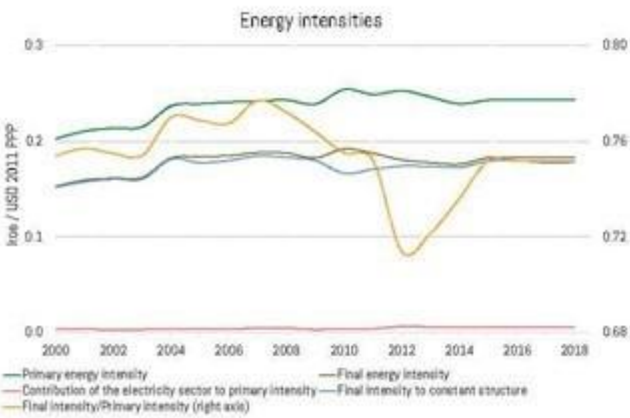

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Value added variation rate (Industrial) [%]

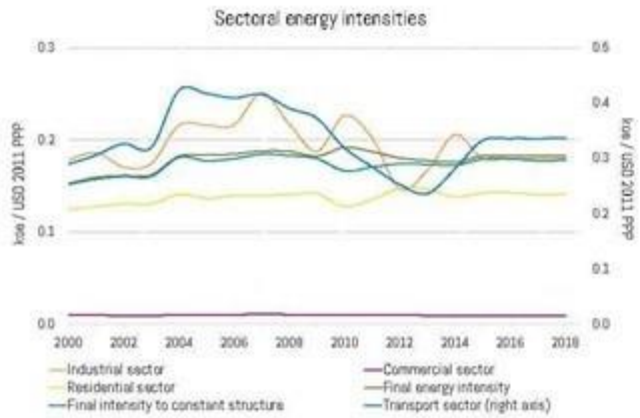

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Biomass
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Final consumption variation rate [%]


Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Gasoline / alcohol
Liquefied Petroleum Gas
Value added variation rate (Transportation) [%]


Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]


Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Biomass per capita
Total per capita
Liquefied Petroleum Gas per capita
Other energy sources per capita


Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Contribution of the electricity sector to primary intensity
Final intensity/Primary intensity (right axis)
Final energy intensity
Final intensity to constant structure


Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

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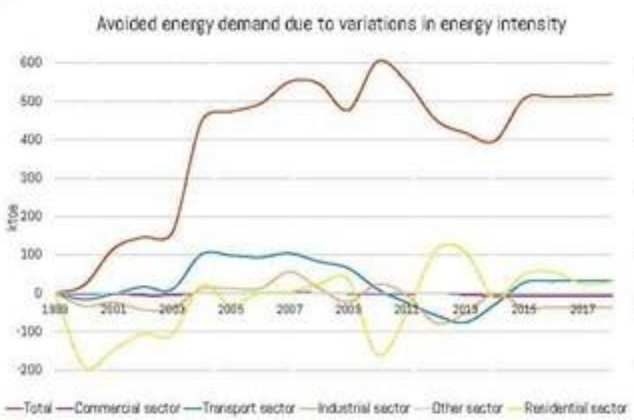
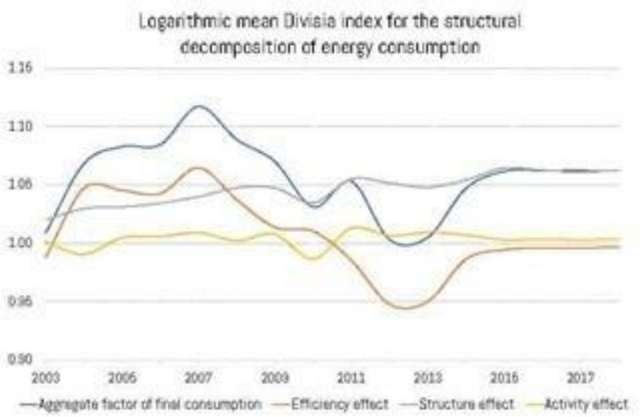
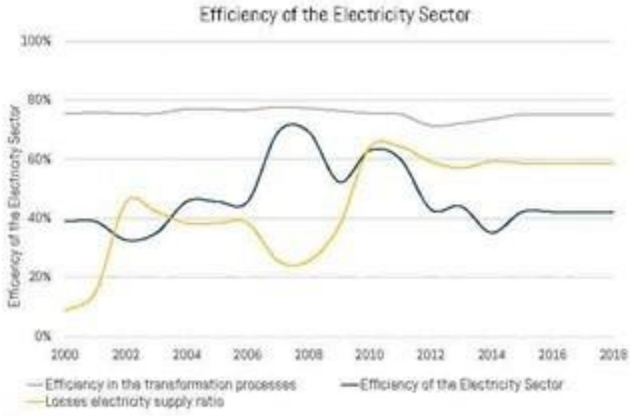
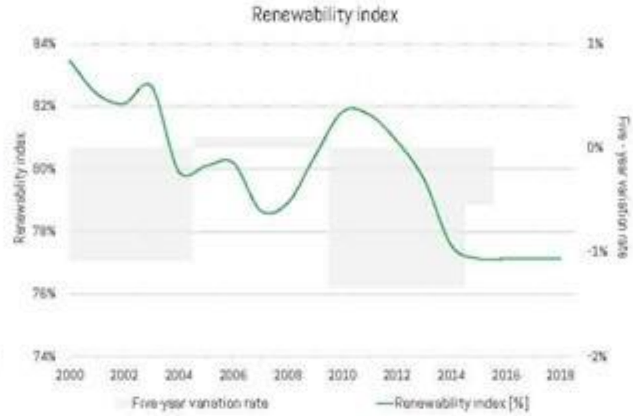
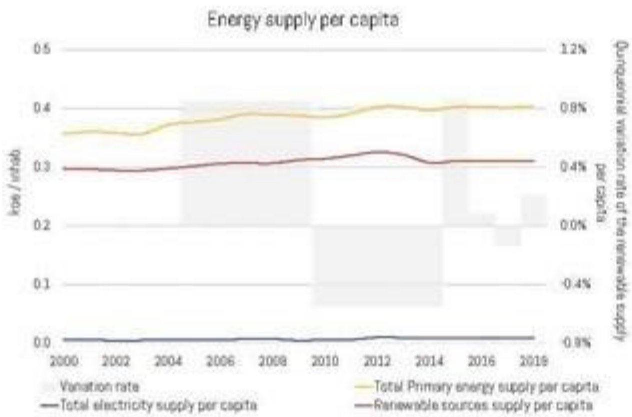
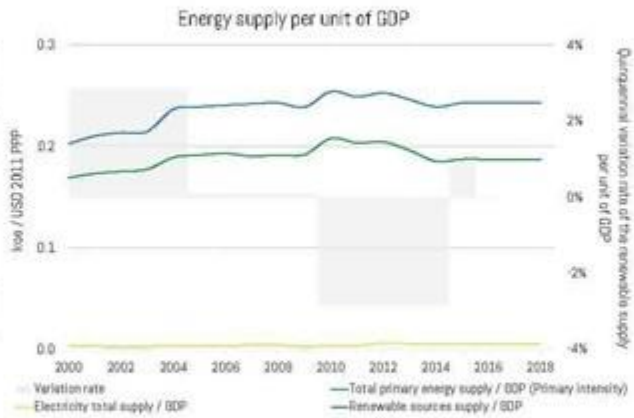

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

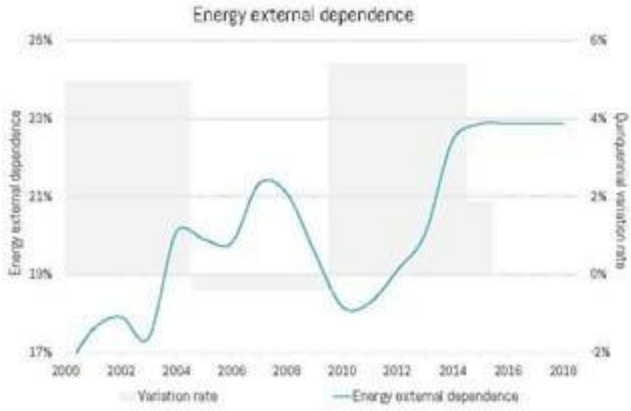

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

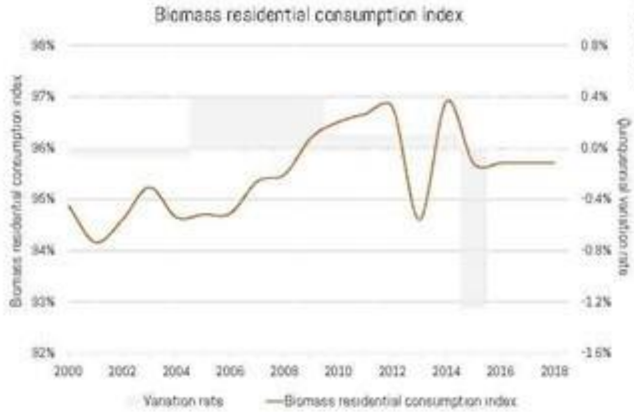

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio


Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

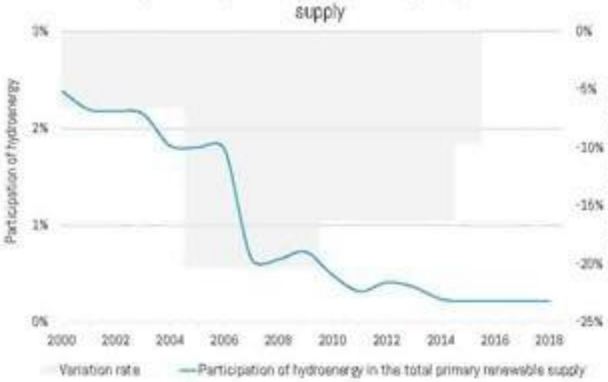

Energy supply per capita
koe / inhab
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

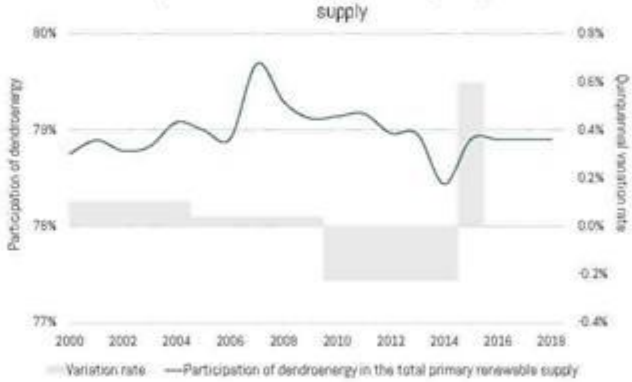

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence


Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

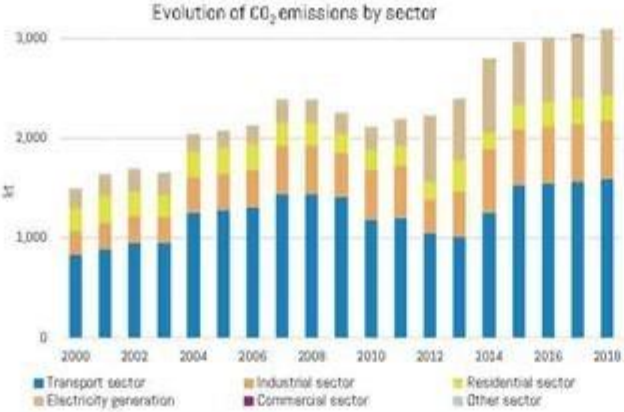
Participation of hydroenergy in the total primary renewable supply



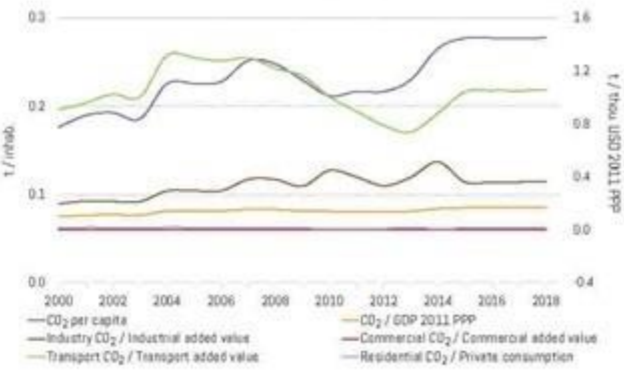
Participation of dendroenergy in the total primary renewable supply



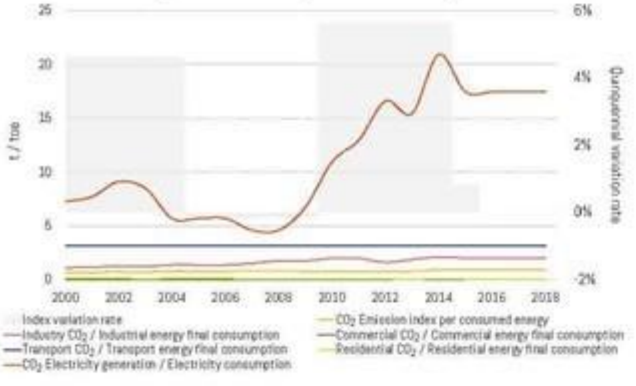
Evolution of CO_2 emissions by sector



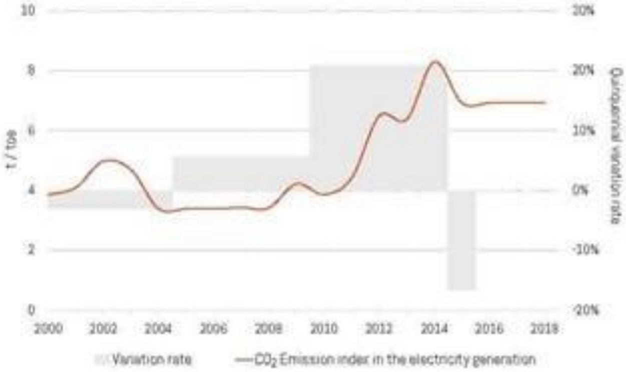
Evolution of CO_2 emissions per capita and per unit of GDP

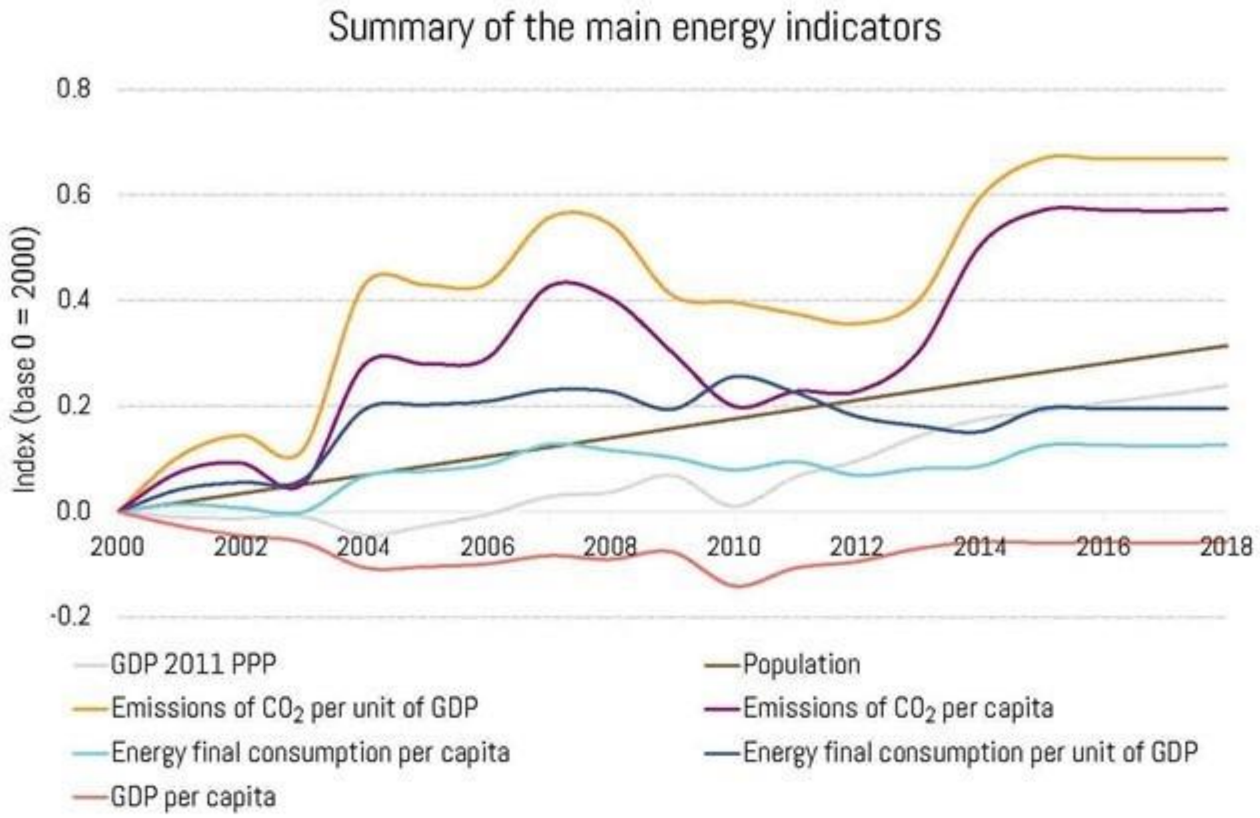


CO_2 Emission index per consumed energy

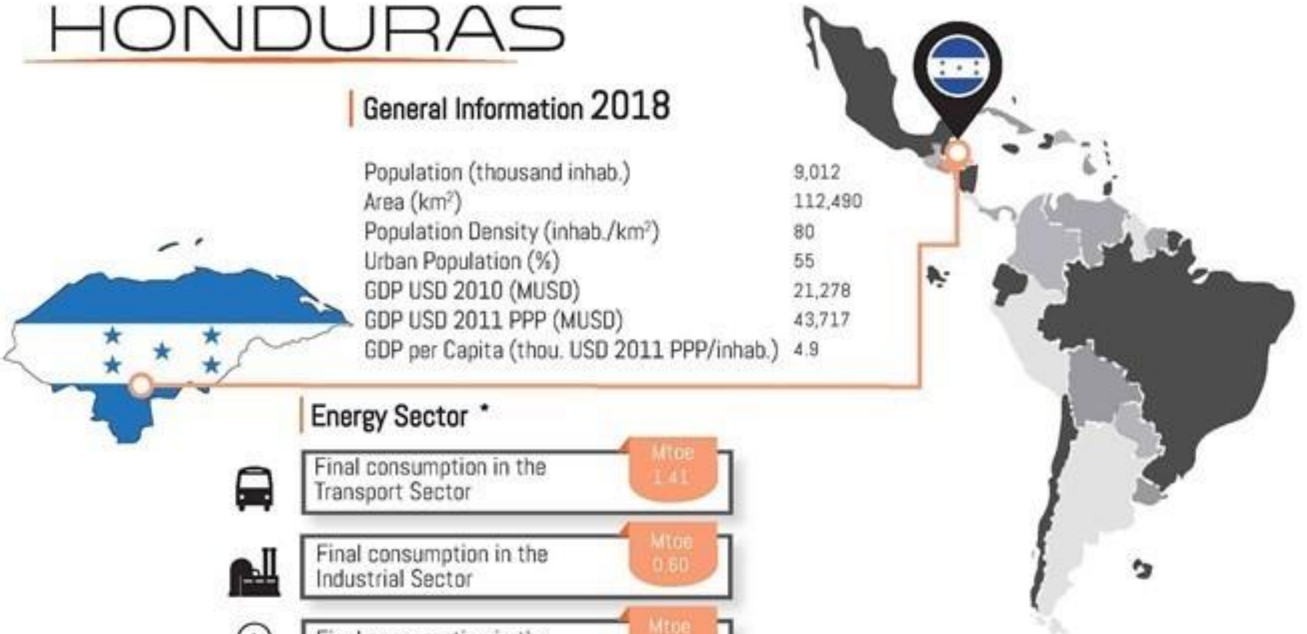


CO_2 Emission index of electricity generation




Summary of the main energy indicators
Index (base 0 = 2000)
0.8
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
GDP per capita

HONDURAS



General Information 2018

Population (thousand inhab.)	9,012
Area (km²)	112,490
Population Density (inhab./km²)	80
Urban Population (%)	55
GDP USD 2010 (MUSD)	21,278
GDP USD 2011 PPP (MUSD)	43,717
GDP per Capita (thou. USD 2011 PPP/inhab.)	4.9

Energy Sector *

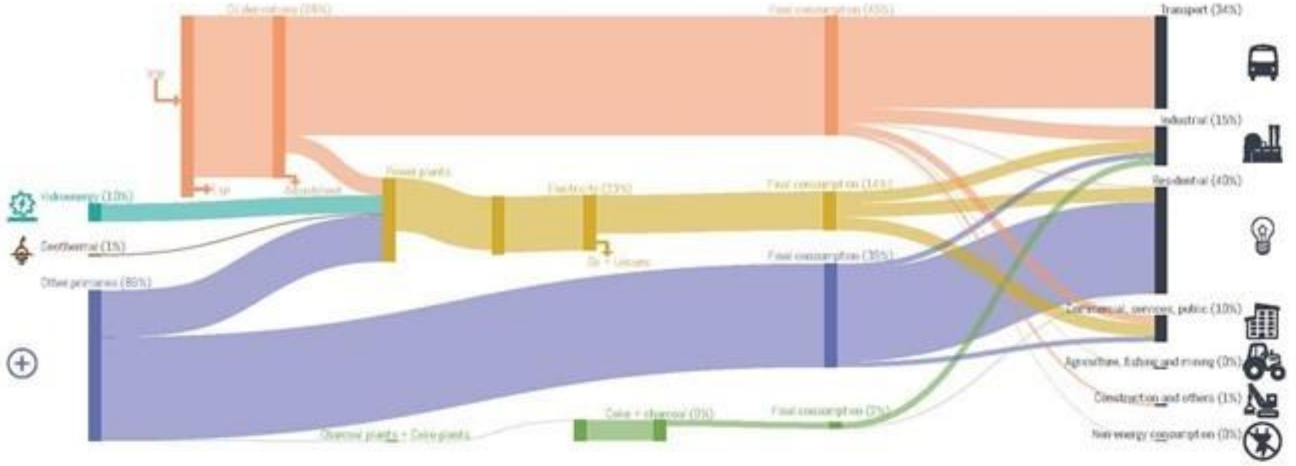
	Mtoe
Final consumption in the Transport Sector	1.41
Final consumption in the Industrial Sector	0.60
Final consumption in the Residential Sector	1.63
Final consumption in the Commercial and Service Sector	0.41
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.04

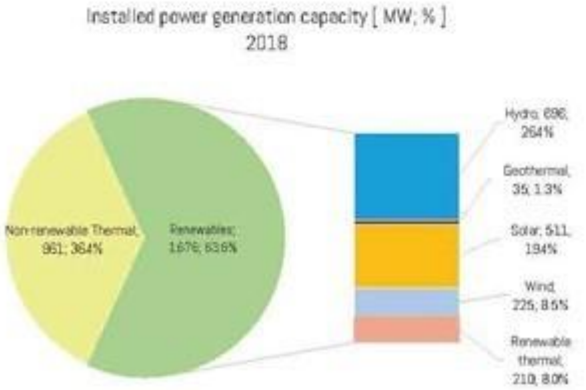
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a	n.a.

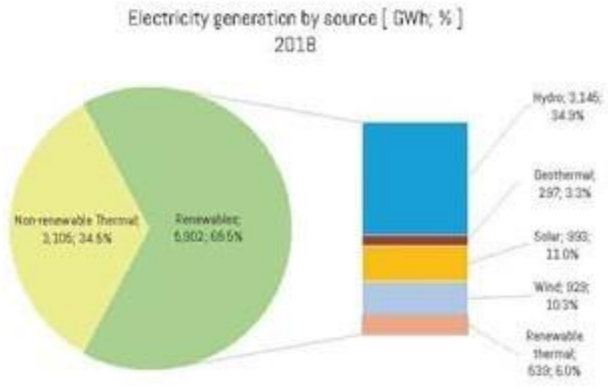
*Preliminary 2018 data, subject to review and update.

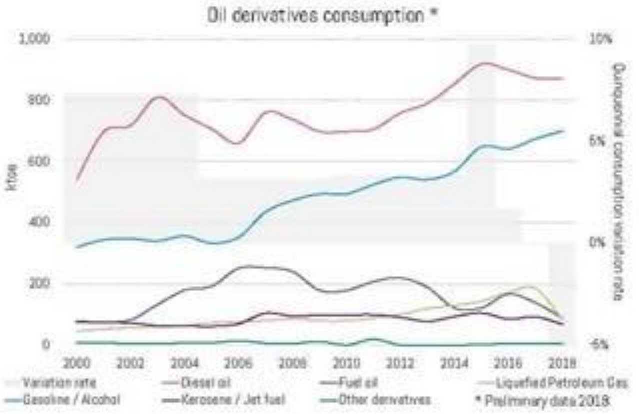
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	757
Final consumption per capita	toe/inhab.	0.45
Electrification rate	%	80.82
Total energy supply	Mtoe	5.41
Total energy production	Mtoe	2.59
Total energy imports	Mtoe	3.15
Total energy exports	Mtoe	0.33
Total final energy consumption	Mtoe	4.08
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	2.64
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.12/ 0.09

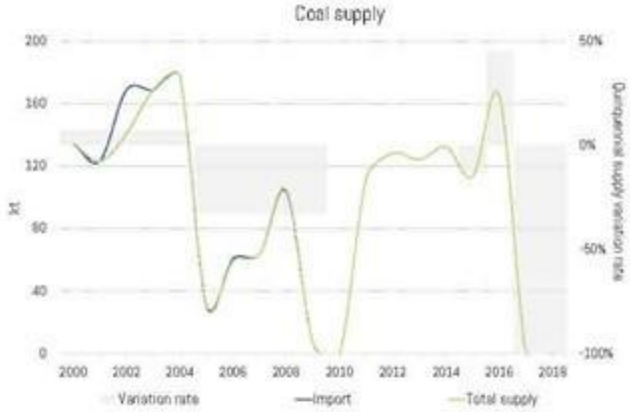
Summarized energy balance 2018

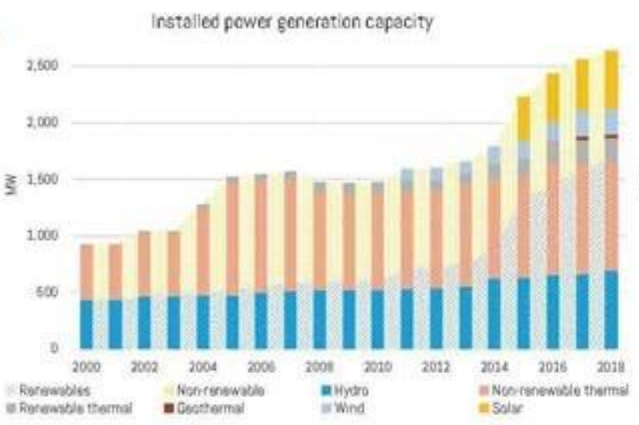


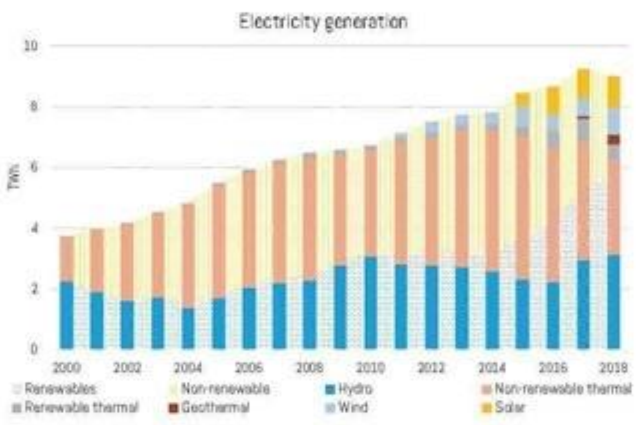

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 961; 36.4%
Renewables; 1,676; 63.6%
Hydro; 696; 26.4%
Geothermal; 35; 1.3%
Solar; 511; 19.4%
Wind; 225; 8.5%
Renewable thermal; 210; 8.0%


Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 3,105; 34.5%
Renewables; 5,902; 65.5%
Hydro; 3,145; 34.9%
Geothermal; 297; 3.3%
Solar; 993; 11.0%
Wind; 928; 10.3%
Renewable thermal; 539; 6.0%

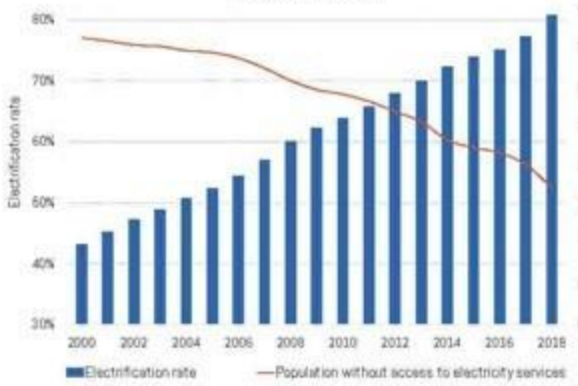

Oil derivatives consumption *
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives
* Preliminary data 2018


Coal supply
kt
Quinquennial supply variation rate
Variation rate
Import
Total supply

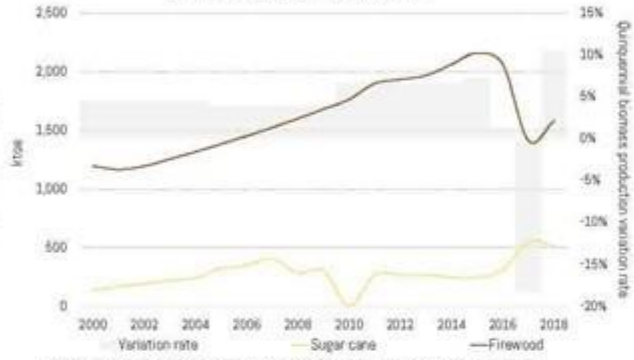

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Geothermal
Wind
Solar


Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Geothermal
Wind
Solar

Electrification rate

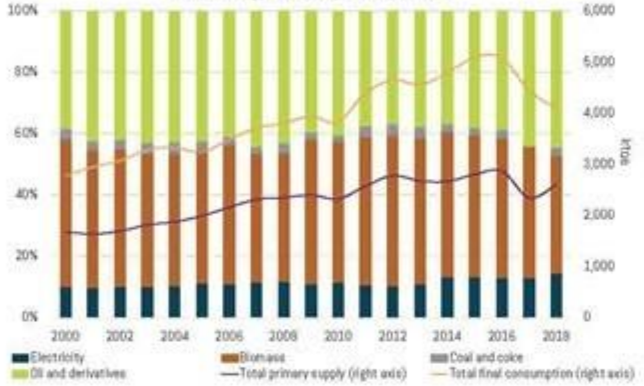


Biomass and biofuels production *

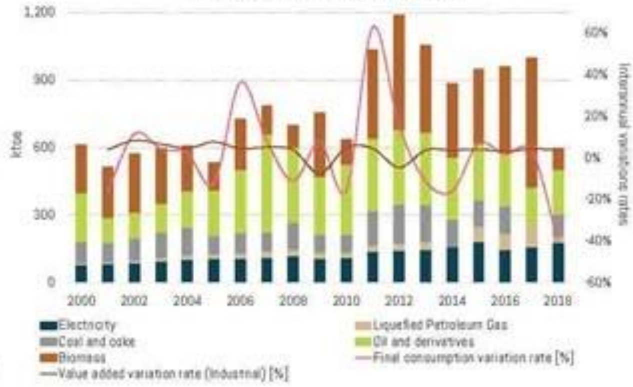


* As of 2017, the methodology that improves the estimate of wood consumption is modified

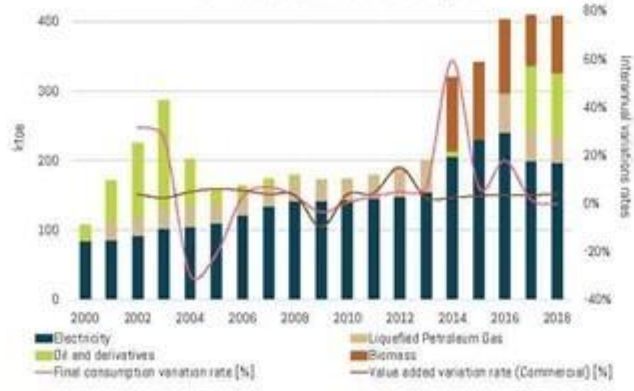
Final energy consumption by source



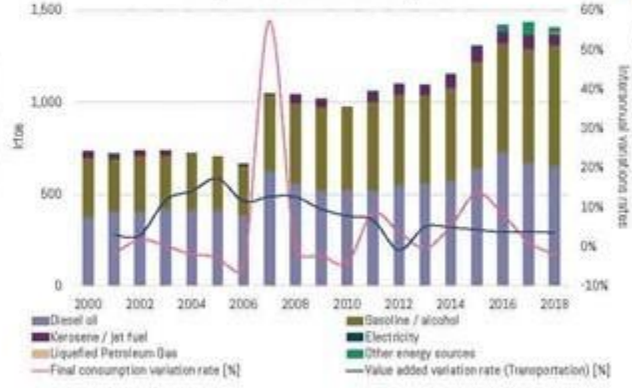
Industrial sector final consumption

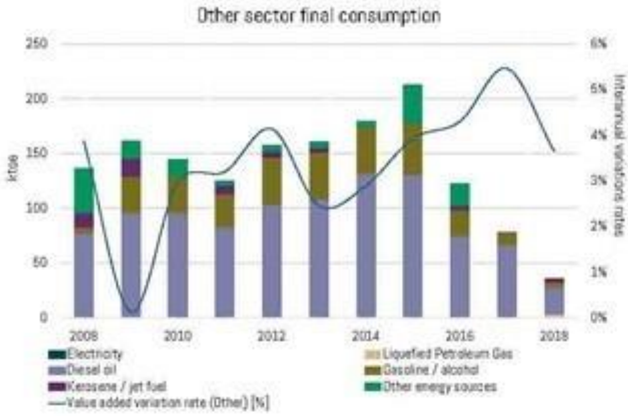


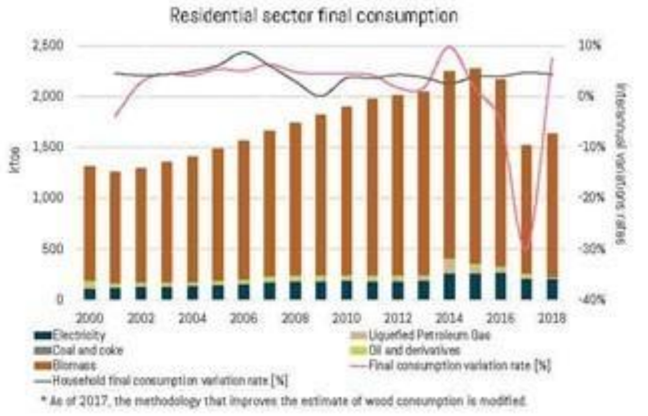
Commercial sector final consumption

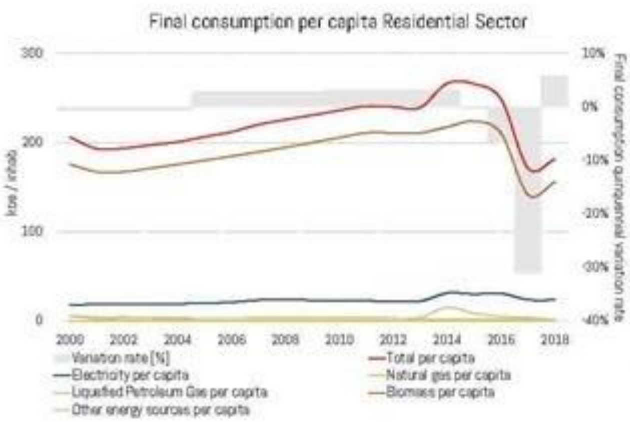


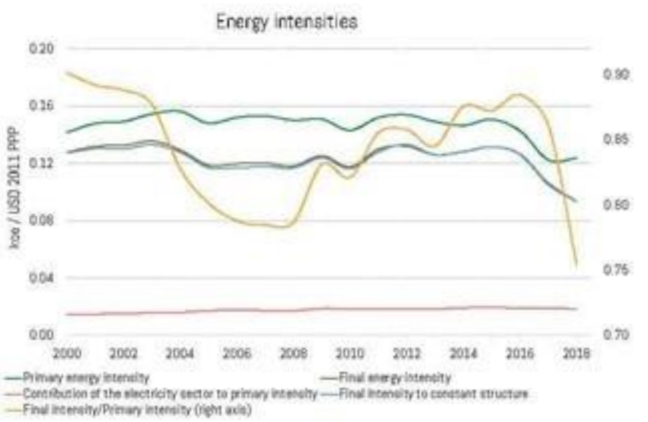
Transport sector final consumption

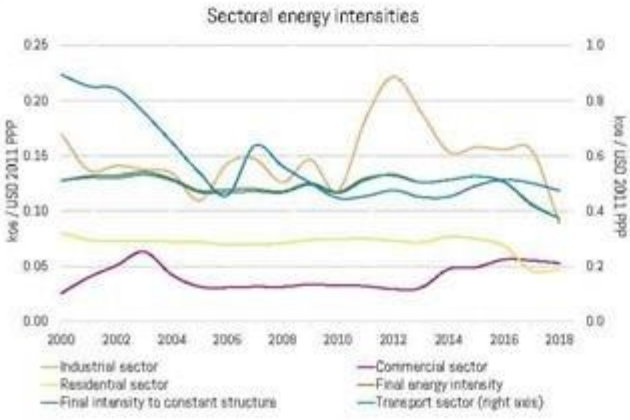


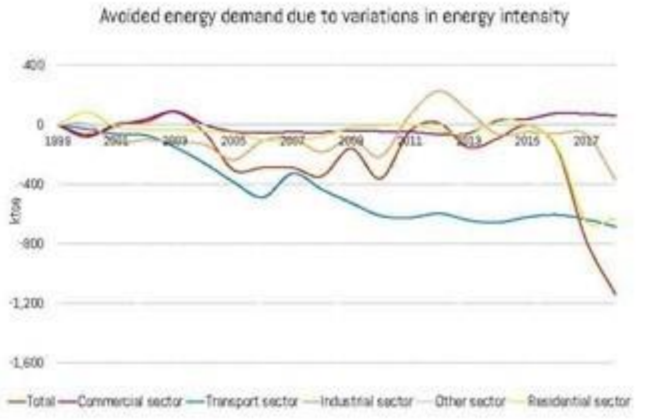

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Diesel oil
Kerosene / jet fuel
Value added variation rate (Other) [%]
Liquefied Petroleum Gas
Gasoline / alcohol
Other energy sources

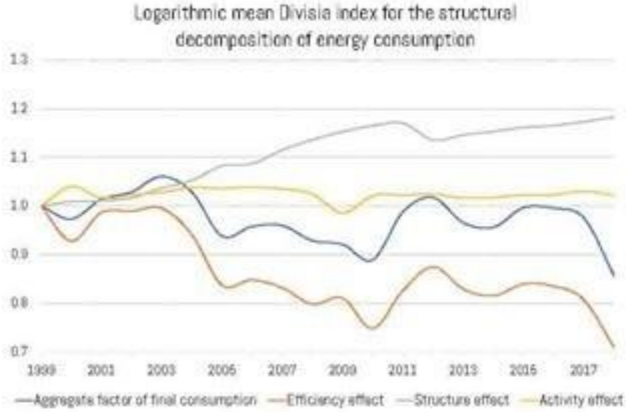

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Household final consumption variation rate [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
* As of 2017, the methodology that improves the estimate of wood consumption is modified.

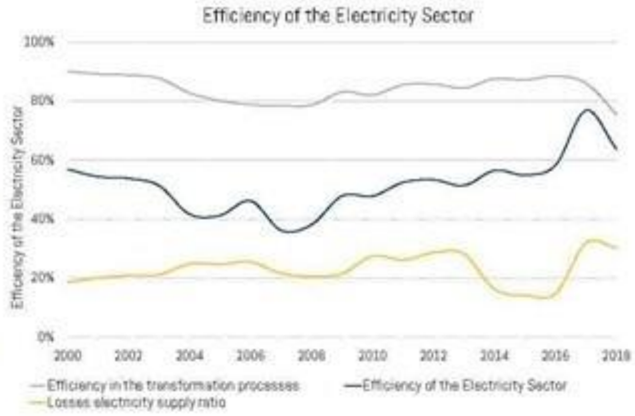

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Electricity per capita
Liquefied Petroleum Gas per capita
Other energy sources per capita
Total per capita
Natural gas per capita
Biomass per capita

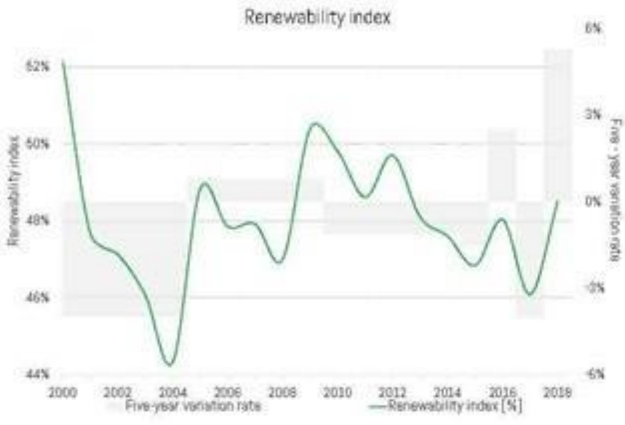

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Contribution of the electricity sector to primary intensity
Final intensity/Primary intensity (right axis)
Final energy intensity
Final intensity to constant structure

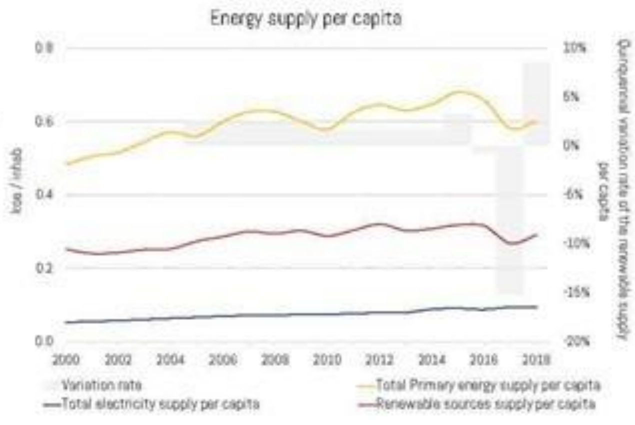

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

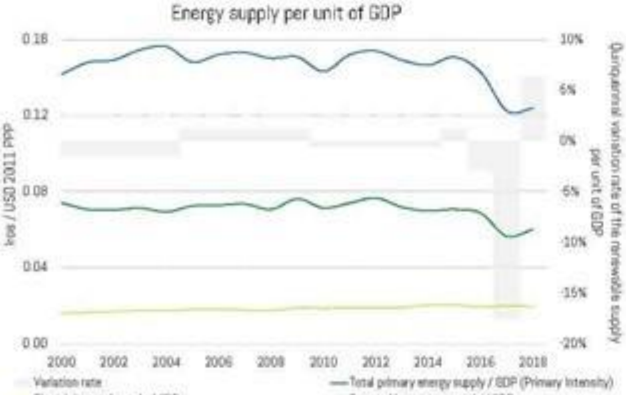

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

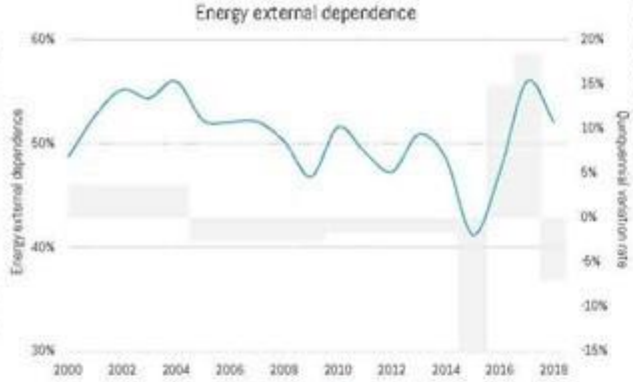

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

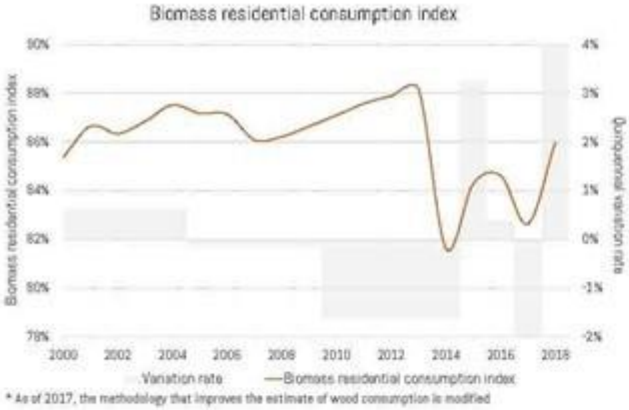

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

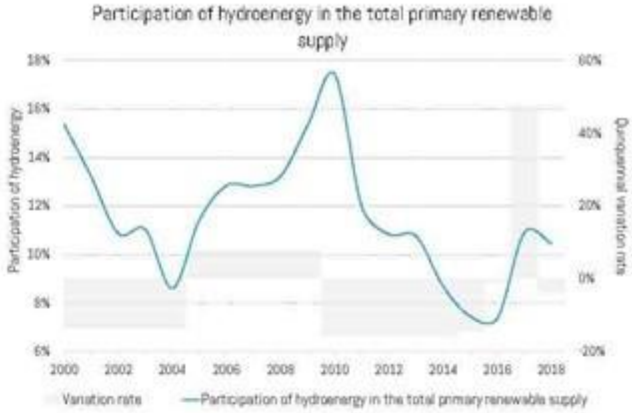

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

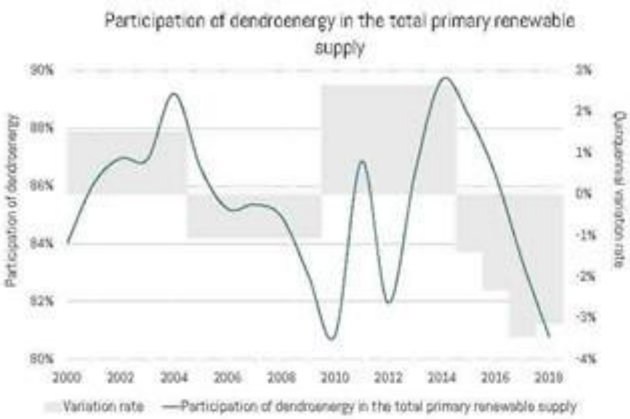

Energy supply per capita
koe / inhab
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total electricity supply per capita
Total Primary energy supply per capita
Renewable sources supply per capita

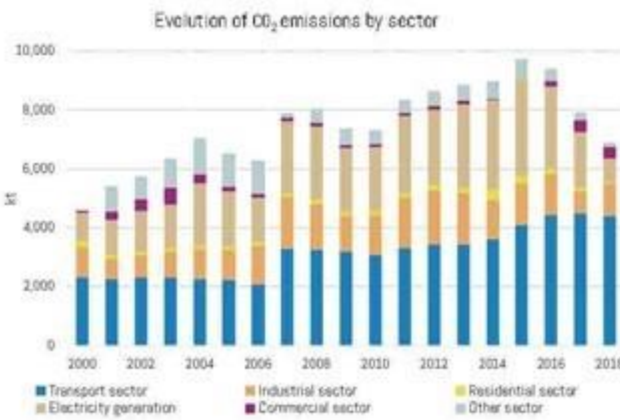

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Electricity total supply / GDP
Total primary energy supply / GDP (Primary Intensity)
Renewable sources supply / GDP

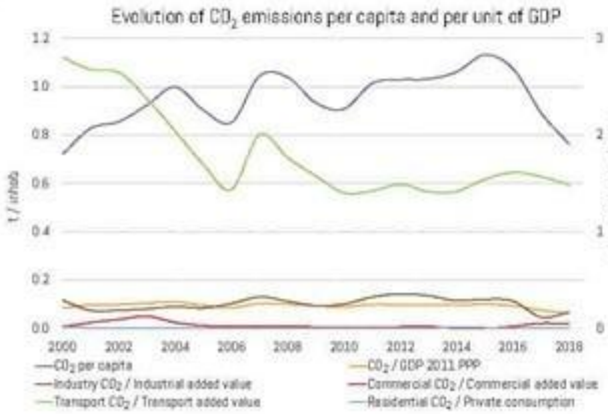

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

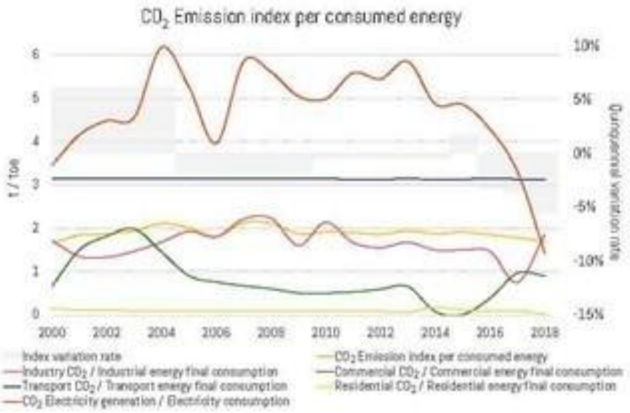

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index
* As of 2017, the methodology that improves the estimate of wood consumption is modified

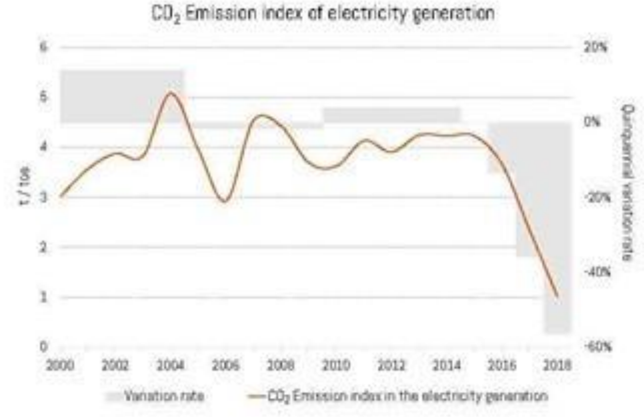

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply


Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply

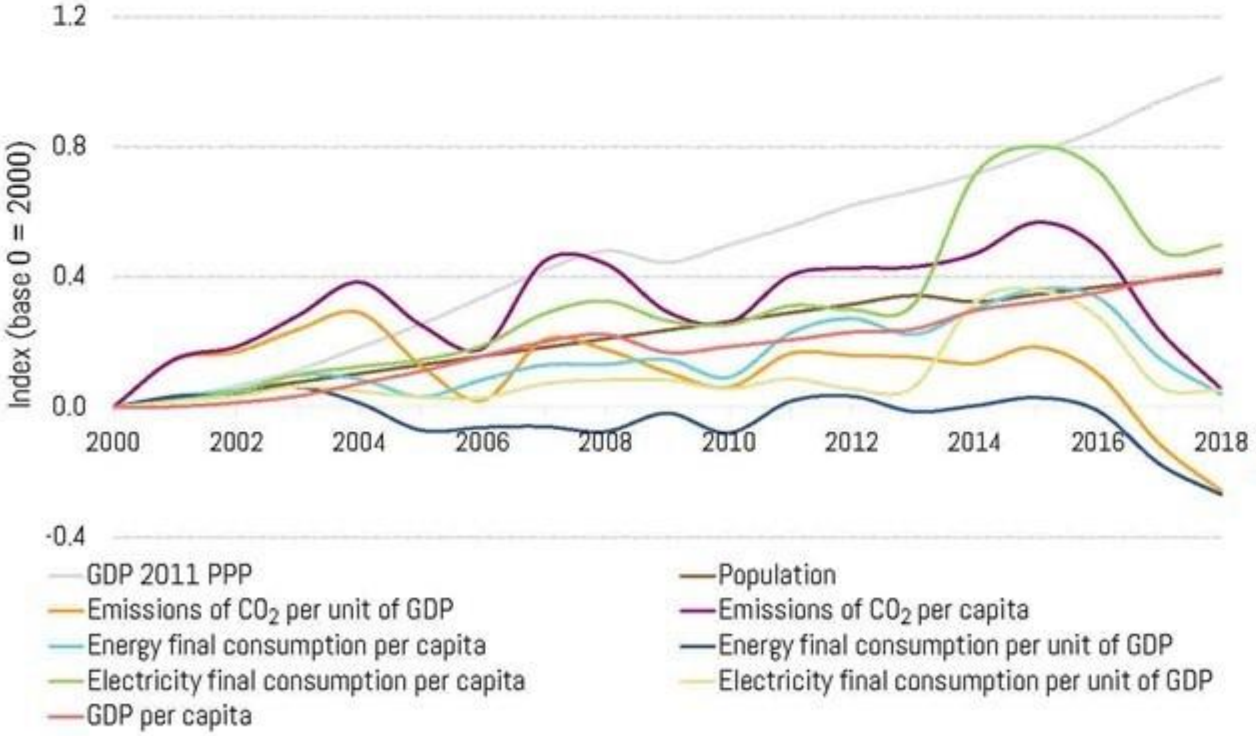

Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou. USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption



Summary of the main energy indicators



JAMAICA

General Information 2018

Population (thousand inhab.)	2,935
Area (km²)	10,990
Population Density (inhab./km²)	267
Urban Population (%)	56
GDP USD 2010 (MUSD)	14,231
GDP USD 2011 PPP (MUSD)	24,258
GDP per Capita (thou. USD 2011 PPP/inhab.)	8

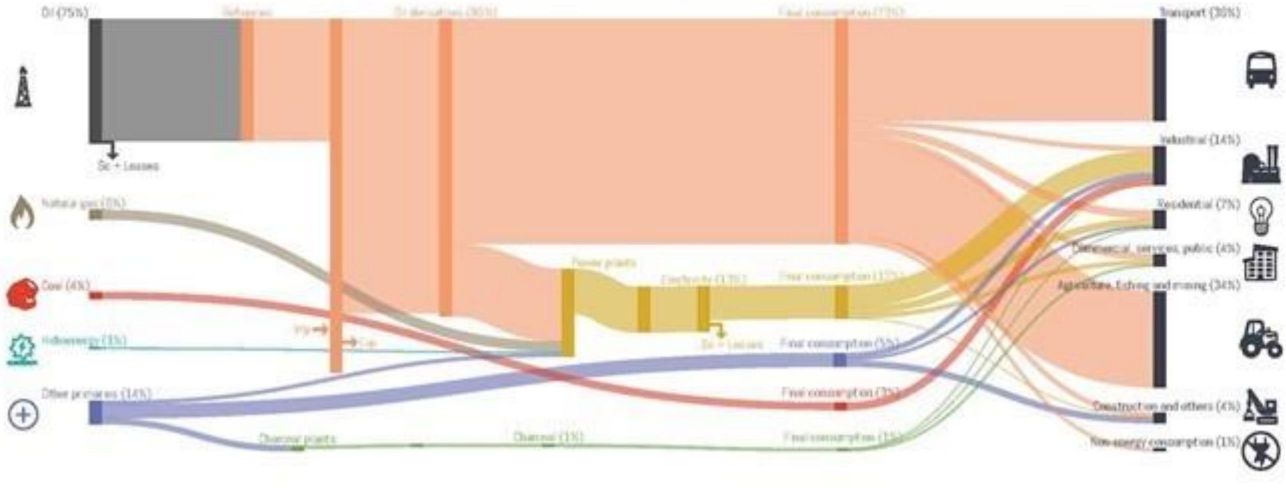
Energy Sector

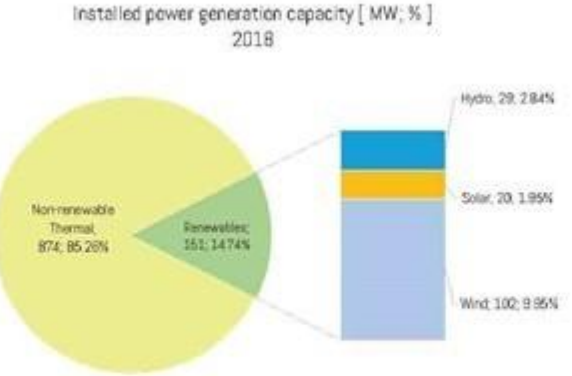
	Mtoe
Final consumption in the Transport Sector	0.85
Final consumption in the Industrial Sector	0.33
Final consumption in the Residential Sector	0.16
Final consumption in the Commercial and Service Sector	0.10
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.91

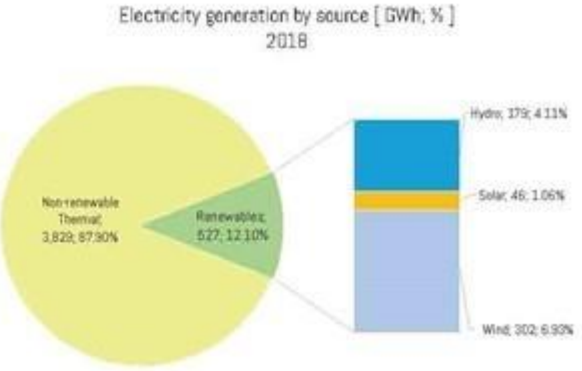
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

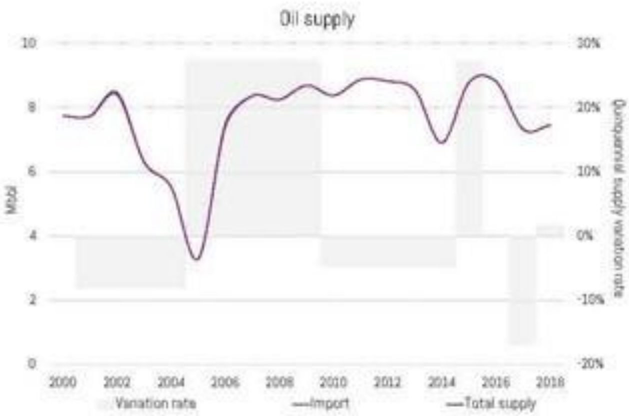
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,103
Final consumption per capita	toe/inhab.	0.80
Electrification rate	%	97.50
Total energy supply	Mtoe	2.84
Total energy production	Mtoe	0.21
Total energy imports	Mtoe	3.11
Total energy exports	Mtoe	0.49
Total final energy consumption	Mtoe	2.35
Refining capacity	kbbl/day	35
Installed power generation capacity	GW	1.03
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.12 / 0.10

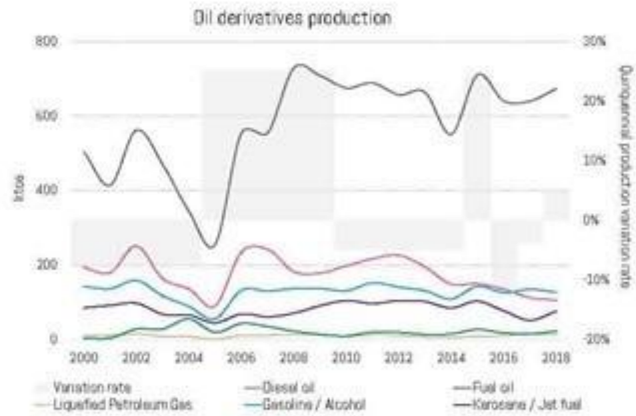
Summarized energy balance 2018



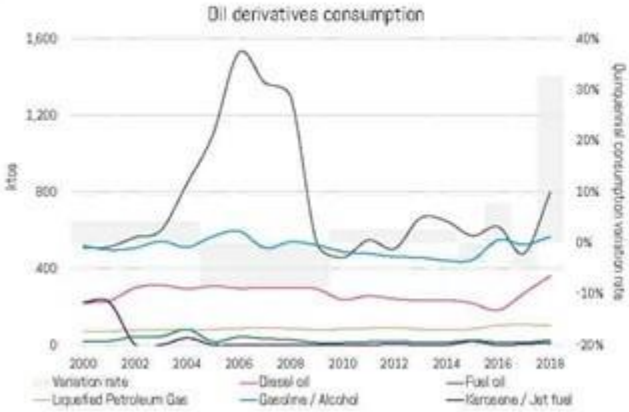

Installed power generation capacity [MW; %]
2018
Non-renewable
Thermal
874; 85.26%
Renewables;
151; 14.74%
Hydro; 29; 2.84%
Solar; 20; 1.95%
Wind; 102; 9.95%

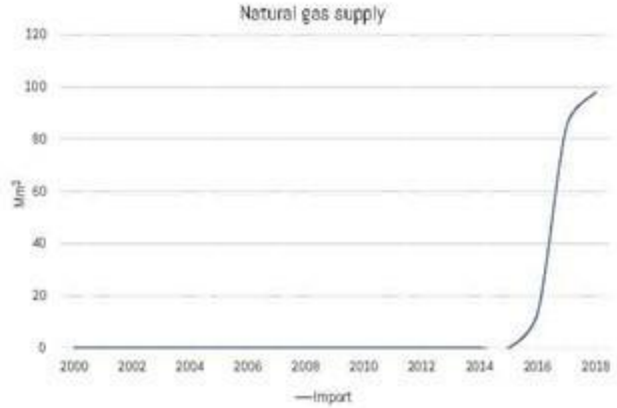

Electricity generation by source [GWh; %]
2018
Non-renewable
Thermal;
3,829; 87.90%
Renewables;
527; 12.10%
Hydro; 179; 4.11%
Solar; 46; 1.06%
Wind; 302; 6.93%

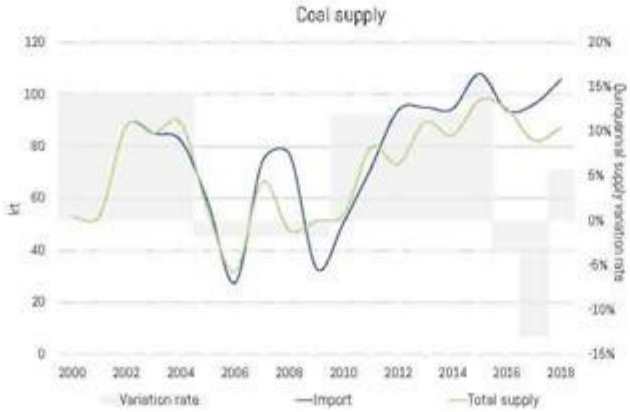

Oil supply
Mbbl
Quinquennial supply variation rate
Variation rate
Import
Total supply

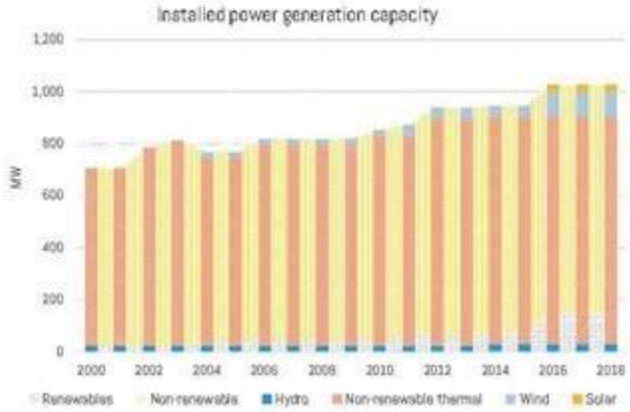

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Liquefied Petroleum Gas
Diesel oil
Gasoline / Alcohol
Fuel oil
Kerosene / Jet fuel

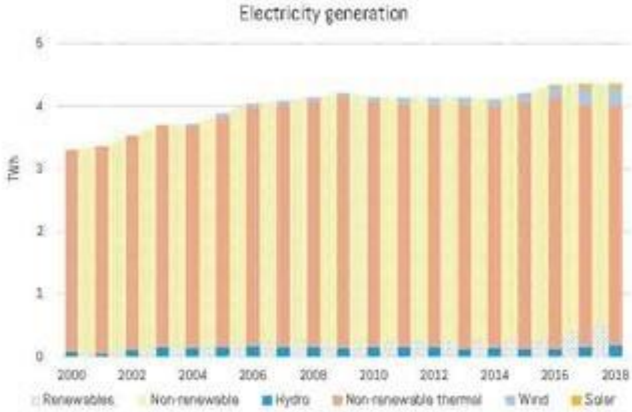
JAMAICA

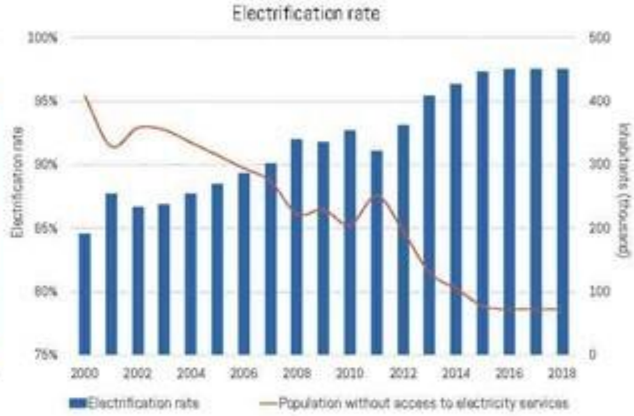

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Liquefied Petroleum Gas
Diesel oil
Gasoline / Alcohol
Fuel oil
Kerosene / Jet fuel

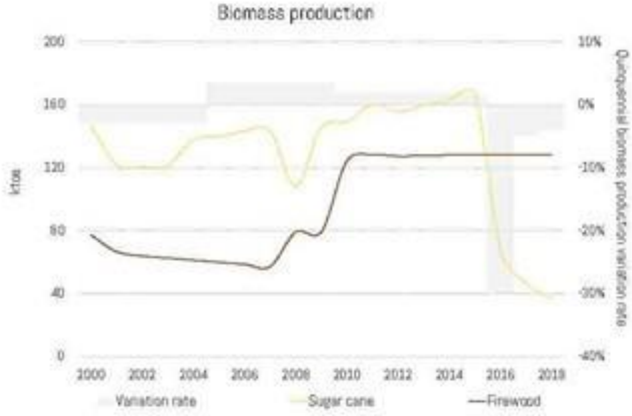

Natural gas supply
Mm³
Import

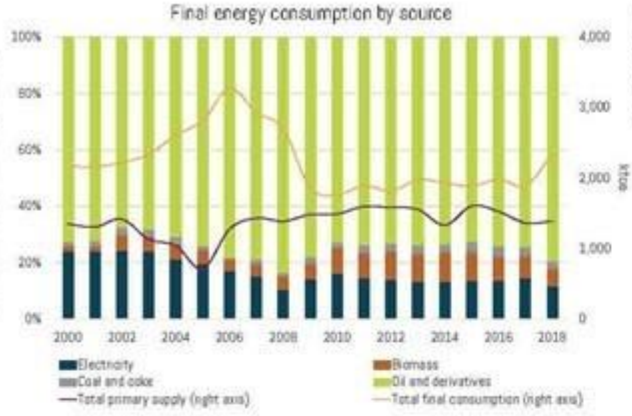

Coal supply
kt
Quinquennial supply variation rate
Variation rate
Import
Total supply


Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Wind
Solar

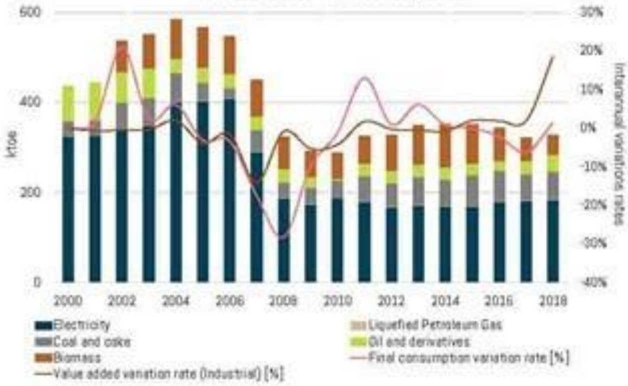

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Wind
Solar


Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services

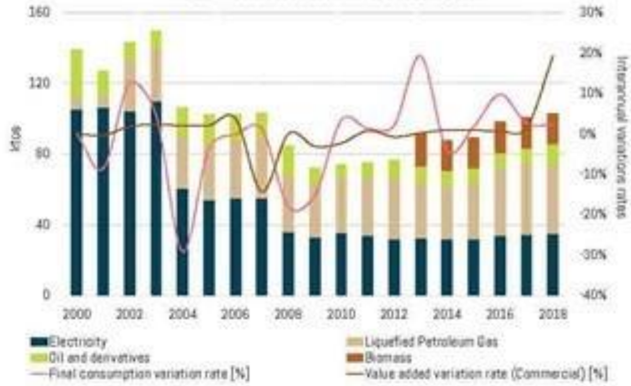

Biomass production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood


Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

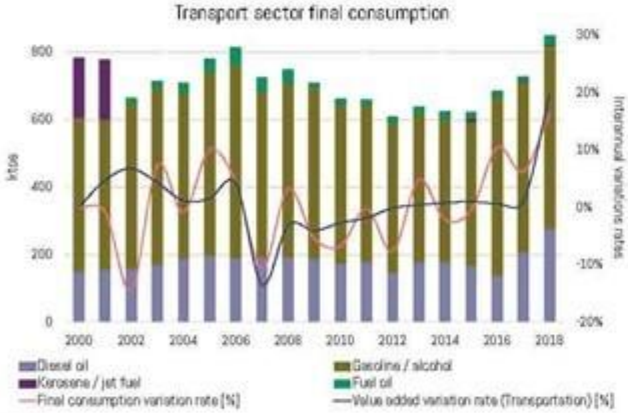
Industrial sector final consumption



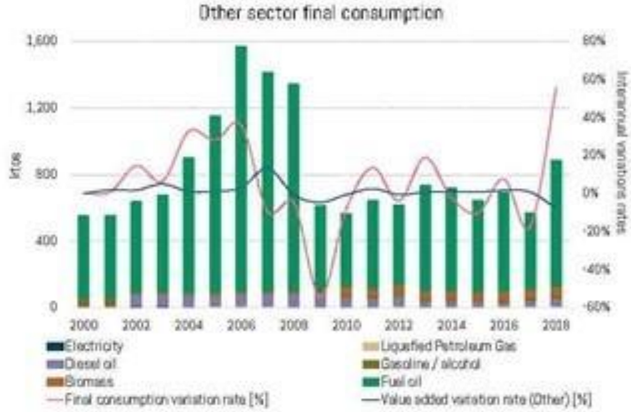
Commercial sector final consumption



Transport sector final consumption

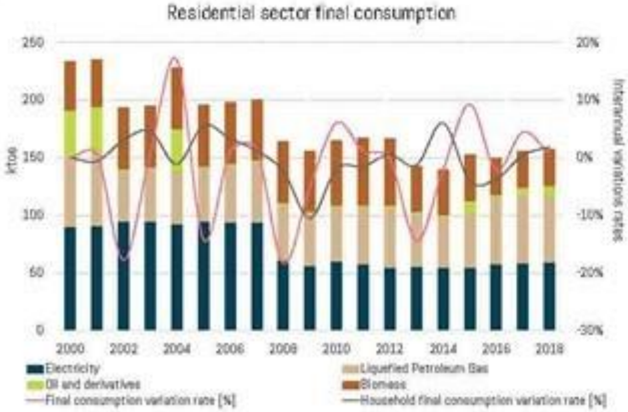


Other sector final consumption

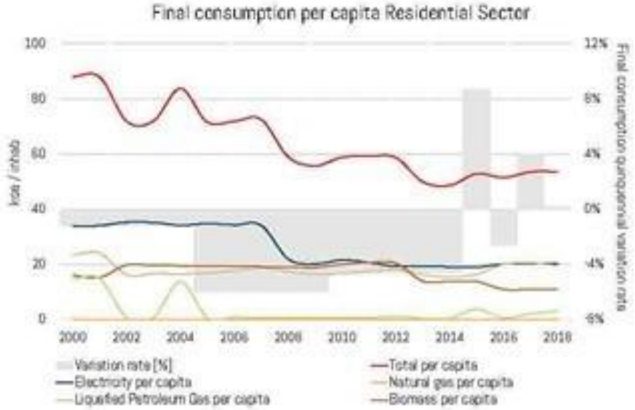


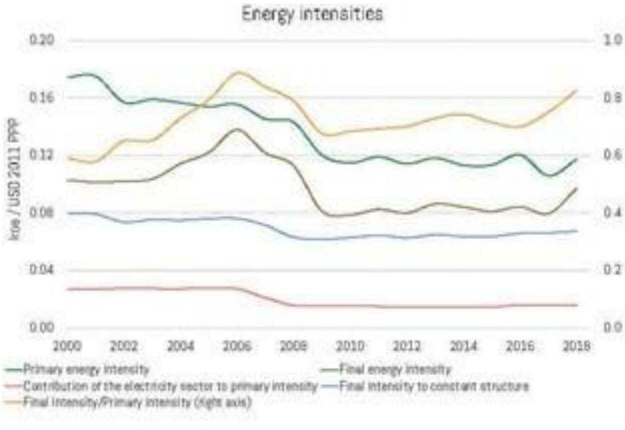
JAMAICA

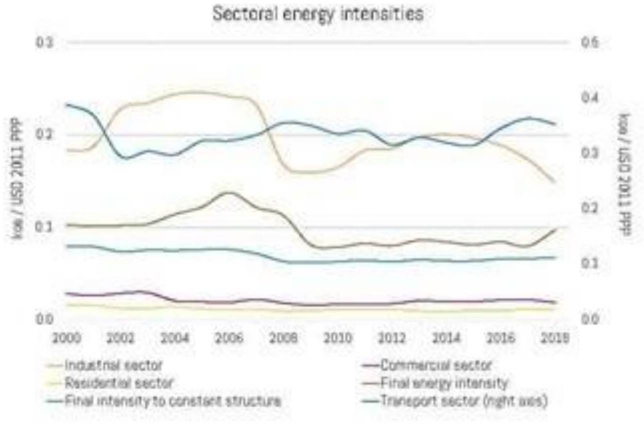
Residential sector final consumption

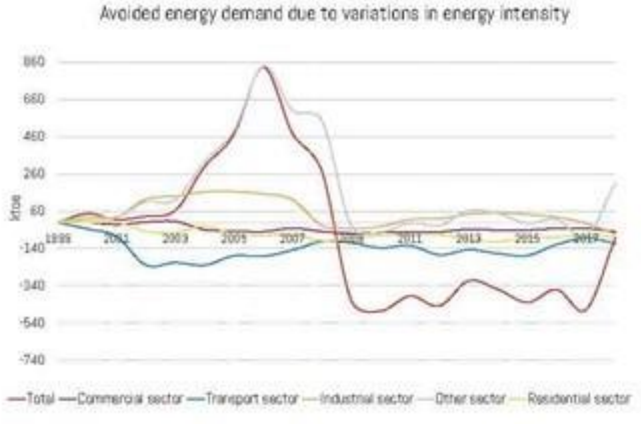


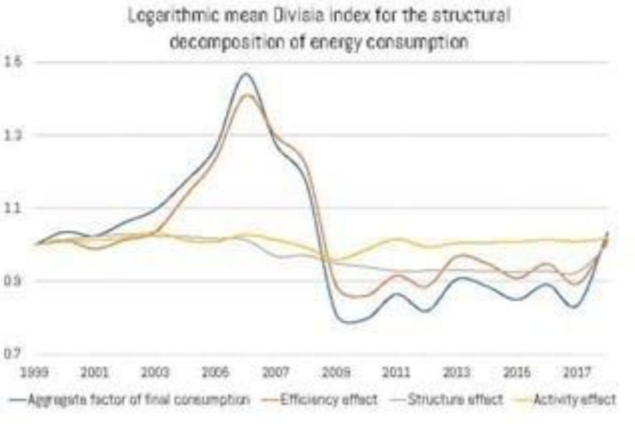
Final consumption per capita Residential Sector

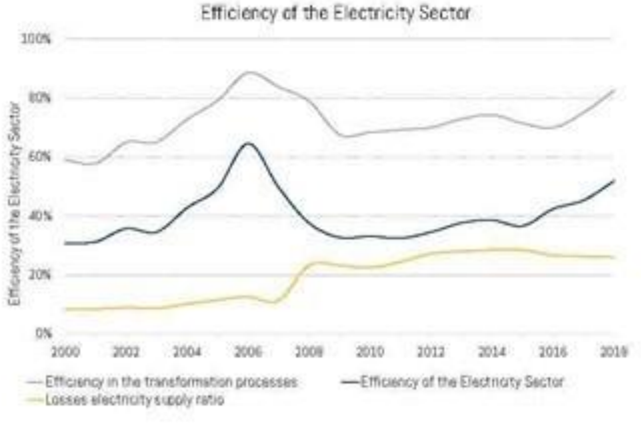


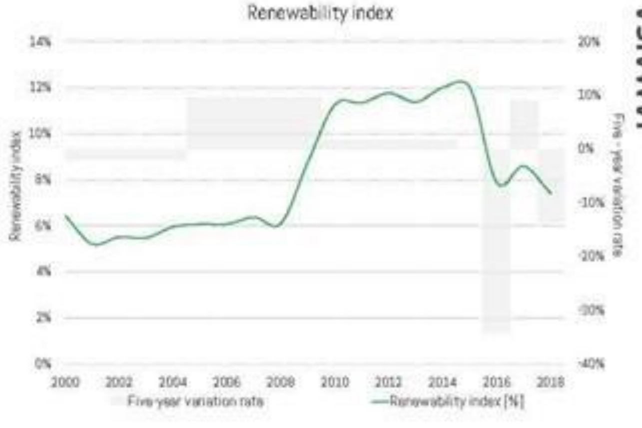

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

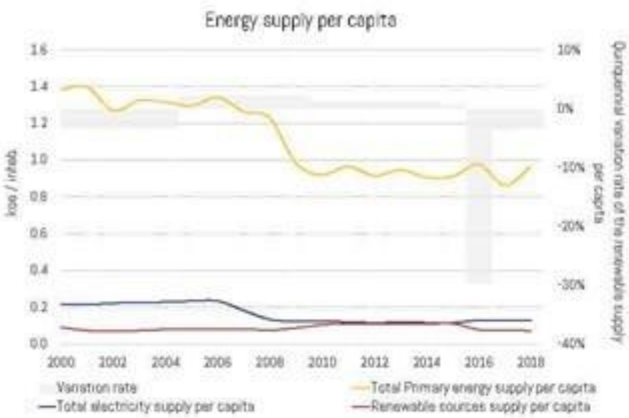

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

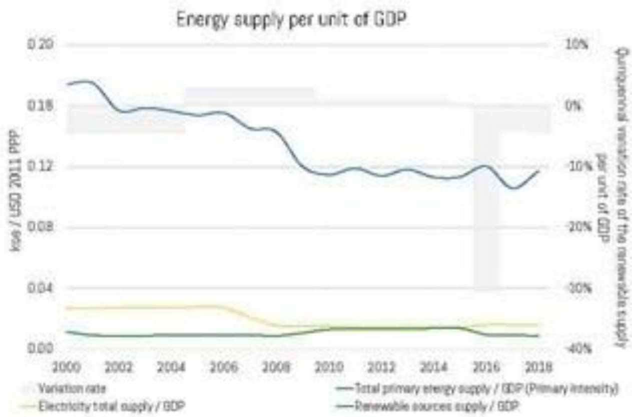

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

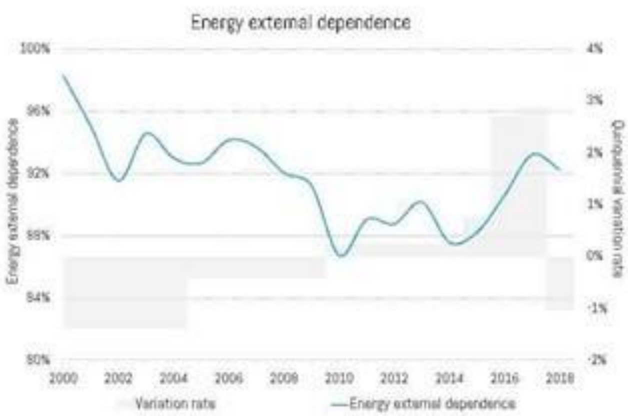

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

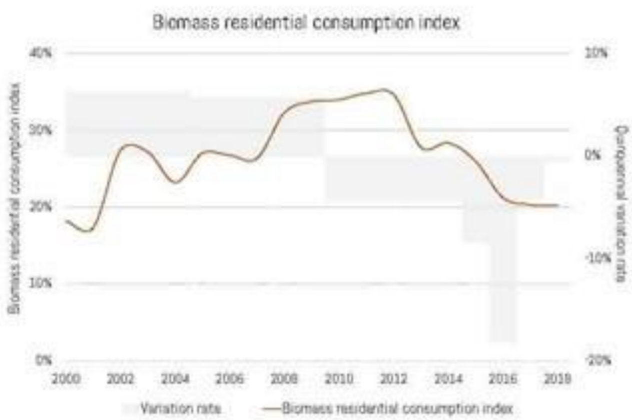

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

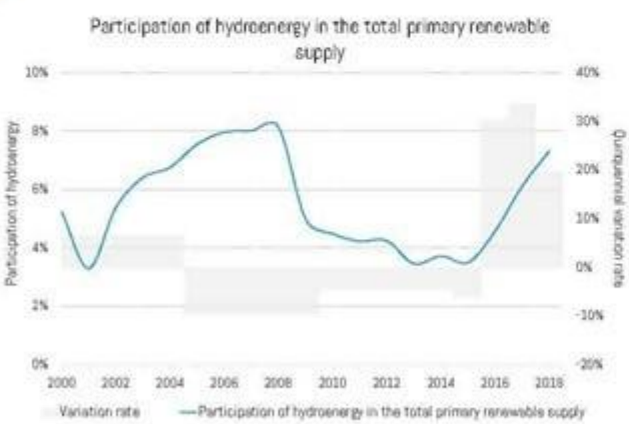

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

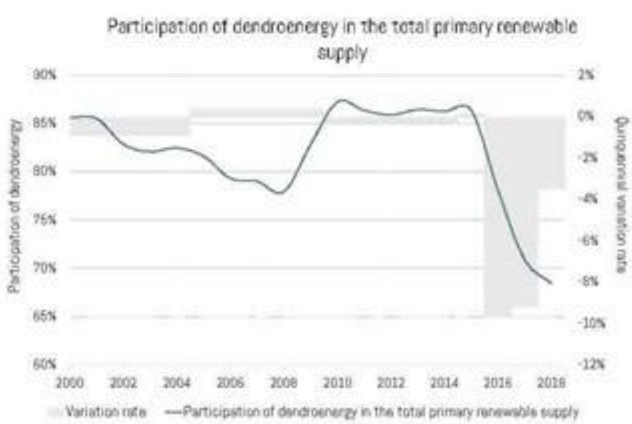

Energy supply per capita
koe / inhab
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

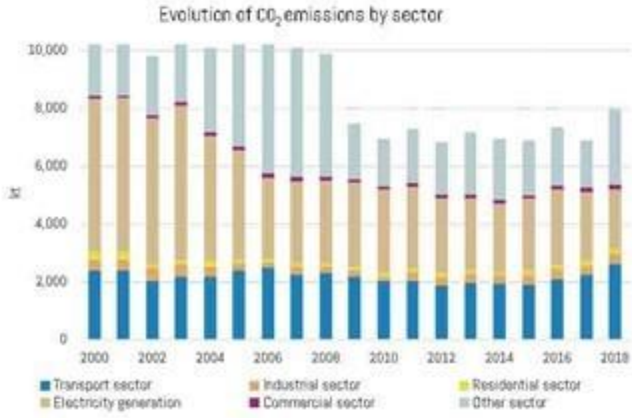

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

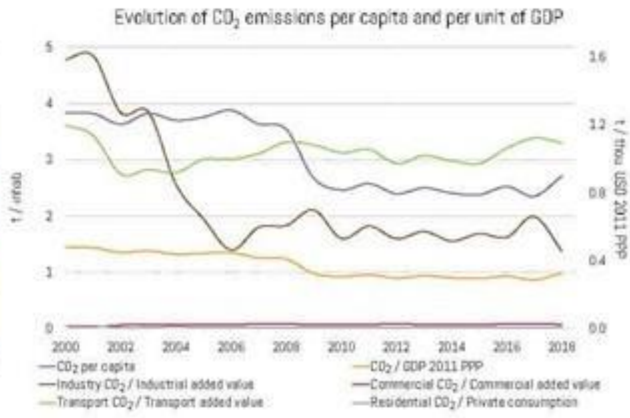

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

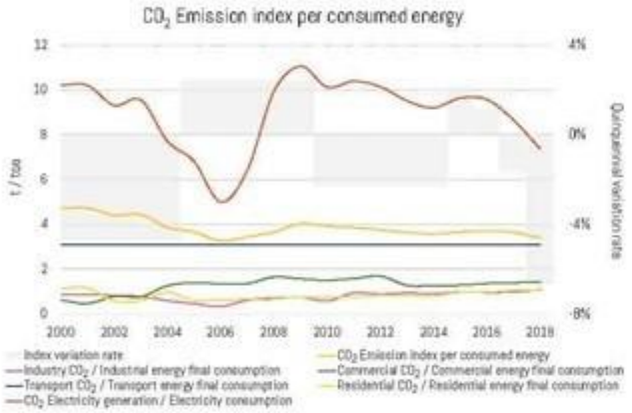

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

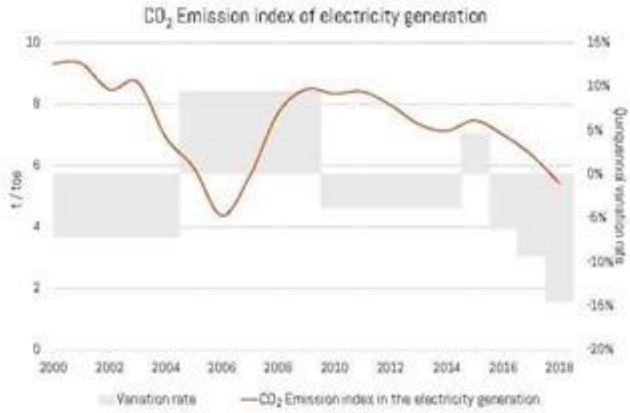

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

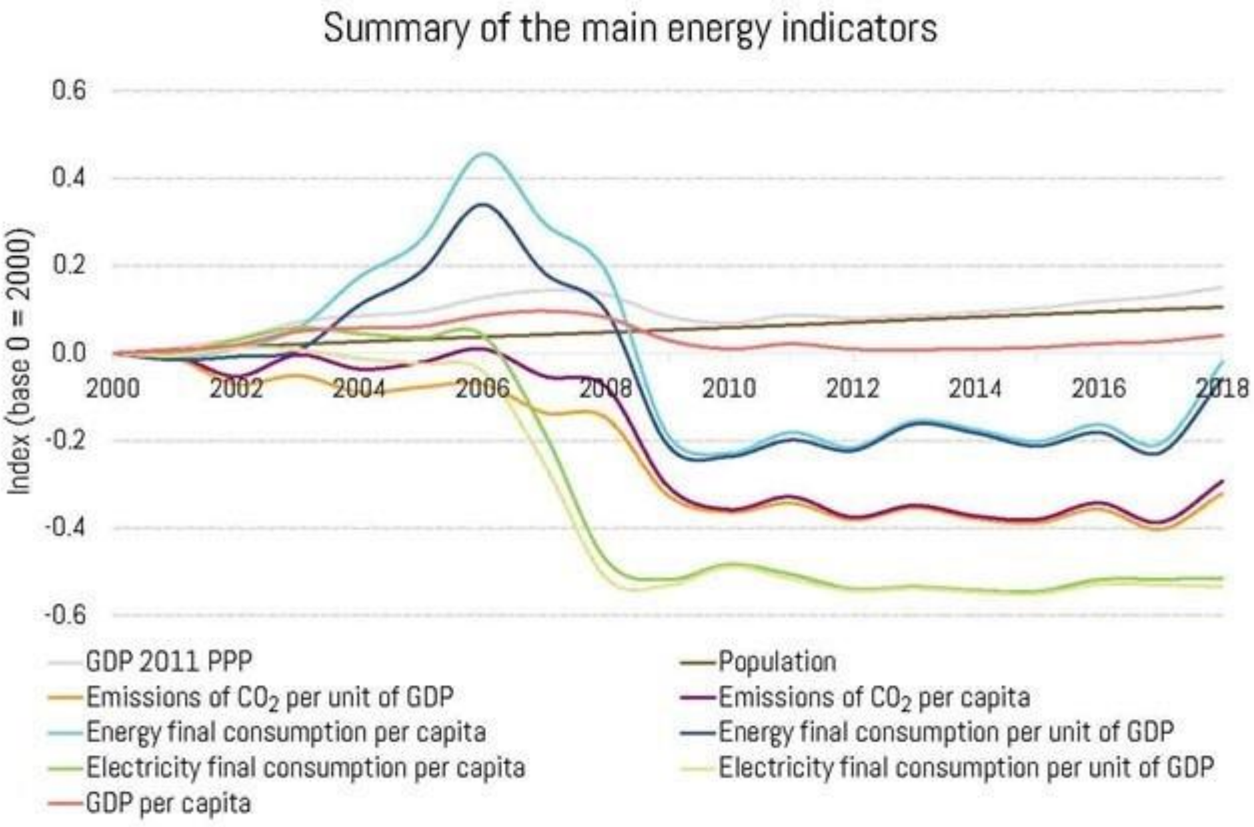

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
10,000
8,000
6,000
4,000
2,000
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector

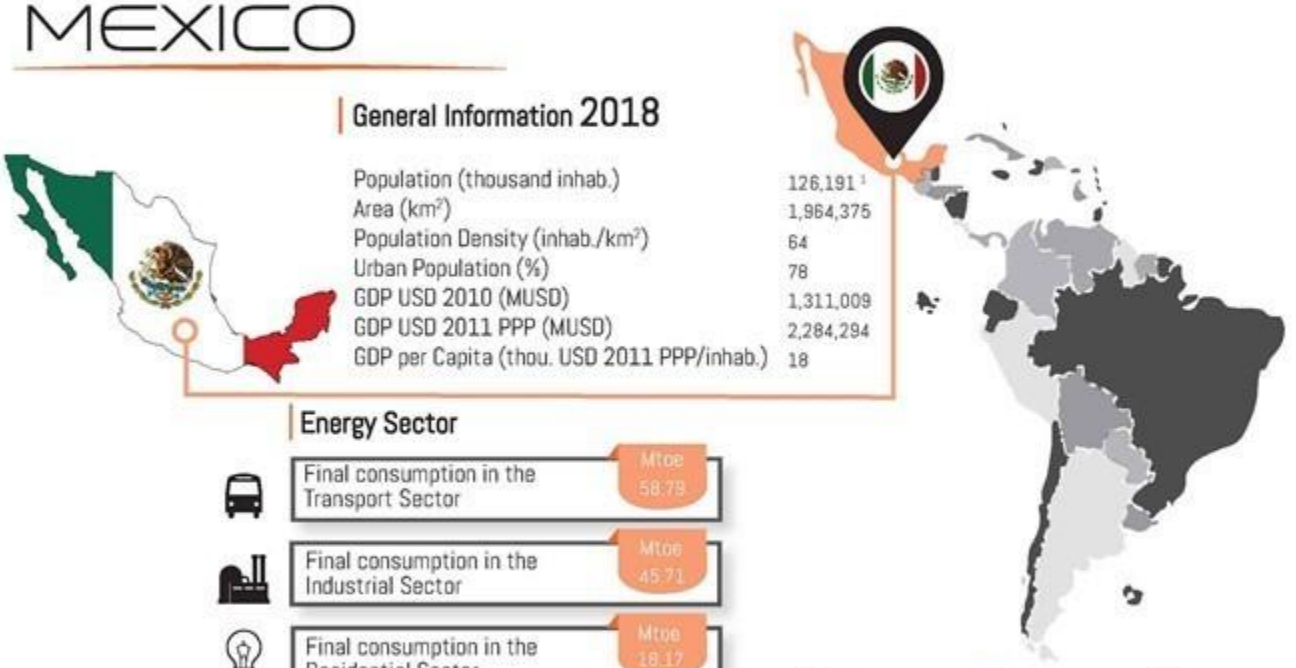

Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou USD 2011 PPP
5
4
3
2
1
0
1.6
1.2
0.8
0.4
0.0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
12
10
8
6
4
2
0
4%
0%
-4%
-8%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
10
8
6
4
2
0
15%
10%
5%
0%
-5%
-10%
-15%
-20%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

MEXICO



General Information 2018

Population (thousand inhab.)	126,191 [1]
Area (km²)	1,964,375
Population Density (inhab./km²)	64
Urban Population (%)	78
GDP USD 2010 (MUSD)	1,311,009
GDP USD 2011 PPP (MUSD)	2,284,294
GDP per Capita (thou. USD 2011 PPP/inhab.)	18

Energy Sector

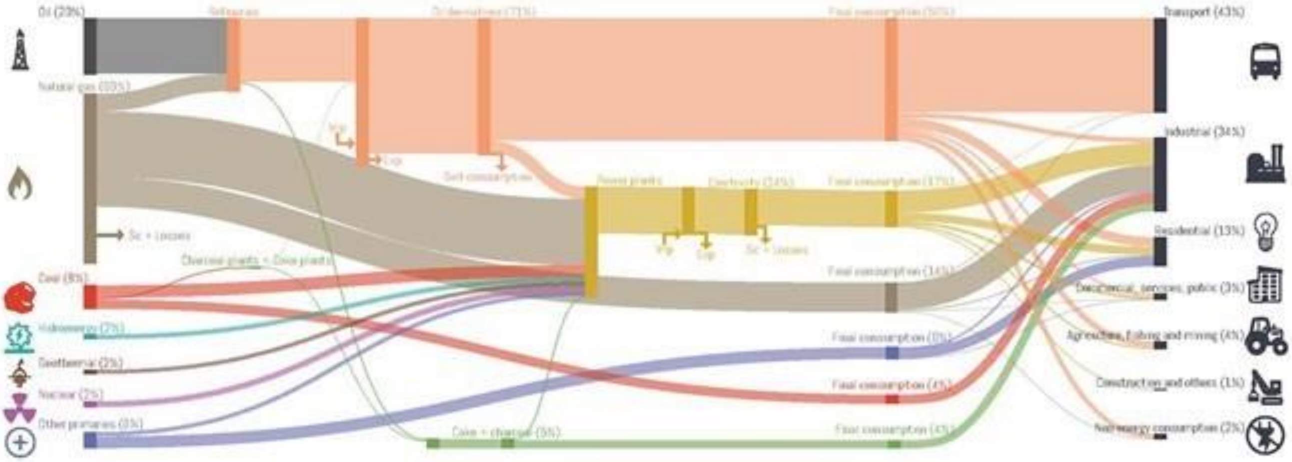
Final consumption in the Transport Sector	Mtoe 58.79
Final consumption in the Industrial Sector	Mtoe 45.71
Final consumption in the Residential Sector	Mtoe 18.17
Final consumption in the Commercial and Service Sector	Mtoe 3.94
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 8.86

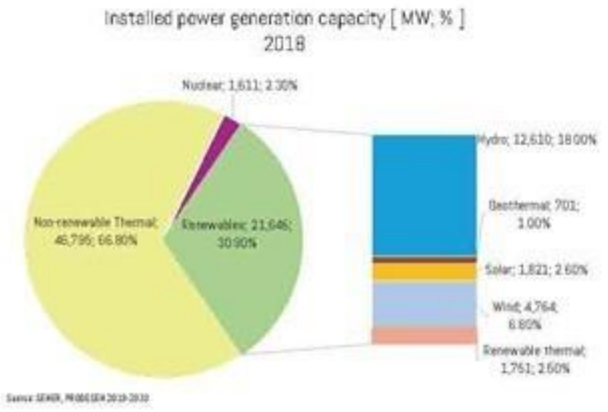
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 6,464 [3]	Gm³ 284 [3]	Mt 1,211 [4]

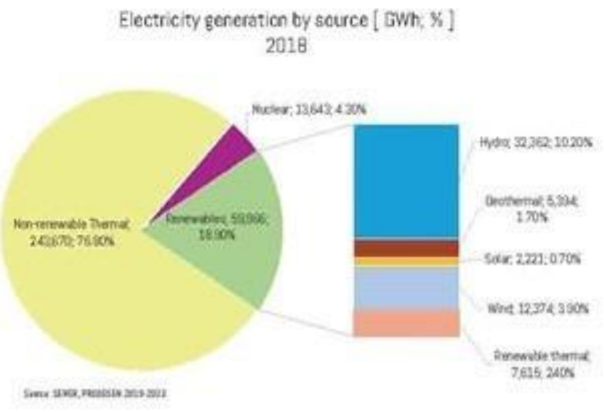
[1] Source: ECLAC.
[2] Federal Electricity Commission - Annual Report 2018.
[3] Pemex institutional database and National Hydrocarbons Commission.
[4] BP Statistical Review of World Energy.
Note: Supply and demand data for the year 2018 estimated by OLADE.

