Energy Outlook of Latin America and the Caribbean 2018

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sieLAC | Energy Information System of Latin America and the Caribbean

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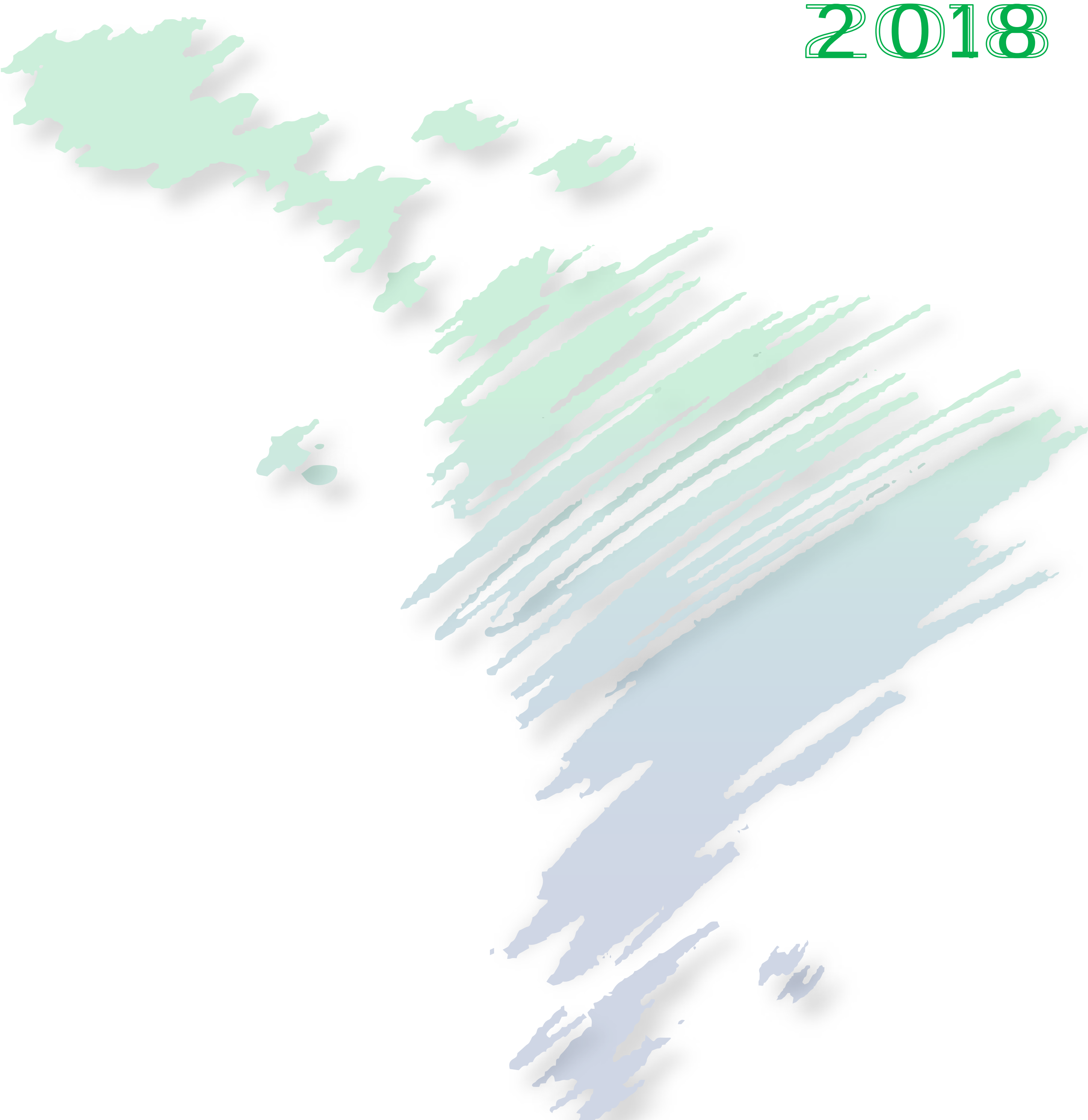

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This year we have move about from working exclusively in the construction and official monitoring of the statistics of the energy sector in Latin America and the Caribbean to the development of an Energy Outlook for our region. Our traditional Energy Statistics Yearbook has become the Energy Outlook of Latin America and the Caribbean.

What is the meaning of this new contribution in terms of the information made by OLADE, beyond the obvious name change?

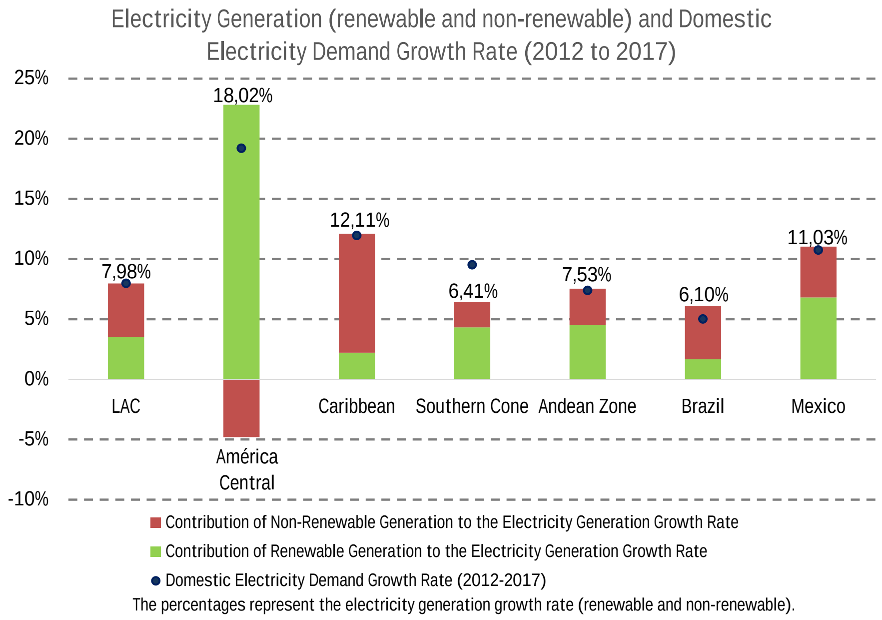
The answer is simple and concrete. We have returned in the path of creating knowledge, focused on provide freely the prospective studies of Latin America and the Caribbean. The studies provide possible scenarios for the development and evolution of our region's energy sector, constructed under the work and the official contribution of our Member Countries.

Likewise, equally important, relevant and valid are the studies on the projection of the evolution of the energy sector made by global agencies, such as the International Energy Agency, published in their "World Energy Outlook". However, we also need to contrast these global results and trends with what is observed in our region. In this sense, in this first Energy Outlook of Latin America and the Caribbean, published in 2018, based on information of 2017, we present the important results of the analysis of the different probable scenarios for the LAC sector, and the respective comparative analysis with main global studies.

The Energy Outlook of Latin America and the Caribbean 2018, also collects and presents official statistical information of our Member Countries, processed based on information of 2017. In the analysis of the base year information, it is concluded that the energy sector of Latin America and the Caribbean is on a deep and continuous change, marked mainly by the new technological trends in sources and energy uses.

One of these changes refers to the introduction of non-conventional renewable energy sources into the regional energy matrix. This phenomenon is gradually consolidating with great advances in this regard in some of the region's main economies. However, the gap between countries in the development of renewable potential, leads to the increase in the final energy demand in the last 5 years, which is higher to the rate of introducing the renewable generation. Therefore, on LAC average, the contribution of renewable generation to cover the increase in electricity demand has been lower than 45%, and the introduction of fossil generation has covered large part of this growth (in a proportion equivalent to the remaining 55%) to supply the final electricity demand. It is worth to highlight the evolution of Central America that, beyond achieving in the last 5 years the increase in electricity demand with the generation from renewable sources, there has been a gradual replacement of fossil power generation. Nevertheless, if we analyze this important subregional result with the LAC average, the result has a very simple interpretation. The renewability of our power generation has shown a decline in the last 5 years. Although there have been advances in the introduction of renewable generation in many countries, these have not been enough to offset the increase in electricity demand in our region.

Between 2016 and 2017, we have observed an auspicious progress regarding to electricity access, the region has gone from 20 million people without electricity access to 19 million in 2017. In the analyzed year, Haiti presented important improvements due to concrete electrification projects. If we maintain the rate of electricity access observed in the last 5 years, the region should have energy universal access in a span of 13 years. It is well known that the compliance of this component as one of the specific objectives of ODS 7 will require more time than expected, given that the latest electrification efforts are more complex, costly and will occurred at a lower rate. Though, the improvements observed throughout the last decade are auspicious.



Another point to highlight in the evolution of the energy sector in our region, is the role Natural Gas in the primary energy matrix. Natural gas has gone from representing 29% of the primary energy matrix in 2012 to 34% in 2017. This evolution is strongly conditioned by the technological improvements associated with liquefied natural gas, which have allowed the development of liquefaction and regasification projects throughout the entire region. The development of Argentina's non-conventional reserves will projected the production of the country from the development of one the main non-conventional hydrocarbons global reserves. This gradual introduction of Natural Gas is mainly focus on the replacement of liquid hydrocarbons in the power generation. The share of Natural Gas in the power generation has increased from 23% in 2012 to 28% in 2017.

In 2018, OLADE celebrated 45 years since its creation. From there to now, since the signing of Lima Agreement, our region has achieved great progress in many of its principal indicators. As known, LAC had more than 130 million people without access to electricity in 1973, and today the value has been reduced to less than 20 million. This is a clear example of the results in terms of planning, policies and investment in the sector (private and public). However, we are still the most unequal region in the planet, we have needs at the infrastructure and investment level. Also, we have the need to consolidate our institutions by defining State policies, as well as, stable regulatory and legal frameworks that go beyond government administration and that provide the necessary trust of our institutions.

We must coordinate to break the existing gaps between the countries of our region. We have to generate regional markets, that allow dynamic and complementary energy exchanges, that are not only based exclusively on bilateral relationships among countries; that contribute to regional electricity security of and provide robustness to energy systems. These are some of the many challenges and fundamental opportunities that our region faces nowadays.

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The 2018 Energy Outlook presents about 1,000 graphs containing detailed information about the recent evolution of the energy matrixes of the 27 Member Countries of the Latin American Energy Organization (OLADE). Likewise, it presents a set of graphs showing the trends of the regional aggregates that the organization usually considers, namely Central America, Brazil, the Caribbean, the Southern Cone, Mexico and the Andean Region, as well as Latin America and the Caribbean entirely. In the case of hydrocarbons, regional and global trends are compared considering the regions of Africa, Latin America and the Caribbean, Asia and Australasia, Europe, the Commonwealth of Independent States (i.e. some countries of the former Soviet republics), Middle East and North America. The information presented comes from the Latin American and Caribbean Energy Information System (sieLAC) managed by the OLADE's 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 of 2016-2040. It was 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 of the regions' energy sector within the next 20 years.

The first page of each country presents the values of the main energy indicators to the year 2017 or the latest year available according to each case, together with a summarized version of the Sankey diagram for each one. The graphs presented contain information on reserves and production from different sources, energy supply and flows, primary and final energy consumption, considering also their values at the sectorial level. An extensive set of indicators is also presented, including energy intensities of various kinds, renewability indices, energy autarky, avoided demands, indicators per capita and per unit of value-added, evolution of the relative shares of different energy sources, etc. Then, some indicators that analyze the registered trends of CO_2 are presented. Finally, a summary graph that shows the recent and comparative evolution of several energy and economic indicators is presented.

Those indicators that do not appear to be of common use are defined and described in the respective chapter of this Energy Outlook. To facilitate and make the visualization of indicators much more user-friendly, it was decided to present the trend information in the form of smoothed curves. Also, as you can see, in some cases, in addition to presenting the respective variables, the accumulated variation rates for the five-year periods of 2001-2005 / 2006 - 2010/2011 - 2015 and the annual rates for the years 2016 and 2017 were included on the right axis.

We hope that the Energy Outlook will become a tool of regular use and consultation that accounts for the evolution of the trends of the region in the field of energy. Given that, as of 2017, the Energy Information System of Latin American and Caribbean, sieLAC, is of free access, you only need to register to have access to the entire database. We recommend and invite those who are interested in furthering the analysis and work with the available information, to do so by visiting our web page:

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

In compliance with the provisions of the Law regulating electrical transmission, the National Electric Coordinator of **Chile** began its operation, after the integration of the two Economic Load Dispatch Centers (CDEC) of the country. It is a technical and independent body, responsible for the operation of the set of installations of the National Electric System; it is headed by the Board of Directors, composed of five directors appointed by the Special Nomination Committee through public tender.

The Ministry of Energy and Mines (MEM) of the **Dominican Republic** presented the proposals for fiscal policy and contractual regime for the development of the oil and gas industry, with the regime options based on taxes and shared production, for a balanced benefit for the State and for investors. The definition of the tax scheme closes the first stage of the oil and gas exploration and production project, in order to make way for the bidding of the most interesting blocks. The tax regime and the contractual model were carried out by the Ministry with assistance from consultants contracted by the Latin American Energy Organization (OLADE), with non-reimbursable technical cooperation funds from Canada.

Ecuador made the official launch of the Electricity Master Plan (PME) and the Energy Efficiency National Plan (PLANEE). The policy lead by the Ministry of Electricity and Renewable Energy, reflected in these plans, will ensure the supply of the electricity demand of Ecuador in the short, medium and long term in an efficient way, which optimizes resources use and reach throughout the country.

Guatemala, launched the National Energy Plan, an instrument that sets special emphasis on reducing greenhouse gas emissions (GHG). By applying the aforementioned plan, a target of 29.2% reduction in GHG emissions is expected to be achieved by 2032, which is equivalent to 11.9 million tons of avoided carbon dioxide equivalent - CO2e -, by promoting the use of technologies for energy efficiency and savings, through the development of three strategic axes: sustainable use of natural resources, energy efficiency and savings and reduction of greenhouse gas emissions.

In **Haiti**, the National Energy Regulation Authority (ANARSE) started operations; conceived as an autonomous body attached to the Ministry of Public Works, Transport and Communication, in charge of promoting the development of the energy sector through the regulation of activities of production, operation, transport, distribution and commercialization of electricity throughout the national territory.

Mexico published the Public Policy of Minimum Storage of Oil, aimed at ensuring that the country has strategic reserves of gasoline, diesel and jet fuel to reinforce the supply of fuels to the population in case of emergencies; as well as to boost the construction of oil storage infrastructure, reinforcing the national energy security.

Aware of the importance of strengthening the participation of all sectors in energy sustainability, through planning, discussion and long-term execution, the National Secretariat of Energy (SNE) of **Panama** with the support of the United Nations Development Program (UNDP), delivered to the National Government the energy roadmap to 2050 called Energy Atlas: "Panama the Future We Want". The fundamental pillars on which the development of the energy policy of Panama will focus, contained in the aforementioned Atlas are aimed at the decarbonization of the matrix, efficiency, access and security in the energy supply. It is a didactic instrument developed through active listening and broad participation, reflecting the vision and needs of all sectors at community level.

II HYDROCARBONS

2.1 Exploration y Exploitation

Colombia announced the discovery, by Ecopetrol and Anadarko, of a new deep waters' gas well in the Colombian Caribbean. According to the government authorities of the sector, this new situation will allow the country to guarantee self-sufficiency of gas in the upcoming decades. The Colombian company Ecopetrol and its partner

Anadarko, completed the drilling of the Gorgon-1 well, which is considered the largest gas discovery in 28 years, since Cusiana in 1989. Gorgon-1, is the third successful well in the south of the Colombian Caribbean, along with Kronos and Purple Angel. Continuing offshore exploration, Repsol and Ecopetrol advance the drilling of another well in the north of the Colombian Caribbean. The activities of the oil industry in Colombia recovered its dynamism. On the one hand, 578 exploratory wells were drilled and in development in 2017, 182% more than the 205 registered in 2016. Likewise, a monthly average of 78 drills were used during drilling activities in 2017, showing a growth of 179% compared to the 28 used in 2016.

In July 2017, **Grenada**'s Upper House approved the Oil Exploration Incentive Act, weeks after it was adopted in the Lower House of the Parliament. The bill offers incentives to attract investors who are interested in exploring oil and natural gas in Grenada's waters.

Haiti declared the beginning of the exploration of hydrocarbons in the Department du Centre, Paret Petroleum Company will be in charge of the operations.

During 2017, **Jamaica** continued the exploration of indigenous oil and gas. Tullow Oil Company will move to three-dimensional topography. This constitutes the first 3D survey in Jamaica. The company conducted two rounds of 2D seismic studies over the past 18 months and, based on the data from the two-dimensional seismic studies, the explorers decided to examine more in depth. These activities are framed in the Production Sharing Agreement (PSA) with the Petroleum Corporation of Jamaica (PCJ) signed in November 2014.

In **Mexico** the new strategy for the Five-Year Plan for Exploration and Extraction of Hydrocarbons was presented, which aims to offer certainty and promote activity in the oil sector. The document contemplates tendering 509 areas for the exploration and extraction of hydrocarbons in the complete geological column, as well as 70 fields for the extraction of hydrocarbons, located on an area of 239,000 km². Likewise, four tenders of Round One and three of Round Two were successfully concluded, in which 70 contracts were awarded for the exploration and extraction of hydrocarbons to 66 companies from 17 countries. The awards of the aforementioned contracts were made with competence and full transparency, ensuring the best terms for the State. On the other hand, the International Council of Extractive Industries Transparency Initiative (EITI), gathered in Manila, Philippines, decided to accept Mexico as a candidate to implement this international standard. When accepted as candidate, Mexico undertakes, in a period of no more than two years, to present a report where all the payments of the companies and public revenues derived from the extractive activity are paid to give room to a constructive dialogue that responds to any shortcomings in the rules or practice, and that allows to know how the government invests these resources.

Staatsolie Maatschappij **Suriname** N.V. concluded shared production contracts for two offshore blocks. For Block 59, an agreement was signed with a consortium formed by the oil companies ExxonMobil, Hess Corporation and Statoil. With Statoil, a contract was signed for block 60. The agreements are the result of the "Open Door Policy Offshore Suriname" of Staatsolie. According to the pre-defined selection criteria, Blocks 59 and 60 were awarded to the consortium and Statoil, respectively. The agreements are in force for 30 years. Block 59 has an approximate size of 11,500 km² and is located about 400 km from the coast, in water depths of more than 1,900 m (ultra-deep). Block 60, an area of 6,200 km², is located about 250 km from the coast, with water depths from 800 to 1.900 m.

Trinidad and Tobago announced two significant gas discoveries in the exploration wells of Savannah and Macadamia, of the coast of Trinidad. The results have unlocked approximately 2 trillion cubic feet (TCF) of gas in place to support new developments in these areas. The Savannah exploration well was drilled into an untested fault block east of the Juniper field in water depths of over 500 feet, approximately 80 km off the south-east coast of Trinidad. The well was drilled using a semi-submersible rig and penetrated hydrocarbon-bearing reservoirs in two main intervals with approximately 650 feet net pay. Based on the success of the Savannah well, BPTT expects to develop these reservoirs via future tieback to the Juniper platform that is due to come online mid-2017. The Macadamia well was drilled to test exploration and appraisal segments below the existing SEQB discovery which sits 10 km south of the producing Cashima field. The well penetrated hydrocarbon-bearing reservoirs in seven intervals with approximately 600 feet net pay. Combined with the shallow SEQB gas reservoirs, the Macadamia discover is expected to support a new platform within the post-2020 timeframe.

2.2 Petroleum and oil products

Bolivia began the construction stage of the civil works of the Jaguar X6 well, located in the province of O'Connor of the Department of Tarija, from which it is estimated a potential of 2 trillion cubic feet (TCF) of recoverable gas, with an investment of USD 109 million in the well, flattening and roads. An oil revenue of approximately USD 2,000 million is calculated.

In 2017, **Ecuador** achieved a historic milestone when the companies Petroamazonas EP and the Electric Corporation of Ecuador (Celec EP) defined the interconnection between the electrical and oil systems, with the purpose of taking advantage of the electric energy produced in the National Interconnected System (SNI) in the operations of the State oil company. The interconnection, which in its first phase reached the Shushufindi and Sacha fields, was carried out between the substations Jivino 230/69 kV (Celec) and Petroamazonas. One part of the infrastructure was developed by the oil company and is connected to the facilities built by Celec EP for the expansion of the national transmission system. With the connection to the National Interconnected System (SNI), Petroamazonas EP further reduces the volume of diesel used in all its operations, with a gross savings of more than USD 230 million per year. On the other hand, the operations at the substation Jivino of 230 kV and 69 kV began with a processing capacity of 167 MVA, located in the province of Sucumbios, km 25 of the Via Lago Agrio-Coca. The Ecuadorian State made an investment of USD 26.2 million for the benefit of the inhabitants of the provinces of Sucumbíos and Francisco de Orellana. The start of operations of Jivino supplies the northeastern zone with renewable energy from the Coca-Codo Sinclair hydroelectric power plant. In addition, it allows the decrease of the use of fossil fuels in the generation of electricity.

2.3 Natural Gas

Chile inaugurated in Puerto Montt the Regasification Satellite Plant (PSR), a fundamental piece to receive and distribute natural gas to the city's homes, businesses and large companies. The Regasification Satellite Plant is located in the industrial sector, close to the north access of the regional capital. Likewise, the Regasification Satellite Plant (PSR) located in an industrial sector close to the south access of Osorno (on the way to Puerto Octay) was inaugurated, which stores 120 m^3 of LNG, which corresponds to 90,000 m^3 in gaseous state.

Peru inaugurated a loading terminal for liquefied natural gas trucks in Peru LNG, which is considered a milestone in the development of natural gas' mass production in the country, since this terminal will transport fuel to 11 cities in Peru to supply and improve the quality of life of the population. Peru LNG made an investment of USD 17 million in this terminal which has a station with capacity for 240,000 gallons per day of LNG. It is enabled to load trucks with cryogenic containers of 13,000 gallons capacity, at a loading rate of 90 m^3/hour. Also, the project has a control center, a depressurization station, pipelines to transfer gas from the plant, security mechanisms, electrical systems, control systems, communications and closed television circuits.

BP **Trinidad and Tobago** LLC announced the development of its offshore gas project Angelin. The project will include the construction of a new platform, the 15th production facility on the high seas of BPTT, 60 km off the south-east coast of Trinidad in a water-depth of approximately 65 m. The development will include four wells and have a production capacity of approximately 600 million standard cubic feet (mmscfd) of gas per day. The gas from Angelin will flow to the Serrette platform hub through a new 21 km pipeline.

III ELECTRICITY

3.1 Generation, transmission, distribution and consumption

Argentina reported the start of electrical power generation operations of the CT Perez and CT Cañada de Gomez thermal power stations for the National Interconnected System, both in the province of Santa Fe. The CT Perez, has an installed capacity of 76 MW and is suitable for consuming natural gas, gas oil and fuel oil in indistinct form. The CT Cañada de Gomez has 64 MW and is suitable for consuming the three fuels mentioned above. Thus, there are already 10 generating plants contracted within the framework of Resolution SEE N° 21/2016, with a total of 774 MW, equivalent to the capacity of generation of the Atucha II nuclear power plant. The investment (estimated in USD 696.6 million) has been made entirely by private equity and its repayment will be made by long-term supply contracts (up to 10 years). The total of the new generation capacity will allow the system to operate in the critical days of summer with greater reliability and safety, reducing the risks of power outages and allowing the operation of the service to be more economical.

The modern infrastructure of the Chuquiaguillo sub-station was inaugurated in **Bolivia**, which will strengthen the supply of electricity to customers in the cities of La Paz and El Alto, and particularly the areas of Villa Fatima, Chuquiaguillo and Villa El Carmen. Government authorities in the energy sector reported that the aforementioned sub-station will solve the problems of low intensity of electrical energy affecting that sector of the city. This state-of-the-art infrastructure was built with the aim of providing greater safety in the supply of electrical energy with the construction of high voltage sub-transmission lines and sub-stations. The sub-station is located in the Chuquiaguillo area of the city of La Paz at 3,960 M.A.S.L. (substation in height), between the Peripheral Avenue (Juan Jose Torrez) and Street 3. It includes the installation of a modern Gas-Insulated-Switchgear SF6 sub-station (GIS) at 115 kV. An electric sub-station was also inaugurated in the municipality of Villa Tunari, in the Tropic of Cochabamba, with a 25 MVA transformer. Its installation will improve and enhance the distribution system, benefiting more than 51,800 inhabitants of Villa Tunari, Paracti, Cristal Mayu, Chocolatal, Eterazama, Isinuta, San Gabriel, Villa 14 de Septiembre, Puerto San Francisco, Aroma and the area of Tipnis, among other communities.

The installed capacity for electric generation in **Brazil** reached 157,580 MW in 2017, with net expansion of 4.8%, or 7,159 MW, including new plants, extensions, demobilizations and micro and mini distributed generation. The largest expansion was hydraulic, with 3,389 MW, being the UHE Belo Monte with the largest participation in the indicator. The second place was for wind energy, with 2,164 MW of expansion, and in third place solar energy, with expansion of 1,012 MW. It is notable that 98% of the total expansion was of renewable sources.

For the third consecutive year, the electricity supply tenders reduced the price of energy in **Chile** and attracted more competition. The National Energy Commission awarded the National and International Public Tender for Power and Electric Energy Supply 2017/01, which offered 2,200 GWh/year of energy and that it would supply the requirements of electricity of the regulated clients (households and SMEs) of the National Electrical System for 20 years from 2024. The tender was awarded at an average price of 32.5 USD/MWh, to projects with Non-Conventional Renewable Energies and incorporated new players into the national electricity market.

Colombia adopted the Transmission Generation Reference Expansion Plan for the period 2016-2030 developed by the Energy Mining Planning Unit (UPME), which contains the recommendations on electrical generation and transmission projects required at the national level.

The **Dominican Republic** concluded the construction of the new marine installations of AES Andres, which, with an investment of USD 9 million, allows to adapt the existing receiving terminal of Liquefied Natural Gas (LNG) to operate as an export terminal for small boats of up to 10,000 m^3. Additionally, in June 2017, the Los Mina VII plant was inaugurated, by the Dominican Power Partner generator (DPD), of AES Dominicana, that contributes 114 MW, with an approximate investment of USD 260 million, steam turbine, which takes advantage of the exhaust gases of the existing units: Los Mina V and VI gas turbines, closing the combined cycle and increasing the total capacity. With this contribution, the Dominican Power Partner generator becomes the largest power plant in the country, increasing its capacity to 324 MW based on natural gas.

In **Ecuador**, the delivery of the Chorrillos Sub-station took place, a work that contributes to the economic and productive growth of Ecuador in particular of the provinces of Guayas, Los Rios and El Oro. The construction of this work involved an investment of more than USD 80 million executed by the Electric Corporation of Ecuador, through its business unit Transelectric. The Chorrillos Sub-station, completes the Ecuadorian Electric Network. It was built in an area of 26 hectares and receives the clean energy generated by the hydro-electric plants Coca Codo Sinclair and Sopladora, it is part of the transmission system: El Inga - Tisaleo - Chorrillos of 500 KV. This infrastructure increases reliability and safety in the provision of electricity services for the beneficiary provinces.

In **Mexico**, the Internal Combustion Plants Guerrero Negro III were completed, with an investment of USD 25.29 million, which provides a capacity of 11.14 MW, and Baja California Sur V, with an investment of USD 106.9 million and a capacity of 47.50 MW; the Agua Prieta II Combined Cycle Plant, with an investment of USD 394.11 million and a capacity of 410.47 MW; the Cogeneration Plant Salamanca Phase I, with an investment of USD 319.95 million and a capacity of 402.21 MW; the Humeros Geothermal III Power Plant Phase A, with an investment of USD 42.99 million and a capacity of 25.13 MW; and the rehabilitation and modernization by Combined Cycle of the Poza Rica Plant, with an investment of USD 136.820 million and a capacity of 214.74 MW. In addition, under the scheme of Independent Producer of Energy, the works of the Baja California III Combined Cycle Central also concluded, with an investment of USD 215.6 million and a capacity of 298.17 MW.

In **Paraguay**, the National Electricity Administration (ANDE) inaugurated important electrical infrastructure works in Alto Parana, including: the expansion of the Hernandarias Sub-station and the construction of a new 220 kV Transmission Line, double ternary, that unites the Sub-stations of Acaray and Presidente Franco, benefiting several localities in the east of the country, and quadrupling the capacity of transmission for a zone of great industrial and commercial growth. The route of the new 220 kV transmission line has 8.5 km of extension approximately and goes from the exit gate at the Acaray Central to the arrival gate at the Presidente Franco Sub-station. The transmission capacity of the line is 600 MVA, three-phase circuit with two conductors per phase (double ternary) and goes through the same domain of the current transmission line at 220 kV that links both sub-stations. The cost of the investment by ANDE in the construction of the TL 2x220 kV amounts to USD 3,000,876.66 and was carried out by the company TECNOPLUS ING. S.A. through contract N° 6243/15.

In order to guarantee energy supply in the region of Loreto, **Peru**, the new Iquitos Thermoelectric Power Plant was inaugurated, which will allow continuous electric supply to the city of Iquitos; as well as the development of new industries. With the implementation of this plant, it is expected to meet the existing demand and generate trust in large, medium and small investors for the development of various activities in the industry, commerce, tourism, among others. The central is located 10 km from the city of Iquitos, near the oil refinery (Petroperu).

3.2 Universalization of energy

Costa Rica achieved significant results in the implementation of the Rural Electrification Programme with Renewable Energy Sources aimed at ensuring the rural electrification service in isolated areas of the electric network, with photovoltaic systems or micro hydroelectric plants. In the year 2017, approximately 373 communities were benefited and 289 SFV were installed.

In **Ecuador**, the public companies Petroamazonas EP and CNEL EP signed an agreement for the execution of an electrification programme in rural areas of the provinces of Sucumbios and Orellana for an amount exceeding USD 2.2 million. Approximately 200 families from 25 rural communities in the provinces of Orellana and Sucumbios will benefit from this project. The contribution of Petroamazonas EP reaches the USD 1.16 million, while the National Electricity Corporation, responsible for the implementation compromises USD 1.25 million.

In June 2017, the **Guyana** Energy Agency (GEA) provided technical support to the Renewable Energy Corporate Social Responsibility Project executed by OLADE which seeks to implement demonstration/pilot sustainable energy initiatives in three rural communities in Guyana. Funded by the Canadian Government, the project focused on enhancing and accelerating productivity in the rural communities of Shulinab (Region 9), Powaikoru (Region 1) and Moraikobai (Region 5); through the use of renewable energy technology. It is expected, as a final result, that the project will contribute to improving Corporate Social Responsibility (CSR) through the promotion of attention and support of the private sector of Guyana to replicate, advance and/or expand these practices in terms of results and experiences.

In **Mexico**, the first call for the electrification of rural communities and marginalized urban areas through the isolated component was issued, involving the installation of photovoltaic solar modules in distant and scattered locations. This call will impact in 898 localities distributed in 11 states nationwide with the installation of more than 10,000 system, guaranteeing benefits for 45,000 citizens living in a situation of energy poverty.

In order to expand the electric border at the national level and thus achieve access to service in the areas of scarce economic resources, an innovative renewable energy project was inaugurated in **Peru** that will provide electricity for the first time to the community of Ocoruro, in Arequipa. This initiative is consistent with the State policy that seeks to promote the use of renewable energies to meet the goal of bringing rural electrification to

100% of the population by the year 2021. The project uses photovoltaic technology, allowing electricity to be supplied through solar energy in areas outside the conventional electrification network. It should be pointed out that this initiative envisages the sustainability of the project through local communal management, through a Rural Electrical Services Company (ESER) and will benefit the families that used to light their homes with battery lamps, generating a positive impact on their economy.

3.3 Hydroelectricity

In the **Dominican Republic**, during 2017, four micro hydropower projects, with a capacity of 130 kV, were inaugurated, benefiting 538 families, within the framework of the Small Grants Programme of the Global Environment Fund (PPS-SGP-GEF-UNDP) and the execution of the Rural and Sub-Urban Electrification Unit (UERS). To date, the aforementioned project has developed 48 hydropower plants with an installed capacity of 1.46 MW since 1998.

In 2017, in **Peru**, three hydroelectric plants came into operation: Yarucaya, Potrero and Marañon with 15, 19.90 and 18 MW respectively.

IV ENERGY EFFICIENCY

Argentina informed the launching, at the national level, of a new Efficient Lighting Plan, which consists of a replacement of public street lighting by more efficient equipment of LED technology, with the aim of saving energy, maintaining or even improving the quality of the service, and providing greater security to public spaces. This action will generate energy savings of up to 50% over current consumption. The implementation of the new Plan will include a survey of current facilities for the generation of a baseline with the main characteristics of these. The implementation of the new Efficient Lighting Plan is in charge of the National Directorate for the Implementation of Energy Savings and Efficiency Programs.

The Government of **Barbados** signed an agreement with the Barbados Light and Power Company to facilitate the modernization of 85% of the island's street lighting with LED technology. The Public lighting replacement program will contribute to the fulfilment of the Government's objective in terms of 22% reduction in electricity consumption by the year 2029.

In **Colombia**, the Energy Mining Planning Unit (UPME) in agreement with the Ministry of Mines and Energy launched the first Electric Vehicle Pilot Program for the Public Sector. The initiative will allow to structure the projections of the UPME in electric mobility with real data of consumption from daily use, during the coming months, of different vehicles of brands like BYD, Nissan, Renault, BMW and Kia. At the end of the four-month duration of the pilot program, the UPME will present a document that will leave evidence of the cost-benefit analysis, both operational and investment associated with the proposed mobility scheme, which contributes to the discussion on the restriction in force in the Budget Law for vehicle substitution in government entities.

The Ministry of Energy and Mines (MEM) of the **Dominican Republic** and the Latin American Energy Organization (OLADE) worked together, throughout 2017, in the development of an appropriate institutional framework for the promotion of energy efficiency nationwide. In this area, workshops were held for capacity building in the field and the document was published for the Institutional Framework for Energy Efficiency and Roadmap for the Development of Energy Efficiency in the Tourism Sector in the Dominican Republic.

The first Thermal Characterization Laboratory of **Ecuador** was inaugurated. "Thermal characterization of materials and constructive elements for sustainable buildings through implementation of laboratories" is a project promoted by the Ministry of Electricity and Renewable Energy (MEER) and executed by the line of Energy Efficiency Research in Buildings of the National Institute of Energy Efficiency and Renewable Energies (INER). The labs will be located at the facilities of the National Polytechnic School (EPN) in Quito and the Polytechnic Graduate School of the Littoral (ESPOL) in Guayaquil. The objective of the project is to generate technical and analytical capacities to evaluate the thermal performance of the different materials and construction elements used in the building sector. The implementation of the laboratories in Quito and Guayaquil will contribute to the development and improvement of new materials to be used in the envelope of buildings. The thermal characterization laboratory is implemented and equipped to carry out the tests of basic properties resulting from the construction materials.

With the support of OLADE, the Ministry of Energy and Mines (MEM) of **Guatemala** carried out in October 2017, the workshop "Insertion of electric vehicles in Guatemala." The event was aimed at contributing to the attention of established commitments and proposed goals in energy policy 2013-2027 and the Framework Law to Regulate Vulnerability Reduction, the Compulsory Adaptation to the effects of climate change and Greenhouse Gas Mitigation (GHG). The analysis of the introduction of electric vehicles (EV) in Guatemala was included as part of the possible actions for the mitigation of the (GHG) of the country. The workshop brought together institutions related to the issue electric vehicles mobility and focused on demonstrating the arguments that validate the rise of this measure as part of the evolution of technology used in the transport sector.

In 2017, the **Guyana** Energy Agency (GEA) implemented energy efficiency and power-saving initiatives at the St. Joseph's High and North Ruimveldt Multilateral Secondary Schools in Georgetown. Actions included replacement of inefficient lighting with Light Emitting Diode (LED) lighting technology and replacement of lighting switches with occupancy sensors.

The National Electric Power Company (ENEE) of **Honduras**, within the framework of the presidential program "Honduras Shines", managed to install in the last quarter of 2017, 14,806 LED luminaires nationwide. The "Honduras Shines" initiative began its activities in 2015 with the aim of contributing to the improvement, modernization and efficiency of the country's electricity service.

Paraguay initiated the application of voluntary energy efficiency labelling standards for appliances including: air conditioners, ventilators, refrigerators and lamps. In addition, the implementation of a labelling standard for Sustainable Construction -Energy and Atmosphere was initiated.

Uruguay, initiated the application the zero taxes of global tariff rate for the vehicles of transport of goods with electric motor, promoting in this way the use of more efficient and friendly with the environment technologies. This new incentive adds to the instruments driven with the aim of efficient and low-emission mobility. These incentives, added to other support, allowed the incorporation of 1 electric bus and 24 electric taxis. In addition, UTE, through the installation of charging points for electric vehicles in Montevideo and the development of the "electric roadmap" throughout the country promotes the fortifying of the infrastructure necessary for the impulse of electric mobility. In this regard, in September 2017, the project "Towards a sustainable and efficient urban mobility system in Uruguay" was approved within the framework of the Global Environment Fund, which will be running for the next four years and will allow the massification of a clean and efficient transport.

V RENEWABLE SOURCES

Argentina decreed the year 2017 as the "Year of Renewable Energies", which served as an official framework to guarantee by the executive power the sponsorship of activities, seminars, conferences and educational programs aimed at contributing to the diffusion in the country of different aspects related to the development and use of renewable energies. In this context, the projects of Round 2 of the RenovAr Program were awarded. Government authorities in the sector announced the tender results with 66 projects awarded for wind, solar, biomass, biogas, landfill biogas and small hydroelectric exploitations. The program aims to diversify the energy matrix by including clean sources that help mitigate the effects of the energy sector activities on climate change.

The distributed generation in **Brazil** reached 100 MW with almost 9,000 systems. The power generation by the consumer - known as micro and mini distributed generation – exceeded the 100 MW installed mark. This is the result of the increasing number of connections made by the National Electric Energy Agency (ANEEL), which only in the first two months of the year registered 1,197 new micro generators, totaling 8,993 installations in Brazil. The number of new facilities in the same period last year was 612 projects, representing a growth of 83%. Among the plants installed in 2017, the photovoltaic source continues leading, with about 1,129 projects (7,380 kW). The forecast is that the pace of new distributed generation facilities will continue to grow.

The 110 MW Quilapilun photovoltaic plant was inaugurated in **Chile**. Located in the area of Quilapilun Alto, in the Colina commune, about 40 km north of the Chilean capital; it is considered the first large-scale plant developed in the metropolitan region of Santiago. This project of Atlas Renewable Energy, which incorporates into the Central Interconnected System (SIC), will produce enough energy to supply approximately 110,000 households per year and is expected to generate 243 GWh per year, which will prevent the annual emission of more than one hundred thousand tons of carbon dioxide, equivalent to the emission of 22,000 cars. The plant is composed of more than 350,000 photovoltaic panels and occupies a total area of 288 hectares. Additionally, the tests for electricity generation and connection to the large North Interconnected System (SING) of the first unit of the Cerro Pavilion geothermal plant were initiated: the first geothermal project of electric generation on a commercial scale in South America and the highest in the world, since it is installed at 4,500 M.A.S.L. Cerro Pavilion manages to position Chile on the map of the countries producing geothermal energy, is located in the Ollague commune, Antofagasta Region, and has an installed power of 48 MW, reaching a plant factor of 81%, i.e., similar to those that the thermoelectric plants operating at full capacity can reach. The geothermal plant will provide 340 GWh per year into the Grand North Interconnected System (SING); it has the energy needed to supply 165,000 households and reduce 166,000 tons of CO_2 annually, contributing to the fight against climate change. On the other hand, the first health center in Atacama relying on solar energy for its operation was inaugurated. El Palomar is one of the 4 health centers of the region benefited through the program "Public Solar Roofs", the installation of 120 panels, will save an amount equivalent to the energy consumption of 25 houses.

Costa Rica generated 99.35% of its electricity with renewable resources during the first semester of 2017, according to data from the National Center of Energy Control (CENCE). This percentage is higher than any annual average of the last 30 years. Between January 1 and June 30, the National Electrical System (SEN) produced 5,575.61 GWh with the five renewable sources of the national matrix: water (74.85%), geothermics (11.10%), wind (11.92%), biomass (1.47%) and solar (0.01%). The thermal contribution represented 0.65%. At the end of the semester, Costa Rica accumulates 160 days with 100% renewable electricity in 2017, and in the same period the SEN exported 93.5 GWh to the Regional Electric Market (MER).

In Havana, **Cuba**, on June 2, 2017, during the last session of the IX International Conference on Renewable Energies, Energy Saving and Energy Education, intensive scientific conferences were held, including keynote speeches and more than 20 lectures. The forum, which met in Havana since May 31, was aimed at analyzing alternative sources for energy generation and its projection into the future, under the slogan "The Caribbean 100 percent with Renewable Sources of Energy." The next edition of this event will be held in 2019. Also in April 2017, the construction of its first bioelectric nationwide begun. The company Biopower S.A., formed by Cuban-British capital, announced the beginning of this work, as part of the implementation strategy by the Caribbean nation to expand the use of renewable energy sources within its energy matrix. The installation, whose investment exceeds USD 160 million, will generate 60 MWh from the daily consumption of 2,100 tons of bagasse and 1,200 tons of marabou, which will mean savings of about USD 50 million by substituting oil in energy production. The construction of the bio plant, with an area of approximately five hectares, will be under the command of the Chinese companies Shanghai Electric S.A. and the Institute of Mechanical and Electrical Engineering of Shanghai (Simee), who have 30 months for the execution of the work, whose operation is planned for the sugar harvests of 2019 and 2020.

The new Solar Thermal System was inaugurated in **El Salvador** at the Francisco Menendez de Ahuachapan National Hospital, a system implemented by the United States Agency for International Development (USAID) with an investment amounting to USD 42,820.00.

In **El Salvador**, the opening of economic offers was carried out in the tender process of 170 MW with solar photovoltaic and wind technology. The result of this evaluation was completely satisfactory in obtaining a total of 169.9 MW distributed in 50 MW of projects of generation with wind energy and 119.9 MW of projects with solar photovoltaic technology, with prices ranging from $49.55 per MWh in solar energy and $98.78 per MWh in wind power.

In 2017, with the supervision of the Guyana Energy Agency (GEA), 178.5 kWp of new solar photovoltaic installations were completed in **Guyana**. In addition, as a result of an open tender procurement process, a contract was awarded for the supply and installation of solar photovoltaic systems in 57 government buildings adding to 740 kWp. Based on savings, a new tender was announced for the supply and installation of solar photovoltaic systems that will be installed in 18 additional buildings with 382 kWp of new solar photovoltaic systems. Additionally, the Guyana Energy Agency (GEA), in collaboration with the Ministry of Education (MoE) and the Ministry of Indigenous People Affairs (MoIP), initiated the installation of 9 grid-connected photovoltaic solar systems in public institutions (mainly high schools) across the country which will produce approximately 124,321 kWh of energy per year.

In October 2017, the World Bank Executive Board approved two donations for a total of USD 35 million for **Haiti** to improve access to electricity for more than two million Haitians and to increase investments in renewable energy in neglected rural and urban areas. Specifically the projects, "Renewable energy for all" and "Haiti's modern energy services for all", will help to: improve the environment for private investment in clean energies; expand access for rural households through leveraged investments in micro and mini-networks and systems at community level; strengthen the capacity of local institutions and inform local people on the benefits of the use of renewable energies; as well as to obtain financing for private operators, NGOs and community organizations for the supply of solar lanterns and individual and domestic solar systems.

In order to strengthen the energy supply of the National Electric Energy Company (ENEE) in **Honduras**, the first 10 MW of solar energy, of the 30 agreed with ENERGYS consortium, entered the state system. The ENERGYS complex has two photovoltaic farms that are located, one in the Lajas sector of the Cubulero and the other in Manzanillas, both are settled at 14 km from the road leading to the municipality of Marcovia, Choluteca.

In March 2017, a Power Purchase Agreement was signed between Eight Rivers Energy Company Limited and **Jamaica** Public Service Company Limited to supply for 20 years solar-generated electricity to the national network. In this regard, the official ceremony of the beginning of the construction of the 37MW solar power plant, in Paradise Park, Westmoreland, was held at an estimated cost of USD 48.7 million. The proposed price (total rate) is 8.54 US cents/kWh to supply power to the network and is planned to reach the commercial operations date (COD) for the first quarter of 2019. The project will lead Jamaica closer to reaching its renewable energy target of 20% by 2030. Additionally, WRB Energy Company inaugurated a 20 MW solar powered electricity generation plant in June 2017 in the district of Content, Clarendon.

Mexico published the Special Programme for the Energy Transition, a national policy planning tool aimed at the establishment of actions to promote the use of cleaner technologies and fuels. It contains objectives, strategies, lines of action and goals for the participation of clean energies at the national level.

The American Chamber of Commerce of **Nicaragua** (AMCHAM) announced the installation of the first vehicle parking lot with solar roof in the country. Built by the real estate company ESCALA, the new parking lot will contribute to reduce the costs on the electrical bill. In addition, the Military Hospital Alejandro Davila Bolaños of Nicaragua invested USD 4.5 million in a new solar power-based electrical system, with support from the United Nations agency for the Industrial Development (UNIDO). Energia Limpia XXI highlighted that the new solar plant that will be built by the Austrian firm SOLID in an area of 4,450 m^2 of extension, will have a positive impact on the environment eliminating emission by more than 1,100 tons of carbon dioxide each year with this first major project of this type financed by a soft loan. Also, data from Energia Limpia XXI indicate that the leader company in supermarkets known as La Colonia has started a major investment in solar energy. The project is being developed by the company ECAMI with more than 20 years in the development of photovoltaic energy systems. The investment will save 90 MW per year equivalent to the consumption of about 50 households. Also, the Central University of Nicaragua (UCN) invested USD 182,000 in the installation of 120 solar panels in its Central Campus. University authorities explained that investment seeks to contribute to the development of renewable energies and to promote awareness among students on the importance of mitigating the effects of climate change. Solar panels will supply the entire university, reducing 70% of its electrical bill.

In **Panama**, the commercial operation of 42 MW photovoltaic plant in Real Sol began. With the commissioning service of Sol Real, Enel has reached 354 MW of installed capacity of renewable energies in Panama. With 42 MW of capacity, about 70 GWh of electricity per year can be generated, equivalent to the annual energy consumption needs of around 33,000 local households, thus avoiding the emission of around 60,000 tons of CO_2 each year. The energy generated by the 310,860 photovoltaic modules of the Sol Real installation will be purchased by Fortuna Hydroelectric Power Plant from EGPPA. This new photovoltaic plant will contribute to improve the security of the energy supply and the balance of the prices of the electricity market in Panama, particularly during the dry season of the country.

Since March 2017, the Ministry of Energy and Mines (MEM) of **Peru**, within the framework of an investment contract signed with the company Ergon Peru S.A.C., has installed 6,000 solar panels that benefit with electric energy to 27,000 inhabitants of rural towns of Amazonas, San Martin, Huanuco, Huancavelica and Puno. These facilities were carried out as part of the project "Electricity Supply with Renewable Energy Resources in Areas not Connected to the Network." The referred project envisages the installation of 194,038 solar panels at the national level with an investment close to USD 300 million for all its implementation, which will benefit 850,000 inhabitants of the country's isolated rural areas. For 2017 the implementation of another 24,000 panels was planned in different regions of the country, while in the 2018 the goal is to install about 100,000 additional solar panels and culminate the year 2019 with the remaining 64,038 panels. In addition, the San Jacinto plant, which will operate on the basis of biomass and biogas, came into operation. With a capacity of 21.71 MW, it will generate 140.60 GWh per year.

VI ENERGY AND ENVIRONMENT

In 2017, the **Barbados** Water Authority (BWA) obtained a grant of USD 3.5 million from the United Arab Emirates (UAE) for two renewable energy projects. The collaboration involves the construction of a 500 kW ground mounted solar photovoltaic system at the Bowmanston Pumping Station in St. John; as well as the cargo installation for electronic vehicles in Lakes Folly, Bridgetown. In addressing the launching of the projects, the government authorities of the sector highlighted that this achievement is the result of the government's impulse to significantly reduce the dependence on fossil fuels of the island, as well as to build "strategic alliances".

Colombia issued its first green bond in the local market for 200 billion pesos with the support of the IDB. The funds will be used to finance projects to mitigate the impacts of climate change and improve the environmental performance of national companies. The bidding exceeded expectations, achieving a demand of 510 million, more than 2.5 times the amount auctioned. On the other hand, the launching of the National Climate Change Policy was unveiled, instrument that reinforces the commitment of the national energy mining industry in the implementation of actions to reduce carbon emissions in the sector and to contribute to the fulfillment of the Paris agreements.

In **Mexico**, the secretariats of Social Development (SEDESOL) and Energy (SENER) signed a collaboration agreement to promote the substitution of firewood and coal by liquefied gas in communities located in marginalized rural and urban areas in the country, in order to promote greater access to decent housing and protect the family economy, health and the environment. This agreement will allow to carry more than 13,000 gas stoves to the same number of households, whose inhabitants live in a situation of extreme food poverty. The substitution of these traditional fuels will generate environmental benefits by preserving millions of trees and mitigating polluting emissions to the environment. On the other hand, in November 2017, in the framework of the trilateral meeting of Ministers of Energy of North America, **Mexico** announced that the Secretariat of Energy (SENER) and the National Council of Science and Technology (CONACYT) launched the call for the creation of the Mexican Center of Capture, Use and Storage of Carbon Dioxide or CO_2 (CEMCCUS). CO_2 Capture, Use and Storage Technology (CCUS) is the only technology currently available to achieve the reduction of emissions from industrial processes using fossil fuels, such as the generation of conventional electricity, petrochemicals, steel mills, refineries, among others. The purpose of this technology is to reduce the CO_2 emissions generated by the aforementioned industries to prevent these gases from being released into the atmosphere, where their high concentrations cause adverse impacts to the environment.

VII INTEGRATION, COOPERATION AND ENERGY COMPLEMENTATION

As a result of the joint work of the representatives of member countries before the Andean Committee of Regulatory Entities and Regulatory Bodies for Electricity Services (CANREL) and technical support from the General Secretariat of the **Andean Community of Nations** (CAN), on April 24, 2017, the decision on the general framework for the Sub-Regional Interconnection of Electrical Systems and Intra-Community Electricity Exchange was approved. This document materializes in the 141 Period of extraordinary sessions of the Andean Community Commission and is of great importance in aspects of Andean integration, in order to achieve one of the objectives envisaged in the Cartagena Agreement on the physical integration of the member countries by propitiating the interconnection of electrical systems at the sub-regional level. The normative approval for the Sub-regional Interconnection of Electrical Systems and Intra-Community Electricity Exchange and the Andean Regional Electric Market is, without a doubt, a milestone in the field of electrical interconnection in South America and generates high expectations for electricity exchanges between Andean countries. In order to achieve the implementation and operation of this decision, countries undertake to develop the institutional, technical, and commercial regulatory instruments to be able to make the Andean Decision operational in the short term.

Chile and **Peru** signed an agreement to initiate electrical interconnection studies. The energy ministers of both countries met to agree on the terms of reference for the economic benefit analysis for the integration between Arica and Tacna. This fact is considered the first step in the materialization of the project. The signing of the aforementioned document agrees the conditions for the construction of the Tacna – Arica transmission line, which will benefit both countries by increasing the supply security and generating market options to export the surplus energy that Chile owns. The preliminary long-term energy planning report identifies six possible interconnection points, four with Argentina and two with Peru, which could enter into operation between 2023 and 2040. The study will have an estimated cost of USD 250,000 and will be financed by the IDB. This electrical interconnection would make it possible to achieve a safe and stable energy supply, which strengthens the system and facilitates a better emergency response capacity.

On March 29, 2017, the presidents of **Guatemala**, **Panama** and **Costa Rica** gathered in **Guatemala** City to analyze the prospects for regional energy integration through the connection of the countries of the Isthmus and **Mexico**. The project for a regional interconnection positions Guatemala as a leading country in the development of the strategy, both for its geographical position and for the investments that have been allocated to the field in recent years. This is the possible extension of the Electrical Interconnection System of the Central American Countries (SIEPAC) with Mexico.

In November 2017, two Official Signatures of the Loan Mechanism for Energy Efficiency and Management Program (EMEP) were held between the Inter-American Development Bank (IDB), the Japan International Cooperation Agency and the Investment Mechanism of the Caribbean of the European Union (EU-CIF). The total loan for the program is valued at USD 40 million. The overall objective of this expanded program is to promote energy efficiency in government facilities and fuel conservation in road transport to help reduce **Jamaica's** government debt by reducing fuel imports. The specific objectives and expected results of this programme are: reduction of electricity consumption within health, education, public and government facilities, resulting in lower CO_2 emissions; reduced travel times and lower fuel consumption through better management of traffic control, which also results in lower CO_2 emissions; and greater capacity within the MSET to allow to update their Integrated Resource Plan for Jamaica.

The governments of **Jamaica** and **Venezuela** signed an agreement to implement the Petrojam Refinery Expansion Project, which will cost approximately USD 1 billion. Expansion will increase crude oil capacity of Jamaica's national oil refinery of 36 kbbl /day of oil at 50 kbbl/day.

In December 2017, the Vice Minister of Mines and Energy of the Ministry of Public Works and Communications of the Republic of **Paraguay** and the National Hydrocarbons Agency of the Plurinational State of **Bolivia** (A.N.H.), signed a Memorandum of Understanding to strengthen bilateral cooperation in the area of hydrocarbons.

In Port of Spain, the Joint Coordination Committee formed by representatives of the companies Petróleos de Venezuela S. A (PDVSA), NGC and Shell was held for negotiation of the interconnection and export of natural gas from **Venezuela** to the **Republic of Trinidad and Tobago**. The initiative responds to the commitments acquired in the agreement signed between Venezuela and Trinidad and Tobago, with the aim of initiating the construction, operation and maintenance of an underwater pipeline of about 20 km that will range from the Campo Dragon, in Venezuela, to the Campo Hibiscus in Trinidad and Tobago.

VIII NATURAL PHENOMENA THAT AFFECTED THE ENERGY SECTOR

Tropical storm NATE, the fourteenth-named storm of the destructive Atlantic hurricane season of 2017, produced torrential rains throughout the Central American region. In the coverage area of the **Costa Rican** Electricity Institute (ICE), the storm NATE caused a great deal of damage to the telecommunications and electricity services. The impact on the electricity service was mainly present in the distribution system, accounting for about 1,775 km of affected network, which integrate affectations in productive assets such as poles, transformers and luminaires. Most were resolved in the first 24 hours and the rest were gradually recovering to a very small remnant of 45 sites for not having access to them. These 45 were electricity cases.

During 2017, the **Dominican Republic** was affected by two hurricanes, Irma and Maria, which caused damage to the power lines, especially in the northern part of the country, causing long interruptions, and leaving a large portion of the population without electricity. The Dominican Company of Electric Transmission (ETED) reported on the outage of some lines to 69 kV that were affected due to the strong winds. The maintenance brigades offered the corresponding follow-up to normalize service in the affected areas.

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 ,25 2019, and the BP Statistical Review of World Energy 2018[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, 2017).

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/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2018-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 2016. 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

Crude oil

It corresponds to the individual audited oil productions of all the country's oil fields, after the separation process that is carried out at the wellhead of the extraction fluid which may contain natural gas liquids, natural gas, and water in addition to crude oil.

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.

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.

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 electric 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).

$$EICS_t = \frac{\left[\frac{VA_{t_0}^{Ind}}{VA_t^{Ind}}\right] \cdot FC_t^{Ind} + \left[\frac{VA_{t_0}^{Serv}}{VA_t^{Serv}}\right] \cdot FC_t^{Serv} + \left[\frac{GDP_{t_0}}{GDP_t}\right] \cdot FC_t^{Trans} + \left[\frac{C_{t_0}^{Resid}}{C_t^{Resid}}\right] \cdot FC_t^{Resid}}{GDP_{t_0}}$$

Where:

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

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:

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

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:

$$\frac{FC_t^{Tot}}{FC_{t0}^{Tot}} = D_t^{Tot} = D_t^{act} \cdot D_t^{str} \cdot D_t^{eff}$$

With:

$$D_t^{act} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i} \cdot \ln\left(\frac{Q_t}{Q_{t_0}}\right)\right]$$

$$D_t^{str} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i} \cdot \ln\left(\frac{P_t^i}{P_{t_0}^i}\right)\right]$$

$$D_t^{eff} = \exp\left[\sum_{i=1}^{n_{sectors}} \widetilde{w_t^i} \cdot \ln\left(\frac{EI_t^i}{EI_{t_0}^i}\right)\right]$$

Being:

$$\widetilde{w_t^i} = \frac{\left[\frac{FC_t^i - FC_{t_0}^i}{\ln(FC_t^i) - \ln(FC_{t_0}^i)}\right]}{\left[\frac{FC_t^{Tot} - FC_{t_0}^{Tot}}{\ln(FC_t^{Tot}) - \ln(FC_{t_0}^{Tot})}\right]}$$

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 2000 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

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 hydro-energy 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:

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

METHODOLOGY

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 electricity 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:

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

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:

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

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

LATIN AMERICA AND THE CARIBBEAN

General Information 2017

Population (thousand inhab.)	634,694
Area (km²)	20,397,622
Population Density (inhab./km²)	31
Urban Population (%)	80
GDP USD 2010 (MUSD)	5,681,993
GDP USD 2011 PPP (MUSD)	9,404,030
GDP per capita (thou. USD 2011 PPP/inhab.)	15

Energy Sector

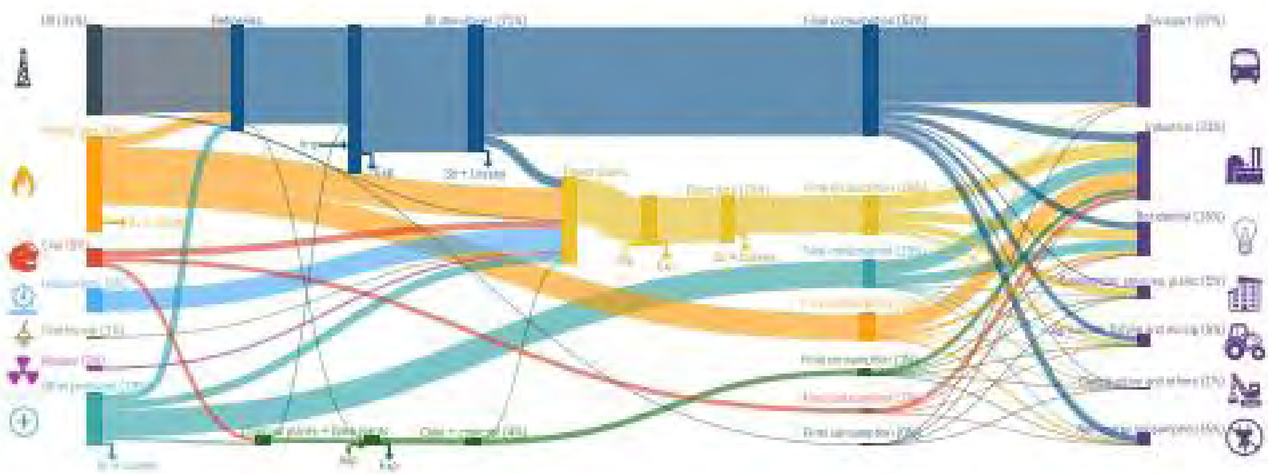
Final consumption in the Transport Sector	Mtoe 227
Final consumption in the Industrial Sector	Mtoe 198
Final consumption in the Residential Sector	Mtoe 99.91
Final consumption in the Commercial and Service Sector	Mtoe 23.24
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 67.48

Oil reserves	Natural gas reserves	Coal reserves
Mbbl 333,611	Gm³ 7,909	Mt 16,339

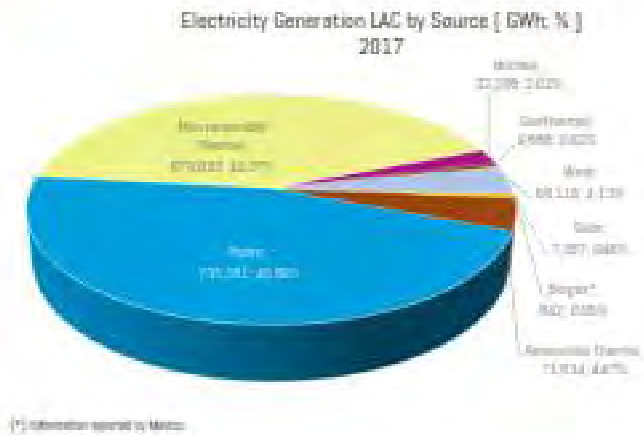
* Does not include own consumption of the energy sector.

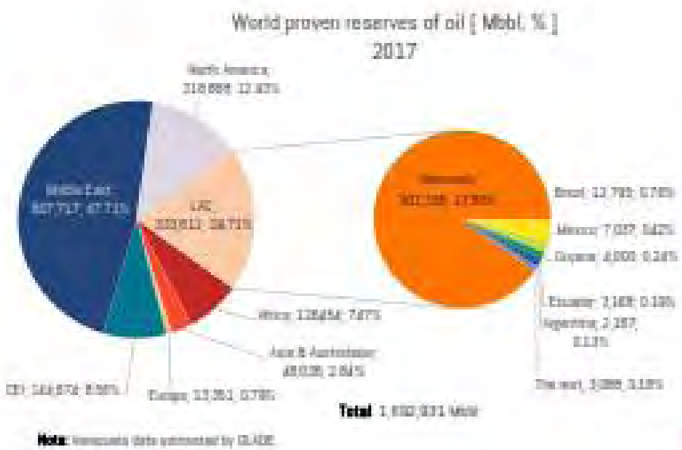
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,051	1.00	97	896	1,068	291	445	636*	7,443	415	0.09 / 0.07

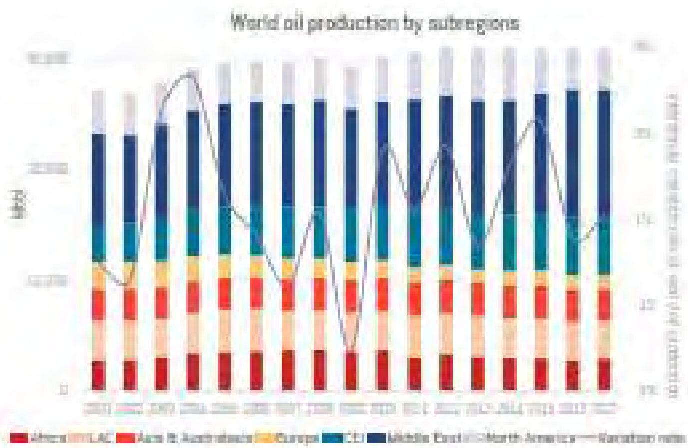
Summarized energy balance 2017



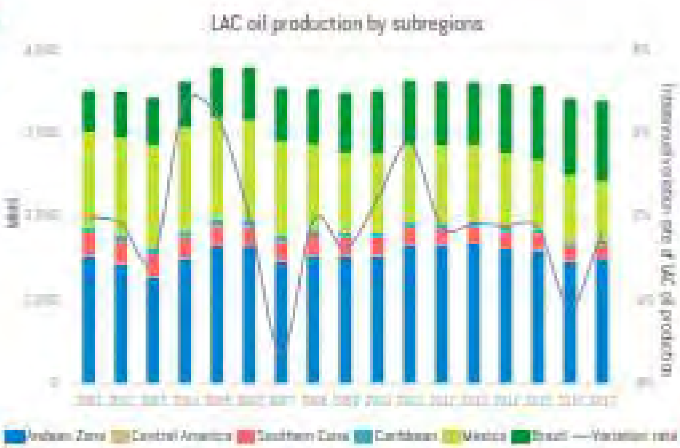

Installed power generation capacity LAC [MW; %]
2017

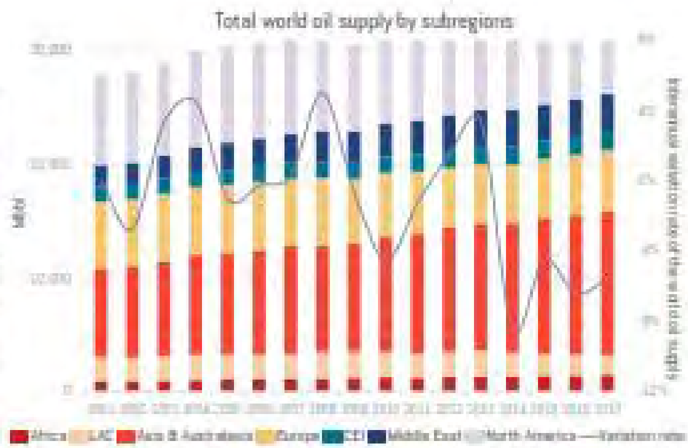

Electricity Generation LAC by Source [GWh; %]
2017

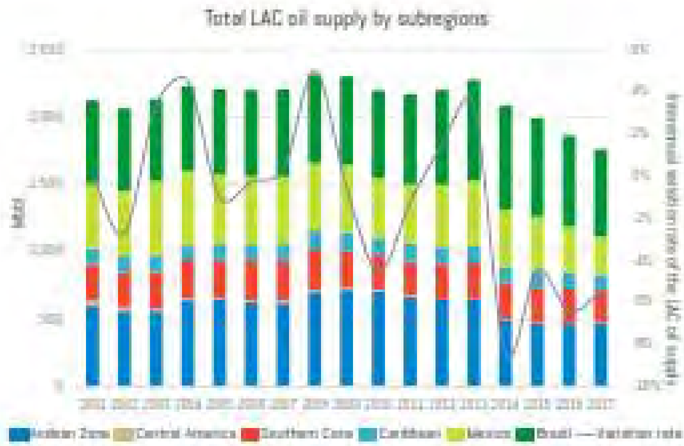

World proven reserves of oil [Mbbl; %]
2017
Total 1,692,931 Mbbl

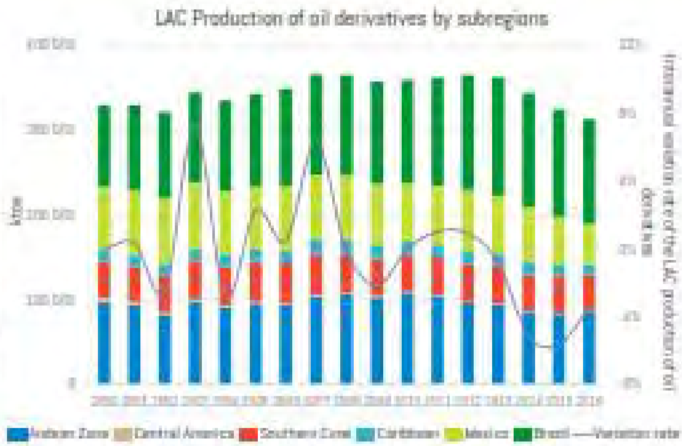

World oil production by subregions
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

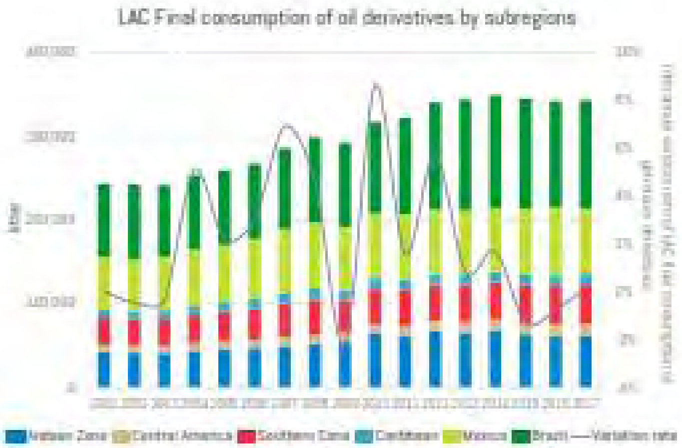
LAC

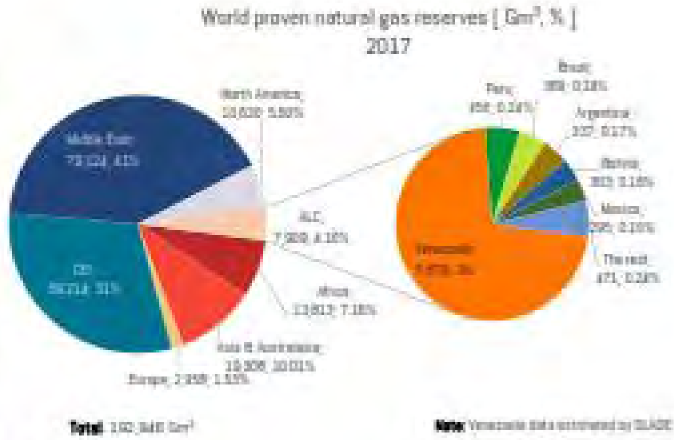

LAC oil production by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

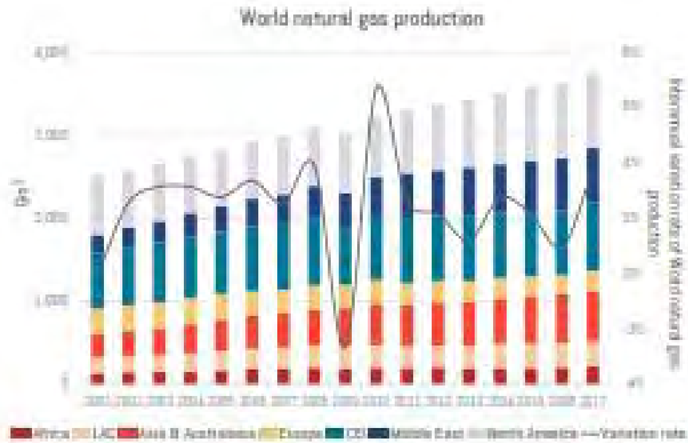

Total world oil supply by subregions
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

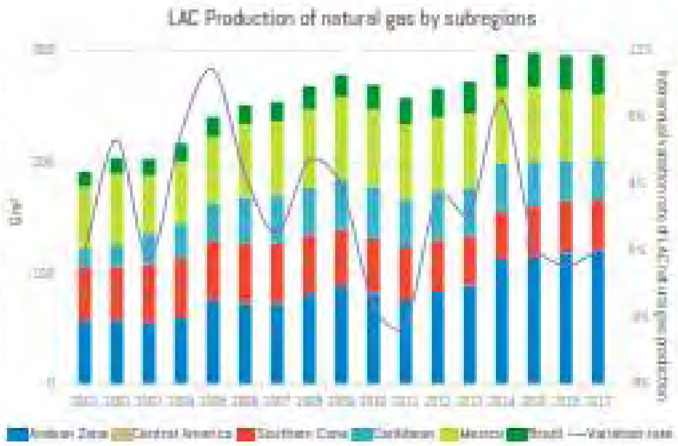

Total LAC oil supply by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate


LAC Production of oil derivatives by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

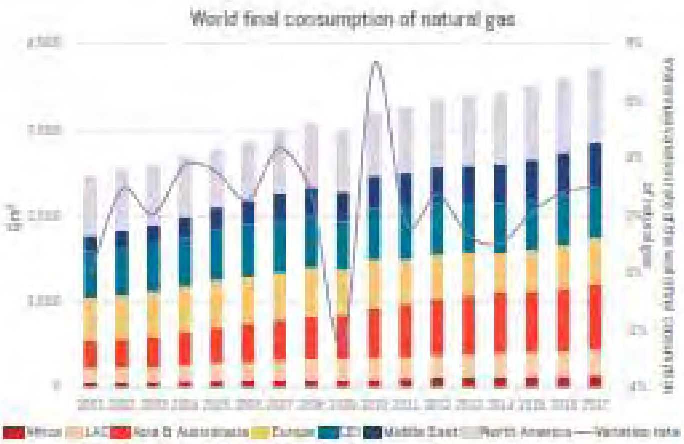

LAC Final consumption of oil derivatives by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

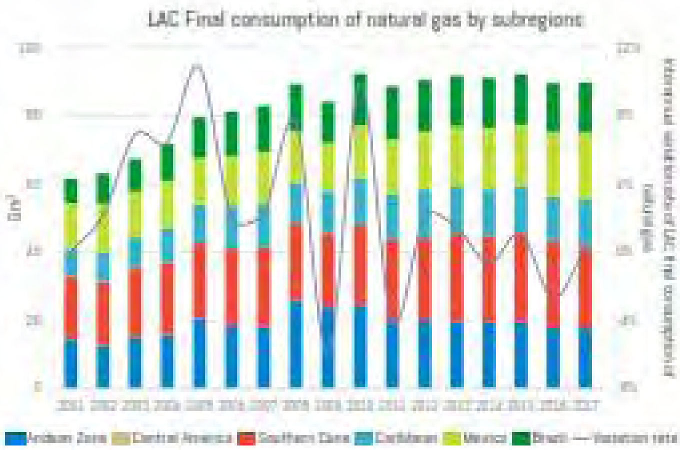

World proven natural gas reserves [Gm³, %] 2017
Middle East
CEI
North America
LAC
Africa
Asia & Australasia
Europe
Venezuela
Peru
Brazil
Argentina
Bolivia
Mexico
The rest
Total
Note: Venezuela data estimated by OLADE

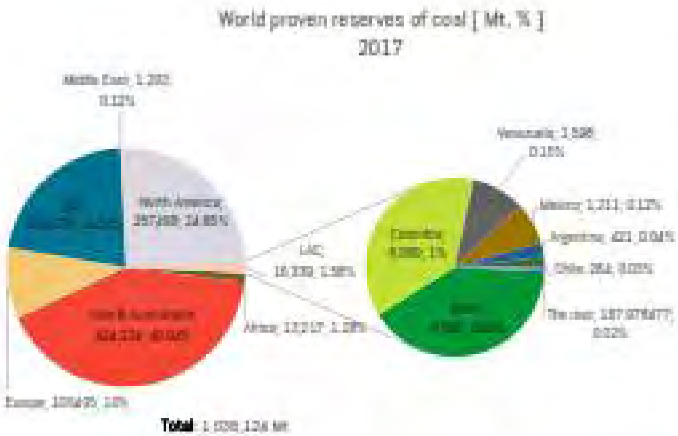

World natural gas production
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

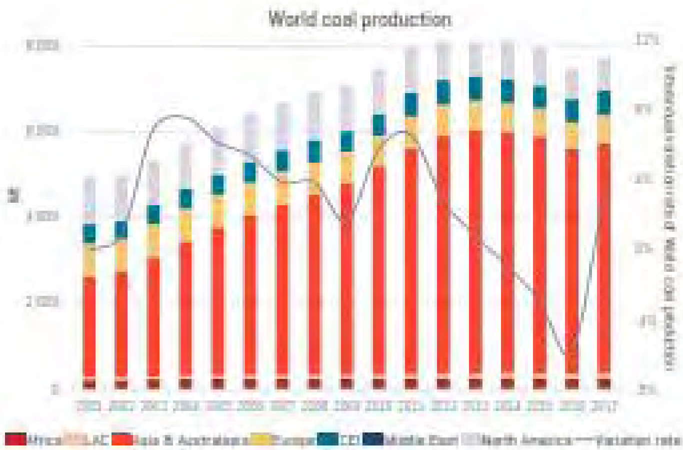

LAC Production of natural gas by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

LAC

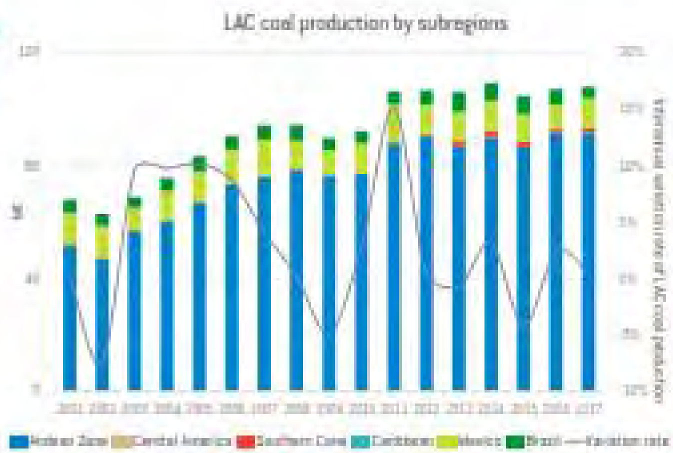

World final consumption of natural gas
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

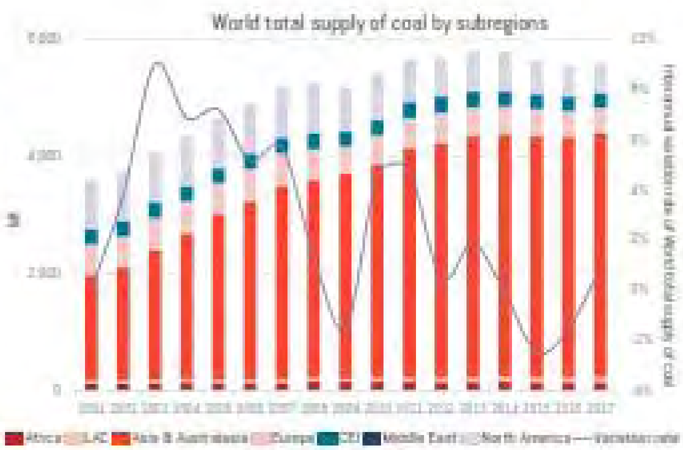

LAC Final consumption of natural gas by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

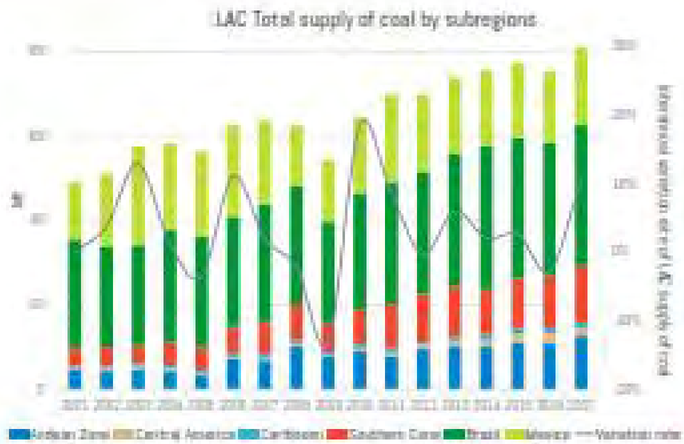

World proven reserves of coal [Mt, %]
2017

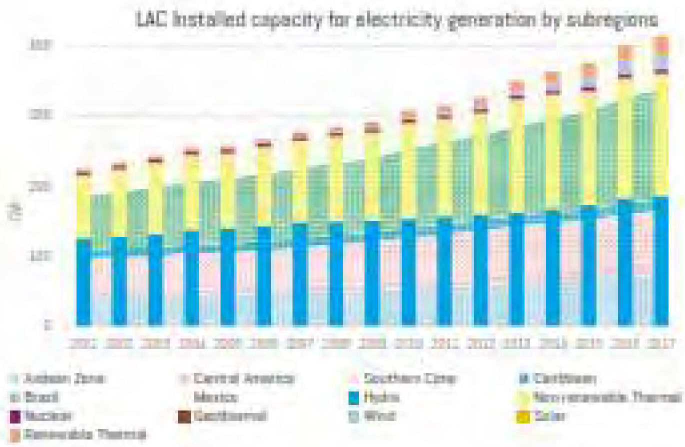

World coal production
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

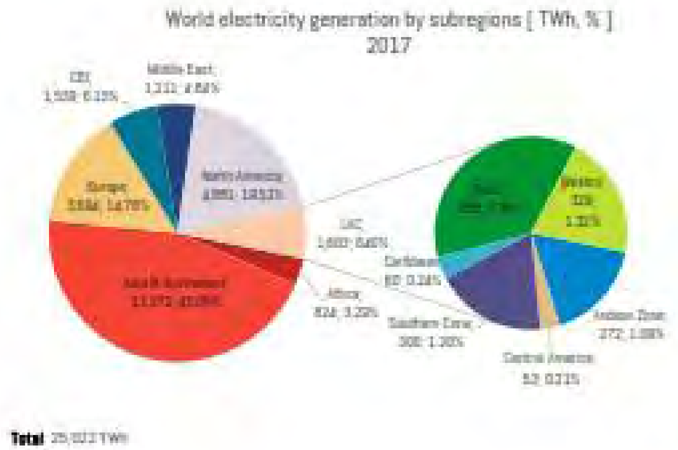
LAC

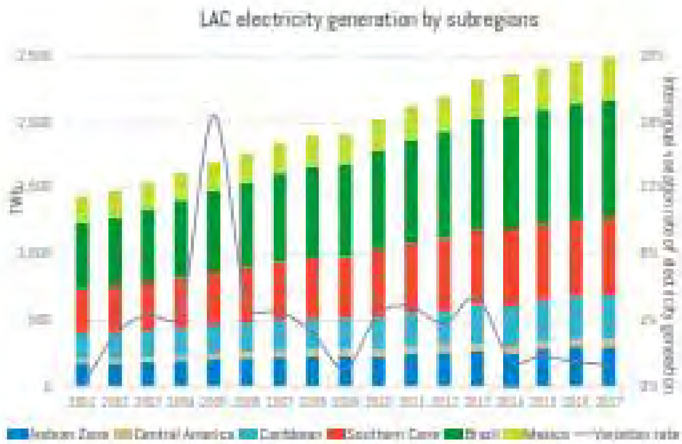

LAC coal production by subregions
Andean Zone
Central America
Southern Cone
Caribbean
Mexico
Brazil
Variation rate

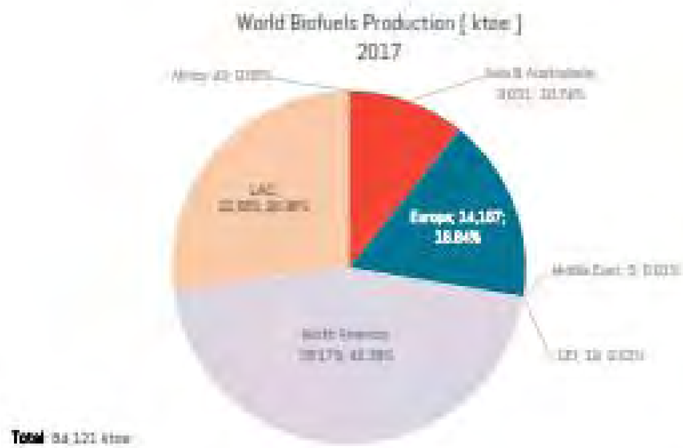

World total supply of coal by subregions
Africa
LAC
Asia & Australasia
Europe
CEI
Middle East
North America
Variation rate

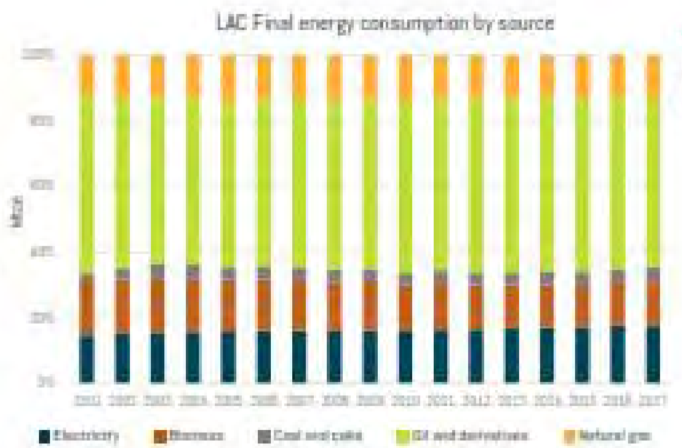

LAC Total supply of coal by subregions
Andean Zone
Central America
Caribbean
Southern Cone
Brazil
Mexico
Variation rate


LAC Installed capacity for electricity generation by subregions
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, %]
2017
Total 25,022 TWh

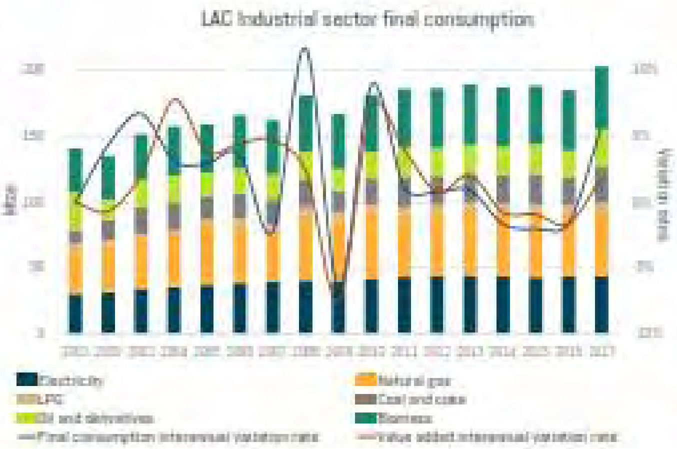

LAC electricity generation by subregions
TWh
Andean Zone
Central America
Caribbean
Southern Cone
Brazil
Mexico
Variation rate

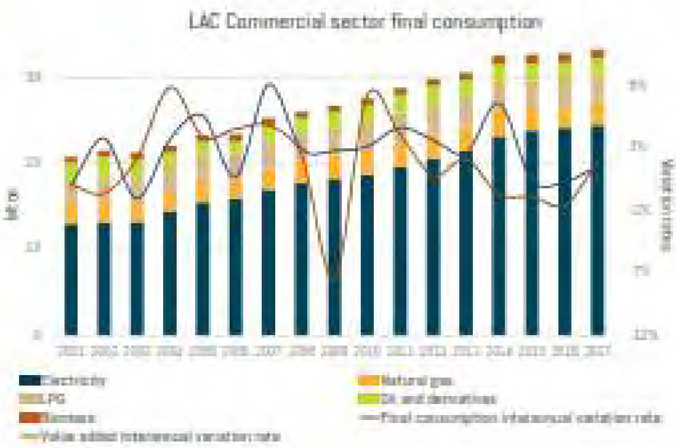

World Biofuels Production [ktoe]
2017
Europe; 14,167;
18.84%
Total 84,121 ktoe

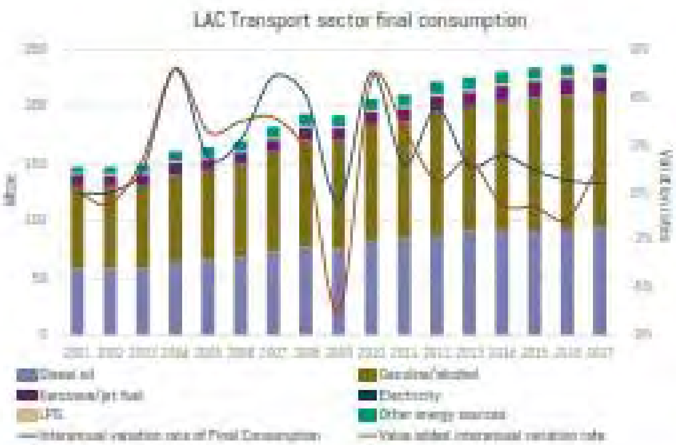

LAC Final energy consumption by source
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas

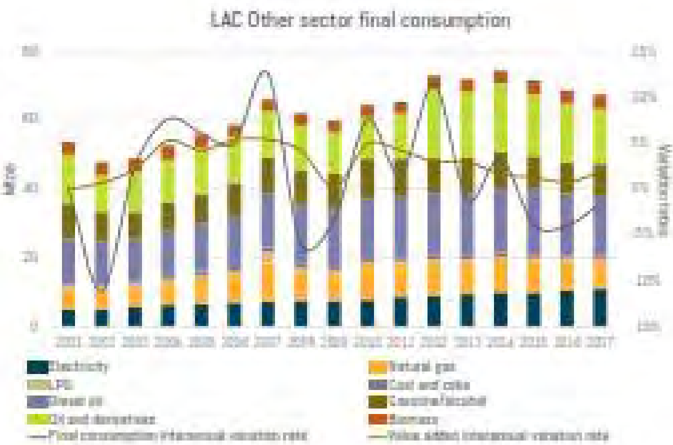
LAC

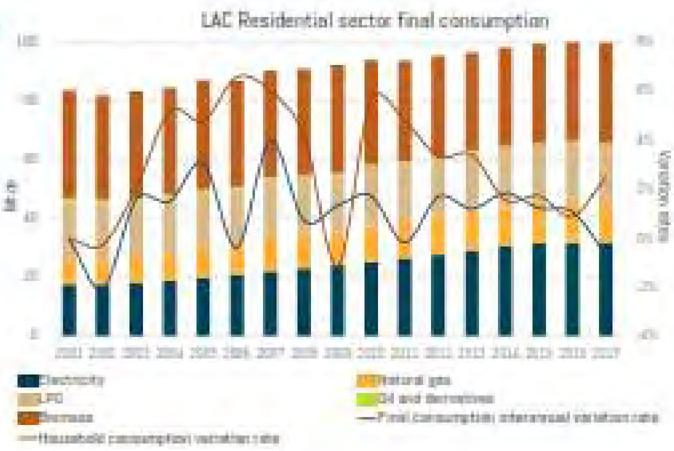
LAC

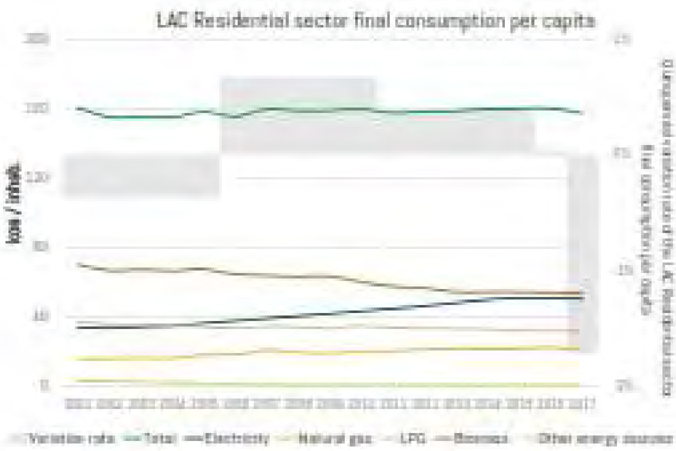

LAC Industrial sector final consumption
Mtoe
Variation rates
Electricity
Natural gas
LPG
Coal and coke
Oil and derivatives
Biomass
Final consumption interannual variation rate
Value added interannual variation rate

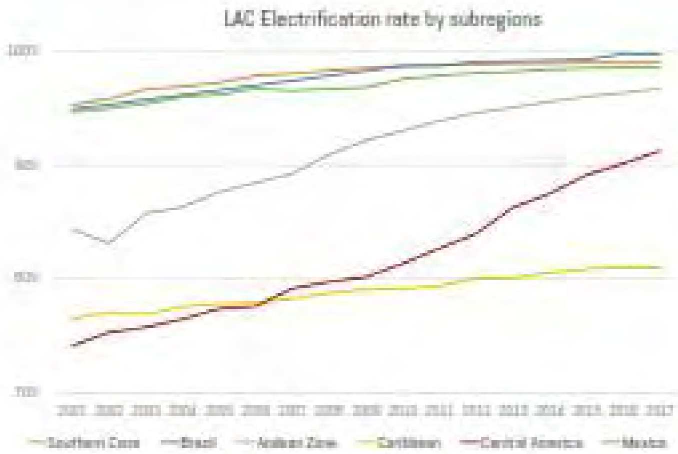

LAC Commercial sector final consumption
Mtoe
Variation rates
Electricity
Natural gas
LPG
Oil and derivatives
Biomass
Final consumption interannual variation rate
Value added interannual variation rate

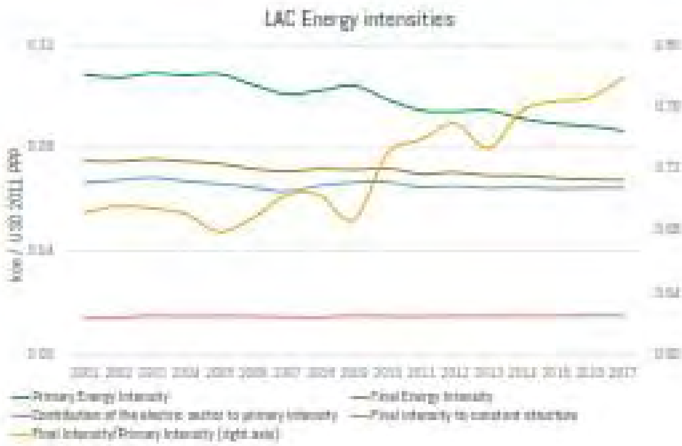

LAC Transport sector final consumption
Mtoe
Variation rates
Diesel oil
Gasoline/alcohol
Kerosene/jet fuel
Electricity
LPG
Other energy sources
Interannual variation rate of Final Consumption
Value added interannual variation rate

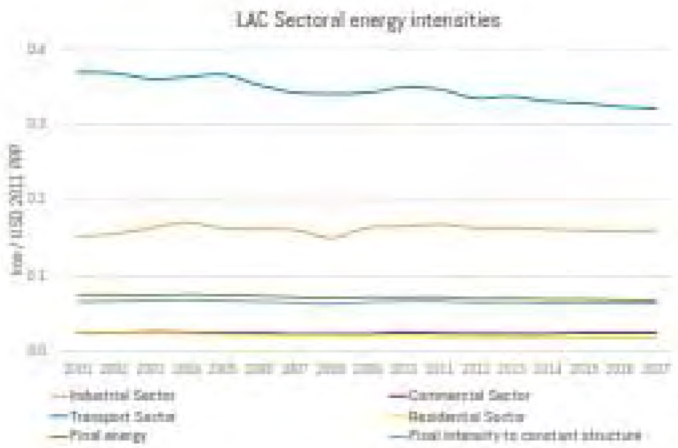

LAC Other sector final consumption
Mtoe
Variation rates
Electricity
Natural gas
LPG
Coal and coke
Diesel oil
Gasoline/alcohol
Oil and derivatives
Biomass
Final consumption interannual variation rate
Value added interannual variation rate

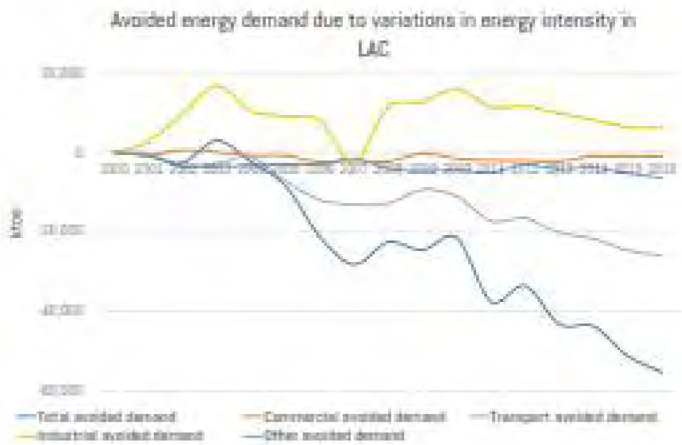

LAC Residential sector final consumption
Mtoe
Variation rates
Electricity
Natural gas
LPG
Oil and derivatives
Biomass
Final consumption interannual variation rate
Household consumption variation rate

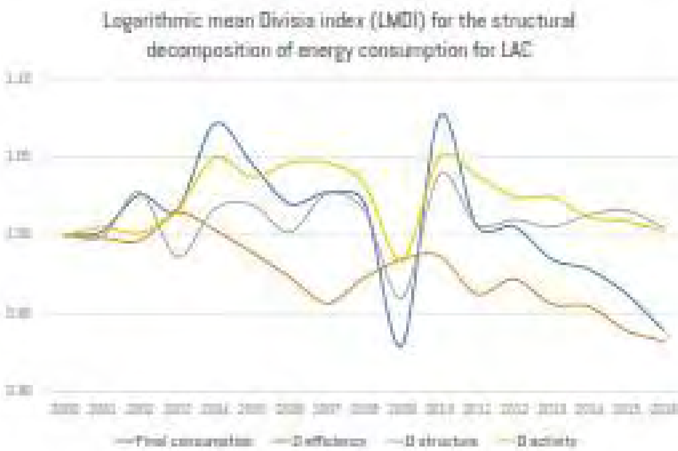

LAC Residential sector final consumption per capita
koe / inhab.
Variation rate
Total
Electricity
Natural gas
LPG
Biomass
Other energy sources

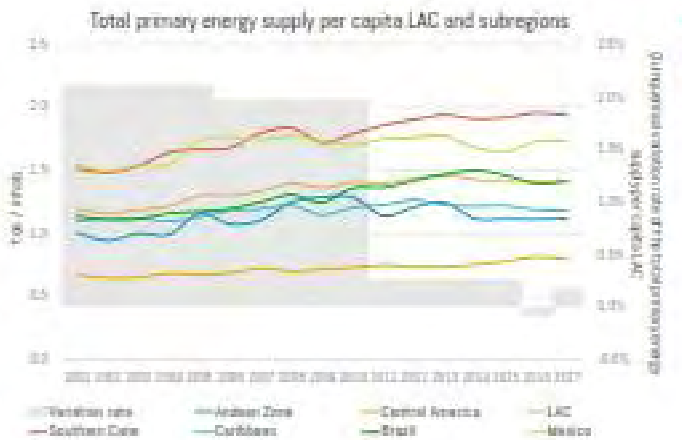

LAC Electrification rate by subregions
Southern Cone
Brazil
Andean Zone
Caribbean
Central America
Mexico


LAC Energy intensities
koe / USD 2011 PPP
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 Sectoral energy intensities
koe / USD 2011 PPP
Industrial Sector
Commercial Sector
Transport Sector
Residential Sector
Final energy
Final intensity to constant structure

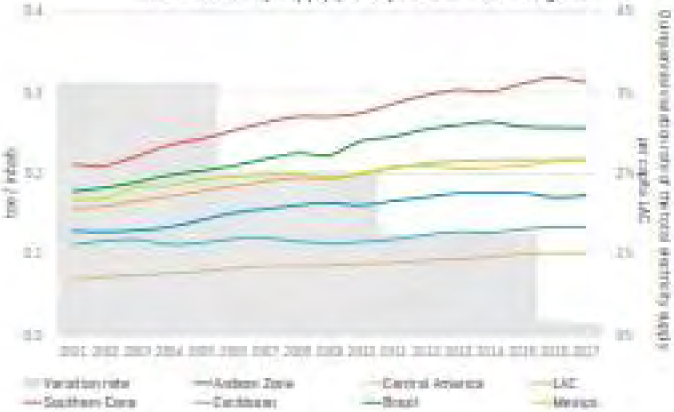

Avoided energy demand due to variations in energy intensity in LAC
ktoe
Total avoided demand
Commercial avoided demand
Transport avoided demand
Industrial avoided demand
Other avoided demand


Logarithmic mean Divisia index (LMDI) for the structural decomposition of energy consumption for LAC
Final consumption
D efficiency
D structure
D activity

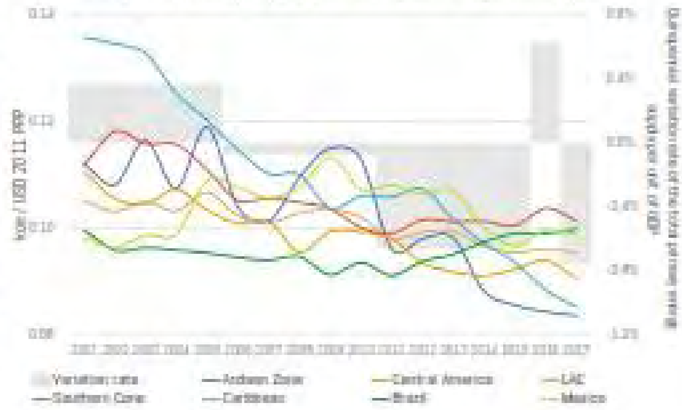

Total primary energy supply per capita LAC and subregions
TOE / inhab
Variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico

LAC

Total electricity supply per capita LAC and subregions

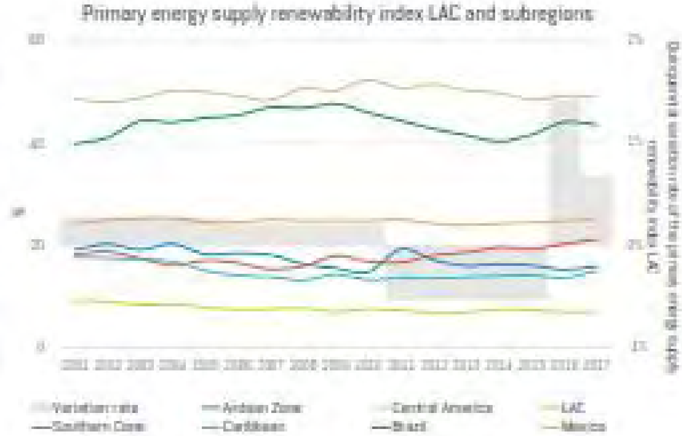


Total primary energy supply per unit of GDP LAC and subregions



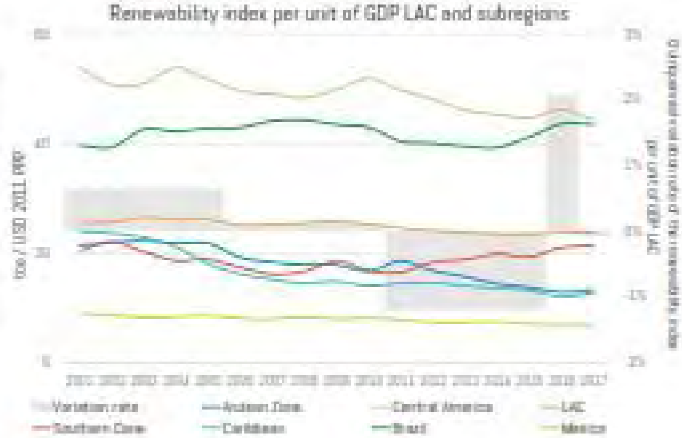
Total electricity supply per unit of GDP LAC and subregions

Primary energy supply renewability index LAC and subregions

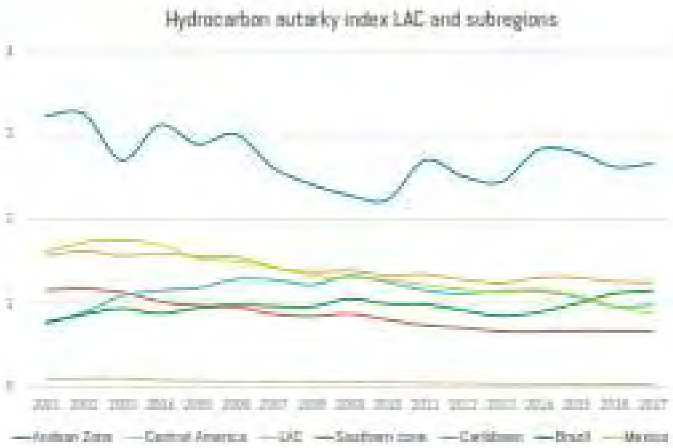


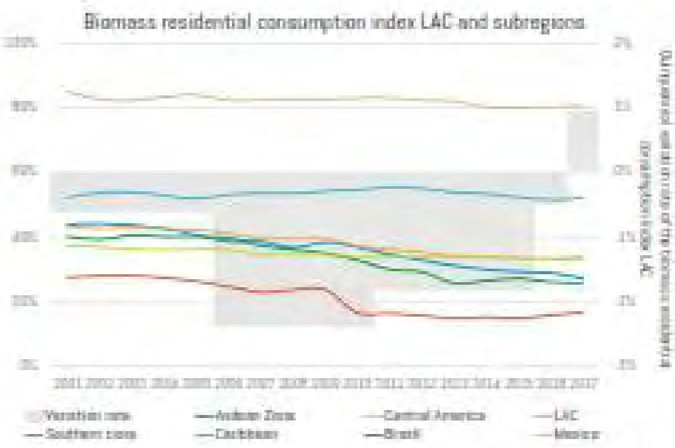
Per capita renewability index LAC and subregions

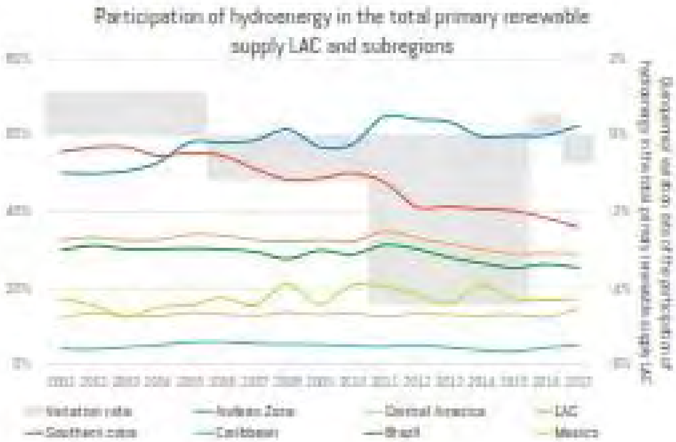
Renewability index per unit of GDP LAC and subregions