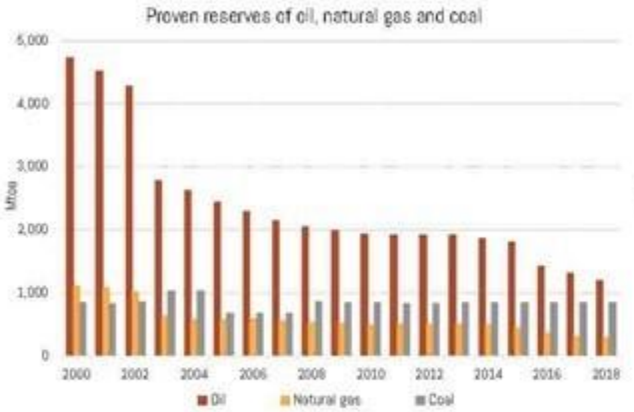
Unit	Value	Indicator
kWh/inhab.	2,090	Electricity consumption per capita
toe/inhab.	1.07	Final consumption per capita
%	98.75 [2]	Electrification rate
Mtoe	223.24	Total energy supply
Mtoe	186.18	Total energy production
Mtoe	109.61	Total energy imports
Mtoe	71.36	Total energy exports
Mtoe	135.46	Total final energy consumption
kbbl/day	1,640	Refining capacity
GW	70.05	Installed power generation capacity
koe/USD 2011 PPP	0.10 / 0.06	Primary energy intensity and final energy intensity

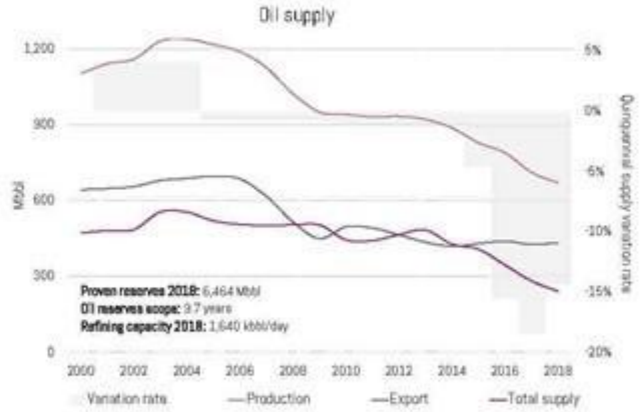
Summarized energy balance 2018

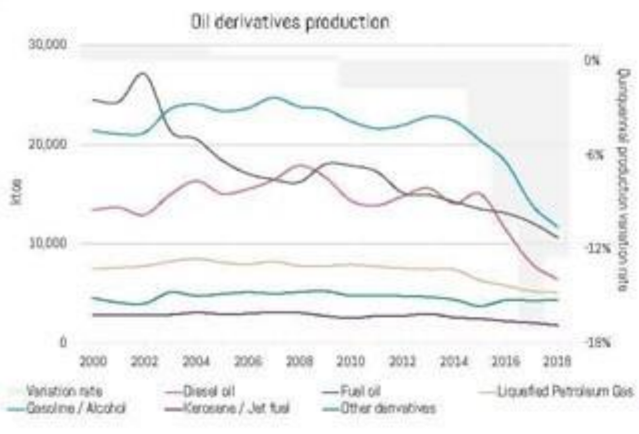


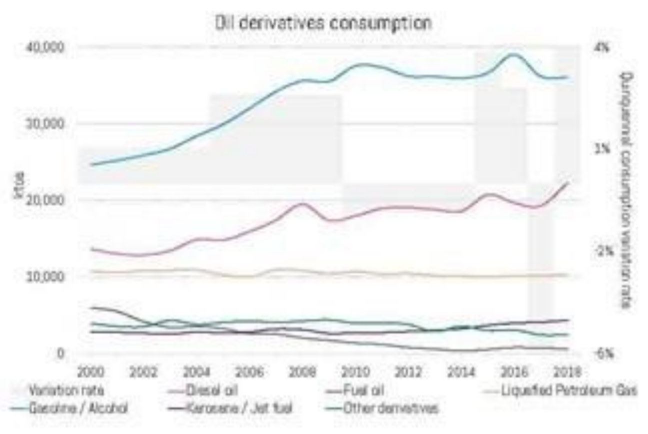

Installed power generation capacity [MW; %]
2018
Nuclear; 1,611; 2.30%
Non-renewable Thermal; 46,795; 66.80%
Renewables; 21,646; 30.90%
Hydro; 12,610; 18.00%
Geothermal; 701; 1.00%
Solar; 1,821; 2.60%
Wind; 4,764; 6.80%
Renewable thermal; 1,751; 2.50%

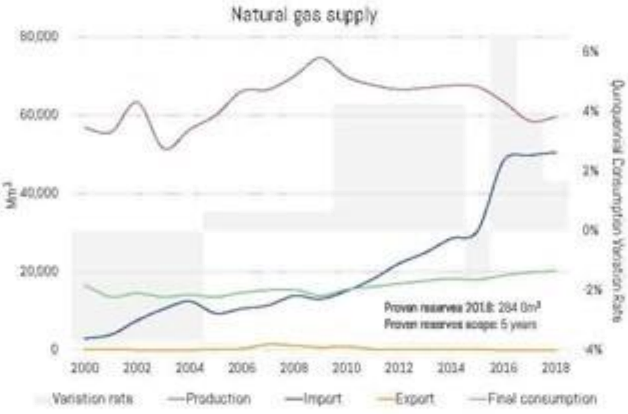

Electricity generation by source [GWh; %]
2018
Nuclear; 13,643; 4.30%
Non-renewable Thermal; 243,670; 76.80%
Renewables; 59,966; 18.90%
Hydro; 32,362; 10.20%
Geothermal; 5,394; 1.70%
Solar; 2,221; 0.70%
Wind; 12,374; 3.90%
Renewable thermal; 7,615; 2.40%

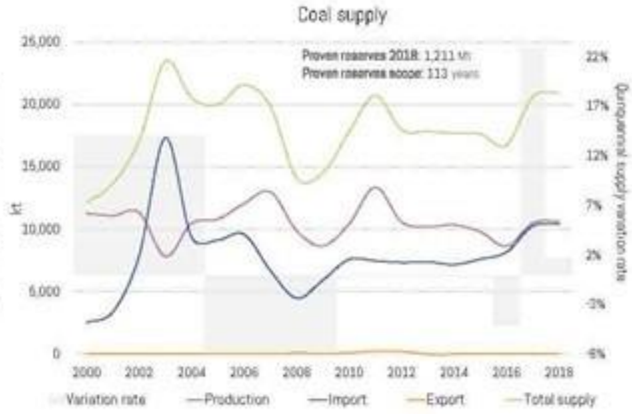

Proven reserves of oil, natural gas and coal
Mtoe
Oil
Natural gas
Coal

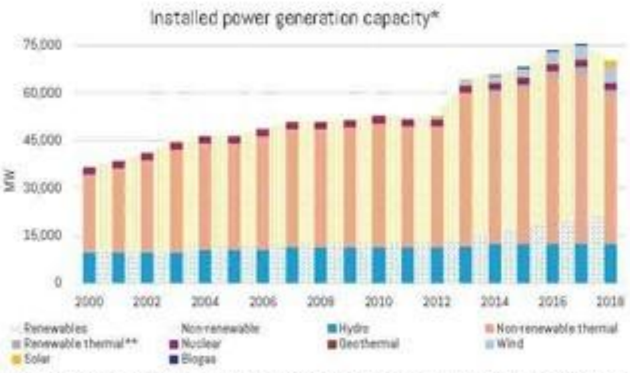

Oil supply
Mbbl
Quinquennial supply variation rate
Proven reserves 2018: 6,464 Mbbl
Oil reserves scope: 9.7 years
Refining capacity 2018: 1,640 kbbl/day
Variation rate
Production
Export
Total supply


Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

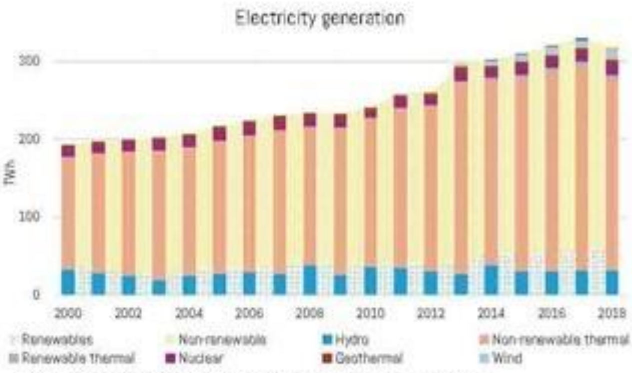

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives



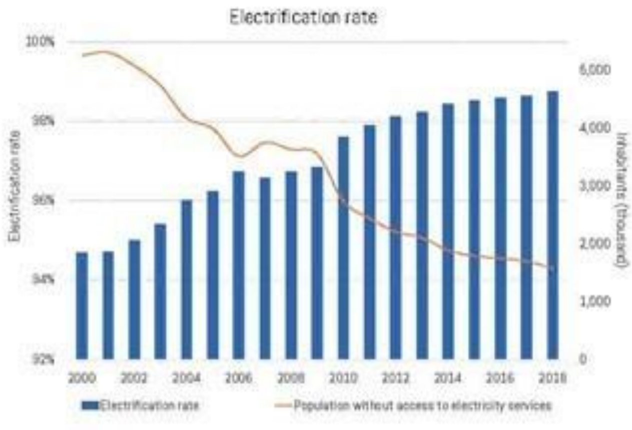


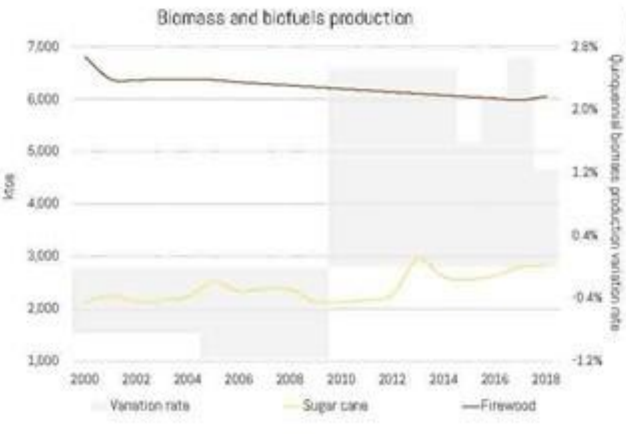


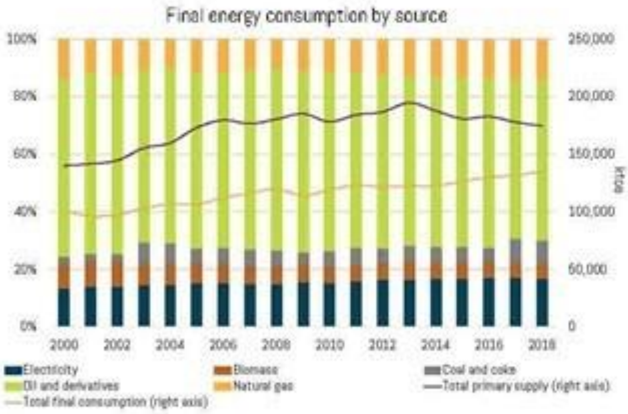
(*): 2000-2017: Nominal installed capacity
(*): 2018: Effective installed capacity
(**): Includes efficient cogeneration, regenerative brakes and bioenergy
Note: As of 2013, the data includes renewable thermal and biogas

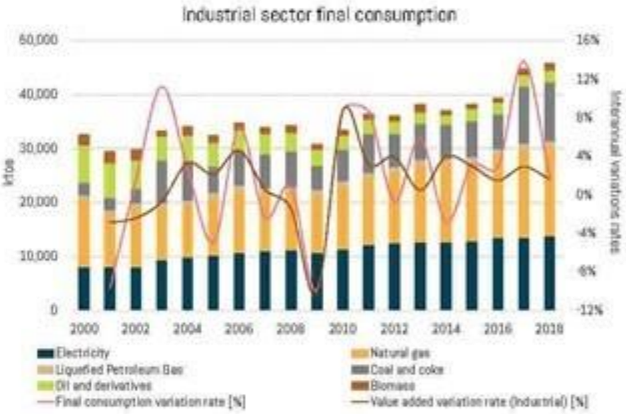


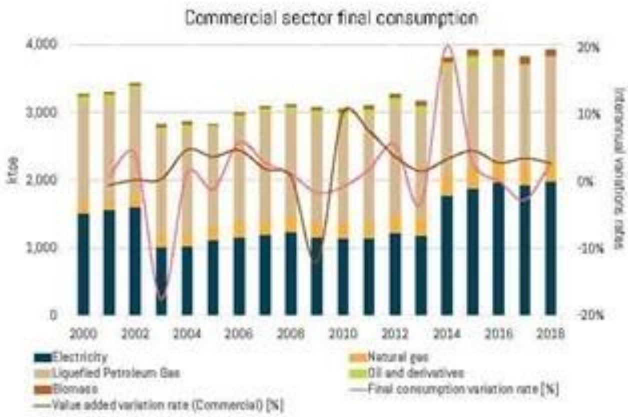
Renewable thermal: Includes efficient cogeneration, regenerative brakes and bioenergy
Note: As of 2013, data includes renewable thermal and biogas

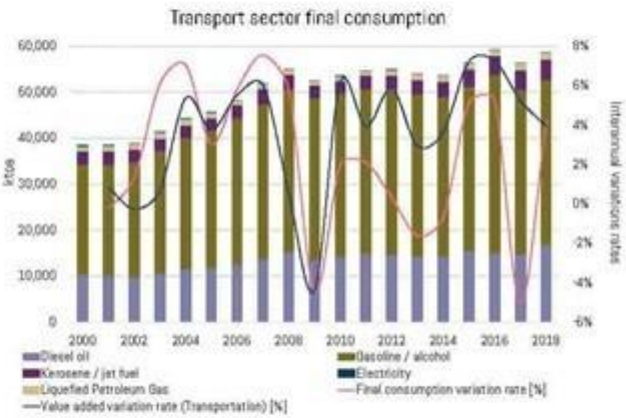


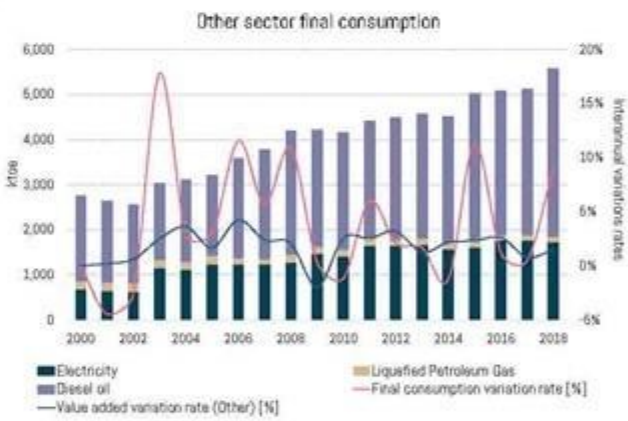


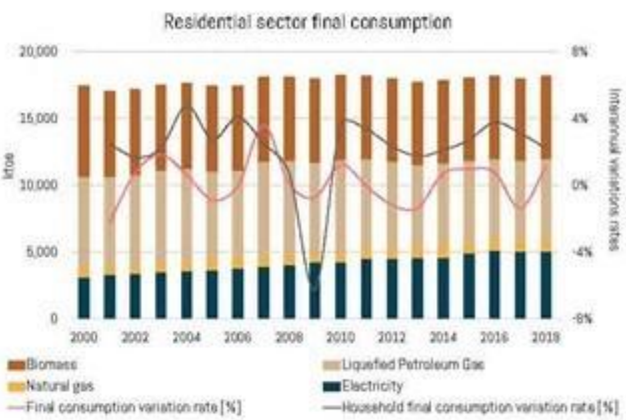

Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)

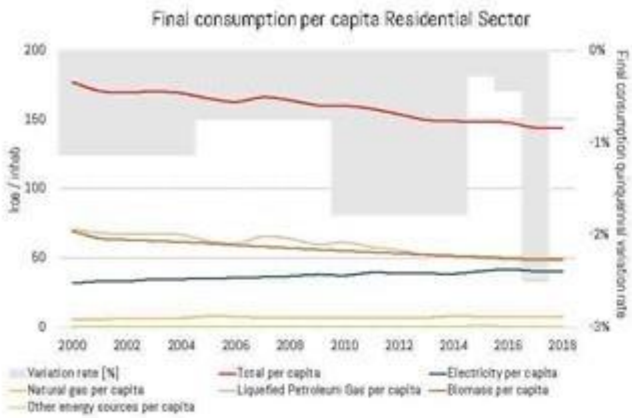

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied Petroleum Gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

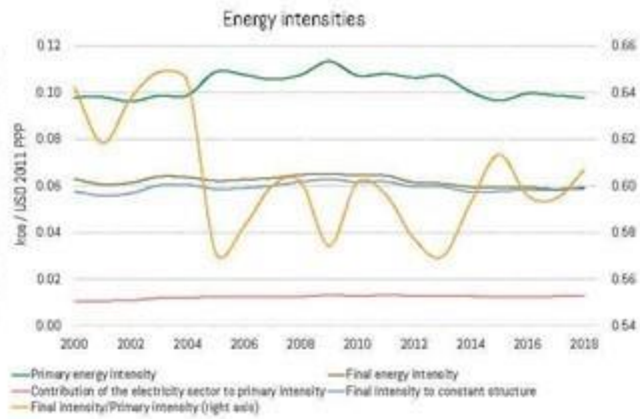

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

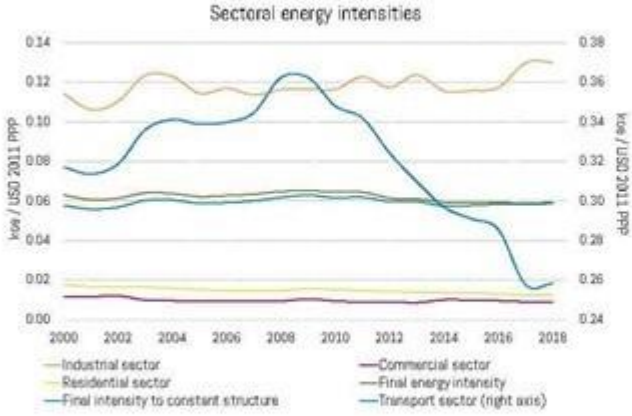

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied Petroleum Gas
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

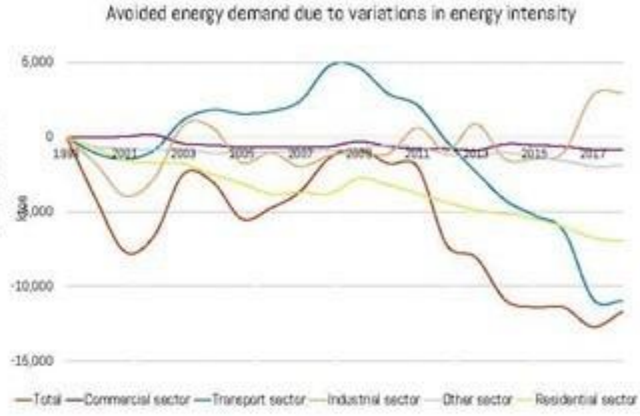

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Diesel oil
Final consumption variation rate [%]
Value added variation rate (Other) [%]

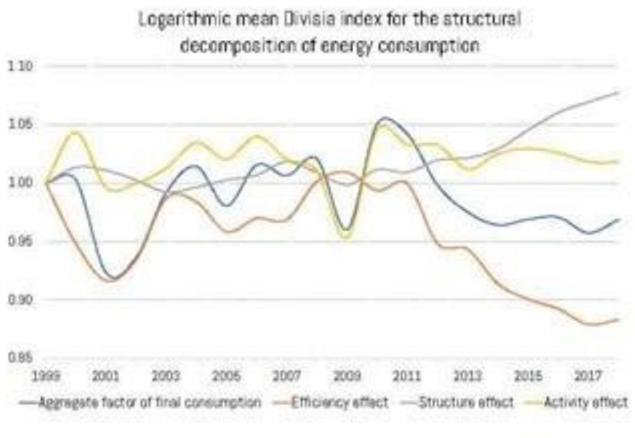

Residential sector final consumption
ktoe
Interannual variations rates
Biomass
Liquefied Petroleum Gas
Natural gas
Electricity
Final consumption variation rate [%]
Household final consumption variation rate [%]

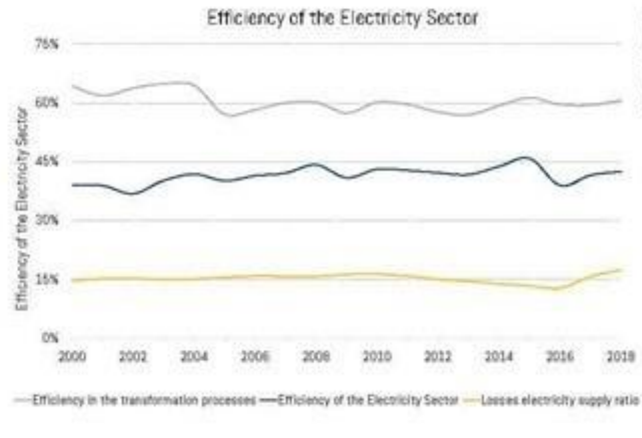

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

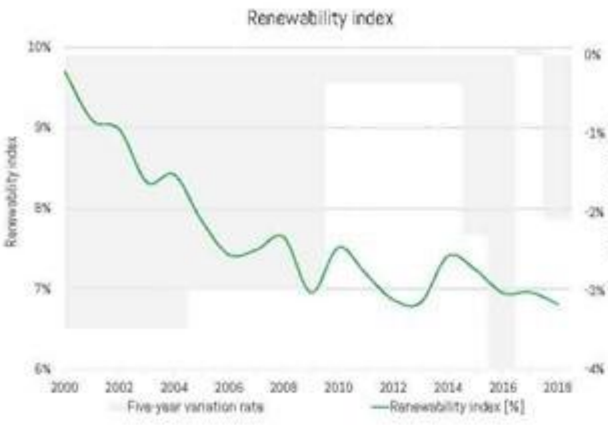

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

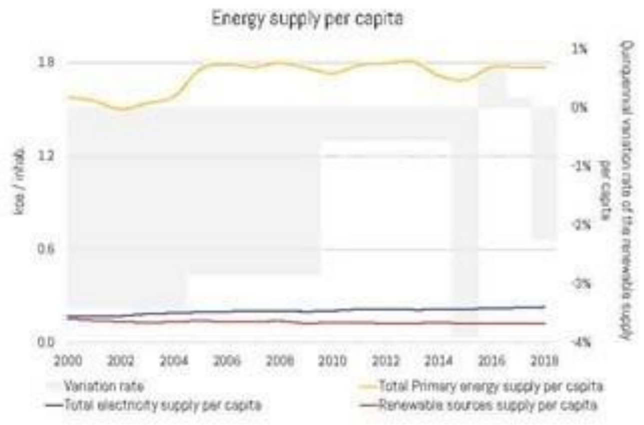

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

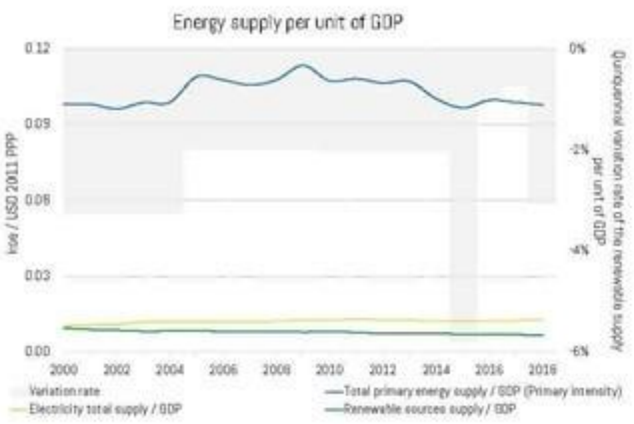

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

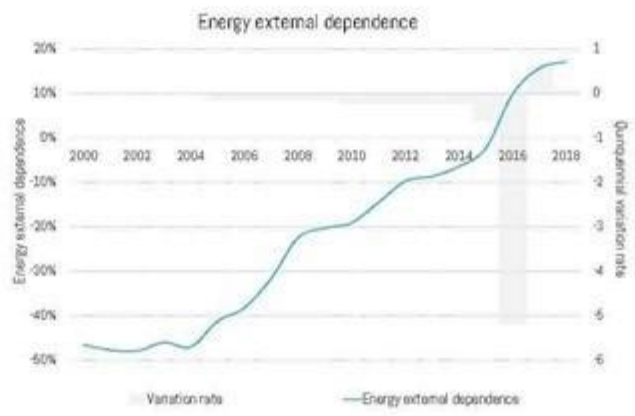

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

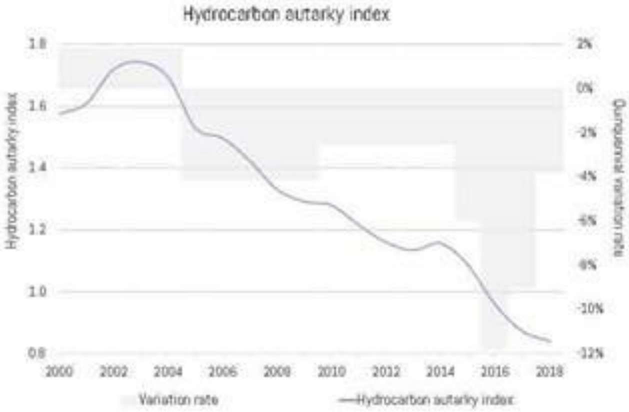
MEXICO

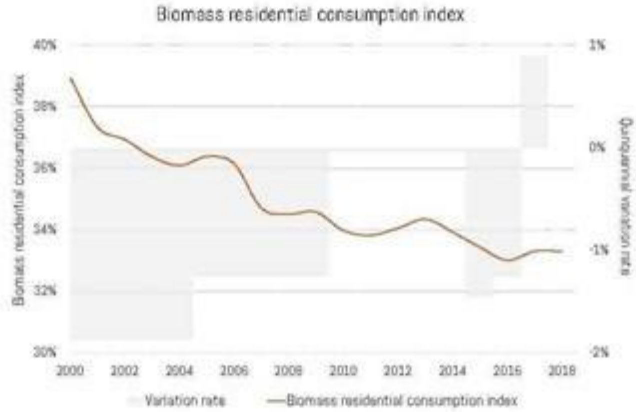

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]


Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

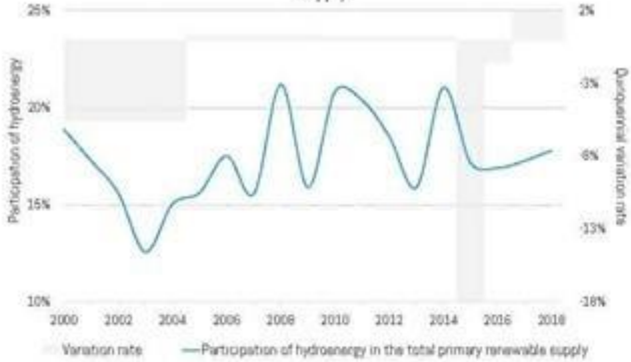

Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP


Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

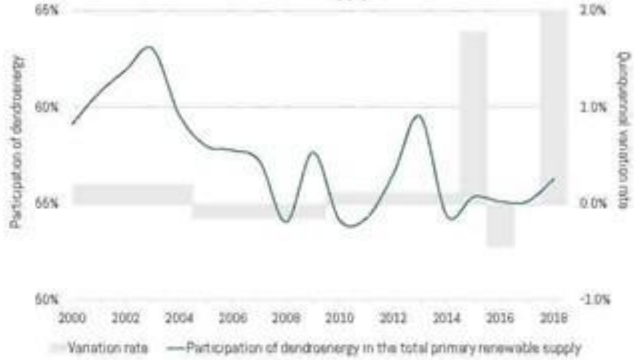

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index


Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

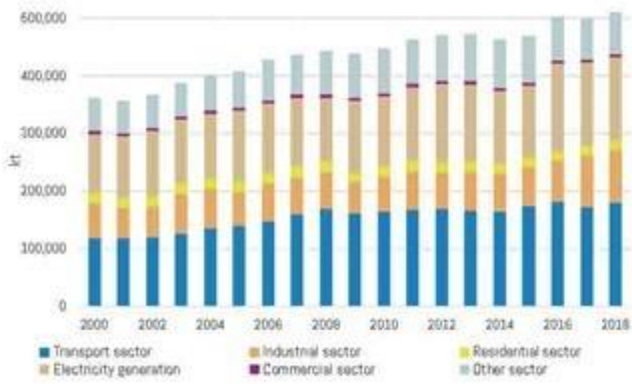
Participation of hydroenergy in the total primary renewable supply



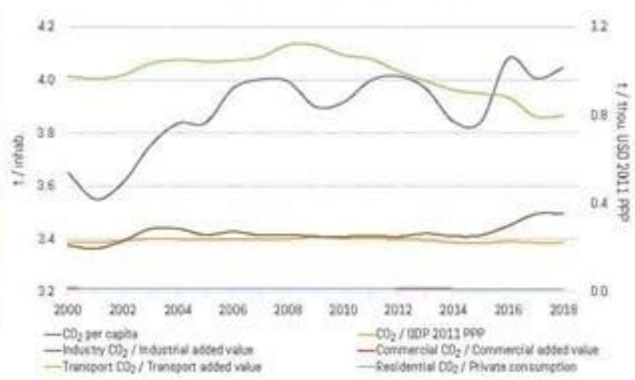
Participation of dendroenergy in the total primary renewable supply



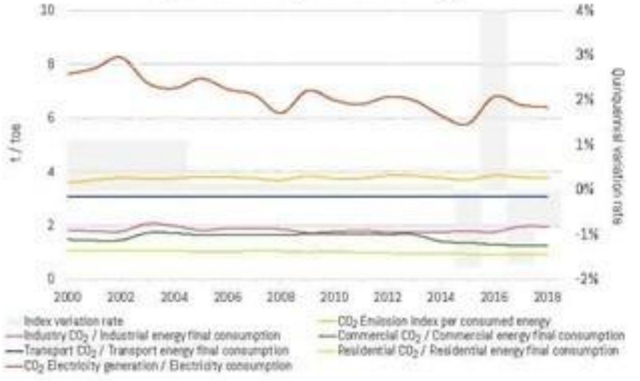
Evolution of CO_2 emissions by sector



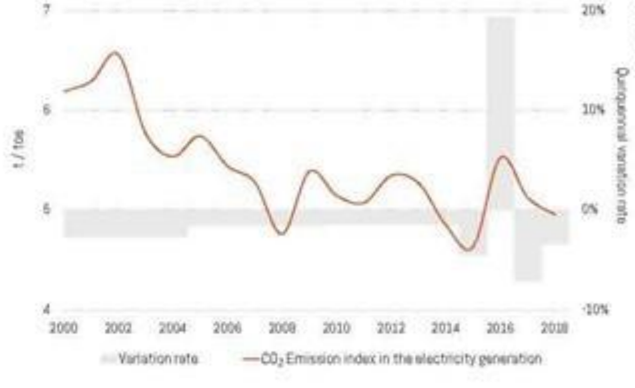
Evolution of CO_2 emissions per capita and per unit of GDP



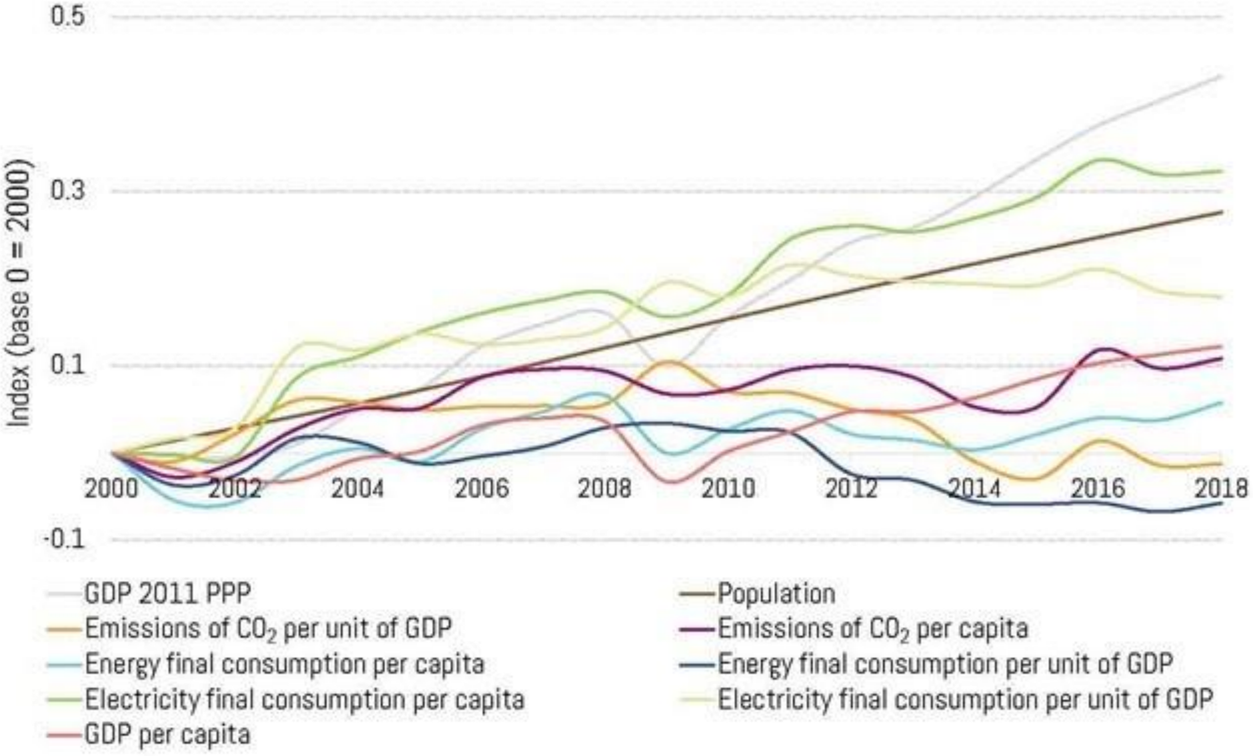
CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation



Summary of the main energy indicators



MEXICO

NICARAGUA

General Information 2018

Population (thousand inhab.)	6,460
Area (km²)	130,370
Population Density (inhab./km²)	50
Urban Population (%)	58
GDP USD 2010 (MUSD)	12,029
GDP USD 2011 PPP (MUSD)	31,746
GDP per Capita (thou. USD 2011 PPP/inhab.)	5

Energy Sector

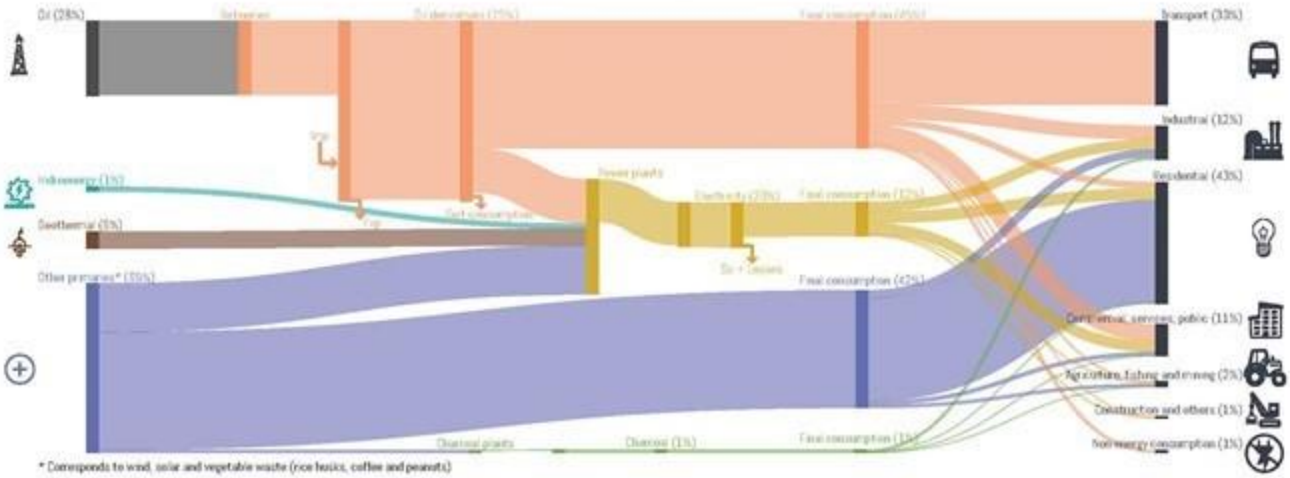
Final consumption in the Transport Sector	Mtoe 0.79
Final consumption in the Industrial Sector	Mtoe 0.32
Final consumption in the Residential Sector	Mtoe 1.14
Final consumption in the Commercial and Service Sector	Mtoe 0.30
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.11

Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	n.a.

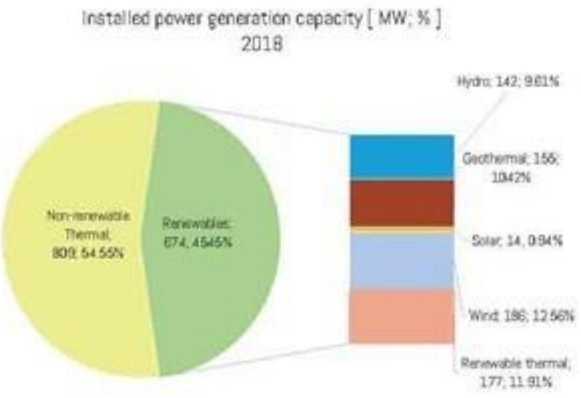
Note: The supply and demand information for the year 2018 in this publication is preliminary and is subject to review by the country.

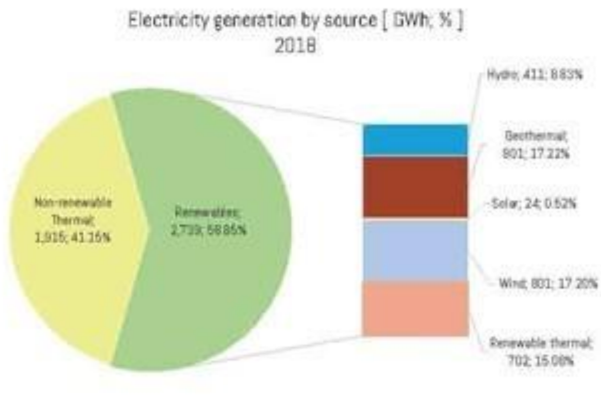
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
576	0.41	95.60	3.52	1.96	1.77	0.03	2.64	20	1.48	0.11 / 0.08

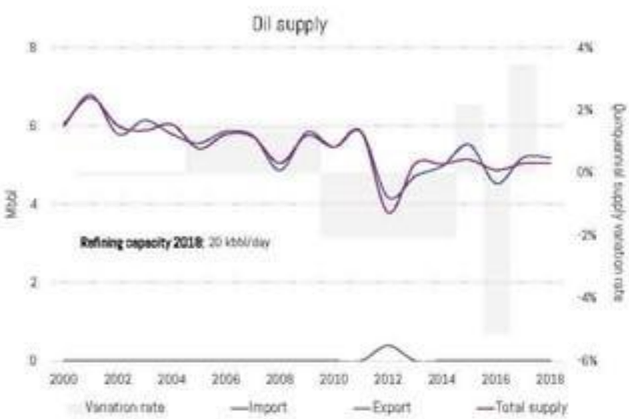
Summarized energy balance 2018

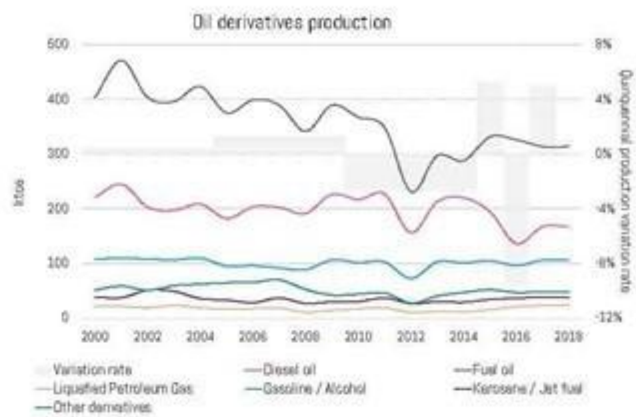


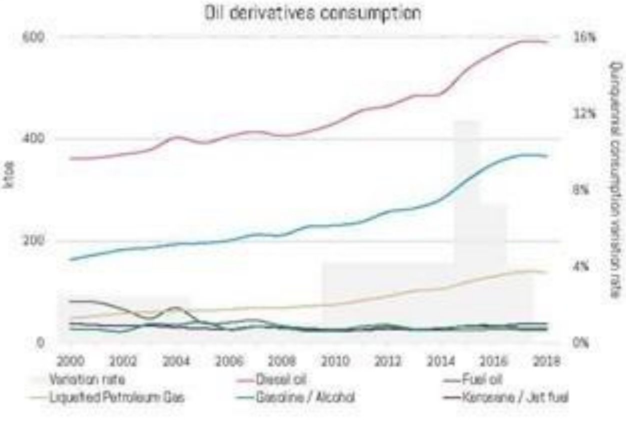
* Corresponds to wind, solar and vegetable waste (rice husks, coffee and peanuts)

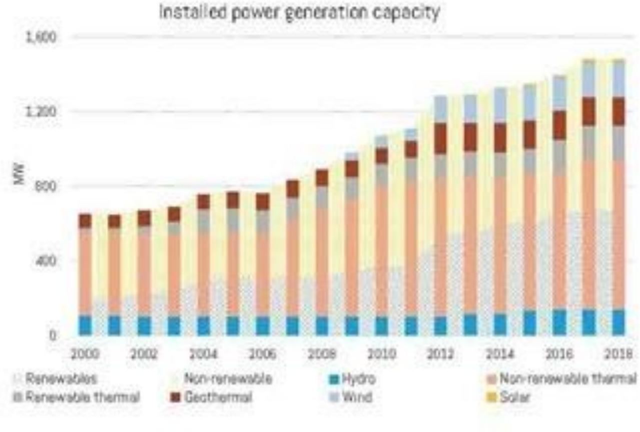

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 809; 54.55%
Renewables; 674; 45.45%
Hydro; 142; 9.61%
Geothermal; 155; 10.42%
Solar; 14; 0.94%
Wind; 186; 12.56%
Renewable thermal; 177; 11.91%

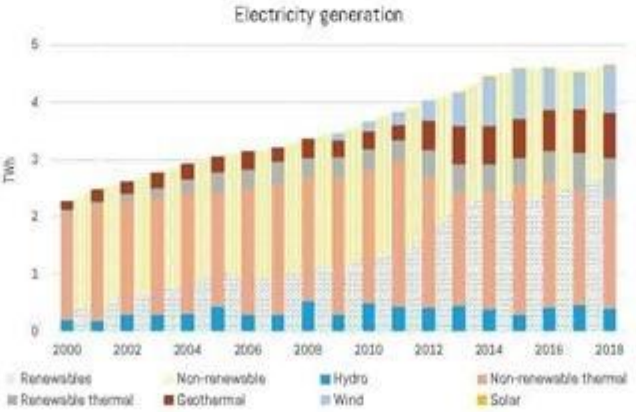

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 1,915; 41.15%
Renewables; 2,739; 58.85%
Hydro; 411; 8.83%
Geothermal; 801; 17.22%
Solar; 24; 0.52%
Wind; 801; 17.20%
Renewable thermal; 702; 15.08%

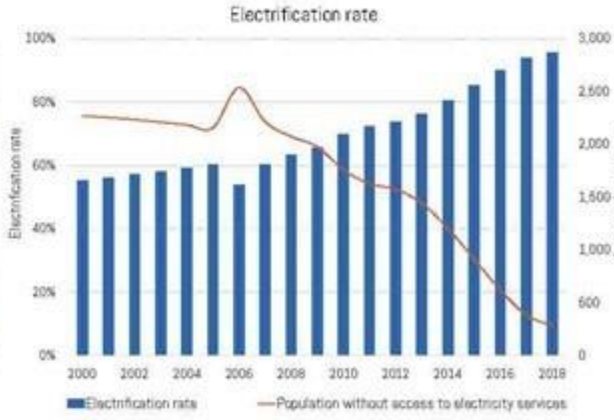

Oil supply
Mbbl
Quinquennial supply variation rate
Refining capacity 2018: 20 kbbl/day
Variation rate
Import
Export
Total supply

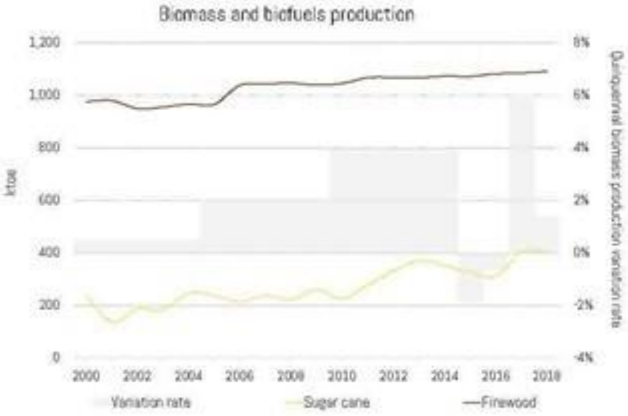

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

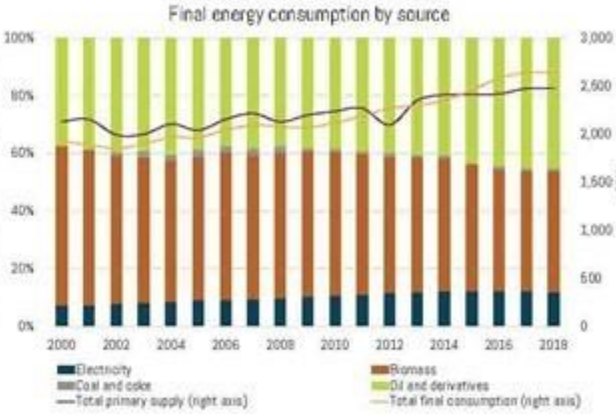

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel

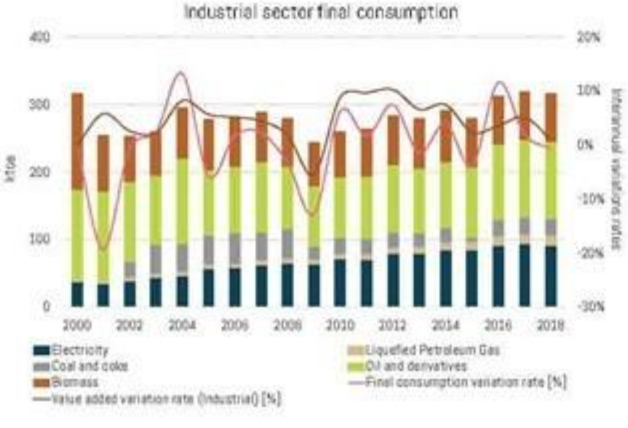

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Geothermal
Wind
Solar

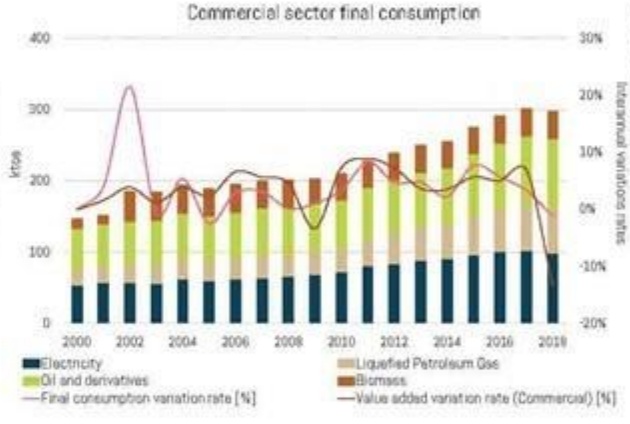

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Geothermal
Wind
Solar


Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services

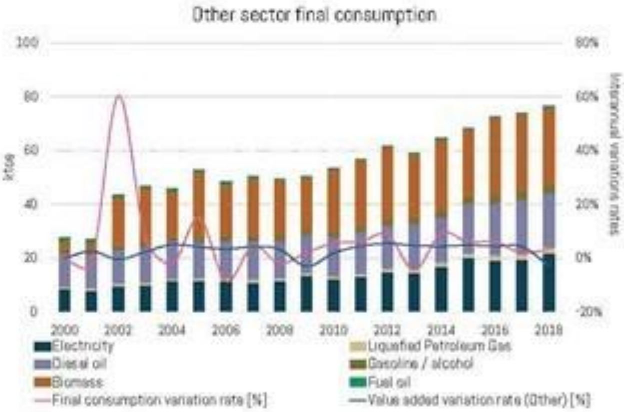

Biomass and biofuels production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood

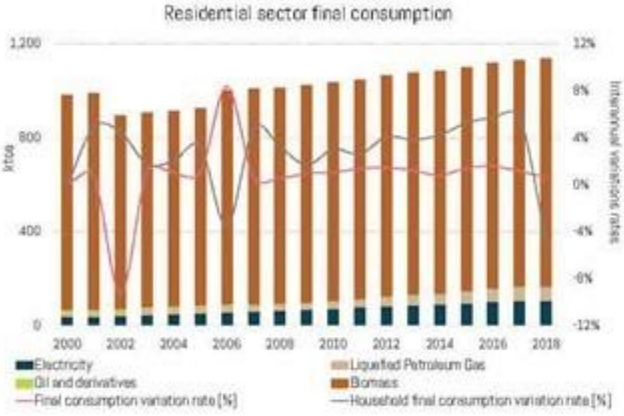

Final energy consumption by source
ktoe
Electricity
Coal and coke
Total primary supply (right axis)
Biomass
Oil and derivatives
Total final consumption (right axis)

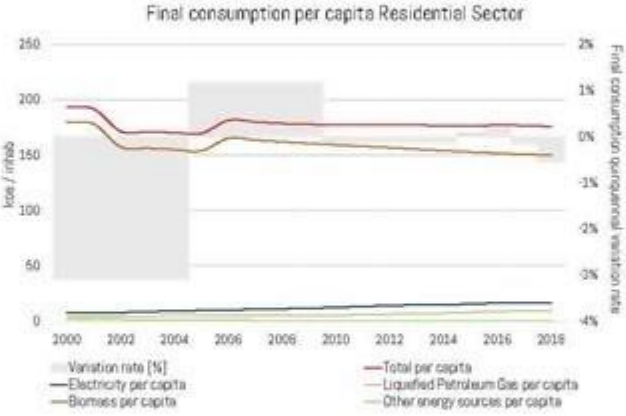

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]

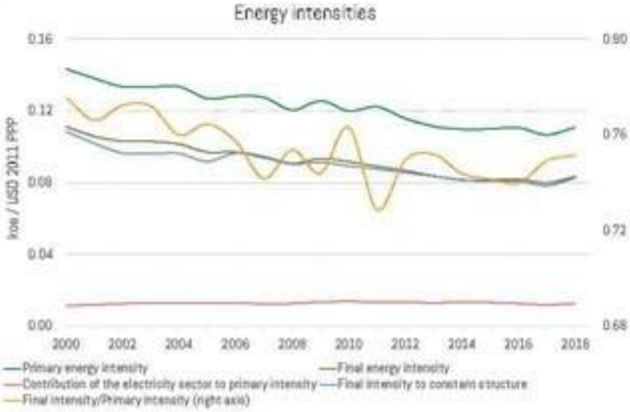

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Value added variation rate (Commercial) [%]

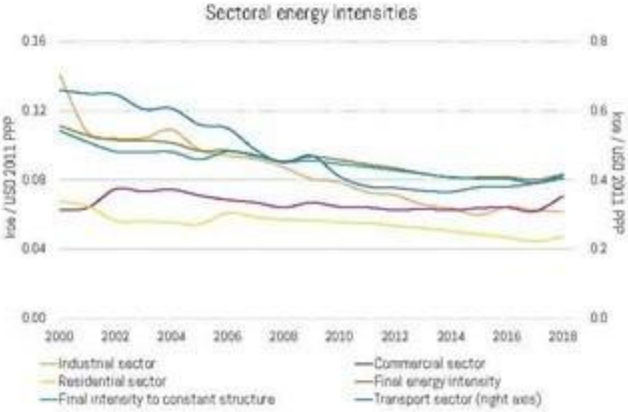

Transport sector final consumption
ktoe
Interannual variations rates
Kerosene / jet fuel
Gasoline / alcohol
Diesel oil
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

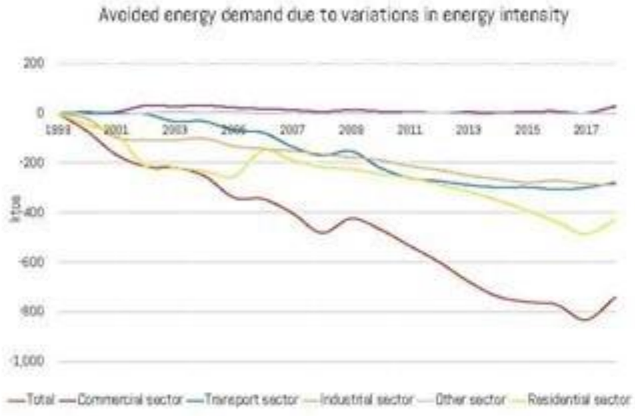

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Diesel oil
Gasoline / alcohol
Biomass
Fuel oil
Final consumption variation rate [%]
Value added variation rate (Other) [%]

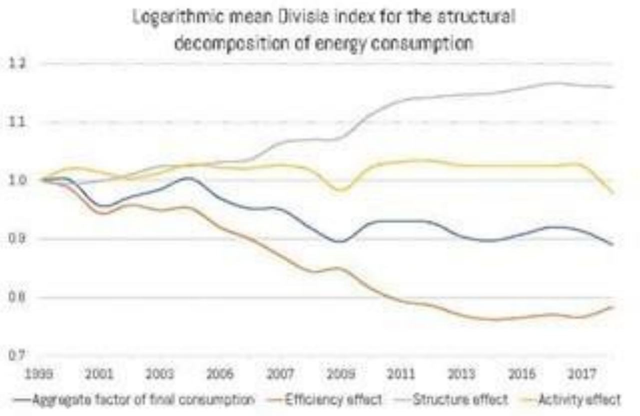

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

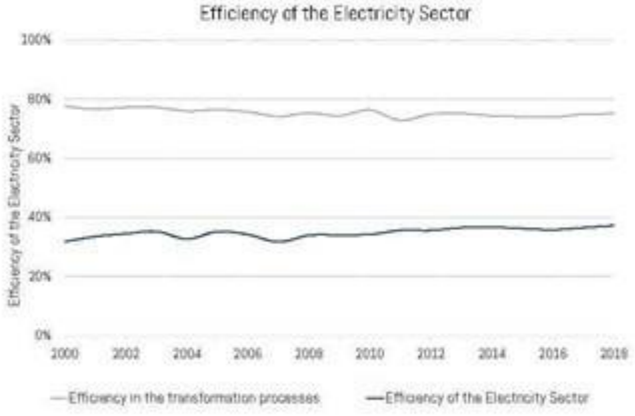

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

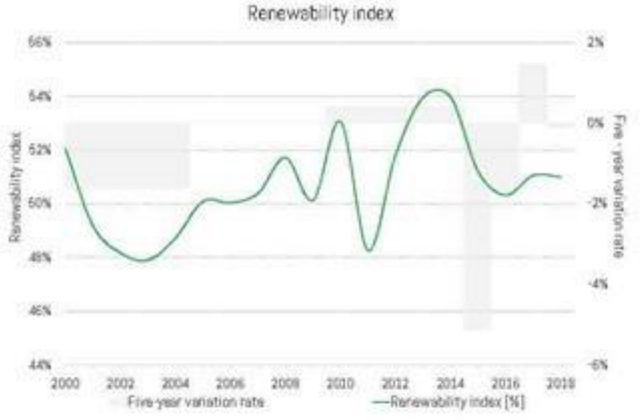

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

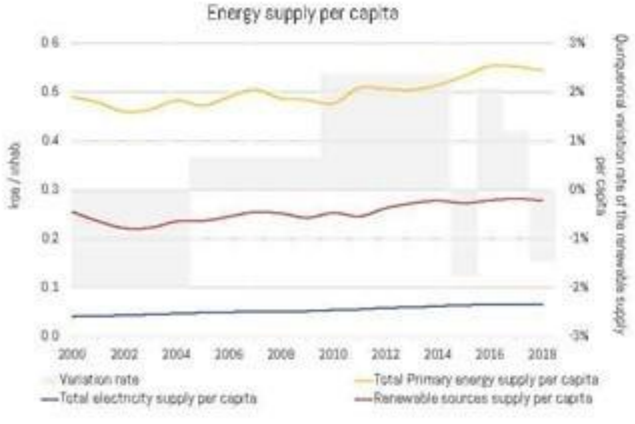

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

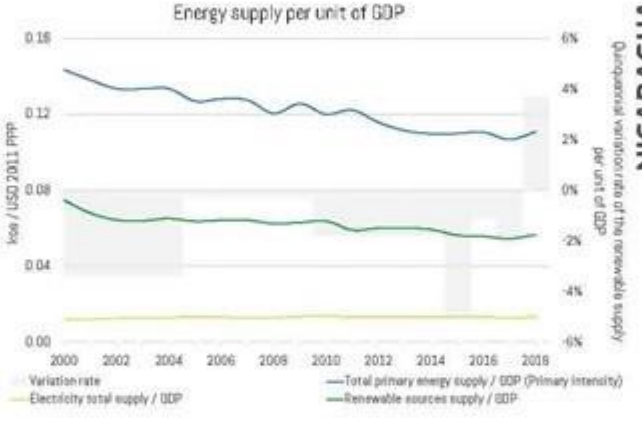

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

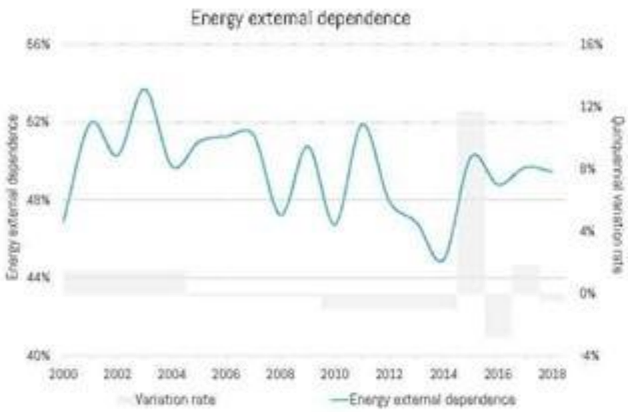

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

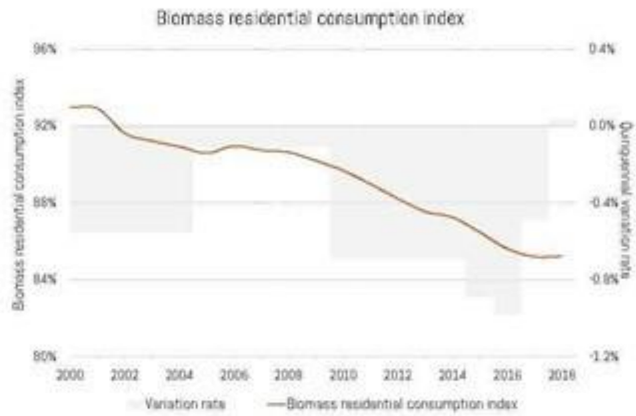

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector

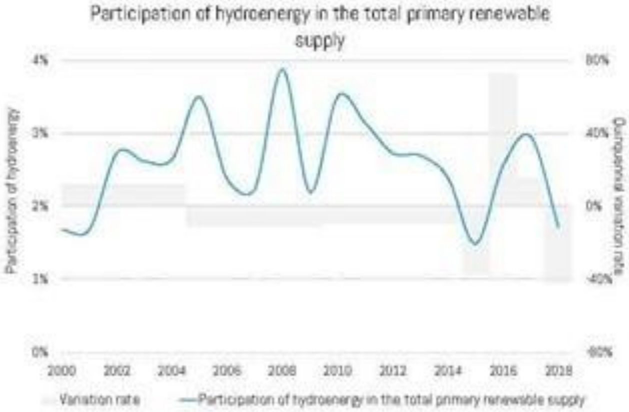

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

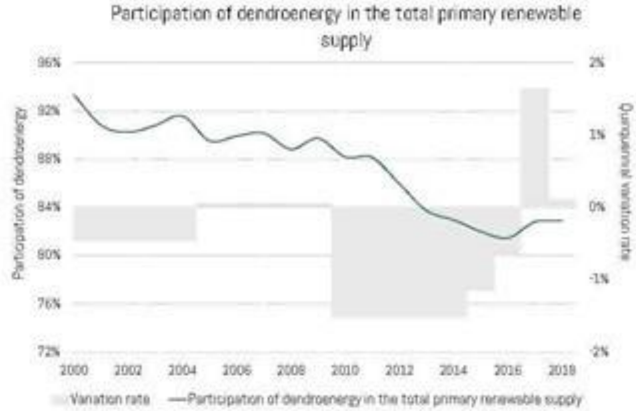

Energy supply per capita
koe / inhab
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

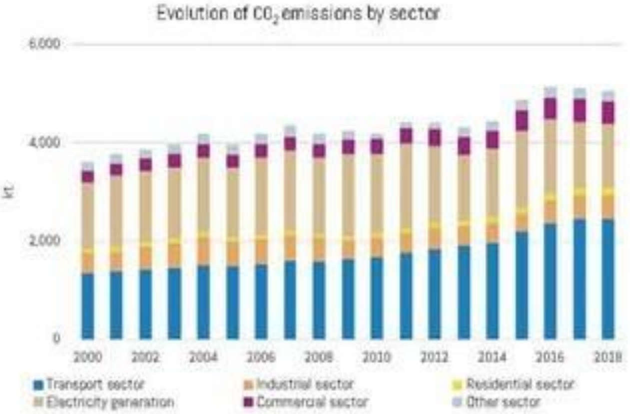

Energy supply per unit of GDP
koe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

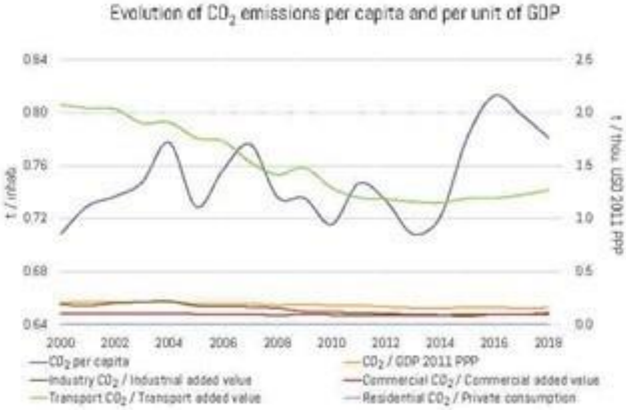

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

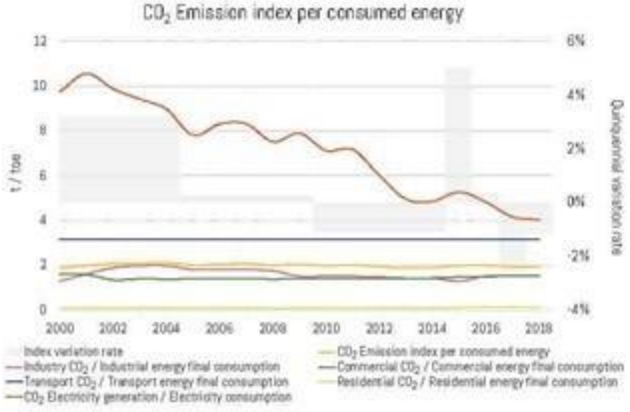

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index


Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

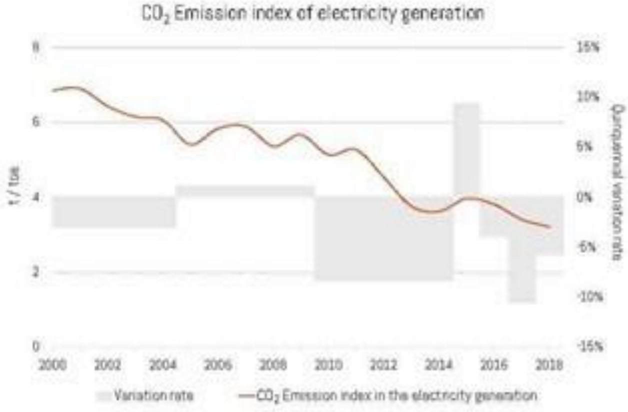

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector

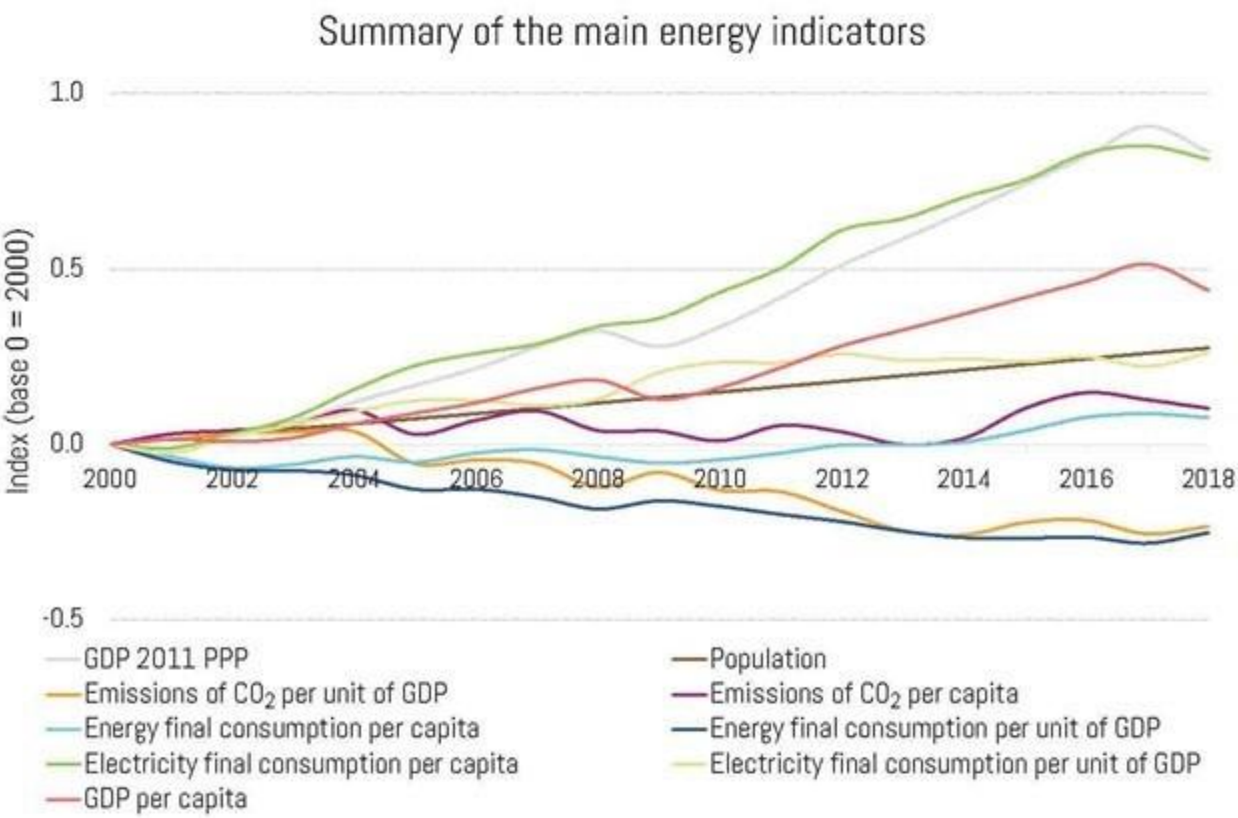

Evolution of CO2 emissions per capita and per unit of GDP
t / inhab.
t / thou. USD 2011 PPP
CO2 per capita
CO2 / GDP 2011 PPP
Industry CO2 / Industrial added value
Commercial CO2 / Commercial added value
Transport CO2 / Transport added value
Residential CO2 / Private consumption



CO_2 Emission index per consumed energy
12
10
8
6
4
2
0
6%
4%
2%
0%
-2%
-4%
t / toe
Quinquennial variation rate
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption

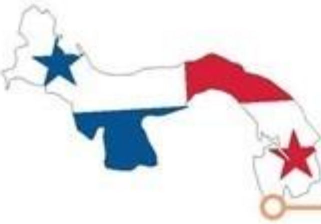


CO_2 Emission index of electricity generation
8
6
4
2
0
15%
10%
5%
0%
-5%
-10%
-15%
t / toe
Quinquennial variation rate
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
CO_2 Emission index in the electricity generation



Summary of the main energy indicators
1.0
0.5
0.0
-0.5
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

PANAMA



General Information 2018

Population (thousand inhab.)	4,177
Area (km²)	75,420
Population Density (inhab./km²)	55
Urban Population (%)	67
GDP USD 2010 (MUSD)	48,969
GDP USD 2011 PPP (MUSD)	94,708
GDP per Capita (thou. USD 2011 PPP/inhab.)	23

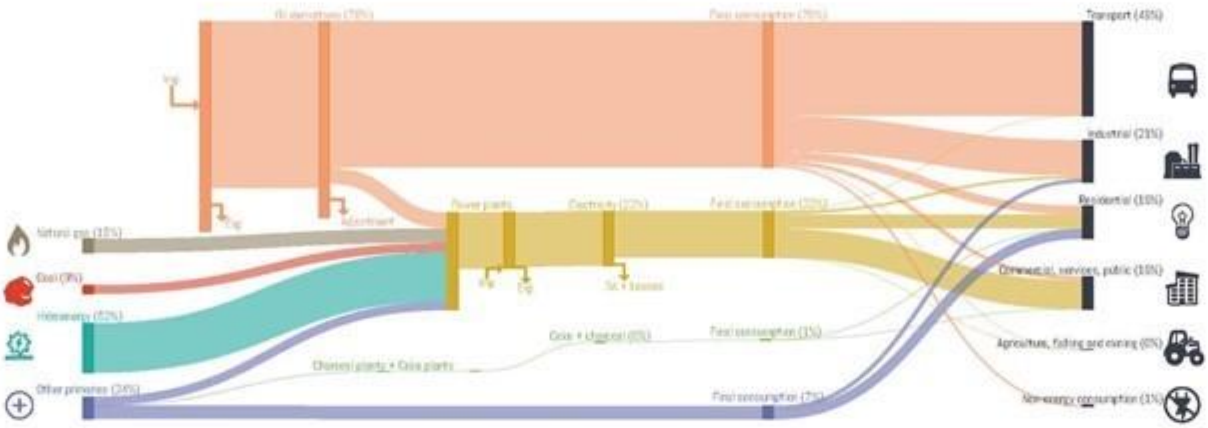
Energy Sector

	Mtoe
Final consumption in the Transport Sector	1.61
Final consumption in the Industrial Sector	0.73
Final consumption in the Residential Sector	0.56
Final consumption in the Commercial and Service Sector	0.56
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.06

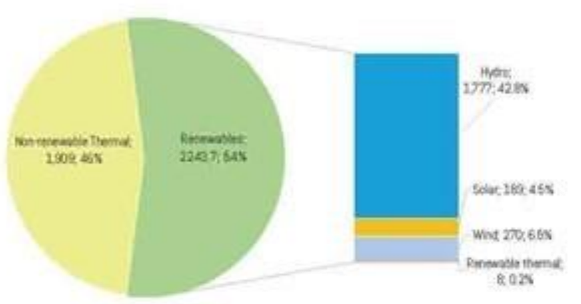
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	118

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,226	0.84	93.35	4.96	1.23	3.98	0.77	3.53	n.a.	4.15	0.05 / 0.04

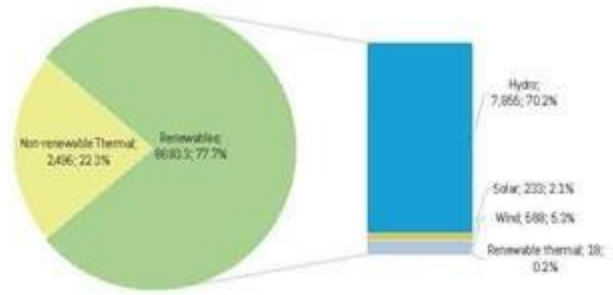
Summarized energy balance 2018



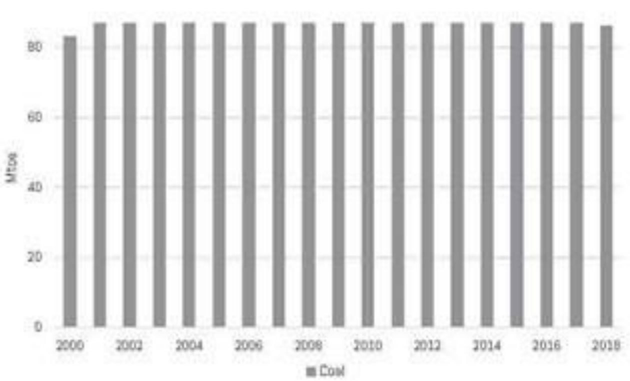
Installed power generation capacity [MW; %]
2018



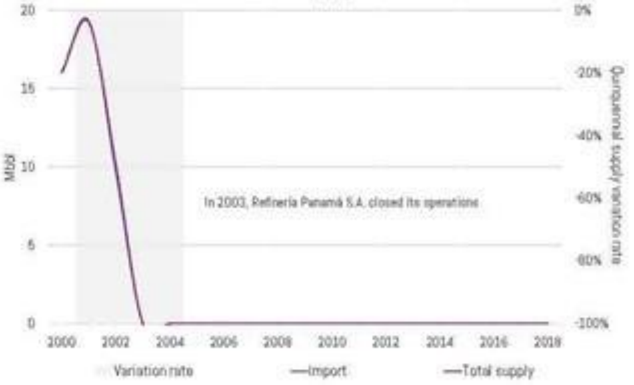
Electricity generation by source [GWh; %]
2018



Proven reserves of coal

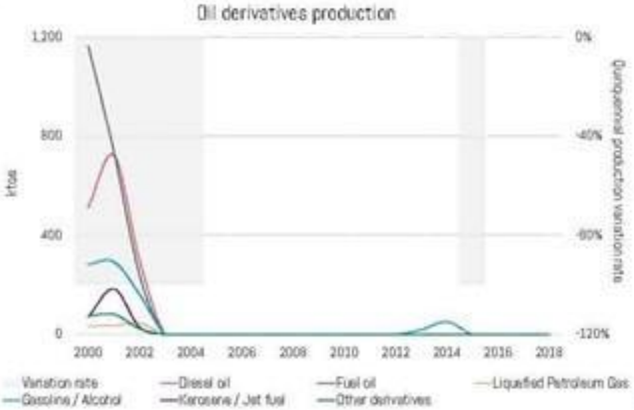


Oil supply

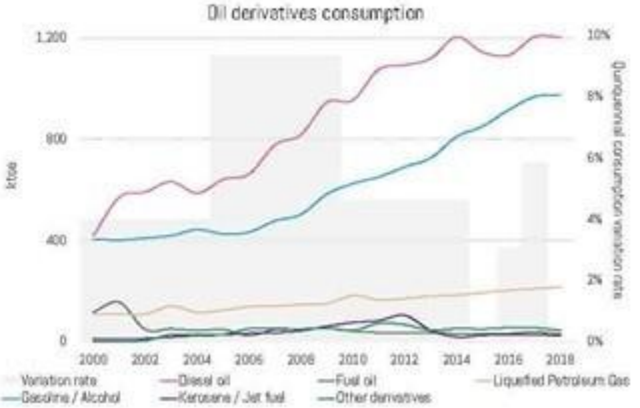


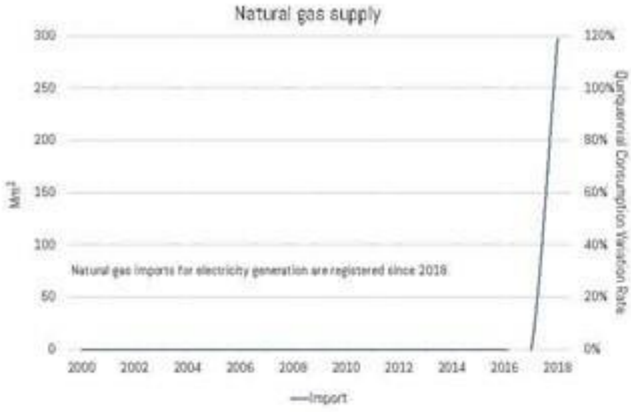
PANAMA

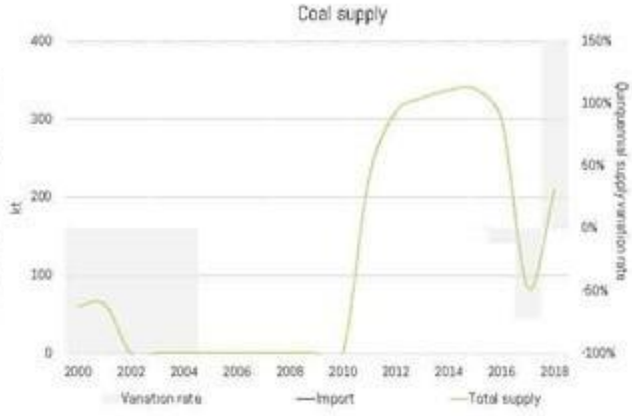
Oil derivatives production

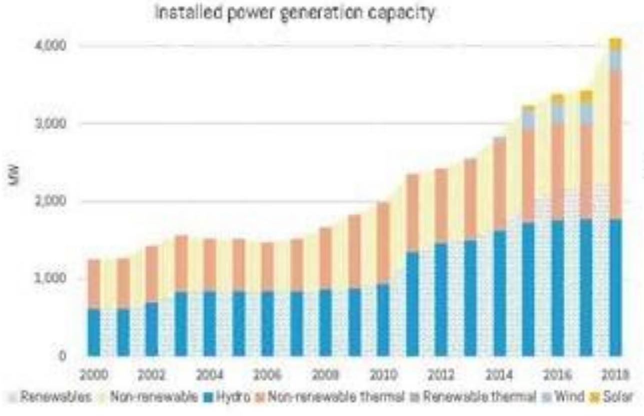


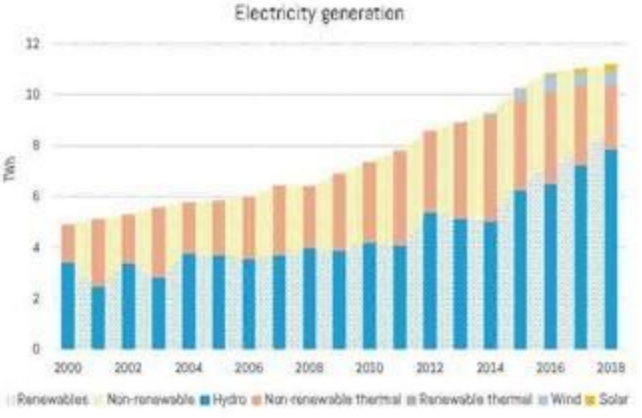
Oil derivatives consumption

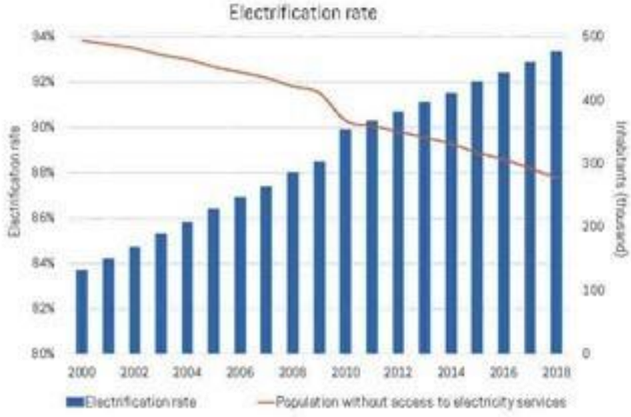


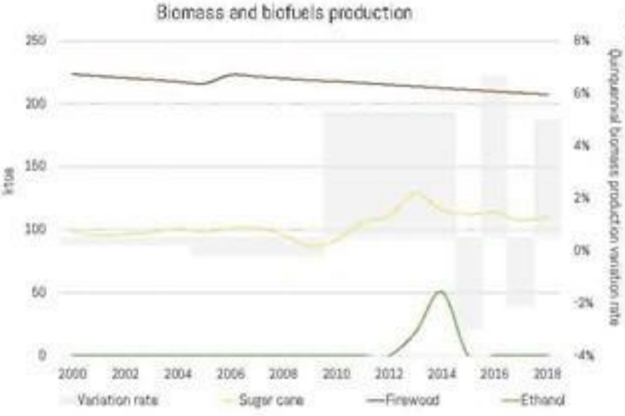

Natural gas supply
Mm³
Quinquennial Consumption Variation Rate
Natural gas imports for electricity generation are registered since 2018
Import

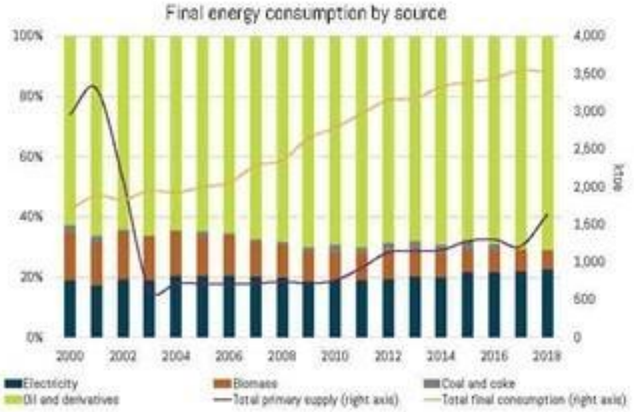

Coal supply
kt
Quinquennial supply variation rate
Variation rate
Import
Total supply

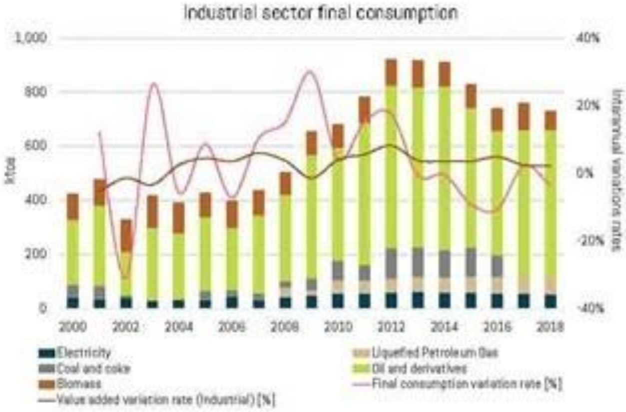

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

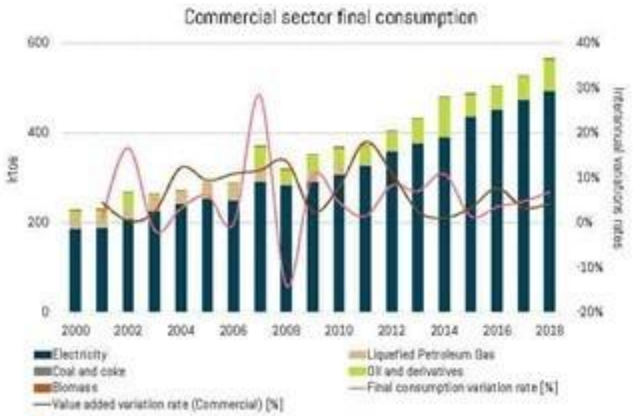

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

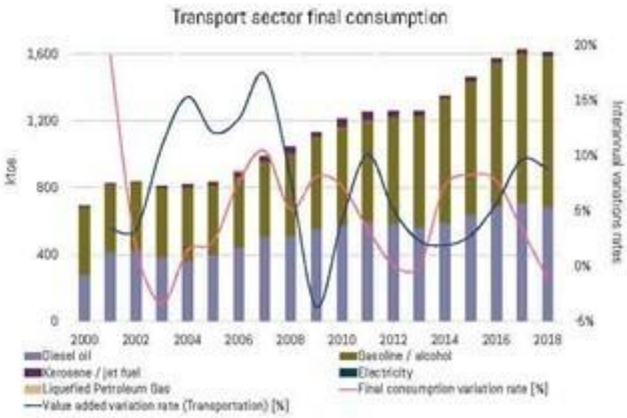

Electrification rate
Electrification rate
Inhabitants (thousand)
Electrification rate
Population without access to electricity services

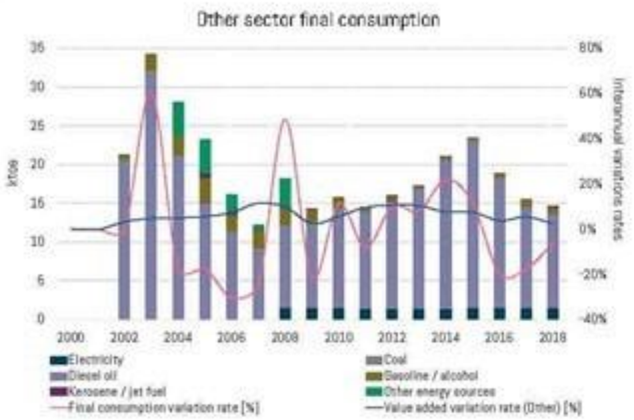

Biomass and biofuels production
ktoe
Quinquennial biomass production variation rate
Variation rate
Sugar cane
Firewood
Ethanol


Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

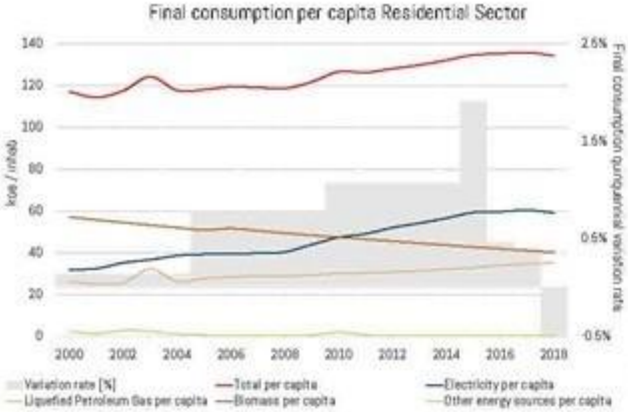

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]

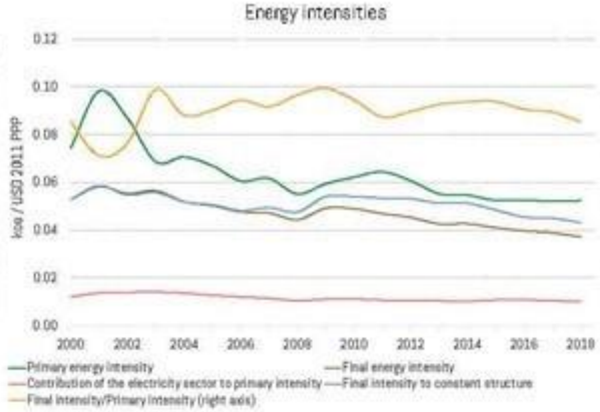

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]

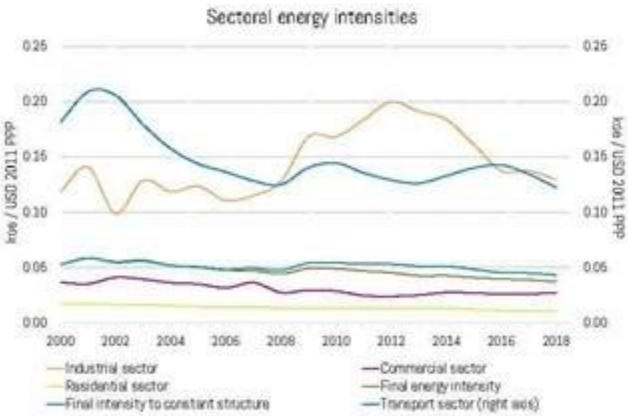

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Liquefied Petroleum Gas
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

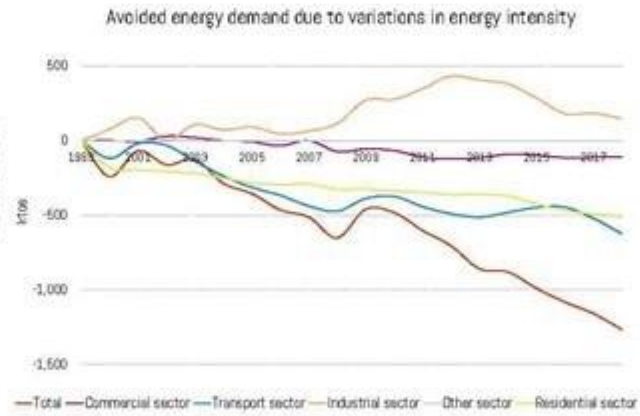

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Coal
Gasoline / alcohol
Other energy sources
Value added variation rate (Other) [%]

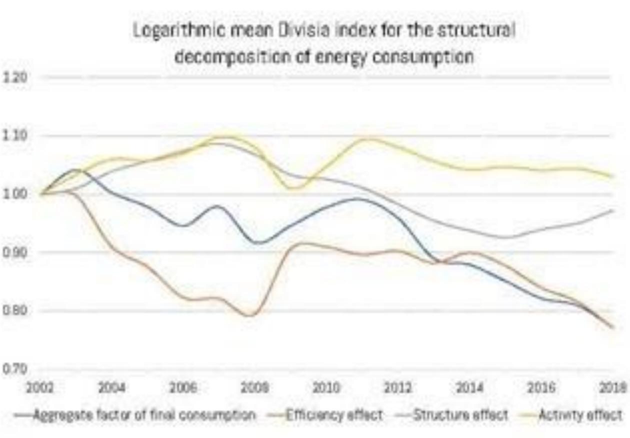

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]

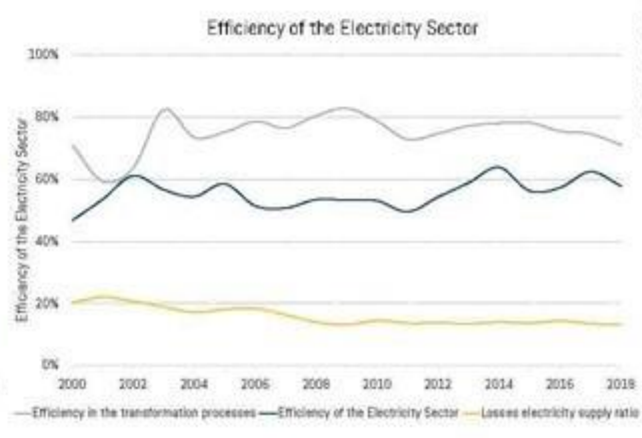

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

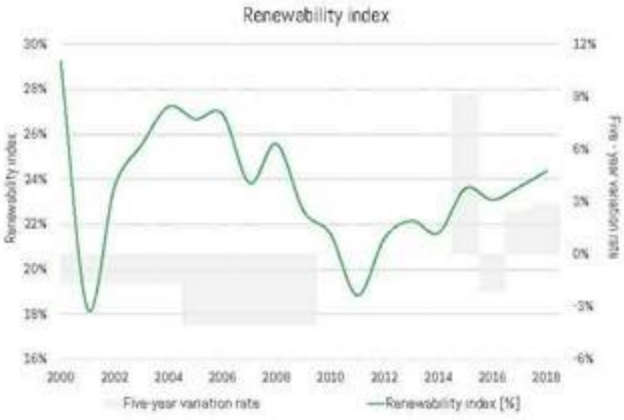

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

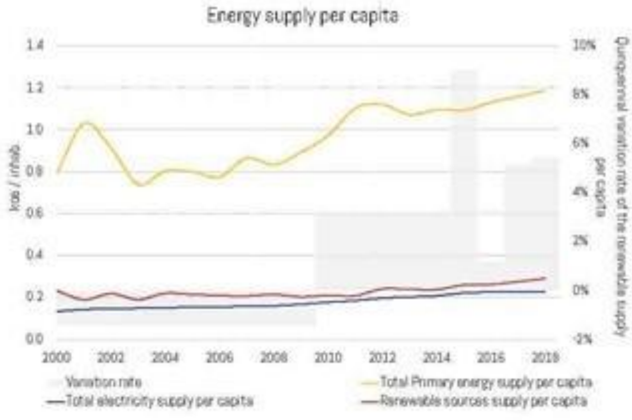

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

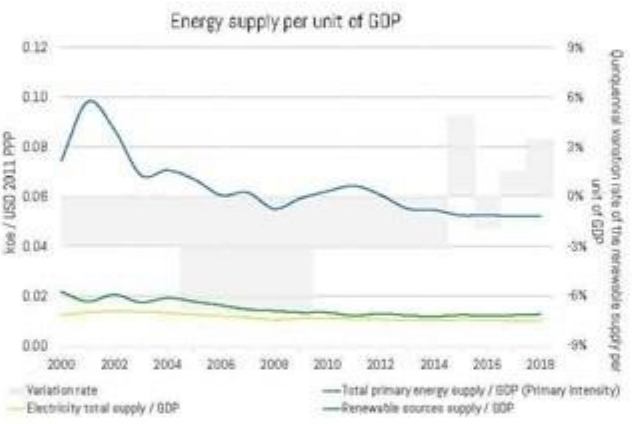

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

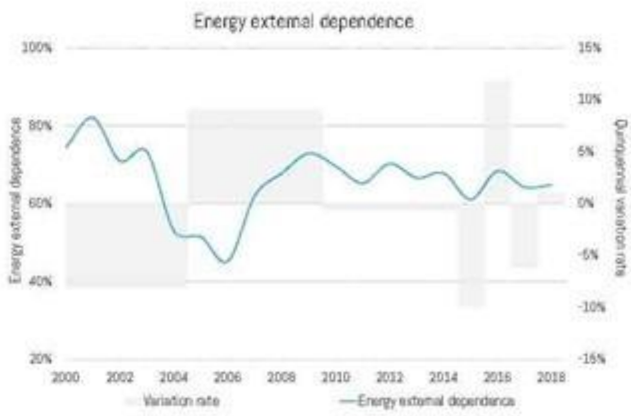

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

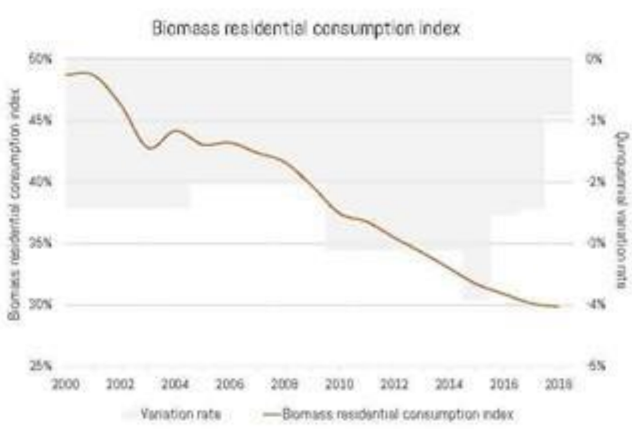




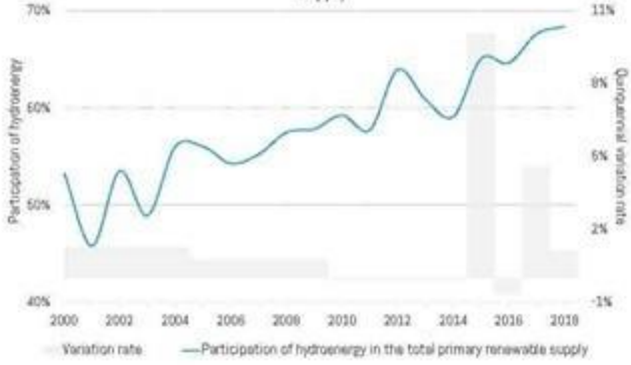




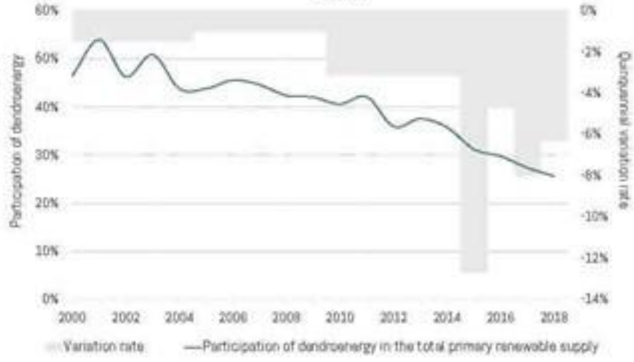
The first plant for generating electricity based on liquefied natural gas, with an installed capacity of 381 MW, began operating in Colón, Panama, which was inaugurated on August 17, 2018.



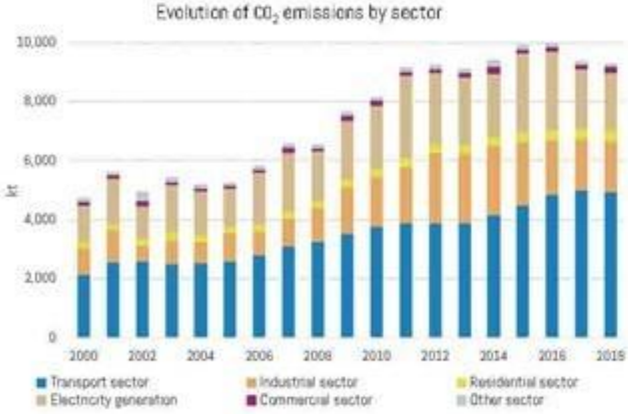
Participation of hydroenergy in the total primary renewable supply



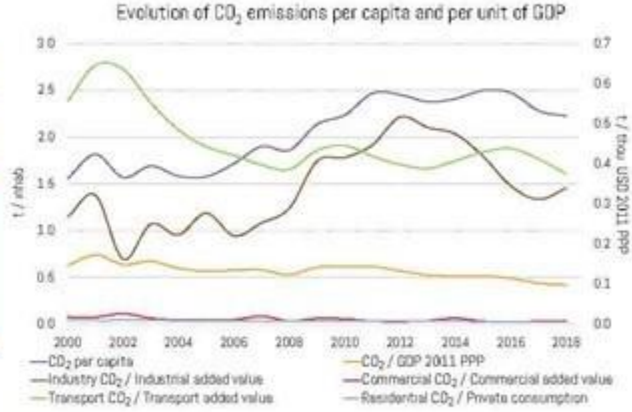
Participation of dendroenergy in the total primary renewable supply



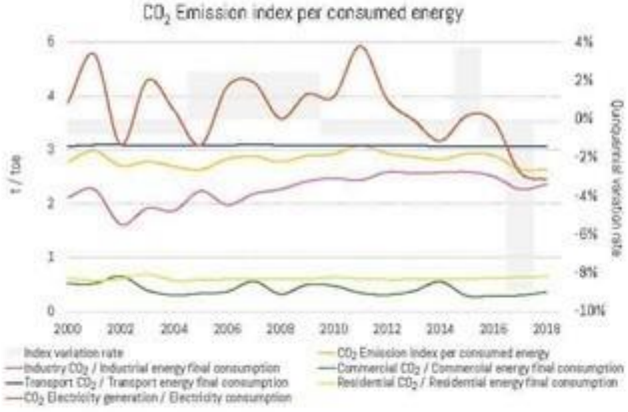
Evolution of CO_2 emissions by sector



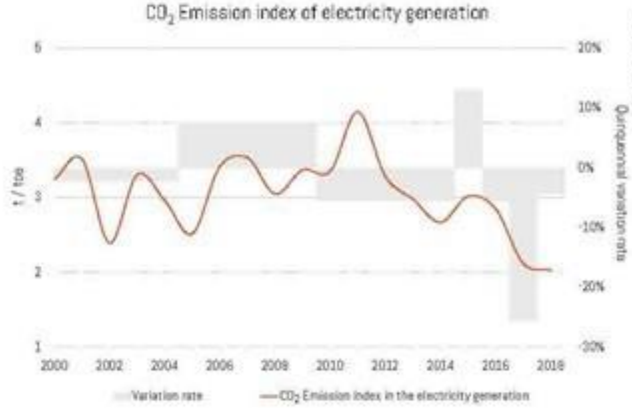
Evolution of CO_2 emissions per capita and per unit of GDP

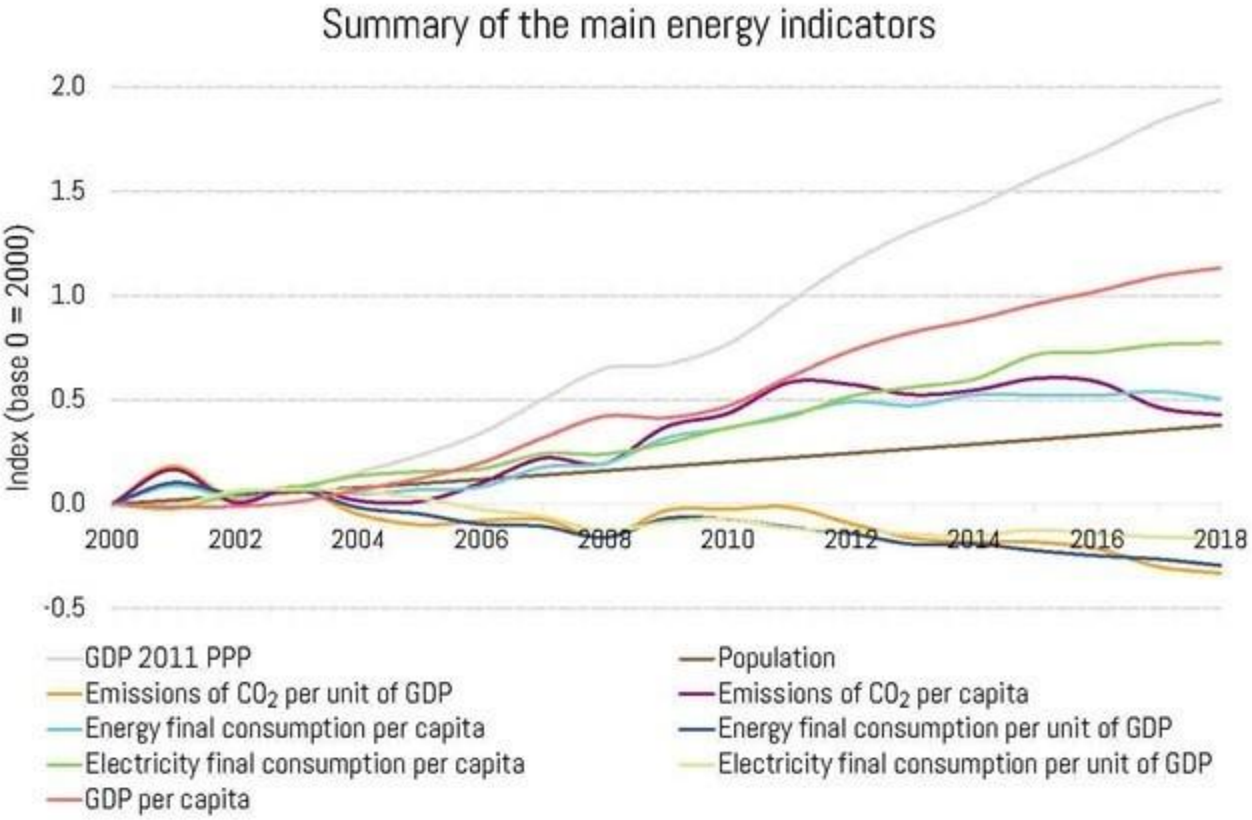


CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation




Summary of the main energy indicators
Index (base 0 = 2000)
2.0
1.5
1.0
0.5
0.0
-0.5
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO2 per unit of GDP
Emissions of CO2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

PARAGUAY

General Information 2018

Population (thousand inhab.)	7,053 [1]
Area (km²)	406,752
Population Density (inhab./km²)	17
Urban Population (%)	61.7
GDP USD 2010 (MUSD)	37,587
GDP USD 2011 PPP (MUSD)	83,911
GDP per Capita (thou. USD 2011 PPP/inhab.)	12

Energy Sector

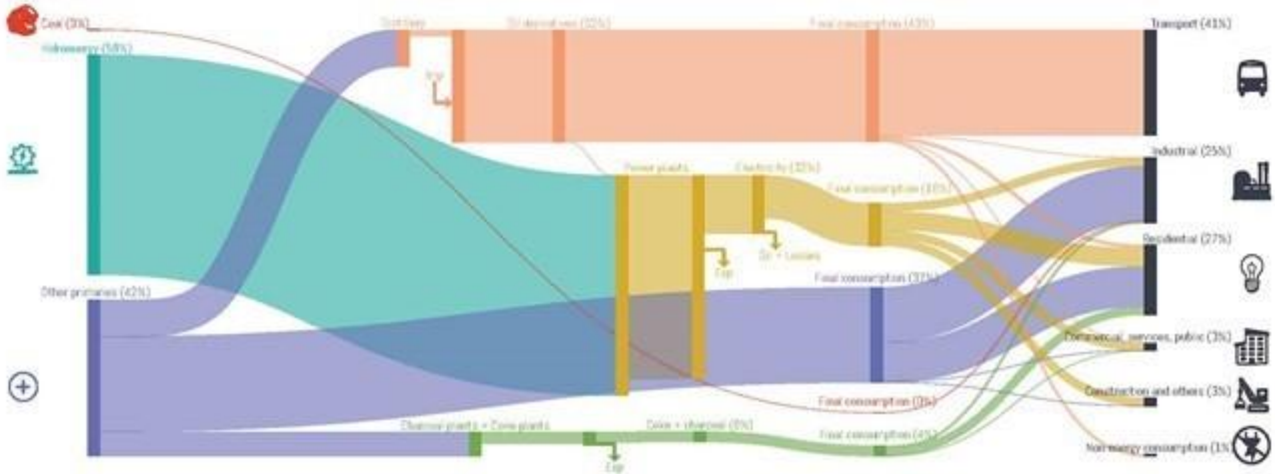
Final consumption in the Transport Sector	Mtoe 2.55
Final consumption in the Industrial Sector	Mtoe 1.55
Final consumption in the Residential Sector	Mtoe 1.75
Final consumption in the Commercial and Service Sector	Mtoe 0.21
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.27

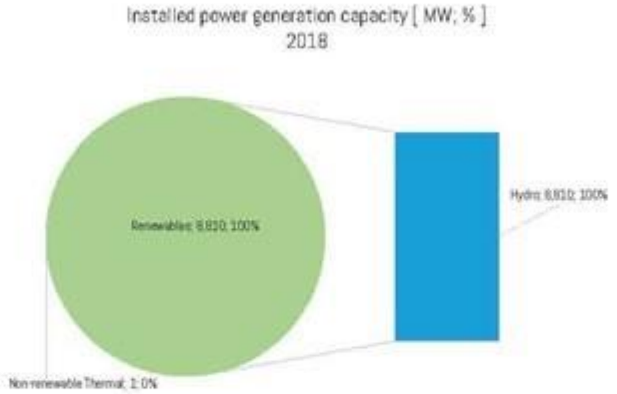
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	n.a.

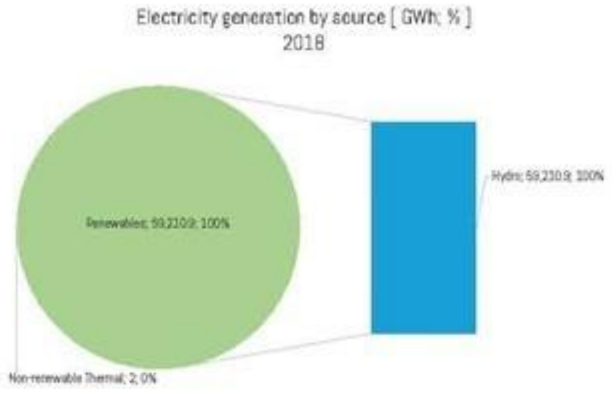
[1] Directorate General for Statistics, Surveys and Censuses.
[2] The "Villa Elisa" refinery is inactive but has not been dismantled, corresponding to 2005.
Note: The country updated the density of firewood to 768.8 kg / m³ based on recent studies and was applied for the years 2016 to 2018.

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,773	0.93	99.54	8.43	9.87	2.71	3.71	6.54	0.0 [2]	8.81	0.10 / 0.08

Summarized energy balance 2018

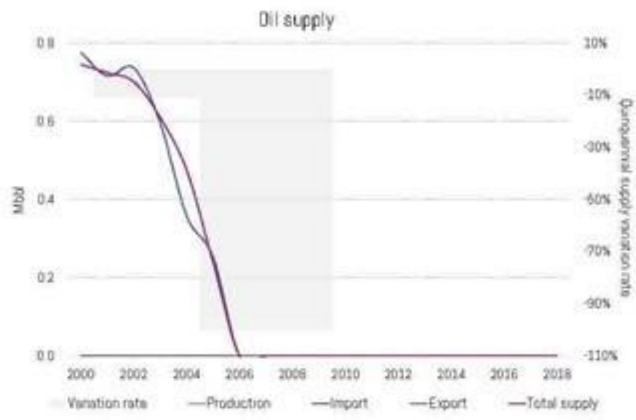


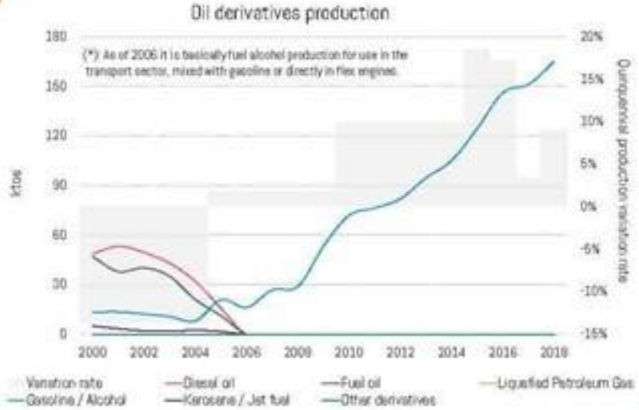


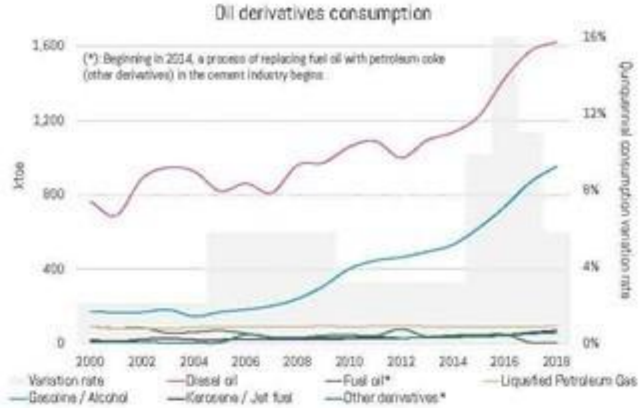


In 2005, the Villa Elisa Refinery, owned by the state-owned company PETROPAR, is closed.

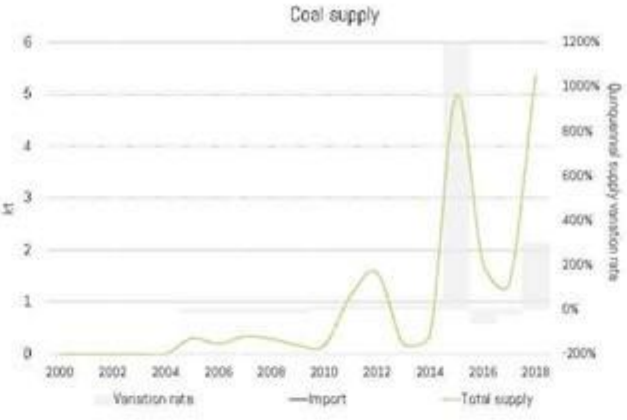
Its capacity was 7.5 kbbl / day.

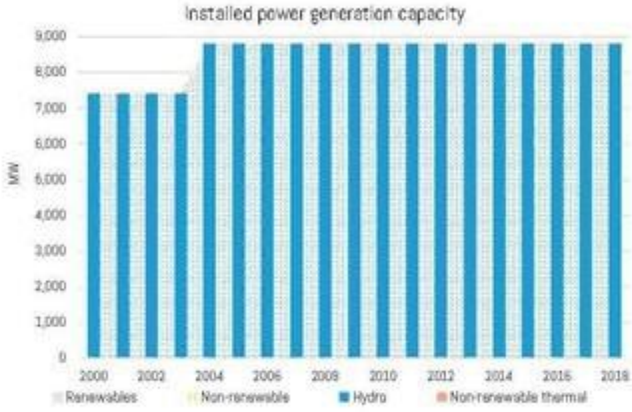


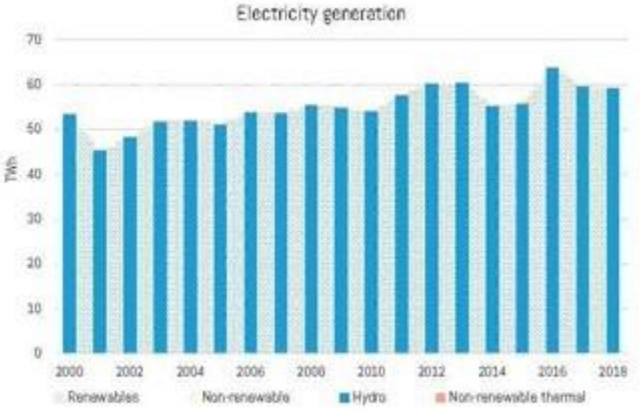


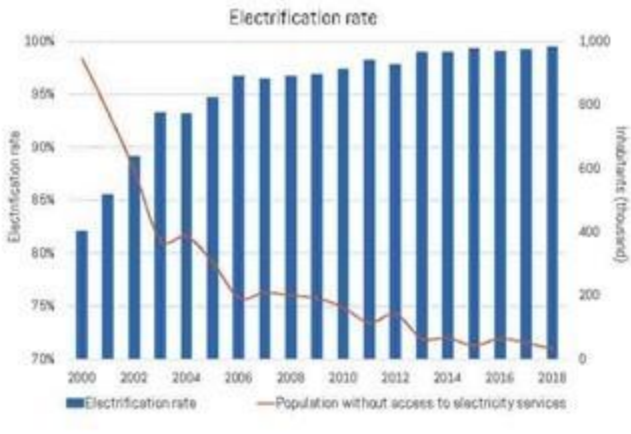


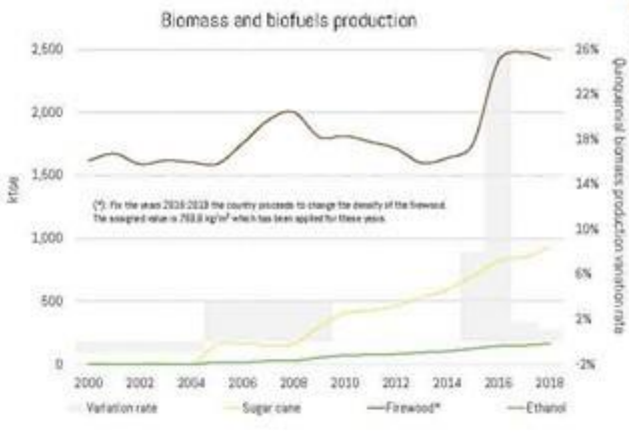
The second work is inaugurated in 500 kV Yacyretá - Ayolas - Villas Hayes (YACAYO - VHA) to increase the levels of safety, reliability and optimization in the operation of the National Electric System.