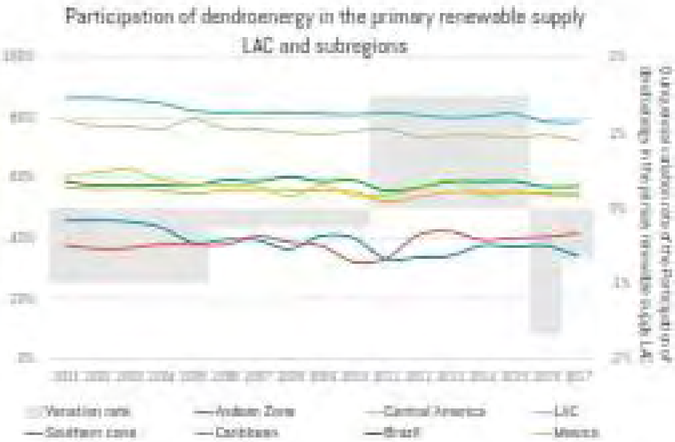


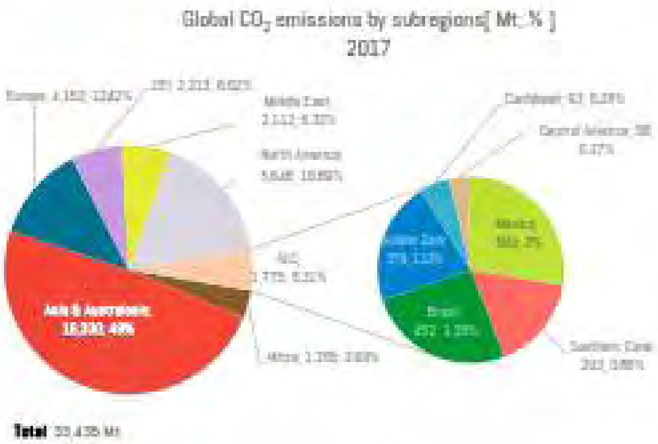
LAC

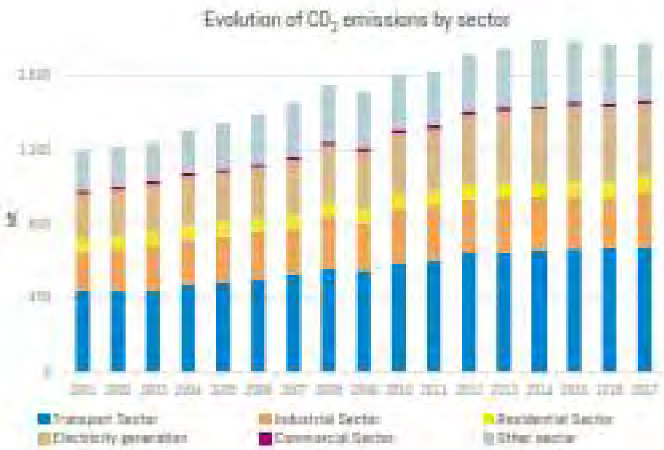

Hydrocarbon autarky index LAC and subregions
Andean Zone
Central America
LAC
Southern zone
Caribbean
Brazil
Mexico


Biomass residential consumption index LAC and subregions
Variation rate
Andean Zone
Central America
LAC
Southern zone
Caribbean
Brazil
Mexico

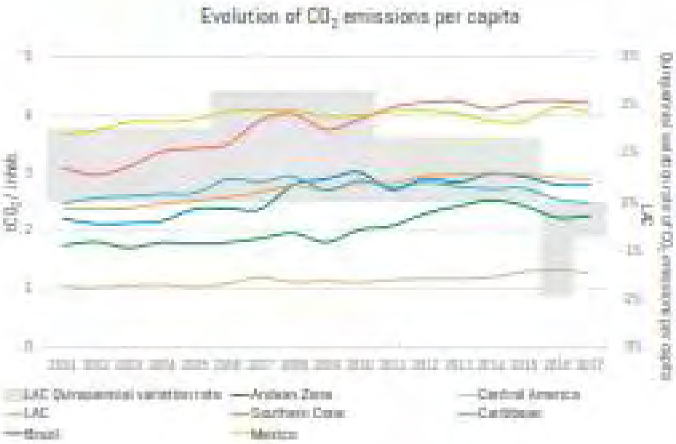

Participation of hydroenergy in the total primary renewable supply LAC and subregions
Variation rate
Andean Zone
Central America
LAC
Southern zone
Caribbean
Brazil
Mexico


Participation of dendroenergy in the primary renewable supply LAC and subregions
Variation rate
Andean Zone
Central America
LAC
Southern zone
Caribbean
Brazil
Mexico

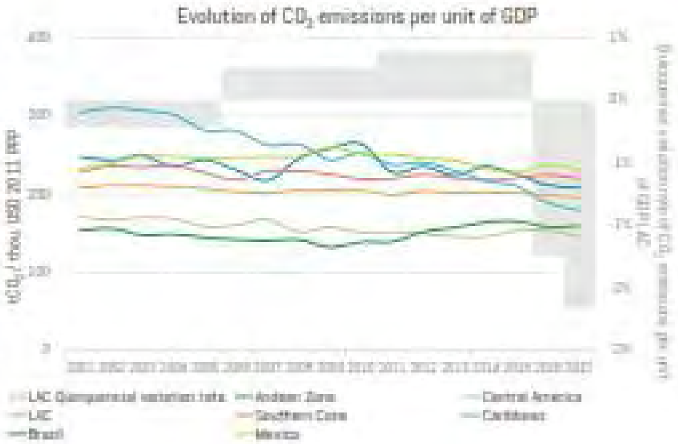

Global CO2 emissions by subregions[Mt; %] 2017
Asia & Australasia
16,330; 49%
Total 33,435 Mt


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

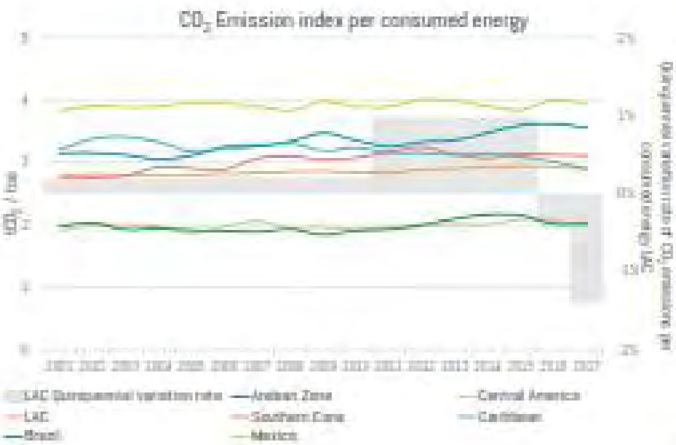
LAC



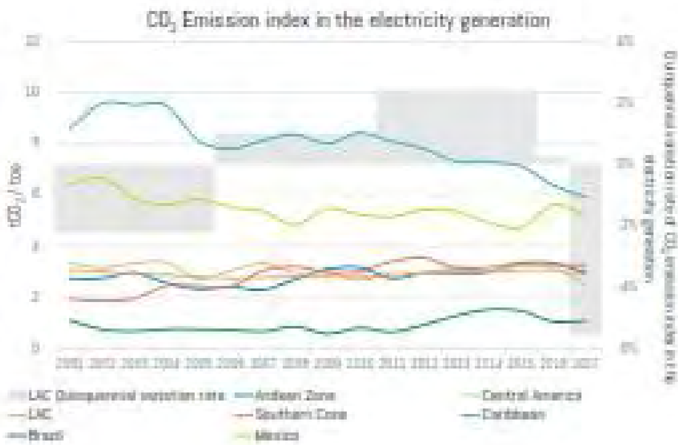
Evolution of CO2 emissions per capita
LAC Quinquennial variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico



Evolution of CO2 emissions per unit of GDP
LAC Quinquennial variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico

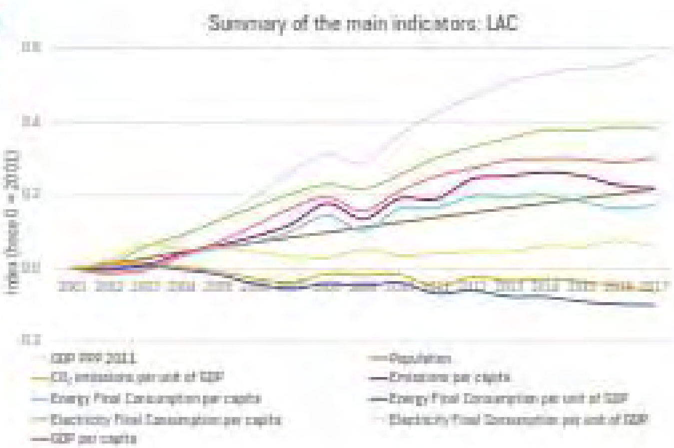


CO2 Emission index per consumed energy
LAC Quinquennial variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico

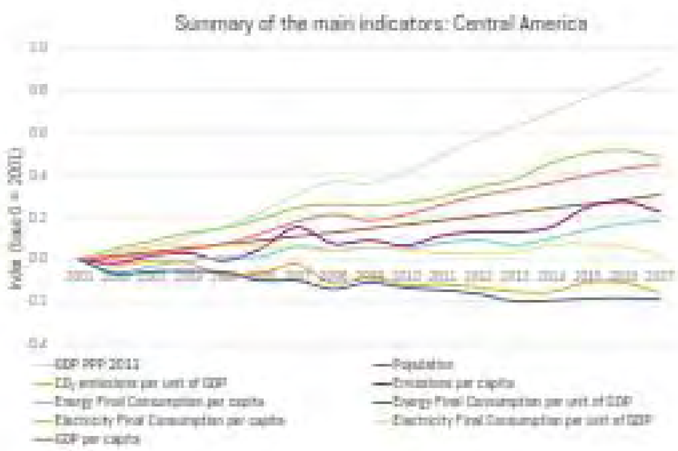


CO2 Emission index in the electricity generation
LAC Quinquennial variation rate
Andean Zone
Central America
LAC
Southern Cone
Caribbean
Brazil
Mexico

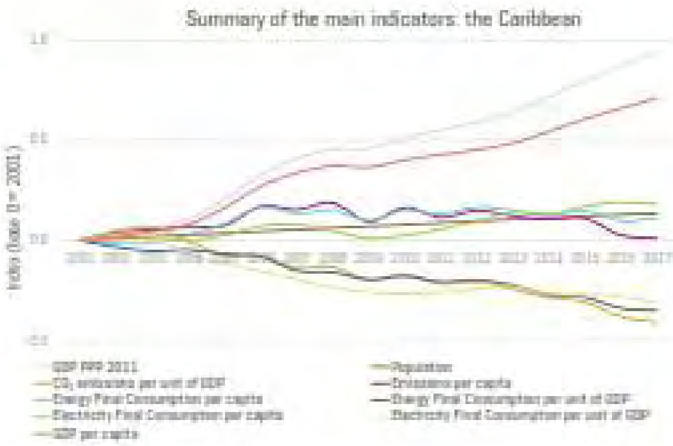
LAC

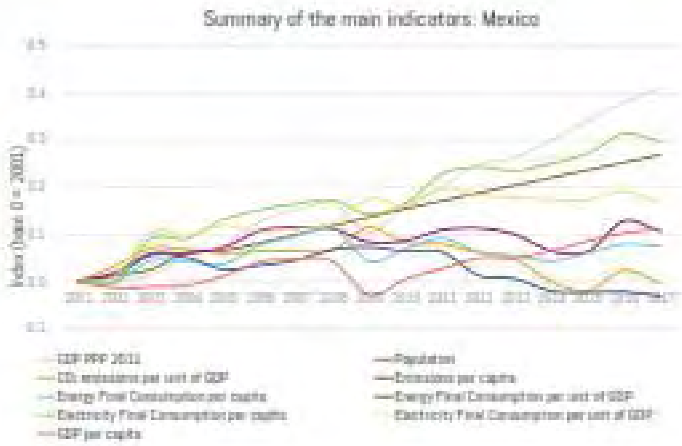


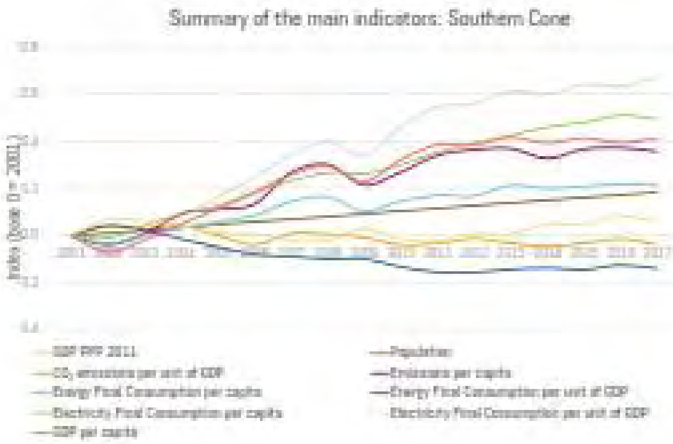
Summary of the main indicators: LAC
GDP PPP 2011
Population
CO2 emissions per unit of GDP
Emissions per capita
Energy Final Consumption per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per capita
Electricity Final Consumption per unit of GDP
GDP per capita

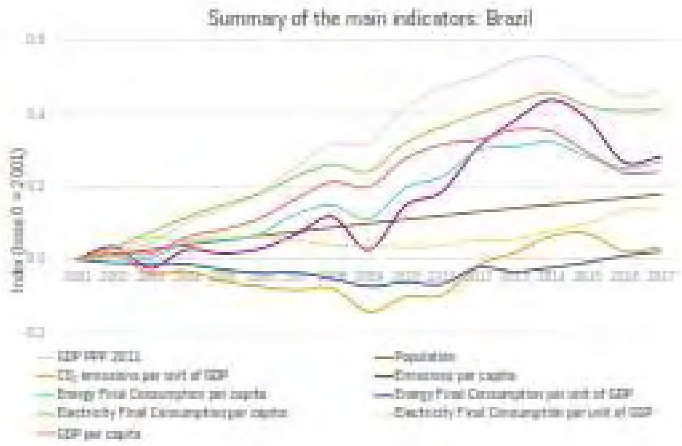


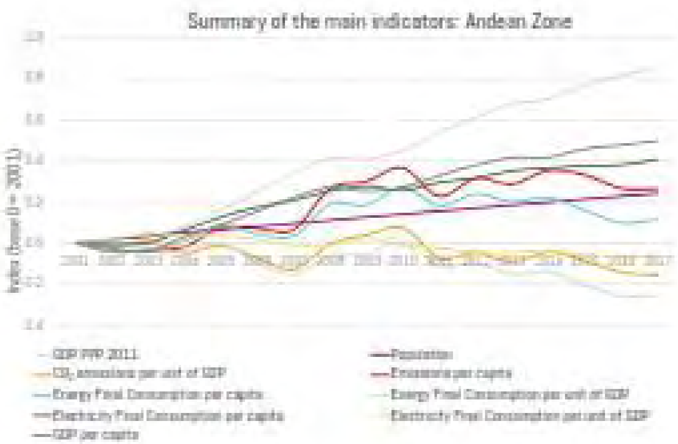
Summary of the main indicators: Central America
GDP PPP 2011
Population
CO2 emissions per unit of GDP
Emissions per capita
Energy Final Consumption per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per capita
Electricity Final Consumption per unit of GDP
GDP per capita


Summary of the main indicators: the Caribbean
Index (base 0 = 2001)
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 = 2001)
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

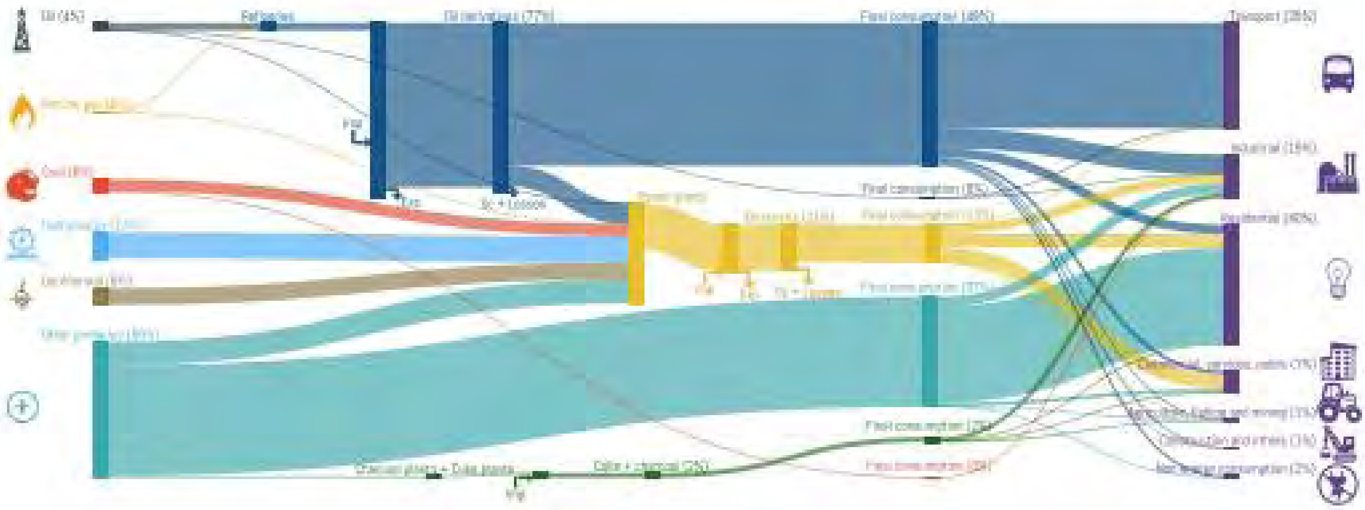

Summary of the main indicators: Southern Cone
Index (base 0 = 2001)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy Final Consumption per capita
Electricity Final Consumption per capita
GDP per capita
Population
Emissions per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per unit of GDP


Summary of the main indicators: Brazil
Index (base 0 = 2001)
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

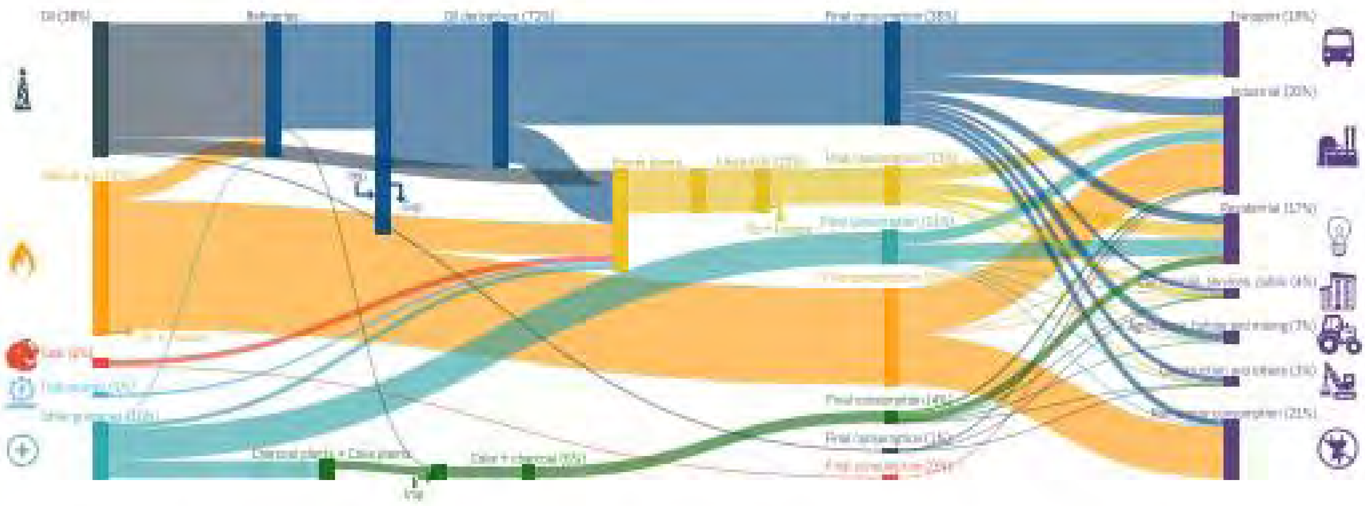

Summary of the main indicators: Andean Zone
Index (base 0 = 2001)
GDP PPP 2011
CO_2 emissions per unit of GDP
Energy Final Consumption per capita
Electricity Final Consumption per capita
GDP per capita
Population
Emissions per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per unit of GDP

LAC

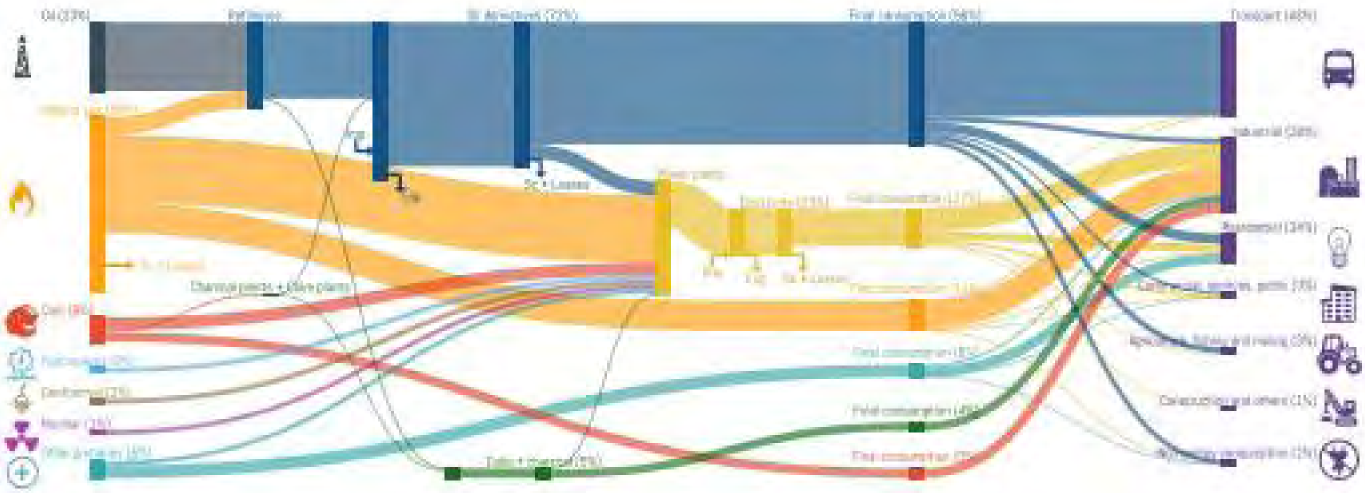
Summarized energy matrix: Central America - 2017 | Total energy supply: 37,772 ktoe



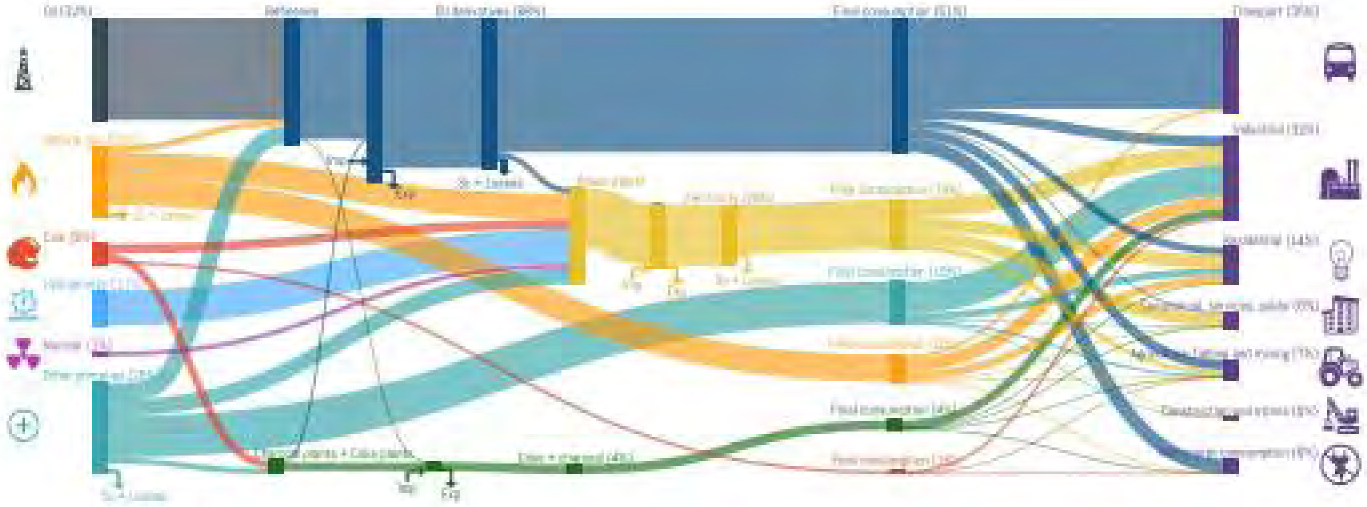
Summarized energy matrix: Caribbean - 2017 | Total energy supply: 45,390 ktoe



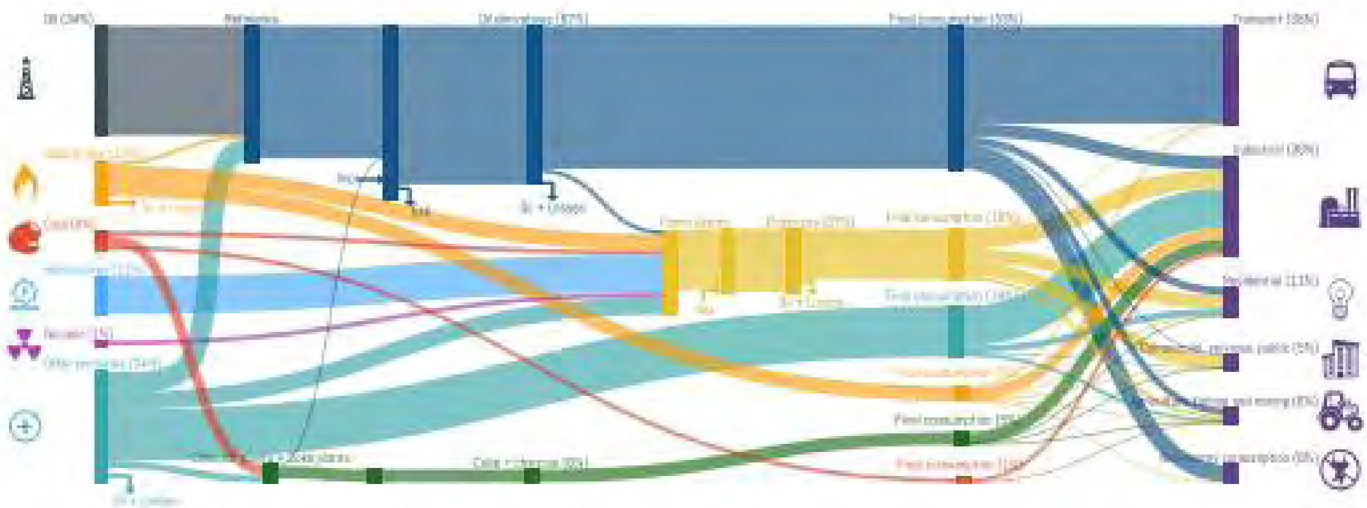
Summarized energy matrix: Mexico - 2017 | Total energy supply: 221,074 ktoe



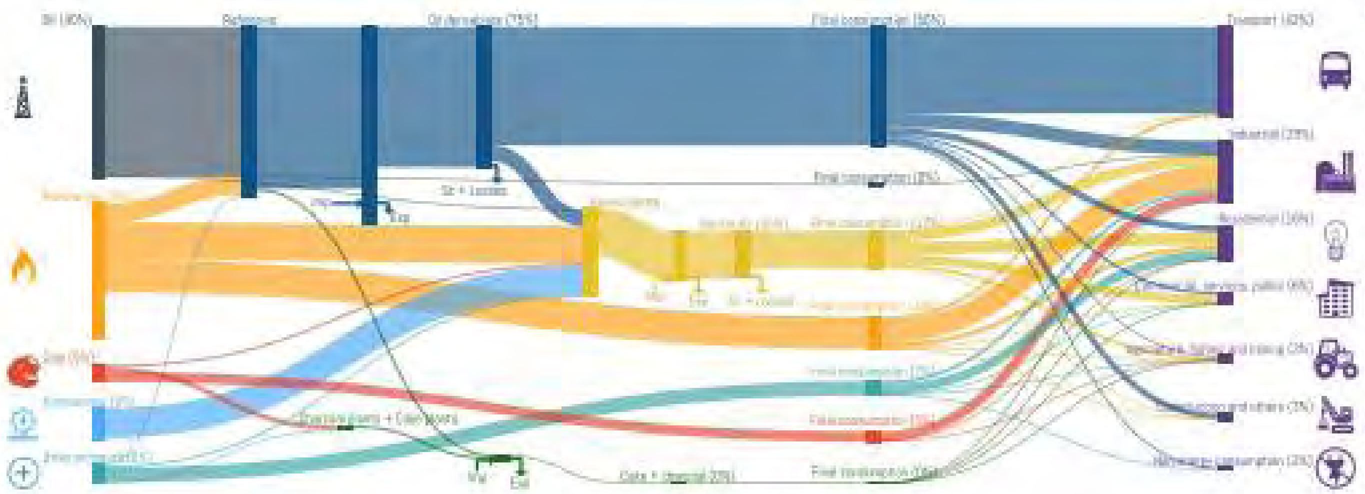
Summarized energy matrix: Southern Cone - 2017 | Total energy supply: 434,496 ktoe



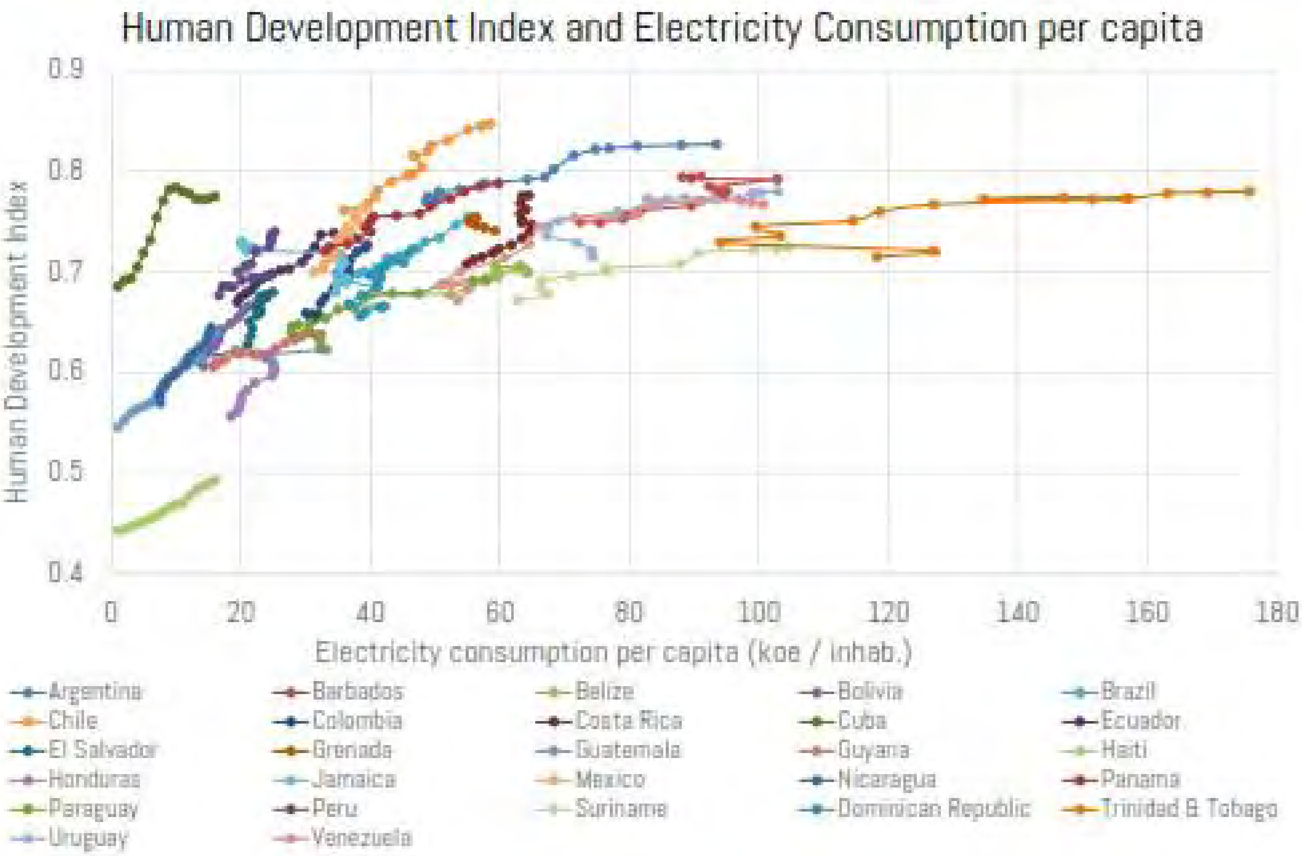
Summarized energy matrix: Brazil - 2017 | Total energy supply: 294,546 ktoe

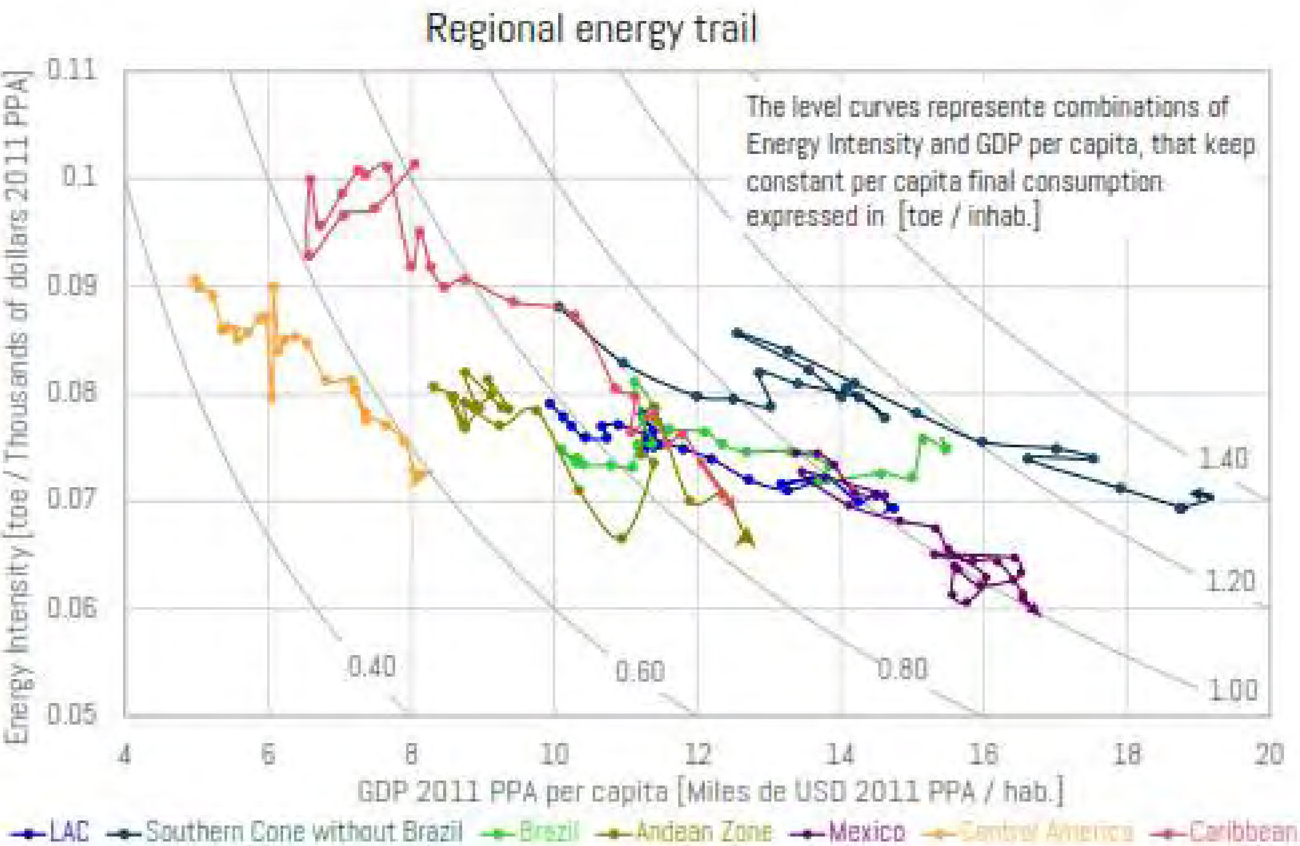


Summarized energy matrix: Andean Zone - 2017 | Total energy supply: 156,999 ktoe



LAC


Human Development Index and Electricity Consumption per capita
Human Development Index
0.9
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100
120
140
160
180
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
Energy Intensity [toe / Thousands of dollars 2011 PPA]
0.11
0.1
0.09
0.08
0.07
0.06
0.05
4
6
8
10
12
14
16
18
20
GDP 2011 PPA per capita [Miles de USD 2011 PPA / hab.]
The level curves represente combinations of Energy Intensity and GDP per capita, that keep constant per capita final consumption expressed in [toe / inhab.]
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 2017

Population (thousand inhab.)	44,121
Area (km²)	2,780,400
Population Density (inhab./km²)	16
Urban Population (%)	92
GDP USD 2010 (MUSD)	463,400
GDP USD 2011 PPP (MUSD)	838,224
GDP per capita (thou. USD 2011 PPP/inhab.)	19

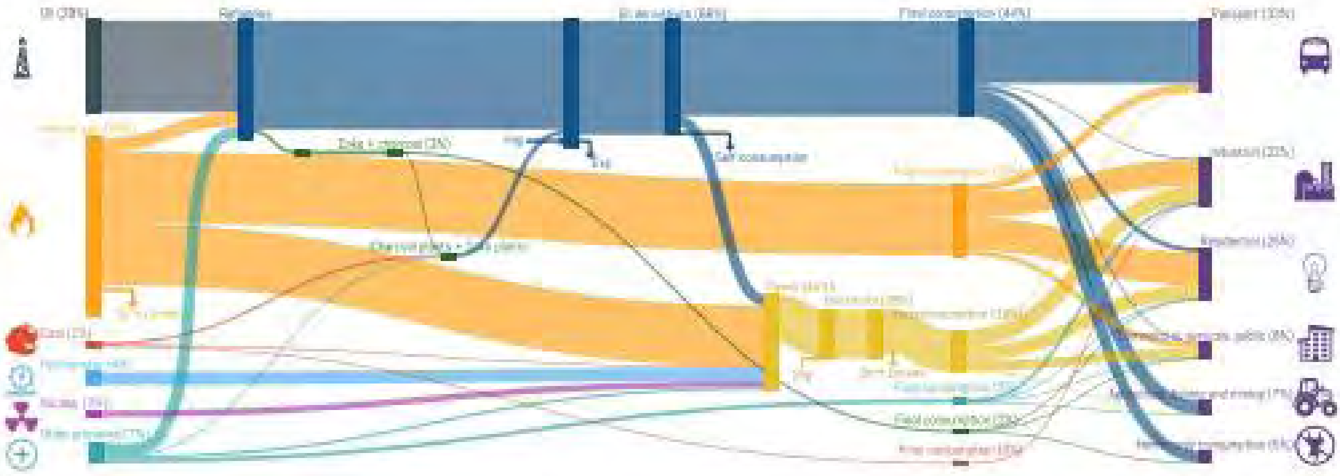
Energy Sector

Final consumption in the Transport Sector	Mtoe 19.25
Final consumption in the Industrial Sector	Mtoe 12.62
Final consumption in the Residential Sector	Mtoe 14.27
Final consumption in the Commercial and Service Sector	Mtoe 4.69
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 7.39

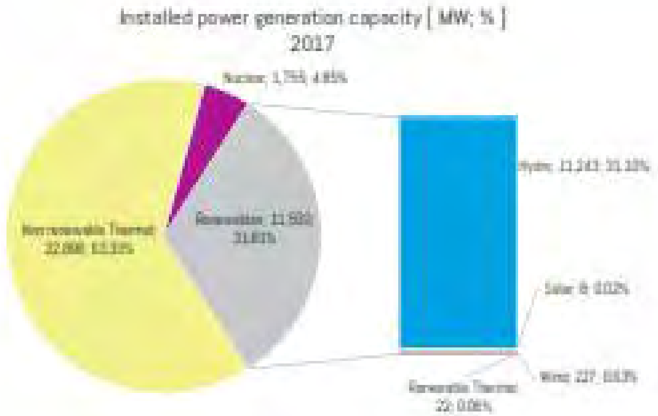
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 2,167	Gm³ 337	Mt 421

Electricity consumption per capita	Final energy 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
2,924	1.32	99.79	85.73	73.08	18.10	5.13	58.22	627	36.15	0.10 / 0.07

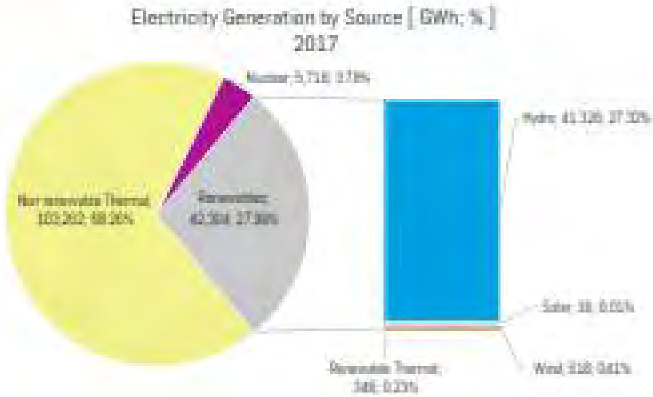
Summarized energy balance 2017



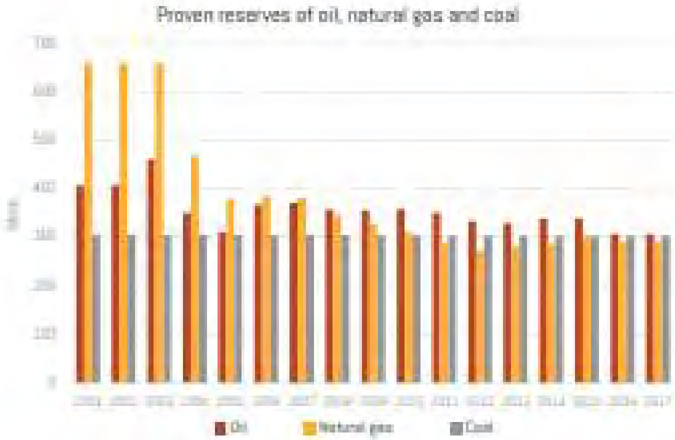
ARGENTINA



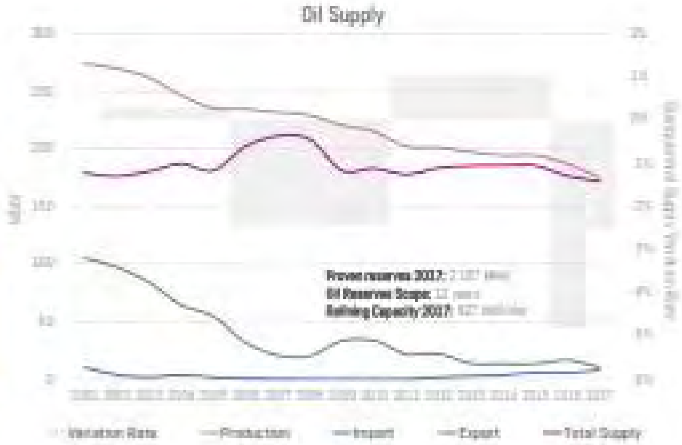
Installed power generation capacity [MW; %]
2017
Nuclear; 1,755; 4.85%
Non renewable Thermal; 22,888; 63.33%
Renewables; 11,500; 31.81%
Hydro; 11,243; 31.10%
Solar; 8; 0.02%
Wind; 227; 0.63%
Renewable Thermal; 22; 0.06%



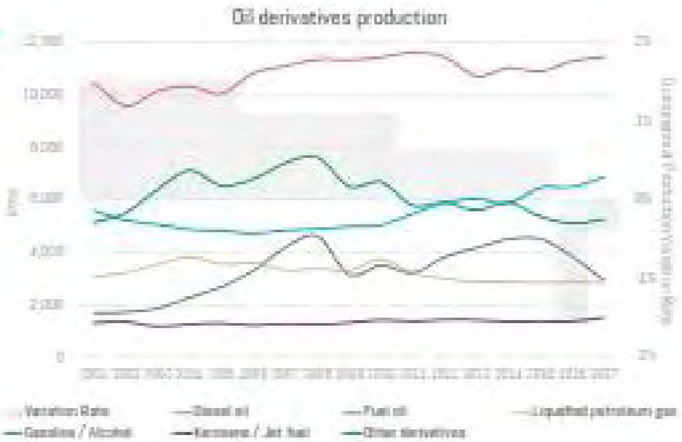
Electricity Generation by Source [GWh; %]
2017
Nuclear; 5,716; 3.78%
Non renewable Thermal; 103,262; 68.26%
Renewables; 42,304; 27.96%
Hydro; 41,326; 27.32%
Solar; 16; 0.01%
Wind; 618; 0.41%
Renewable Thermal; 346; 0.23%



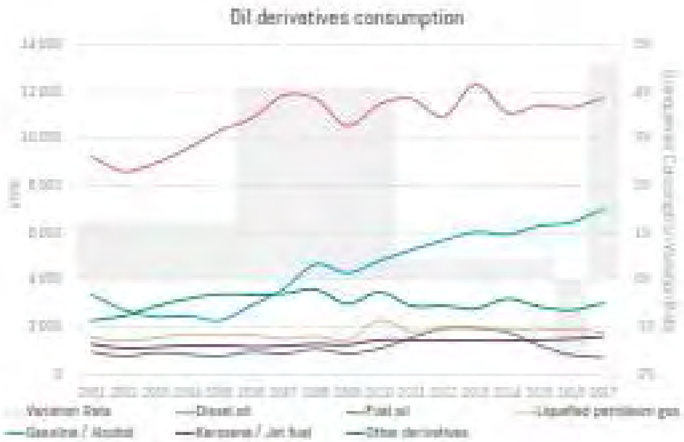
Proven reserves of oil, natural gas and coal
Oil
Natural gas
Coal



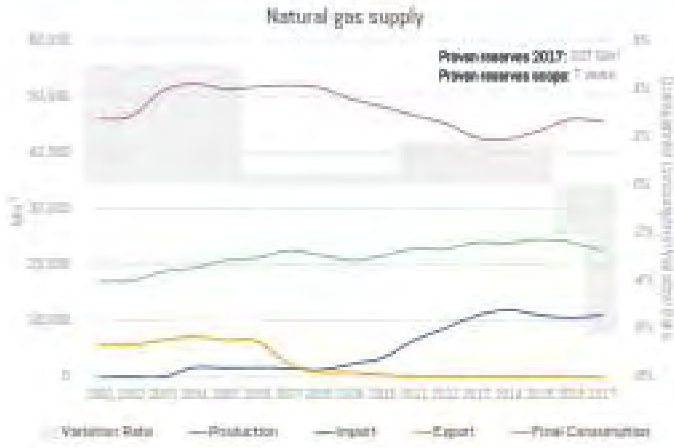
Oil Supply
Proven reserves 2017:
Oil Reserves Scope:
Refining Capacity 2017:
Variation Rate
Production
Import
Export
Total Supply

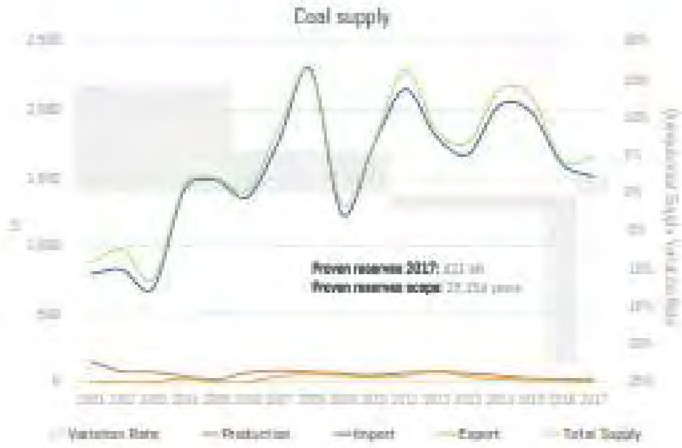


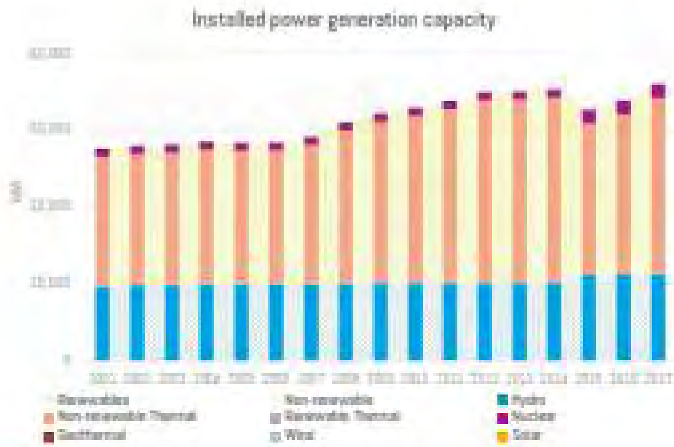
Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

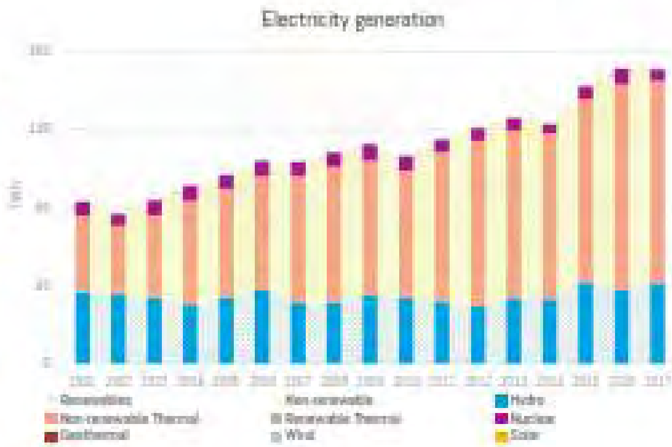


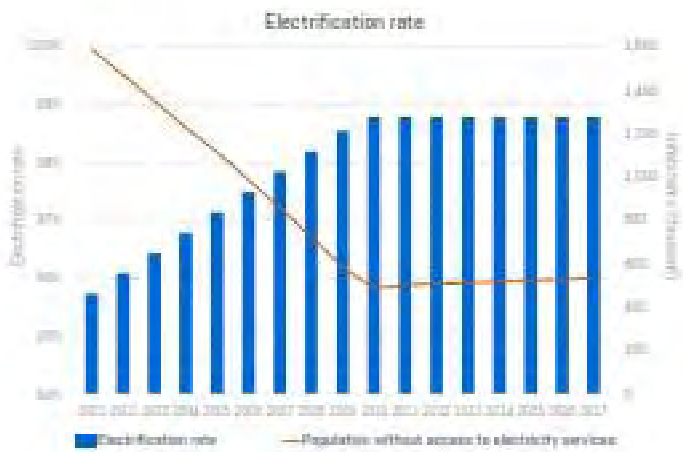
Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

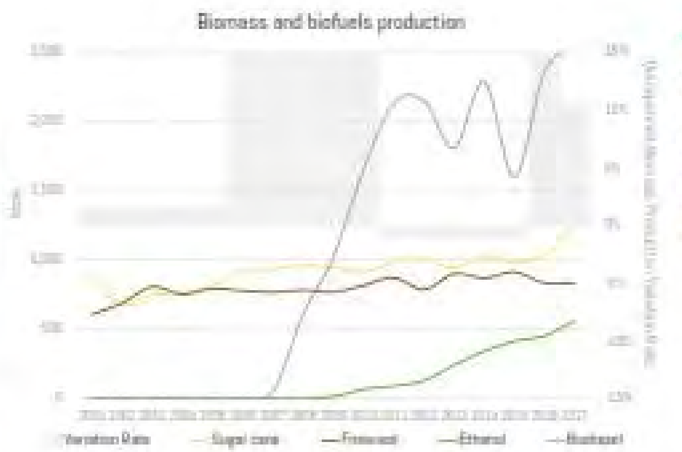

Natural gas supply
Proven reserves 2017:
Proven reserves scope:
Variation Rate
Production
Import
Export
Final Consumption


Coal supply
Proven reserves 2017:
Proven reserves scope:
Variation Rate
Production
Import
Export
Total Supply

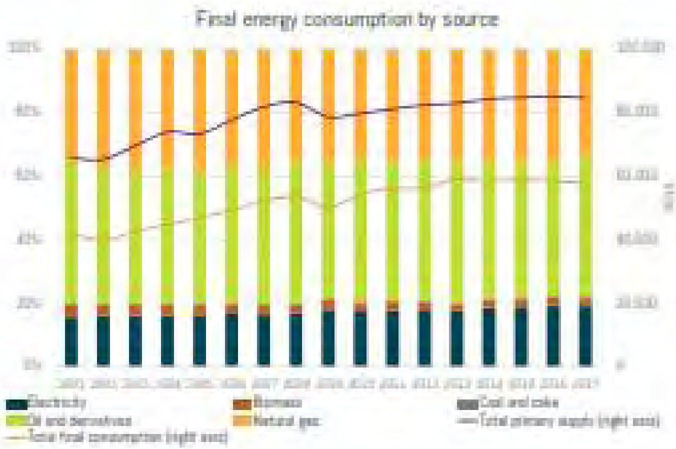

Installed power generation capacity
MW
Renewables
Non-renewable Thermal
Geothermal
Non-renewable
Renewable Thermal
Wind
Hydro
Nuclear
Solar

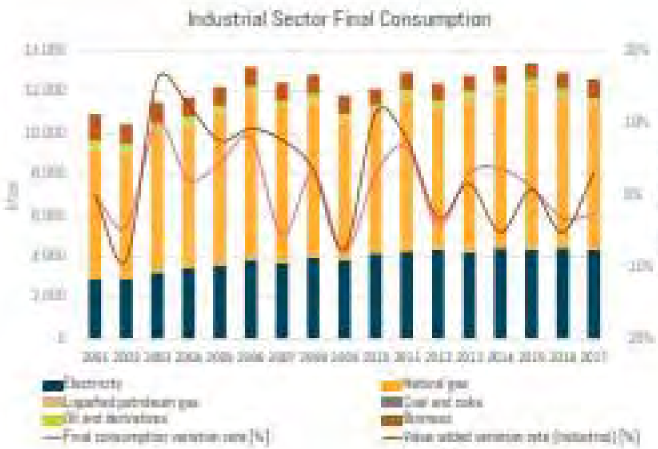

Electricity generation
TWh
Renewables
Non-renewable Thermal
Geothermal
Non-renewable
Renewable Thermal
Wind
Hydro
Nuclear
Solar

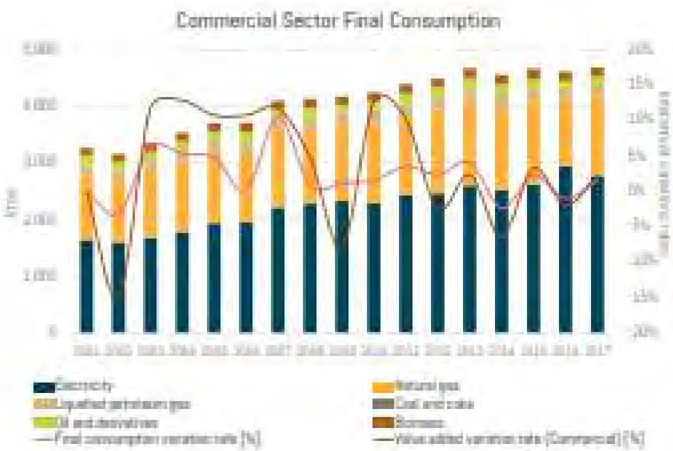

Electrification rate
Electrification rate
Population without access to electricity services

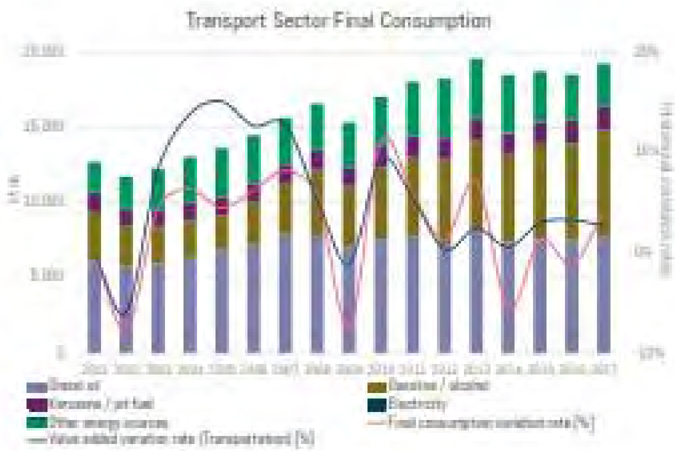

Biomass and biofuels production
Variation Rate
Sugar cane
Firewood
Ethanol
Biodiesel

ARGENTINA

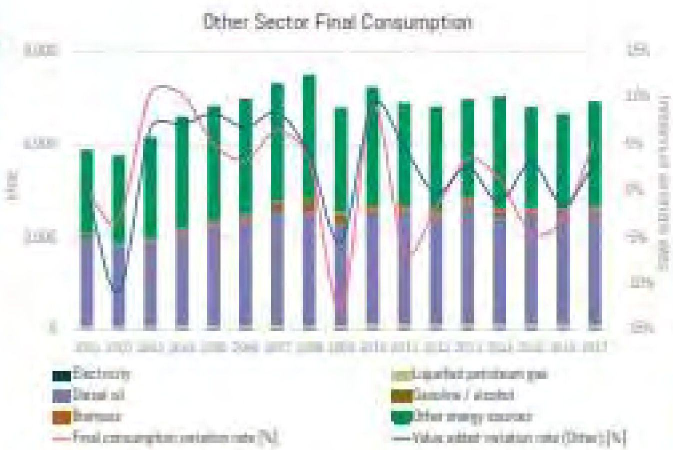

Final energy consumption by source
Electricity
Oil and derivatives
Total final consumption (right axis)
Biomass
Natural gas
Coal and coke
Total primary supply (right axis)

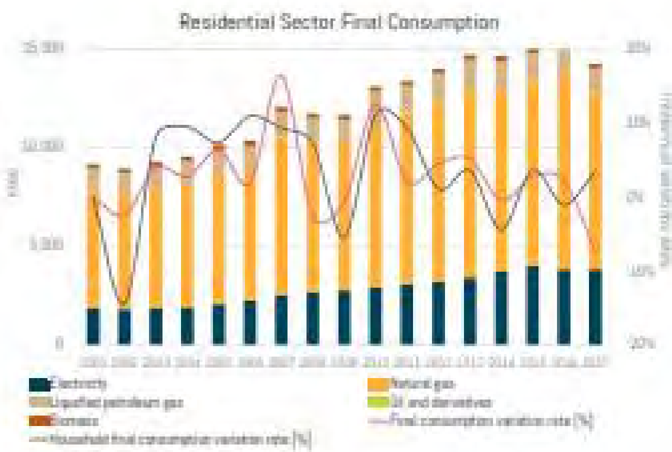

Industrial Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Industrial) [%]


Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]
Natural gas
Coal and coke
Biomass
Value added variation rate (Commercial) [%]

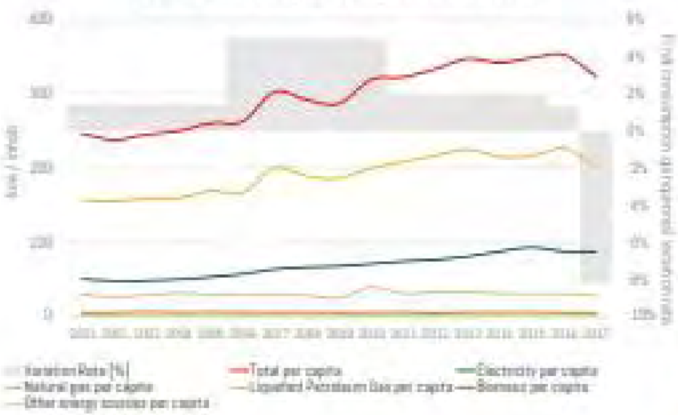

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Other energy sources
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

ARGENTINA

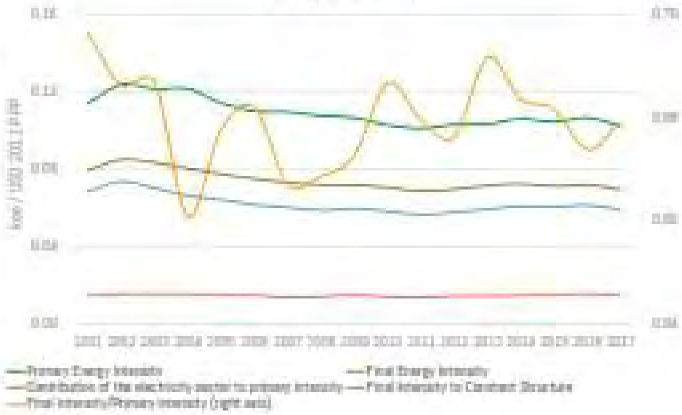

Other Sector Final Consumption
Electricity
Diesel oil
Biomass
Final consumption variation rate [%]
Liquefied petroleum gas
Gasoline / alcohol
Other energy sources
Value added variation rate (Other) [%]


Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

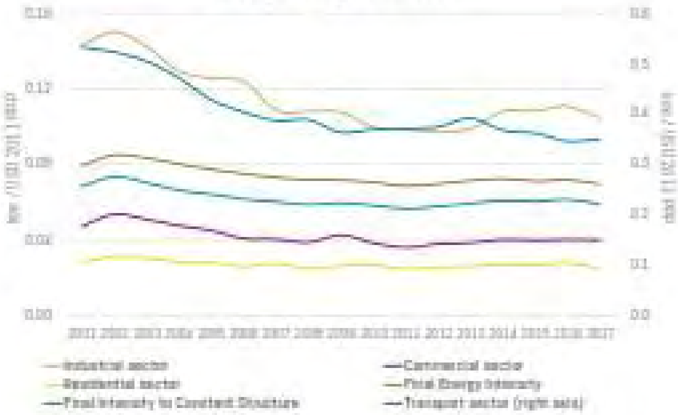
Final consumption per capita Residential Sector



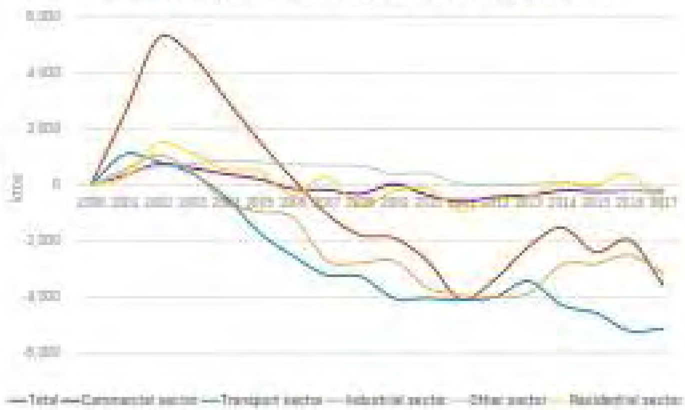
Energy intensities



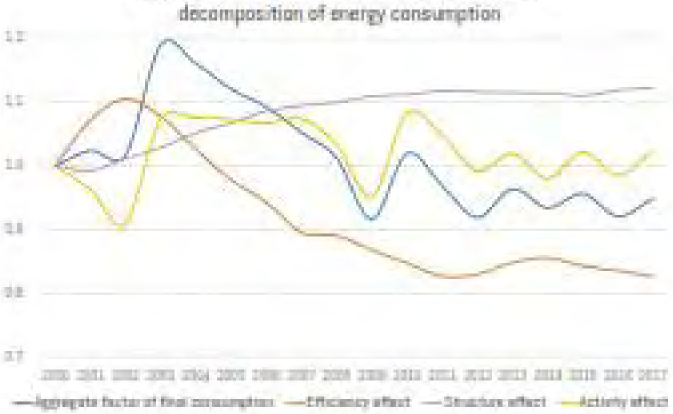
Sectoral energy intensities



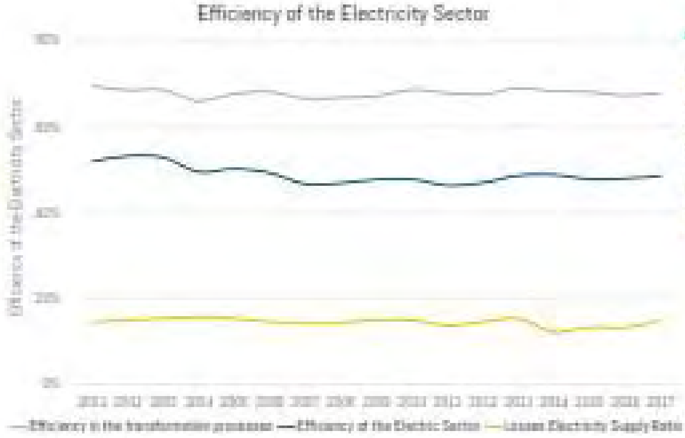
Avoided energy demand due to variations in energy intensity



Logarithmic mean Divisia index for the structural decomposition of energy consumption



Efficiency of the Electricity Sector



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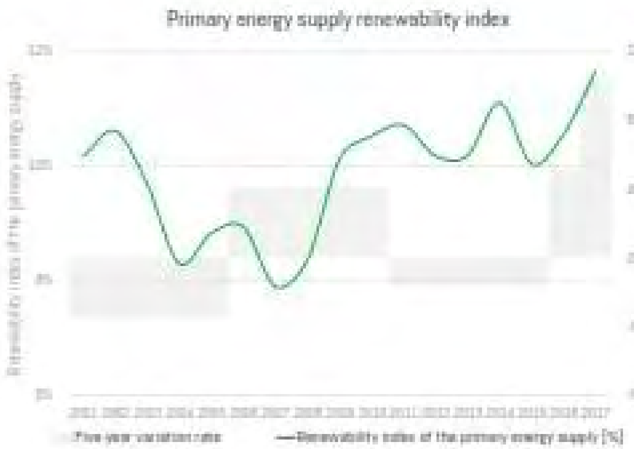
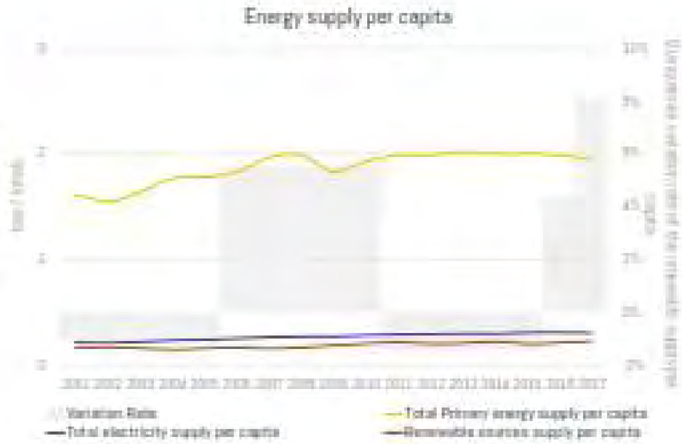
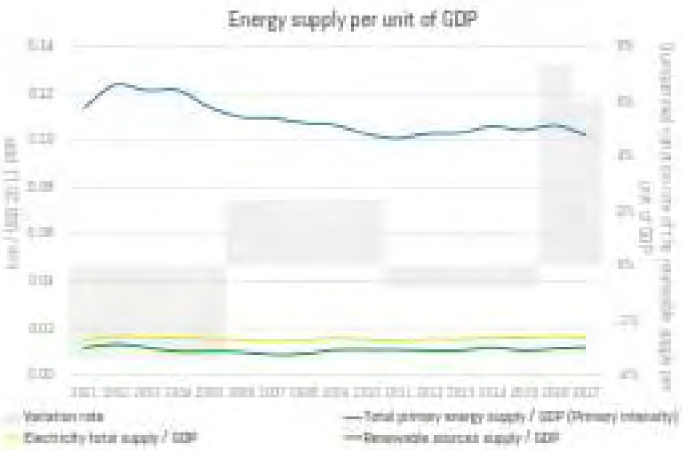
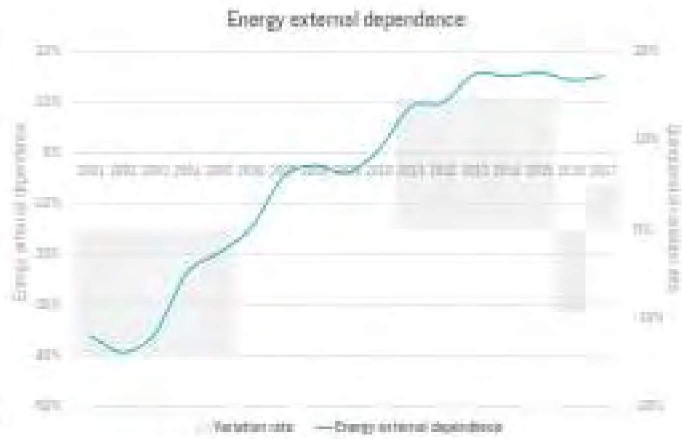
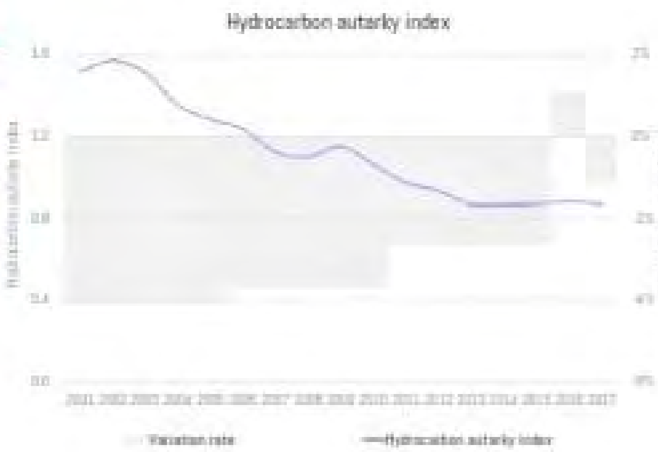

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

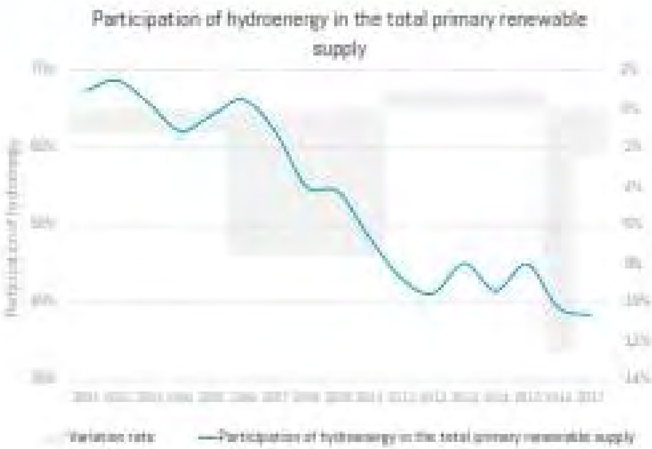

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

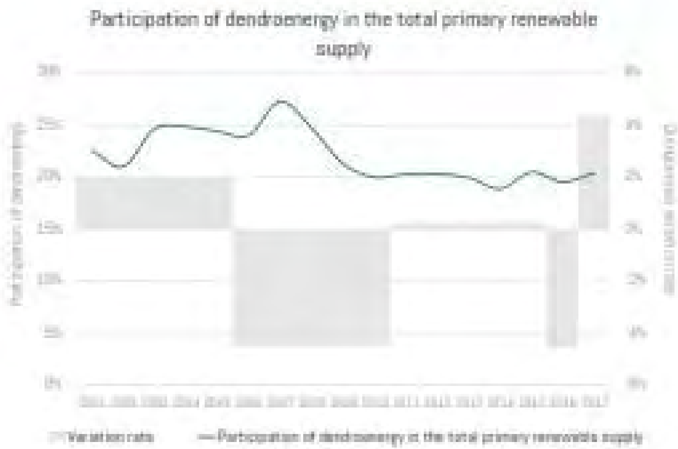

Energy external dependence
Variation rate
Energy external dependence

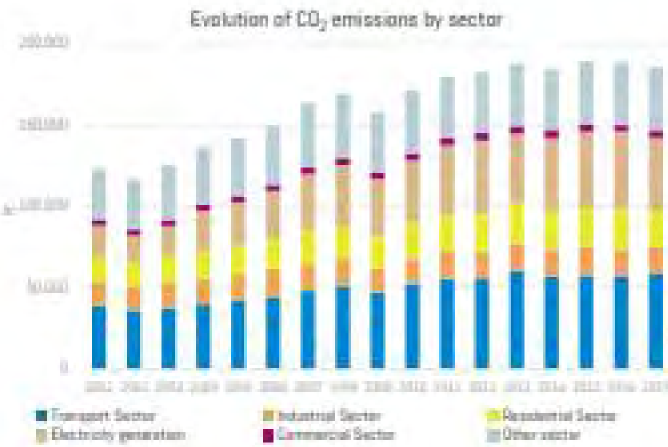
ARGENTINA

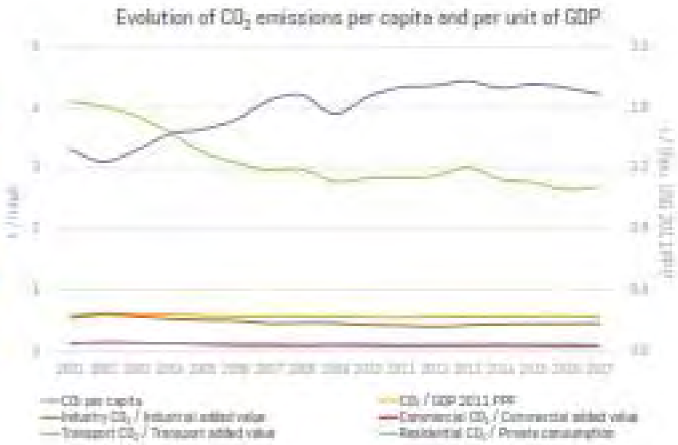

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

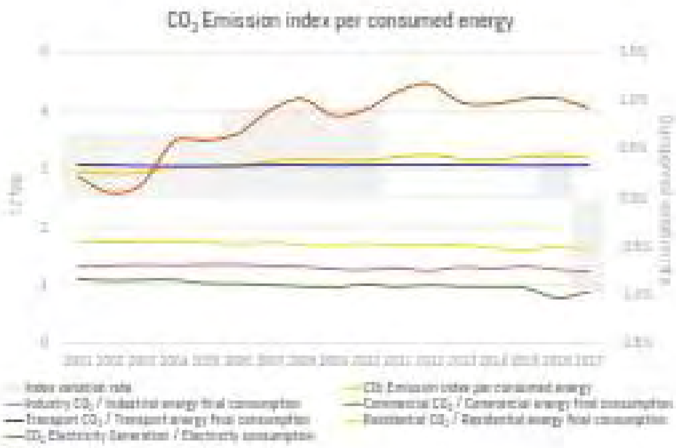

Biomass residential consumption index
Variation rate
Biomass residential consumption index

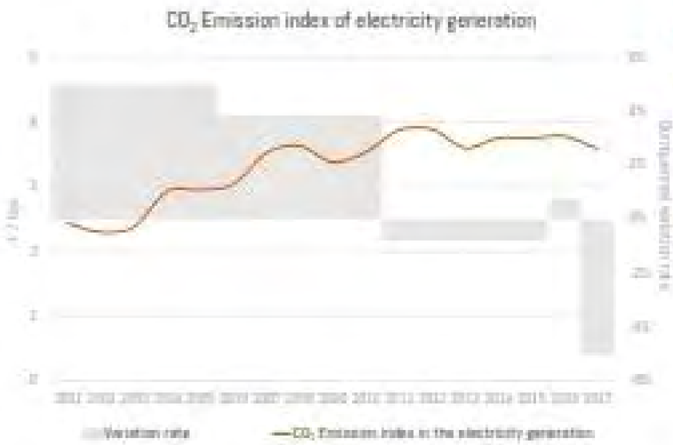

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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

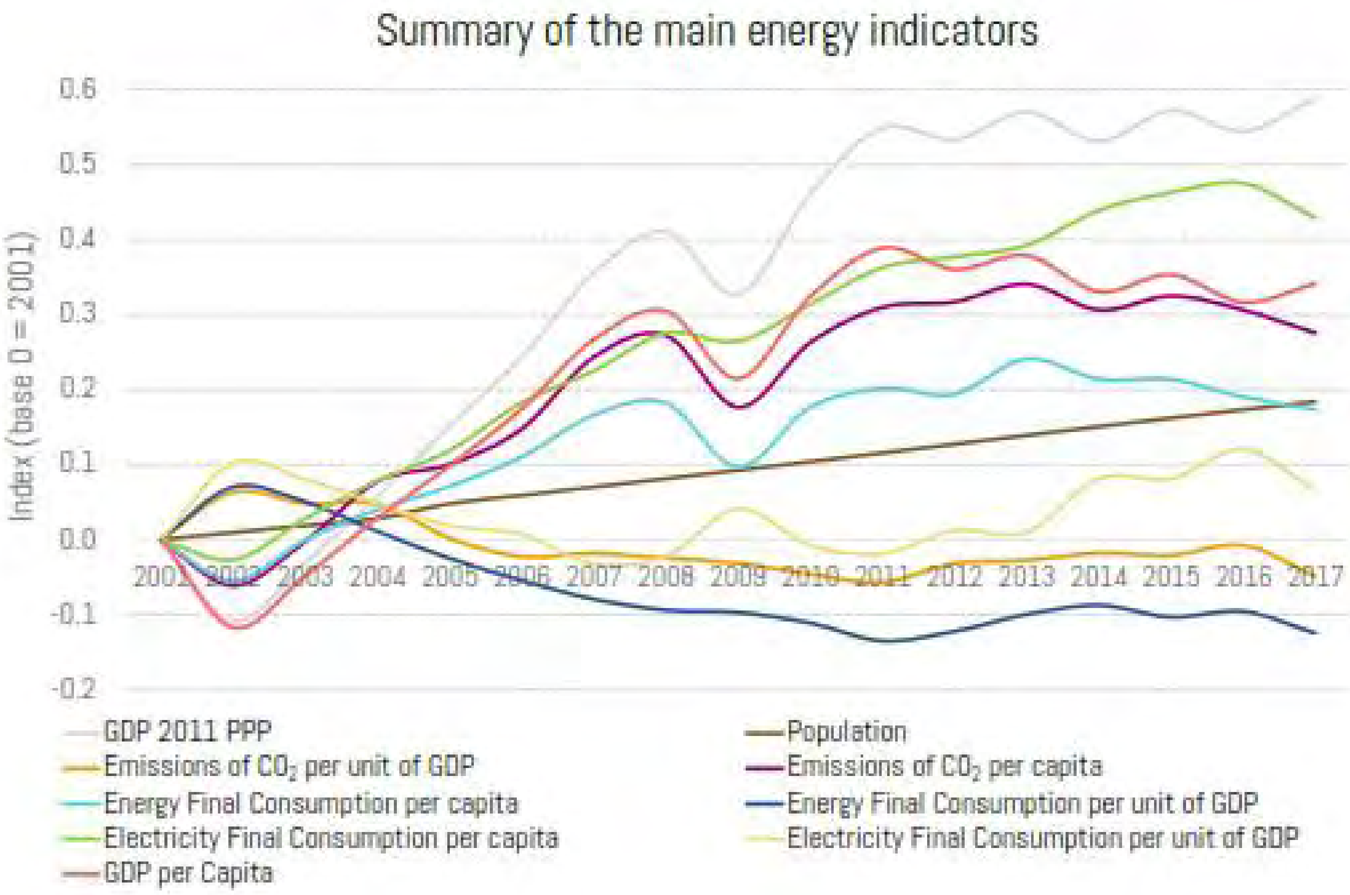

Evolution of CO_2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation

ARGENTINA



Summary of the main energy indicators
Index (base 0 = 2001)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
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

BARBADOS

General Information 2017

Population (thousand inhab.)	286
Area (km²)	430
Population Density (inhab./km²)	665
Urban Population (%)	31
GDP USD 2010 (MUSD)	4.738
GDP USD 2011 PPP (MUSD)	4.951
GDP per capita (thou. USD 2011 PPP/inhab.)	17

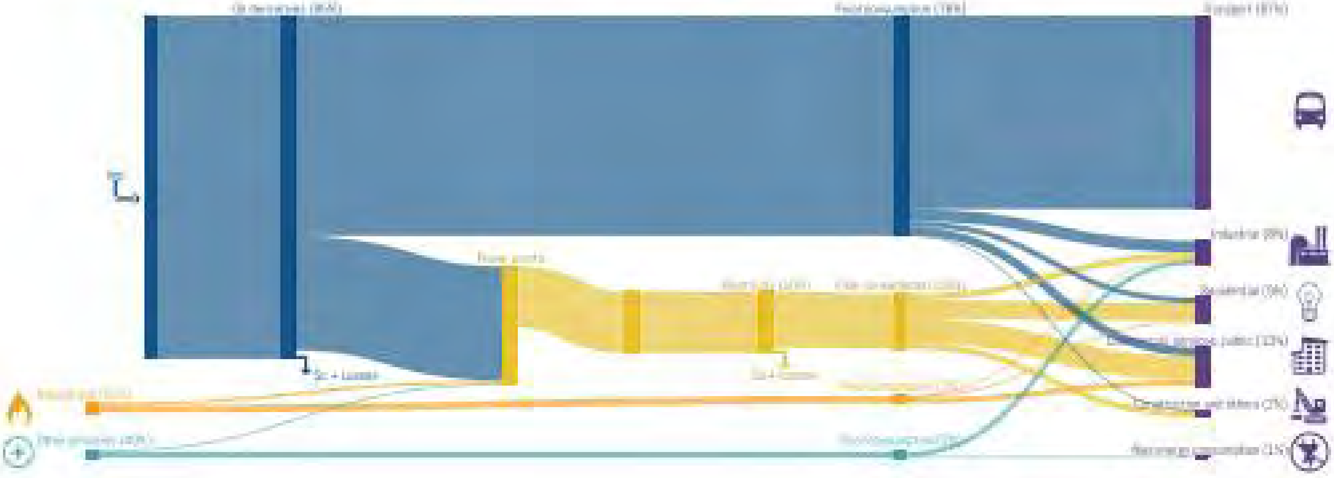
Energy Sector

	Mtoe
Final consumption in the Transport Sector	0.28
Final consumption in the Industrial Sector	0.03
Final consumption in the Residential Sector	0.04
Final consumption in the Commercial and Service Sector	0.06
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.01

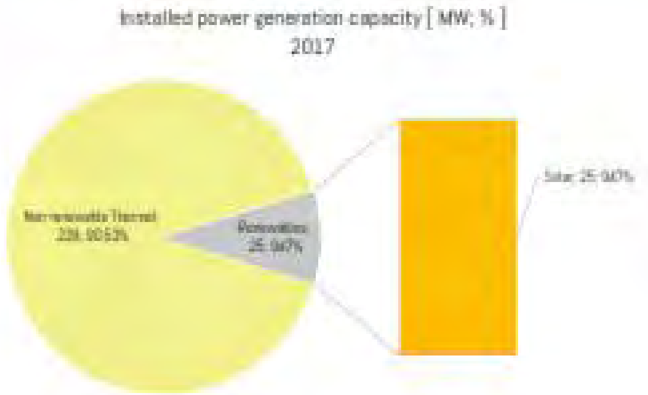
	Unit	Value
Oil reserves	Mbbl	2.5
Natural gas reserves	Gm³	0.14
Coal reserves	Mt	n.a

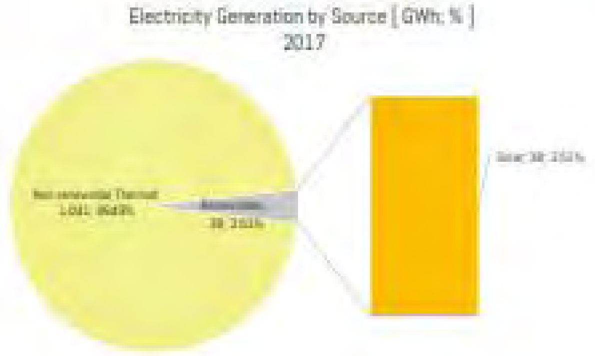
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	3.304
Final energy consumption per capita	toe/inhab.	1.49
Electrification rate	%	99.80
Total energy supply	Mtoe	0.51
Total energy production	Mtoe	0.06
Total energy imports	Mtoe	0.50
Total energy exports	Mtoe	0.03
Total final energy consumption	Mtoe	0.42
Refining capacity	kbbl/day	n.a
Installed power generation capacity	GW	0.26
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.11 / 0.09

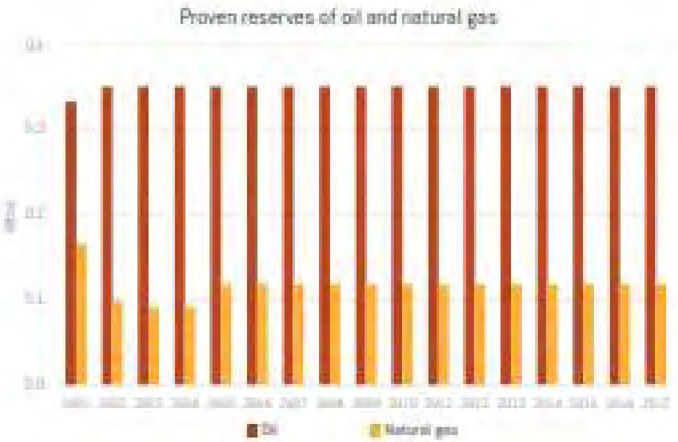
Summarized energy balance 2017

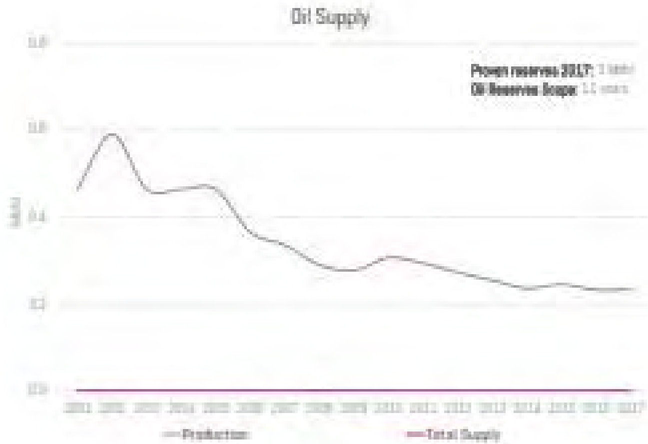


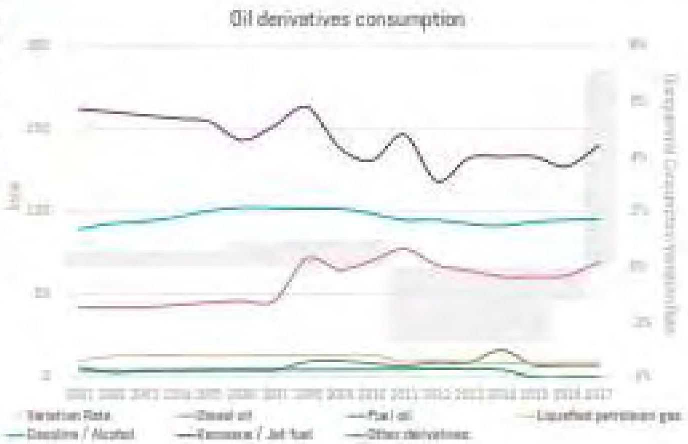
BARBADOS

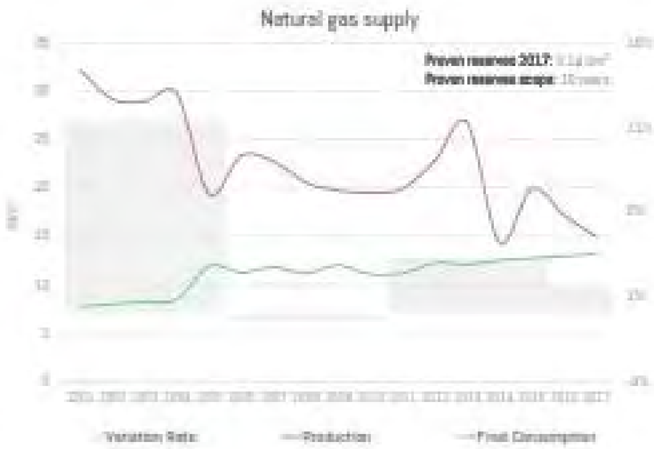

Installed power generation capacity [MW; %]
2017
Non-renewable Thermal
Renewables
Solar

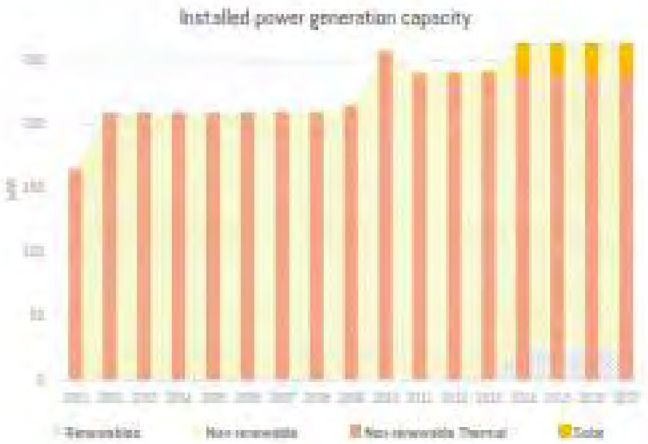

Electricity Generation by Source [GWh; %]
2017
Non-renewable Thermal
Renewables
Solar

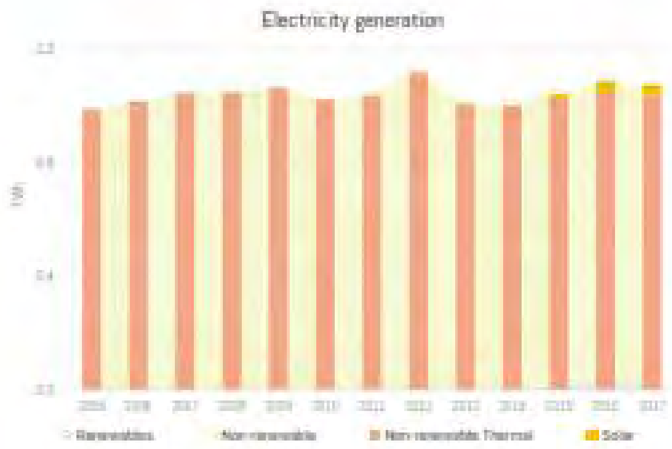

Proven reserves of oil and natural gas
Oil
Natural gas

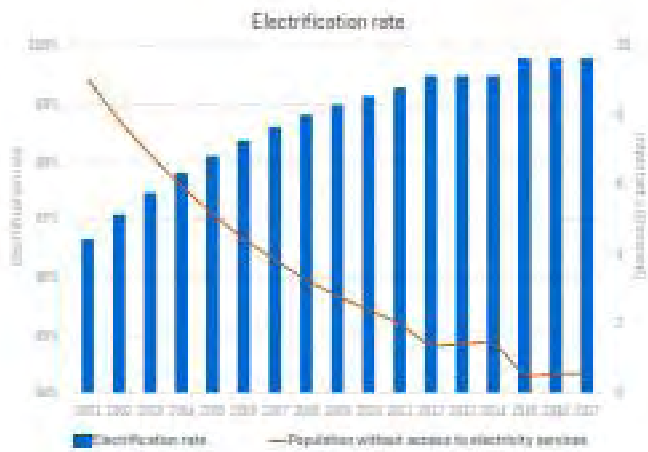

Oil Supply
Proven reserves 2017:
Oil Reserves Scope:
Production
Total Supply

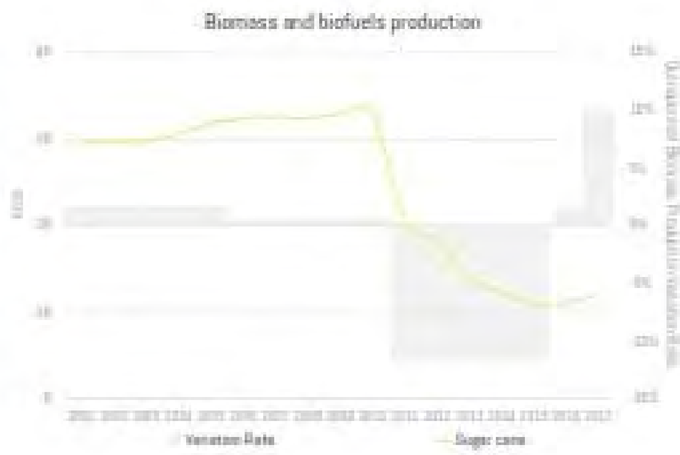

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

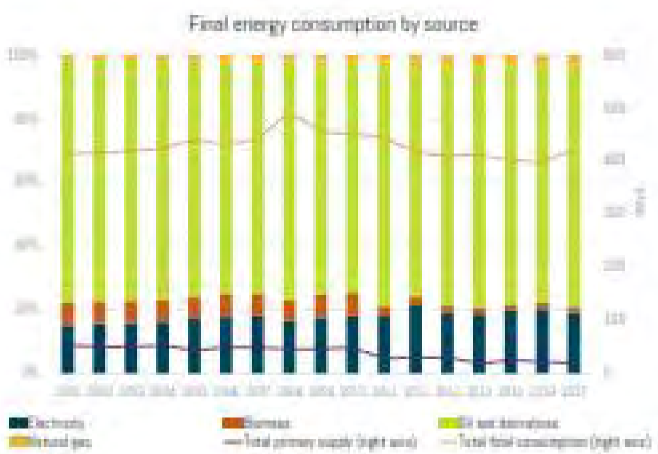

Natural gas supply
Proven reserves 2017:
Proven reserves scope:
Variation Rate
Production
Final Consumption


Installed power generation capacity
Renewables
Non-renewable
Non-renewable Thermal
Solar


Electricity generation
Renewables
Non-renewable
Non-renewable Thermal
Solar

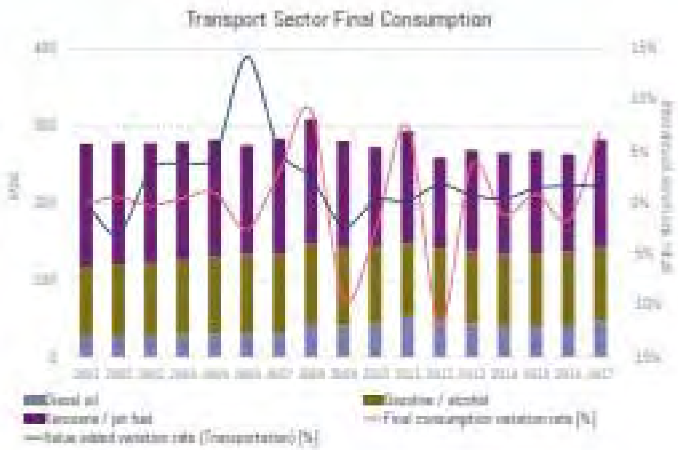

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane


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


Industrial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (industrial) [%]

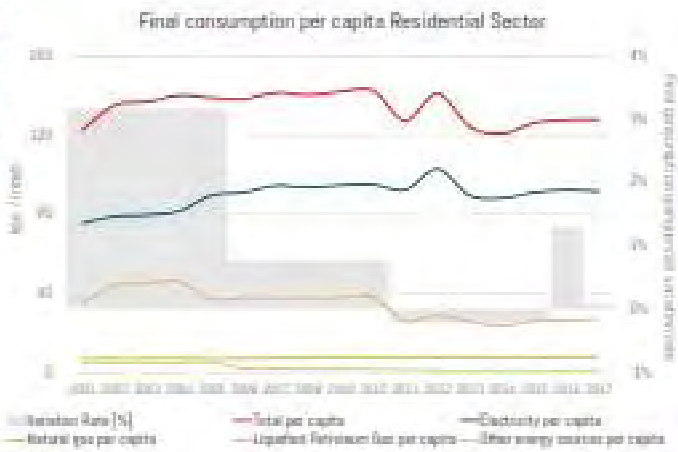

Commercial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

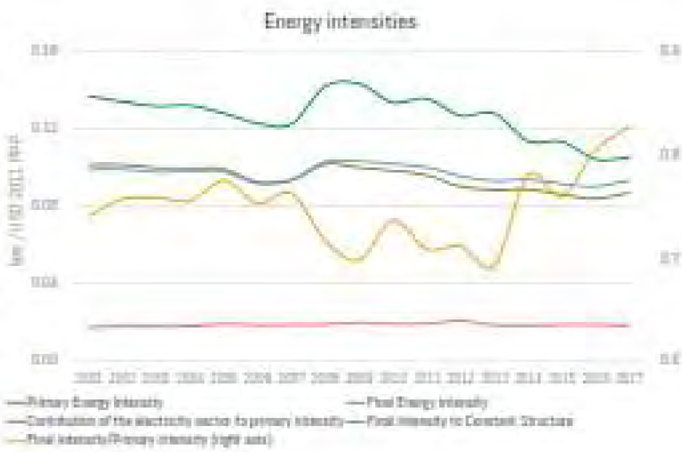

Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

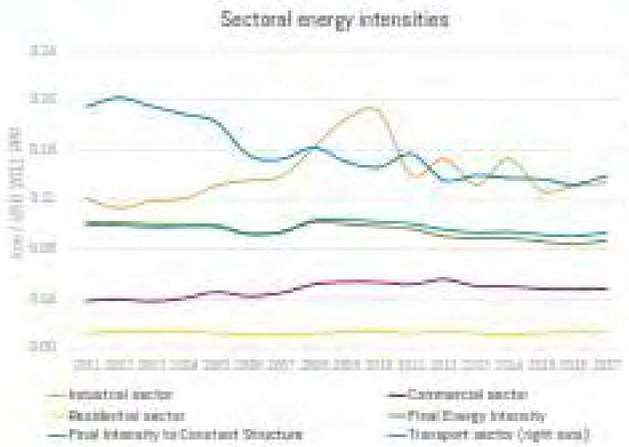

Other Sector Final Consumption
Electricity
Diesel oil
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Other) [%]

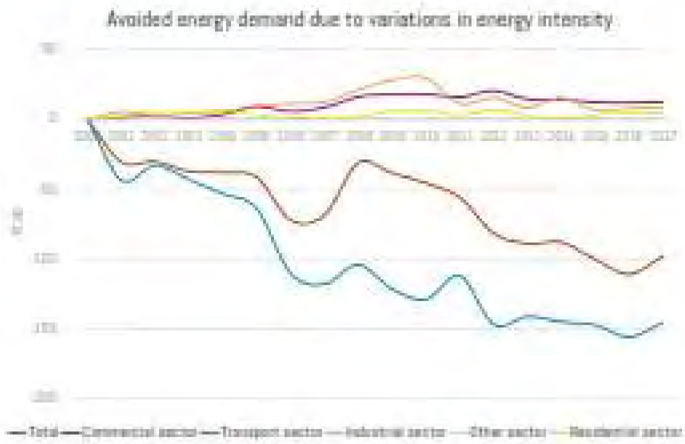

Residential Sector Final Consumption
Oil and derivatives
Liquefied petroleum gas
Natural gas
Electricity
Final consumption variation rate [%]
Household final consumption variation rate [%]

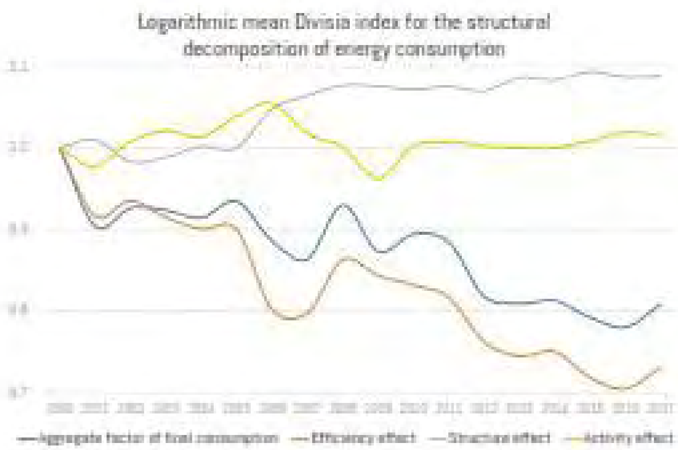
BARBADOS

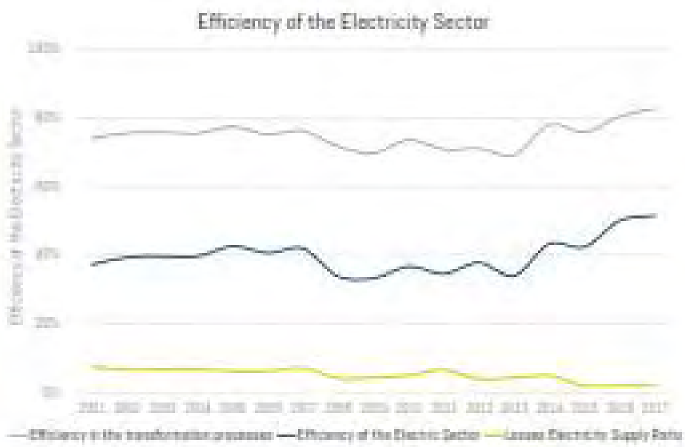

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Other energy sources per capita

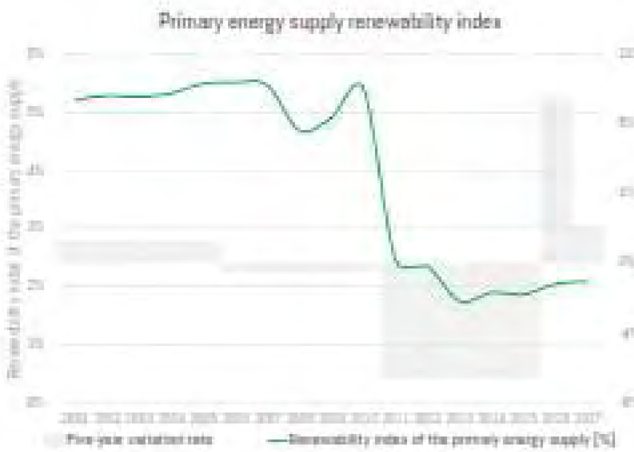

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)

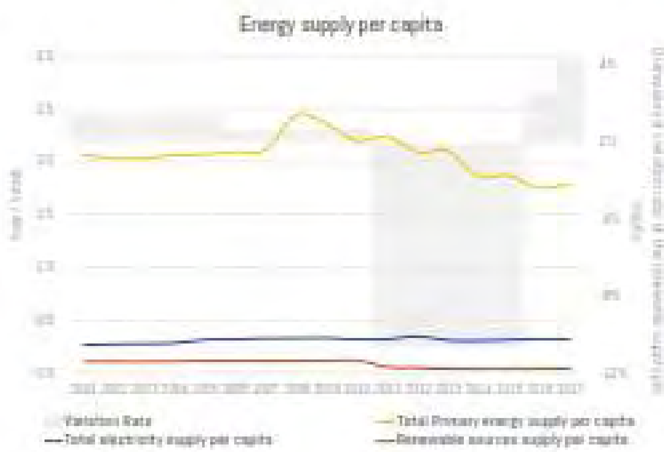

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)


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

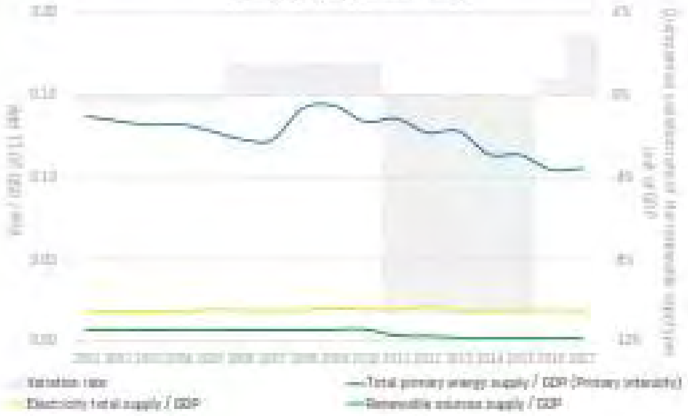

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

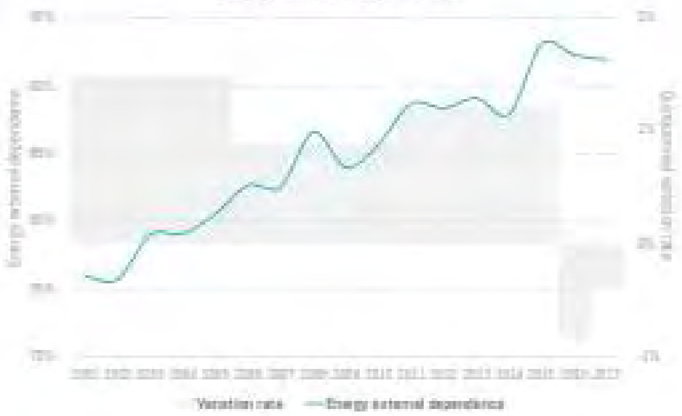

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

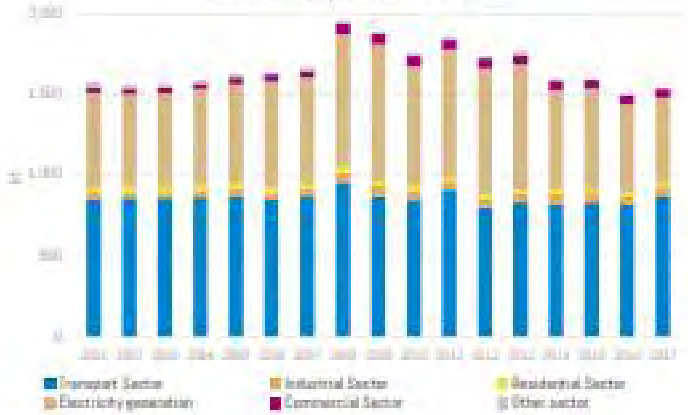
Energy supply per unit of GDP



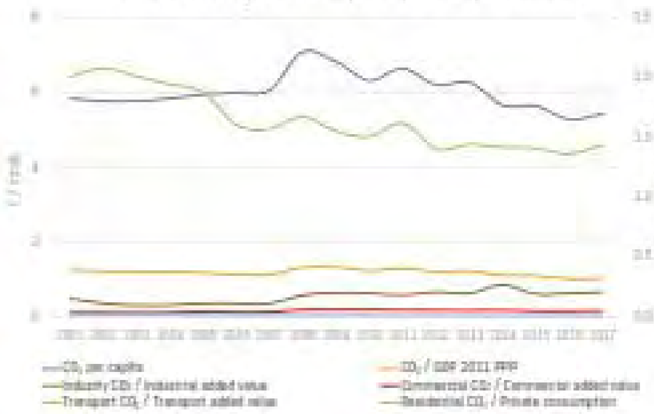
Energy external dependence



Evolution of CO_2 emissions by sector

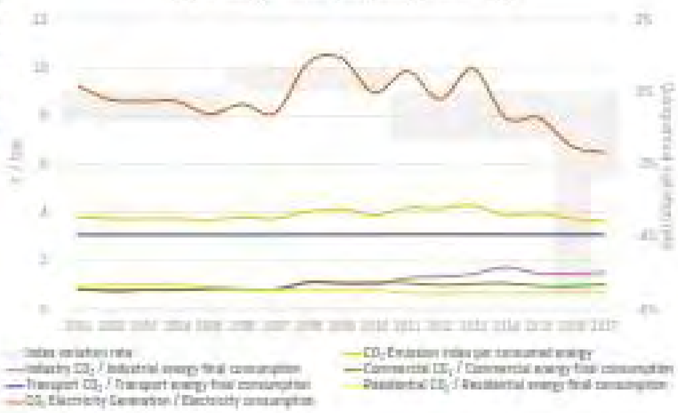


Evolution of CO_2 emissions per capita and per unit of GDP

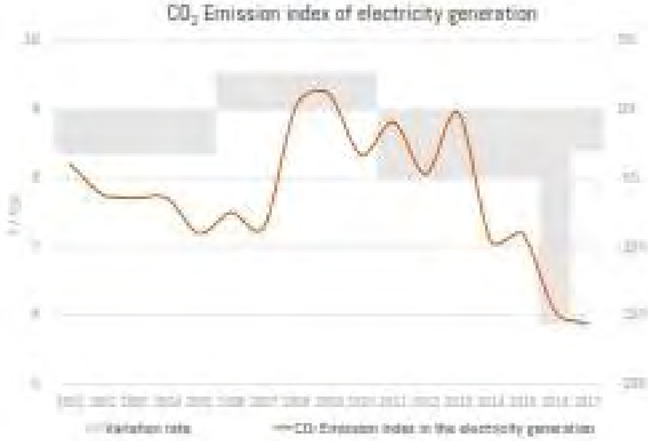


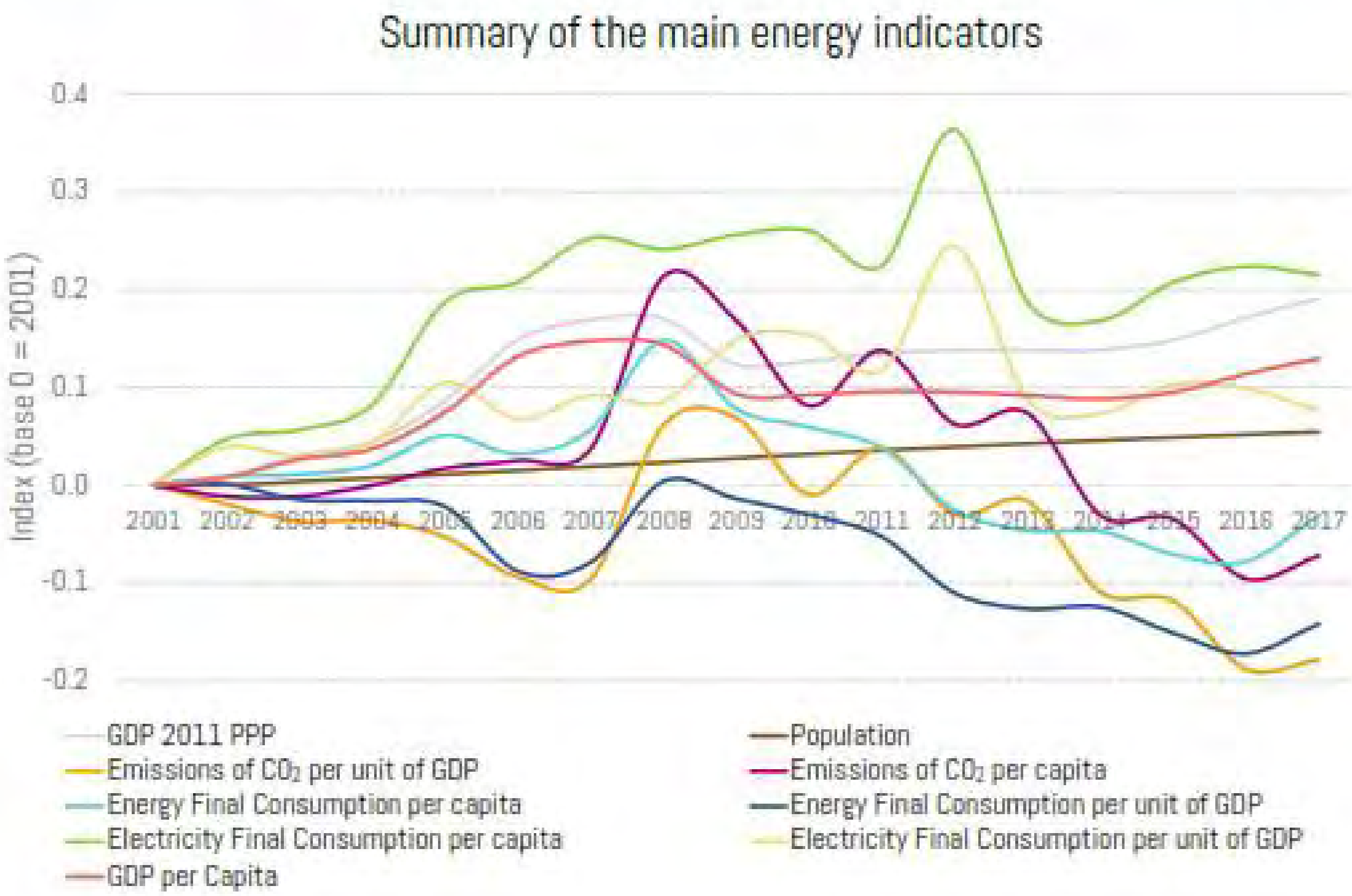
BARBADOS

CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation




Summary of the main energy indicators
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
Index (base 0 = 2001)
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
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

BELIZE

General Information 2017

Population (thousand inhab.)	388
Area (km²)	22,970
Population Density (inhab./km²)	17
Urban Population (%)	44
GDP USD 2010 (MUSD)	1,613
GDP USD 2011 PPP (MUSD)	2,932
GDP per capita (thou. USD 2011 PPP/inhab.)	8

Energy Sector

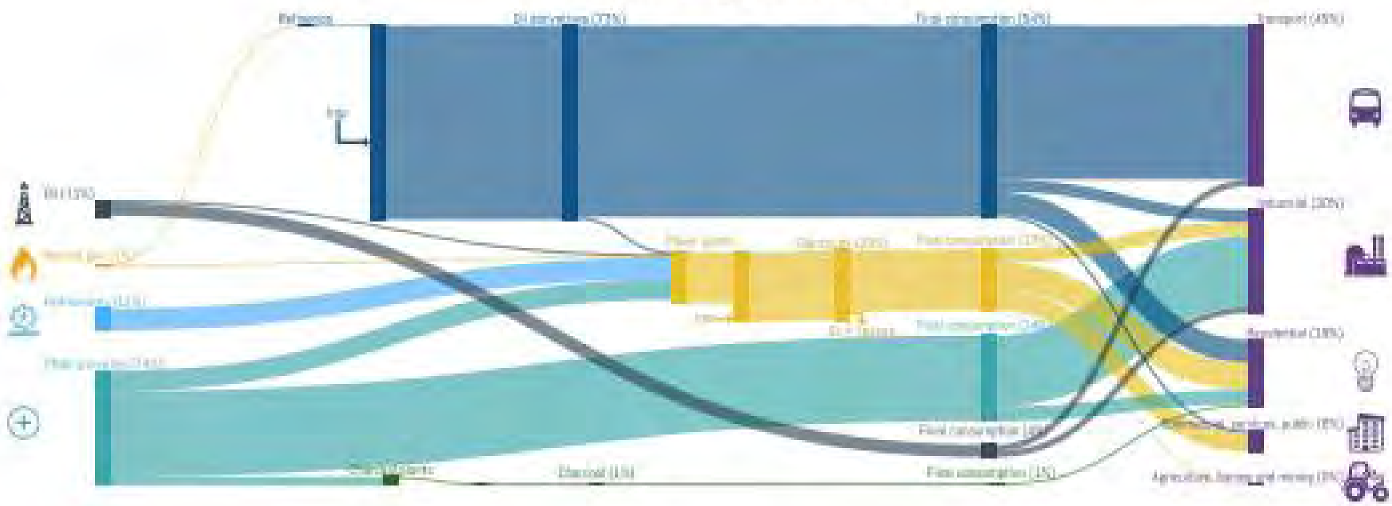
Final consumption in the Transport Sector	Mtoe 0.17
Final consumption in the Industrial Sector	Mtoe 0.11
Final consumption in the Residential Sector	Mtoe 0.07
Final consumption in the Commercial and Service Sector	Mtoe 0.02
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.00

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

Note: The supply and demand data are presented for the 2013-2017 period, data from the previous years are being revised by the country.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,963
Final energy consumption per capita	toe/inhab.	0.97
Electrification rate	%	91.30
Total energy supply	Mtoe	0.39
Total energy production	Mtoe	0.20
Total energy imports	Mtoe	0.23
Total energy exports	Mtoe	0.04
Total final energy consumption	Mtoe	0.38
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	0.15
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.13 / 0.13

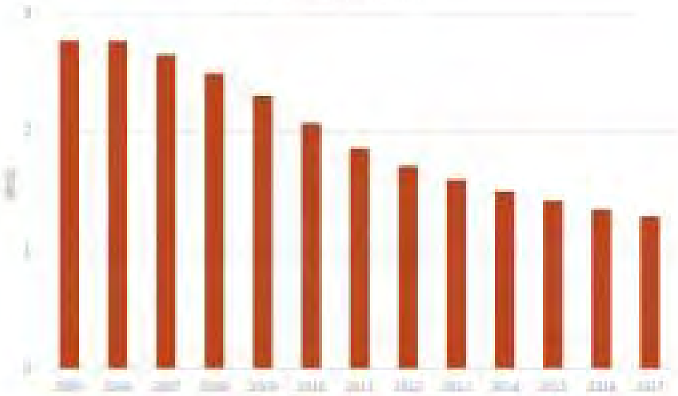
Summarized energy balance 2017



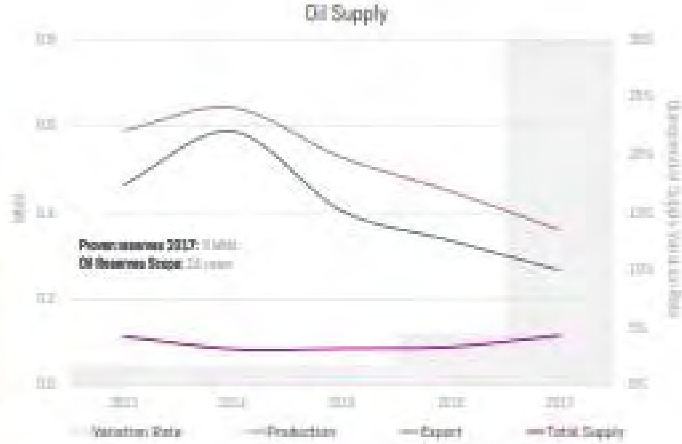
Installed power generation capacity [MW; %]
2017

Electricity Generation by Source [GWh; %]
2017

Proven reserves of oil

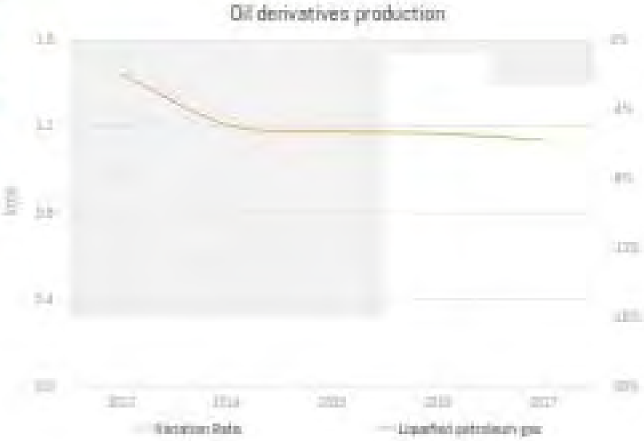


Oil Supply

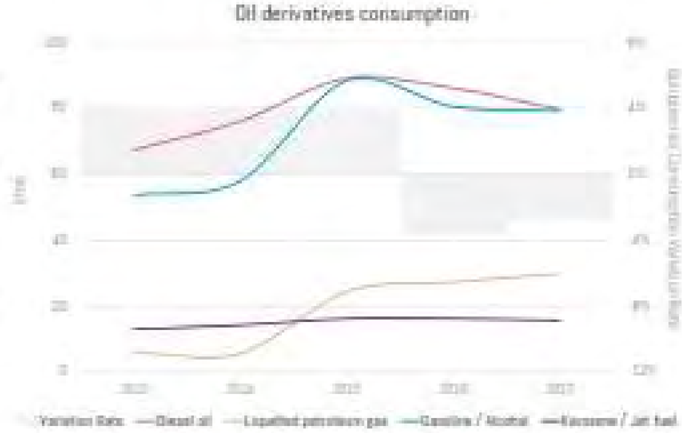


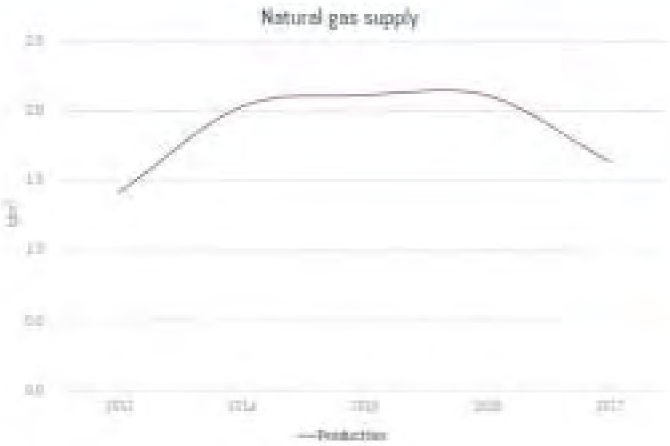
BELIZE

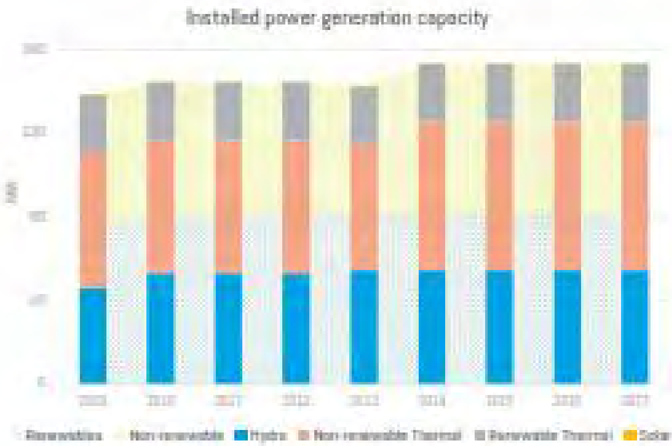
Oil derivatives production

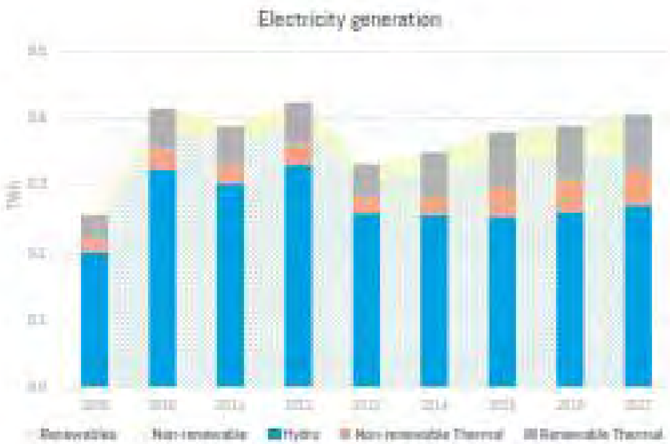


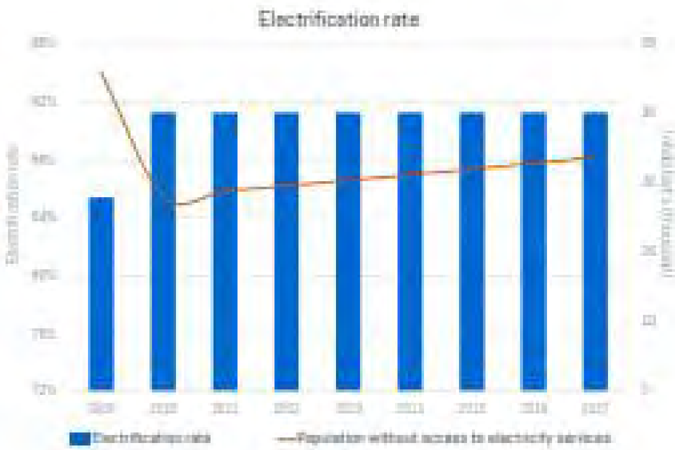
Oil derivatives consumption

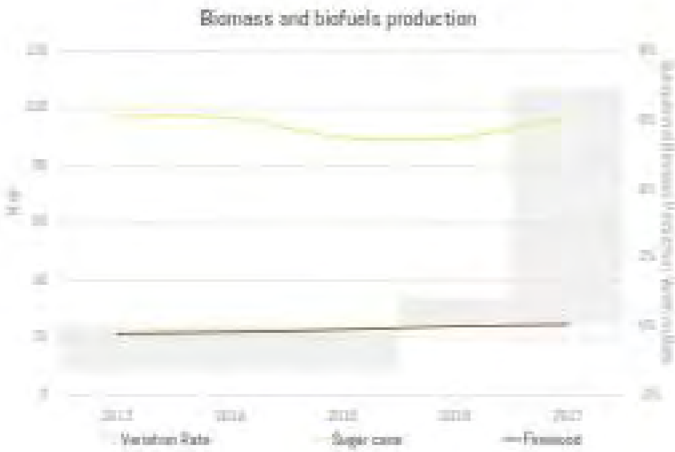


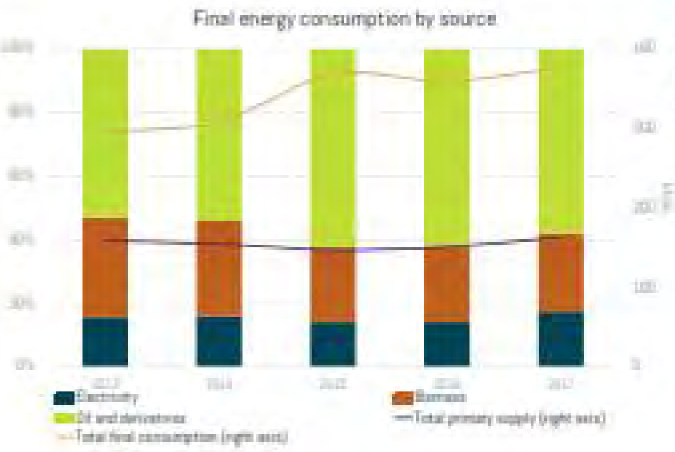

Natural gas supply
Production


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

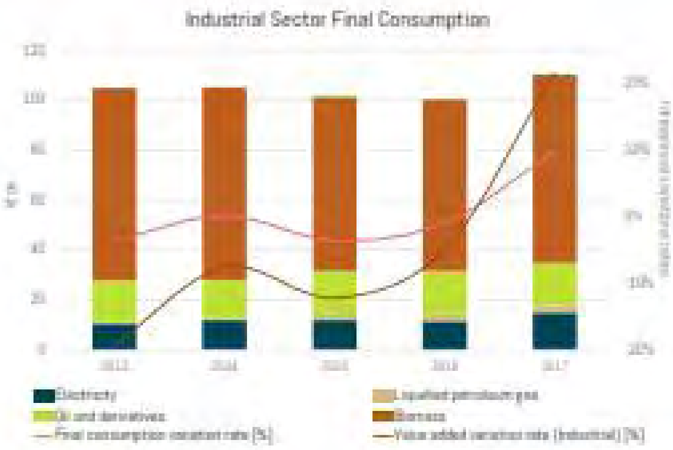

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal


Electrification rate
Electrification rate
Population without access to electricity services

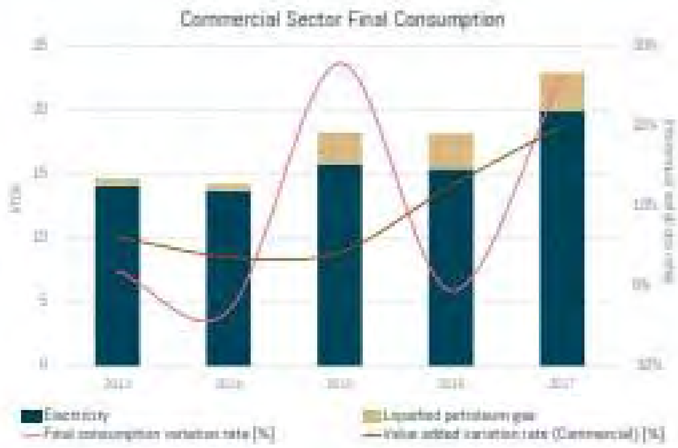

Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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

BELIZE

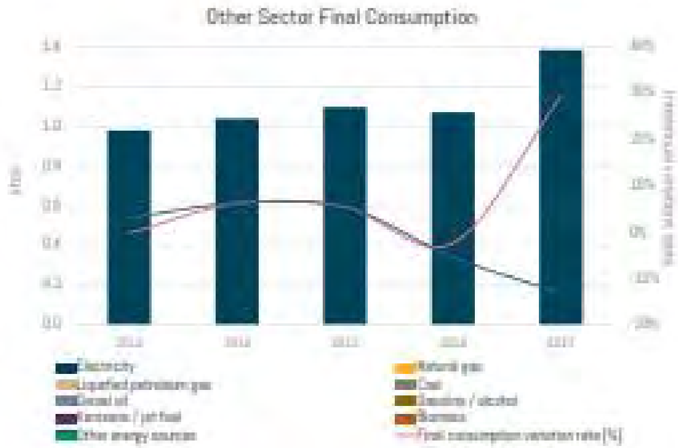


Industrial Sector Final Consumption
ktoe
Electricity
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]



Commercial Sector Final Consumption
ktoe
Electricity
Liquefied petroleum gas
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

Transport Sector Final Consumption
ktoe
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied petroleum gas
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

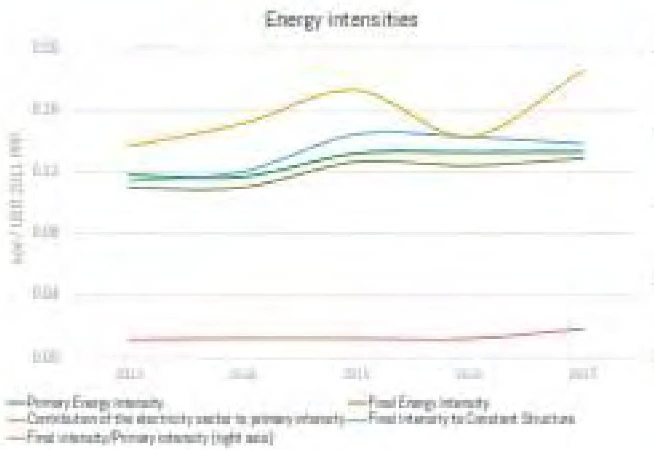


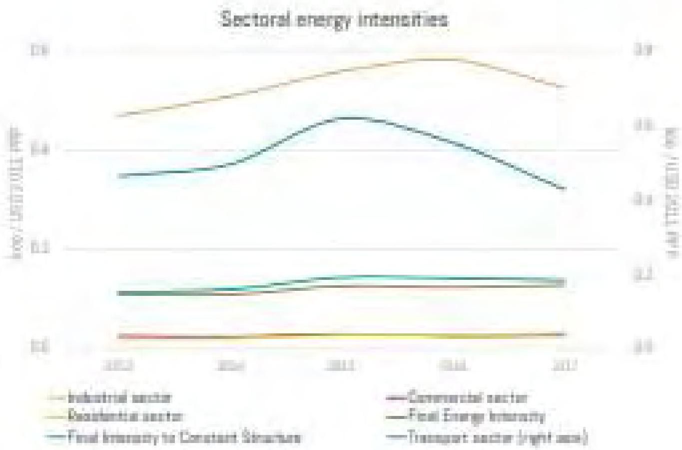
Other Sector Final Consumption
ktoe
Electricity
Natural gas
Liquefied petroleum gas
Coal
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Biomass
Other energy sources
Final consumption variation rate [%]

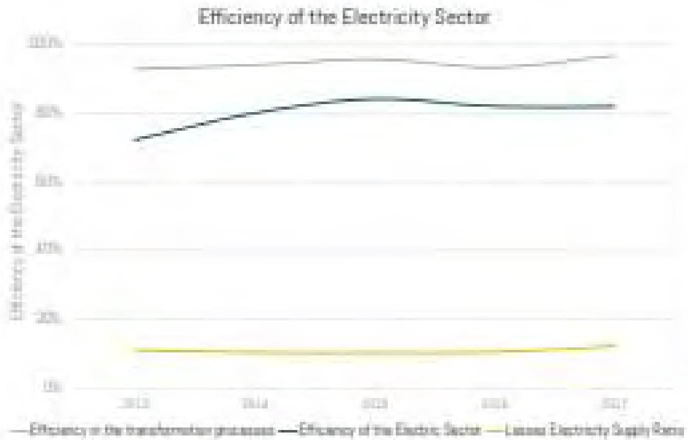
BELIZE

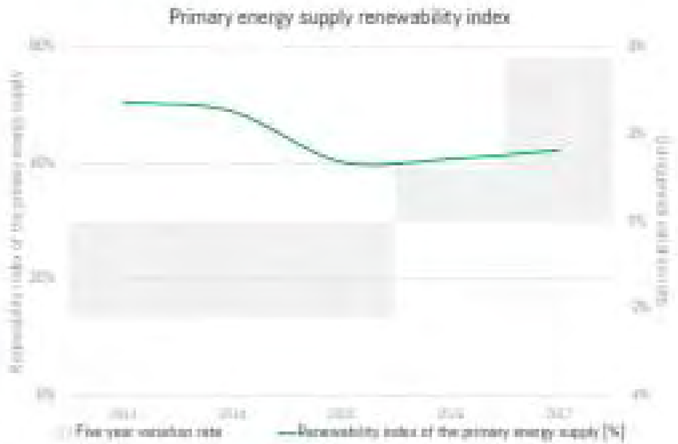
Residential Sector Final Consumption
ktoe
Electricity
Liquefied petroleum gas
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

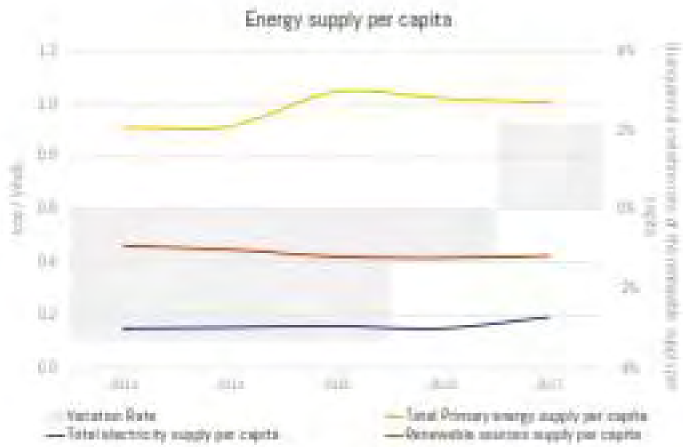
Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

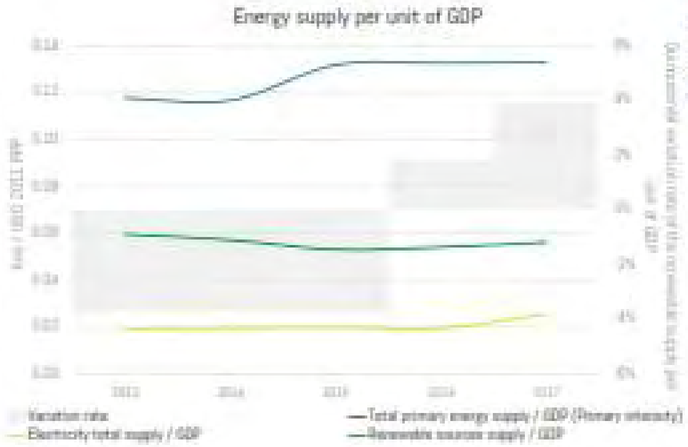

Energy intensities
2013
2014
2015
2016
2017
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)

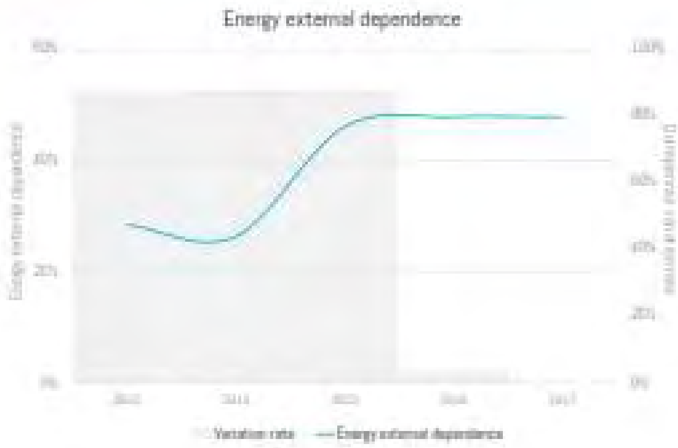

Sectoral energy intensities
2013
2014
2015
2016
2017
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

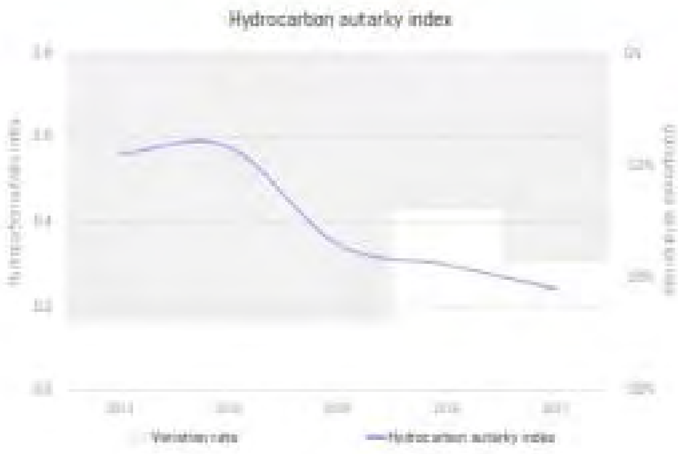

Efficiency of the Electricity Sector
100%
80%
60%
40%
20%
0%
2013
2014
2015
2016
2017
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

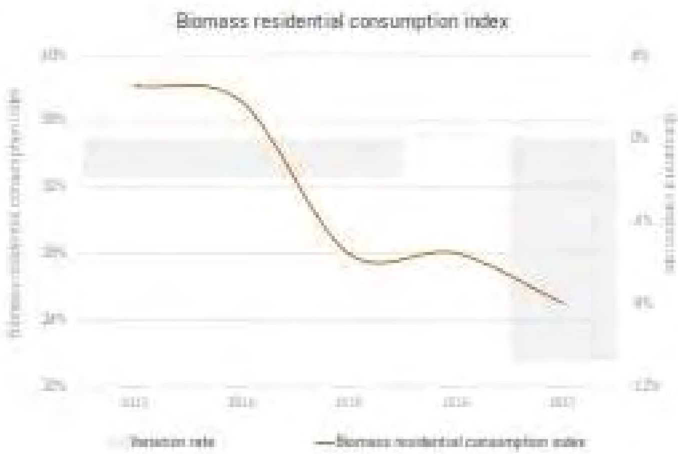

Primary energy supply renewability index
2013
2014
2015
2016
2017
Five year variation rate
Renewability index of the primary energy supply [%]

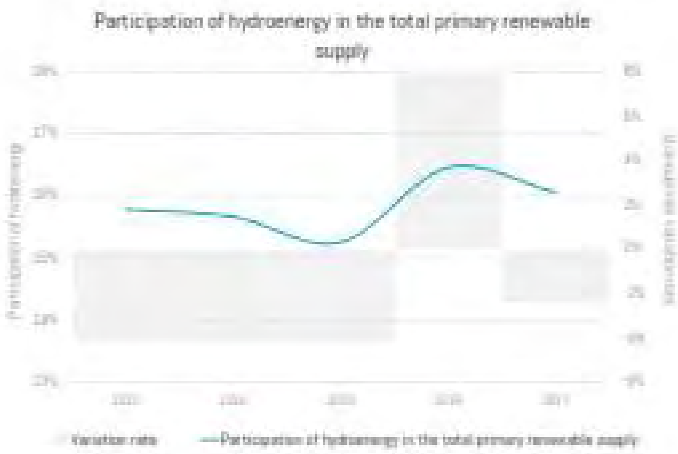

Energy supply per capita
2013
2014
2015
2016
2017
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


Energy supply per unit of GDP
2013
2014
2015
2016
2017
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

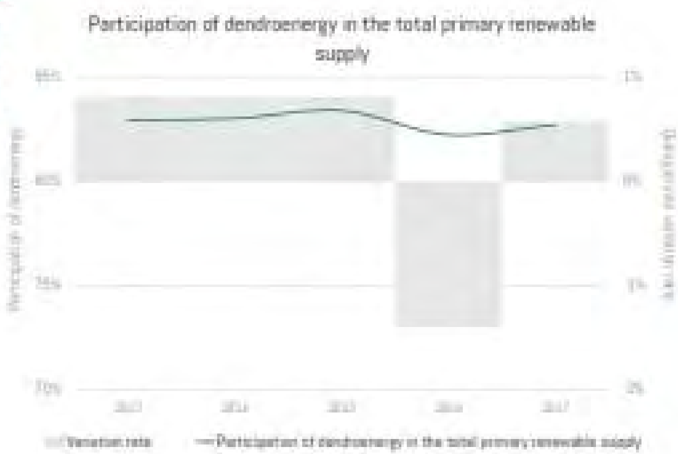

Energy external dependence
Variation rate
Energy external dependence

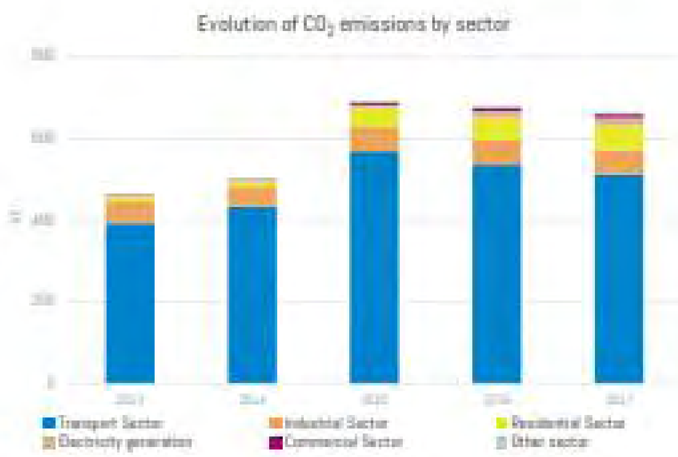

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

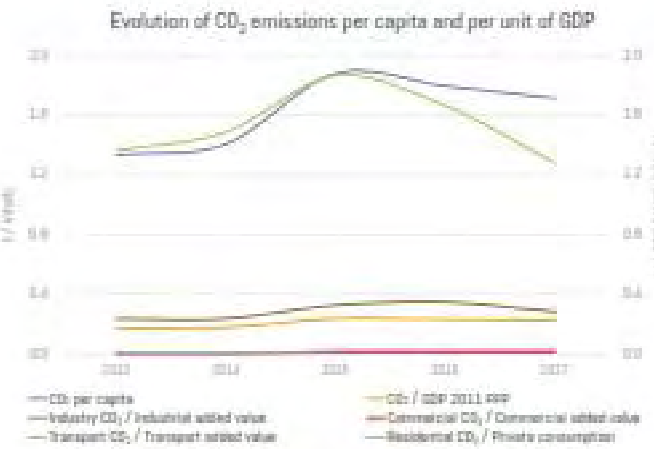

Biomass residential consumption index
Variation rate
Biomass residential consumption index

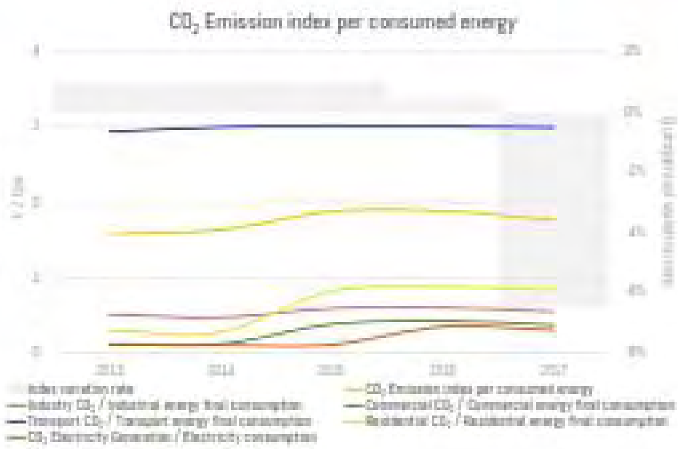

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

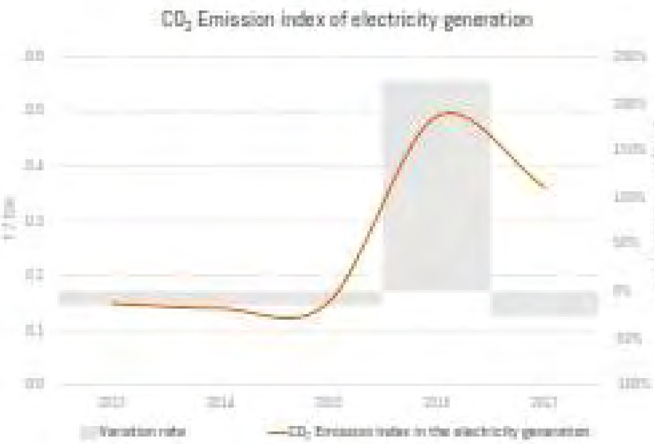
BELIZE


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

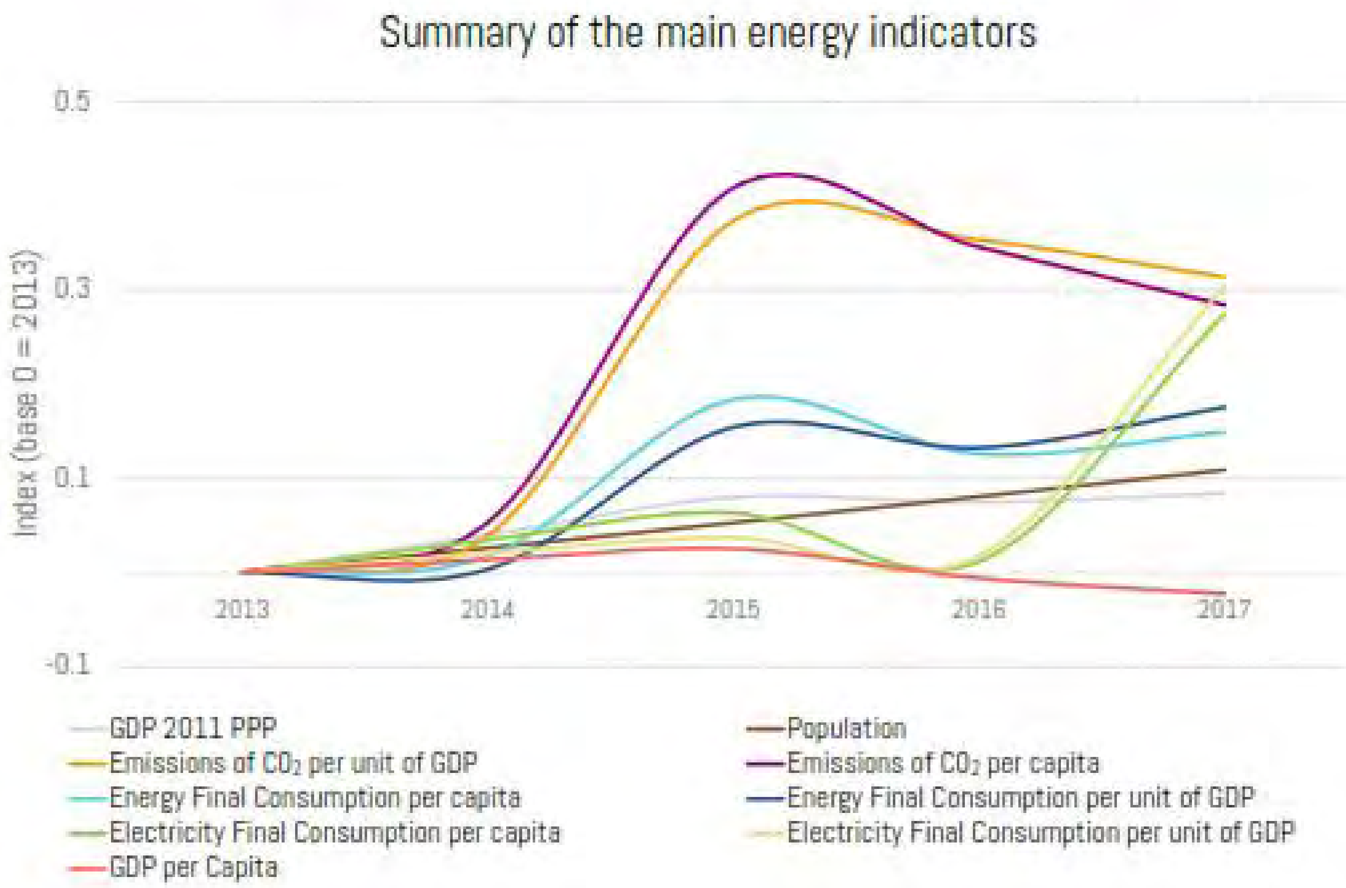

Evolution of CO2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO2 emissions per capita and per unit of GDP
2012
2014
2015
2016
2017
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
2013
2014
2015
2016
2017
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
2013
2014
2015
2016
2017
Variation rate
CO2 Emission index in the electricity generation

BELIZE


Summary of the main energy indicators
0.5
0.3
0.1
-0.1
Index (base 0 = 2013)
2013
2014
2015
2016
2017
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

BOLIVIA

General Information 2017

Population (thousand inhab.)	11,146
Area (km²)	1,098,581
Population Density (inhab./km²)	10
Urban Population (%)	70
GDP USD 2010 (MUSD)	27,881
GDP USD 2011 PPP (MUSD)	76,099
GDP per capita (thou. USD 2011 PPP/inhab.)	6.8

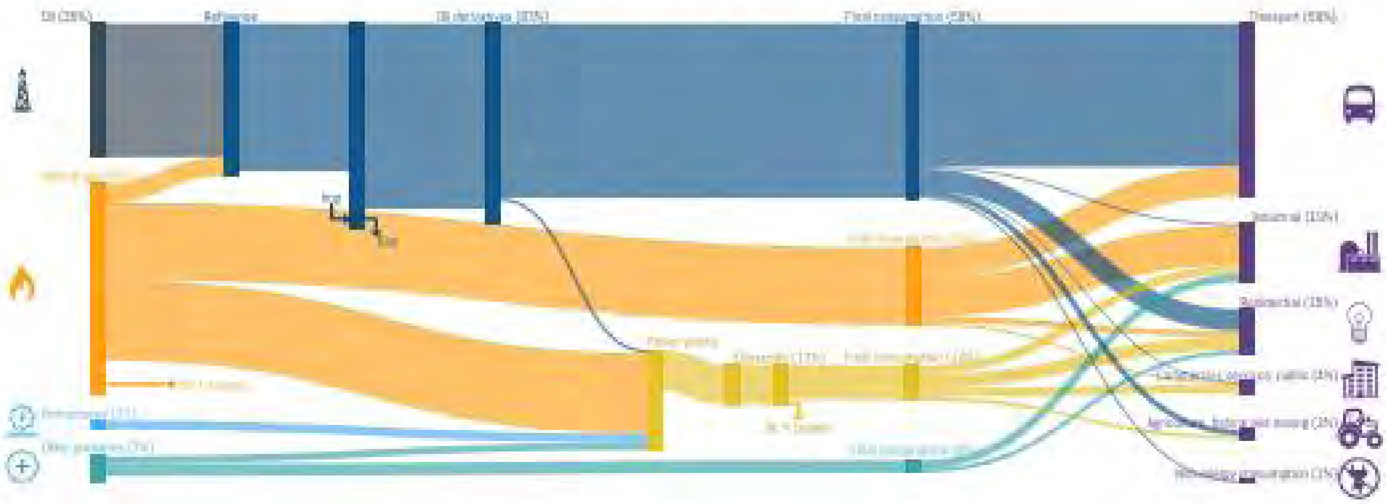
Energy Sector

Final consumption in the Transport Sector	Mtoe 3.61
Final consumption in the Industrial Sector	Mtoe 1.21
Final consumption in the Residential Sector	Mtoe 0.94
Final consumption in the Commercial and Service Sector	Mtoe 0.24
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.24

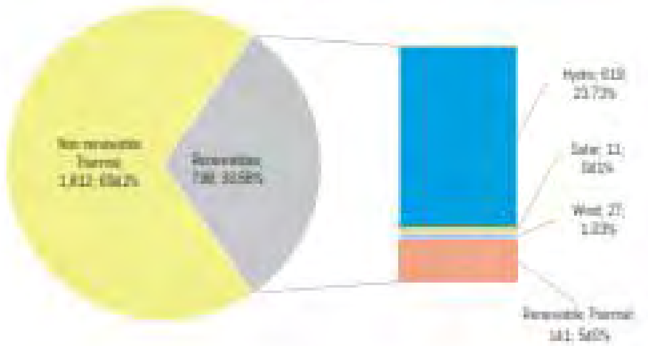
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 241	Gm³ 303	Mt n.a.

Electricity consumption per capita	Final energy 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
751	0.56	90.70	9.02	20.69	1.21	13.09	6.24	69	2.61	0.12 / 0.08

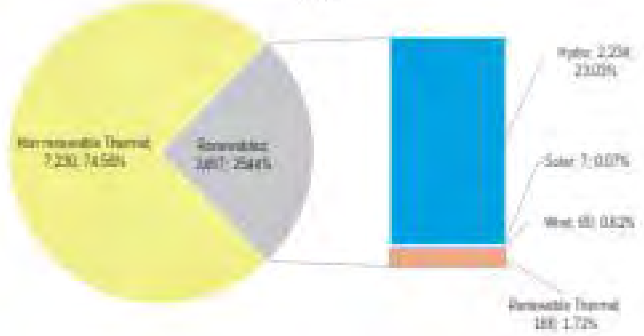
Summarized energy balance 2017



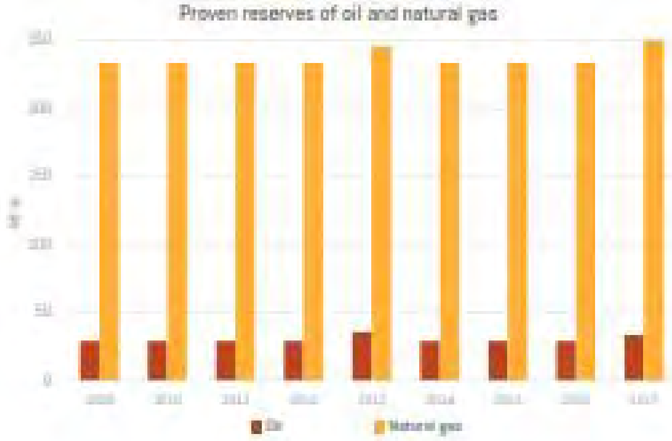
Installed power generation capacity [MW; %]
2017



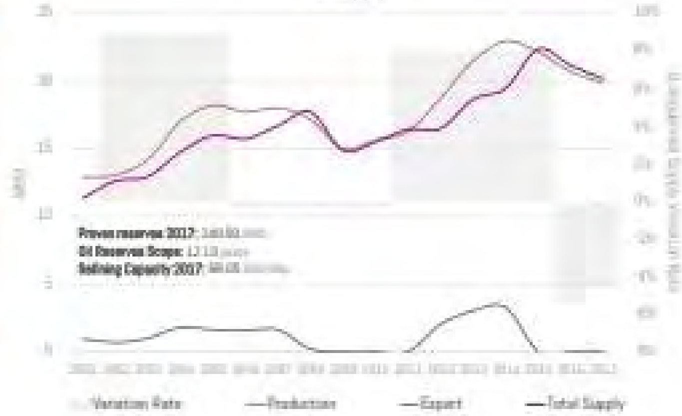
Electricity Generation by Source [GWh; %]
2017



Proven reserves of oil and natural gas



Oil Supply



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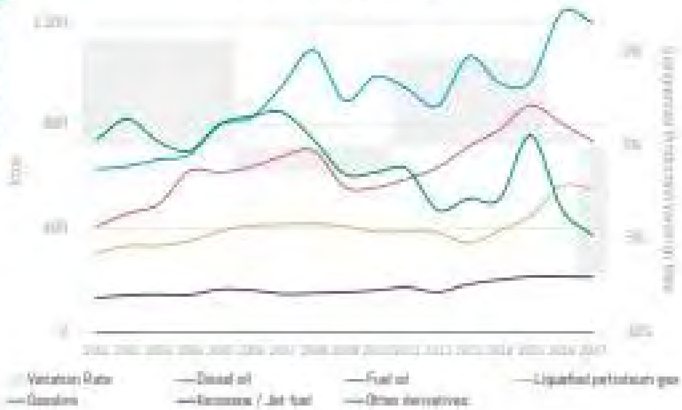
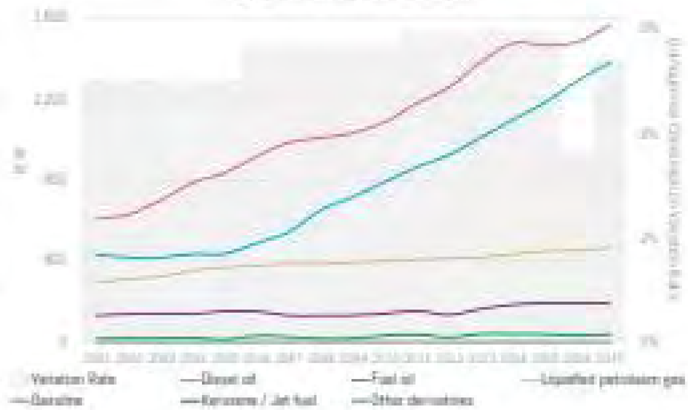
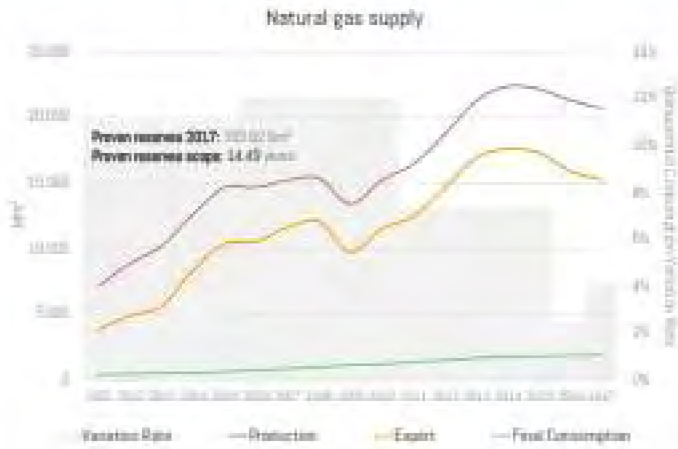
Oil derivatives production

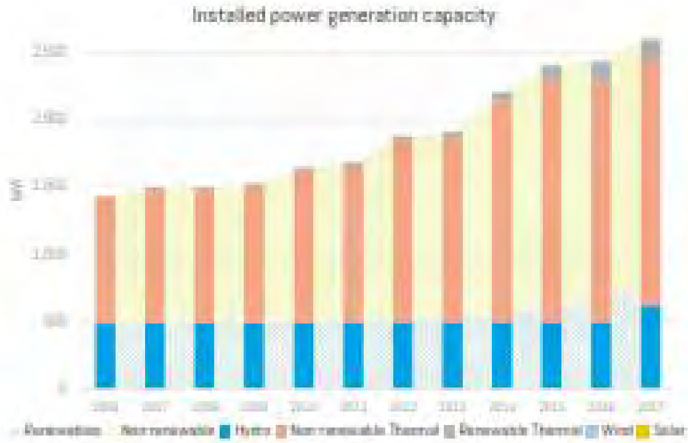


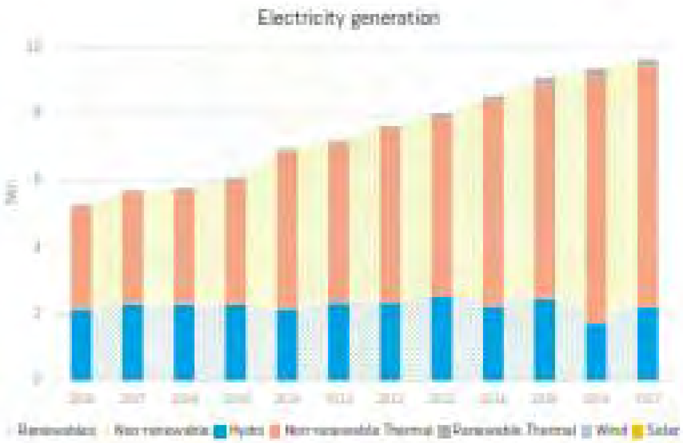
Oil derivatives consumption

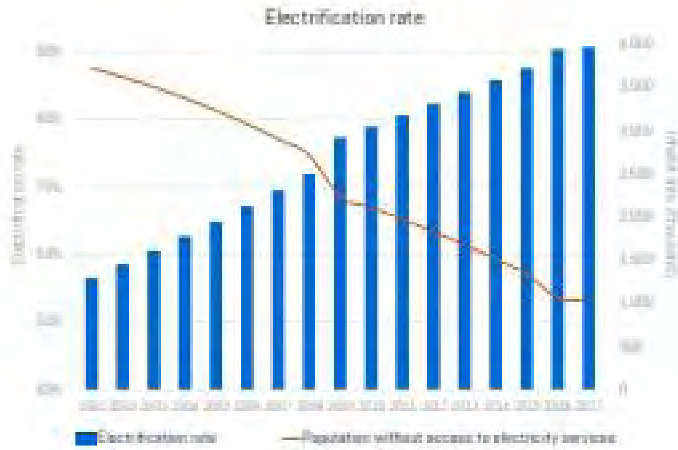


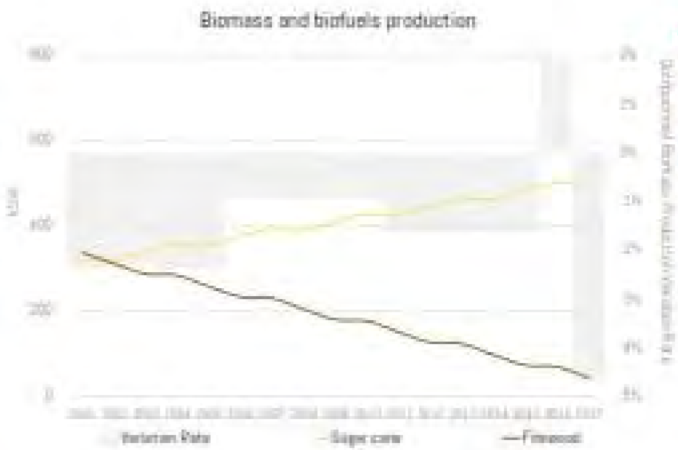


In 2017 initiated the construction phase of civil works of the Jaguar X6 well, located in the O'Connor of the Tarija department, with an estimated potential of 2 Trillion cubic feet (TCF's) of recoverable gas.









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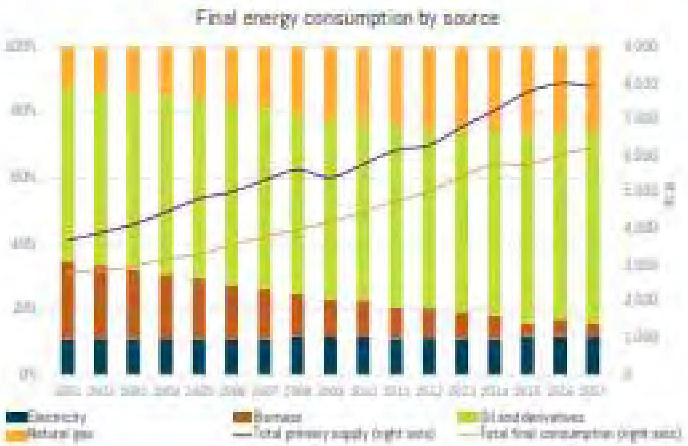
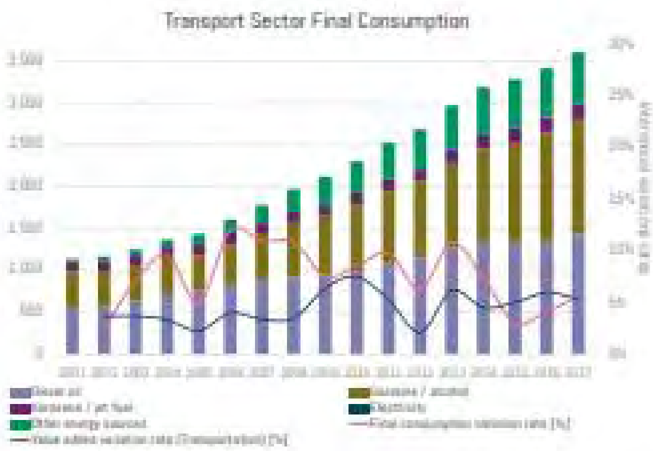

Final energy consumption by source
Electricity
Natural gas
Biomass
Total primary supply (right axis)
Oil and derivatives
Total final consumption (right axis)


Industrial Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]


Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Final consumption variation rate [%]
Natural gas
Coal and coke
Value added variation rate (Commercial) [%]


Transport Sector Final Consumption

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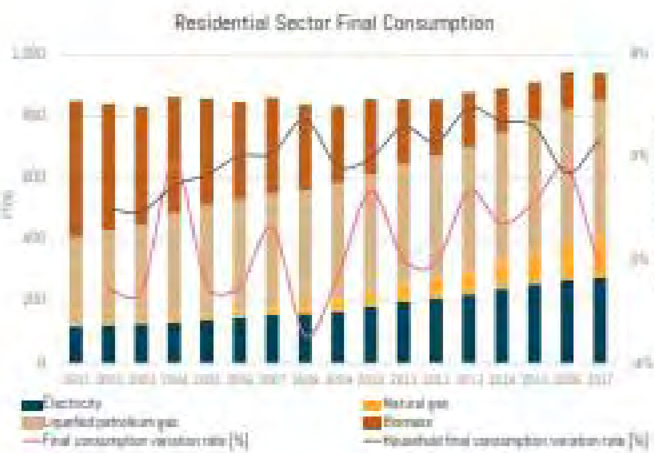
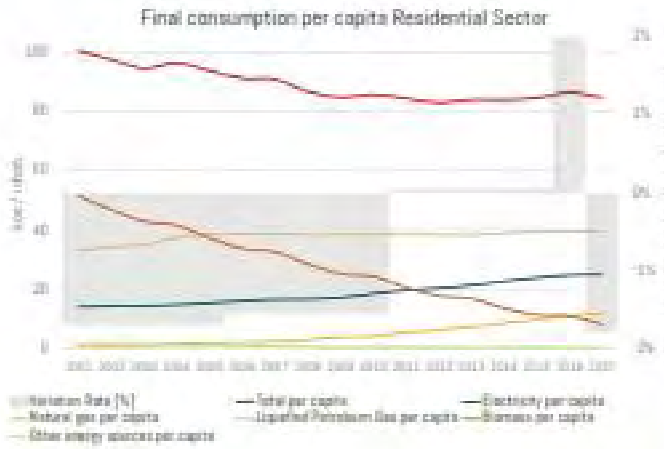
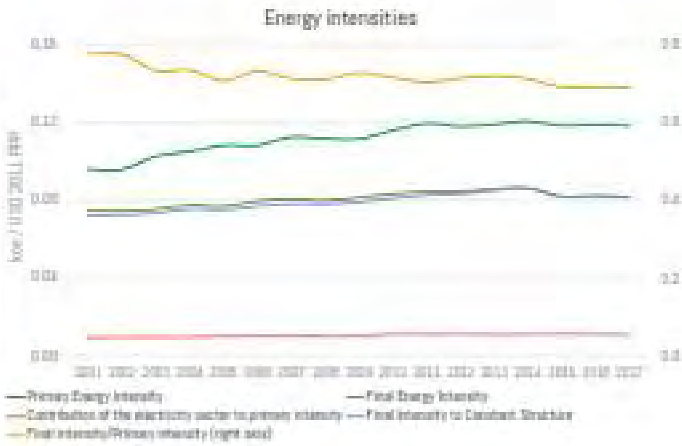
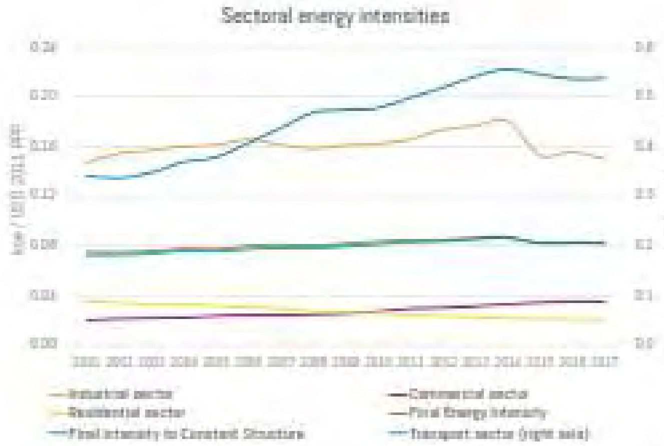
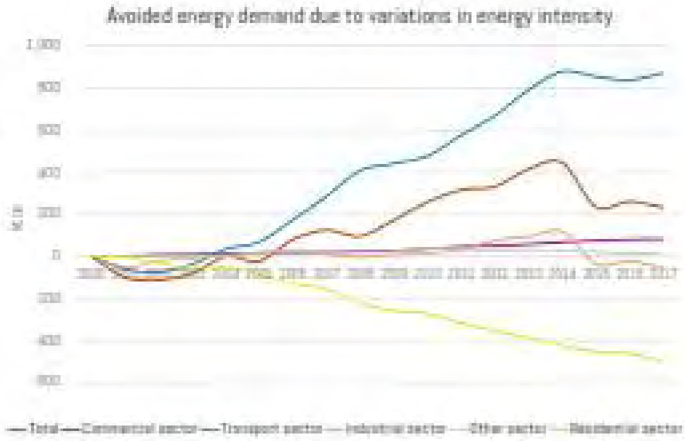
Other Sector Final Consumption
Electricity
Final consumption variation rate [%]
Diesel oil
Value added variation rate (Other) [%]

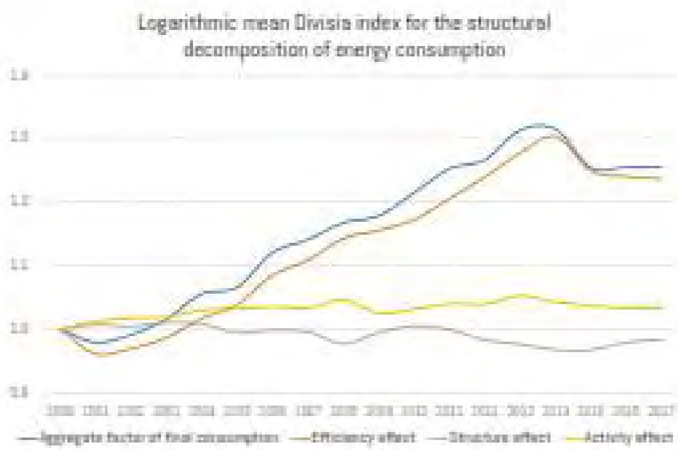

Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Final consumption variation rate [%]
Natural gas
Biomass
Household final consumption variation rate [%]

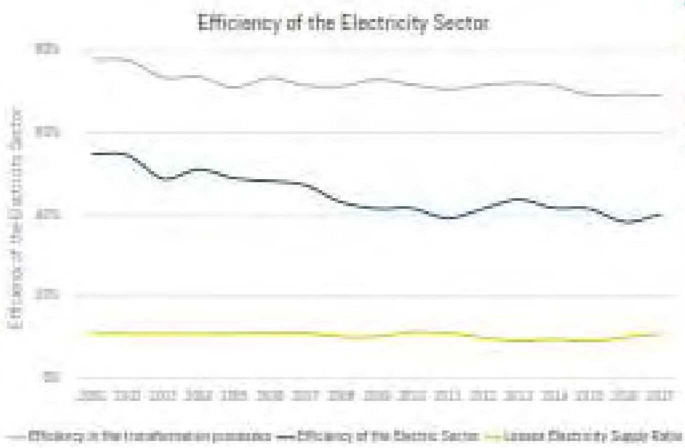

Final consumption per capita Residential Sector
koe / inhab.
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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
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 Electric Sector
Losses Electricity Supply Ratio

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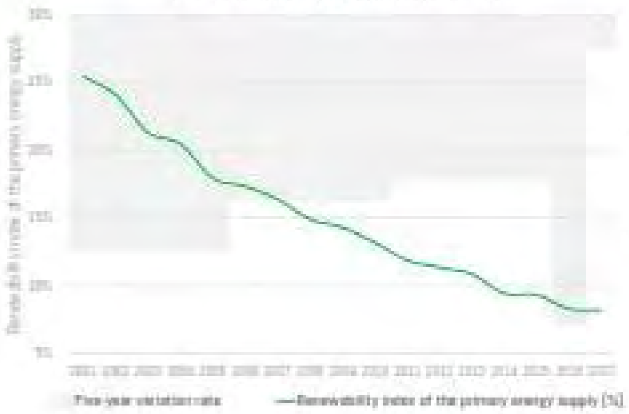
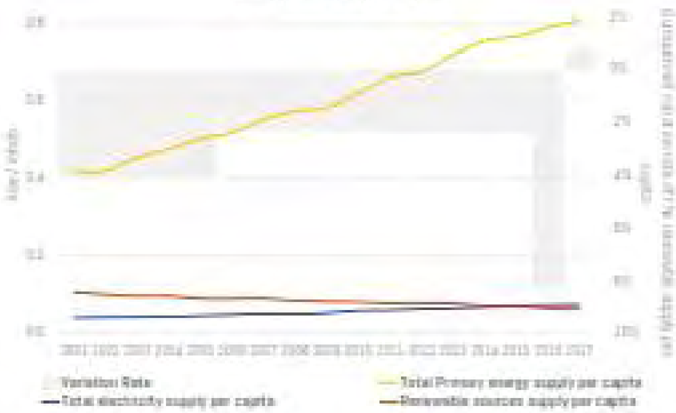
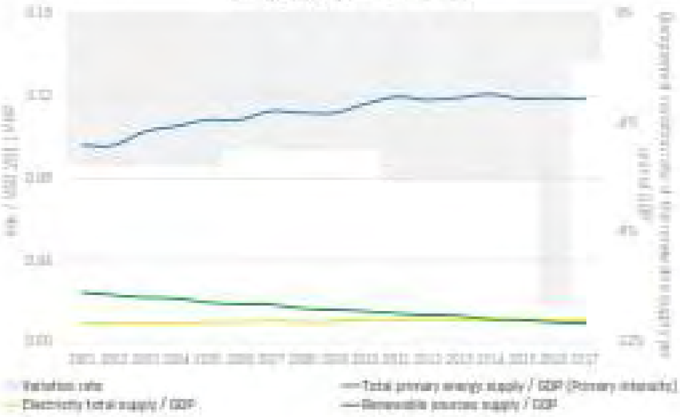
Primary energy supply renewability index



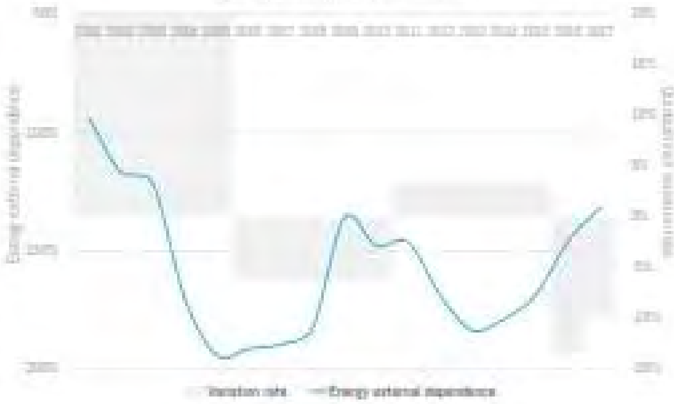
Energy supply per capita



Energy supply per unit of GDP



Energy external dependence



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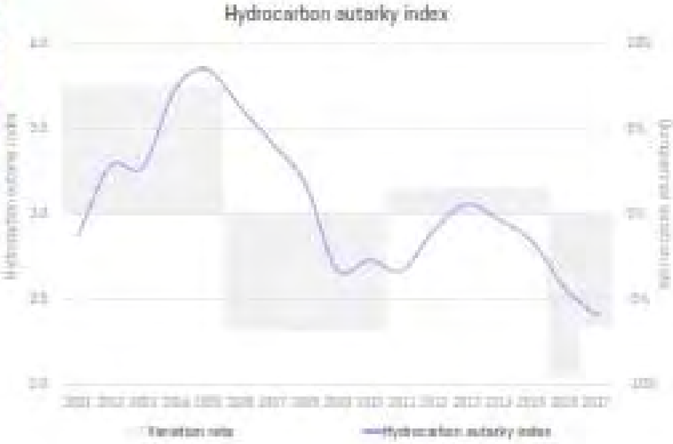
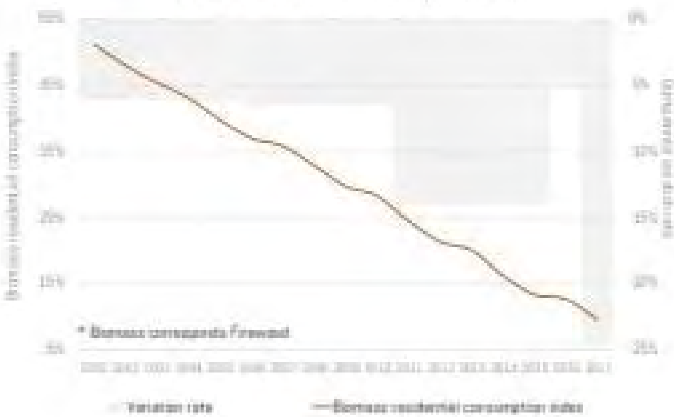
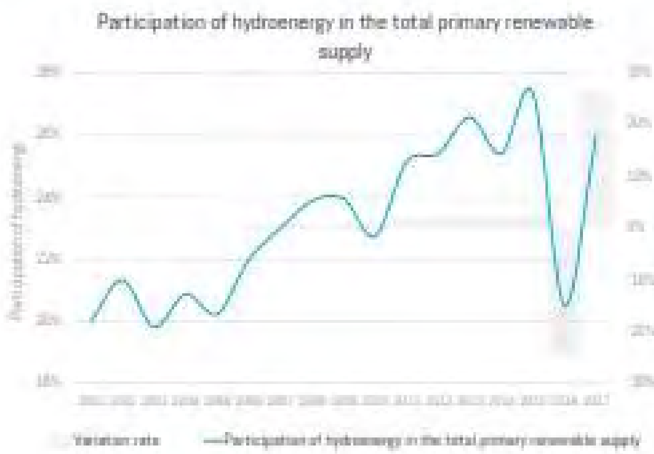
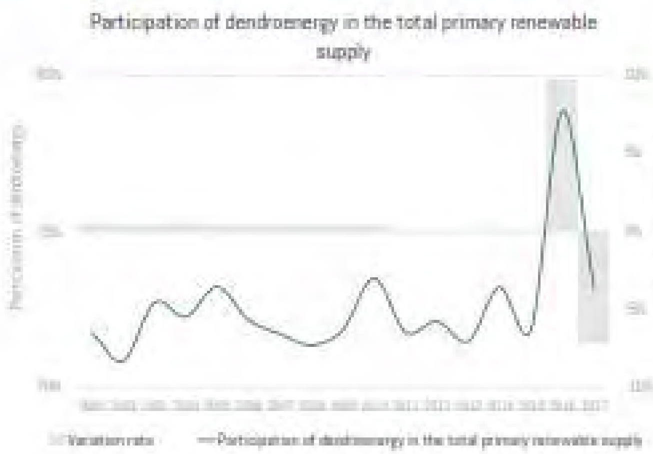
Hydrocarbon autarky index

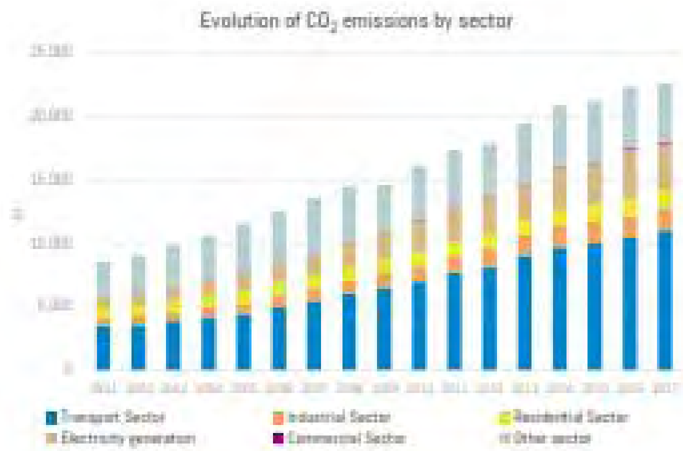


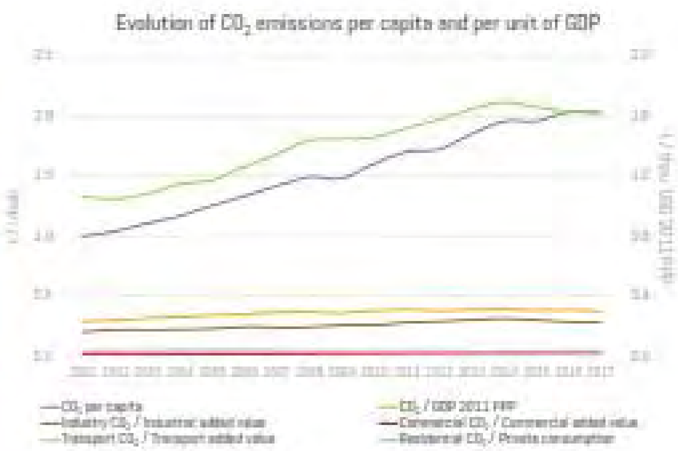
Biomass* residential consumption index

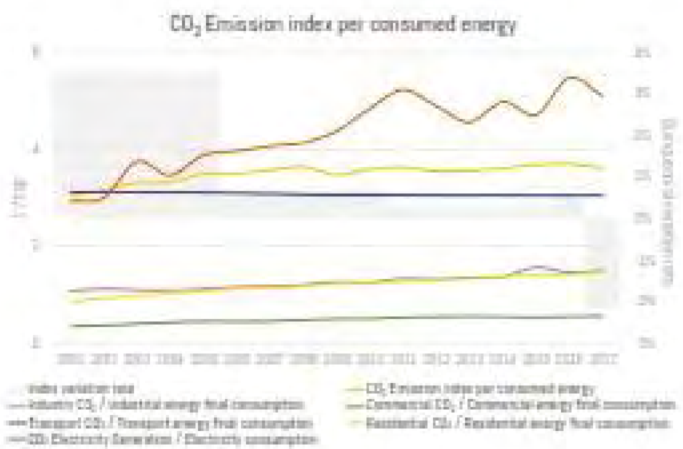


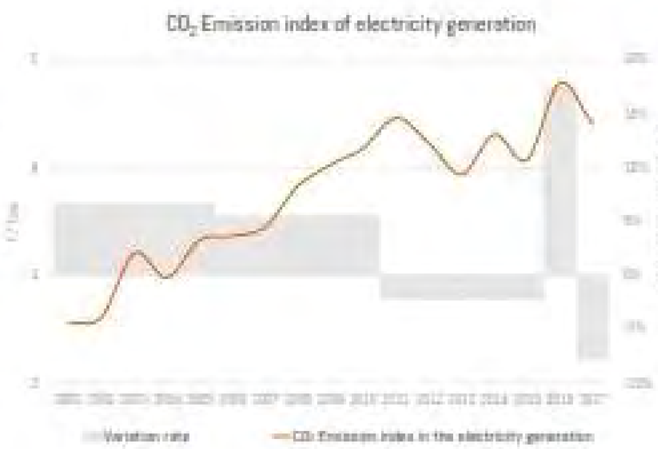

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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

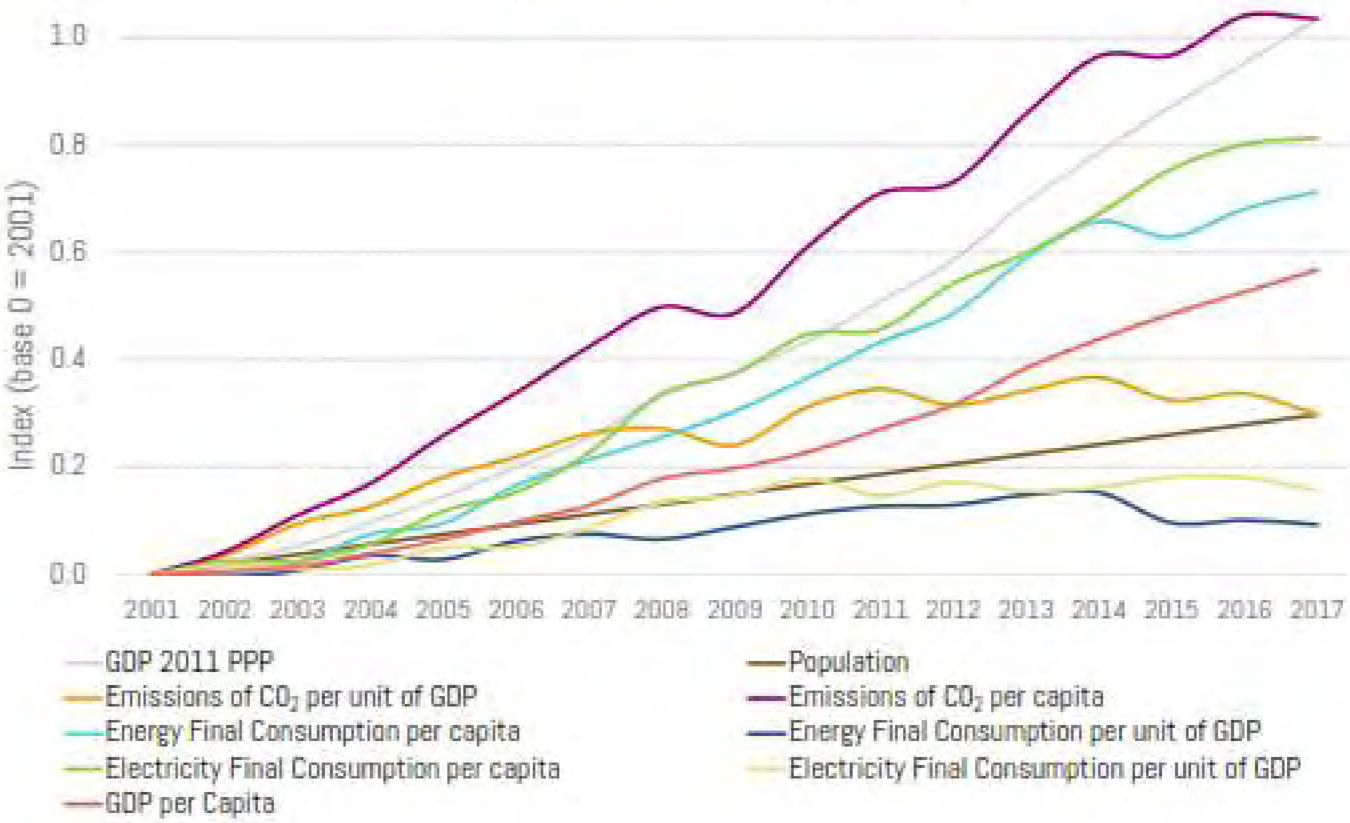

Evolution of CO_2 emissions per capita and per unit of GDP
CO_2 per capita
Industry CO_2 / Industrial added value
Transport CO_2 / Transport added value
CO_2 / GDP 2011 PPP
Commercial CO_2 / Commercial added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy
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
Variation rate
CO_2 Emission index in the electricity generation

BOLIVIA

Summary of the main energy indicators



BOLIVIA

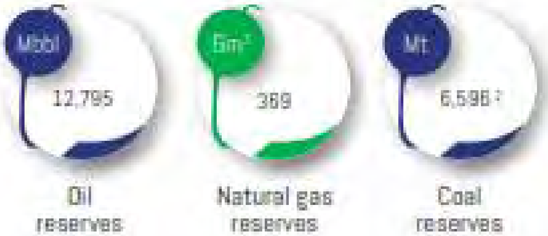
BRAZIL

General Information 2017

Population (thousand inhab.)	208,547
Area (km²)	8,515,759
Population Density (inhab./km²)	24
Urban Population (%)	86
GDP USD 2010 (MUSD)	2,278,613
GDP USD 2011 PPP (MUSD)	2,951,687
GDP per capita (thou. USD 2011 PPP/inhab.)	14

Energy Sector

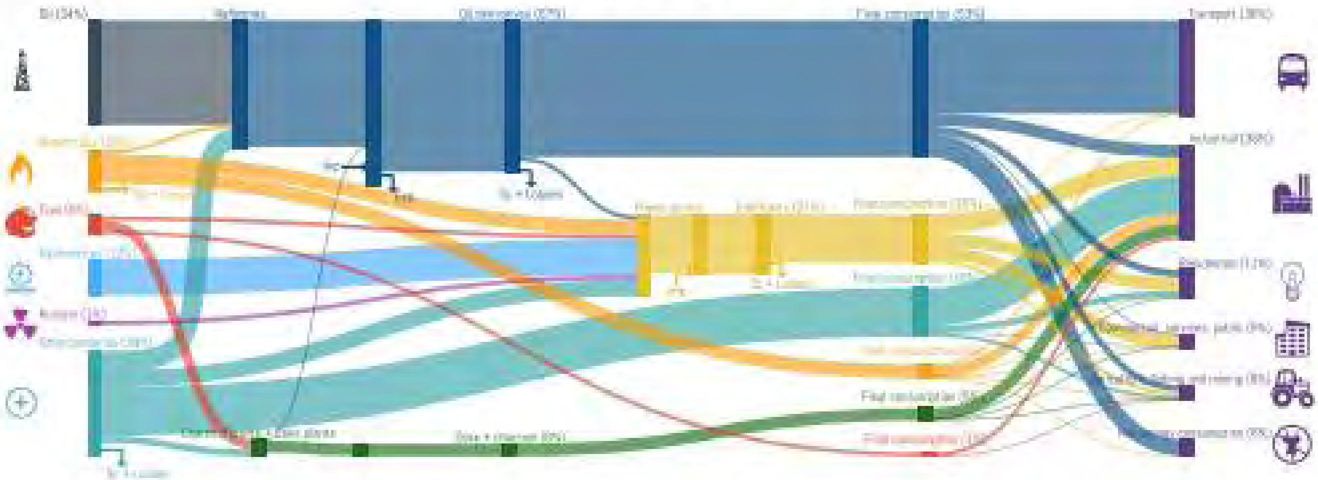
Sector	Mtoe
Final consumption in the Transport Sector	84.25
Final consumption in the Industrial Sector	83.71[3]
Final consumption in the Residential Sector	24.91
Final consumption in the Commercial and Service Sector	12.45
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	28.14[4]

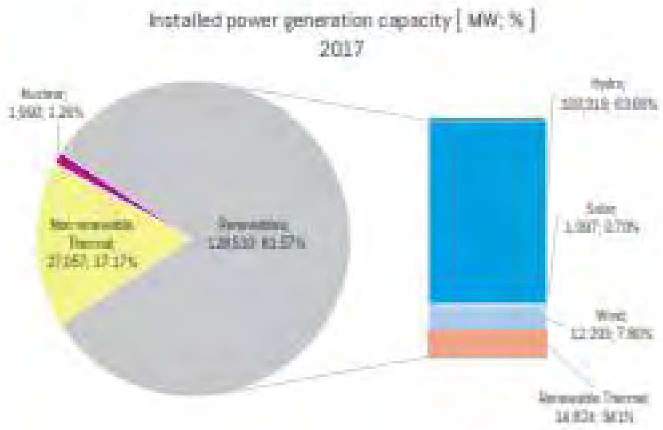


[1] Does not include own consumption of the energy sector.
[2] Data estimated by OLADE.
[3] Does not include Mining and Pelletizing.
[4] Includes non-energy consumption.

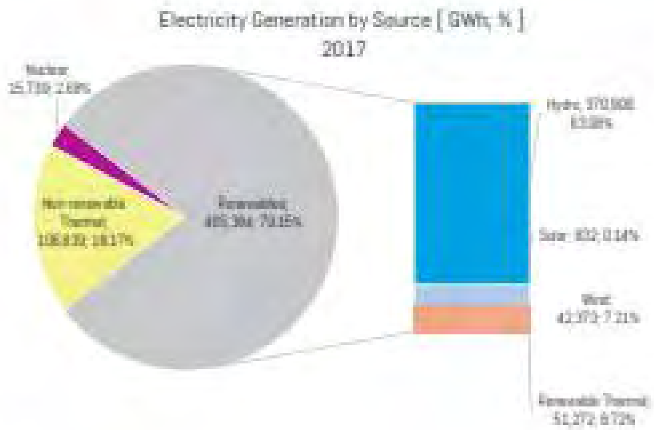
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	2,382
Final energy consumption per capita	toe/inhab.	1.12[1]
Electrification rate	%	99.79
Total energy supply	Mtoe	294.55
Total energy production	Mtoe	299.14
Total energy imports	Mtoe	63.65
Total energy exports	Mtoe	66.68
Total final energy consumption	Mtoe	233.46[1]
Refining capacity	kbbl/day	2,409
Installed power generation capacity	GW	157.58
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.10 / 0.08

Summarized energy balance 2017

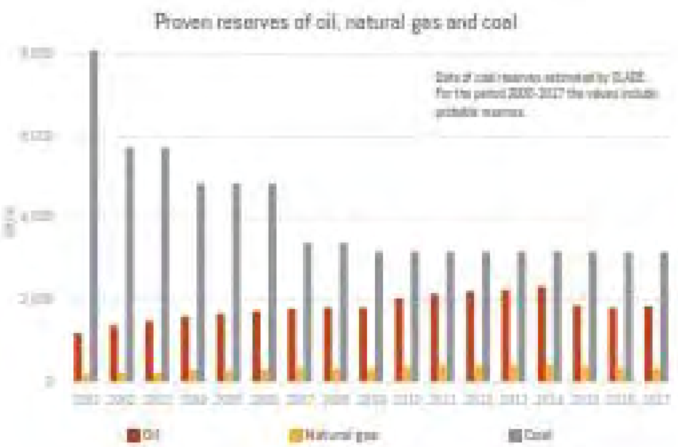




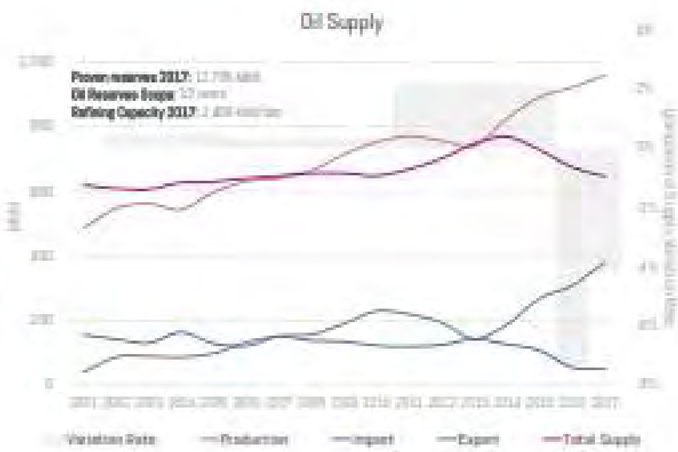
Installed power generation capacity [MW; %]
2017
Nuclear; 1,990; 1.26%
Non-renewable Thermal; 27,057; 17.17%
Renewables; 128,530; 81.57%
Hydro; 100,319; 63.66%
Solar; 1,097; 0.70%
Wind; 12,293; 7.80%
Renewable Thermal; 14,824; 9.41%



Electricity Generation by Source [GWh; %]
2017
Nuclear; 15,739; 2.69%
Non-renewable Thermal; 106,830; 18.17%
Renewables; 465,384; 79.15%
Hydro; 370,906; 63.08%
Solar; 832; 0.14%
Wind; 42,373; 7.21%
Renewable Thermal; 51,272; 8.72%

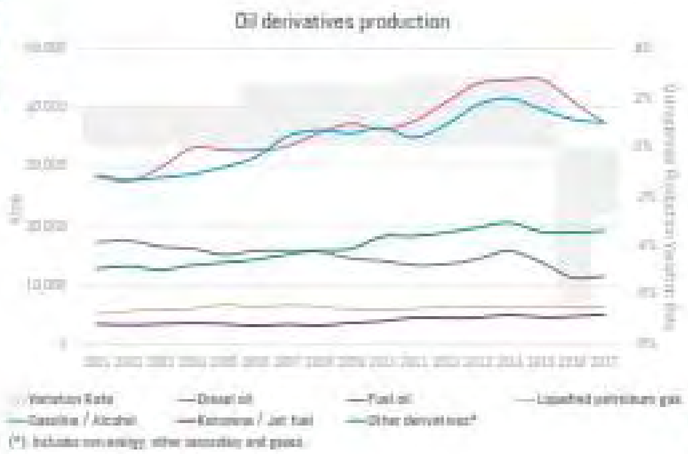


Proven reserves of oil, natural gas and coal
Oil
Natural gas
Coal

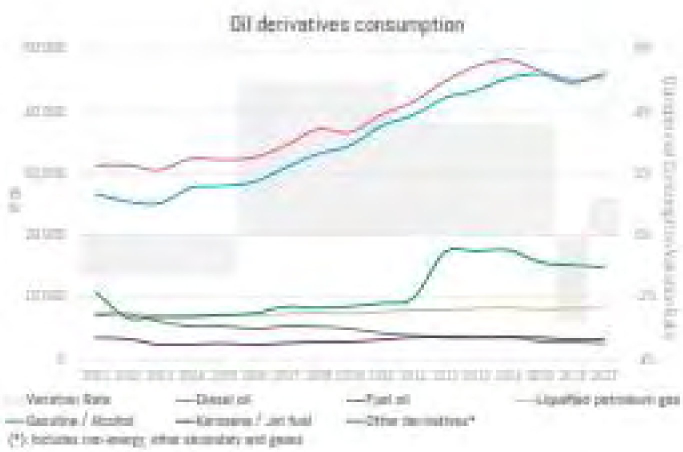


Oil Supply
Proven reserves 2017:
Oil Reserves Scope:
Refining Capacity 2017:
Variation Rate
Production
Import
Export
Total Supply

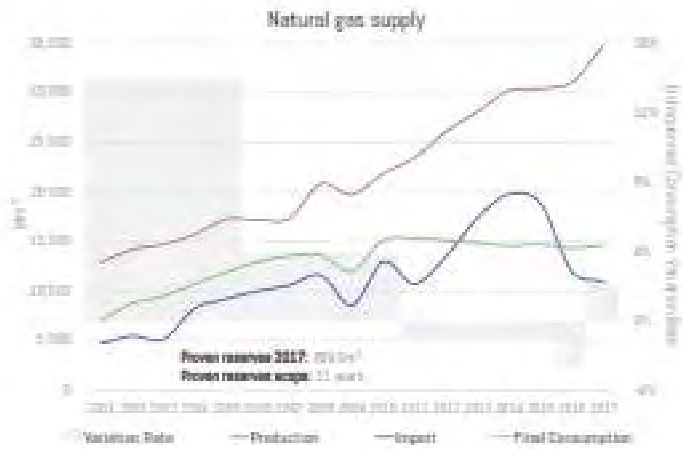
BRAZIL

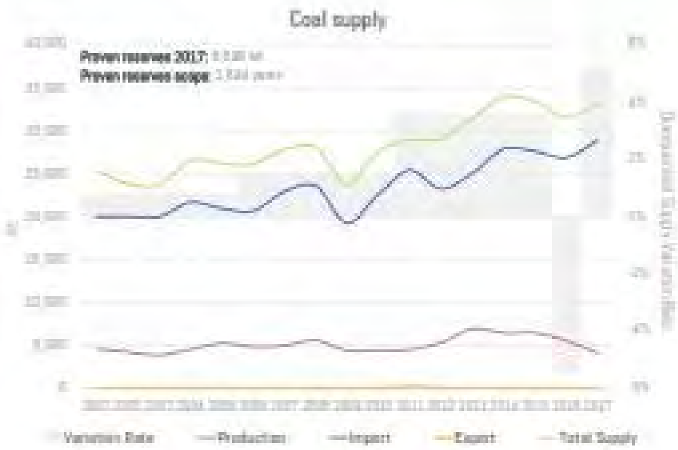


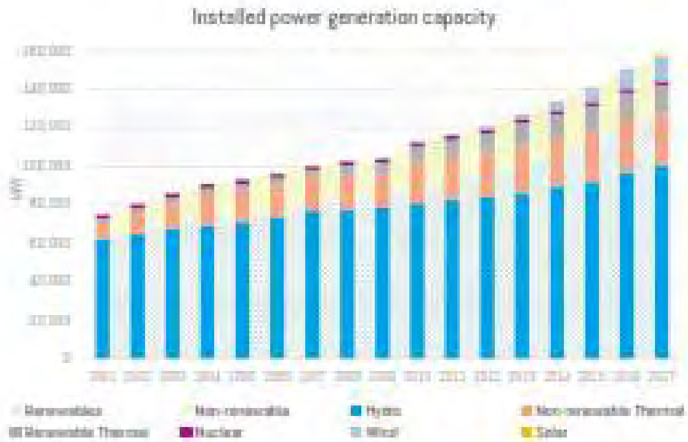
Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
(*): Includes non-energy, other secondary and gases

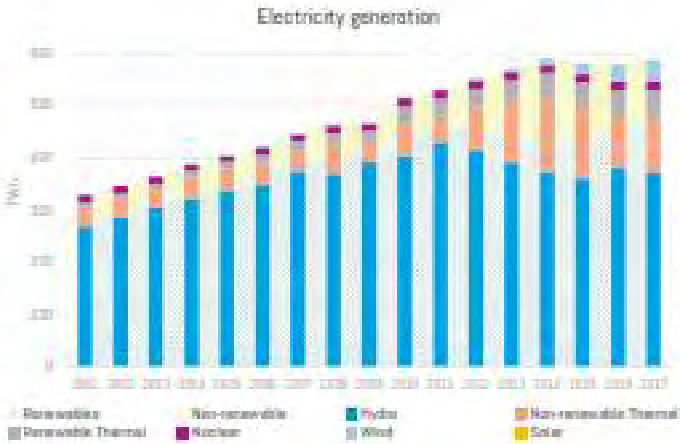


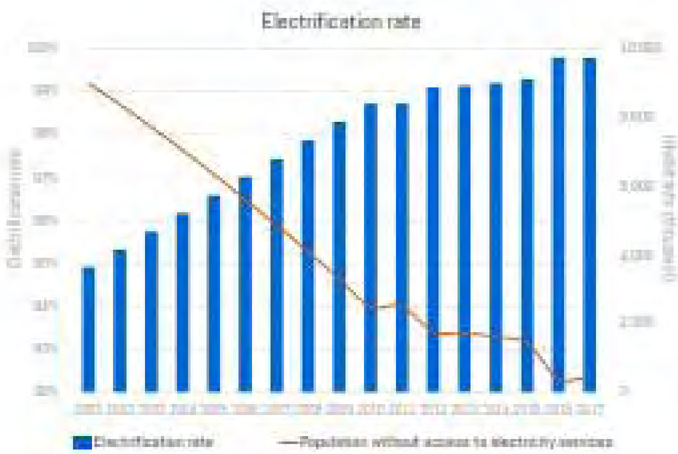
Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
(*): Includes non-energy, other secondary and gases

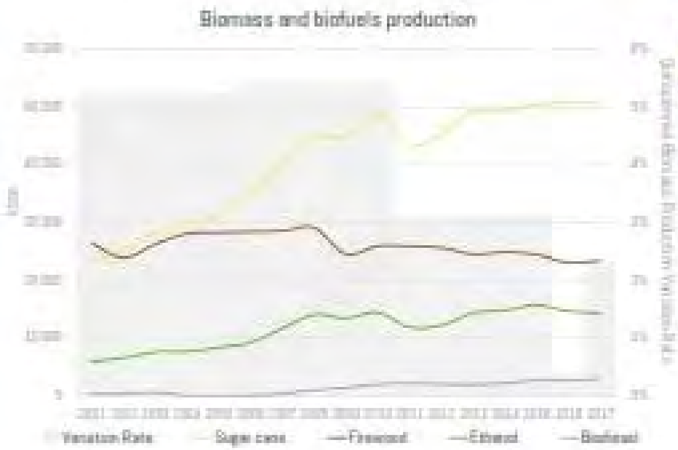

Natural gas supply
Proven reserves 2017:
Proven reserves scope:
Variation Rate
Production
Import
Final Consumption


Coal supply
Proven reserves 2017:
Proven reserves scope:
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
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood
Ethanol
Biodiesel

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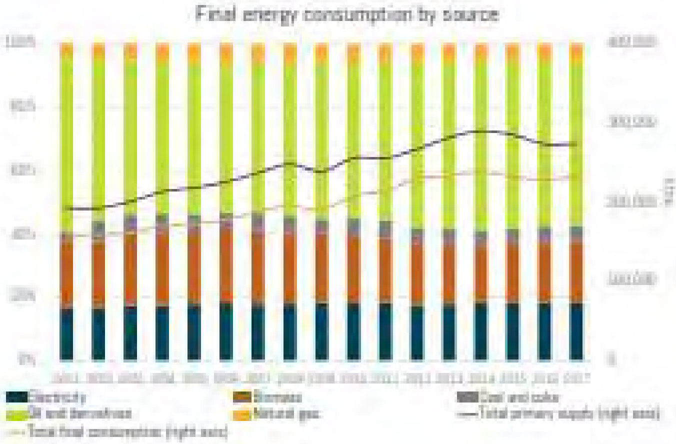
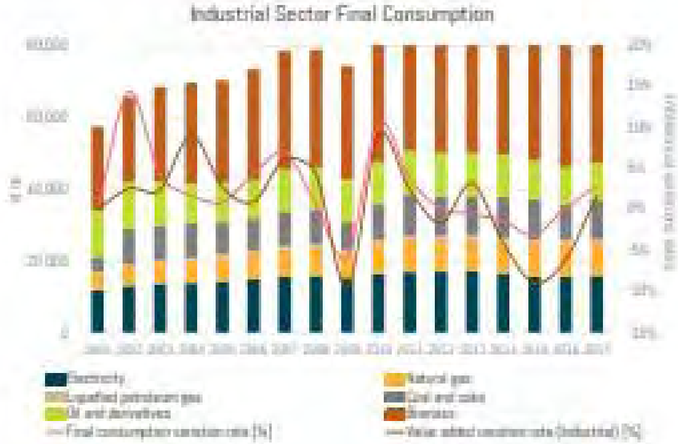
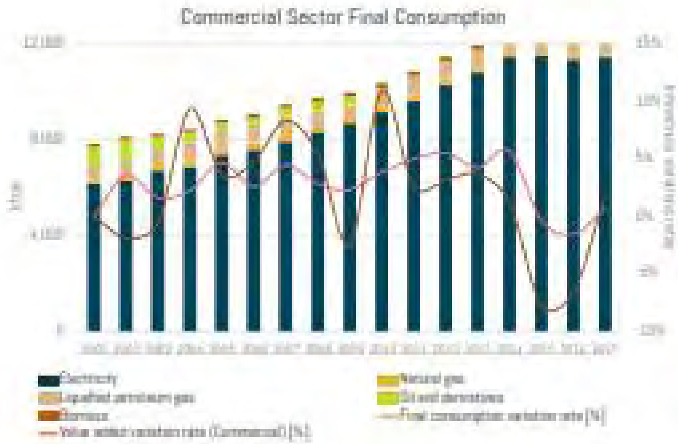


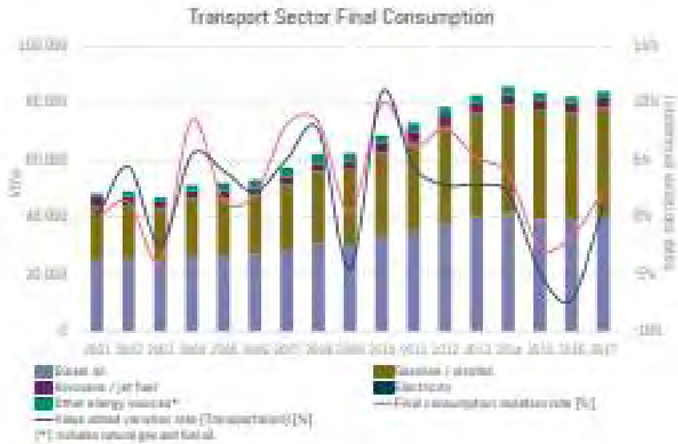
Final energy consumption by source
Electricity
Oil and derivatives
Total final consumption (right axis)
Biomass
Natural gas
Coal and coke
Total primary supply (right axis)



Industrial Sector Final Consumption
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
Electricity
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]



Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Other energy sources*
Value added variation rate (Transportation) [%]
(*) Includes natural gas and fuel oil.
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

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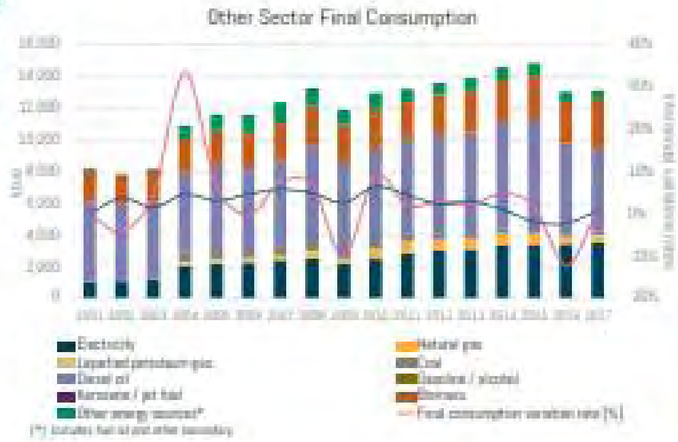
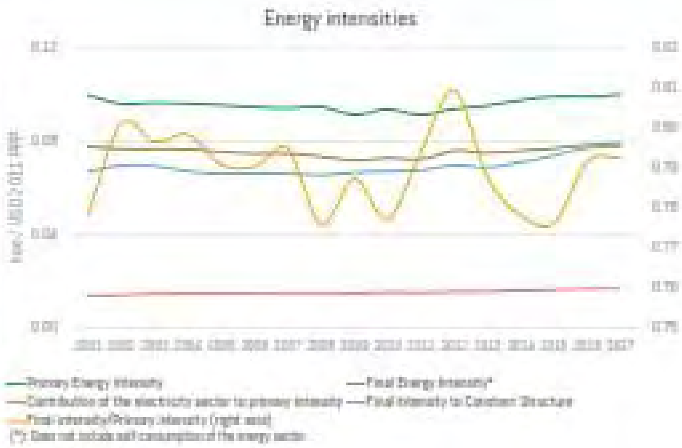
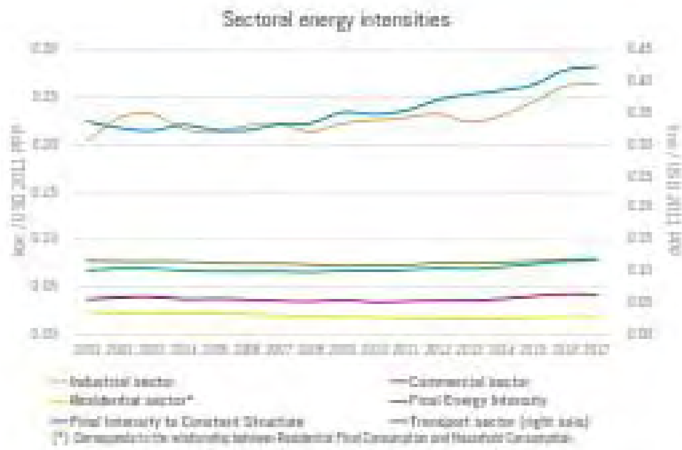


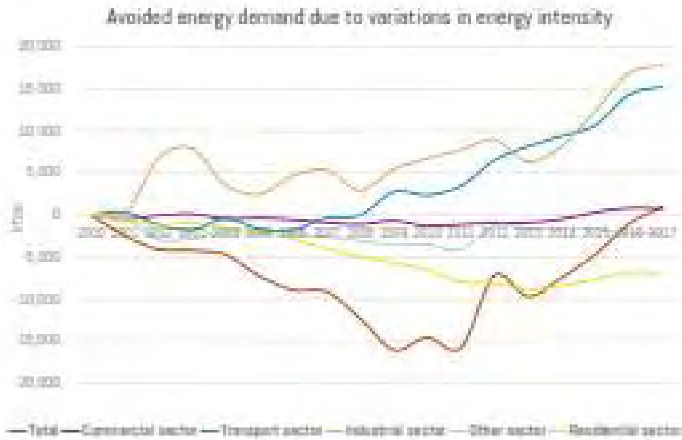
Other Sector Final Consumption
Electricity
Liquefied petroleum gas
Diesel oil
Kerosene / jet fuel
Other energy sources*
(*) Includes fuel oil and other secondary
Natural gas
Coal
Gasoline / alcohol
Biomass
Final consumption variation rate [%]

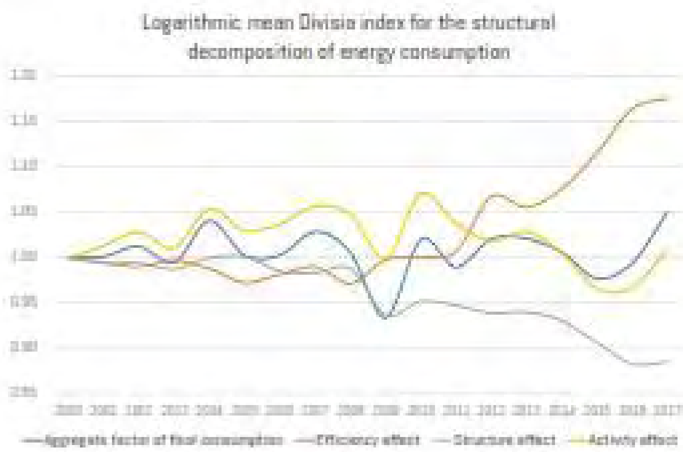
Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

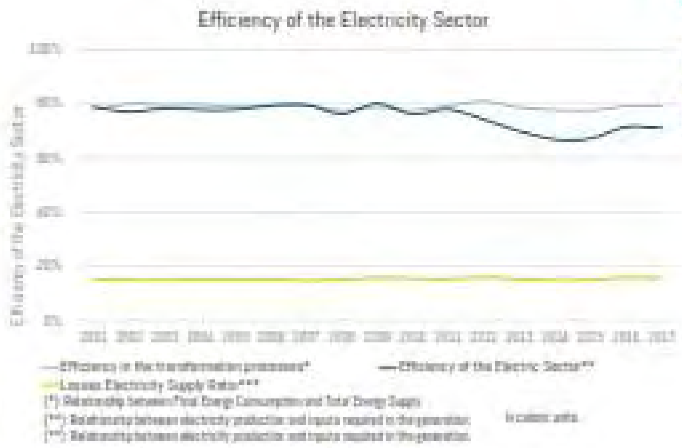

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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)
(*): Does not include self consumption of the energy sector.


Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector*
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)
(*): Corresponds to the relationship between Residential Final Consumption and Household Consumption.


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 in the transformation processes*
Efficiency of the Electric Sector**
Losses Electricity Supply Ratio***
(*): Relationship between Final Energy Consumption and Total Energy Supply.
(**): Relationship between electricity production and inputs required in the generation.
(***): Relationship between electricity production and inputs required in the generation.

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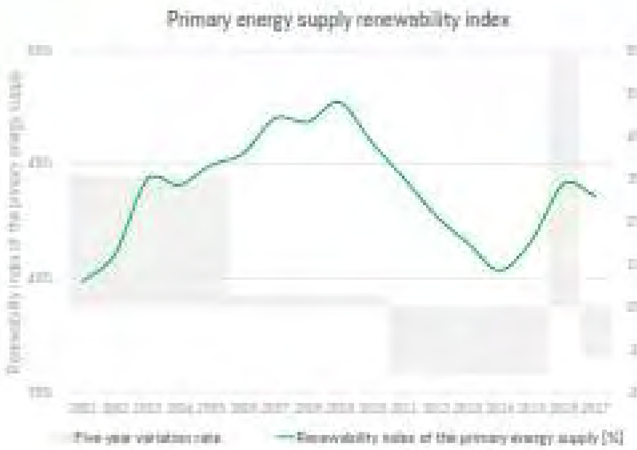

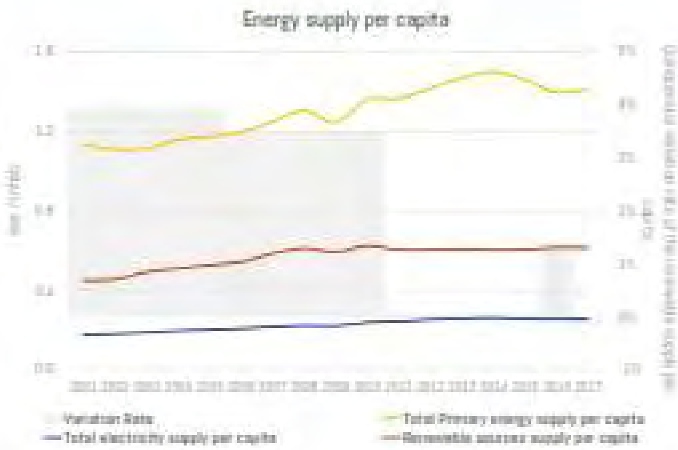

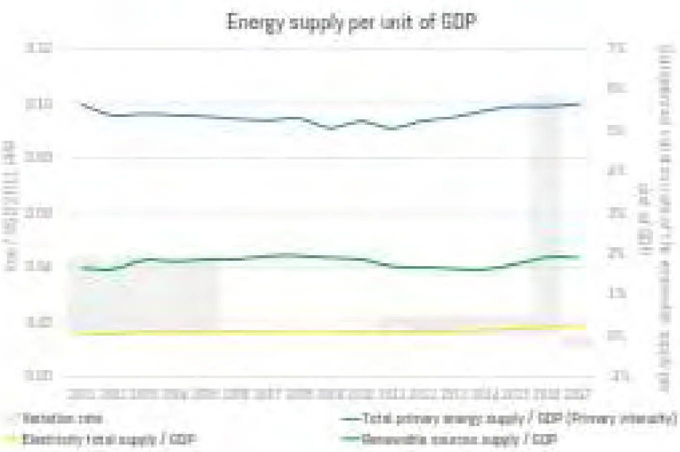

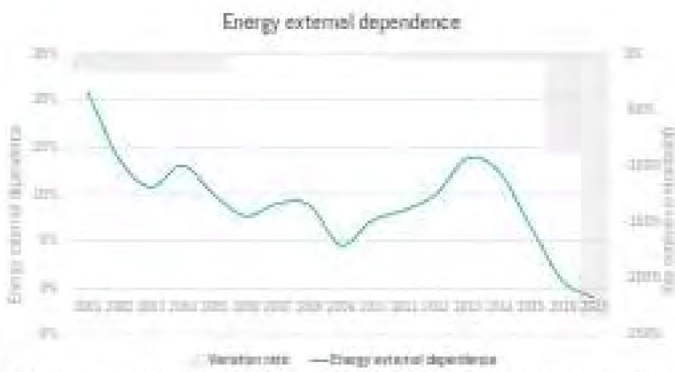

Note: According to the OLADE methodology, there is an export in 2017, however, in the balance developed by Ministry of Mines and Energy of Brazil, it identifies that the country still has external energy dependency. These differences are due to the existence of a significant import of uranium in the Brazil BEN which is not accounted in the OLADE BEN, because there is no transformation center for "Nuclear Fuel Cycle".

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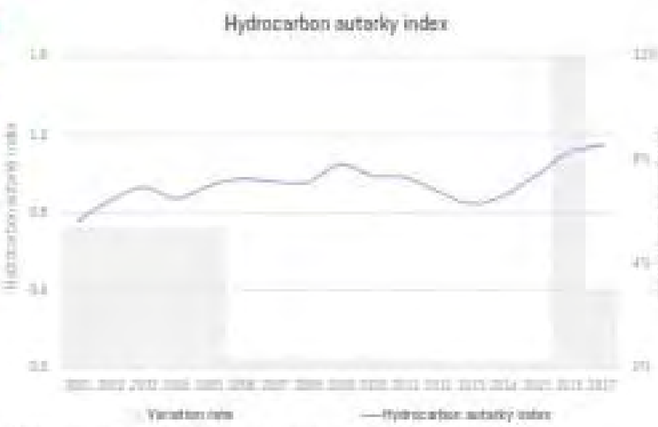
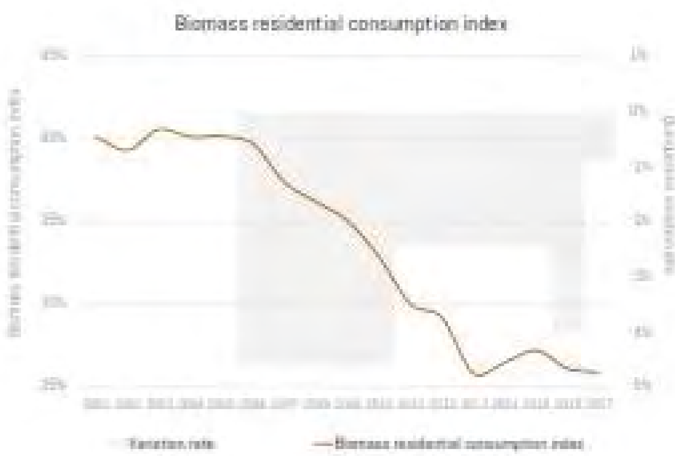
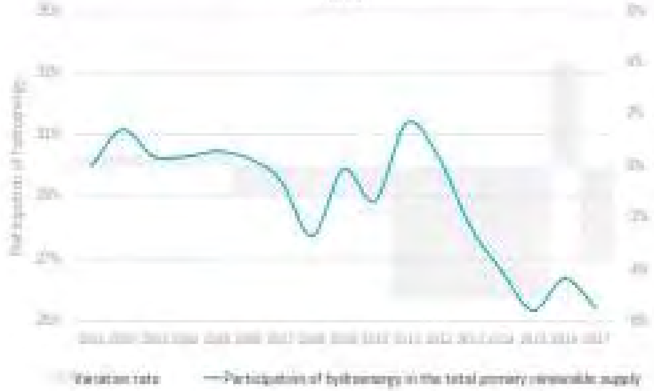


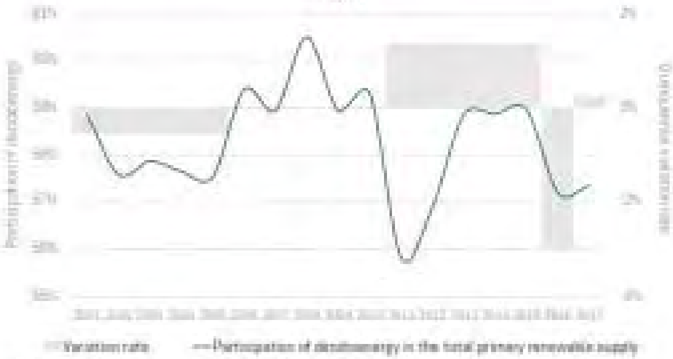
Note: Values above 1 represent a surplus and values less than 1 represent a deficit.



Participation of hydroenergy in the total primary renewable supply

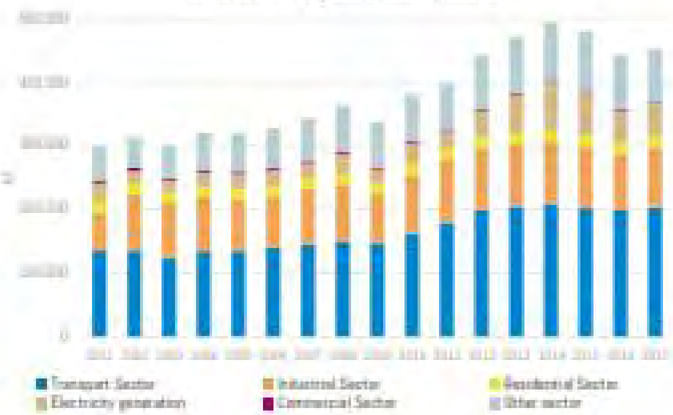


Participation of dendroenergy in the total primary renewable supply

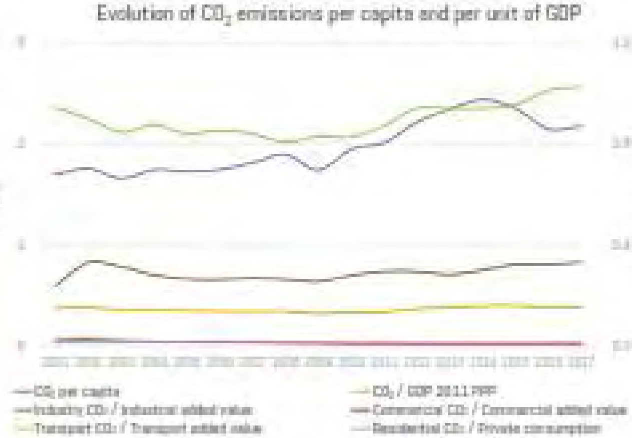


Note: Dendroenergy corresponds to the fuels obtained from wood such as firewood, charcoal, pellets, etc.

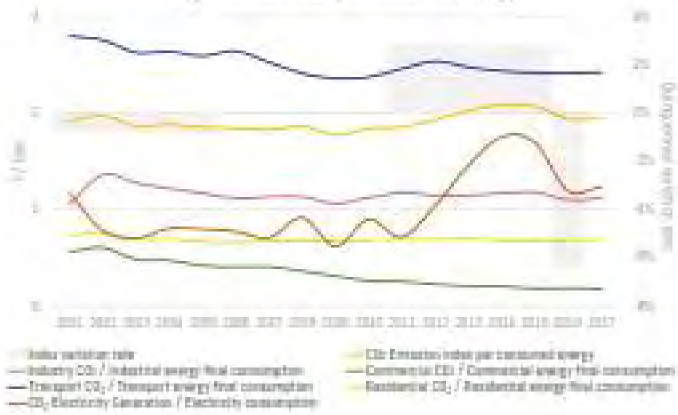
Evolution of CO_2 emissions by sector



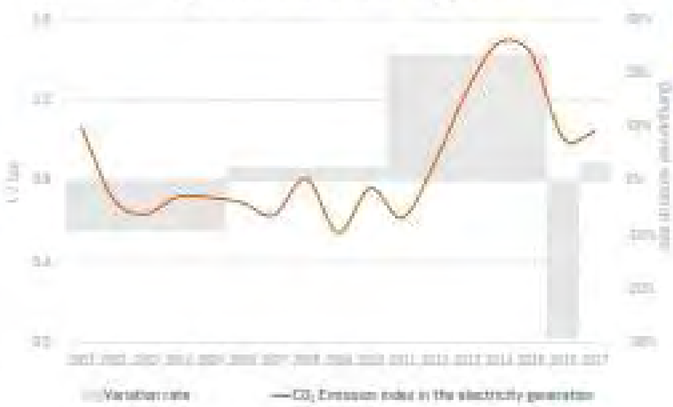
Evolution of CO_2 emissions per capita and per unit of GDP



CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation



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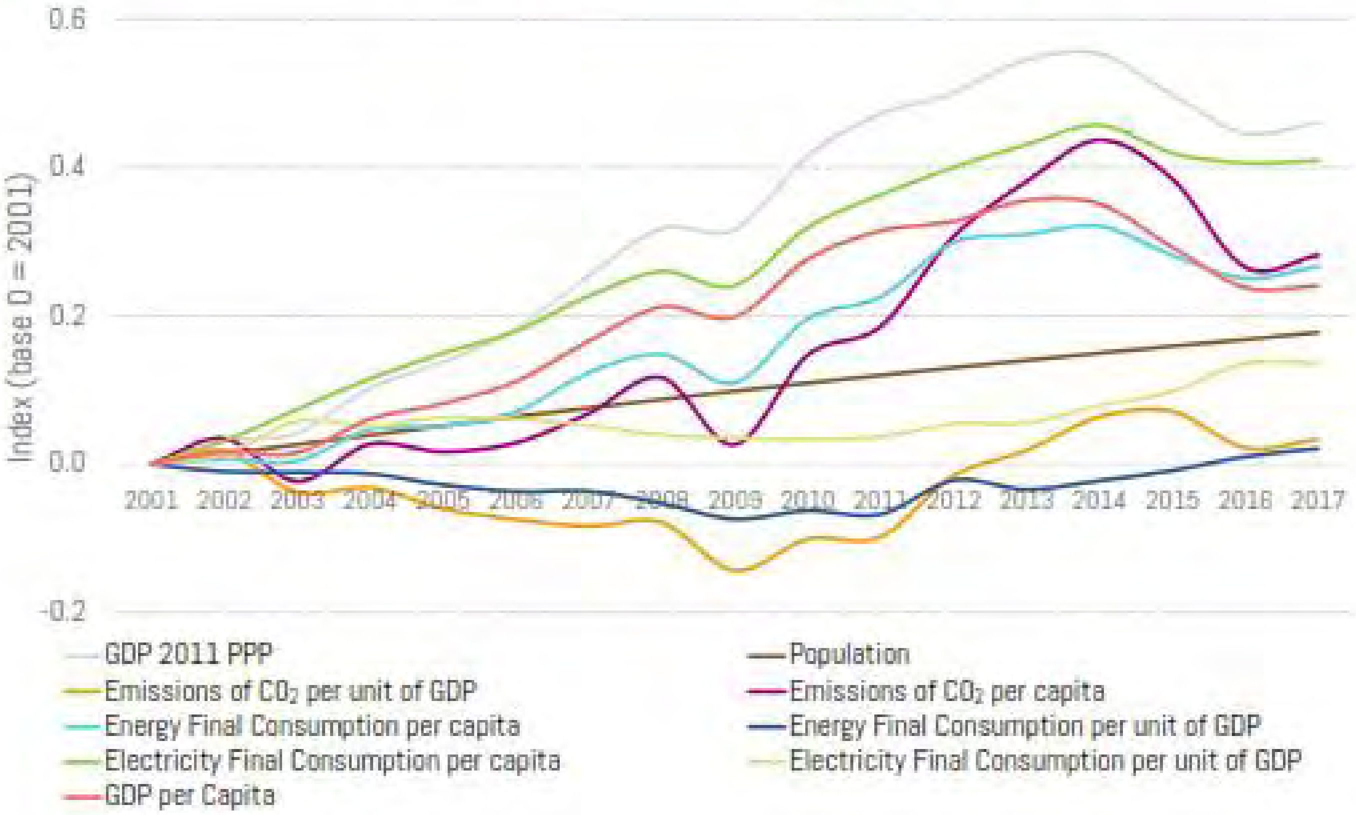
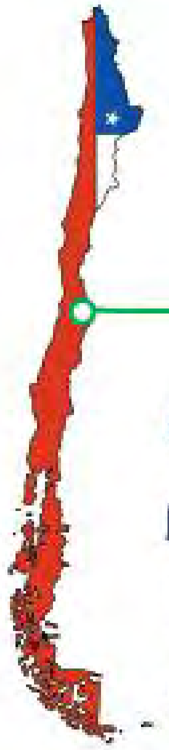
Summary of the main energy indicators



BRAZIL

CHILE



General Information 2017

Population (thousand inhab.)	17,574
Area (km²)	756,096
Population Density (inhab./km²)	23
Urban Population (%)	88
GDP USD 2010 (MUSD)	271,411
GDP USD 2011 PPP (MUSD)	411,053
GDP per capita (thou. USD 2011 PPP/inhab.)	23

Energy Sector

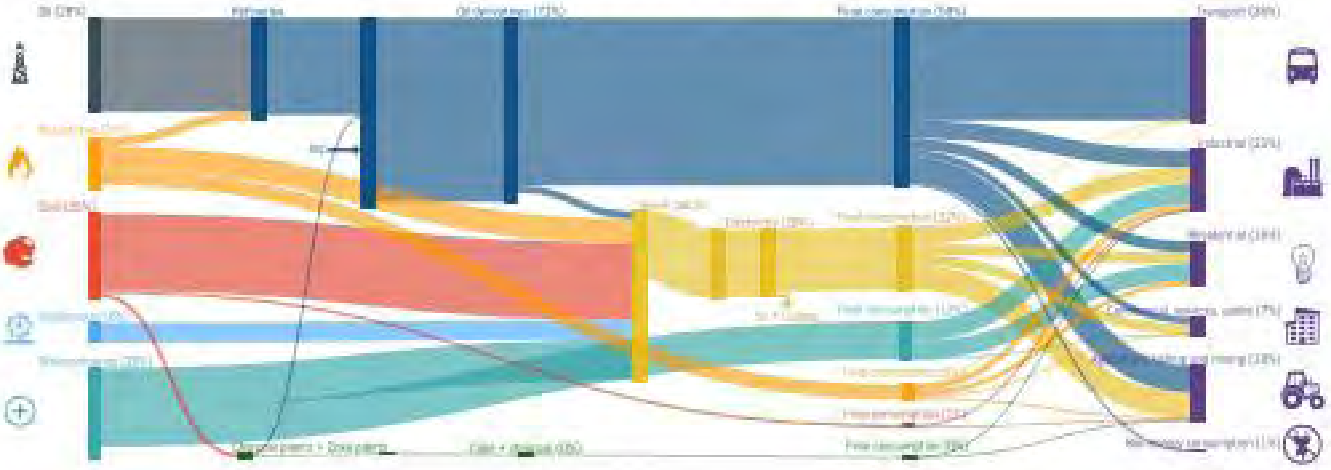
Sector	Mtoe
Final consumption in the Transport Sector	10.82
Final consumption in the Industrial Sector	6.02
Final consumption in the Residential Sector	4.39
Final consumption in the Commercial and Service Sector	2.01
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	5.54[3]

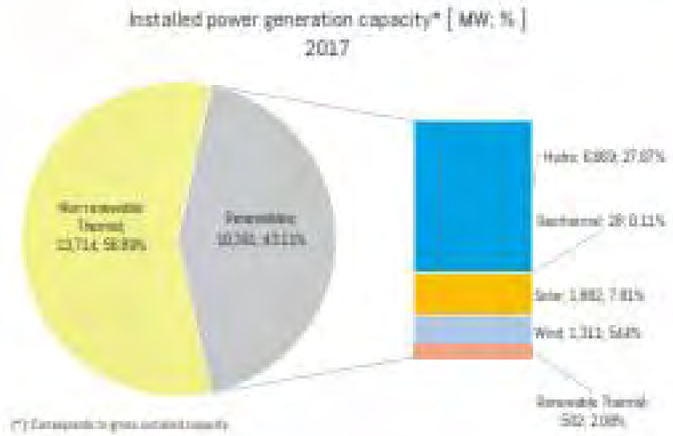
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
6	6	n.d.

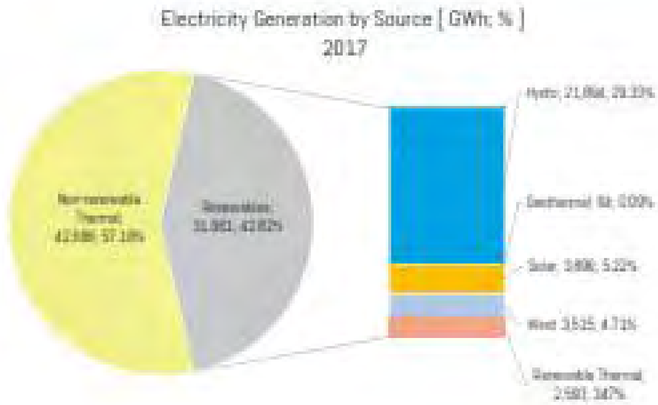
[1] Supply and demand data for 2017 estimated by OLADE.
[2] Does not include own consumption of the energy sector.
[3] Includes non-energy consumption.

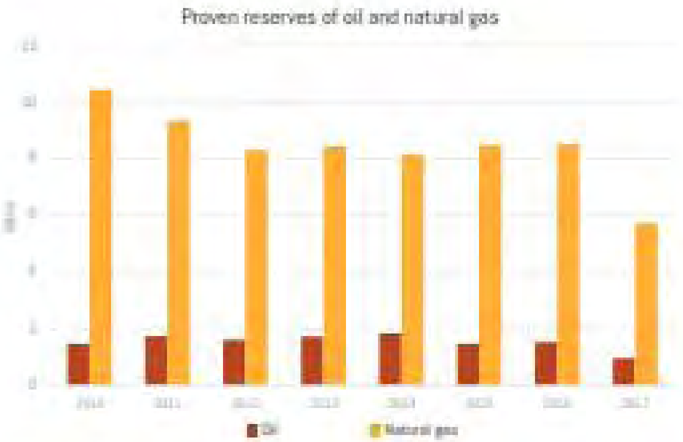
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	4,105[1]
Final energy consumption per capita	toe/inhab.	1.63[1]
Electrification rate	%	99.49
Total energy supply	Mtoe	40.79
Total energy production	Mtoe	13.33[1]
Total energy imports	Mtoe	30.58[1]
Total energy exports	Mtoe	1.73[1]
Total final energy consumption	Mtoe	28.69[2]
Refining capacity	kbbl/day	220
Installed power generation capacity	GW	24.11
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.08 / 0.07

Summarized energy balance 2017



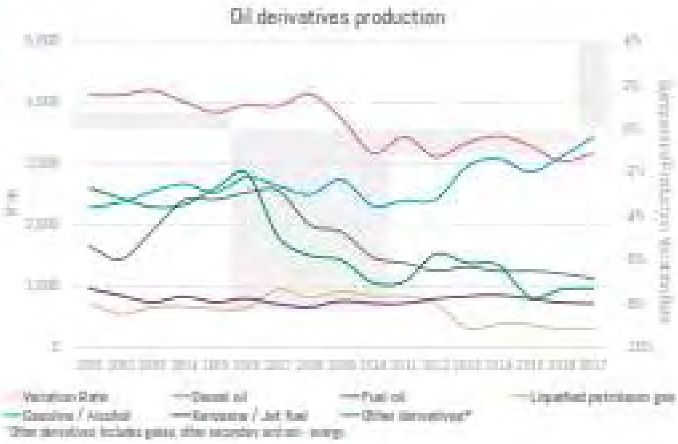

Installed power generation capacity* [MW; %]
2017
Non-renewable Thermal 13,714; 56.89%
Renewables 10,391; 43.11%
Hydro: 6,689; 27.67%
Geothermal: 28; 0.11%
Solar: 1,882; 7.81%
Wind: 1,311; 5.44%
Renewable Thermal: 502; 2.08%

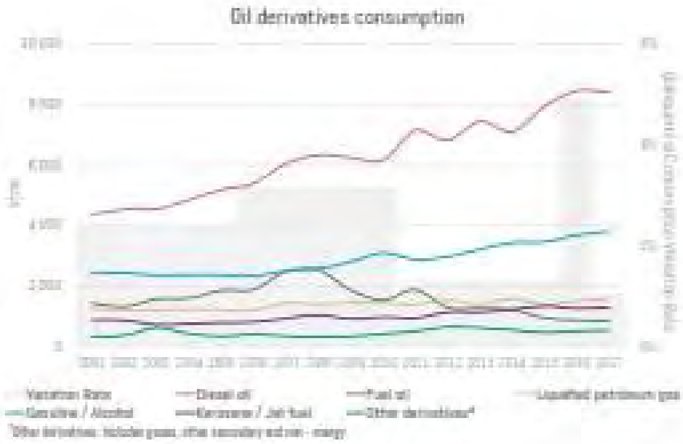

Electricity Generation by Source [GWh; %]
2017
Non-renewable Thermal 43,686; 57.18%
Renewables 31,981; 42.82%
Hydro: 21,864; 29.33%
Geothermal: 0; 0.00%
Solar: 3,896; 5.22%
Wind: 3,515; 4.71%
Renewable Thermal: 2,581; 3.47%

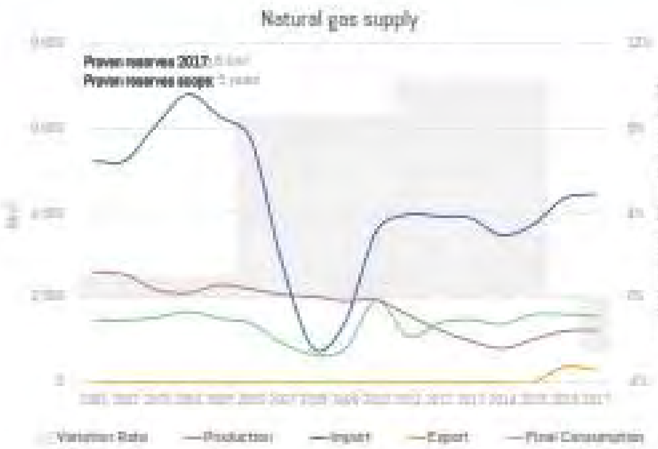

Proven reserves of oil and natural gas
Oil
Natural gas

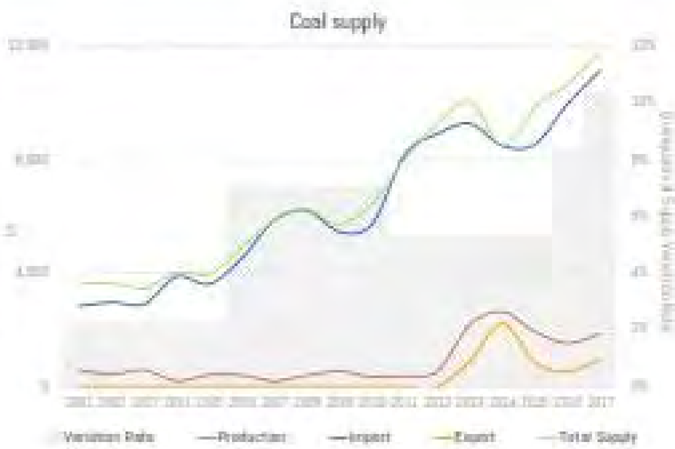

Oil Supply
Proven reserves 2017:
Oil Reserves Scope:
Refining Capacity 2017:
Variation Rate
Production
Import
Export
Total Supply

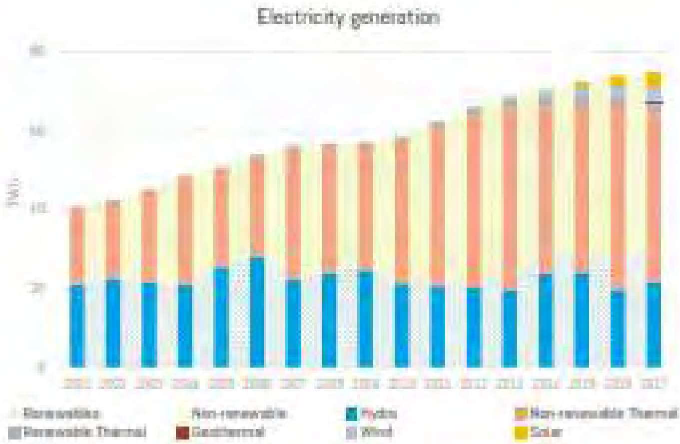
CHILE

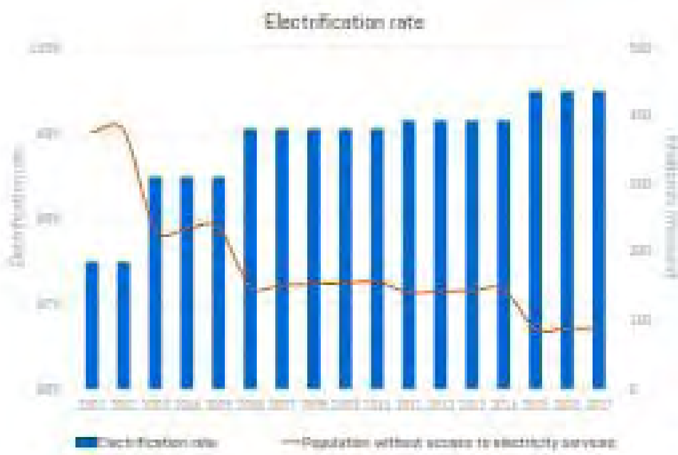

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
*Other derivatives: Includes gases, other secondary and non - energy


Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
*Other derivatives: Includes gases, other secondary and non - energy





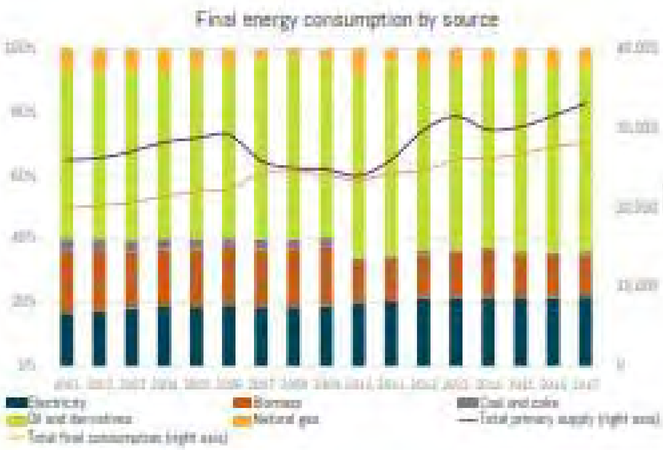


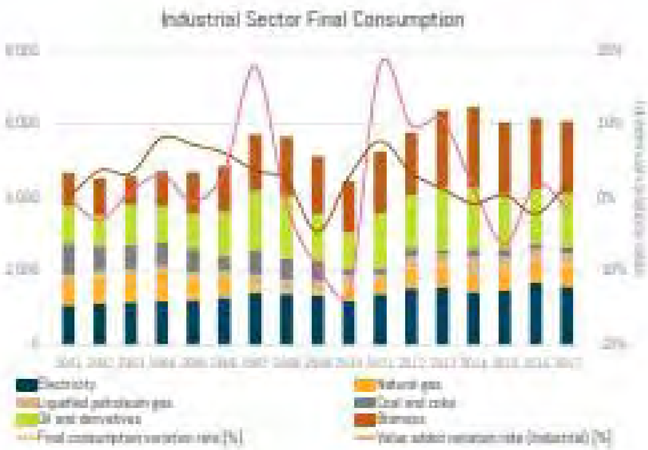


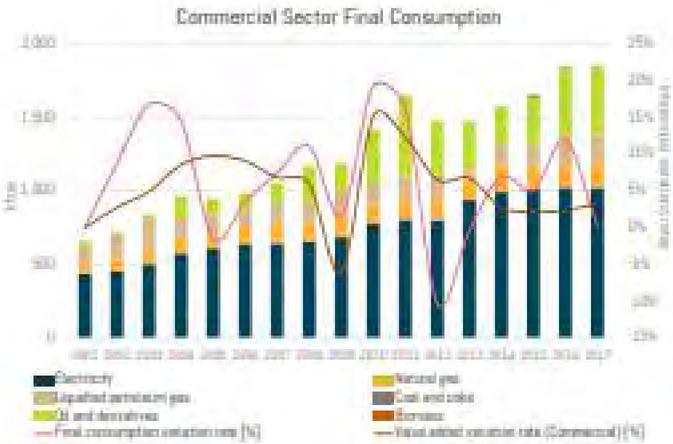
(*) Includes Firewood, biomass pellets and charcoal

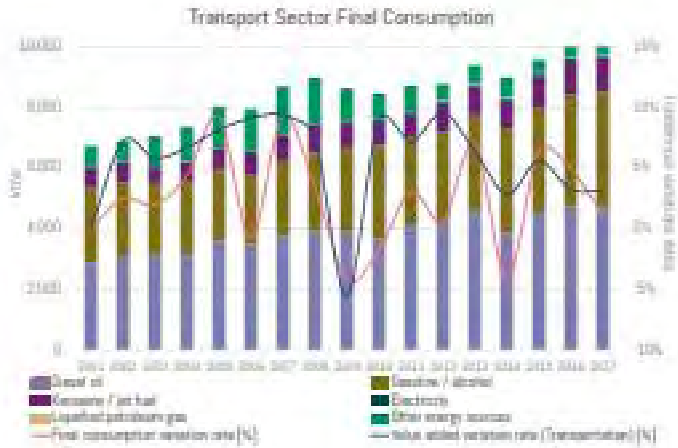
Note: The fall between 2009 and 2010 corresponds to a methodological change made by the country in the National Energy Balance.

CHILE









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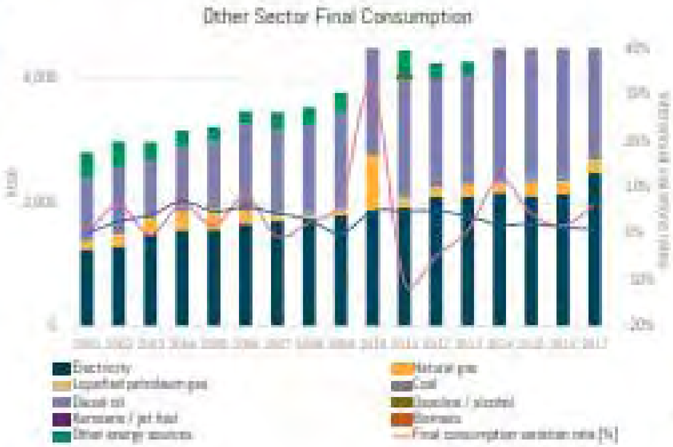
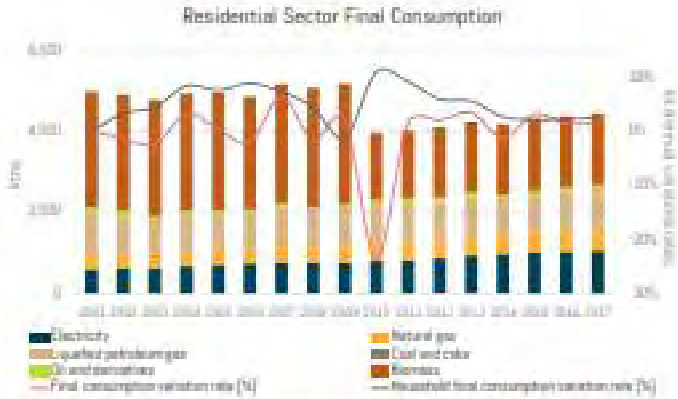
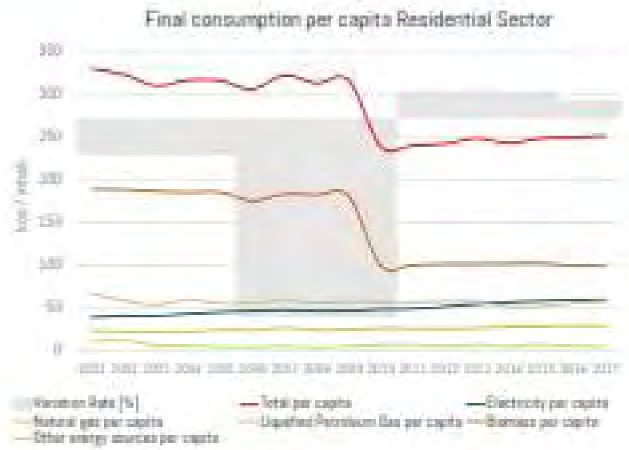
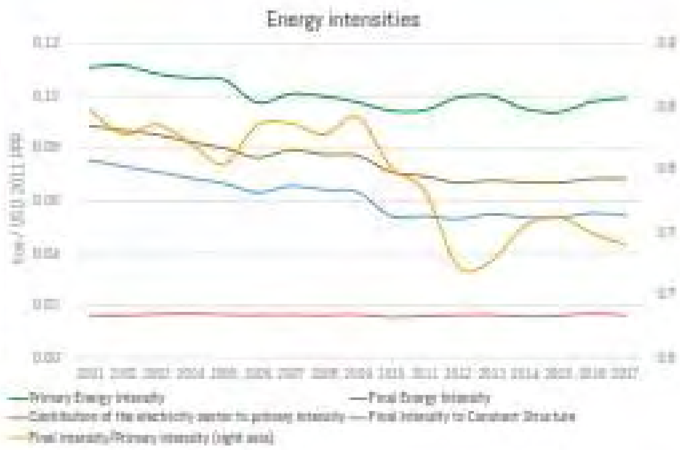




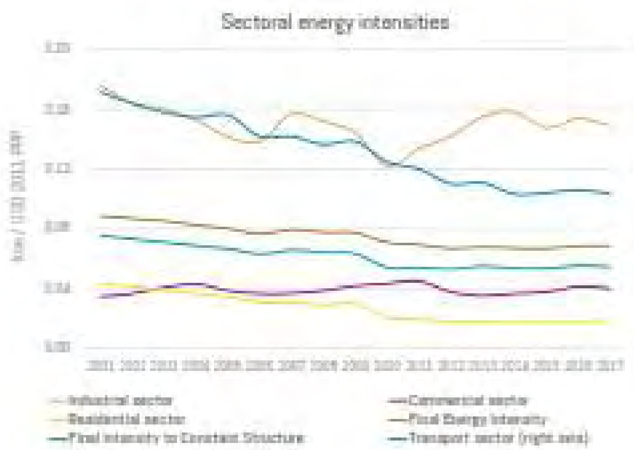
Note: The decrease in biomass consumption in the residential sector as from 2010 corresponds to a methodological change made by the country in the National Energy Balance



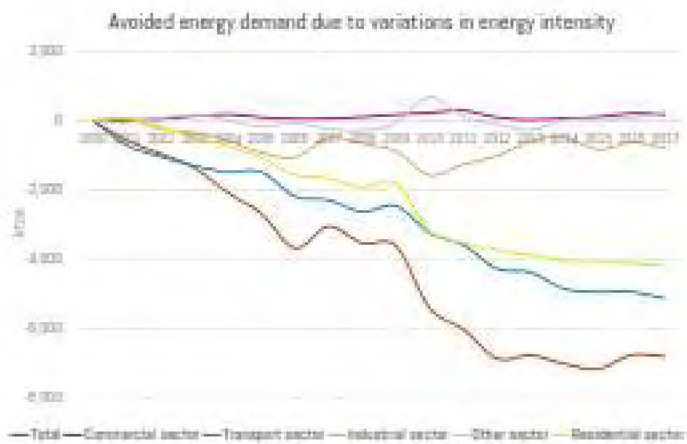
Final consumption per capita Residential Sector
kep / inhab
Final consumption per capita variation rate
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita



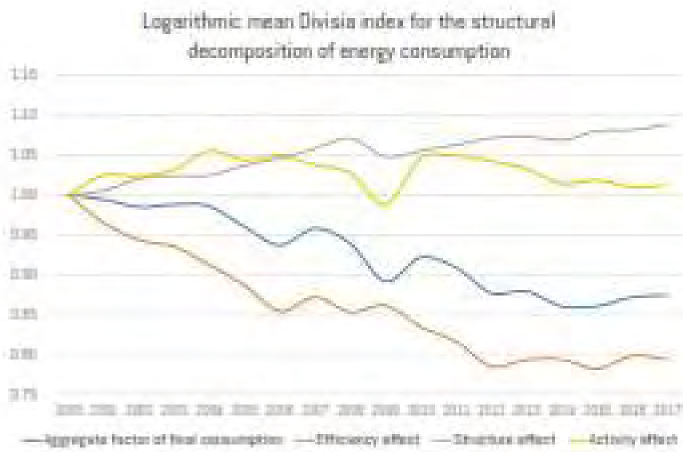
Energy intensities
toe / USD 2011 PPP
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final Intensity/Primary intensity (right axis)



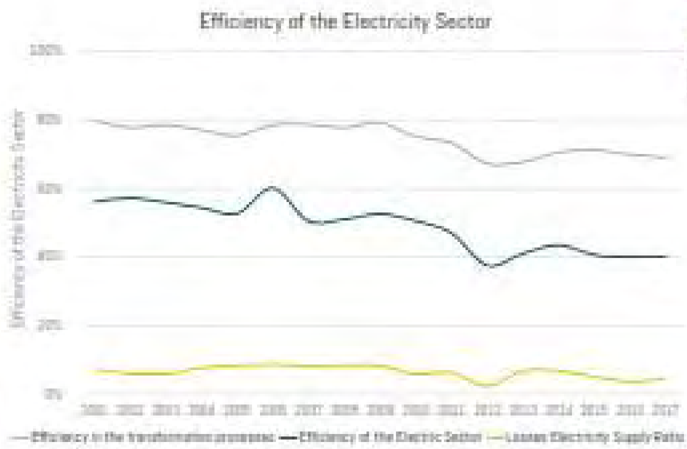
Sectoral energy intensities
kep / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)



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

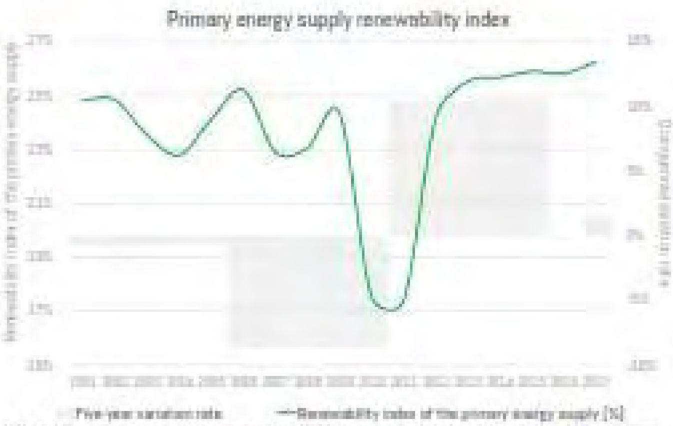


Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

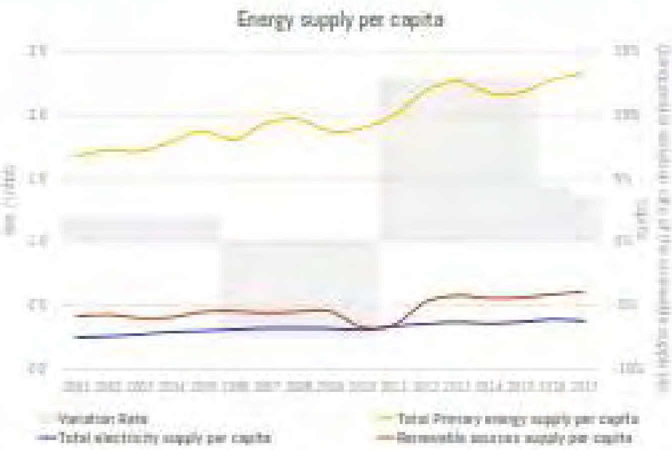


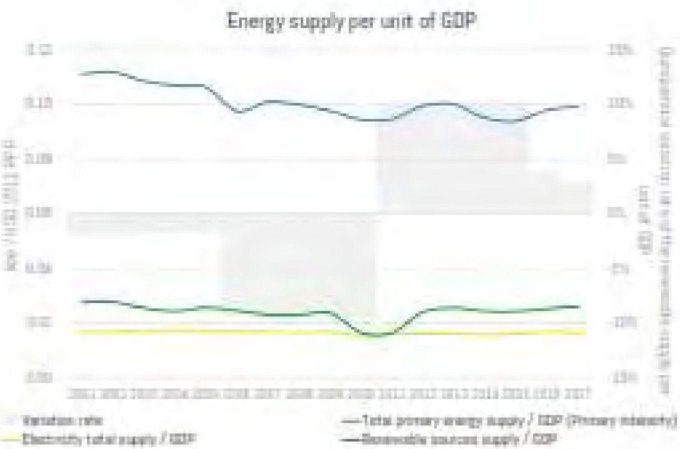
Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

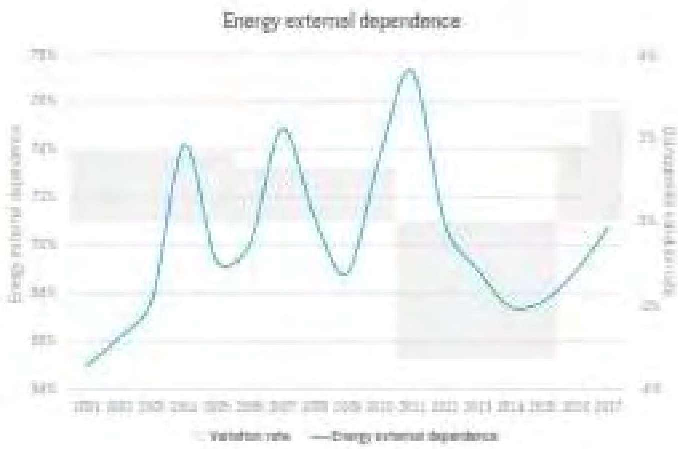
CHILE



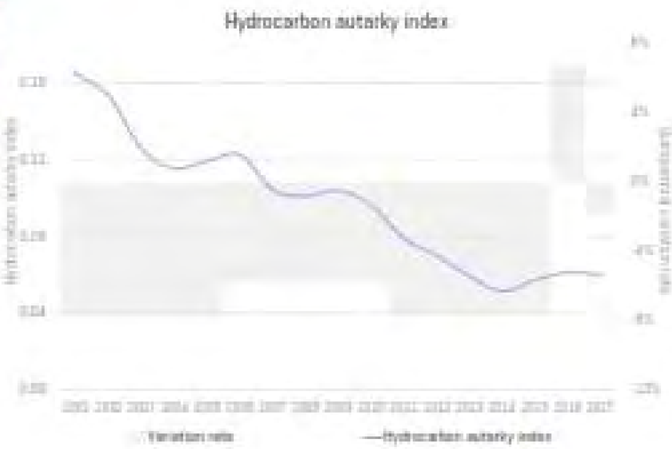
Note: The fall between 2009 and 2010 corresponds to a methodological change made by the country in the National Energy Balance.

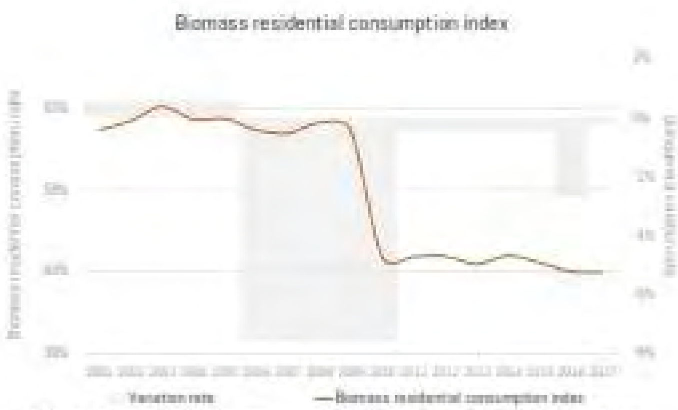




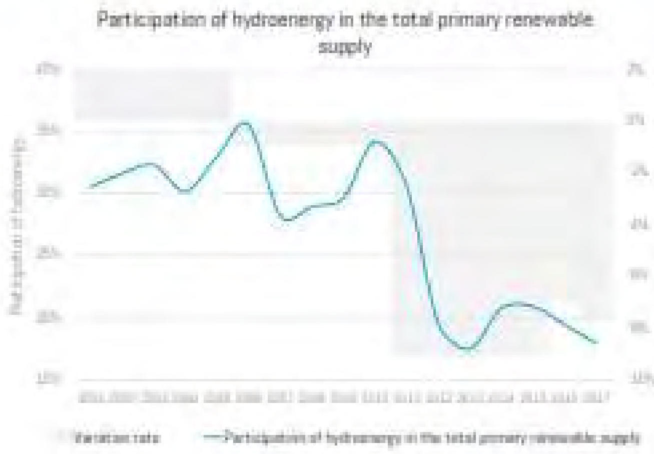


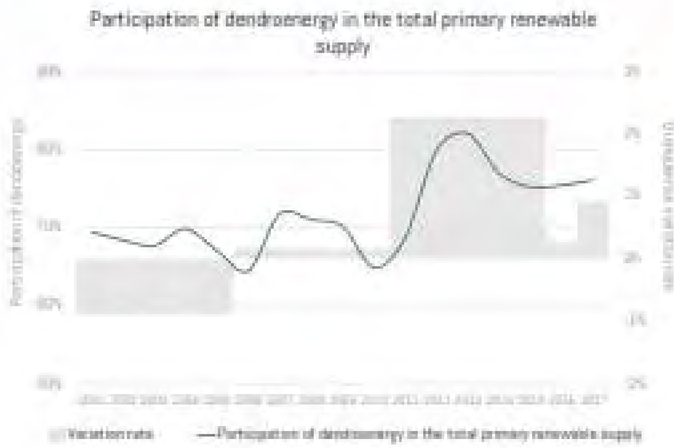
CHILE

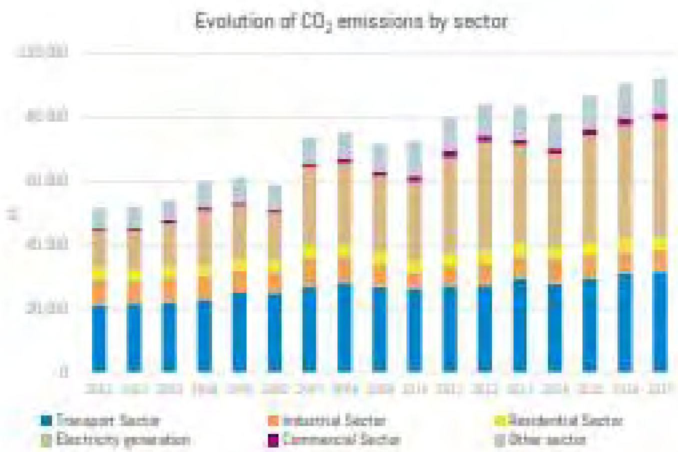


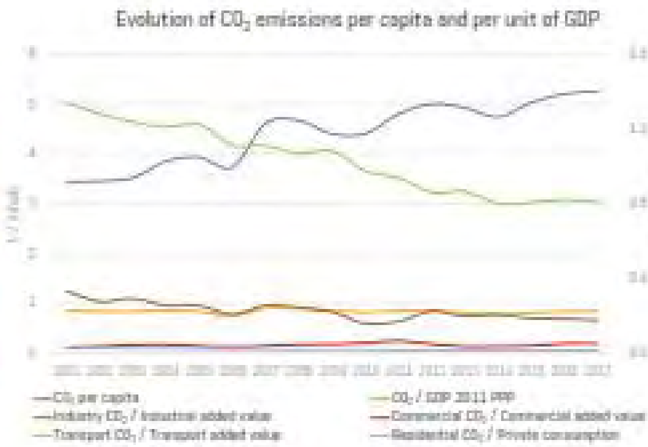


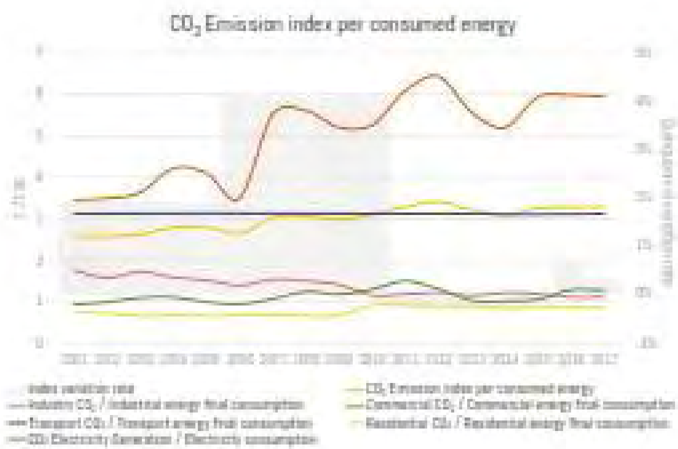
Note: The fall between 2009 and 2010 corresponds to a methodological change made by the country in the National Energy Balance.

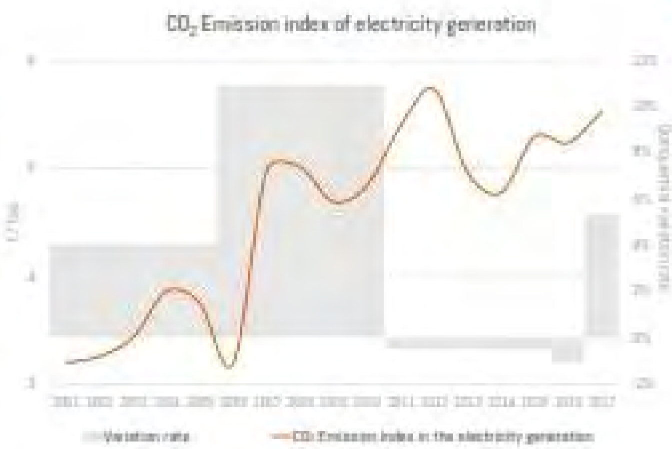

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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

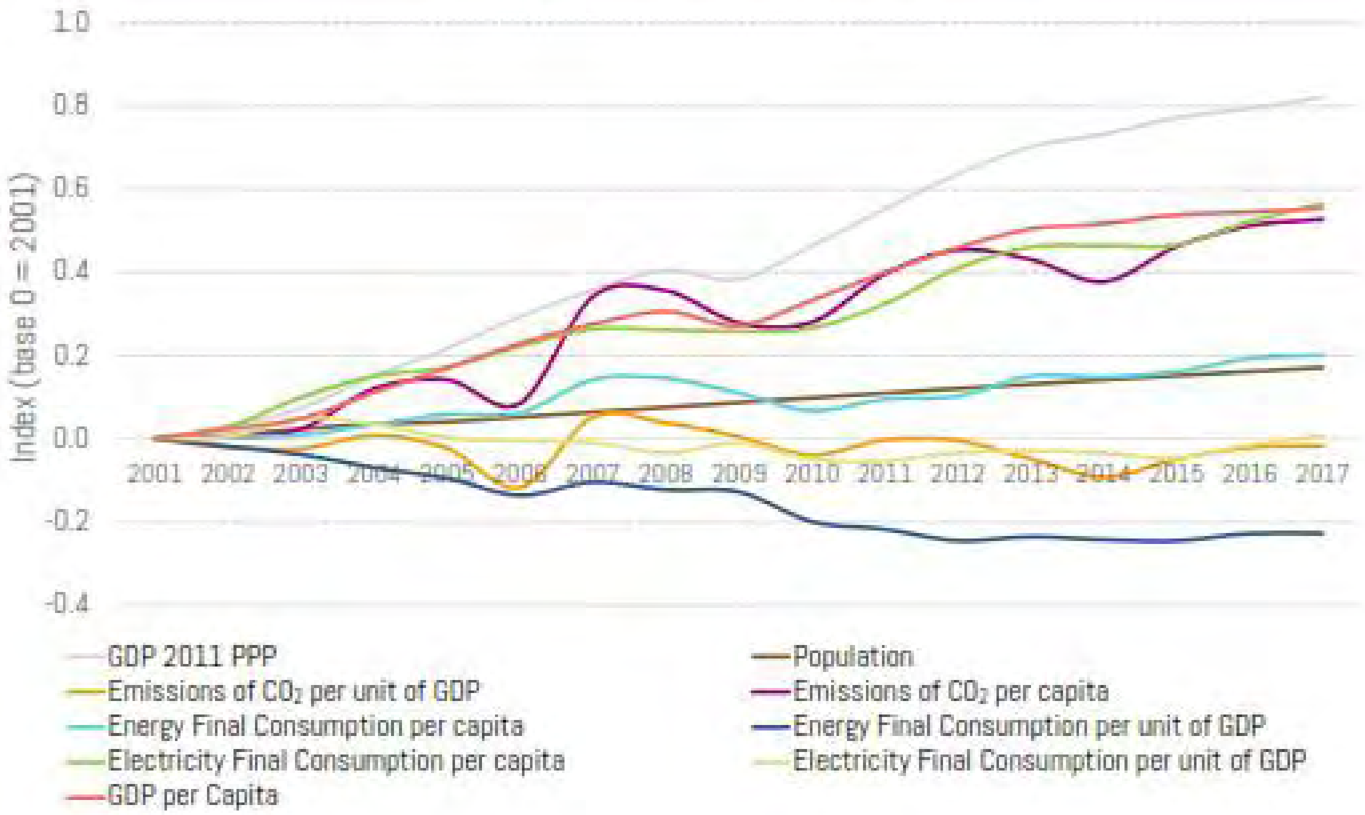

Evolution of CO_2 emissions per capita and per unit of GDP
CO_2 per capita
CO_2 / GDP 2011 PPP
Industry CO_2 / Industrial added value
Commercial CO_2 / Commercial added value
Transport CO_2 / Transport added value
Residential CO_2 / Private consumption


CO_2 Emission index per consumed energy


CO_2 Emission index of electricity generation
Variation rate
CO_2 Emission index in the electricity generation

CHILE

Summary of the main energy indicators



CHILE

COLOMBIA

General Information 2017

Population (thousand inhab.)	49,059
Area (km²)	1,141,748
Population Density (inhab./km²)	43
Urban Population (%)	80
GDP USD 2010 (MUSD)	373,471
GDP USD 2011 PPP (MUSD)	650,362
GDP per capita (thou. USD 2011 PPP/inhab.)	13

Energy Sector

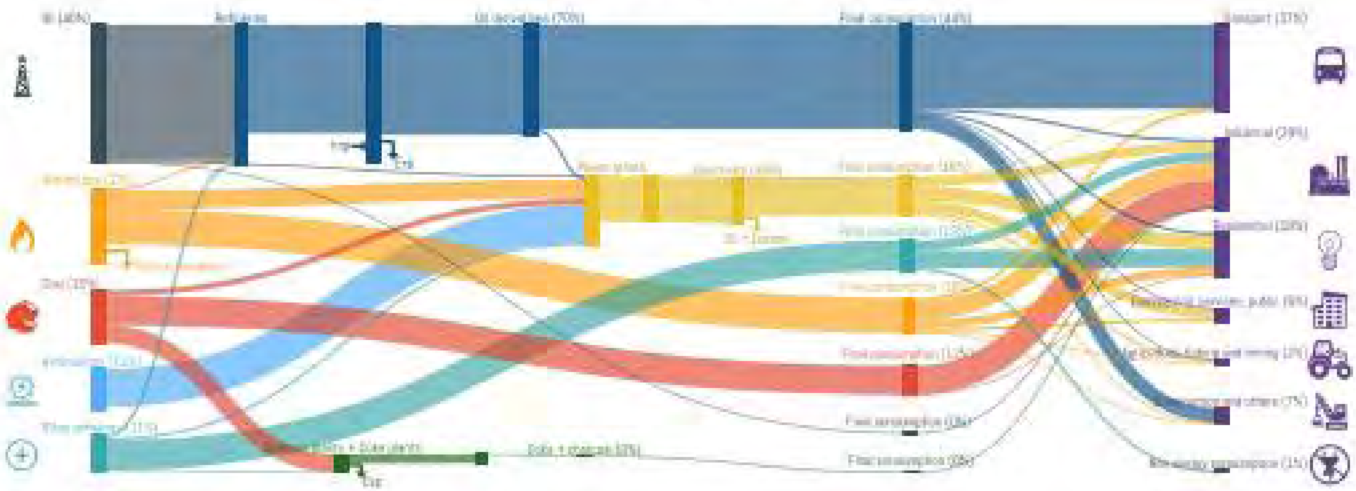
Final consumption in the Transport Sector	Mtoe 12.16
Final consumption in the Industrial Sector	Mtoe 8.71
Final consumption in the Residential Sector	Mtoe 6.06
Final consumption in the Commercial and Service Sector	Mtoe 1.96
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 3.32

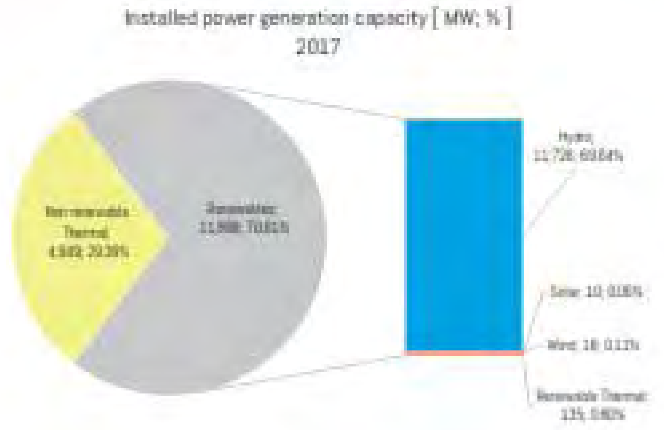
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 1,723	Gm³ 110	Mt 6,080 [2]

[1]Data 2016.
[2]Data estimated by OLADE.

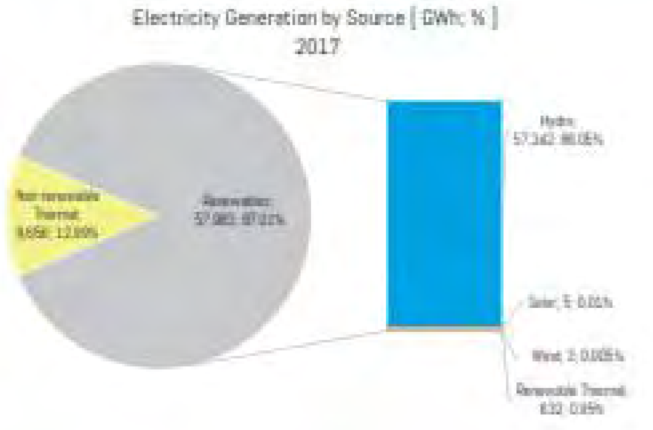
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,279	0.67	97.02 [1]	46.98	136.50	4.00	108.90	33.11	356	16.84	0.07 / 0.05

Summarized energy balance 2017

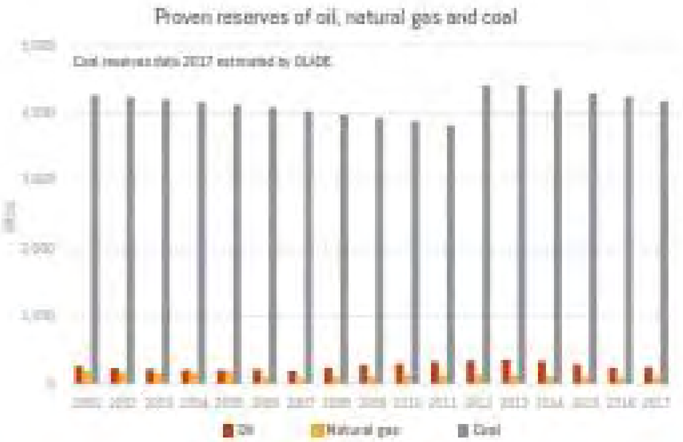




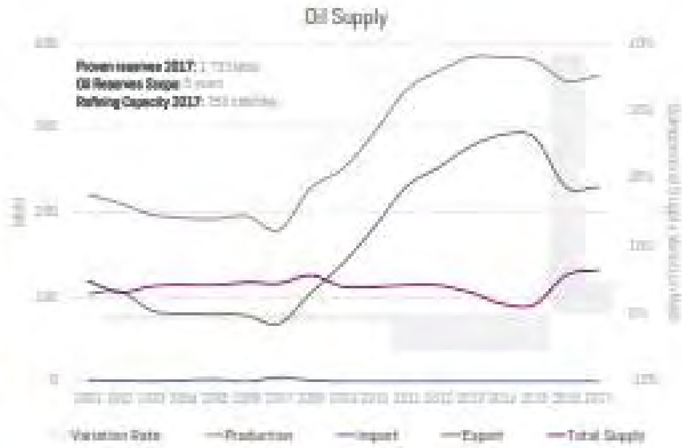
Installed power generation capacity [MW; %]
2017
Hydro
Solar
Wind



Electricity Generation by Source [GWh; %]
2017
Hydro
Solar
Wind

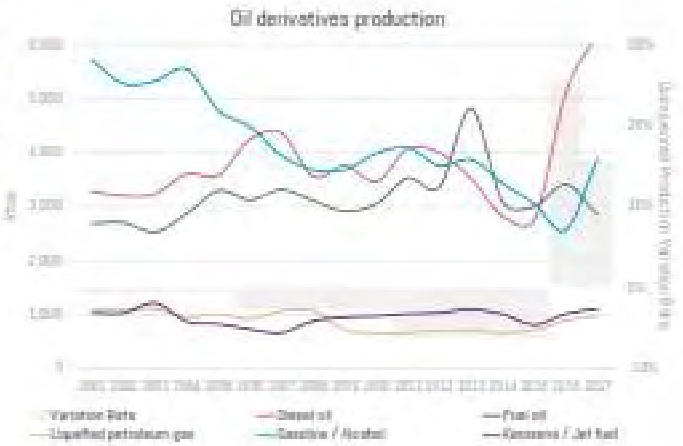


Proven reserves of oil, natural gas and coal
Oil
Natural gas
Coal

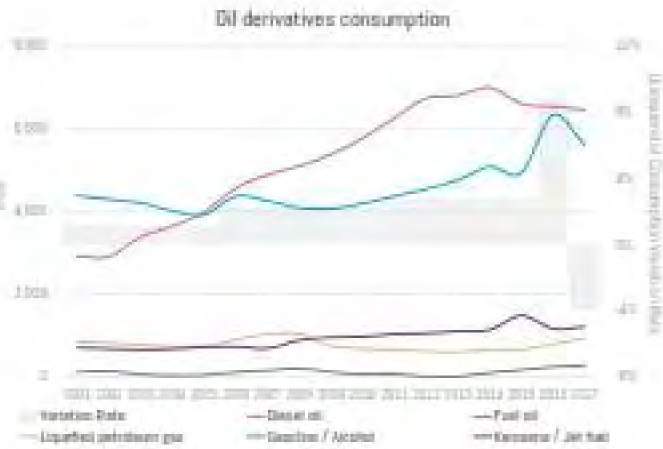


Oil Supply
Proven reserves 2017:
Oil Reserves Scope:
Refining Capacity 2017:
Variation Rate
Production
Import
Export
Total Supply

COLOMBIA

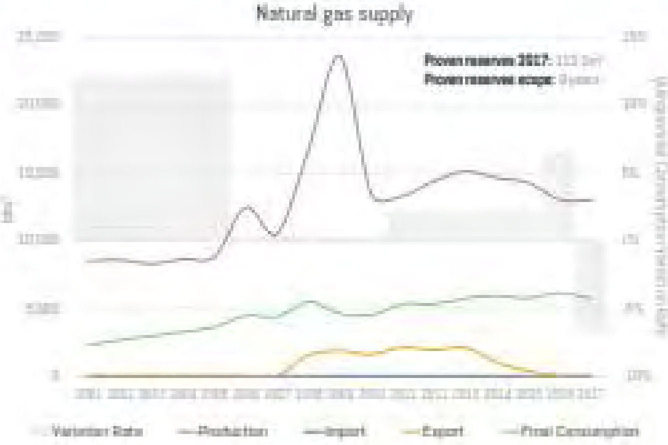


Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel

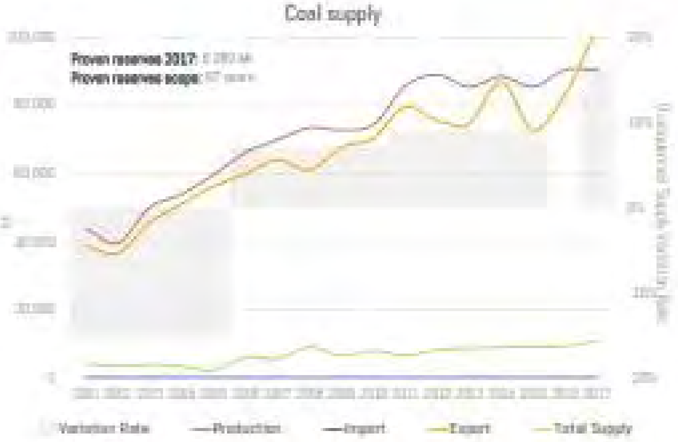


Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel

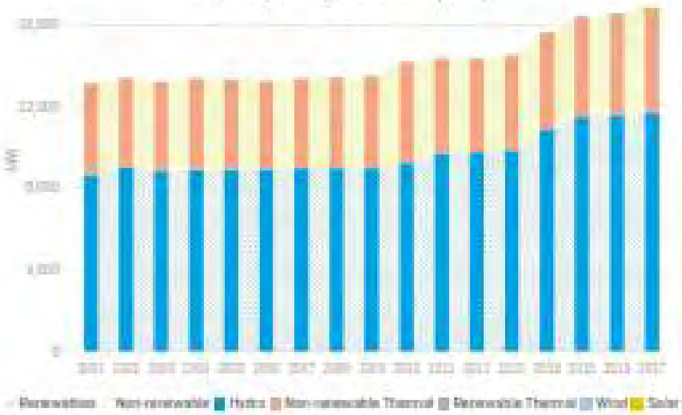
Natural gas supply



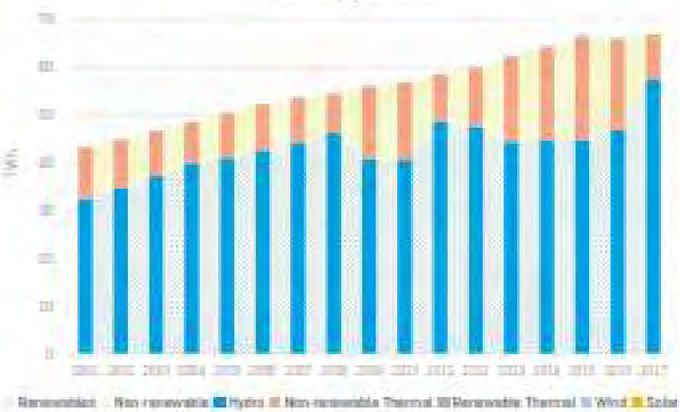
Coal supply



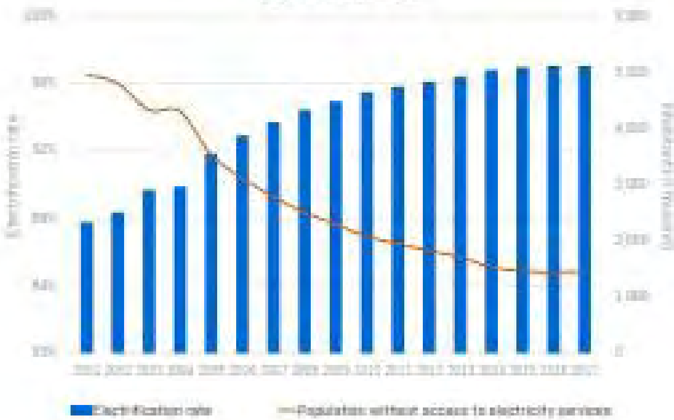
Installed power generation capacity



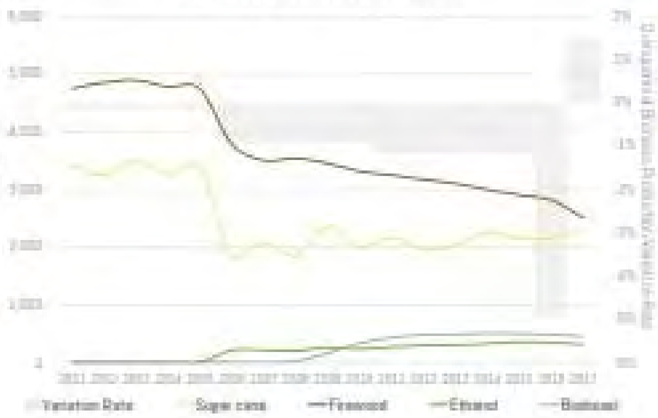
Electricity generation



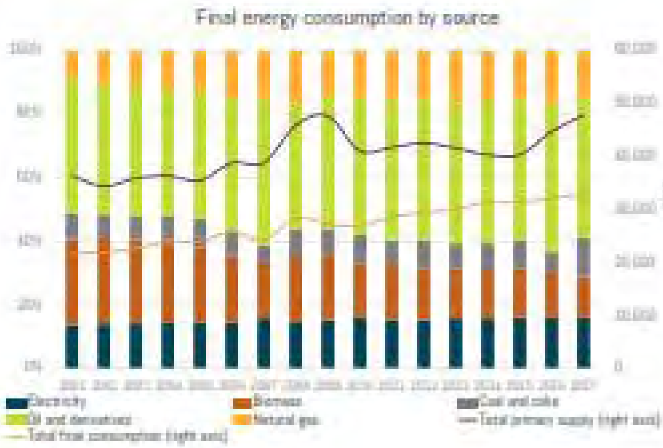
Electrification rate

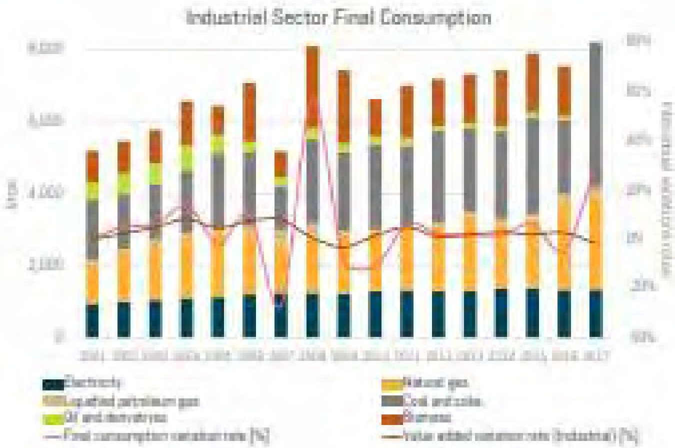


Biomass and biofuels production



COLOMBIA


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


Industrial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

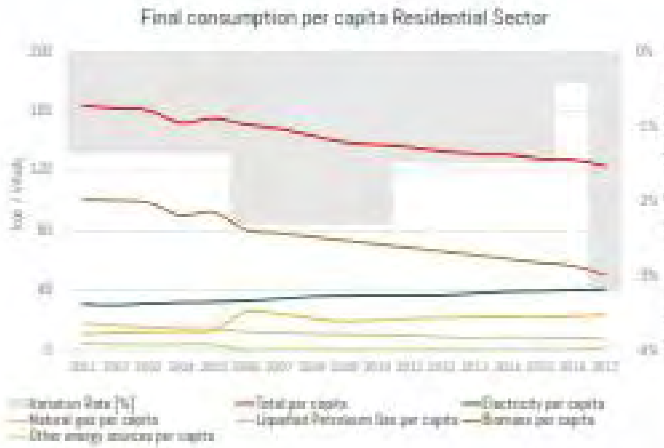

Commercial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

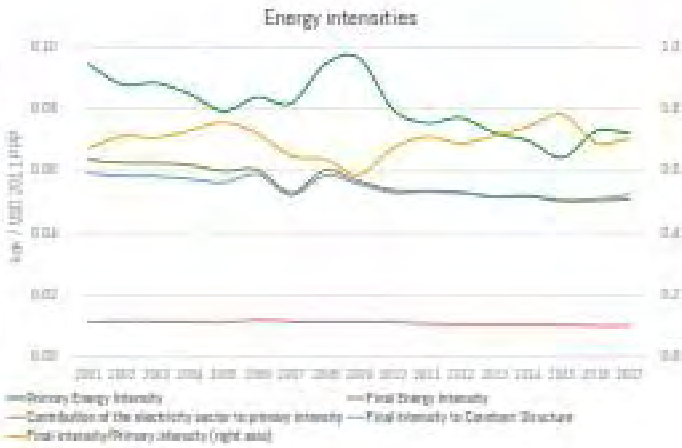

Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Other energy sources
Final consumption variation rate [%]

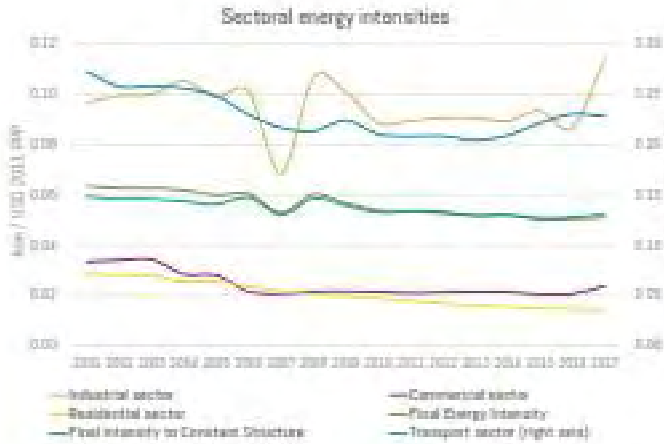
COLOMBIA

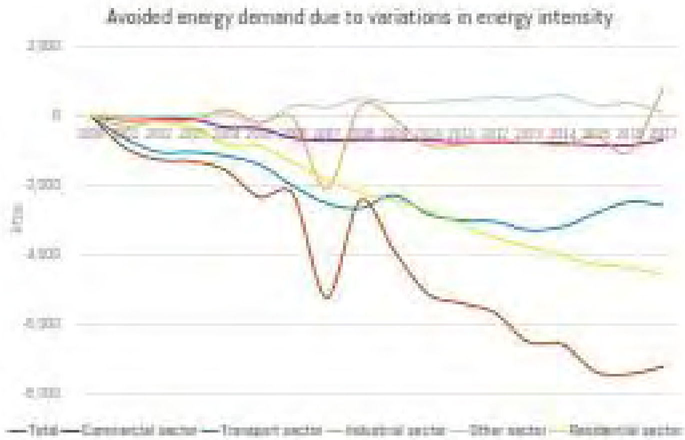

Other Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Biomass
Other energy sources
Final consumption variation rate [%]


Residential Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

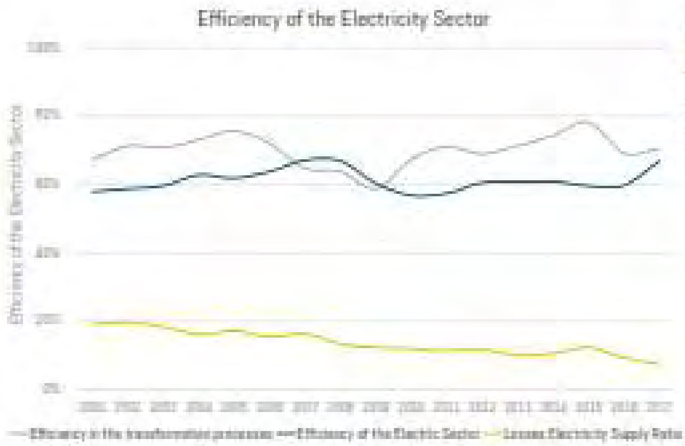

Final consumption per capita Residential Sector
kep / Inhab
Final consumption per inhabitant variation rate
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
kep / 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)

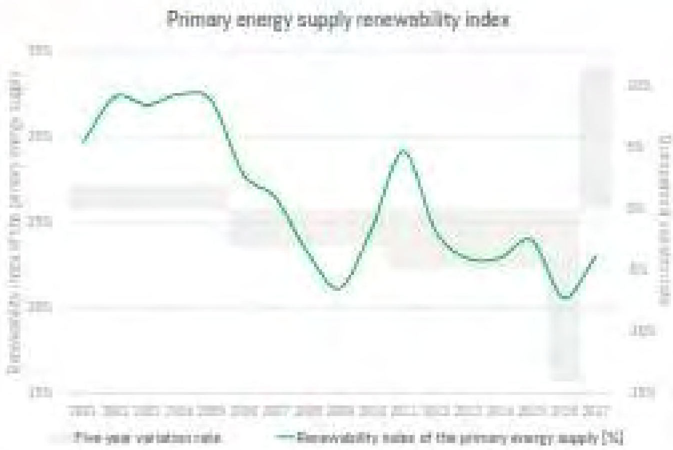

Sectoral energy intensities
kep / USD 2011 PPP
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final intensity to Constant Structure
Transport sector (right axis)

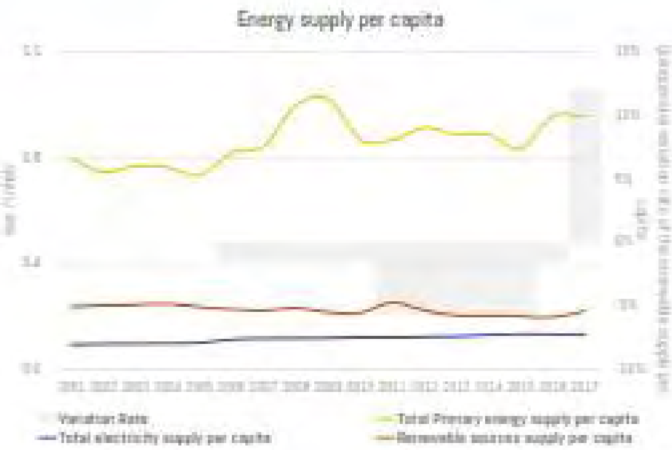

Avoided energy demand due to variations in energy intensity
ktoe
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

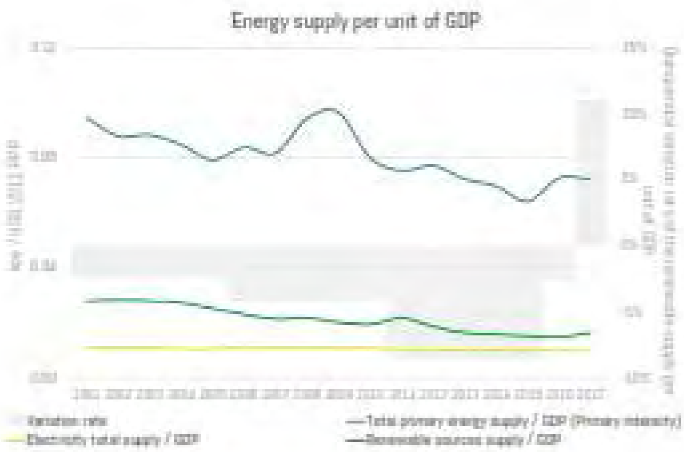

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

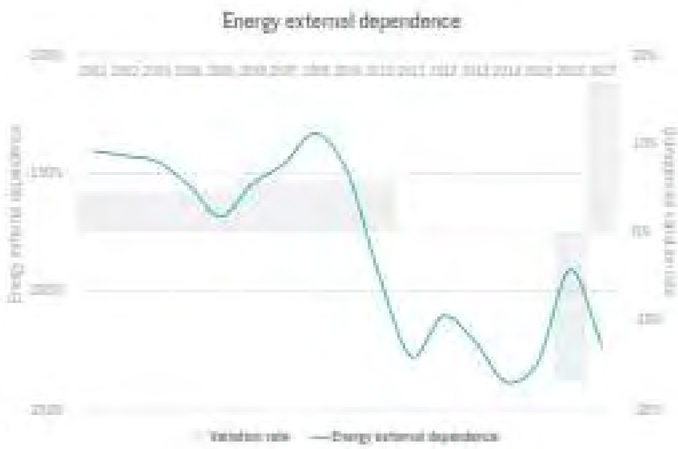

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

COLOMBIA

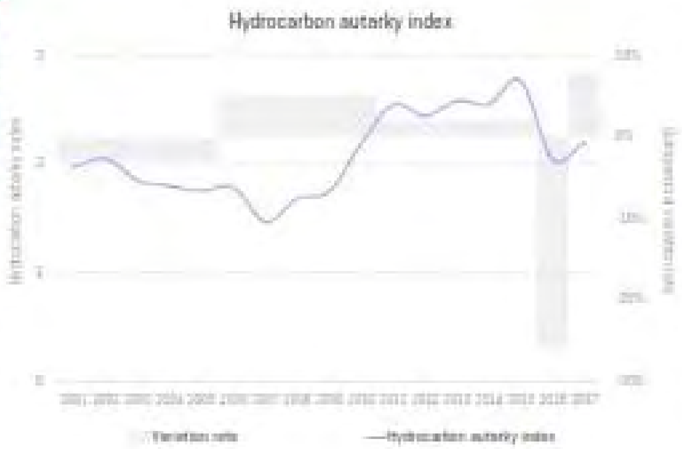

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

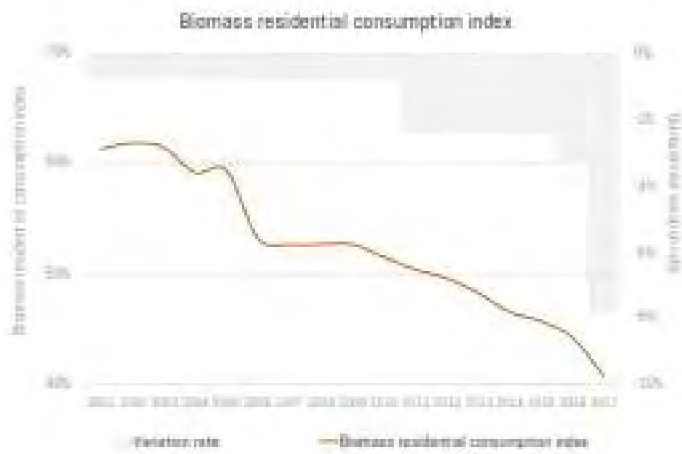

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

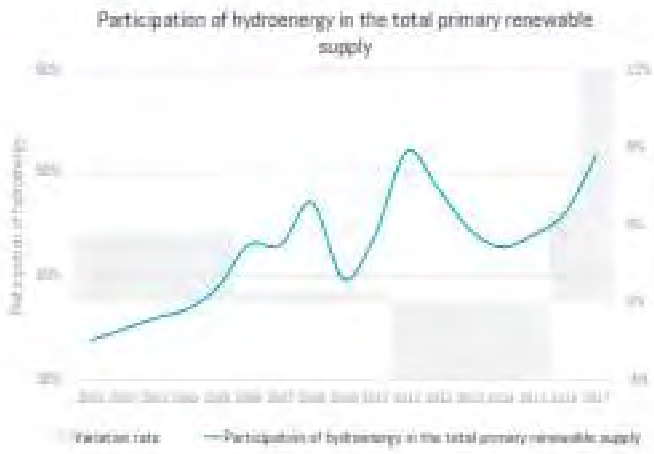

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

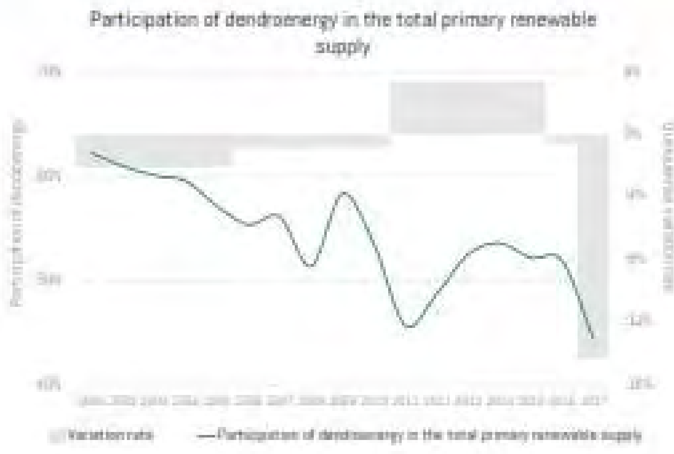

Energy external dependence
Variation rate
Energy external dependence

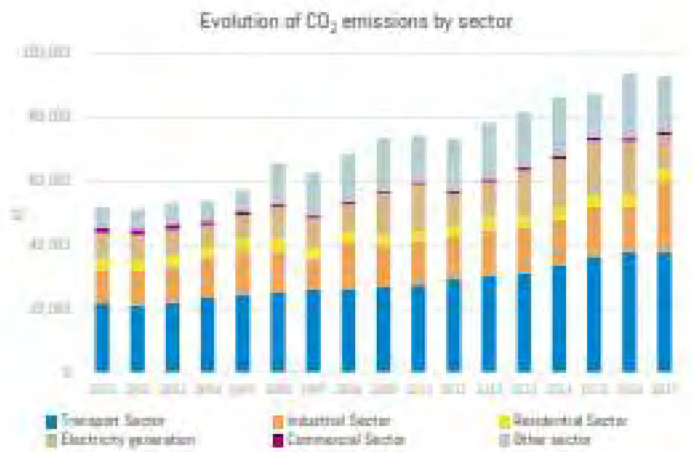
COLOMBIA

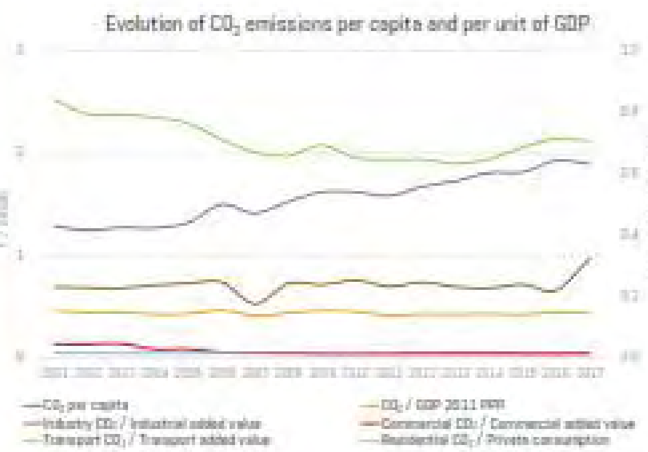

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

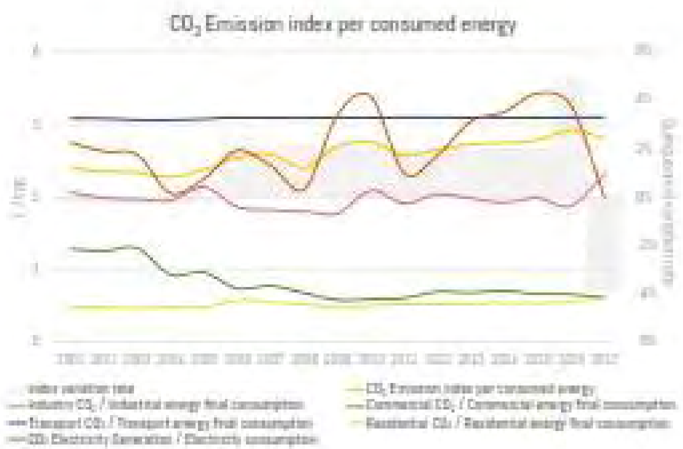

Biomass residential consumption index
Variation rate
Biomass residential consumption index

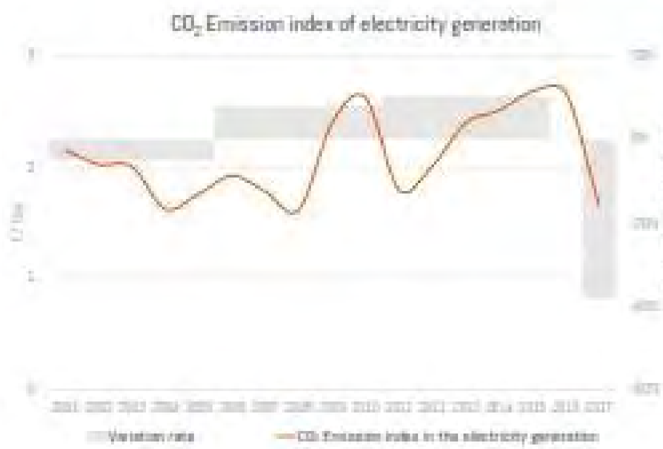

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

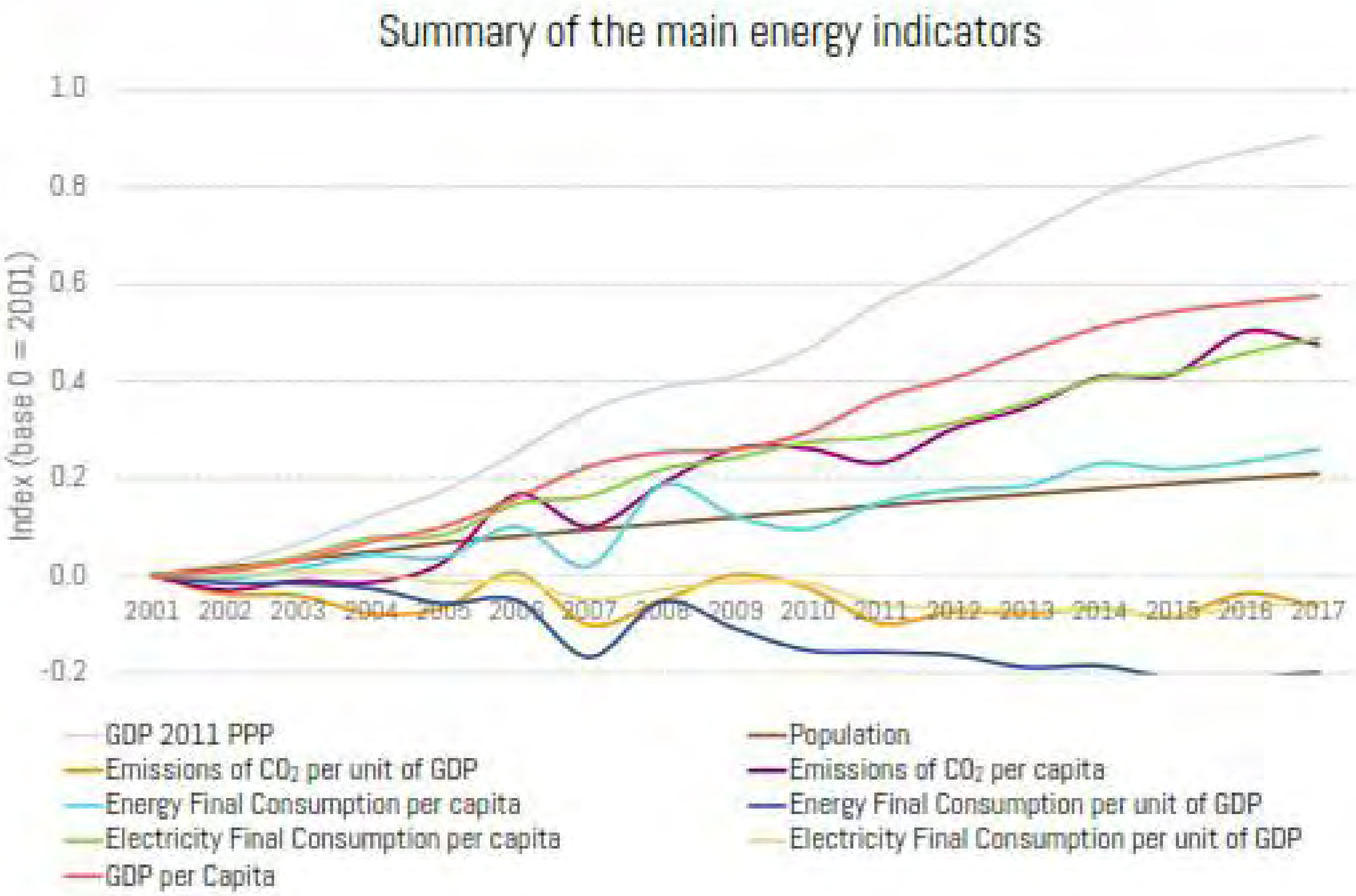

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2001)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
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

COSTA RICA

General Information 2017

Population (thousand inhab.)	4,918
Area (km²)	51,100
Population Density (inhab./km²)	96
Urban Population (%)	78
GDP USD 2010 (MUSD)	48,037
GDP USD 2011 PPP (MUSD)	76,162
GDP per capita (thou. USD 2011 PPP/inhab.)	15

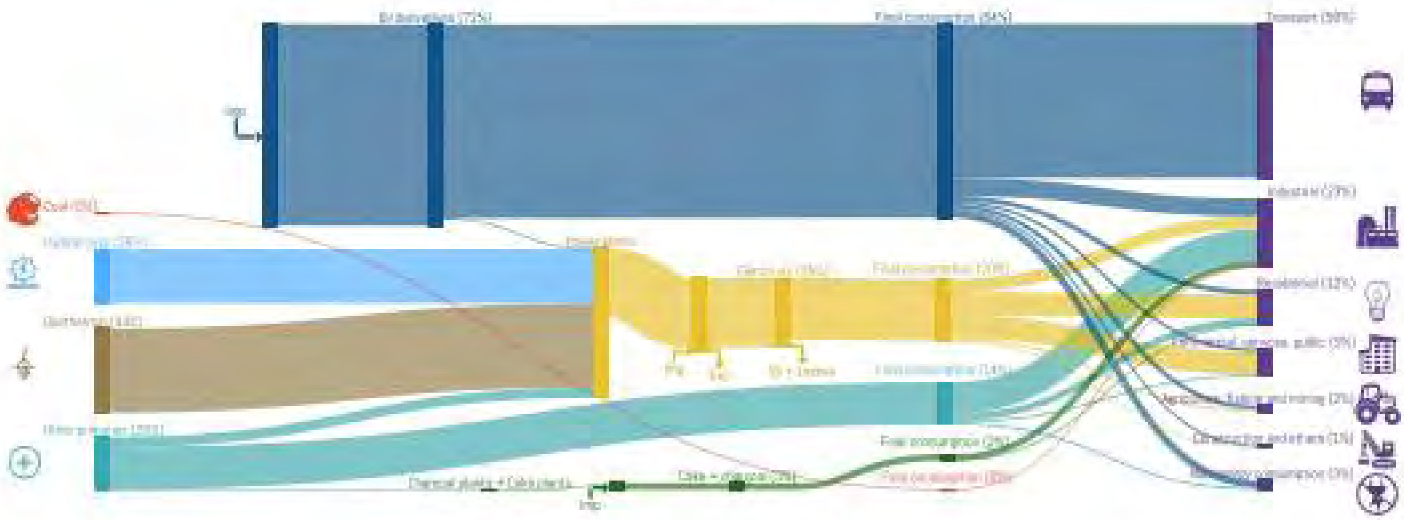
Energy Sector

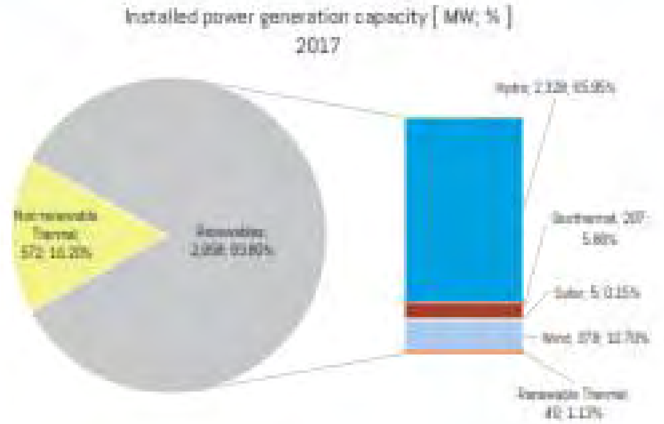
Final consumption in the Transport Sector	Mtoe 2.13
Final consumption in the Industrial Sector	Mtoe 0.95
Final consumption in the Residential Sector	Mtoe 0.49
Final consumption in the Commercial and Service Sector	Mtoe 0.39
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.26

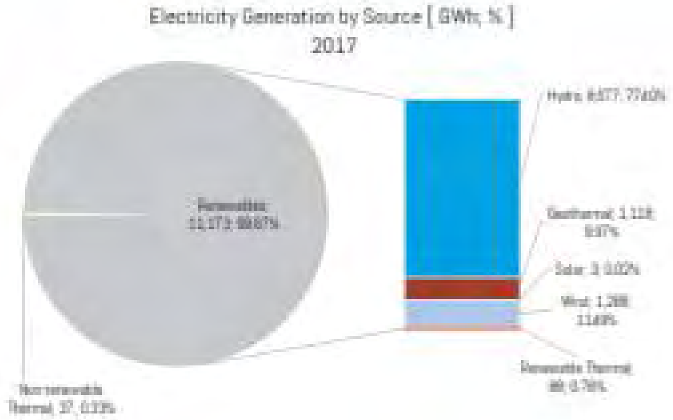
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	32.8

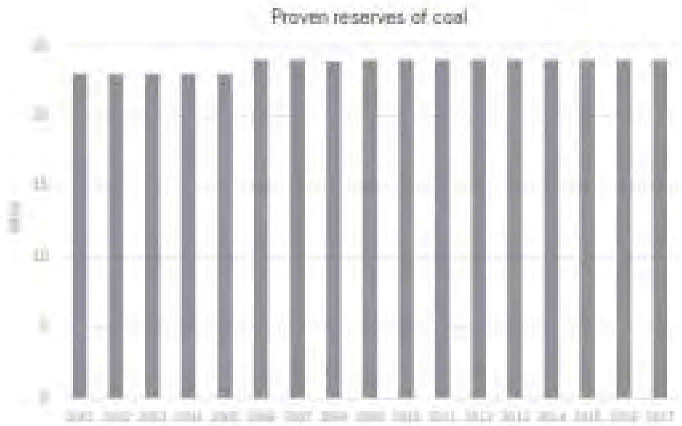
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
2,013	0.86	99.40	5.44	3.09	2.92	0.09	4.21	n.a.	3.53	0.07 / 0.06

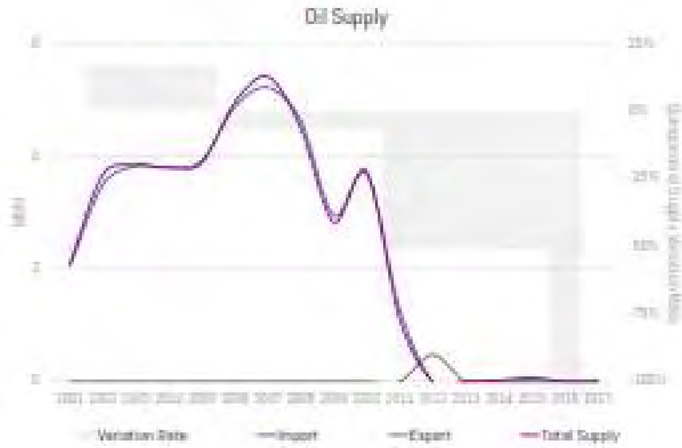
Summarized energy balance 2017



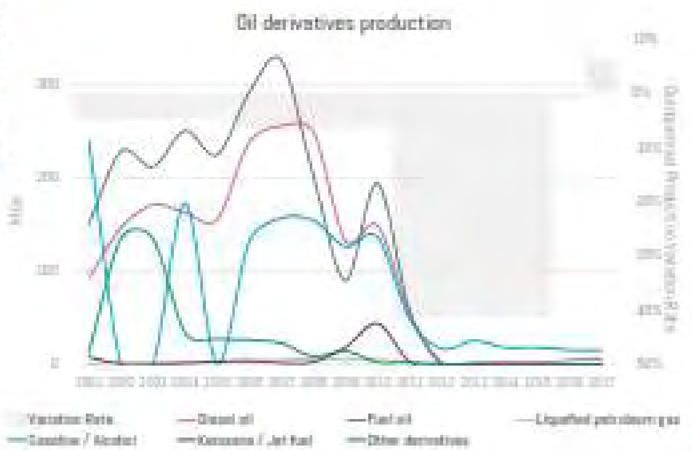

Installed power generation capacity [MW; %]
2017

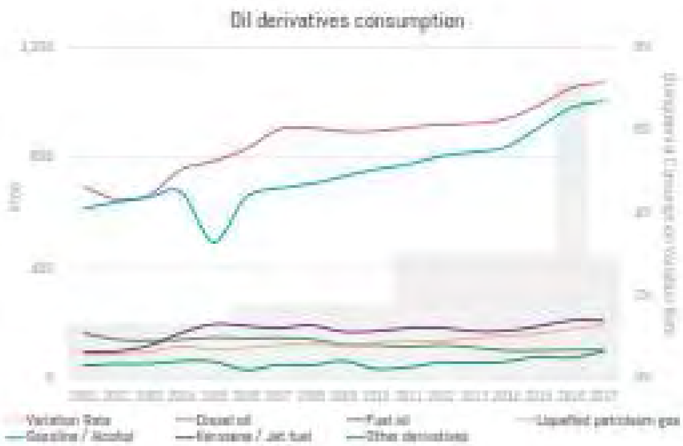

Electricity Generation by Source [GWh; %]
2017


Proven reserves of coal

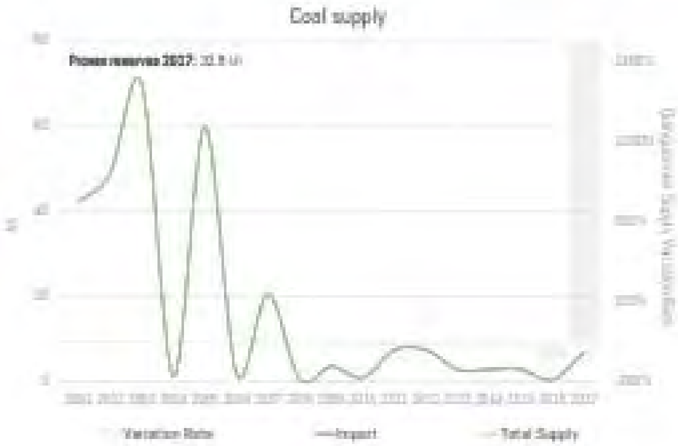

Oil Supply
Variation Rate
Import
Export
Total Supply

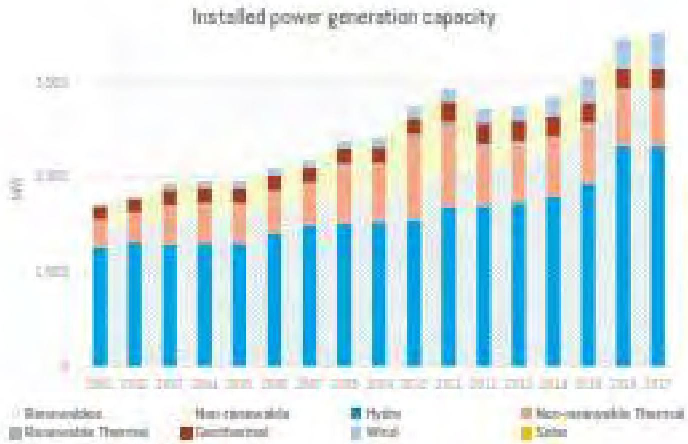
COSTA RICA

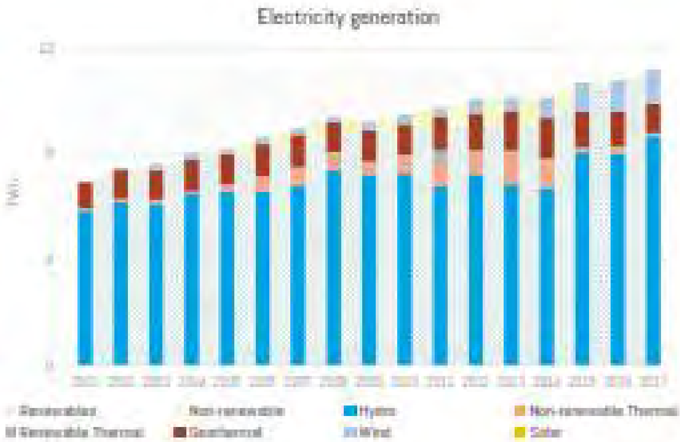

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

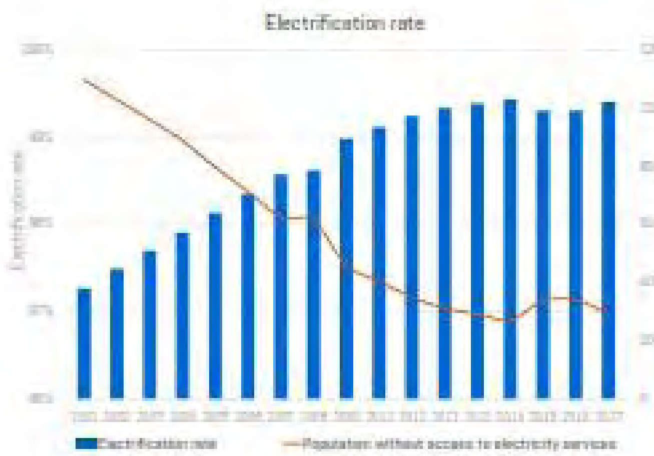

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

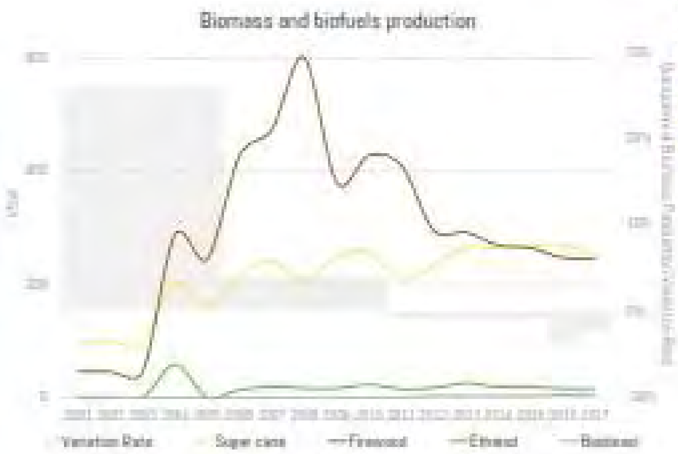
Costa Rica generated 99.35% of its electricity with renewable resources during the first half of 2017, according to the data from the National Center for Energy Control (CENCE).