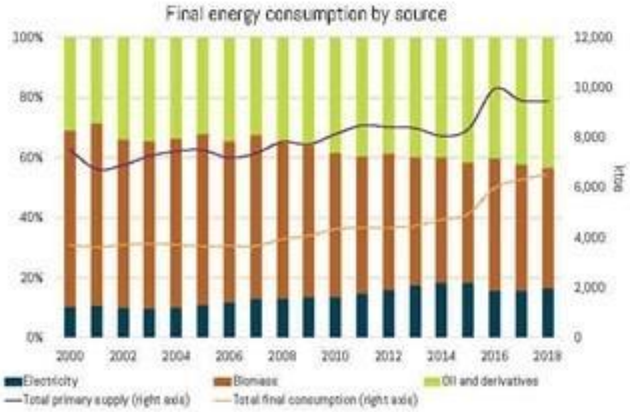


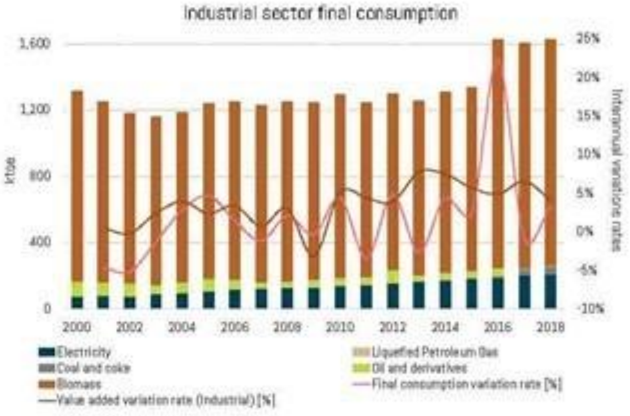


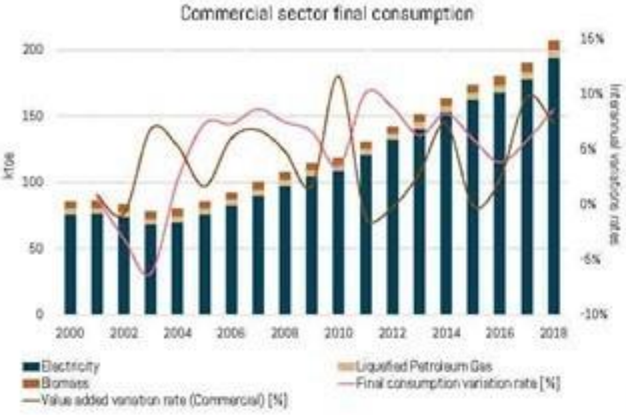


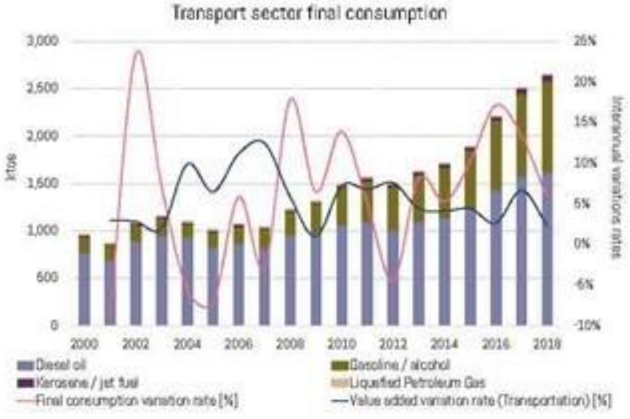


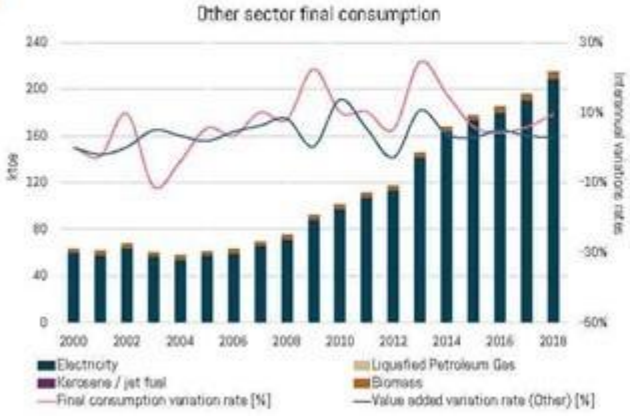
PARAGUAY

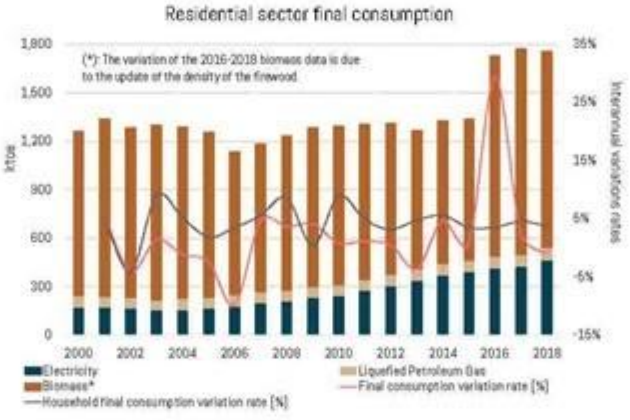

Final energy consumption by source
ktoe
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

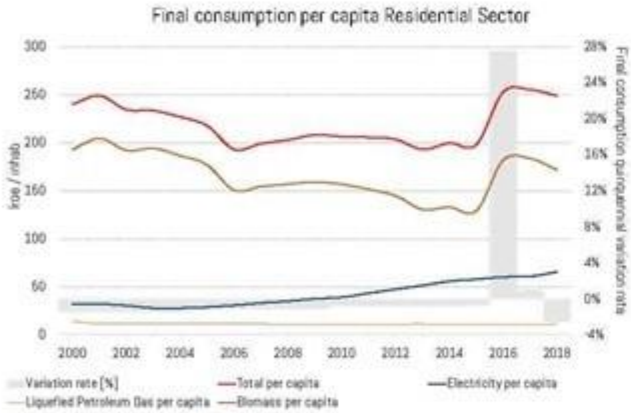

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]

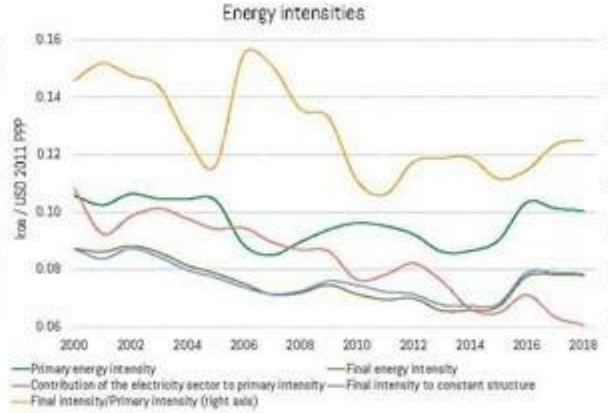

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Biomass
Value added variation rate (Commercial) [%]
Liquefied Petroleum Gas
Final consumption variation rate [%]

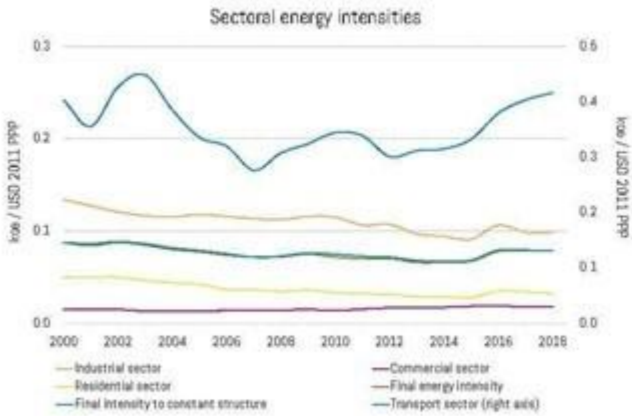

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Gasoline / alcohol
Liquefied Petroleum Gas
Value added variation rate (Transportation) [%]

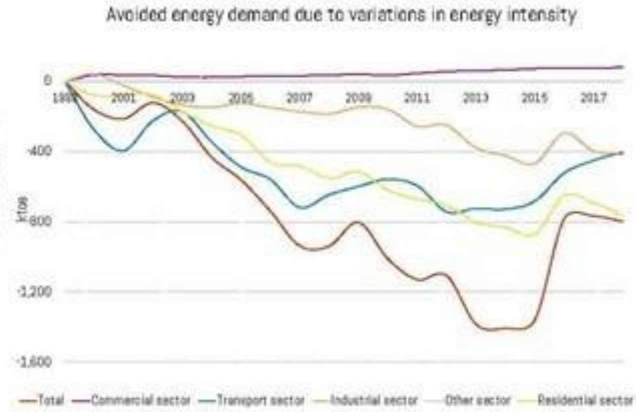

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Kerosene / jet fuel
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Value added variation rate (Other) [%]

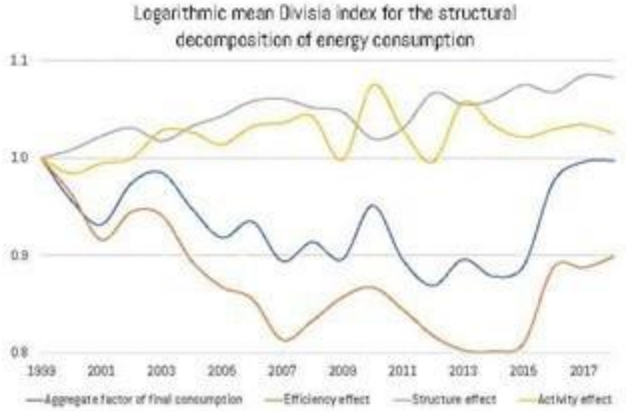

Residential sector final consumption
(*): The variation of the 2016-2018 biomass data is due to the update of the density of the firewood
ktoe
Interannual variations rates
Electricity
Biomass*
Household final consumption variation rate [%]
Liquefied Petroleum Gas
Final consumption variation rate [%]

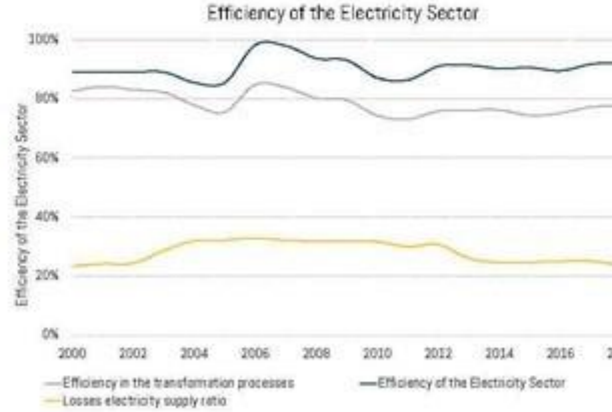

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita

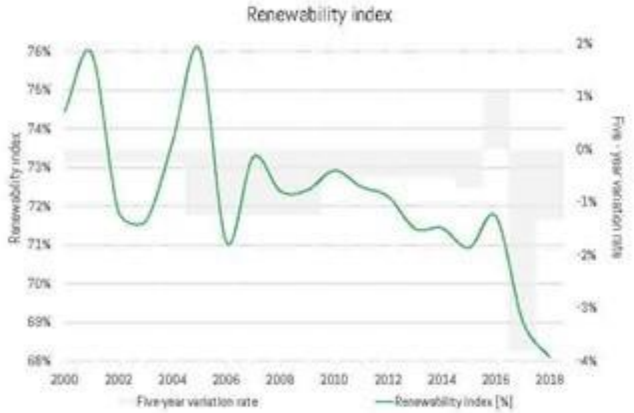

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

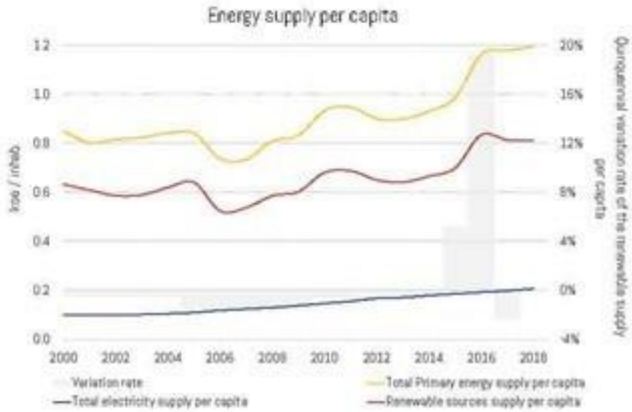

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

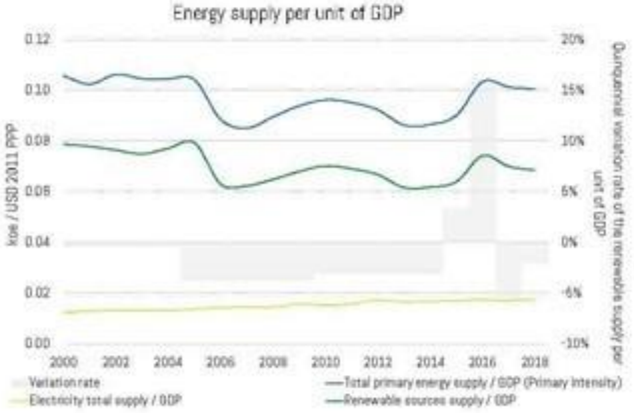

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

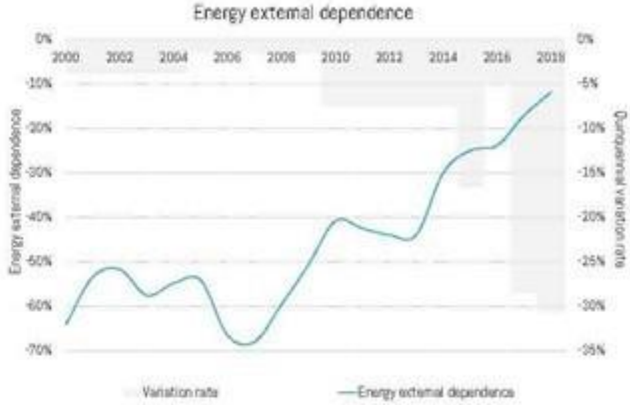

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

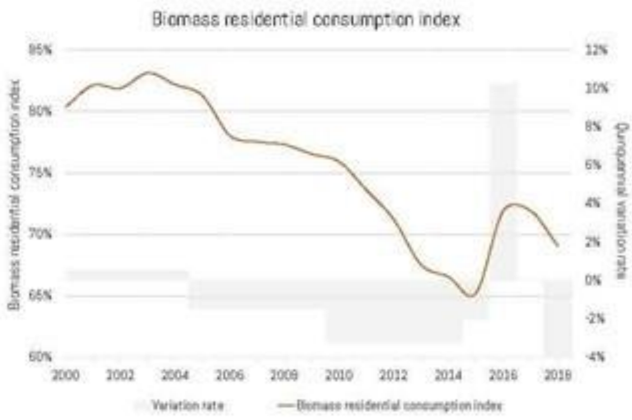


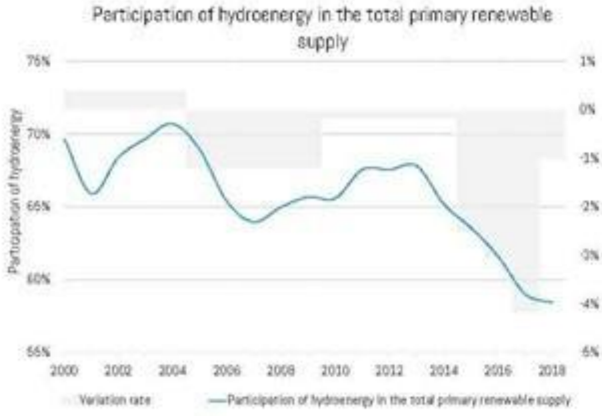


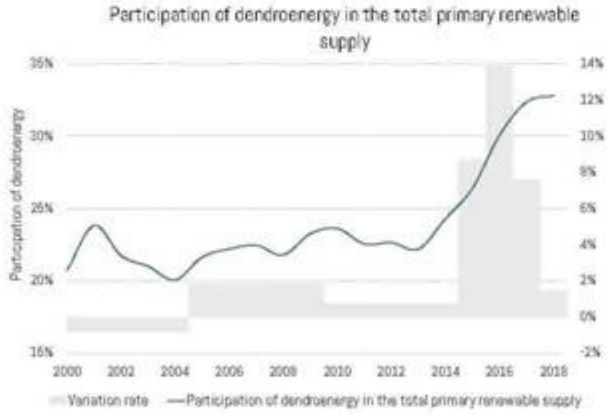


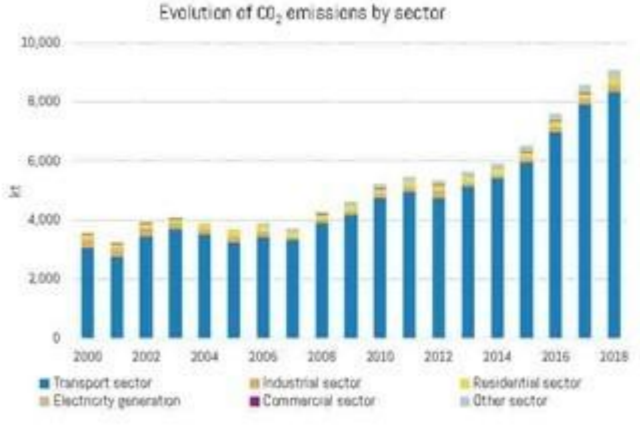


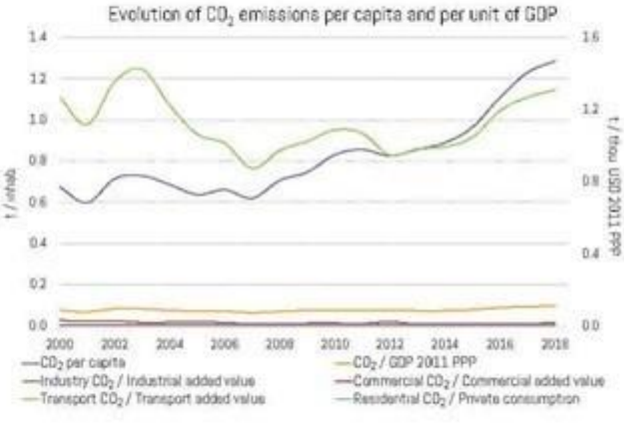
In 2018, ITAIPU Binacional generates 9.6 million MWh of energy (50% belongs to Paraguay), which corresponds to its fourth best historical mark.

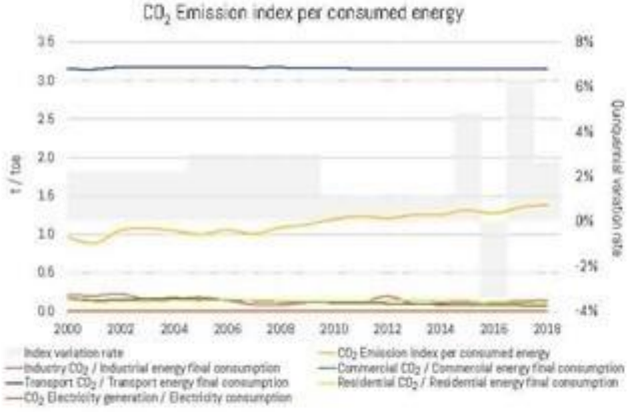


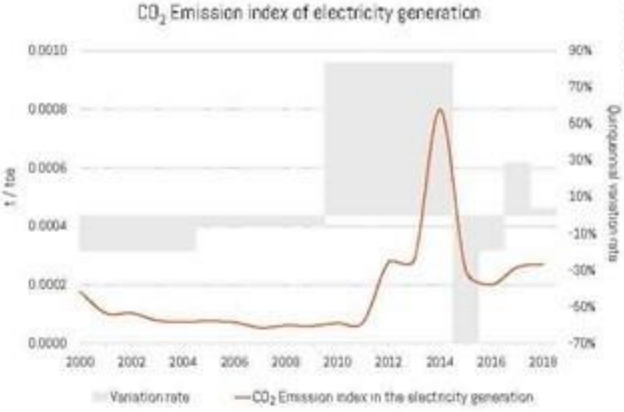

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

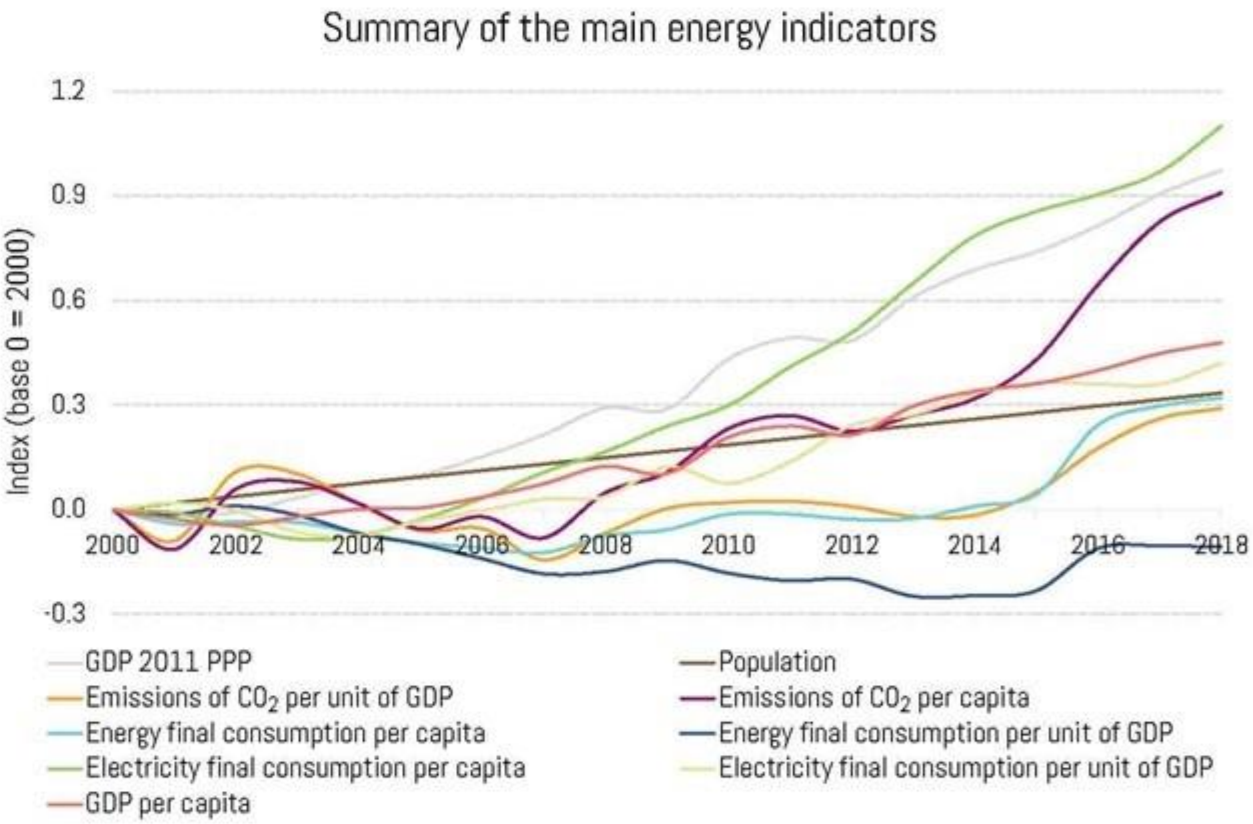

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
Transport sector
Industrial sector
Residential sector
Electricity generation
Commercial sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.2
0.9
0.6
0.3
0.0
-0.3
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

PERU

General Information 2018

Population (thousand inhab.)	32,162
Area (km²)	1,285,220
Population Density (inhab./km²)	25
Urban Population (%)	80
GDP USD 2010 (MUSD)	206,454
GDP USD 2011 PPP (MUSD)	409,277
GDP per Capita (thou. USD 2011 PPP/inhab.)	13

Energy Sector

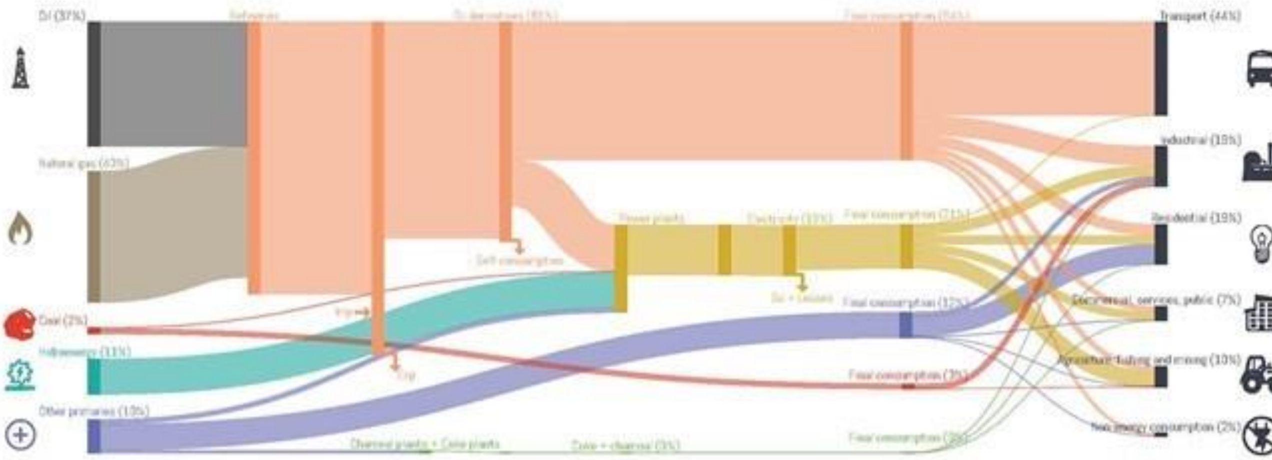
	Mtoe
Final consumption in the Transport Sector	8.77
Final consumption in the Industrial Sector	3.81
Final consumption in the Residential Sector	3.80
Final consumption in the Commercial and Service Sector	1.38
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	2.35

Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
339 [1]	365 [1]	7 [2]

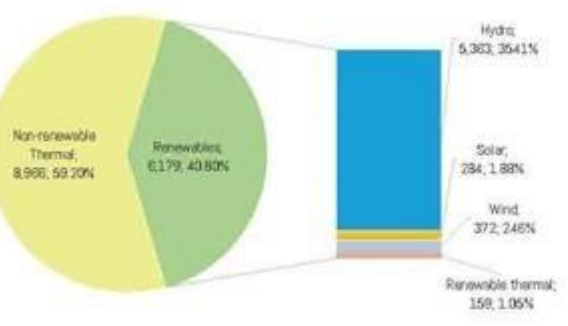
[1] Data corresponding to the year 2017. **Source:** 2017 Annual Book of Hydrocarbons Resources, MINEM.
[2] Data corresponding to the year 2017.
[3] It includes bunker of 1.15 Mtoe.

Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,502	0.63	97.00	26.41	30.52	11.90	11.72 [3]	20.11	198 [1]	15.14	0.08 / 0.05

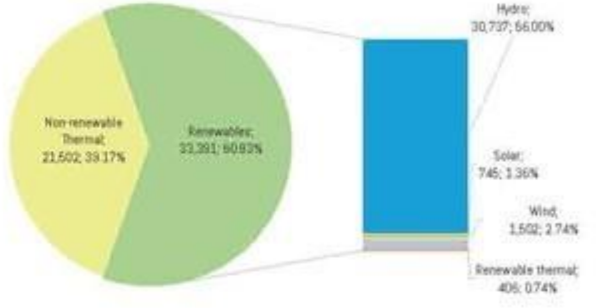
Summarized energy balance 2018



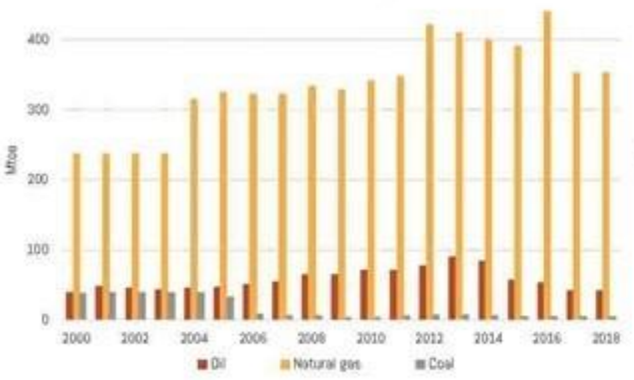
Installed power generation capacity [MW; %]
2018



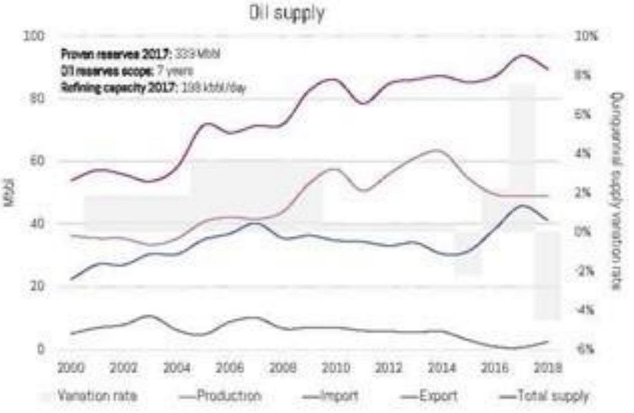
Electricity generation by source [GWh; %]
2018



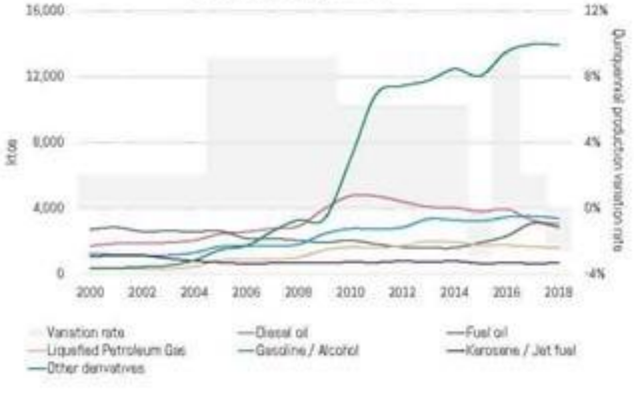
Proven reserves of oil, natural gas and coal



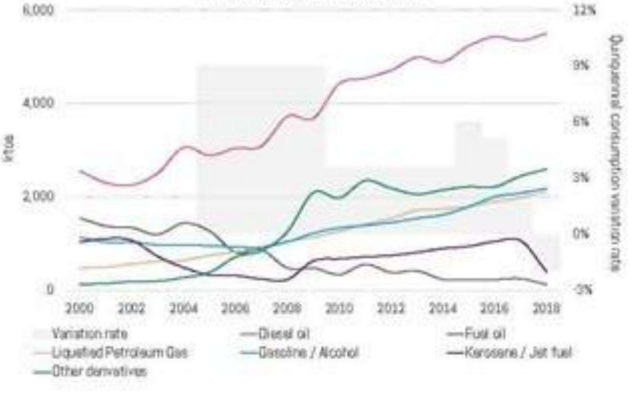
Oil supply

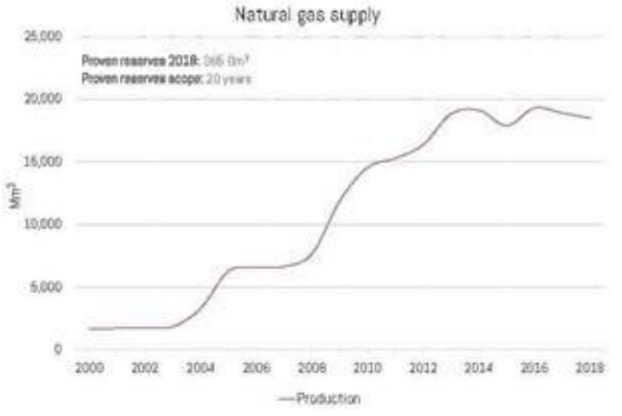


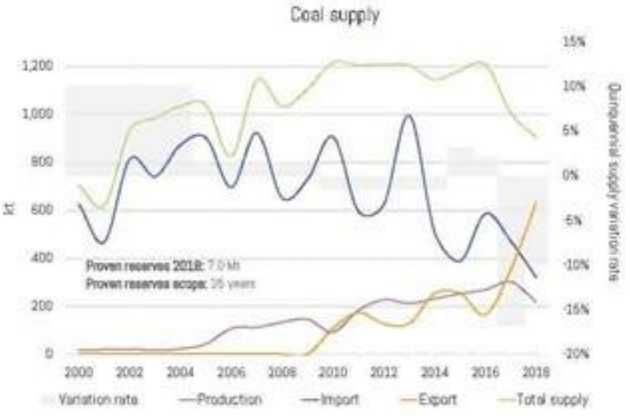
Oil derivatives production

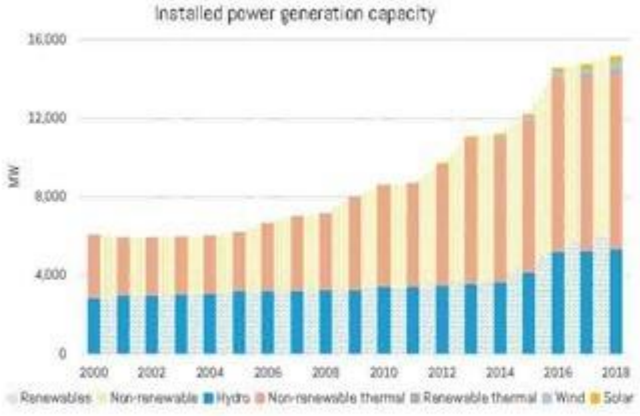


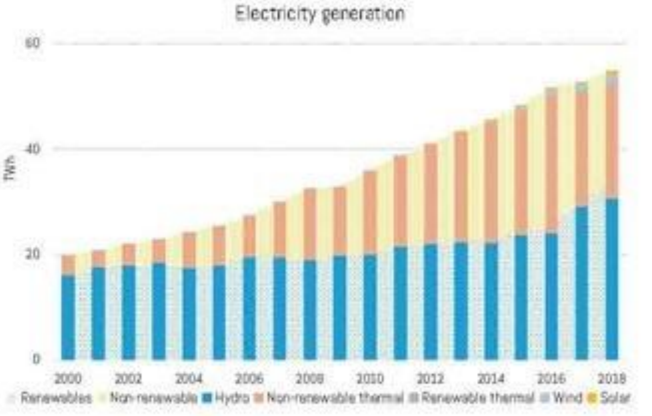
Oil derivatives consumption

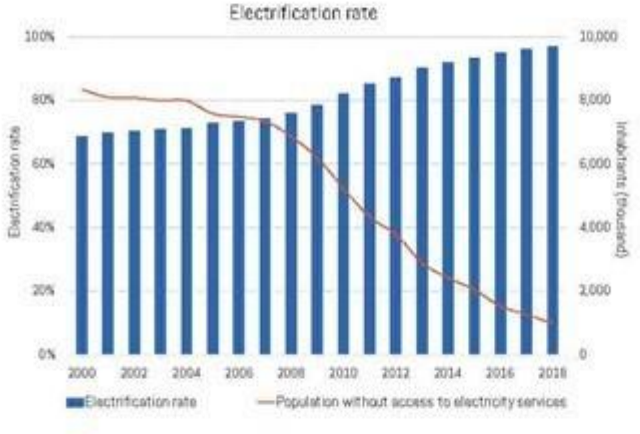


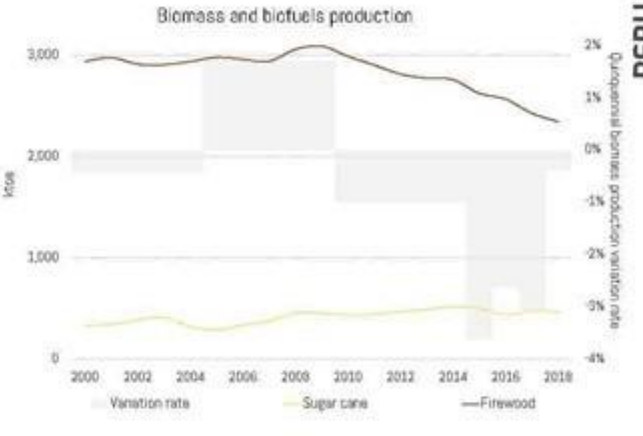

Natural gas supply
Proven reserves 2018:
Proven reserves scope: 20 years
Mm³
25,000
20,000
15,000
10,000
5,000
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Production

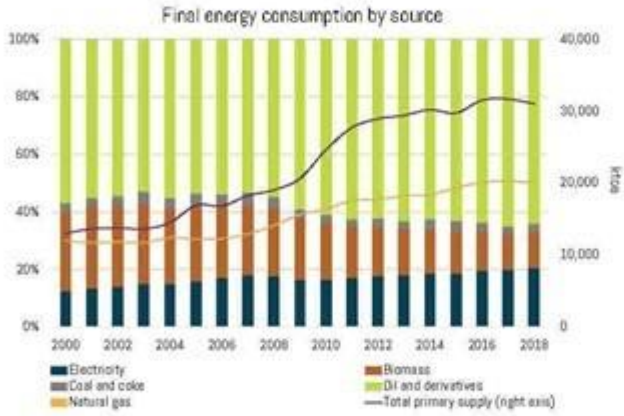

Coal supply
Proven reserves 2018: 7.0 Mt
Proven reserves scope:
kt
1,200
1,000
800
600
400
200
0
15%
10%
5%
0%
-5%
-10%
-15%
-20%
Quinquennial supply variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Production
Import
Export
Total supply

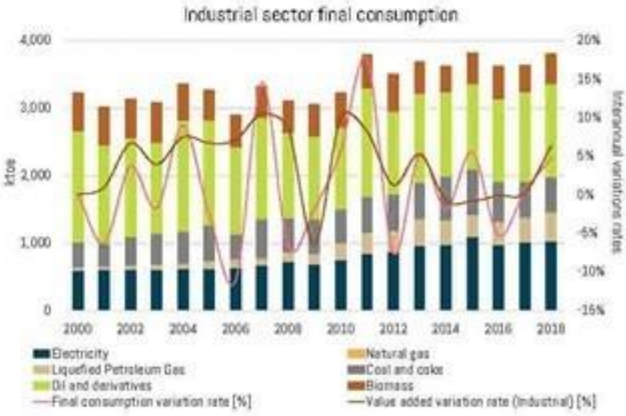

Installed power generation capacity
MW
16,000
12,000
8,000
4,000
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar

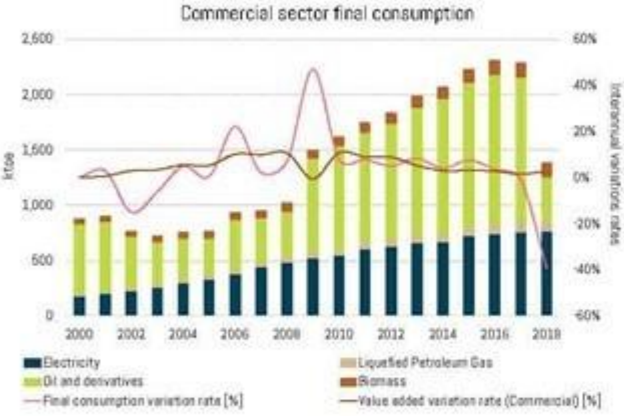

Electricity generation
TWh
60
40
20
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Wind
Solar


Electrification rate
Electrification rate
100%
80%
60%
40%
20%
0%
10,000
8,000
6,000
4,000
2,000
0
Inhabitants (thousand)
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Electrification rate
Population without access to electricity services

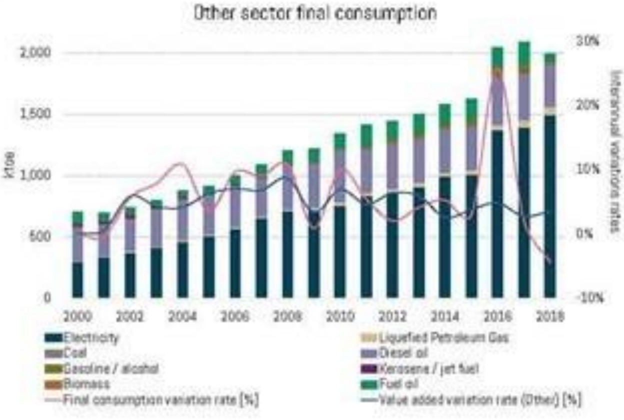

Biomass and biofuels production
ktoe
3,000
2,000
1,000
0
2%
1%
0%
-1%
-2%
-3%
-4%
Quinquennial biomass production variation rate
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Sugar cane
Firewood


Final energy consumption by source
ktoe
Electricity
Coal and coke
Natural gas
Biomass
Oil and derivatives
Total primary supply (right axis)

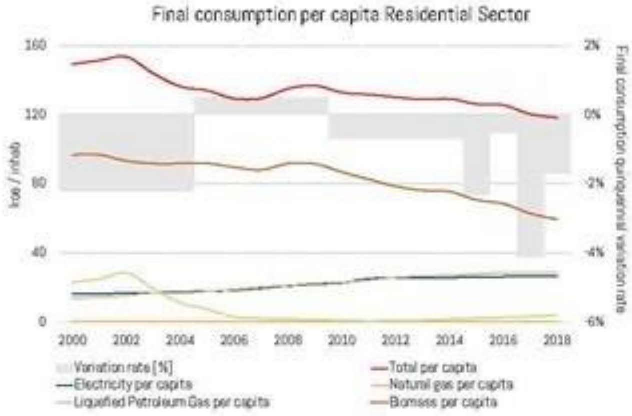

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]

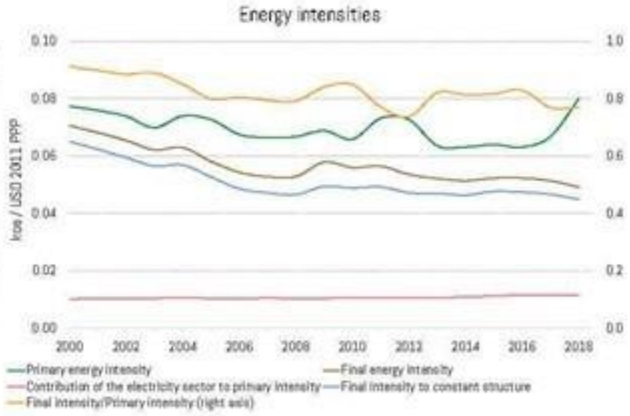

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied Petroleum Gas
Biomass
Value added variation rate (Commercial) [%]

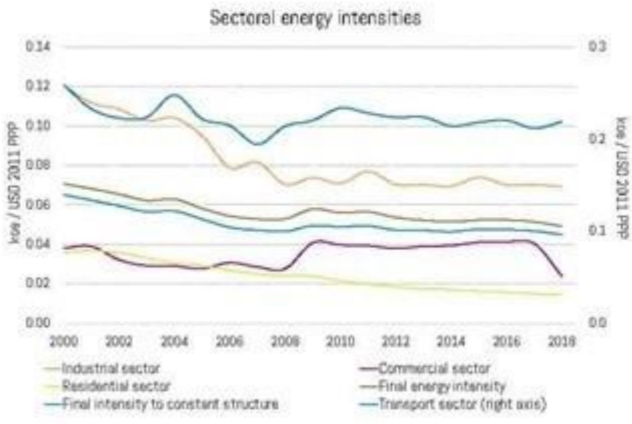

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Kerosene / jet fuel
Liquefied Petroleum Gas
Final consumption variation rate [%]
Gasoline / alcohol
Electricity
Fuel oil
Value added variation rate (Transportation) [%]

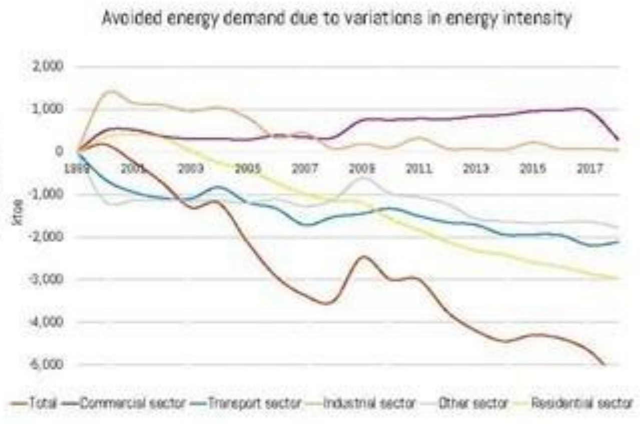

Other sector final consumption
ktoe
Interannual variations rates
Electricity
Coal
Gasoline / alcohol
Biomass
Final consumption variation rate [%]
Liquefied Petroleum Gas
Diesel oil
Kerosene / jet fuel
Fuel oil
Value added variation rate (Other) [%]

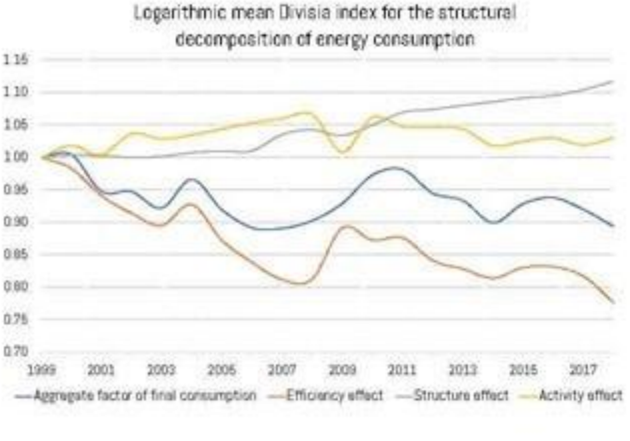

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Household final consumption variation rate [%]

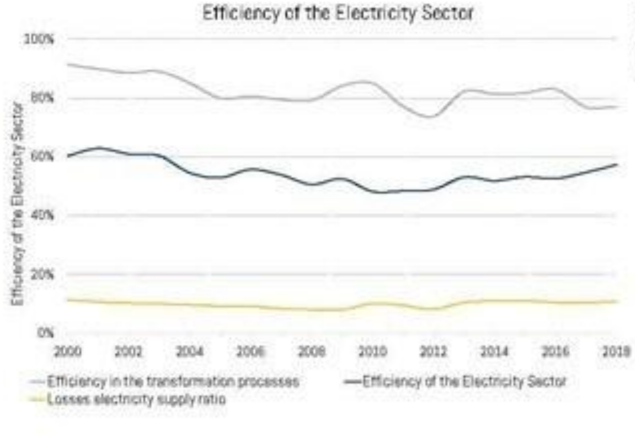

Final consumption per capita Residential Sector
160
120
80
40
0
2%
0%
-2%
-4%
-6%
kep / inhab
Final consumption quinquennial variation rate
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita

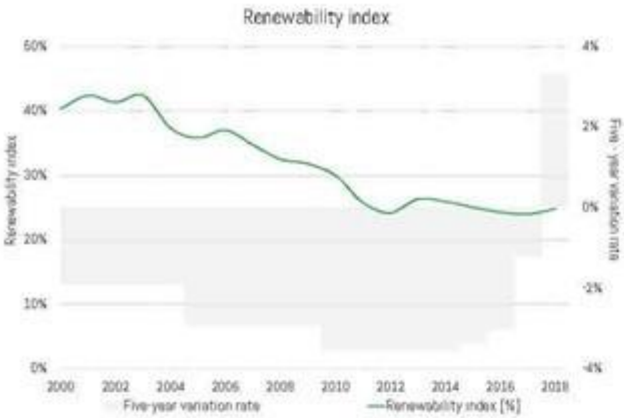

Energy intensities
0.10
0.08
0.06
0.04
0.02
0.00
1.0
0.8
0.6
0.4
0.2
0.0
koe / USD 2011 PPP
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

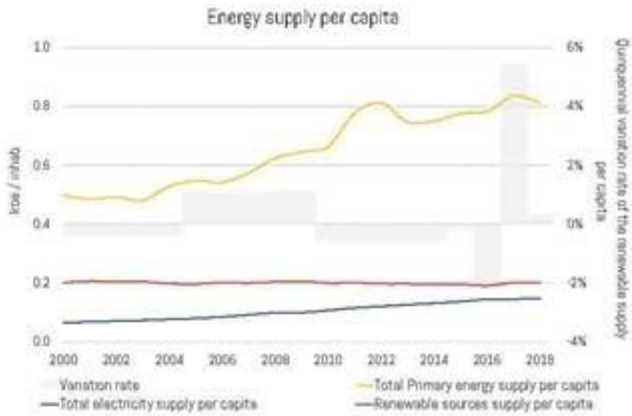

Sectoral energy intensities
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.3
0.2
0.1
0.0
koe / USD 2011 PPP
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

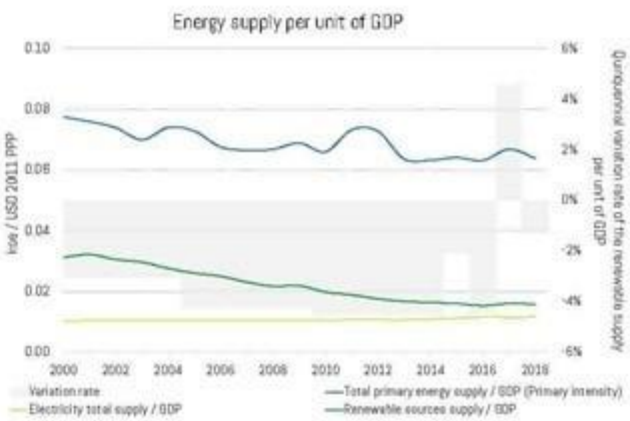

Avoided energy demand due to variations in energy intensity
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
ktoe
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

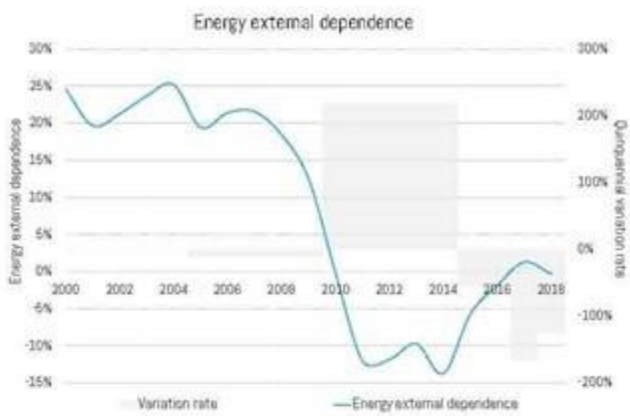

Logarithmic mean Divisia index for the structural decomposition of energy consumption
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

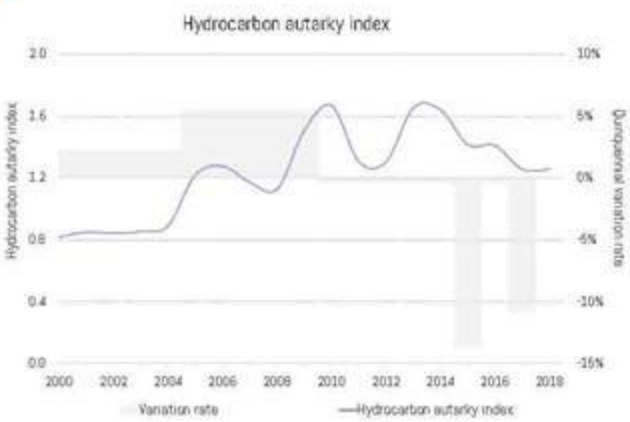

Efficiency of the Electricity Sector
100%
80%
60%
40%
20%
0%
Efficiency of the Electricity Sector
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

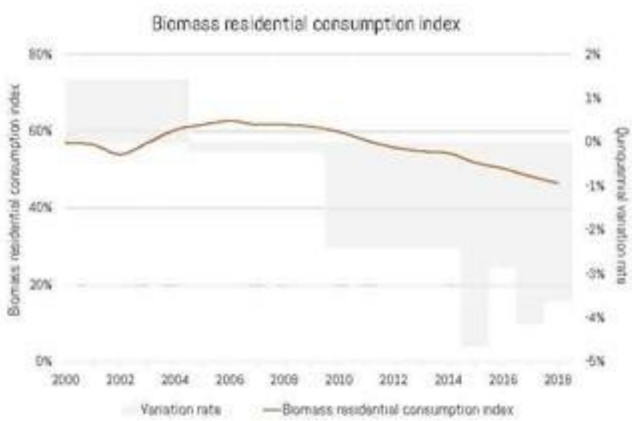

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]


Energy supply per capita
toe / inhab
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

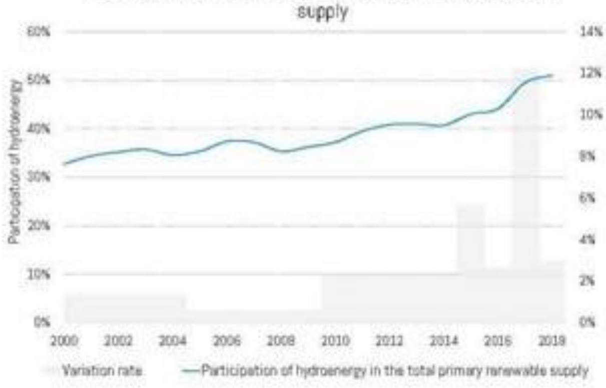

Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Electricity total supply / GDP
Total primary energy supply / GDP (Primary intensity)
Renewable sources supply / GDP


Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

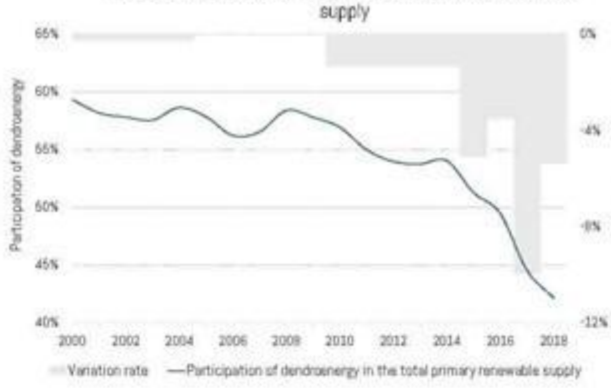

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index


Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

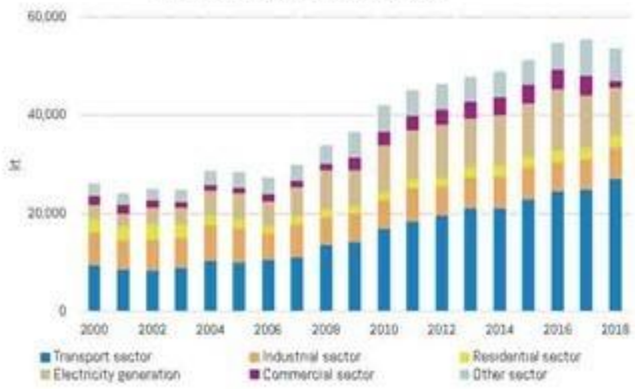
Participation of hydroenergy in the total primary renewable supply



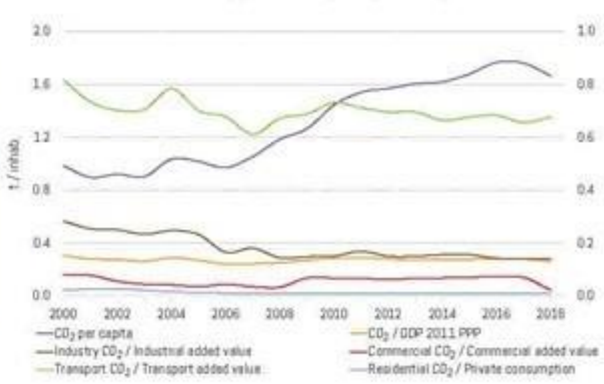
Participation of dendroenergy in the total primary renewable supply



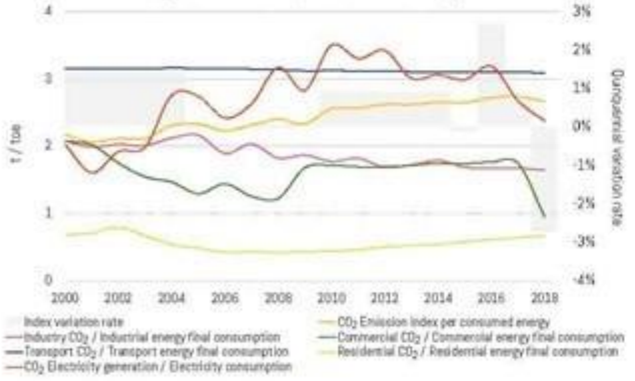
Evolution of CO_2 emissions by sector



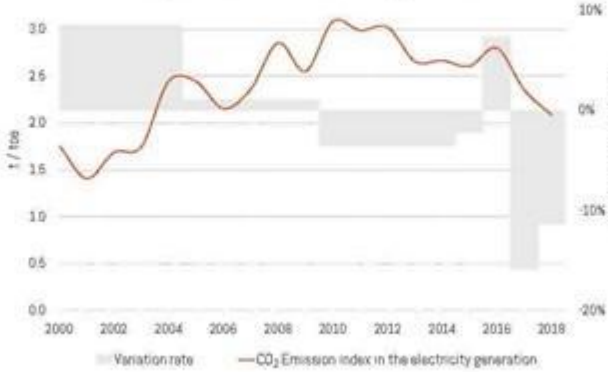
Evolution of CO_2 emissions per capita and per unit of GDP

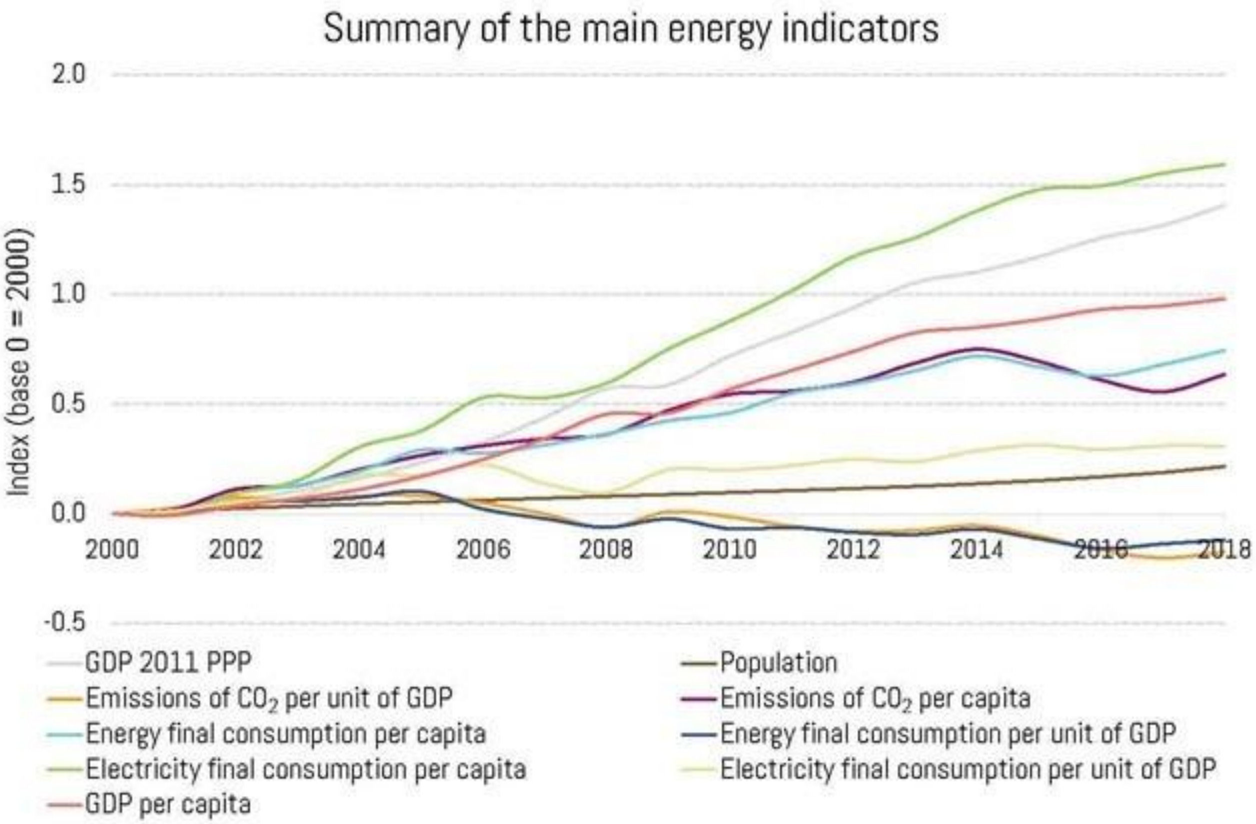


CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation





Summary of the main energy indicators
Index (base 0 = 2000)
2.0
1.5
1.0
0.5
0.0
-0.5
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy final consumption per capita
Energy final consumption per unit of GDP
Electricity final consumption per capita
Electricity final consumption per unit of GDP
GDP per capita

SURINAME

General Information 2018

Population (thousand inhab.)	576
Area (km²)	163,820
Population Density (inhab./km²)	4
Urban Population (%)	66
GDP USD 2010 (MUSD)	4,531
GDP USD 2011 PPP (MUSD)	7,935
GDP per Capita (thou. USD 2011 PPP/inhab.)	14

Energy Sector

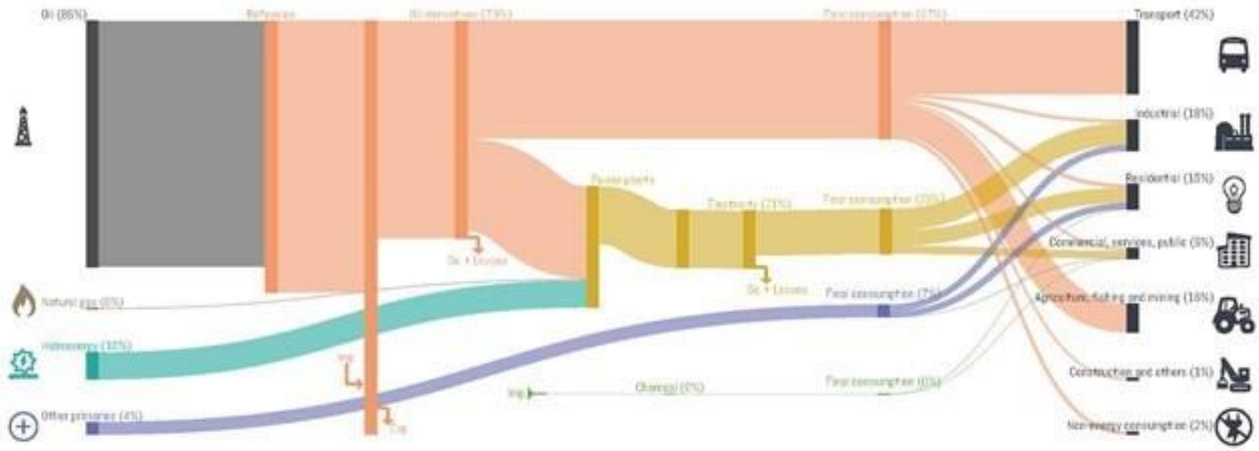
	Mtoe
Final consumption in the Transport Sector	0.25
Final consumption in the Industrial Sector	0.11
Final consumption in the Residential Sector	0.09
Final consumption in the Commercial and Service Sector	0.04
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.12

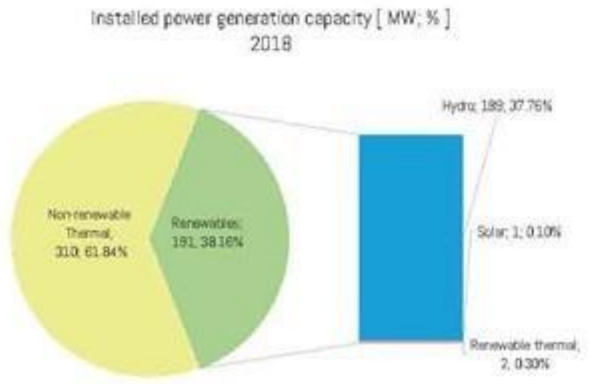
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
81	n.a.	n.a.

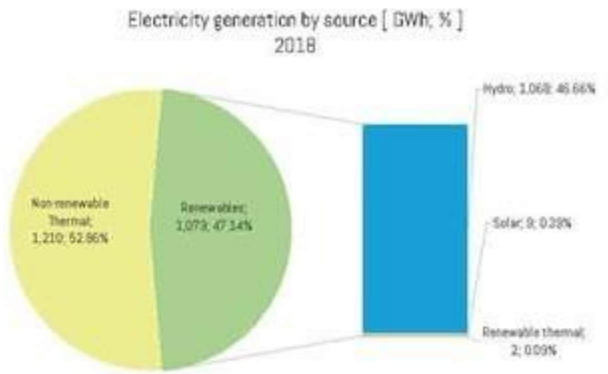
* Data corresponding to the year 2017.

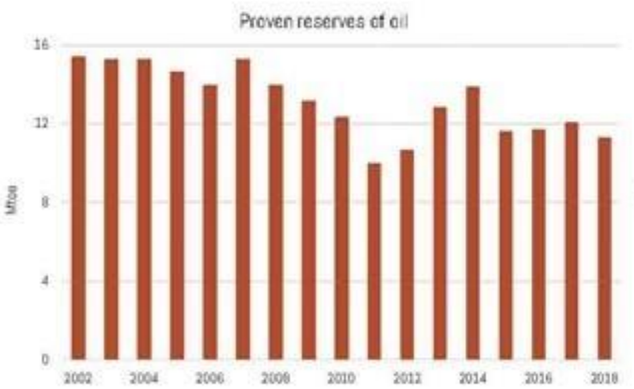
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
3,096	1.04	90.34 *	0.78	0.99	0.46	0.66	0.60	15	0.50	0.10 / 0.08

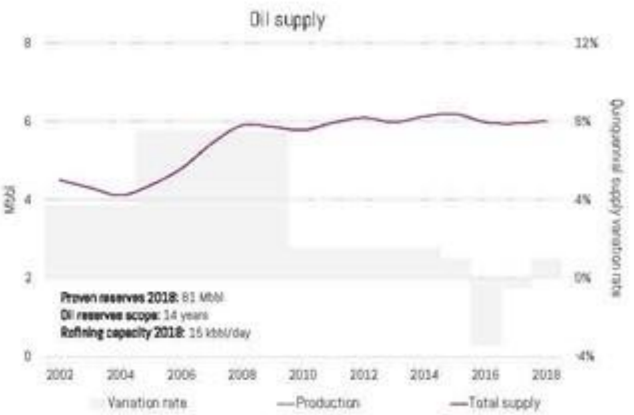
Summarized energy balance 2018

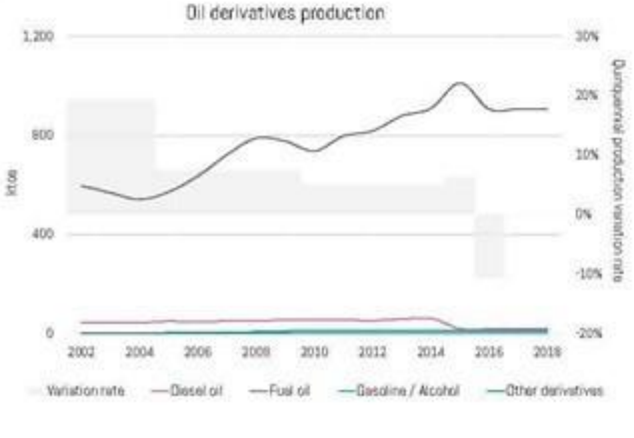


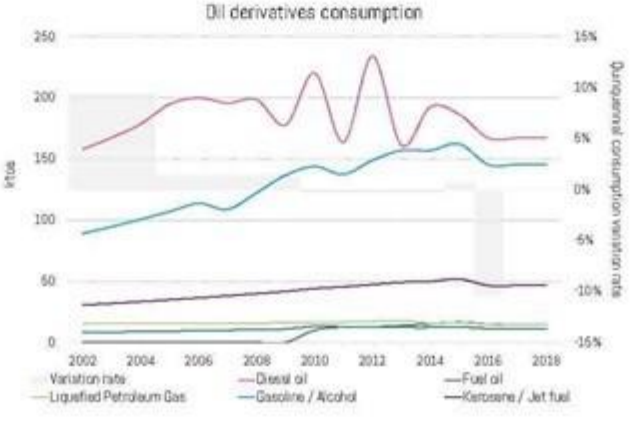

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 310; 61.84%
Renewables; 191; 38.16%
Hydro; 189; 37.76%
Solar; 1; 0.10%
Renewable thermal; 2; 0.30%

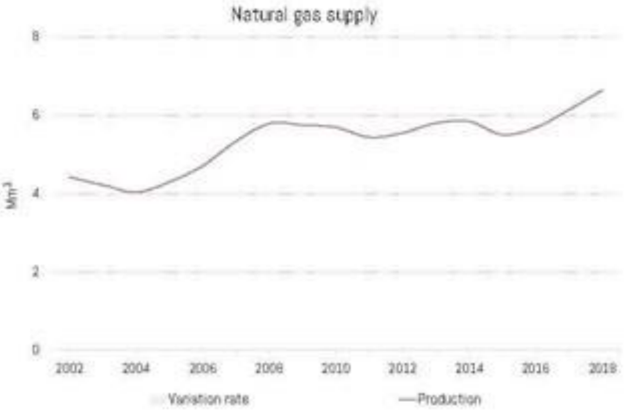

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 1,210; 52.86%
Renewables; 1,079; 47.14%
Hydro; 1,068; 46.66%
Solar; 9; 0.39%
Renewable thermal; 2; 0.09%

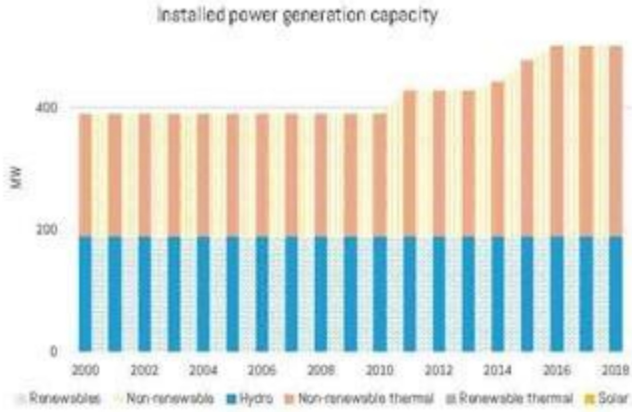

Proven reserves of oil
Mtoe
2002
2004
2006
2008
2010
2012
2014
2016
2018

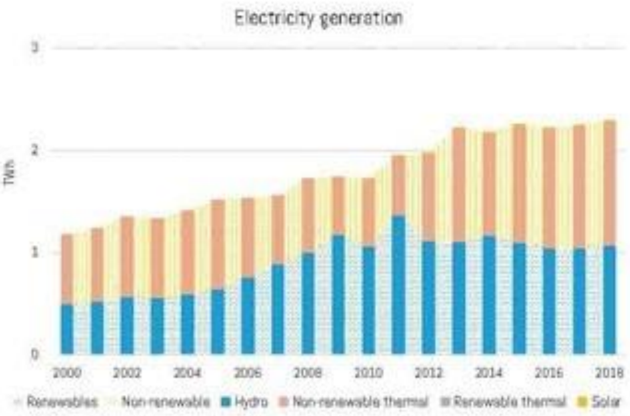

Oil supply
Mtoe
Quinquennial supply variation rate
Proven reserves 2018: 81 Mbbl
Oil reserves scope: 14 years
Refining capacity 2018: 15 kbbl/day
Variation rate
Production
Total supply

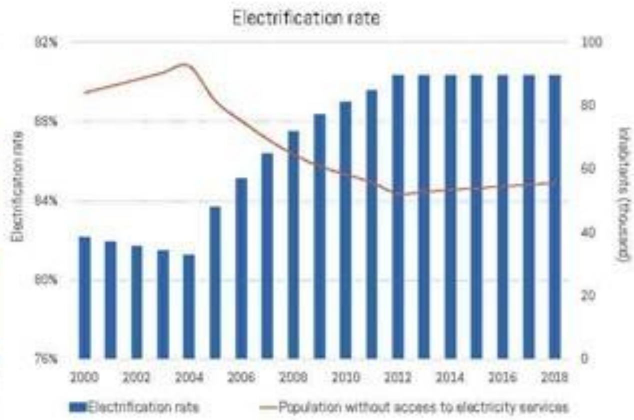

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Gasoline / Alcohol
Other derivatives

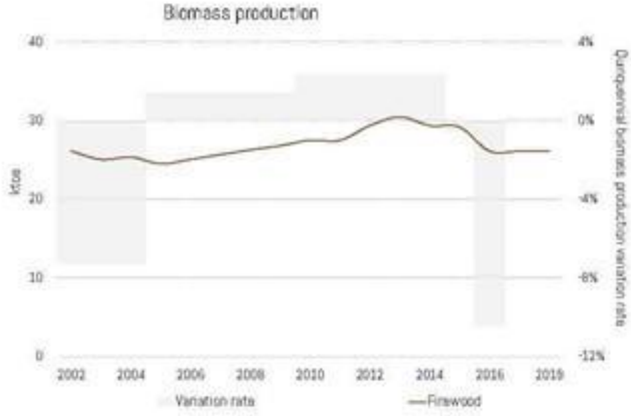

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel

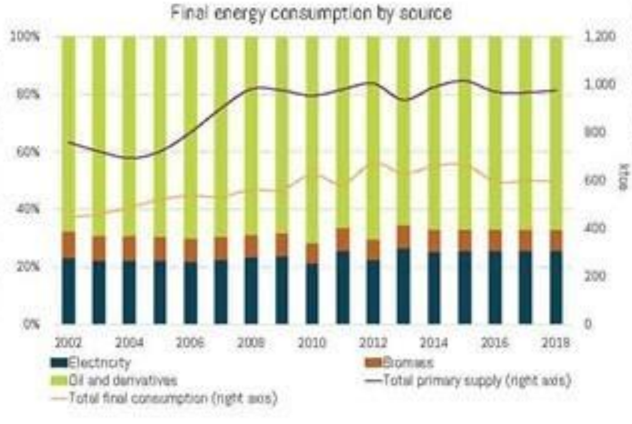

Natural gas supply
Mm³
8
6
4
2
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Production


Installed power generation capacity
MW
400
200
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Solar

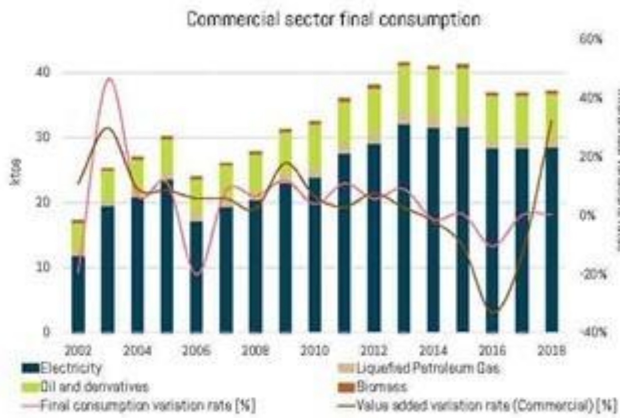

Electricity generation
TWh
3
2
1
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Renewables
Non-renewable
Hydro
Non-renewable thermal
Renewable thermal
Solar

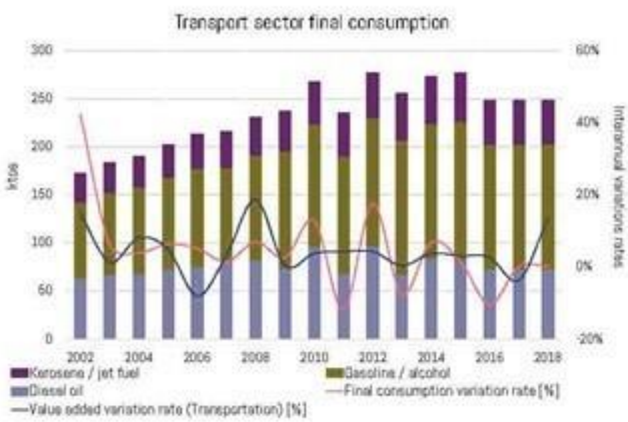

Electrification rate
Electrification rate
Inhabitants (thousand)
92%
88%
84%
80%
76%
100
80
60
40
20
0
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Electrification rate
Population without access to electricity services

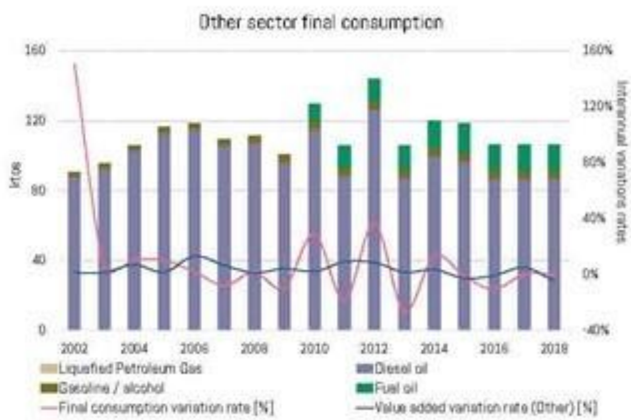

Biomass production
ktoe
Quinquennial biomass production variation rate
40
30
20
10
0
4%
0%
-4%
-8%
-12%
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
Firewood


Final energy consumption by source
ktoe
100%
80%
60%
40%
20%
0%
1,200
1,000
800
600
400
200
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
Electricity
Oil and derivatives
Total final consumption (right axis)
Biomass
Total primary supply (right axis)

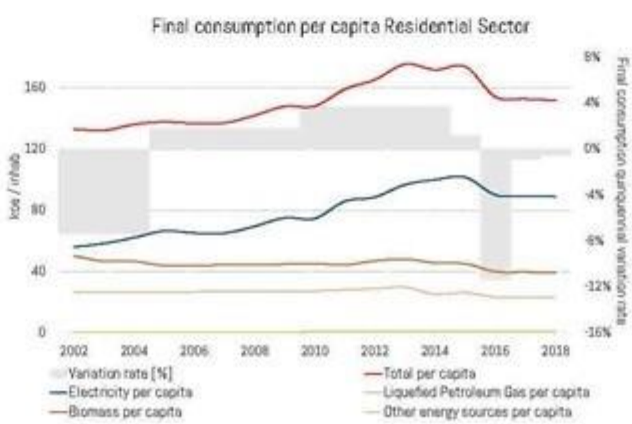

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]


Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

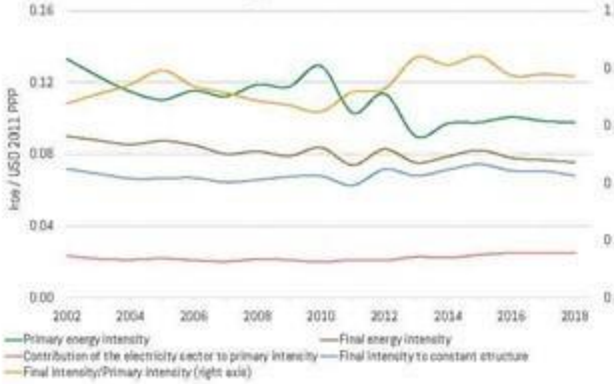

Transport sector final consumption
ktoe
Interannual variations rates
Kerosene / jet fuel
Gasoline / alcohol
Diesel oil
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]


Other sector final consumption
ktoe
Interannual variations rates
Liquefied Petroleum Gas
Diesel oil
Gasoline / alcohol
Fuel oil
Final consumption variation rate [%]
Value added variation rate (Other) [%]

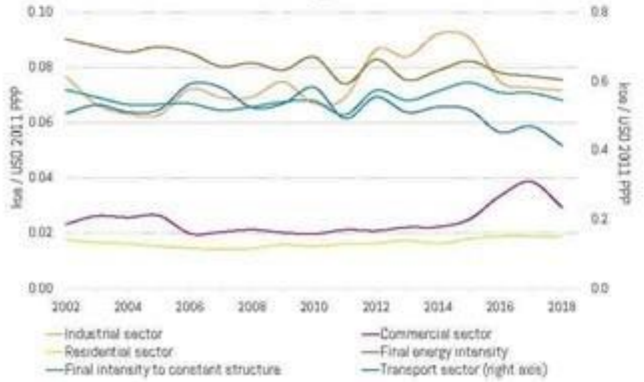

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]


Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rates
Variation rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

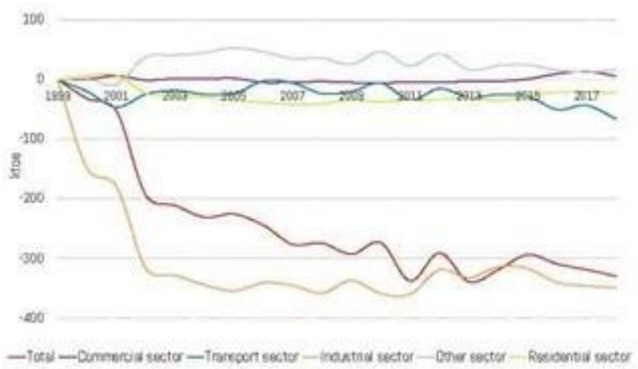
Energy intensities



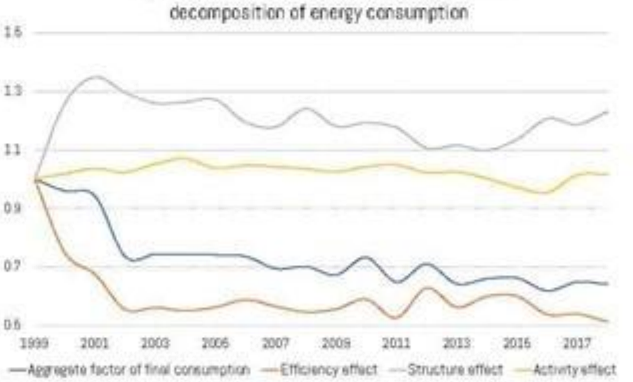
Sectoral energy intensities



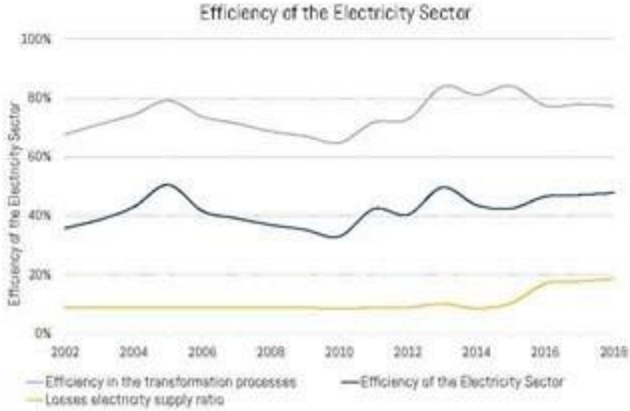
Avoided energy demand due to variations in energy intensity



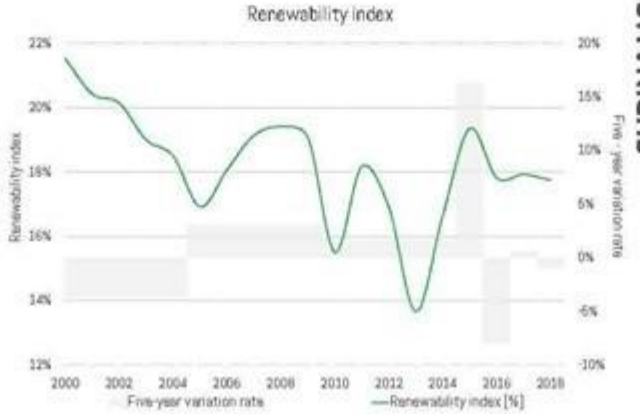
Logarithmic mean Divisia index for the structural decomposition of energy consumption

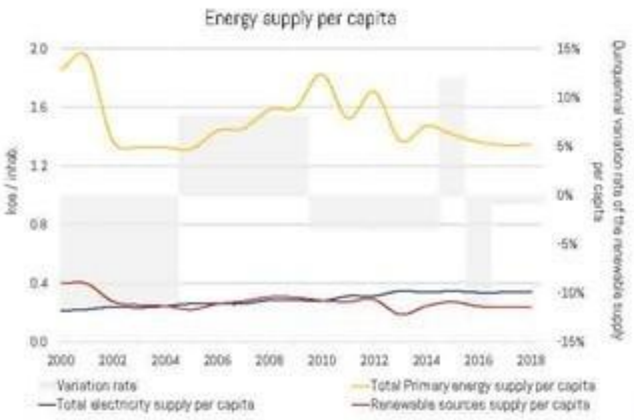


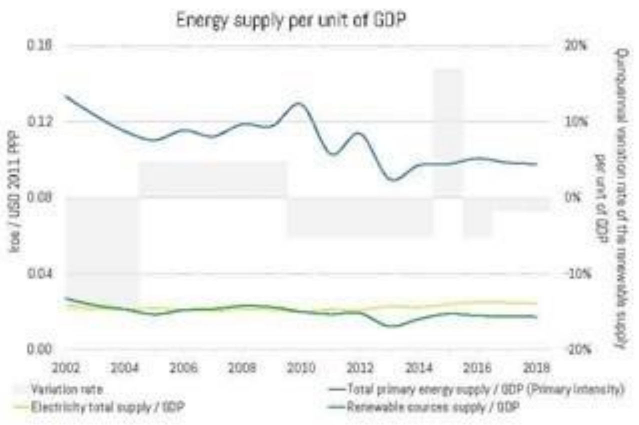
Efficiency of the Electricity Sector

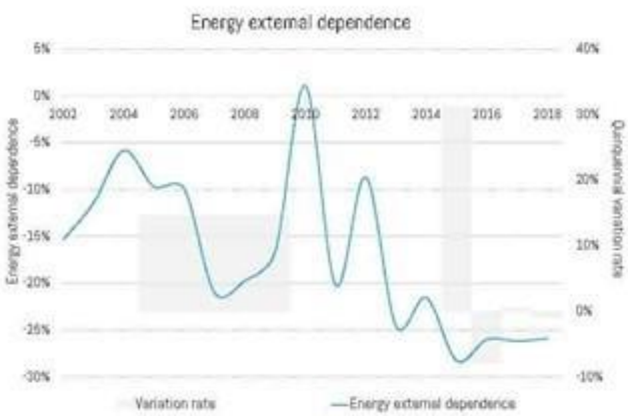


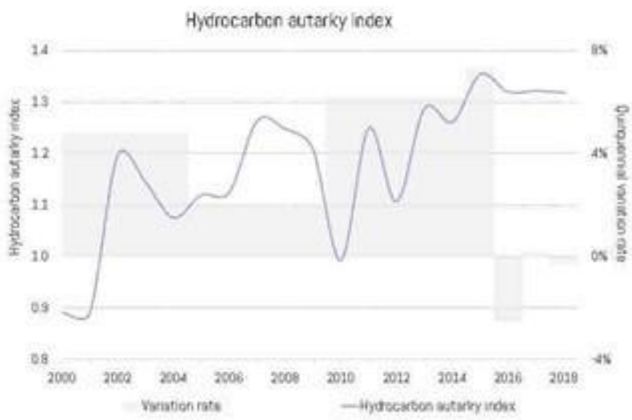
Renewability index

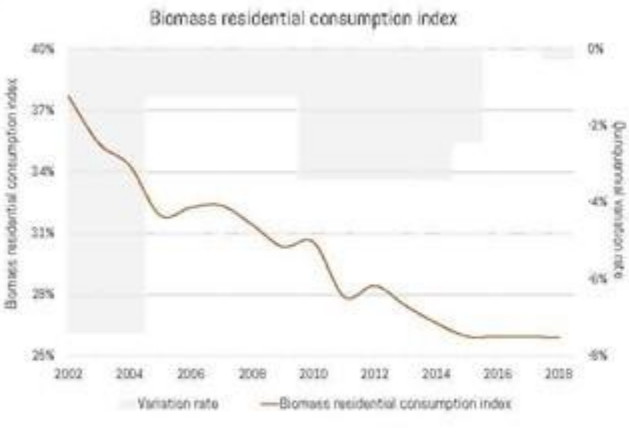


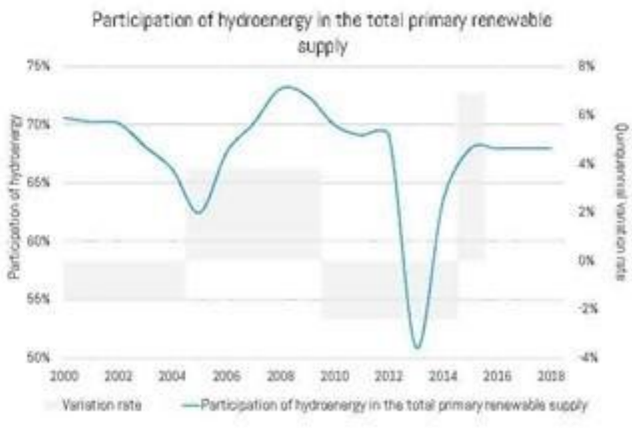

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


Energy supply per unit of GDP
toe / USD 2011 PPP
Quinquennial variation rate of the renewable supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

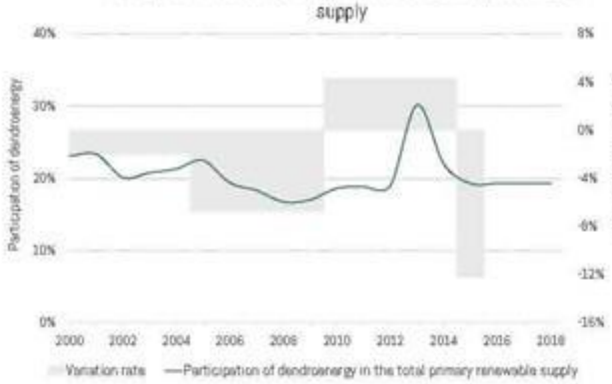

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence


Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

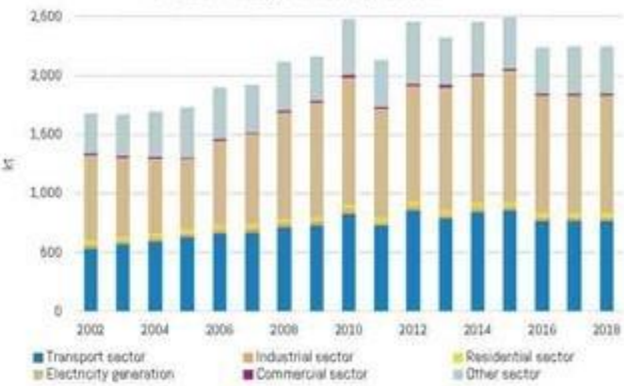

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index


Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

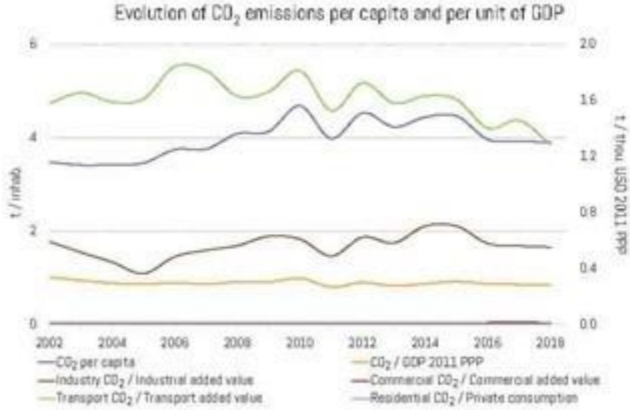
Participation of dendroenergy in the total primary renewable supply



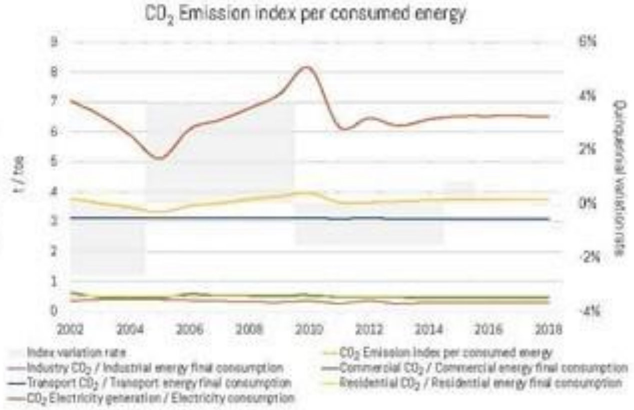
Evolution of CO_2 emissions by sector



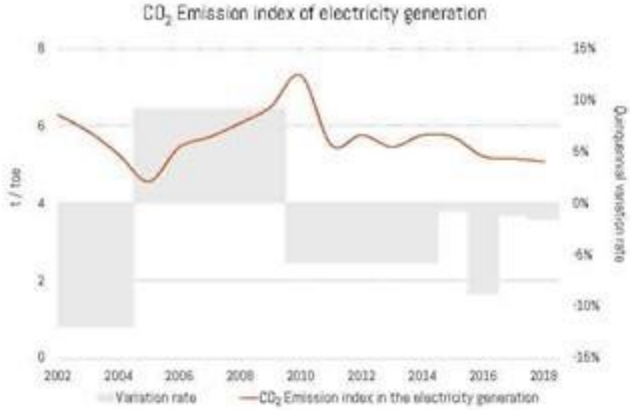
Evolution of CO_2 emissions per capita and per unit of GDP



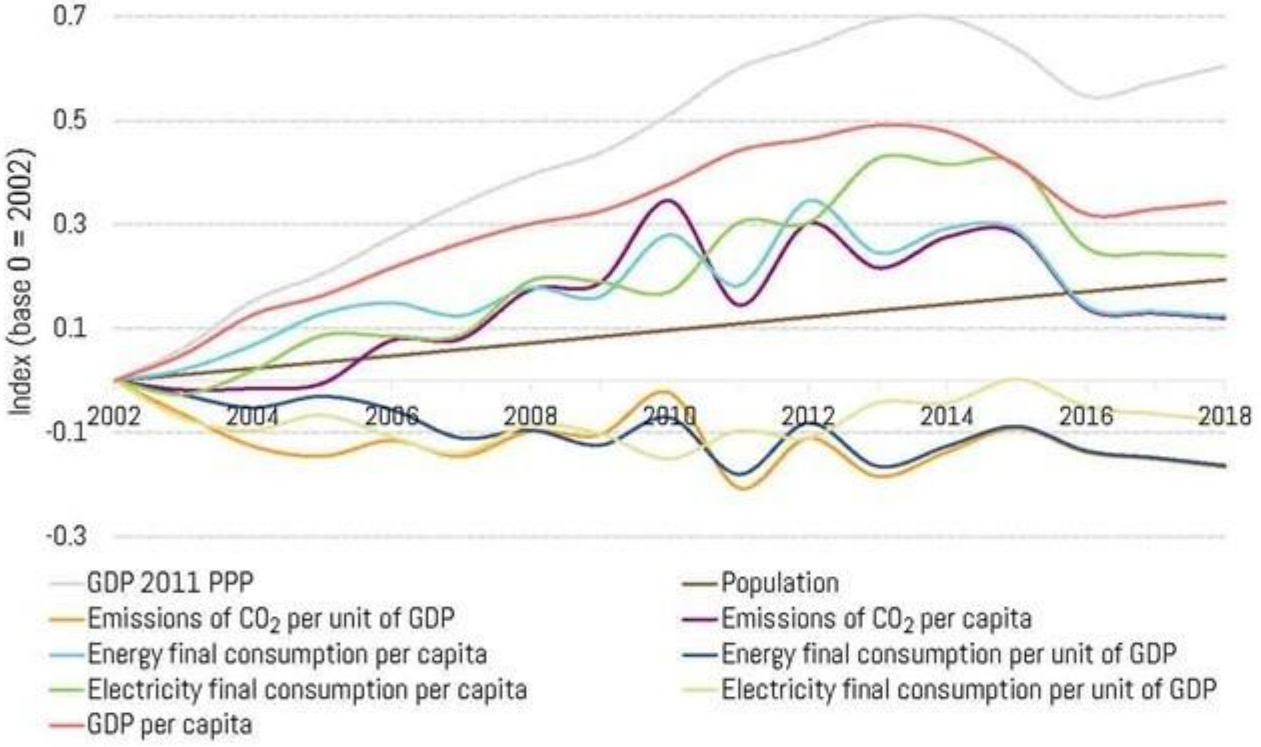
CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation



Summary of the main energy indicators



TRINIDAD AND TOBAGO

General Information 2018

Population (thousand inhab.)	1,390
Area (km[2])	5,130
Population Density (inhab./km[2])	271
Urban Population (%)	53
GDP USD 2010 (MUSD)	21,249*
GDP USD 2011 PPP (MUSD)	39,815
GDP per Capita (thou. USD 2011 PPP/inhab.)	29

Energy Sector

Final consumption in the Transport Sector	Mtoe 0.83
Final consumption in the Industrial Sector	Mtoe 5.92
Final consumption in the Residential Sector	Mtoe 0.28
Final consumption in the Commercial and Service Sector	Mtoe 0.09
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 6.05

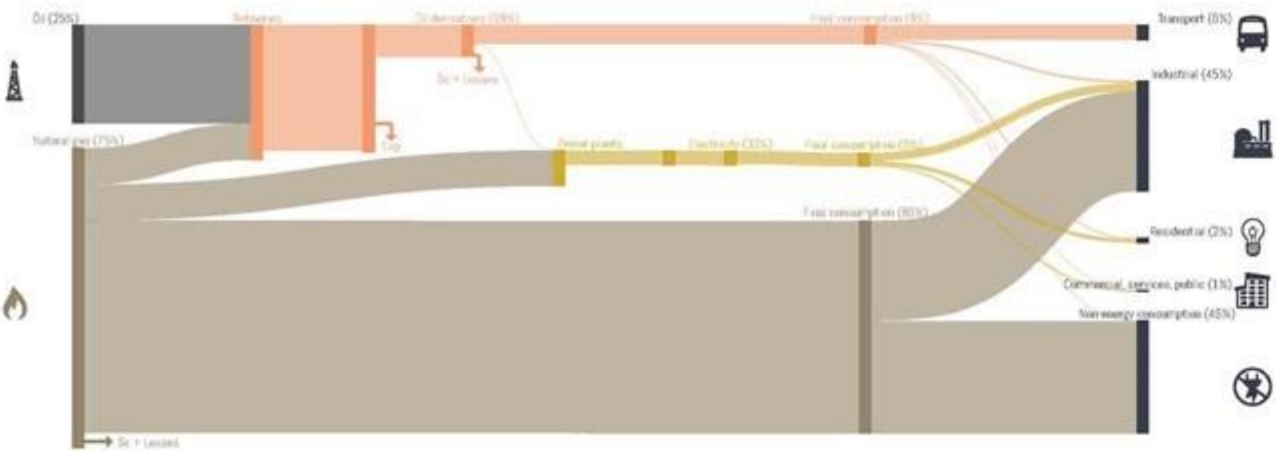
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 370	Gm[3] 289	Mt n.a.

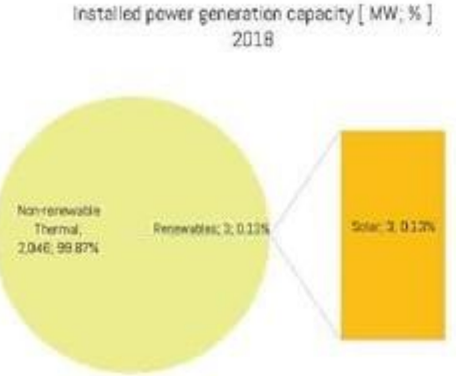
* Data Source: The World Bank.

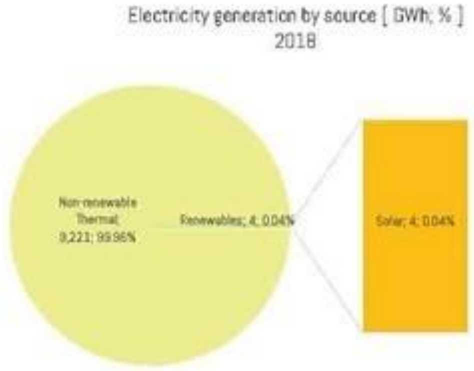
Note: The data for 2018, presented in this publication are provisional and are subject to review by the country.