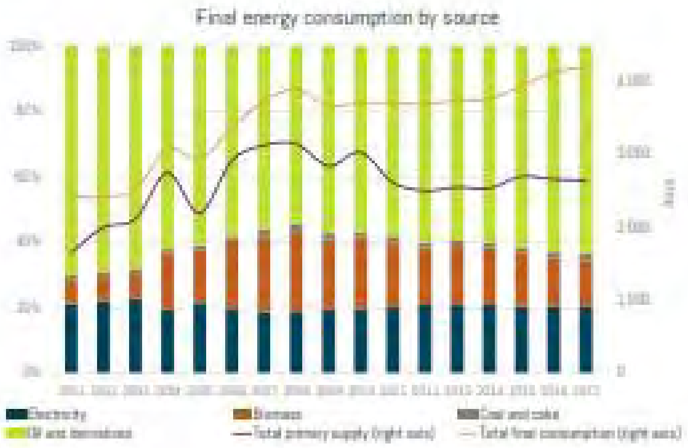






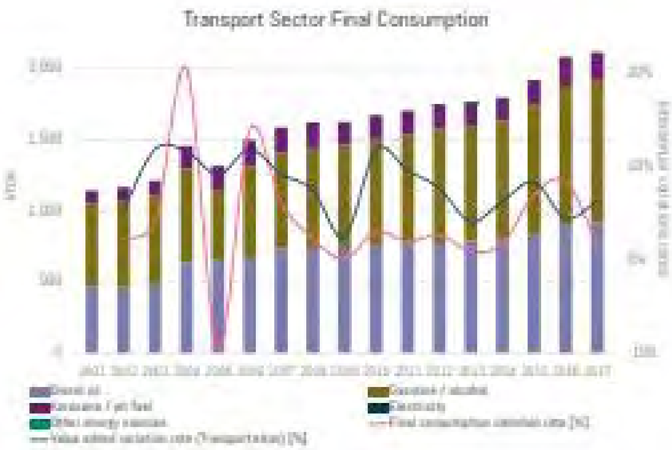


COSTA RICA


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


Industrial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]


Commercial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Commercial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

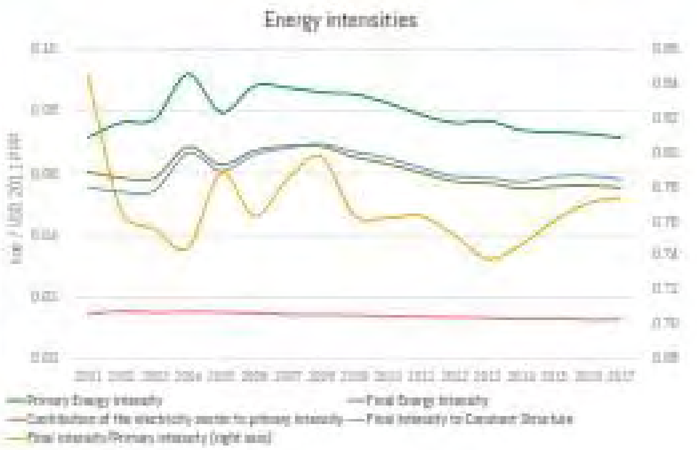

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Other energy sources
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

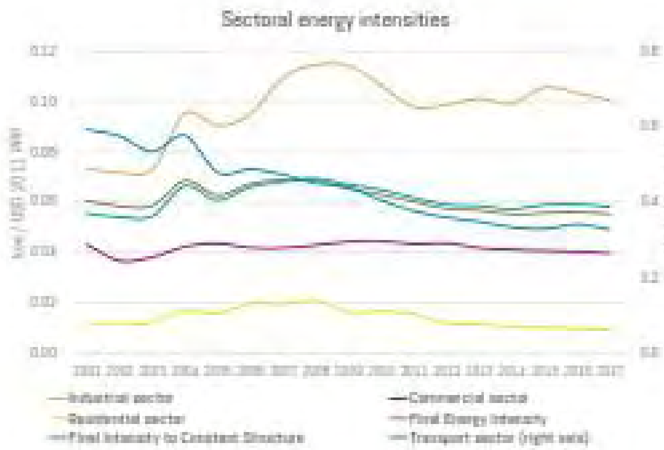
COSTA RICA

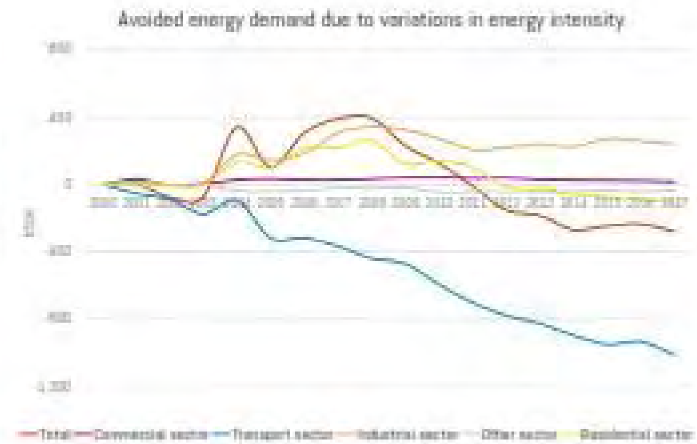

Other Sector Final Consumption
Electricity
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Coal
Gasoline / alcohol
Biomass
Value added variation rate (Other) [%]

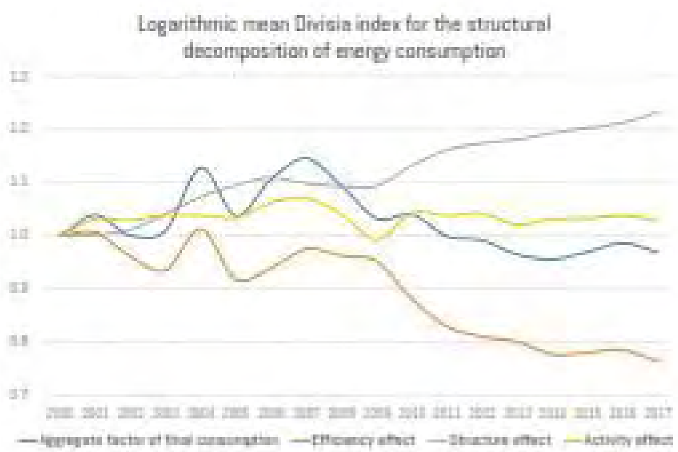

Residential Sector Final Consumption
Electricity
Coal and coke
Biomass
Final consumption variation rate [%]
Liquefied petroleum gas
Oil and derivatives
Other energy sources
Household final consumption variation rate [%]

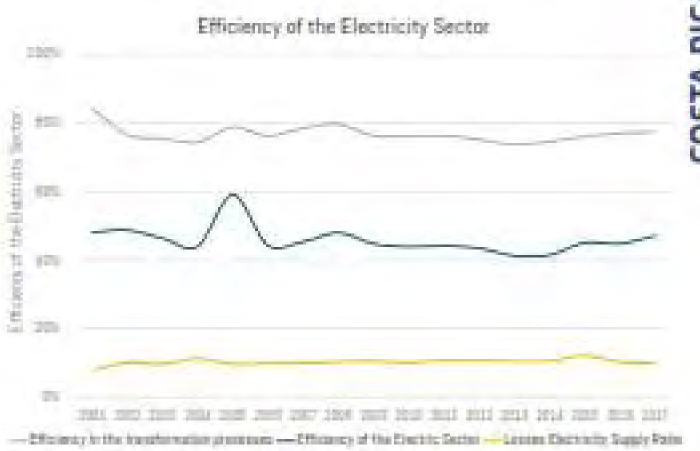

Final consumption per capita Residential Sector
toe / inhab.
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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)

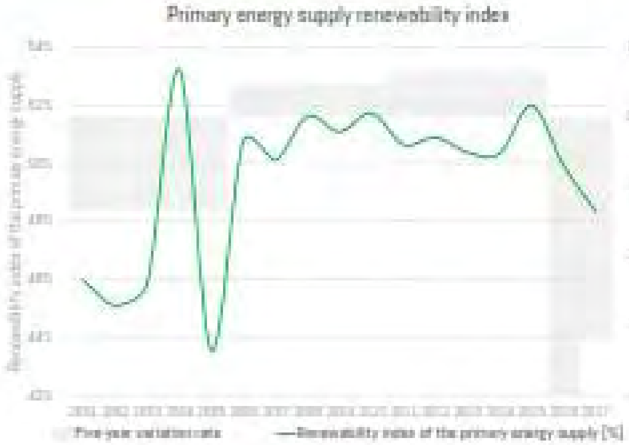

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

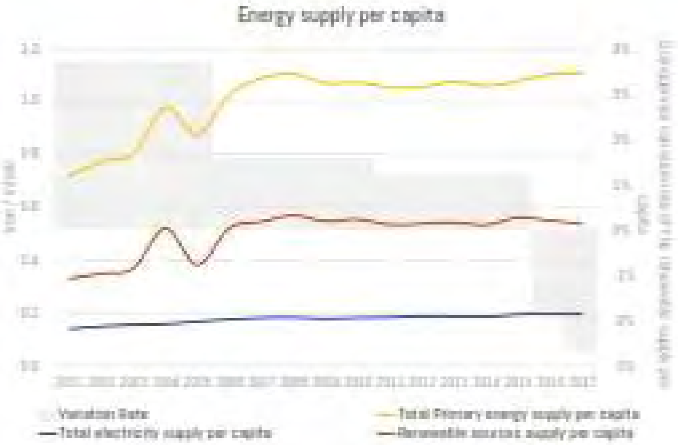

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

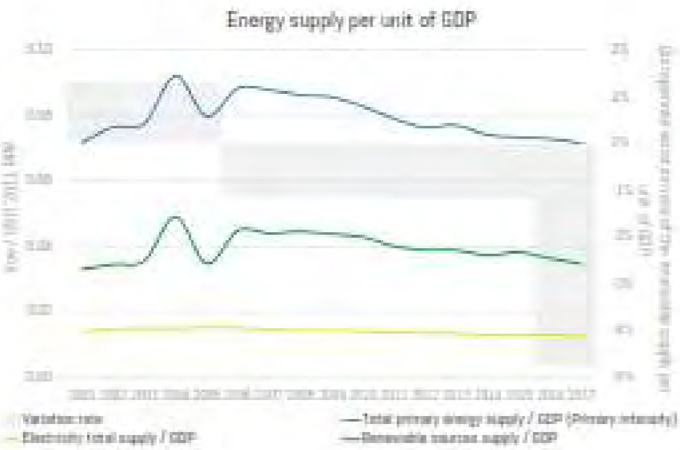

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

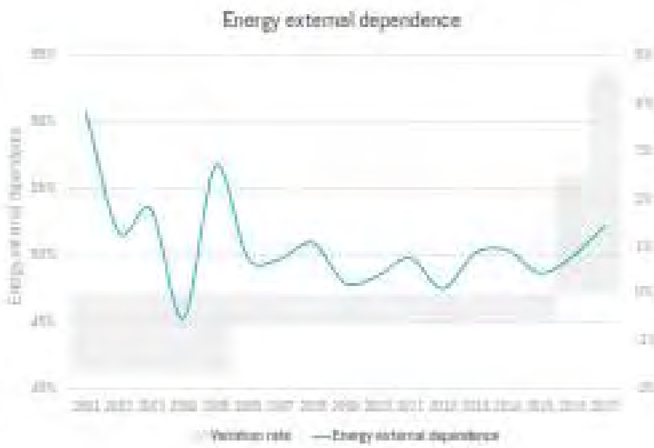

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

COSTA RICA



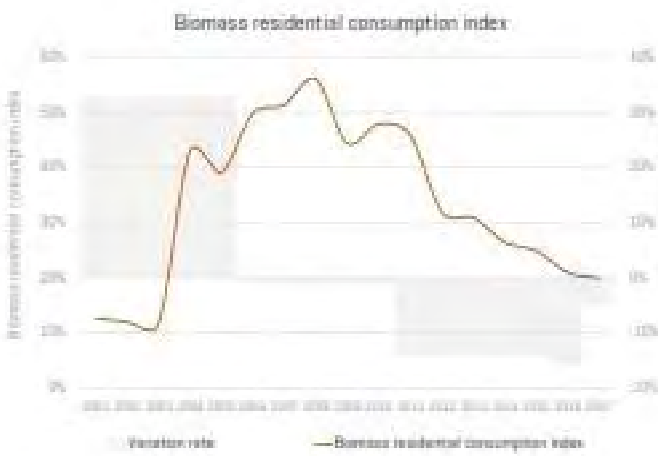


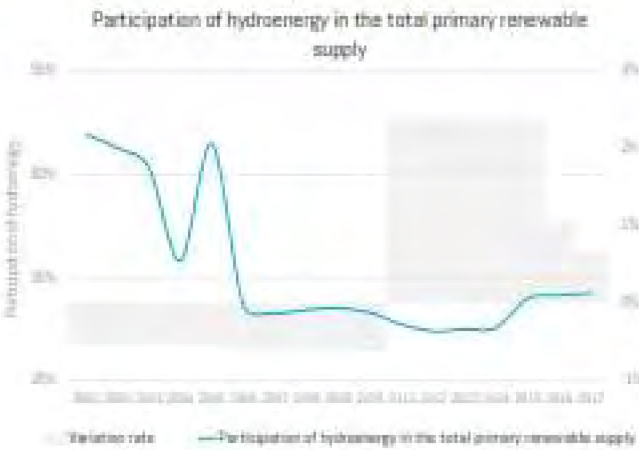


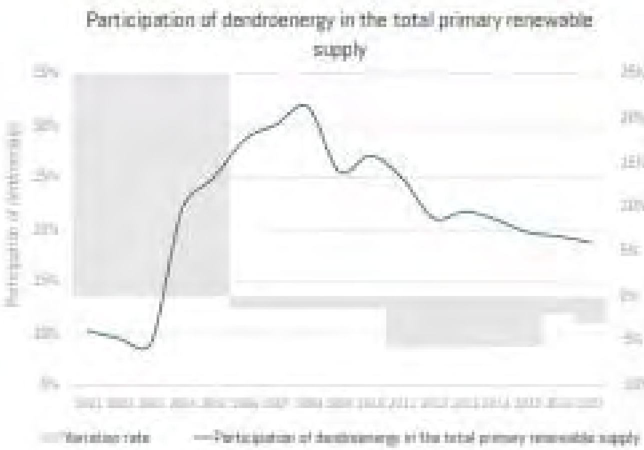


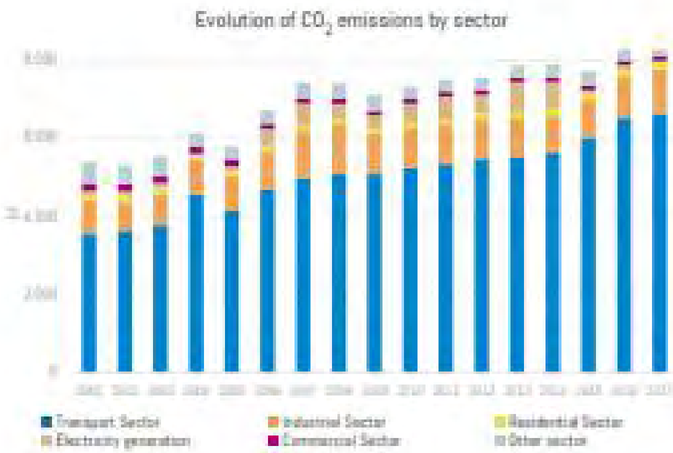
COSTA RICA

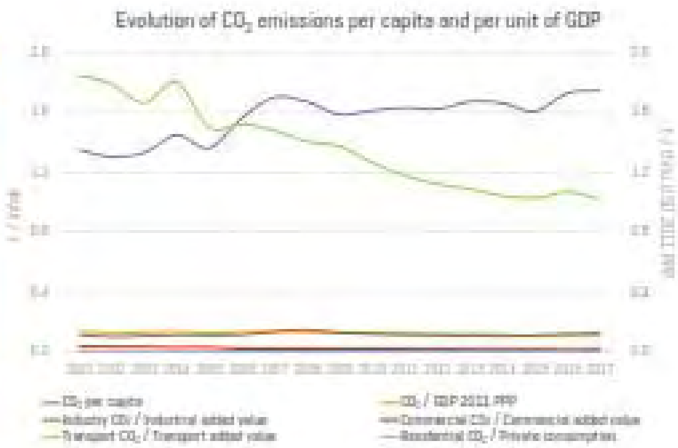
Costa Rica achieved important results with the implementation of the Rural Electrification Program with Renewable Sources of Energy. In 2017, approximately 373 communities were benefited and 289 SFV were installed.

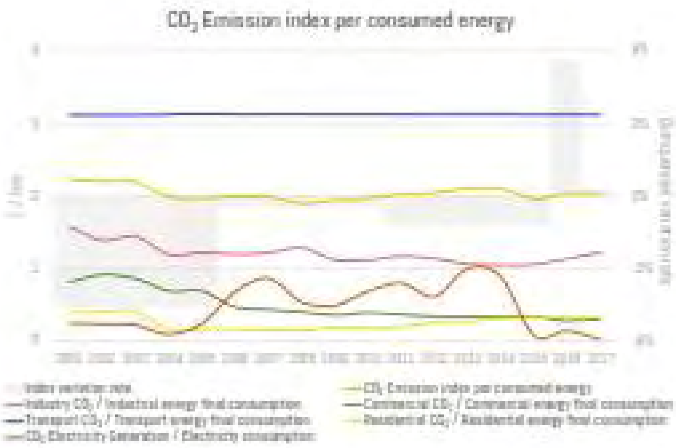


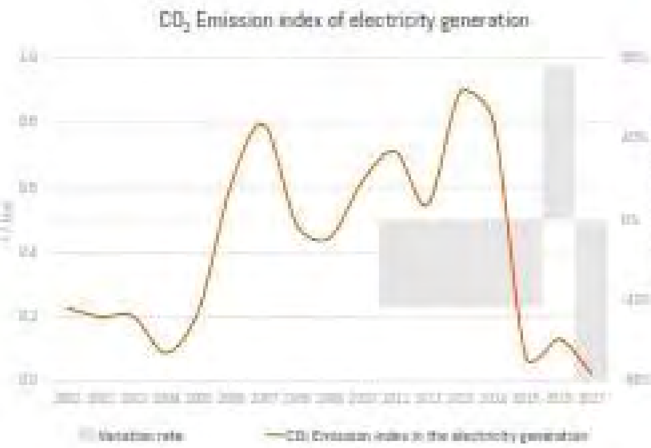

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

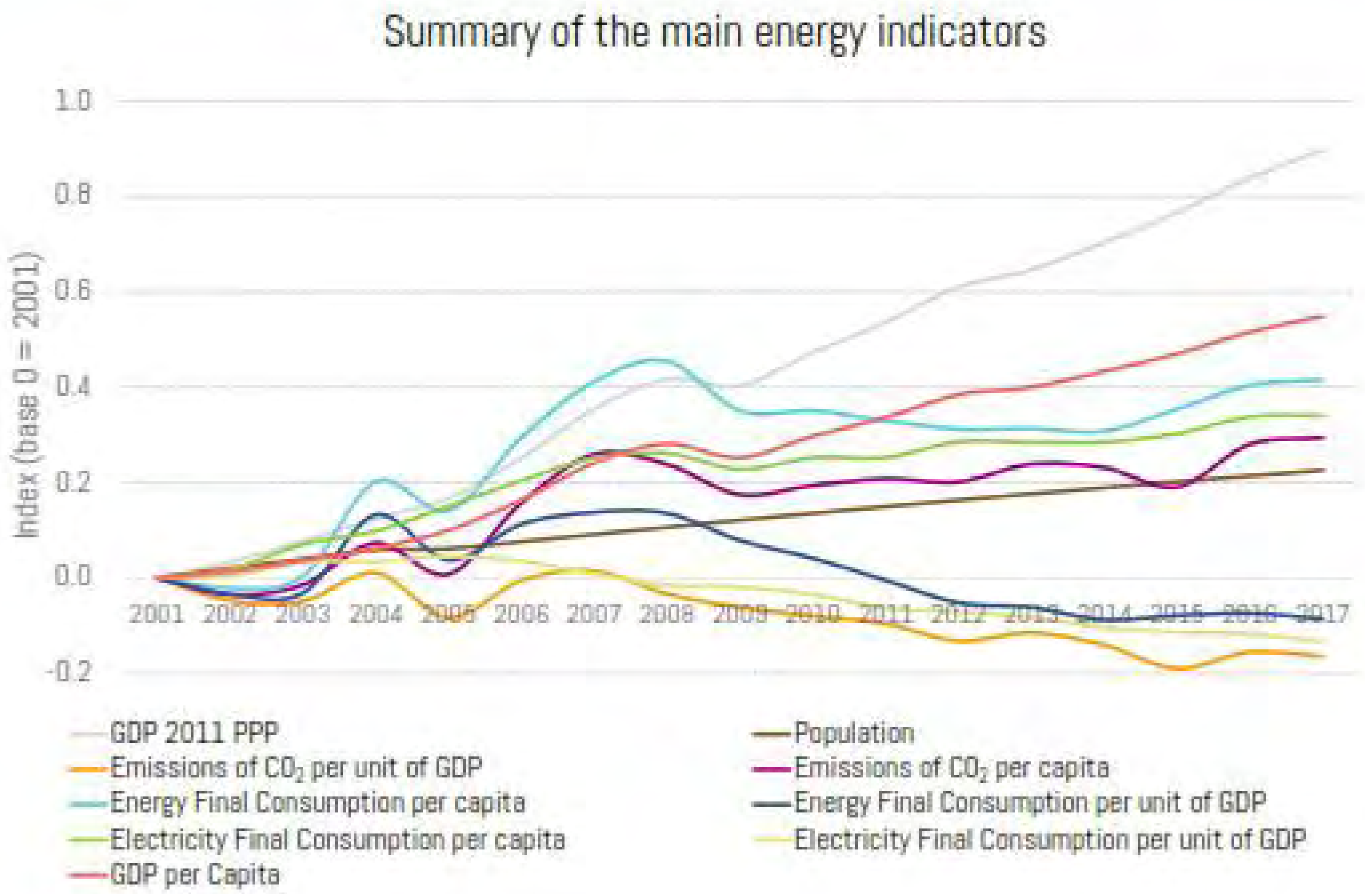

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2001)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

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General Information 2017

Population (thousand inhab.)	11,423
Area (km²)	109,884
Population Density (inhab./km²)	104
Urban Population (%)	77
GDP USD 2010 (MUSD)	75,439
GDP USD 2011 PPP (MUSD)	275,537
GDP per capita (thou. USD 2011 PPP/inhab.)	24

Energy Sector 2016

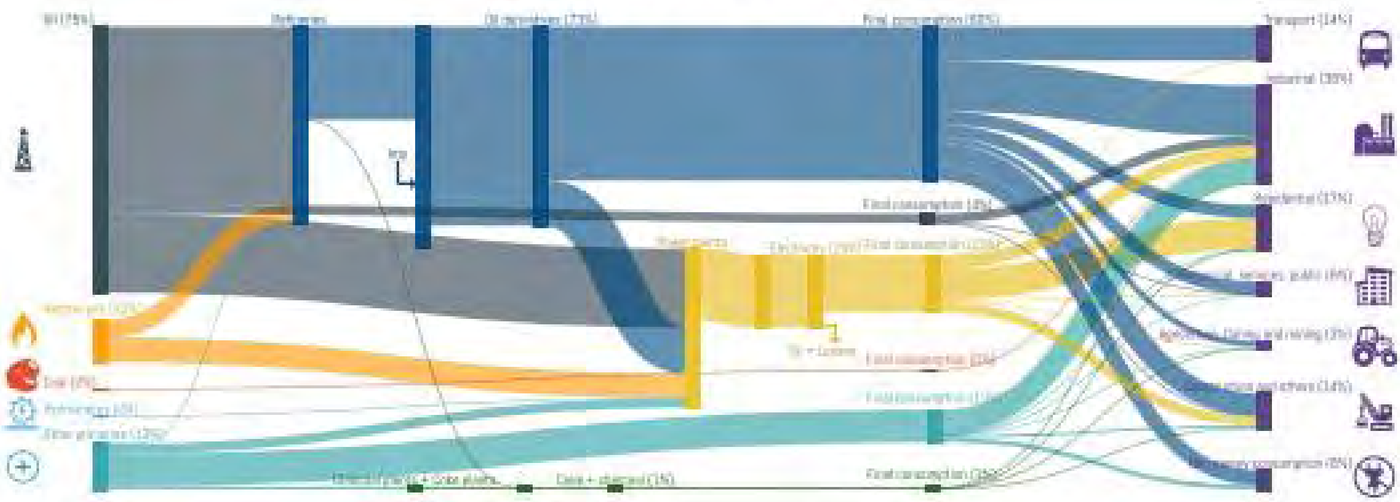
	Mtoe
Final consumption in the Transport Sector	0.85
Final consumption in the Industrial Sector	2.40
Final consumption in the Residential Sector	1.09
Final consumption in the Commercial and Service Sector	0.35
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	1.57

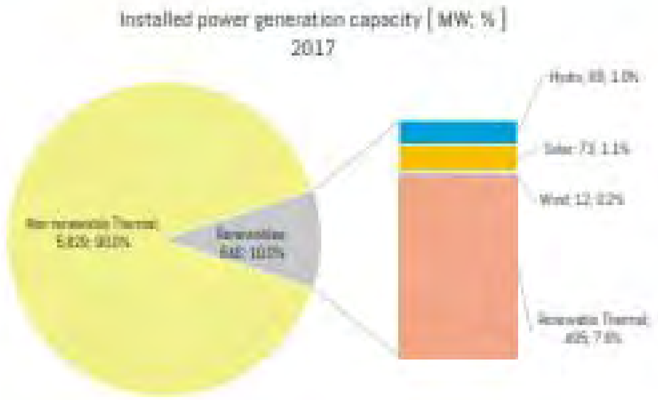
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
124[2]	71[2]	n.a.

[1] Data 2017
[2] Data estimated by OLADE.

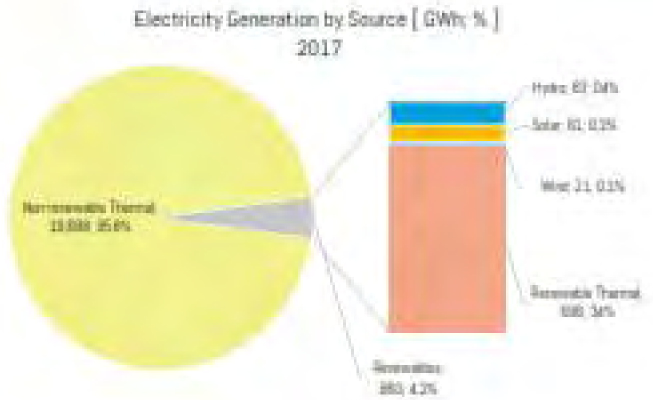
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,356[1]	0.55	99.70[1]	11.29	4.89	6.92	0.53	6.26	123	6.48[1]	0.04 / 0.02

Summarized energy balance 2016

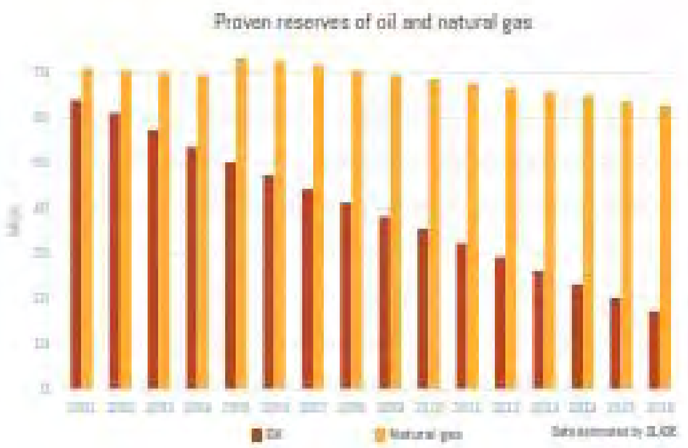




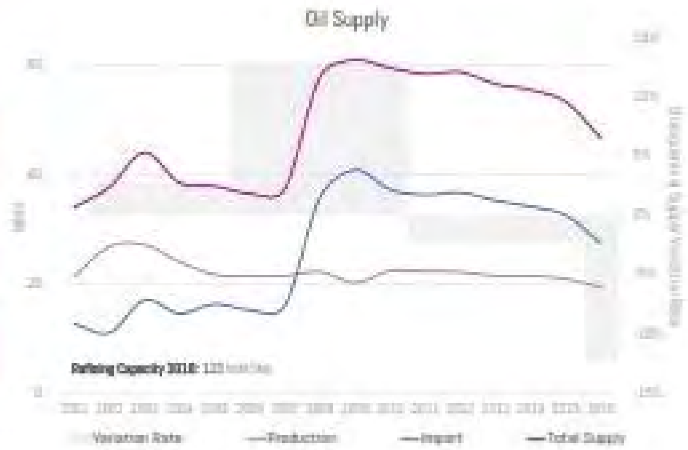
Installed power generation capacity [MW; %]
2017
Solar: 73; 1.1%
Wind: 12; 0.2%
Renewable Thermal



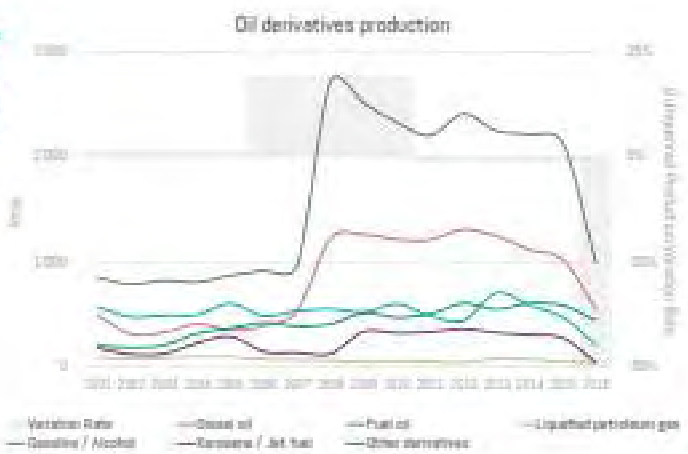
Electricity Generation by Source [GWh; %]
2017
Renewable Thermal
Renewables



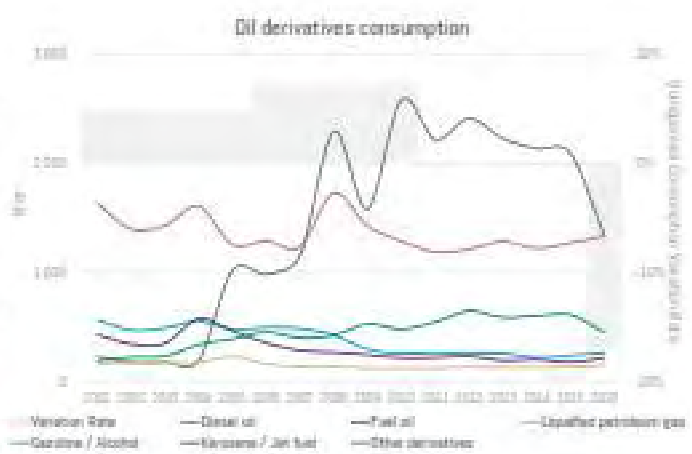
Proven reserves of oil and natural gas
Oil
Natural gas



Oil Supply
Variation Rate
Production
Import
Total Supply

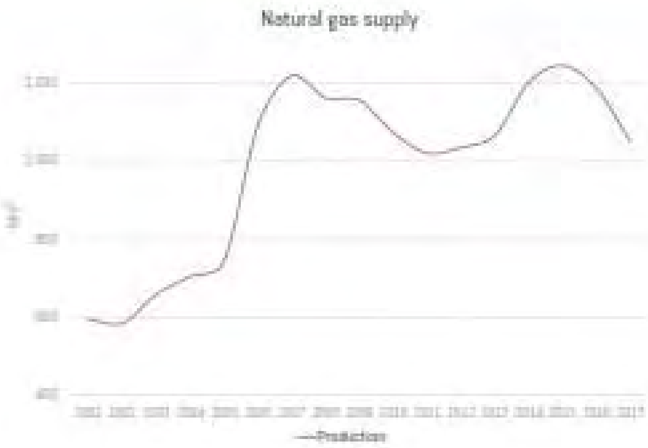


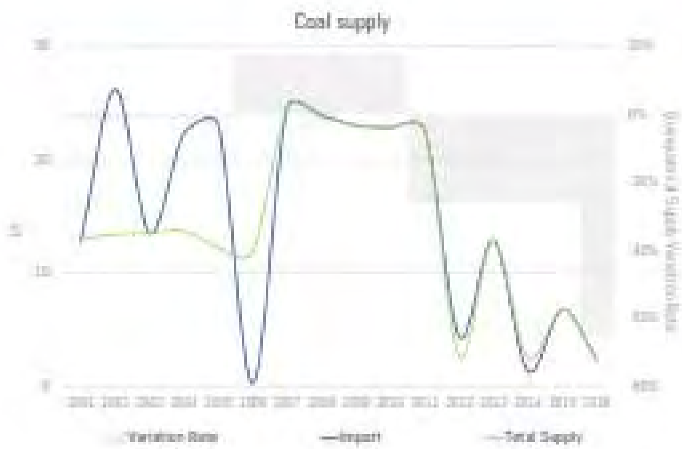
Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

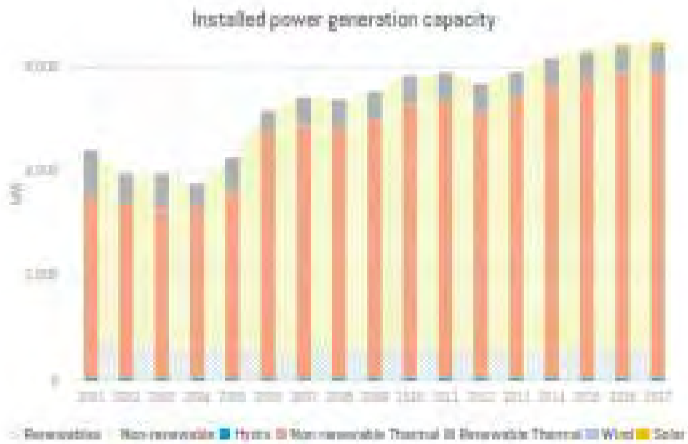


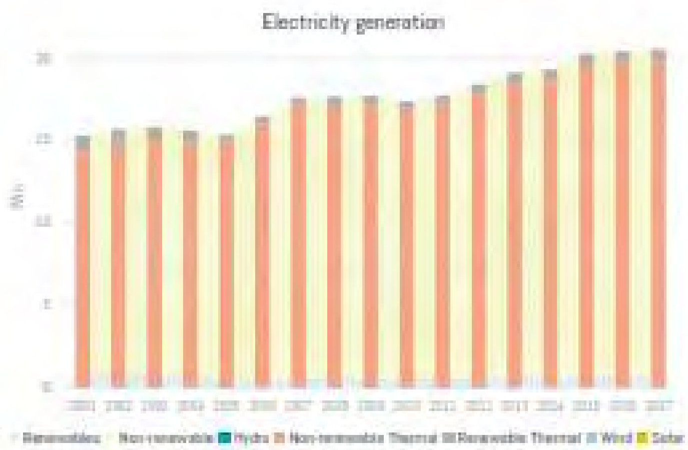
Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

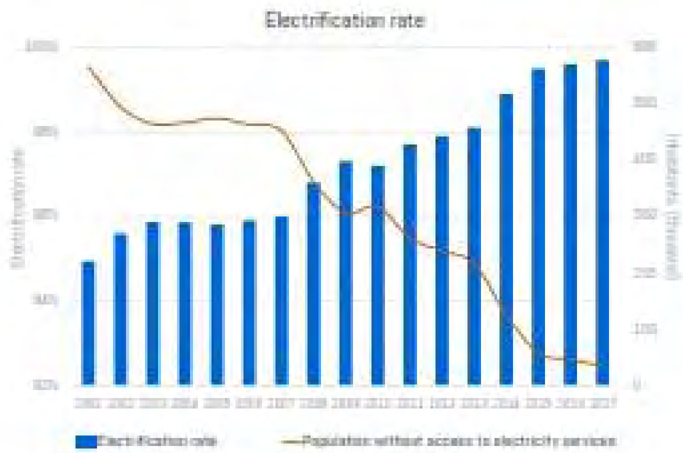
CUBA

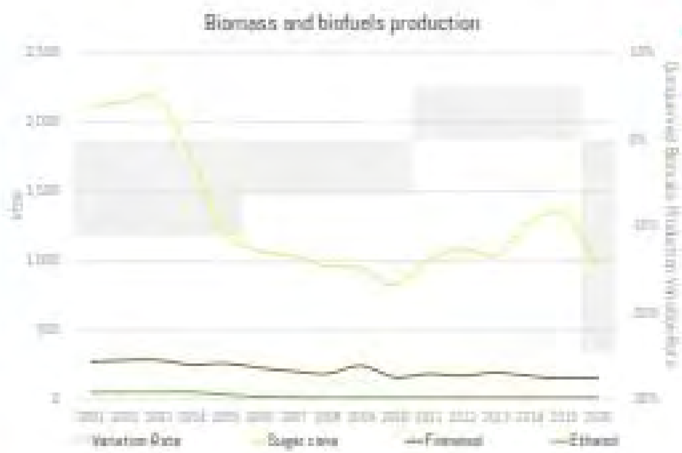

Natural gas supply
Production


Coal supply
Variation Rate
Import
Total Supply

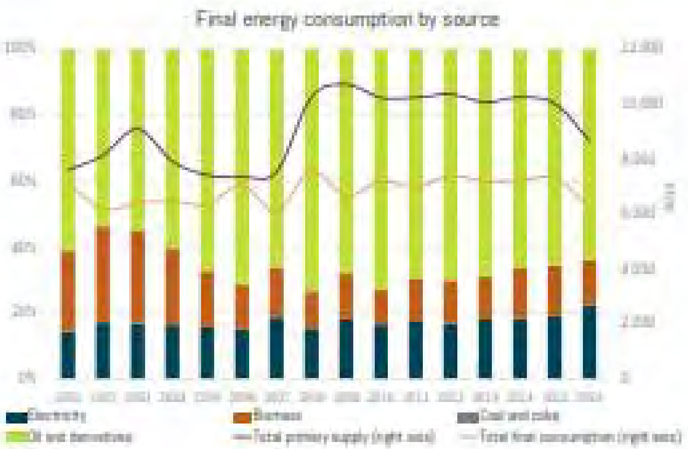

Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar

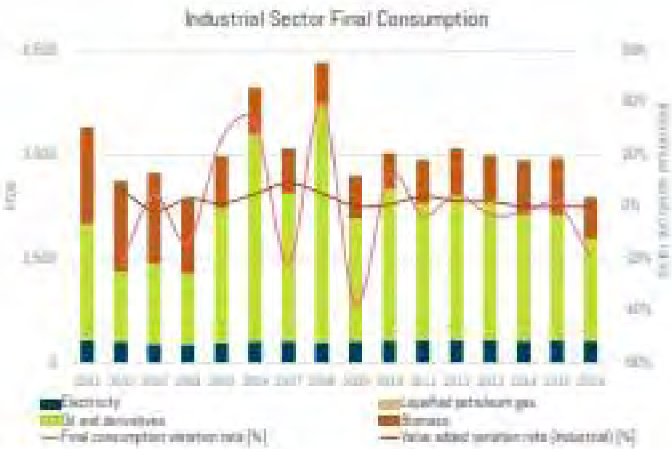

Electricity generation
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar

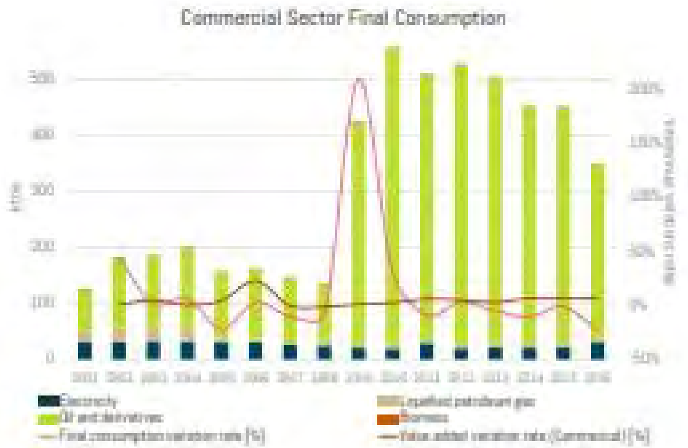

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood
Ethanol

CUBA

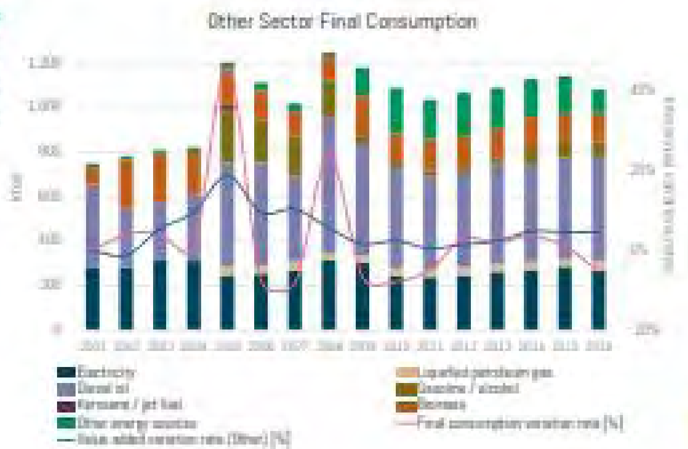

Final energy consumption by source
Electricity
Oil and derivatives
Biomass
Total primary supply (right axis)
Coal and coke
Total final consumption (right axis)

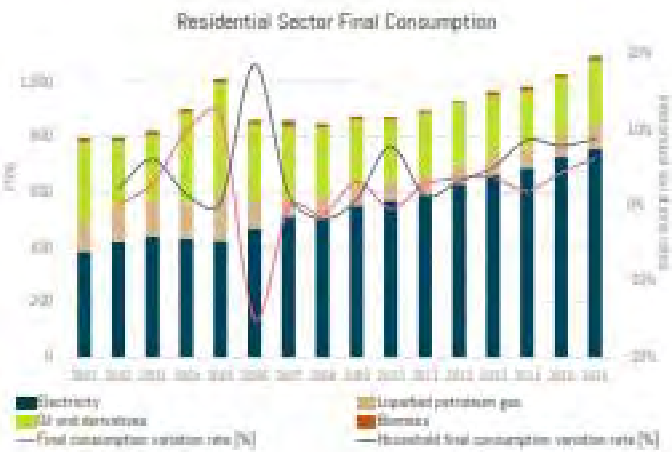

Industrial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Industrial) [%]


Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]

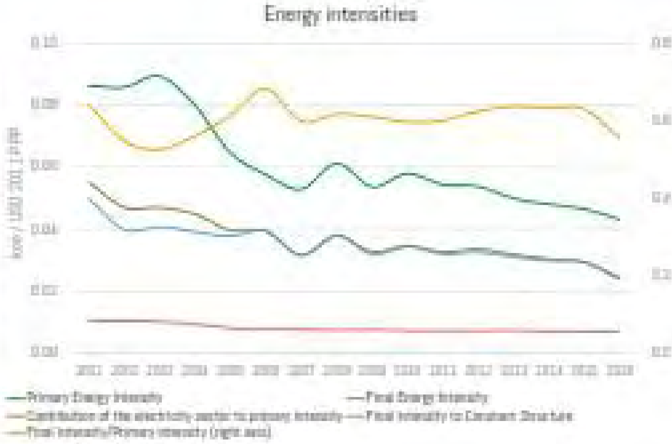

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Liquefied petroleum gas
Final consumption variation rate [%]
Gasoline / alcohol
Electricity
Other energy sources
Value added variation rate (Transportation) [%]

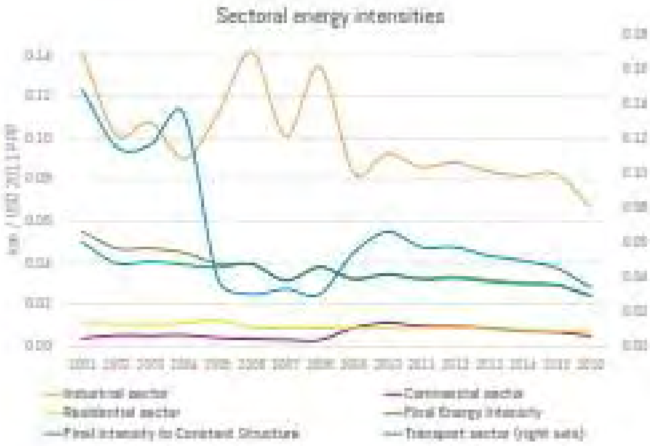
CUBA

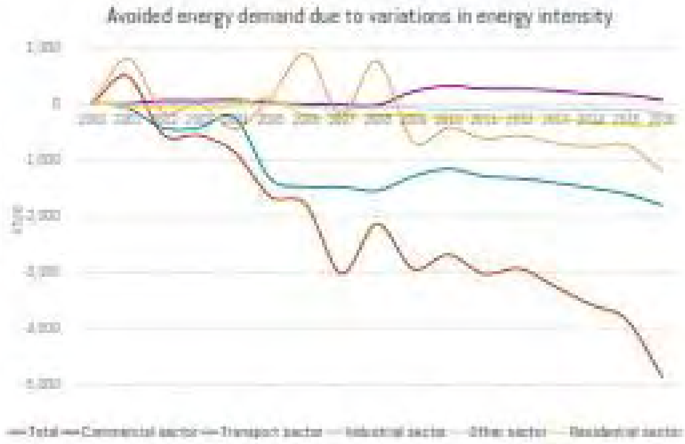

Other Sector Final Consumption
Electricity
Diesel oil
Kerosene / jet fuel
Other energy sources
Value added variation rate (Other) [%]
Liquefied petroleum gas
Gasoline / alcohol
Biomass
Final consumption variation rate [%]

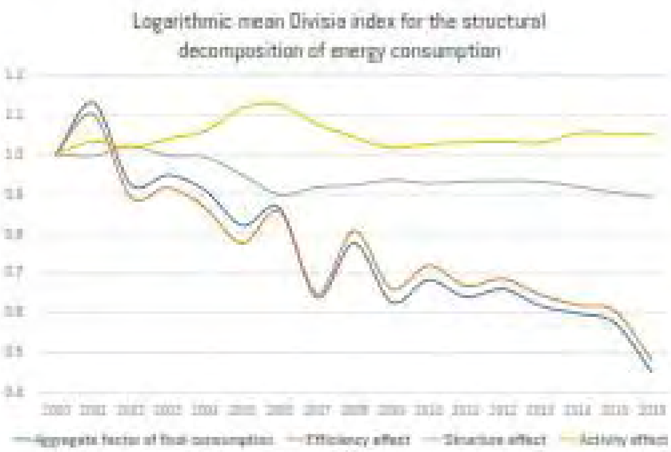

Residential Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]

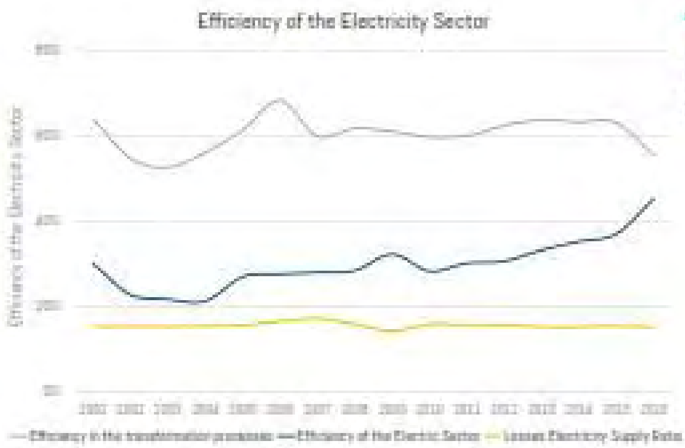

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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)

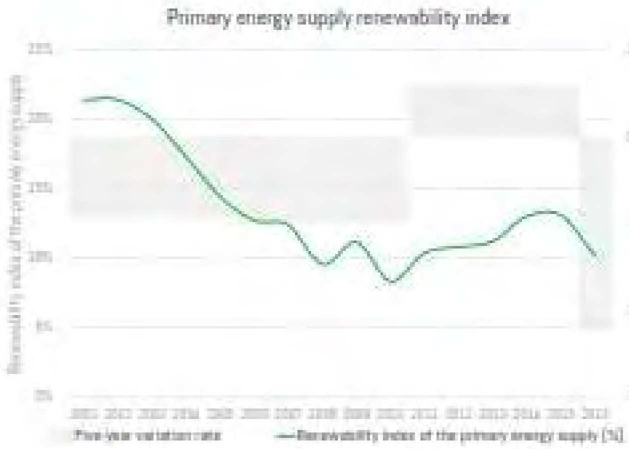

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final intensity to Constant Structure
Transport sector (right axis)

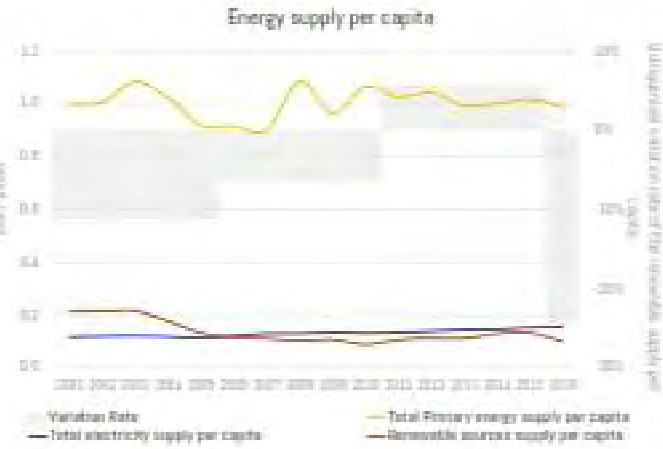

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

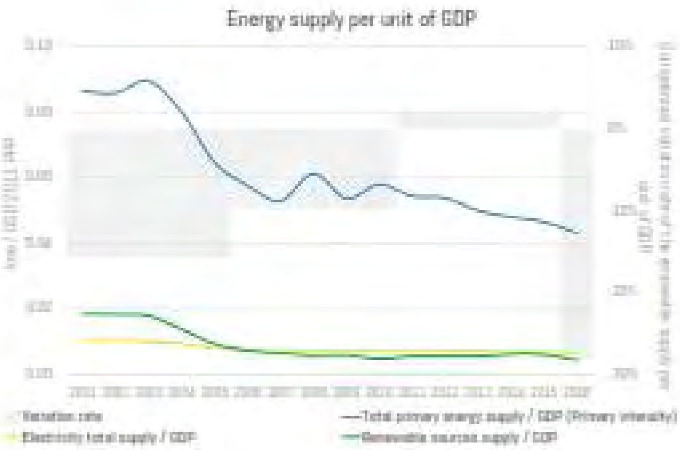

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

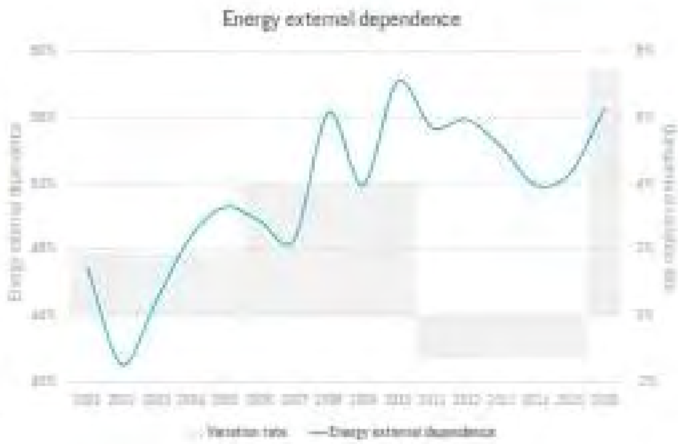

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

CUBA

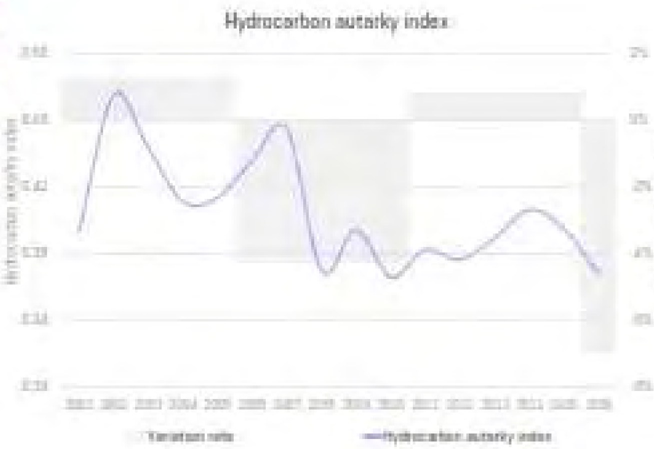

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

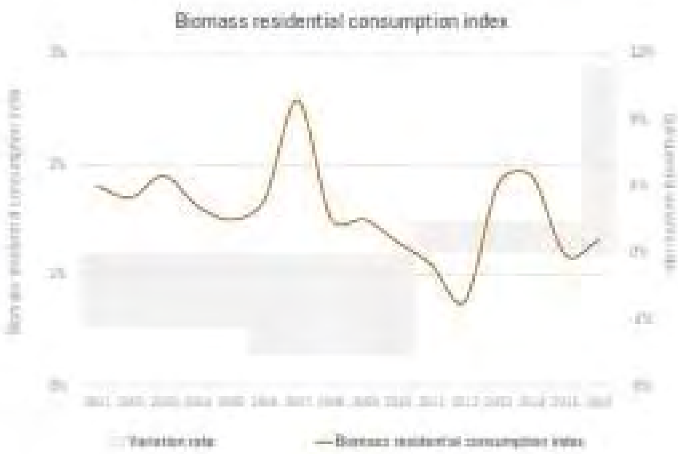

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

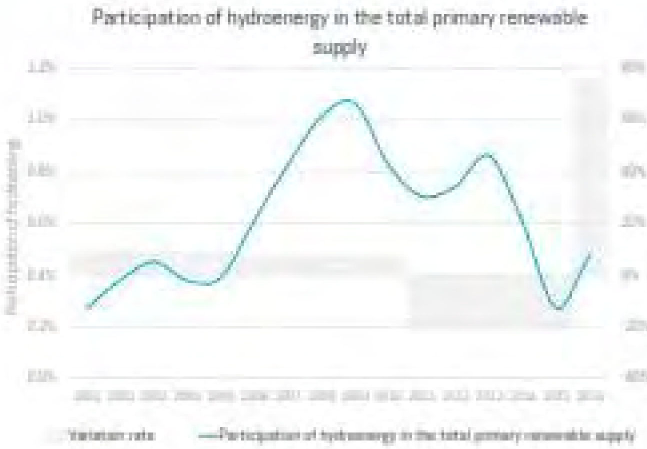

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

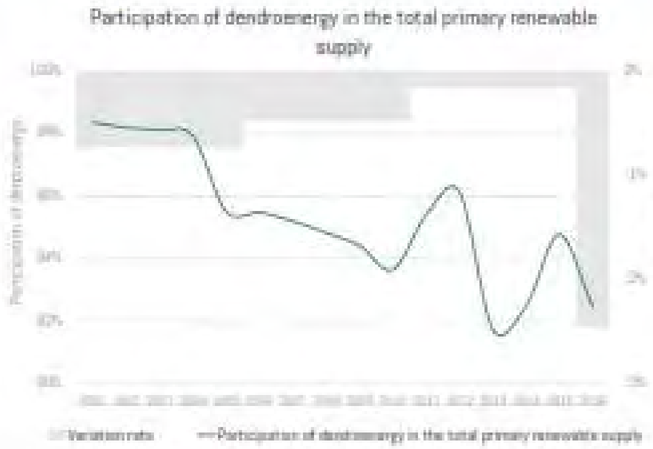

Energy external dependence
Variation rate
Energy external dependence

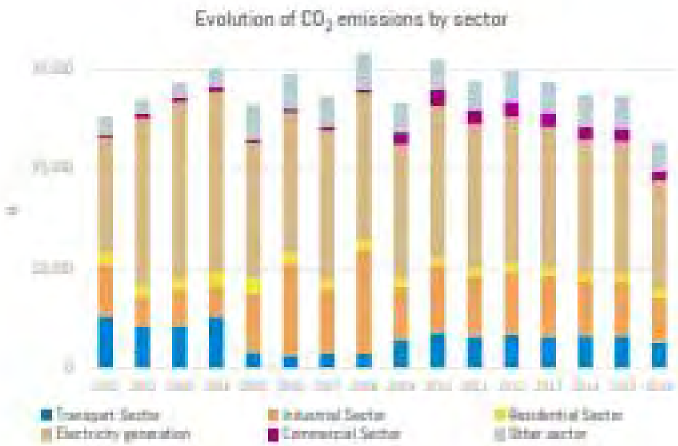
CUBA

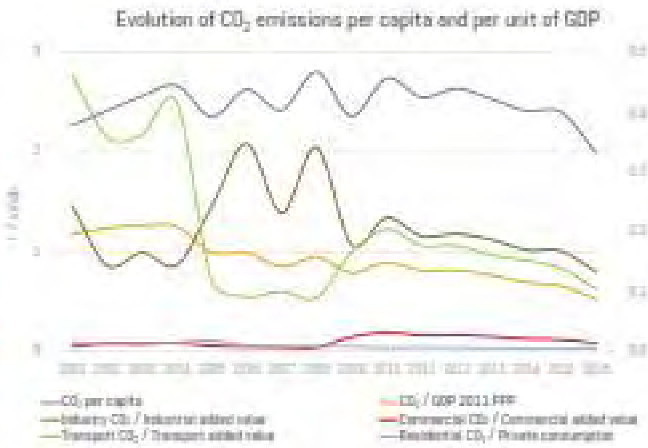

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

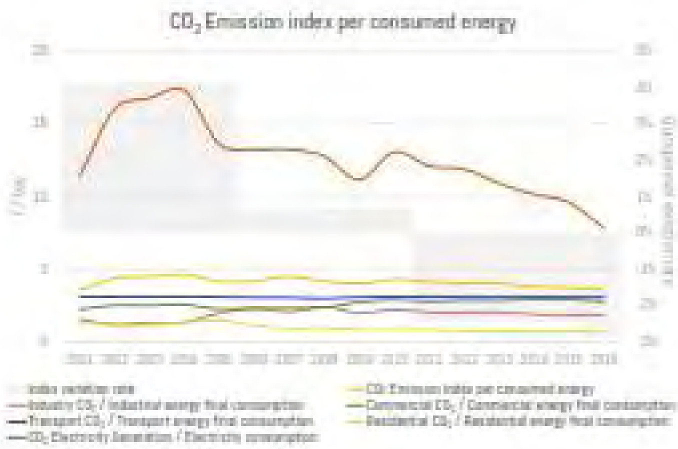

Biomass residential consumption index
Variation rate
Biomass residential consumption index

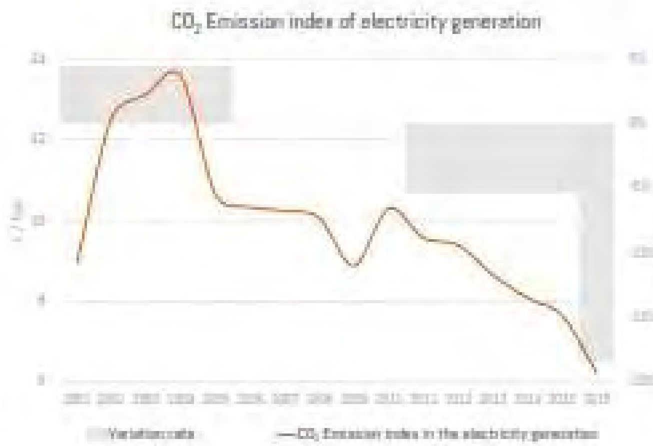

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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

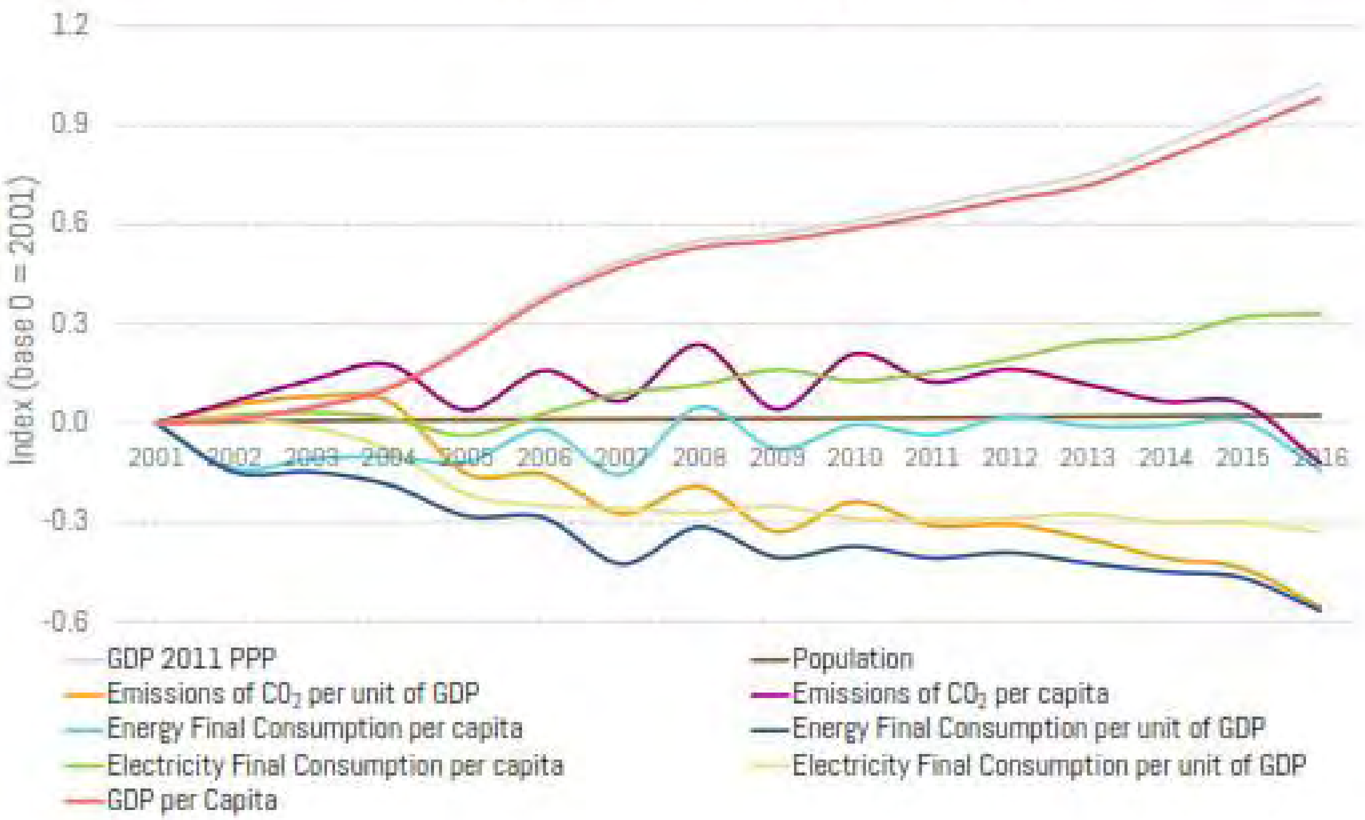

Evolution of CO_2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation

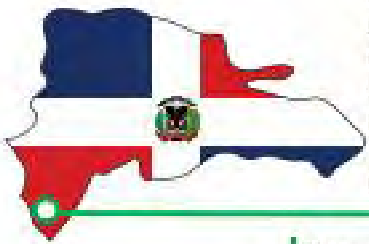
Summary of the main energy indicators



CUBA

DOMINICAN REPUBLIC

General Information 2017



Population (thousand inhab.)	10,169 [1]
Area (km²)	48,442
Population Density (inhab./km²)	210
Urban Population (%)	80
GDP USD 2010 (MUSD)	76,729
GDP USD 2011 PPP (MUSD)	157,207
GDP per capita (thou. USD 2011 PPP/inhab.)	15

Energy Sector

Final consumption in the Transport Sector	Mtoe 2.20
Final consumption in the Industrial Sector	Mtoe 1.65
Final consumption in the Residential Sector	Mtoe 1.42
Final consumption in the Commercial and Service Sector	Mtoe 0.44
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.50

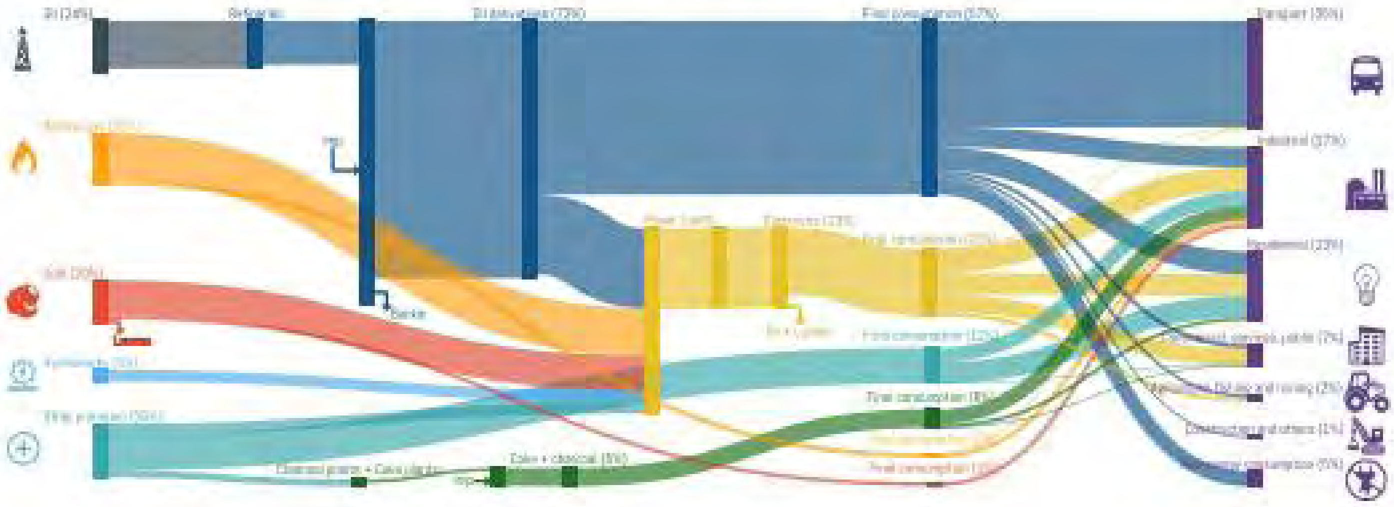
Oil reserves	Mbbl n.a.
Natural gas reserves	Gm³ n.a.
Coal reserves	Mt n.a.

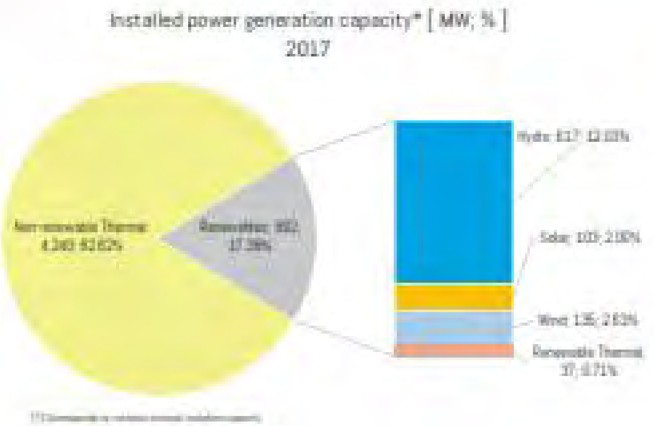
[1] National Office of Statistics

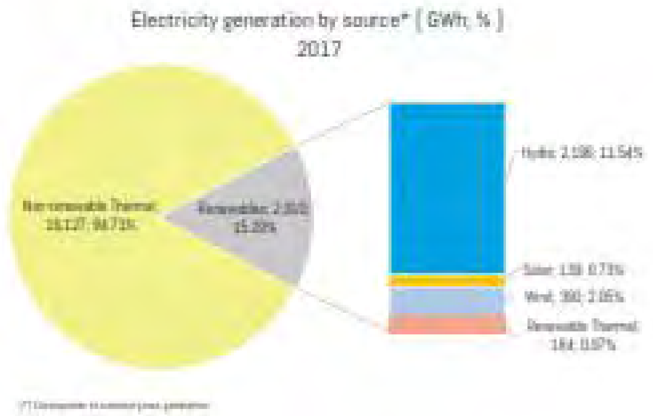
[2] Exports include AVTUR bunkers.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,582
Final energy consumption per capita	toe/inhab.	0.61
Electrification rate	%	97.25
Total energy supply	Mtoe	8.95
Total energy production	Mtoe	1.33
Total energy imports	Mtoe	8.19
Total energy exports	Mtoe	0.59 [2]
Total final energy consumption	Mtoe	6.21
Refining capacity	kbbl/day	34
Installed power generation capacity	GW	5.13
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.06 / 0.04

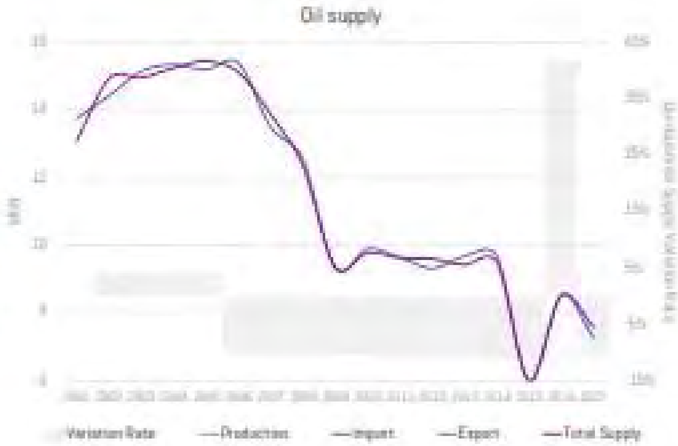
Summarized energy balance 2017



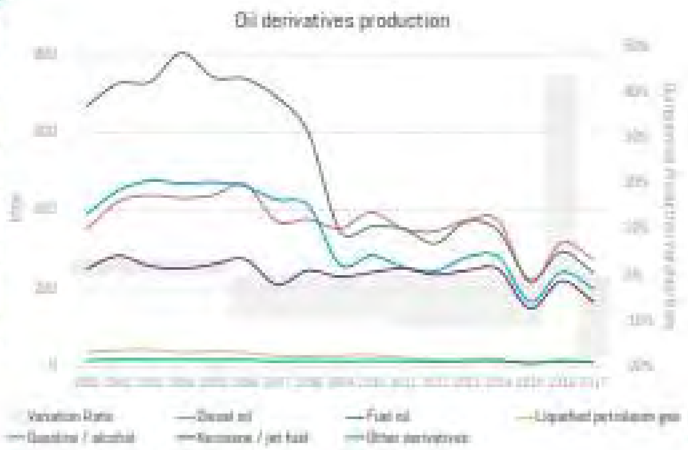


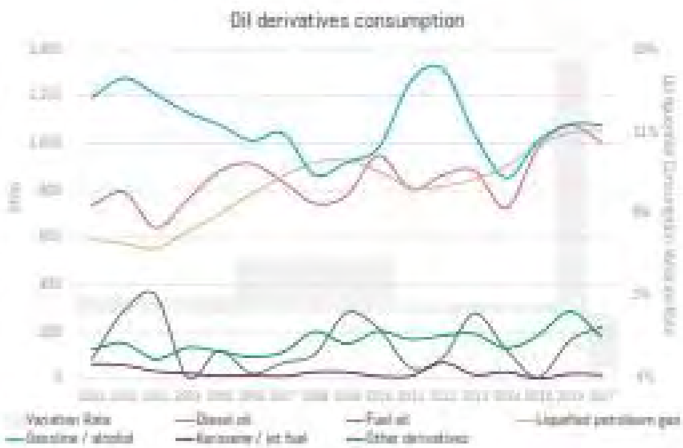


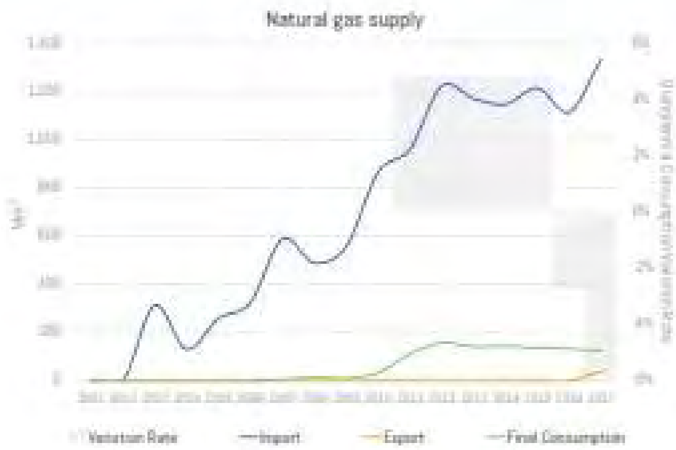
In June 2017, it was inaugurated the Los Mina VII plant of the Dominican Power Plant Partner of AES Dominicana, contributing to the national electricity system with 114 MW of clean energy and it became the largest power plant in the country, with 324 MW (natural gas), until the launch of Punta Catalina at the end of 2018, with a gross capacity of 752 MW (mineral coal).

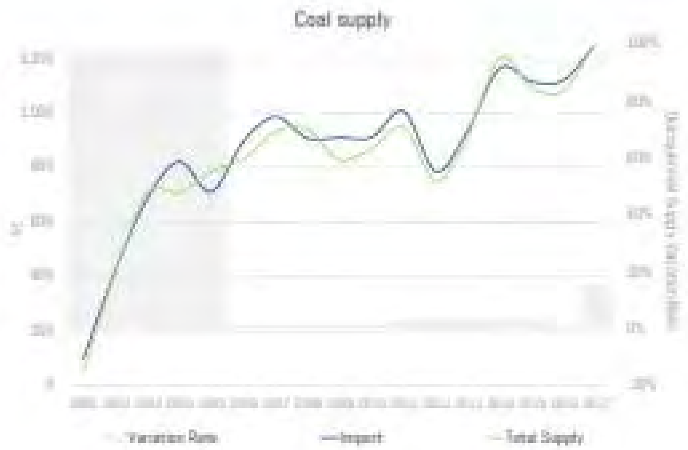


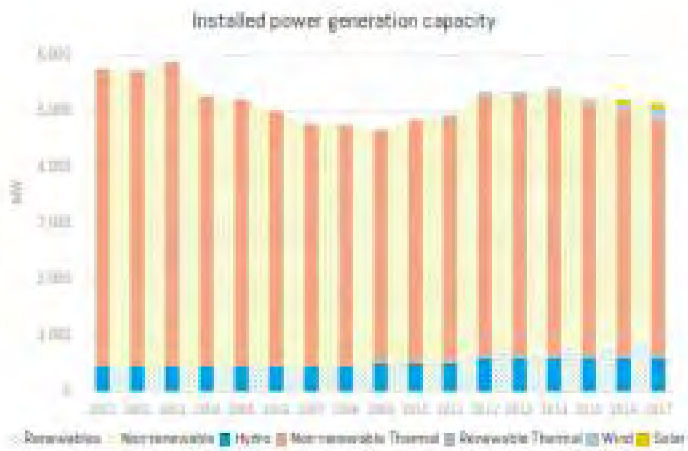
DOMINICAN REPUBLIC

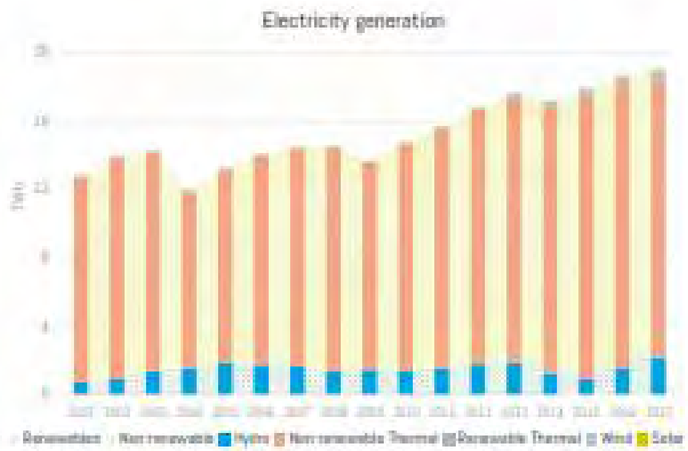


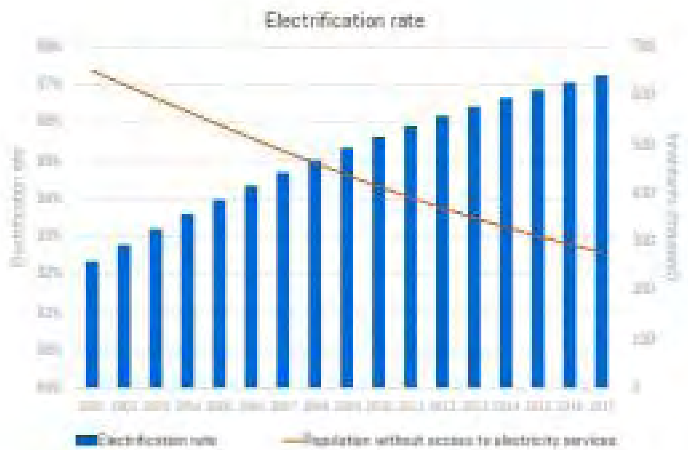


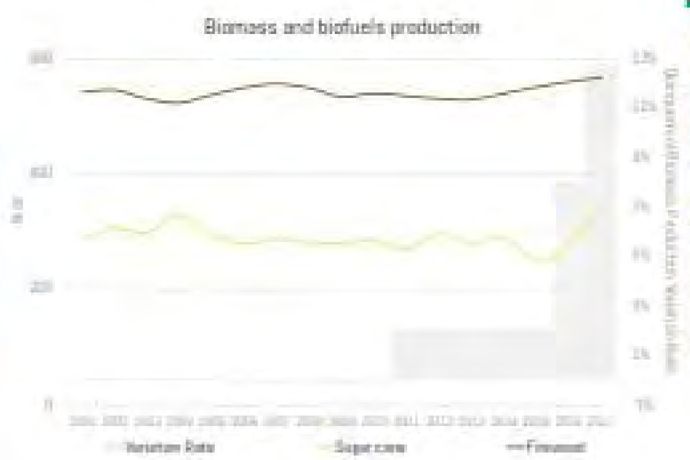












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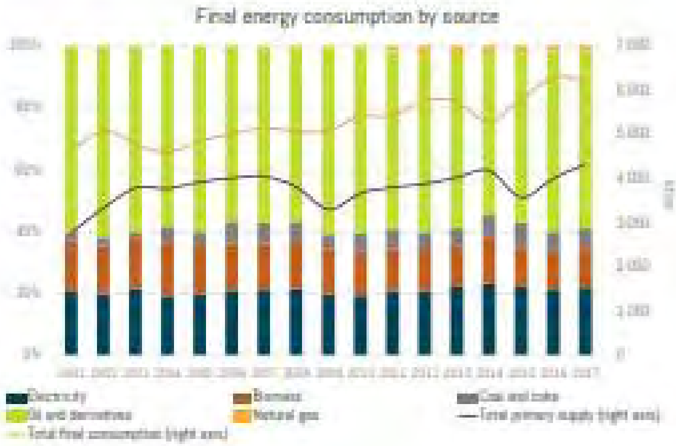

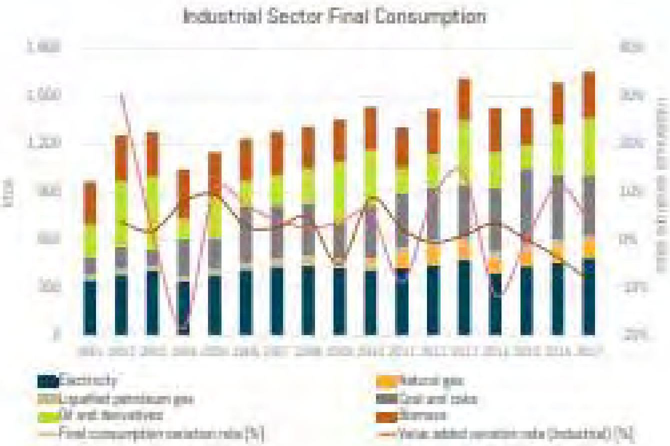

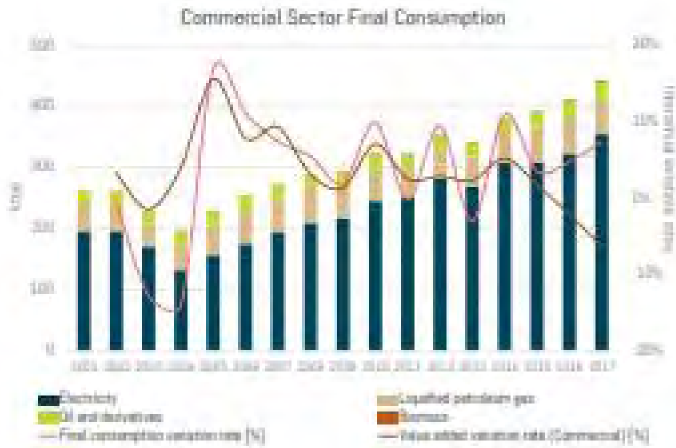

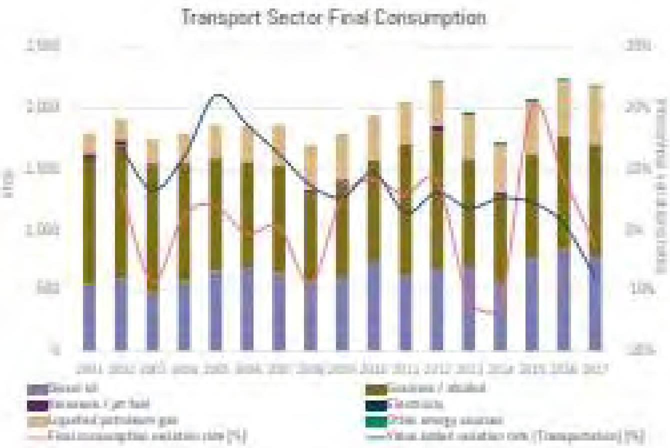

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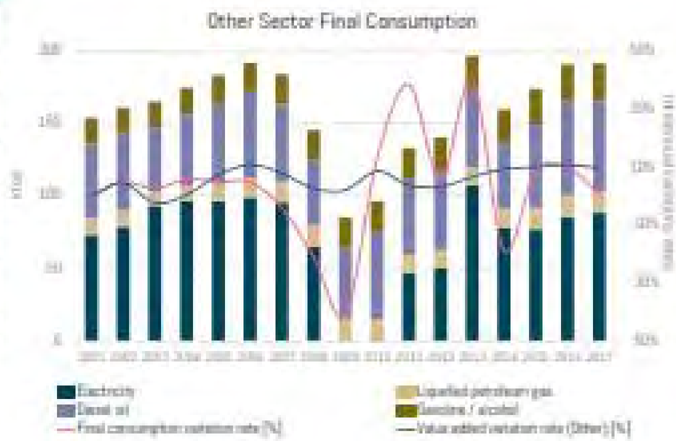
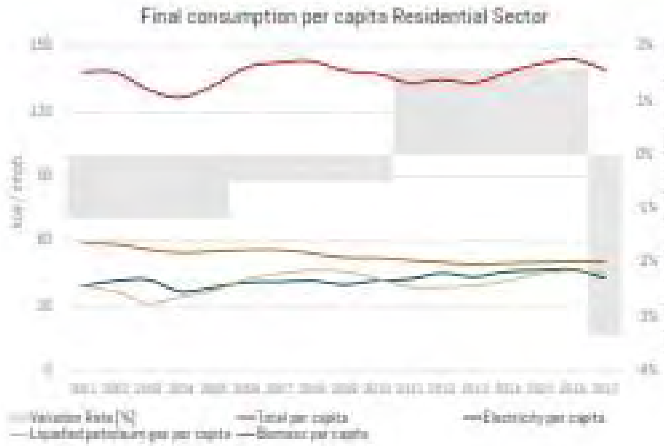
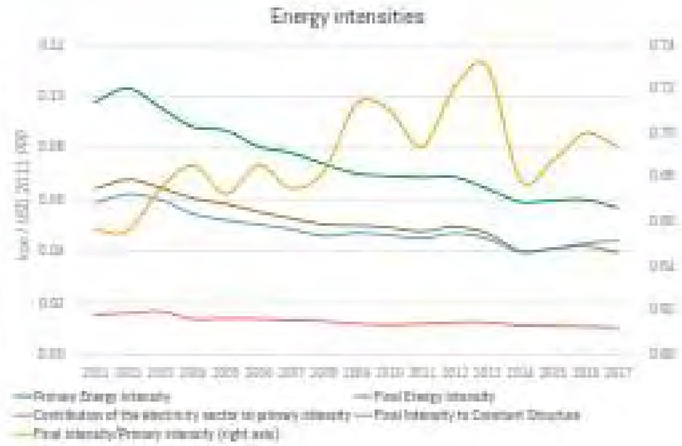
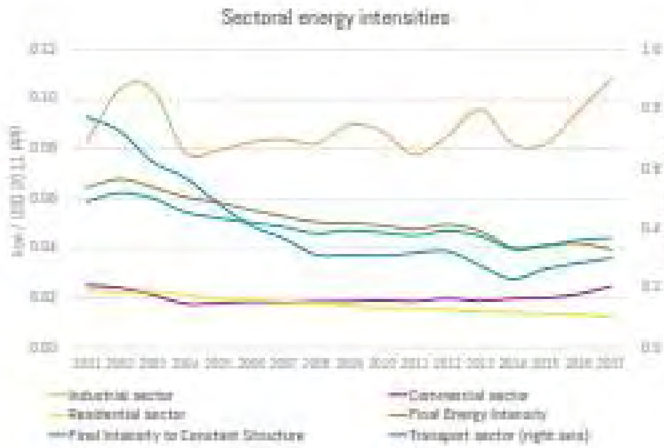
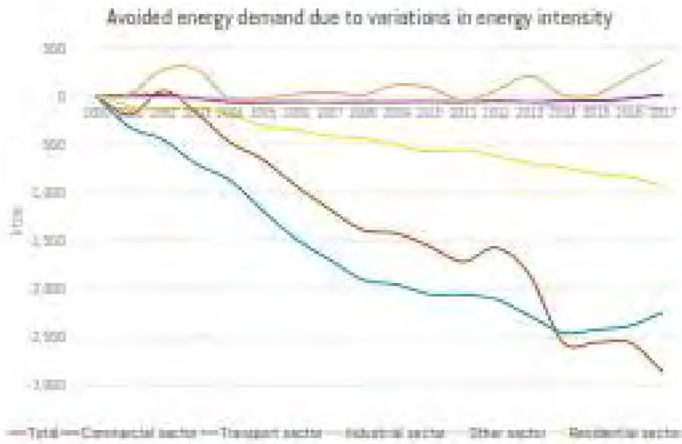
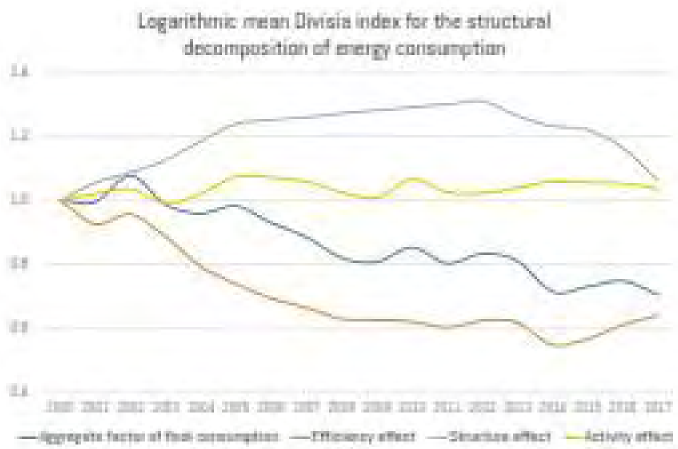


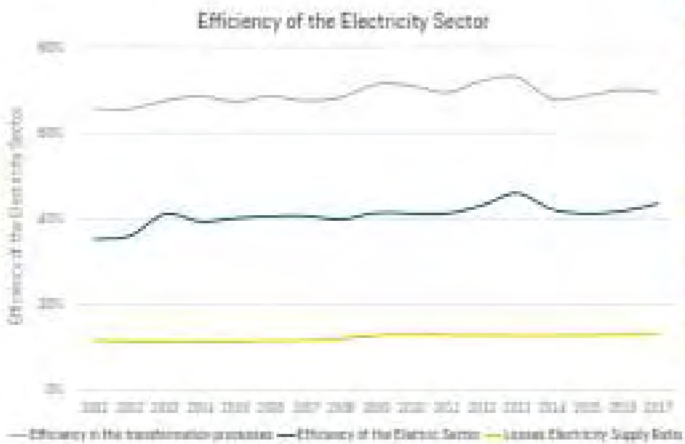




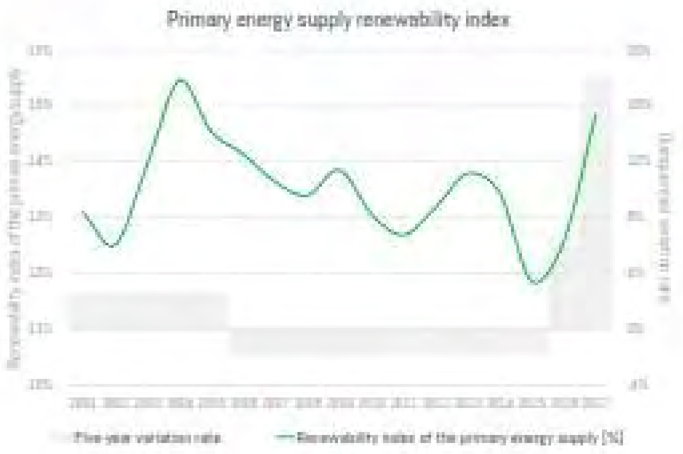


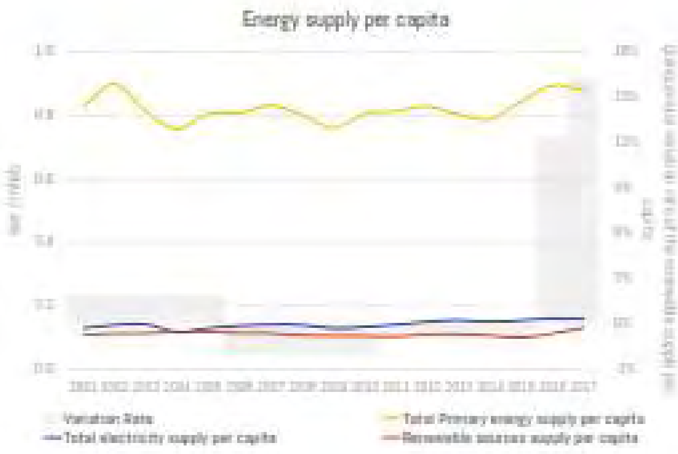


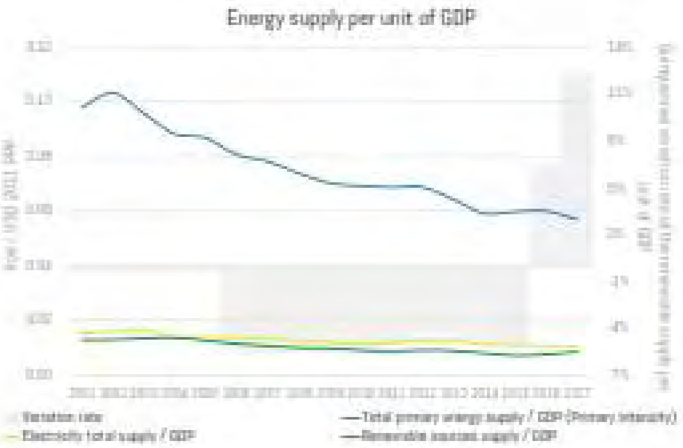


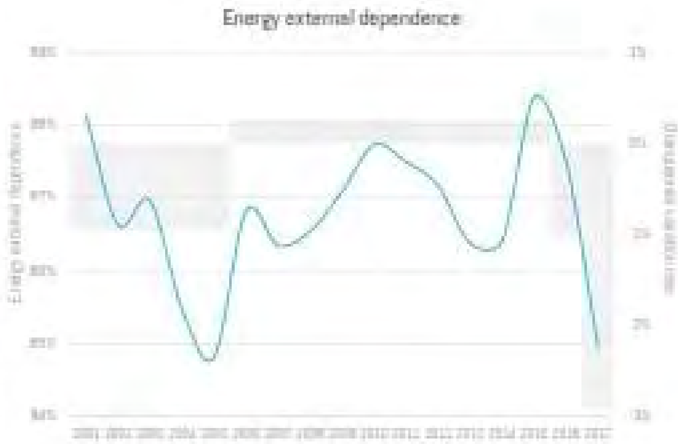


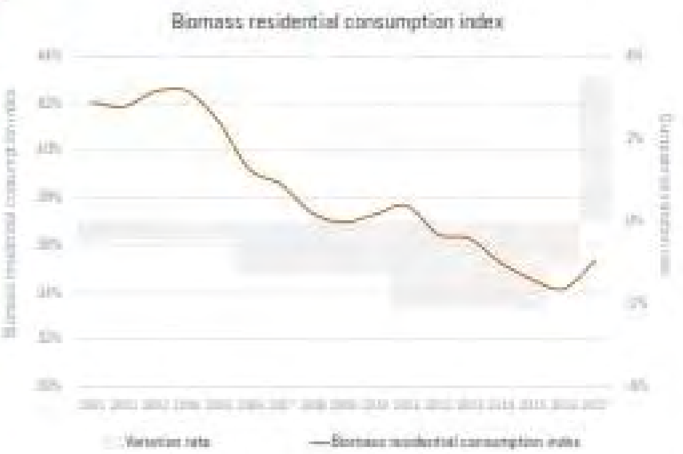
DOMINICAN REPUBLIC

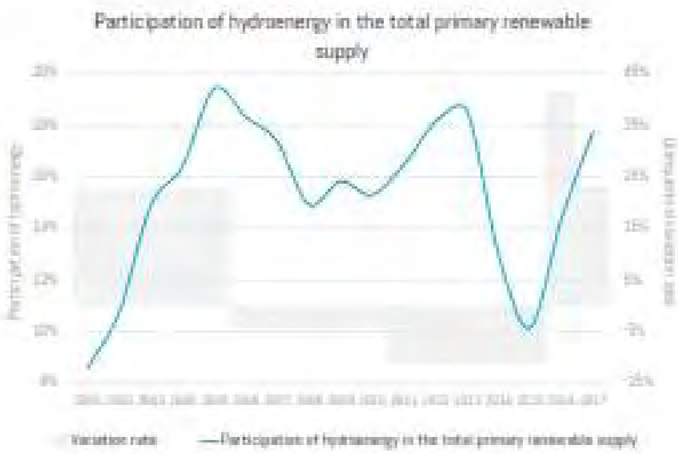






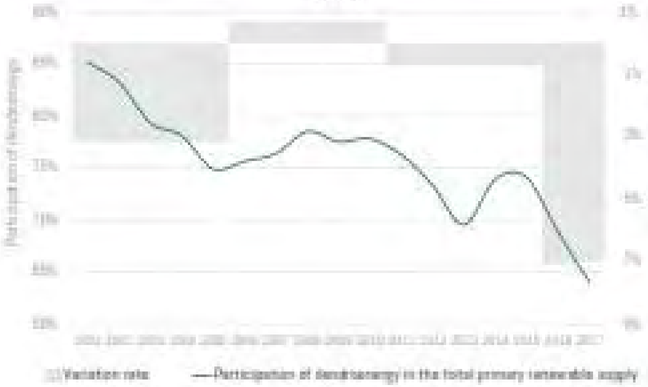






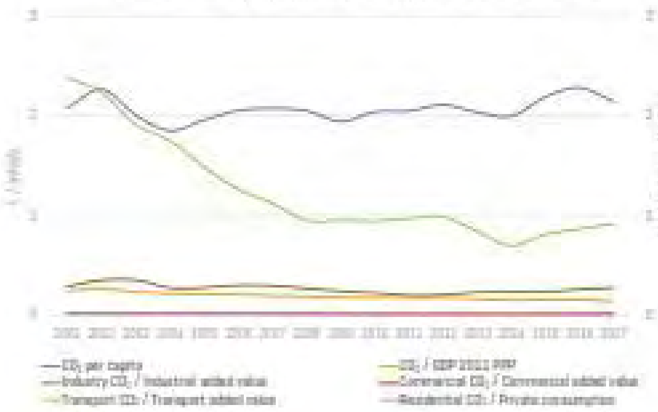
DOMINICAN REPUBLIC

Participation of dendroenergy in the total primary renewable supply

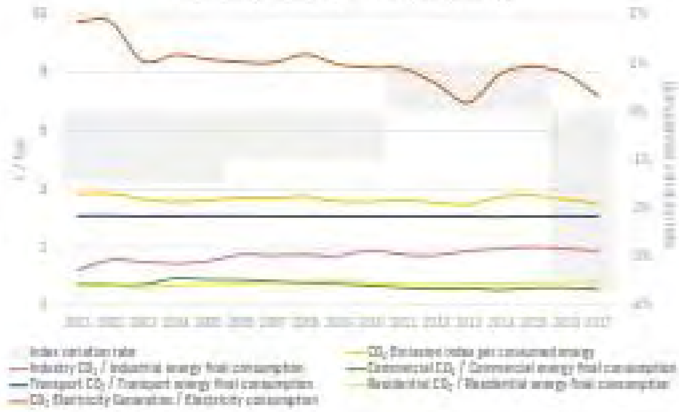


Evolution of CO_2 emissions by sector

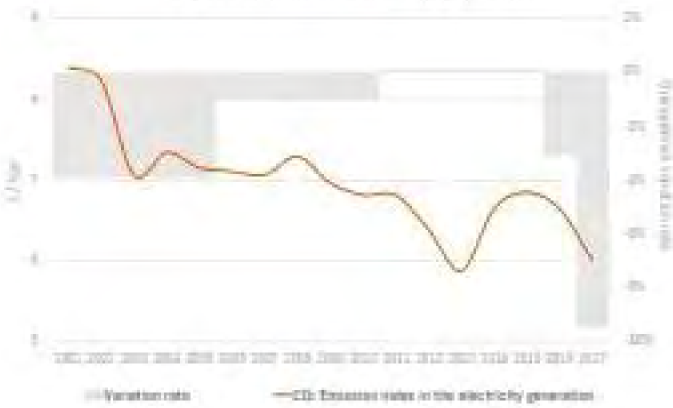
Evolution of CO_2 emissions per capita and per unit of GDP



CO_2 Emission index per consumed energy



CO_2 Emission index of electricity generation



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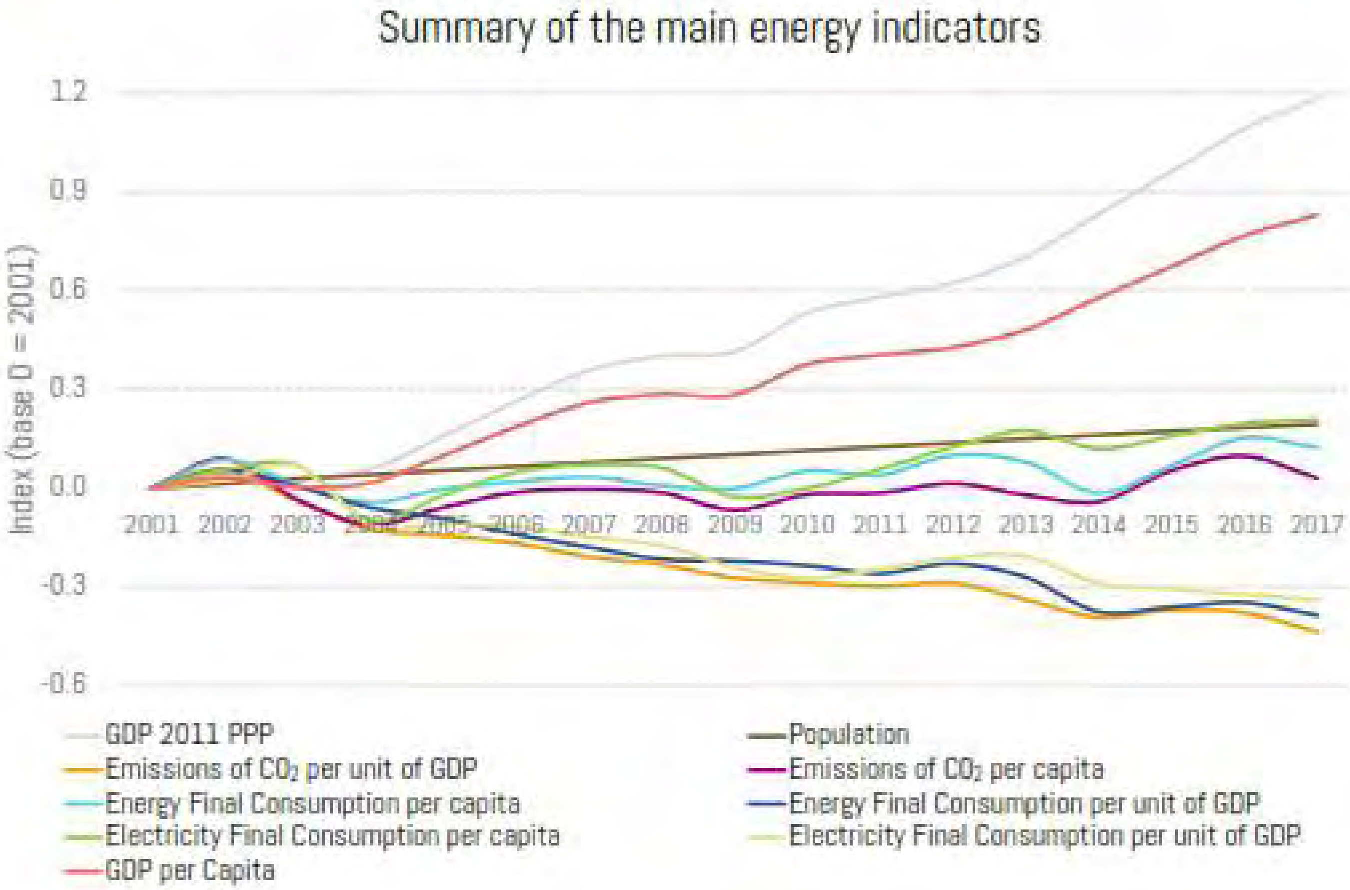

Summary of the main energy indicators
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
Index (base 0 = 2001)
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
GDP 2011 PPP
Population
Emissions of CO_2 per unit of GDP
Emissions of CO_2 per capita
Energy Final Consumption per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per capita
Electricity Final Consumption per unit of GDP
GDP per Capita

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General Information 2017

Population (thousand inhab.)	16,624
Area (km²)	256,370
Population Density (inhab./km²)	65
Urban Population (%)	65
GDP USD 2010 (MUSD)	87,607
GDP USD 2011 PPP (MUSD)	175,923
GDP per capita (thou. USD 2011 PPP/inhab.)	11

Energy Sector

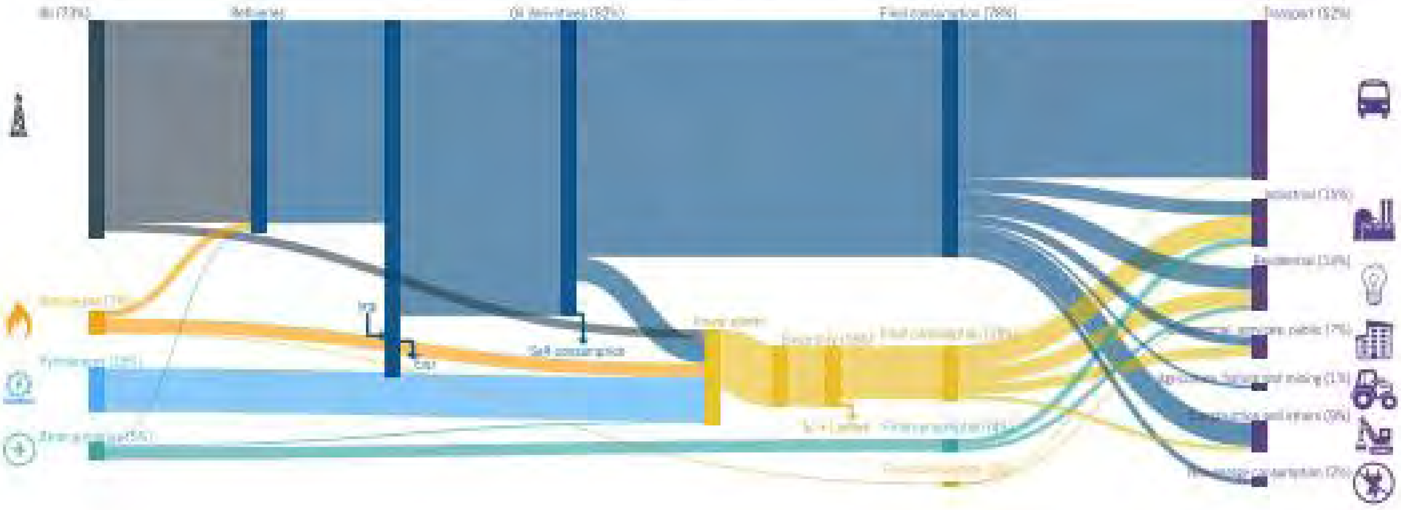
Final consumption in the Transport Sector	Mtoe 6.26
Final consumption in the Industrial Sector	Mtoe 1.78
Final consumption in the Residential Sector	Mtoe 1.69
Final consumption in the Commercial and Service Sector	Mtoe 0.81
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 1.50

Oil reserves	Natural gas reserves	Coal reserves
Mbbl 3,168*	Gm³ 5,224*	Mt n.a.