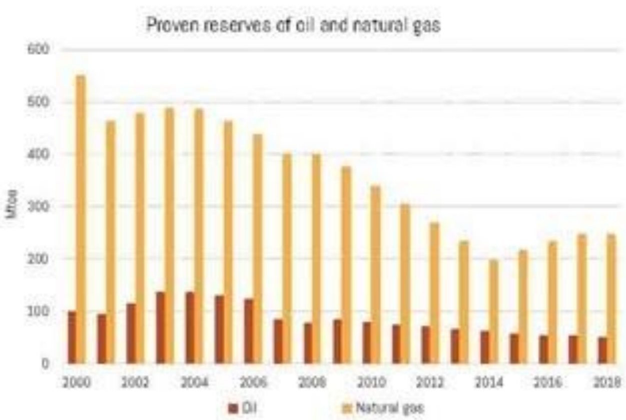
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
6,089	9.47	99.40	16.25	34.06	3.26	19.71	13.17	190	2.05	0.41 / 0.33

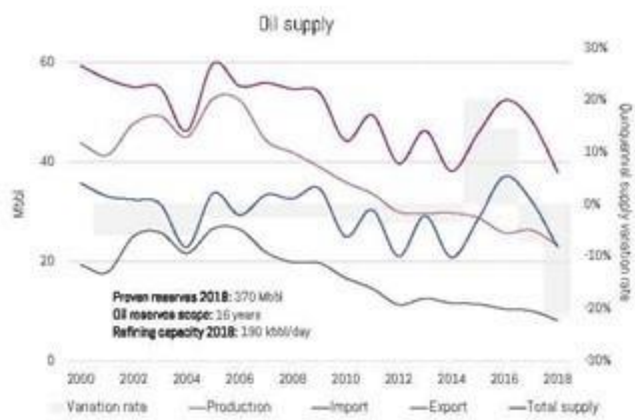
Summarized energy balance 2018

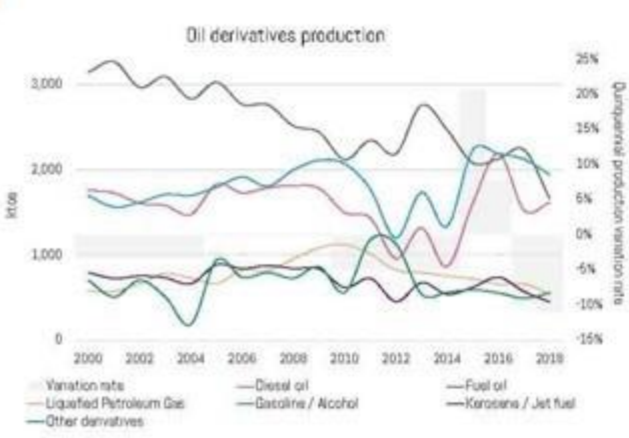


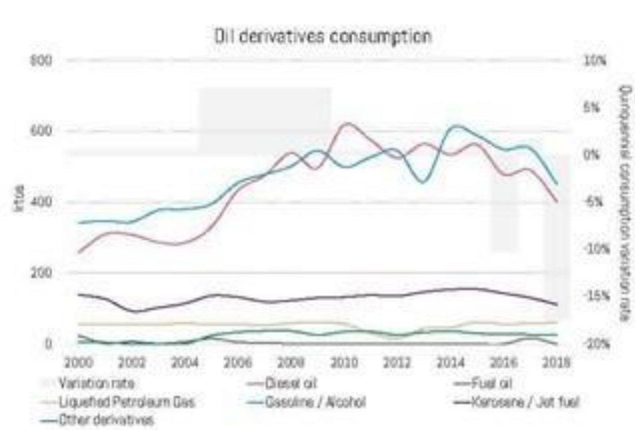

Installed power generation capacity [MW; %]
2018
Non-renewable Thermal; 2,046; 99.87%
Renewables; 3; 0.13%
Solar; 3; 0.13%

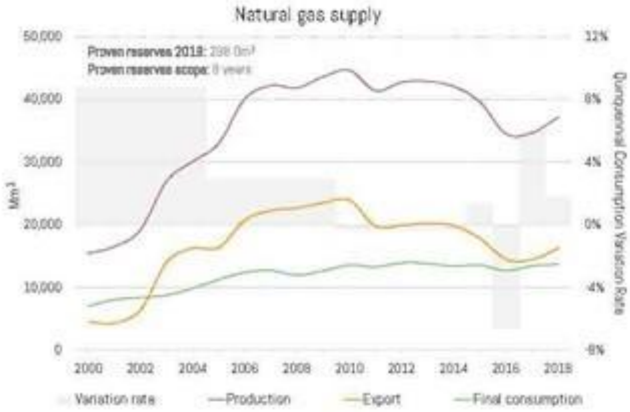

Electricity generation by source [GWh; %]
2018
Non-renewable Thermal; 9,221; 99.96%
Renewables; 4; 0.04%
Solar; 4; 0.04%

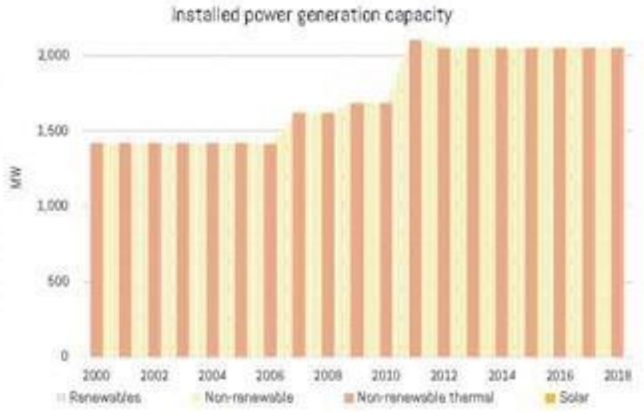

Proven reserves of oil and natural gas
Mtoe
Oil
Natural gas

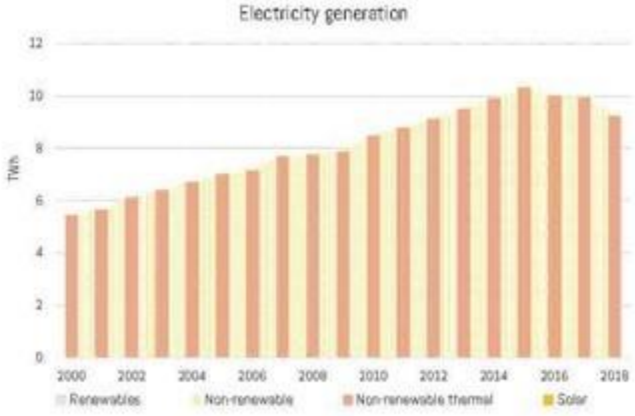

Oil supply
Mbbl
Quinquennial supply variation rate
Proven reserves 2018: 370 Mbbl
Oil reserves scope: 16 years
Refining capacity 2018: 190 kbbl/day
Variation rate
Production
Import
Export
Total supply

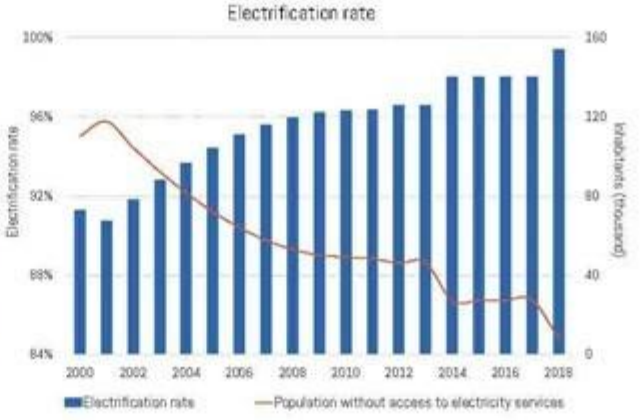

Oil derivatives production
ktoe
Quinquennial production variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

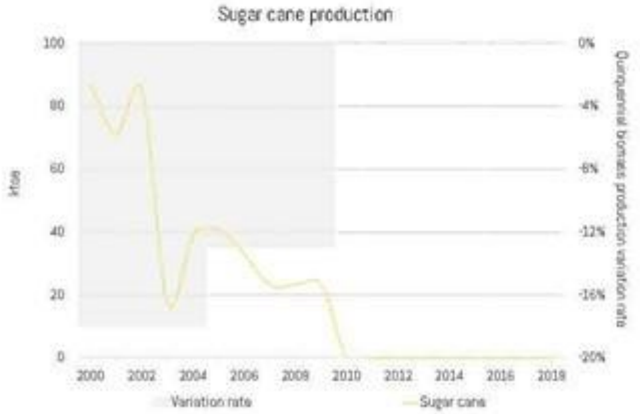

Oil derivatives consumption
ktoe
Quinquennial consumption variation rate
Variation rate
Diesel oil
Fuel oil
Liquefied Petroleum Gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

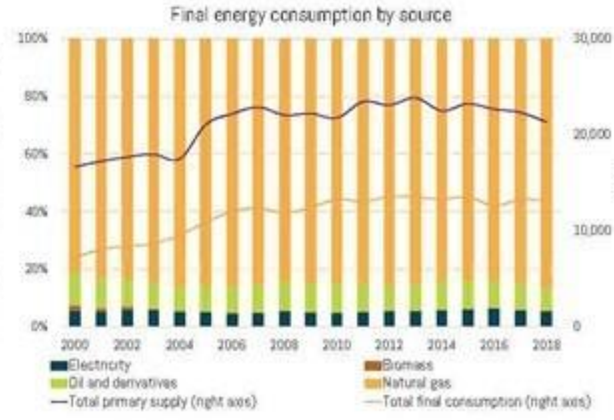

Natural gas supply
Proven reserves 2018:
Proven reserves scope:
Mm³
Quinquennial Consumption Variation Rate
50,000
40,000
30,000
20,000
10,000
0
12%
8%
4%
0%
-4%
-8%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Production
Export
Final consumption

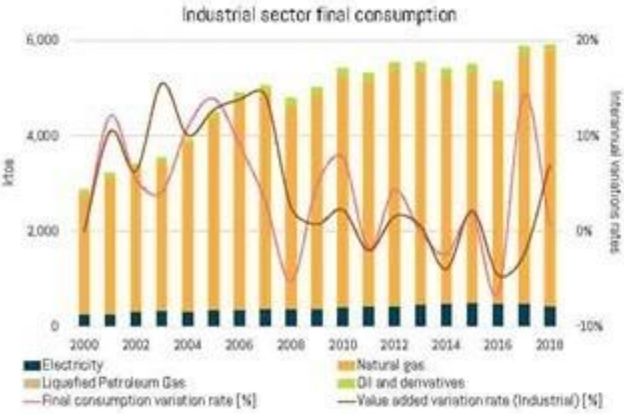

Installed power generation capacity
MW
2,000
1,500
1,000
500
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables
Non-renewable
Non-renewable thermal
Solar

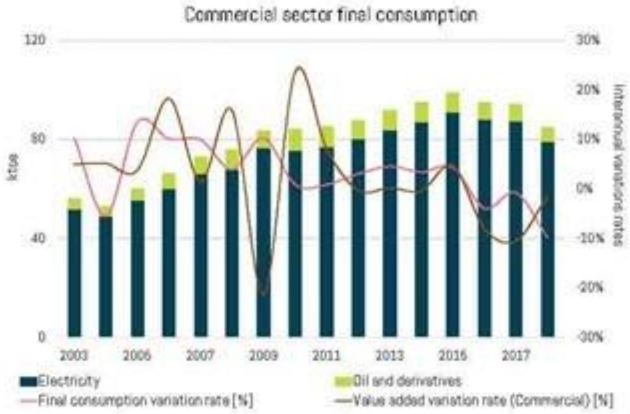

Electricity generation
TWh
12
10
8
6
4
2
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Renewables
Non-renewable
Non-renewable thermal
Solar

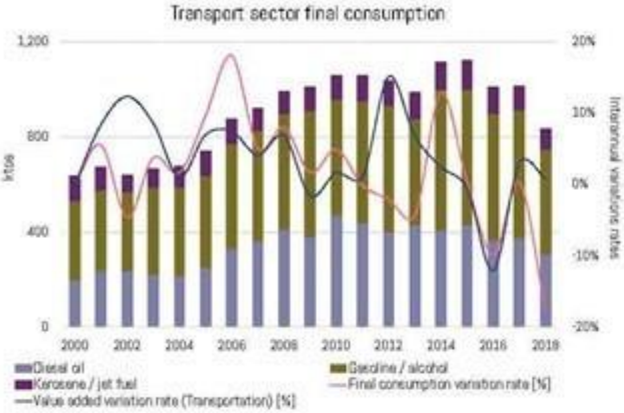

Electrification rate
Electrification rate
Inhabitants (thousand)
100%
96%
92%
88%
84%
160
120
80
40
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Electrification rate
Population without access to electricity services


Sugar cane production
ktoe
Quinquennial biomass production variation rate
100
80
60
40
20
0
0%
-4%
-8%
-12%
-16%
-20%
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Variation rate
Sugar cane

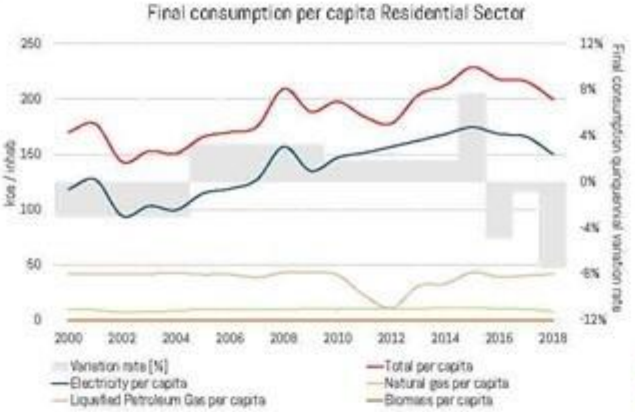

Final energy consumption by source
ktoe
100%
80%
60%
40%
20%
0%
30,000
20,000
10,000
0
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Electricity
Biomass
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)

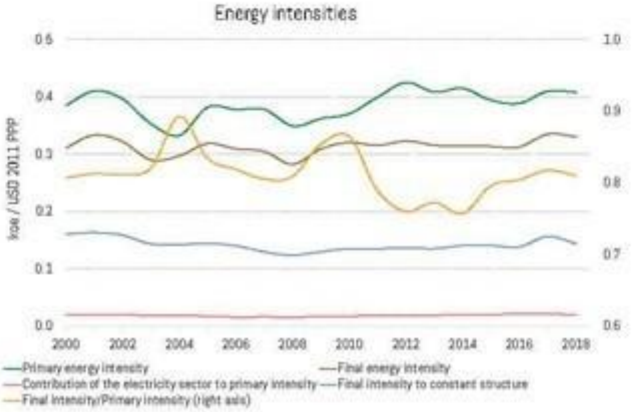

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

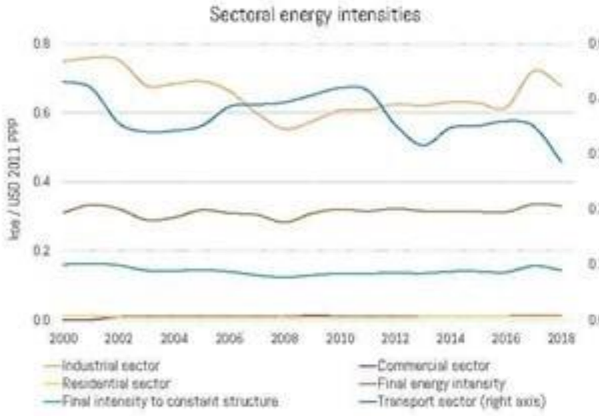

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Oil and derivatives
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

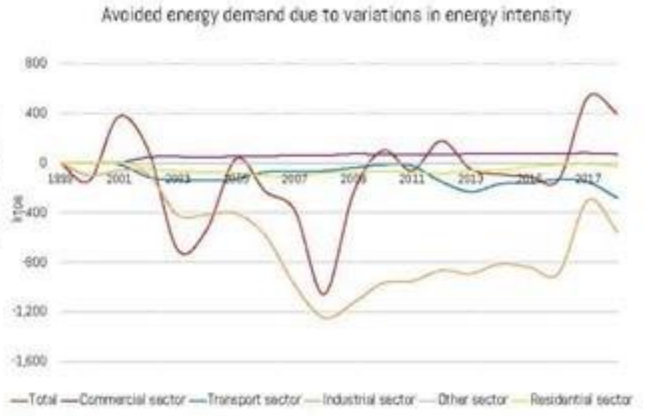

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

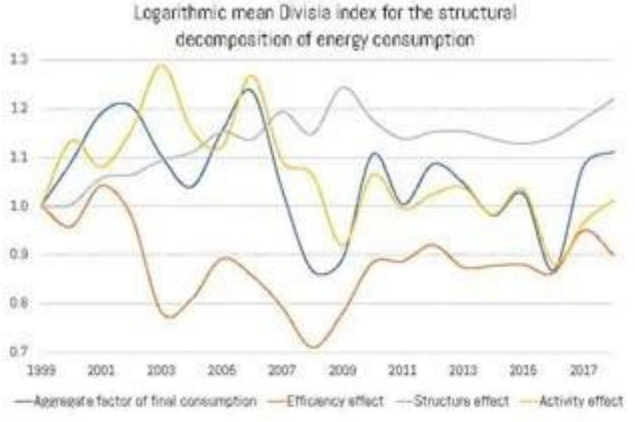

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Oil and derivatives
Final consumption variation rate [%]
Household final consumption variation rate [%]

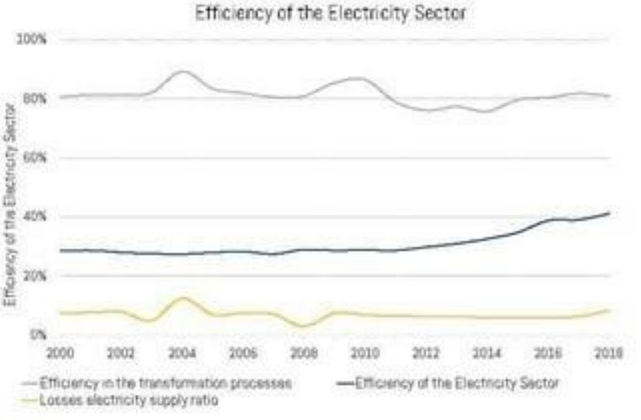

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita

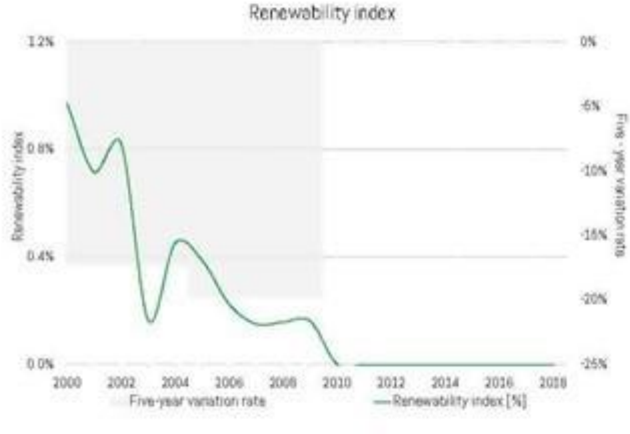

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

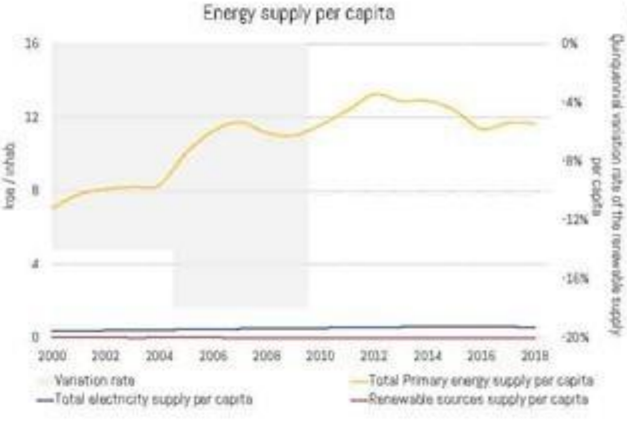

Sectoral energy intensities
kep / USD 2011 PPP
kep / USD 2011 PPP
Industrial sector
Residential sector
Final intensity to constant structure
Commercial sector
Final energy intensity
Transport sector (right axis)

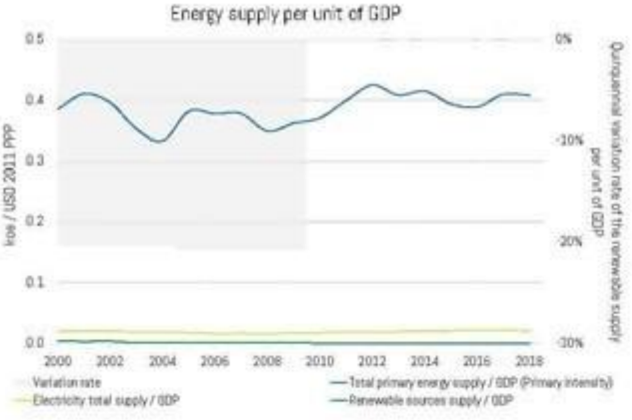

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

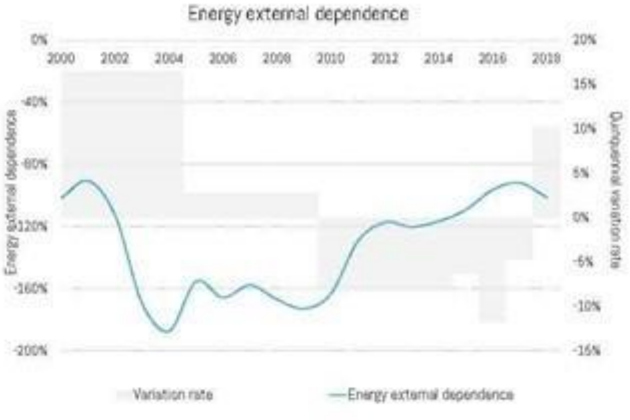

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

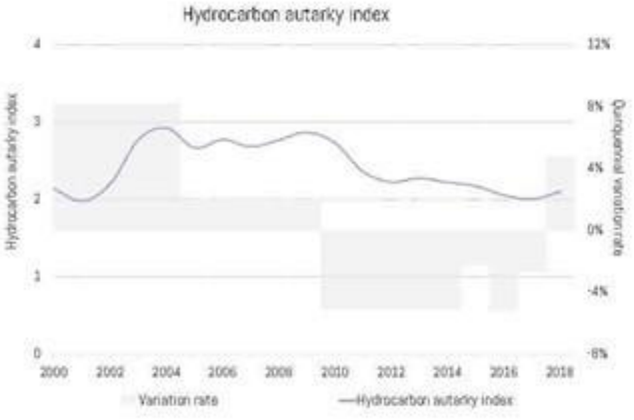

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio

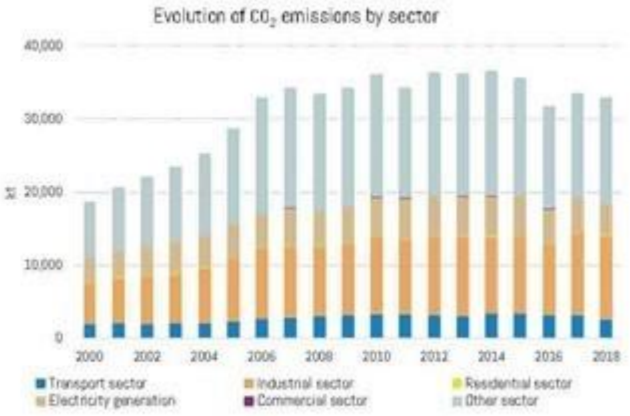

Renewability index
Renewability index
Five - year variation rate
Five-year variation rate
Renewability index [%]

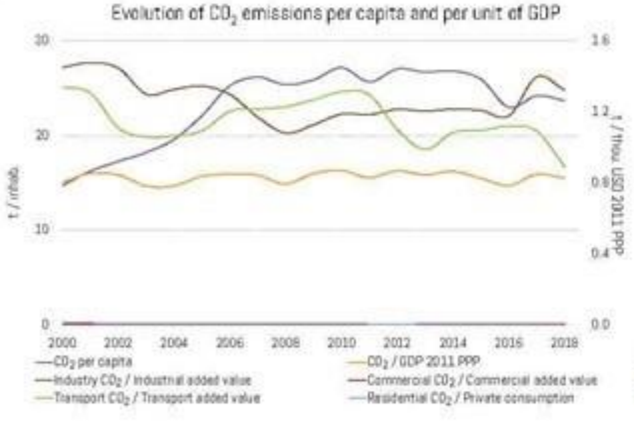

Energy supply per capita
toe / inhab.
Quinquennial variation rate of the renewable supply per capita
Variation rate
Total electricity supply per capita
Total Primary energy supply per capita
Renewable sources supply per capita

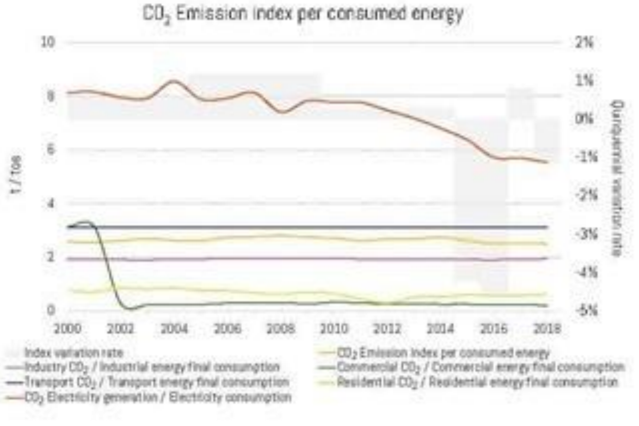




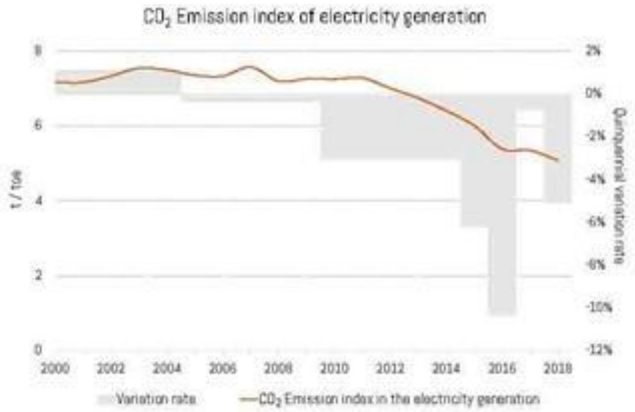


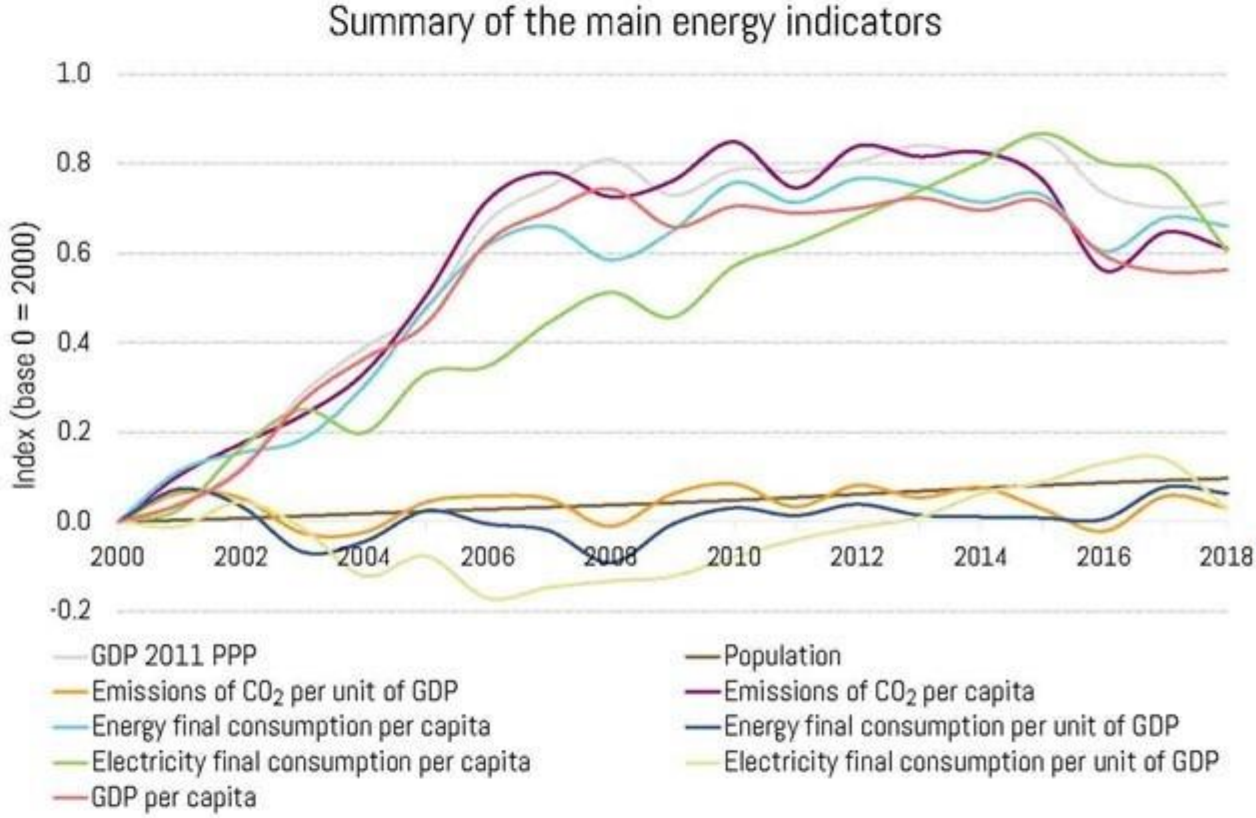






TRINIDAD AND TOBAGO


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
8
6
4
2
0
2%
0%
-2%
-4%
-6%
-8%
-10%
-12%
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2000)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

URUGUAY

General Information 2018

Population (thousand inhab.)	3,506 [1]
Area (km²)	176,215
Population Density (inhab./km²)	20
Urban Population (%)	95
GDP USD 2010 (MUSD)	50,420
GDP USD 2011 PPP (MUSD)	72,146
GDP per Capita (thou. USD 2011 PPP/inhab.)	21

Energy Sector

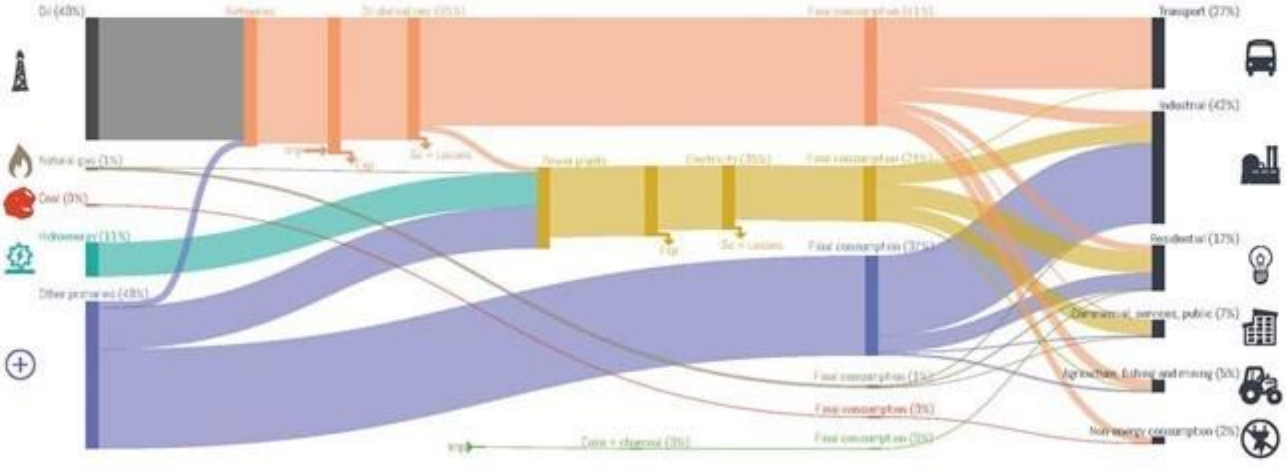
	Mtoe
Final consumption in the Transport Sector	1.27
Final consumption in the Industrial Sector	2.02
Final consumption in the Residential Sector	0.82
Final consumption in the Commercial and Service Sector	0.32
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.35 [4]

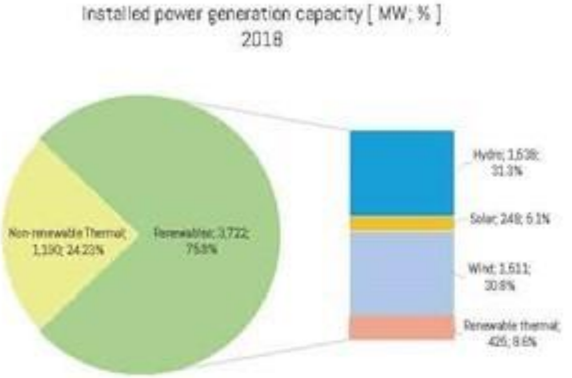
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

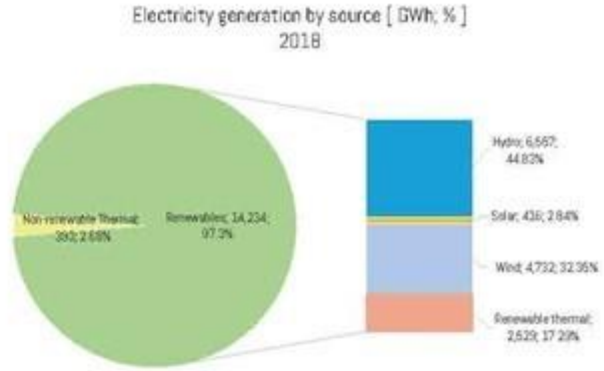
[1] National Statistical Institute (INE).
[2] Total energy supply does not include losses.
[3] Exports includes international bunker.
[4] It includes non-energy consumption.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	3,257
Final consumption per capita	toe/inhab.	1.36
Electrification rate	%	99.80
Total energy supply	Mtoe	5.35 [2]
Total energy production	Mtoe	3.41
Total energy imports	Mtoe	2.43
Total energy exports	Mtoe	0.36 [3]
Total final energy consumption	Mtoe	4.78
Refining capacity	kbbl/day	50
Installed power generation capacity	GW	4.91
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.07 / 0.07

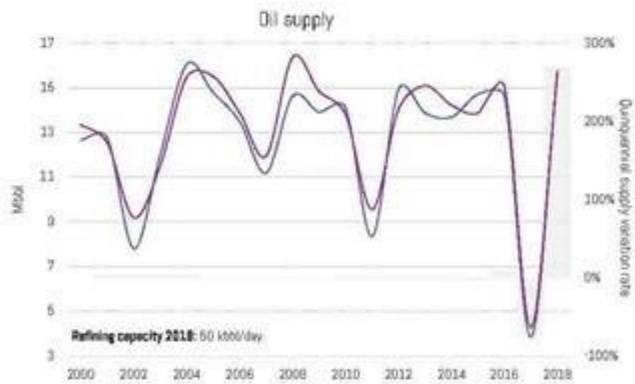
Summarized energy balance 2018

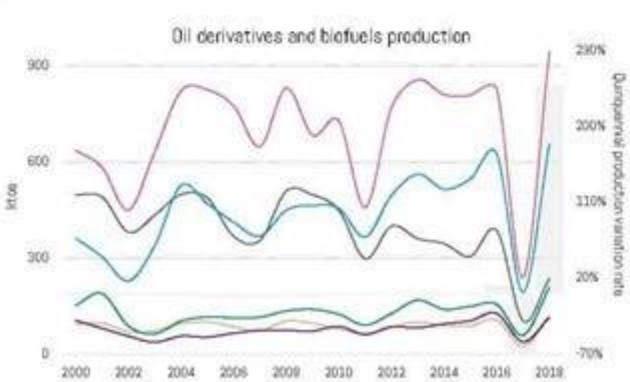


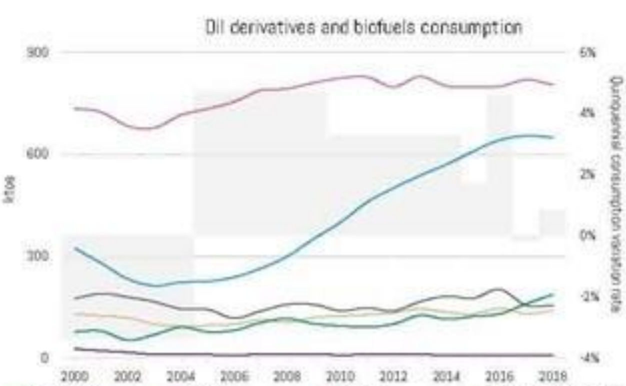


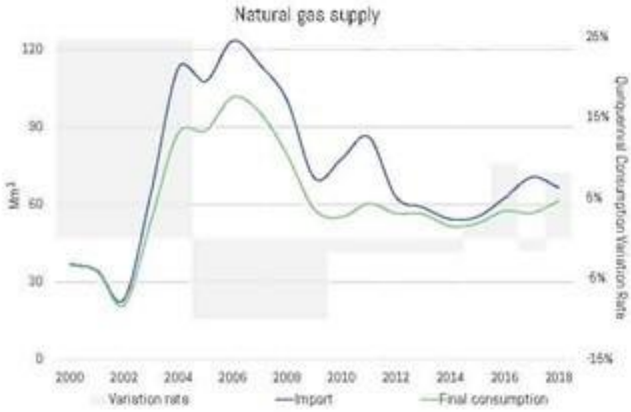


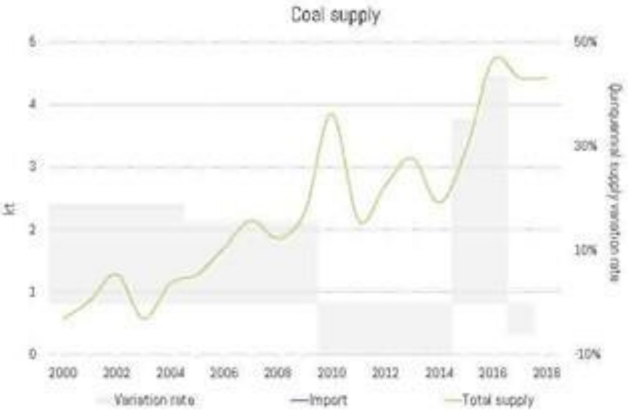
In 1993 the remodeling of the La Teja refinery began, with no production in 1994. In the periods September 2002 to March 2003, September 2011 to January 2012 and much of the year 2017 the refinery was stopped for maintenance.

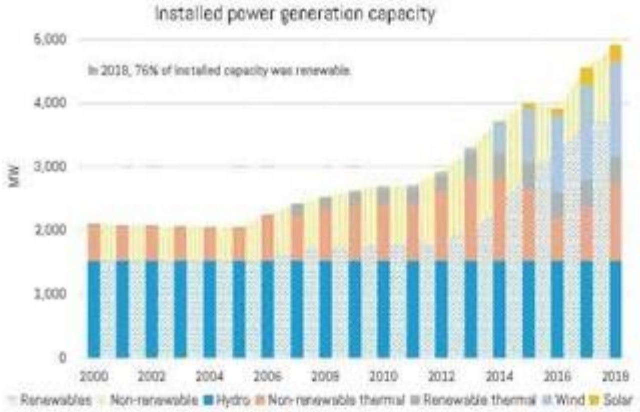


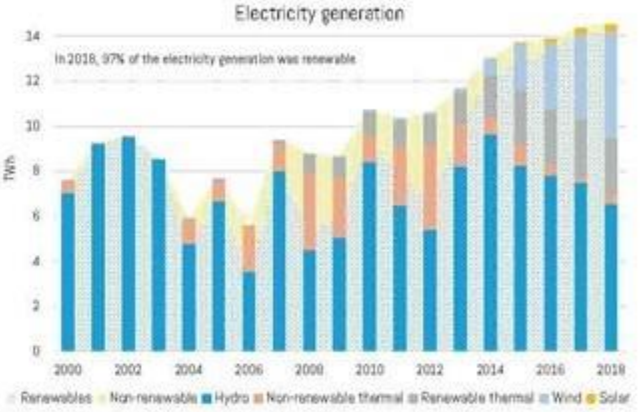


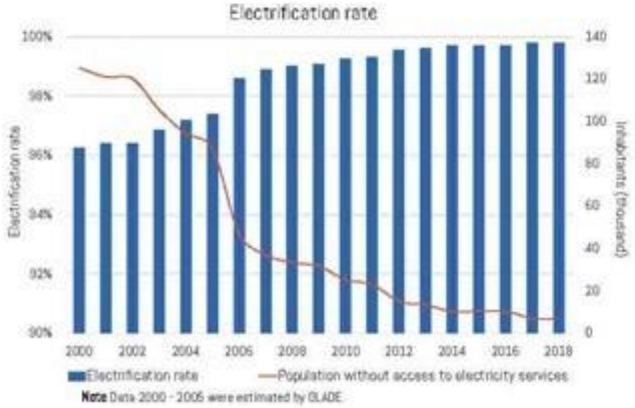




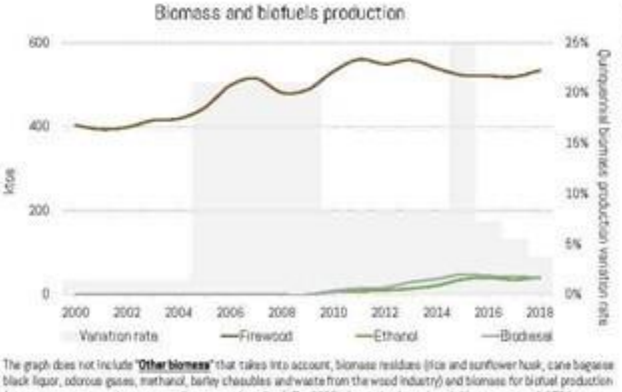




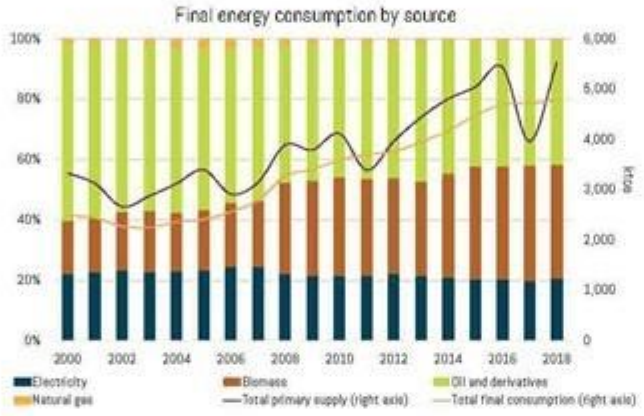


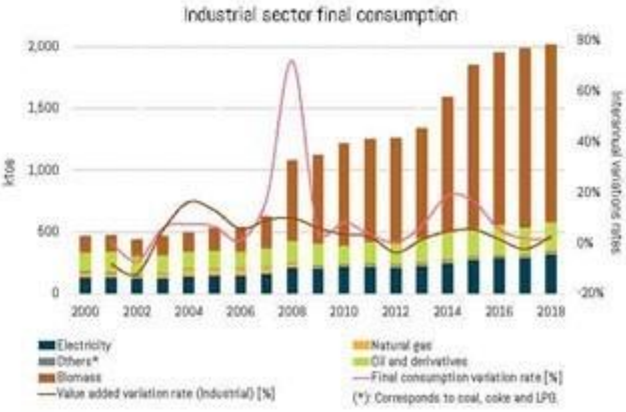


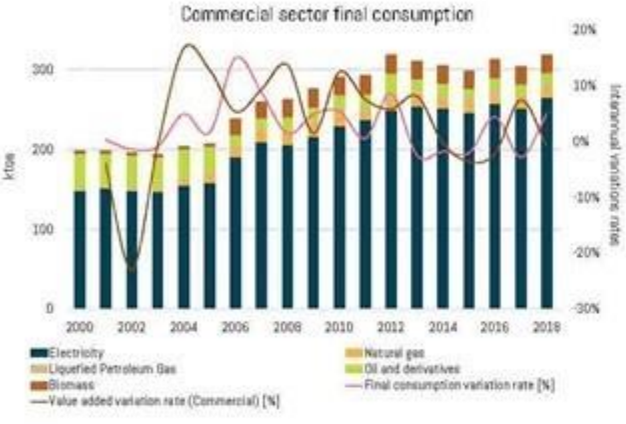
Note Data 2000 - 2005 were estimated by OLADE

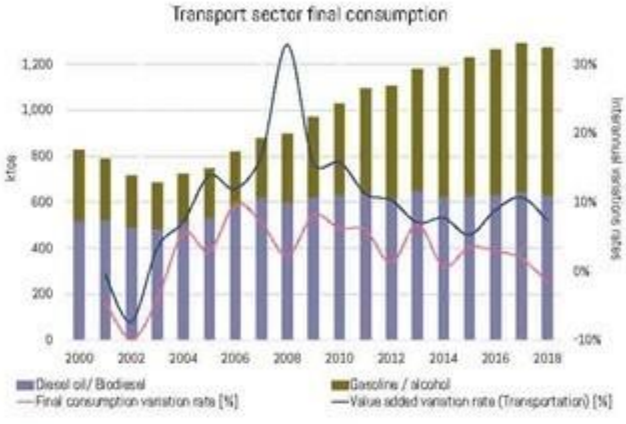


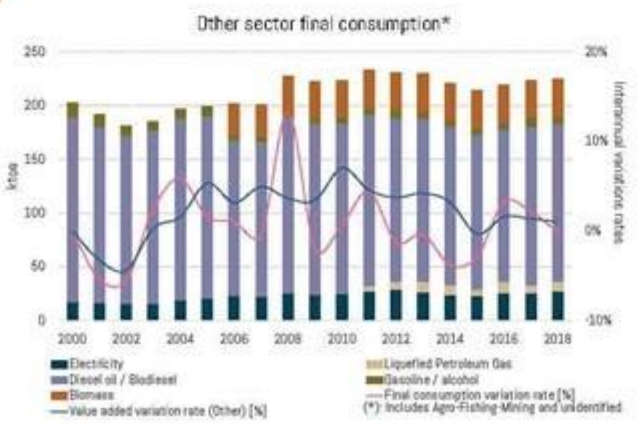
The graph does not include "**Other biomass**" that takes into account, biomass residues (rice and sunflower husk, cane bagasse black liquor, odorous gases, methanol, barley chasubles and waste from the wood industry) and biomass for biofuel production (sugarcane, sweet sorghum soy, sunflower, canola, tallow). For 2018, the production value of this source was 1,678 ktoe

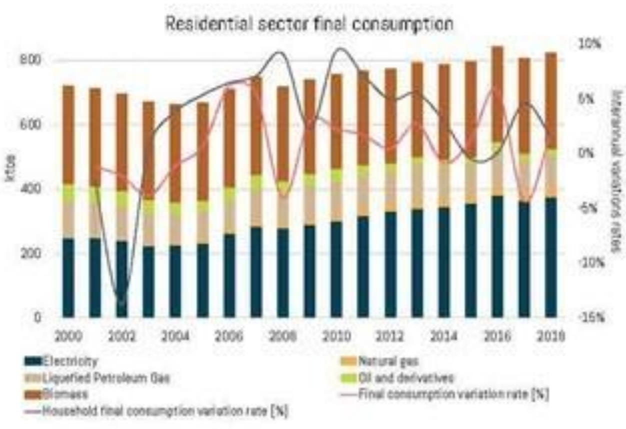

Final energy consumption by source
ktoe
Electricity
Natural gas
Biomass
Total primary supply (right axis)
Oil and derivatives
Total final consumption (right axis)

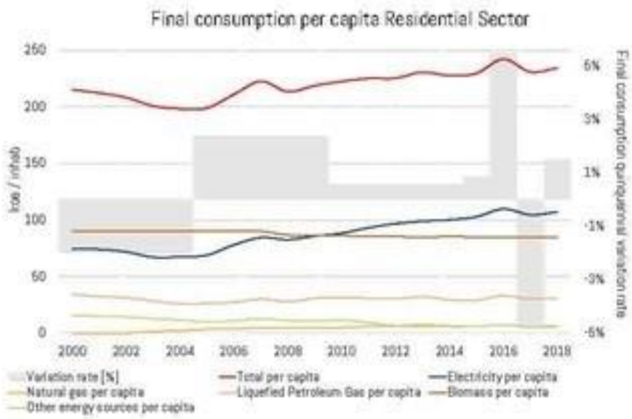

Industrial sector final consumption
ktoe
Interannual variations rates
Electricity
Others*
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]
(*): Corresponds to coal, coke and LPG

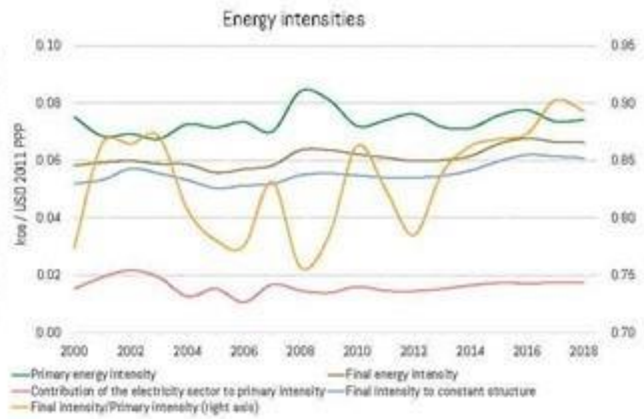

Commercial sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

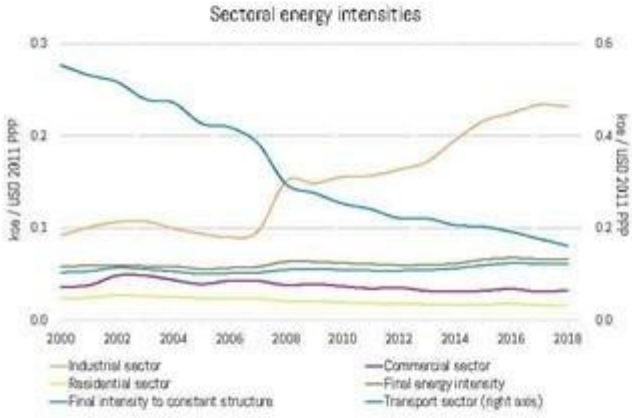

Transport sector final consumption
ktoe
Interannual variations rates
Diesel oil/ Biodiesel
Final consumption variation rate [%]
Gasoline / alcohol
Value added variation rate (Transportation) [%]

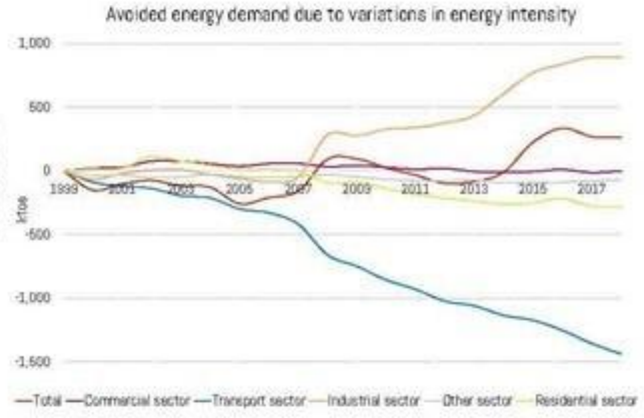

Other sector final consumption*
ktoe
Interannual variations rates
Electricity
Diesel oil / Biodiesel
Biomass
Value added variation rate (Other) [%]
Liquefied Petroleum Gas
Gasoline / alcohol
Final consumption variation rate [%]
(*): Includes Agro-Fishing-Mining and unidentified

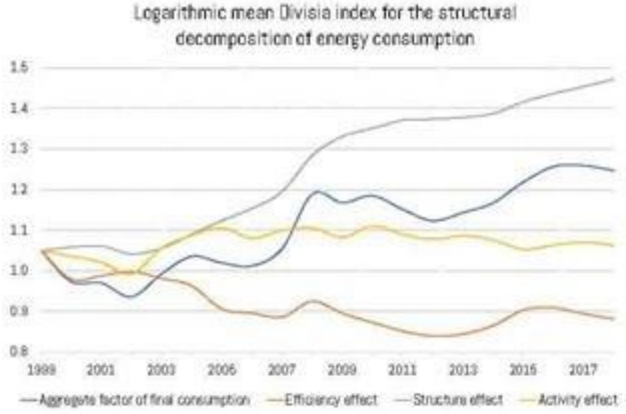

Residential sector final consumption
ktoe
Interannual variations rates
Electricity
Liquefied Petroleum Gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

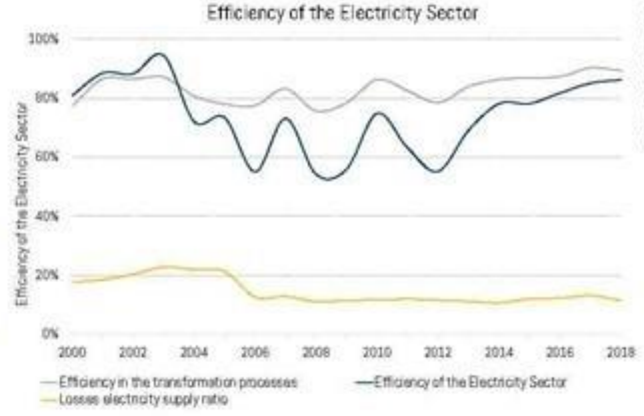

Final consumption per capita Residential Sector
koe / inhab
Final consumption quinquennial variation rate
Variation rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

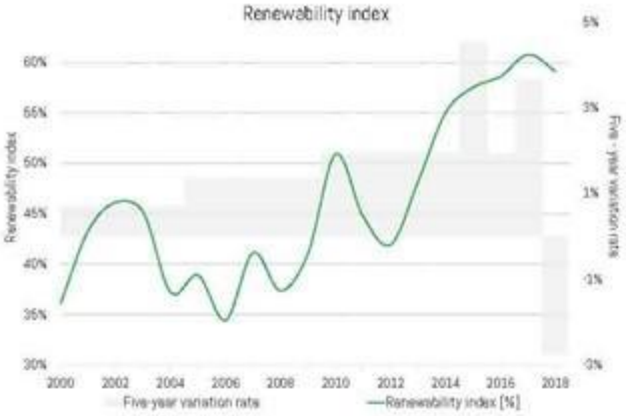

Energy intensities
koe / USD 2011 PPP
Primary energy intensity
Final energy intensity
Contribution of the electricity sector to primary intensity
Final intensity to constant structure
Final intensity/Primary intensity (right axis)

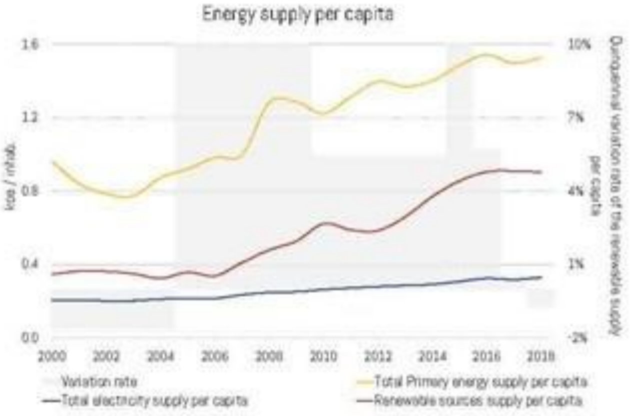

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final energy intensity
Final intensity to constant structure
Transport sector (right axis)

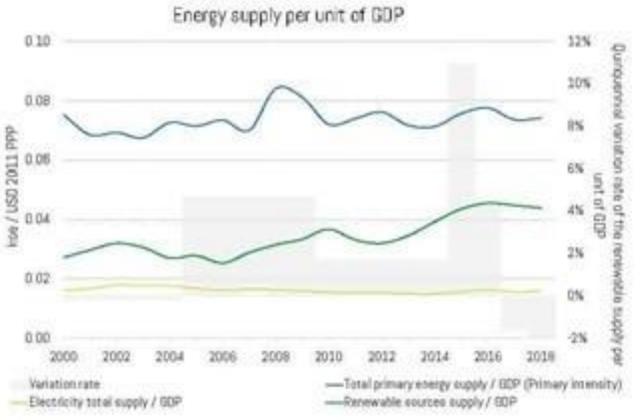

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

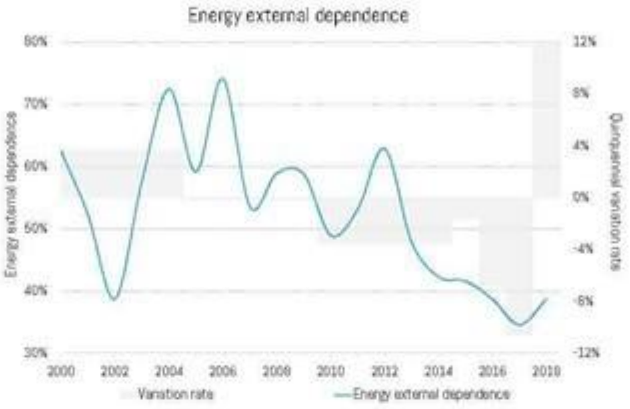

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electricity Sector
Losses electricity supply ratio







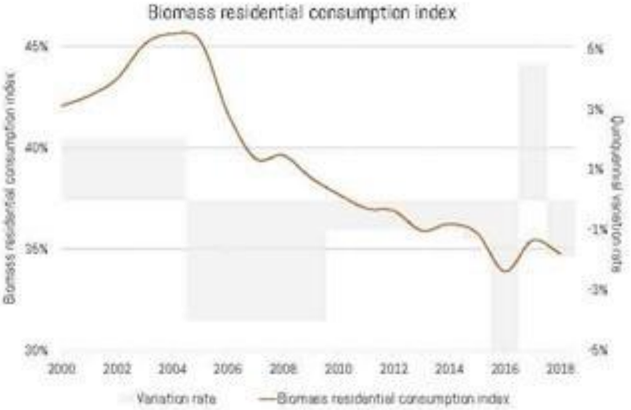


There was an important leap in electric mobility, with the new incorporation of utility vehicles - powered by UTE - with a total of 90 currently. Added to this, more than 40 electric taxis, and the approval of funds with a subsidy scheme for the replacement of 100 urban buses, covering the investment gap compared to traditional buses. The installation of charging points for these vehicles, in conjunction with UTE, has been promoted and an electric mobility rate has been created. These policies have been jointly coordinated by MIEM, MTOP, MEF, IM, UTE.

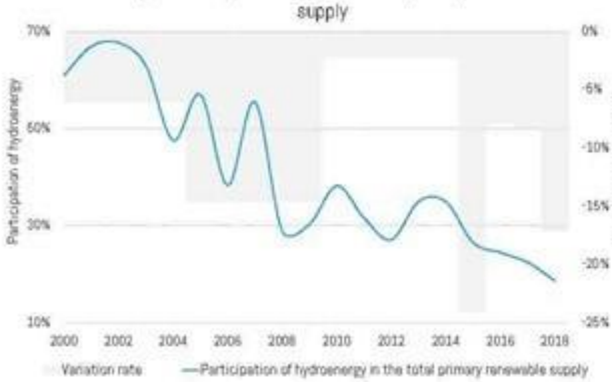
The energy avoided in 2018 represented 2% of the country's total energy demand for that year. The equivalent of the average electricity consumption of 386 thousand households.

Renewables:

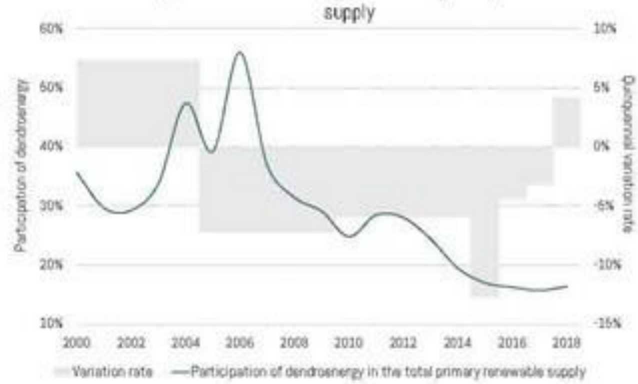
- Commissioning of the first photovoltaic solar energy pilot project in Antarctica, with the installation of a 1.2 kWp plant.
- Creation of the Training Center for Operation and Maintenance in Renewable Energies (Cefomer) in the department of Durazo. It seeks to meet training needs in terms of operation and maintenance in the wind, solar and biomass sectors.



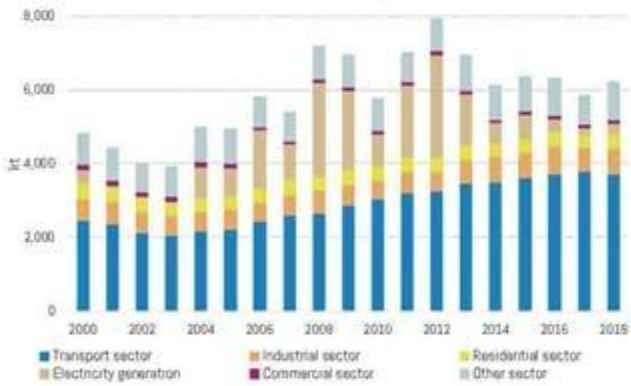
Participation of hydroenergy in the total primary renewable supply



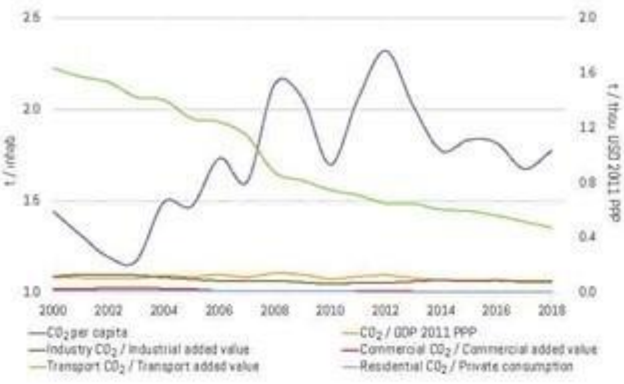
Participation of dendroenergy in the total primary renewable supply



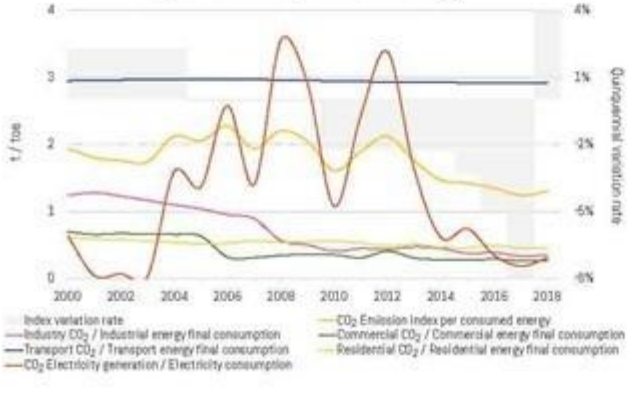
Evolution of CO_2 emissions by sector



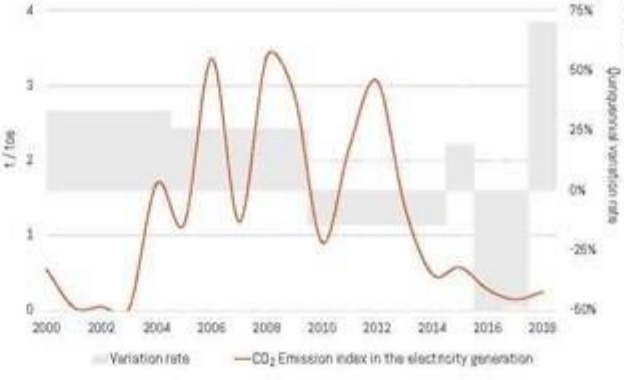
Evolution of CO_2 emissions per capita and per unit of GDP

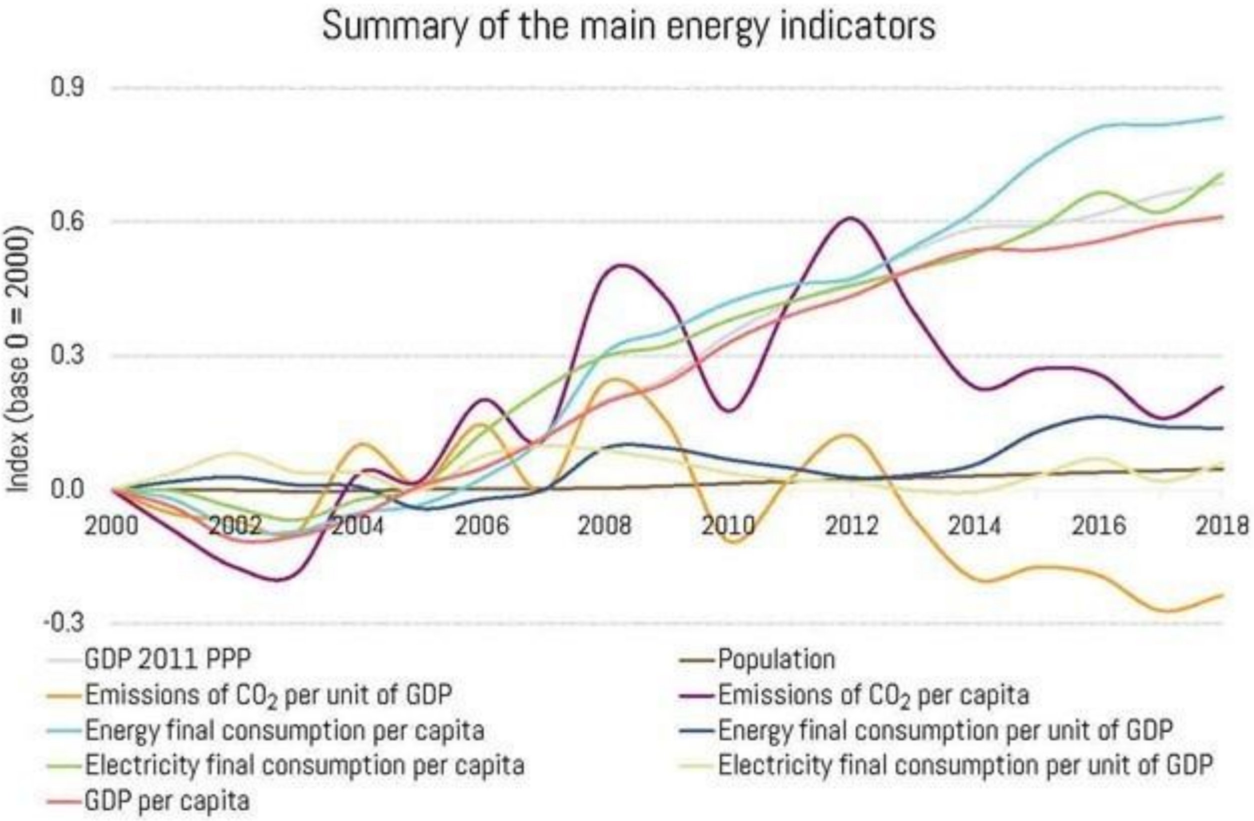


CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation





Summary of the main energy indicators
0.9
0.6
0.3
0.0
-0.3
Index (base 0 = 2000)
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
GDP 2011 PPP
Emissions of CO_2 per unit of GDP
Energy final consumption per capita
Electricity final consumption per capita
GDP per capita
Population
Emissions of CO_2 per capita
Energy final consumption per unit of GDP
Electricity final consumption per unit of GDP

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General Information 2018

Population (thousand inhab.)	28,887
Area (km²)	912,050
Population Density (inhab./km²)	32
Urban Population (%)	90
GDP USD 2010 (MUSD)	135,628
GDP USD 2011 PPP (MUSD)	439,098
GDP per Capita (thou. USD 2011 PPP/inhab.)	15

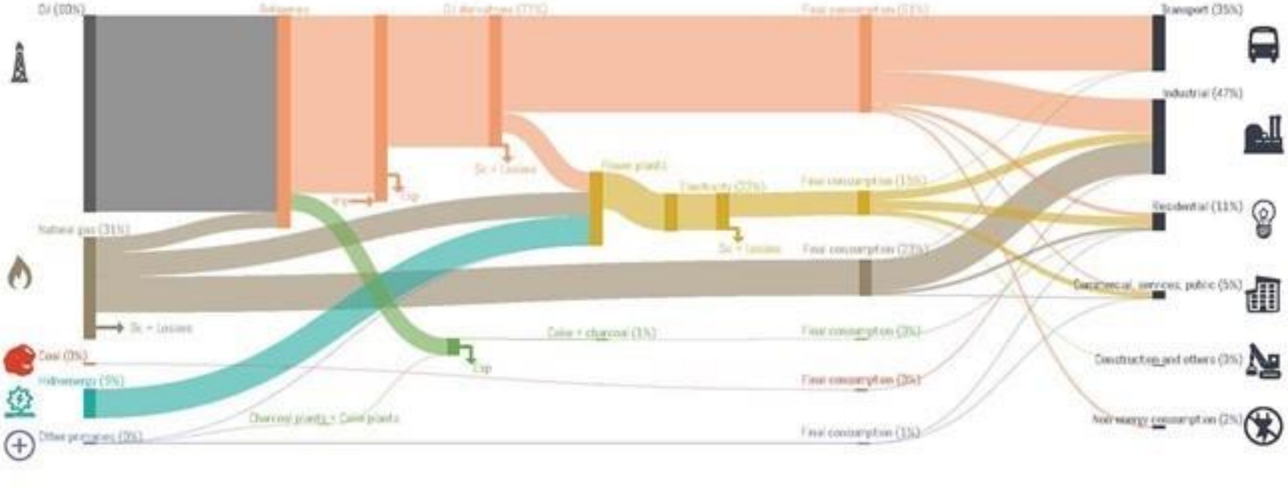
Energy Sector 2013

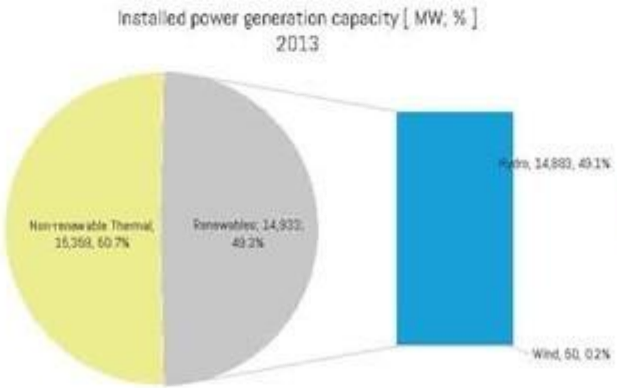
Final consumption in the Transport Sector	Mtoe 16.72
Final consumption in the Industrial Sector	Mtoe 22.57
Final consumption in the Residential Sector	Mtoe 5.42
Final consumption in the Commercial and Service Sector	Mtoe 2.39
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.85

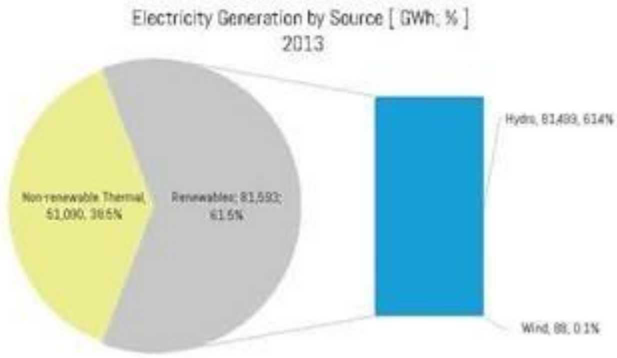
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 298,353	Gm³ 5,581	Mt 1,767

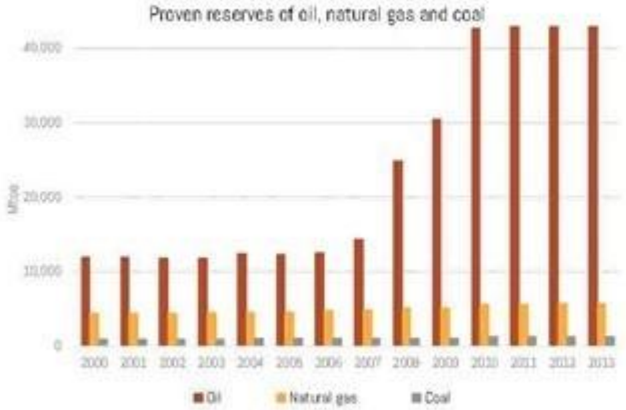
Electricity consumption per capita	Final consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,918	1.61	98.90	79.43	191.17	5.29	123.82	47.95	1,303	30.29	0.19 / 0.09

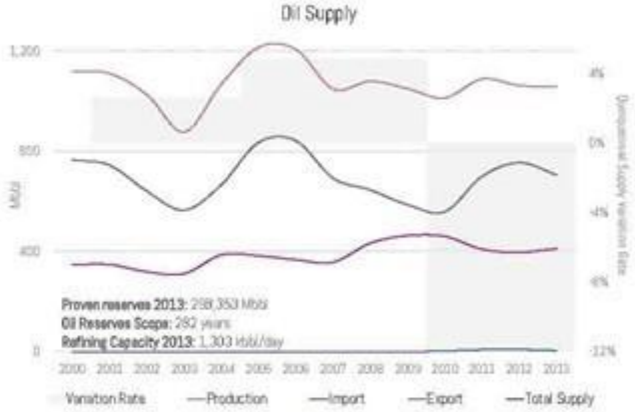
Summarized energy balance 2013

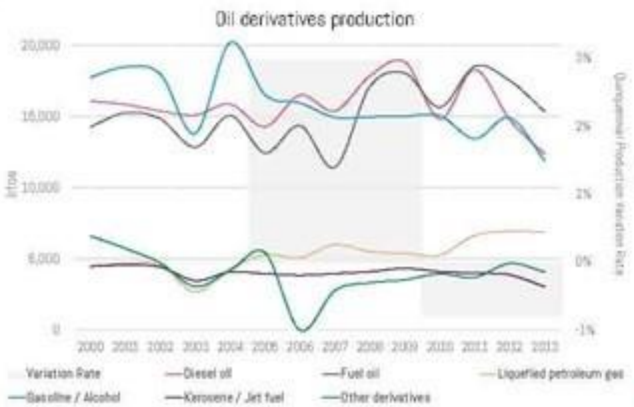


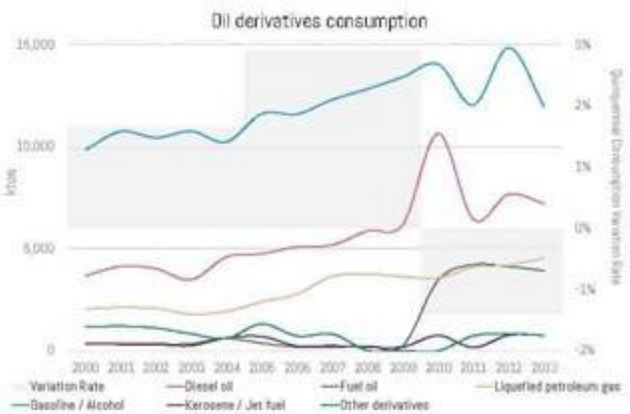

Installed power generation capacity [MW; %]
2013
Non-renewable Thermal; 15,359; 50.7%
Renewables; 14,933; 49.3%
Hydro; 14,883; 49.1%
Wind; 50; 0.2%

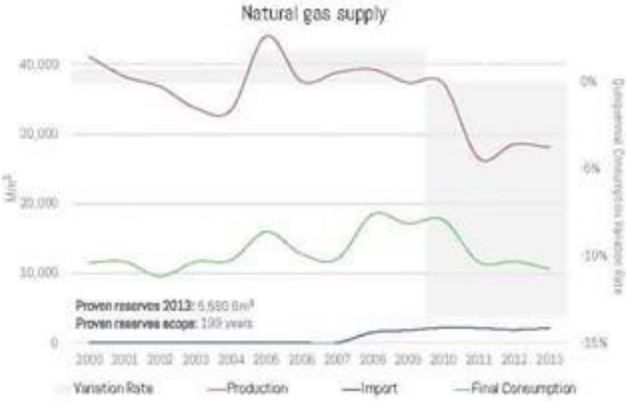

Electricity Generation by Source [GWh; %]
2013
Non-renewable Thermal; 51,090; 38.5%
Renewables; 81,593; 61.5%
Hydro; 81,499; 61.4%
Wind; 88; 0.1%

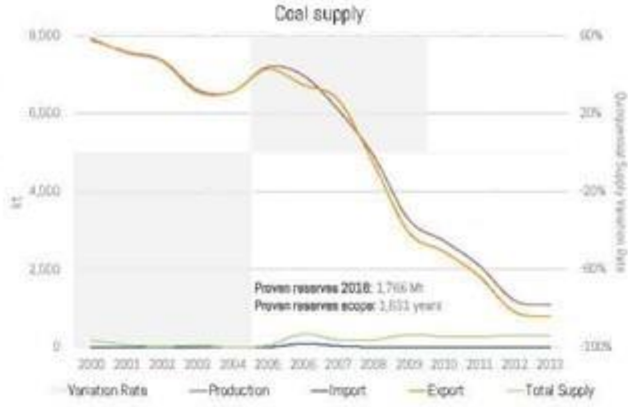

Proven reserves of oil, natural gas and coal
Mtoe
Oil
Natural gas
Coal

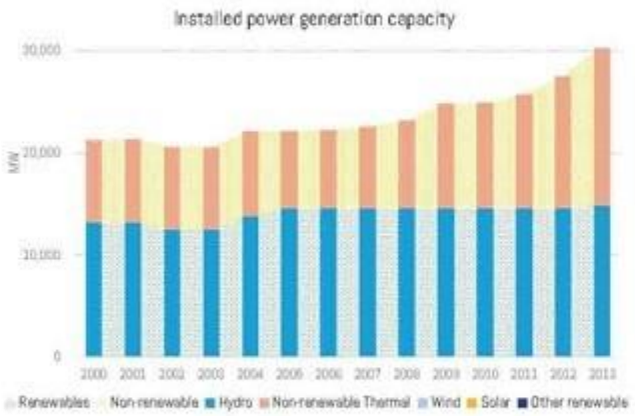

Oil Supply
Mbbl
Proven reserves 2013: 298,353 Mbbl
Oil Reserves Scope: 282 years
Refining Capacity 2013: 1,303 kbbl/day
Variation Rate
Production
Import
Export
Total Supply

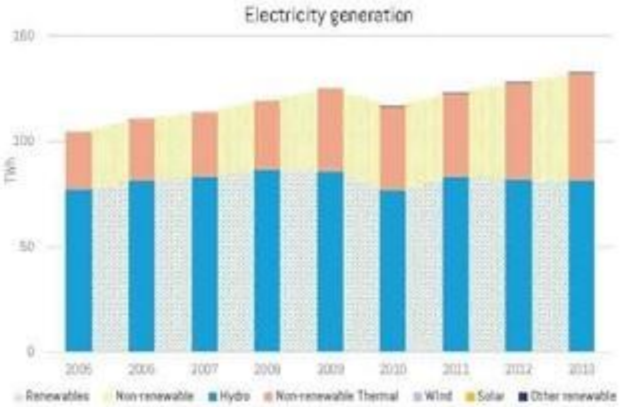

Oil derivatives production
ktoe
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

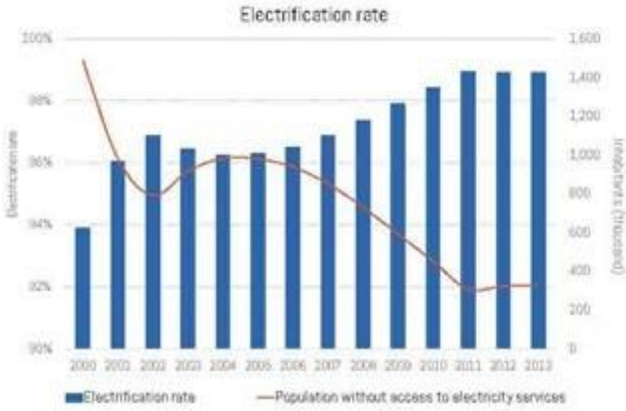

Oil derivatives consumption
ktoe
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

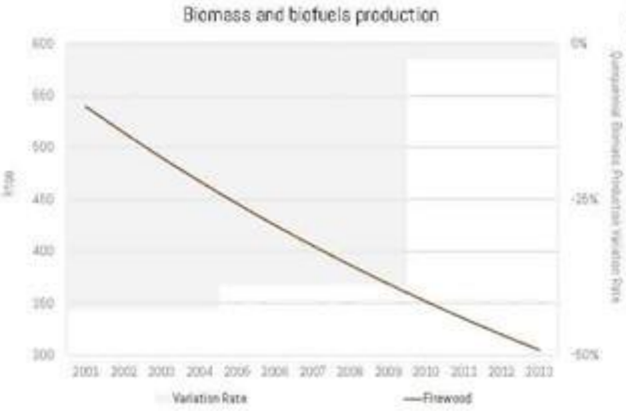

Natural gas supply
40,000
30,000
20,000
10,000
0
Mm³
0%
-5%
-10%
-15%
Quinquennial Consumption Variation Rate
Proven reserves 2013: 5,550 Gm³
Proven reserves scope: 199 years
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Variation Rate
Production
Import
Final Consumption


Coal supply
8,000
6,000
4,000
2,000
0
kt
60%
20%
-20%
-60%
-100%
Quinquennial Supply Variation Rate
Proven reserves 2013: 1,766 Mt
Proven reserves scope: 1,631 years
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Variation Rate
Production
Import
Export
Total Supply


Installed power generation capacity
30,000
20,000
10,000
0
MW
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Wind
Solar
Other renewable


Electricity generation
150
100
50
0
TWh
2005 2006 2007 2008 2009 2010 2011 2012 2013
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Wind
Solar
Other renewable


Electrification rate
100%
98%
96%
94%
92%
90%
Electrification rate
1,600
1,400
1,200
1,000
800
600
400
200
0
Inhabitants (thousand)
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Electrification rate
Population without access to electricity services


Biomass and biofuels production
600
550
500
450
400
350
300
ktoe
0%
-25%
-50%
Quinquennial Biomass Production Variation Rate
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013
Variation Rate
Firewood

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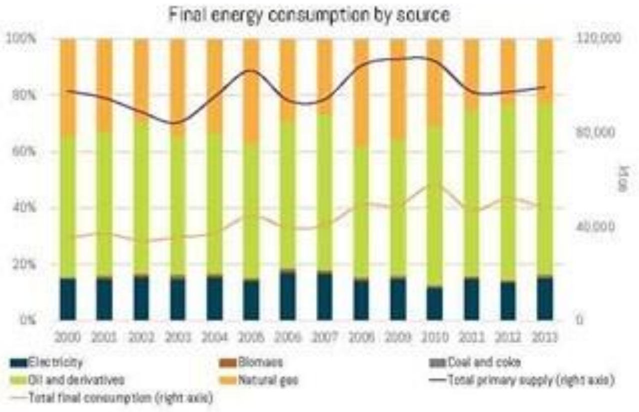
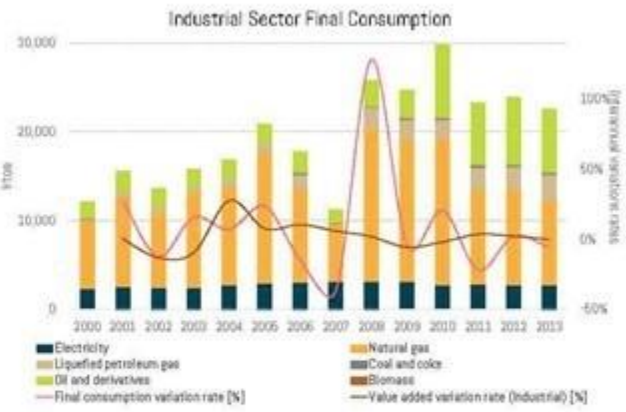
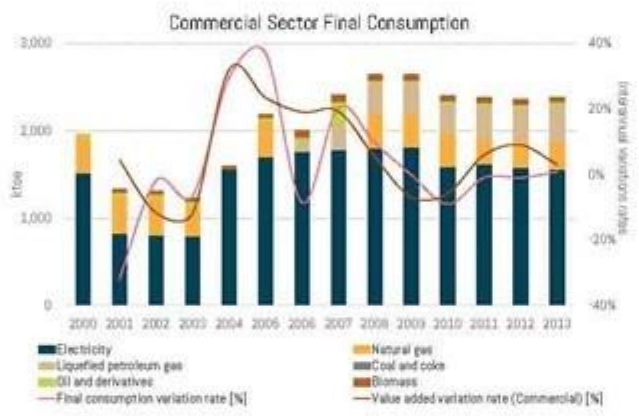
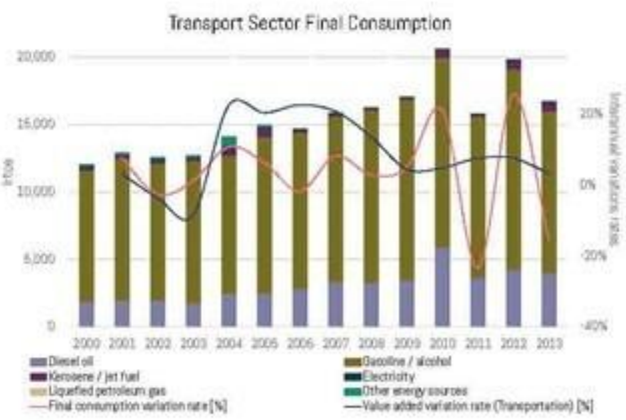

Final energy consumption by source
ktoe
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)


Industrial Sector Final Consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]


Commercial Sector Final Consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]


Transport Sector Final Consumption
ktoe
Interannual variations rates
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied petroleum gas
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

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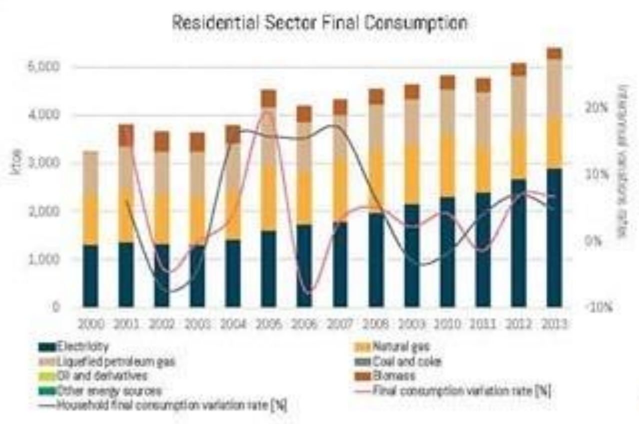
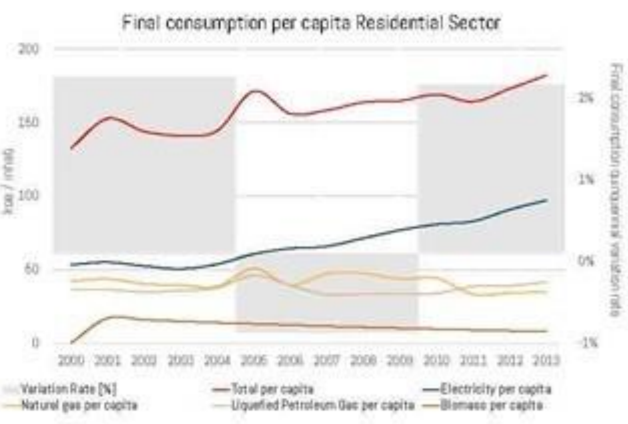
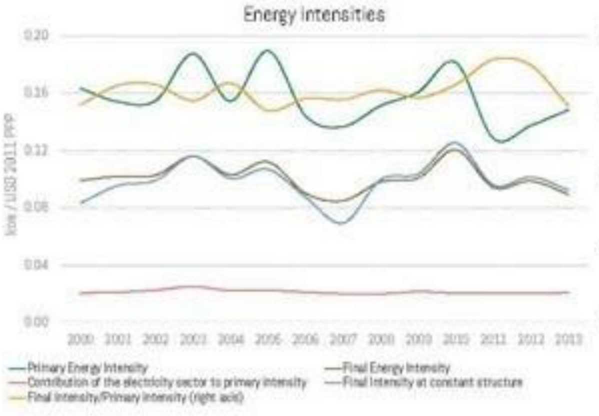
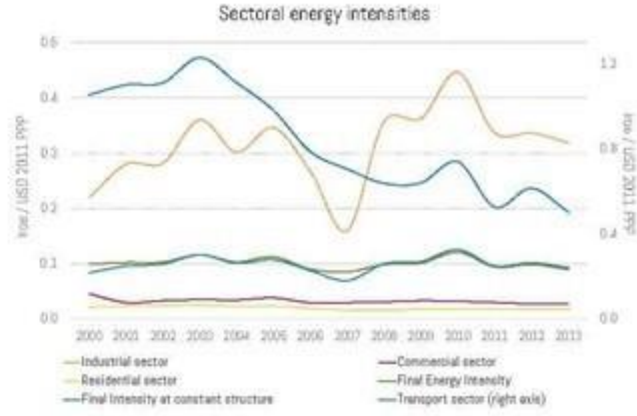
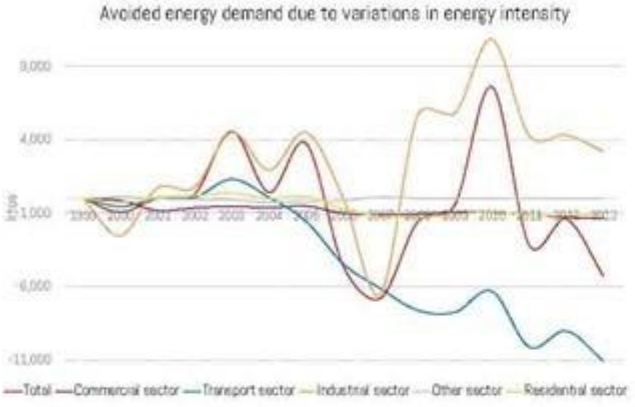
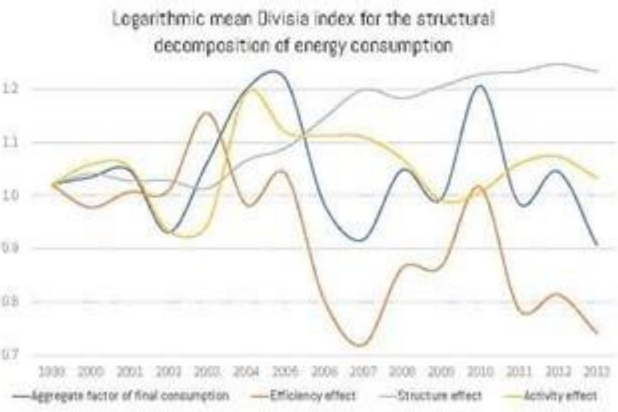

Residential Sector Final Consumption
ktoe
Interannual variations rates
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Other energy sources
Final consumption variation rate [%]
Household final consumption variation rate [%]

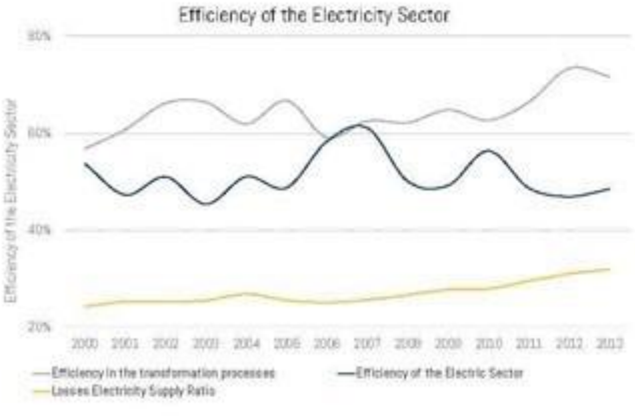

Final consumption per capita Residential Sector
kep / inhab
Final consumption quinquennial variation rate
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita

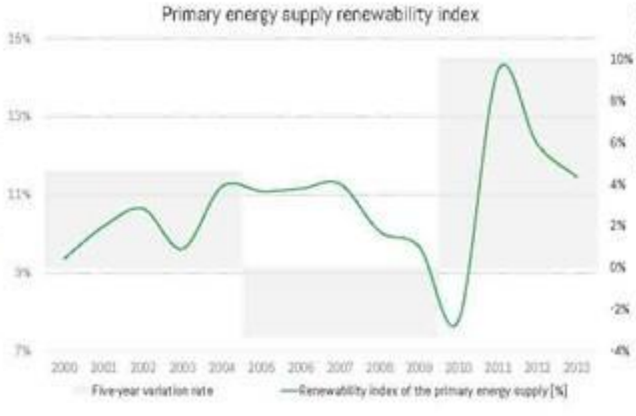

Energy intensities
koe / USD 2011 PPP
Primary Energy Intensity
Contribution of the electricity sector to primary intensity
Final intensity/Primary intensity (right axis)
Final Energy Intensity
Final intensity at constant structure

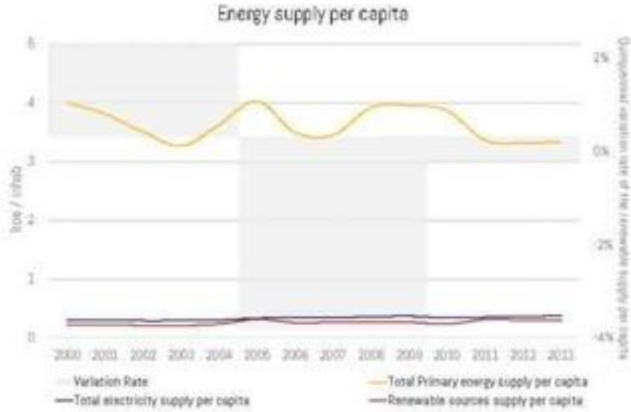

Sectoral energy intensities
koe / USD 2011 PPP
Industrial sector
Residential sector
Final intensity at constant structure
Commercial sector
Final Energy Intensity
Transport sector (right axis)

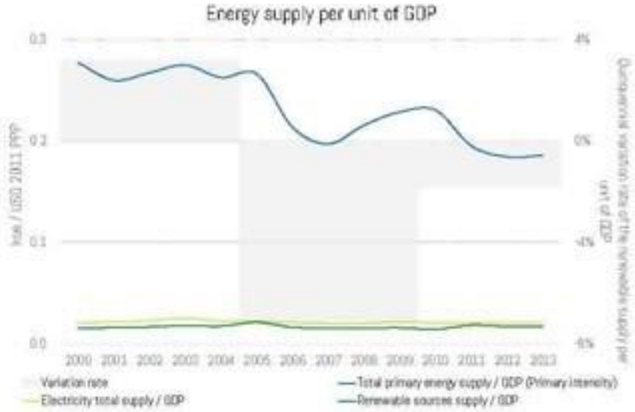

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

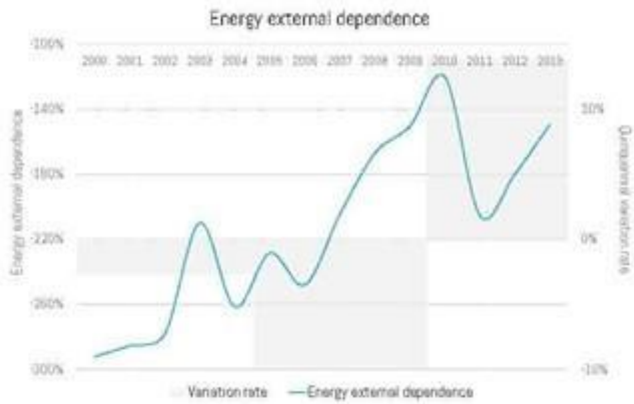

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

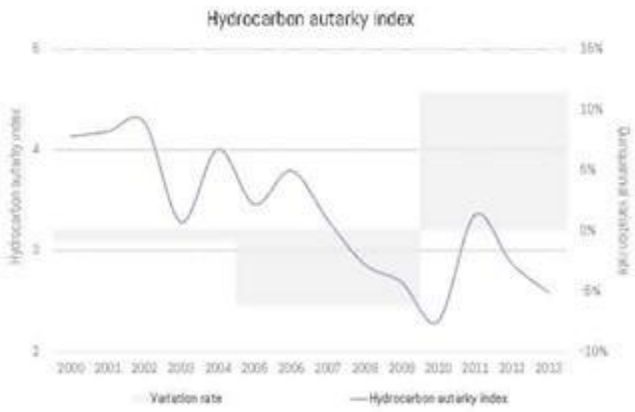

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

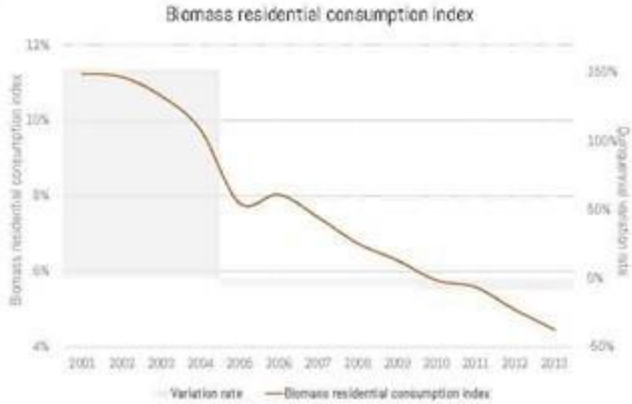

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

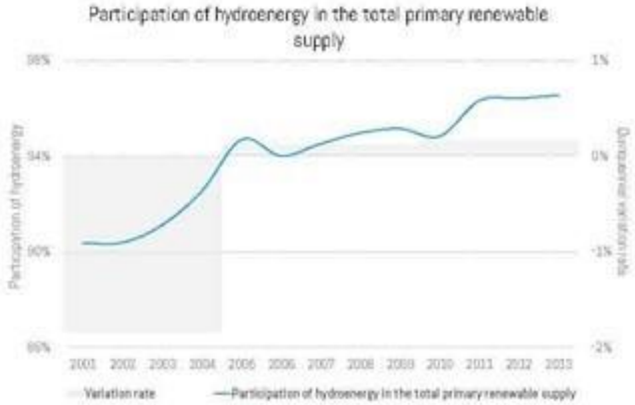

Energy supply per capita
toe / inhab
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

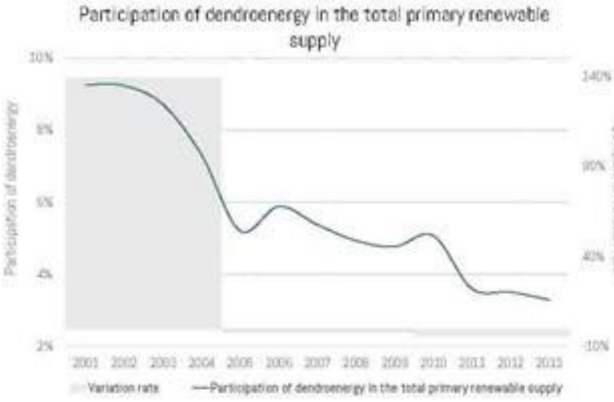

Energy supply per unit of GDP
toe / USD 2011 PPP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

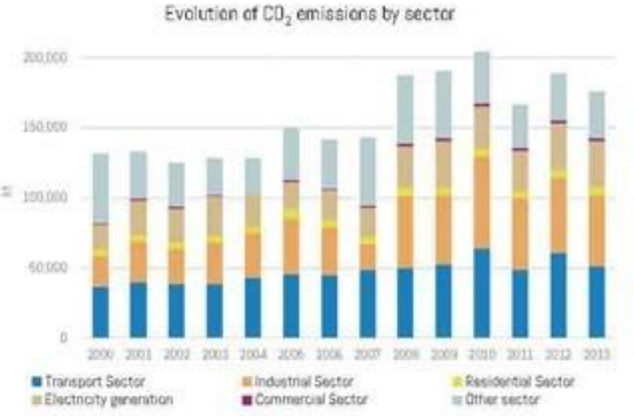

Energy external dependence
Energy external dependence
Quinquennial variation rate
Variation rate
Energy external dependence

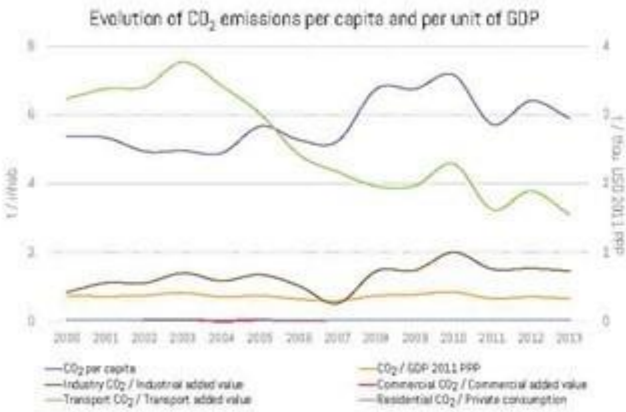

Hydrocarbon autarky index
Hydrocarbon autarky index
Quinquennial variation rate
Variation rate
Hydrocarbon autarky index

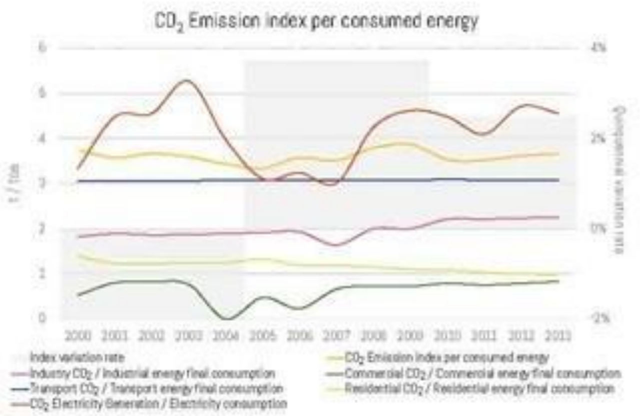

Biomass residential consumption index
Biomass residential consumption index
Quinquennial variation rate
Variation rate
Biomass residential consumption index

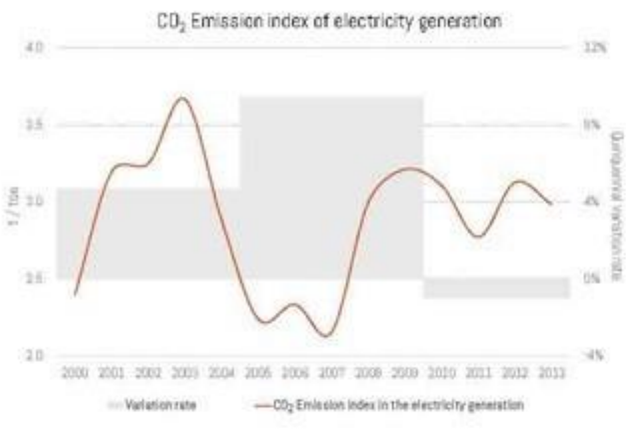

Participation of hydroenergy in the total primary renewable supply
Participation of hydroenergy
Quinquennial variation rate
Variation rate
Participation of hydroenergy in the total primary renewable supply

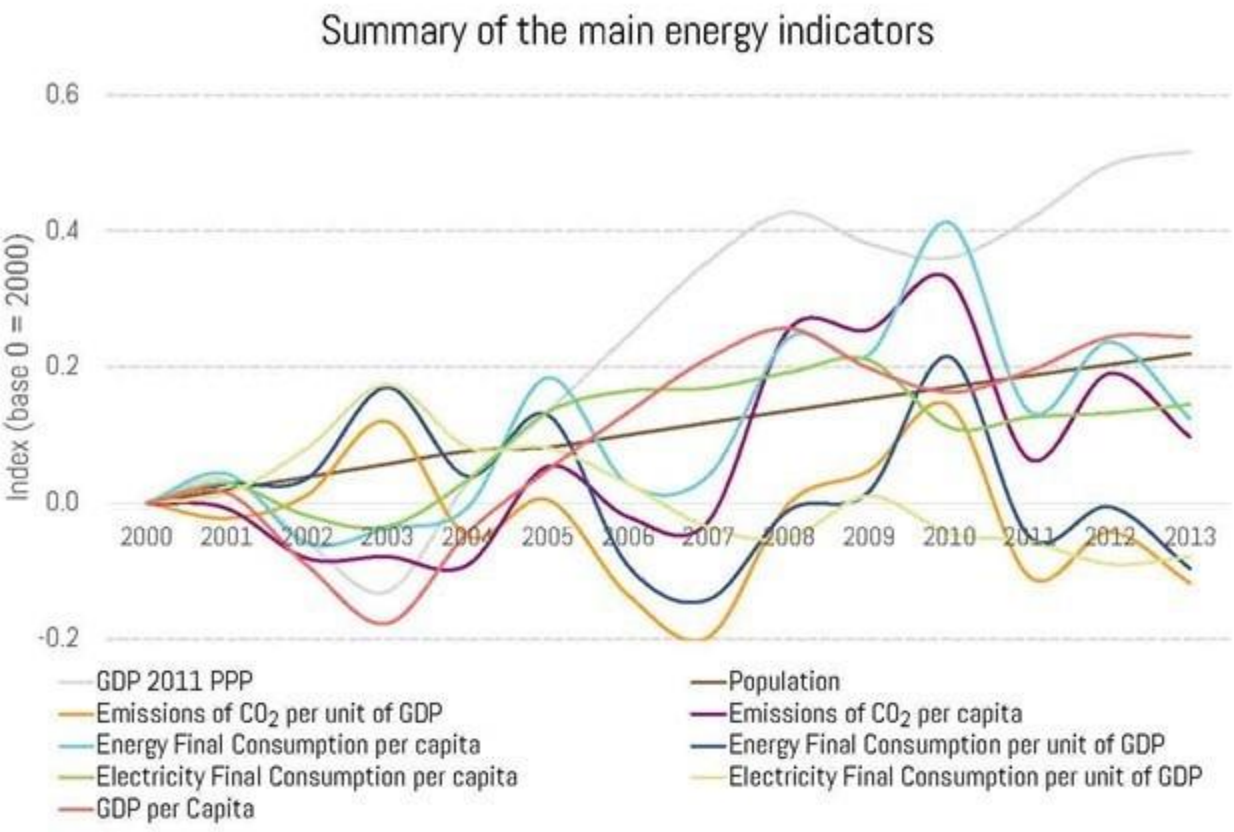

Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Quinquennial variation rate
Variation rate
Participation of dendroenergy in the total primary renewable supply


Evolution of CO_2 emissions by sector
kt
200,000
150,000
100,000
50,000
0
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
t / inhab
t / thou. USD 2011 PPP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
t / toe
Quinquennial variation rate
Index variation rate
CO_2 Emission index per consumed energy
Industry CO_2 / Industrial energy final consumption
Commercial CO_2 / Commercial energy final consumption
Transport CO_2 / Transport energy final consumption
Residential CO_2 / Residential energy final consumption
CO_2 Electricity Generation / Electricity consumption


CO_2 Emission index of electricity generation
t / toe
Quinquennial variation rate
Variation rate
CO_2 Emission index in the electricity generation



Summary of the main energy indicators
0.6
0.4
0.2
0.0
-0.2
Index (base 0 = 2000)
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
GDP 2011 PPP
Population
Emissions of CO2 per unit of GDP
Emissions of CO2 per capita
Energy Final Consumption per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per capita
Electricity Final Consumption per unit of GDP
GDP per Capita

Legislation, regulation and energy policy

Legislation, regulation and energy policy 2018

1. *INSTITUCIONAL*

Approval of policies, plans, programs and institution building

Argentina made reforms to the Law on Ministries which implied the modification of the name of the Ministry of Energy and Mines, which in order to adequately reflect its tasks was renamed the Ministry of Energy. To this end, the competences in mining policy were transferred to the Ministry of Production. This strategic reorganization measure was based on the need to specify the goals set and the promotion of more efficient management through the rational use of public resources. Subsequently, new modifications were made to the Law of Ministries, under which mergers of ministries were directed to centralize competencies in a smaller number of jurisdictions on the basis of budget reduction; in this regard, the assistance to the President of the Nation and the Chief of the Cabinet of Ministers was included in the powers of the Ministry of Finance, in everything inherent to the elaboration, proposal and execution of the national energy policy, with the Ministry of Treasury as a continuator to all its effects of the former Ministry of Energy.

In order to improve its technical regulations for the hydrocarbons subsector Bolivia approved the new Regulation of the Monitoring and Control Units for Petroleum Operations, instances aimed at guaranteeing the supervision, evaluation, monitoring and control of the obligations of the Holder and Petroleum Operations emerging from the execution of the Operation Contracts. For this purpose, Ministerial Resolution No. 130-09 dated June 16, 2009, which approved the previous regulation was repealed.

With the objective of promoting efficiency in the exploitation of the oil potential of the national underground; guarantee the maintenance and expansion of the area in operation; and attract investments through the periodicity and predictability of the offers, Brazil, via Decree, delegated powers to the National Agency of Petroleum, Natural Gas and Biofuels (ANP) to define the blocks in the terrestrial basins that will be tendered in concession regime in the Permanent Offer system. On the other hand, it was approved via Decree, the inclusion of: the electric power transmission installation ventures, the areas offered in the fifth round of offers under the regime of participation of production in the oil and natural gas sector; and the transmission facilities subject to Auction # 04/2018 of the National Electric Energy Agency - ANEEL within the scope of the Investment Partnerships Program of the Presidency of the Republic. The aforementioned Investment Partnerships Program (PPI) was created by law in 2016, with the aim of expanding and strengthening the interaction between the State and the private sector, expanding investment and employment opportunities and stimulating technological and industrial development. This, in harmony with the social and economic development goals of the country. Once the ventures are qualified in the PPI, they will be considered a national priority. Likewise, modifications were made to the structure and operation of the National Energy Policy Council - CNPE, according to which the CNPE is composed of the following government authorities: Minister of State for Mines and Energy (who chairs it), Minister of State Head of the Civil House of the Presidency of the Republic, Minister of State and Foreign Affairs; Minister of State for Agriculture, Livestock and Supply. Additionally, it is permitted the participation with voice and vote of: a representative of the States and the Federal District indicated by the National Forum of Secretaries of State of Mines and Energy; two representatives of civil society, energy specialists, two representatives of Brazilian academic institutions, energy specialists.

Chile created the Permanent Presidential Advisory Committee on Climate Change in charge of advising the Presidency of the Republic on all matters related to the identification and formulation of policies, plans, programs, measures and other activities related to climate change, including compliance with international commitments acquired under the Paris Agreement, as well as the development and proposal of a national climate public policy. Additionally, it approved its long-term energy planning (2018 - 2022), for the different energy scenarios of expansion of generation and consumption, including projection of energy supply and demand and in particular electricity, considering the identification of generation development poles, distributed generation, international energy exchanges, environmental policies and energy efficiency objectives among others. On the other hand,

and in line with the provisions incorporated in the General Law of Electric Services and the Law of Gas Services, the new Regulation of the Panel of Experts, established in the General Law of Electric Services, was approved. It regulates the provisions applicable to the integration, operation, financing and competencies of this instance, as well as the procedures and other matters necessary for the proper exercise of its functions. The Panel of Experts is a body with limited competence, composed of expert professionals, whose function is to pronounce, by means of opinions of binding effect, on those discrepancies that occur in relation to the matters that are expressly indicated in the General Law of Electrical Services, and in other laws regarding energy. Also, considering the establishment of a new electrical transmission system, and the creation of a technical and independent body responsible for coordinating the operation of all the installations of the national electrical system that operate interconnected with each other, the regulation establishing the provisions applicable to the organization, composition and operation of the Independent Coordinator of the National Electric System was approved.

Colombia adopted the Generation-Transmission Reference Expansion Plan 2017 - 2031, in compliance with the national objective of supplying the demand for electricity under economic and financial viability criteria, ensuring its coverage in a framework of rational and efficient use of the different energy resources of the country and guaranteeing an efficient, safe and reliable operation in the activities of the electricity sector. Additionally, the regulation of the Non-Conventional Energy and Efficient Energy Management Fund, FENOGE, was approved by adding a Section to the Single Regulatory Decree of the Mining and Energy Administrative Sector. The aforementioned FENOGE is in charge of the financing of programs of Non-Conventional Energy Sources (FNCE) and efficient energy management, through its promotion, encouragement, stimulus and incentive.

In accordance with the entry into force of the Law on Incentives and Promotion for Electric Transportation, Costa Rica instituted the Ministry of Environment and Energy (MINAE) as the governing authority for the application in charge of the direction, monitoring, evaluation and control of all provisions established in the aforementioned law. It is in charge of the formulation and execution of the national policy on renewable energy for transport and the National Plan for Electric Transportation, in coordination with the Ministry of Public Works and Transportation (MOPT), entity designated to establish the goals on the replacement of the current public and private transport fleet, define the indicators of compliance with electric transport in the country and issue the corresponding certificates to certify that the electric vehicles that are imported meet the characteristics established by law. For the drafting of the policy, the plan and the technical regulations, the law entrusts MINAE with the duty to guarantee the participation of institutions, related sectors and civil society, in the participatory construction of the instruments aimed at protecting and improving the environment. Additionally, the aforementioned law delegates to the National Institute of Learning (INA), the establishment of channels for the training of human resources, that can be developed at work, in the maintenance and repair of electric vehicles and their parts. On the other hand, the General Mechanism for Consultation of Indigenous Peoples was approved by Decree. It regulates the obligation of the Executive Power to consult indigenous peoples in a free, prior and informed manner. Whenever the application of any of the specific administrative measures contained in Convention 169 of the International Labor Organization on indigenous and tribal peoples is expected. Including the exploration or exploitation of natural resources located within the territories; the measures related to the affectation of lands or territories and other resources, related to the development, use or exploitation of mineral, water or other resources, will also be consulted. To this end, all agreements that have been reached between indigenous peoples, public institutions and private companies are considered fully binding for all parties involved.

Having identified the need to undertake an institutional optimization that meets the social and economic demands on which government priorities have been defined, Ecuador decreed the merger by absorption to the Ministry of Hydrocarbons, of the following institutions: Ministry of Electricity and Renewable Energy, Ministry of Mining and the Ministry of Hydrocarbons. Once the merger by absorption was concluded, the name of the Ministry of Hydrocarbons was modified to the Ministry of Energy and Non-Renewable Natural Resources, and all the powers, responsibilities, functions, representations and delegations that corresponded to the mentioned public entities were assumed by the aforementioned Ministry. Additionally, the National Institute of Energy Efficiency and Renewable Energies was merged by absorption into the National Institute of Geological, Mining and Metallurgical Research, and once the merger by absorption process was completed, its name was modified to "Institute of Geological and Energy Research", entitiy attached to the Ministry of Energy and Non-Renewable Natural Resources. On the other hand, assessing that since 2012, the country has been part of the SGIP "Smart Grid Interoperability Panel", an international organization that promotes the harmonization of systems and device standards; the Ecuador Smart Grid Program (REDIE) was established, conceived as a policy aimed at guaranteeing a more efficient and flexible network, with high availability and quality of energy supply; based on the benefits provided by information and communication technologies, through the establishment of a single frame of reference for the management and execution of the different initiatives associated with this Program.

Guatemala approved the 2018-2032 Indicative Expansion Plan of the Generation System, focused on prioritizing renewable energies, diversifying the energy matrix, reducing greenhouse gases, and providing security for electricity supply at competitive prices. The aforementioned document, prepared on the basis of the criteria and procedures established in this regard in Article 15a of the Regulation of the Wholesale Market Administrator, contemplates the alternatives of the most suitable supply of the demand for electricity; based on the data obtained from the projects under construction, the price of fuels and projections of energy and power demand at the national level. In each of the scenarios, the assumptions are presented, the projection of fuel prices, Energy dispatch, Energy demand, Plant Installation Schedule, Cost comparison, Capacity Installed during the Generation Plan, CO_2 Emissions, among other analyzes. Likewise, the 2018-2032 Transportation System Expansion Plan was approved, which establishes the guidelines for the addition of new power generation plants and transportation networks, with emphasis on the planning of the growth of the necessary Electric Power Transmission infrastructure to meet the future demand of the country, guaranteeing the quality of the supply and the fulfillment of the goals determined in the Energy Policy 2013-2027, specifically in regard to its number one axis: "Security of electricity supply at competitive prices".

México carried out important reforms and additions to federal law to prevent and punish crimes committed in the area of hydrocarbons. Under the reforms, specific provisions aimed at the prevention of the commission of crimes or the suspension of their effects are included and the penalties for crimes committed in the area of hydrocarbons, petroleum or petrochemicals and other assets are increased, with penalties of between 20 and 30 years in prison and fines of 20,000 to 25,000 times the value of the Unit of Measure and current update. Also, assessing the need for adaptation to current legislation, it was issued the new organic statute of the National Center for Energy control, CENACE, a decentralized public body of the Federal Public Administration, which is in charge of the Operational Control of the National Electric System and the operation of the Wholesale Electricity Market. On the other hand, and within the framework of the reforms made to the General Law on Climate Change, the National Institute for Ecology and Climate Change (INECC) was included, referring to the contributions determined at the national level. Additionally, in the formulation of the national climate change policy, the observation of a new principle related to the progressivity and gradualness of the goals for the fulfillment of the postulates of the law was incorporated. This, taking into account the principle of common but differentiated responsibilities and their respective capacities, in the light of different national circumstances, in the context of sustainable development and efforts to eradicate poverty. Also, the federation was commissioned to prepare a National Adaptation Policy within the framework of the National Climate Change System. Furthermore, it was determined that the National Climate Change mitigation policy should consider the contributions determined at the national level for the fulfillment of the objectives of the Paris Agreement, access to financial resources, technology transfer and capacity development, as well as any other international treaty signed by the Mexican State regarding climate change. Additionally, as part of the powers of the Climate Change Inter-Ministerial Commission the following were included: the approval of the national strategy and the contributions determined at the national level, participation in the elaboration and implementation of the Special Climate Change Program and the National Adaptation Policy, as well as the review and information on the progress of the National Strategy and the contributions determined at the national level. Likewise, as part of the powers of the Climate Change National Council the following were included: the follow-up to the policies, actions and goals foreseen in this Law, evaluations of the National Strategy, the Program and the state programs, the contributions determined at the national level; as well as making proposals to the Commission, the INECC Evaluation Coordination and the members of the National Climate Change System. Finally, the National Adaptation Policy, the nationally determined contributions, and the programs of the Federal Entities are included in the planning instruments of the national climate change policy.

Nicaragua created, under the sectoral rectory of the Presidency of the Republic, the Energy Cabinet, in charge of coordinating the design and management of actions and policies in the energy sector, composed of the following government authorities: Minister of Energy and Mines; President of the Board of Directors of the INE; Minister of Finance and Public Credit, Executive President of ENATREL; Executive President of ENEL; Chairman of the

Board of Directors of PETRONIC; Advisor to the President of the Republic for energy issues with emphasis on renewable sources; and, a delegate indicated by the President of the Republic.

To ensure the efficient development of the electricity system, the Ministry of Energy and Mines of Peru (MEM) approved the Transmission Plan 2019 - 2028 and convened the construction and operation of nine projects in various regions of the country. The aforementioned instrument constitutes the periodic study that identifies, through a centralized analysis, the requirements of transmission equipment necessary to maintain or improve the quality, reliability, safety or economy of the system for a horizon of up to ten (10) years.

The Ministry of Energy and Mines of the Dominican Republic (MEM) formally assumed the drafting, adoption, monitoring, evaluation and control of policies, strategies, general plans, programs, projects and services related to the energy sector and its electric power subsectors and renewable energy. To this end, MEM assumes the strengthening of its professional and technical structure by creating the Conventional Energy Directorate, under the coordination of the Vice Ministry of Energy, after assuming the rectory of the electricity sector since September 2018. On the other hand, the resolution approved the creation, attributions and operation of the joint commission of authorization of the Non-Profit Associations (ASFL) of the Ministry of Energy and Mines. The aforementioned commission, linked by the nature of its activities to the Ministry of Energy and Mines, constitutes a decentralized body, aimed at applying the Enabling Procedure to the corresponding associations that request it, guaranteeing that the services they offer meet the minimum conditions and particular in terms of their physical, human, structural and operational resources.

2. *ELECTRICITY*

2.1 Generation, transmission and distribution

Brazil provided, by decree, the gradual reduction of the discounts granted in the usage rate of the distribution system and the electricity tariff. To this end, the cumulative application of the planned discounts is prohibited, with the one giving the greatest benefit to the consumer prevailing. As of January 1, 2019, in the corresponding adjustments or in the procedures of revision of ordinary tariffs, the previously valid discounts are reduced at an annual rate of 20% on the initial value, until reaching zero. On the other hand, the regulation of the provisional measure that it has on the recognition of rights to resources associated with the concessions of distribution of electrical energy foreseen in the current legislation was approved. Under the regulations, it will expect, at the discretion of the seller and at the request of the National Electric Energy Agency - ANEEL, the obligation to deliver electricity for a thermoelectric plant that has been contracted in an electric auction of new projects and whose expenses with the natural gas pipeline transport infrastructure, they are reimbursable by the Fuel Consumption Account - CCC.

Chile made modifications to the General Law of Electric Services, aimed at imposing on the Energy Distribution Company the obligation to resolve the removal and replacement of the splice and meter in case of disuse of the installations by force majeure. Under the reforms, the splice and the meter are part of the distribution network and, therefore, the property and responsibility of the concessionaire of the public distribution service or of the provider of the distribution service. For such purposes the tariff decrees corresponding will determine how to include in their tariff formulas the remuneration of these facilities, as well as the conditions of application of the associated rates. Additionally, and in order to encourage the development of residential generators, the following reforms were approved: an increase of 100 kW to 300 kW in the installed capacity of each property or installation of a client or end user, which can benefit from the distributed generation; applicability of the discount for energy injection to all items or charges of the electricity supply accounts and not only to the charge for energy; transfer to other properties or facilities owned by the same client, surplus energy that cannot be discounted from billing; regulation of the payment, by means of money obligations, of the surpluses that have not been discounted from the electricity supply accounts; and socialization for the benefit of the other users, of the surpluses that after five years have not been able to be paid or discounted, ensuring that said surpluses do not enter the assets of the distributors; and, allow the installation of community or joint ownership generation systems.

In correspondence with the recent modifications made to the public policy guidelines, Colombia approved the implementation of a mechanism aimed at promoting long-term contracting for electricity generation projects complementary to those existing in the Wholesale Energy Market. The aforementioned mechanism is proposed: strengthen the resilience of the electric power generation matrix in the event of climate variability and change through risk diversification, promote competition and increase efficiency, promote sustainable economic development and strengthen regional energy security, as well as reducing greenhouse gas (GHG) emissions from the electricity generation sector in accordance with the commitments made by Colombia at the World Summit on Climate Change in Paris (COP21).

Costa Rica, approved the Regulation that controls the exposure to electromagnetic fields of non-ionizing radiation in high voltage electric power transmission systems. The aforementioned legal instrument establishes the requirements and criteria aimed at protecting the health of technical personnel and the population in general, from the potential risks and harmful effects associated with the exposure of electromagnetic fields from non-ionizing radiation, which may derive from exploitation and use of high voltage electric power transmission systems. On the other hand, within the framework of the entry into force of the Law of Incentives and Promotion for Electric Transportation, the Ministry of Environment and Energy (MINAE) was entrusted with the obligation to ensure the proper construction and operation of the charging centers, in charge of the electricity distributors, which must comply with current international standards. In accordance with the aforementioned provisions, at least one charge center should be built and put into operation on national roads every 80 km and on cantonal roads at least one charge center every 120 km. Additionally, the charging centers must have an information board on the closest charging points, charge times, consumption statistics and other relevant information.

Given the entry into force of the Organic Law for the Comprehensive Planning of the Amazonas Special Territorial Circumscription, Ecuador made modifications to the Organic Law of the Electric Power Public Service. This, aimed at ensuring that the economic resources corresponding to the 30% surplus obtained in the phase of operation of the electric generators in charge of public companies as well as 12% of profits, are destined to the financing of the Common Fund for the Special Amazon Territorial Circumscription.

In order to promote the development of the national industry, Uruguay, through Decree, urged the National Administration of Electric Power Plants and Transmissions (UTE) to incorporate the national component (according to the criteria established by the Ministry of Industry, Energy and Mining) in goods and services intended for the expansion or extension of its electric power generating park.

2.2 Marketing, consumption and subsidies

Brazil made reforms to the law that establishes the concession and permit system for the provision of public services under which concessionaires and public service providers, including electricity, are obliged to disclose on their website, clearly and easy to understand for users, the table with the evolution of the rate value (including revisions and adjustments made in the last five years) and the price. Likewise, the Decree regulating the commercialization of electric energy and the process of granting concessions and authorizations for the generation of electric power were modified; as part of the reforms, the approval procedure for the inventory and feasibility studies of the implementation of hydroelectric projects is determined.

In order to safeguard the safety of people and things, through a joint resolution of the Ministry of Energy and the Superintendence of Electricity and Fuels, Chile established the procedure for the commissioning of infrastructure for charging electric vehicles. Additionally, in order to guarantee the safety conditions to which the facilities, machinery, instruments, devices, equipment, appliances and electrical materials of all nature must be subjected, as well as the quality and safety conditions of the instruments intended to record consumption or transfer of electrical energy, the Regulation of Security of the Electrical Installations destined to the production, transport, provision of complementary services, storage systems and distribution of electrical energy was approved.

In order to promote efficient management and allow the incorporation of new technologies in electrical systems, Colombia established the mechanisms for implementing the Advanced Measurement Infrastructure in the public electric power service. The aforementioned infrastructure allows two-way communication with users of the electric power service. This, through a mechanism that includes hardware (advanced meters, measurement management centers, routers, concentrators, antennas, among others), software, architectures and communication networks, that allow the operation of the infrastructure and the management of the data of the electric power distribution system and the measurement systems. This implementation is focused on: facilitating Energy Efficiency schemes, demand response and hourly pricing models and / or tariff baskets, allowing the incorporation into distributed systems, among others, of distributed self-generation technologies and electric vehicles, improving the service quality through the monitoring and control of distribution systems, boost competition in the retail sale of electricity and generate new business and service models, manage the reduction of technical and non-technical losses; as well as reduce the costs of providing electric power service.

In order to stimulate and strengthen public policies aimed at encouraging the use of electric transport within the public sector and in the general public, as an effective measure to reduce the country's fossil fuel consumption, environmental pollution, damage to public health and mobility spending on new vehicles, Costa Rica published the Law of Incentives and promotion for electric transport. It regulates the public administrative organization linked to electric transport, institutional competencies and its stimulation, through exemptions, incentives and public policies, based on the fulfillment of the commitments acquired in the international conventions ratified by the country and article 50 of the Political Constitution. Under the aforementioned law, the promotion of electric transport is declared of public interest and economic incentives, ease of use in circulation, access to credit and others determined in the corresponding regulations are established. For this purpose, electric vehicles will benefit from the exemption of the general sales tax, the selective consumption tax and the customs value tax, according to the gradual scale of percentages determined in relation to their CIF value in customs for vehicles imported and manufacturing value for vehicles assembled or produced in national territory. Additionally, the law provides for the exemption of: the spare parts of electric vehicles, the equipment for the assembly and production of electric vehicles, the vehicle ownership tax. It also exempts from the total payment of the selective consumption tax, and the 1% tax on the customs value, to the parts necessary for the installation of the charge centers. Also, contemplated as an incentive for these vehicles, the inapplicability of the vehicular traffic restriction in force for the metropolitan area, the exemption of the payment of parking meters established by municipal agreement, the use of blue parking lots, among other facilities that stimulate their use and acquisition. Some of the incentives established in the law, were extended, by decree, to vehicles used with no more than 5 years old, with 100% electric power or with zero emission technology that does not contain combustion engine, with last battery generation, in its version of cars, motorcycles, cargo transport vehicles, minibuses or buses. On the other hand, the Public Administration institutions are authorized to promote the purchase and use of electric vehicles that meet the required technical specifications. For this, in the valuation of tenders and direct competitive purchases must grant an additional 10% to bidders who, on equal terms, demonstrate that the products offered are electric.

In order to promote sustainable development, in accordance with the publication of the Law for Productive Promotion, Investment Attraction and Employment Generation, Ecuador established the 0% VAT rate on imports of LED lamps; chargers for hybrid and electric vehicles charging stations; 0% VAT rate for electric vehicles for private use, public transport and charging and; 0% ICE rate for electric motorized vehicles for public passenger transport, provided they have the authorizations of the competent entity.

Within the framework of Plan 10 and with the objective of benefiting 950 thousand families in the electricity bill, El Salvador increased the subsidy for residential energy consumption, for households that consume between 1 and 99 kWh to all households that use between one and 105 kWh per month. The beneficiaries will have their USD 5.00 electricity subsidy fixed by means of a discount on the bill, for 6 consecutive months, from August 2018 to January 2019. Subsequently, a semiannual procedure will be applied to review the base of these users. Families that are not included in this subsidy may apply after verifying their electric power consumption.

With the purpose of guaranteeing the operation and economic sustainability of the electricity sector, Nicaragua approved reforms to the law of the electrical industry, law of variation of the rate of electricity to the consumer and law of the elderly, which imply gradual reductions in the subsidy to the rate for energy consumption in the home sector. Under the modifications, the subsidy will be determined as a percentage of the full rate for consumers from 0 to 150 kWh per month, a segment that will be divided into 4 groups. Consumers from 0 to 50 kWh per month will enjoy the full subsidy until 2020, and by 2021 this benefit will be 50%. Consumers of 51 to 100 kWh will maintain, like the previous group, the subsidy until complete until 2020, in 2021 they will receive only 50% of the subsidy, and from 2022 only 45% of the full rate. Those who consume between 101 and 125 kWh will benefit from a 50% subsidy until 2018, which will fall to 40% in 2019, to 35% in 2020, to 30% in 2021 and will finally be set at 25% from the year 2022. The tariff charges between 126 and 150 kWh will receive a subsidy of 40% in 2018, 30% in 2019 and 25% in 2020. Household energy bills with consumption between 151 and 300 kWh per month will pay between 2018, 2019 and 2020 a special rate for 7% of VAT and from 2021 they will pay 15% for VAT. Invoices between 301 and 1000 kWh per month will also pay in 2018 and 2019 a special rate of 7% for VAT, but from 2020 they will pay 15%. The reforms also affect the subsidy policy of the electricity tariff applicable to retirees. Thus, those who consume between 151 and 300 kWh will enjoy a subsidy on the first 150 kWh applied as follows: 45% subsidy in 2018, 40% in 2019, 35% in 2020, 30% in 2021 and 25% as of 2022. Retirees who consume more than 300 kWh will have a subsidy of 40% in 2018, 30% in 2019, 20% in 2020, 10% in 2021 and from 2022 the corresponding rate will be applied. In compensation, other prerogatives are granted to retirees.

The Ministries of Finance and Energy and Mines of the Dominican Republic signed a joint resolution under which a model is created that guarantees the supply of permanent electricity to the institutions considered as public services, such as hospitals, schools, asylum police barracks and street lighting. The text of the resolution indicates that electricity distribution companies may not immediately cut off the electricity service to the aforementioned institutions due to non-payment. It establishes that any State entity directly responsible for providing a public service will be considered as Non-Cuttable Government Institutions (IGNC), so that the interruption of the electricity supply doesn't risk citizen security, national defense, health care, education, passenger transport, water management both for drinking purposes and for irrigation or public lighting purposes. Additionally, the implementation of an energy saving program and the criteria for the determination of public entities that qualify as Non-Cuttable Government Institutions (IGNC) are contemplated, as well as the establishment of the regulation of their billing and payments. In no case will the funds allocated to the IGNC for energy efficiency projects be greater than the amounts equivalent to the savings in energy consumption projected or actually achieved with the energy efficiency projects executed. The Ministry of Finance, as the governing body of public finances, is committed to direct payment to electricity distribution companies of those electricity supply bills of the IGNC, which have exceeded their approved annual budget for electricity expenditure.

Granting the residential consumer the opportunity to reduce their expenses in electricity, Uruguay, via Decree, approved a new differential rate for the National Administration of Electric Power Plants and Transmissions (UTE) that reduces the cost of energy between the hours 00:00 and 07:00. The new triple hourly rate reduces the energy cost to residential users who consume more energy between 00:00 and 07:00 hours, equivalent to 20% of the value established in the hours of greatest consumption, between 17:00 and 23:00 hours. The novelty lies in a rate that includes three lapses with different costs. Residential users who subscribe to this regime will benefit more as they move more consumption at dawn. With this provision, the consumption of electricity in the early morning (known as valley hours) will cost 1.7 pesos per kilowatt / hour, which represents 20% of the cost during peak hours (from 17:00 to 23:00 hours), which is worth 8.5 pesos per kilowatt / hour. This rate is suitable for residential customers whose contracted power is equal to or greater than 3.7 kW and less than or equal to 40 kW. It is considered a future rate, also thinking about the energy that electric cars will require. Residential customers who change their rate to triple residential hours before December 2018 may return to the previous regime after one year. On the other hand, in order to promote a more rational use of the transportation and distribution capacities of the electrical system in the off-peak time zone and to promote the maintenance and eventual increase of the jobs used for large consumers of electric energy, UTE was urged to implement a program of commercial benefits for subscribers that have an annual expense in acquisition of electric power to UTE that represents a value greater than or equal to 5% of the annual Gross Production Value (VBP), and that are included in the tariff categories "Great Consumption" at all levels of tension in rate list. The benefit, consisting of a discount in the billing of the energy charge without net VAT of other commercial discounts granted to the company, will be associated with the maintenance or increase of jobs in a quarter by the company and have some supply in the Great Consumer rate category with a utilization factor out of the tip greater than its rate category in the same time zone.

2.3 Rural Electrification or Universalization of electricity

Brazil made reforms to the Decree that establishes the National Program for Universalization of Access to the Use of Electricity "Luz para todos". According to the modifications, the validity of the program is extended until

2022. All the families residing in rural areas that do not yet have access to the public electric power service are included in the beneficiaries of the program, with priority of attention for: families of low income registered in the Single Registry of Social Programs of the Federal Government, families benefiting from government programs that aim at social and economic development, rural settlements, indigenous communities, quilombolas and other communities located in extractive reserves or directly impacted by enterprises of generation or transmission of electric power, whose responsibility is not the concessionaire's own, as well as schools, health posts and community water wells. Additionally, it is determined that the Ministry of Mines and Energy will define the goals and terms of the Program, in each State or in areas of concession or permit and will consider the following: attention to beneficiaries with priorities, reduction of the tariff impact resulting from the application of the Plan of Universalization, the contribution to the "LUZ PARA TODOS" Program for the anticipation of the year of universalization, the budgetary and financial availability of the Energy Development Account, the limit years established in the Universalization Plan. Likewise, other administrative aspects of the Program related to the powers of the Ministry of Mines and Energy in terms of contracts and deadlines are reformed.

Colombia approved the National Rural Electrification Plan 2018-2031 with focus on the post-conflict areas and the resolution by which its guidelines are adopted. The specific objectives of the aforementioned energy planning instrument focus on: expanding the coverage of electric energy; promote and increase the appropriate technological solutions for electricity generation (according to the particularities of the rural environment and communities), for which the Non-Conventional Sources of Energy-FNCE will be used preferentially; assist technically and promote the organizational capacities of the communities to tend for the maintenance and sustainability of the works; and train communities in the proper use of energy for their sustainability.

3. HYDROCARBONS

3.1 Exploration, exploitation and transformation

Argentina, via Decree, instructed the Ministry of Energy Government (under the Ministry of Finance) to convene an international public tender for the granting of hydrocarbon exploration permits in offshore areas. The aforementioned measure is based on the need to increase knowledge, exploration and production of offshore areas located on the national continental shelf, through effective investments in seismic exploration and exploration tasks, in charge of companies that have the technical and financial capacity required. Additionally, the inclusion, in the exploration permits granted in the framework of the public tender and in the exploitation concessions, of clauses that establish the extension of jurisdiction in favor of international arbitral tribunals based in a State that is a party of the Convention on the Recognition and Enforcement of Foreign Arbitral Sentences (New York, 1958). In this regard, the Regulations for the granting of surface recognition permits in the national offshore area were approved. The aforementioned legal instrument establishes: the requirements and procedures that must be followed by the interested parties to obtain surface recognition permits in search of hydrocarbons and the execution of work in the national offshore territory; the terms and conditions applicable to the corresponding permits; and the terms and conditions applicable to the right of commercial use of the information obtained as a result of the activities carried out using the permission obtained under the regulation. Likewise, to stimulate new hydrocarbon ventures, the effect of the tax and customs benefits provided for in the Special Fiscal and Customs Regime of Law No. 19.640 and its complementary regulations for activities related to the production of gas and oil was reactivated, through the establishment of an exception to the provisions of the first paragraph of article 1 of Decree No. 751 of May 15, 2012 and its amendment, applicable to activities related to the production of gas and oil related to new hydrocarbon ventures.

Brazil made modifications to the law it has on national energy policy and activities related to the oil monopoly. Under the reforms, the resources from the payment of royalties will be distributed based on the calculations of the amounts owed to each beneficiary, provided by the competent administrative authority (specific provisions are established in case the beneficiaries are the Union, the States or Municipalities). Additionally, the special procedure for the allocation of rights for exploration, exploitation and production of oil, natural gas and other hydrocarbons is determined, by Petróleo Brasileiro S.A. - Petrobras, determined on the basis of new governance, transparency and good market practices. The special procedure applies without prejudice to the regime of private companies in the nature of free competition that Petrobras presents. The established provisions apply to the transfer of goods, rights, facilities, belongings and infrastructure related to the purpose of transfer of rights and are aimed at: favoring the adoption of government methods that ensure the achievement of Petrobras' corporate purpose; confer impersonality to the management of Petrobras' exploration and production portfolio; guarantee legal certainty for assignments as well as the quality and integrity of the decision-making process that determines the granting of rights; and to obtain the best economic-financial return for Petrobras, considering its subjection to the legal regime of private companies in the nature of free competition. On the other hand, modifications were made to the Decree that defines the criteria for calculating the collection of government shares applicable to the activities of exploration, development and production of oil and natural gas.

In compliance with the provisions established in the Organic Law for productive promotion, investment attraction, employment generation, stability and fiscal balance, Ecuador made modifications to the Hydrocarbons Law in relation to the State's participation in surplus sales prices of oil. According to which in the participation contracts for exploration and/or exploitation of hydrocarbons, the percentage of the State's participation will be adjusted according to the reference price and the volume of production; as the reference price increases, the State's participation will also increase to control the contractor's benefits for the surpluses in the sale prices, in no case will the State's participation be lower than the original participation established in the contract. The State will annually review its benefits, which in no case will be less than the contractor's benefits in accordance with the provisions of article 408 of the Constitution of the Republic. Under the reforms to the Hydrocarbons Law, the requirement was established for national or foreign or mixed economy companies that enter into or maintain association, participation, service provision for exploration and exploitation of hydrocarbons or through other contractual forms of delegation in force in Ecuadorian legislation, establish their tax domicile in the canton, and in the region where the field is located, or the largest area of the sum of them in the case of companies with contracts in different provinces or the main project of exploration or exploitation. Likewise, and with the objective of increasing reserves, encouraging investment in projects in new areas, the regulations for the application of the Hydrocarbons Law was reformed. This, to give way to the signing of contracts for oil exploration and exploitation through the modality of participation. This model contract allows the contractor to assume the costs of operation, transportation and marketing corresponding to its participation. As part of the reforms, and given the entry into force of the Organic Law for Integral Planning of the Amazonian special territorial constituency, modifications were made to the conditions of the profit allocation percentages by labor participation in the case of related workers to hydrocarbon activity, when hydrocarbon exploitation occurs in the Amazon Special Territorial Circumscription, since the economic resources corresponding to 12% of the profits will be destined to finance the Common Fund for the Amazon Special Territorial Constituency and will be invested and allocated accordingly to the provisions of the Law that governs it. On the other hand, and having evidenced the need to update the current regulations in accordance with the best practices of the Hydrocarbons Industry, a new Regulation of Hydrocarbons Operations was approved. The regulation establishing the accounting criteria and guidelines that contractors must apply regarding investments, income, costs and expenses during the term of the participation contract for the exploration and exploitation of hydrocarbons, concluded under the Hydrocarbons Law, was also approved.

Through a Presidential Agreement, Nicaragua declared its Pacific waters open for oil exploration and exploitation, which will be included in the second round of international bidding. In this context, amendments to the regulations of the Special Law on Exploration and Exploitation of Hydrocarbons were approved via decree. According to the modifications, based on the need to promote the use of hydrocarbon resources of the continental shelf and the adjacent sea, a fourth condition is added to assess the technical-financial capacity of those interested in entering into an exploration and exploitation contract. Oil companies must also present instruments that demonstrate compliance with what is established in relation to PETRONIC's participation, except in cases of concurrence of supply that follow the public tendering procedure, which must be signed prior to the negotiation and signing of contracts.

Paraguay approved the Regulation of the legal regime for prospecting, exploration and exploitation of oil and other hydrocarbons, applicable to the granting of oil areas to Petroleum Paraguay (PETROPAR), as an entity designated to carry out these activities on behalf of the Paraguayan State. The aforementioned regulation is mandatory for all natural or legal persons requesting rights for prospecting, exploration and exploitation of hydrocarbon deposits in their solid, liquid and gaseous states.

In order to determine the conditions that will govern the exploration and eventual exploitation of hydrocarbons to be carried out as a result of the Uruguay III Round, Uruguay, through Executive Decree, established the areas for hydrocarbon exploration and exploitation activities for a term of 30 years, the basis for the selection process of oil companies for offshore exploration and exploitation, including the respective contract model and created a Working Group, composed of representatives of the National Administration of Fuels, Alcohol and Portland (ANCAP) and of the Executive Power, who through the Ministry of Industries, Energy and Mining of the Oriental Republic of Uruguay (MIEM) will be in charge of monitoring the process and developing possible contracts.

3.2 Storage, transport, marketing and consumption

Brazil made modifications to the Decree that reduces the rates of the Intervention Contribution in the Economic Domain related to the importation and commercialization of petroleum and its derivatives, natural gas and its derivatives, and ethyl alcohol; and the Decree that reduces the rates of the Contribution to PIS / Pasep and Cofins on the importation and sale of gasoline, diesel, liquefied petroleum gas and aviation kerosene. Under the reforms, the specific rates set for the following products are reduced to zero: LPG, natural gas and naphtha; fuel ethyl alcohol; and diesel oil and its derivatives. On the other hand, the subsidy granted by the Union to the commercialization of diesel for road use in the national territory was regulated, in the form of compensation of part of the costs for diesel producers and importers. Additionally, the regulation modifies the Law that regulates the national energy policy, the activities related to the oil monopoly, and institutes the National Energy Policy Council and the National Petroleum Agency. The reforms imply administrative clarifications in relation to the government participation foreseen in the concession contracts and in the tenders. Additionally, legislative amendments that deal with the marketing policy of oil, natural gas and other hydrocarbons were approved. Including, in the competences of the Pré-Sal Petroleum (PPSA) company, the conclusion of contracts representing the Union, for refining and processing of oil, natural gas and other fluid hydrocarbons. Likewise, it is established that the expenses directly related to the commercialization must be foreseen in: the contract signed between the PPSA and the marketing agent; the contract signed between the PPSA and the buyer; and in the tender document. Remuneration and expenses incurred by the PPSA in the execution of its activities, such as cost of expenses and investment and the payment of taxes on the object of its activity, will not be included in the marketing expenses. The commercial agent's remuneration shall be calculated in the manner provided for in the contract, in compliance with the guidelines of the National Energy Policy Council (CNPE) incorporated in the Union's oil and natural gas marketing policy. The commercialization by the PPSA will use the policy established by the CNPE and the reference price established by the ANP.

Paraguay decreed that the retail price of common diesel (type III) will be freely established by distribution companies authorized by the Ministry of Industry and Commerce (MIC). To this end, decree 8370/2018 was repealed, which established a ceiling on the maximum selling price for diesel type III. In addition, Article 1 of Decree 4692/2015 was canceled and decrees 6128/2016, and 4823/2016 were repealed. It is also specified that all authorized service stations in the country must clearly and accurately inform and display the price of commercialized fuels to users. The aforementioned instrument provides that the import activity of Diesel / Gasoil Type I (Type A) and Diesel / Gasoil Type III (Type C), is subject to the system of Automatic Prior License, eliminating restrictions on maximum import quotas, without affecting the current provisions regarding the quality and technical specifications of these products. Additionally, and with the purpose of ensuring that the variation in international prices is reflected in local prices, while at the same time protecting free competition and acting within the limits established by public order regulations, by decree, the maximum price of sale of gasoil/diesel type III to permitting passenger transport companies of the Ministry of Public Works and Communications was established through the cabinet of the vice minister of transport and the National Directorate of Transportation (DINATRAN). Moreover, the mechanism for its modification was determined, in compliance with the percentage of price variations in the retail market. The measure is based on the fact that the Public Passenger Transport Service is an indispensable public service for the development of the commercial, industrial, labor and social activity of the Republic and as such depends on the parameters and regulations that the State establishes for its correct operation and fulfillment of its purposes. On the other hand, as part of the implementation of global programs aimed at coordinating and guiding national economic activity, a new bonus margin was established by decree for the commercialization of diesel/gasoil type III with a percentage variation of up to a maximum of thirteen percent (13%) for the Distribution Companies and Service Stations, based on the calculation of the delivery price at the PETROPAR distribution plant in Villa Elisa. This percentage will be valid up to a radius of 50 km from the delivery plants authorized by the Ministry of Industry and Commerce and the cost of freight will be added from the indicated distance. The bonus percentage for the Type III Diesel/Gasoil marketing chain will be distributed as follows: a) for the Distribution Companies, 37.5%; and b) for Service Stations, 62.5%.

Uruguay published the law that empowers the executive branch to grant producers of milk, rice, flowers, fruits and vegetables that do not pay the Income Tax for Economic Activities (IRAE), the return of Value Added Tax (VAT) included in its diesel acquisitions destined to the development of the aforementioned productive activities. Likewise, the law authorizing the Executive Power to grant bovine and sheep producers that do not pay the Income Tax of Economic Activities (IRAE), the refund of Value Added Tax (VAT) was published. This included in the gasoil acquisitions for the development of the breeding or fattening of cattle and sheep.

3.3 Oil and derivatives

Ecuador issued the regulation that establishes the necessary provisions and procedures for the analysis and obtaining the feasibility authorization for the location of new distribution centers for petroleum derivatives or petroleum derivatives and their mixtures with biofuels in the different market segments. The aforementioned legal instrument applies at the national level to natural or legal persons, national or foreign, public, private or mixed, interested in obtaining a feasibility authorization for the location of new distribution centers for petroleum derivatives, biofuels and mixtures thereof, in the different market segments, established in the Regulations for the Authorization of Marketing Activities of Petroleum Derivatives, Biofuels and their Mixtures, except Liquefied Petroleum Gas (LPG).

Nicaragua published the mandatory standard that establishes the technical and safety specifications that must be met by industrial facilities for direct consumption destined for the storage of combustible and flammable liquids derived from petroleum, including their construction, operation, maintenance, closure and any associated activity. Excluded from this technical standard, refineries, terminals, thermal plants for electric power generation, automotive and marine service stations for sale to the public.

3.4 Natural Gas

Argentina modified the models of guidelines for the administration of dispatch annexed to the regulations of services of carriers and distributors, in order to favor the operation of a free access environment, non-discriminatory and fully competitive, with alternatives that guarantee quality and continuity of the public transport and gas distribution service; as well as avoiding recurrent crises, which affect transport and distribution systems on the days of maximum consumption, trying to preserve customers with non-interruptible services, with a management methodology that is considered more efficient. The new internal regulation of dispatch centers establishes guidelines for demand and transport capacity scenarios superior to the supply of natural gas, aimed at preserving the operation of transport and distribution systems, favoring the consumption of Priority Demand: R (residential), SG-P (service for non-domestic uses where the customer does not have a minimum contractual amount, there is no gas service contract) full service and SDB (sub-distributor). On the other hand, and as an adaptation to the recommended international operational and safety regulations, the "Minimum Safety Standard for Liquefied Natural Gas Storage Plants on Land" was approved by resolution. The aforementioned standard establishes the minimum safety requirements related to the design, location, construction, operation and maintenance of LNG storage plants on land (on shore), including the processes of liquefaction of natural gas and LNG regasification. Activities related to LNG or river transport, the interface between methane ships and LNG facilities, and the design, construction, operation and maintenance of maritime or river facilities destined to LNG reception and regasification operations. Additionally, and in order to facilitate and optimize the management of purchase and sale of Wafers and Identification Cards, both for the Producers of Complete Equipment and for ENARGAS, taking advantage of the available web technology, a new procedure was approved for the sale of authorization wafers and identification cards for vehicles propelled to natural gas that replaces the procedure in force since 2006.

Brazil made modifications to the regulation of the law that controls the activities related to the transport of natural gas, as established in Article 177 of the Federal Constitution and the activities of treatment, processing, storage, liquefaction, regasification and commercialization of natural gas. The reforms are focused on applying, through the National Agency of Petroleum, Natural Gas and Biofuels of Brazil, autonomy and independence criteria for the exercise of natural gas transport activities for new and existing transporters. This, with a view to promoting free concurrence, transparency of information and non-discriminatory access to gas pipelines and efficient use of infrastructure.

Colombia made modifications to the technical regulations applicable to service stations that supply compressed natural gas for vehicular use in force since 2017. Under the reforms, provisions related to the technical requirements for the operation and maintenance of service stations, including personnel and infrastructure, are clarified and specified.

In order to develop in greater detail the content of the Electricity Market Bases, Mexico approved the Manual that establishes the general rules for coordination between CENACE, Administrators and Generators in relation to the availability of Natural Gas, the procedures to carry the exchange of information between them, the use that will be given to this information and its impact on the Wholesale Electricity Market; as well as the calculation of the corresponding opportunity costs (if applicable) that the Generators must use to make their Sale Offers in the Day Market in Adelanto and in the Real Time Market.

In order to ensure the safe, efficient and reliable introduction of natural gas into the energy matrix, and taking into account that there is currently no technical regulation for the use of this fuel, and the natural gas-based power generation plant is in an advanced stage, Panama established, via resolution, the temporary technical specifications of natural gas that will be imported and distributed in the domestic market, in national and international airports and to electric power generation companies.

3.5 LPG

Colombia, via resolution, established new provisions aimed at improving the quality and safety in the provision of the LPG's domiciliary public service, applicable to the containers used in its distribution and commercialization.

In order to guarantee the supply to the end user, the environmental protection and the security of the people, Costa Rica approved the General Regulation for the Control of the Supply of Liquefied Petroleum Gas. Also, assessing the increase in accidents related mainly to the poor state of portable cylinders, stationary tanks, equipment and devices used for the supply and use of liquefied petroleum gas in the country, the Technical Regulation: equipment for the oil industry. Portable cylinders, stationary tanks, equipment and devices for the supply and use of liquefied petroleum gas (LPG), safety specifications. The aforementioned regulation establishes the specifications that regulate the manufacture, importation, use and maintenance of portable cylinders, stationary tanks, equipment and devices that are used for the supply and use of liquefied petroleum gas in the country, so that its conditions of operation guarantee environmental protection and safety of people.

4. RENEWABLE SOURCES

Incentives

In order to guarantee compliance with the declaration of national interest of the distributed generation of electric energy from renewable energy sources destined for self-consumption and the injection of eventual surpluses of electricity to the distribution network, Argentina issued the regulation of Law 27.424. It establishes the system for promoting the distributed generation of renewable energy integrated into the network. The aforementioned legal instrument establishes general and technical procedures aimed at ensuring the proper functioning of the national electricity grid, without the implementation of distributed generation systems causing alterations at the different levels at which the electricity sector is segmented, including related provisions to the different promotion tools designed to achieve the aforementioned purposes.

Bolivia published the Law that establishes the regulatory framework for the production, storage, transport, marketing and mixing of additives of plant origin, with the purpose of gradually replacing the import of inputs, additives for gasoline and diesel, precautionary food safety and sovereignty and energy, within the framework of the precepts established the "Framework Law of Mother Earth and Integral Development to Live Well", effective since 2012. The aforementioned instrument determines that the productive sector must guarantee the gradual growth of the volumes of the raw material for the production of additives of plant origin. The law provides for the elaboration of a Multisectoral Plan for Integral Development of Food and Energy Production, as part of the State Integral Planning System - SPIE, in charge of: defining the surpluses necessary for the provision of raw material for the production of plant-based additives, promote the progressive and sustainable improvement of crop yields for the production of plant-based additives, establish deforestation and displacement control mechanisms for other crops for the production of crops for the production of additives of origin plant, rehabilitate degraded soils for crops intended for the production of additives of plant origin and strengthen the productive capacities of small and medium agricultural producers. Under the standard, the requirement of raw material for the production of additives of plant origin, will be developed under criteria of productive and energy efficiency through the progressive and sustainable improvement of crop yields and respecting the land uses determined for production agricultural, guaranteeing the regeneration of the zones and life systems of Mother Earth. The proportion of additives of plant origin will be mixed with gasoline or diesel in a percentage of up to 25%. YPFB will prioritize the purchase of additives of plant origin produced in the country by public or private companies and with raw materials of national origin, compared to products of another origin. YPFB may export fuels resulting from the mixture of additives of plant origin, based on a certification of the existence of surpluses. The sale on the domestic market of anhydrous ethanol made by the producer to YPFB, for the mixing, addition or any other process with gasoline or diesel, is exempt from the Specific Consumption Tax - ICE. In order to ensure that, during the first calculation period, the price contemplates the investments made at the beginning of the production process, and the price of indifference between transforming the raw material into alcohol or another main product, the resolution approving the methodology for the determination of prices of anhydrous ethanol, as an additive of national vegetable origin for its mixture with base gasoline was issued. Likewise, legal, technical and safety aspects were regulated for the commercialization of liquid fuels with a mixture of additives of vegetable origin in service stations. Additionally, the Regulations for the transport by tanks and storage of additives of vegetable origin and base gasoline were approved. In addition, the guidelines were approved to determine the price of liquid fuel with octane 92, resulting from the mixture of anhydrous ethanol with base gasoline, as well as its update; and marketing aspects related to final fuel and base gasoline were regulated. Together, in order to ensure that the entities of the hydrocarbons sector, within the framework of their powers and current regulations, can develop the technical, economic and regulatory calculations for the production of a new fuel, the Supreme Decree that determines the percentage of anhydrous ethanol to be mixed with the base gasoline, regulatory for the production of a new fuel, was approved. In which it is determined that the fuels to be marketed with anhydrous ethanol content will have a volumetric proportion of up to 12% of the referred additive of vegetable origin.

In order to ensure the participation of small producers and family farmers in the commercialization of biodiesel, that is carried out through public tenders, Brazil regulated article 27 of the Law that establishes the National Biofuels Policy. Additionally, via Decree, the RenovaBio Committee was established, within the scope of the Ministry of Mines and Energy, composed of representatives of the following bodies: Ministry of Mines and Energy, Civil House of the Presidency of the Republic, Ministry of Finance, Ministry of Agriculture, Livestock and Supply, Ministry of Industry, Foreign Trade and Services, Ministry of Planning, Development and Management, and Ministry of Environment. The RenovaBio Committee is responsible, among other functions, for monitoring the supply and development of biofuel production and market, as well as the prices of Decarbonization Credits -CBios issued and negotiated from the commercialization of biofuels.

In order to guarantee an efficient service and to safeguard the safety of operators and users, as well as the physical and operational integrity of the electricity distribution network, through a joint resolution of the Ministry of Energy and the Superintendence of Electricity and Fuels, Chile approved the instruction technique that establishes the requirements that must be observed for the design, execution, inspection and maintenance of photovoltaic electrical installations connected to distribution networks.

Within the framework of the approval of the Law of Incentives and Promotion for Electric Transportation, Costa Rica established as a national priority the use of renewable electricity in public transport, both in the modalities of railways, trains, buses, taxis, as in any other public means of mobilization. For these purposes, the National Electric Transportation Plan must schedule the gradual replacement of the existing vehicle fleet. Ordinary taxi service dealers who wish to replace their carbureted vehicles with electric vehicles may benefit from the benefits offered by law. Subsequently, when the MOPT starts new taxi concession processes, it will require that at least 10% of concessions be granted to electric vehicles.

In compliance with government policies aimed at ensuring that energy security for electricity supply considers the diversification and participation of non-conventional renewable energies, in order to reduce the vulnerability and dependence of fossil fuel electricity generation; and assessing the need to strengthen the construction of a diversified power generation matrix, with the participation of clean and renewable energies, oriented towards a decrease in the use of fossil polluting fuels used for thermal generation; Ecuador issued the Regulation called "Photovoltaic generation for self-supply of final consumers of electrical energy". It establishes the conditions for the development, implementation and participation of consumers who have photovoltaic microgeneration systems -uSFV- up to 100 kW of nominal installed capacity, located in ceilings, housing surfaces or buildings for residential and general categories determined in the low or medium voltage rate list. The aforementioned regulation is applicable to distribution companies and for those regulated users, who decide, prior to compliance with requirements, to install a uSFV photovoltaic microgeneration system with a nominal installed capacity of up to 100 kW in medium and / or low voltage, operating in synchronism with the network, whose production is self-consumed in its own facilities and contribute any surpluses to the distribution network, if they exist. The regulations determine: technical and commercial conditions, requirements and procedure for the connection to the networks of the distribution company and the authorization of installation and operation of the uSFV, conditions for measurement, operation in synchronism with the distribution network; and the commercial treatment of the energy produced, of the energy consumed and possible surpluses of generation delivered to the distribution system. Additionally, the 0% VAT rate on imports of solar panels was established.

Uruguay approved the Decree that urges the National Administration of Electric Power Plants and Transmissions (UTE) to implement a program of commercial benefits for industrial companies located in the national territory that increase the physical volume exported. UTE subscribers categorized as industrial, according to their main line of business, will be able to access the aforementioned benefits. The benefit will be associated with the increase in one quarter of the physical volume sold to the external market and will consist of a discount in the billing of the energy charge without net VAT of other commercial discounts granted to the company, which will be made by UTE after the evaluation that perform the MIEM, for each quarter considered. The measure is aimed at promoting the use of industrial production capacity through the implementation of a measure that encourages the increase in physical volume exported from companies in the industrial sector, assessing that, as a consequence of the energy policy promoted, the generation of renewable origin has undergone extraordinary development and has strengthened the national energy matrix, causing that there are, at certain times, surpluses of electricity generation from renewable sources in relation to the internal demand for electrical energy, which offers opportunities to implement sectoral policies of promotion to the industry.

5. ENERGY AND ENVIRONMENT

Pollution, emissions and climate change

Based on the provisions of the law that sets the National Biofuels Policy (RenovaBio), Brazil approved new provisions regarding the definition of the mandatory annual targets for reducing greenhouse gas emissions applicable to the marketing of fuels. The aforementioned goals, defined by the National Energy Policy Council for a period of 10 years, are aimed at improving the carbon intensity of the Brazilian fuel matrix by observing: the international commitments to reduce greenhouse gas emissions assumed by Brazil and the sector actions involved in the scope of these commitments, the availability of the offer of biofuels by producers and by importers carrying the Certificate of Efficient Production of Biofuels, the valuation of energy resources, the evolution of national fuel consumption and imports, protection of consumer interests in terms of prices, quality and supply of fuels and the impact of fuel prices on inflation rates.

Colombia approved, via resolution, the adoption of the Climate Change Management Plan for the mining and energy sector, which aims to reduce vulnerability to climate change and promote low-carbon development at the sector level, strengthening and protecting the sustainability and competitiveness of the industry. The aforementioned Plan is constituted as an instrument through which the Ministry of Mines and Energy identifies, evaluates and guides the incorporation of strategies for mitigating greenhouse gases (GHG) and adapting to climate change in sectoral planning and supporting its policies and regulations, in a planning horizon of 12 years. It is structured in three components: mitigation, adaptation and governance.

Costa Rica decreed the promotion of sustainable mobility in the institutions of the central public administration with a view to achieving the reduction of air pollution and greenhouse gases, improvements in people's quality of life, modernization and increased use of public transport, increased productivity and savings of public resources, as well as road decongestion, and fuel savings. To this end, the implementation of an Institutional Plan for Sustainable Mobility is determined. This, to promote the acquisition or exchange of zero-emission vehicles, the promotion of teleworking and the shared use of the automobile, among other sustainable mobility measures. In this regard and for the purpose of achieving an adequate use of the energy resources available to the country, making rational use of energy, and reducing polluting emissions, without affecting productive activities or meeting the basic needs of the population, the Guideline was issued to promote the transition to an electric vehicle fleet or zero emissions in Public Administration institutions. For this purpose, the corresponding bodies must incorporate into their Institutional Environmental Management Plans (PGAI), the measures and actions pertinent to such purposes. On the other hand, and with the objective of promoting protection, the promotion of biodiversity and quality in the provision of public electricity services in harmony with the environment and the mobility of specimens, an updated version of the Guide was issued for the Prevention and Mitigation of the Electrocution of Wildlife by power lines. Additionally, assessing the need to establish articulated actions in the institutions of the environment and energy sector, in order to find solutions that allow research and production of alternative fuels, the Guideline that instructs the institutions that comprise the environment and energy sector was approved. This, to develop, within the framework of its powers, an action plan aimed at promoting the research, production and marketing of hydrogen as fuel. Together, considering that hybrid technology has already completed its transition technology cycle and that it is currently insufficient to achieve significant progress, taking into account that the country has decided to move towards the use of electrical technology to replace internal combustion engines by electric motors, the Executive Decree that Incentives the Use of Hybrid-Electric Vehicles as a Part of the Use of Clean Technologies was repealed. This, considering that it no longer meets the country's needs to achieve the goals of energy decarbonization. The regulation, establishing the procedure to be followed in order to update and prepare the report on the state of the Costa Rican environment in accordance with the provisions of the Organic Law of the Environment, was also approved.

As a result of the reform approved in referendum and popular consultation of February 4, 2018, Ecuador made reforms to the Organic Code of the Environment according to which the extractive activities of hydrocarbons and non-metallic mining are prohibited within the National System of Protected Areas and in areas declared as intangible, including logging, except as otherwise provided in the Constitution, in which case the relevant provisions of the Code will apply. On the other hand, the organic law that regulates the integral planning of the special Amazon territorial circunscription aimed at promoting a sustainable socio-economic, cultural and environmental model, based on the principles of in dubio pro natura, environmental responsibility, those who contaminate pay and the deforester restores, among others aimed at ensuring the establishment of special policies and regulations that guide the conservation, protection, sustainable use and comprehensive repair of biodiversity. The law determines that the economic and productive activities of the Amazon Special Territorial Circumscription will be subject to its integral planning, in order to minimize the negative impacts on the human being, the environment and the cultural heritage, considering their special features and special conditions. Under the law, the change in the productive matrix, territorial economic development and the use of clean technologies, as well as the strengthening of popular and solidarity economy organizations, through the implementation of renewable energy and energy efficiency, is expected. Additionally, in terms of access to the electric service, it is established that the national authority of the sector, in coordination with the entity responsible for regulating electricity rates, will implement policies that promote the productive activities prioritized in the Comprehensive Plan for the Amazon and guarantee access to the service of vulnerable households. The law establishes that the Decentralized Autonomous Governments will plan, articulate and coordinate with the national environmental authority, the incorporation of climate change criteria in territorial planning and other local planning instruments, in a manner articulated with national planning and the Comprehensive Plan of the Amazon. In addition, climate change adaptation and mitigation measures will be included in your planning.

Mexico carried out important reforms to the General Law of Climate Change, according to which the need to regulate the emissions of greenhouse gases and compounds is included in the object of the law so that Mexico contributes to the stabilization of its concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference in the climate system. The provisions in this regard are also incorporated in the United Nations Framework Convention on Climate Change and other related provisions aimed at promoting the transition to a competitive, sustainable, low carbon and resilient economy to extreme hydrometeorological phenomena associated with climate change. It also determines the establishment of the bases for the country to contribute to the fulfillment of the Paris Agreement. The conceptual part of the aforementioned legislative instrument includes new definitions such as: Paris Agreement, short-lived climate pollutants, nationally determined contributions, black carbon, CORSIA, Intergovernmental Panel on Climate Change (IPCC), National Adaptation Policy, and early warning systems. In the powers of the federation are added those of formulating, conducting and publishing (with the participation of society) the National Strategy, the nationally determined contributions, as well as carrying out its instrumentation, monitoring and evaluation, including the preparation, update and publication of the National Adaptation Policy. In addition, it is established that the policy must ensure that the baseline to be compromised does not limit the economic growth of the country, and takes into account for the definition of guidelines, the participation of the productive sectors in coordination with the national agencies that intervene in the economic policy. The Paris Agreement is also included in the programs and other mitigation instruments recognized for the purposes of the law. It is determined that the national strategy should reflect the objectives of the mitigation and adaptation policies to climate change established in the Law and will contain, among other elements, the actions and goals of adaptation and mitigation, with a target year of 2050, with intermediate short and medium term, differentiated by issuing source and issuing sector and with a road map to ensure compliance. The progressive and gradual establishment of an emissions trading system is approved with the aim of promoting emission reductions that can be carried out at the lowest possible cost, in a measurable, reportable and verifiable manner, without violating the competitiveness of the participating sectors in the face of international markets. The national commitment is established to reduce in an unconditional manner 22% of its greenhouse gas emissions and 50% of its black carbon emissions by 2030 with respect to the baseline. This commitment, assumed as a nationally determined contribution, implies reaching a maximum of national emissions by 2026; and decouple greenhouse gas emissions from economic growth. The intensity of emissions per unit of gross domestic product will be reduced by around 40% between 2013 and 2030, which will be achieved through the commitment of the different participating sectors, of agreement with the following goals: transport -18%; power generation -31%; residential and commercial -18%; oil and gas -14%; industry -5%; agriculture and livestock -8% and waste -28%. It is determined that the targets for reducing greenhouse gas and black carbon emissions by 2030 may be increased up to 36% and 70% respectively, subject to the adoption of a global agreement that includes issues such as a price to international carbon, adjustments to tariffs for carbon content, technical cooperation, access to low-cost financial resources and technology transfer, all on an equivalent scale with the challenge of global climate change.

The Framework Law on Climate Change, which establishes the general principles, approaches and provisions to coordinate, articulate, design, execute, report, monitor, evaluate and disseminate public policies for the integral, participatory and transparent management of climate change adaptation and mitigation measures, entered into force in Peru. This, in order to reduce the country's vulnerability to climate change, take advantage of low carbon growth opportunities and fulfill (with an intergenerational approach) with the international commitments assumed by the State to the Framework Convention United Nations on Climate Change. The aforementioned Law considers the following climate management instruments: National and Regional Climate Change Strategies, Nationally Determined Contributions and other management instruments related to climate change. The comprehensive management instruments for climate change are binding and mandatory for competent authorities, and must be considered in their institutional budgets. The planning instruments of the public entities of the three levels of government and the investment projects subject to the National System of Environmental Impact Assessment must agree and complement the instruments of environmental management for climate change. Additionally and in order to reduce the environmental impacts of the hydrocarbon subsector and ensure greater efficiency in the protection of the environment and people's health, amendments to the Regulation for Environmental Protection in Hydrocarbon Activities were approved. The reforms guarantee predictable rules that promote responsible investments and ensure the sustainable development of the activities of the Hydrocarbons Sector, strengthening the National System of Environmental Impact Assessment (SEIA). Among the changes made is the establishment of a mechanism to ensure environmental remediation in cases where the Abandonment Plan is not approved by the owner of the activity. In those cases, the State will be empowered to entrust the preparation and execution of said plan to FONAM (or another public or private entity), on behalf of the company and under the financial guarantee of the plan. An incentive regime applicable to hydrocarbon activities is also established within the framework of the environmental impact assessment procedure, aimed at promoting the assumption of greater environmental commitments.

Uruguay approved the regulation of articles 15 to 17 ter of the Investment and Industrial Promotion Law referring to the application of tax benefits to investment projects based on their contribution to development objectives, including the deepening of the link between the production and improvement of environmental conditions. Indicators for evaluating investment projects include clean technologies. The clean technologies indicator will assign 1 point for every 5% share of the investment in clean technologies with respect to the total eligible investment, varying in all cases between 0 and 10 points. The Executive Power will promote the formation of an advisory commission composed of qualified technicians in the field and chaired by the Ministry of Industry, Energy and Mining, with possible external advice, in charge of the definition and periodic evaluation of a taxable list of goods eligible for the computation of investment in clean technologies, and its updating and analysis to reflect policy priorities and the evolution of technology diffusion. The goods that generate tax exemptions in this framework should contribute to a more environmentally sustainable production, whether through the efficiency in the use of resources such as raw materials, water and energy, the substitution of fossil fuels by renewables or the reduction in the generation of waste, effluent and polluting emissions including greenhouse gases. For investment projects submitted between May 1, 2018 and April 30, 2021, the acquisition of passenger vehicles with exclusively electric motorization, which are destined directly to the activity of the company will be considered eligible investment, whose battery Gravimetric energy density is greater than or equal to 100 Wh / kg.

6. *ENERGY EFFICIENCY*

With the objective of improving the regulations referring to the minimum requirements for safety and Energy Efficiency for domestic appliances that use gas as fuel, and considering that the MERCOSUR Common Market Group approved the "MERCOSUR Technical Regulation for atmosphere sensing devices installed in appliances for domestic use "and the" MERCOSUR Technical Regulations for sensing devices for the exit of combustion products installed in appliances for domestic use ", which were collected as reference to Technical Specifications NAG-E 309 and NAG-E, respectively, both elaborated by ENARGAS, Argentina updated NAG-E 309, by approving a new standard that incorporates the content of MERCOSUR technical regulations. The aforementioned Technical Regulation defines the minimum requirements, for the purposes of job security and the corresponding test methods, for the verification of both the devices equipped with an atmospheric sensor pilot, and the operation of those devices installed in each type of artifact. Likewise, considering that the MERCOSUR Common Market Group approved by Resolution No. 06/18 the "MERCOSUR Technical Regulations for instant water heaters for domestic use that use gas as fuel", which was collected as a reference to the Argentine Standard NAG-313 Year 2009 and to the update of the European Norm EN-26, the LAG-313 of 2009 was renewed by means of the approval of a norm that incorporates the content of the technical regulation of MERCOSUR, including also labeling of Energy Efficiency. The aforementioned regulation has defined the minimum requirements and test techniques related to construction, safety, rational use of energy and fitness for the function, as well as the classification and marking of instantaneous hot water production apparatus for planned domestic use of atmospheric burners that use gaseous fuels, called "water heaters".

As a result of a total revision that determined the need to update certain regulations on Energy Efficiency, Colombia modified the deadlines for labeling and clarified some requirements established in the General

Annex of the Technical Labeling Regulation -RETIQ. The aforementioned provisions are aimed at fulfilling the objectives of the Labeling Plan, recognizing the progress achieved and promoting the penetration of energy efficient technology, as well as informing and limiting both the use and marketing of equipment with low levels of performance, ensuring that consumers actively participate in the economic benefits of lower consumption, and the related benefits of improved energy affordability conditions. Part of the reforms are focused on specifying some definitions to facilitate the interpretation and application of the Regulation, as well as clarifying the conditions of use and bearing of the labels.

In order to promote the rational and efficient use of energy, by promoting the shift to more efficient technology in those uses of greater relevance in the consumption of electric energy, El Salvador approved the Salvadoran Technical Regulations for Energy Efficiency (RTSEE) in engines, air conditioners, commercial refrigeration and domestic use.

Panama approved the technical norm and the Technical Regulation of Energy Efficiency that establishes the maximum consumption limits for refrigerators and freezers operated by hermetic motor-compressor, defines the requirements that must be included in the information label to the public, and determines the procedure for Conformity assessment. The aforementioned regulation applies to household refrigerators, household refrigerator-freezers up to 1,104 dm^3 (39 ft^3) household freezers up to 850 dm^3 (30 ft^3) operated by hermetic motor-compressor, which are manufactured, imported, distributed and marketed in the national territory. Vertical or horizontal freezers manufactured for commercial use are excluded from the scope of the standard. Additionally, the technical standard establishing the associated minimum nominal Energy Efficiency values and the test method for electric motors of alternating current, three-phase, induction, squirrel cage type, in nominal power of 0.746 kW up to 373 kW and the Regulation for its application were approved.

Paraguay approved the regulation of the Decree that creates the Register of Manufacturers and Importers of Incandescent and Fluorescent Lamps, under the Ministry of Industry and Commerce, establishes the prior import licensing regime and the mandatory Energy Efficiency certification. The regulation is focused on guaranteeing the application of the current measures in the field of Energy Efficiency, even determining the imposition of fines for offenders.

Within the framework of the declaration of national interest in the efficient use of energy, Uruguay published the law that grants tax benefits to promote the national production of LED luminaires for public lighting such as: VAT exemption for LED luminaires sold to the State or Departmental Governments for public lighting, establishment of a VAT refund regime included in purchases in place and imports of goods and services, which integrate the manufacturing cost of LED luminaires, exemption from any surcharge, including the minimum surcharge, the Single Customs Import Tax, the Mobilization Rate of Packages, the Consular Rate and, in general, all taxes whose application corresponds to the import of inputs for the manufacture of LED luminaires intended for street lighting, provided they are not competitive with the national industry.

7. INTERNATIONAL AGREEMENTS, INTEGRATION AND INTERCONNECTIONS

Within the framework of the G20 Leaders Summit, held between November and December 2018, Argentina signed important agreements related to the energy sector. With the United States, commitments were made to facilitate private capital investments throughout the chain of value of the energy sector including the production of hydrocarbons, the development of markets for LNG, gas infrastructure, generation, transmission and distribution of electrical energy, international interconnections and the promotion of energy efficiency and smart grids policies. An action plan was signed with China that includes cooperation in the fields related to exploration and development of unconventional oil and gas, engineering equipment and services in the oil and gas sector and trade, infrastructure and LNG operation, it was also agreed that the parties will actively cooperate in hydroelectric, wind, solar and biofuel energy, among other areas of renewable energy; in solar energy, the expansion of the Cauchari solar park, located in the province of Jujuy, from 300 MW to 500 MW was signed, and both countries reinforced cooperation for peaceful uses of nuclear energy and technology, including cooperation in the nuclear fuel cycle fields, power reactors, small and medium modular reactor technology, research reactors, nuclear technology applications and human resources development, among others. A document on cooperation in the field of peaceful use of nuclear energy with the State Atomic Energy Corporation was signed with Russia. The Agreement for the Promotion and Protection of Investments, a bilateral treaty aimed at promoting Japanese investments in various sectors of the Argentine economy, was signed with Japan. The aforementioned instrument aims to generate a framework of predictability and legal certainty for Japanese investors with interests in Argentina. With Canada, three memoranda of understanding were signed, one on energy efficiency, another on policies in the mining sector and the third on nuclear energy cooperation.

Considering energy integration as a priority, in April 2018, Argentina and Chile signed the Agreement Protocol for the export, import, marketing and transportation of electric energy and natural gas. Thus, eliminating barriers and restrictions that existed for more than a decade, and paving the way for a new export cycle that represents a bi-national integration milestone for both nations. To this end, an expeditious, transparent and non-discriminatory regime for the granting of natural gas export permits for short and long-term, firm and interruptible agreements, and summer exports and operational exchanges, always conditional on internal security of supply, is created.

With the objective of promoting environmental diplomacy and the decarbonization process for the sustainable green economy, Costa Rica became a full member of the International Renewable Energy Agency (IRENA), through the publication of the law that approves the Statute of the aforementioned intergovernmental organization. On the other hand, the Costa Rican Institute of Electricity (ICE) and the Abu Dhabi Future Energy Company (Masdar) of the United Arab Emirates signed a memorandum of understanding that will allow the exchange of technical knowledge and experience in renewable energy projects. Costa Rica also seeks to promote collaboration in floating solar photovoltaic (PV) technology, "smart cities" technology, utility-scale and off-grid power generation, and battery storage. The two companies also expect to offer advisory services to other Latin American and Caribbean countries on energy diversification. With the agreement, ICE will potentially have access in the triangular cooperation modality to funds destined to countries of the Caribbean Community and Afro-descendant populations for more than USD 50 million.

Following recommendations from the International Atomic Energy Agency (IAEA), government authorities of Ecuador and the United States signed a memorandum of understanding on Physical and Radiological safety issues. Under the commitments assumed by the parties, the US Department of Energy (DOE) will offer technical advice and cooperation to the Undersecretariat for Nuclear Control and Applications (SCAN), of the Ministry of Electricity and Renewable Energy (MEER), on issues of security reinforcement to facilities and bunkers that use ionizing radiation, training of personnel for the elaboration of technical regulations, removal of disused sources and the use of specialized laboratories. Additionally, it seeks to support with technology the national development axes such as: Health, Agriculture, Industry, Environment and Education.

Mexico officially became the 30th member country of the International Energy Agency and its first member in Latin America. Membership came after the Agreement on an International Energy Program (IEP) was signed and ratified by the Mexican Senate and subsequently deposited with the Belgian government. On the other hand, a joint cooperation agreement on sustainable hydroelectric energy was signed with the government of China. The aforementioned instrument is aimed at encouraging research and innovation in clean technologies, with emphasis on the development of small hydroelectric plants.

Through the promulgation of Law No. 6.064 / 2018, Paraguay ratified the "Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management", adopted in the City of Vienna, Austria, on September 5, 1997 ".

In order to promote planning, Energy Efficiency and renewable energy generation and use actions, Peru signed a Framework Cooperation Agreement with the Energy Research Center of the Netherlands. This initiative (which will be valid for 3 years with possibilities for renewal) will allow the development of a long-term energy strategy that provides the framework for investment decisions in the energy sector.

Global and regional energy prospective 2016 - 2040

Comparative presentation of some results of prospective studies

Comparative presentation of some results for the World and Latin America and the Caribbean from recent prospective studies

1. INTRODUCTION

OLADE, for the second consecutive year, presents a comparative analysis for the different agencies that carry out prospective energy studies, with the aim of providing a comprehensive and consolidated vision of the different projections, scenarios and variables that characterize the global and regional energy sector with a horizon of study for the period 2017 - 2040, disaggregated by five-year periods. In the case of Latin America and the Caribbean (LAC), the projections prepared by OLADE using the "Model for the Simulation and Analysis of the Energy Matrix"[1] - SAME, developed by our Organization and whose general characteristics can be reviewed in Annex III of this Energy Outlook, are included.

As a summary, some results derived from this work are cited, which was carried out both with information published worldwide and regionally. Overall, the average cumulative variation rate between 2017 and 2040 of the 12 prospective studies is 1.03% per year, from 14,021 Mtoe to 17,576 Mtoe in 2040. The highest recorded value of this rate is 1.36% corresponding to GREENPEACE and the lowest, 0.69% of the WEC. Fossil fuels will continue to play a relevant role in the demand for primary energy in 2040, although natural gas and renewables grow faster. As a result, the share of oil and coal decreases while those of natural gas and renewable energies increase.

In the case of final energy consumption, petroleum products are the fuels with the highest participation in final energy consumption in 2017 and this trend continues until 2040 in all outlooks analyzed; due to the growth in the transport and non-energy use sector in non-OECD countries, mainly China and India, which will increase their vehicle fleet with their income. However, the use of natural gas for final energy consumption will gradually increase until 2040 and its participation will grow rapidly. The transportation and electricity generation sectors will be the main drivers of this increase.

For the Latin America and the Caribbean (LAC) region, the average variation rate of primary energy consumption between 2017 and 2040 from 7 prospective studies is 1.93% per year, from 742 Mtoe to 1,109 Mtoe. Natural gas will contribute more to the growth of primary energy consumption in LAC and this trend turns out to be similar to the situation posed globally.

The average variation rate between 2017 and 2040 of the final energy consumption of the 5 prospective studies analyzed is 2.04%, from 573 Mtoe in 2017 to 873 Mtoe in 2040, while that of electricity generation will grow at a cumulative average rate of 2.6% per year, from 1,465 TWh in 2017 to 2,607 TWh in 2040.

2. RESEARCH PROCESS

2.1 Collection of Prospective Studies

From the research carried out the previous year, it was identified that approximately 109 prospective studies (or outlooks) are available worldwide and which can be categorized according to the periodicity and thematic they address as follows:

1. http://www.olade.org/producto/same-2/

Table 2.1 Categorization of energy prospective studies

Type of prospective study	Amount
Studies with global energy prospective	24
Studies with prospective energy disaggregated by regions	46
Studies with projects by type of fuel	28
Studies that include variables of sustainable development and climate change	9
Studies conducted by research institutes	2

In order to determine the group of prospective studies with which one would work, the following selection criteria were applied:

a) Related to the base year; 2017 was taken as a reference in order to reflect the most current situation that is possible.
b) Similarity of variables that can be analyzed both at the geographical and energy disaggregation level.

On this basis, 13 prospective studies were selected, highlighting that only 5 agencies present data for the 2017 base year (British Petroleum (BP); EXXONMOBIL; International Energy Agency (IEA), Forum of Gas Exporting Countries (FGEC) and OLADE (prospective for LAC), while the Institute of Energy Economics of Japan (IEEJ), the Organization of Petroleum Exporting Countries (OPEC) and the Massachusetts Institute of Technology (MIT) and EQUINOR present new projections for the period 2016 - 2040 and in order to maintain the analysis presented in the previous edition of the Energy Panorama, the prospective studies carried out in 2017 (base year 2016) were maintained.

Below is the list of the selected prospective studies:

1. World Energy Outlook 2018, International Energy Agency (IEA, 2018)
2. International Energy outlook 2017, US Energy Information Administration (DOE - EIA, 2017)
3. 2019 Outlook for Energy: A Perspective to 2040, ExxonMobil (2019)
4. IEEJ Outlook 2019, Japan Energy Economics Institute (IEEJ, October 2018)
5. BP Energy Outlook 2019 (BP, 2019)
6. World Oil Outlook 2040, Organization of Petroleum Exporting Countries (OPEC, September 2018)
7. GECF 2018 Global Gas Outlook - Forum of Gas Exporting Countries (FPEG, December 2018)
8. World Energy Scenarios 2016 - World Energy Council (WEC, 2016)
9. World Energy Scenarios 2017, Energy Scenarios of Latin America and the Caribbean (WEC, 2017)
10. Food, Water, Energy, Climate Outlook: Perspectives from 2018, Massachusetts Institute of Technology (Chen, H.and Ejaz Qudsia, 2018)
11. Global and Russian Energy Outlook 2016, Energy Research Institute of the Russian Academy of Sciences (ERIRAS, 2016)
12. Energy [r]evolution: A Sustainable World Energy Outlook 2015 (GREENPEACE, 2015)
13. Energy Perspectives 2018 (EQUINOR, 2018)

The following is a succinct description of the author organizations of Outlooks to be analyzed:

1. International Energy Agency (IEA)
   International organization, created after the 1973 oil crisis, which seeks to coordinate the energy policies of its member states, in order to ensure reliable energy.[2]

2. https://es.wikipedia.org/wiki/Agencia_Internacional_de_la_Energ%C3%ADa

2. British Petroleum (BP)
   Energy company, mainly dedicated to oil and natural gas based in London and the third largest private company worldwide.[3]
3. World Energy Council (WEC)
   Agency based in London, its mission is to promote the supply and sustainable use of energy.[4]
4. EQUINOR
   Norwegian multinational energy company based in Stavanger, focused mainly on oil and wind energy with operations in 36 countries, was initially founded under the name of Statoil.[5]
5. ExxonMobil Corporation
   American oil company, initially founded as Standard Oil Company in 1870 and its activities include the exploitation, processing and marketing of petroleum products and natural gas.[6]
6. Forum of Gas Exporting Countries (FGEC)
   Intergovernmental organization of 11 of the world's leading producers of natural gas; controls more than 70% of the world's natural gas reserves.[7]
7. Greenpeace
   Environmental NGO founded in 1971 in Vancouver, Canada, and the objective is to protect and defend the environment.[8]
8. Institute of Energy Economics of Japan (IEEJ)
   Institution created with the objective of carrying out research activities in the area of environmental and energy economics.[9]
9. Energy Research Institute of the Russian Academy of Sciences (ERIRAS)
   Institute created to develop the contents of the Energy Program of the USSR, with the purpose of proposing solutions to different topics of global concern, especially in the field of energy and has 8 departments for scientific research.[10]
10. Massachusetts Institute of Technology (MIT)
    Private university located in Cambridge, Massachusetts (United States), mainly dedicated to teaching and research.[11]
11. Latin American Energy Organization (OLADE)
    Intergovernmental public body, established on November 2, 1973, by signing the Lima Agreement. Cooperation, coordination and advisory body, with its own legal status, whose main purpose is the integration, protection, conservation, rational use, commercialization and defense of the Region's energy resources.[12]
12. Organization of Petroleum Exporting Countries (OPEC)
    It is an international body founded in Baghdad, Iraq in 1960 dedicated to the oil market.[13]
13. US Energy Information Administration (EIA)
    United States Statistical and Analysis Agency. The EIA collects, analyzes and disseminates energy information to promote policy formulation.[14]

2.2 Search for common variables

Each study considered, presents information on energy prospects for different topics, highlighting the following:

3. https://es.wikipedia.org/wiki/BP
4. https://es.wikipedia.org/wiki/Consejo_Mundial_de_Energ%C3%ADa
5. https://en.wikipedia.org/wiki/Equinor
6. https://es.wikipedia.org/wiki/ExxonMobil
7. https://es.wikipedia.org/wiki/Foro_de_Pa%C3%ADses_Exportadores_de_Gas
8. https://es.wikipedia.org/wiki/Greenpeace
9. https://eneken.ieej.or.jp/en/about/purpose.html
10. https://en.wikipedia.org/wiki/Energy_Research_Institute_of_Russian_Academy_of_Sciences
11. https://es.wikipedia.org/wiki/Instituto_Tecnol%C3%B3gico_de_Massachusetts
12. http://www.olade.org/quienes-somos/
13. https://es.wikipedia.org/wiki/Organizaci%C3%B3n_de_Pa%C3%ADses_Exportadores_de_Petr%C3%B3leo
14. https://es.wikipedia.org/wiki/Energy_Information_Administration

- Primary / final energy consumption by fuel / region / sector
- Import / export of fuel and prices
- Energy supply by fuel / region / sector
- Energy investment or investment needs by fuel / region / sector
- Electricity generation by fuel / region / sector
- Fuel production
- CO_2 emissions (greenhouse gases)
- Energy efficiency
- Installed capacity for power generation

To define the variables to be analyzed, it was considered that at least they are considered in 4 of the 13 prospective studies analyzed; derived from this, 6 global variables and 4 for LAC were obtained and are detailed in **Table 2.2**.

Table 2.2 List of common variables

Six global common variables	
1.	Global primary energy consumption by energy source (12 studies)
2.	Final global energy consumption by type of fuel (4 prospective studies)
3.	Final global energy consumption by sector (4 studies)
4.	Global electricity generation by energy source (6 studies)
5.	World natural gas production (4 prospective studies)
6.	Global CO_2 emissions (5 prospective studies)
4 common LAC variables	
7.	LAC primary energy consumption by energy source (6 prospective studies)
8.	LAC final energy consumption by type of fuel (4 prospective studies)
9.	LAC final energy consumption by sector (4 studies)
10.	LAC power generation by energy source (5 prospective studies)

Source: OLADE, own elaboration.

2.3 Data collection

Each prospective study presents different scenarios, which are called differently, for which scenarios with characteristics as similar as possible were selected. Thus, the base scenarios (or "business-as-usual" or BAU) were used, that is, those of a trend nature that do not add more counterfactual hypotheses, than those that have been happening according to current trends and policies. The purpose of using these scenarios is to obtain the most comparable results possible. Despite this and given that in each prospective study, a different simulation model is used, there may be differences in the way in which the various projections are made. The objective of this work is to show general results obtained from each study in order to have a framework of comparability that allows us to know how each study considered conceives the future evolution of such general results and not to compare models with each other.

Likewise, the units were standardized converting all available information to millions of equivalent tons of oil (Mtoe); Terawatt hour (TWh) for the variables associated with electricity generation and millions of tons (Mt) for emissions.

In the case of time periods, prospective studies may have different periods. Given that the 2017-2040 period was taken as a reference, the values for five-year periods were extrapolated, as well as for the studies that had as a base year 2016, so the rates of interannual variations were calculated by expressing the variation rate cumulative average:

$$\overline{VR_{t+n}^{t}} = \left[\left(\frac{M_{t+n}}{M_t} \right)^{\frac{1}{n}} - 1 \right] \cdot 100$$

where:

$$\overline{VR_{t+n}^{t}} = \text{Average accumulated variation rate between } t+n \text{ and } t$$
$$M_t = \text{Amount or value in time } t$$
$$M_{t+n} = \text{Amount or value in time } t+n$$

Then, the rate of variation of the entire TT period between t and t + n can be calculated by the expression:

$$TT_{t+n}^{t} = [(1 + \frac{\overline{TV_{t+n}^{t}}}{100})^{n} - 1] \cdot 100$$

Both rates being expressed in percentage terms.

3. HYPOTHESES USED

Most prospective studies consider some socio-economic variables such as population and gross domestic product (GDP) to build the respective scenarios. In **tables 3.1** and **3.2**, the period, the scenarios used and average cumulative variation rates used are recorded.

Table 3.1 Hypotheses used in each prospective study - worldwide

	Period	Scenario	GDP growth rate (% p.y.)	Growth rate of population (% p.y.)
IEA (2018)	2017 – 2040	Current Policy	3.4	0.9
DOE - EIA (2017)	2015 – 2050	Reference	2.8	0.8
ExxonMobil (2019)	2017 – 2040	Baseline	2.8	*0.95
IEEJ (2019)	2016 – 2050	Reference	2.7	0.8
BP (2019)	2017 – 2040	**ET	3.25	*0.89
OPEC (2018)	2017 – 2040	Reference	3.4	0.7
FPEG (2018)	2017 – 2040	Reference	3.4	*0.89
WEC (2017)	2015 – 2060	**Modern jazz	3.3	0.7
MIT (2018)	2015 – 2050	-	*2.74	*0.81
ERIRAS (2016)	2015 – 2040	Probable	2.8	0.89
GREENPEACE (2015)	2012 – 2050	Reference	3.1	*0.81
EQUINOR (2018)	2016 – 2050	**Rivalry	2.2	*0.82

Source: Data reported by each international organization.
** Own estimates.*
*** ET - Evolving Transition scenario.*
Modern jazz - Consider a highly productive scenario, with rapid economic growth.
Rivalry - Assumes a volatile geopolitical environment, with less environmental regulation.

Table 3.2 Main hypotheses of each prospective study - LAC

	Period	GDP growth rate (% p.y.)	Population growth rate (% p.y.)
IEA (2018)	2017 – 2040	2.8	0.7
ExxonMobil (2019)	2017 – 2040	2.8	**
IEEJ (2019)	2016 – 2050	2.7	0.6
WEC (2017)	2014 – 2040	*3.8	*0.74
ERIRAS (2016)	2015 – 2040	1.9	0.69
GREENPEACE (2015)	2012 – 2050	2.9	0.67
OLADE (2018)	2016 – 2040	2	1.14

Source: Data reported by each international organization.
** Own estimates from the Modern Jazz Stage (rapid economic growth).*
*** In the case of ExxonMobil, no population data is presented, so it was not feasible to calculate the growth rates.*
***IEA**: LAC- OLADE Member Countries, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Falkland Islands, French Guiana, Guadeloupe, Martinique, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines and Turks and Caicos Islands.*
***IEEJ**: LAC- Brazil, Chile, Mexico and other LAC countries.*
***WEC**: LAC - Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Paraguay, Peru, Trinidad & Tobago, Uruguay and Venezuela.*
***ERIRAS**: Central and South America.*
***Greenpeace**: LAC - IEA countries.*
***OLADE**: LAC - Argentina, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic, Suriname, Trinidad & Tobago, Uruguay and Venezuela.*

4. *MICRO-LEVEL OF ANALYSIS RESULTS AND DISCUSSION*

4.1. Primary energy consumption

Each prospective study has a different definition for primary energy consumption. For example, IEA and FGEC have the same definition, representing only internal demand and excluding the production of pumped storage and marine plants (tide and wave) for the hydroelectric power part. In the case of BP, it excludes traditional biomass. WEC uses the concept of total energy supply. **Table 4.1** shows the primary energy consumption for the different organisms.

Table 4.1 Primary energy consumption by organization

Mtoe	2017	2020	2025	2030	2035	2040
IEA	13,972	14,547	15,387	16,216	17,133	17,715
EIA	14,745	15,120	15,873	16,578	17,430	18,410
ExxonMobil	14,116	14,617	15,279	15,912	16,394	16,774
IEEJ	13,949	14,968	16,365	16,553	17,831	18,164
BP	13,511	14,304	15,264	16,095	16,980	17,866
OPEC	14,157	14,749	15,535	16,386	17,460	17,911
GECF	12,757	13,225	14,078	14,850	15,465	16,017
WEC	14,314	14,794	15,466	16,086	16,351	16,650
MIT	13,502	13,799	14,308	14,892	15,605	16,349
ERIRAS	14,261	14,680	15,507	16,252	16,946	17,576
GREENPEACE	15,081	15,740	16,920	18,130	19,296	20,300
EQUINOR	13,881	14,445	15,476	16,400	16,760	17,175

Source: Data reported by each international organization.
Definition: IEA, ExxonMobil, OPEC, GECF, GREENPEACE, EQUINOR _ primary energy demand
EIA, IEEJ, BP, ERIRAS _ Primary energy consumption (BP excludes traditional biomass)
WEC _ Primary energy supply
MIT _ Primary energy use

Table 4.2 shows the variation rates of the world primary energy consumption for each organization.

Table 4.2 Variation rates of world primary energy consumption

Annual variation rate 2017 - 2040 (%)					
IEA	EIA	EXXON	IEEJ	BP	OPEC
26.79	24.86	18.83	30.22	32.23	26.52
GECF	WEC*	MIT	ERIRAS*	GREENPEACE*	EQUINOR
25.55	16.32	21.09	23.25	34.61	23.73
Cumulative annual average variation rate 2017 - 2040 (%)					
IEA	EIA	EXXON	IEEJ	BP	OPEC
1.08	1.01	0.79	1.21	1.28	1.07
GECF	WEC	MIT	ERIRAS	GREENPEACE	EQUINOR
1.04	0.69	0.87	0.95	1.36	0.97

Source: Data reported by each international organization.
(*): Estimates made by OLADE.

Overall, the average cumulative variation rate between 2017 and 2040 of the 12 prospective studies is 1.03% per year, from 14,021 Mtoe to 17,576 Mtoe in 2040. The highest recorded value of this rate is 1.36% corresponding to GREENPEACE and the lowest, 0.69% of the WEC.

4.1.1 Primary energy consumption by energy source

The results for the main primary energy sources are presented below:

Oil

The highest cumulative annual average variation rate recorded is 1.41% of ERIRAS and the lowest, 0.31% corresponding to the BP study and the average 0.68% rate per year for the 12 prospective studies.

All the prospective studies analyzed indicate that, in the primary consumption of energy, oil and derivatives will continue to have the largest share due mainly to the contribution of China and India, due to population and industry growth; however, by the end of 2040 it presents a decline. The share of this energy in the base year reaches values above 35% and gradually decreases, to values that are between 27% (ERIRAS) to 32% (GECF) to cite as examples.

The IEA cites that "The time of growth in oil demand slows down, and 11.5 Mtoe / day, increase between 2017 and 2040 in developing economies. Demand growth is strong in the Middle East and India, especially for trucks and petrochemical feeders, but China is the country that will become the world's largest oil consumer and, by 2040, will be the largest net importer of oil in history. " (IEA, 2018, p.36).

Natural gas

Natural gas is the energy of the transition and whose participation for the study period is increasing. In 2017 for prospective studies the participation is close to 22% while in 2040 it will be 25% (IEA and EIA). The growth in natural gas demand will be led by Asia Pacific, North America, the Middle East and Africa.

The highest cumulative annual average variation rate is 1.89% of GREENPEACE and the lowest is 0.44% of ERIRAS and the average annual rate of the 12 studies is 1.47%.

The IEA cites that "Natural gas continues to be used in almost all advanced economies; The impacts of stagnant or declined primary energy demand are cushioned by the increasing share of gas in the energy matrix. In the United States, the wide availability of gas at adequate prices will encourage demand growth. In Korea, the demand for gas increases as the use of nuclear energy and coal in the energy matrix decreases." (IEA, 2018, p.177).

The IEEJ indicates that "Natural gas, increases faster than any other form of energy, will become the second source of energy with greater participation after oil, surpassing coal in the mid-2030s. Natural gas will be the largest source of energy for the United States around 2030, for the European Union (EU) around 2040 and, in the early 2020s, for non-Asian countries. Unlike oil, the consumption of natural gas in the OECD will increase. However, the non-OECD growth is much higher: 8.6 times that of the OECD. " (IEEJ, 2019, p.3).

Coal

Mineral coal was the second most consumed energy in 2017. This trend changes gradually since mineral coal will be replaced by natural gas and renewable energy. However, it remains significant by 2040.

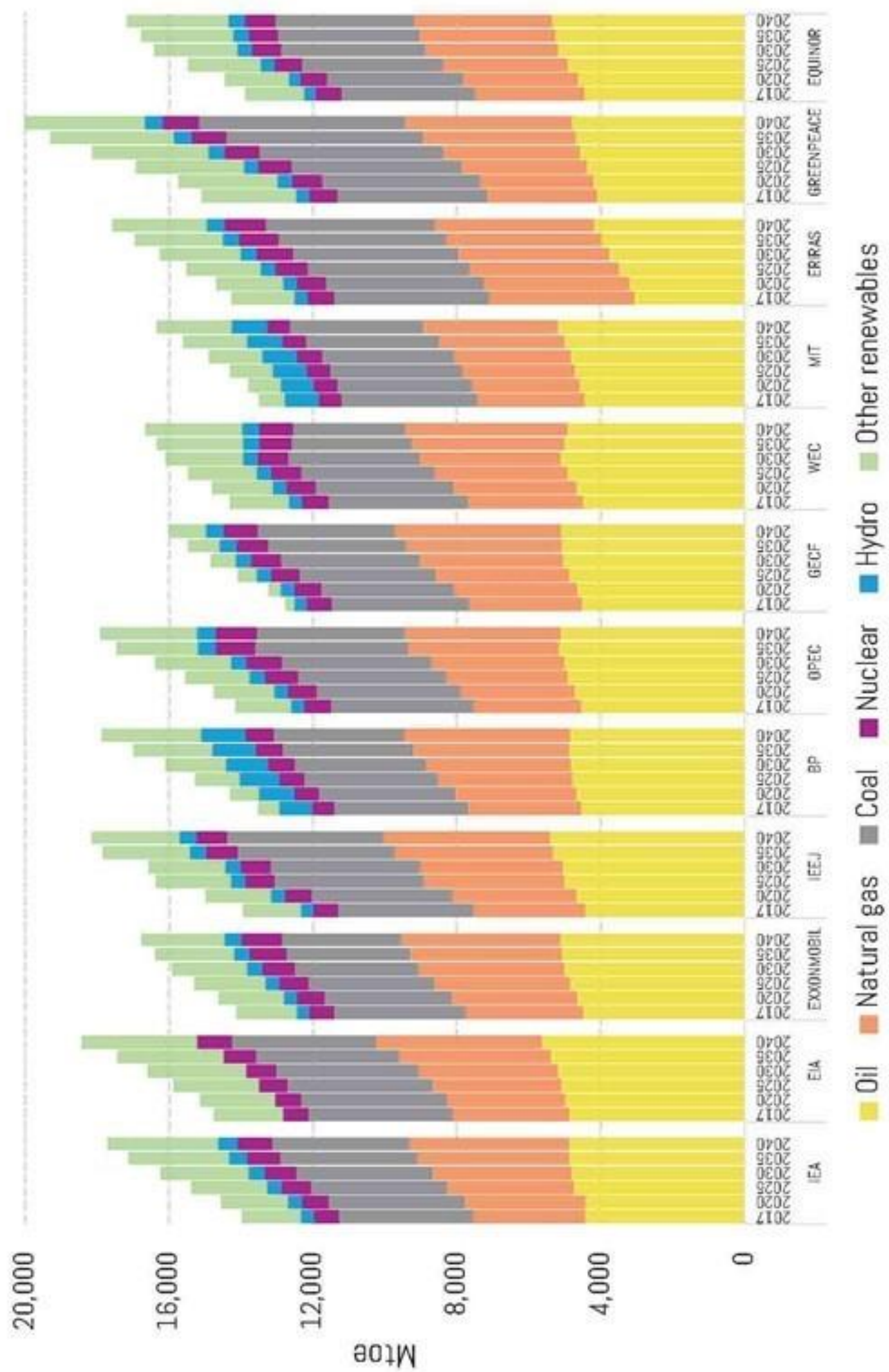
The highest cumulative annual average variation rate recorded is 1.45% corresponding to GREENPEACE and the lowest is -0.99% of the WEC and the average rate of 0.10% per year of the 12 studies. The share of coal gradually decreases in 11 of the outlooks except GREENPEACE (**Figure 4.2**).

The projections presented by WEC are the ones that show the greatest reduction in the share of coal consumption from 27% in 2017 to 19% in 2040.

The IEA cites that "The growth of coal-fired power generation in China, which is the world's largest consumer of coal, continues in 2018, but the demand for coal is contracted by the political priority to improve urban air quality, supported for the replacement of coal to gas in the industrial and residential sectors with a boost of renewable energies in electricity generation and the continuous restructuring of the economy. " (IEA, 2018, p215).

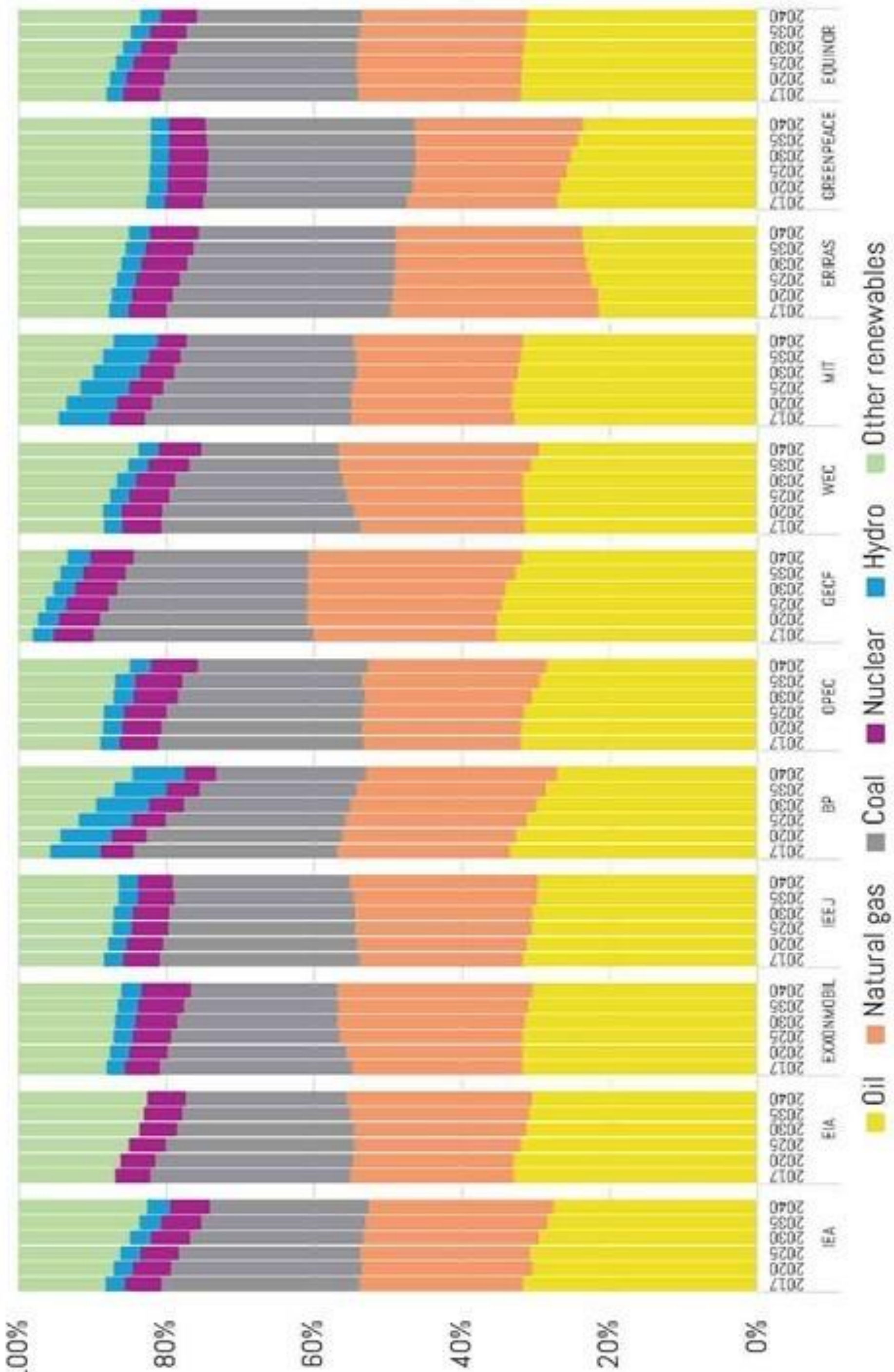
According to BP, "World coal consumption stagnates around current levels, in stark contrast to the last 20 years or so, when coal was the largest source of energy growth." (BP, 2019, p.52).

Figure 4.1 Global primary energy consumption by energy source (Mtoe)



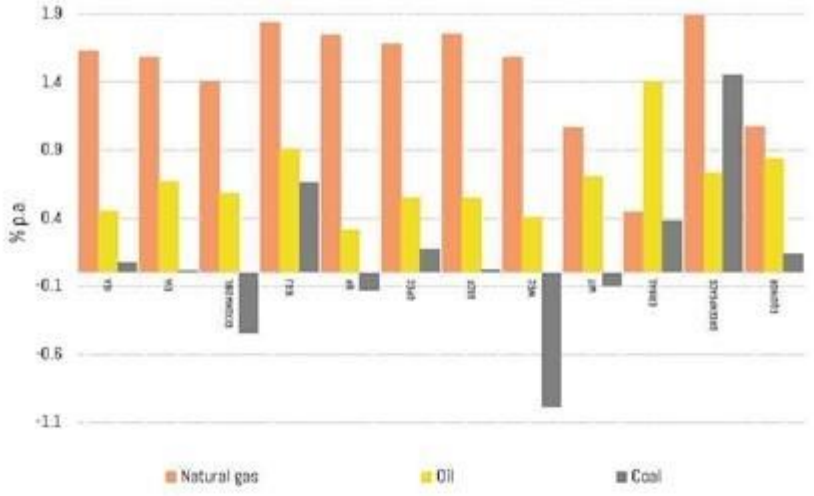
Source: Prepared by OLADE based on data reported by international organizations.
Definition: IEA, ExxonMobil, OPEC, GECF, GREENPEACE, EQUINOR - primary energy demand
EIA, IEEJ, BP, ERIRAS - primary energy consumption (BP excludes traditional biomass);
WEC - primary energy supply;
MIT primary energy use

Figure 4.2 Share of world primary energy consumption by energy source



Source: Prepared by OLADE based on data reported by international organizations.
Definition: IEA, ExxonMobil, OPEC, GECF, GREENPEACE, EQUINOR - primary energy demand
EIA, IEEJ, BP, ERIRAS - primary energy consumption (BP excludes traditional biomass);
WEC - primary energy supply;
MIT primary energy use

Figure 4.3 Variation rate of world primary energy consumption (fossil fuels 2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

Hydroelectricity

For the 2017-2040 period, hydropower has the lowest participation in primary energy consumption in almost all prospective studies analyzed with the exception of BP and MIT (**Figure 4.2**).

The highest cumulative annual average variation rate is 1.87% of IEA and the lowest is 0.26% of MIT and the average annual rate of the 11 prospective studies of 1.34%.

All prospective studies analyzed indicate that, in primary energy consumption, hydropower will continue to grow slightly from a participation of approximately 2.5% in 2017 to 2.9% in 2040 in the case of IEA and whose trend is similar in rest of the studies. BP indicates, for example, that hydropower will increase by 1.3% over the outlook and whose growth will be the slowest seen in the last 20 years and the contribution is given by China, South America, Central America and Africa.

Nuclear

Nuclear participation in primary energy consumption is around 5% in 2017 and gradually increases to values above 6.5% (ExxonMobil).

The highest cumulative annual average variation rate is 2.33% of ExxonMobil and the lowest is -0.10% of MIT and the average rate of 1.34% per year of the twelve studies.

Ten prospective studies indicate that the primary consumption of nuclear energy in the study period will increase except for GREENPACE and EQUINOR, which show a reduction at the end of 2040 compared to 2017.

The IEA cites that "Nuclear energy is an important low carbon option for many countries. The average annual investment for nuclear energy is USD 47 billion in the 2017-2040 period, including duration extensions for existing plants and new constructions. The majority of nuclear investment is in China (28% of the total), the European Union (19%), Russia (11%), India (9%) and the United States (8%), although many other countries are interested in the expansion of its nuclear power plant fleets. " (IEA, 2018, p.455).

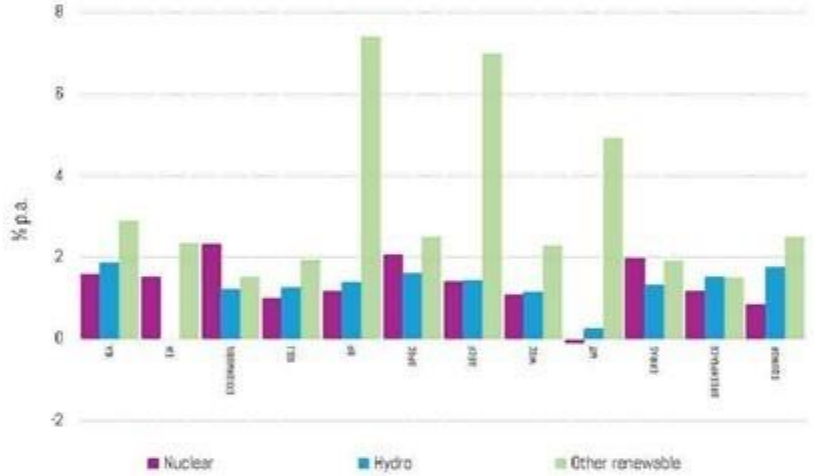
Other Renewables

All prospective studies analyzed indicate that primary energy consumption, the share of other renewable energy will continue to increase continuously. The IEA cites that "Renewable energy represents more than 70% of the increase in electricity generation. It is predicted that the costs of photovoltaic solar energy will decrease by more than 40% until 2040, pointing to a nine-fold growth in the generation of photovoltaic solar energy, mainly in China, India and the United States. Low carbon technologies represent half of the world's electricity generation by 2040. " (IEA, 2018, p.44).

The highest accumulated annual average variation rate is 7.40% of BP and the lowest is 1.51% of GREENPEACE, and the average rate per year of the twelve studies of 3.22%. The other renewables that include biomass, wind, solar and geothermal energy sources are the fastest growing compared to other energy sources; its participation is in values higher than 11% in 2017 reaching up to 18% in 2040.

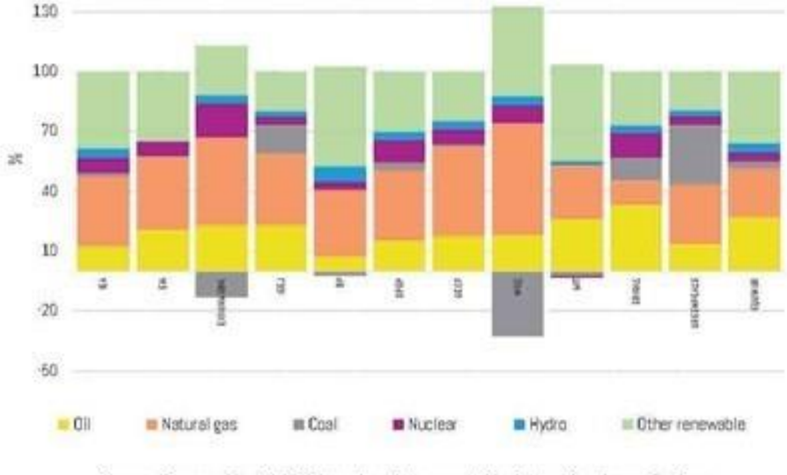
BP indicates that "Renewable energy (7.1% per year), is the fastest growing energy source, contributing half of the growth of global energy with its share of primary energy, increasing from the current 4% to around 15% by 2040. " (BP, 2019, p.40).

Figure 4.4 Variation rate of world primary energy consumption (fossil fuels 2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

Figure 4.5 Contribution to the growth of primary energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

4.2 Final energy consumption

On average, the final energy consumption in 2017 for the four studies analyzed **Table 4.3** reaches 9,755 Mtoe and in 2040 it will be 12,585 Mtoe; experiencing an interannual growth of 29%.

The final energy consumption worldwide is dominated by the consumption of oil and derivatives whose participation in 2017 reaches values above 40%, followed by electricity with approximately 19%, natural gas 15% and the rest distributed between renewable sources (mainly biomass) and mineral coal.

The BP indicates that "Global energy grows at an average annual rate of 1.2% in the ET scenario, below 2% annually in the last 20 years or so. This weaker increase reflects slower population growth and faster improvements in energy intensity. " (BP, 2019, p.21).

Table 4.3 shows the total global final energy consumption for each of the organizations.

Table 4.3 World final energy consumption

Mtoe	2017	2020	2025	2030	2035	2040
IEA	9,695	10,694	10,872	11,473	12,068	12,581
IEEJ	9,680	10,266	11,322	11,357	12,151	12,447
WEC	10,066	10,554	11,179	11,713	12,054	12,359
GREENPEACE	9,580	9,999	10,799	11,597	12,327	12,954

Source: Data reported by each international organization.

4.2.1 By type of fuel

Four prospective studies (IEA, IEEJ, WEC and GREENPEACE) provide information on final energy consumption by fuel. Next, an analysis is made for the final energy consumption for the main energy sources.

Oil and derivatives

The highest cumulative annual average variation rate is 1.00% of GREENPEACE and the lowest is 0.45% of WEC and the average rate per year for the 4 studies of 0.76%. Petroleum products are the fuels with the highest participation in final energy consumption in 2017 and this trend continues until 2040 in all outlooks; due to the growth in the transport and non-energy use sector in non-OECD countries, mainly to China and India, which will increase their vehicle fleet with their income. The participation of these energy products among the fuels consumed is the greatest, although it will gradually decrease with an increase in natural gas and electricity.

Natural gas

The highest cumulative annual average variation rate is 1.95% of IEA and the lowest is 1.44% of IEEJ and the average rate of 1.65% per year for the 4 prospective studies.

The use of natural gas for final energy consumption will gradually increase until 2040 and its participation will have a rapid growth from participation values in 2017 from 12.5% to 16.5% in 2040 for example in the case of IEA. The transportation and electricity generation sectors will be the main drivers of natural gas growth and according to GECF estimates "These two sectors will represent approximately 48% of the world's natural gas consumption in 2040. However, the industrial sector still occupies the second place from the point of view of absolute consumption, after the generation of energy. " (GECF, 2018, p.103).

The IEA indicates that "The industry sector is the main source of growth in the demand for natural gas in the New Policies Scenario, which represents one third of the total. The chemical industry is the biggest contributor: it uses gas to generate heat and steam, as well as a raw material to produce ammonia and methanol. Today, gas is mainly used in high energy consumption industries that require high temperature heat. " (IEA, 2018, p178).

"The electricity sector is the second largest contributor to the increase in demand for natural gas in the period until 2040." (IEA, 2018, p.178).

"The demand for natural gas for transportation almost triples in the period until 2040, as a result of policy-driven efforts to promote compressed natural gas (CNG) and LNG-fueled vehicles, especially in China." (IEA, 2018, p.178).

Coal

The highest cumulative annual average variation rate is 0.66% of GREENPEACE and the lowest is -0.08% of WEC, and the average rate per year for the 4 studies of 1.78%.

Coal has the lowest participation among the fuels used for final energy consumption, higher than 10% in 2017 and will present a decrease until 2040 with values greater than 8%. Of the 4 studies, WEC shows a more favorable trend for coal with a 12% share in 2017 and in 2040 of 9.58%.

According to the IEA, "Increasing attention to air quality, efforts to diversify the energy mix of coal in power generation and the construction sector with a strong boost for the use of gas in the industry have led to a downward revision of more than 40 Mtce (Millions of tons of carbon equivalent) in 2040 of the demand for coal in China in the New Policy Scenario, compared to the WEO-2017." (IEA, 2018, p.220).

The BP indicates that "The consumption of coal within the industry decreases as China, the European Union and North America change to cleaner and lower carbon fuels, partially offset by growth in India and Other Asian Countries." (BP, 2019, p.31).

Electricity

Electricity is one of the most used energy in final consumption, it is the third most consumed and its participation for 2017 is in values higher than 18% and will culminate in 2040 with values up to 25% depending on the prospective study analyzed.

The highest accumulated annual average variation rate is 2.34% of GREENPEACE and the lowest, of 1.87% of WEC and the average rate per year for the 4 studies of 2.16%.

In all prospective studies, electricity is shown as a source that has the greatest contribution to the growth of final energy consumption. The average share of electricity for the contribution to growth among 4 studies is 39.92%. The IEA indicates that "In the New Policies Scenario, the demand for electricity reaches around 26,400 TWh in 2025 and more than 35,500 TWh in 2040, an increase of 60% today. From now until 2025, electricity, oil and natural gas contribute around 85% of the growth in final energy demand in almost equal parts. However, after 2025, the growth in demand for electricity exceeds that of other fuels by a wide margin, driven by developing economies." (IEA, 2018, p.325).

The IEEJ indicates that "Electricity is preferred at all stages of economic development in each country and region and will increase more than any other source of energy. Your participation in final energy consumption will increase from 19% to 26%. In the non-OECD domestic sector, which is key for the future, the demand for appliances such as electric water heaters, air conditioners, lighting fixtures and refrigerators will increase consumption, along with the expansion of the electrical infrastructure." (IEEJ, 2019, p.5).

Renewables

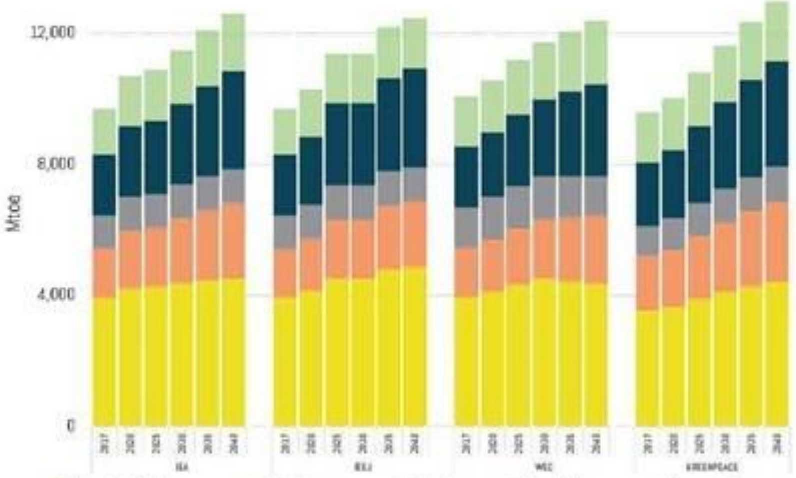
The highest cumulative annual average variation rate is 1.07% of WEC and the lowest is 0.44% of IEEJ and the average rate per year for the 4 studies of 0.83%.

According to the IEA, "Renewable energy exceeds coal for power generation in the 2020s and provides 40% of electricity by 2040. Investment in electricity based on renewable energy increases from USD 300 billion in 2017 to around USD 410 billion in 2040. Photovoltaic (PV) solar energy represents about 35% of the investment in power generation." (IEA, 2018, p244).

In addition, the IEA indicates that "The use of renewable energies to meet the demand for heating and transport increases in the New Policies Scenario. Renewable energy for heating increases by about 85% over the 875 Mtoe forecast in 2040. The share of renewable energy in transport energy demand is constantly increasing to reach 8% in 2040 compared to 3.5% today." (IEA, 2018, p244).

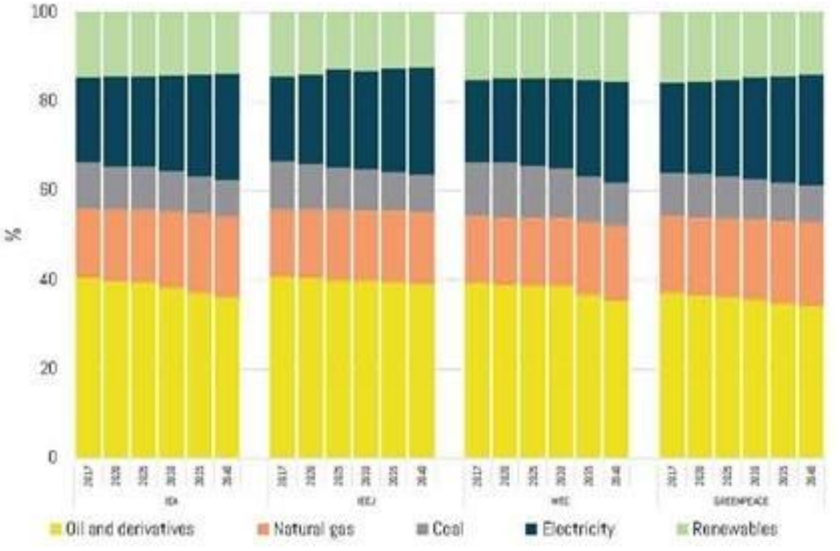
BP indicates that "Renewable energy (7.1% per year), is the fastest growing energy source, contributing half of the growth of global energy with its share of primary energy, increasing from the current 4% to around 15% by 2040." (BP, 2019, p40).