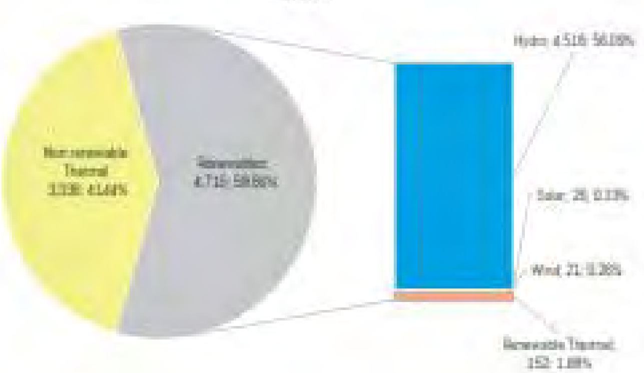
(*) Data from 2016.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,489
Final energy consumption per capita	toe/inhab.	0.72
Electrification rate	%	97.33
Total energy supply	Mtoe	14.88
Total energy production	Mtoe	30.76
Total energy imports	Mtoe	6.10
Total energy exports	Mtoe	21.00
Total final energy consumption	Mtoe	12.05
Refining capacity	kbbl/day	175
Installed power generation capacity	GW	8.05
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.08 / 0.07

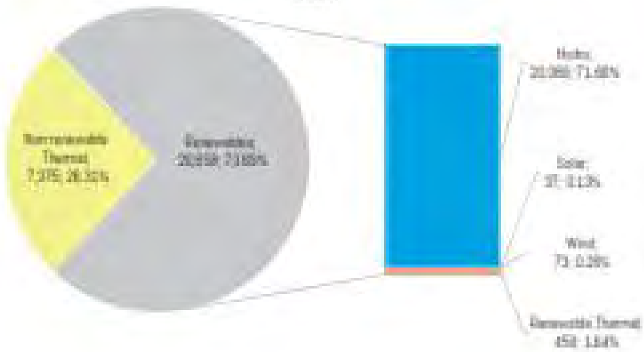
Summarized energy balance 2017



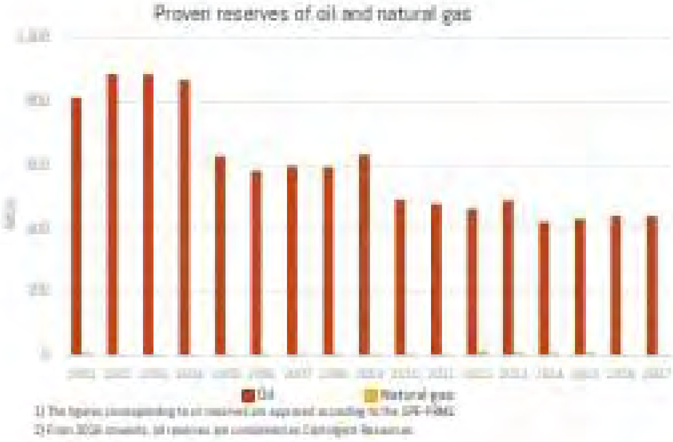
Installed power generation capacity [MW; %] 2017



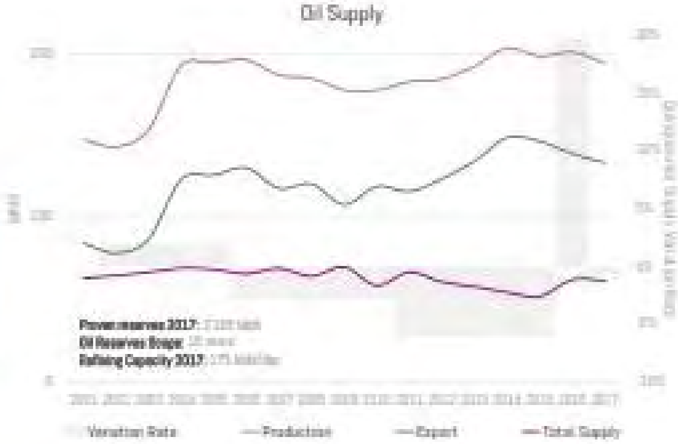
Electricity Generation by Source [GWh; %] 2017



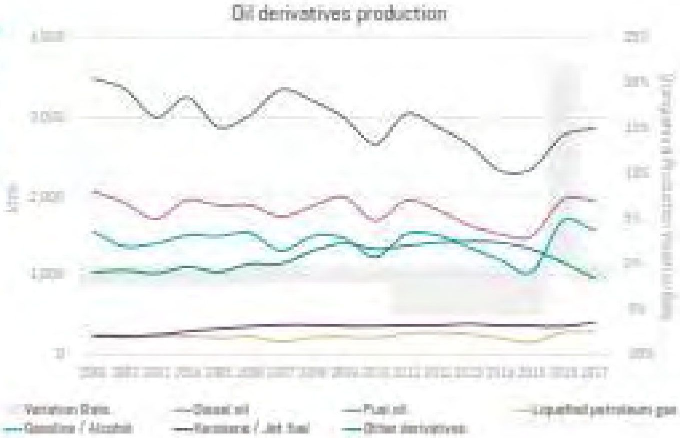
Proven reserves of oil and natural gas



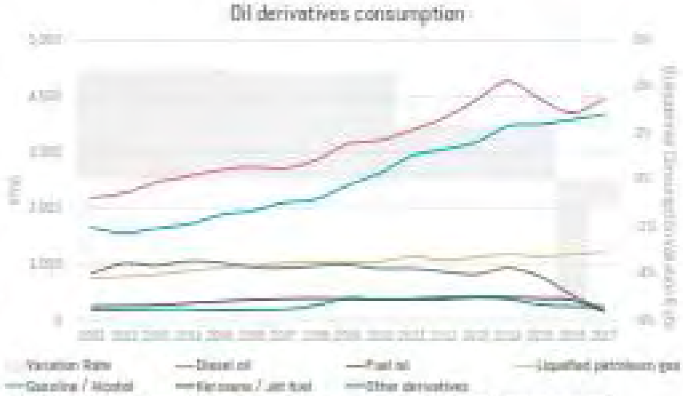
Oil Supply



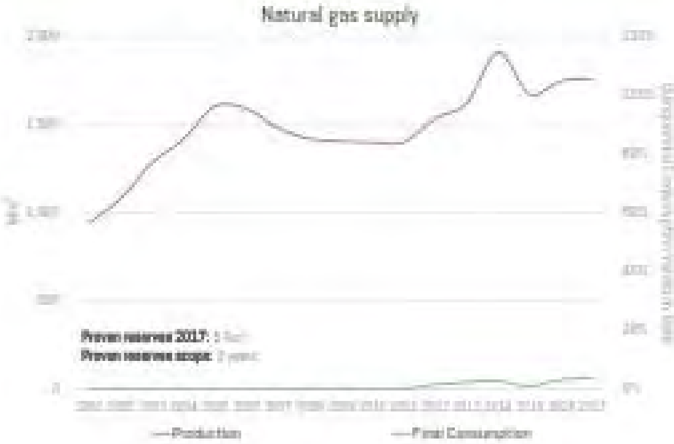
Oil derivatives production



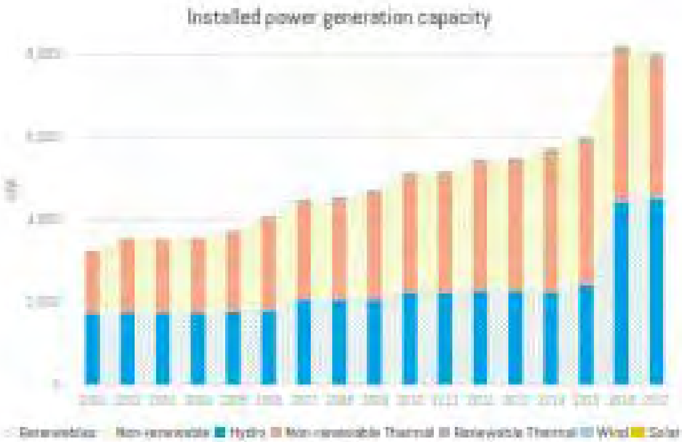
Oil derivatives consumption

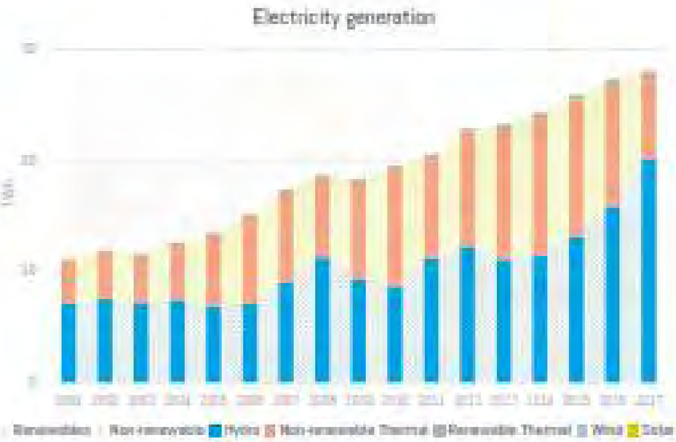


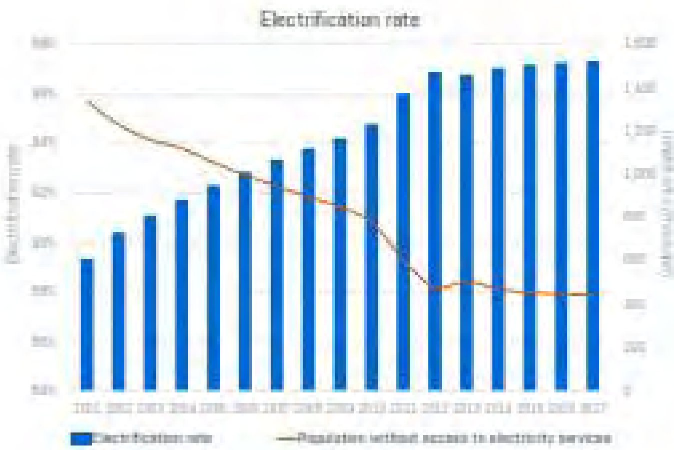
(*) For 2017 fuel oil consumption does not include shipping for international maritime transport. Due to a methodological update, this value is included in bunkers.

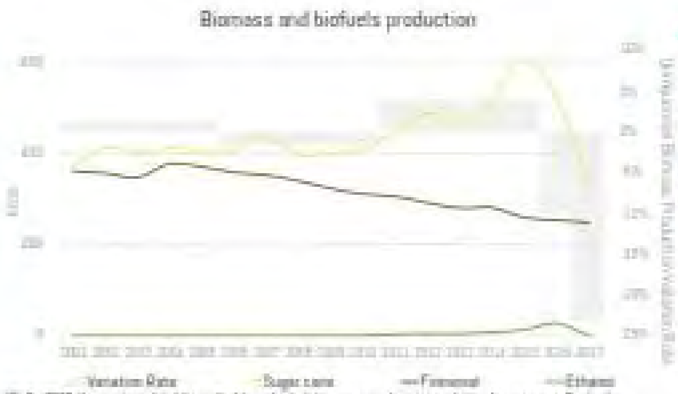


In 2017, the effective power matrix by plant type of Ecuador highlighted the majority participation of hydroelectric plants with 4,486 MW, followed by non-renewable power plants, on which the MCI had the largest participation with 1,544 MW. Likewise, in this year, the first biogas power plant of the El Inga sanitary landfill with an installed power of 6.2 MW came into operation.









(*) For 2017, the country updated the methodology of calculating sugarcane bagasse production for energy use. Previously, it was estimated based on data taken from the Survey of Surface and Continuous Agricultural Production (ESPAC), while for 2017, the estimation was made based on the energy production reported by ARCONEL.

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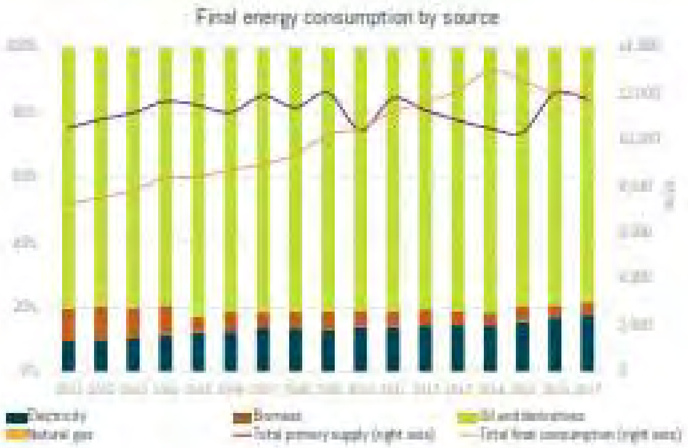
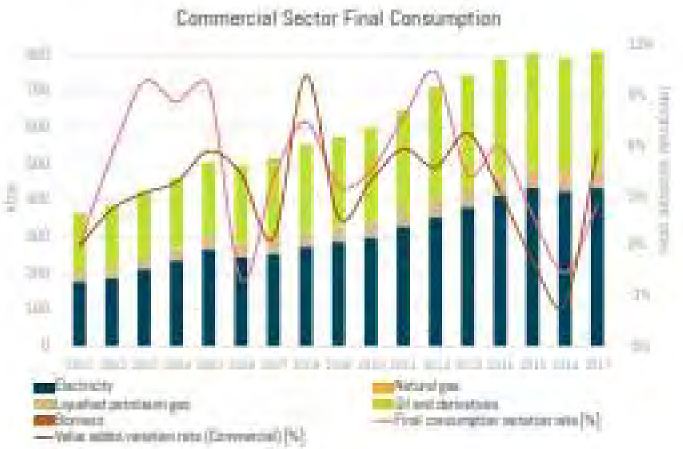
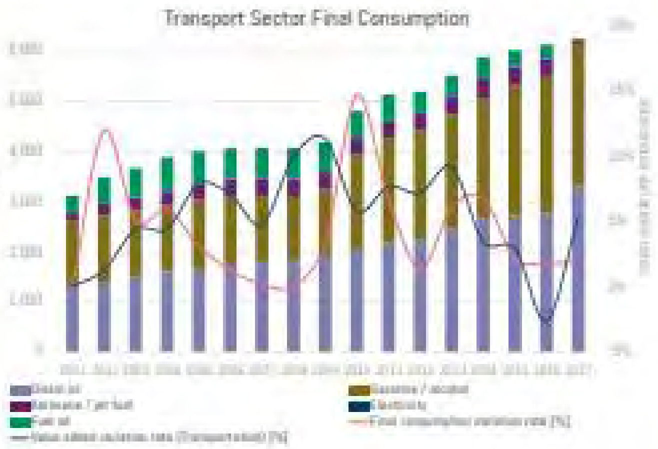

Final energy consumption by source
Electricity
Natural gas
Biomass
Total primary supply (right axis)
Oil and derivatives
Total final consumption (right axis)


Industrial Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]


Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]


Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Fuel oil
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Electricity
Final consumption variation rate [%]

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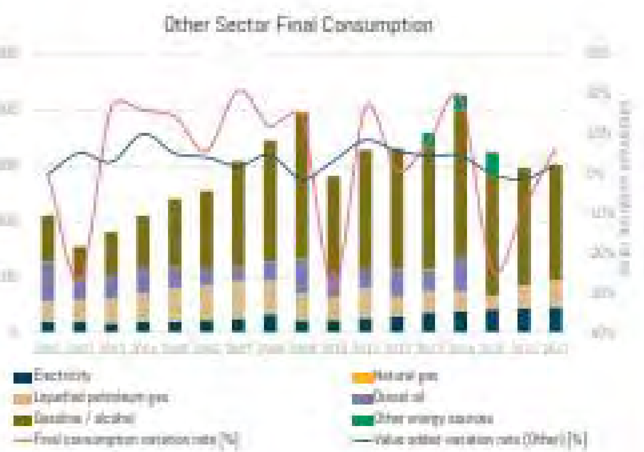
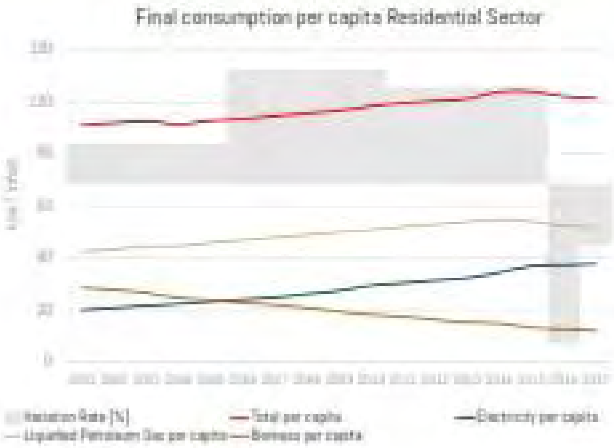
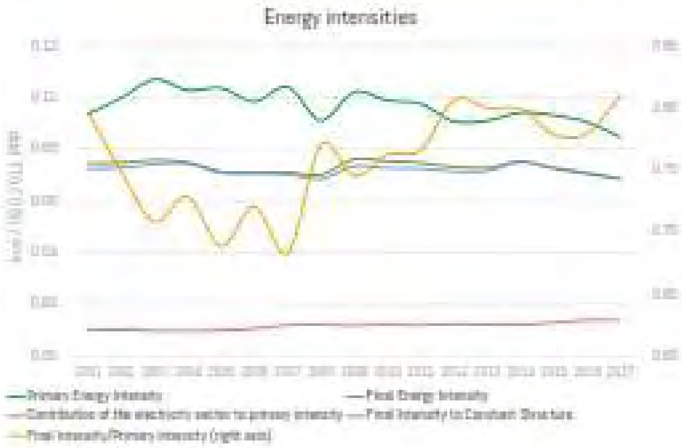
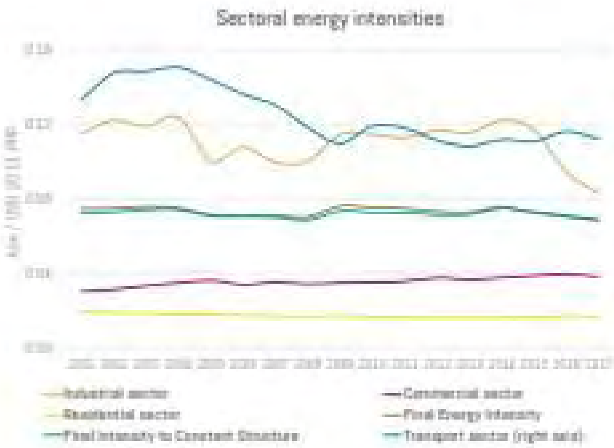
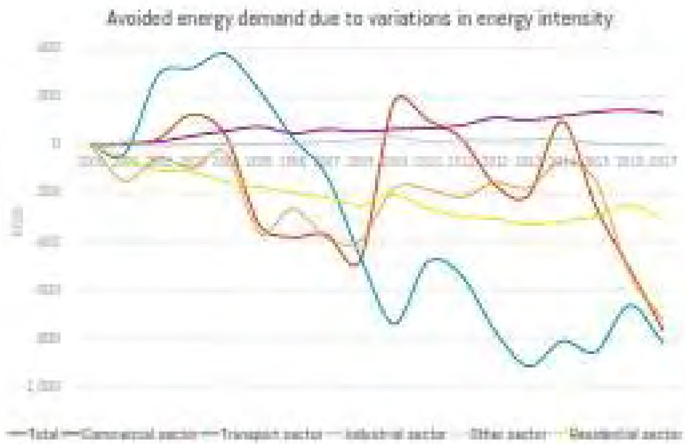

Other Sector Final Consumption
Electricity
Liquefied petroleum gas
Gasoline / alcohol
Final consumption variation rate [%]
Natural gas
Diesel oil
Other energy sources
Value added variation rate (Other) [%]

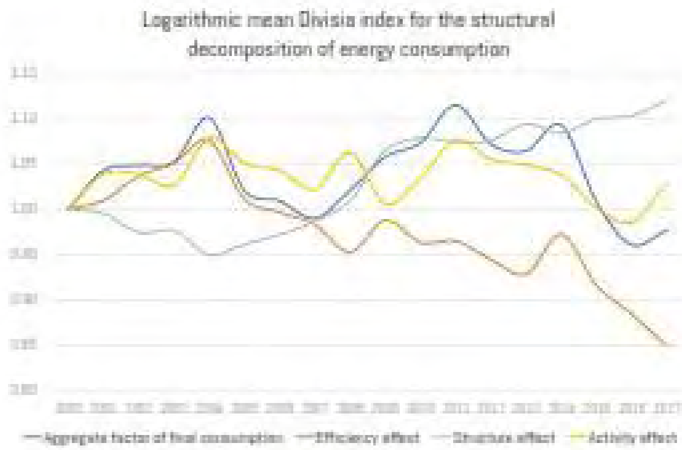

Residential Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]

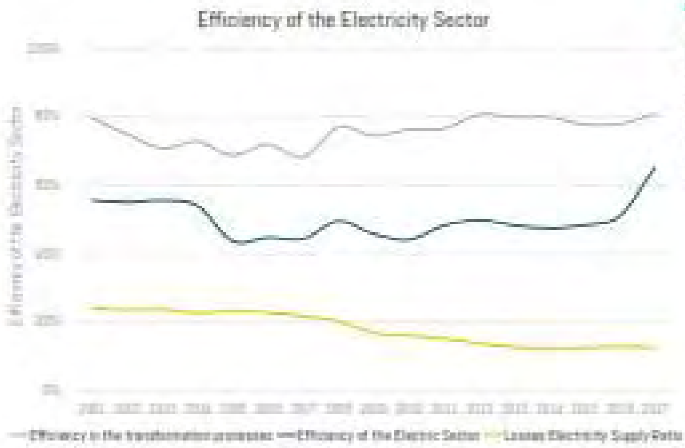

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita


Energy intensities
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)

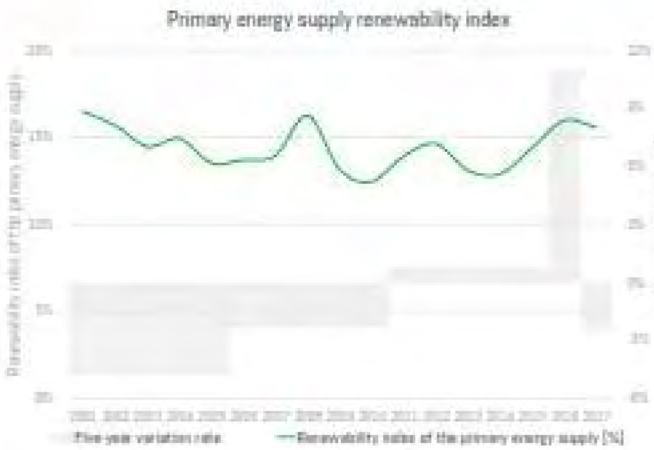

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

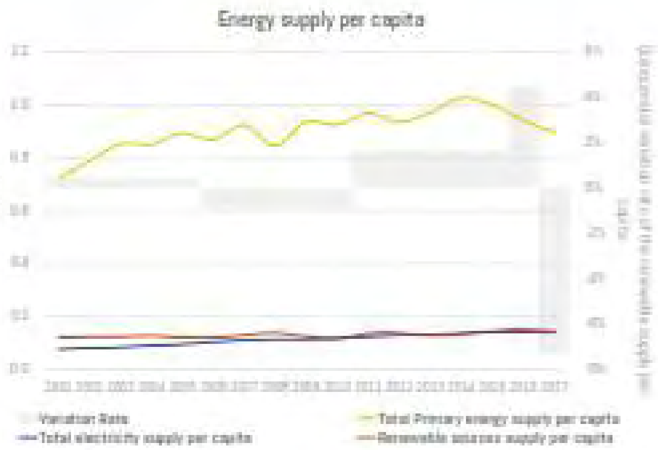

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

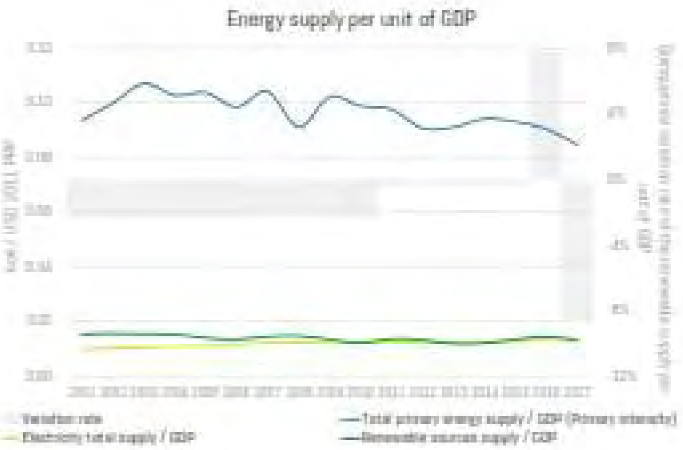

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

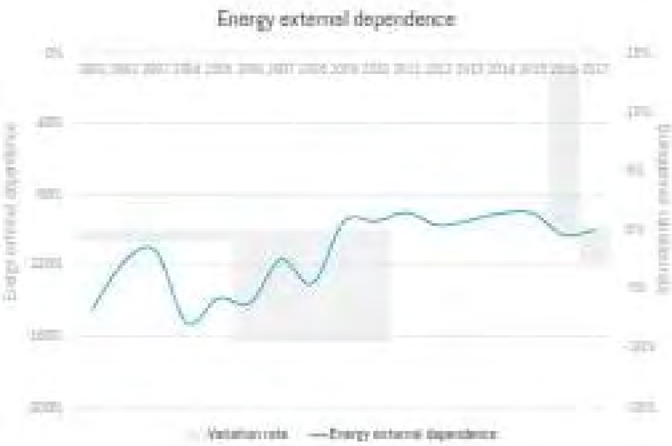

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Rate

ECUADOR

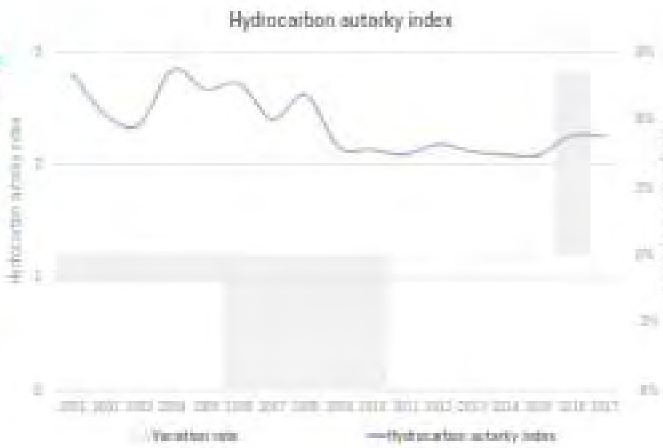

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

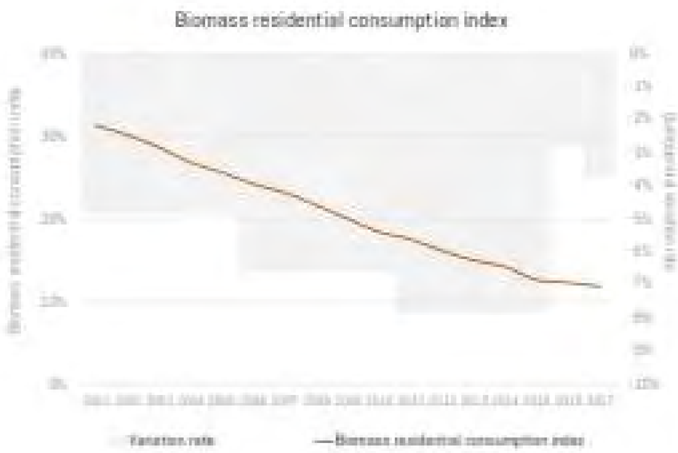

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

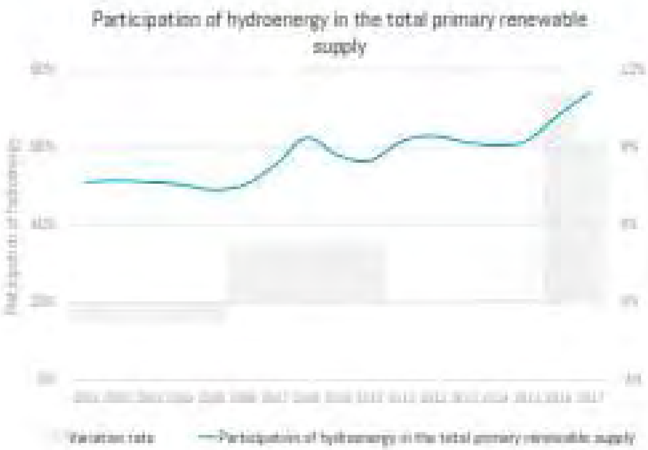

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

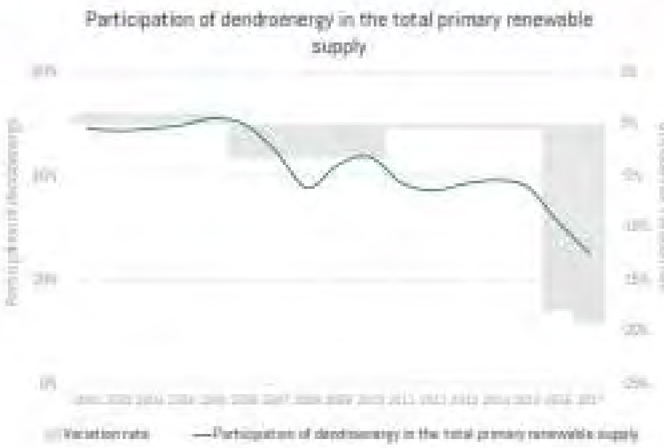

Energy external dependence
Variation rate
Energy external dependence

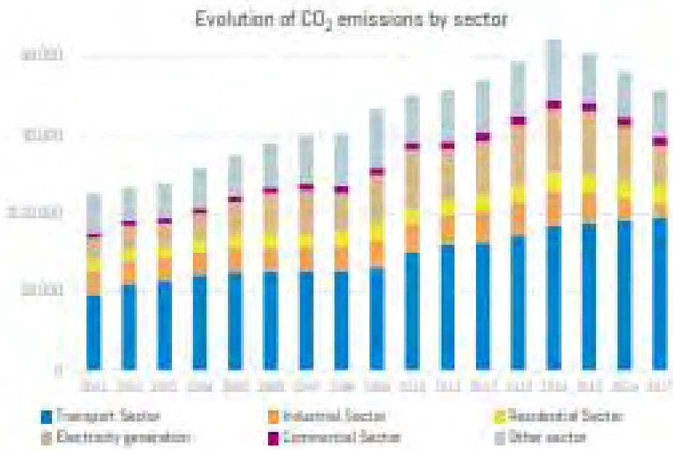
ECUADOR

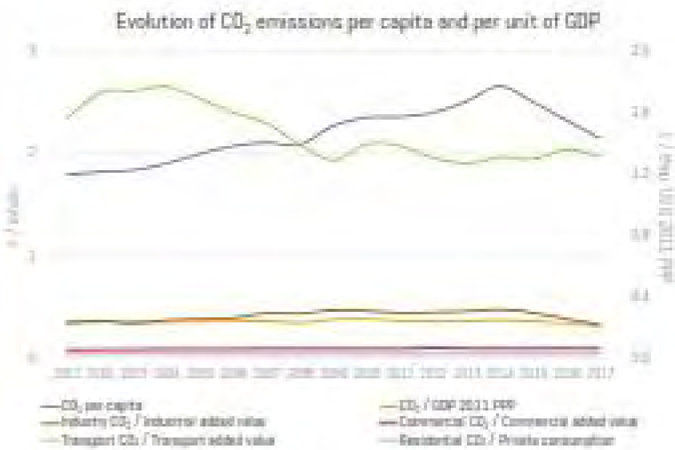

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

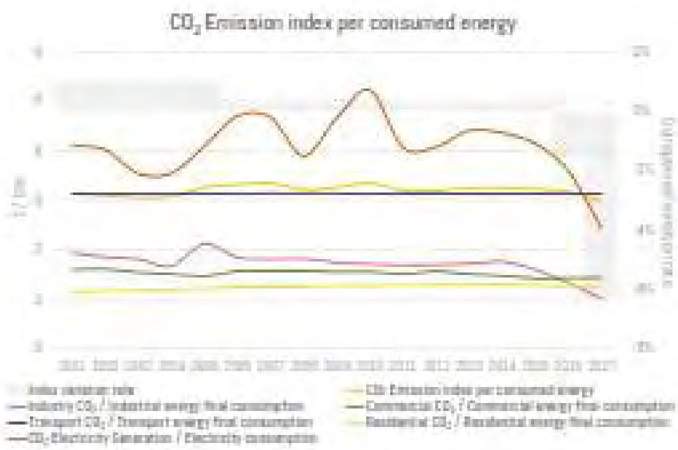

Biomass residential consumption index
Variation rate
Biomass residential consumption index

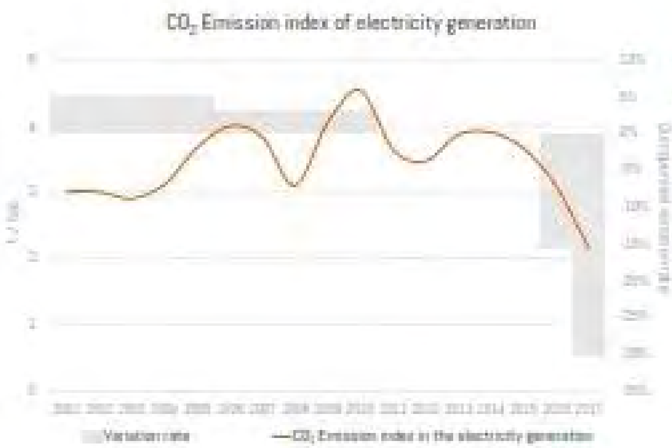

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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

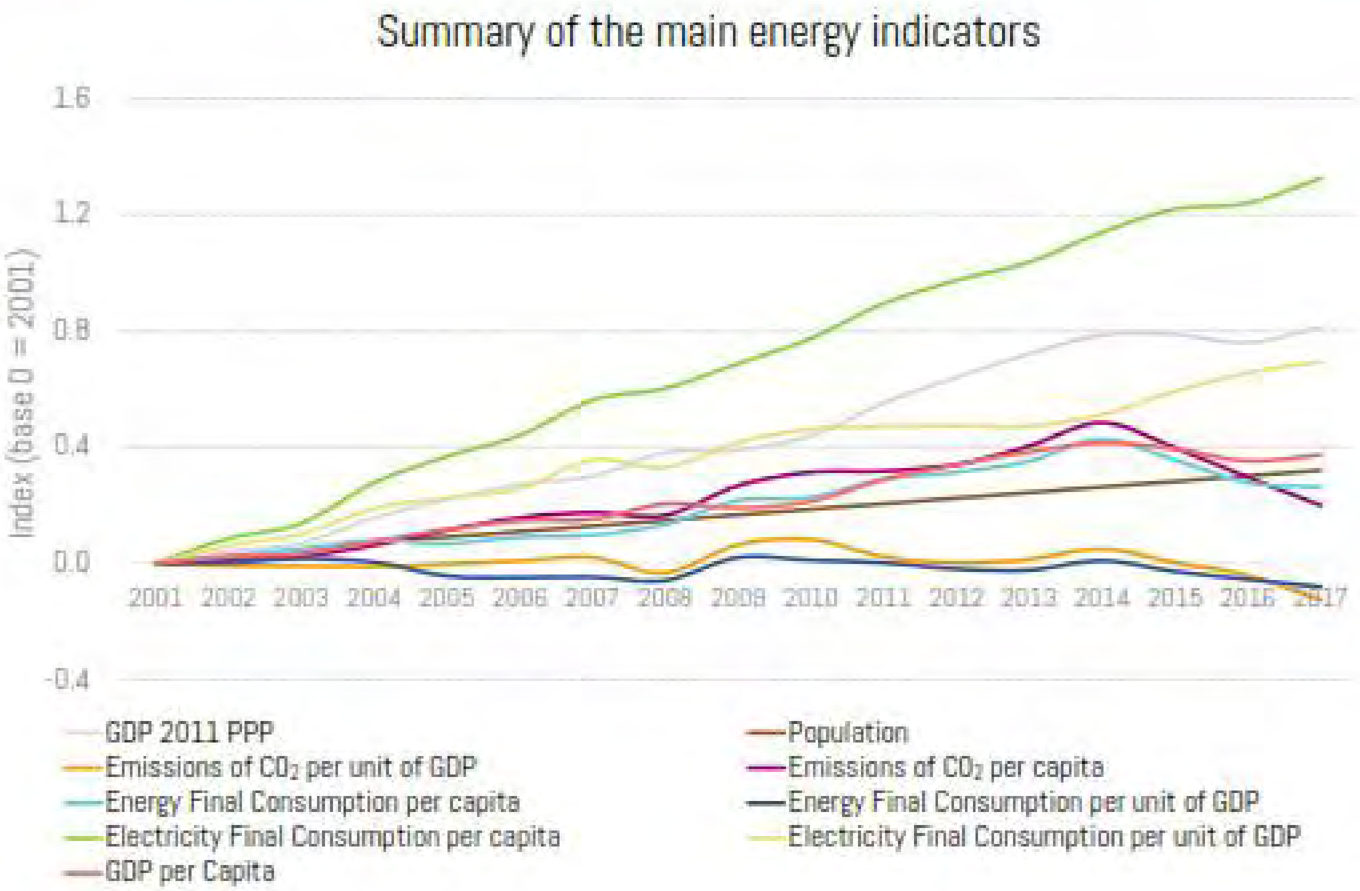

Evolution of CO2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO2 emissions per capita and per unit of GDP
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
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
Variation rate
CO2 Emission index in the electricity generation

ECUADOR



Summary of the main energy indicators
1.6
1.2
0.8
0.4
0.0
-0.4
Index (base 0 = 2001)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

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General Information 2017

Population (thousand inhab.)	6,582[1]
Area (km²)	21,041
Population Density (inhab./km²)	313
Urban Population (%)	60
GDP USD 2010 (MUSD)	22,091
GDP USD 2011 PPP (MUSD)	46,510
GDP per capita (thou. USD 2011 PPP/inhab.)	7

Energy Sector

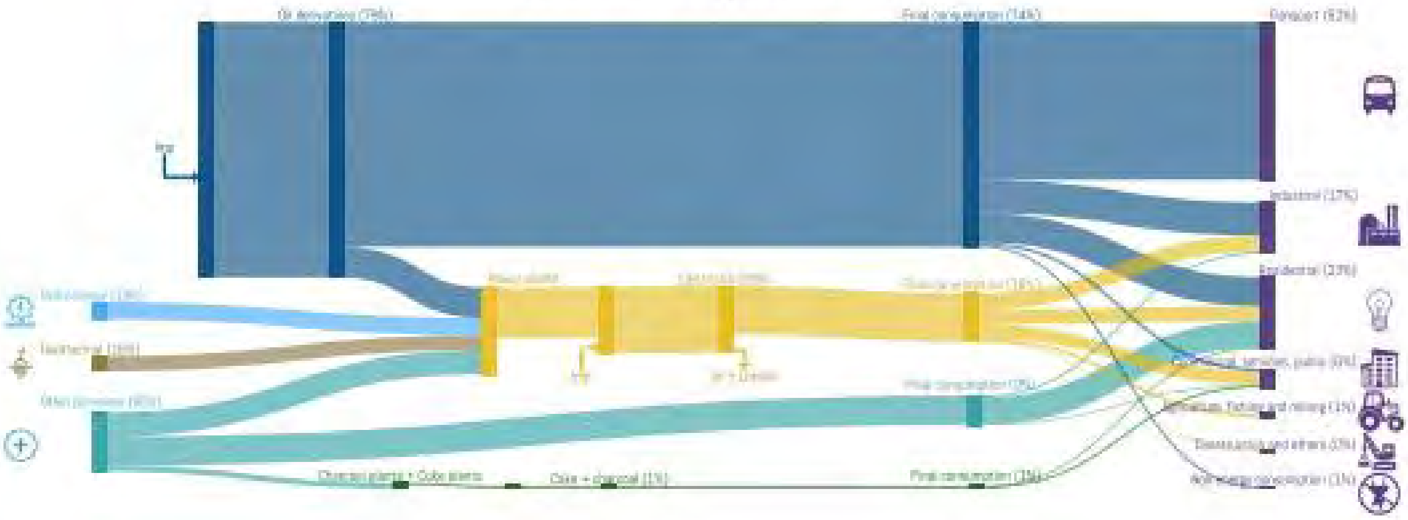
Final consumption in the Transport Sector	Mtoe 1.42
Final consumption in the Industrial Sector	Mtoe 0.46
Final consumption in the Residential Sector	Mtoe 0.64
Final consumption in the Commercial and Service Sector	Mtoe 0.17
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.05

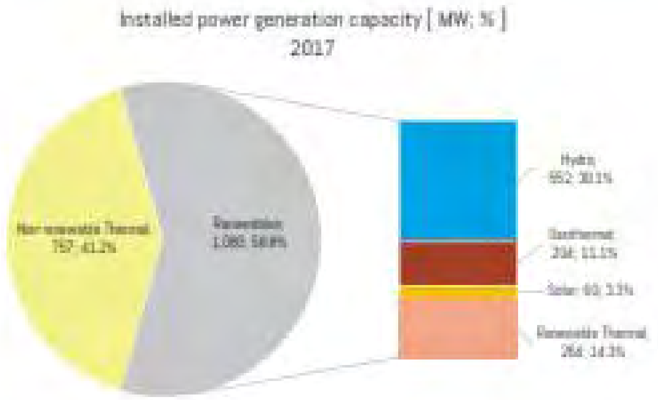
Oil reserves	Natural gas reserves	Coal reserves
Mbbl n.a.	Gm³ n.a.	Mt n.a.

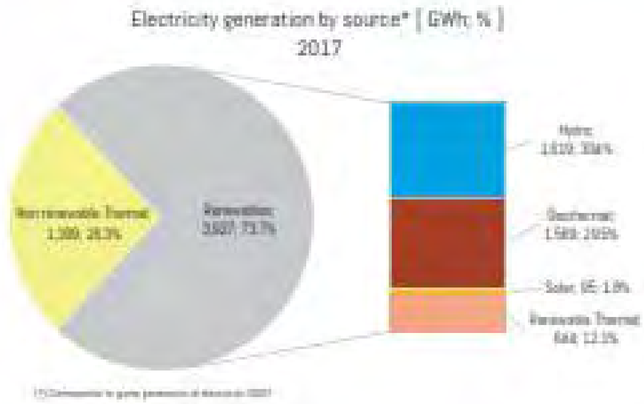
[1] General Direction of Statistics and Census - El Salvador

Electricity consumption per capita	Final energy 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
768	0.42	96.70	3.25	0.82	2.44	0.01	2.74	n.a.	1.84	0.07 / 0.06

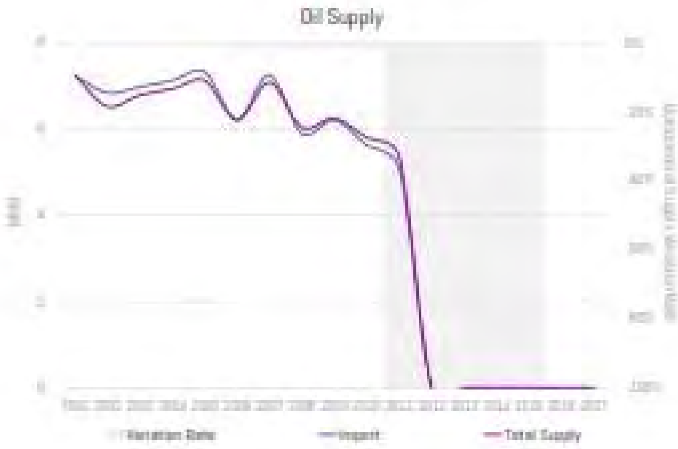
Summarized energy balance 2017







In September 2012, the Refinery of El Salvador (RASA) in Acujatla ceased operations.



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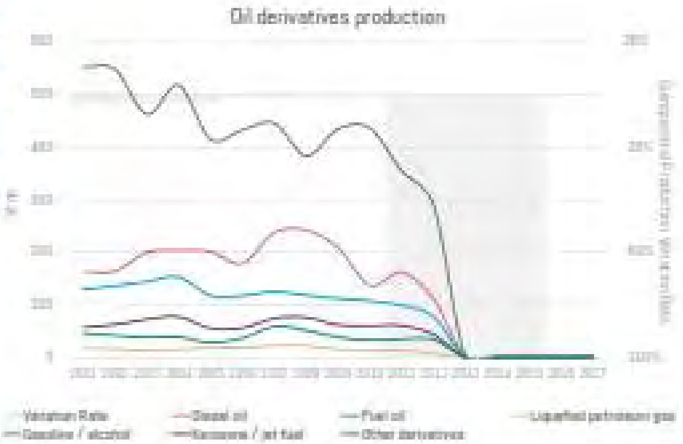
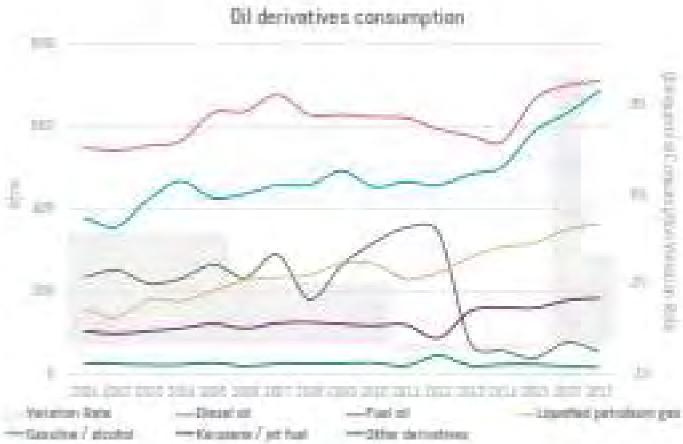
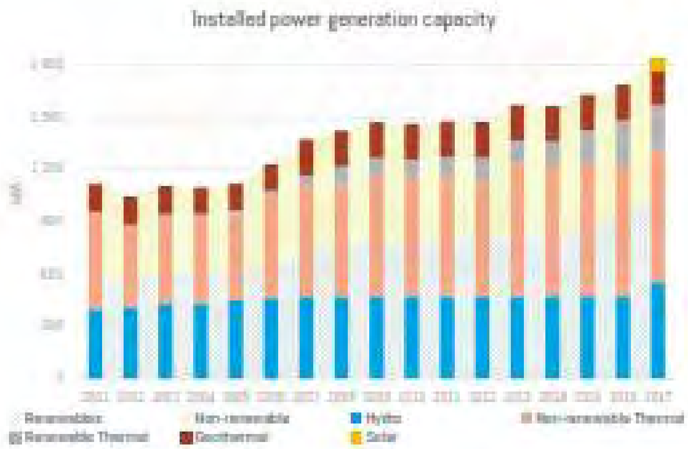
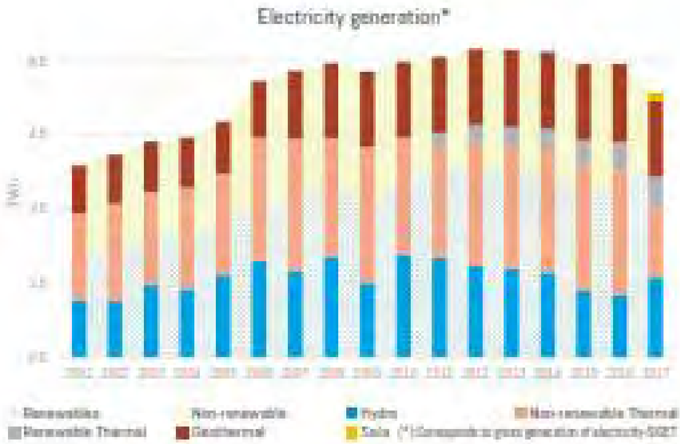


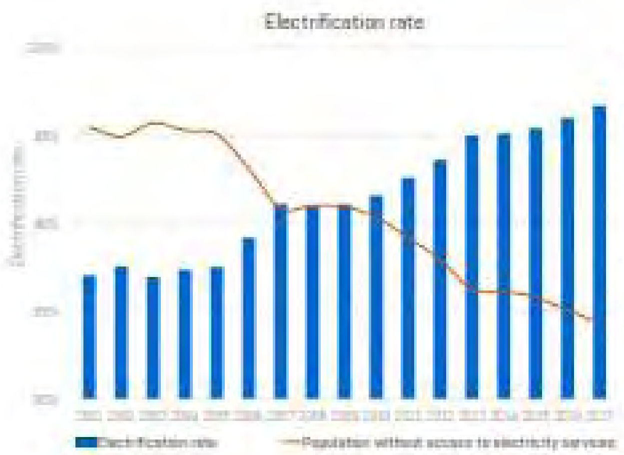


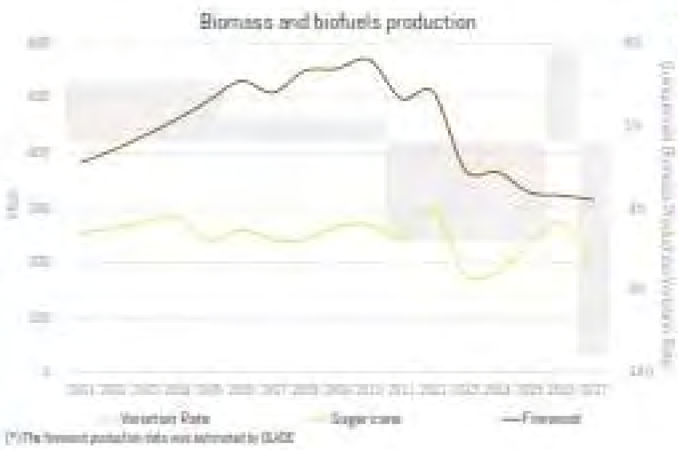


On January 6, 2017, the Biogas generation plant of the Agrosania S.A, C.V. began its commercial operation with a nominal capacity of 150 kW.

In April 2017, the Antares Photovoltaic Solar Plant, owned by Sociedad Providencia Solar S.A, C.V. entered into commercial operation in the Wholesale Market of El Salvador, with a nominal capacity of 60 MW. Being the largest operating photovoltaic solar plant both in the country and in Central America.







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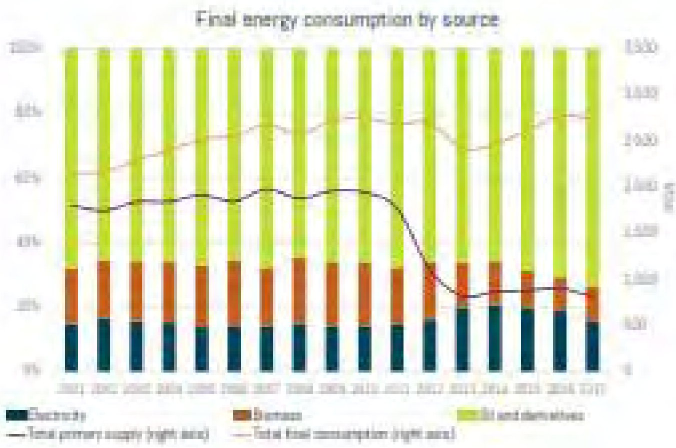
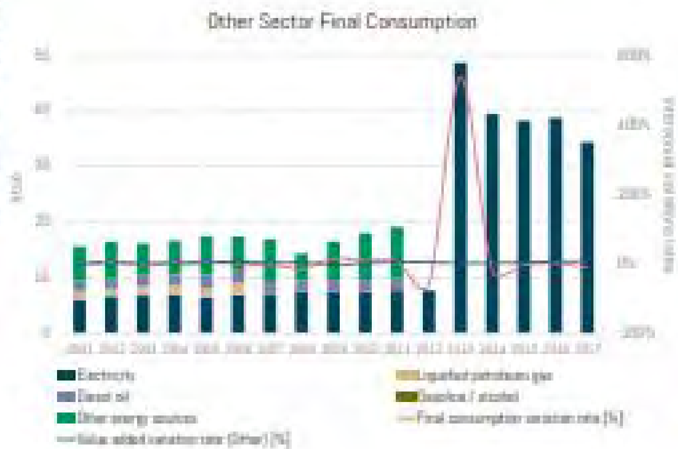

Final energy consumption by source
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

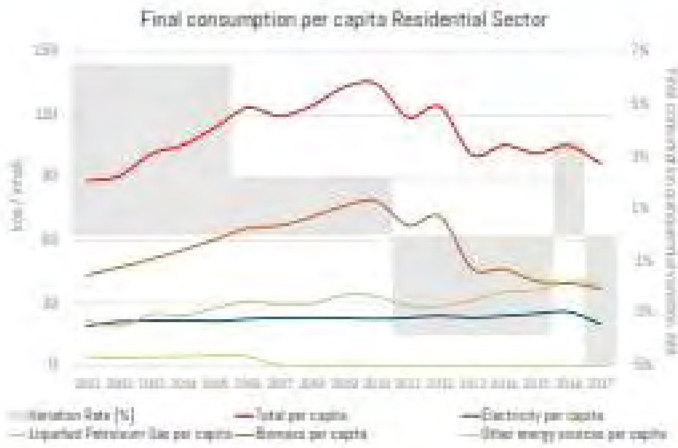

Industrial Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

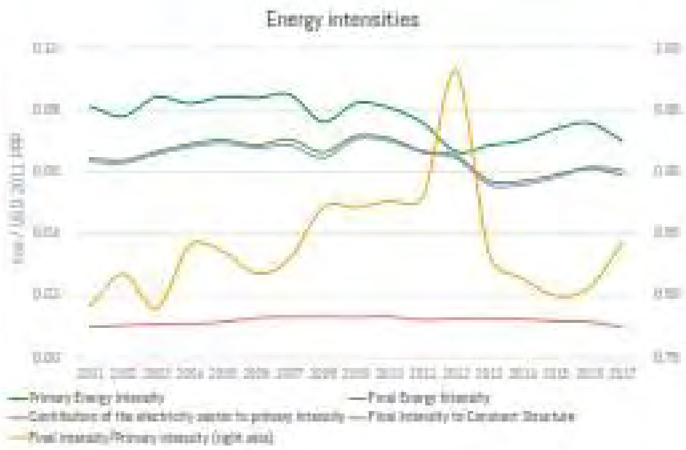

Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

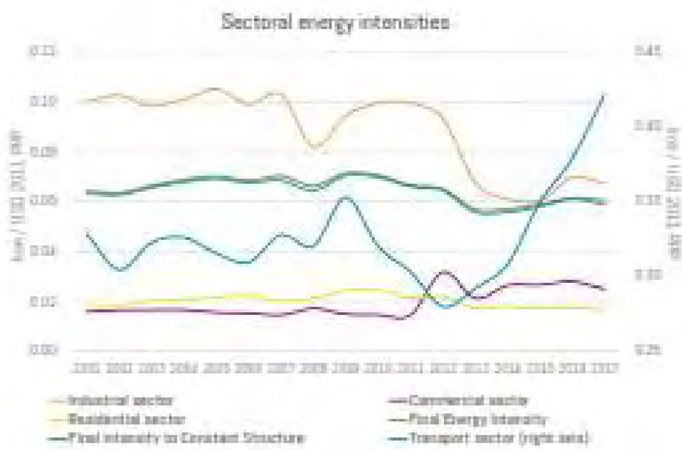

Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

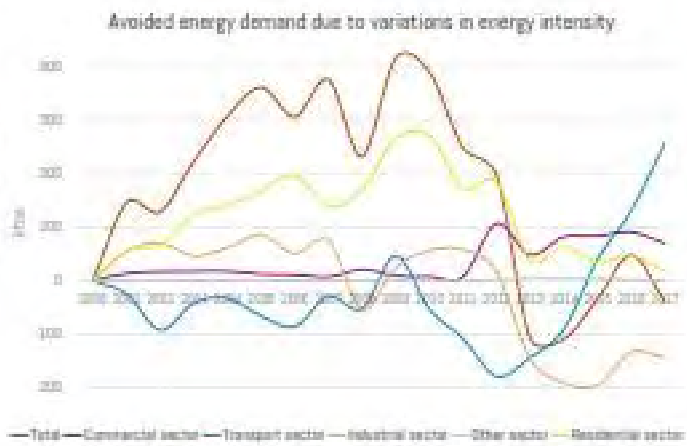

Other Sector Final Consumption
Electricity
Liquefied petroleum gas
Diesel oil
Gasoline / alcohol
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Other) [%]

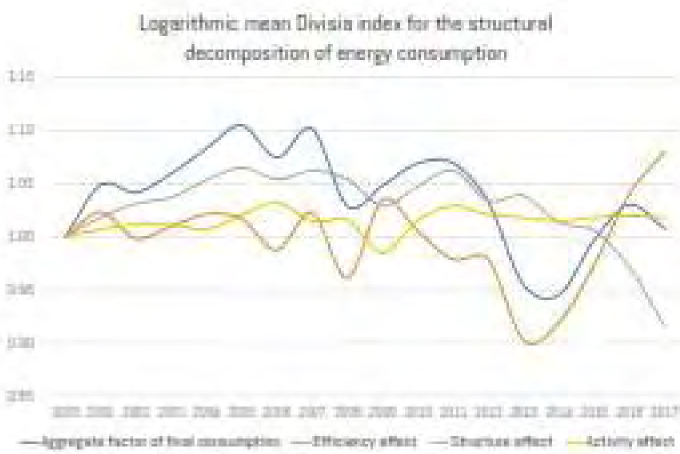

Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

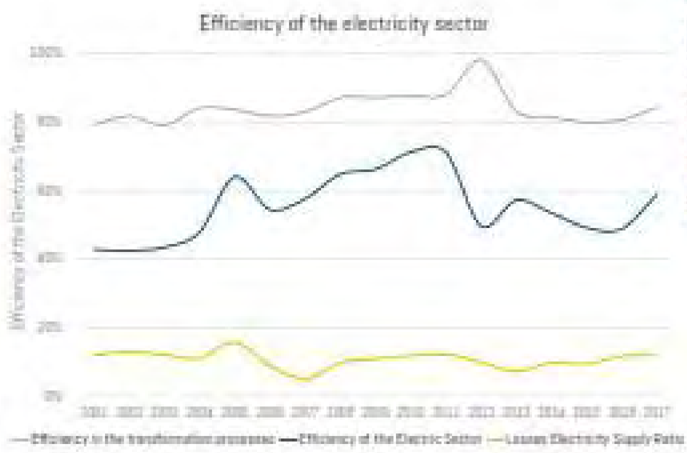

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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
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 in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

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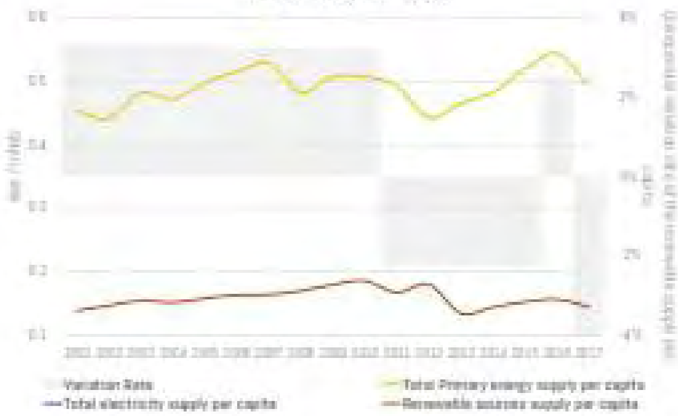
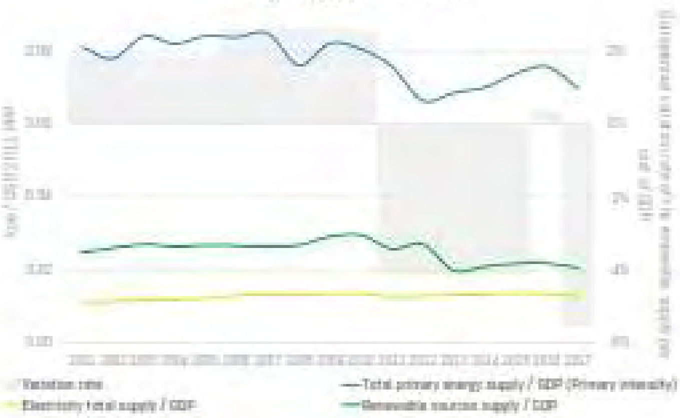
Primary energy supply renewability index

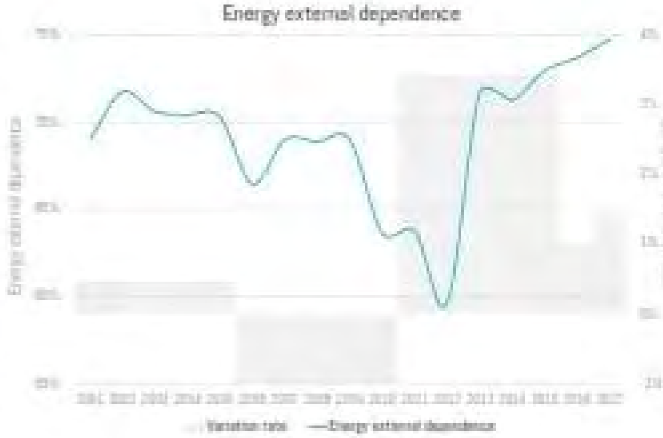
Energy supply per capita



Energy supply per unit of GDP



Energy external dependence



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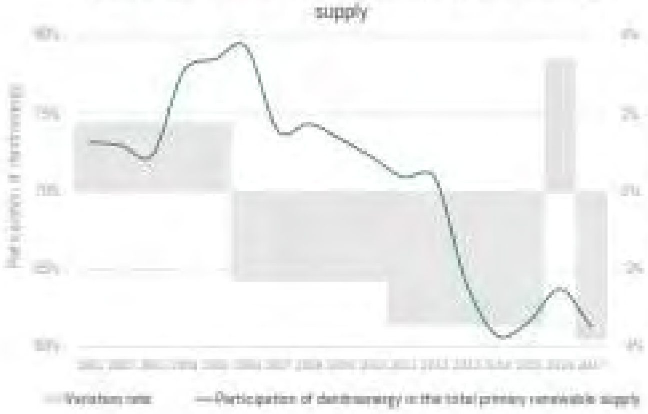
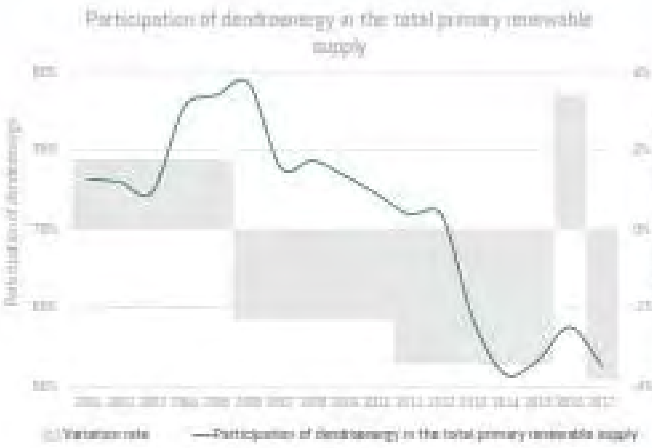
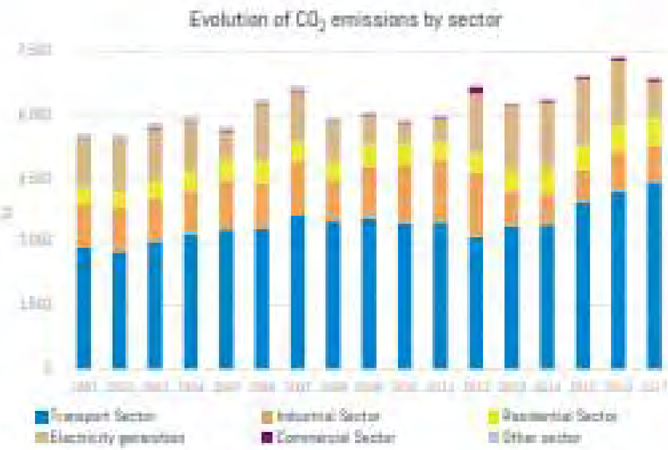
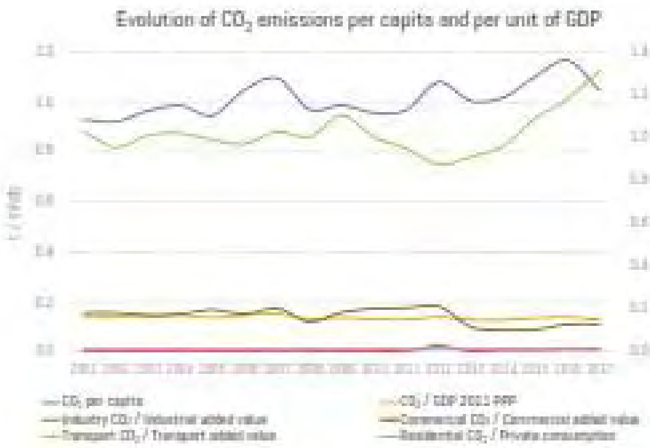
Participation of hydroenergy in the total primary renewable supply

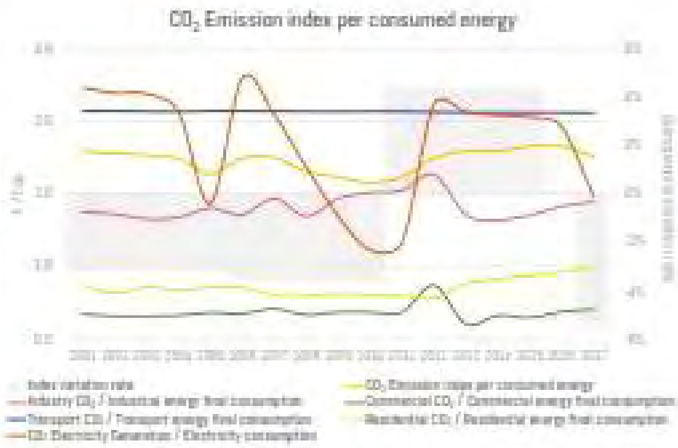
Participation of dendroenergy in the total primary renewable supply

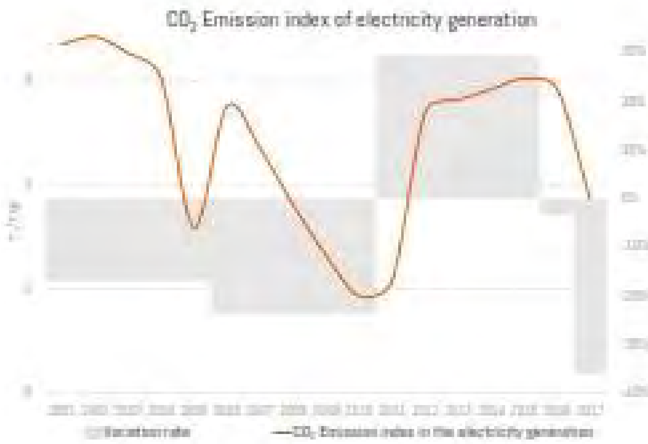



Participation of dendroenergy in the total primary renewable supply
Participation of dendroenergy
Variation rate
Participation of dendroenergy in the total primary renewable supply


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


Evolution of CO2 emissions per capita and per unit of GDP
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
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
Variation rate
CO2 Emission index in the electricity generation

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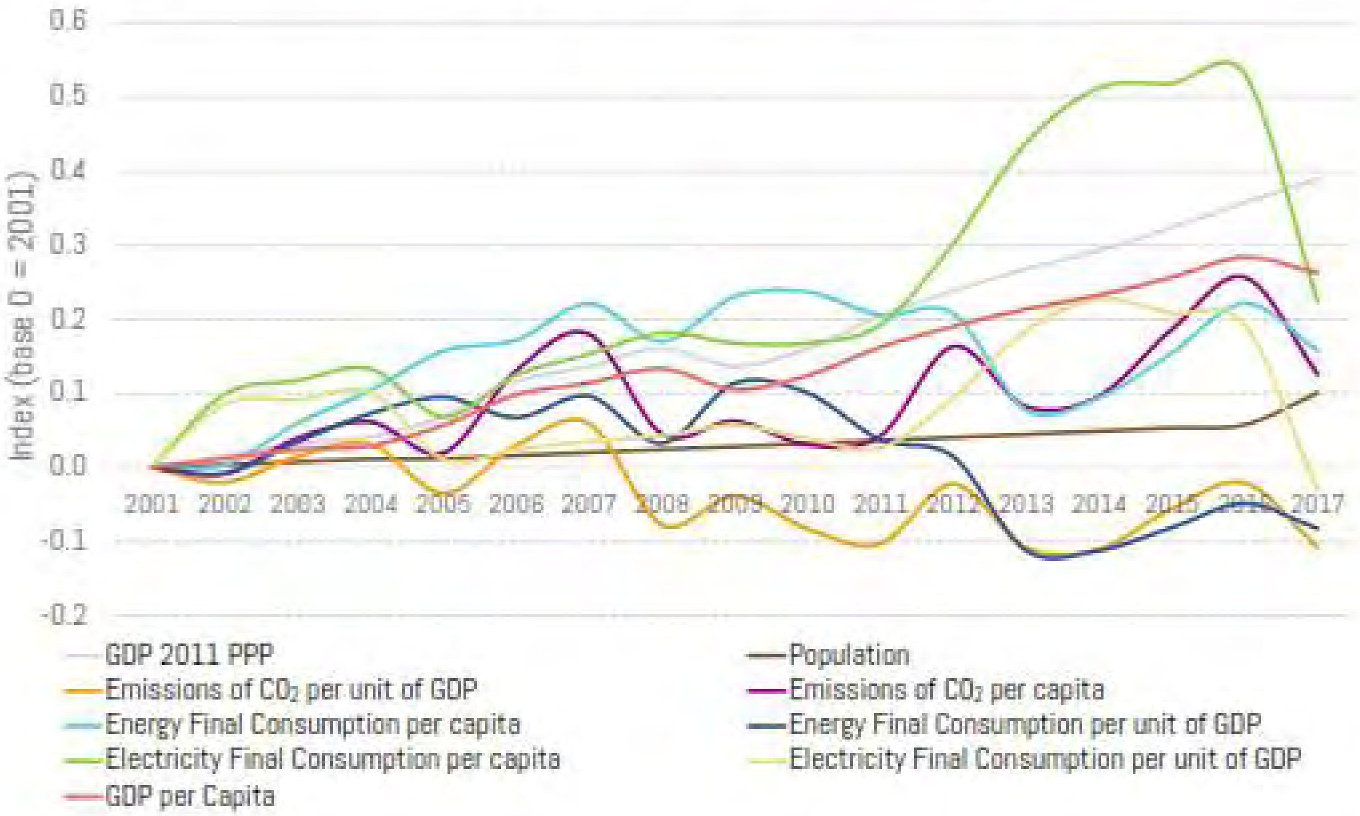
Summary of the main energy indicators



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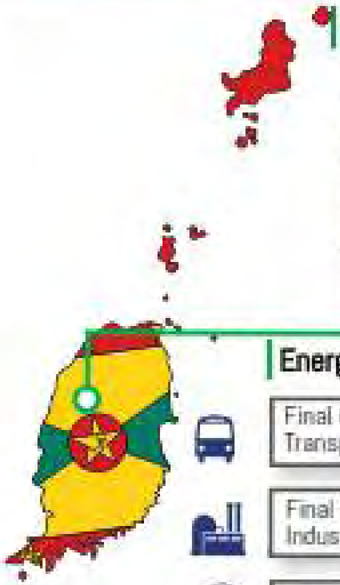
GRENADA



General Information 2017

Population (thousand inhab.)	108
Area (km²)	340
Population Density (inhab./km²)	317
Urban Population (%)	36
GDP USD 2010 (MUSD)	979
GDP USD 2011 PPP (MUSD)	1,466
GDP per capita (thou. USD 2011 PPP/inhab.)	14

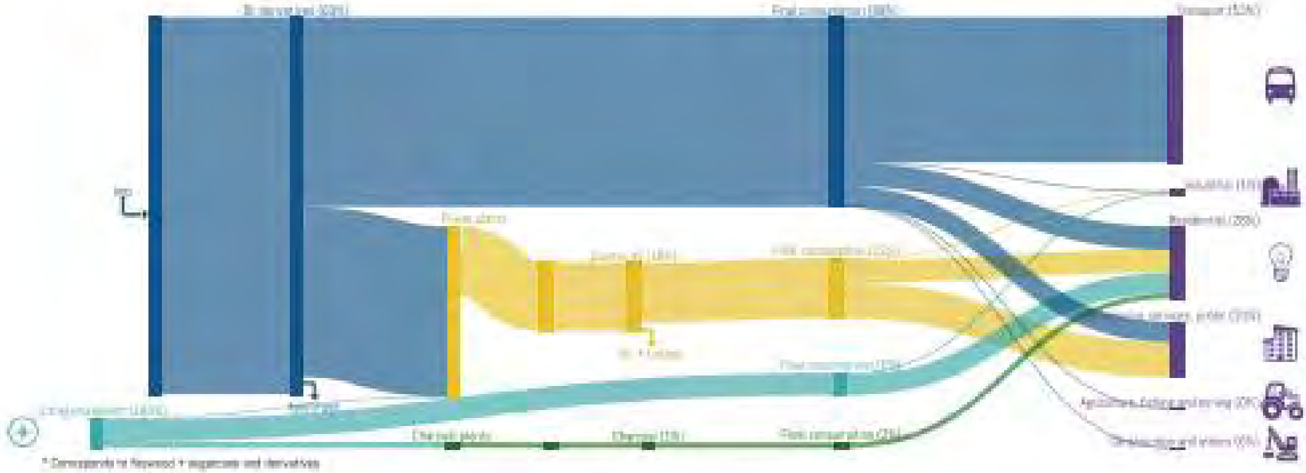
Energy Sector

	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	0.02
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.00

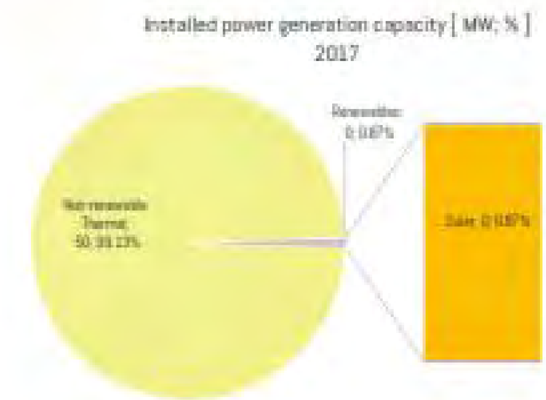
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

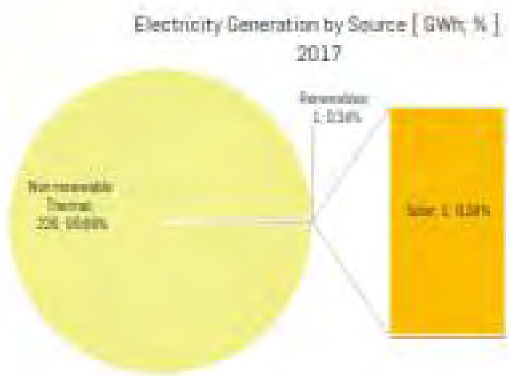
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,818
Final energy consumption per capita	toe/inhab.	0.73
Electrification rate	%	98.10
Total energy supply	Mtoe	0.11
Total energy production	Mtoe	0.01
Total energy imports	Mtoe	0.11
Total energy exports	Mtoe	0.00
Total final energy consumption	Mtoe	0.08
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 / 0.05

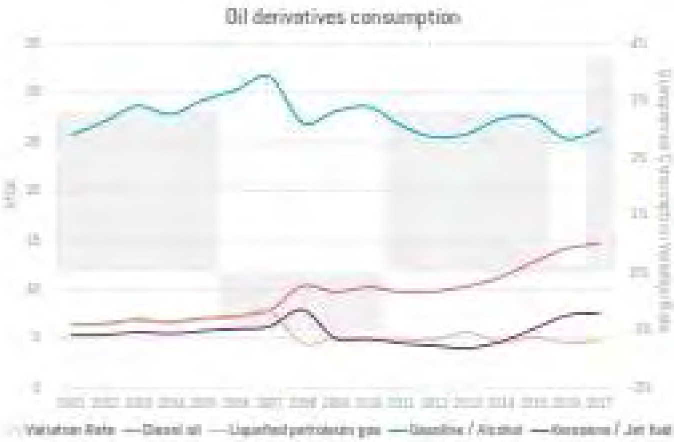
Summarized energy balance 2017



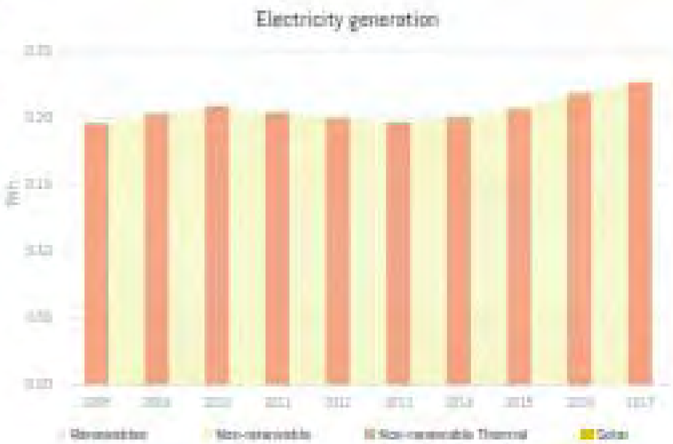
* Corresponds to firewood + sugarcane and derivatives

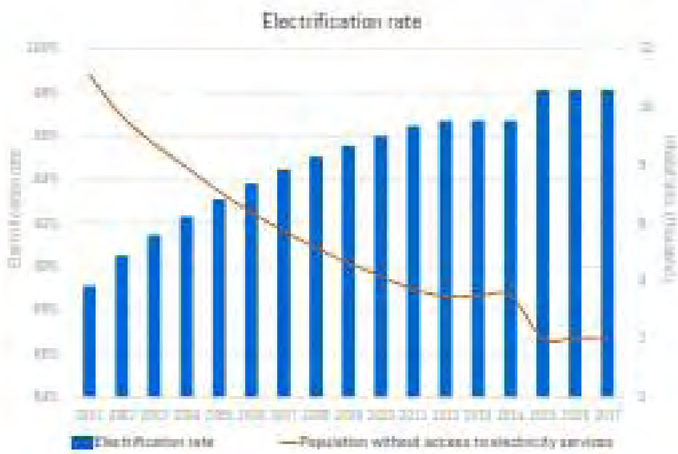

Installed power generation capacity [MW; %]
2017
Renewables
Non-renewable Thermal
Solar

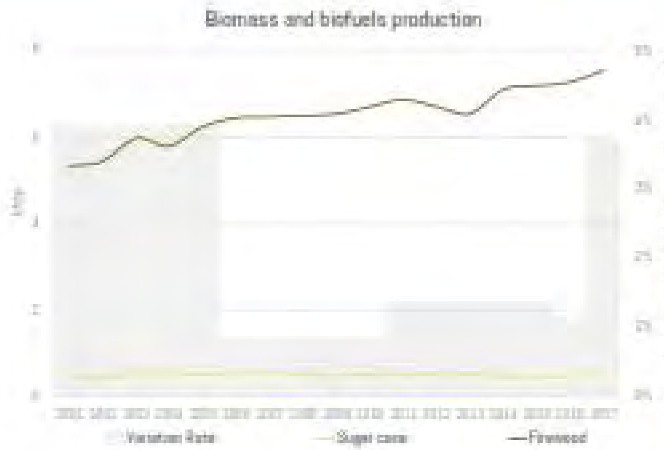

Electricity Generation by Source [GWh; %]
2017
Renewables
Non-renewable Thermal
Solar

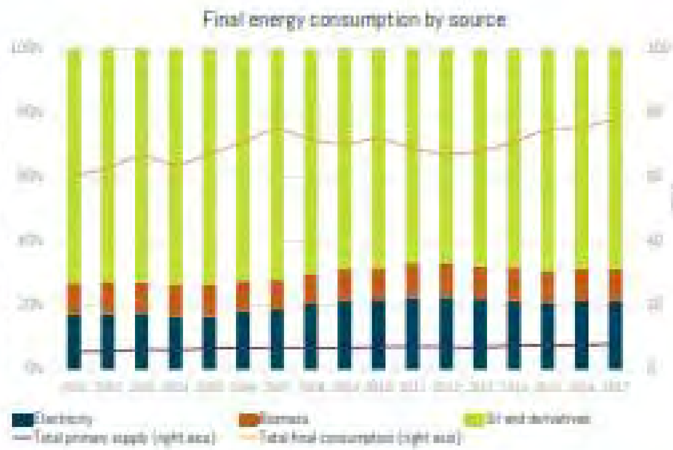

Oil derivatives consumption
Variation Rate
Diesel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel


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

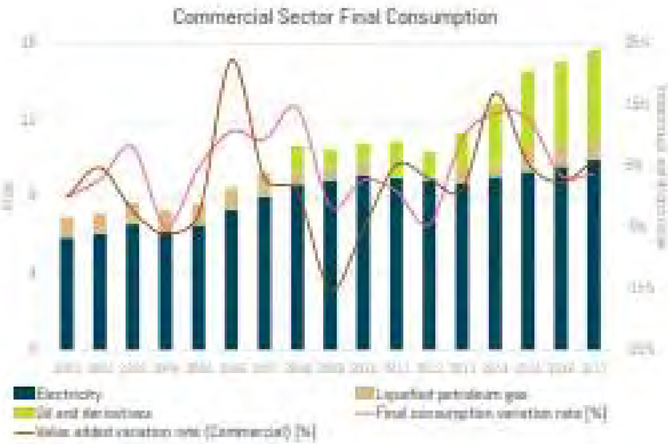

Electricity generation
TWh
Renewables
Non-renewable
Non-renewable Thermal
Solar

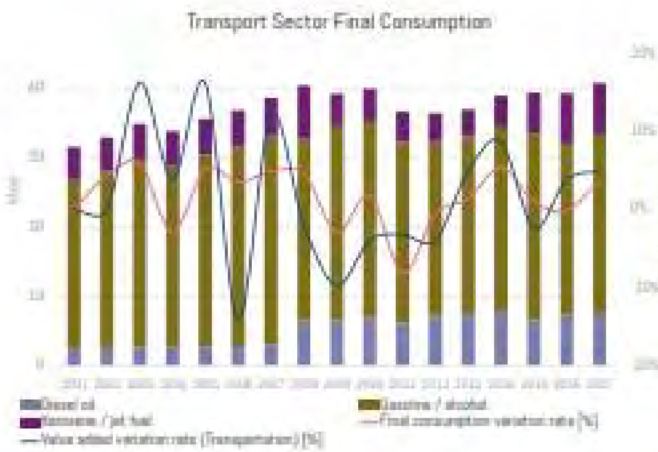

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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

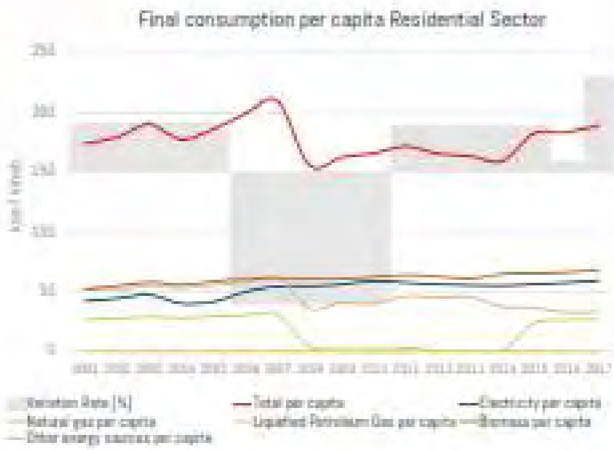

Industrial Sector Final Consumption
Electricity
Biomass
Oil and derivatives
Value added variation rate (Industrial) [%]
Final consumption variation rate [%]

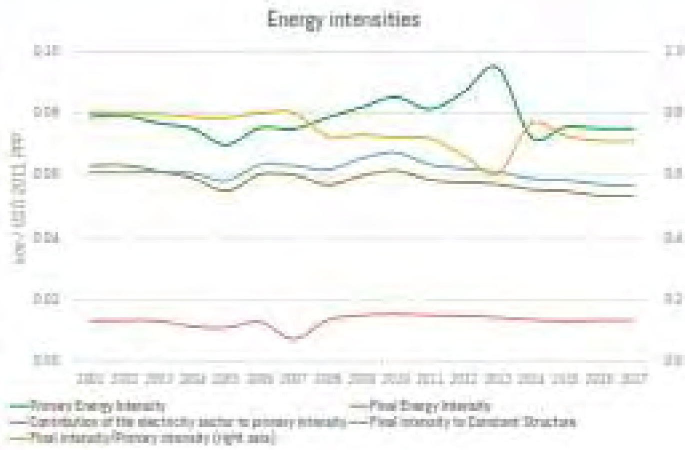

Commercial Sector Final Consumption
Electricity
Oil and derivatives
Liquefied petroleum gas
Value added variation rate (Commercial) [%]
Final consumption variation rate [%]

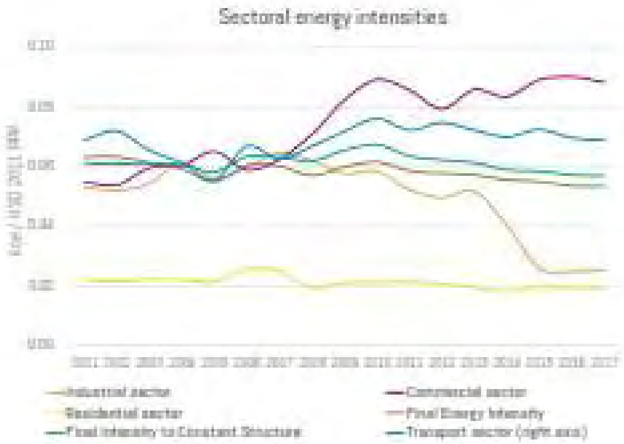

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Gasoline / alcohol
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

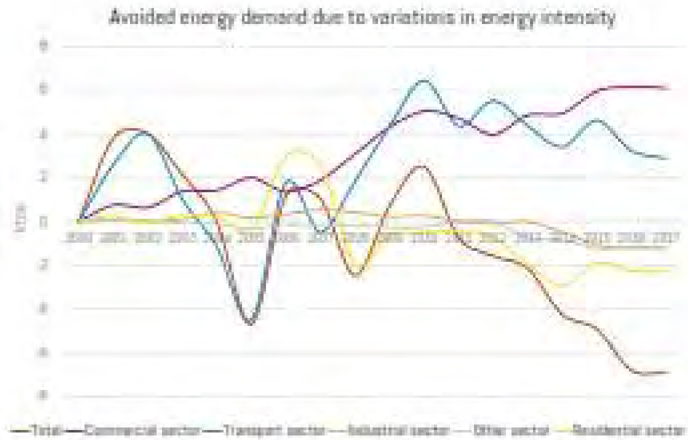

Residential Sector Final Consumption
Electricity
Oil and derivatives
Liquefied petroleum gas
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

GRENADA

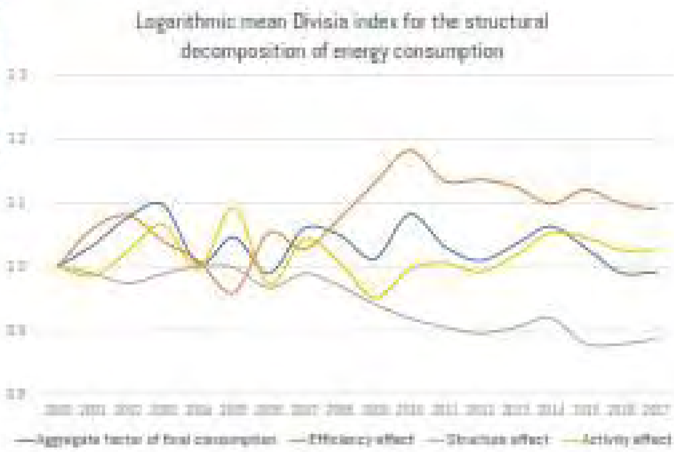

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

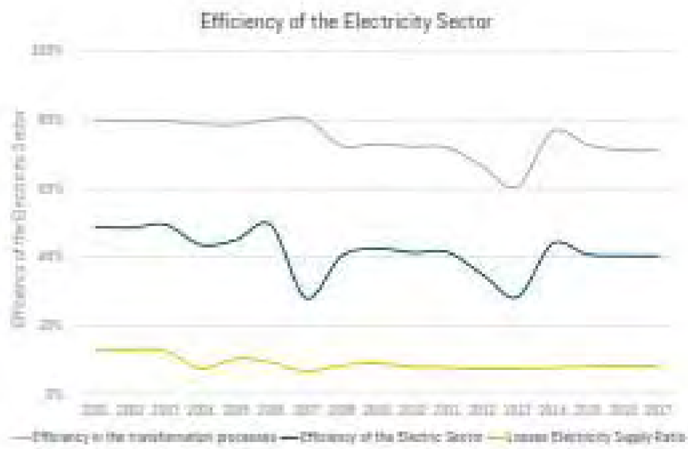

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)

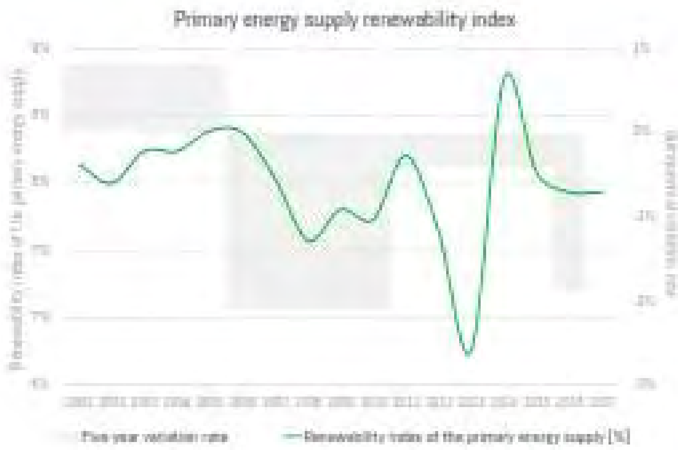

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

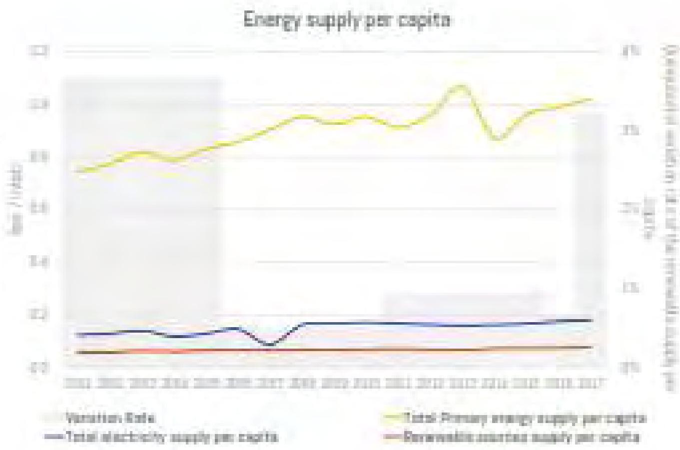

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

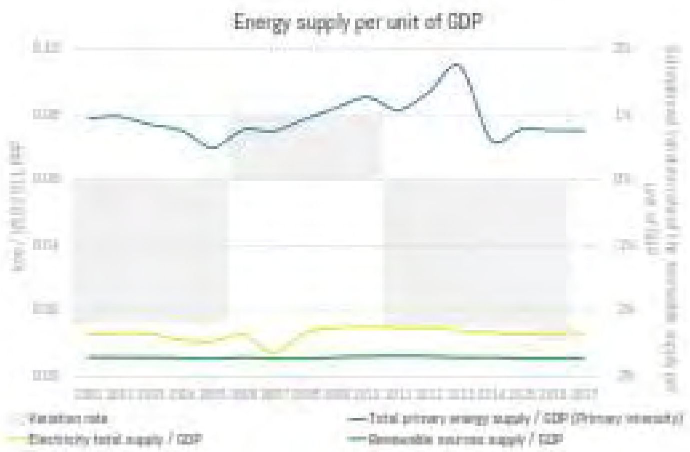
GRENADA

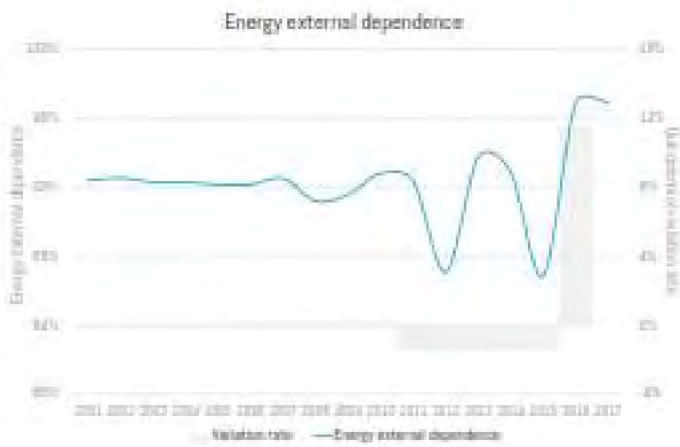

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

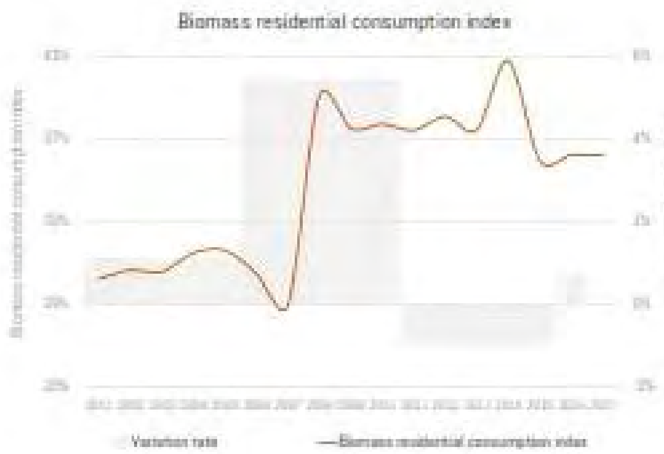

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

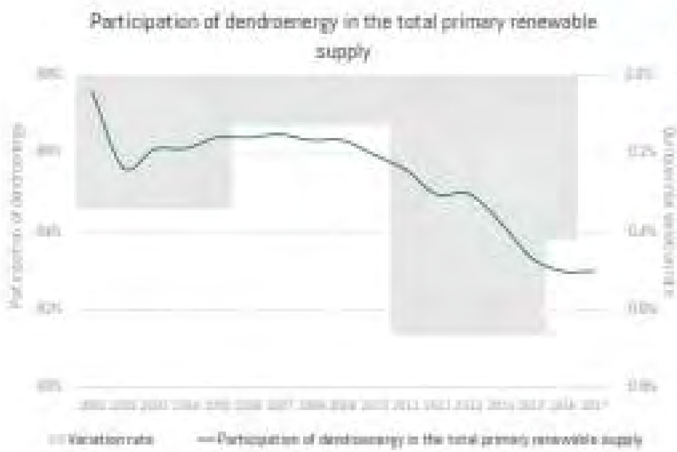

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

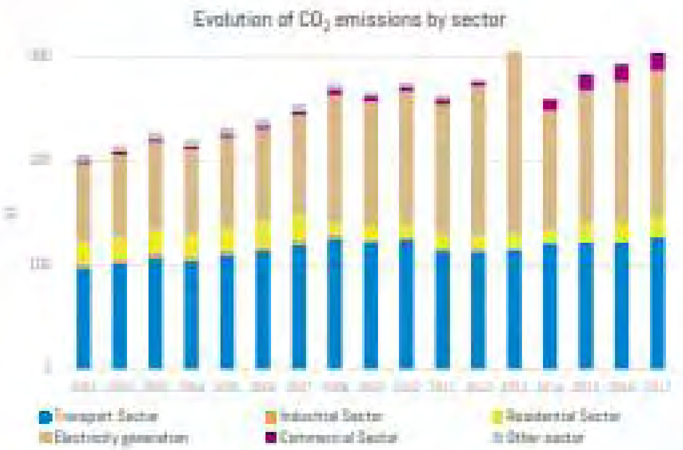

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

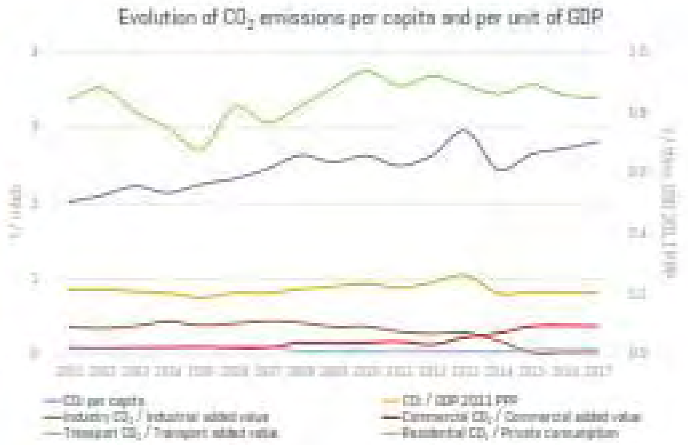

Energy external dependence
Variation rate
Energy external dependence

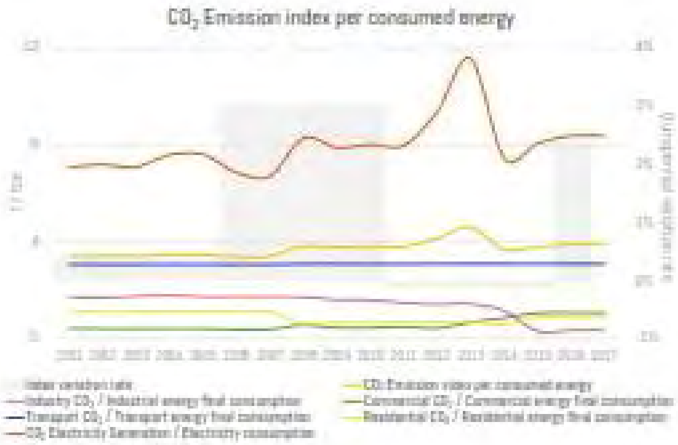

Biomass residential consumption index
Variation rate
Biomass residential consumption index