Figure 4.6 Global final energy consumption by type of fuel



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA) heat, hydrogen and other (IEEJ) heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

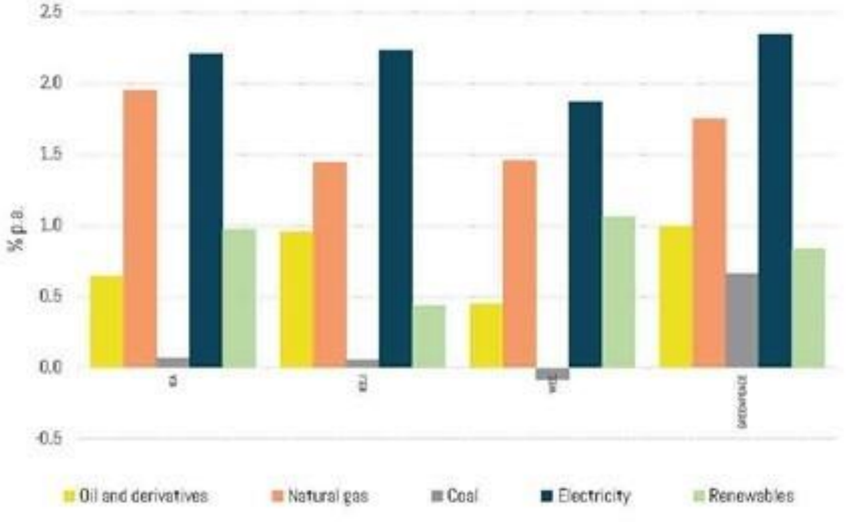
Figure 4.7 Share of global final energy consumption by fuel



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA) heat, hydrogen and other (IEEJ) heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

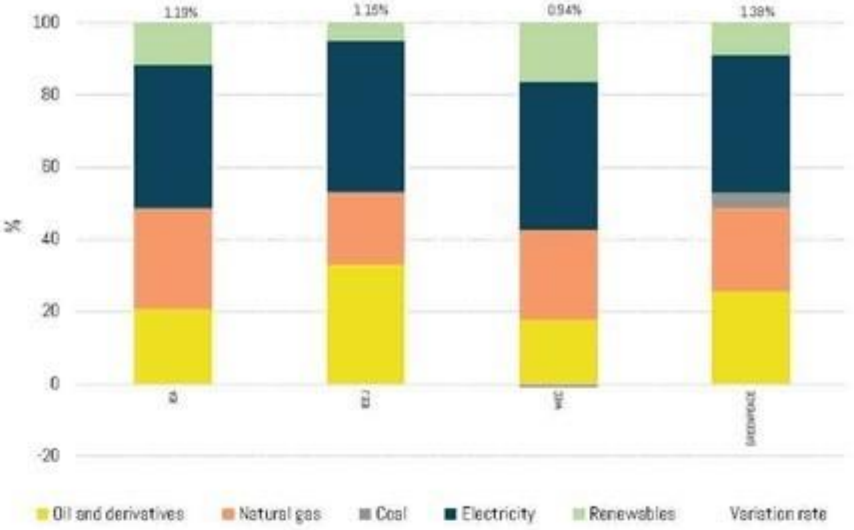
Prospective studies show similar trends; for example, electricity has the highest variation rate among energy sources (an average rate for the 4 studies of 2.16%); followed by natural gas, while coal has the lowest value between 2017 and 2040 (**Figure 4.8**).

Figure 4.8 Variation rate of global final energy consumption by type of fuel (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA) heat, hydrogen and other (IEEJ) heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE)

Figure 4.9 Contribution to the growth of global final energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA) heat, hydrogen and other (IEEJ) heat, biomass, biofuel and others; (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE)
The numbers above the bars correspond to the cumulative average variation rate of the total energy consumption forecast in each prospective study.

4.2.2 By sector

Each organization has its own definition for the economic sectors. The IEA defines the industrial sector as the fuel used within the manufacturing and construction industries. The main branches of the industry include iron and steel, chemical and petrochemical, cement, and pulp and paper. The use by industries for the transformation of energy in another form or for the production of fuels is excluded and disclosed separately under another energy sector. The consumption of fuels for the transport of goods is reported as part of the transport sector, while in the industry the consumption of off-road vehicles is reported.

The transport sector is defined as: fuels and electricity used in the transport of goods or people within the national territory, regardless of the economic sector in which the activity occurs. This includes fuel and electricity delivered to vehicles that use public roads or for use in rail vehicles; fuel delivered to ships for national navigation; fuel delivered to aircraft for domestic aviation; and the energy consumed in the delivery of fuels through pipelines. Fuel delivered to international marine and aviation bunkers is presented only worldwide and is excluded from the national transport sector.

In the case of Other Sectors, it includes buildings, residential (energy used by households including space heating and cooling, water heating, lighting, appliances, electronics and kitchen equipment), etc. For the non-energy use sector, it includes fuels used for chemical raw materials and non-energy products. Examples of non-energy products include lubricants, paraffin waxes, asphalt, bitumen, coal tars and oils as wood preservatives (IEA, 2017, p. 743-747).

GREENPEACE, defines the industry as: consumption in the industry sector includes the following subsectors (energy used for transport by industry, see "transport") is not included, for example, the steel industry; chemistry; non-metallic mineral products such as glass, ceramic, cement etc.; transport equipment; machinery; mining; food and tobacco; paper, pulp and printing; wood and wood products (except pulp and paper); textile and leather construction.

The transport sector includes all modes of transport such as road, rail, air and national navigation. The fuel used for oceanic, coastal and inland fishing is included in "other sectors". Other sectors include agriculture, forestry, fishing, residential, commercial and public services. The non-energy sector covers the use of other petroleum products such as paraffin waxes, lubricants, bitumen, etc. (GREENPEACE, 2015, p. 311).

A brief description of the final energy consumption in the main economic sectors follows:

Industry

In the 4 outlooks analyzed (IEA, IEEJ, WEC and GREENPEACE), the industrial sector has the largest share in total final consumption. Its participation is in values higher than 28% in 2017 and in 2040 it will reach values greater than 30%. Most of the growth in this sector will come from developing countries such as China and India.

The BP quotes that "After tripling in the last 20 years, the demand for industrial energy, China on the ET scenario peaks in the mid-2020s and then gradually decreases. Part of this decline comes from policy efforts to improve the efficiency of existing industries. In addition, it reflects the continuous transition of the Chinese economy from energy-intensive industrial sectors to less intensive services and consumer-oriented sectors." (BP, 2019, p.31).

The highest cumulative annual average variation rate is 1.51% of GREENPEACE and the lowest is 1.09% of IEEJ and the average rate per year of the 4 prospective studies of 1.26%.

According to the IEA, "Oil has lost competitiveness as a source of fuel in the industrial sector in most regions. Today it provides a little more than 10% of the total energy use in the industry. Demand in the industry increases 0.7 ktoe / day, in the New Policies Scenario, but the share of oil in the sector falls steadily until 2040 despite greater growth in all other fuel sources." (IEA, 2018, p.141).

Transportation

The transport sector is the second sector with the greatest contribution in total final energy consumption. In 2017, its participation has values higher than 27% and the trend in the period of analysis is towards diminution, mainly due to the use of cleaner and more efficient technologies.

The highest accumulated annual average variation rate is 1.50% of GREENPEACE and the lowest is 0.89% of WEC and the average rate of 1.15% per year for the 4 studies.

The most commonly used fuels in this sector are petroleum products (mainly gasoline and diesel), in this regard, the IEA indicates that "In the transport sector, oil represents less than 50% of the growth in demand, below a participation of almost 90% in the period since 1990." (IEA, 2018, p42).

Also, BP indicates that "In the transport sector, most of the emissions come from the continuous use of oil (45 Mbbl / d) in 2040. More than half of this consumption comes from the use of oil in light and medium duty cars and trucks that can be gradually electrified during overtime. However, the rest is concentrated in modes of transport that are more difficult to electrify: including heavy truck, aviation and marine elements. " (BP, 2019, p.60).

Others

This sector mainly includes the residential and commercial sector. The highest accumulated annual average variation rate is 1.27% corresponding to GREENPEACE and the lowest, 0.64% WEC and the average rate per year for the 4 studies of 1.01%.

The WEC indicates that "the increasing availability of networks, meters and smart devices gives consumers more information and autonomy to do more with less energy and quantifies the value of the investment. As a result, the use of energy demand in this sector grows at a moderate pace" (WEC, 2016, p. 45).

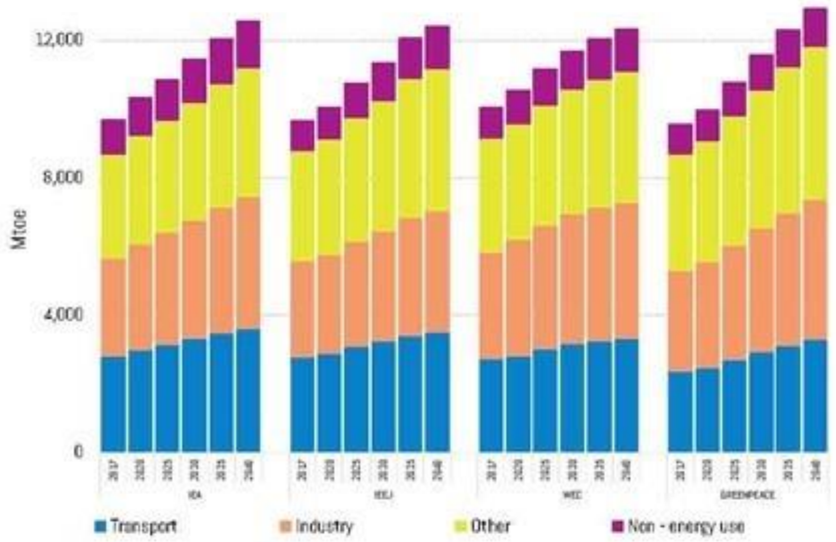
Similarly, the BP indicates that "Most of the growth in energy used in buildings comes from electricity, which reflects a greater use of lighting and appliances and the growing demand for space cooling in much of the developing world (Asia, Africa and the Middle East), increasing living standards." (BP, 2019, p. 37).

Non-Energy Use

The highest accumulated annual average variation rate is 1.60% of the IEEJ and the lowest, 1.02% corresponding to GREENPEACE and the average rate per year for the 4 studies of 1.39%.

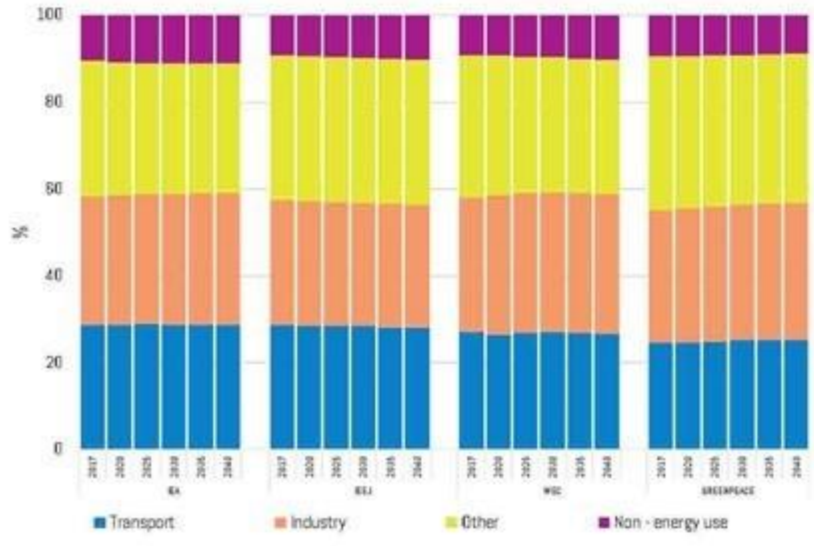
The growth comes from the demand of developing chemical markets such as China and India (WEC, 2016, p. 45).

Figure 4.10 Final global energy consumption by sector



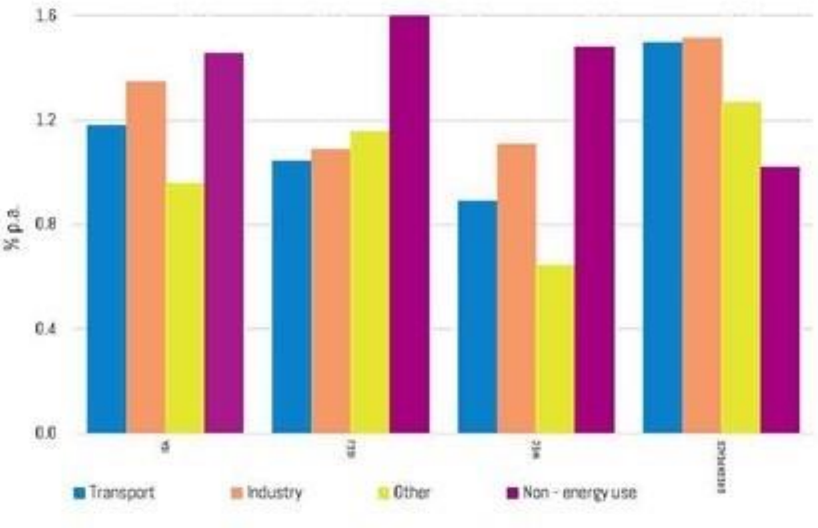
Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 4.11 Final global energy consumption by sector



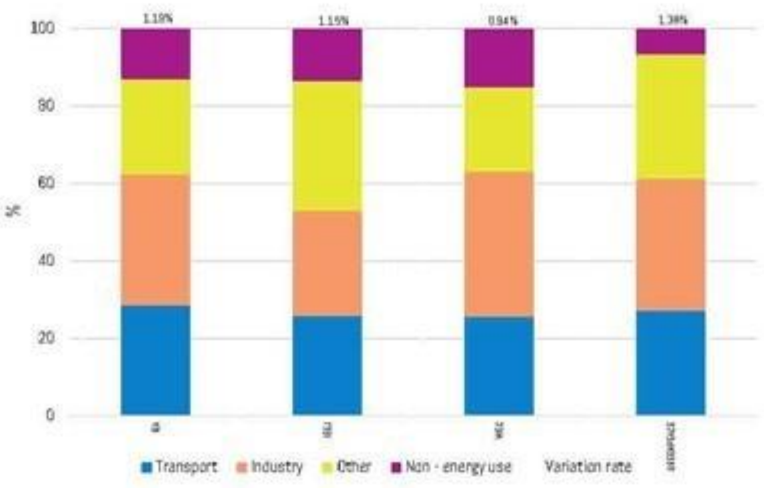
Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 4.12 Variation rate of final global energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 4.13 Contribution to the growth of global final energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.
The numbers above the bars correspond to the cumulative average variation rate of the total energy consumption forecast in each outlook.

4.3 Electricity generation

The global electricity generation on average for 2017 for the six studies that present this information (**Table 4.4**) was 25,560 TWh and has a significant growth by 2040, reaching a value of 38,914 TWh, representing an interannual growth exceeding 52\%, which is mainly due to the increase in generation with renewable sources and natural gas.

Table 4.4 shows the data for global power generation by organization.

Table 4.4 World electricity generation

TWh	2017	2020	2025	2030	2035	2040
IEA	25,641	28,057	33,479	37,086	42,477	40,412
IEEJ	25,513	27,883	32,633	34,471	39,744	40,913
WEC	25,623	27,124	29,590	32,171	34,894	37,724
MIT	24,057	24,773	26,382	28,457	30,763	33,212
ERIRAS	25,901	27,424	30,215	32,791	35,125	37,216
GREENPEACE	26,624	28,492	32,374	36,256	40,353	44,008

Source: Data reported by each international organization.

4.3.1 By energy source

For the generation of electricity worldwide, the most commonly used energy is mineral coal which has total generation shares of over 38% in 2017, due to the consumption of China and whose tendency in the 5 studies is to decrease, however, GREENPACE indicates that its increase will continue.

Natural gas is the second most used energy to produce electricity with a contribution of more than 21% in 2017, followed by hydroelectric 15%, nuclear 11% and the rest corresponds to other renewable sources mainly wind, solar and geothermal energy and petroleum products: diesel and fuel oil.

Next, an analysis is presented for electricity generation by energy source.

Oil and derivatives

The highest cumulative annual average variation rate is 0.27% corresponding to the IEEJ study and the lowest is -4.66% of the MIT; the average rate per year of the 6 prospective studies is -2.25%. The six outlooks analyzed predict that the use of oil and derivatives for power generation will also decrease, as well as their participation (**Figure 4.15**).

According to the IEA, "The use of oil in the electricity sector is reduced in almost all regions and is generally replaced by natural gas and renewable energy. The decline is slower in the Middle East, where there are large volumes of low-cost (and often subsidized) oil and the region accounts for half of the 2.7 kbbl / d of oil used to produce energy in 2040." (IEA, 2018, p.141).

Natural gas

Natural gas will remain the second most used fuel for power generation until 2040. "The electricity sector is the second largest contributor to the increase in demand for natural gas in the period until 2040." (IEA, 2018, p.178).

The highest cumulative annual average variation rate is 3.17% of the WEC and the lowest, 2.01% AIE and the average rate per year of the 6 studies of 2.61%.

According to the BP, "The growth of the demand for gas is wide, and it increases in almost all the countries and regions considered in the projections. The use in energy and industry drives this increase." (BP, 2019, p.48).

The GECF notes that "In 2040, approximately 55% of the electricity generation will come from fossil fuels and natural gas will represent 26% of the electricity generation matrix. The demand for gas from the electricity sector is expected to grow 67% to 2,219 bcm (billion cubic meters) in 2040." (GECF, 2018, p.96).

Coal

Coal is currently the most consumed energy worldwide for electricity generation, however, its use in the study period is gradually decreasing due to its replacement with other energy sources such as natural gas and renewable energy.

The highest accumulated annual average variation rate is 2.37% corresponding to GREENPEACE and the lowest is -1.11% WEC; the average rate is 0.57% per year for the 6 prospective studies.

The IEA notes that "Coal and renewable energy change their position in the electricity sector. The proportion of coal decreases from around 40% today to a quarter in 2040, while that of renewable energy grows from a quarter to just over 40% during the same period." (IEA, 2018, p.44).

According to the BP, "The proportion of coal decreases considerably, so that by 2040 it will be surpassed by renewable energy as the main source of energy in the global energy sector." (BP, 2019, p53).

Hydroenergy

Hydroenergy has a participation greater than 15% for 2017 and until 2040 it experiences a reduction reaching values up to 13%, in the prospective studies analyzed (IEEJ, WEC, MIT and ERIRAS). IEA and GREENPEACE do not include information as it is grouped into other renewable.

The highest accumulated annual average variation rate is 1.32%, from ERIRAS and the lowest is 0.55% of MIT and the average annual rate for the 4 prospective studies is 0.86%.

Nuclear

Nuclear energy in 2017 has a share of more than 10%, however, it decreases to reach 8% in 2040. The highest accumulated annual average variation rate is 1.97% of ERIRAS and the lowest, of 0.13% of MIT; The average rate per year for the 6 studies is 1.16%.

The IEA indicates that "Nuclear power offers about one tenth of the generation of electricity during the whole period, although the center of gravity changes, since the nuclear capacity in China exceeds that of the United States in 2030. " (IEA, 2018, p.323-324).

On the other hand, the IEEJ indicates that "The global capacity for nuclear power generation will increase from 406 GW in 2016 to 518 GW in 2050, and the electricity generated by nuclear energy will increase 1.3 times. However, it will not reach the rapid increase in total energy generation, and its participation in energy generation will fall by 3%." (IEEJ, 2019, p.9).

Renewables

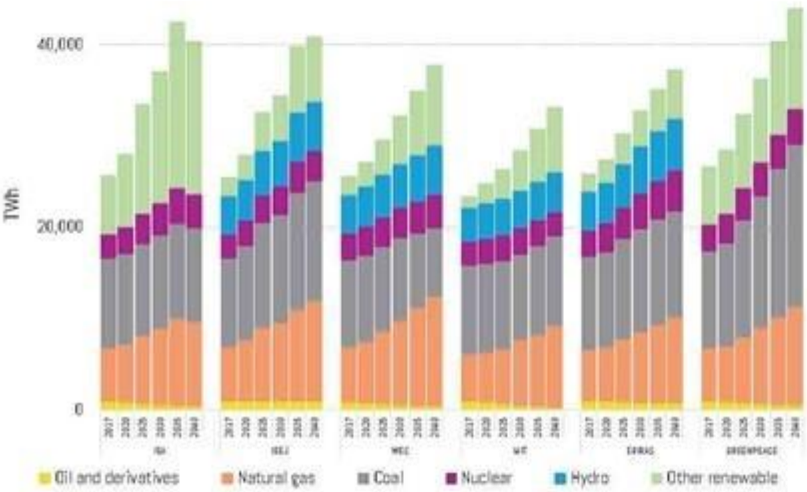
Globally, the generation with renewable energy registers a favorable and fast-growing panorama, presenting the greatest contribution to the growth of electricity generation by 2040. The total share of renewables almost doubled in 2040 compared to 2017 in all outlooks analyzed.

The highest cumulative annual average variation rate is 7.14% of MIT and the lowest is 2.61% of GREENPEACE; the average rate per year for the 6 studies is 5.21%.

According to the IEA, "Almost 150 countries have in their objectives the increase in the use of renewable energy in electricity. Globally, photovoltaic solar energy and wind energy are the main focus of policy support." (IEA, 2019, p.340).

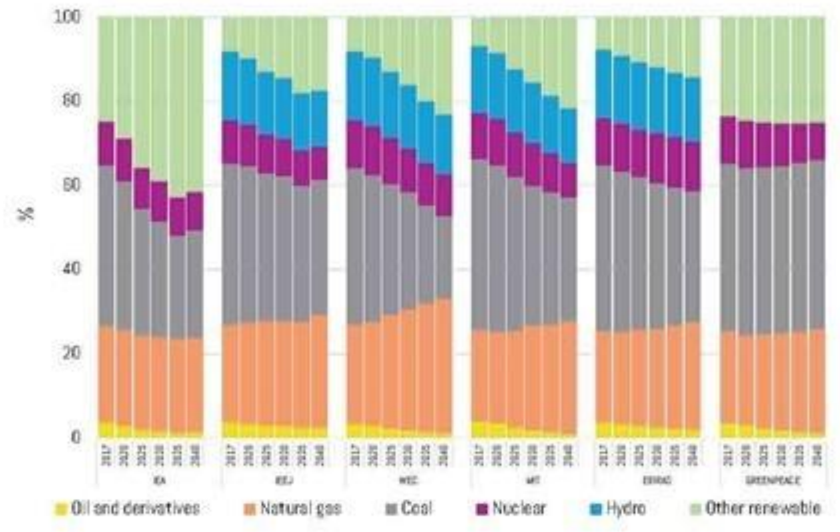
Also, BP indicates that "In the ET scenario, renewable energies are the fastest growing energy source (7.6% annually), which represent about two thirds of the increase in global energy generation, and become the source world's largest power generation by 2040." (BP, 2019, p.105).

Figure 4.14 World electricity generation by energy source



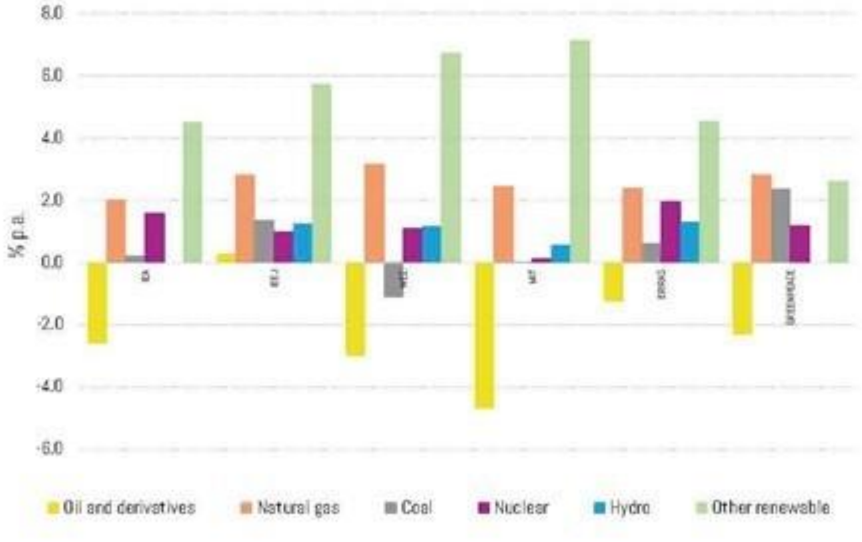
Source: Prepared by OLADE based on data reported by international organizations.

Figure 4.15 Participation of the world's electricity generation by energy source



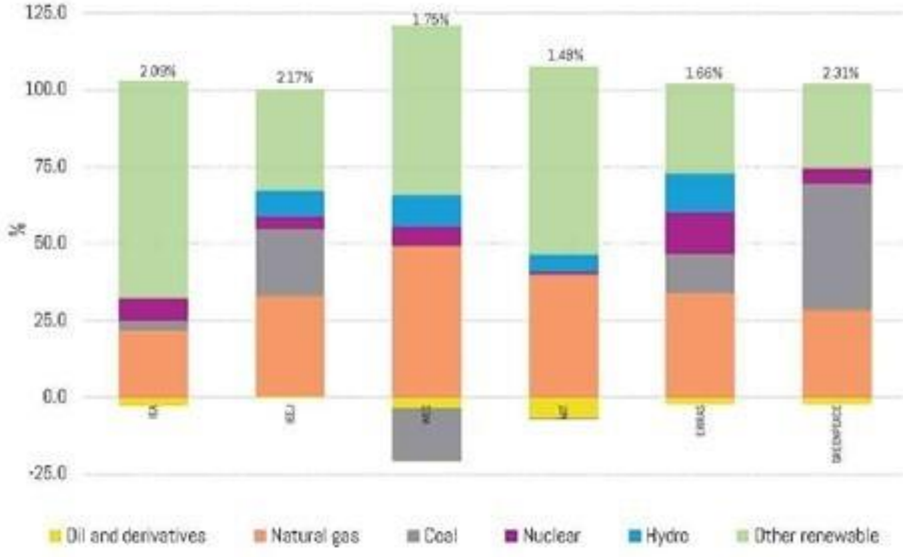
Source: Prepared by OLADE based on data reported by international organizations.

Figure 4.16 Variation rate of the world's electricity generation (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

Figure 4.17 Contribution to the growth of global electricity generation (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
The numbers above the bars correspond to the cumulative average variation rate of the electricity generation forecast in each Outlook.

4.4 Natural gas production

Natural gas is the energy of the transition to low-carbon systems and its production and final demand during the study period are increasing mainly in electricity generation, the industrial sector and transport due to its lower carbon emissions compared to other fuels and for diversification in energy matrices.

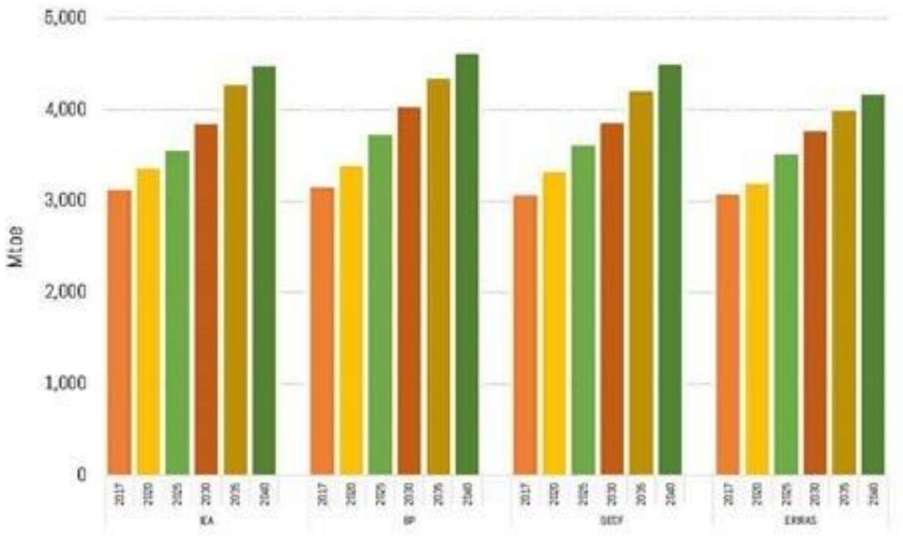
This energy grows much faster than oil and coal, surpassing mineral coal, which is the second most consumed energy source in the world. Production is centered in the United States, Russia and Iran who are currently the largest producers of gas and which remains in the study period, although projections indicate that China is close to Iran's production in 2040.

ERIRAS indicates that "the fastest growth in shale gas production will be in the 2025 period. At that time, production volumes will have increased to almost 700 bcm, of which 600 bcm will come from the US. In later years, shale gas production in the United States will stabilize and in 2030-2035 it will peak as the most attractive reserves run out (as was the case with the production of liquid hydrocarbons from shale fields in the United States). After 2025, global shale gas production will expand, due to the production of other countries: production is forecast to increase in Canada, Mexico and Argentina (175 bcm), in Asian countries (at 100 bcm), and in Africa (at 25 bcm). Due to geological, economic and political limitations, shale gas production volumes in Europe and the CIS will not exceed 20 bcm" (ERIRAS, 2016, p. 118).

According to the GECF, the "General growth of production of 1.7% per year is expected until 2040, and that total production reaches 5,427 bcm (billion cubic meters) by that date. Africa is expected to grow faster, albeit from a low base, while North America will be the largest contributor by 2040 with a 28% overall share of world gas production. " (GECF, 2018, p.142).

While the IEEJ indicates that "World natural gas production will grow approximately 1.7 times between 2016 and 2050. Although the initial investments were delayed in 2014, due to the weak prices of crude oil, recently recovered in 2017, leading the production of natural gas to embark on a constant upward trend." (IEEJ, 2019, p61).

Figure 4.18 World natural gas production



Source: Prepared by OLADE based on data reported by international organizations.

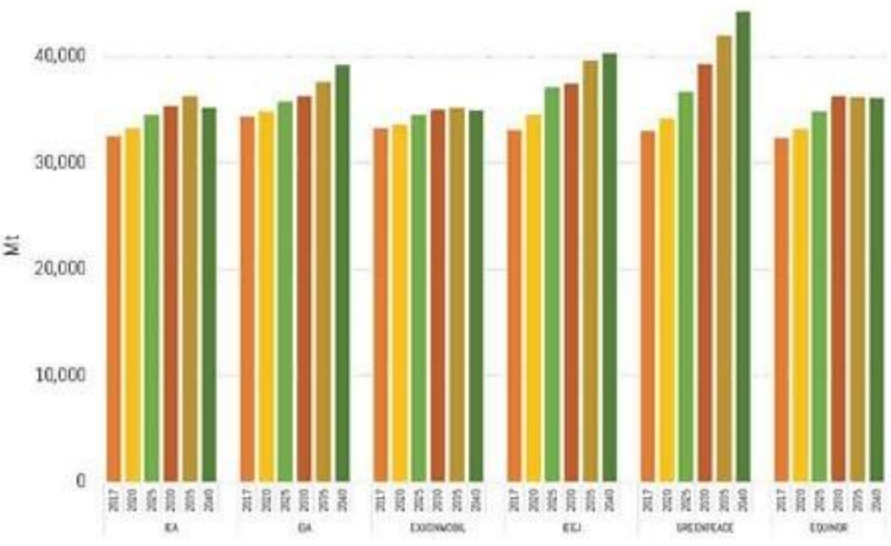
4.5 CO_2 emissions

Total global CO_2 emissions in 2017 are in values higher than 32,000 Mt in the prospective studies analyzed as shown in Figure 4.19, evidencing an upward trend with an average annual variation rate of 1.68%. However, the IEA indicates that emissions will be reduced from 36,934 Mt in 2035 to 35,304 Mt. Similar behavior is observed in EQUINOR projections due to the use of more efficient and low carbon fuels such as natural gas.

The IEA indicates that "Direct CO_2 emissions increase by about 20% until 2040 in the industry and transport sectors. The growth of the industry occurs despite an increase in the use of electricity and gas, at the expense of coal, which reduces the intensity of CO_2 in the sector. The increase in electric car sales and improvements in vehicle efficiency and logistics limit the growth of CO_2 emissions in road transport to less than 15%, butCO2 in other modes of transport increase in more than 40%. The building sector registers a slight decrease in direct emissions, supported by the change from fuel to electricity and gas and continuous efficiency improvements. " (IEA, 2018, p.46).

On the other hand, the IEEJ notes that "Global energy-related CO_2 emissions will reach the peak in the mid-2020s and will begin to gradually decrease, reaching 28.7 Gt in 2050, a decrease of 1.7 Gt, or 6% from 2010." (IEEJ, 2019, p12). And "By region, OECD CO_2 emissions are reduced by 49% in 2050 as of 2010, while non-OECD emissions will increase by 23% as of 2010. Non-OECD emissions will decrease after reaching the peak in the mid-2030s. " (IEEJ, 2019, p12).

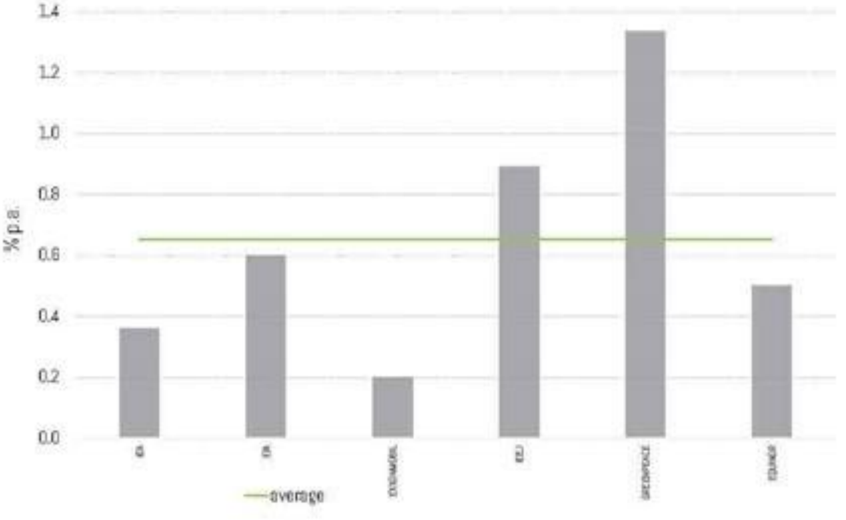
Figure 4.19 Global CO_2 emissions



Source: Prepared by OLADE based on data reported by international organizations.

The highest accumulated annual average variation rate is 1.34% of GREENPEACE and the lowest is 0.21% of ExxonMobil; the average rate per year for the 6 studies is 0.69% (**Figure 4.20**).

Figure 4.20 Variation rate of global CO_2 emissions (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

5. COMPARABLE RESULTS FOR LATIN AMERICA AND THE CARIBBEAN

5.1 Primary energy consumption

Of the 13 prospective studies, 7 register information for LAC. In relation to Primary Energy Consumption, it will be analyzed both by energy source and by sector, based on the definitions cited in 4.1 and 4.2 corresponding to the overall results.

5.1.1 By energy source

Seven prospective studies (IEA, ExxonMobil, IEEJ, WEC, ERIRAS, GREENPEACE and OLADE) present information on the primary energy consumption of LAC by energy source. The average variation rate between 2017 and 2040 is 1.93% for the 7 studies, from 742 Mtoe to 1,109 Mtoe.

Table 5.1 presents data on primary energy consumption for Latin America and the Caribbean for each prospective study.

Table 5.1 LAC primary energy consumption

Mtoe	2017	2020	2025	2030	2035	2040
IEA	668	693	730	784	848	916
ExxonMobil	571	594	650	716	770	826
IEEJ	855	915	1,026	1,066	1,174	1,228
WEC	736	769	835	893	968	1,036
ERIRAS	717	737	792	855	919	977
GREENPEACE	772	813	898	983	1,067	1,142
OLADE	872	932	1,051	1,202	1,393	1,635

Source: Data reported by each international organization.

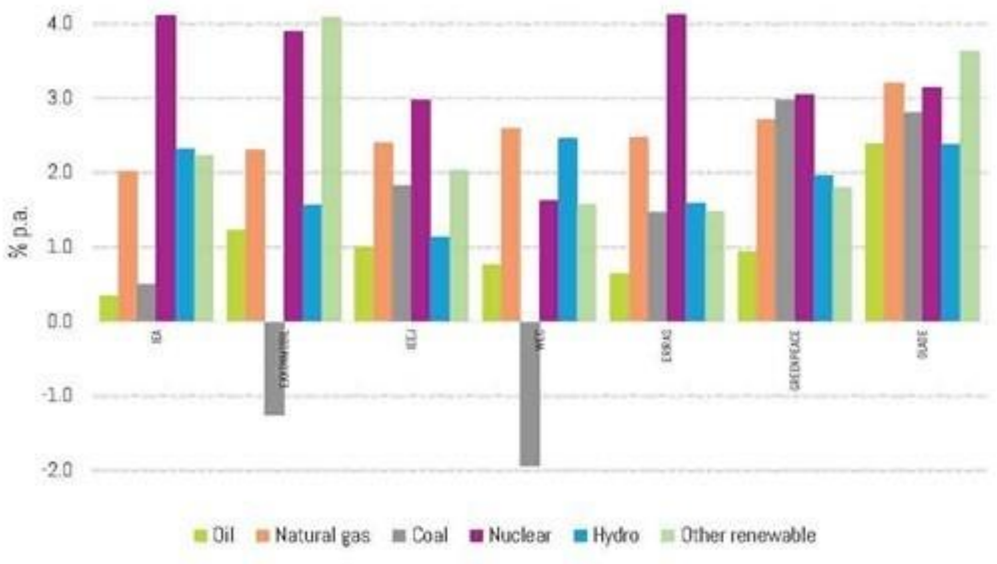
The following is a description of the situation of energy consumption by source:

Oil

More than 40% of the primary energy consumption is given by oil and derivatives in 2017 and will gradually decrease during the study period (**Figure 5.1**), however, they will continue to have the highest participation. ExxonMobil cites that "In general, the demand for liquids is expected to increase around 16 million barrels per day by 2040 with almost all growth in emerging markets in Asia, Africa, the Middle East and Latin America." (ExxonMobil, 2019, p.30).

The highest cumulative annual average variation rate is 2.39% of OLADE and the lowest is 0.35% of IEA and the average rate per year for the 7 studies is 1.05%.

Figure 5.1 LAC rate of variation of primary energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

Natural gas

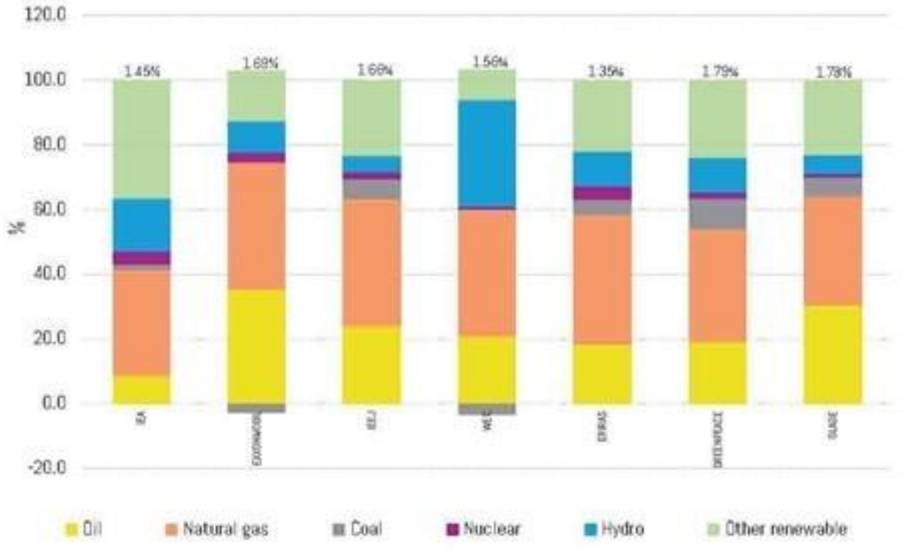
Natural gas will continue to be the source of energy with the greatest contribution to the growth of primary energy consumption in LAC with an average of 24% for the study period. Comparing **Figures 4.5** and **5.2** we can show that this trend is maintained both globally and regionally. Its variation rate is the highest among energy sources in six studies (except GREENPEACE in which electricity predominates).

The highest cumulative annual average variation rate is 3.20% of the WEC and the lowest, 2.02% IEA and the average rate per year of the 7 studies of 2.53%.

All prospective studies analyzed indicate that in LAC's primary energy consumption, the share of natural gas will continue to increase, the GECF "forecasts that the demand for natural gas in Latin America will increase at an average annual rate of 2.2% during the period of perspective, a general increase of 63%, from 178 bcm in 2017 to approximately 291 bcm in 2040. The main drivers of growth are developing economies, an increase in population and subsidized electricity prices that encourage consumption. Demand growth comes mainly from Chile (5.3%), Peru (3.9%), Brazil (3.1%) and Venezuela (2.0%) during the forecast period." (GECF, 2018, p.131).

While EQUINOR points out that "The demand for gas in Latin America is increasing, due to economic growth and the increase in demand in the electricity sector. The continent is rich in gas resources, although price regulations have failed to provide investment incentives, which has led to dependence on LNG imports. Brazil and Argentina are implementing energy policy frameworks to attract investments on the supply side." (EQUINOR, 2019, p.33).

Figure 5.2 LAC contribution to the growth of primary energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
The numbers above the bars correspond to an average annual growth rate of primary LAC energy consumption forecast in each prospective study.

Coal

All prospective studies analyzed indicate that in LAC's primary energy consumption, the share of coal will continue to decline. The IEEJ indicates that "Coal production will increase from 7.3 Gt in 2016 to 9.1 Gt in 2050, led by the increase in coal consumption mainly in Asia and by non-OECD countries, such as Latin America and Africa." (IEEJ, 2019, p.8). The highest cumulative annual average variation rate is 2.98% corresponding to GREENPEACE and the lowest is -1.94% WEC; the average rate for the 7 prospective studies is 0.91% per year.

The WEC forecasts that in 2040 the use of coal for primary energy is lower than in 2016. Other outlooks foresee an increase in coal, but the share of coal among fuels is small compared to other fossil and renewable fuels (**Figure 4.23**) because "the role of coal in LAC outside Colombia and Chile will also be limited" (WEC, 2017, p. 40).

Hydroenergy

All prospective studies analyzed indicate that in LAC's primary energy consumption, hydroenergy participation will continue to increase. To cite as a reference the GECF indicates that "Latin America has a great potential for renewable energy thanks to the geological diversity of the region. For example, well-developed hydroelectric power has made this renewable energy a key source of power generation in some parts of the continent, specifically in Brazil. " (GECF, 2018, p.157).

Hydroenergy in primary energy consumption occupies the fourth place in importance of participation and as shown in **Figure 4.24** it is shown that during the study period there will be a greater increase, however, its participation will decrease due to a greater penetration of natural gas especially in 2040.
The highest accumulated annual average variation rate is 2.47% corresponding to the WEC and the lowest is 1.13% of IEEJ and the average annual rate for the 7 studies is 1.92%.

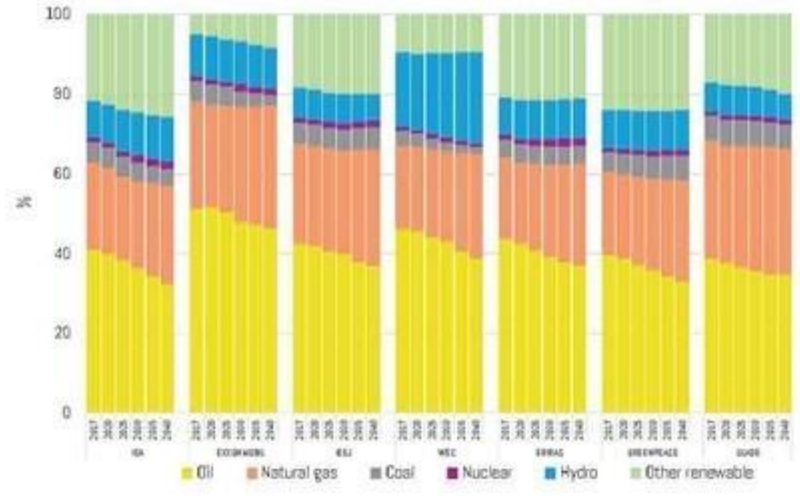
Nuclear

All prospective studies analyzed indicate that in LAC's primary energy consumption, nuclear participation will continue to grow gradually. According to the IEEJ, "From 2030, the countries of the Middle East, Africa, Latin America and others, which until now have little exposure to nuclear power generation, will grow as nuclear power generators." (IEEJ, 2019, p.74).

Nuclear energy has a very limited role in the LAC region in 2017 and this trend continues until 2040. The participation of nuclear energy in primary energy consumption is low for the entire study period (**Figure 5.3**).

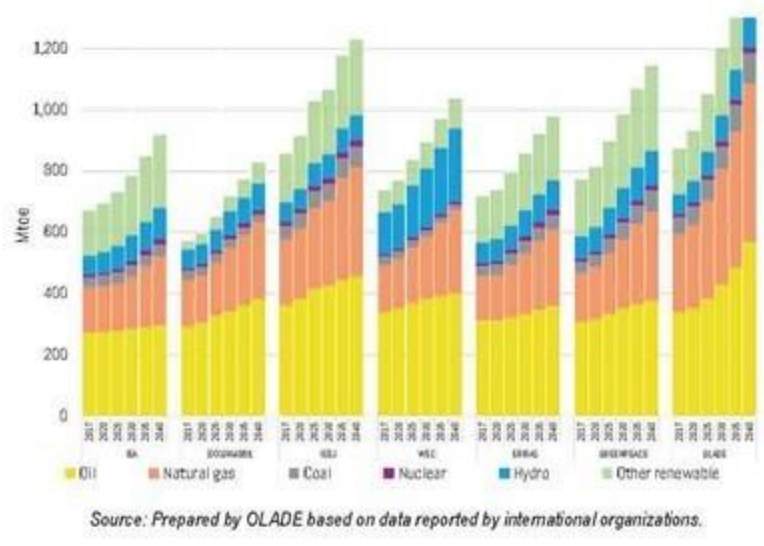
The highest accumulated annual average variation rate is 4.12% of ERIRAS and the lowest, of 1.62% of WEC; the average rate is 3.27% per year for the 7 studies.

Figure 5.3 Participation of primary energy consumption by energy source for LAC



Source: Prepared by OLADE based on data reported by international organizations.

Figure 5.4 LAC primary energy consumption by energy source



Source: Prepared by OLADE based on data reported by international organizations.

Renewables

All prospective studies analyzed indicate that in LAC's primary energy consumption, hydropower participation will continue to increase. The IEA indicates that "From 2017 to 2025, the use of biofuels worldwide increases at a rate of 5% each year, influenced by the extension to 2030 of the guidelines on renewable energies in the European Union and policies to promote biofuels in transport in Latin America, the United States and China." (IEA, 2019, p.268).

The highest accumulated annual average variation rate is 4.09% of EXXONMOBIL and the lowest, of 1.49% of ERIRAS; the average rate per year for the 7 studies is 2.41%.

Five of the six studies analyzed indicate that renewable energies will have the greatest contribution to the growth of LAC's primary consumption with an average annual rate for the 2017-2040 period of 22.06%, while OLADE forecasts that it will be natural gas.

5.2 Final energy consumption

Five studies analyzed (IEA, IEEJ, WEC, GREENPEACE and OLADE) provide information on the consumption of final LAC energy by fuel or sector. The average variation rate between 2017 and 2040 is 2.04%, from 573 Mtoe in 2017 to 873 Mtoe in 2040.

Table 5.2 shows data on final energy consumption for each of the analyzed outlooks.

Table 5.2 Final energy consumption LAC

Mtoe	2017	2020	2025	2030	2035	2040
IEA	495	548	558	599	649	693
IEEJ	620	654	715	768	825	875
WEC	556	582	639	690	745	794
GREENPEACE	559	590	658	726	771	847
OLADE	636	677	758	861	989	1,154

Source: Data reported by each international organization.

Next, a description is made of the situation of final energy consumption by type of fuel.

5.2.1 By type of fuel

Oil and derivatives

Petroleum and its derivatives maintain their leading role in final energy consumption during the investigation period, although their participation percentage decreases continuously, as the participation of other sources such as natural gas and electricity increases. However, the IEEJ and OLADE predict that they will have the greatest contribution in the growth of final consumption with 37.3% and 42.3% respectively.

The highest cumulative annual average variation rate is 2.47% of OLADE and the lowest is 0.67% of IEA; the average rate for the 5 prospective studies is 1.26% per year.

Natural gas

Natural gas is the third most used fuel in the final energy demand and has a share of more than 12% in 2017, reaching 2040 values close to 19% as in the case of WEC who has the highest participation of all prospective studies analyzed for this five year period. The highest accumulated annual average variation rate is 3.31% corresponding to the WEC and the lowest is 1.83% of IEEJ; the average rate per year for the 5 studies of 2.49%.

The GECF indicates that "The demand for natural gas in Brazil has increased significantly at an average annual growth rate of 7.4%, from 11 bcm in 2000 to 38 bcm in 2017. During the study period, the GECF forecasts that gas consumption will reach 76 bcm by 2040 with a constant growth rate of 3.1% per year. This volume will allow Brazil to consolidate its position as the largest consumer of gas in Latin America. " (GECF, 2019, p132).

Coal

In the world, coal is one of the most consumed energy sources at the sector level and for electricity generation, especially in non-OECD countries, while in LAC it is one of the energy sources with the lowest participation in total final consumption and that is increasing slightly in the study period for most of the outlooks with the exception of WEC that from 2030 presents a reduction.

The highest accumulated annual average variation rate is 3.27% of OLADE and the lowest, of -0.59% of WEC; the average rate per year for the 5 studies is 1.86%.

Electricity

Electricity is the second most consumed energy in the region, with an average participation in 2017 of 18.3% compared to total fuels consumed for electricity generation, reaching 2040 values of 21.8%.
In the region, the electricity matrix is dominated by hydropower which has a participation in 2017 of more than 45% followed by the generation with energy products derived from petroleum (mainly diesel and fuel oil), nuclear 2% and the rest with sources renewable (thermal renewable (biogas); geothermal, wind and solar). (OLADE, Energy Panorama 2018, p.44).

The highest accumulated annual average variation rate is 3.63% of OLADE and the lowest, of -2.36% of WEC; the average rate per year for the 5 studies is 2.77%.

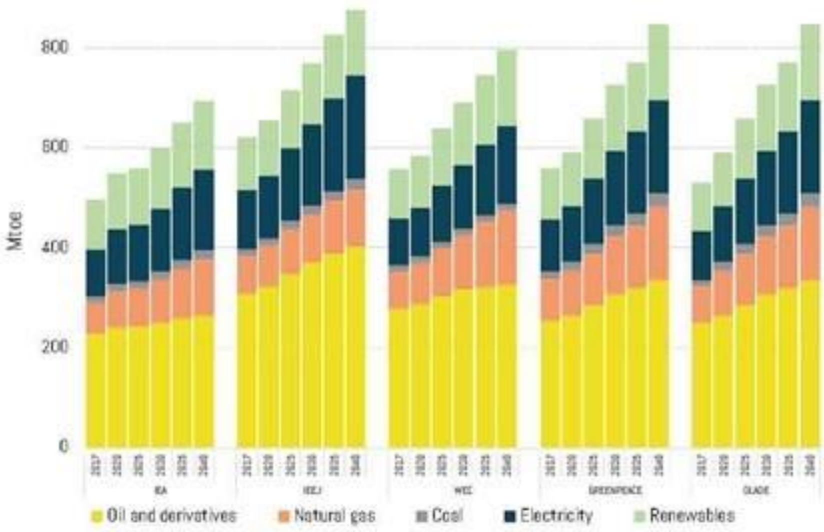
Renewables

Renewables have a significant contribution to primary energy consumption with an average participation of 18% in 2017 for the 5 prospective studies analyzed and which will be reduced in 2040 to 17.83%; this trend is indicated in 4 studies with the exception of OLADE, which indicates that there will be an increase of 3.8%.

Wind and solar energy will have a rapid increase, for example, the GECF indicates that "According to the Energy Development Plan, issued in 2017, a rapid development of renewable energy (wind and solar) in Brazil is expected." (GECF, 2019, p.133).

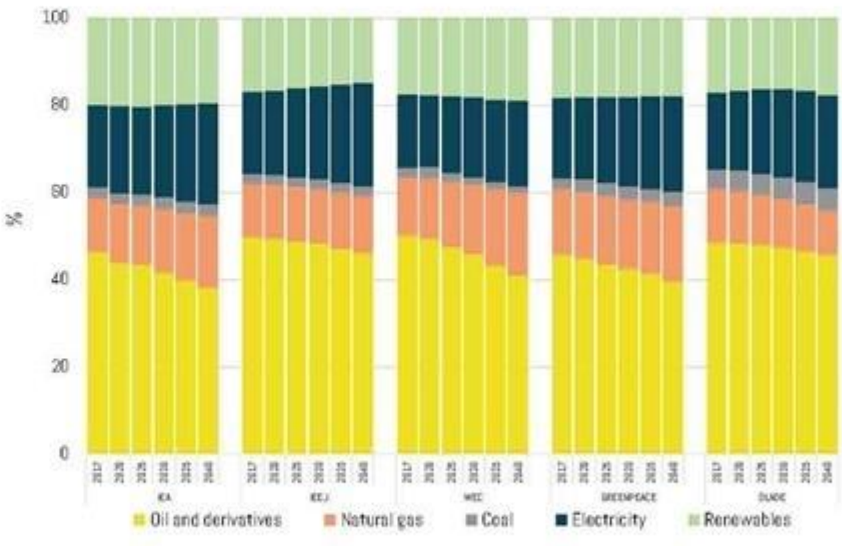
The highest accumulated annual average variation rate is 2.92% of OLADE and the lowest, of -0.97% of WEC; the average rate per year for the 5 studies is 1.84%.

Figure 5.5 LAC final energy consumption by fuel



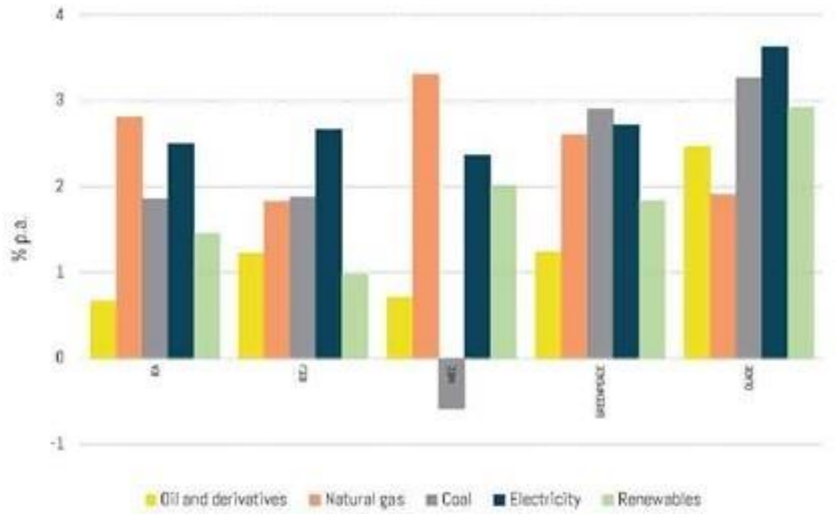
Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA); heat, hydrogen and other (IEEJ); heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

Figure 5.6 LAC share of final energy consumption by type of fuel



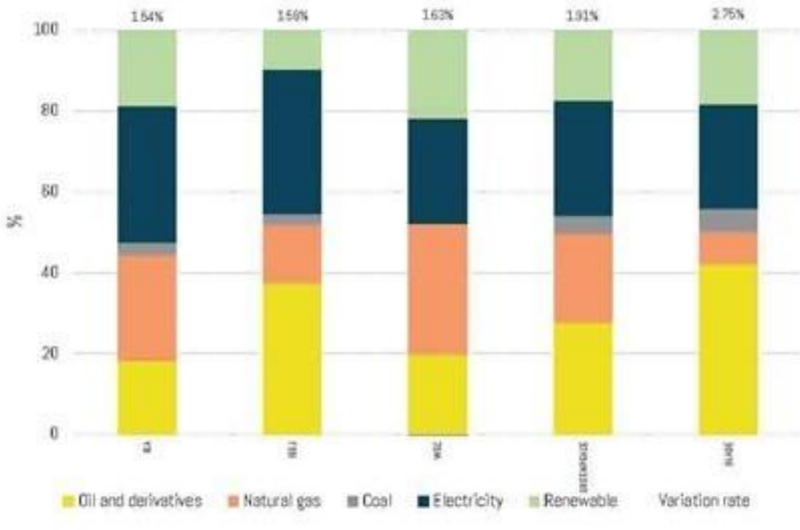
Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA); heat, hydrogen and other (IEEJ); heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

Figure 5.7 Variation rate of global final energy consumption by type of fuel
(2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and other (IEA); heat, hydrogen and other (IEEJ); heat, biomass, biofuel and other (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

Figure 5.8 Contribution to the growth of final energy consumption by type of LAC fuel
(2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Renewables include: bioenergy, heat and others (IEA); heat, hydrogen and others (IEEJ); heat, biomass, biofuels and others (WEC); solar, biomass, geothermal, hydrogen and others (GREENPEACE).
The numbers above the bars correspond to the average annual variation rate of the final LAC energy consumption forecast in each Outlook.

5.2.2 By sector

The transport sector has the largest share in final consumption followed by the industry. According to the projections of the 5 organizations that present information for LAC, during the 2017 - 2040 period the consumption in the industry will increase while in transport it will decrease, a similar trend is presented worldwide, due to the use of cleaner technologies and efficient. According to GECF, "In Latin America, in 2040, the power generation sector will use 41% (approximately 119 bcm) of gas, followed by the industrial sector (25% or 72 bcm), the domestic sector (28 bcm or 9 %), the transport sector (17 bcm or 6%), raw material sector (5% or 16 bcm) and refinery sector (4% or 12 bcm). " (GECF, 2018, p.400).

The following is a description of the situation of energy consumption by source:

Transportation

During the 2017 -2040 period, the transport sector will maintain the highest participation with respect to final consumption, although its consumption will decrease. The highest cumulative annual average variation rate recorded is 3.29% corresponding to OLADE and the lowest, 1.29% WEC; the average rate per year for the 5 studies is 1.80%.

The use of gasoline and diesel will decrease due to the diversification of the vehicle fleet through the use of Compressed Natural Gas Vehicles, biofuels and electricity. The IEEJ indicates that "In Brazil, the consumption of biofuels will expand strongly thanks to the diffusion of flexible fuel vehicles that can use both ethanol and gasoline." (IEEJ, 2019, p.76).

On the other hand, according to the GECF, "Argentina is also one of the largest markets in the world for gas vehicles. Thanks to a policy to support the use of gas in this sector through lower tax rates compared to gasoline, and the availability of CNG service stations, consumption in the transport sector is expected to increase by 4 bcm in 2017 at approximately 5.5 bcm in 2040." (GECF, 2018, p.132).

Industry

The industry in LAC, is the second economic sector with the highest participation in final energy consumption, going on average for the 5 studies analyzed from 182 Mtoe in 2017 to 280 Mtoe 2040, with an interannual increase of over 53% and will be the sector with the greatest contribution to the growth of final consumption with the exception of OLADE projections, which point to the transport sector.

The highest cumulative annual average variation rate is 2.32% of the OLADE and the lowest is 1.71% of IEA and the average rate per year for the 5 prospective studies is 1.94%.

The industry will be diversified mainly with natural gas. For example, the GECF indicates that "In Argentina, the increase in the demand for gas will be driven by the domestic (particularly residential and commercial) and industrial sectors. The industrial sector, which consumes the third largest volume of gas with more than 12 bcm in 2017, will represent 16 bcm (22%) of total gas demand in 2040. The key users are the iron and steel, chemical and mineral sectors. " (GECF, 2018, p.132).

Others

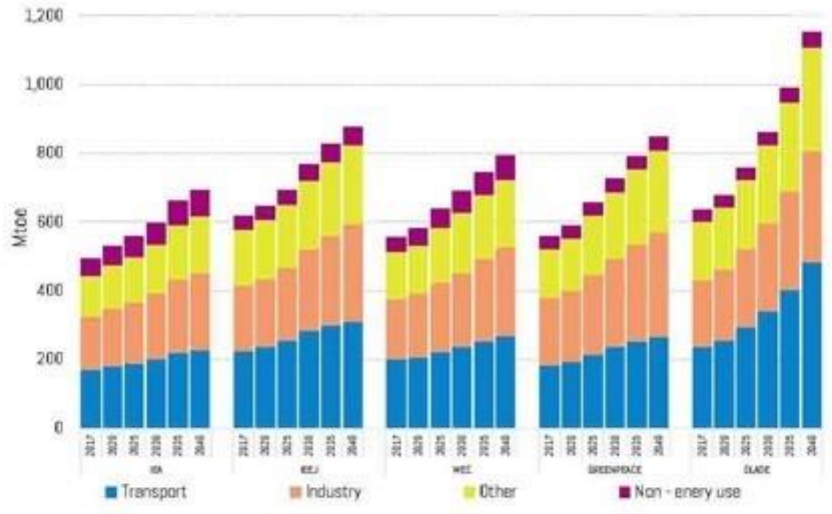
This sector is the third one with the highest participation in final energy consumption on average for the 5 studies analyzed, from 147 Mtoe in 2017 to 226 Mtoe 2040 with an increase of 54%. OLADE notes that this sector has the highest variation rate among the final energy consumption sectors.

The highest cumulative annual average variation rate is 2.65% (OLADE) and the lowest, 1.50% (IEA); the average rate for the 5 prospective studies of 1.94% per year.

Non-Energy Use

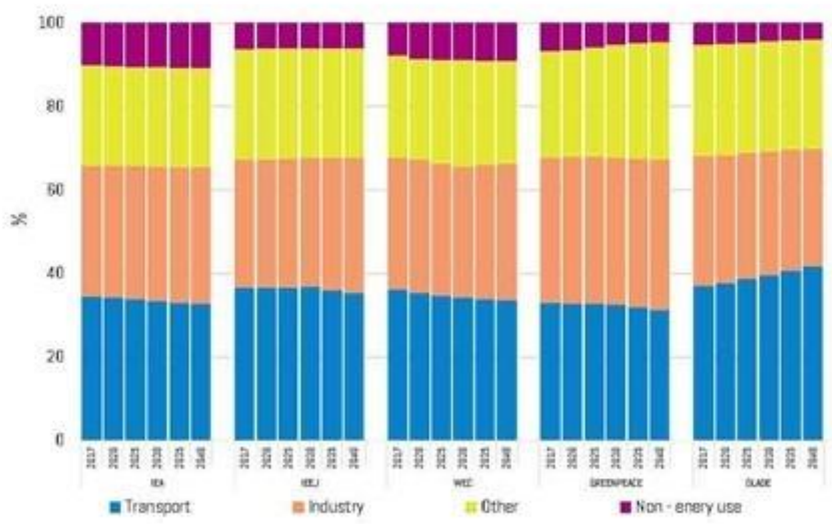
Non-energy use has the lowest contribution in final consumption, going from an average of 40 Mtoe in 2017 to 56 Mtoe in 2040. The highest accumulated annual average variation rate is 2.36% of the WEC and the lowest is 0.05% of GREENPEACE; the average rate is 1.43%.

Figure 5.9 LAC final energy consumption by sector



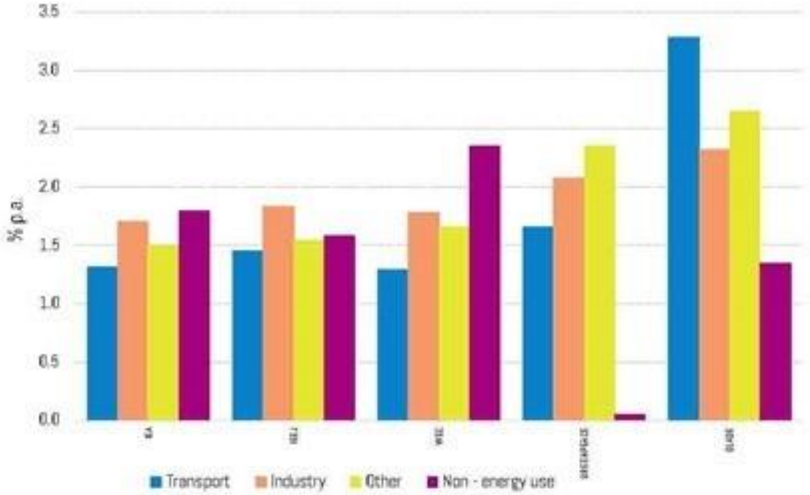
Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 5.10 LAC final energy consumption by sector



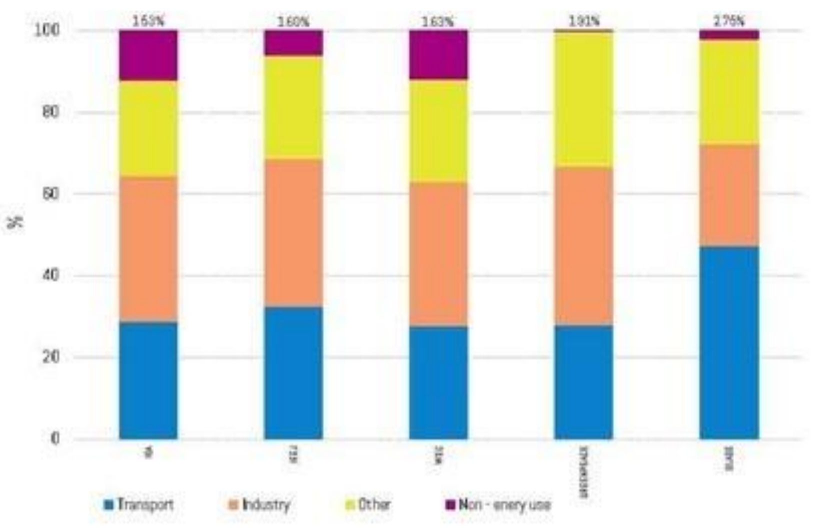
Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 5.11 LAC Variation rate of final energy consumption by sector (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 5.12 Contribution to the growth of global final energy consumption (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
Others include: Buildings (residential, commercial) for IEA, IEEJ, WEC; Agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE
The numbers above the bars correspond to the average annual variation rate of the final LAC energy consumption forecast in each Outlook.

5.3 Electricity generation

The 5 prospective studies (IEA, IEEJ, WEC, ERIRAS, GREENPEACE and OLADE) offer information on the electricity generation of LAC. The average variation rate between 2017 and 2040 is 2.6%, from 1,465 TWh to 2,607 TWh. Table 5.3 shows the power generation for LAC.

Table 5.3 LAC electricity generation

TWh	2017	2020	2025	2030	2035	2040
IEA	1,358	1,452	1,606	1,804	2,052	2,283
IEEJ	1,658	1,792	2,045	2,300	2,602	2,895
WEC	1,354	1,425	1,633	1,870	2,060	2,245
ERIRAS	1,350	1,411	1,577	1,747	1,914	2,072
GREENPEACE	1,453	1,567	1,818	2,067	2,332	2,574
OLADE	1,614	1,808	2,133	2,524	2,996	3,571

Source: Data reported by each international organization.

5.3.1 By type of fuel

Next, an analysis is presented for electricity generation by energy source:

Hydroenergy

Five prospective studies (IEEJ, WEC, ERIRAS, GREENPACE and OLADE) present information on hydroenergy; while the IEA has included in Other renewable.

Hydroenergy during the analysis period continues to have the highest participation among the energy sources used to produce electricity. However, it is decreasing due to a greater generation with natural gas and renewable sources. The IEEJ indicates that as of 2035 the generation with natural gas exceeds that of all other fuels used, contrary to what the other studies indicate.

The highest accumulated annual average variation rate is 2.49% of the OLADE and the lowest, of 1.19% is the IEEJ; the average rate per year for the 6 prospective studies is 1.71%.

Natural gas

Natural gas shows the second largest participation among six fuels for electricity generation in LAC. The IEEJ expects that it will contribute more to the growth of electricity generation. Five other outlooks also predict a significant contribution, with an average of 20.34% in 2017 and in 2040 it will reach values higher than 26%.

Of the studies analyzed, OLADE projections are the highest indicating that in 2017, natural gas has a 26.5% share in 2017 and by 2040 it will be 34.3%. The highest cumulative annual average variation rate is 4.90% corresponding to the OLADE study and the lowest is 2.58% of IEA; the average rate per year for the 6 prospective studies is 3.82%.

For example, the GECF forecasts that "Gas demand in Brazil will overwhelmingly lead the electricity sector, since electricity consumption is expected to be more than double (from 637 TWh in 2017 to approximately 1,271 TWh in 2040)." (GECF, 2019, p.132).

Renewables

The participation of renewables to generate electricity in 2040 will almost double. Beyond 2030, it is expected that wind, solar and other renewable energy will be the dominant factor in the growth of energy generation together with natural gas, promoted mainly by countries of the Southern Cone.

The highest cumulative annual average variation rate is 6.81% of OLADE and the lowest is 2.39% of GREENPEACE; the average rate per year for the 6 prospective studies is 4.92%.

Oil and derivatives

The consumption of petroleum derivatives for electricity generation is reduced to approximately one third until 2040.

The highest accumulated annual average variation rate is 0.66% of OLADE and the lowest of -3.44% of the IEA; the average rate per year for the 6 prospective studies of -1.90%.

Coal

The use of natural gas in the electricity generation matrix is reduced compared to other fuels used. According to the projections presented, their participation will decrease to 2040 with the exception of those of the IEEJ that indicate an increase, from 109 GWh in 2017 to 191 TWh in 2040.

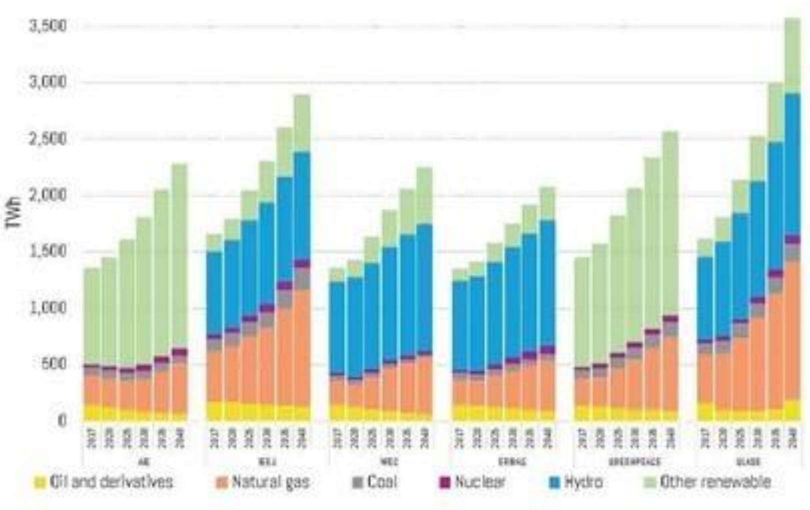
The highest accumulated annual average variation rate is 3.42% of GREENPEACE and the lowest, of -3.01% of WEC; the average rate per year for the 6 studies is 0.75%.

Nuclear

Nuclear electricity generation is less than 3% of the total. The projections indicate that during the period of analysis there will be further development with this technology, however, it will continue to be reduced in relation to other energy sources.

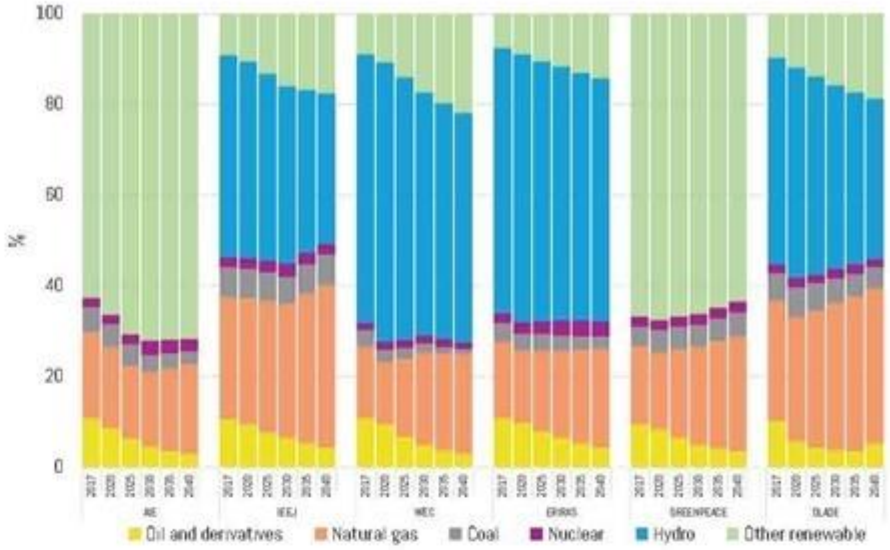
The highest cumulative annual average variation rate is 4.33% of IEA and the lowest, of 1.59% of WEC; The average annual rate for the 6 prospective studies is 3.18%.

Figure 5.13 LAC electricity generation by energy source



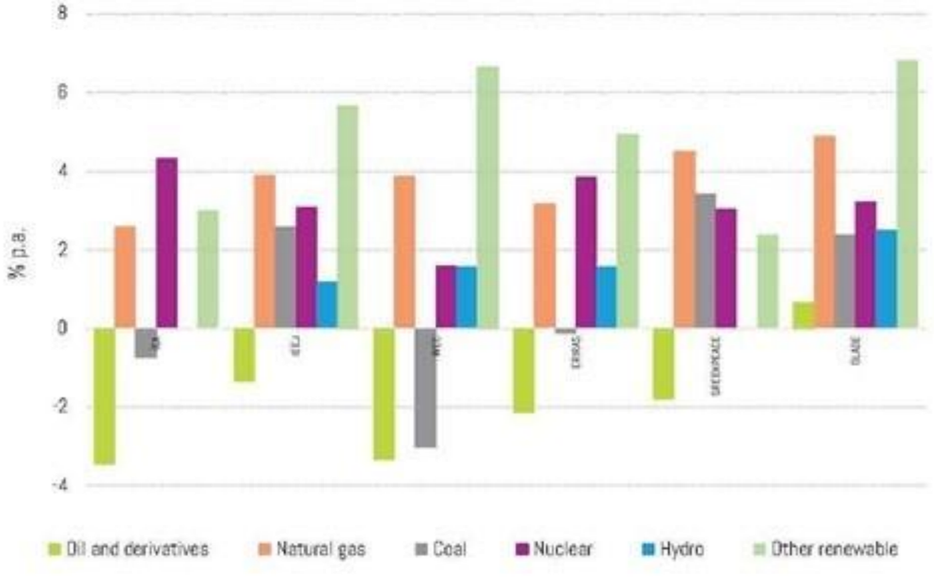
Source: Prepared by OLADE based on data reported by international organizations.

Figure 5.14 LAC share of electricity generation by energy source



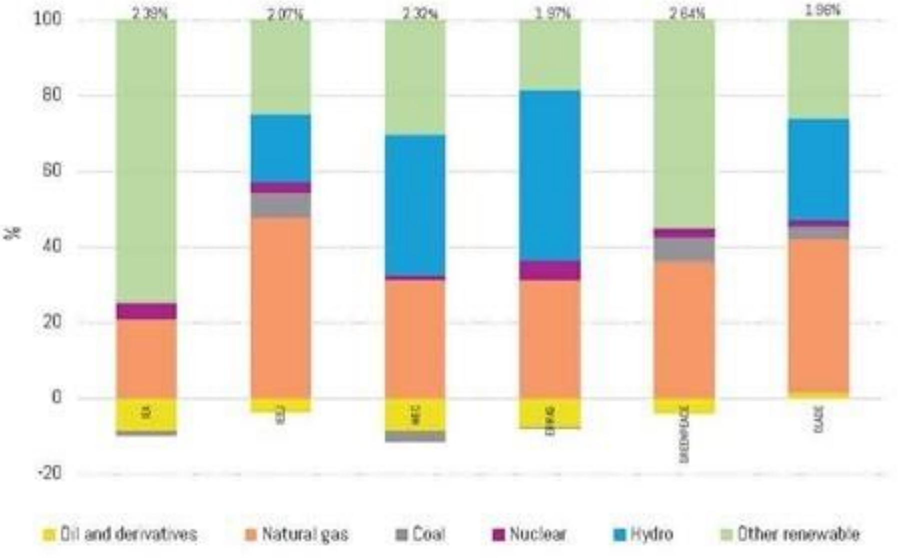
Source: Prepared by OLADE based on data reported by international organizations.

Figure 5.15 LAC rate of variation of electricity generation by energy source (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.

Figure 5.16 LAC contribution to the growth of electricity generation by energy source (2017 - 2040)



Source: Prepared by OLADE based on data reported by international organizations.
The numbers above the bars correspond to the annual average growth rate of LAC power generation forecast in each Outlook.

6. FINAL CONSIDERATIONS

Despite the high expectations that renewable energies have worldwide, fossil fuels will continue to be the main source of supply to meet the growth of energy demand in the future. On a global level, the consumption of mineral coal will be reduced by the replacement with natural gas, especially in electricity generation, industrial sectors and transport.

As a result of the countries' policies and programs for the development of their energy sector, Latin America and the Caribbean has a diversified and clean energy matrix (it has high rates of participation from renewable sources compared to other regions of the world) and in the future has a high penetration of natural gas, so it is necessary to create an integrated market.

The projections presented in this document constitute an approximation which allows us to have an integral vision of the different results made by the different international organizations and which have been processed according to the available information in order to make it comparable. However, as observed, there are significant differences in some variables due to the hypotheses used to make the projections and construct the different analysis scenarios.

Energy prospective for Latin America and the Caribbean

Energy Prospective of Latin America and the Caribbean (2017-2040)

1. *INTRODUCTION*

Since the beginning of this decade, the natural gas market in the Latin American and Caribbean region has accelerated, thanks, mainly to the electricity generation sector, driven by a competitive price, compared to petroleum products, one each increasing technological versatility for its transport and use, a potential growing offer, coming from both conventional and unconventional deposits and much cleaner combustion conditions, in terms of CO_2 emissions, compared to that of liquid and solid fuels of fossil origin. This is how its penetration into the energy matrix of some countries has been considered as another strategy for sustainable energy development.

The energy forecasting exercise, presented below, is oriented to the analysis of a greater penetration of natural gas in the energy matrix of LAC countries, with respect to current trends, partially replacing liquid fuels derived from petroleum and fossil solids such as coal and coke, both in the main sectors of final consumption, and in the electricity generation sector.

The analysis is based on the comparison of two energy scenarios for the 2017-2040 projection period: a "Current Policy Scenario (CPS)", which reflects the current plans and policies for expansion of the energy sector of OLADE Member Countries; which constitutes the baseline or reference line of the study; and a "High Gasification Scenario (HGS); which simulates a greater penetration of natural gas in the energy matrix of countries, displacing petroleum-derived fuels, such as LPG, gasoline, diesel oil and fuel oil; and solid fuels such as coal and coke. This substitution is made specifically in the consumer sectors: Transportation, Industrial and Residential; and in the electricity generation sector where natural gas plants, mainly combined cycle, replace gas turbines, steam turbines and internal combustion engines, whose main fuel is diesel oil, fuel oil, coal or coke.

For the purpose of the study, the LAC region has been divided into 4 subregions and 2 countries analyzed individually:

- Brazil
- Mexico
- Central America (Belize, Costa Rica, the Salvador, Guatemala, Honduras, Nicaragua, and Panama)
- Andean Zone (Bolivia, Colombia, Ecuador, Peru and Venezuela)
- Southern Cone (Argentina, Chile, Paraguay and Uruguay)
- The Caribbean (Barbados, Cuba, Grenada, Guyana, Haiti, Jamaica, Dominican Republic, Suriname and Trinidad and Tobago)

Prospective scenarios were built using the Energy Matrix Simulation and Analysis Model - SAME, developed by OLADE.

2. *GENERAL PREMISES OF THE SCENARIOS ANALYZED*

2.1 Current Policy Scenario CPS

The general premises used for the construction of the current policy scenario (CPS), which constitutes the baseline of the prospective analysis, are the following:

- The final consumption of the different energy sources, in the different socio-economic sectors, was projected using average annual growth rates, either extracted from the expansion plans of the energy sector available in some countries, or failing that, through linear logarithmic regressions of historical series of the last 10 years (2007-2017), obtained from the Energy Information System of Latin America and the Caribbean of OLADE (SieLAC).

- For cases in which the expansion plans contemplate more than one scenario of consumption projection, the one defined as the medium, recommended or reference scenario was selected.
- The electricity supply is projected based on the installation / removal schedules of installed capacity, considered in the countries' expansion plans. For the years of the study horizon that exceed the projection periods of these plans, the schedules were extended, keeping the installation trends identified.
- The order of dispatch of electricity supply technologies in each subregion responds mainly to an economic criterion, although also due to environmental and technological considerations, renewable energies are prioritized in said dispatch.
- The total supply of each energy source is determined based on the demand of said source, establishing the balance in the energy balance in each projection year.

2.2 High Demand Gasification Scenario (HGS)

The HGS scenario constitutes a branch of the CPS scenario, starting in 2020, in which a more accelerated penetration of natural gas is simulated, both in the main socio-economic sectors and in the electricity generation matrix. The premises considered for this scenario are the following:

- The final consumption sectors, selected to simulate the greatest penetration of natural gas are transport, industrial and residential.
- The penetration of natural gas in each selected consumer sector, aims to partially replace liquid fuels, petroleum products and solids with high CO_2 emission factors such as mineral coal and coke.
- The penetration of natural gas, starts in the year 2020 and evolves progressively until the year 2040, until reaching predetermined goals of substitution of liquid and solid fuels already mentioned, with respect to the projected consumptions in the CPS scenario.
- The replacement of fuels is done, keeping the same supply of useful energy in each sector of consumption, during the entire projection period.
- The goals and substituted fuels depend on the importance of these fuels in the sector consumption matrix of each country or subregion and the ease of replacement by natural gas. These goals can be observed in the **Table 2.1.**

Table 2.1. Replacement goals of liquid and solid fuels with natural gas by 2040, CPS

Country or subregion	Consumption sector	Diesel Oil	Gasoline	Fuel Oil	LPG	Coke	Coal
Brazil	Transport	20%	10%				
	Industrial			20%		20%	
	Residential				20%		
Mexico	Transport	20%	10%				
	Industrial	20%				20%	20%
	Residential				20%		
Central America	Transport	20%	10%				
	Industrial	20%			20%		
	Residential				20%		
Andean Zone	Transport	20%	10%				
	Industrial	20%		20%			20%
	Residential				20%		
Southern Cone	Transport	20%	10%				
	Industrial	20%					
	Residential				20%		
The Caribbean	Transport	20%	10%				
	Industrial	20%				20%	
	Residential				20%		

Source: Own elaboration

3. COMPARATIVE RESULTS OF THE CPS AND HGS SCENARIOS OF THE ENERGY FORECASTING EXERCISE (2017-2040)

3.1 Brazil

3.1.1 Projection of final energy consumption

In the projection of final energy consumption in Brazil, based on the Ten-Year Energy Plan (2017-2027), the sources with the highest growth are biomass and electricity. Natural gas occupies a third place in annual growth rate, which doubles that of petroleum-derived fuels and is higher than that of mineral coal and coke (**Table 3.1**).

According to the premises substitution premises, simulated in the high gasification scenario (HGS), natural gas would grow at an average annual rate of (5.6%), allowing total annual energy consumption savings of about 4,000 ktoe, in the year 2040, thanks to the greater efficiency of this source, with respect to the fuels it replaces (**Table 3.2**).

Table 3.1. Projection of final energy consumption in Brazil, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	102,915	107,980	117,199	127,493	138,991	151,845	1.7%
Natural gas	11,903	13,122	15,469	18,282	21,664	25,741	3.4%
Coal and coke	11,377	12,471	14,554	17,011	19,912	23,340	3.2%
Biomass	62,989	67,920	78,447	93,246	114,908	147,886	3.8%
Electricity	42,756	47,459	56,522	67,393	80,457	96,195	3.6%
TOTAL	231,940	248,952	282,191	323,424	375,932	445,008	2.9%

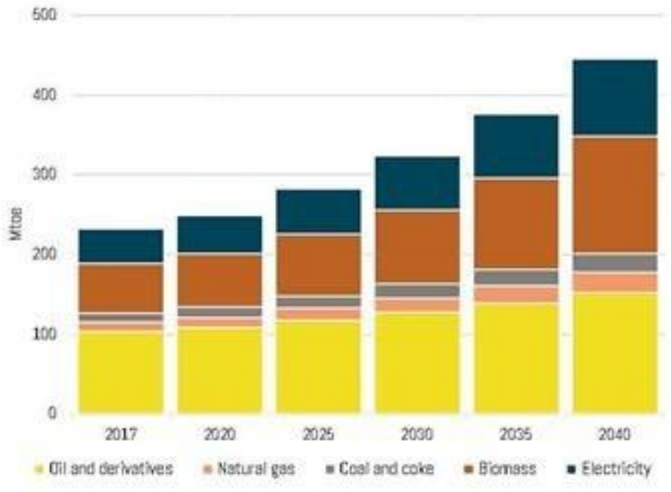
Source: Projection based on the 2017-2027 Ten-Year Energy Expansion Plan (PDE 2027)

Table 3.2. Projection of final energy consumption in Brazil, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	102,915	107,980	114,967	121,921	128,647	135,058	1.2%
Natural gas	11,903	13,122	17,094	22,650	30,554	41,947	5.6%
Coal and coke	11,377	12,471	14,009	15,735	17,672	19,843	2.4%
Biomass	62,989	67,920	79,000	94,279	116,010	147,886	3.8%
Electricity	42,756	47,459	56,689	67,678	80,731	96,195	3.6%
TOTAL	231,940	248,952	281,759	322,263	373,613	440,929	2.8%

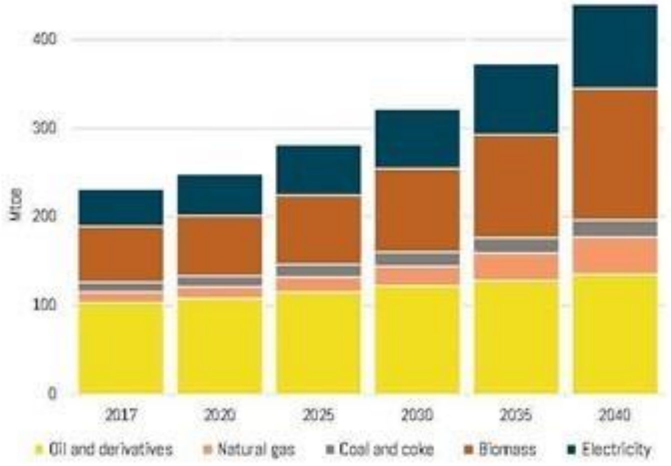
Source: Own elaboration

Figure 3.1. Projection of final energy consumption in Brazil, CPS



Source: Projection based on the 2017-20127 Ten-Year Energy Expansion Plan (PDE 2027)

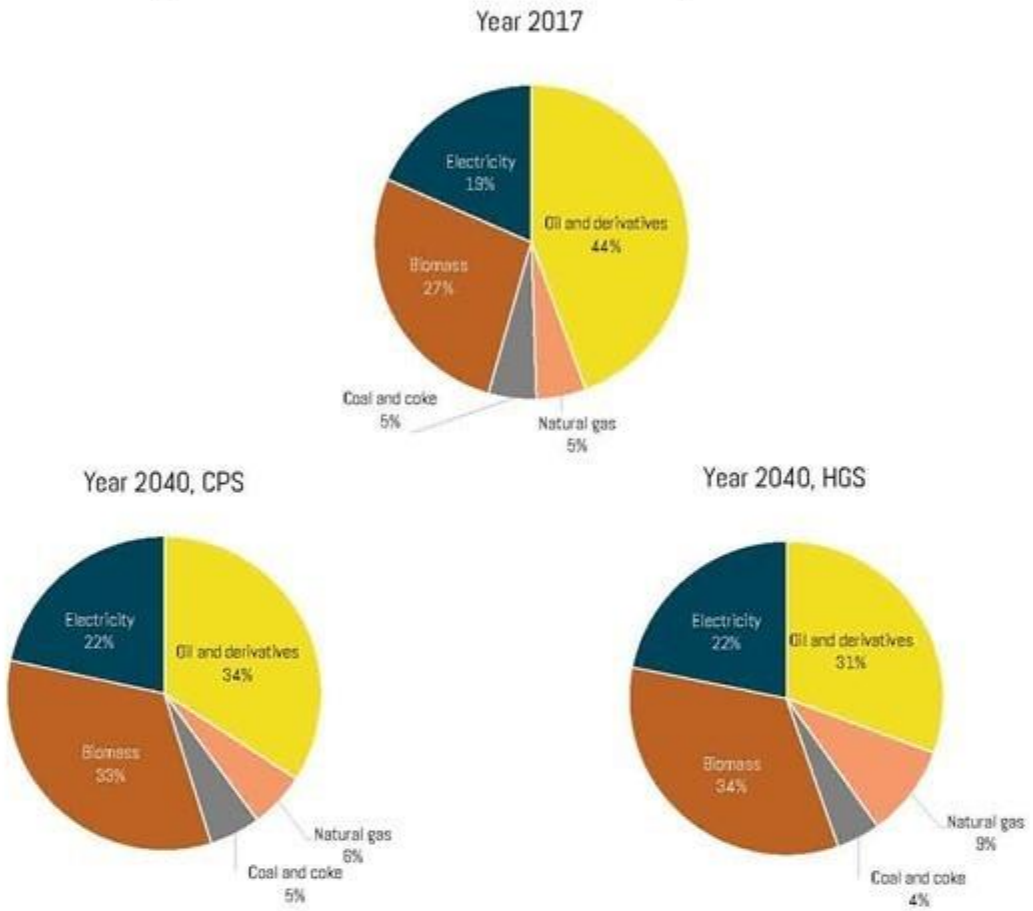
Figure 3.2. Projection of final energy consumption in Brazil, HGS



Source: Simulation results

At the end of the study horizon (2040), oil derivatives, which in the base year represented almost 50% of the consumption matrix, lose ground against biomass, electricity and natural gas, although the latter, in The CPS scenario only increases its participation percentage point, going from 5% in 2017 to 6% in 2040, while under the premises of the CPS scenario, its participation reaches 9% in the same year as appreciate in **Figure 3.3.**

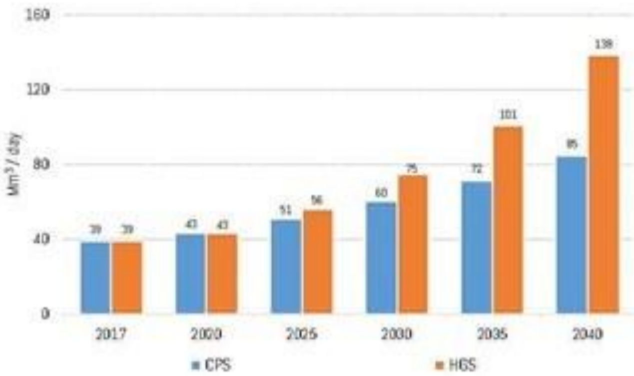
Figure 3.3. Evolution of the final energy consumption matrix in Brazil



Source: Simulation results

In physical units, natural gas consumption for the CPS scenario would exceed 53 Mm^3 per day, to that projected for the CPS scenario (**Figure 3.4.**).

Figure 3.4. Projection of final consumption of natural gas, Brazil

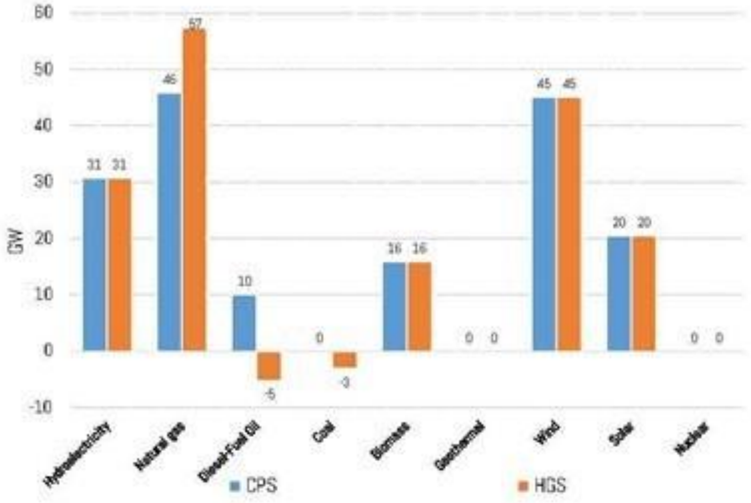


Source: Simulation results

3.1.2 Projection of electricity generation

Under the premises of the CPS scenario, the expansion of the power generation park in Brazil, during the projection period, is mostly from natural gas, wind and hydroelectricity power plants, as can be seen in **Figure 3.5**, however, still in this scenario, a small expansion of the conventional thermal (Diesel - Fuel Oil) is foreseen, while with the HGS scenario, withdrawals of this type of power plants and of the hydroelectric plants are registered, to give way to the installation of around 11 additional GW of natural gas plants, with combined cycle.

Figure 3.5. Expansion of electricity generation capacity, during the projection period, Brazil



Source: Projection based on the "Ten-Year Energy Plan of Brazil 2017-2027"

Due to the greater inherent plant factor of natural gas plants with combined cycle, with respect to the Diesel-Fuel Oil thermal plants, although the electricity demand of the two simulated scenarios is the same, the total capacity required in the HGS scenario is lower in around 7,000 MW, to that of the CPS scenario, as can be seen in the **Tables 3.3** and **3.4.**

Table 3.3. Projection of installed capacity in Brazil, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	100,768	108,407	110,492	116,569	124,069	131,569
Natural gas	12,510	12,510	20,476	33,356	45,856	58,356
Diesel-Fuel Oil	5,209	7,785	13,062	14,214	14,214	15,214
Coal	3,075	3,075	3,075	3,075	3,075	3,075
Biomass	13,517	13,653	15,404	19,464	24,464	29,464
Wind	12,674	15,069	21,350	32,850	45,350	57,850
Solar	1,180	2,258	6,639	11,639	16,639	21,639
Nuclear	1,990	1,990	1,990	1,990	1,990	1,990
TOTAL	150,923	164,747	192,488	233,157	275,657	319,157

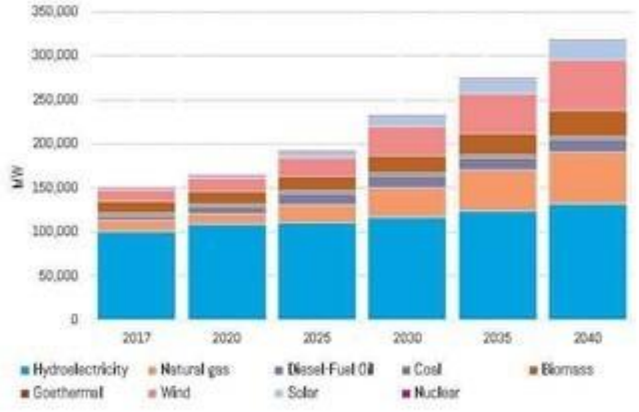
Source: Projection based on the "Ten-Year Energy Plan of Brazil 2017-2027"

Table 3.4. Projection of installed capacity in Brazil, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	100,768	108,407	110,492	116,569	124,069	131,569
Natural gas	12,510	15,010	25,476	39,856	54,856	69,856
Diesel-Fuel Oil	5,209	5,983	5,983	0	0	0
Coal	3,075	2,575	75	0	0	0
Biomass	13,517	13,653	15,404	19,464	24,464	29,464
Wind	12,674	15,069	21,350	32,850	45,350	57,850
Solar	1,180	2,258	6,639	11,639	16,639	21,639
Nuclear	1,990	1,990	1,990	1,990	1,990	1,990
TOTAL	150,923	164,945	187,409	222,368	267,368	312,368

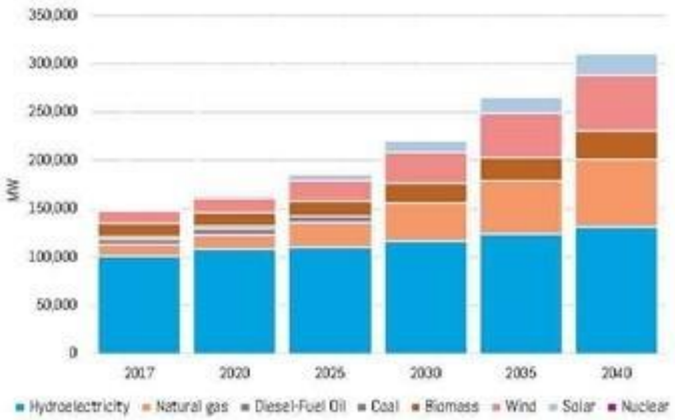
Source: Simulation results

Figure 3.6. Projection of installed capacity in Brazil, CPS



Source: Projection based on the "Ten-Year Energy Plan of Brazil 2017-2027"

Figure 3.7. Projection of installed capacity in Brazil, HGS



Source: Simulation results

The projection of the electricity generation matrix, shows that while in the base year, hydroelectricity, participates with a preponderant fraction of more than 60% of said matrix, this fraction is reduced throughout the projection period, giving ground to the natural gas and wind power plants, in both scenarios analyzed. However, while in the CPS scenario, small generation fractions with Diesel-Fuel Oil and Coal prevail, in the HGS scenario, these types of plants are completely displaced by natural gas plants, since 2030, as it can be seen in the **Tables 3.5** and **3.6.**

Table 3.5. Projection of electricity generation in Brazil, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	370,038	427,340	464,597	490,149	521,685	553,221
Natural gas	71,189	82,191	134,527	219,149	301,274	383,399
Diesel-Fuel Oil	18,995	8,249	14,564	833	8,576	55,346
Coal	17,547	17,547	17,547	17,547	17,547	17,547
Biomass	51,241	51,757	58,395	73,786	92,740	111,695
Wind	42,348	52,802	74,810	115,106	158,906	202,706
Solar	831	2,967	8,724	15,294	21,864	28,434
Nuclear	15,730	15,730	15,730	15,730	15,730	15,730
TOTAL	624,213	656,582	788,893	947,593	1,138,322	1,368,077

Source: Simulation results

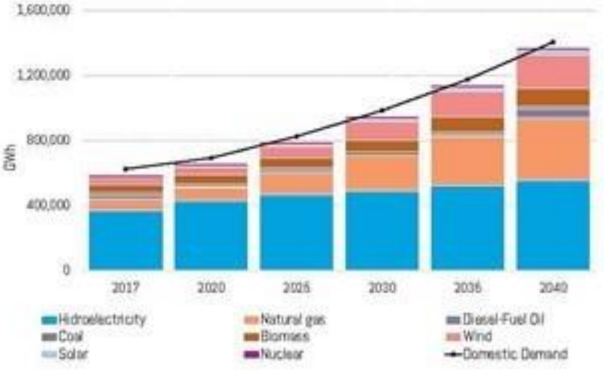
Table 3.6. Projection of electricity generation in Brazil, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	370,038	427,340	464,597	490,149	521,685	553,221
Natural gas	71,189	91,293	167,377	241,687	331,391	456,292
Diesel-Fuel Oil	18,995	0	1,277	0	0	0
Coal	17,547	14,693	428	0	0	0
Biomass	51,241	51,757	58,395	73,786	92,740	111,695
Wind	42,348	52,802	74,810	115,106	158,906	202,706
Solar	831	2,967	8,724	15,294	21,864	28,434
Nuclear	15,730	15,730	15,730	15,730	15,730	15,730
TOTAL	624,213	656,582	791,338	951,752	1,142,316	1,368,077

Source: Simulation results

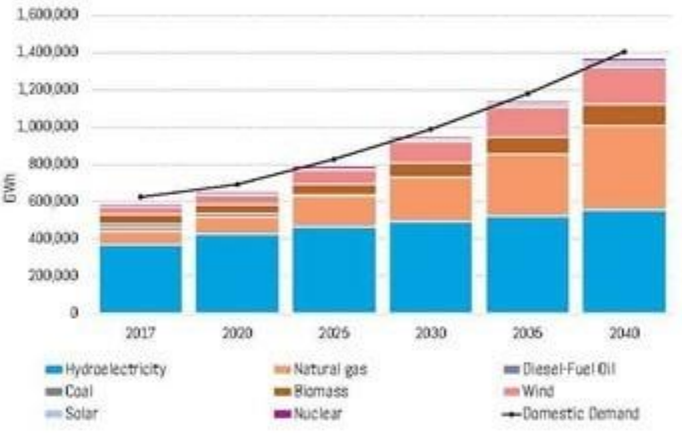
The difference between the internal demand for electricity and the total generation observed in the **Figures 3.8** and **3.9**, corresponds to the importation of energy, mainly from the part belonging to Paraguay of the Itaipu Binational Hydroelectricity Power Plant.

Figure 3.8. Projection of electricity generation in Brazil, CPS



Source: Simulation results

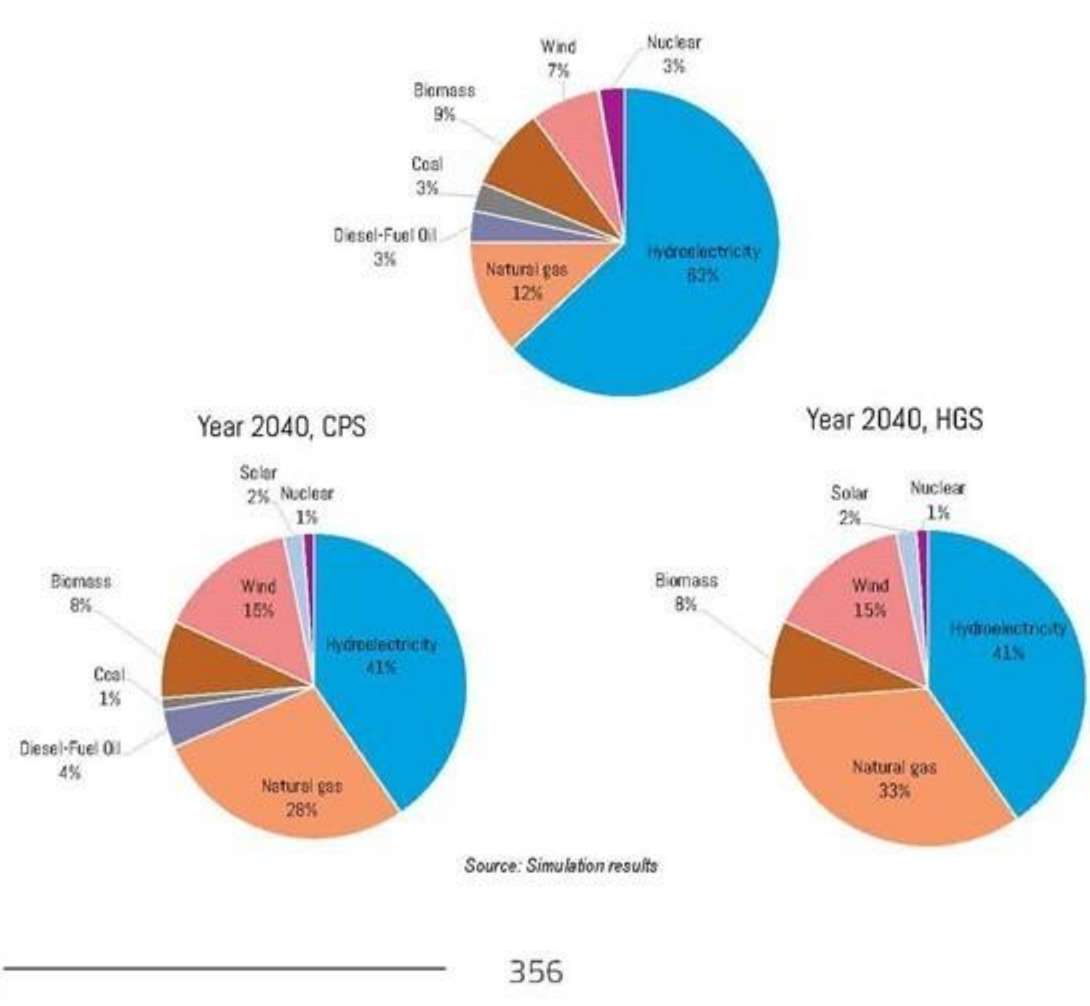
Figure 3.9. Projection of electricity generation in Brazil, HGS



Source: Simulation results

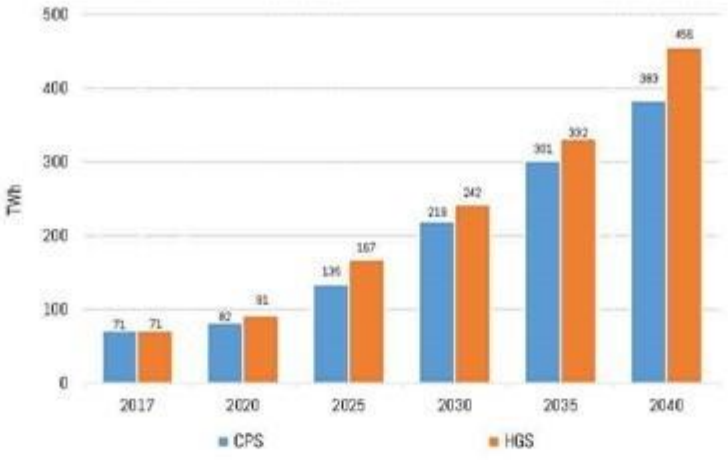
As observed in **Figure 3.10**, natural gas, it increases its participation in the electricity generation matrix, from 12% in the base year, to 28% in the CPS scenario and 33% in the HGS scenario, generating in the latter about 73 additional TWh, with respect to the CPS, in the year 2040 (**Figure 3.11**).