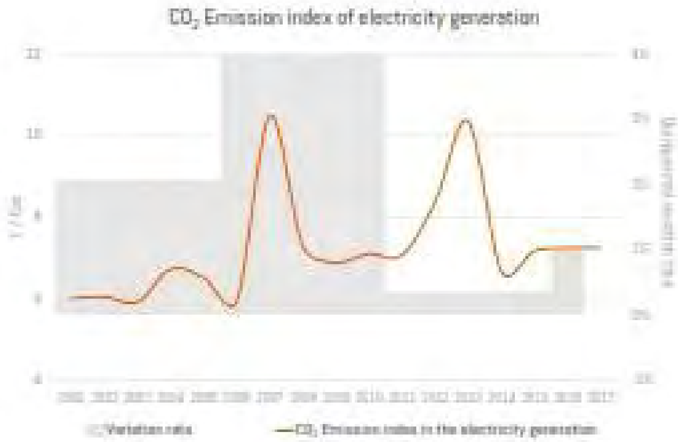

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply

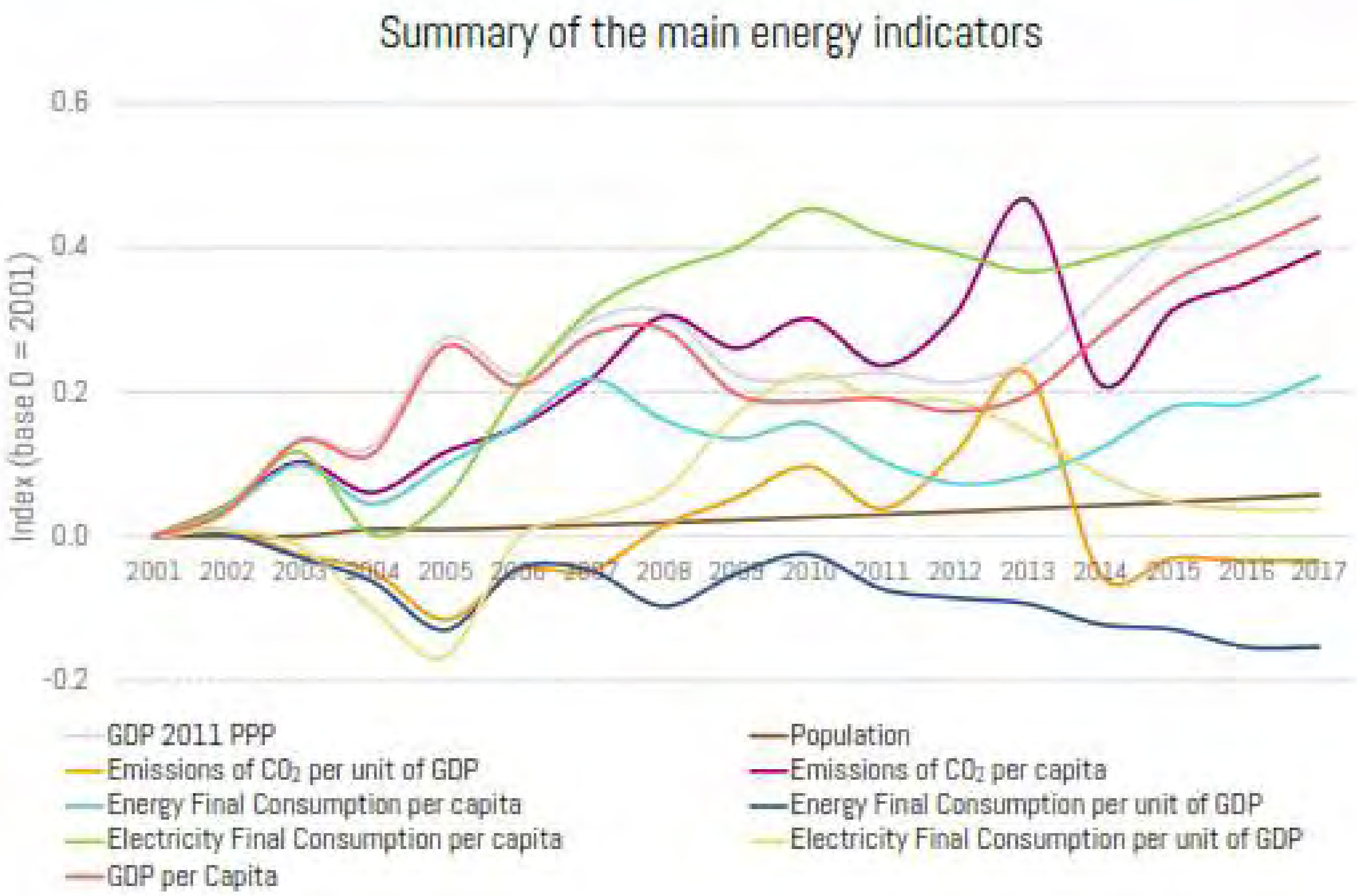
GRENADA


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
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 = 2001)
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
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

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General Information 2017

Population (thousand inhab.)	16,924
Area (km²)	108,890
Population Density (inhab./km²)	155
Urban Population (%)	58
GDP USD 2017 (MUSD)	75,590
GDP USD 2011 PPP (MUSD)	125,563
GDP per capita (thou. USD 2011 PPP/inhab.)	7.4

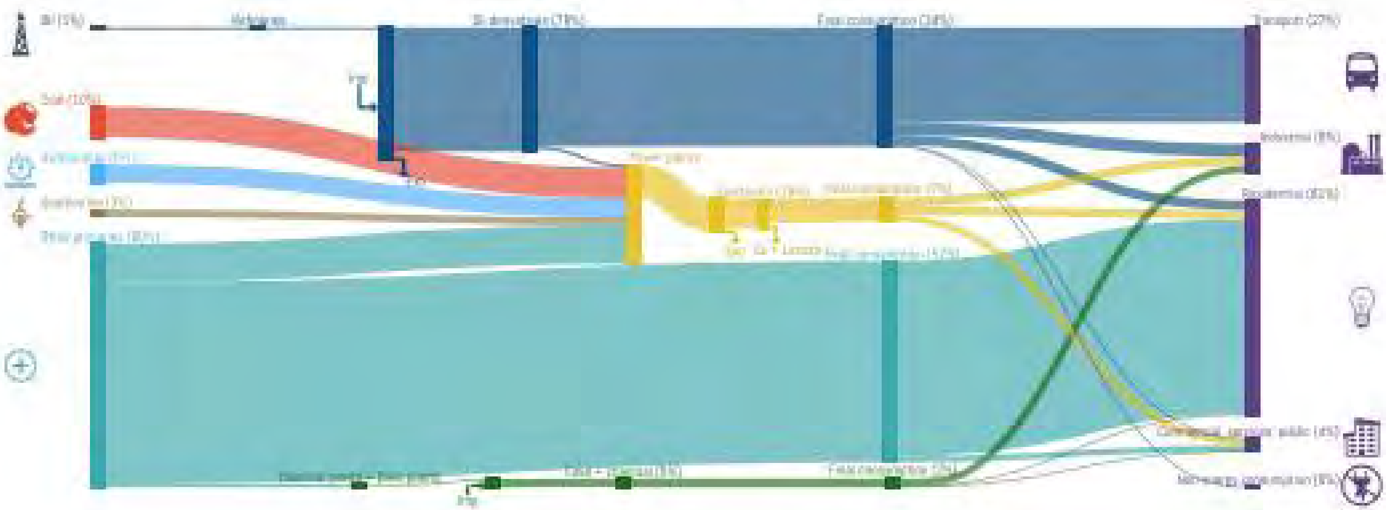
Energy Sector

	Mtoe
Final consumption in the Transport Sector	3.21
Final consumption in the Industrial Sector	0.98
Final consumption in the Residential Sector	7.24
Final consumption in the Commercial and Service Sector	0.46
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.03

Oil reserves	Natural gas reserves (Bitter)	Coal reserves
Mbbl 88.57	Gm³ 0.52	Mt n.a

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	567
Final energy consumption per capita	toe/inhab.	0.70
Electrification rate	%	92.26
Total energy supply	Mtoe	14.49
Total energy production	Mtoe	9.58
Total energy imports	Mtoe	5.87
Total energy exports	Mtoe	0.87
Total final energy consumption	Mtoe	11.93
Refining capacity	kbbl/day	6
Installed power generation capacity	GW	4.07
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.12 / 0.09

Summarized energy balance 2017



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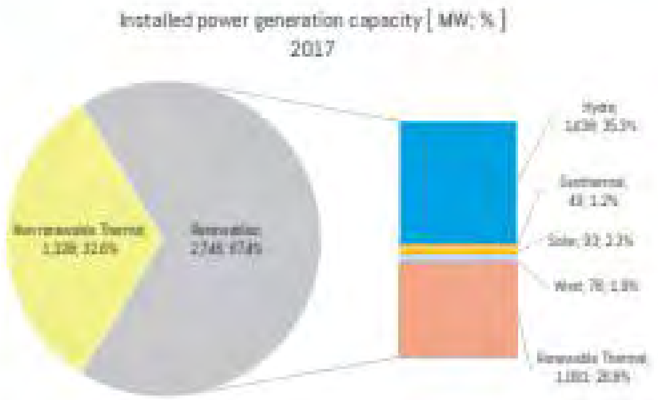
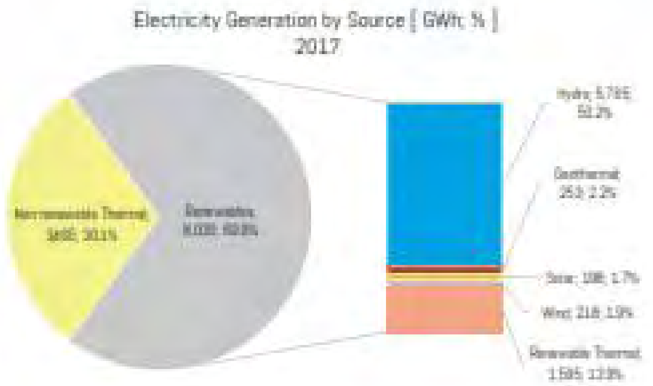
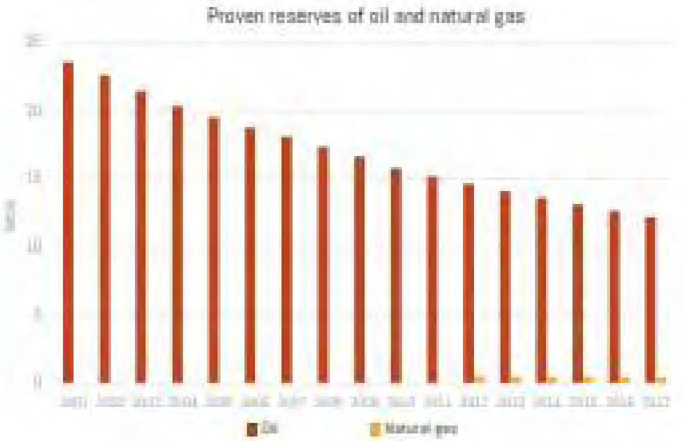


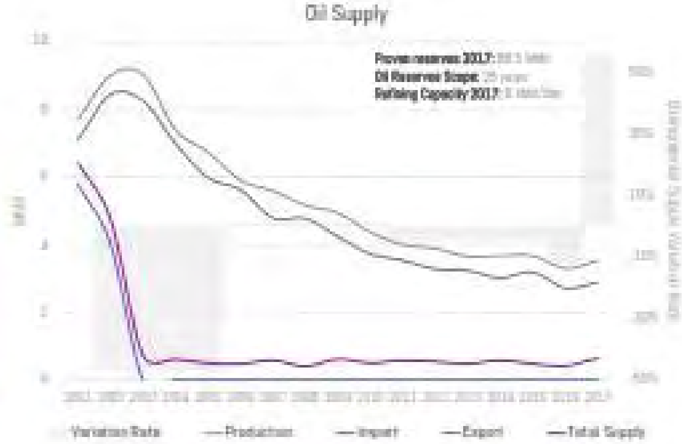
Installed power generation capacity [MW; %]
2017



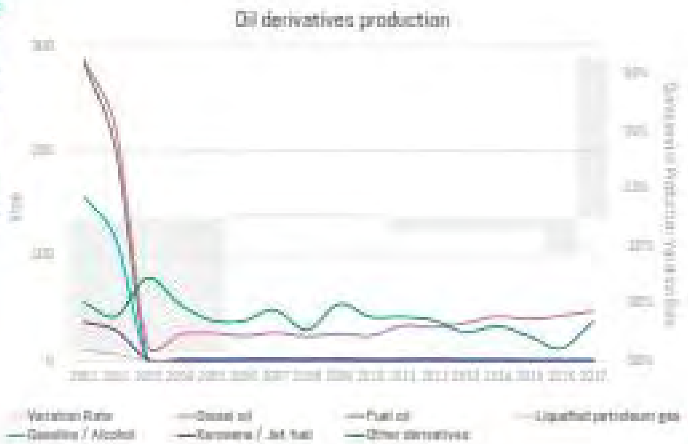
Electricity Generation by Source [GWh; %]
2017



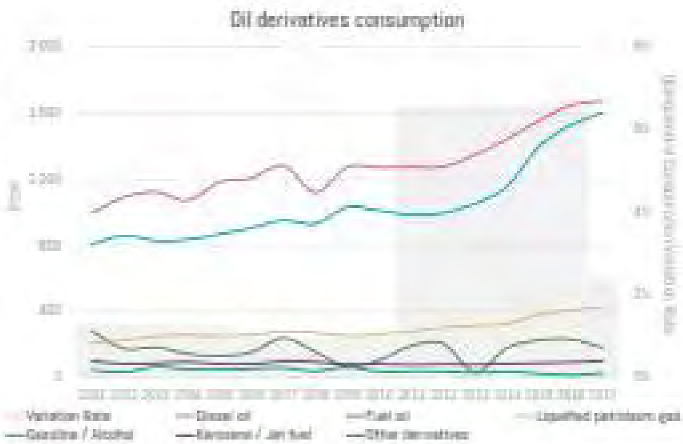
Proven reserves of oil and natural gas
Oil
Natural gas



Oil Supply
Variation Rate
Production
Import
Export
Total Supply

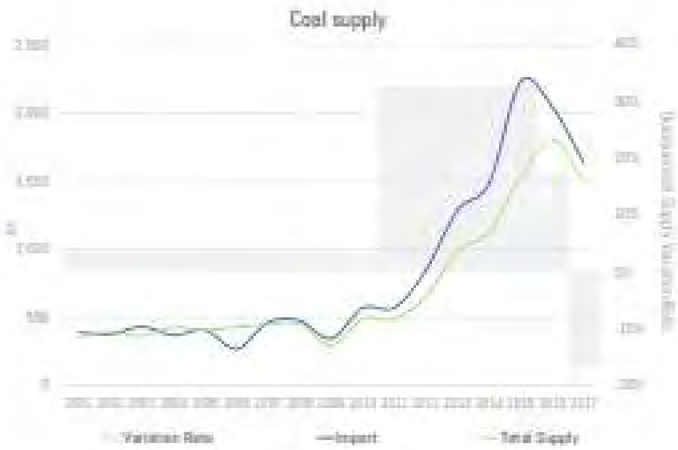


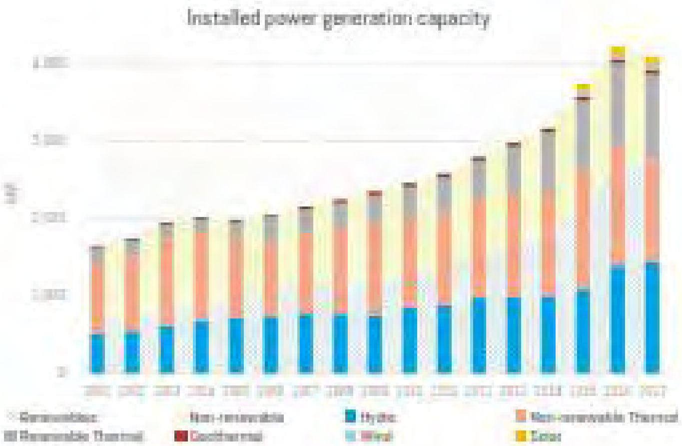
Oil derivatives production

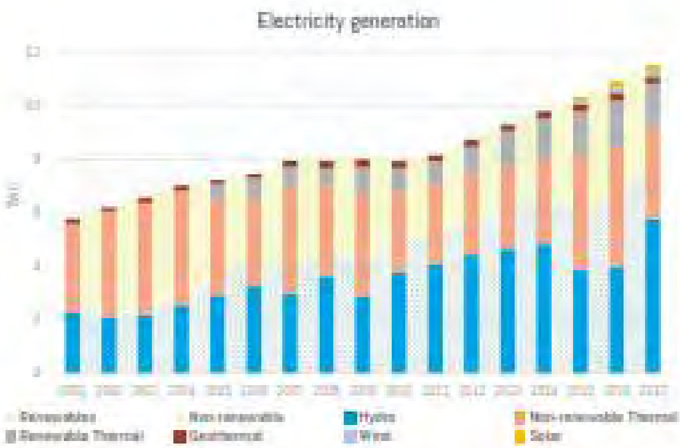


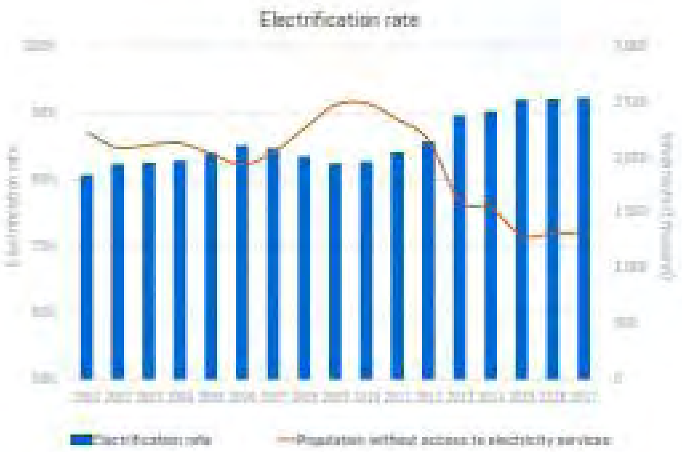
Oil derivatives consumption

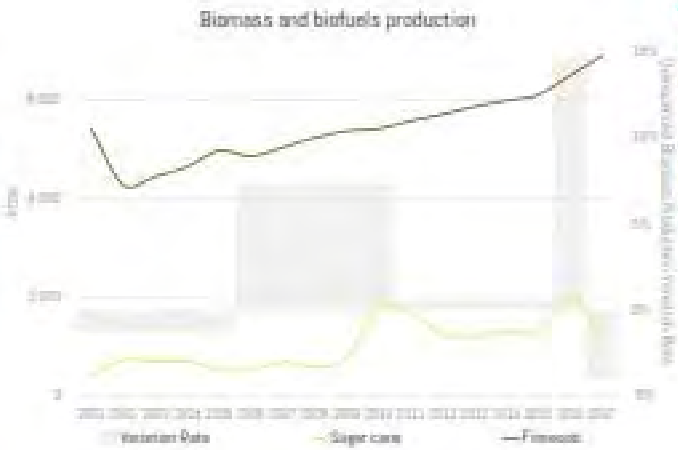
Guatemala launched the National Energy Plan, an instrument that places special focus on the reduction of Greenhouse Gas (GHG) emissions, through the plan, it is expected to reach the goal of 29.2% reduction of GHG emissions by the year of 2023, equivalent to 11.9 million tons of carbon dioxide equivalent -CO_2e- avoided.











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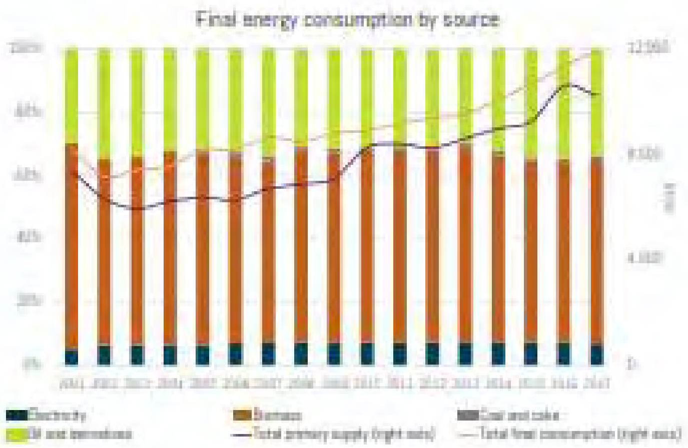

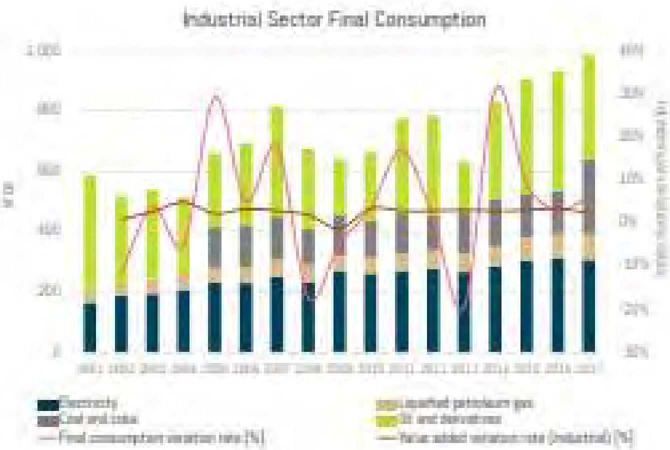

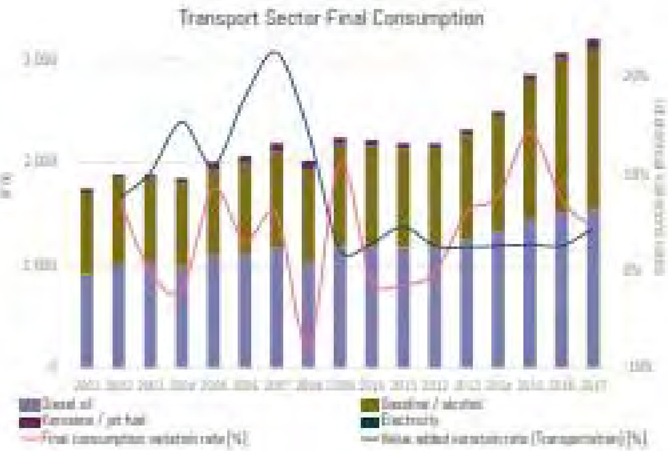

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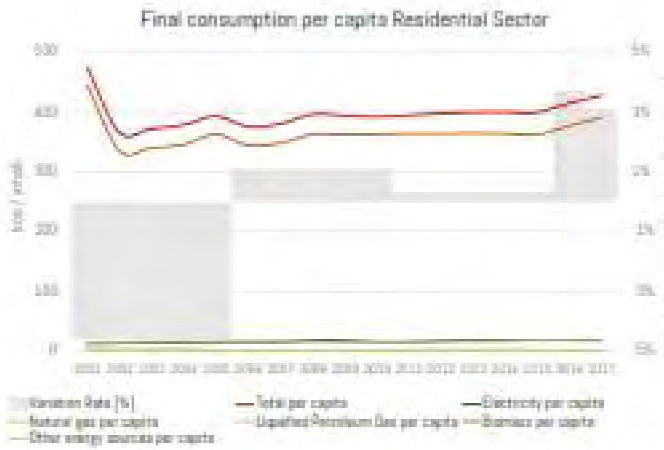
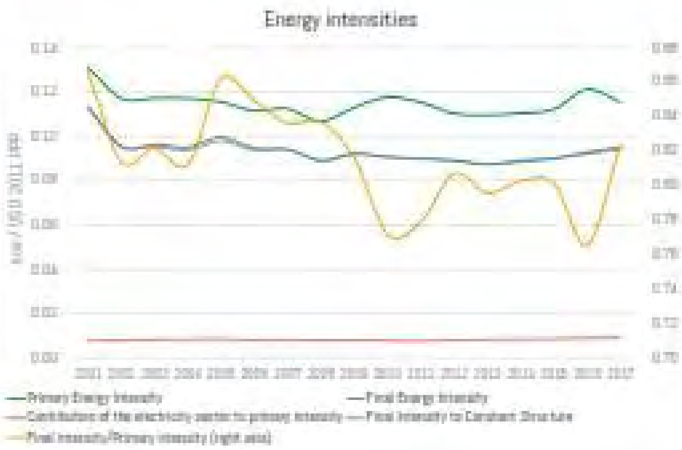
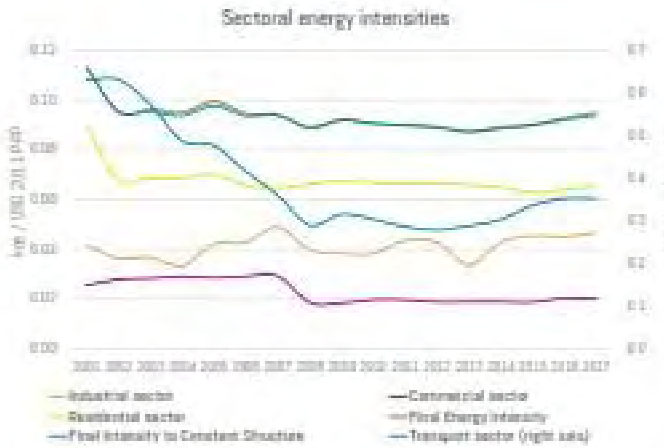
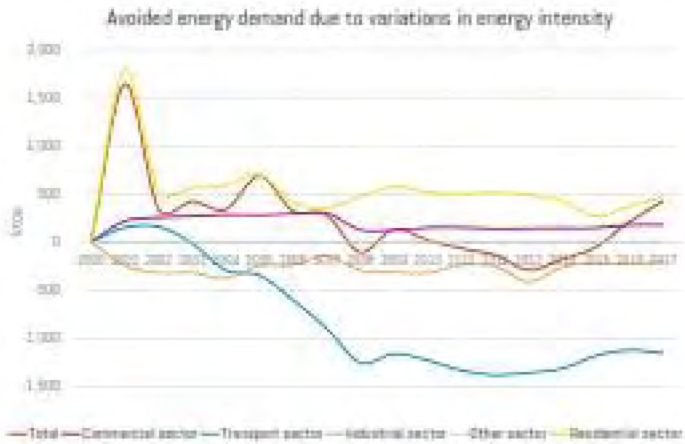
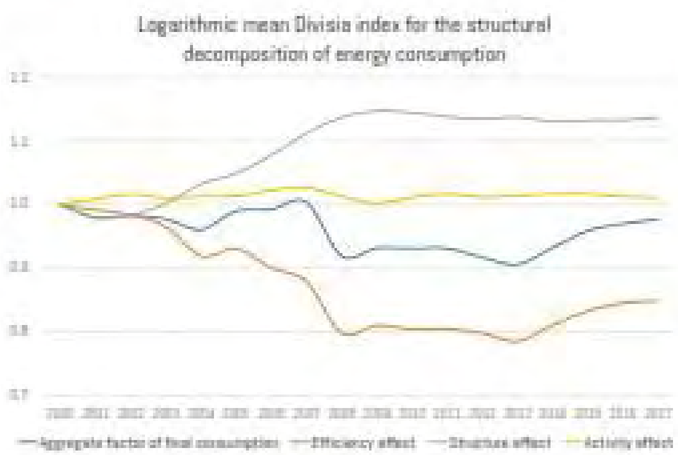
With the support of OLADE, the Ministry of Energy and Mines (MEM) of Guatemala held the workshop "Insertion of electric vehicles in Guatemala" in October 2017. The analysis of the introduction of electric vehicles (EV) in Guatemala was included as part of the possible actions for the mitigation of GHGs in the country.

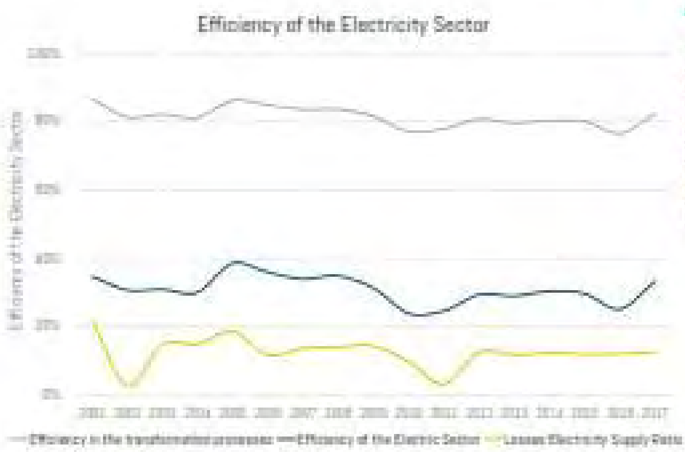

Final consumption per capita Residential Sector
kep / inhab
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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)

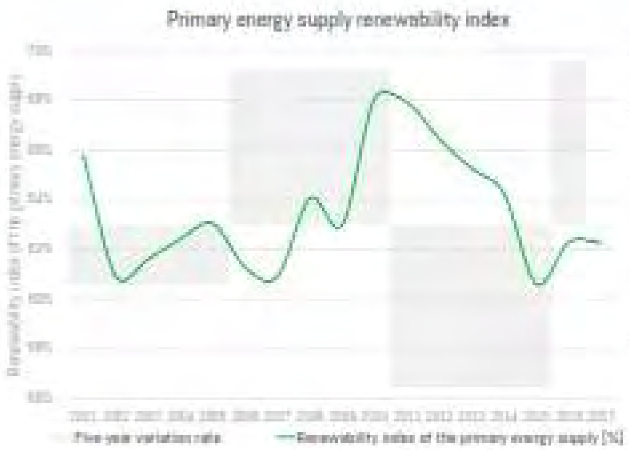

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

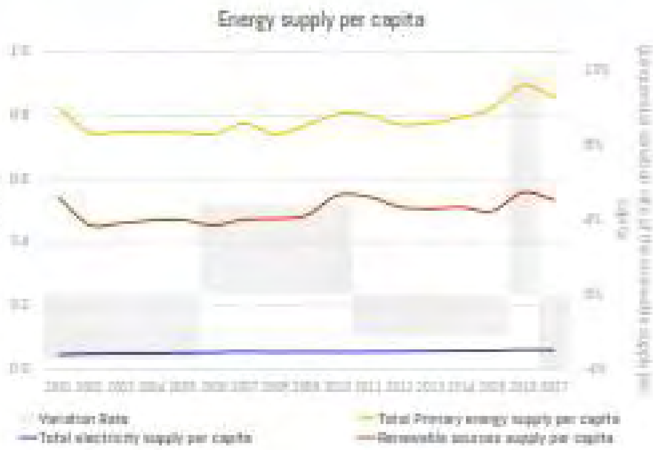

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

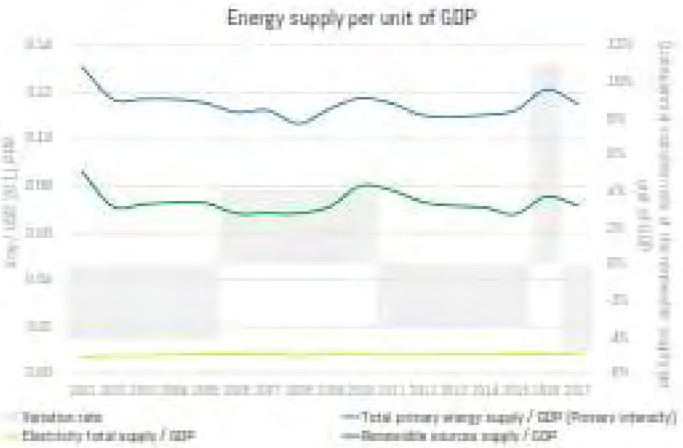

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

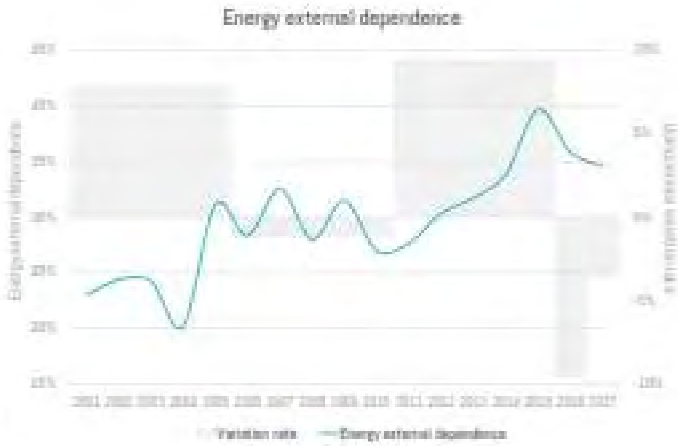

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Rate

GUATEMALA


Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

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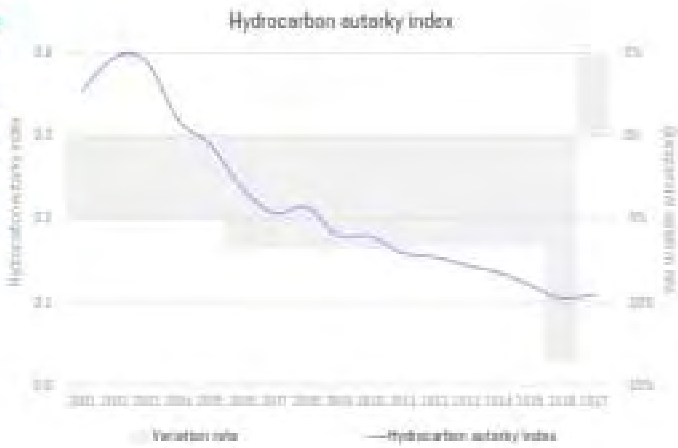
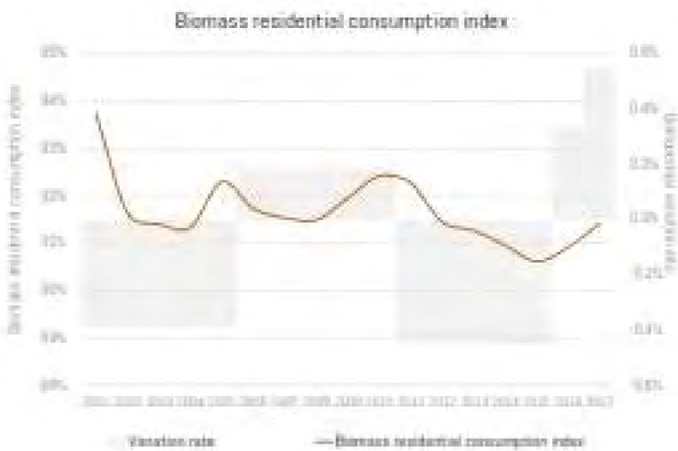
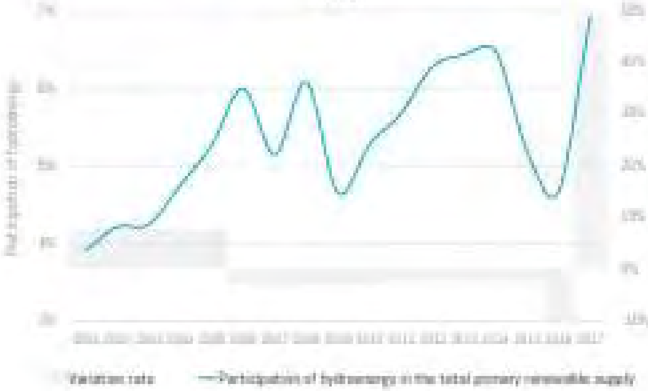
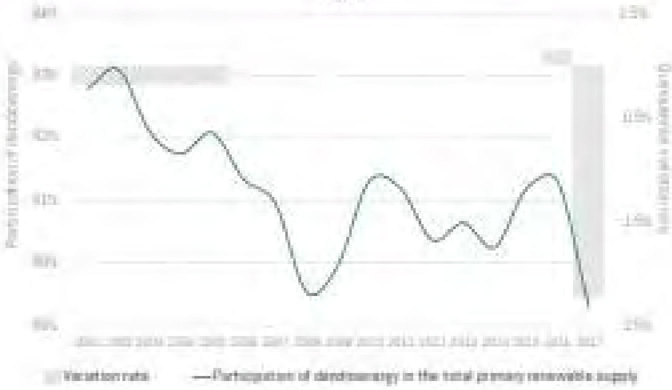

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index


Biomass residential consumption index
Variation rate
Biomass residential consumption index

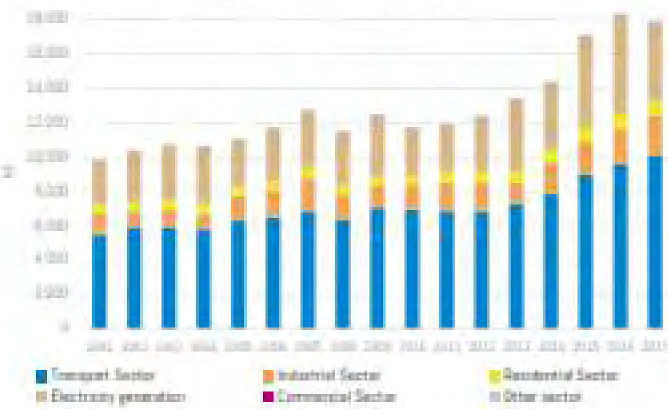
Participation of hydroenergy in the total primary renewable supply



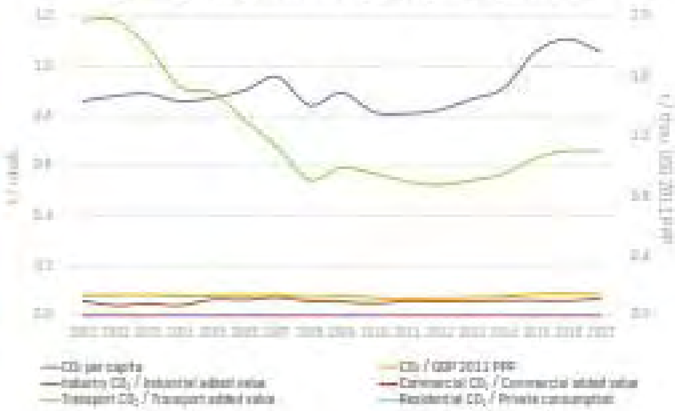
Participation of dendroenergy in the total primary renewable supply



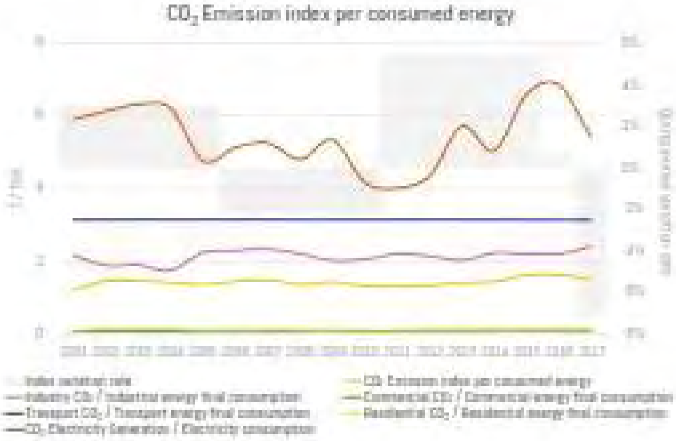
Evolution of CO_2 emissions by sector



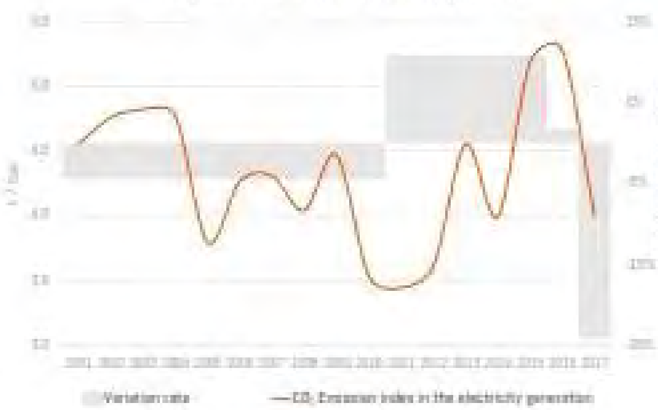
Evolution of CO_2 emissions per capita and per unit of GDP



CO_2 Emission index per consumed energy

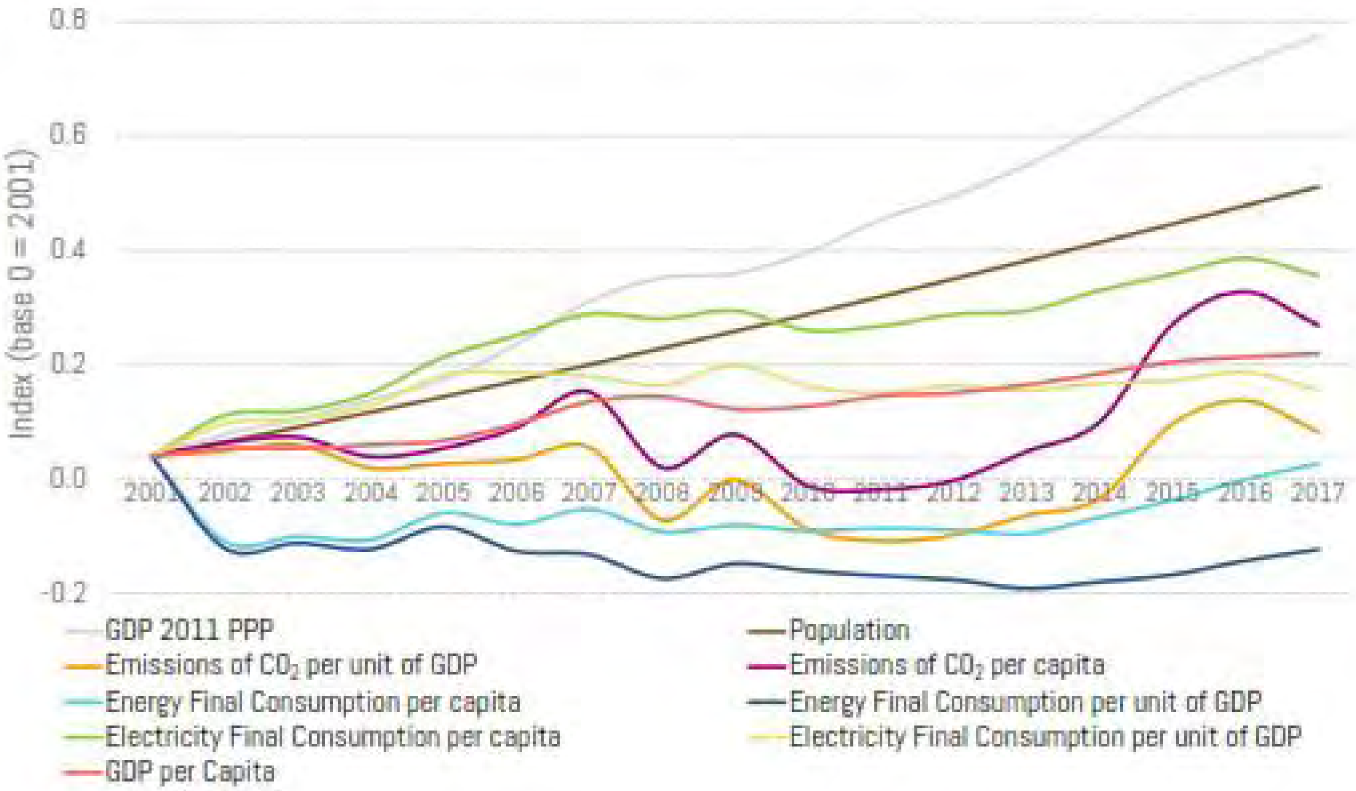


CO_2 Emission index of electricity generation



GUATEMALA

Summary of the main energy indicators



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General Information 2017

Population (thousand inhab.)	774
Area (km²)	214,970
Population Density (inhab./km²)	4
Urban Population (%)	29
GDP USD 2010 (MUSD)	2,990
GDP USD 2011 PPP (MUSD)	5,783
GDP per capita (thou. USD 2011 PPP/inhab.)	7

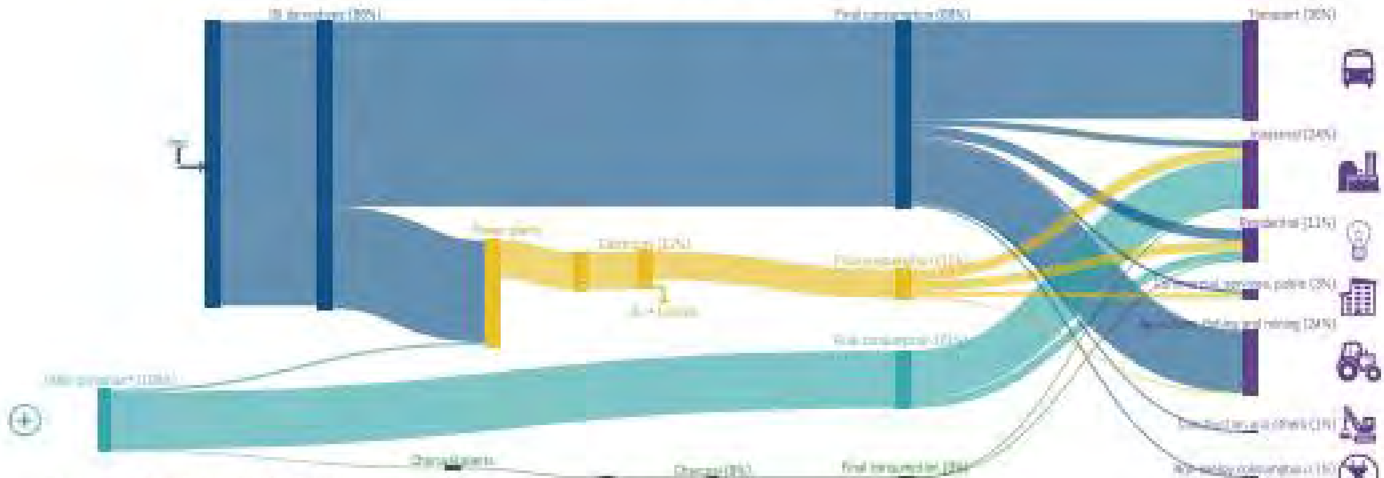
Energy Sector

	Mtoe
Final consumption in the Transport Sector	0.25
Final consumption in the Industrial Sector	0.17
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	0.18

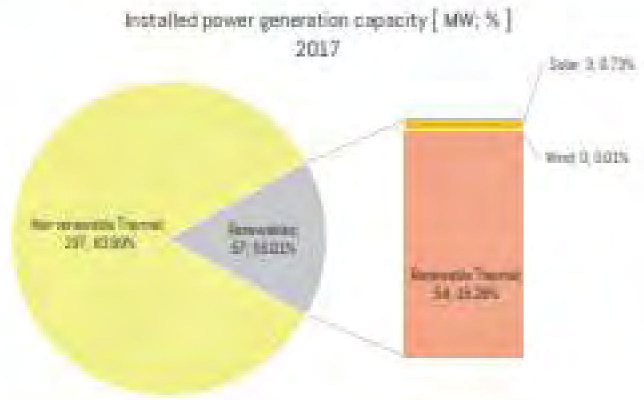
Oil reserves	Natural gas reserves	Coal reserves
4,000 Mbbl	18 Gm³	n.a. Mt

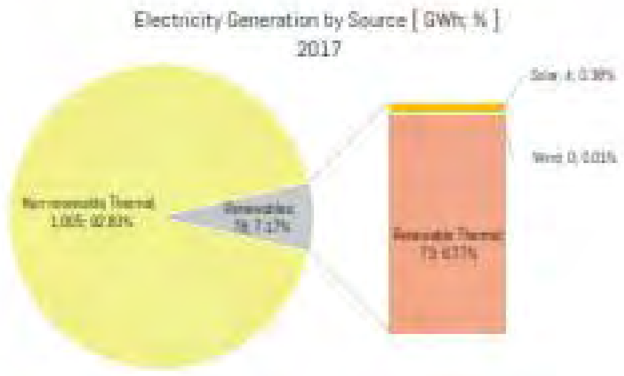
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,110	0.91	88.80	0.90	0.16	0.73	0.00	0.70	n.a.	0.35	0.16 / 0.12

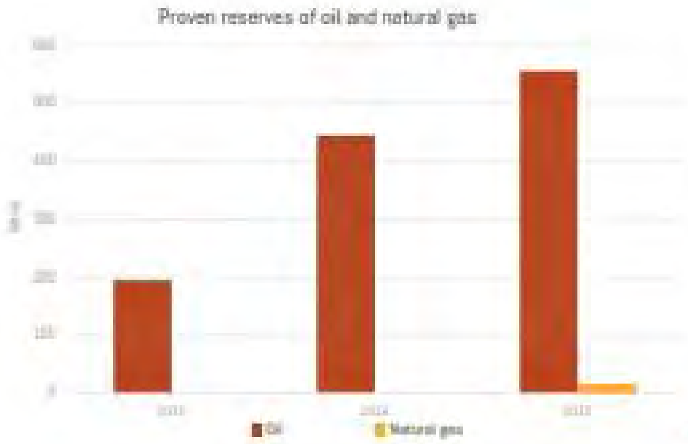
Summarized energy balance 2017

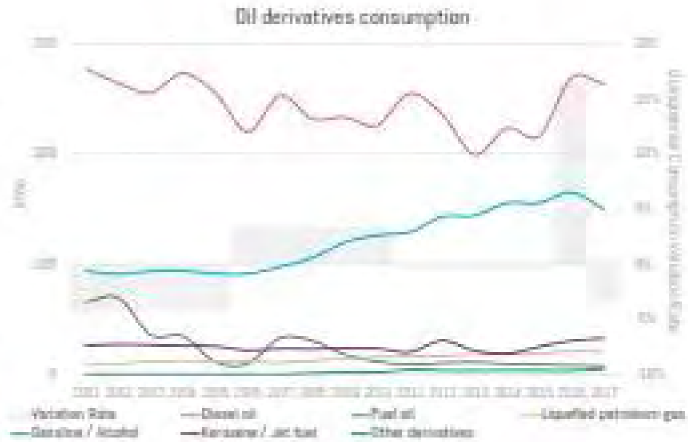


* Corresponds to firewood + sugarcane and derivatives.


Installed power generation capacity [MW; %]
2017


Electricity Generation by Source [GWh; %]
2017


Proven reserves of oil and natural gas
Oil
Natural gas


Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

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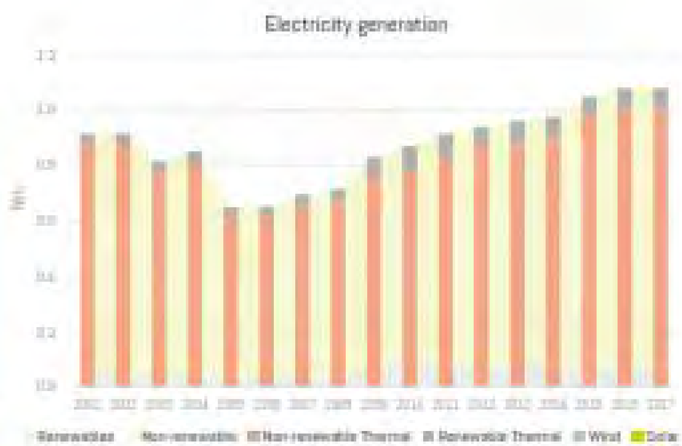
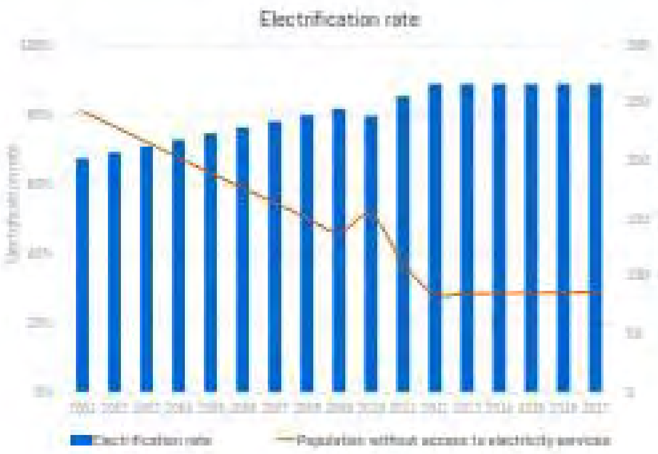
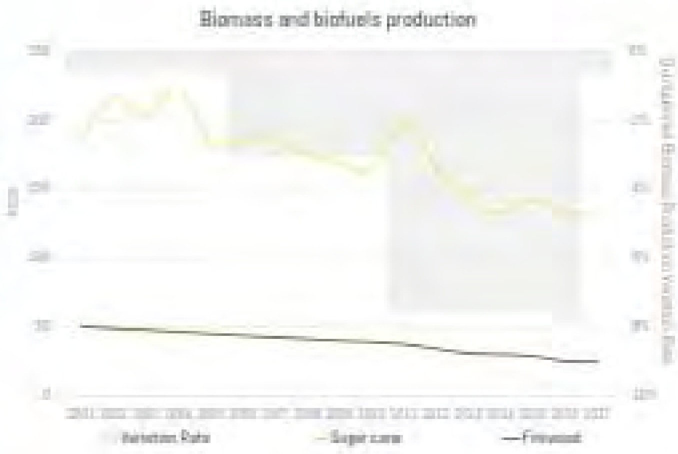
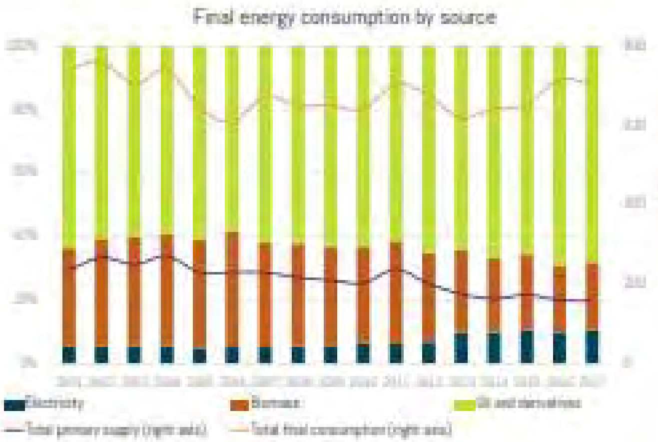
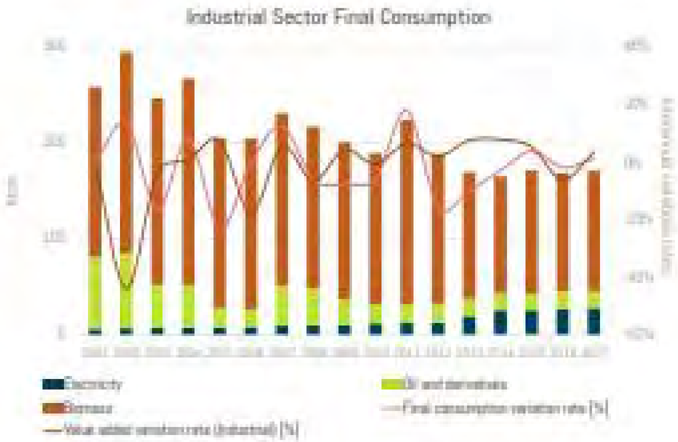
Installed power generation capacity
Renewables
Non-renewable
Non-renewable Thermal
Renewable Thermal
Wind
Solar

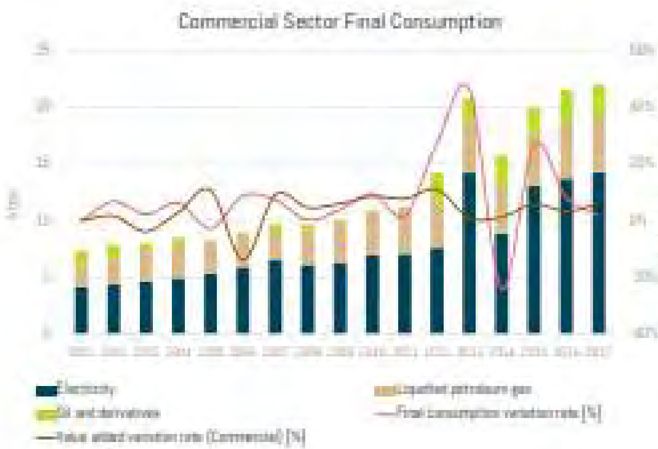

Electricity generation
Renewables
Non-renewable
Non-renewable Thermal
Renewable Thermal
Wind
Solar

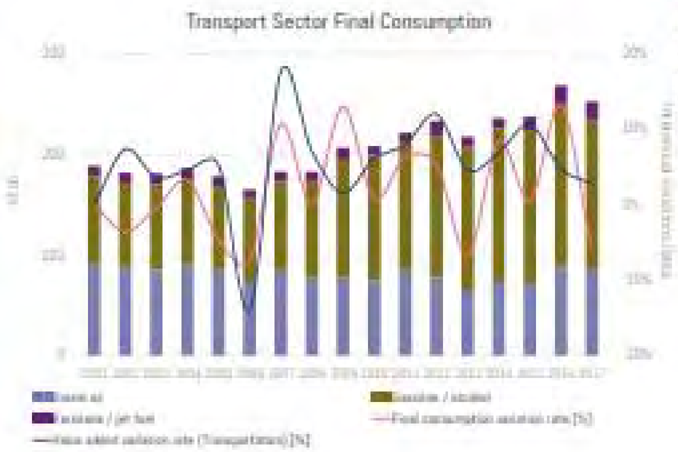

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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


Industrial Sector Final Consumption
Electricity
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]


Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]


Transport Sector Final Consumption
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

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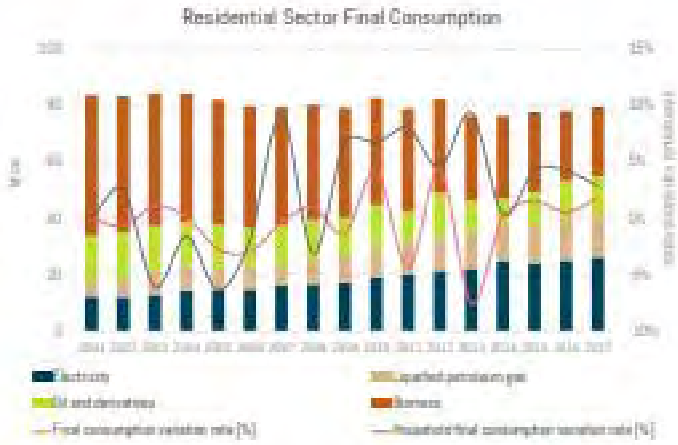
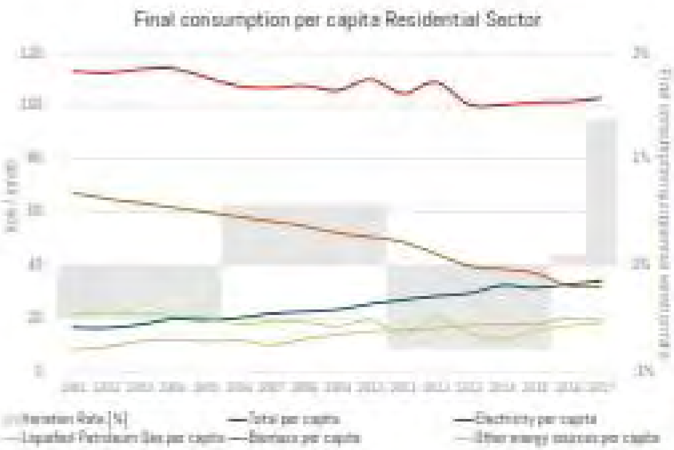
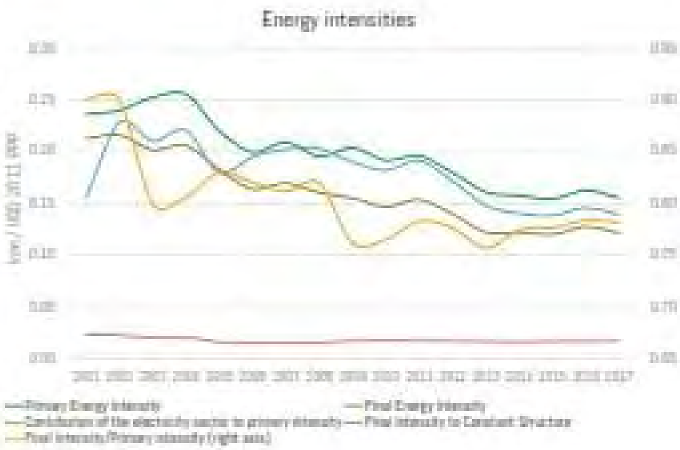
Other Sector Final Consumption
Electricity
Diesel oil
Kerosene / jet fuel
Value added variation rate (Other) [%]
Liquefied petroleum gas
Gasoline / alcohol
Final consumption variation rate [%]


Residential Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]


Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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)

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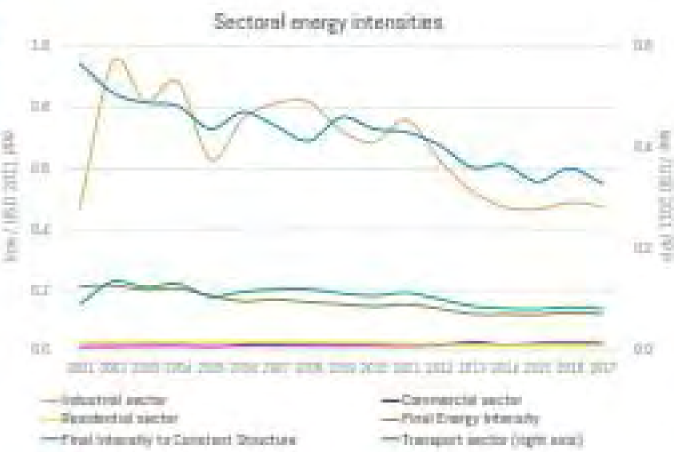
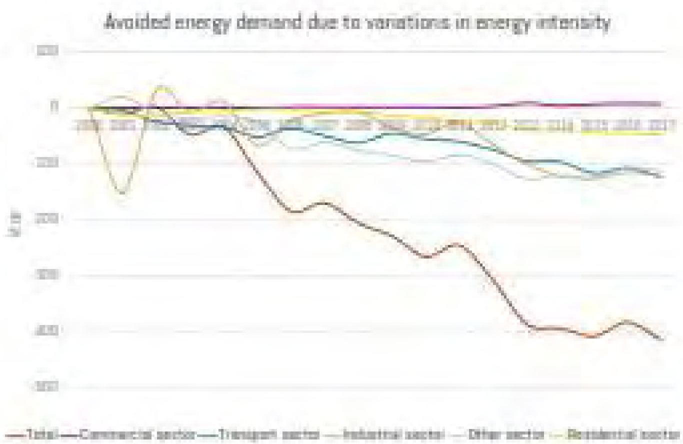
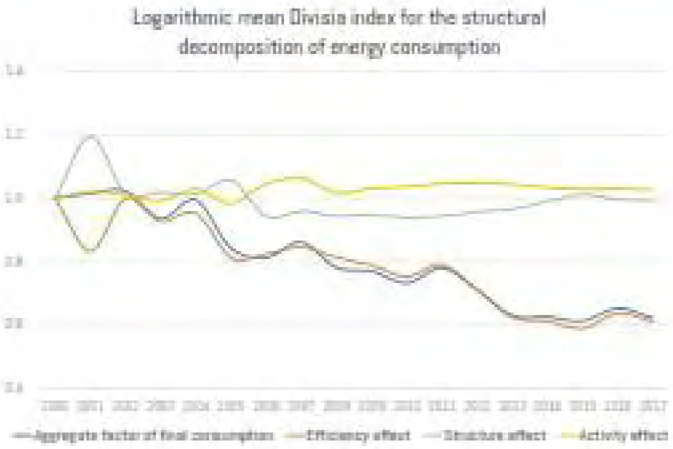
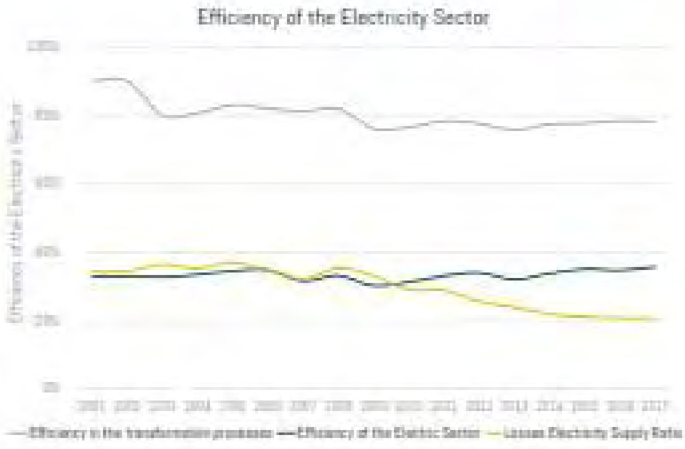
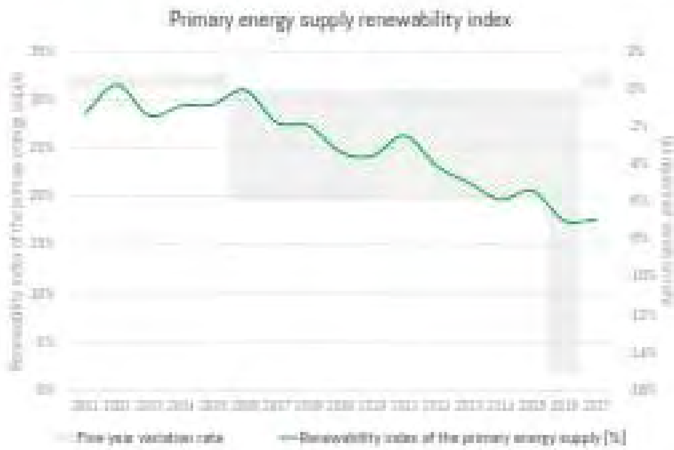
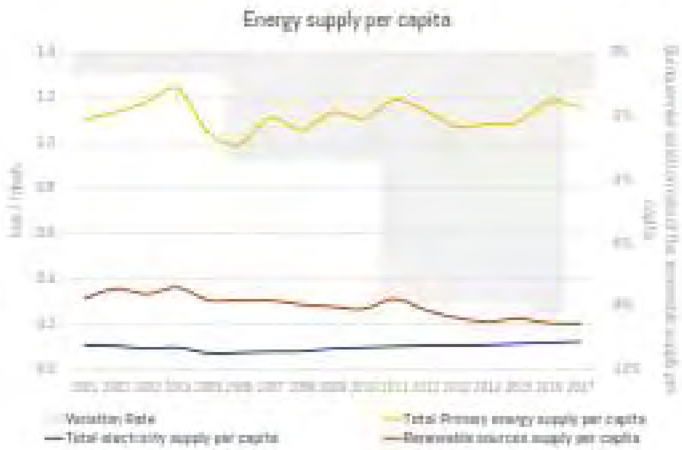

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

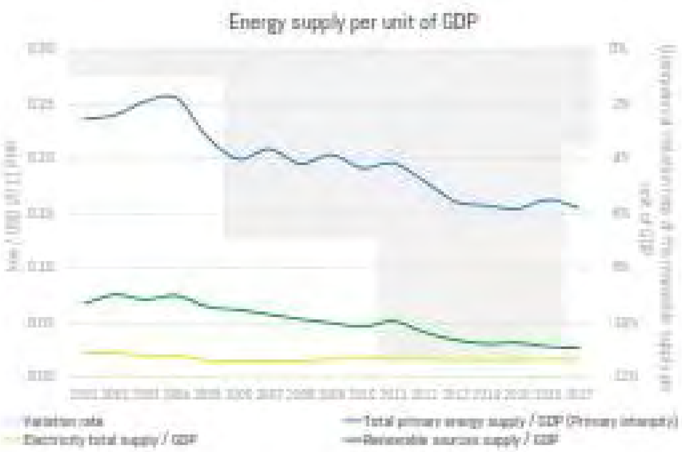

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

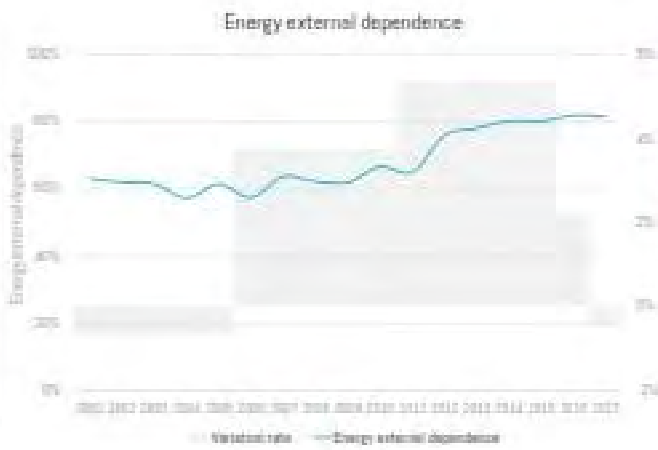

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Rate


Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

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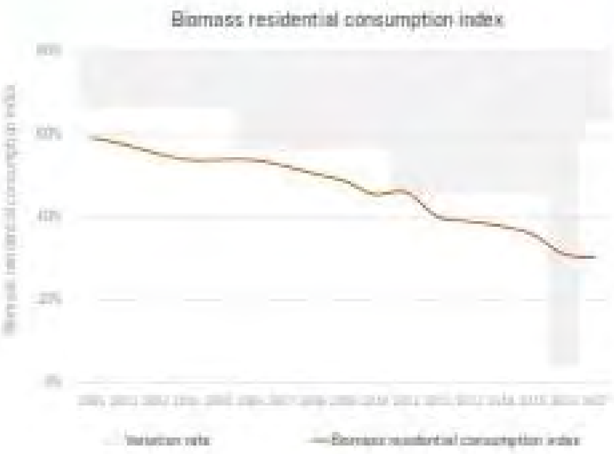
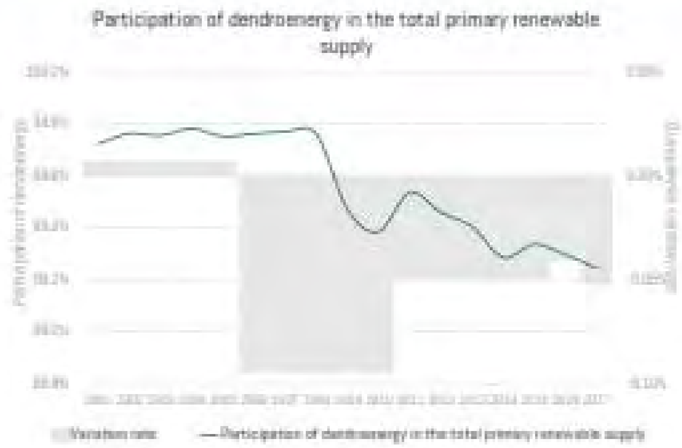
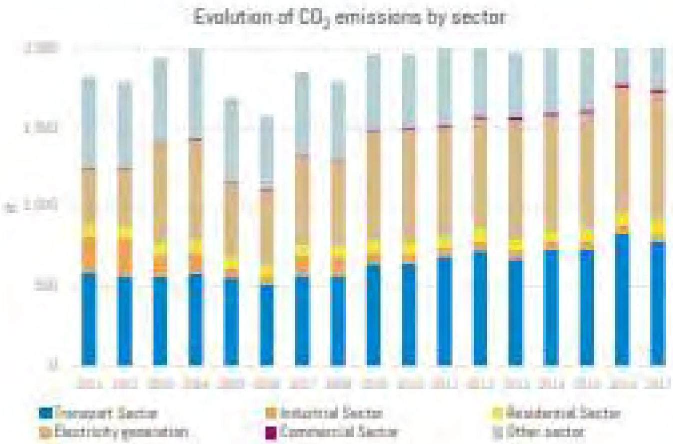
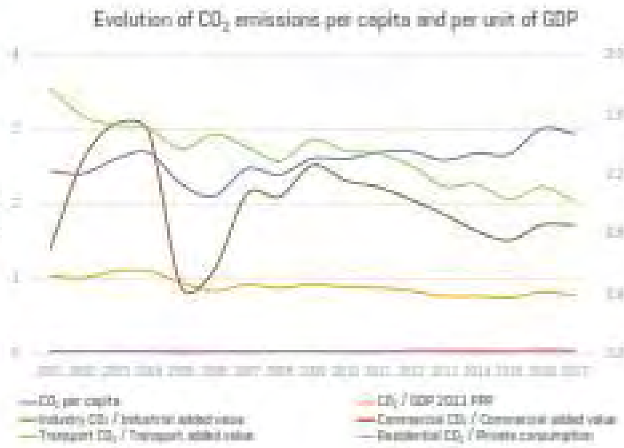

Biomass residential consumption index
Variation rate
Biomass residential consumption index


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


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


Evolution of CO_2 emissions per capita and per unit of GDP
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

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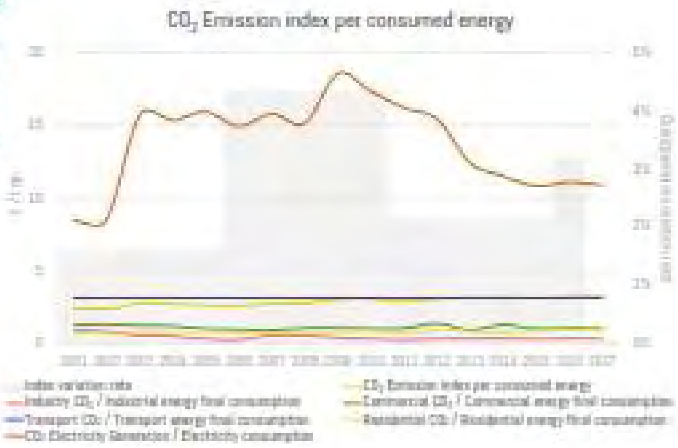
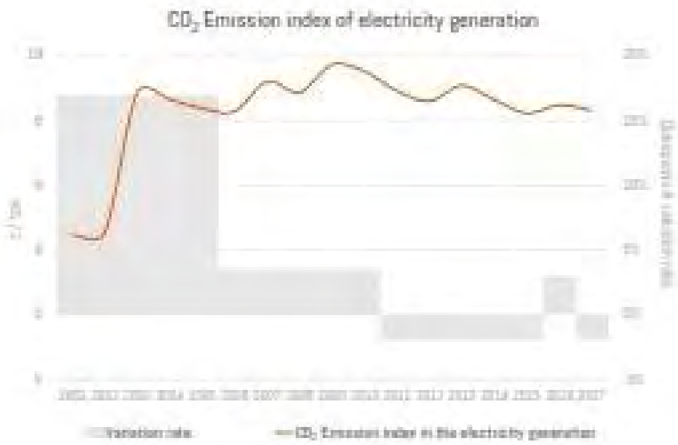
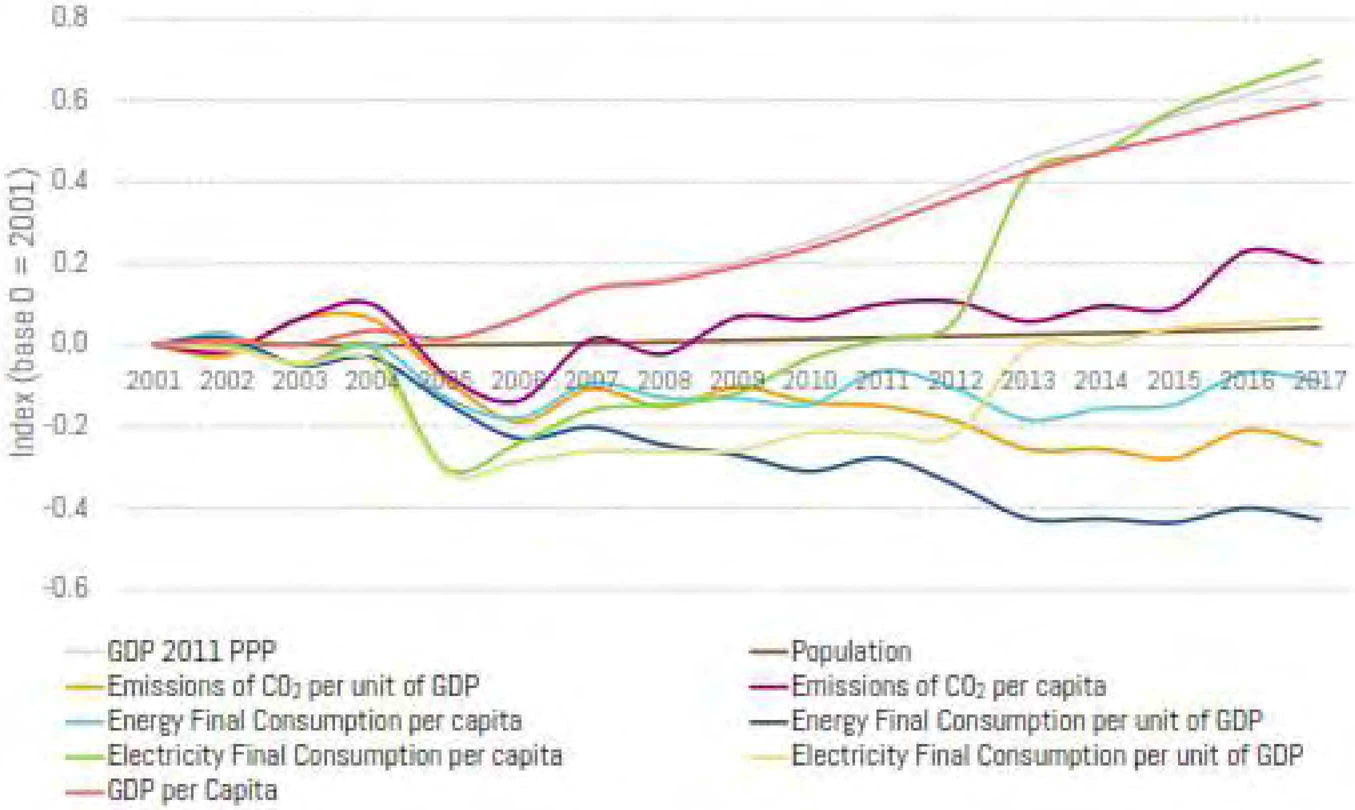

CO_2 Emission index per consumed energy
Index variation rate
Industry CO_2 / Industrial energy final consumption
Transport CO_2 / Transport energy final consumption
CO_2 Electricity Generation / Electricity consumption
CO_2 Emission index per consumed energy
Commercial CO_2 / Commercial energy final consumption
Residential CO_2 / Residential energy final consumption


CO_2 Emission index of electricity generation
Variation rate
CO_2 Emission index in the electricity generation

Summary of the main energy indicators



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General Information 2017

Population (thousand inhab.)	11,029
Area (km²)	27,750
Population Density (inhab./km²)	397
Urban Population (%)	54
GDP USD 2010 (MUSD)	8,107
GDP USD 2011 PPP (MUSD)	18,154
GDP per capita (thou. USD 2011 PPP/inhab.)	2

Energy Sector

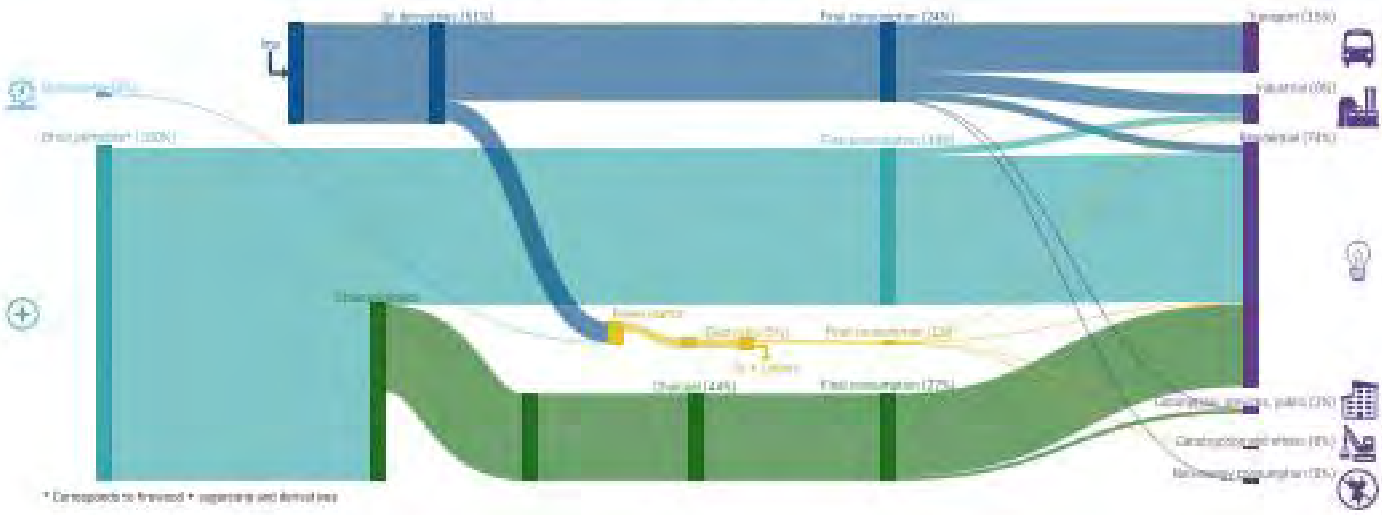
Sector	Mtoe
Final consumption in the Transport Sector	0.52
Final consumption in the Industrial Sector	0.29
Final consumption in the Residential Sector	2.47
Final consumption in the Commercial and Service Sector	0.05
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.01

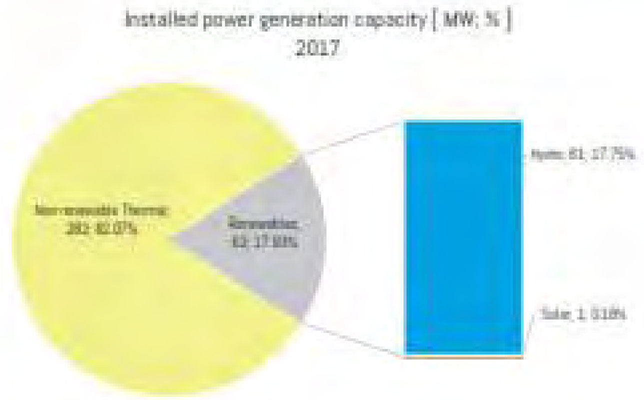
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	0

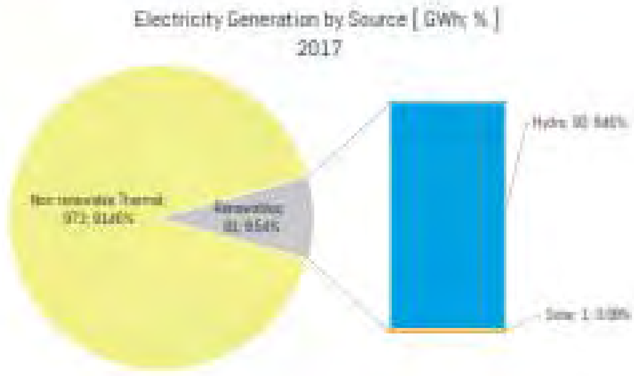
*Data from 2016. Source: World Bank.

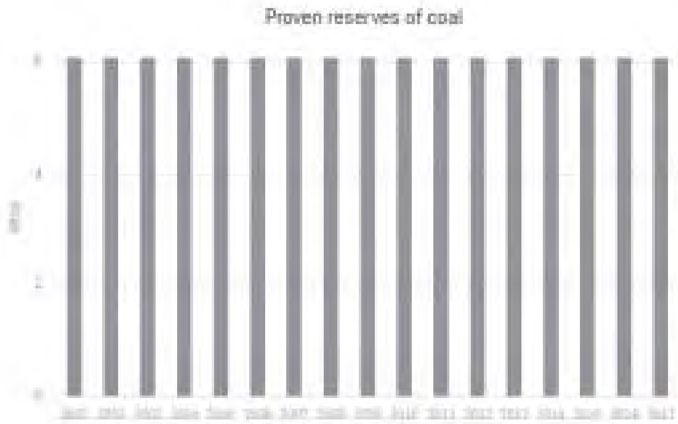
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	38
Final energy consumption per capita	toe/inhab.	0.30
Electrification rate	%	38.69 *
Total energy supply	Mtoe	4.41
Total energy production	Mtoe	3.46
Total energy imports	Mtoe	1.01
Total energy exports	Mtoe	0.00
Total final energy consumption	Mtoe	3.32
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	0.34
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.24 / 0.19

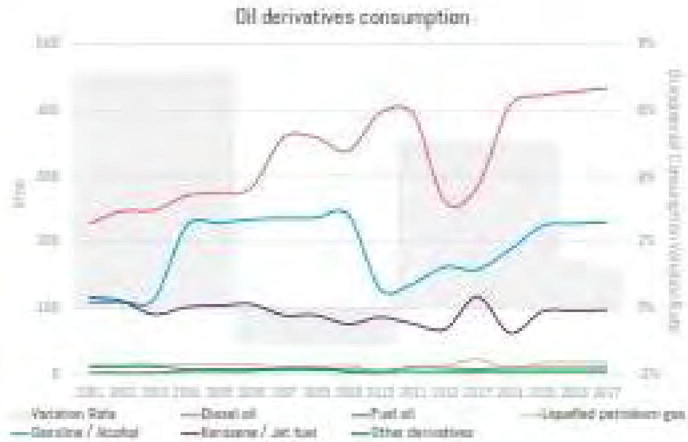
Summarized energy balance 2017




Installed power generation capacity [MW; %]
2017
Non-renewable Thermal; 282; 82.07%
Renewables; 63; 17.93%
Hydro; 61; 17.75%
Solar; 1; 0.18%


Electricity Generation by Source [GWh; %]
2017
Non-renewable Thermal; 973; 91.46%
Renewables; 91; 8.54%
Hydro; 90; 8.46%
Solar; 1; 0.08%


Proven reserves of coal


Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

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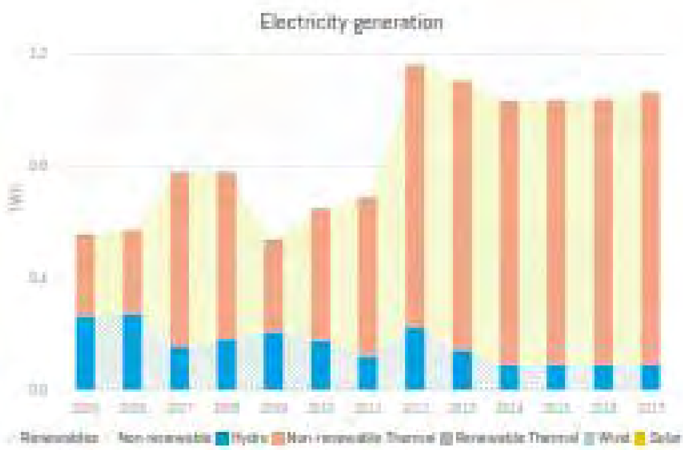
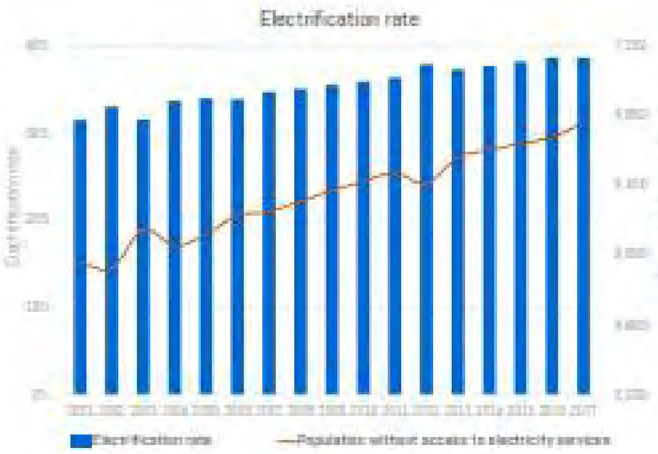
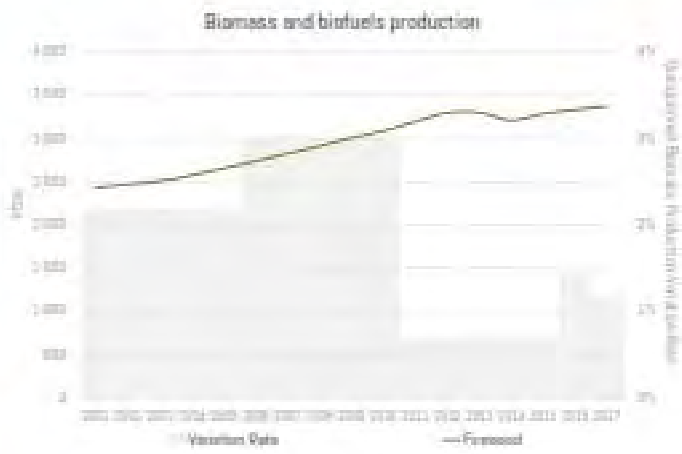
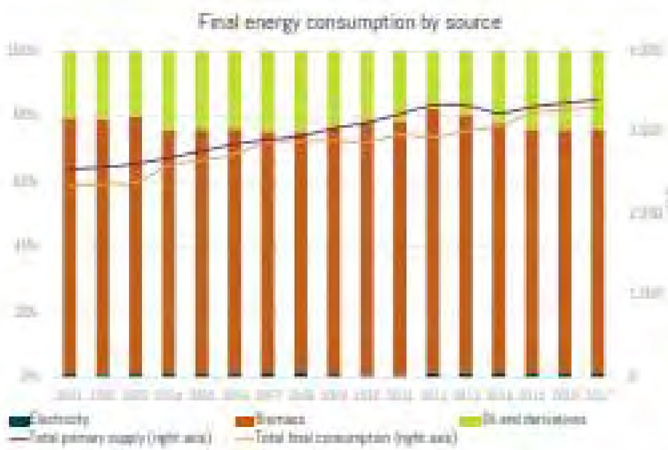
Installed power generation capacity
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar


Electricity generation
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar

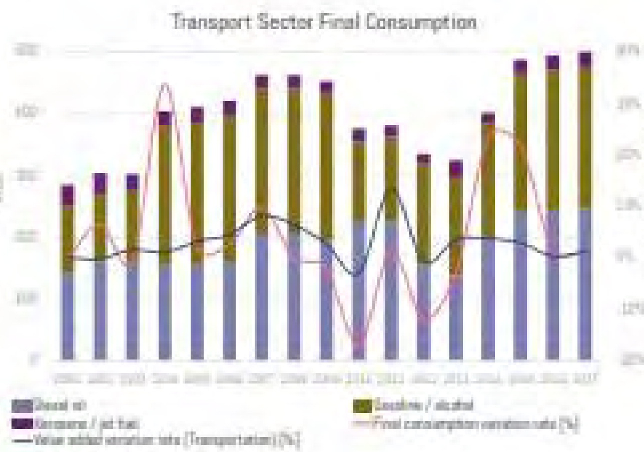

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Firewood


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


Industrial Sector Final Consumption
Electricity
Biomass
Value added variation rate (Industrial) [%]
Oil and derivatives
Final consumption variation rate [%]


Commercial Sector Final Consumption
Electricity
Biomass
Value added variation rate (Commercial) [%]
Oil and derivatives
Final consumption variation rate [%]


Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Final consumption variation rate [%]

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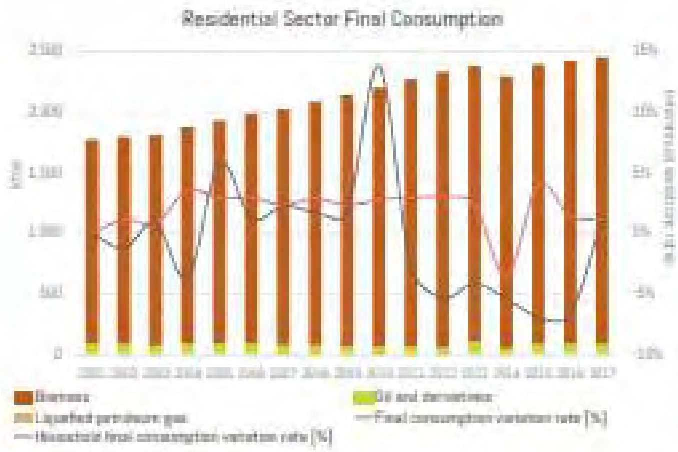
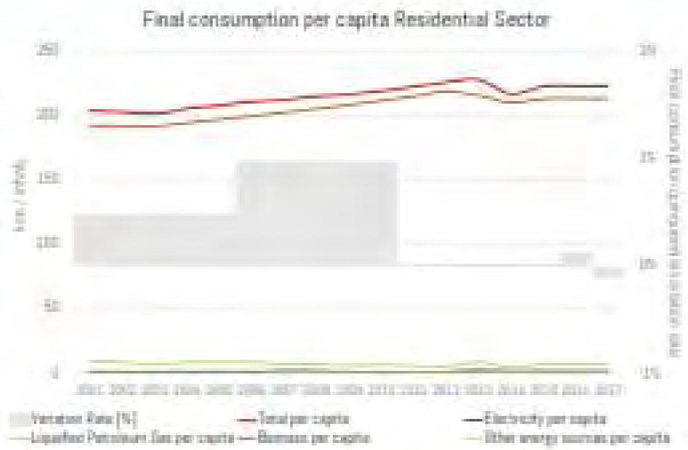
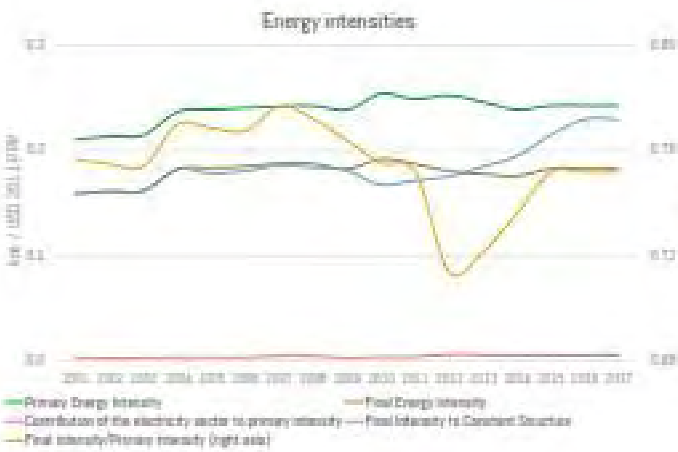
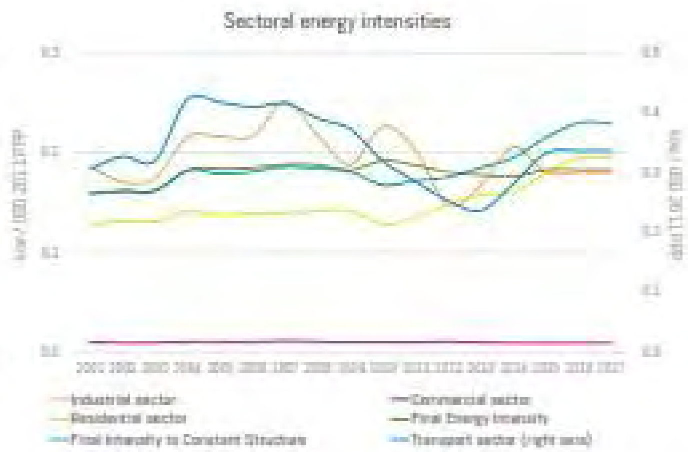
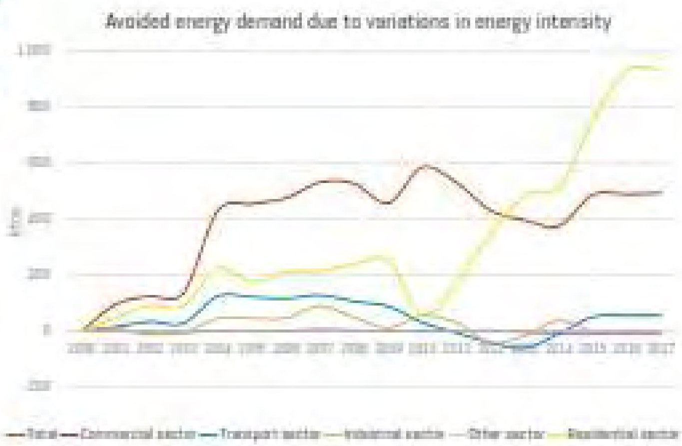

Residential Sector Final Consumption
ktoe
Biomass
Oil and derivatives
Liquefied petroleum gas
Final consumption variation rate [%]
Household final consumption variation rate [%]

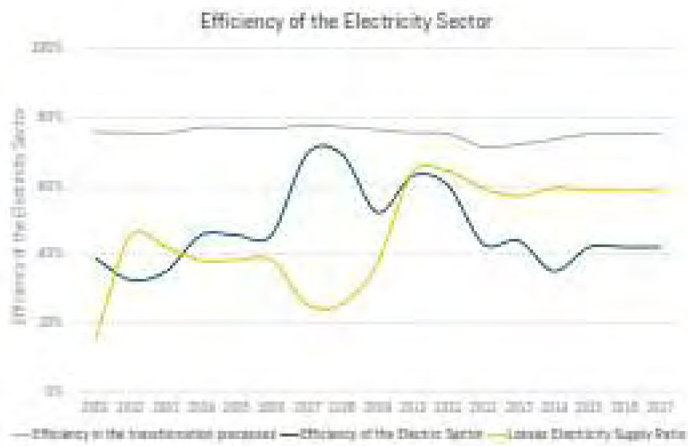

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

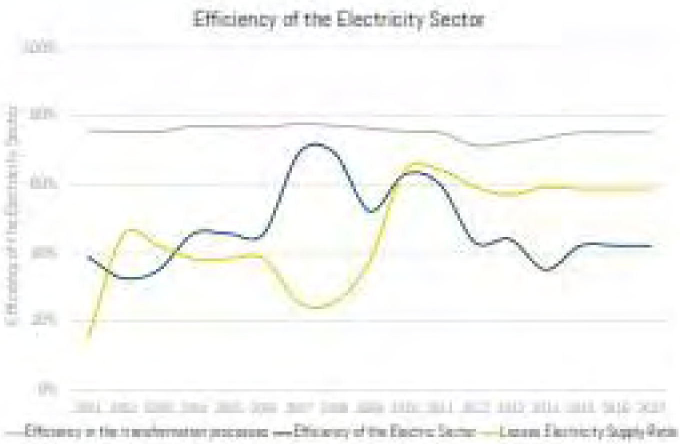

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)

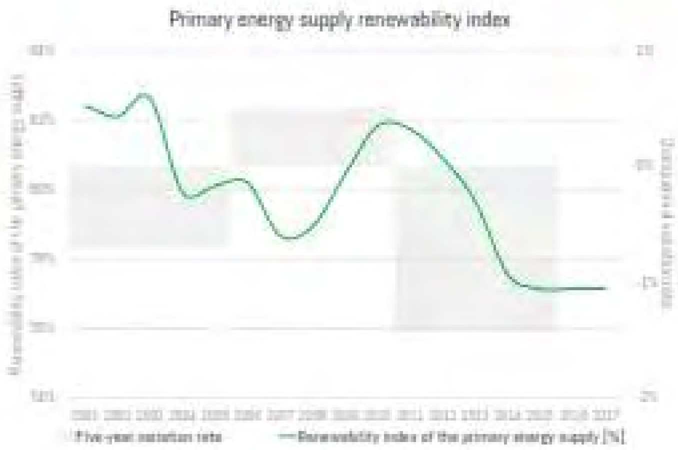

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

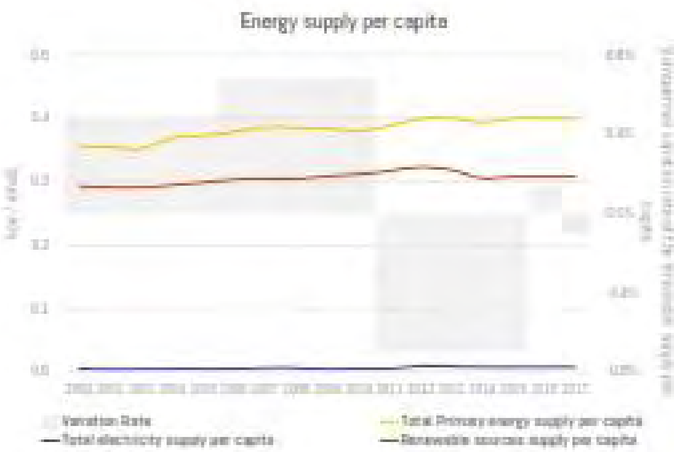
HAITI


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

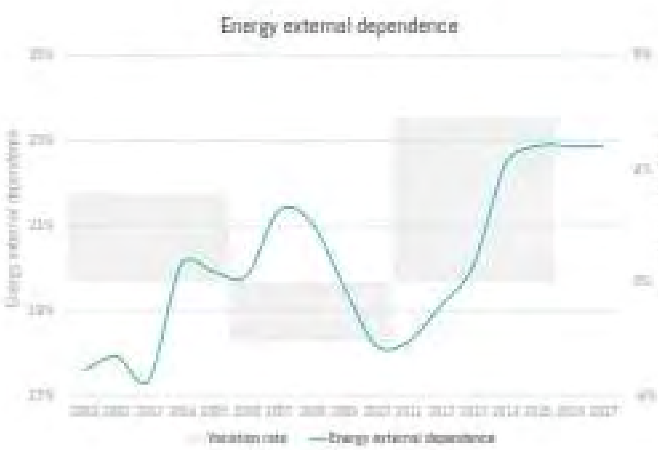

Efficiency of the Electricity Sector
Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