Figure 3.10. Evolution of the structure of the electricity generation matrix in Brazil



Source: Simulation results

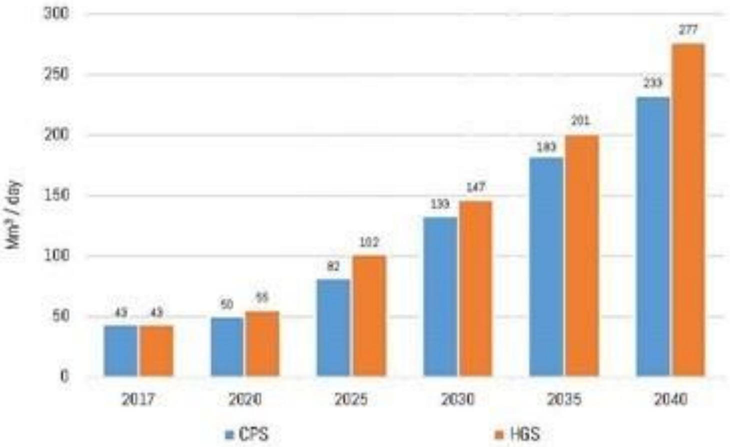
Figure 3.11. Electricity generation with natural gas, Brazil



Source: Simulation results

The input of natural gas required for electricity generation, in 2040, is higher by 44 Mm^3 per day in the HGS scenario, compared to the CPS scenario, as shown in the **Figure 3.12**.

Figure 3.12. Natural gas input for electricity generation, Brazil



Source: Simulation results

3.1.3 Projection of the total energy supply

Due to the substitution of liquid and solid fuels of fossil origin, with natural gas in the Brazilian energy matrix, a net benefit is obtained at the end of the projection period in terms of annual energy savings, with respect to the baseline scenario (CPS) of about 600 ktoe (**Tables 3.7** and **3.8**).

Table 3.7. Projection of the total energy supply in Brazil, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	110,257	113,258	124,544	132,806	146,342	168,709	1.9%
Natural gas	35,296	39,611	55,017	78,461	102,137	126,789	5.7%
Coal and coke	16,772	17,493	19,568	21,574	24,474	28,590	2.3%
Nuclear	4,105	4,106	4,106	4,106	4,106	4,106	0.0%
Hydroelectricity	34,937	39,865	43,068	45,266	47,977	50,689	1.6%
Biomass	84,811	90,755	104,159	123,563	150,893	190,151	3.6%
Other renewable	3,713	4,795	7,183	11,213	15,544	19,875	7.6%
TOTAL	289,892	309,883	357,645	416,988	491,472	588,907	3.1%

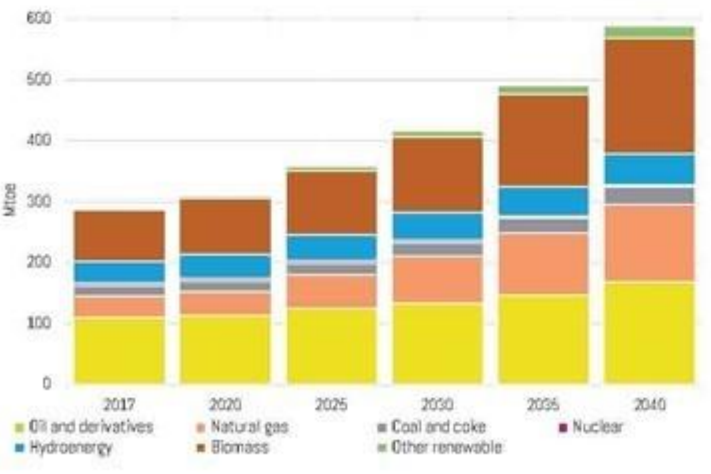
Source: Simulation results

Table 3.8. Projection of the total energy supply in Brazil, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	110,257	111,697	119,302	126,313	133,271	139,746	1.0%
Natural gas	35,296	41,691	64,544	89,043	120,074	163,597	6.6%
Coal and coke	16,772	16,744	15,035	16,464	18,267	20,289	0.8%
Nuclear	4,105	4,106	4,106	4,106	4,106	4,106	0.0%
Hydroelectricity	34,937	39,865	43,068	45,266	47,977	50,689	1.6%
Biomass	84,811	90,737	104,685	124,609	151,983	189,990	3.4%
Other renewable	3,713	4,795	7,183	11,213	15,544	19,875	7.4%
TOTAL	289,892	309,635	357,923	417,014	491,222	588,293	3.0%

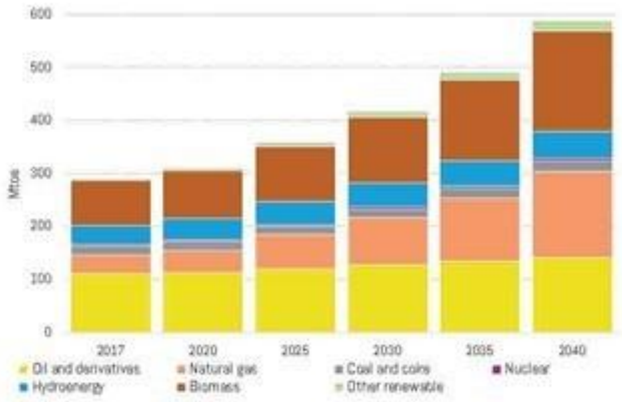
Source: Simulation results

Figure 3.13. Projection of the total energy supply in Brazil, CPS



Source: Simulation results

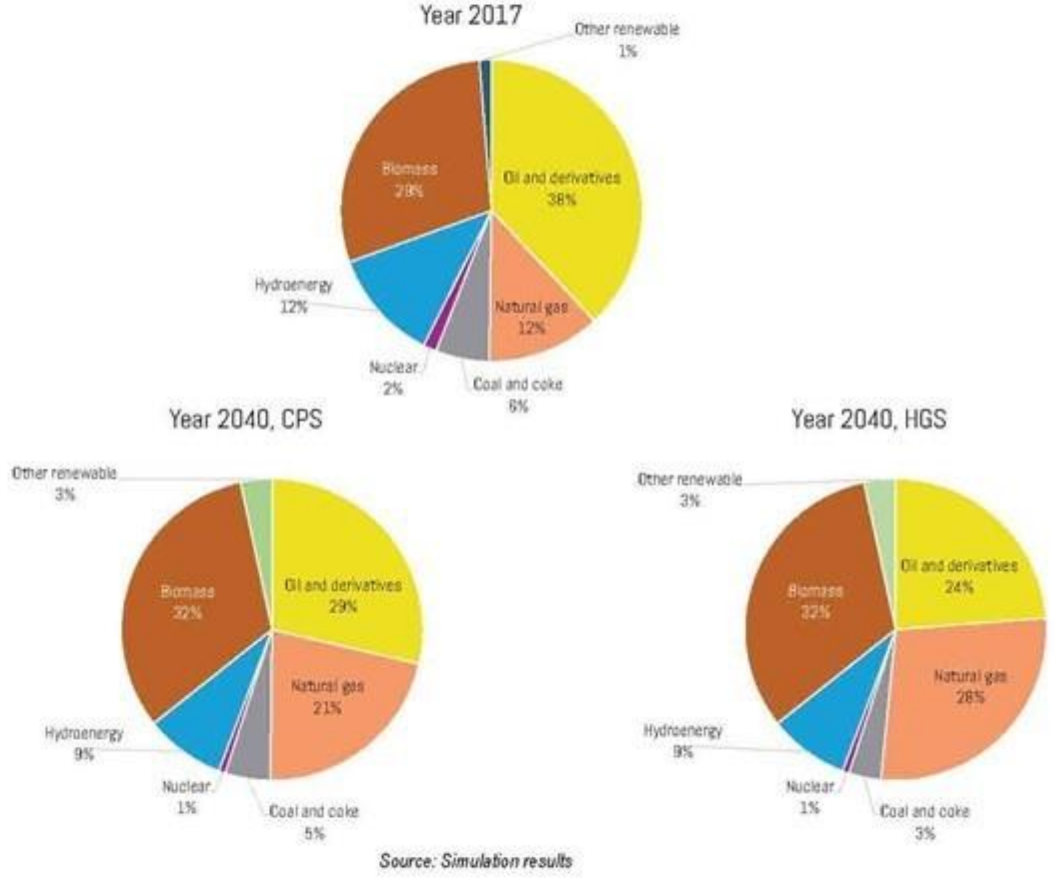
Figure 3.14. Projection of the total energy supply in Brazil, HGS



Source: Simulation results

In both the CPS and HGS scenarios, the total internal supply of oil and its derivatives is displaced mainly by natural gas and biomass, reducing its participation in the total supply matrix, by spending close to 40% in the base year at 29% in the CPS and 24% in the HGS, by 2040. On the contrary, natural gas increases its participation in said matrix in a very important way, going from 12% in the base year, to values of 21% and 28% in the CPS and HGS, by 2040, respectively (**Figure 3.15**).

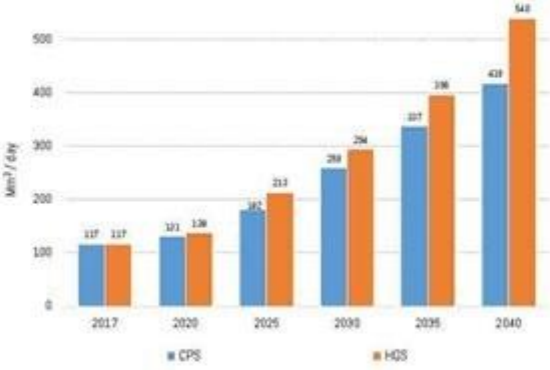
Figure 3.15. Evolution of the total energy supply matrix in Brazil



Source: Simulation results

In volumetric units, the increase in the total internal supply of natural gas to the year 2040, in the HGS scenario, with respect to the CPS scenario, reaches 121 Mm³ per day, as can be seen in **Figure 3.16**.

Figure 3.16. Total supply of natural gas in Brazil



Source: Simulation results

3.2 Mexico

3.2.1 Projection of final energy consumption

In the base year, oil derivatives participate with 56% of final energy consumption in Mexico, followed by electricity and natural gas. In the CPS scenario, natural gas presents the average annual growth rate, higher after electricity, while in the HGS scenario, this source is the one that leads the growth rate (4%), by displacing oil companies and to coal and coke. It is also observed that, thanks to the better efficiency of natural gas in the consumption processes, there is in the year 2040, a total annual energy saving of around 4,000 ktoe, compared to the HGS and CPS scenarios, as observed in **Tables 3.9** and **3.10**.

Table 3.9. Projection of final energy consumption in Mexico, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	74,424	77,862	84,567	92,443	101,543	111,988	1.8%
Natural gas	18,032	19,470	22,136	25,180	28,657	32,630	2.6%
Coal and coke	10,601	11,263	12,480	13,858	15,418	17,188	2.1%
Biomass	7,441	7,388	7,376	7,502	7,844	8,529	0.6%
Electricity	22,361	24,577	28,769	33,676	39,420	46,145	3.2%
TOTAL	132,858	140,560	155,328	172,658	192,882	216,479	2.1%

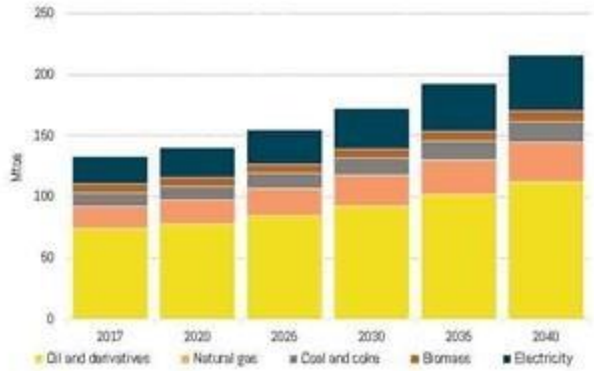
Source: Projection based on 2018-2032 Prospective documents, (SENER, 2018)

Table 3.10. Projection of final energy consumption in Mexico, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	74,424	77,862	84,114	91,068	97,521	99,669	1.3%
Natural gas	18,032	19,470	22,777	26,988	33,228	44,835	4.0%
Coal and coke	10,601	11,263	11,822	12,420	13,061	13,751	1.1%
Biomass	7,441	7,388	7,443	7,587	7,905	8,529	0.6%
Electricity	22,361	24,577	28,871	33,829	39,550	46,145	3.2%
TOTAL	132,858	140,560	155,028	171,893	191,265	212,928	2.1%

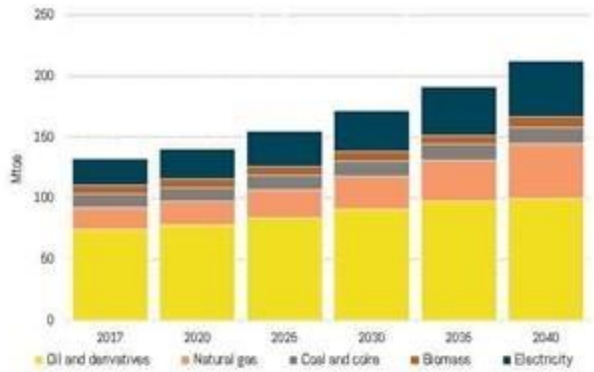
Source: Simulation results

Figure 3.17. Projection of final energy consumption in Mexico, CPS



Source: Projection based on 2018-2032 Prospective documents, (SENER, 2018)

Figure 3.18. Projection of final energy consumption in Mexico, HGS

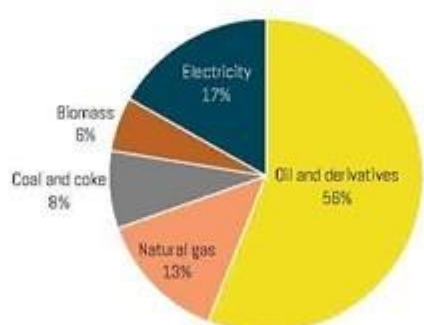


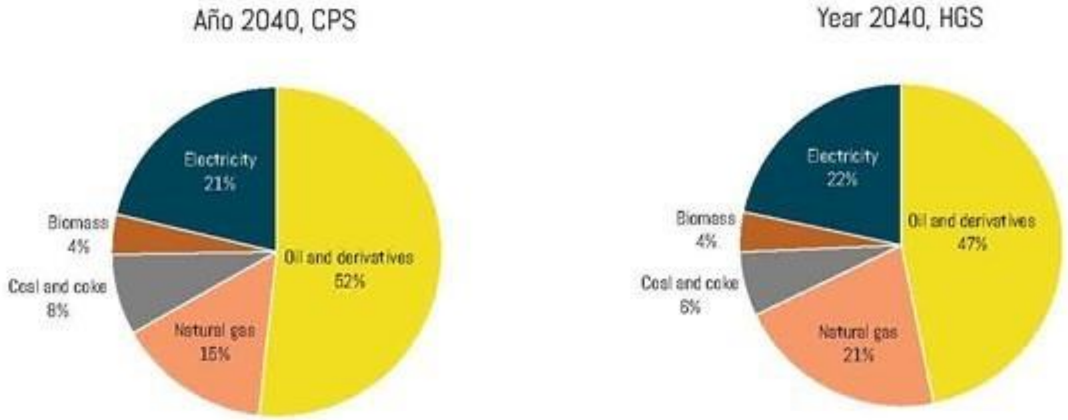
Source: Simulation results

The share of natural gas in the final consumption matrix, improved from 13% in the base year to 15% in 2040, for the CPS scenario and 21% for the HGS scenario, winning in both cases share to oil and its derivatives. (**Figure 3.19**)

Figure 3.19. Evolution of the final energy consumption matrix of Mexico

Year 2017

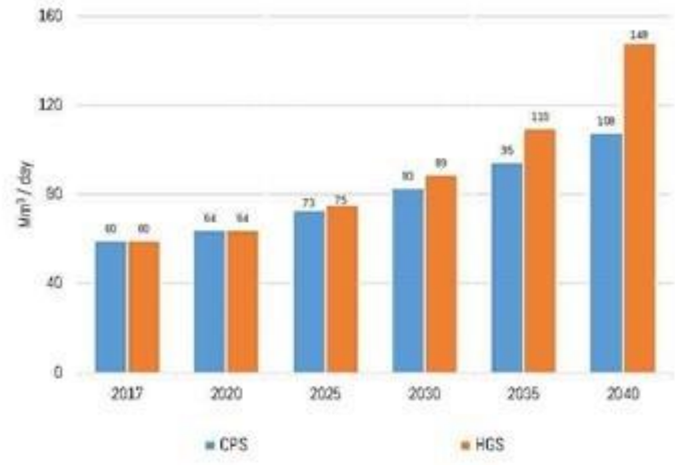




Source: Simulation results

After the processes of substitution of liquid and solid fuels modeled under the HGS scenario, the consumption of natural gas in this scenario, at the end of the projection period, is 40 Mm^3 per day higher than projected with the CPS scenario (**Figure 3.20**).

Figure 3.20. Projection of final consumption of natural gas in Mexico

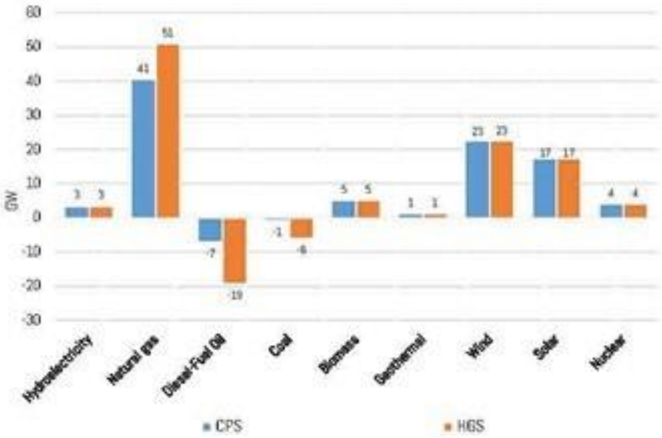


Source: Simulation results

3.2.2 Projection of electricity generation

Half of Mexico's electricity generation, in the base year, depends on natural gas and the power plants that use it as input, predominate in the plan to expand installed capacity, as can be seen in **Figure 3.21**. It is also observed that, while in the CPS scenario, 41 GW of natural gas plants are installed, during the projection period, in the HGS scenario, an additional 10 GW of this type of plant is installed, replacing 19 GW of diesel plants -Fuel Oil and 6 GW of coal power plants.

Figure 3.21. Expansion of electricity generation capacity, during the projection period, Mexico



Source: Projection based on the document "Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016)

Given that, due to the penetration of natural gas plants in the generator park, the withdrawal of Diesel Fuel Oil plants was simulated, with a lower plant factor, the capacity needed to cover the country's total electricity demand on stage HGS was reduced by around 7,000 MW in 2040, compared to the CPS scenario, as can be seen by comparing the totals of **Tables 3.11** and **3.12**.

Table 3.11. Projection of installed capacity in Mexico, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	12,642	12,671	13,198	14,393	15,299	16,037
Natural gas	28,091	34,288	42,576	50,584	59,829	68,645
Diesel-Fuel Oil	19,356	15,739	12,177	12,164	12,164	12,164
Coal	5,958	6,087	6,548	5,148	5,148	5,148
Biomass	2,692	3,375	4,293	6,015	6,680	7,787
Geothermal	926	906	917	1,550	1,864	2,125
Wind	4,199	8,128	15,530	17,656	21,981	26,920
Solar	214	5,630	8,691	10,577	13,898	17,699
Nuclear	1,608	1,608	1,608	4,329	5,689	5,689
TOTAL	75,686	88,432	105,538	122,416	142,551	162,213

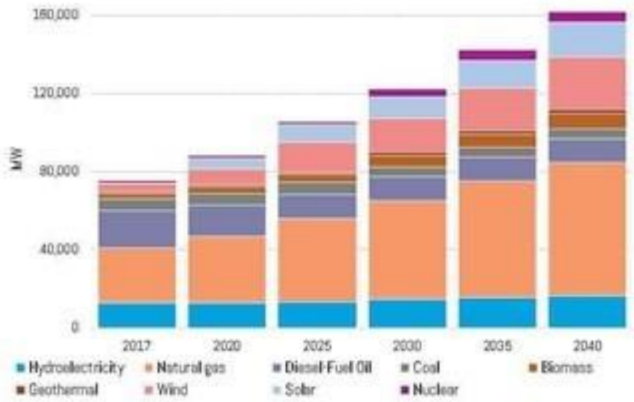
Source: Projection based on 2018-2032 Prospective documents, (SENER, 2018)

Table 3.12. Projection of installed capacity in Mexico, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	12,642	12,671	13,198	14,393	15,299	16,037
Natural gas	28,091	36,233	49,281	57,751	66,912	79,053
Diesel-Fuel Oil	19,356	15,739	0	0	0	0
Coal	5,958	5,587	3,087	0	0	0
Biomass	2,692	3,375	4,293	6,015	6,680	7,787
Geothermal	926	906	917	1,550	1,864	2,125
Wind	4,199	8,128	15,530	17,656	21,981	26,920
Solar	214	5,630	8,691	10,577	13,898	17,699
Nuclear	1,608	1,608	1,608	4,329	5,689	5,689
TOTAL	75,686	89,877	96,605	112,271	132,322	155,310

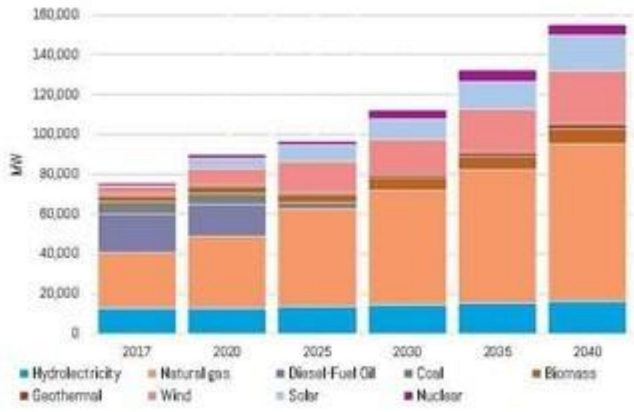
Source: Simulation results

Figure 3.22. Projection of installed capacity in Mexico, CPS



Source: Projection based on 2018-2032 Prospective documents, (SENER, 2018)

Figure 3.23. Projection of installed capacity in Mexico, HGS



Source: Simulation results

Table 3.13. Projection of electricity generation in Mexico, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	31,852	32,404	34,565	39,246	40,128	42,064
Natural gas	165,400	201,243	249,887	296,888	351,146	402,889
Diesel-Fuel Oil	59,725	36,222	17,566	9,631	9,485	30,876
Coal	34,891	35,726	38,432	30,215	30,215	30,215
Biomass	9,577	12,122	15,419	21,603	23,990	27,969
Geothermal	6,042	5,873	5,944	10,048	12,086	13,776
Wind	10,621	20,648	39,452	44,853	55,840	68,387
Solar	349	9,371	14,465	17,604	23,131	29,458
Nuclear	10,834	10,846	10,846	29,200	38,373	38,373
TOTAL	323,758	364,455	426,577	499,288	584,393	684,005

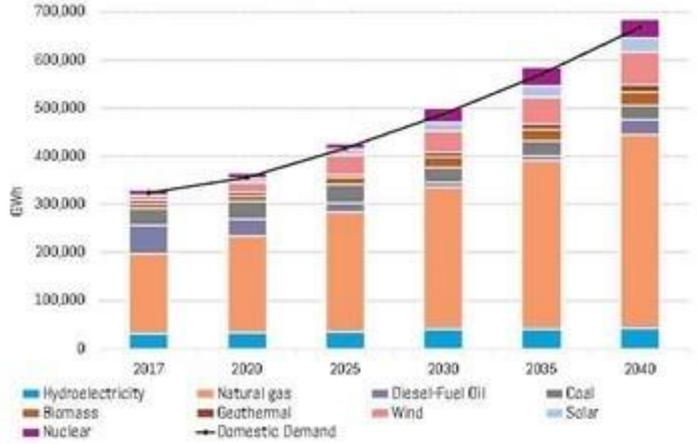
Source: Simulation results

Table 3.14. Projection of electricity generation in Mexico, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	31,852	32,404	34,565	39,246	40,128	42,064
Natural gas	165,400	212,659	289,241	338,950	392,719	463,979
Diesel-Fuel Oil	59,725	27,741	0	0	0	0
Coal	34,891	32,791	18,118	0	0	0
Biomass	9,577	12,122	15,419	21,603	23,990	27,969
Geothermal	6,042	5,873	5,944	10,048	12,086	13,776
Wind	10,621	20,648	39,452	44,853	55,840	68,387
Solar	349	9,371	14,465	17,604	23,131	29,458
Nuclear	10,834	10,846	10,846	29,200	38,373	38,373
TOTAL	323,758	364,455	428,052	501,504	586,268	684,005

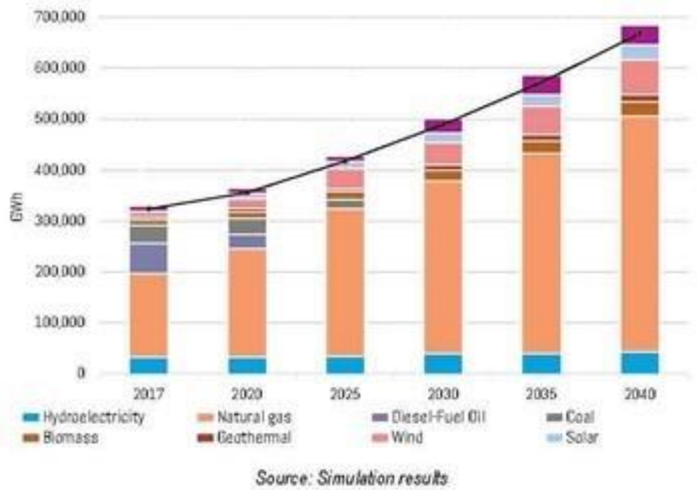
Source: Simulation results

Figure 3.24. Projection of electricity generation in Mexico, CPS



Source: Simulation results

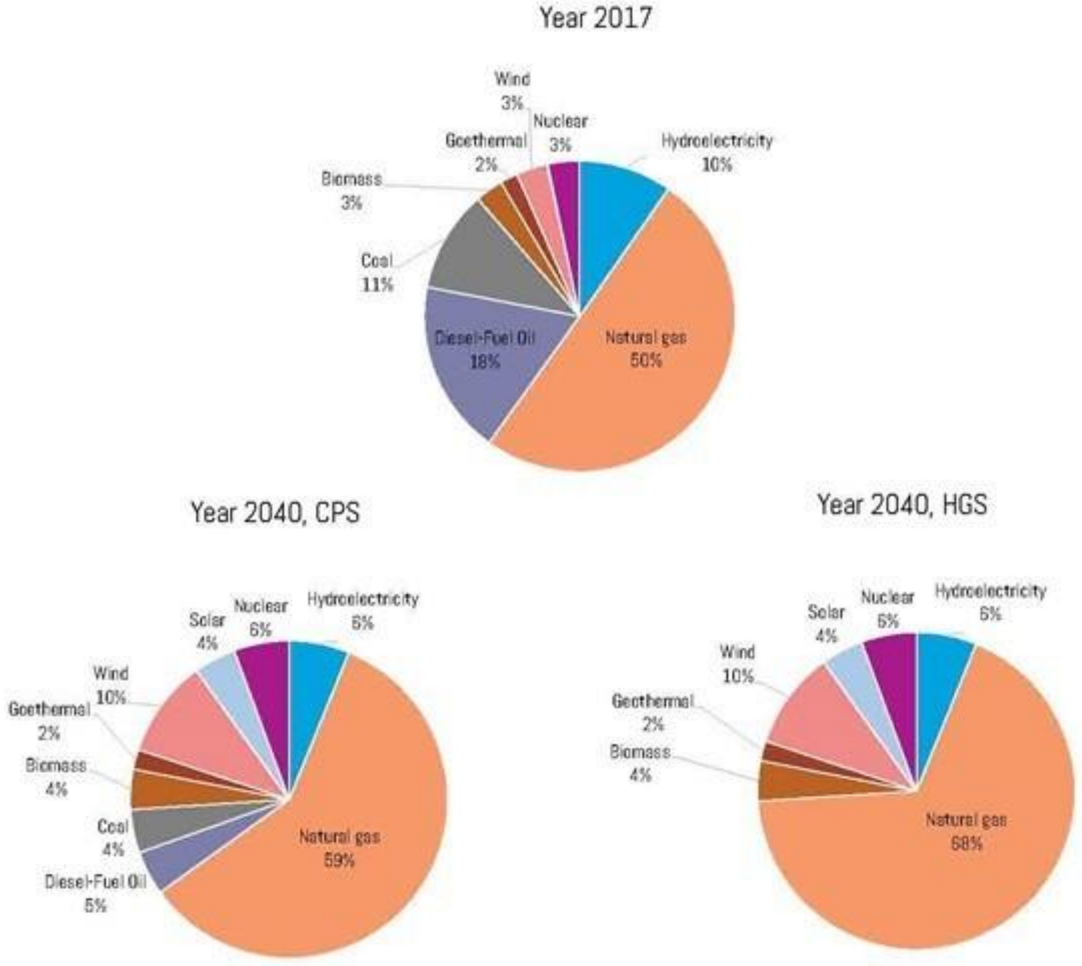
Figure 3.25. Projection of electricity generation in Mexico, HGS



Source: Simulation results

As for the electricity generation matrix, while in the CPS scenario, there is still a small share of Diesel-Fuel Oil and coal power plants, with 5% and 4% respectively, in the HGS scenario, in the projection horizon. Type of power plants are completely displaced by natural gas power plants from the year 2030. The participation of the generation with natural gas, reaches about 60% in the year 2040, with the CPS scenario and about 70% with the HGS scenario (**Figure 3.26**).

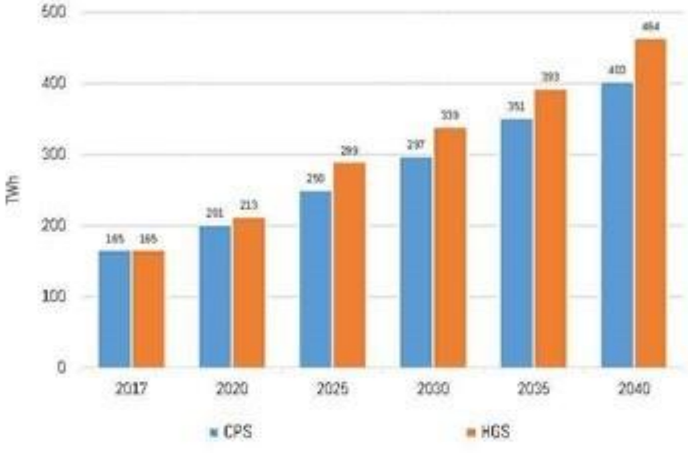
Figure 3.26. Evolution of the structure of the electricity generation matrix in Mexico



Source: Simulation results

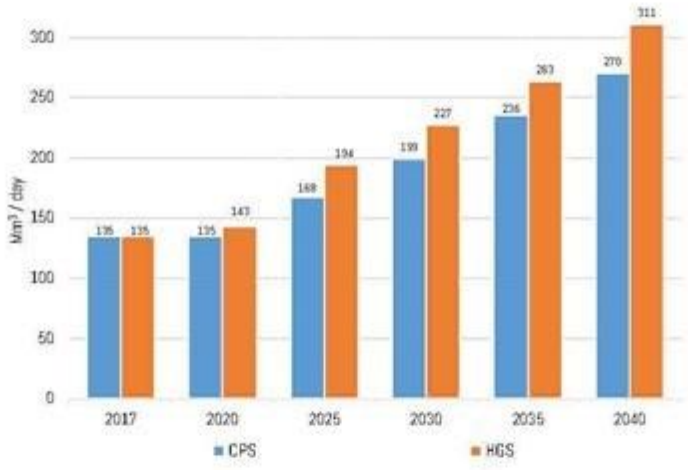
The annual energy generated with natural gas with the HGS scenario, in the year 2040, exceeds 61 TWh to that generated in the CPS scenario, for the same year (**Figure 3.27**), requiring an input of 41 Mm^3 per day additional to those required with the CPS scenario (**Figure 3.28**).

Figure 3.27. Electricity generation with natural gas, Mexico



Source: Simulation results

Figure 3.28. Natural gas input for electricity generation, Mexico



Source: Simulation results

3.2.3 Projection of the total energy supply

With the higher growth rate of the internal supply of natural gas in the HGS scenario, compared to the CPS scenario and thanks to the greater efficiency in its energy use processes, compared to the fuels it replaces, at the end of the projection period, it achieves a net saving in the total energy supply of around 3,000 ktoe, as evidenced by comparing the totals of **Tables 3.15** and **3.16**.

Table 3.15. Projection of the total energy supply in Mexico, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	79,949	84,688	86,036	91,849	101,607	120,060	1.8%
Natural gas	87,545	91,067	107,246	123,500	142,230	160,955	2.7%
Coal and coke	18,581	20,642	22,490	21,496	22,996	24,802	1.3%
Nuclear	2,706	2,693	2,693	7,251	9,529	9,529	5.6%
Hydroelectricity	2,262	2,042	2,105	2,364	2,273	2,244	0.0%
Biomass	9,005	9,537	10,109	11,331	12,096	13,486	1.8%
Other renewable	1,463	3,086	5,147	6,235	7,830	9,598	8.5%
TOTAL	201,512	213,755	235,826	264,026	298,560	340,674	2.3%

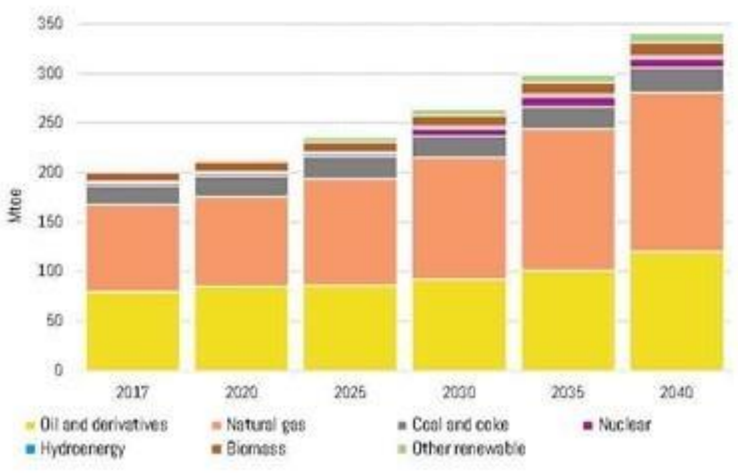
Source: Simulation results

Table 3.16. Projection of the total energy supply in Mexico, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	79,949	82,088	79,660	87,204	94,329	97,206	0.9%
Natural gas	87,545	94,056	118,375	136,842	159,003	192,678	3.5%
Coal and coke	18,581	19,806	16,114	11,630	12,209	12,829	-1.6%
Nuclear	2,706	2,693	2,693	7,251	9,529	9,529	5.6%
Hydroelectricity	2,262	2,042	2,105	2,364	2,273	2,244	0.0%
Biomass	9,005	9,537	10,176	11,416	12,157	13,486	1.8%
Other renewable	1,463	3,086	5,147	6,235	7,830	9,598	8.5%
TOTAL	201,512	213,309	234,271	262,942	297,330	337,570	2.3%

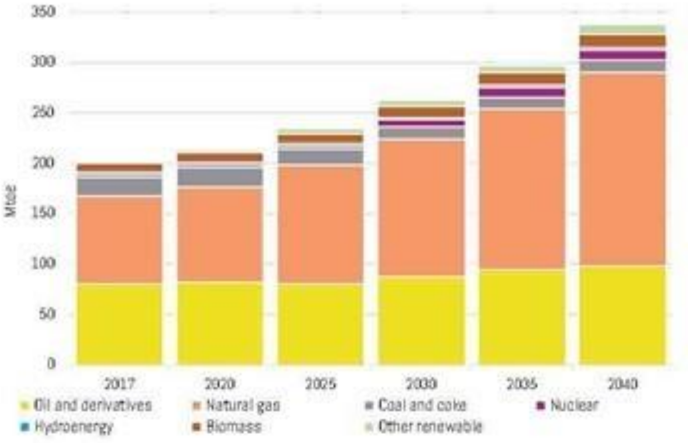
Source: Simulation results

Figure 3.29. Projection of the total energy supply in Mexico, CPS



Source: Simulation results

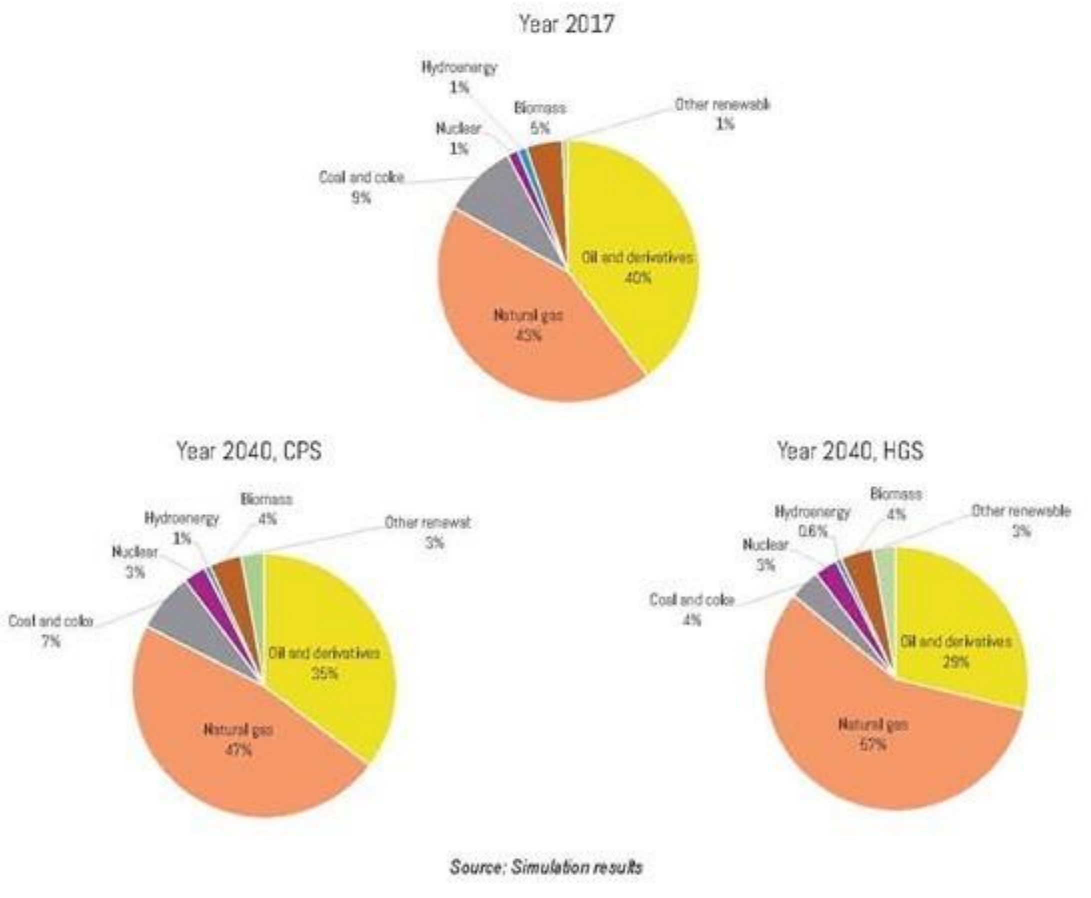
Figure 3.30. Projection of the total energy supply in Mexico, HGS



Source: Simulation results

The participation of natural gas in the matrix of total energy supply in Mexico, by 2040, increases by 10 percentage points in the HGS scenario, with respect to its value in the CPS scenario, for the same year (**Figure 3.31**).

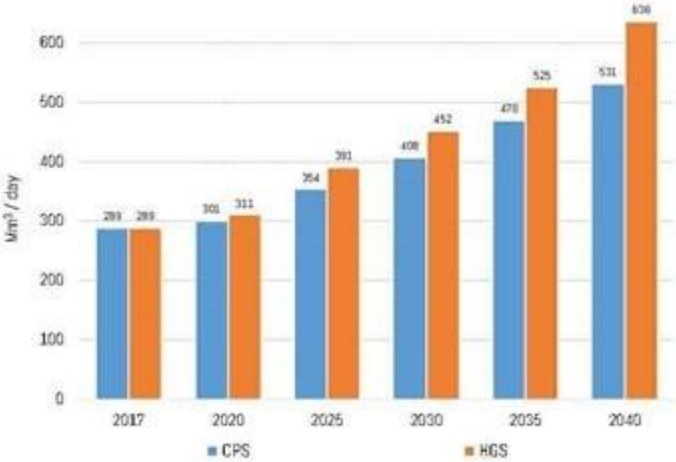
Figure 3.31. Evolution of the total energy supply matrix in Mexico



Source: Simulation results

To comply with the source substitution premises, considered in the HGS scenario, it is necessary to reach the end of the projection period, with a daily supply of natural gas exceeding 105 Mm^3 at the projected value in the CPS scenario (**Figure 3.32**). This increase in the demand for natural gas could be supplied mostly with own production, although a certain fraction could correspond to imports from the United States and Canada.

Figure 3.32. Total supply of natural gas in Mexico



Source: Simulation results

3.3 Central America

3.3.1 Projection of final energy consumption

In the base year, the final consumption of natural gas in Central America is null and remains so, throughout the projection period, according to the premises of the CPS scenario; while in the HGS scenario, the substitution of petroleum-derived fuels and of mineral coal and coke, produces an accelerated growth of the consumption of natural gas, from the year 2020. The greater efficiency in the consumption of the natural gas produces a saving in the final consumption of annual energy in the year 2040 of around 700 ktoe, as observed in **Tables 3.17** and **3.18.**

Table 3.17. Projection of final energy consumption in Central America, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	14,682	16,385	19,879	24,372	30,146	37,579	4.2%
Natural gas	0	0	0	0	0	0	
Coal and coke	491	523	583	652	732	825	2.3%
Biomass	11,456	10,950	10,233	9,684	9,316	9,155	-1.0%
Electricity	3,965	4,513	5,600	6,948	8,621	10,698	4.4%
TOTAL	30,594	32,372	36,295	41,656	48,816	58,256	2.8%

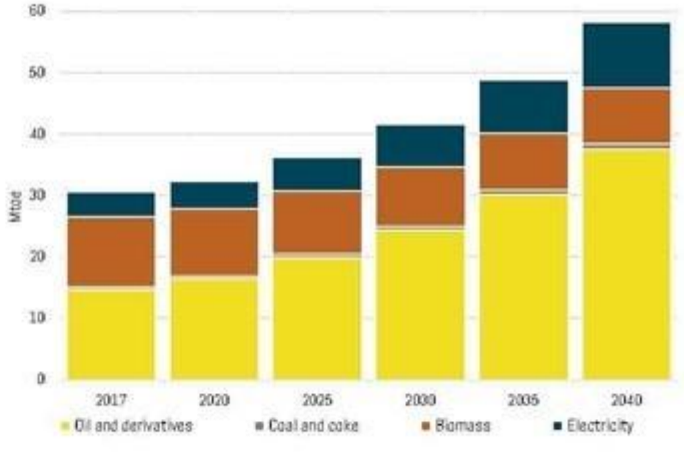
Source: Projection based on the referential expansion plans of the Central American countries

Table 3.18. Projection of final energy consumption in Central America, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	14,682	16,385	19,185	22,656	26,967	32,345	3.5%
Natural gas	0	0	634	1,538	2,795	4,519	14.0%
Coal and coke	491	523	583	651	731	825	2.3%
Biomass	11,456	10,950	10,162	9,590	9,248	9,155	-1.0%
Electricity	3,965	4,513	5,582	6,916	8,590	10,698	4.4%
TOTAL	30,594	32,371	36,146	41,352	48,331	57,541	2.8%

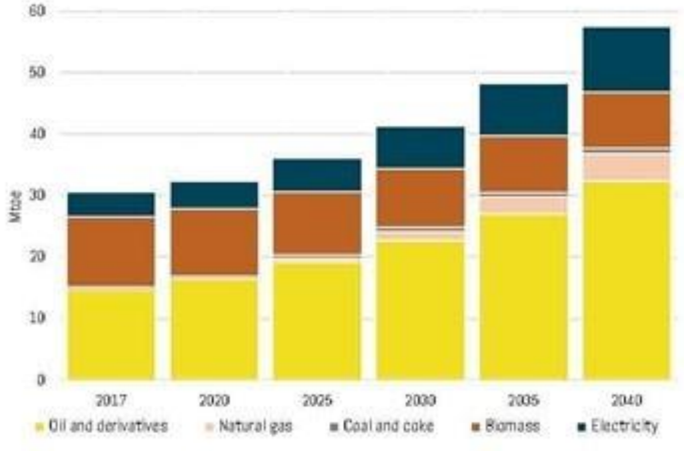
Source: Projection based on the referential expansion plans of the Central American countries

Figure 3.33. Projection of final energy consumption in Central America, CPS



Source: Projection based on the referential expansion plans of the Central American countries

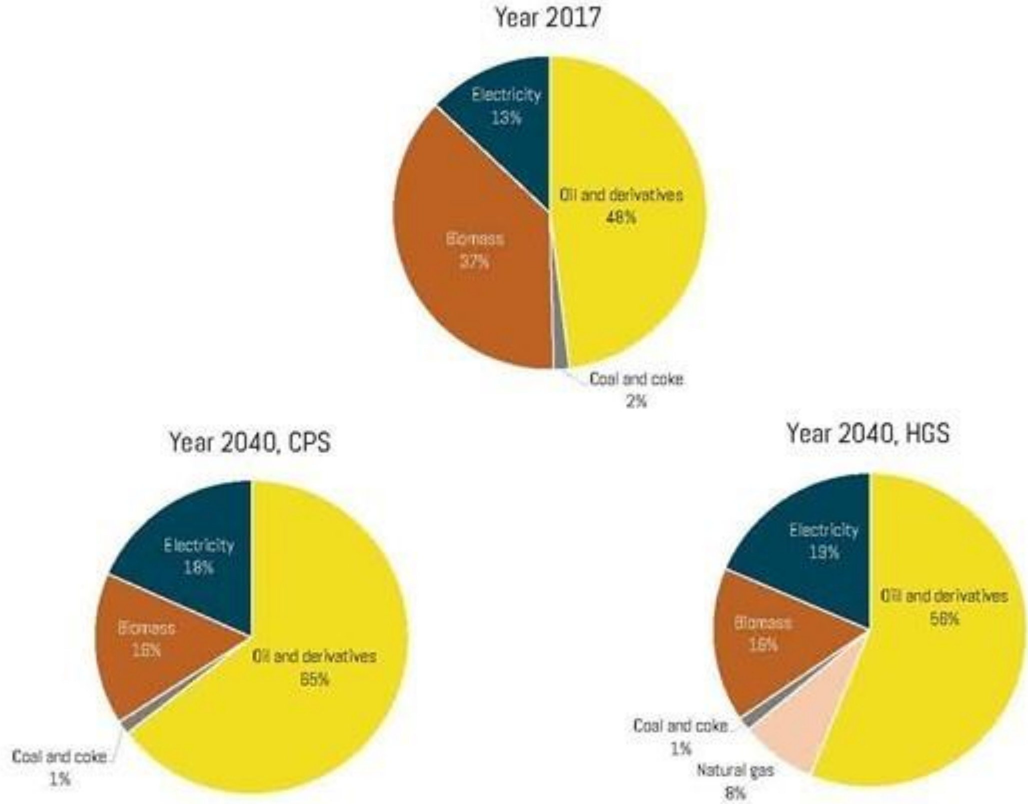
Figure 3.34. Projection of final energy consumption in Central America, HGS



Source: Simulation results

In the CPS scenario, the final consumption matrix evolves during the projection period, with an increase in the share of electricity and oil, displacing biomass consumption, but maintaining the absence of natural gas; while with the HGS scenario, this source displaces oil companies until reaching 8% of the final total energy consumption in 2040 (**Figure 3.35**).

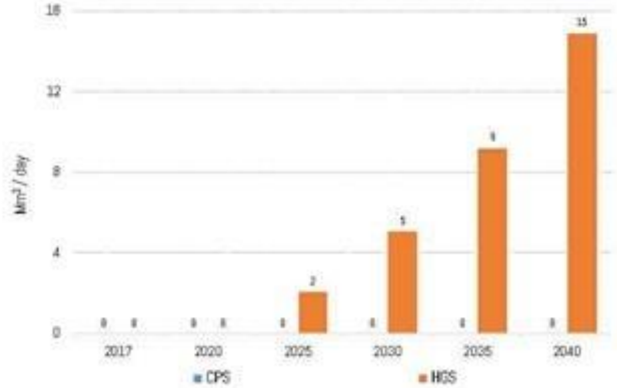
Figure 3.35. Evolution of the final energy consumption matrix in Central America



Source: Simulation results

The volume of natural gas consumed in the projection horizon, for the HGS scenario, reaches 15 Mm³ per day (**Figure 3.36**).

Figure 3.36. Projection of final consumption of natural gas in Central America

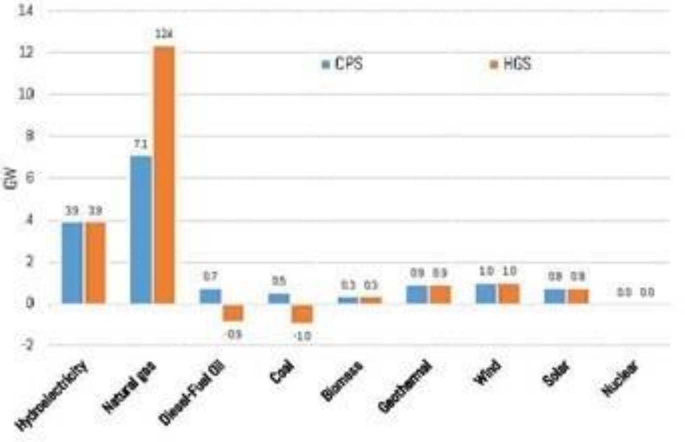


Fuente: Resultados de la simulación

3.3.2 Projection of power generation

In Central America, the expansion schedule of the installed capacity of electricity generation for the CPS scenario, includes the installation of 7.1 GW of natural gas plants, during the entire projection period, while in the HGS scenario, that installation is increased up to 12.4 GW, leading to the withdrawal of diesel-fuel oil and coal-fired power plants (**Figure 3.37**).

Figure 3.37. Expansion of electricity generation capacity in Central America during the projection period



Source: Projection based on the referential expansion plans of the Central American countries

After the replacement, as of 2030, of the existing capacity of Diesel-Fuel Oil and coal power plants, with natural gas plants, combined cycle type, the capacity necessary to meet the demand for electrical energy in the study horizon (2040), is about 1,700 MW less in the HGS scenario, than in the CPS scenario. This is due to the better plant factor of natural gas plants (**Table 3.19** and **3.20**).

Table 3.19. Projection of installed capacity in Central America, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	6,968	6,968	7,958	9,044	9,643	10,893
Natural gas	1	1	2,962	3,462	5,462	7,112
Diesel-Fuel Oil	4,840	4,840	4,414	4,364	4,782	5,582
Coal	895	895	1,215	1,125	1,325	1,425
Biomass	1,816	1,816	2,010	2,010	2,110	2,160
Geothermal	650	650	1,076	1,267	1,372	1,572
Wind	1,135	1,135	1,526	1,711	1,941	2,141
Solar	766	766	1,238	1,298	1,378	1,528
TOTAL	17,071	17,071	22,399	24,281	28,013	32,413

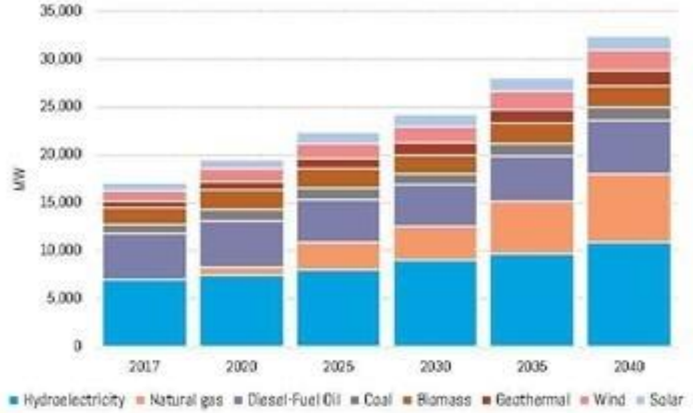
Source: Simulation results

Table 3.20. Projection of installed capacity in Central America, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	6,968	10,893	7,958	9,044	9,643	10,893
Natural gas	1	7,112	3,820	5,778	8,853	12,373
Diesel-Fuel Oil	4,840	5,582	24	24	24	24
Coal	895	1,425	15	0	0	0
Biomass	1,816	2,160	2,010	2,010	2,110	2,160
Geothermal	650	1,572	1,076	1,267	1,372	1,572
Wind	1,135	2,141	1,526	1,711	1,941	2,141
Solar	766	1,528	1,238	1,298	1,378	1,528
TOTAL	17,071	32,413	17,667	21,132	25,322	30,691

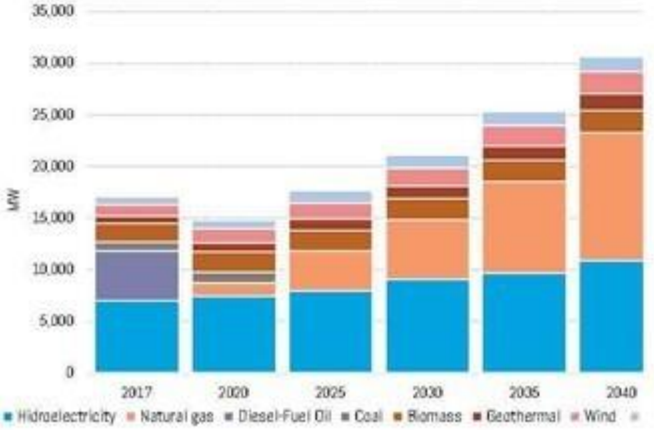
Source: Simulation results

Figure 3.38. Projection of installed capacity in Central America, CPS



Source: Simulation results based on installation / withdrawal schedules

Figure 3.39. Projection of installed capacity in Central America, HGS



Source: Simulation results

Regarding the electricity generation matrix in Central America, it is worth highlighting the great importance that natural gas plants acquire in the study horizon, in both simulated scenarios, taking into account that in the base year, the participation of this type of plant was almost null. Thus, in the CPS scenario, natural gas comes to represent close to a third of the electricity generation matrix, while in the HGS scenario, this share exceeds 50%, completely displacing Diesel - Fuel Oil and coal power plants (**Figure 3.42**).

Table 3.21. Projection of electricity generation in Central America, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	27,162	32,581	34,855	39,611	42,235	47,710
Natural gas	5	5,102	16,830	21,229	33,493	43,611
Diesel-Fuel Oil	10,673	1,501	0	8,234	13,681	24,140
Coal	5,100	6,924	6,924	6,411	7,551	8,120
Biomass	3,840	5,270	5,283	5,283	5,546	5,677
Geothermal	3,786	4,985	6,598	7,769	8,413	9,639
Wind	3,212	4,909	5,347	5,995	6,801	7,502
Solar	1,390	1,657	2,247	2,356	2,501	2,773
TOTAL	55,289	62,928	78,083	96,887	120,220	149,172

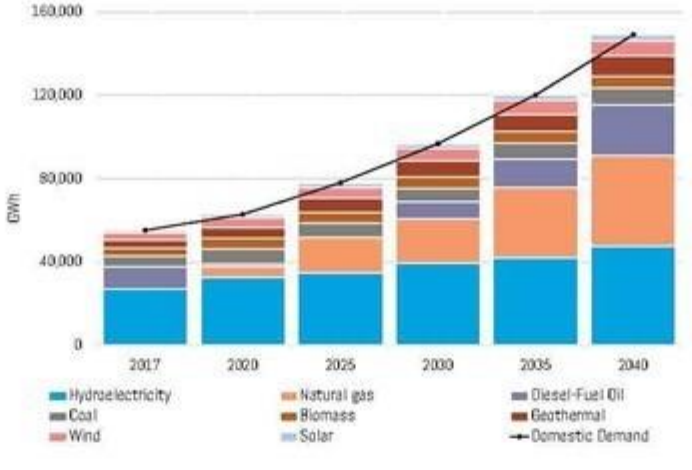
Source: Simulation results

Table 3.22. Projection of electricity generation in Central America, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	27,162	32,581	34,855	39,611	42,235	47,710
Natural gas	5	7,742	23,421	35,431	54,289	75,871
Diesel-Fuel Oil	10,673	0	0	0	0	0
Coal	5,100	5,784	85	0	0	0
Biomass	3,840	5,270	5,283	5,283	5,546	5,677
Geothermal	3,786	4,985	6,598	7,769	8,413	9,639
Wind	3,212	4,909	5,347	5,995	6,801	7,502
Solar	1,390	1,657	2,247	2,356	2,501	2,773
TOTAL	55,289	62,928	77,836	96,445	119,784	149,172

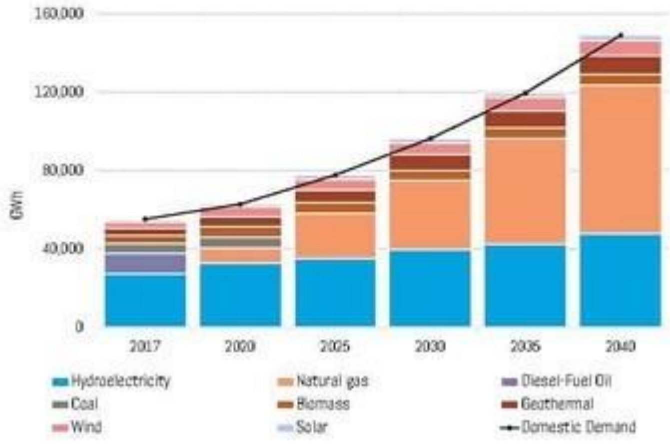
Source: Simulation results

Figure 3.40. Projection of electricity generation in Central America, CPS



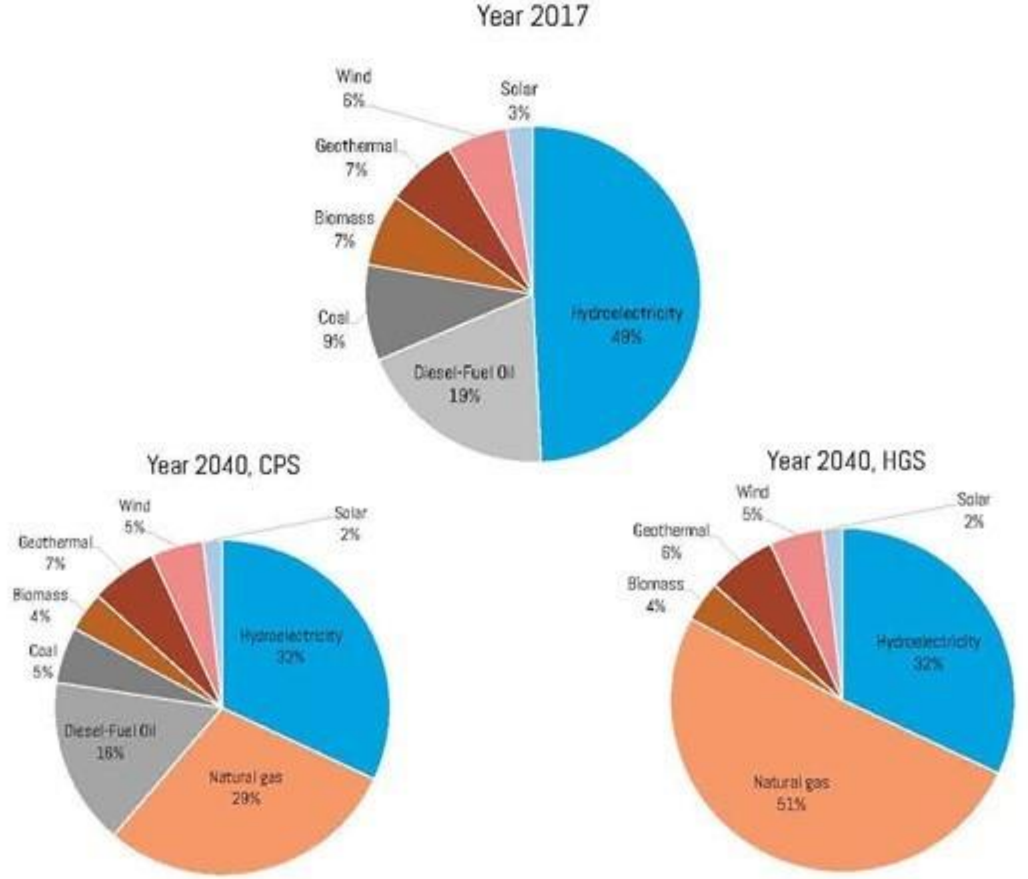
Source: Simulation results

Figure 3.41. Projection of electricity generation in Central America, HGS



Source: Simulation results

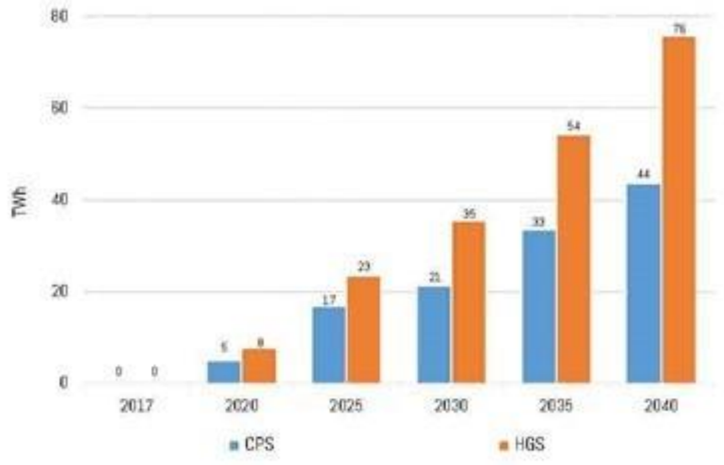
Figure 3.42. Evolution of the electricity generation matrix in Central America



Source: Simulation results

Under the premises of the HGS scenario, in 2040, an additional 32 TWh will be generated with natural gas, compared to the value projected in the CPS scenario, for the same year (**Figure 3.43**).

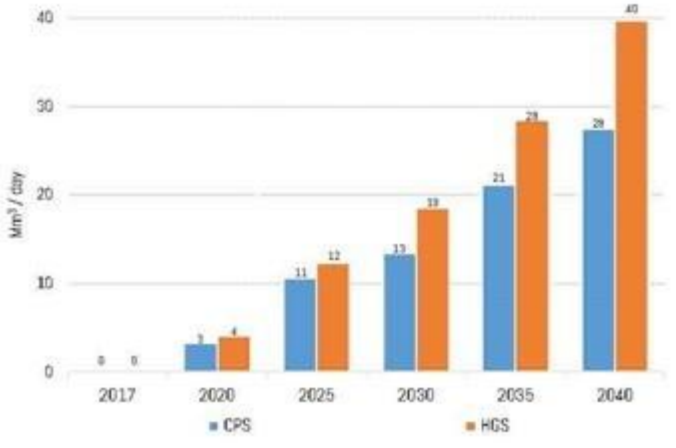
Figure 3.43. Electricity generation with natural gas in Central America



Source: Simulation results

In volumetric terms, in the year 2040, around 28 Mm^3 per day of natural gas would be required for electricity generation, under the premises of the CPS scenario and 40 Mm^3 per day, for the HGS scenario (**Figure 3.44**).

Figure 3.44. Natural gas input for electricity generation in Central America



Source: Simulation results

3.3.3 Projection of the total energy supply

To cover the domestic demand for natural gas, determined by the consumption of this source, both in the socio-economic sectors and in the electricity generation system, it is required that the total supply of the same, be projected with very high average annual growth rates, in both scenarios analyzed. Of course, since most of the countries that make up the subregion of Central America lack natural gas reserves and production, the domestic supply must be supported by imports, mainly as LNG, which could come from the United States, Canada, Peru and Trinidad and Tobago.

The greater efficiency in the different energy uses of natural gas with respect to petroleum derivatives and mineral coal, allows that, in the projection horizon, there is a net saving in the internal energy demand of approximately 1,400 ktoe, when comparing the scenario HGS with the CPS scenario (**Tables 3.23** and **3.24**).

Table 3.23. Projection of the total energy supply in Central America, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	16,885	16,740	19,939	26,095	32,974	42,519	4.1%
Natural gas	2	976	3,217	4,058	6,402	8,337	45.5%
Coal and coke	1,744	2,224	2,284	2,227	2,587	2,820	2.1%
Hydroenergy	2,706	3,234	3,459	3,931	4,192	4,735	2.5%
Biomass	13,580	13,907	13,204	12,661	12,442	12,362	-0.4%
Other renewable	721	993	1,220	1,386	1,523	1,712	3.8%
TOTAL	35,638	38,074	43,324	50,359	60,120	72,485	3.1%

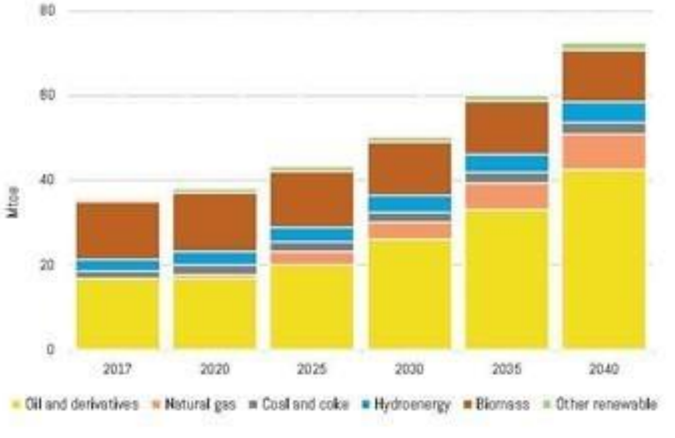
Source: Simulation results

Table 3.24. Projection of the total energy supply in Central America, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	16,885	16,438	19,243	22,719	27,035	32,420	2.9%
Natural gas	2	1,480	5,111	8,310	13,171	19,020	50.8%
Coal and coke	1,744	1,944	604	651	731	825	-3.2%
Hydroenergy	2,706	3,234	3,459	3,931	4,192	4,735	2.5%
Biomass	13,580	13,908	13,132	12,568	12,375	12,363	-0.4%
Other renewable	721	993	1,220	1,386	1,523	1,712	3.8%
TOTAL	35,638	37,998	42,769	49,565	59,027	71,075	3.0%

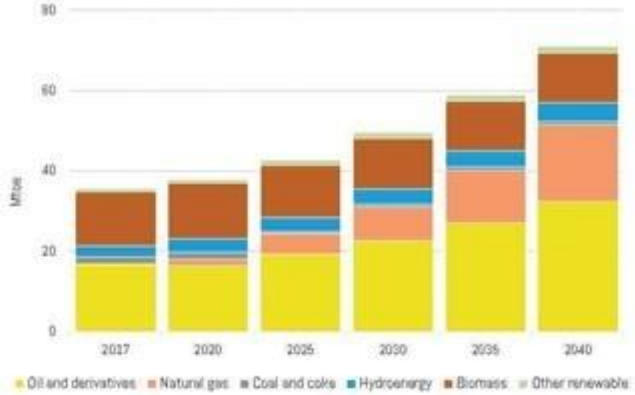
Source: Simulation results

Figure 3.45. Projection of the total energy supply in Central America, CPS



Source: Simulation results

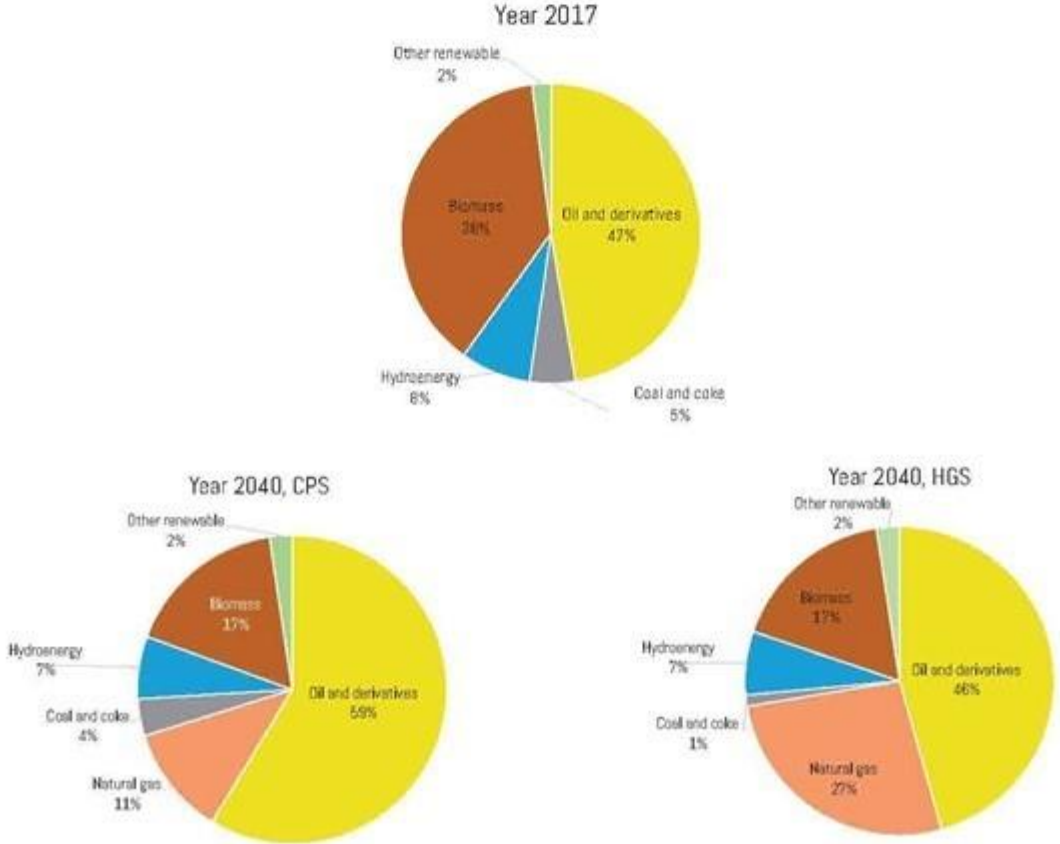
Figure 3.46. Projection of the total energy supply in Central America, HGS



Source: Simulation results

Starting from an almost zero participation in the base year, natural gas would reach in the year 2040, an 11% participation in the matrix of total energy supply, with the premises of the CPS scenario, while simulating the HGS scenario, said participation increases up to 27% (**Figure 3.47**).

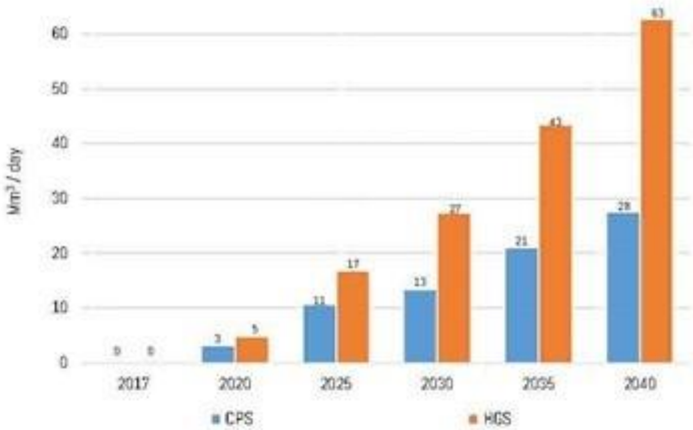
Figure 3.47. Evolution of the total energy supply matrix in Central America



Source: Simulation results

The daily volumetric requirement of natural gas, in the year 2040, is 28 Mm^3 for the CPS scenario and 63 Mm^3 for the HGS scenario, which is a big difference, which is mainly due to that, in the CPS scenario, natural gas penetration was not considered in the final consumption sectors, but only in the power generation system (**Figure 3.48**).

Figure 3.48. Total supply of natural gas in Central America



Fuente: Resultados de la simulación

3.4 Andean Zone

3.4.1 Projection of final energy consumption

Regarding the projection of the final consumption of natural gas in the Andean Zone, it should be noted that for the CPS scenario, the growth of this consumption is extremely modest, with an annual growth rate of only 0.3%, while, with premises of substitution of petroleum derivatives and fossil solid fuels, this rate increases in the HGS scenario, up to 2.7%, producing a saving in the total energy consumption of around 3,500 ktoe per year, at the end of the projection period (**Tables 3.25** and **3.26**).

Table 3.25. Projection of final energy consumption in the Andean Zone, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	60,505	65,635	75,674	87,975	103,125	121,902	3.1%
Natural gas	16,590	16,127	15,705	15,784	16,470	17,924	0.3%
Coal and coke	5,309	6,108	7,735	9,817	12,478	15,878	4.9%
Biomass	8,333	8,084	7,776	7,591	7,524	7,571	-0.4%
Electricity	19,321	21,104	24,720	29,332	35,218	42,741	3.5%
TOTAL	110,058	117,057	131,609	150,498	174,816	206,016	2.8%

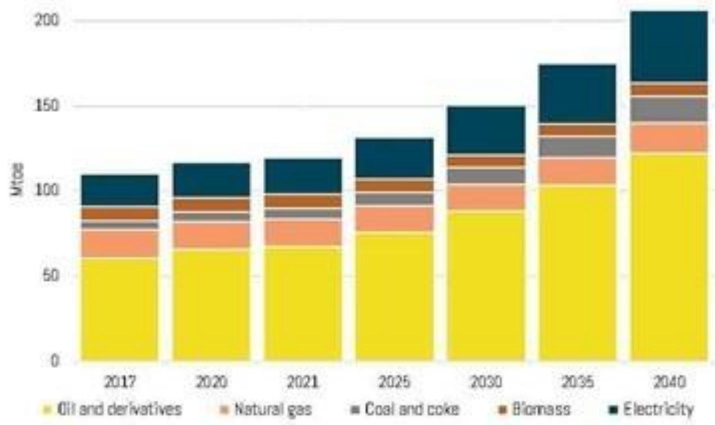
Source: Projection based on the referential expansion plans of the Andean countries

Table 3.26. Projection of final energy consumption in the Andean Zone, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	60,505	65,635	74,219	84,232	95,696	108,567	2.6%
Natural gas	16,590	16,127	17,301	19,701	23,941	30,916	2.7%
Coal and coke	5,309	6,108	7,223	8,638	10,439	12,732	3.9%
Biomass	8,333	8,084	7,772	7,592	7,531	7,571	-0.4%
Electricity	19,321	21,104	24,654	29,251	35,163	42,741	3.5%
TOTAL	110,058	117,057	131,168	149,413	172,771	202,527	2.7%

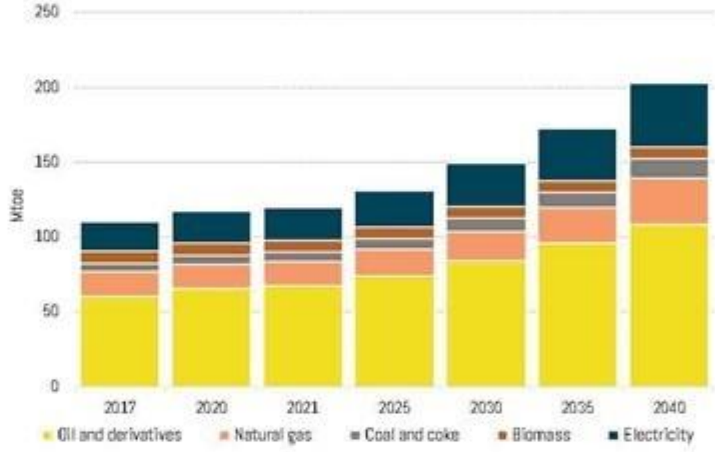
Source: Simulation results

Figure 3.49. Projection of final energy consumption in the Andean Zone, CPS



Source: Projection based on the referential expansion plans of the Andean countries

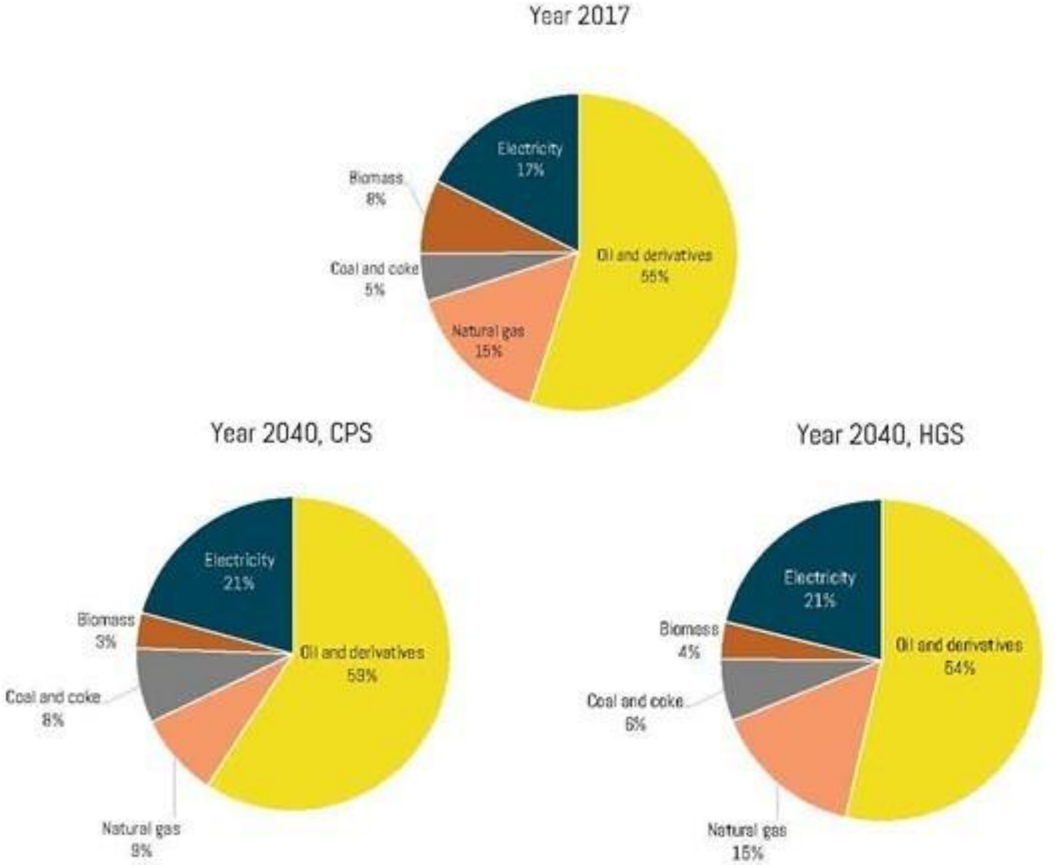
Figure 3.50. Projection of final energy consumption in the Andean Zone, HGS



Source: Simulation results

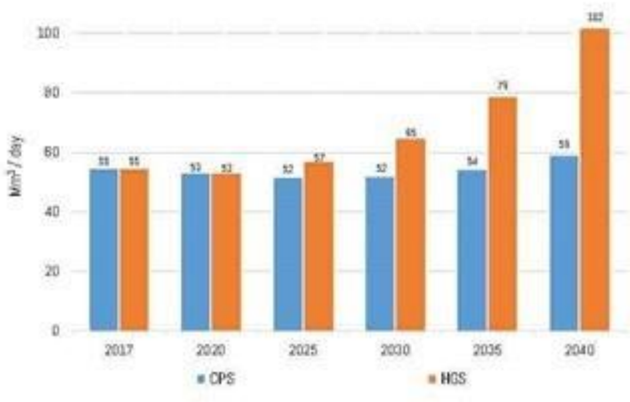
It is worth noting that the CPS scenario, given the low growth rate of natural gas consumption compared to other sources such as electricity and oil derivatives, the share of this product decreases from 15% to 9% in the year 2040 compared to the base year. In the case of HGS, this value is maintained at 15% (**Figure 3.51**) thanks to an increase in the daily consumption of natural gas of around 43 Mm³, comparing the two scenarios (**Figure 3.52**).

Figure 3.51. Evolution of the final energy consumption matrix in the Andean Zone



Source: Simulation results

Figure 3.52. Projection of final consumption of natural gas in the Andean Zone

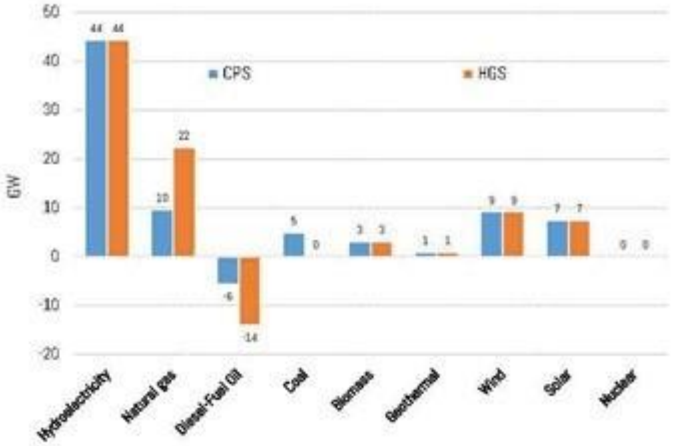


Source: Simulation results

3.4.2 Projection of electricity generation

Due to the great hydropower potential of the countries of the Andean Zone, hydropower plants have a preponderance in the plans for the expansion of electricity generation in this subregion. However, in a second place, the installation of natural gas plants is located, in both scenarios analyzed, with the difference that in the HGS scenario, it is committed to an implementation of more than double the capacity of this type of plants, in comparison with the CPS scenario, replacing capacity of Diesel-Fuel Oil plants and canceling the installation of coal power plants (**Figure 3.53**). With a better plant factor, with respect to Diesel-Fuel Oil, natural gas plants allow 2040, the total installed capacity in the HGS scenario, to be around 600 MW lower than the CPS scenario (**Tables 3.27** and **3.28**).

Figure 3.53. Expansion of installed power generation capacity in the Andean Zone, during the projection period



Source: Simulation results

Table 3.27. Projection of installed capacity in the Andean Zone, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	37,248	43,141	52,196	58,596	68,596	81,596
Natural gas	11,300	14,457	15,373	16,114	18,354	20,954
Diesel-Fuel Oil	14,069	14,408	12,908	11,408	9,908	8,408
Coal	700	1,700	2,400	2,800	4,100	5,600
Biomass	427	752	752	1,052	2,052	3,552
Geothermal	0	101	101	201	451	951
Wind	357	1,062	1,462	2,062	4,862	9,562
Solar	295	892	1,392	1,792	3,892	7,792
TOTAL	64,396	76,513	86,584	94,024	112,215	138,415

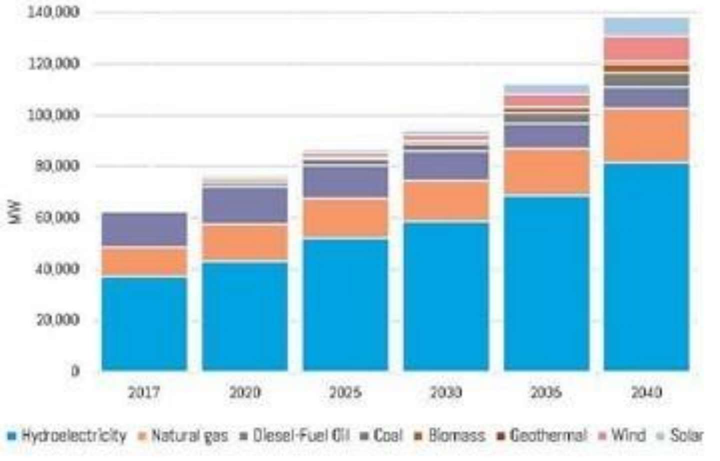
Source: Simulation results

Table 3.28. Projection of installed capacity in the Andean Zone, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	37,248	43,141	52,196	58,596	68,596	81,596
Natural gas	11,300	15,265	19,265	23,292	28,009	33,607
Diesel-Fuel Oil	14,069	14,708	0	0	0	0
Coal	700	790	790	790	790	790
Biomass	427	752	752	1,052	2,052	3,552
Geothermal	0	101	101	201	451	951
Wind	357	1,062	1,462	2,062	4,862	9,562
Solar	295	892	1,392	1,792	3,892	7,792
TOTAL	64,396	76,711	75,958	87,784	108,652	137,850

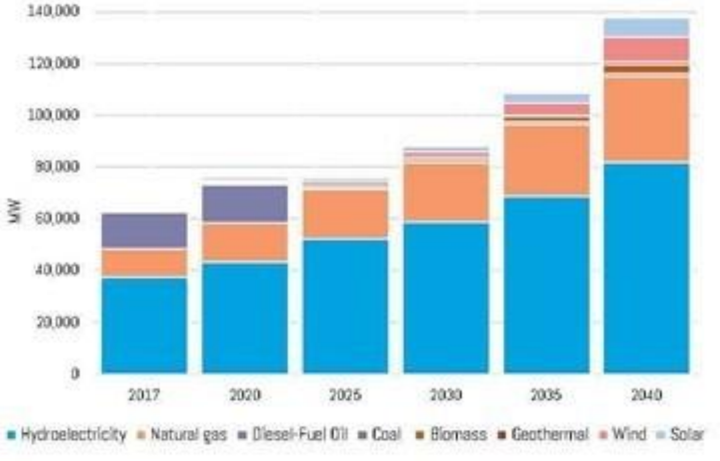
Source: Simulation results

Figure 3.54. Projection of installed capacity in the Andean Zone, CPS



Source: Simulation results

Figure 3.55. Projection of installed capacity in the Andean Zone, HGS



Source: Simulation results

Due to the high penetration of hydropower and non-conventional renewable energies in the Andean Zone power generation matrix, the share of natural gas is reduced in the CPS scenario, from 26% in the base year, to 20% in the year 2040, however, by displacing diesel-fuel oil and coal-fired power plants, in the HGS scenario, natural gas plants increase their participation in the matrix reached 29% in 2040 (**Figure 3.58**). For this, it is necessary to generate an additional 53 TWh with natural gas (**Figure 3.59**) and an input of 45 Mm^3 per day more from said source (**Figure 3.60**) in the HGS scenario, with respect to the CPS scenario, for that year.

Table 3.29. Projection of electricity generation in the Andean Zone, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	171,629	198,783	240,503	269,993	316,070	375,971
Natural gas	74,175	88,650	94,267	98,808	112,547	128,490
Diesel-Fuel Oil	30,811	4,107	3,328	30,113	30,039	23,214
Coal	4,565	10,424	14,717	17,170	25,141	34,339
Biomass	1,258	2,216	2,216	3,100	6,045	10,464
Geothermal	0	796	796	1,585	3,556	7,498
Wind	1,309	3,896	5,363	7,565	17,839	35,085
Solar	341	1,563	2,439	3,140	6,819	13,652
TOTAL	284,089	310,436	363,630	431,473	518,057	628,712

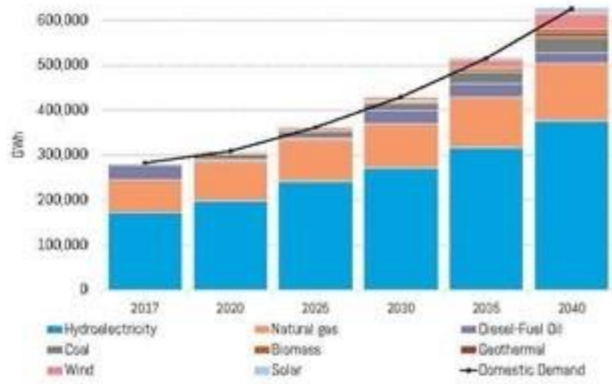
Source: Simulation results

Table 3.30. Projection of electricity generation in the Andean Zone, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	171,629	198,783	240,503	269,993	316,070	375,971
Natural gas	74,175	93,605	106,503	140,060	162,076	181,199
Diesel-Fuel Oil	30,811	4,733	0	0	0	0
Coal	4,565	4,844	4,844	4,844	4,844	4,844
Biomass	1,258	2,216	2,216	3,100	6,045	10,464
Geothermal	0	796	796	1,585	3,556	7,498
Wind	1,309	3,896	5,363	7,565	17,839	35,085
Solar	341	1,563	2,439	3,140	6,819	13,652
TOTAL	282,842	310,436	362,665	430,286	517,250	628,712

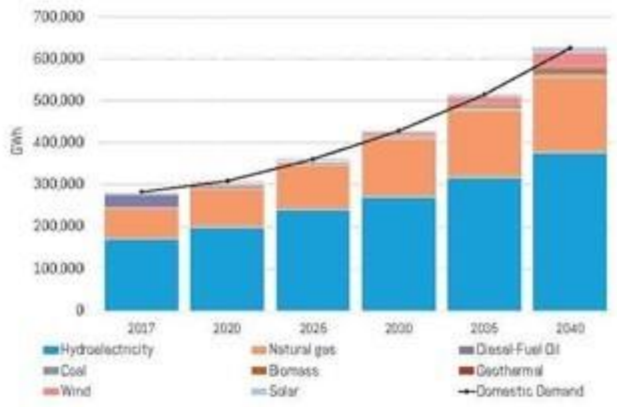
Source: Simulation results

Figure 3.56. Projection of electricity generation in the Andean Zone, CPS



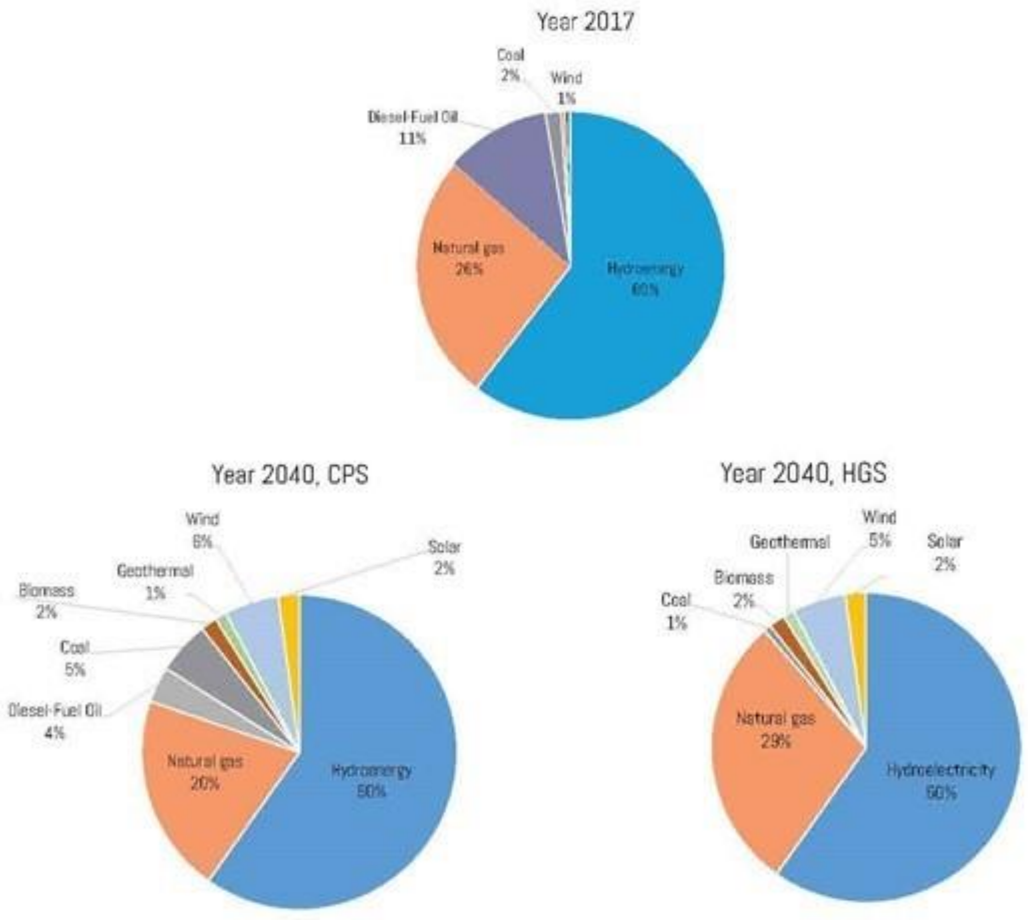
Source: Simulation results

Figure 3.57. Projection of electricity generation in the Andean Zone, HGS



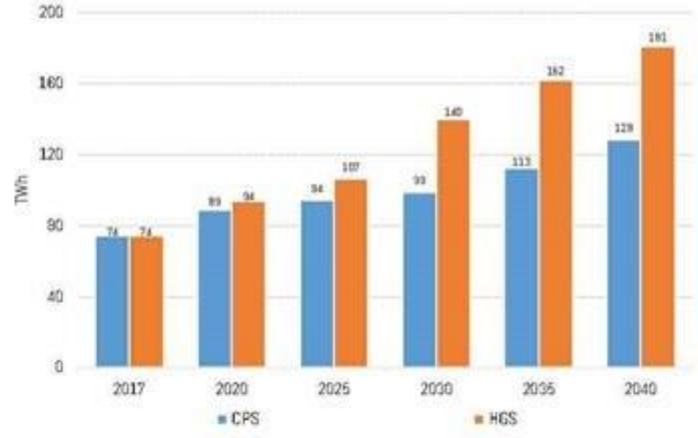
Source: Simulation results

Figure 3.58. Evolution of the electricity generation matrix in the Andean Zone



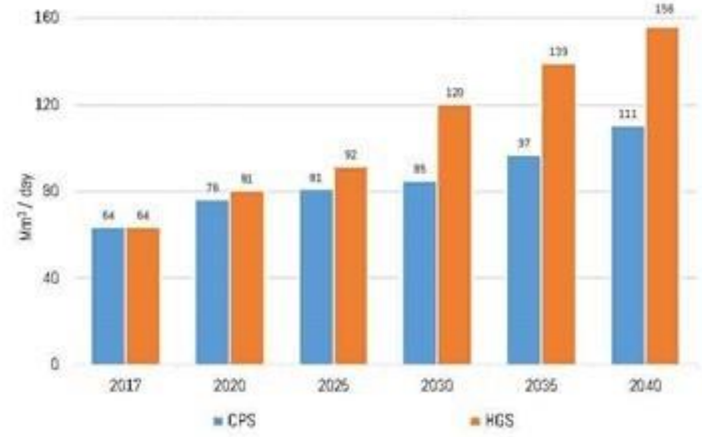
Source: Simulation results

Figure 3.59. Electricity generation with natural gas in the Andean Zone



Source: Simulation results

Figure 3.60. Natural gas input for electricity generation in the Andean Zone



Source: Simulation results

3.4.3 Projection of the total energy supply

In the CPS scenario, natural gas is the source with the lowest growth rate in the projection period (**Table 3.31**), however, under the premises of the HGS scenario, the total supply of natural gas has a higher average annual growth rate, comparable with that of hydropower (**Table 3.32**). Due to the difference in energy efficiencies, with the HGS scenario, annual savings in the total energy supply of around 9,000 ktoe are achieved in 2040, compared to the projected with the CPS scenario.

Table 3.31. Projection of the total energy supply in the Andean Zone, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	66,476	63,678	72,478	91,444	104,961	119,829	2.6%
Natural gas	64,592	70,402	74,412	79,443	89,628	102,914	2.0%
Coal and coke	6,431	8,544	11,297	13,925	18,612	24,215	5.9%
Hydroelectricity	15,222	17,628	21,332	23,938	28,018	33,323	3.5%
Biomass	8,947	11,320	11,227	11,887	14,084	17,427	2.9%
Other renewable	142	698	899	1,375	3,139	6,340	18.0%
TOTAL	161,810	172,269	191,646	222,012	258,443	304,048	2.8%

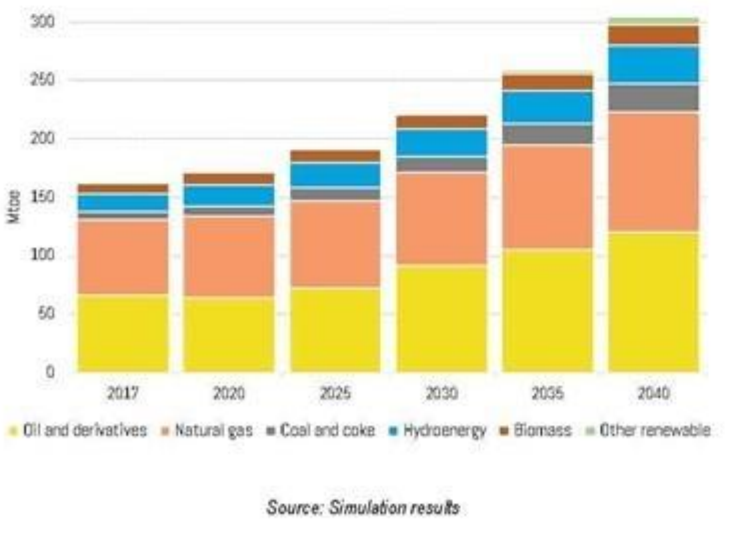
Source: Simulation results

Table 3.32. Projection of the total energy supply in the Andean Zone, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	66,476	63,861	70,023	79,409	89,297	100,235	1.8%
Natural gas	64,592	64,137	72,067	87,975	104,006	123,555	2.9%
Coal and coke	6,431	7,173	8,360	9,718	11,587	13,823	3.4%
Hydroelectricity	15,222	17,628	21,332	23,938	28,018	33,323	3.5%
Biomass	8,947	11,320	11,258	11,947	14,147	17,428	2.9%
Other renewable	142	698	899	1,375	3,139	6,340	18.0%
TOTAL	161,810	164,816	183,940	214,362	250,195	294,703	2.6%

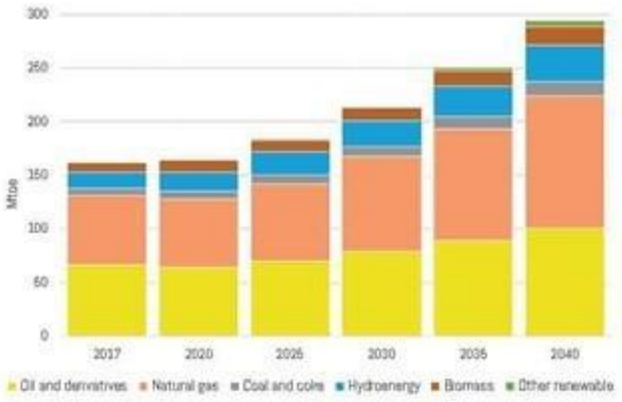
Source: Simulation results

Figure 3.61. Projection of the total energy supply in the Andean Zone, CPS



Source: Simulation results

Figure 3.62. Projection of the total energy supply in the Andean Zone, HGS

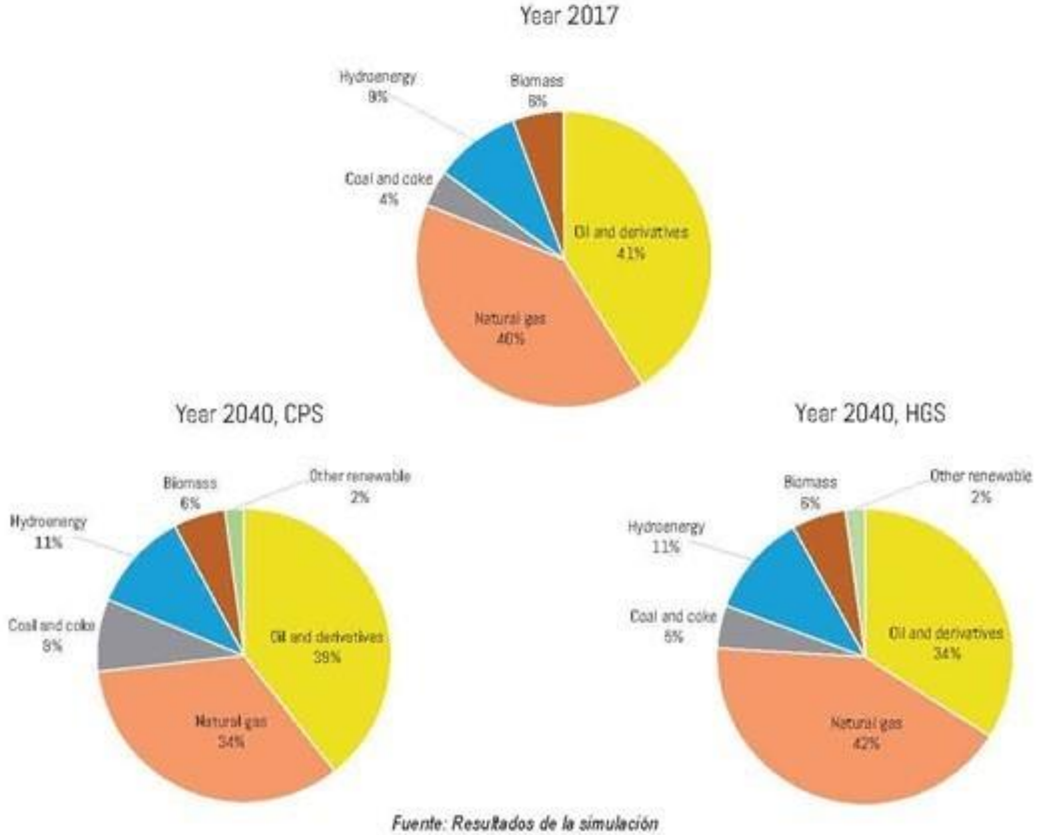


Source: Simulation results

It should be noted that, unlike the HGS scenario, where natural gas maintains its second place in the supply matrix, behind oil and its derivatives, throughout the projection period, in the HGS scenario, this source becomes established in the year 2040, as the main source of energy offered in the countries of the Andean Zone (**Figure 3.63**).

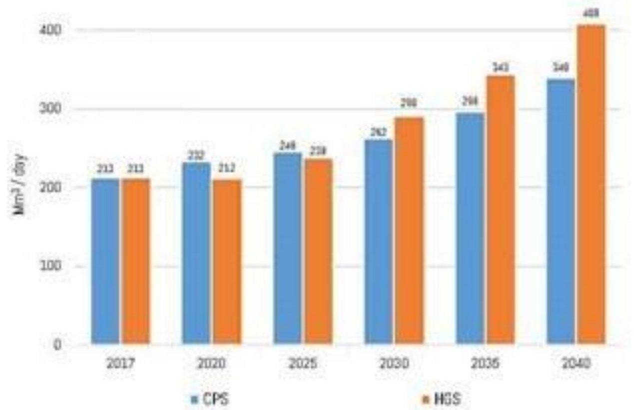
In volumetric units, the total supply of natural gas for the year 2040, in the HGS scenario, is 68 Mm^3 per day higher than that projected in the CPS scenario (**Figure 3.64**). This important volume of natural gas supply in the Andean Zone, would be supported mainly in the reserves and production capacities of countries such as Bolivia, Peru and Venezuela.

Figure 3.63. Evolution of the total energy supply matrix in the Andean Zone



Fuente: Resultados de la simulación

Figure 3.64. Total supply of natural gas in the Andean Zone



Source: Simulation results

3.5 Southern Cone

3.5.1 Projection of final energy consumption

Mainly due to the presence of Argentina, the Southern Cone subregion has a high gas component in its final consumption matrix, which reaches a 21% share in the base year. With the CPS scenario, this consumption increases in the projection period at an average annual rate of 1.5%, while in the HGS scenario, where oil consumption shifts, the annual growth rate of natural gas consumption reaches 2.5% (**Tables 3.33** and **3.34**). Thanks to the greater efficiency of this source in the final consumption processes, in relation to the use of liquid petroleum fuels, by 2040, a net saving in the annual energy consumed of around 1,400 ktoe is achieved.

Table 3.33. Projection of final energy consumption in the Southern Cone, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	43,617	46,746	53,418	62,277	73,897	89,072	3.2%
Natural gas	20,895	21,784	23,396	25,194	27,202	29,453	1.5%
Coal and coke	689	639	573	521	481	450	-1.8%
Biomass	13,004	13,646	15,114	17,165	19,939	23,618	2.6%
Electricity	19,226	21,179	24,945	29,471	34,926	41,519	3.4%
TOTAL	97,430	103,994	117,446	134,628	156,444	184,111	2.8%

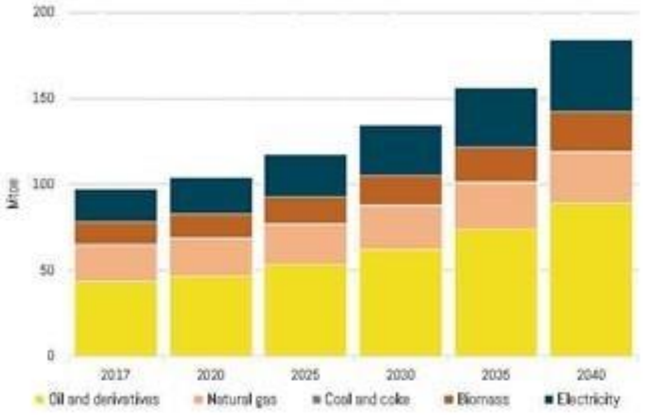
Source: Projection based on the referential expansion plans of the Southern Cone countries

Table 3.34. Projection of final energy consumption in the Southern Cone, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	43,617	46,746	52,155	59,310	68,613	80,615	2.7%
Natural gas	20,895	21,784	24,447	27,668	31,618	36,527	2.5%
Coal and coke	689	639	573	521	481	450	-1.8%
Biomass	13,004	13,646	15,133	17,192	19,959	23,618	2.6%
Electricity	19,226	21,179	24,956	29,489	34,942	41,519	3.4%
TOTAL	97,430	103,994	117,265	134,180	155,612	182,729	2.8%

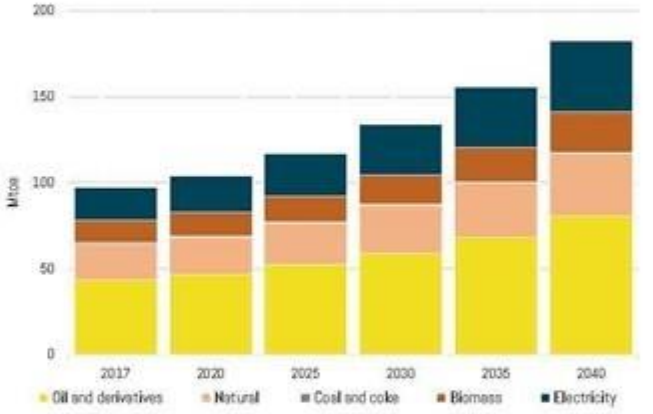
Source: Simulation results

Figure 3.65. Projection of final energy consumption in the Southern Cone, CPS



Source: Projection based on the referential expansion plans of the Southern Cone countries

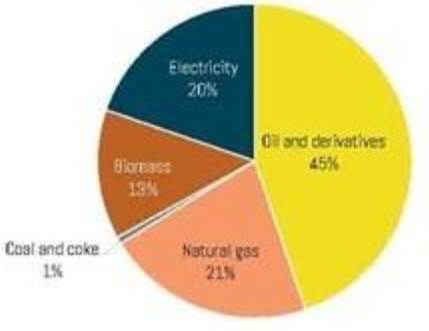
Figure 3.66. Projection of final energy consumption in the Southern Cone, HGS

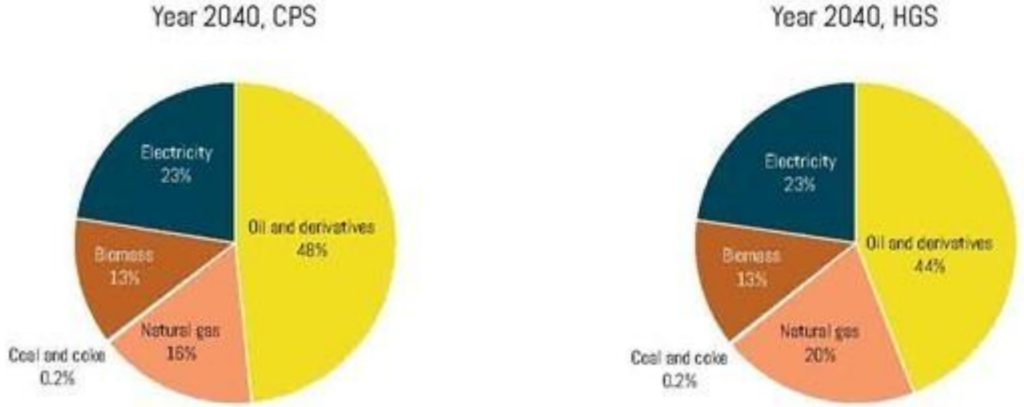


Source: Simulation results

Figure 3.67. Evolution of the final energy consumption matrix in the Southern Cone

Year 2017

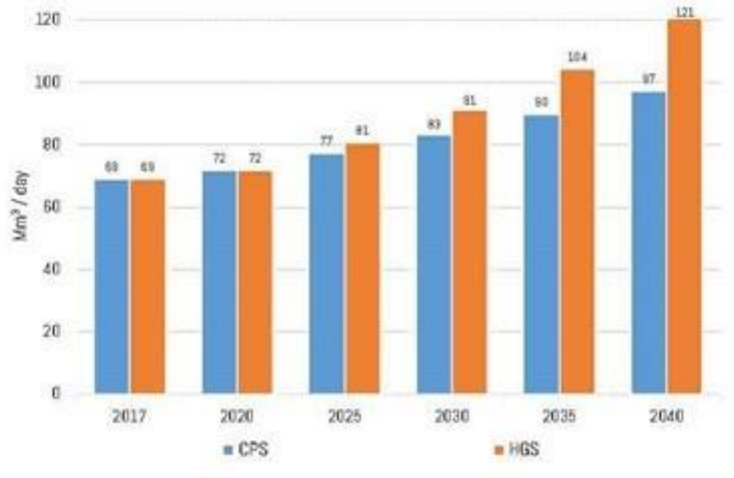




Source: Simulation results

In both scenarios analyzed, natural gas loses some percentage share in the consumption matrix in the year 2040, compared to the base year, due to the greater penetration of electricity, however, in the HGS, the consumption of natural gas, has an increased 4 percent participation than in the CPS (**Figure 3.67**), scenario, which, in volumetric terms, means an additional consumption of 24 Mm^3 per day, in 2040 (**Figure 3.68**).

Figure 3.68. Projection of final consumption of natural gas in the Southern Cone

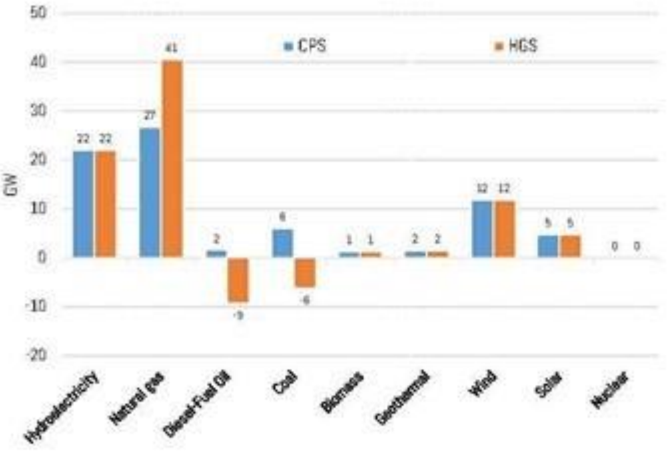


Source: Simulation results

3.5.2 Projection of electricity generation

The natural gas plants are the most relevant in the expansion of the electricity generation system of the Southern Cone, in both scenarios analyzed; following them in order of added capacity, hydraulic and wind power. In the HGS scenario, 14 GW are installed during the projection period, more of natural gas plants than in the CPS scenario, at the expense of the removal of Diesel-Fuel Oil and coal power plants (**Figure 3.69**).

Figure 3.69. Expansion of installed electricity generation capacity in the Southern Cone, during the projection period



Source: Projection based on the referential expansion plans of the Southern Cone countries

Table 3.35. Projection of installed capacity in the Southern Cone, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	28,260	30,906	33,580	38,380	44,380	50,380
Natural gas	18,044	18,544	23,544	29,844	37,344	44,844
Diesel-Fuel Oil	9,272	9,272	9,372	9,872	10,372	10,872
Coal	6,153	7,244	8,244	9,744	10,744	12,244
Biomass	949	1,149	1,549	1,749	1,949	2,349
Geothermal	28	28	28	528	1,028	1,528
Wind	3,048	5,614	7,746	10,446	11,946	14,946
Solar	2,133	3,168	4,168	4,968	5,968	6,968
Nuclear	1,755	1,755	1,755	1,755	1,755	1,755
TOTAL	69,642	77,680	89,986	107,286	125,486	145,886

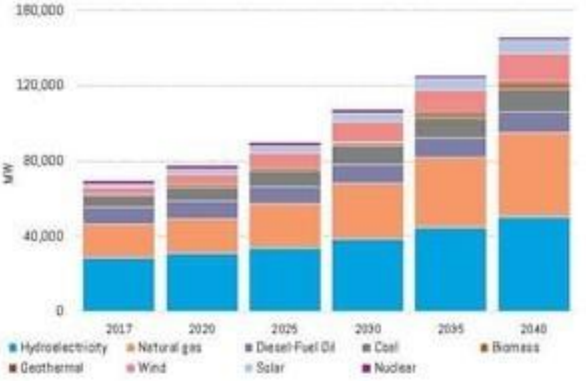
Source: Simulation results

Table 3.36. Projection of installed capacity in the Southern Cone, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	28,260	30,906	33,580	38,380	44,380	50,380
Natural gas	18,044	20,544	30,544	41,044	49,801	58,584
Diesel-Fuel Oil	9,272	9,272	9,272	9,272	0	0
Coal	6,153	6,244	3,744	1,244	0	0
Biomass	949	1,149	1,549	1,749	1,949	2,349
Geothermal	28	28	28	528	1,028	1,528
Wind	3,048	5,614	7,746	10,446	11,946	14,946
Solar	2,133	3,168	4,168	4,968	5,968	6,968
Nuclear	1,755	1,755	1,755	1,755	1,755	1,755
TOTAL	69,642	78,680	92,386	109,386	116,827	136,510

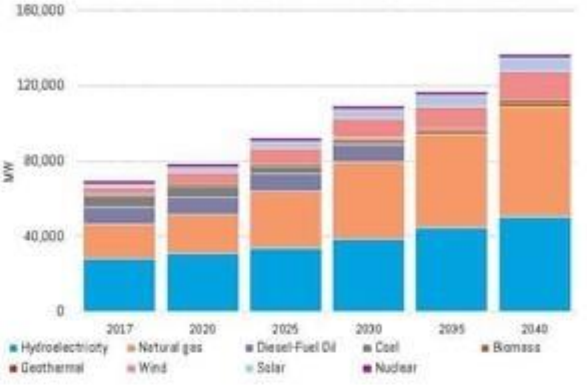
Source: Simulation results

Figure 3.70. Projection of installed capacity in the Southern Cone, CPS



Source: Simulation results

Figure 3.71. Projection of installed capacity in the Southern Cone, HGS



Source: Simulation results

As for the generation of electricity, it should be noted first, that the subregion of the Southern Cone is purely a power exporter, mainly due to Paraguay's exports to Brazil, of the energy that corresponds to it from the Binational Hydroelectric Power Plant Itaipu, this is why the total generation exceeds the internal demand for electricity, as observed in **Figures 3.72** and **Figure 3.73**.

Table 3.37. Projection of electricity generation in the Southern Cone, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	130,523	142,744	155,094	177,264	204,975	232,687
Natural gas	94,834	97,466	123,746	156,859	196,279	235,699
Diesel-Fuel Oil	16,244	32,490	32,304	17,373	8,715	7,863
Coal	32,340	38,075	43,331	51,215	56,471	64,355
Biomass	5,496	6,654	8,972	10,130	11,289	13,606
Geothermal	64	217	217	4,159	8,101	12,043
Wind	7,912	14,754	20,357	27,453	31,395	39,279
Solar	4,184	5,550	7,302	8,704	10,456	12,208
Nuclear	5,721	10,762	10,762	10,762	10,762	10,762
TOTAL	262,657	348,712	402,085	463,918	538,442	628,500

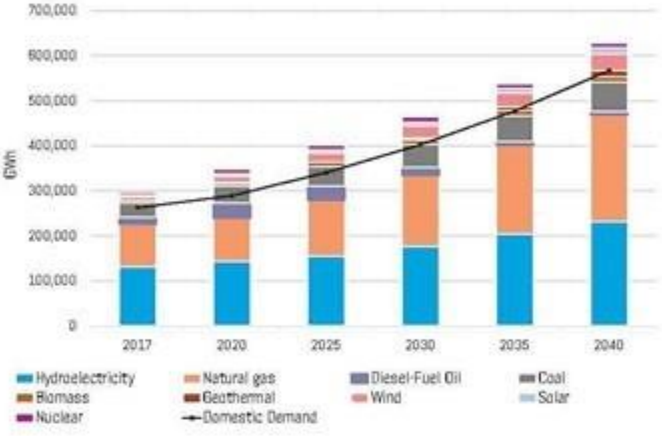
Source: Simulation results

Table 3.38. Projection of electricity generation in the Southern Cone, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	130,523	142,744	155,094	177,264	204,975	232,687
Natural gas	94,834	107,978	160,538	215,726	261,754	307,917
Diesel-Fuel Oil	16,244	29,161	19,373	3,511	0	0
Coal	32,340	32,819	19,679	6,539	0	0
Biomass	5,496	6,654	8,972	10,130	11,289	13,606
Geothermal	64	217	217	4,159	8,101	12,043
Wind	7,912	14,754	20,357	27,453	31,395	39,279
Solar	4,184	5,550	7,302	8,704	10,456	12,208
Nuclear	5,721	10,762	10,762	10,762	10,762	10,762
TOTAL	262,657	350,639	402,294	464,246	538,730	628,500

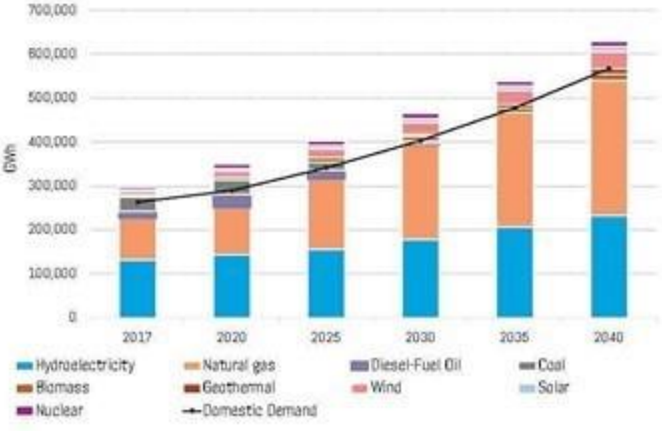
Source: Simulation results

Figure 3.72. Projection of electricity generation in the Southern Cone, CPS



Source: Simulation results

Figure 3.73. Projection of electricity generation in the Southern Cone, HGS

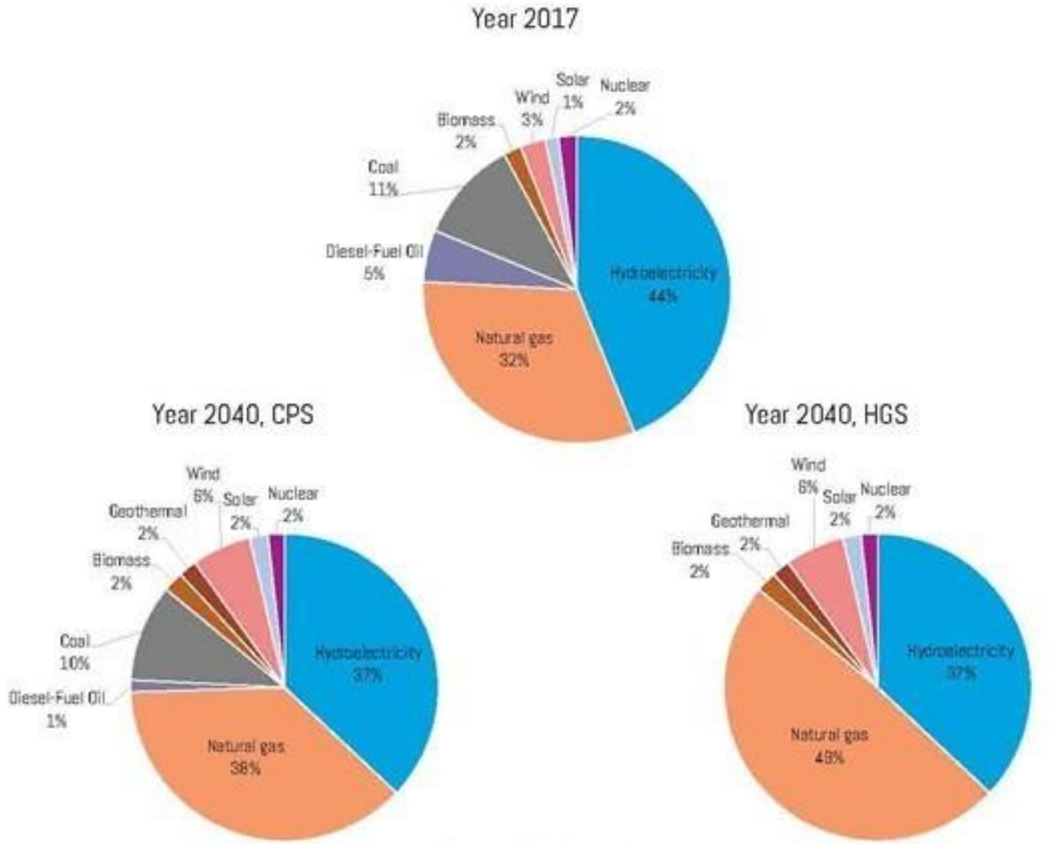


Source: Simulation results

The natural gas plants that, in the base year, were the second most important, behind the hydroelectric plants and had the third part of the total generation matrix, in 2040 will surpass in participation to the hydroelectric plants, occupying the first place and even contributing, in the HGS scenario, with very close to half of the total energy generated (**Figure 3.74**).

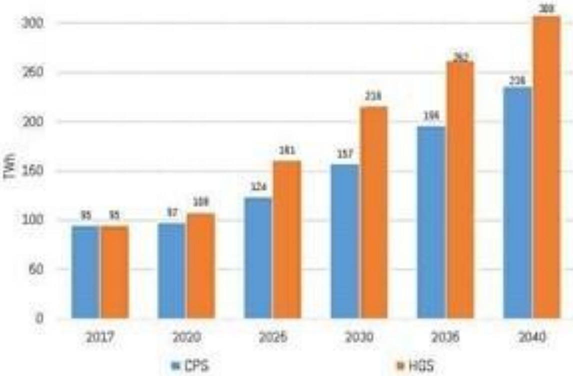
The generation with natural gas in the horizon year of the projection period reaches in the CPS and HGS scenarios, 236 and 308 TWh, with a daily volumetric requirement of natural gas input of 156 and 203 Mm^3 per day, respectively (**Figures 3.75** and **3.76**).

Figure 3.74. Evolution of the electricity generation matrix in the Southern Cone, scenario CPS



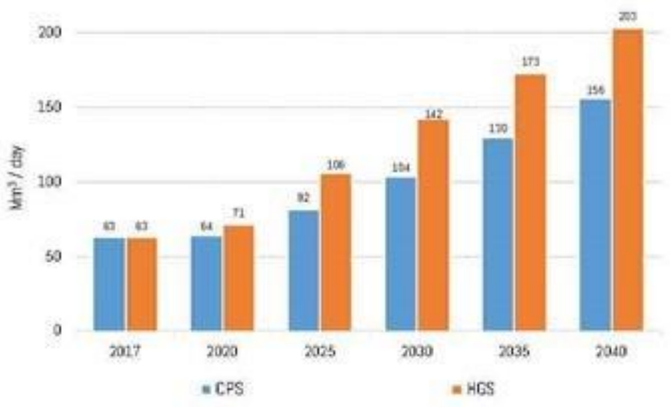
Source: Simulation results

Figure 3.75. Electricity generation with natural gas in the Southern Cone



Source: Simulation results

Figure 3.76. Natural gas input for electricity generation in the Southern Cone



Source: Simulation results

3.5.3 Projection of the total energy supply

In the base year, natural gas was already the main source of energy demanded and supplied in the subregion of the Southern Cone, with a 38% share of the total energy supply matrix. However, due to the higher annual average growth rate in the supply of oil and biomass in the CPS scenario, although in absolute terms it is still the main source offered, it loses some percentage share with respect to the total supply.

Table 3.39. Projection of the total energy supply in the Soutern Cone, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	46,389	55,596	62,882	67,724	76,228	92,677	3.1%
Natural gas	53,161	53,212	60,940	71,070	84,196	94,903	2.6%
Coal and coke	9,323	10,400	11,185	12,683	13,944	15,856	2.3%
Nuclear	1,745	3,283	3,283	3,283	3,283	3,283	2.8%
Hydroelectricity	8,732	7,703	8,645	10,635	13,122	15,608	2.6%
Biomass	18,043	19,668	23,118	26,499	30,772	36,958	3.2%
Other renewable	1,045	1,765	2,397	3,467	4,295	5,463	7.5%
TOTAL	138,438	151,626	172,451	195,360	225,839	264,749	2.9%

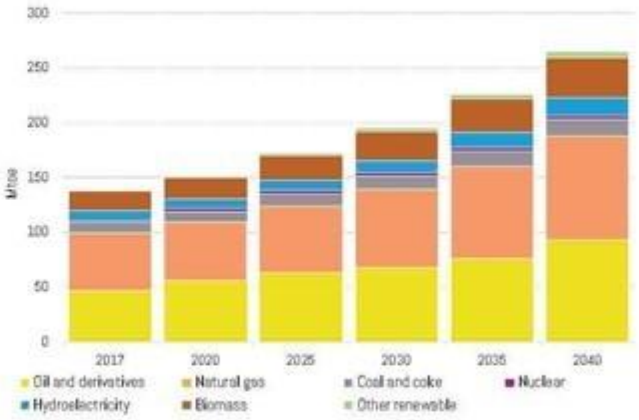
Source: Simulation results

Table 3.40. Projection of the total energy supply in the Southern Cone, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	46,389	54,766	57,856	60,031	68,506	81,322	2.5%
Natural gas	53,161	55,570	70,972	88,686	104,720	120,943	3.6%
Coal and coke	9,323	8,932	5,211	2,080	622	900	-9.7%
Nuclear	1,745	3,283	3,283	3,283	3,283	3,283	2.8%
Hydroelectricity	8,732	7,537	8,645	10,635	13,122	15,608	2.6%
Biomass	18,043	19,671	23,148	26,540	30,805	36,963	3.2%
Other renewable	1,045	1,765	2,397	3,467	4,295	5,463	7.5%
TOTAL	138,438	151,524	171,511	194,721	225,353	264,482	2.9%

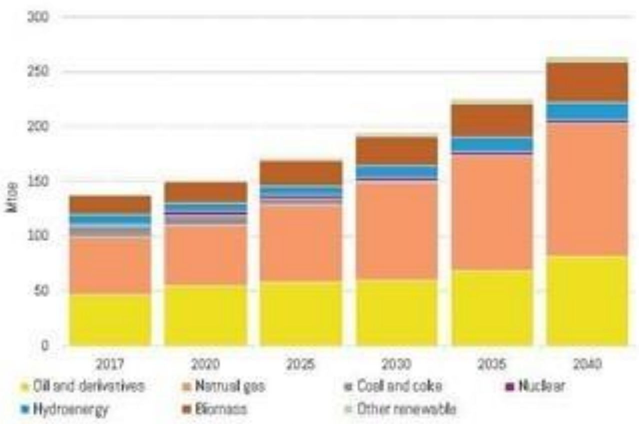
Source: Simulation results

Figure 3.77. Projection of the total energy supply in the Southern Cone, CPS



Source: Simulation results

Figure 3.78. Projection of the total energy supply in the Southern Cone, HGS

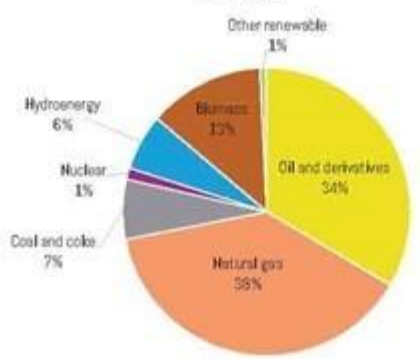


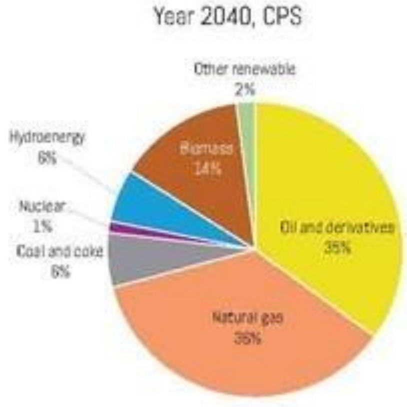
Source: Simulation results

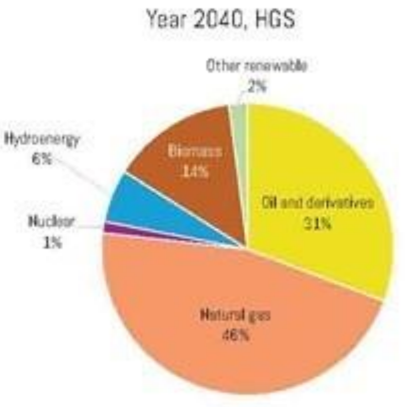
With the CPS scenario, natural gas loses two percentage points of participation in the total supply matrix, at the end of the projection period, while under the premises of substitution of sources of the HGS scenario, the percentage of natural gas participation is recovered, approaching to occupy half of the matrix of total energy supply (**Figure 3.79**).

Figure 3.79. Evolution of the total energy supply matrix in the Southern Cone

Year 2017





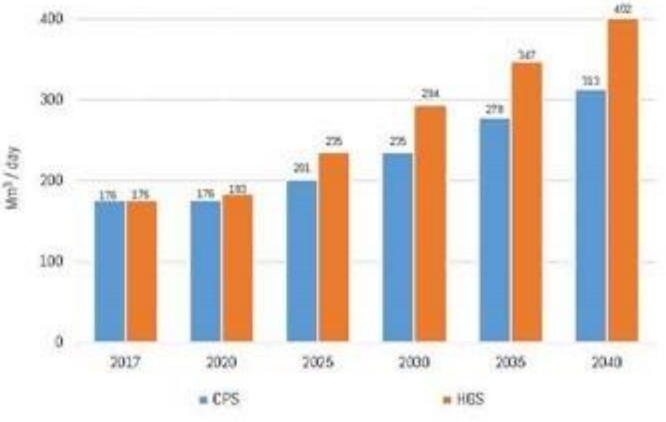


Source: Simulation results

The supply of domestic demand for natural gas in the subregion, which includes: final consumption in the socio-economic sectors, consumption for electricity generation, inputs to other transformation centers, own consumption and losses, requires a total daily supply in the year 2040 of 313 Mm^3 for the CPS scenario and 402 Mm^3 for the HGS scenario (**Figure 3.80**).

The volumes required to cover domestic demand in both scenarios analyzed are expected to come mostly from intra-regional production, given the existing reserves in the shale gas fields of Vaca Muerta in Argentina and the Paraguayan Chaco.

Figure 3.80. Total supply of natural gas in the Southern Cone



Source: Simulation results

3.6 The Caribbean

3.6.1 Projection of final energy consumption

In the final consumption matrix of the Caribbean subregion, oil derivatives and natural gas predominate. The high participation of natural gas in this matrix is mainly due to the presence of Trinidad and Tobago, the only country in the subregion, which is at the same time a net producer and exporter of this fuel. The growth of natural gas consumption under the premises of the CPS scenario, is projected with a very modest annual average rate of less than 1%, and even with the HGS scenario, where growth is accelerated due to the replacement of petroleum derivatives and coke, the average annual rate is still relatively low compared to other sources such as electricity and solid fuels. In any case, the penetration of natural gas in the final consumption, allows a saving in the total annual energy consumption to the year 2040 of around 200 ktoe (**Tables 3.41** and **3.42**).

Table 3.41. Projection of final energy consumption in the Caribbean, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	12,181	12,242	12,528	13,046	13,818	14,890	0.9%
Natural gas	11,290	11,554	12,014	12,501	13,016	13,561	0.8%
Coal and coke	444	491	579	684	807	952	3.4%
Biomass	4,794	4,981	5,323	5,714	6,167	6,702	1.5%
Electricity	4,231	4,553	5,170	5,906	6,787	7,850	2.7%
TOTAL	32,940	33,821	35,615	37,850	40,595	43,956	1.3%

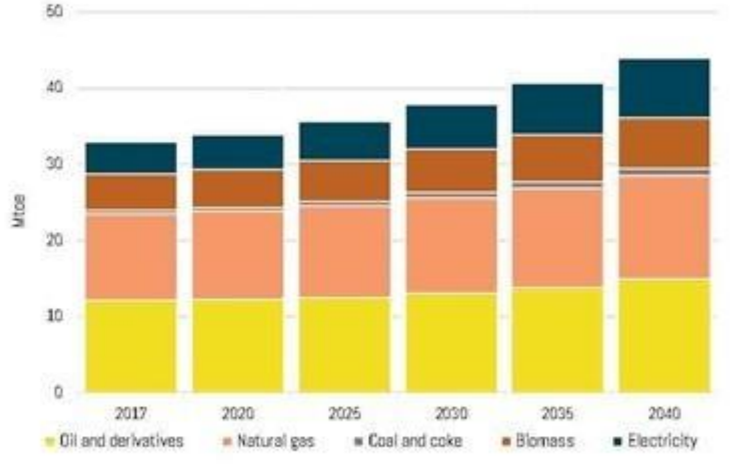
Source: Projection based on the referential expansion plans of the Caribbean countries

Table 3.42. Projection of final energy consumption in the Caribbean, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	12,181	12,242	12,415	12,766	13,234	13,661	0.5%
Natural gas	11,290	11,554	12,096	12,719	13,512	14,688	1.2%
Coal and coke	444	491	559	635	722	821	2.7%
Biomass	4,794	4,981	5,354	5,766	6,220	6,702	1.5%
Electricity	4,231	4,553	5,191	5,946	6,832	7,850	2.7%
TOTAL	32,940	33,821	35,615	37,832	40,519	43,723	1.2%

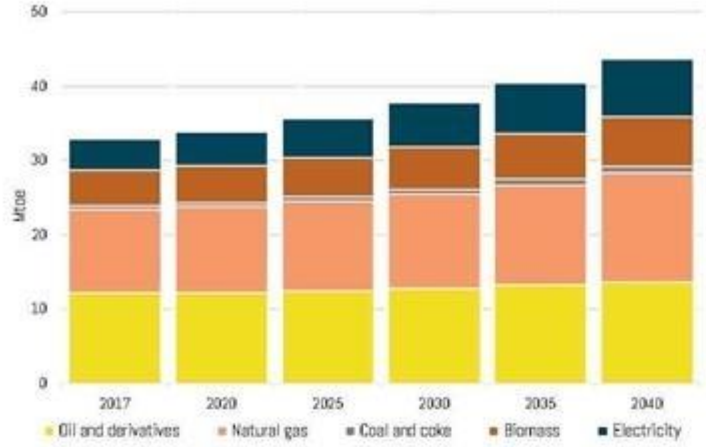
Source: Projection based on the referential expansion plans of the Caribbean countries

Figure 3.81. Projection of final energy consumption in the Caribbean, CPS



Source: Projection based on the referential expansion plans of the Caribbean countries

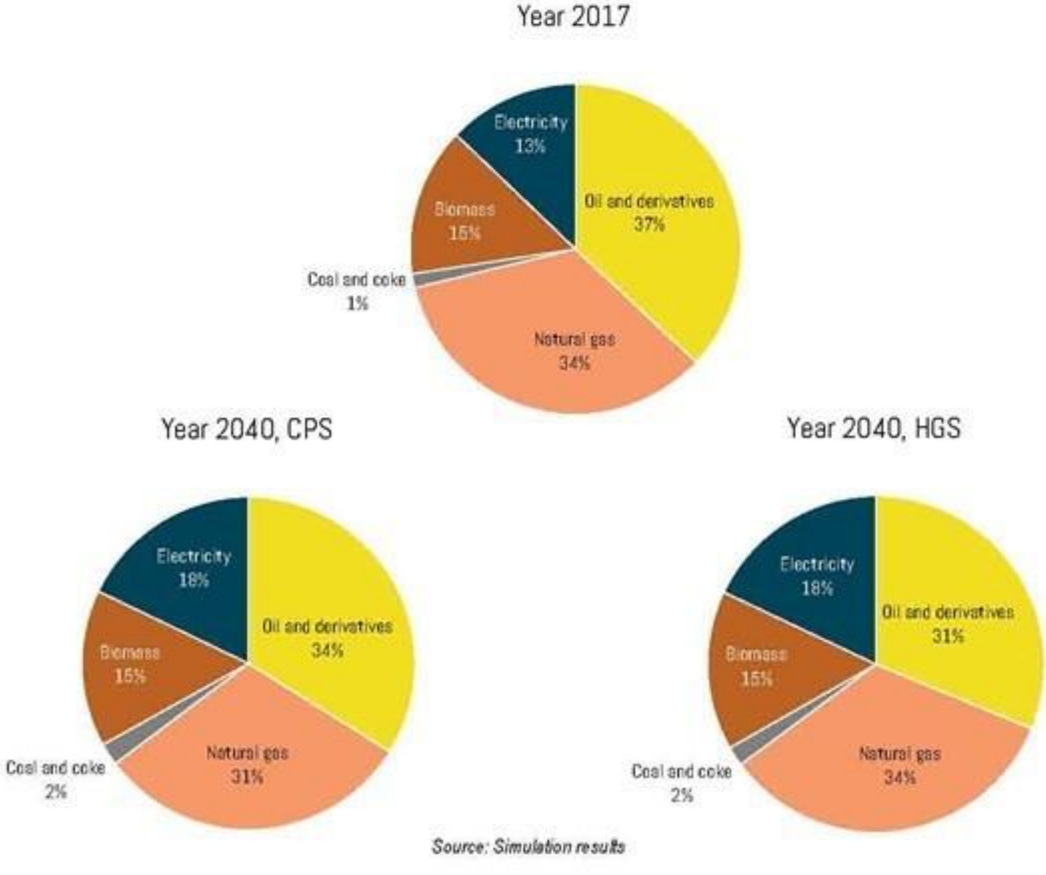
Figure 3.82. Projection of final energy consumption in the Caribbean, HGS



Source: Simulation results

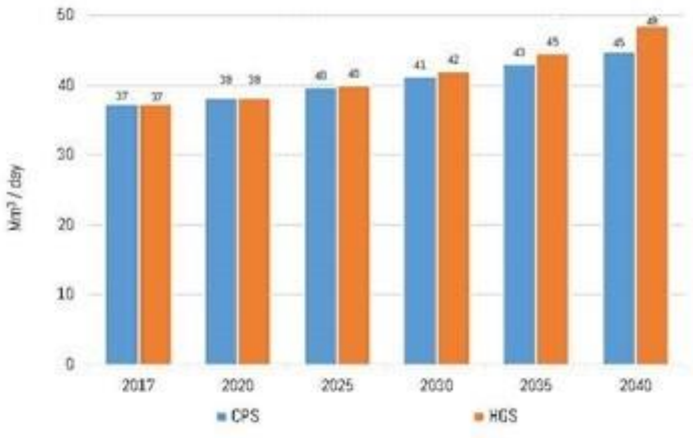
Due to the greater penetration of electricity in the consumption matrix, with the CPS scenario, natural gas loses share with respect to the base year, however, under the premises of the HGS scenario, it at least maintains its participation of one third of said matrix (**Figure 3.83**).

Figure 3.83. Evolution of the final energy consumption matrix in the Caribbean



Source: Simulation results

Figure 3.84. Final consumption of natural gas in the Caribbean

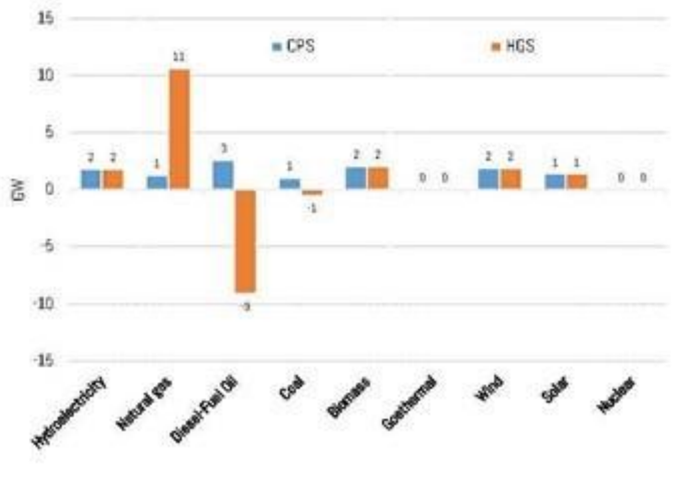


Source: Simulation results

3.6.2 Projection of electricity generation

In the CPS scenario, the expansion of the electricity generation system in the Caribbean still bets more heavily on conventional diesel-fuel oil thermal power plants, while the additional capacity of natural gas plants is modest. On the contrary, under the premises of the HGS scenario, the main expansion is with natural gas plants, replacing Diesel-Fuel Oil and coal power plants, which are removed from the system (**Figure 3.85**).

Figure 3.85. Expansion of installed electricity generation capacity in the Caribbean, during the projection period



Source: Projection based on the referential expansion plans of the Caribbean countries

Thanks to the best plant factor with which the natural gas plants operate, in comparison to Diesel-Fuel Oil, the capacity required in the HGS scenario is about 4,000 MW lower than that required in the CPS scenario, in the end of the projection period (**Tables 3.43** and **3.44**).

Table 3.43. Projection of installed capacity in the Caribbean, CPS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	962	999	1,184	1,742	2,242	2,742
Natural gas	3,709	4,009	4,409	5,009	5,009	5,009
Diesel-Fuel Oil	10,274	10,274	10,274	10,274	10,274	12,853
Coal	538	1,370	1,370	1,570	1,570	1,570
Biomass	588	913	1,413	1,813	2,213	2,613
Wind	249	1,073	1,359	1,609	1,859	2,109
Solar	228	536	786	1,075	1,340	1,605
TOTAL	16,547	19,173	20,794	23,091	24,506	28,500

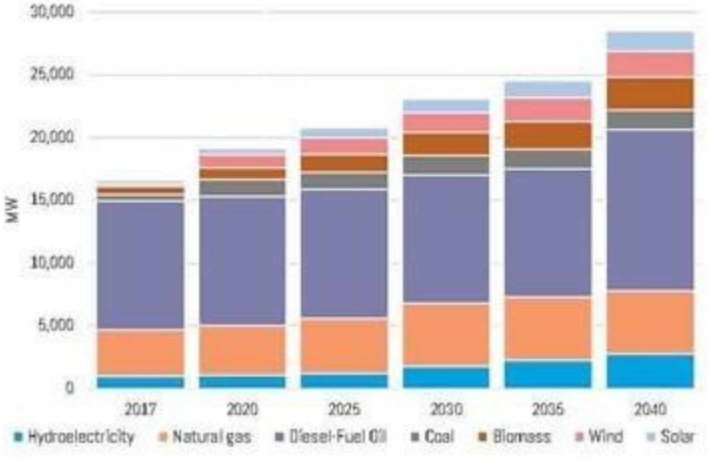
Source: Projection based on the referential expansion plans of the Caribbean countries

Table 3.44. Projection of installed capacity in the Caribbean, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	962	999	1,184	1,742	2,242	2,742
Natural gas	3,709	4,409	6,809	9,309	11,809	14,309
Diesel-Fuel Oil	10,274	5,842	5,350	3,594	2,125	1,137
Coal	538	1,170	170	0	0	0
Biomass	588	913	1,413	1,813	2,213	2,613
Wind	249	1,073	1,359	1,609	1,859	2,109
Solar	228	536	786	1,075	1,340	1,605
TOTAL	16,547	14,941	17,070	19,141	21,587	24,514

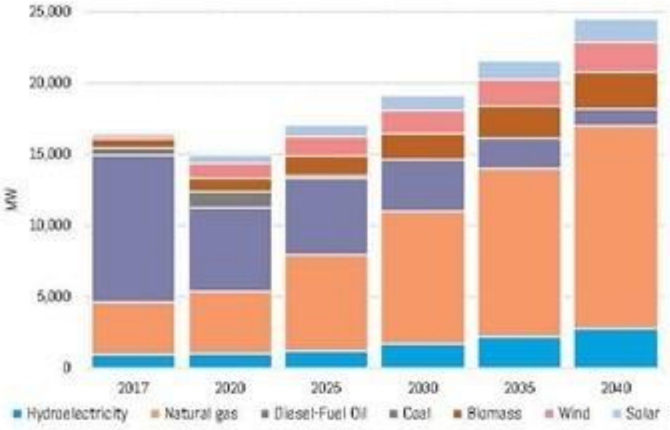
Source: Simulation results

Figure 3.86. Projection of installed capacity in the Caribbean, CPS



Source: Projection based on the referential expansion plans of the Caribbean countries

Figure 3.87. Projection of installed capacity in the Caribbean, HGS



Source: Simulation results

Table 3.45. Projection of electricity generation in the Caribbean, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	3,572	3,709	4,396	6,468	8,324	10,180
Natural gas	22,093	23,880	26,263	29,837	29,837	29,837
Diesel-Fuel Oil	29,699	24,239	28,039	29,996	39,036	50,667
Coal	3,156	8,039	8,039	9,213	9,213	9,213
Biomass	956	1,485	2,299	2,950	3,601	4,251
Wind	701	3,023	3,829	4,533	5,238	5,942
Solar	300	707	1,036	1,417	1,767	2,117
TOTAL	60,480	65,082	73,901	84,414	97,015	112,206

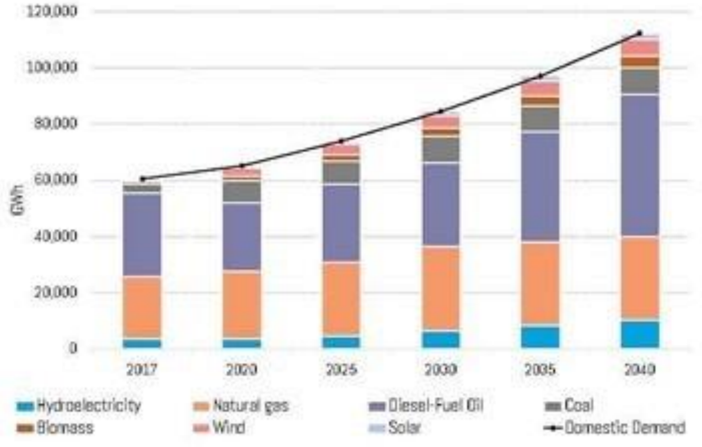
Source: Simulation results

Table 3.46. Projection of electricity generation in the Caribbean, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	3,572	3,709	4,396	6,468	8,324	10,180
Natural gas	22,093	26,263	40,560	55,452	70,343	85,235
Diesel-Fuel Oil	29,699	23,030	21,092	14,166	8,377	4,481
Coal	3,156	6,865	996	0	0	0
Biomass	956	1,485	2,299	2,950	3,601	4,251
Wind	701	3,023	3,829	4,533	5,238	5,942
Solar	300	707	1,036	1,417	1,767	2,117
TOTAL	60,478	65,082	74,207	84,985	97,649	112,206

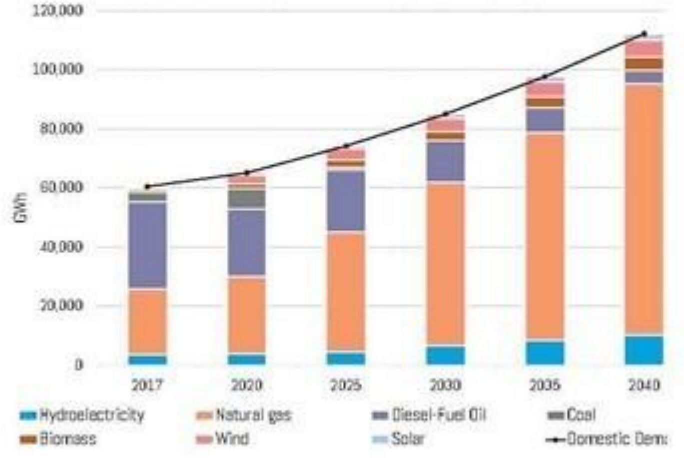
Source: Simulation results

Figure 3.88. Projection of electricity generation in the Caribbean, CPS



Source: Simulation results

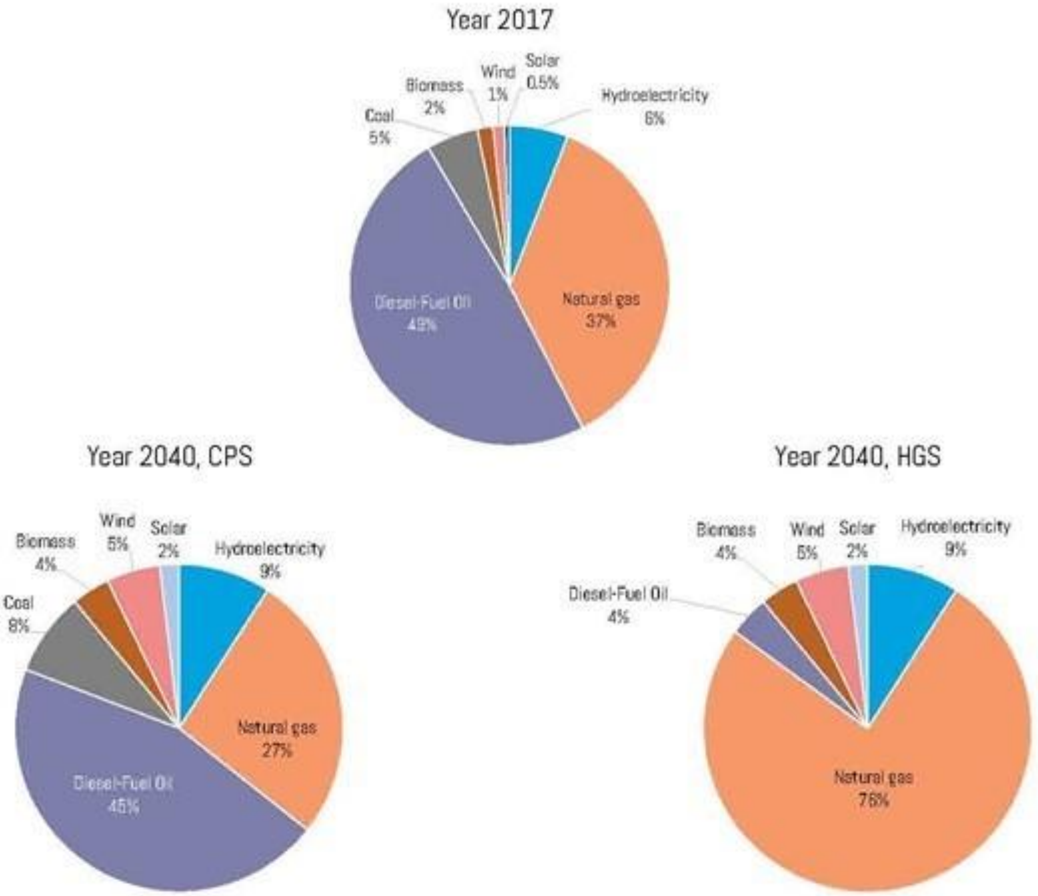
Figure 3.89. Projection of electricity generation in the Caribbean, HGS



Source: Simulation results

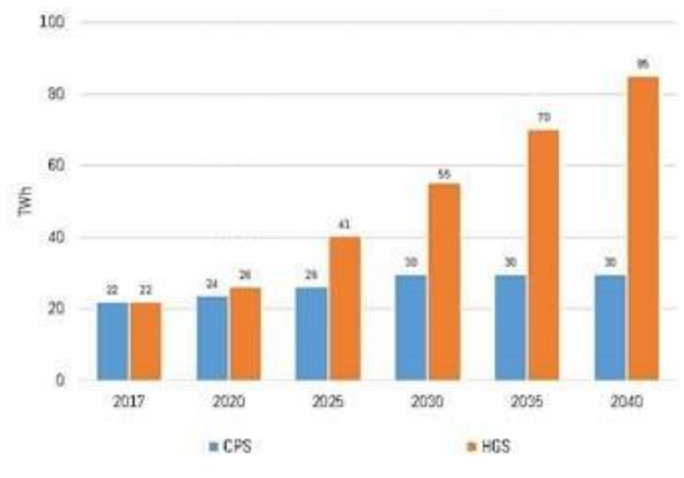
As for the electricity generation matrix, in the CPS scenario, the predominance of the Diesel-Fuel Oil thermal power plants persists, throughout the projection period, and even the natural gas power plants, decrease their percentage share with respect to the base year due to the expansion of renewable energies, such as hydro, wind and solar. However, in the HGS scenario, the natural gas plants, in 2040, have a share of almost three quarters of the matrix (**Figure 3.90**). To achieve this in that year, in the HGS scenario, 55 TWh more than in the CPS scenario must be generated with natural gas plants and an additional 31 Mm^3 are required, as input to these plants (**Figures 3.91** and **3.92**).

Figure 3.90. Evolution of the electricity generation matrix in the Caribbean



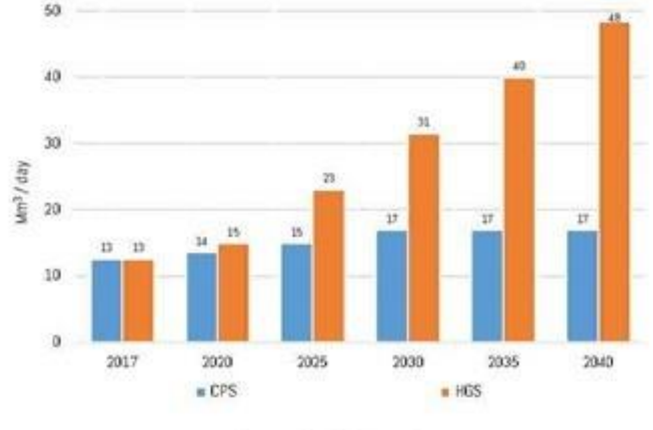
Source: Simulation results

Figure 3.91. Electricity generation with natural gas in the Caribbean



Source: Simulation results

Figure 3.92. Natural gas input for electricity generation in the Caribbean



Source: Simulation results

3.6.3 Projection of the total energy supply

Thanks to the greater efficiency in the use of natural gas, both in the final consumption sectors, and in the electricity generation sector, compared to the use of liquid and solid fossil fuels, with the HGS scenario, in the end of projection horizon, an annual saving in the total energy supply of around 2,000 ktoe is achieved, compared to the results of the CPS scenario (**Tables 3.47** and **3.48**).

Table 3.47. Projection of the total energy supply in the Caribbean, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	19,620	18,541	19,649	20,642	23,415	27,088	1.4%
Natural gas	17,690	18,342	19,372	20,678	21,426	22,258	1.0%
Coal and coke	1,170	2,343	2,431	2,806	2,928	3,072	4.3%
Hydroenergy	357	370	439	646	831	1,016	4.7%
Biomass	6,205	6,715	7,520	8,339	9,262	10,326	2.2%
Other renewable	86	321	418	512	602	693	9.5%
TOTAL	45,128	46,631	49,829	53,621	58,464	64,453	1.6%

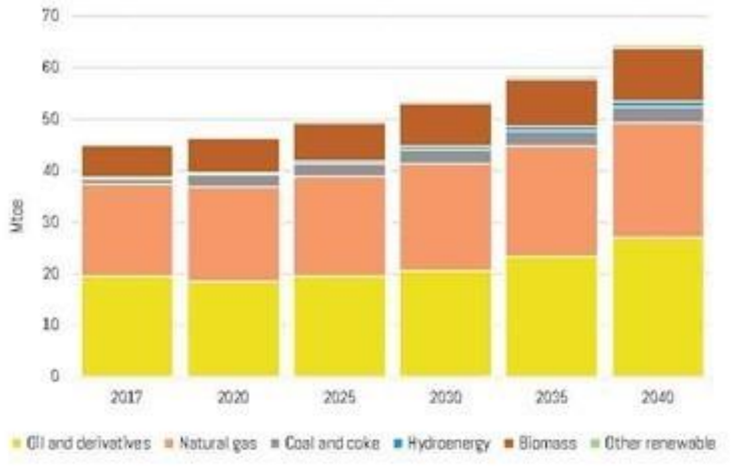
Source: Simulation results

Table 3.48. Projection of the total energy supply in the Caribbean, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	19,620	18,495	18,318	17,262	16,689	16,356	-0.8%
Natural gas	17,690	18,803	22,025	25,462	29,135	33,212	2.8%
Coal and coke	1,170	2,072	784	630	716	814	-1.6%
Hydroenergy	357	370	439	646	831	1,016	4.7%
Biomass	6,205	6,716	7,562	8,411	9,335	10,327	2.2%
Other renewable	86	321	418	512	602	693	9.5%
TOTAL	45,128	46,776	49,546	52,922	57,309	62,417	1.4%

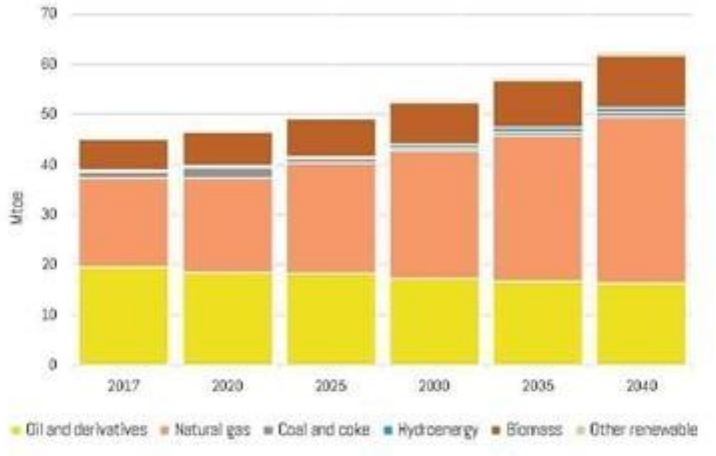
Source: Simulation results

Figure 3.93. Projection of the total energy supply in the Caribbean, CPS



Source: Simulation results

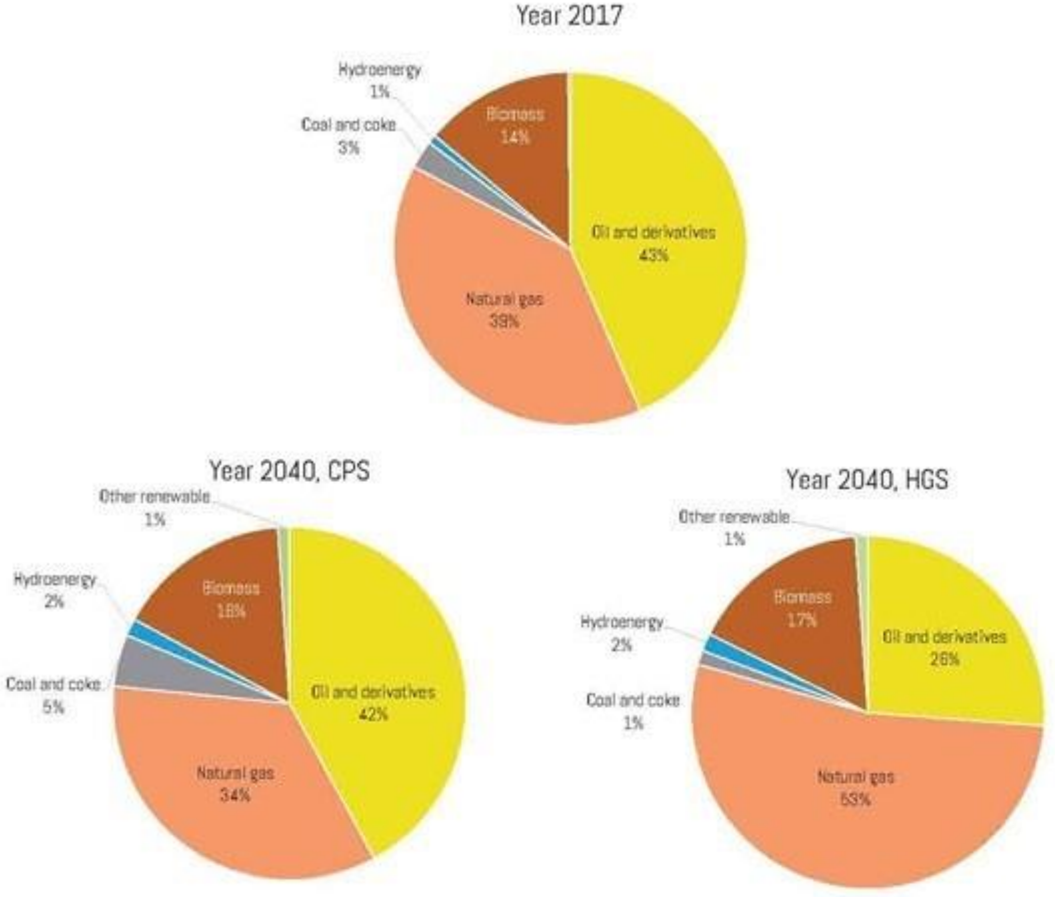
Figure 3.94. Projection of the total energy supply in the Caribbean, HGS



Fuente: Resultados de la simulación

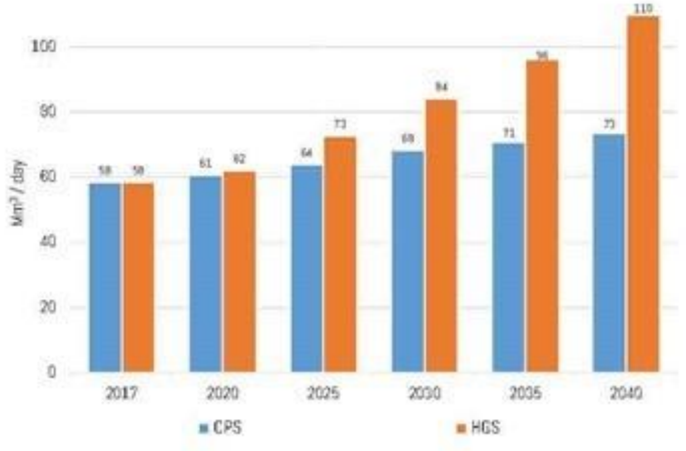
Due to the contribution of Trinidad and Tobago in the subregion, natural gas maintains an important participation in the matrix of total energy supply, very close to that of oil and its derivatives, throughout the projection period. However, while in the CPS scenario, natural gas loses some percentage points, compared to renewable energy and mineral coal, in the HGS scenario, it represents more than half of the total supply matrix at the end of the projection period (**Figure 3.95**). In order to reach this condition, in the HGS Scenario, it is necessary to offer, in 2040, an additional 37 Mm^3 to those offered in the CPS scenario (**Figure 3.96**).

Figure 3.95. Evolution of the total energy supply matrix in the Caribbean



Source: Simulation results

Figure 3.96. Projection of the total supply of natural gas in the Caribbean



Source: Simulation results

As indicated above, Trinidad and Tobago is the largest producer, consumer and exporter of natural gas in the subregion, however, other countries such as Cuba, Dominican Republic and Jamaica, also include in their energy matrix the use of natural gas, although in much more modest quantities.

While most of the natural gas imports within the subregion could come from Trinidad and Tobago, there is also the possibility of imports from the United States and Canada.

3.7 Latin America and the Caribbean (LAC)

3.7.1 Projection of final energy consumption

The accumulated values of final energy consumption of the 2 countries and the 4 subregions analyzed in this chapter, are presented in **Tables 3.49** and **3.50**, for the CPS and HGS scenarios respectively, where it can be observed that the average annual rate of growth in consumption of Natural gas in HGS is almost double that of the CPS, while oil and coal and coke are reduced. As can be seen, for the final year of the projection period, thanks to the replacement of liquid and solid fuels modeled in the HGS scenario, a total energy consumption savings of 13,449 ktoe is achieved.

Table 3.49. Projection of final energy consumption in LAC, CPS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	308,324	326,850	363,265	407,605	461,520	527,276	2.4%
Natural gas	78,709	82,056	88,720	96,940	107,008	119,309	1.8%
Coal and coke	28,911	31,496	36,504	42,542	49,828	58,633	3.1%
Biomass	108,017	112,970	124,269	140,902	165,698	203,462	2.8%
Electricity	111,859	123,384	145,725	172,728	205,431	245,146	3.5%
TOTAL	635,822	676,755	758,483	860,715	989,485	1,153,826	2.6%

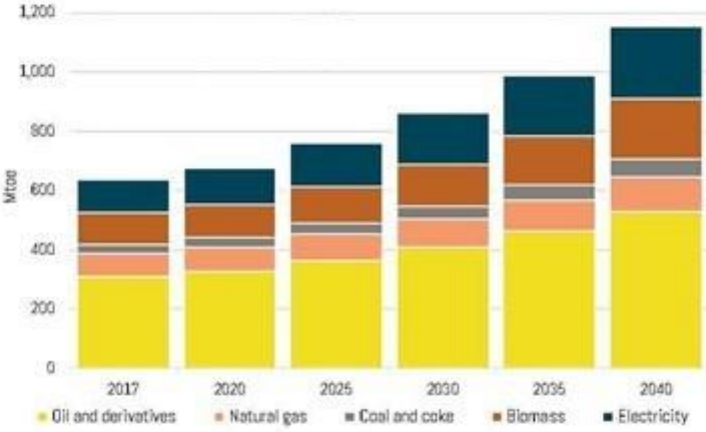
Source: Simulation results

Table 3.50. Projection of final energy consumption in LAC, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	308,324	326,850	357,055	391,953	430,677	469,916	1.8%
Natural gas	78,709	82,056	94,349	111,263	135,647	173,432	3.5%
Coal and coke	28,911	31,496	34,768	38,601	43,107	48,421	2.3%
Biomass	108,017	112,970	124,865	142,007	166,874	203,462	2.8%
Electricity	111,859	123,384	145,944	173,109	205,807	245,146	3.5%
TOTAL	635,822	676,756	756,980	856,933	982,112	1,140,377	2.6%

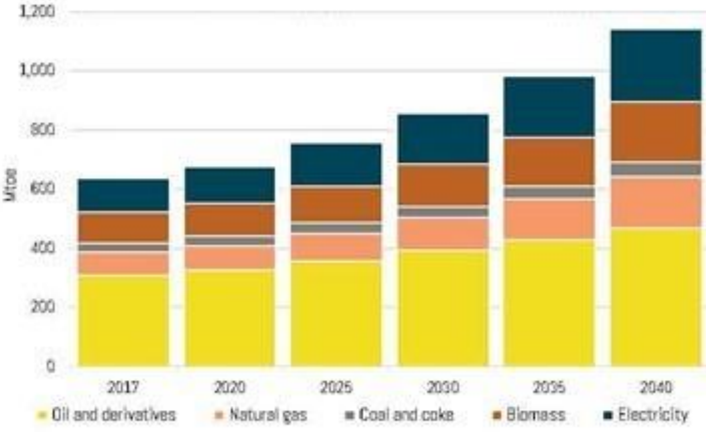
Source: Simulation results

Figure 3.97. Projection of final energy consumption in LAC, CPS



Source: Simulation results

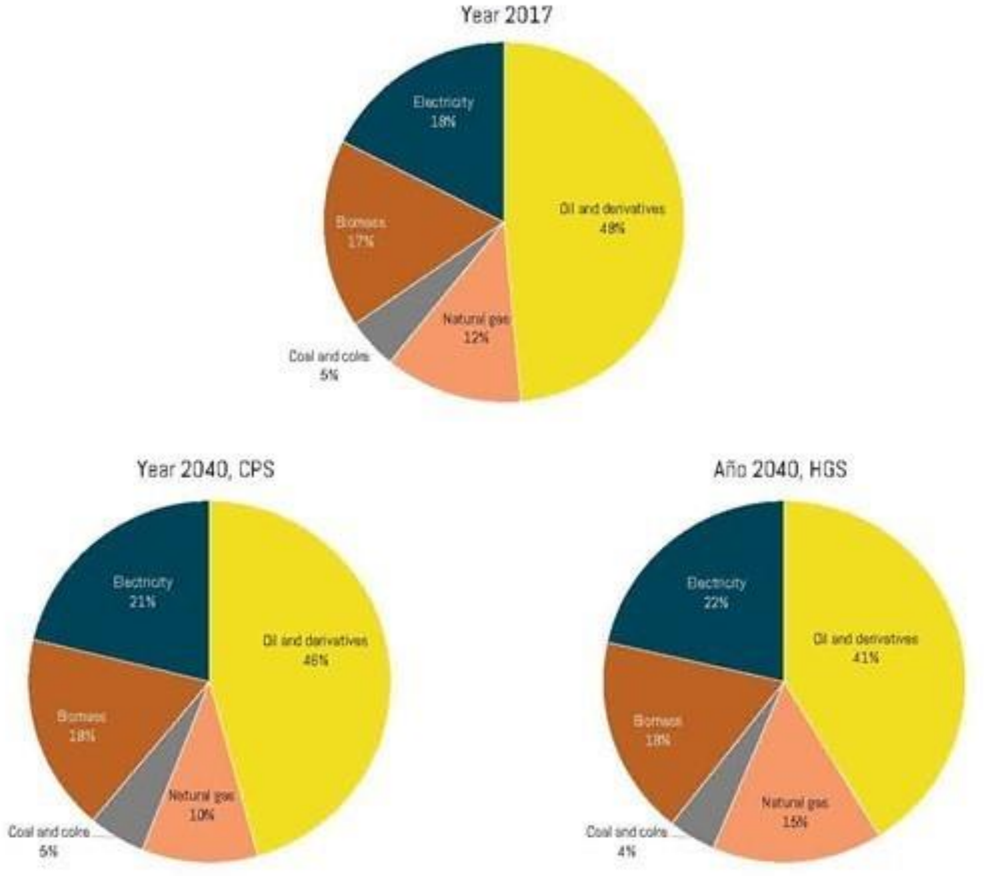
Figure 3.98. Projection of final energy consumption in LAC, HGS



Source: Simulation results

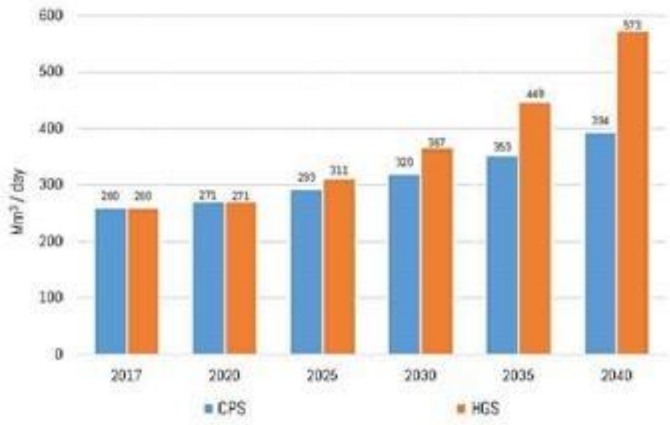
In the structure of the final consumption matrix, it is observed that for the CPS scenario, natural gas loses percentage share throughout the projection period, due to the more accelerated penetration of electricity, biomass and coal and coke, however, in the HGS scenario, having a growth rate similar to that of electricity, natural gas gains 3 percentage points, compared to the base year (**Figure 3.99**). Under this situation, at the end of the projection period, in the HGS scenario, 177 Mm^3 per day are consumed, more than in the CPS scenario (**Figure 3.100**).

Figure 3.99. Evolution of the final energy consumption matrix in LAC, scenario CPS



Source: Simulation results

Figure 3.100. Projection of final consumption of natural gas in LAC

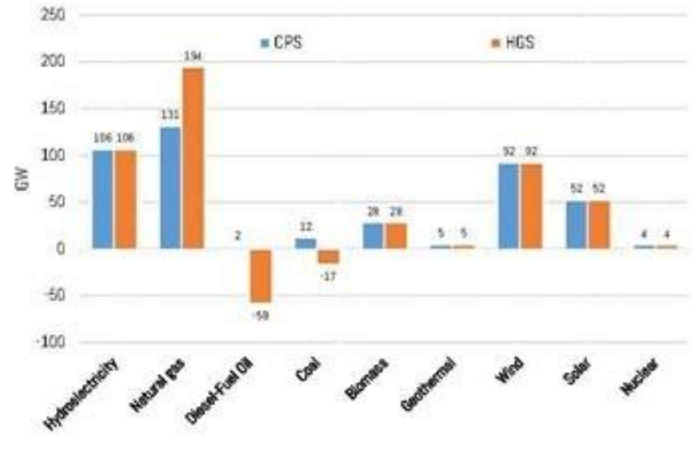


Source: Simulation results

3.7.2 Projection of electricity generation

As can be seen in **Figure 3.101**, the natural gas plants lead the expansion of the power generation park in the LAC region, in the two scenarios analyzed, surpassing even the hydroelectric ones, being opportune to highlight the importance that NCREs also have, as wind and photovoltaic in this expansion.

Figure 3.101. Expansion of installed power generation capacity in LAC, during the projection period



Source: Simulation results

A comparative view between the two scenarios, makes clear the replacement that is carried out in the HGS scenario, of installed capacity of Diesel-Fuel Oil and coal power plants by natural gas plants, which, thanks to a plant factor higher than the first, at the end of the projection period, the required installed capacity is reduced by around 30,000 MW (**Tables 3.51** and **3.52**).

Table 3.51. Projection of installed capacity in LAC, CPS (MW)

	2017	2020	2026	2030	2035	2040
Hydroelectricity	186,848	203,564	218,608	238,724	264,229	293,217
Natural gas	73,655	84,640	109,340	138,368	171,853	204,919
Diesel-Fuel Oil	63,019	62,342	62,207	62,296	61,714	65,093
Coal	17,319	20,691	22,852	23,462	25,962	29,062
Biomass	19,989	21,847	25,421	32,103	39,467	47,925
Geothermal	1,603	1,847	2,121	3,545	4,715	6,176
Wind	21,662	32,347	48,973	66,334	87,938	113,528
Solar	4,815	13,397	22,914	31,349	43,115	57,231
Nuclear	5,353	5,353	5,353	8,074	9,434	9,434
TOTAL	394,264	446,027	517,788	604,254	708,426	826,583

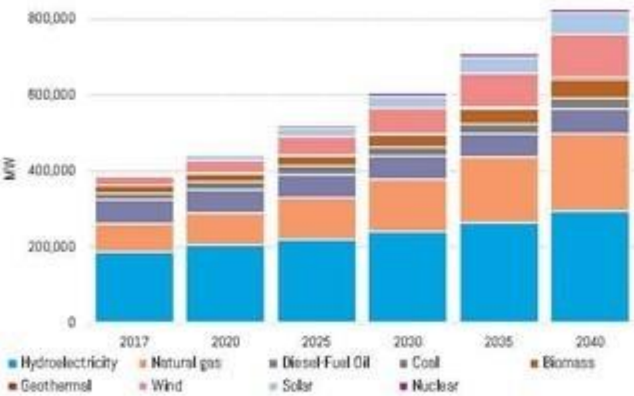
Source: Simulation results

Table 3.52. Projection of installed capacity in LAC, HGS (MW)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	186,848	203,564	218,608	238,724	264,229	293,217
Natural gas	73,655	92,723	135,194	177,029	220,240	267,782
Diesel-Fuel Oil	63,019	51,569	20,630	12,890	2,149	1,161
Coal	17,319	17,381	7,881	2,034	790	790
Biomass	19,989	21,847	25,421	32,103	39,467	47,925
Geothermal	1,603	1,847	2,121	3,545	4,715	6,176
Wind	21,662	32,347	48,973	66,334	87,938	113,528
Solar	4,815	13,397	22,914	31,349	43,115	57,231
Nuclear	5,353	5,353	5,353	8,074	9,434	9,434
TOTAL	394,264	440,027	487,095	572,082	672,077	797,243

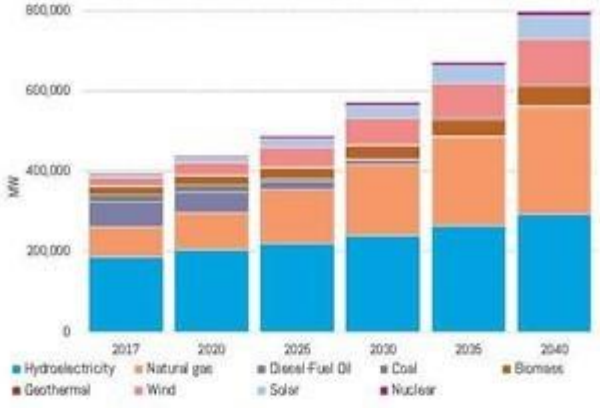
Source: Simulation results

Figure 3.102. Projection of installed capacity in LAC, CPS



Source: Simulation results

Figure 3.103. Projection of installed capacity in LAC, HGS



Source: Simulation results

Table 3.53. Projection of electricity generation in LAC, CPS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	734,777	837,563	934,010	1,022,730	1,133,417	1,261,832
Natural gas	427,696	498,532	645,521	822,770	1,024,576	1,223,925
Diesel-Fuel Oil	166,148	104,808	95,802	96,181	109,533	192,104
Coal	97,598	116,734	128,988	131,769	146,137	163,789
Biomass	72,369	79,504	92,583	116,852	143,211	173,662
Geothermal	9,892	11,871	13,555	23,560	32,155	42,955
Wind	66,103	100,032	149,159	205,505	276,018	358,901
Soler	7,396	21,814	36,213	48,515	66,538	88,640
Nuclear	32,285	37,338	37,338	55,691	64,865	64,865
TOTAL	1,609,239	1,808,196	2,133,169	2,523,574	2,996,449	3,570,673

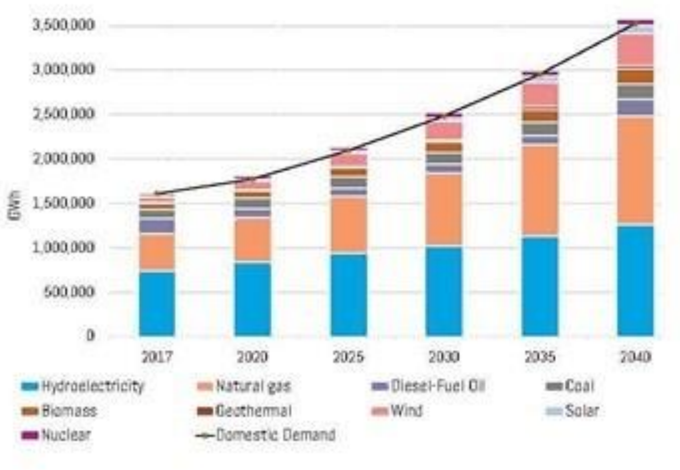
Source: Simulation results

Table 3.54. Projection of electricity generation in LAC, HGS (GWh)

	2017	2020	2025	2030	2035	2040
Hydroelectricity	734,777	837,563	934,010	1,022,730	1,133,417	1,261,832
Natural gas	427,696	539,540	787,641	1,027,764	1,272,960	1,570,493
Diesel-Fuel Oil	166,148	84,664	42,049	17,677	8,377	4,481
Coal	97,598	97,797	44,151	11,383	4,844	4,844
Biomass	72,369	79,504	92,583	116,852	143,211	173,662
Geothermal	9,892	11,871	13,555	23,560	32,155	42,955
Wind	66,103	100,032	149,159	205,505	276,018	358,901
Solar	7,396	21,814	36,213	48,515	66,538	88,640
Nuclear	32,285	37,338	37,338	55,691	64,865	64,865
TOTAL	1,609,239	1,810,123	2,136,698	2,529,678	3,002,385	3,570,673

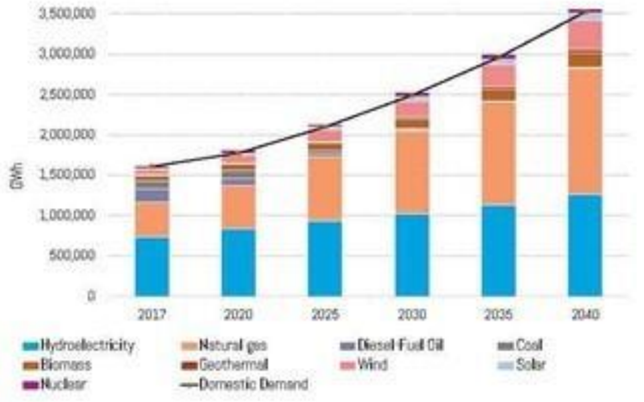
Source: Simulation results

Figure 3.104. Projection of electricity generation in LAC, CPS



Source: Simulation results

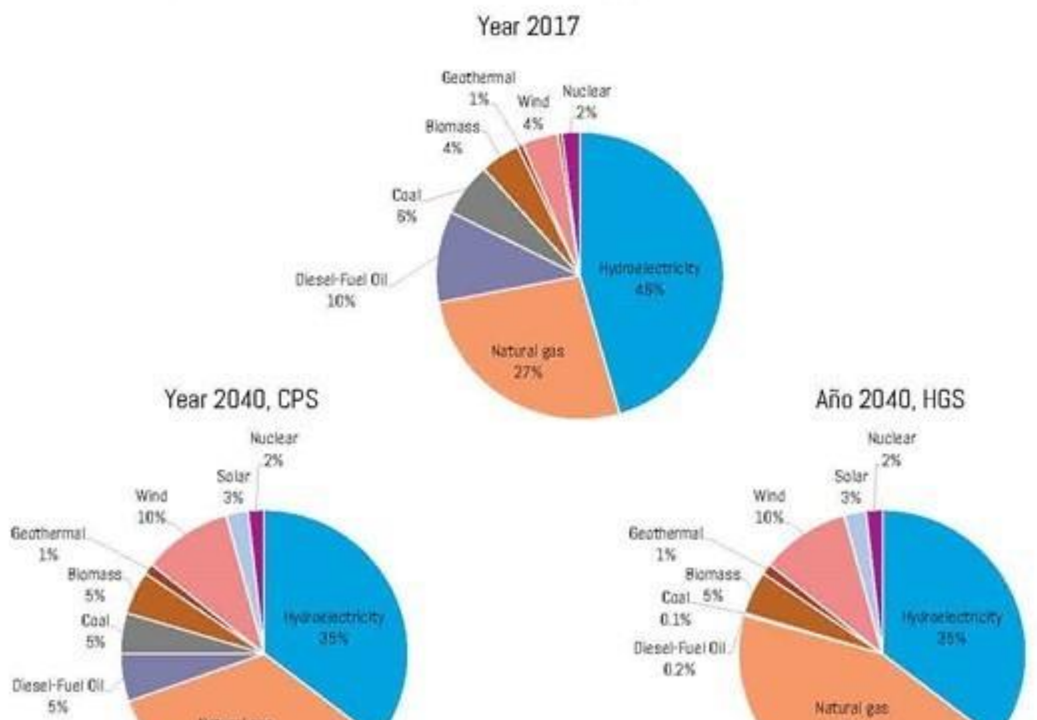
Figure 3.105. Projection of electricity generation in LAC, HGS



Source: Simulation results

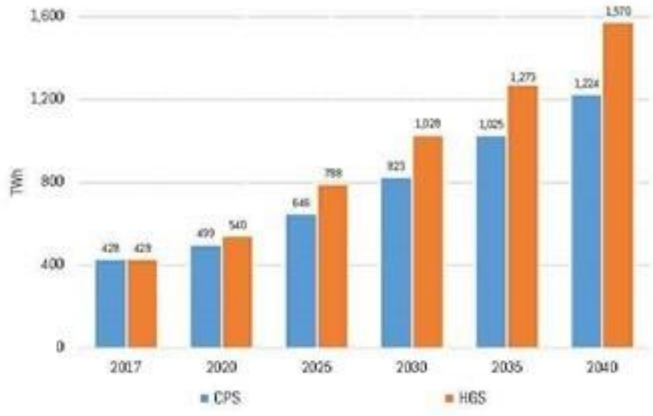
Regarding the evolution of the regional electricity generation matrix, it is observed that, in both scenarios analyzed, natural gas plants gain percentage share, during the projection period, however, while in the CPS scenario, at the end of said period, this type of plant has a second place, behind the hydroelectric plants, in the HGS scenario, natural gas plants become the main means of generation, surpassing hydroelectric plants (**Figure 3.106**). For this it is necessary to generate with natural gas during the year 2040, in the HGS scenario, 347 TWh more than in the CPS scenario (**Figure 3.107**) and an additional input of 230 Mm^3 of natural gas per day (**Figure 3.108**).

Figure 3.106. Evolution of the electricity generation matrix in LAC



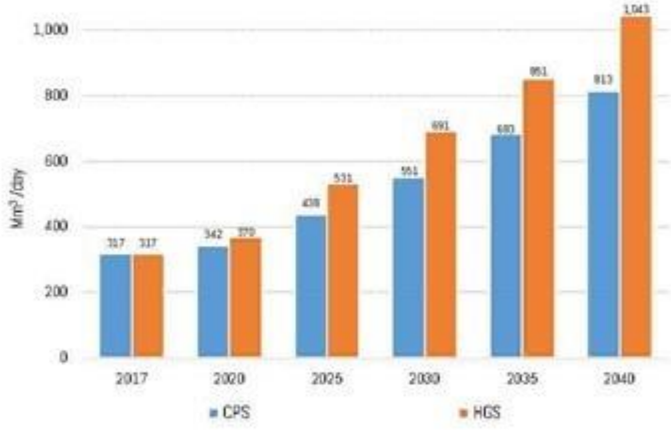
Source: Simulation results

Figure 3.107. Electricity generation with natural gas in LAC



Source: Simulation results

Figure 3.108. Natural gas input for electricity generation in LAC



Source: Simulation results

3.7.3 Projection of the total energy supply

According to the accumulated values for the entire LAC region, natural gas represents, in the base year, about one third of the total energy supply matrix, being one of the fastest growing sources, in both scenarios analyzed. Observing **Tables 3.55** and **3.56**, it can be seen that with the HGS scenario, annual savings in demand and annual energy supply of around 11 Mtoe are achieved by the end of the projection period, compared to the projected in the CPS scenario, thanks to the better efficiency in the processes of use of natural gas, in comparison with the liquid and solid fuels that it replaces.

Table 3.55. Projection of the total energy supply in LAC, CPS (ktoe)

Lorem ipsum

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	339,577	352,499	385,527	430,560	485,525	570,883	2.3%
Natural gas	258,286	273,610	320,204	377,209	446,019	516,156	3.1%
Coal and coke	54,021	61,647	69,255	74,711	85,541	99,354	2.7%
Nuclear	8,557	10,082	10,082	14,640	16,918	16,918	3.0%
Hydroenergy	64,216	70,841	79,049	86,779	96,412	107,616	2.3%
Biomass	140,590	151,902	169,337	194,280	229,549	280,709	3.1%
Other renewable	7,171	11,658	17,265	24,187	32,934	43,681	8.2%
TOTAL	872,417	932,239	1,050,720	1,202,366	1,392,898	1,635,317	2.8%

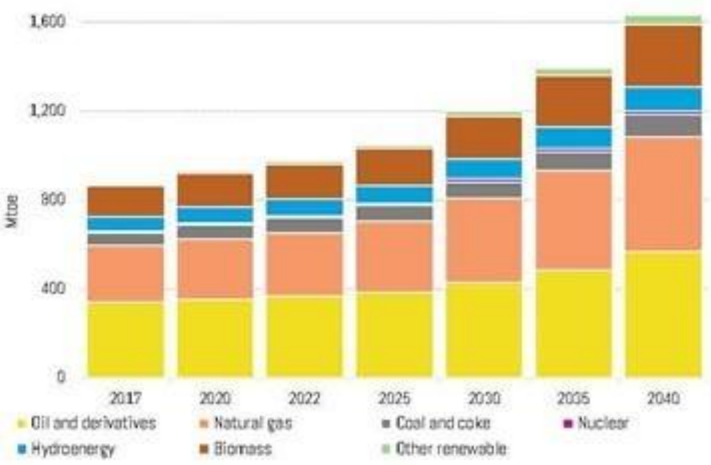
Source: Simulation results

Table 3.56. Projection of the total energy supply in LAC, HGS (ktoe)

	2017	2020	2025	2030	2035	2040	t.p.a.
Oil and derivatives	339,577	347,346	364,387	392,914	429,127	467,285	1.4%
Natural gas	258,286	275,737	353,206	436,576	530,540	653,685	4.1%
Coal and coke	54,021	56,672	45,971	40,856	43,580	48,624	-0.5%
Nuclear	8,557	10,082	10,082	14,640	16,918	16,918	3.0%
Hydroenergy	64,216	70,676	79,049	86,779	96,412	107,616	2.3%
Biomass	140,590	151,888	169,960	195,489	230,802	280,556	3.0%
Other renewable	7,171	11,658	17,265	24,187	32,934	43,681	8.2%
TOTAL	872,417	924,059	1,039,920	1,191,441	1,380,313	1,618,365	2.7%

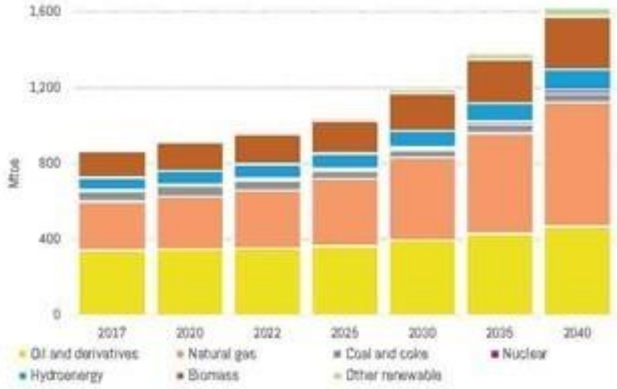
Source: Simulation results

Figure 3.109. Projection of the total energy supply in LAC, CPS



Source: Simulation results

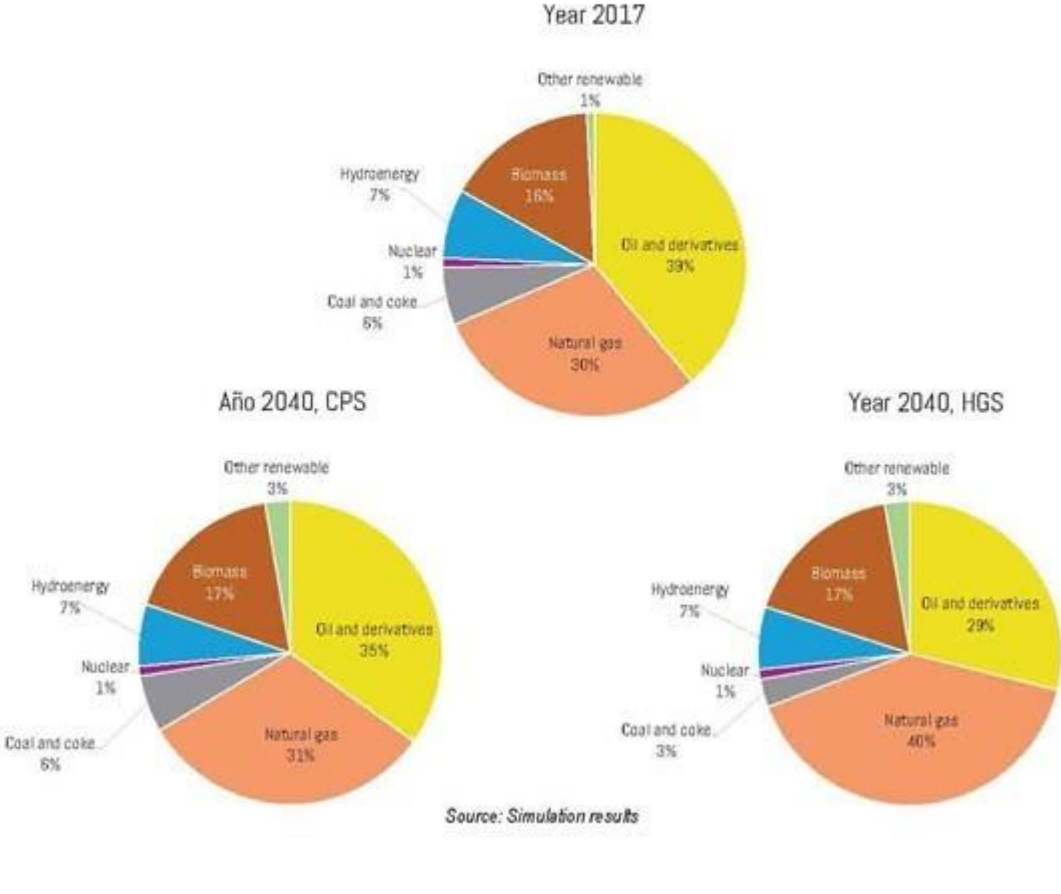
Figure 3.110. Projection of the total energy supply in LAC, HGS



Source: Simulation results

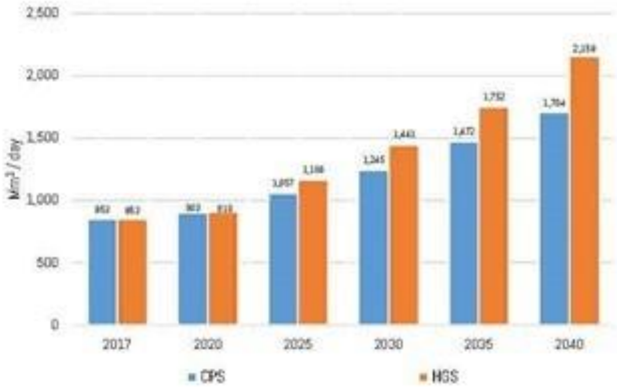
It is also important to highlight that, in the evolution of the total supply matrix, during the projection period, in the CPS scenario, natural gas remains the second most important source, behind oil and its derivatives, while in the HGS scenario, natural gas has the first position, as the main source of energy demanded and offered in LAC in 2040, displacing oil products (**Figure 3.111**). This situation means an additional supply of natural gas for that year, of 454 Mm^3 per day, compared to the projected in the CPS scenario (**Figure 3.112**).

Figure 3.111. Evolution of the total energy supply matrix in LAC



Source: Simulation results

Figure 3.112. Total supply of natural gas in LAC



Source: Simulation results

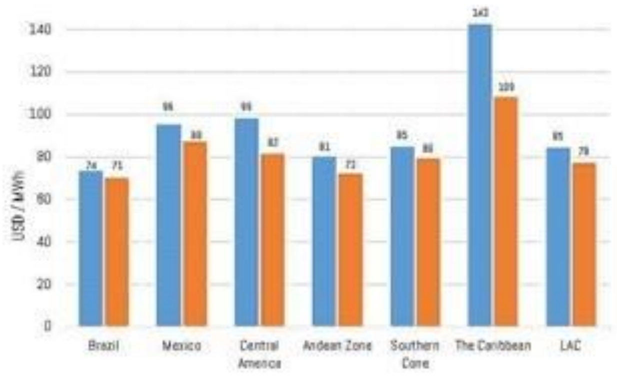
4. ECONOMIC AND ENVIRONMENTAL BENEFITS OF THE HIGH GASIFICATION SCENARIO (HGS)

4.1 Levelized cost of electric power (LCOE)

The levelized cost of electric energy (LCOE) is an indicator that evaluates the total unit cost of the energy generated by a plant or by a whole system, during a certain period of time, transferred to present value (USD / MWh). This total cost has different components: annualized investment costs over the useful life of power plants, fixed and variable costs of operation and maintenance and the costs of fuels used by thermoelectric plants.

One of the economic benefits that can be appreciated, as a result of the simulation of the high gasification scenario (HGS), is the reduction of the levelized cost of electric energy (LCOE), with respect to the values of the scenario of reference (CPS), in each of the countries and subregions analyzed (**Figure 4.1**), this reduction occurs, because in all cases, the LCOE of natural gas power plants, in the projection period, turns out to be lower that of the Diesel-Fuel Oil power plants and that of the power plants, which it replaces. It should be noted that LCOE values were calculated based on international values of unit costs of investment, operation and maintenance and fuels, for the different power generation technologies.

Figure 4.1. Levelized cost of electric power

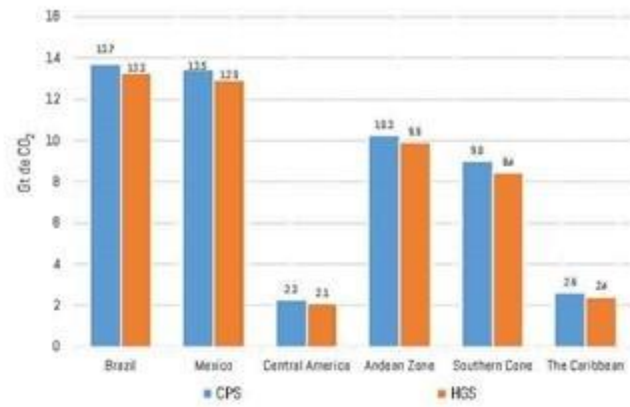


Source: Simulation results

4.2 Total CO_2 emissions during the projection period

The cleaner combustion properties of natural gas, in terms of the CO_2 emission factor, compared to petroleum-derived fuels and mineral coal, also lead to an environmental benefit with the high gasification scenario (HGS), by reducing the total amount of CO_2 released into the atmosphere, as seen in **Figure 4.2**. The calculation of CO_2 emissions was performed using the average emission factors recommended by the IPCC, for the different fuels.

Figure 4.2. Total CO_2 emission during the projection period



Source: Simulation results

5. CONCLUSIONS

- From the base year of the prospective exercise (2017), natural gas was the second most important source in the energy matrix of many of the countries of Latin America and the Caribbean, surpassed only by oil and its derivatives, showing in the last decade, signs of an accelerated growth in its demand, due to the dynamism and competitiveness that the international market of this energy commodity has been presenting and its conditions of use, relatively cleaner and more environmentally friendly compared to the others fossil fuels.
- As its greater use is considered within the policies and expansion plans of the energy sector, of most of the countries in the region, natural gas presents, even in the current policy scenario (CPS), a clear trend towards greater market development in each of the countries and subregions analyzed, a situation that is most evident in the high gasification scenario (HGS), due to the premises of substitution of liquid and solid fossil fuels with natural gas, both in the final consumption sectors such as in the electricity generation sector, in some cases to occupy at the end of the projection period the first place in importance in the energy matrix, as specifically happens in Mexico, Andean Zone, Southern Cone and the Caribbean.
- The best relative efficiency in the use of natural gas, both in the final consumption processes and in the electricity generation with combined cycle plants, compared to the use of liquid and solid fuels, allows to obtain significant energy savings, which translate directly in economic savings and reduction of CO_2 emissions.
- By replacing installed capacity of conventional thermal power plants with Diesel and Fuel Oil, completely idle or operating with low plant factors in interconnected national power generation systems, by combined-cycle natural gas plants, with higher plant factors, it also decreases the additional capacity requirements, with the consequent economic savings in investment costs and fixed operation and maintenance costs, resulting in lower values of the levelized costs of energy LCOE.

Annexes and bibliography

5CS	Caribbean Community Climate Change Center
ANCAP	National Fuel, Alcohol and Portland Administration
ANDE	National Electricity Administration
ANEEL	National Electric Energy Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
BP	British Petroleum
bpTT	British Petroleum Trinidad & Tobago
CABEI	Central American Bank for Economic Integration
CC	Climate Change
CCC	Fuel Consumption Account
CCCN	Costa Rican-North American Cultural Center
CEMOFER	Training Center in Maintenance and Operation of Renewable Energies
CENACE	National Electricity Operator
CNPE	National Council for Energy Policy
CNPS	Social and productive complementarity plan
CONELECTRICAS R.L.	Consorcio Nacional de Empresas de Electrificación de Costa Rica R.L.
COP21	Conference of the Parties to the United Nations Convention on Climate Change in Paris
COP24	Conference of the Parties to the United Nations Convention on Climate Change in Katowice
CREF	Caribbean Renewable Fund
DGEE	General Directorate of Energy Efficiency
DGII	General Directorate of Internal Taxes
DINATRAN	Cabinet of the Transport Vice Minister and of the Transport National Directorate
DOE	United States Department of Energy
EEO	Eastern Electric Company
EIA	U.S. Energy Information Administration
EMEP	Energy Efficiency and Management Program
ENH	National Hydrocarbons Company
ERIRAS	The Energy Research Institute of the Russian Academy of Sciences

FGEC	Forum of Gas Exporting Countries
FIIE	Faculty of Electrical and Electronic Engineering
FISE	Energy Social Inclusion Fund
GEF	Global Environment Facility
GEF	Global Environment Facility
GORTT	Government of the Republic of Trinidad and Tobago
GPG	Global Petroleum Group
GSEP	Global Sustainable Electricity Partnership
GVP	Gross Value of Production
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organization
ICE	Costa Rican Electricity Institute
ICE	Specific Consumption Tax
IDB	Inter-American Development Bank
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics of Japan
IEP	International Energy Programme
IGNC	Non-Cuttable Government Institutions
INA	National Learning Institute
INDECOPI	National Institute for the Defence of Competition and Protection of Intellectual Property
INECC	National Institute of Ecology and Climate Change
Inmujeres	National Women´s Institute
IPCC	Intergovernmental Panel on Climate Change
IRAE	Income Tax of Economic Activities
IRENA	International Renewable Energy Agency
ITT	Ishpingo, Tambococha and Tiputini
JCDC	The Jamaica Cultural Development Commission
KFW	German Development Bank

KIAT	Korean Institute of Advancement of Technology
LPG	Liquefied Petroleum Gas
MEER	Ministry of Electricity and Renewable Energy
MEM	Ministry of Energy and Mines
MIC	Ministry of Industry and Trade
MIEM	Ministry of Industries, Energy and Mining of the Oriental Republic of Uruguay
MINAE	Ministry of Environment and Energy
MIT	Massachusetts Institute of Technology
MOPT	Ministry of Public Works and Transportation
MRV	Measurement, Report and Verification
MSET	Ministry of Science and Technology
MSME	Micro, Small and Medium-sized Enterprises
NCES	Non-Conventional Energy Sources
NCMA	North Coast Marine Area
NGC	National Gas Company
OIE	Internal Energy Offer
OIEE	Internal electricity supply matrix
OLADE	Latin American Energy Organization
OPEC	Organization of the Petroleum Exporting Countries
PCJ	Petroleum Corporation of Jamaica
PDE	Ten-Year Expansion Plan
PETROPAR	Petróleos Paraguayos
PGAI	Institutional Environmental Management Plans
POES	Original Oil on Site
PPI	Investment Associations Program
PPP	Purchasing Power Parity
PPSA	Pré-Sal Petróleo Company
PROEZA	Poverty, Reforestation, Energy and Climate Change

REDIE	Ecuador Smart Grids Program
RenovaBio	National Biofuels Policy
RETIQ	Technical Regulation on Labeling
RTSEE	Salvadoran Technical Regulations for Energy Efficiency
SAME	Model for the Simulation and Analysis of the Energy Matrix
SCAN	Undersecretary of Control and Nuclear Applications
SEEC	Sustainable Energy for the Eastern Caribbean Programme
SEIA	Environmental Impact Assessment National System
SEIN	National Interconnected Electric System
SGIP	Smart Grid Interoperability Panel
SICA	Central American Integration System
sieLAC	Energy Information System of Latin America and the Caribbean
SIN-PY	Paraguayan National Interconnected System
SPIE	State Integral Planning System
TSA	Technical Services Agreement
UAE	United Arab Emirates
UNACIFOR	University of Forest Sciences
UNDP	United Nations Development Programme
UNI	National University of Engineering
UNIDO	United Nations Industrial Development Organization
uSFV	Photovoltaic microgeneration systems
UTE	National Administration of Electric Power Plants and Transmissions
VAT	Value-Added Tax
WEC	World Energy Council
YACAYO- VHA	Yacyreta - Ayolas to the Villa Hayes Substation

bbl / day	american barrels per day
cf^3	Cubic foot
CO_2	Carbon Dioxide
dm^3	Cubic decimeter
GHG	Greenhouse Gases
GWh	Gigawatt hour
GWh/year	Gigawatt hour per year
kbbl	Thousands of American barrels
kbbl / day	Thousands of barrels per day
kcal /m^3	Kilocalorie per cubic meter
km	kilometer
ktoe / year	Thousands of tons of oil equivalent per year
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt hour
kWh/year	Kilowatt hour per year
kWp	Kilowatt peak
LNG	Liquefied natural gas
LPG	Liquefied Petroleum Gas
m	Meter
m.a.s.l	Meters above sea level
m^3 /day	Cubic meters per day
Mbbl	Millions of American barrels
Mbbl / day	Millions of barrels per day
Mbbl / year	Millions of barrels per year
Mcf / day	Million cubic feet per day
Mm^3	Millions of cubic meters
Mm^3 /day	Millions of cubic meters per day

MP2	Fine particulate matter
Mt	Million tonnes
$MtCO_2e$	Millions of tons of carbon dioxide equivalent
Mtoe	Million tons of oil equivalent
MUSD	Millions of United States dollars
MVA	Megavolt ampere
MW	Megawatt
MWh	Megawatt hour
MWh / year	Megawatt hour per year
MWp	Megawatt peak
NOx	Nitrous oxide
SO_2	Sulfur Dioxide
t / hab.	Tons per inhabitant
t / toe	Metric ton per ton of oil equivalent
TCF´s	Trillion cubic feet
tCO_2	Ton of carbon dioxide
tCO_2 / toe	Ton of carbon dioxide per ton of oil equivalent
tCO_2 /year	Ton of carbon dioxide per year
toe / hab.	Tons of oil equivalent per inhabitant
TWh	Terawatt hour
USD / kW	Dollars per kilowatt
USD / kWh	Dollars per kilowatt hour
W	Watt
Wh/kg	Watt hour per kilogram
Wt	Weight

CONVERSION FACTORS USED BY OLADE'S MEMBER COUNTRIES

Original Unit	kbbl	Mm³	kt	GWh	GWh	kt	kt	GWh	kbbl	kbbl	kbbl	kbbl	kbbl	kt	kt	kbbl
A: boe x 10³	Oil	Natural gas	Coal	Hidroenergy	Geothermal	Nuclear	Firewood	Electricity	GLP	Gasoline	Kerosene/Jet	Diesel Oil	Fuel Oil	Coke	Charcoal	Alcohol
Argentina	1.0196	6.2127	5.1881	0.6197		110.1888	1.4916	0.6197	0.7010	0.8934	0.9583	1.0015	1.0304	4.8998	5.0440	0.9096
Barbados	1.0015	5.9806					2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304			
Belize	1.0660	6.6084		0.6200			3.2033	0.6200	0.6976	0.9530	1.0286	1.0598	1.1561		4.9718	
Bolivia	1.0015	5.9806	5.0439	0.6196			2.3417	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304	4.8998	4.9718	
Brazil	1.0590	6.1815	3.4573	0.6181		71.6957	2.2282	0.6181	0.6983	0.8820	0.9300	0.9498	1.0828	4.9596	4.6433	0.6424
Chile	1.0551	6.6721	5.0440	0.6197	0.6196		2.4002	0.6197	0.7624	0.9366	1.0300	1.0300	1.0300	5.0000		
Colombia	1.0476	6.1359	4.9498	0.6196			2.9246	0.6200	0.6981	0.9175	0.8109	0.9760	0.9398	3.4530	4.6829	0.5826
Costa Rica	0.9840		5.2630	0.6200	0.6200		3.0999	0.6200	0.6992	0.8938	0.9438	0.9907	1.0660	4.9392	4.6861	
Cuba	1.0015	6.3604	5.7645	0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304	4.8998	4.9718	
Dominican Republic	1.0015	5.9805	5.0439	0.6196			2.5939	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304	4.8998	4.9723	
Ecuador	1.0015	5.9806		0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304			
El Salvador				0.6196	0.6196		2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304		4.6836	
Grenada							2.5940	0.6196	0.6701	0.8934	0.9583	1.0015			4.9718	
Guatemala	0.9929		5.0439	0.6196	0.6196		2.5940	0.6196	0.6701	0.8913	0.9453	0.9929	1.0695	4.8998	4.9718	
Guyana		5.9806		0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304		4.9718	
Haiti				0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304		4.9718	
Honduras			5.0439	0.6196	0.6196		2.5940	0.6196	0.6701	0.8711	0.9583	1.0087	1.0462	4.8998	3.6028	
Jamaica	1.0015	5.9806	5.0439	0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304		4.9718	
Mexico	1.0543	7.4907	5.0520	0.6196	0.6196	71.2800	2.4948	0.6196	0.7147	0.9240	1.0182	1.0397	1.1306	5.1052		
Nicaragua	1.0059			0.6197	0.6197		2.3086	0.6197	0.6975	0.8906	0.9540	0.9857	1.0679	0.5009	2.7864	
Panama		5.9805	5.2690	0.6196			2.6940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304	4.9100	4.8926	
Paraguay			5.0359	0.6197			2.5940	0.6196	0.6899	0.8901	0.9451	0.9920	1.0701	5.5977	4.9719	0.5957
Peru	0.9973	6.9631	5.0440	0.6197			2.5940	0.6197	0.6845	0.8791	0.9584	0.9903	1.0592	4.6116	4.6837	
Suriname	1.0015	5.9806		0.6196			2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304		4.9718	
Trinidad & Tobago	1.0015	5.9806					2.5940	0.6196	0.6701	0.8934	0.9583	1.0015	1.0304			
Uruguay	1.0076	5.9812	5.0767	0.6197			1.9456	0.6728	0.6629	0.9163	0.9601	0.9927	1.0997	6.7695	5.3461	0.5930
Venezuela	1.0391	7.3453	5.4029	0.6072			2.5219	0.6072	0.7361	0.9990	1.0850	1.1406	1.2058	5.0621	5.6252	

COAL IMPORTS

Argentina	10^3 t =	5.1881	10^3 boe	
Brazil	10^3 t =	3.4573	10^3 boe	
Peru	10^3 t =	5.2601	10^3 boe	
	10^6 m^3	Refinery Gas =	7.9261	10^3 boe
	10^6 m^3	Coke Oven Gas =	3.0263	10^3 boe
Otros	10^6 m^3	Blas furnace gas =	0.6485	10^3 boe
	10^6 m^3	Gas Works Gas =	2.8820	10^3 boe
	10^6 m^3	Biogas =	3.9620	10^3 boe
	10^6 m^3	Bagasse =	1.3114	10^3 boe

CONVERSION TABLE FOR ENERGY UNITS

	boe	toe	tec	Tcal	TJ	10^3 BTU	MWh	kg LPG	m^3 Gas Nat.	cf Gas Nat.
boe	1	0.13878	0.1982593	0.00139	0.00581	5,524.86	1.61394	131.0616	167.2073	5,917.1598
toe	7.205649	1	1.4285868	0.01	0.04184	39,810.22	11.62952	944.3839	1,204.8371	42,636.9763
tec	5.04390	0.6999925	1	0.007	0.029288	27,866.85	8.14067	661.0616	843.3769	29,845.5621
Tcal	720.56490	100	142.85868	1	4.184	3,981,022	1162.9520	94,438.388	120,483.714	4,263,697.6
TJ	172.21914	23.900574	34.144044	0.2390057	1	951,487	277.95214	22,571.316	28,796.2988	1,019,048.19
10^3 BTU	0.00018	2.51E-05	3.59E-05	2.51E-07	1.05E-06	1	0.00029	0.02372	0.030265	1.07101
MWh	0.61960	0.08599	0.1228	0.00086	0.0036	3,423.2	1	81.20577	103.6016	3,666.2722
kg LPG	0.00763	0.00106	0.001513	1.06E-05	4.43E-05	42.154696	0.0123144	1	1.2758	45.1479
m^3 Nat. Gas	0.00598	0.00083	0.001186	8.30E-06	3.47E-05	33.041989	0.0096524	0.783827	1	35.3882
cf Nat. Gas	0.00017	2.35E-05	3.35E-05	2.35E-07	9.81E-07	0.9337017	0.0002728	0.0221494	0.02825803	1

* bbl LPG = 0.6701 boe; * 1 bbl LPG = 0.15898 m^3 = 5.6143 cf; m^3 LPG = 552.4 kg; 1 cf = 0.028317 m^3

Summary description of the SAME Model

The SAME is a simulation model of technical coefficients, developed by OLADE, that allows the construction of different prospective scenarios of demand and supply energy for a given study horizon.

It is very versatile in the projection method being able to generate in a very agile tendential, evolutionary or rupture scenarios, allowing to simulate policies of diversification of the matrix of final consumption and energy supply, measures to reduce greenhouse gas emissions (GHG) and energy efficiency programs.

As a parameter of comparison between the developed scenarios, it provides various energy, economic and environmental indicators, such as the following:

a) Index of the renewability of energy supply
b) Index of autarchy or energy sufficiency,
c) Average GHG emissions factor of the integral energy matrix
d) Average GHG emissions factor of the electricity generation matrix
e) Levelized cost of electricity
f) Structure of energy consumption
g) Structure of the total energy supply
h) Structure of the electricity generation matrix
i) Projected energy balances
j) Forecast of GHG emissions
k) Forecast of the installed capacity of electricity generation and other energy supply infrastructure
l) Scope of proven reserves of fossil energy sources
m) Level of exploitation of the potentials of renewable energy sources
n) Projection of energy efficiency indexes by final use of energy

Utility of the Model

Among other applications of the SAME Model, the following can be mentioned:

⇨ It is ideal for designing and fine-tuning sustainable energy development policies.
⇨ It allows to update studies of energy forecast before the change of premises or of exogenous and endogenous conjuncture.
⇨ Build exploratory scenarios of coherent futures in the energy sector.
⇨ Build scenarios type roadmap or anticipation.
⇨ Prepare national energy development plans, both integral and sectoral.

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