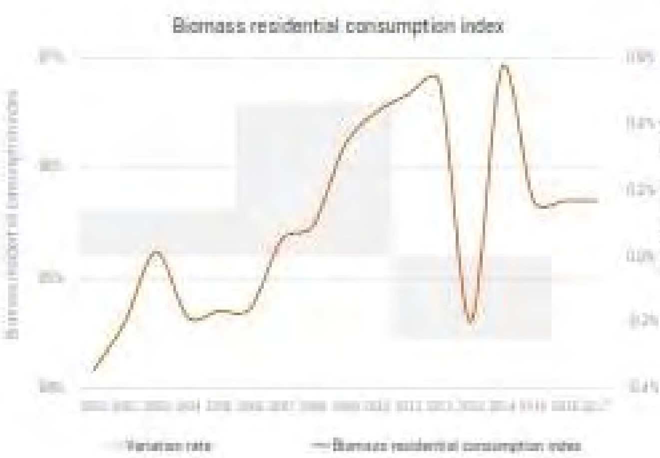

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Rate


Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

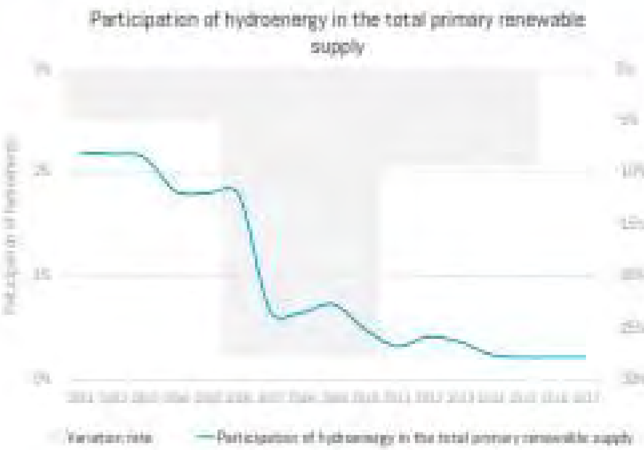

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

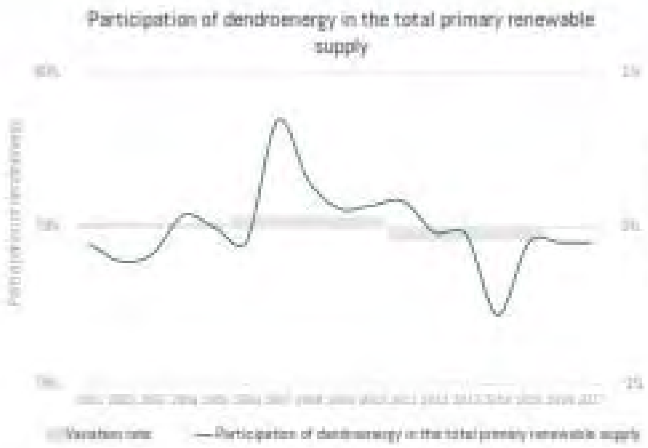

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

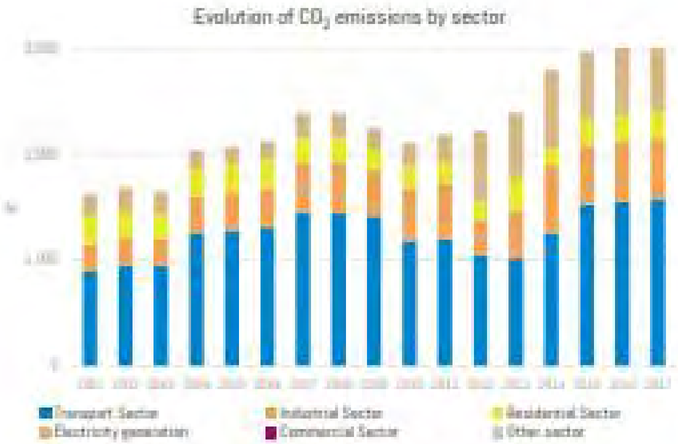

Energy external dependence
Variation rate
Energy external dependence

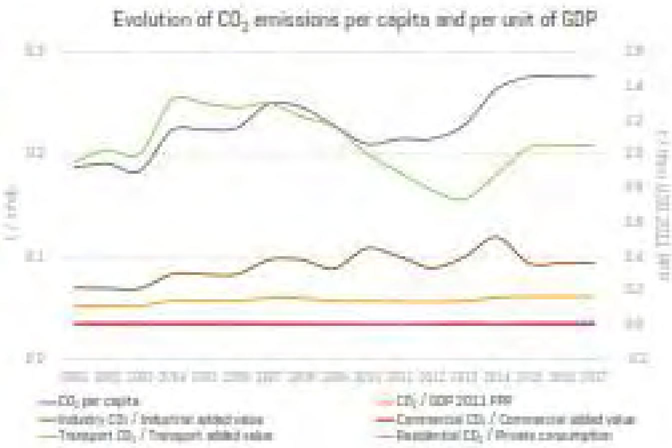

Biomass residential consumption index
Variation rate
Biomass residential consumption index

HAITI

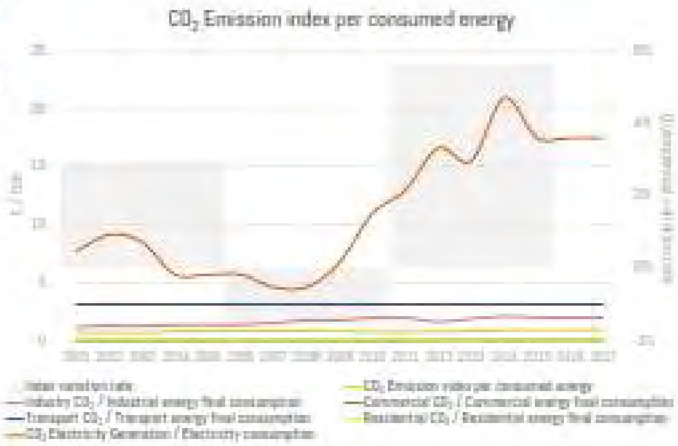

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

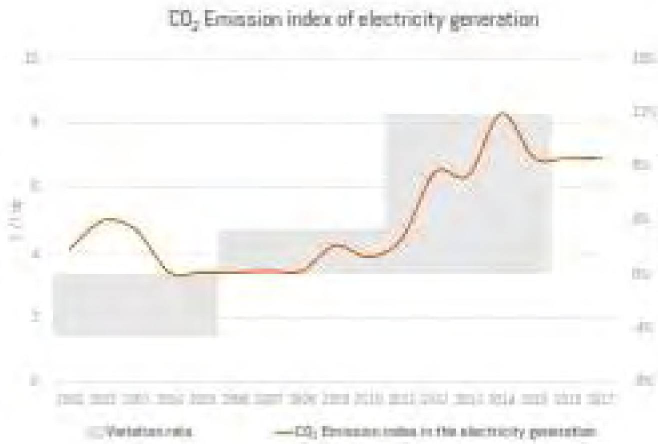

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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

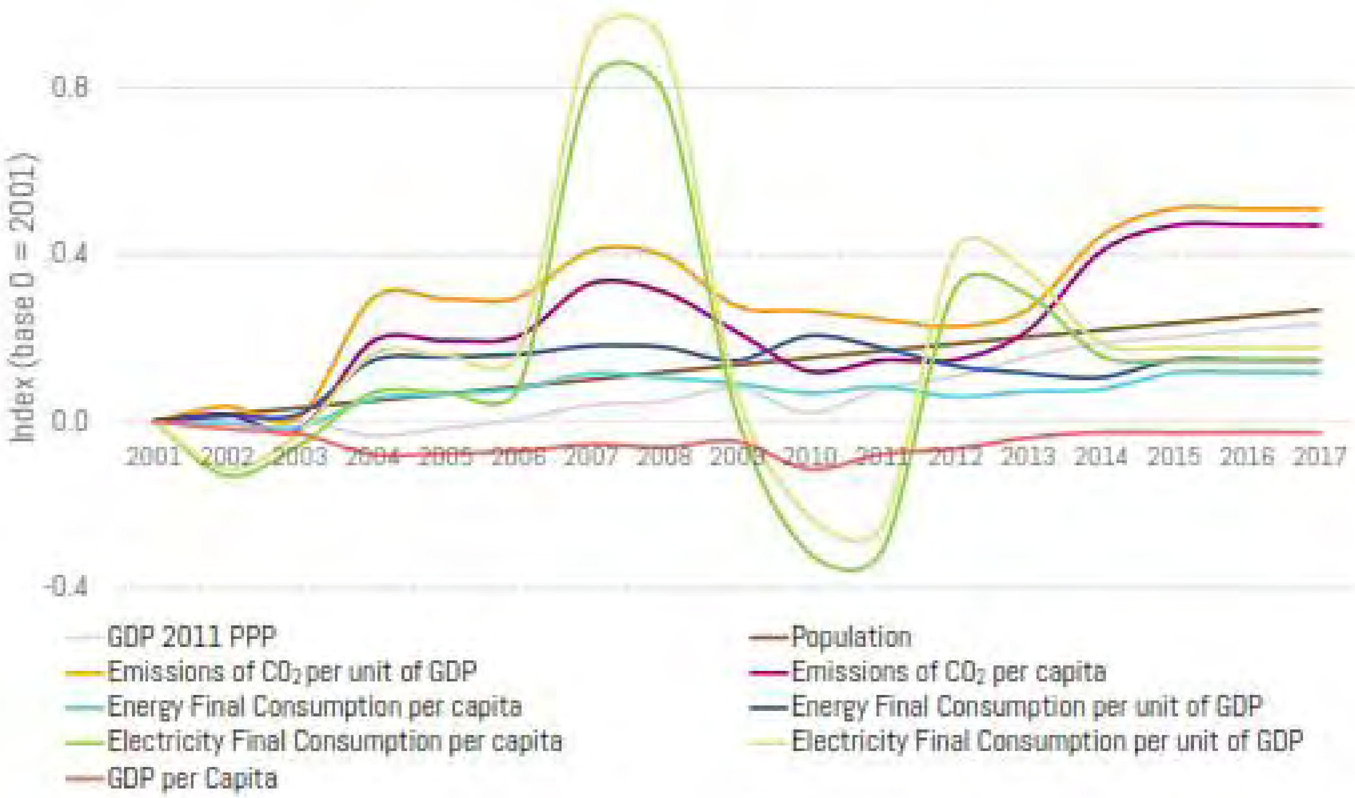

Evolution of CO2 emissions per capita and per unit of GDP
CO2 per capita
CO2 / GDP 2011 PPP

HAITI


CO2 Emission index per consumed energy


CO2 Emission index of electricity generation
Variation rate

Summary of the main energy indicators



HONDURAS

General Information 2017

Population (thousand inhab.)	8,299
Area (km²)	112,490
Population Density (inhab./km²)	74
Urban Population (%)	55
GDP USD 2010 (MUSD)	20,481
GDP USD 2011 PPP (MUSD)	42,080
GDP per capita (thou. USD 2011 PPP/inhab.)	5.1

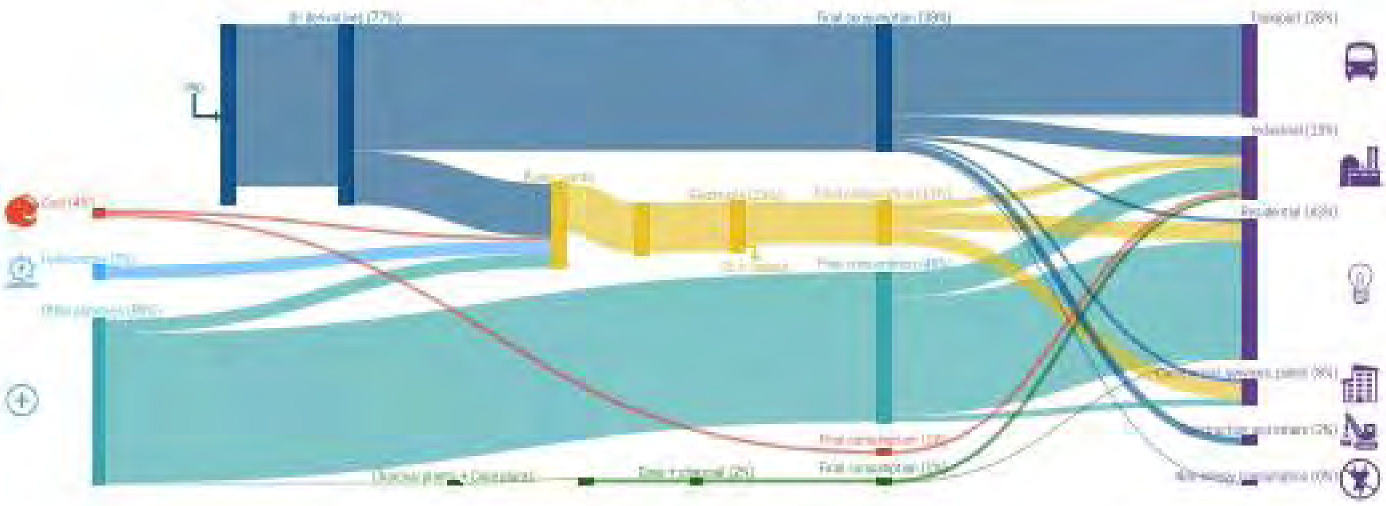
Energy Sector 2016

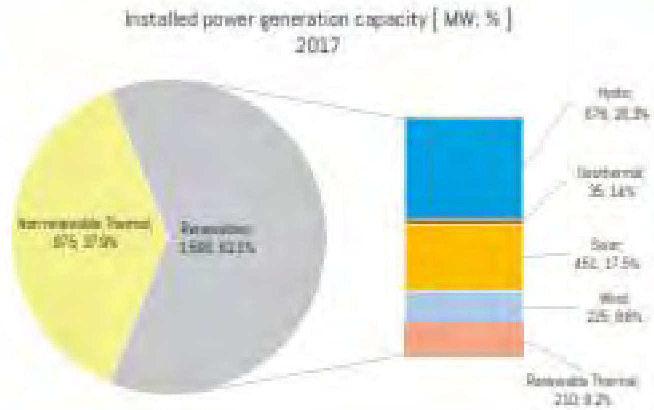
Sector	Mtoe
Final consumption in the Transport Sector	1.42
Final consumption in the Industrial Sector	0.66
Final consumption in the Residential Sector	2.17
Final consumption in the Commercial and Service Sector	0.40
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.13

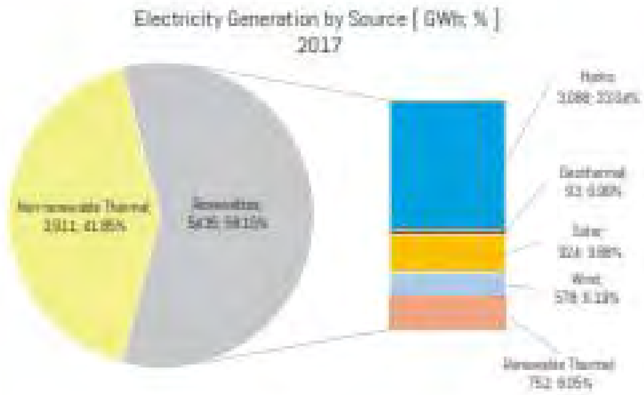
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

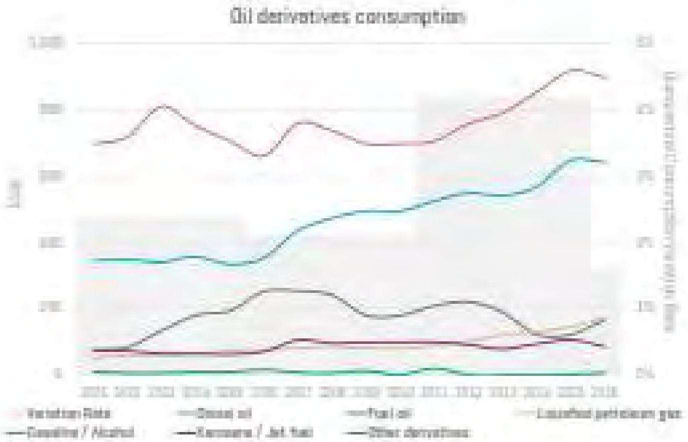
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	931
Final energy consumption per capita	toe/inhab.	0.62
Electrification rate	%	75.12
Total energy supply	Mtoe	5.74
Total energy production	Mtoe	2.75
Total energy imports	Mtoe	3.02
Total energy exports	Mtoe	0.30
Total final energy consumption	Mtoe	5.08
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	2.44
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.14 / 0.13

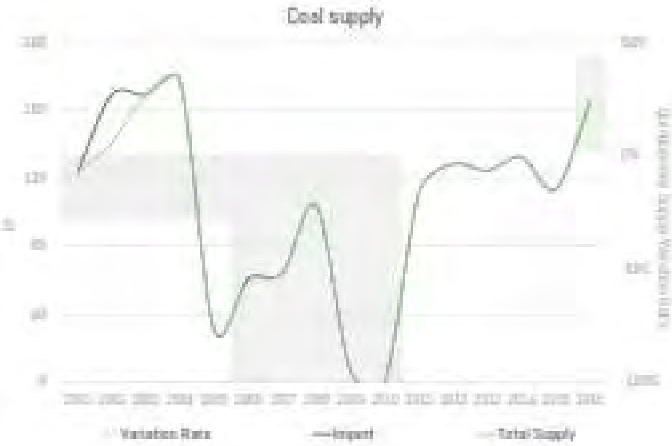
Summarized energy balance 2016




Installed power generation capacity [MW; %]
2017
Hydro
Geothermal
Solar
Wind
Renewable Thermal
Non-renewable Thermal
Renewables

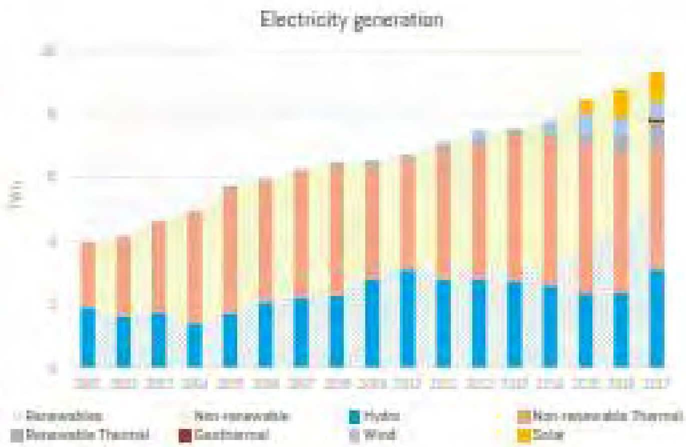

Electricity Generation by Source [GWh; %]
2017
Hydro
Geothermal
Solar
Wind
Renewable Thermal
Non-renewable Thermal
Renewables

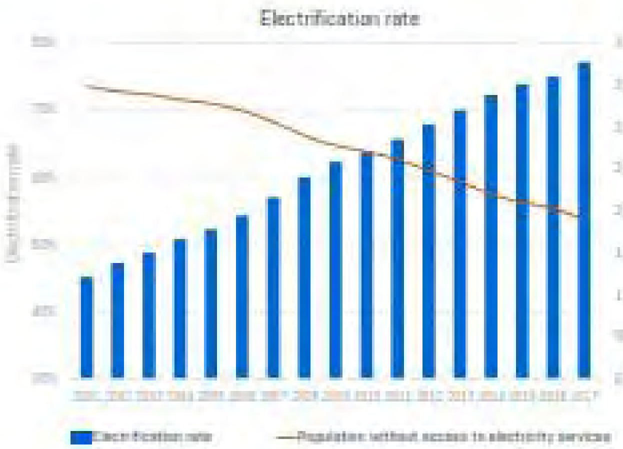

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

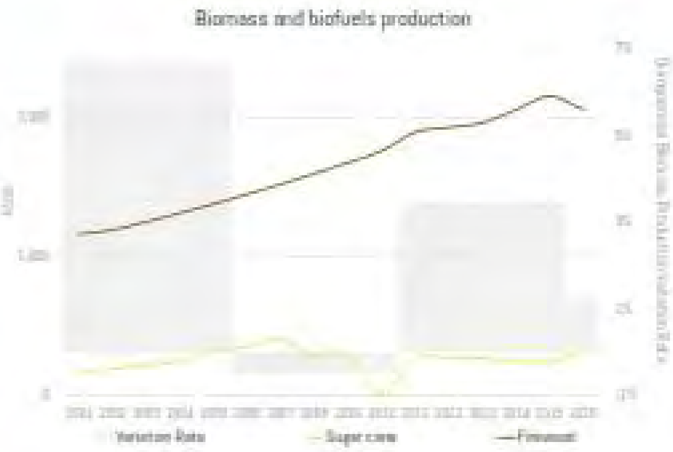

Coal supply
Variation Rate
Import
Total Supply

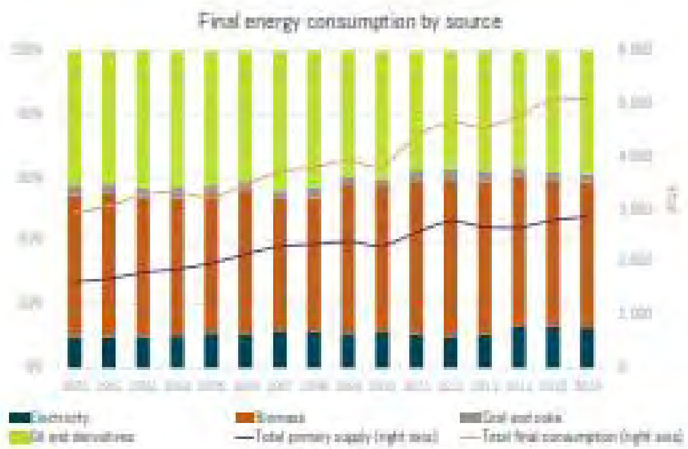
HONDURAS

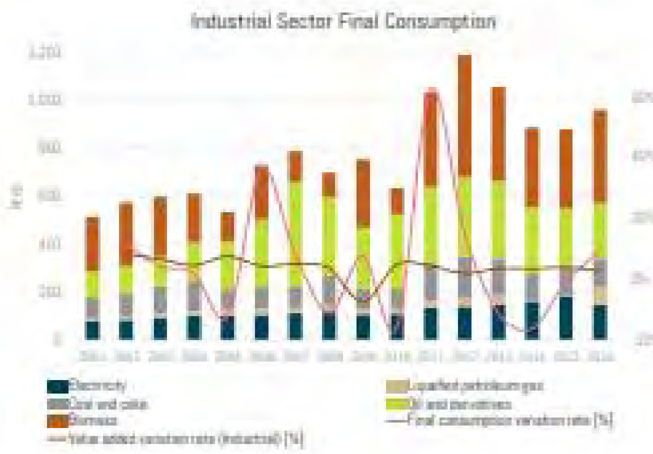

Installed power generation capacity
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Geothermal
Wind
Solar

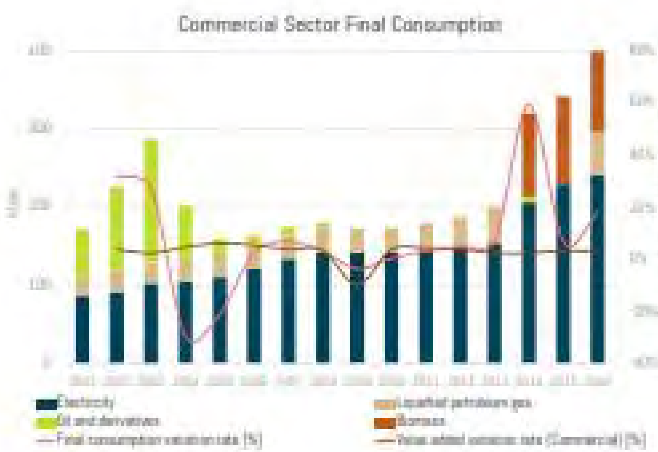

Electricity generation
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Geothermal
Wind
Solar

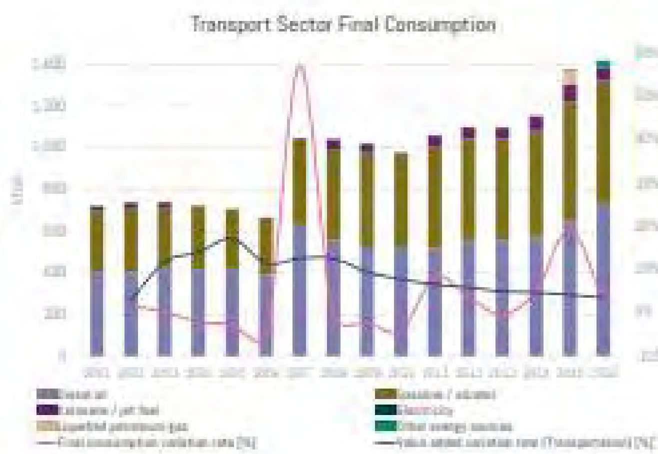

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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

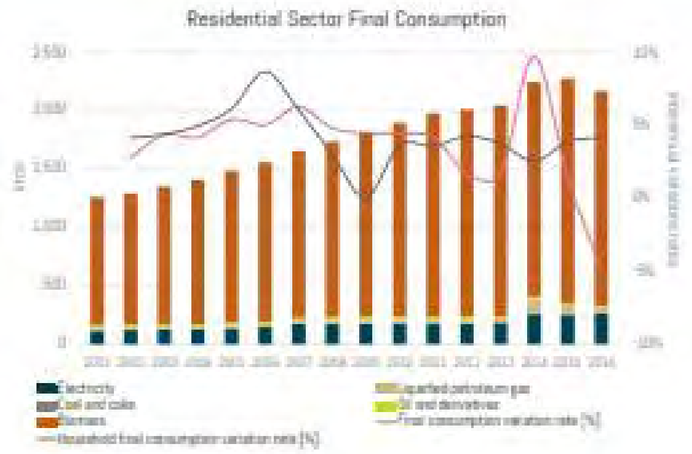

Industrial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

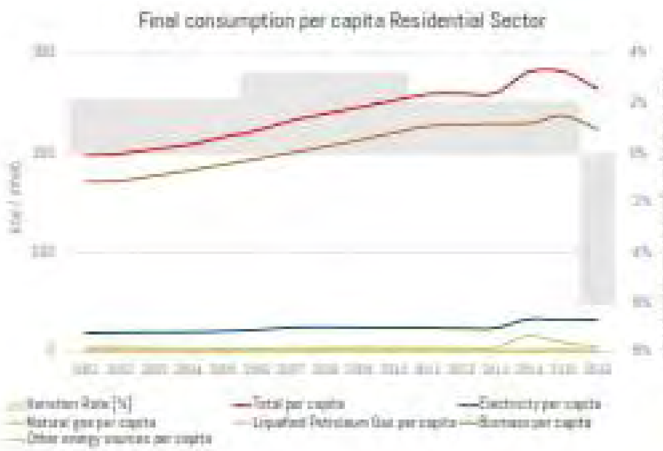

Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]

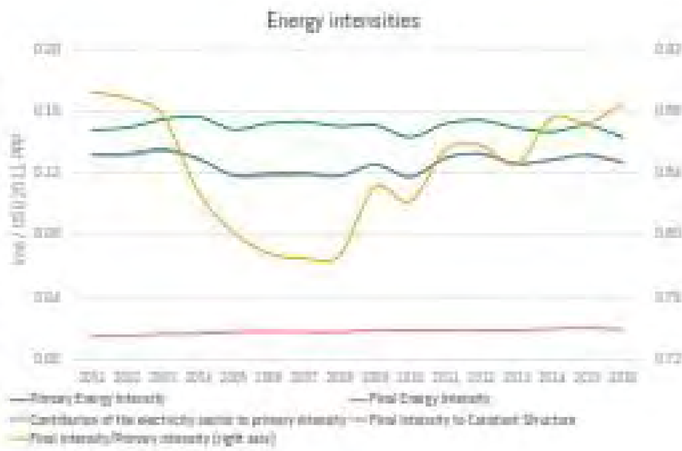

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Liquefied petroleum gas
Final consumption variation rate [%]
Gasoline / alcohol
Electricity
Other energy sources
Value added variation rate (Transportation) [%]

HONDURAS

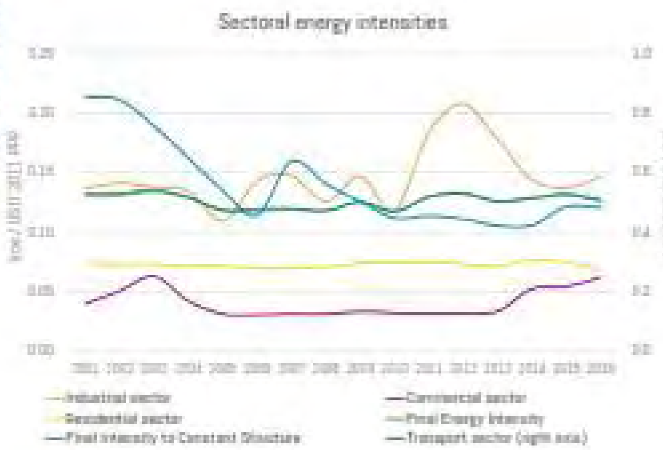

Other Sector Final Consumption
Electricity
Diesel oil
Kerosene / jet fuel
Value added variation rate (Other) [%]
Liquefied petroleum gas
Gasoline / alcohol
Other energy sources

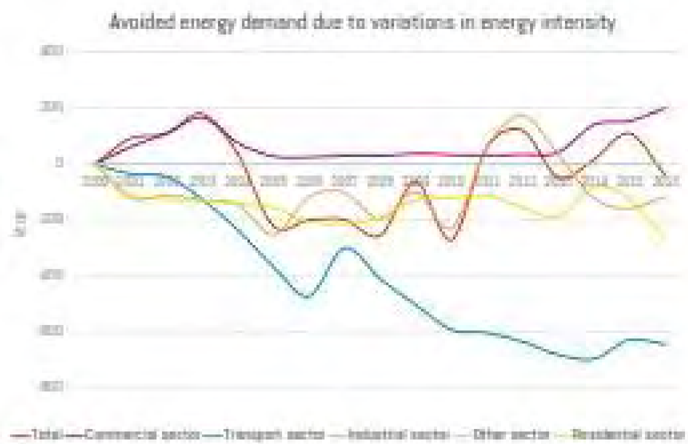

Residential Sector Final Consumption
Electricity
Coal and coke
Biomass
Household final consumption variation rate [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

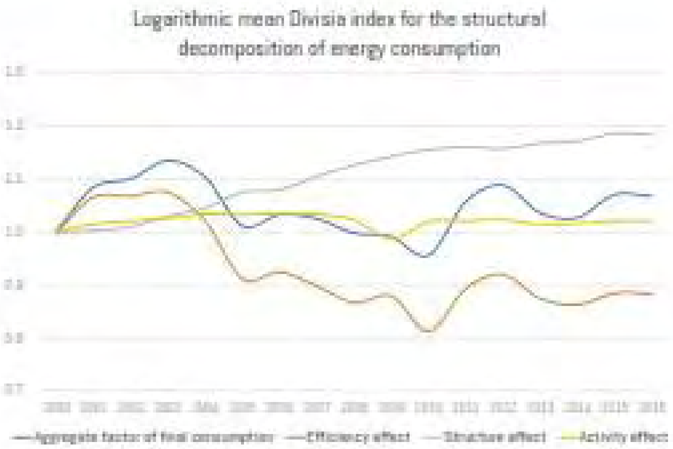

Final consumption per capita Residential Sector
Natural gas per capita
Other energy sources per capita
Total per capita
Liquefied Petroleum Gas per capita
Electricity per capita
Biomass per capita

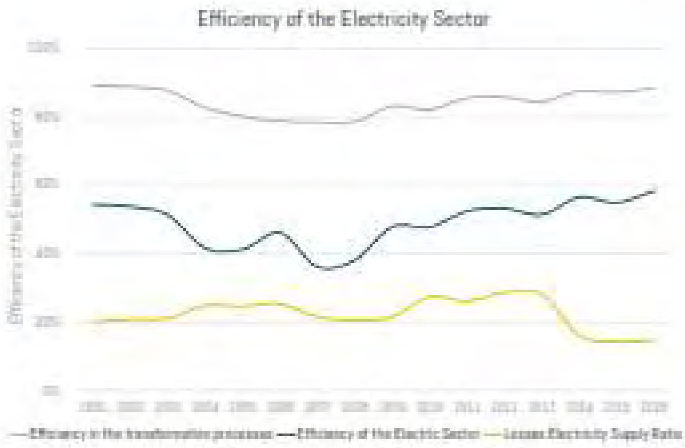

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Final intensity to Constant Structure
Final intensity/Primary intensity (right axis)

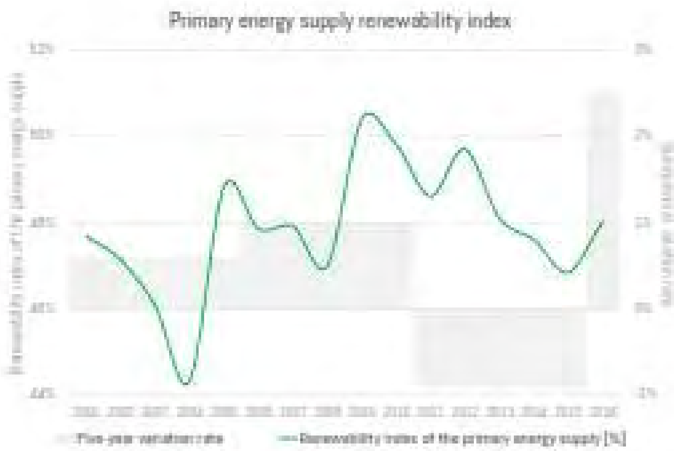
HONDURAS

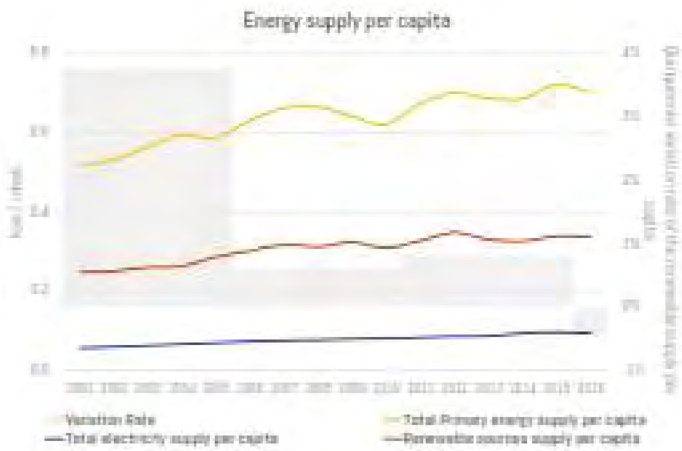

Sectoral energy intensities
Industrial sector
Residential sector
Final intensity to Constant Structure
Commercial sector
Final Energy Intensity
Transport sector (right axis)

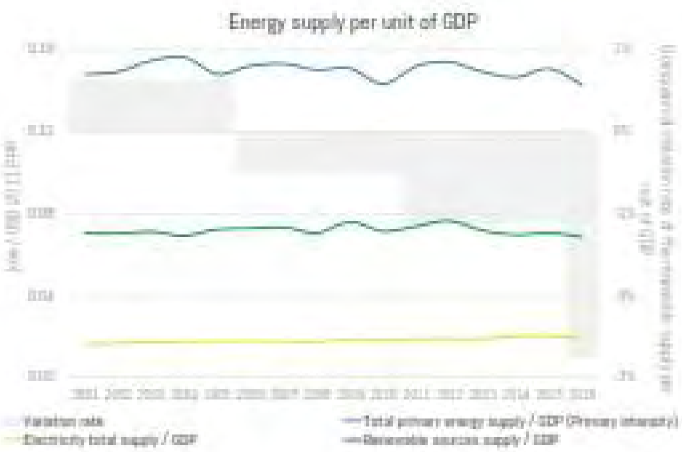

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

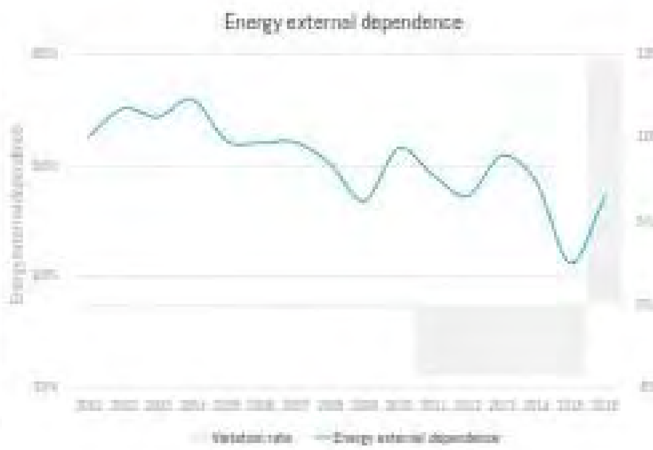

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency 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 [%]

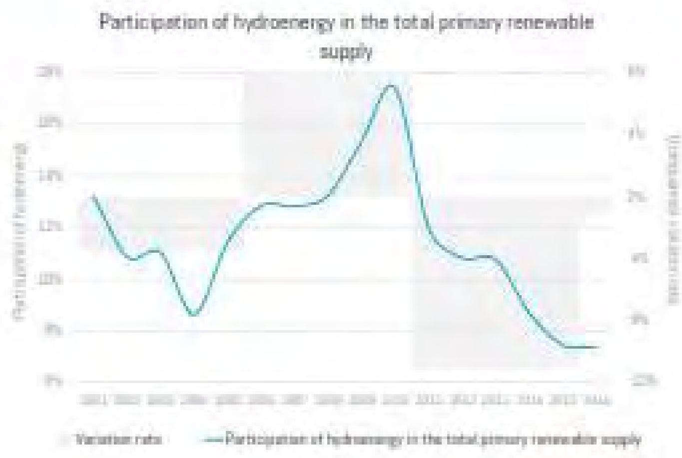

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

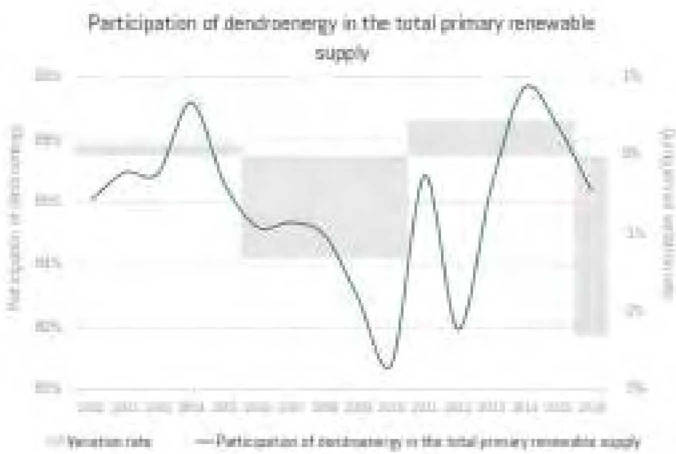

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

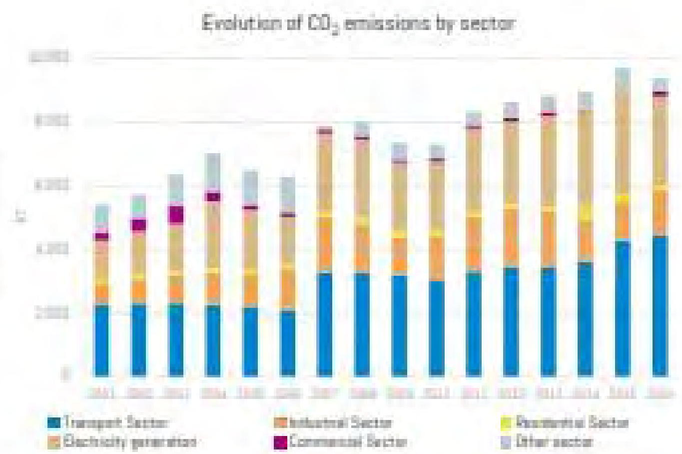

Energy external dependence
Variation rate
Energy external dependence

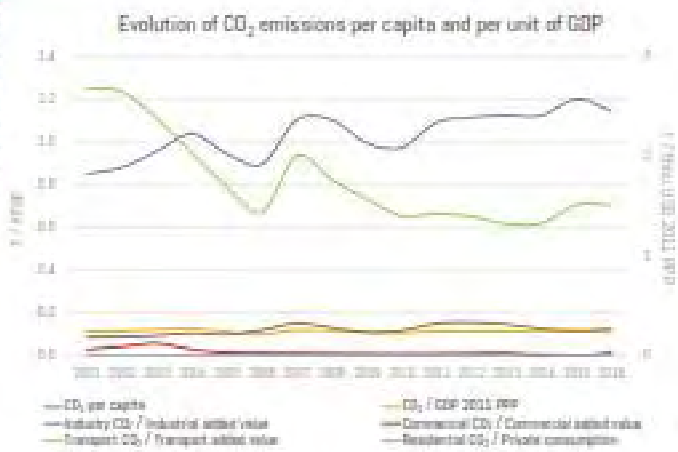
HONDURAS

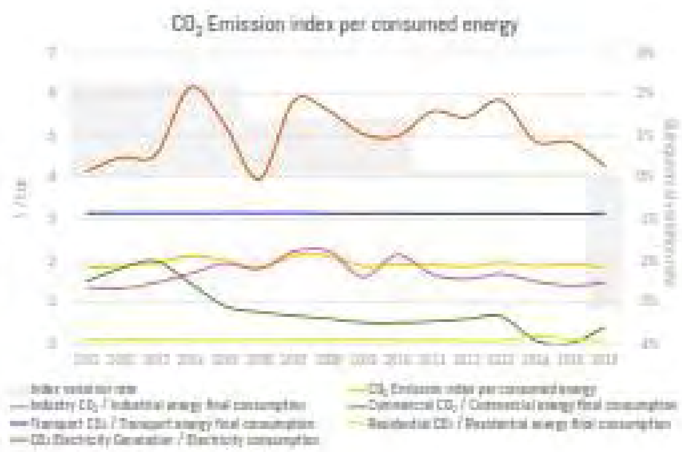

Biomass residential consumption index
Variation rate
Biomass residential consumption index

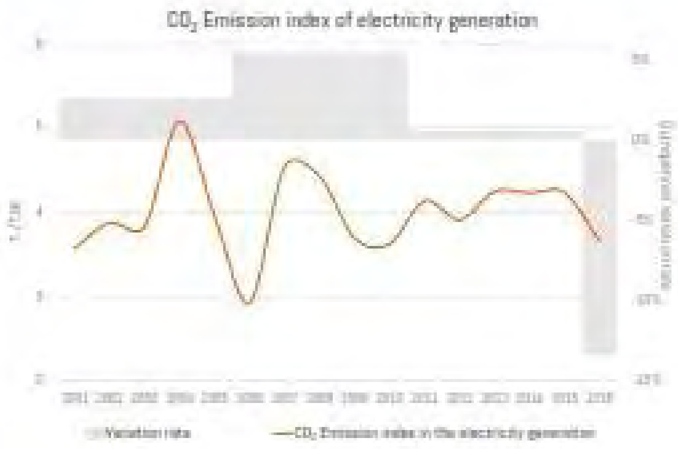

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

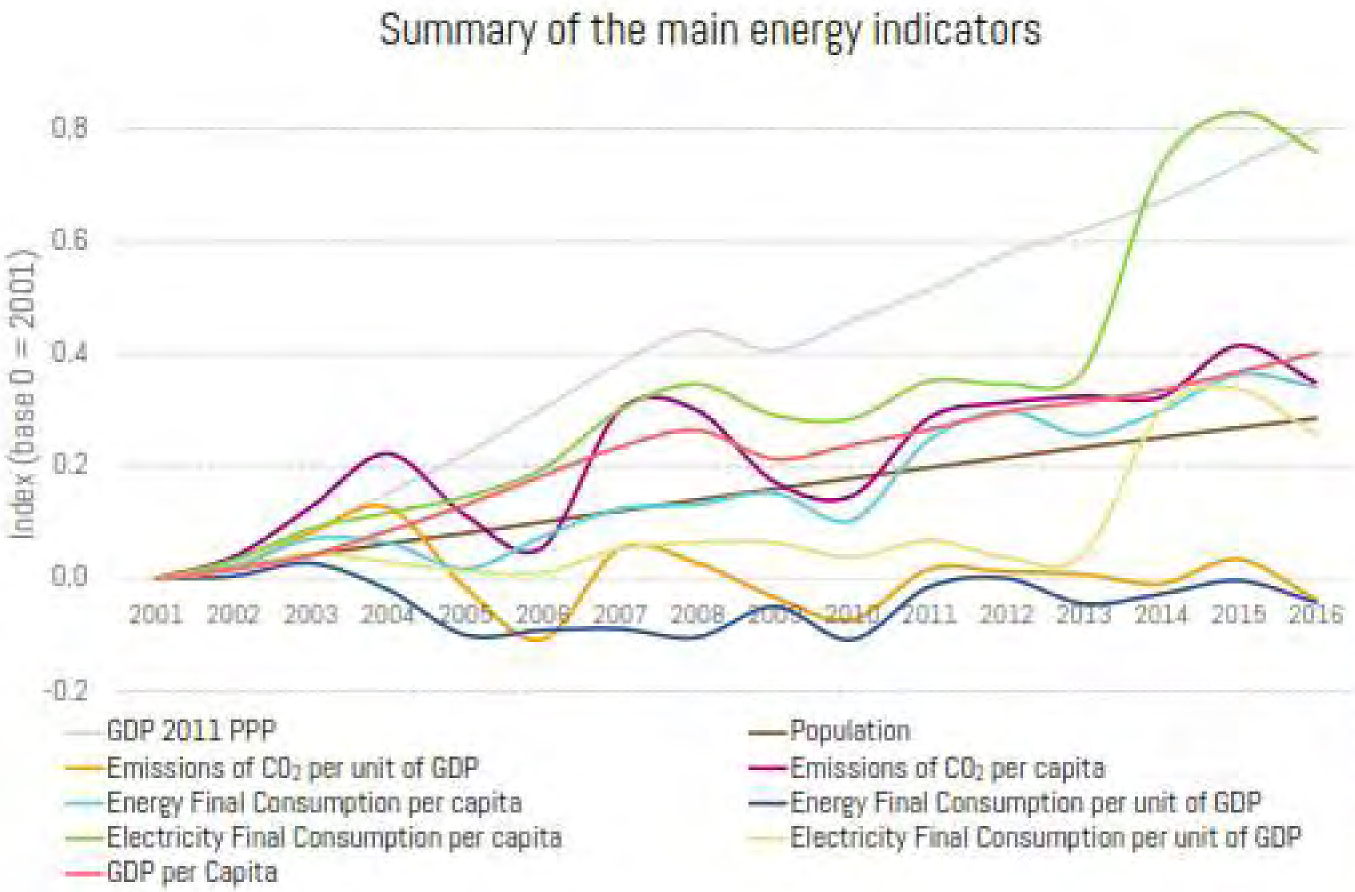

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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
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
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
Variation rate
CO2 Emission index in the electricity generation


Summary of the main energy indicators
0,8
0,6
0,4
0,2
0,0
-0,2
Index (base 0 = 2001)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
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

JAMAICA

General Information 2017

Population (thousand inhab.)	2,729
Area (km²)	11,004
Population Density (inhab./km²)	248
Urban Population (%)	55
GDP USD 2010 (MUSD)	13,900
GDP USD 2011 PPP (MUSD)	23,682
GDP per capita (thou. USD 2011 PPP/inhab.)	9

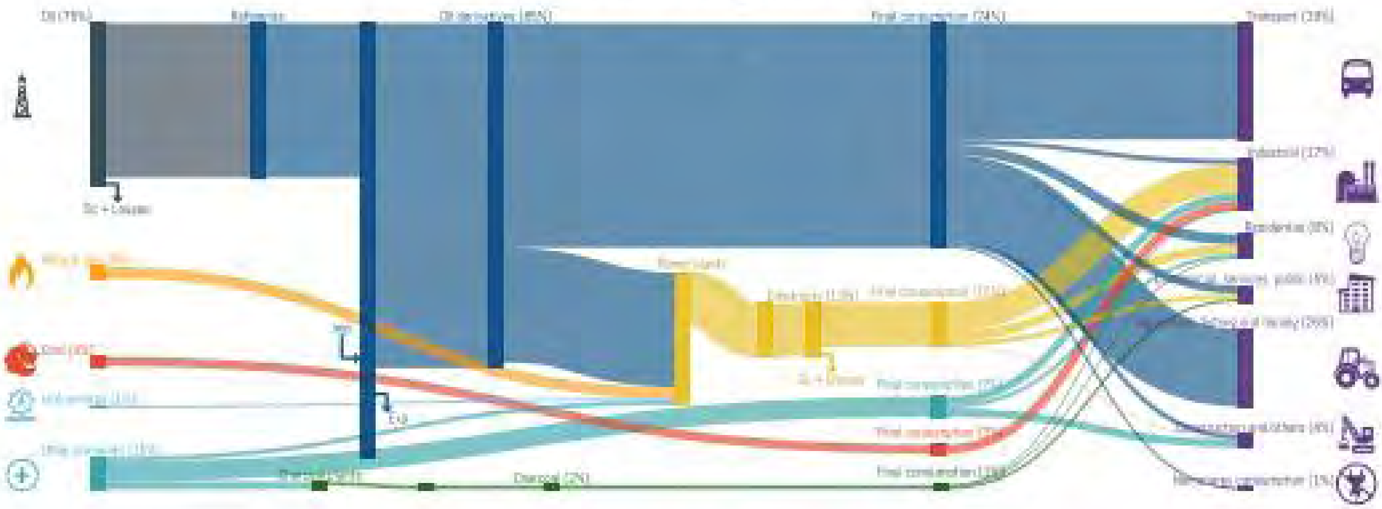
Energy Sector

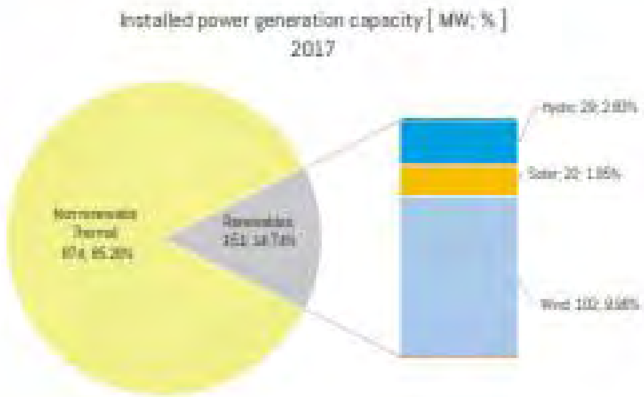
Sector	Mtoe
Final consumption in the Transport Sector	0.73
Final consumption in the Industrial Sector	0.32
Final consumption in the Residential Sector	0.16
Final consumption in the Commercial and Service Sector	0.10
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.58

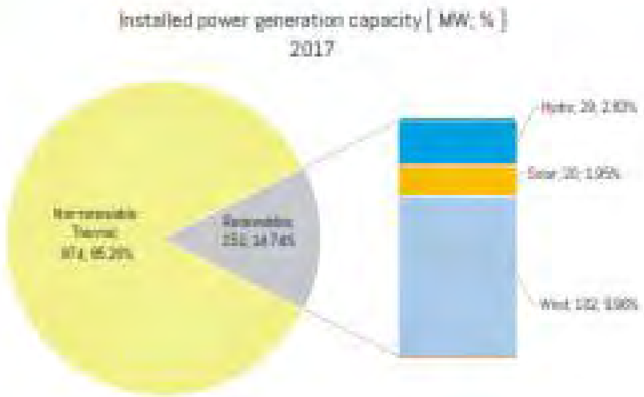
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	n.a.

Electricity consumption per capita	Final energy 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
1,176	0.69	97.50	2.52	0.22	2.91	0.56	1.89	35	1.02	0.11 / 0.08

Summarized energy balance 2017




Installed power generation capacity [MW; %]
2017
Hydro; 29; 2.83%
Solar; 20; 1.95%
Wind; 102; 9.98%
Non-renewable Thermal 874; 85.26%
Renewables 151; 14.74%


Installed power generation capacity [MW; %]
2017
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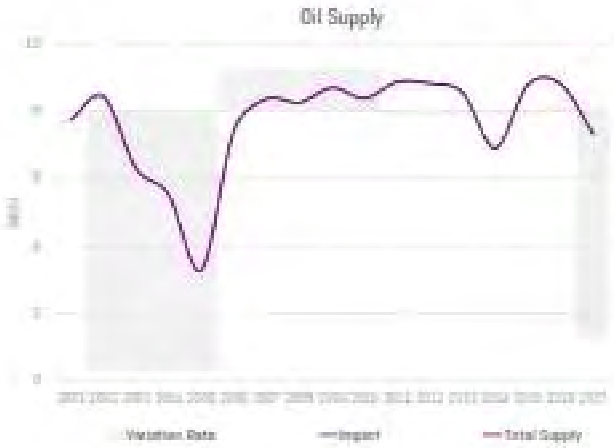
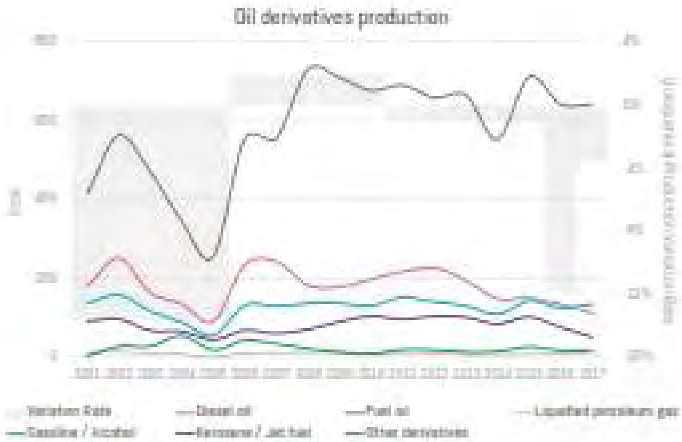
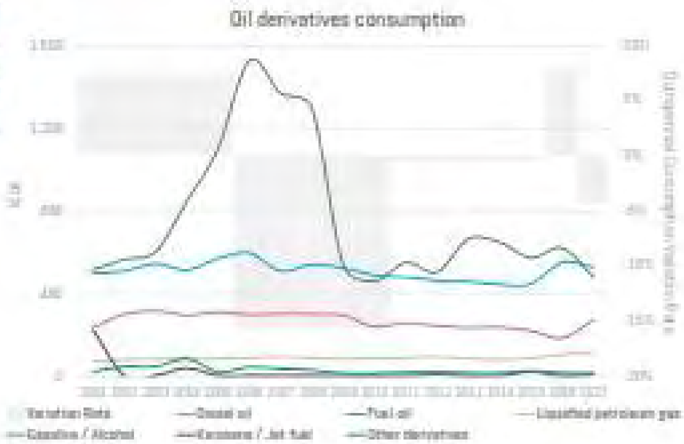
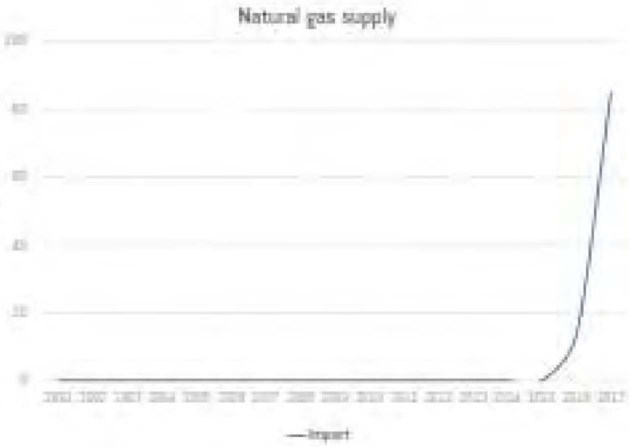
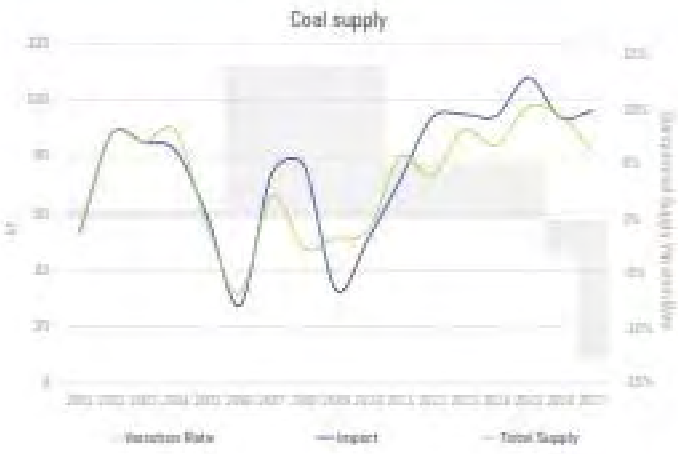

Oil Supply
Variation Rate
Import
Total Supply

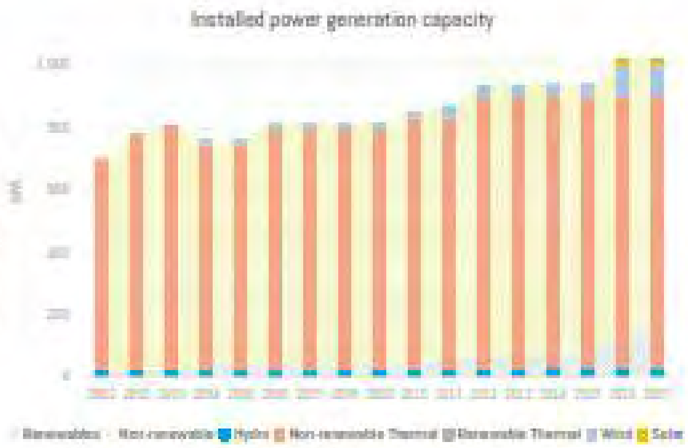

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

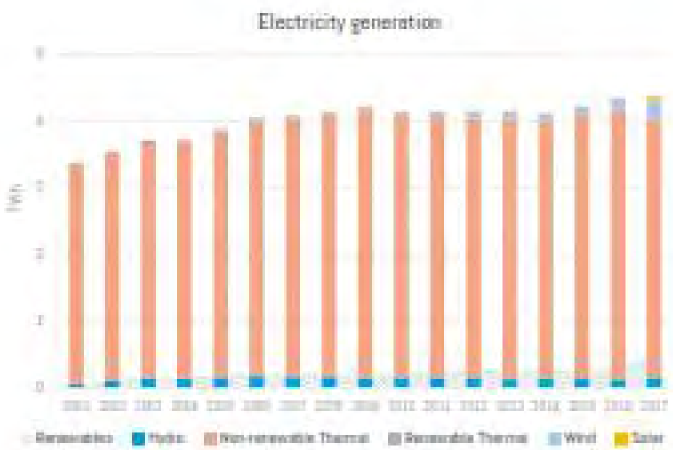
JAMAICA

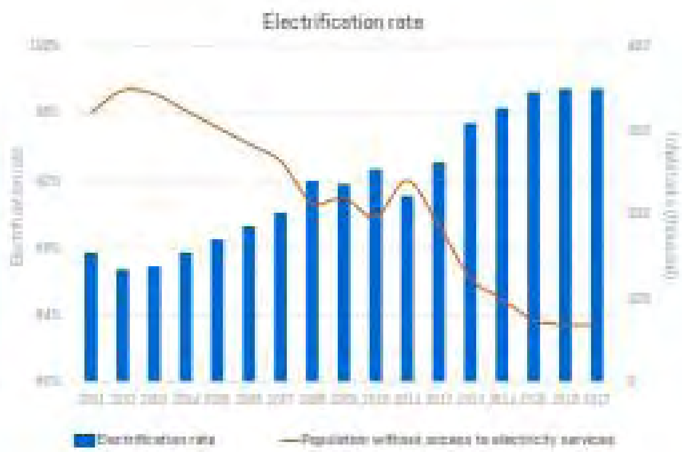

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives


Natural gas supply
Import

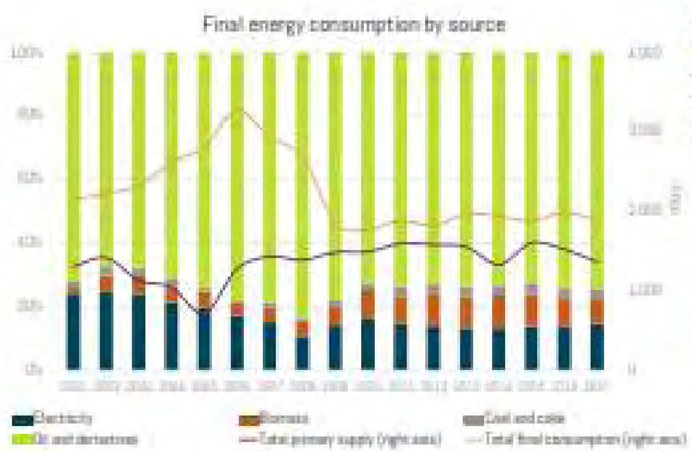

Coal supply
Variation Rate
Import
Total Supply


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


Electricity generation
Renewables
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar


Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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

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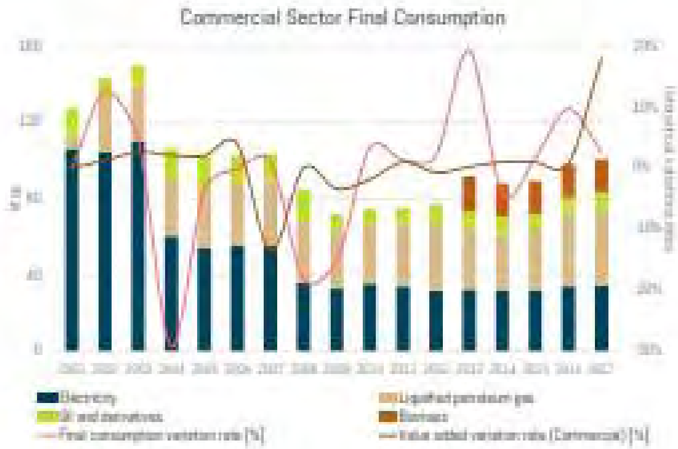
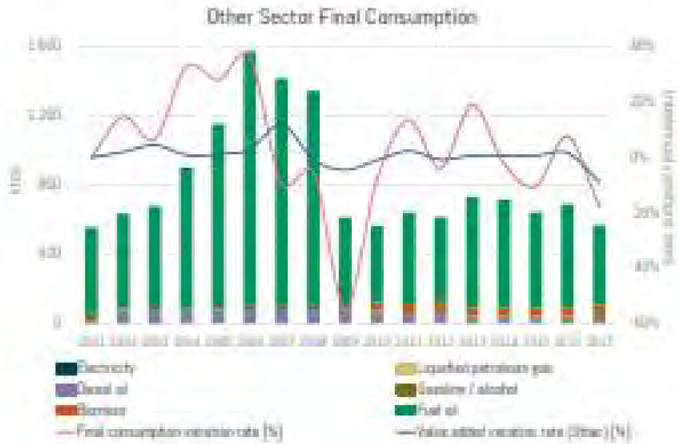
Industrial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

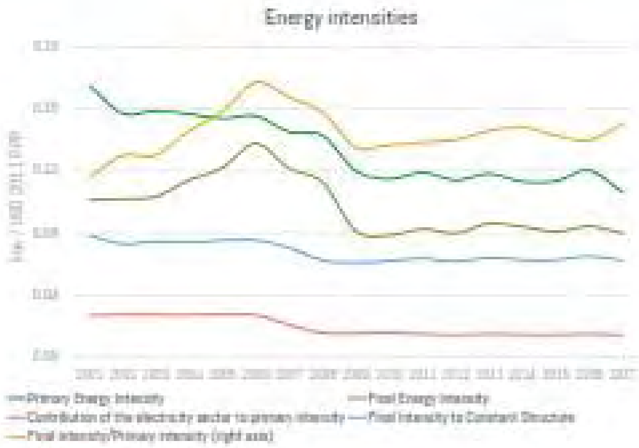

Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]

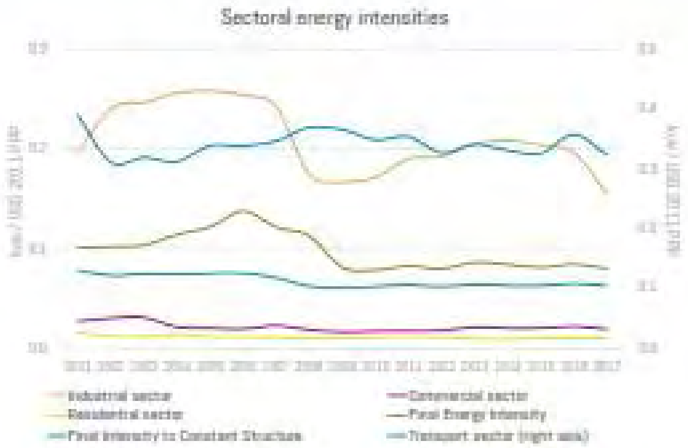

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Gasoline / alcohol
Fuel oil
Value added variation rate (Transportation) [%]

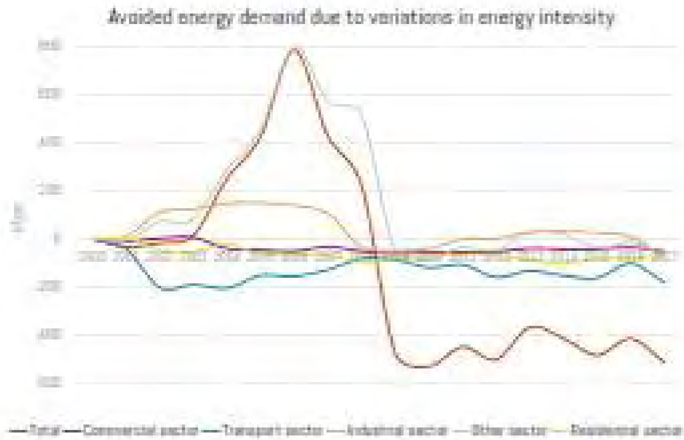

Other Sector Final Consumption
Electricity
Diesel oil
Biomass
Final consumption variation rate [%]
Liquefied petroleum gas
Gasoline / alcohol
Fuel oil
Value added variation rate (Other) [%]

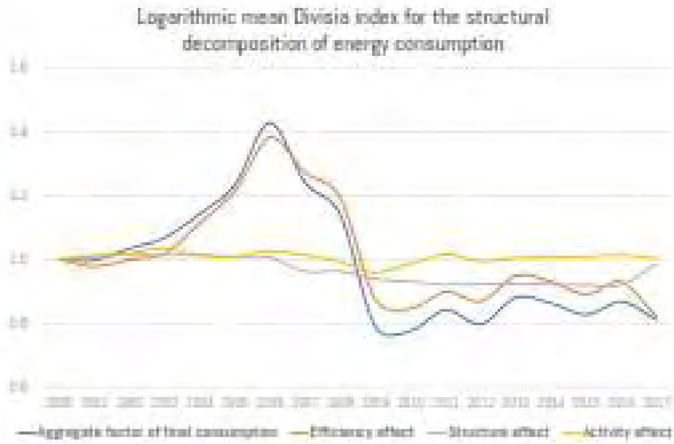

Residential Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]

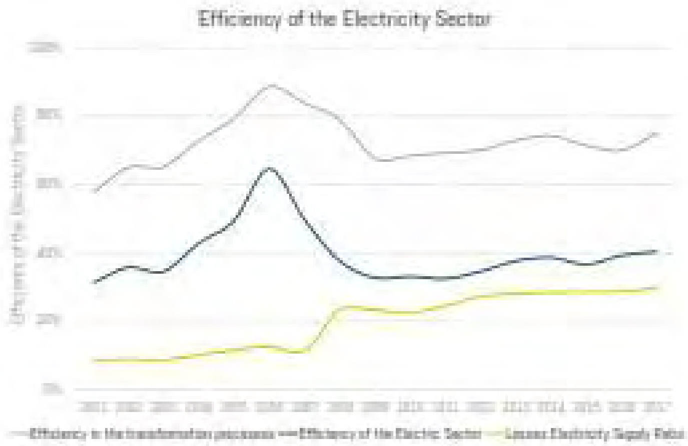

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

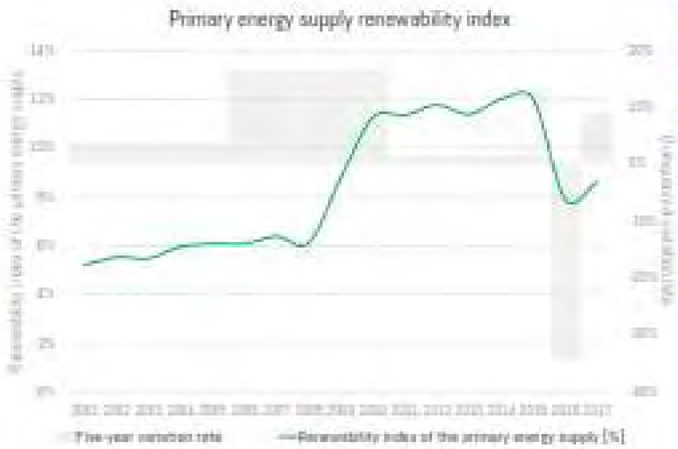

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)


Sectoral energy intensities
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 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 [%]

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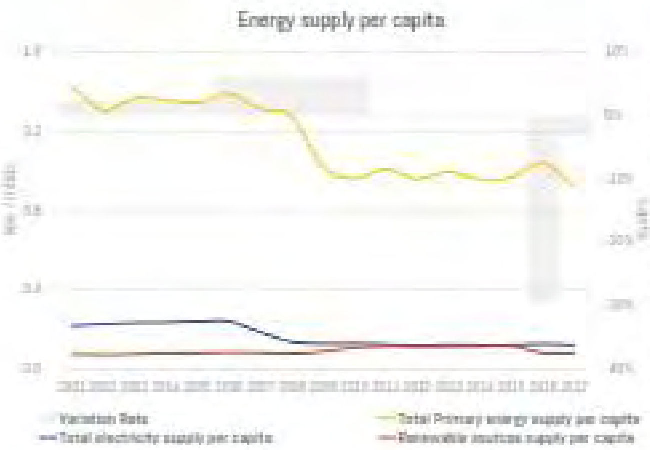
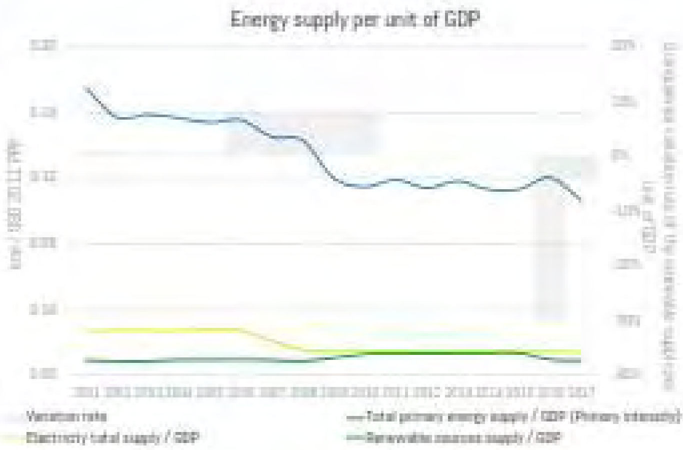
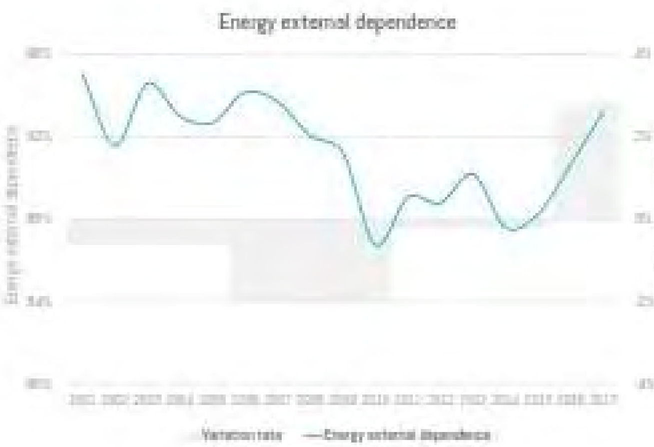
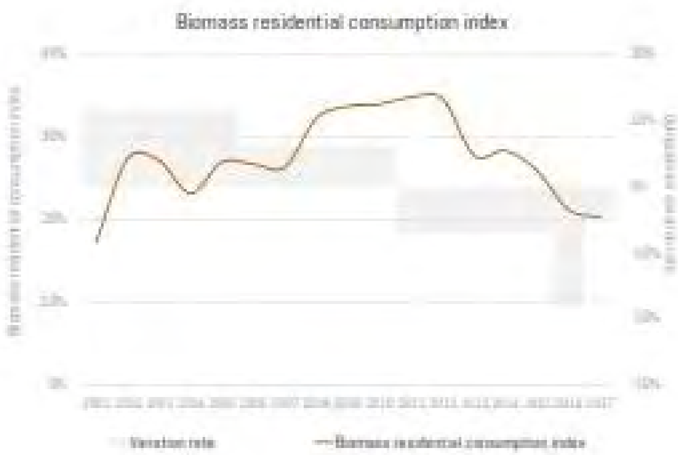

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita


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

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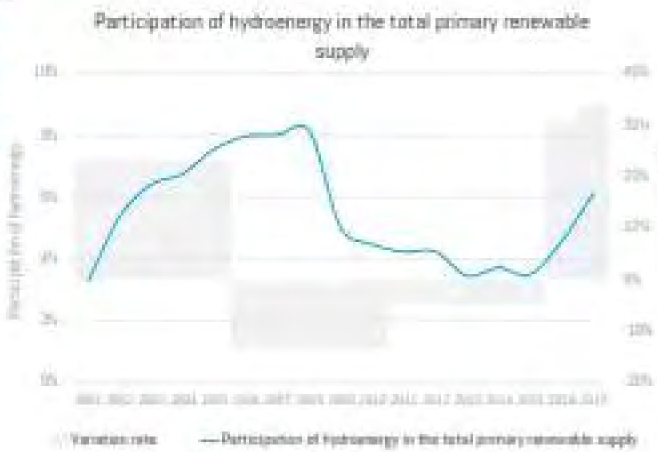
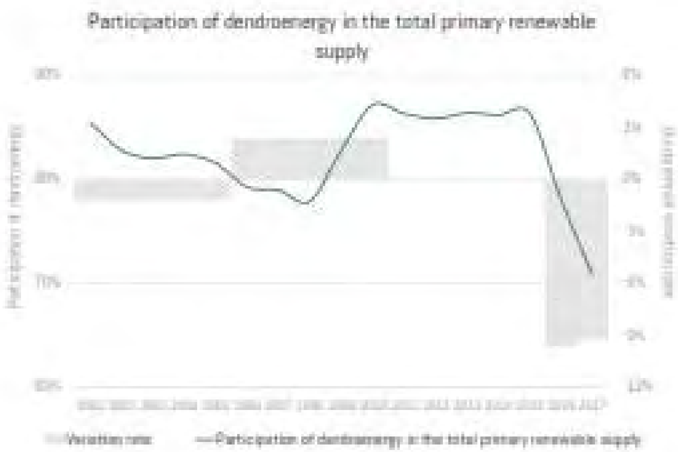
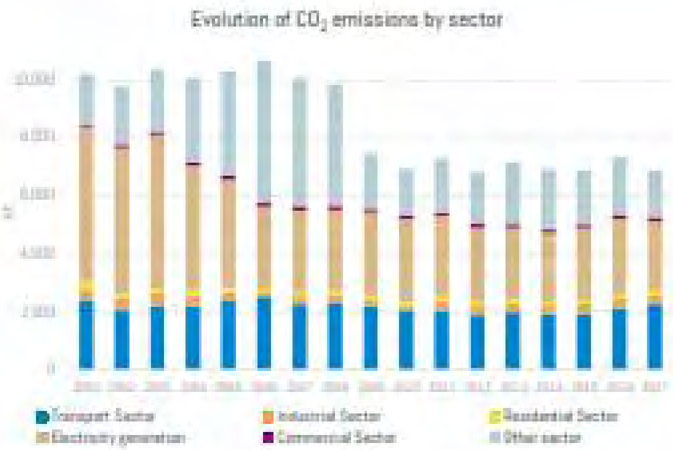
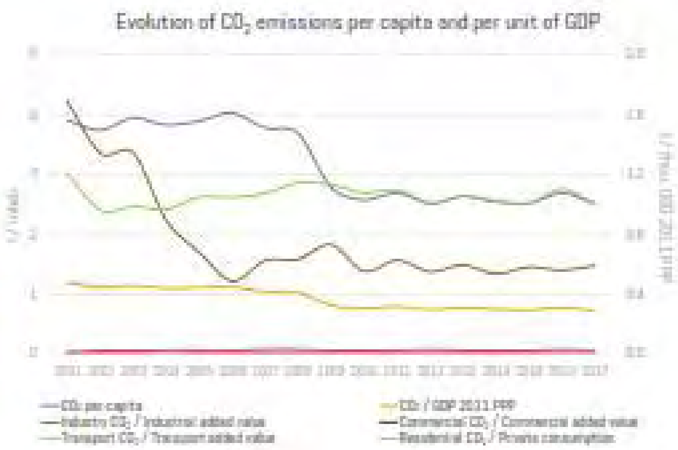
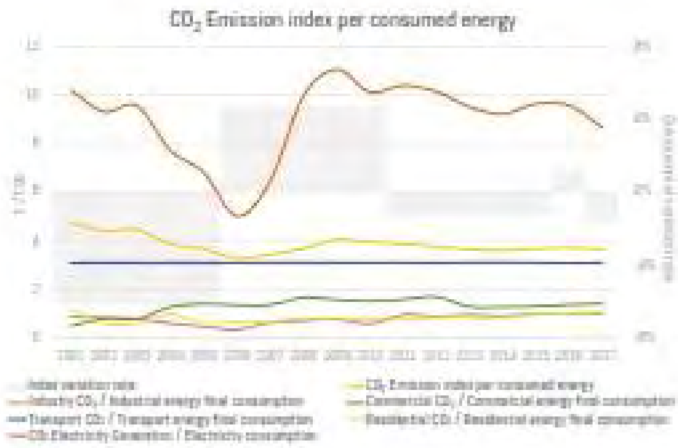
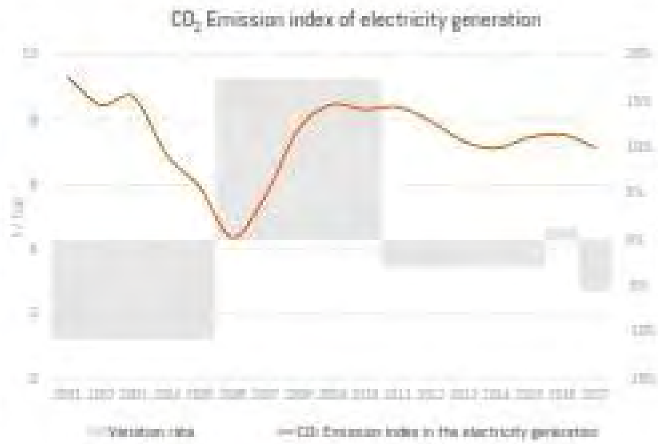

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
Annual 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
Variation rate
CO_2 Emission index in the electricity generation

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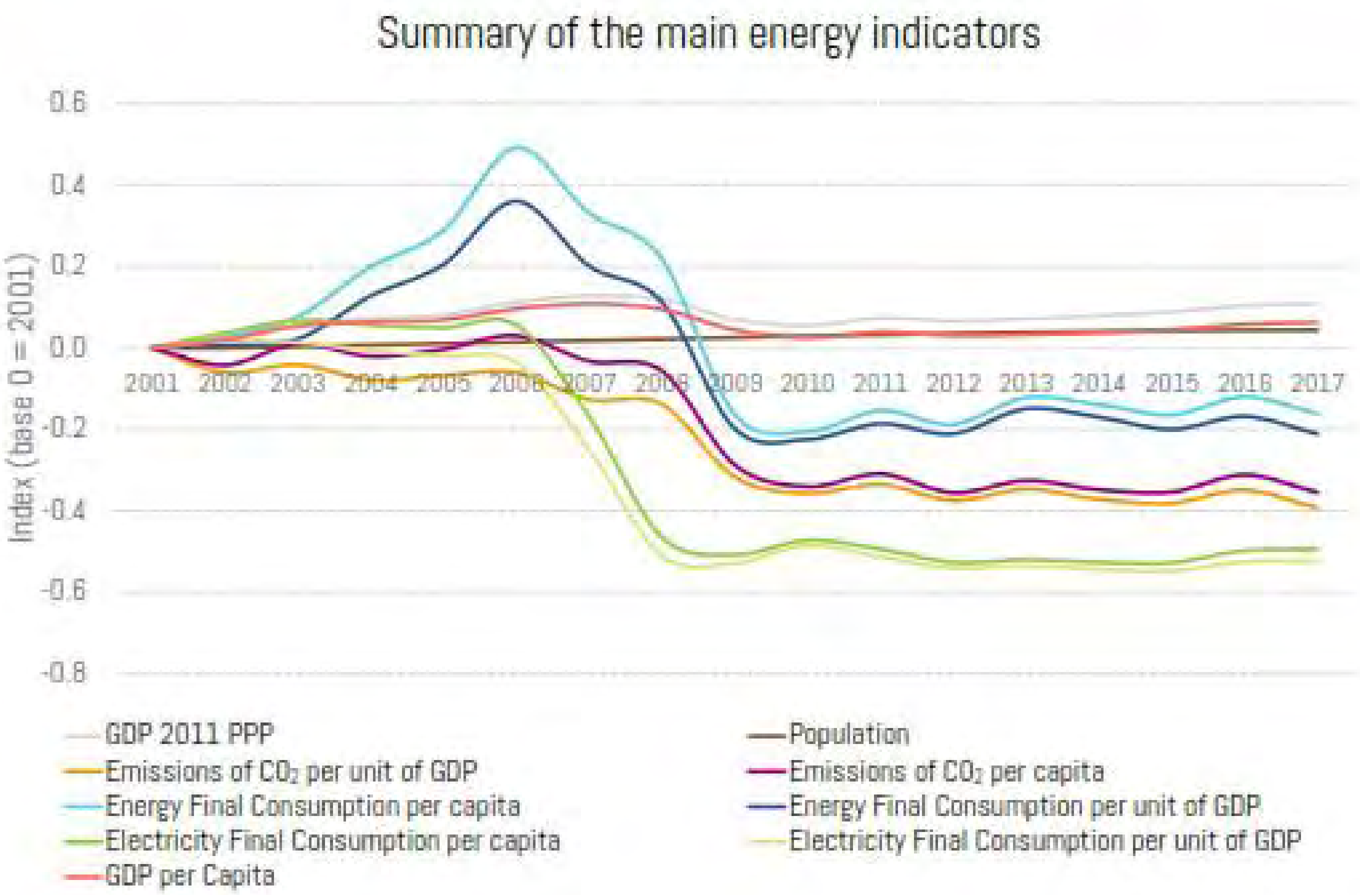
Summary of the main energy indicators
Index (base 0 = 2001)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
GDP 2011 PPP
Population
Emissions of CO2 per unit of GDP
Emissions of CO2 per capita
Energy Final Consumption per capita
Energy Final Consumption per unit of GDP
Electricity Final Consumption per capita
Electricity Final Consumption per unit of GDP
GDP per Capita

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General Information 2017

Population (thousand inhab.)	127,979
Area (km²)	1,964,380
Population Density (inhab./km²)	65
Urban Population (%)	79
GDP USD 2010 (MUSD)	1,284,252
GDP USD 2011 PPP (MUSD)	2,239,235
GDP per capita (thou. USD 2011 PPP/inhab.)	18

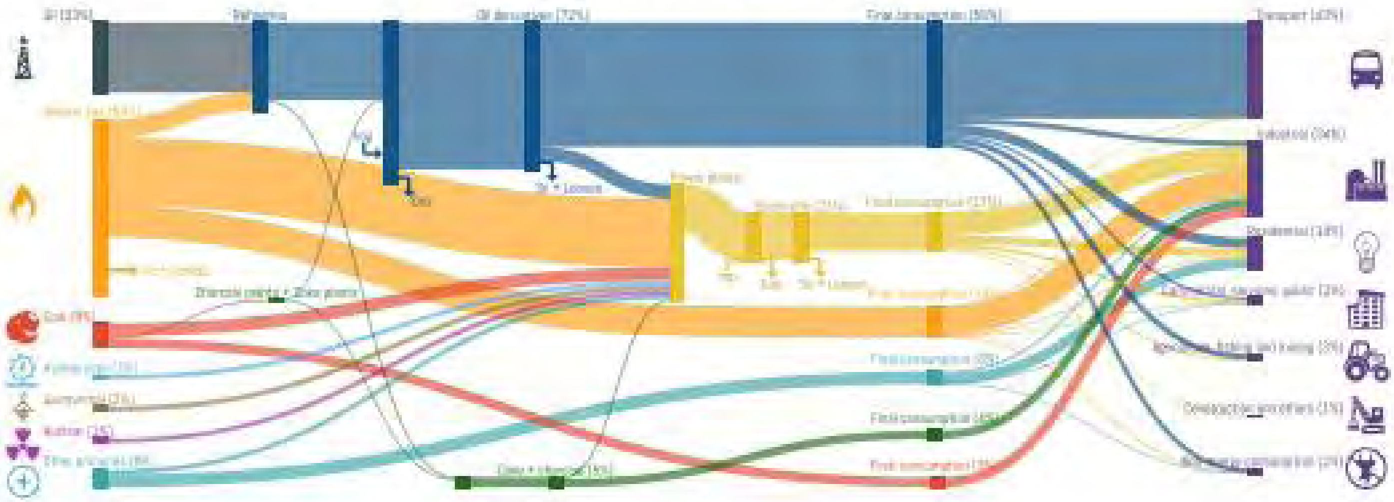
Energy Sector

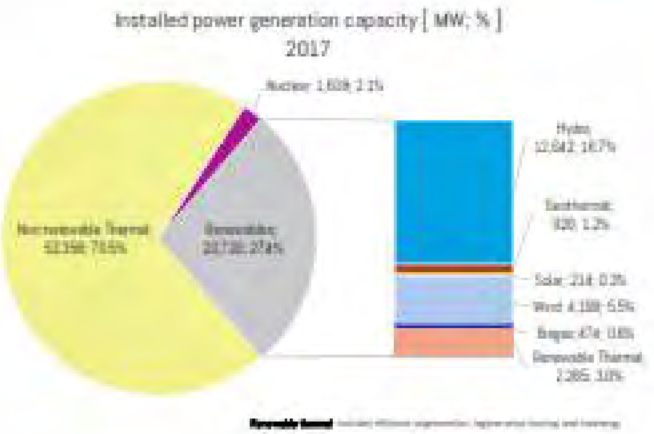
	Mtoe
Final consumption in the Transport Sector	55.41
Final consumption in the Industrial Sector	44.95
Final consumption in the Residential Sector	17.97
Final consumption in the Commercial and Service Sector	3.83
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	8.37

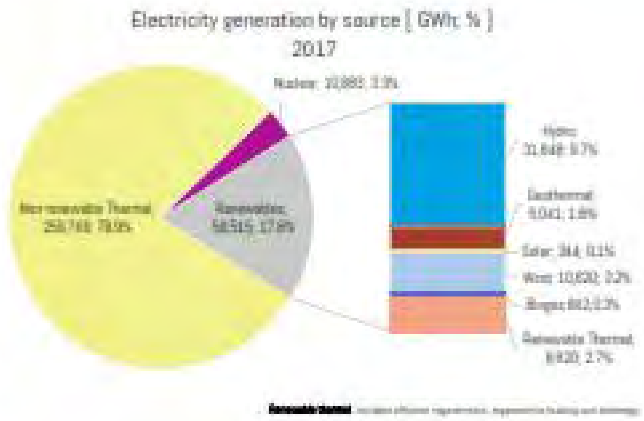
	Unit	Value
Oil reserves	Mbbl	7,037
Natural gas reserves	Gm³	295
Coal reserves	Mt	1,211

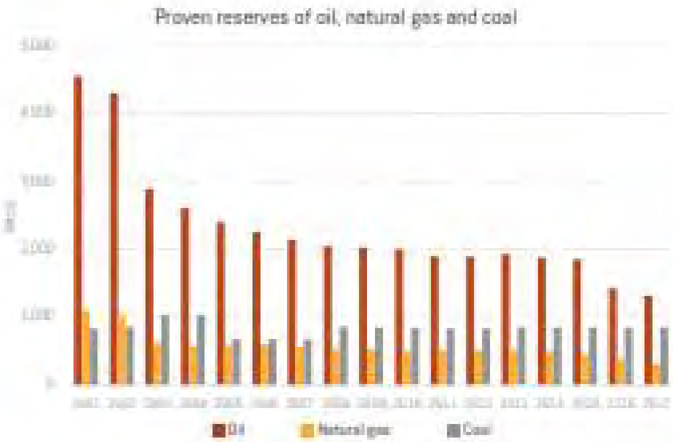
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	2,034
Final energy consumption per capita	toe/inhab.	1.03
Electrification rate	%	98.64
Total energy supply	Mtoe	221.07
Total energy production	Mtoe	190.52
Total energy imports	Mtoe	105.58
Total energy exports	Mtoe	71.10
Total final energy consumption	Mtoe	131.43
Refining capacity	kbbl/day	1,616
Installed power generation capacity	GW	75.69
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.10 / 0.06

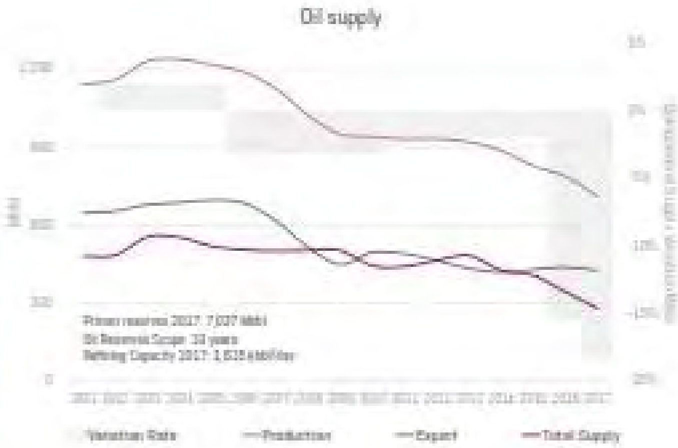
Summarized energy balance 2017




Installed power generation capacity [MW; %]
2017


Electricity generation by source [GWh; %]
2017


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


Oil supply
Variation Rate
Production
Export
Total Supply

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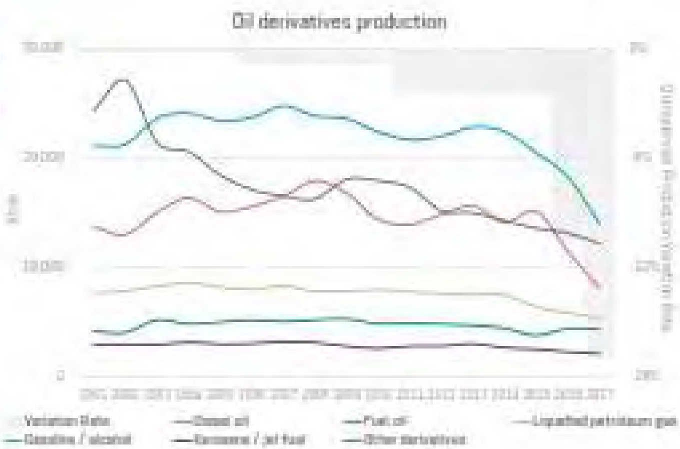
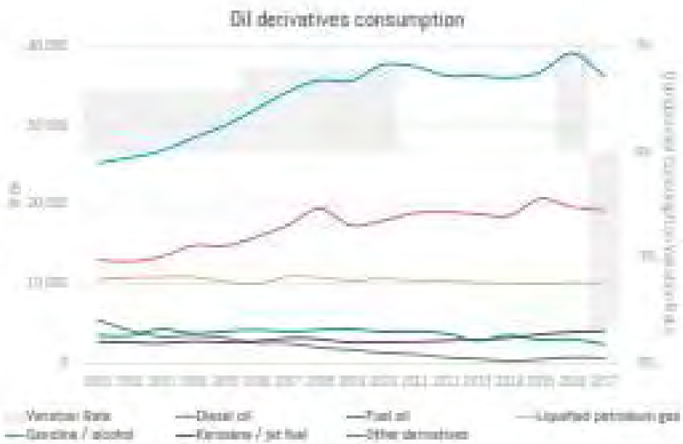
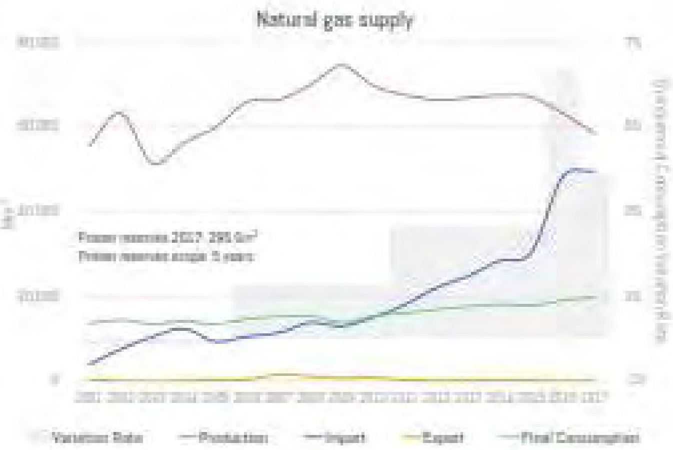
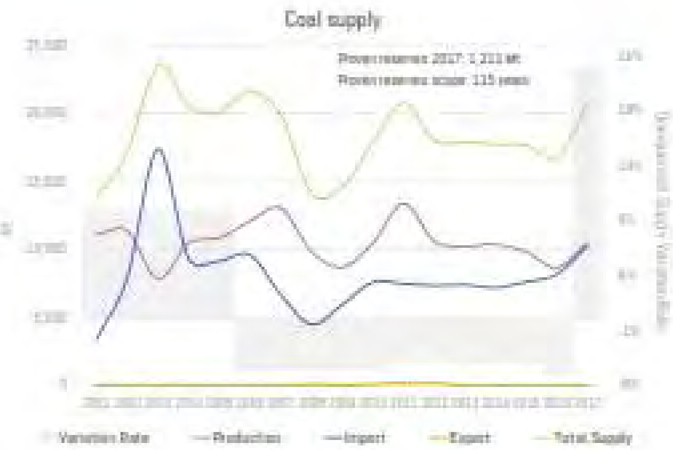
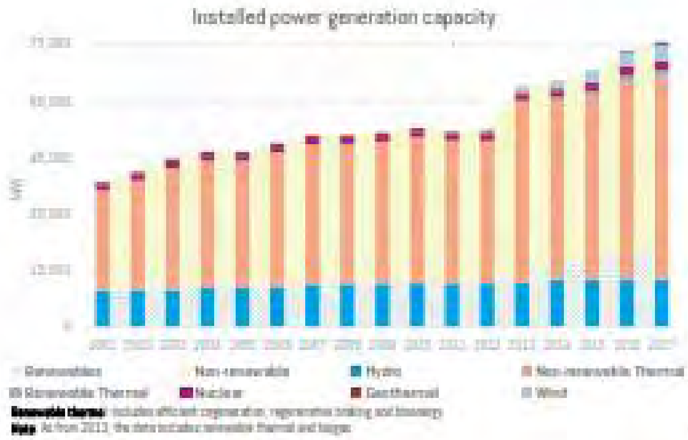
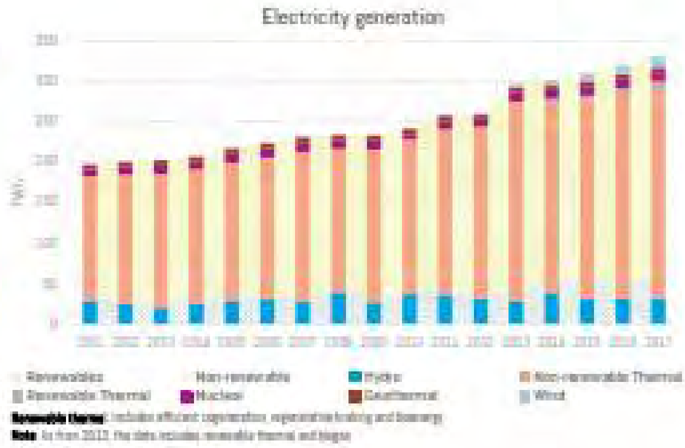

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / alcohol
Kerosene / jet fuel
Other derivatives

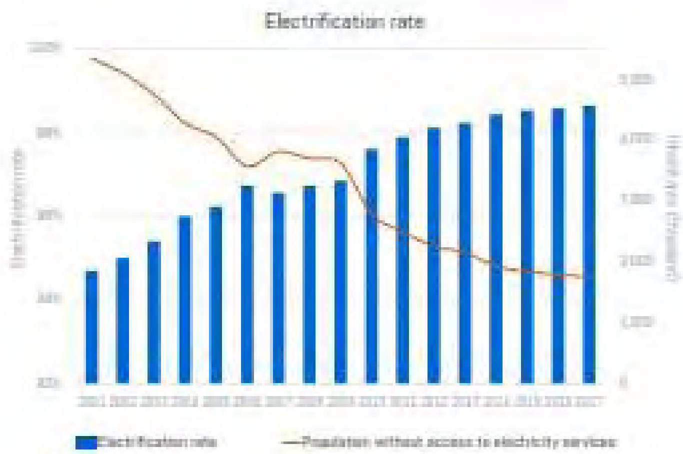

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / alcohol
Kerosene / jet fuel
Other derivatives

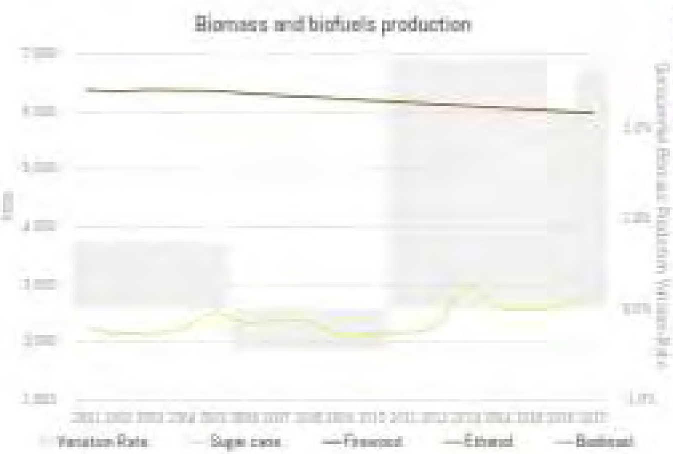

Natural gas supply
Proven reserves 2017: 295 Gm³
Proven reserves scope: 5 years
Variation Rate
Production
Import
Export
Final Consumption


Coal supply
Variation Rate
Production
Import
Export
Total Supply


Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Nuclear
Geothermal
Wind


Electricity generation
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Nuclear
Geothermal
Wind


Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood
Ethanol
Biodiesel

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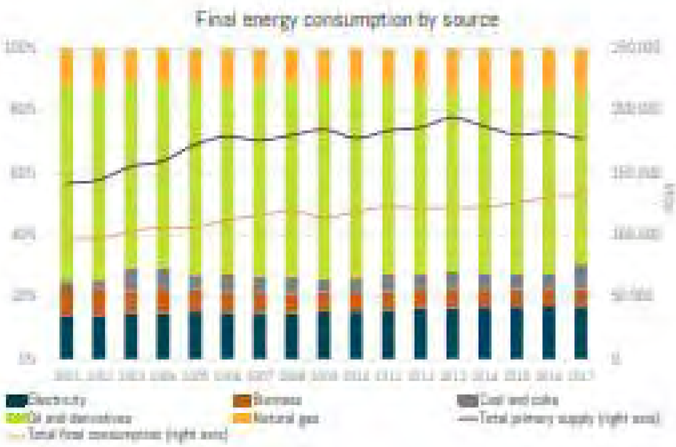
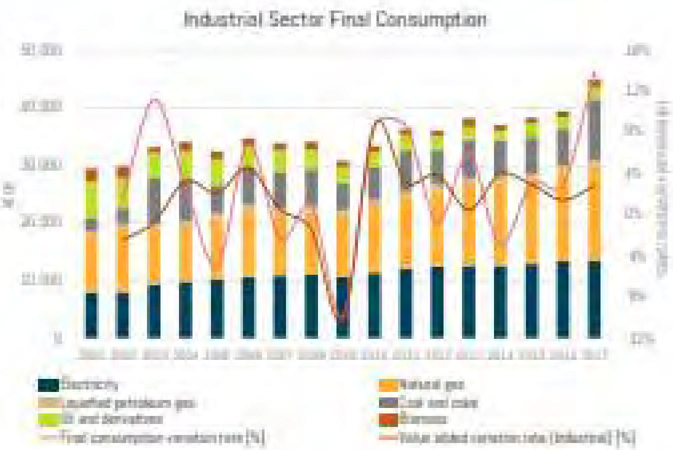
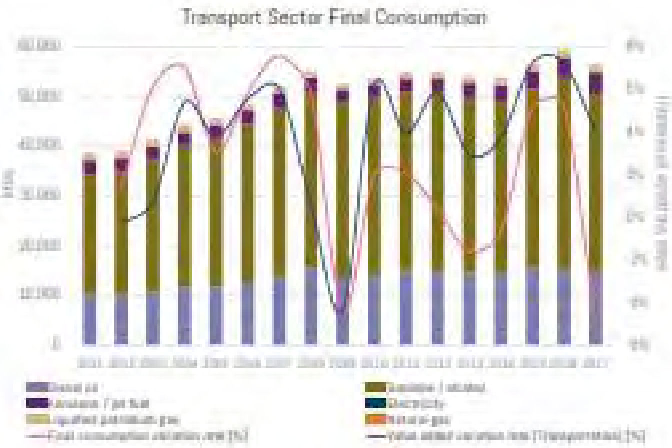


Final energy consumption by source
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)



Industrial Sector Final Consumption
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
Electricity
Natural gas
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]



Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied petroleum gas
Natural gas
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

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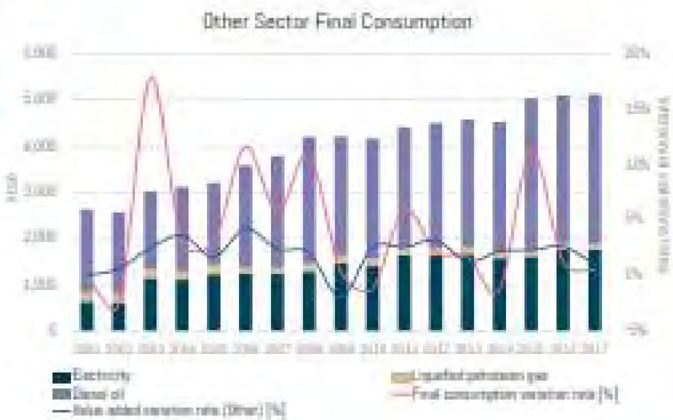
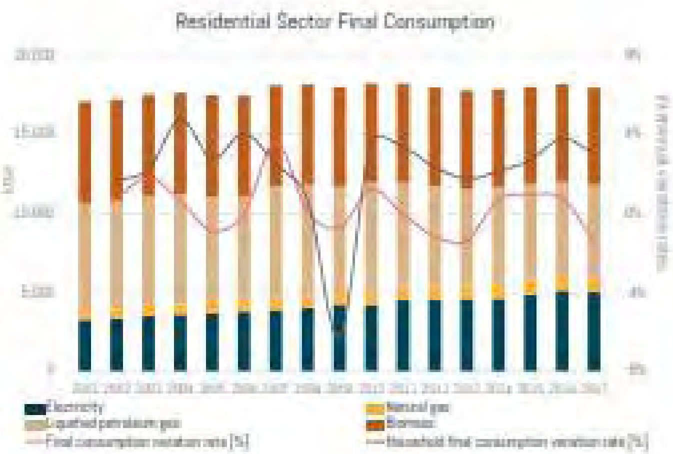
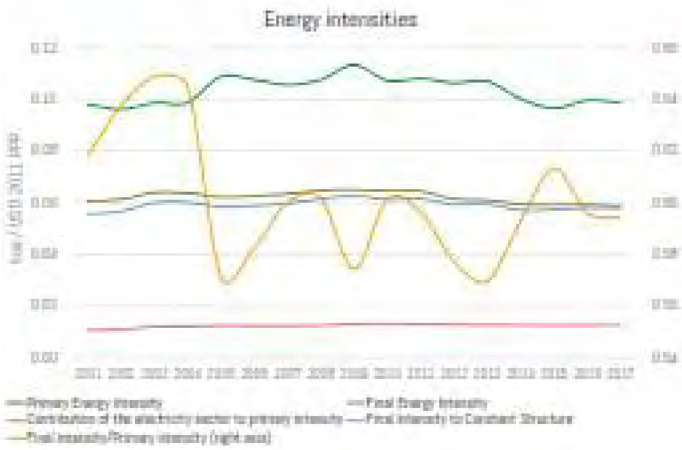


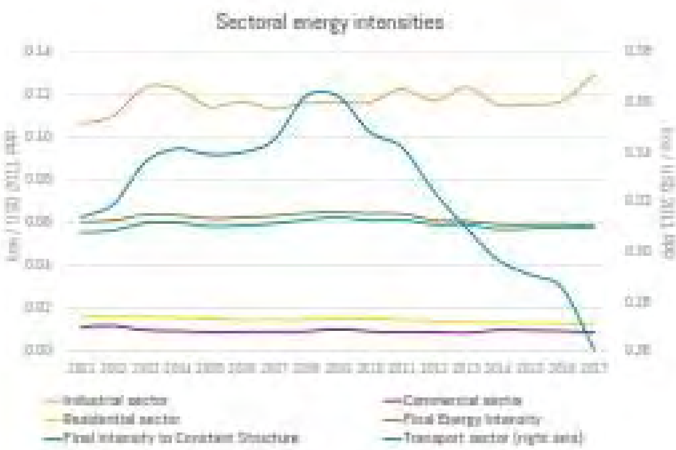
Other Sector Final Consumption
Electricity
Liquefied petroleum gas
Diesel oil
Final consumption variation rate [%]
Value added variation rate (Other) [%]

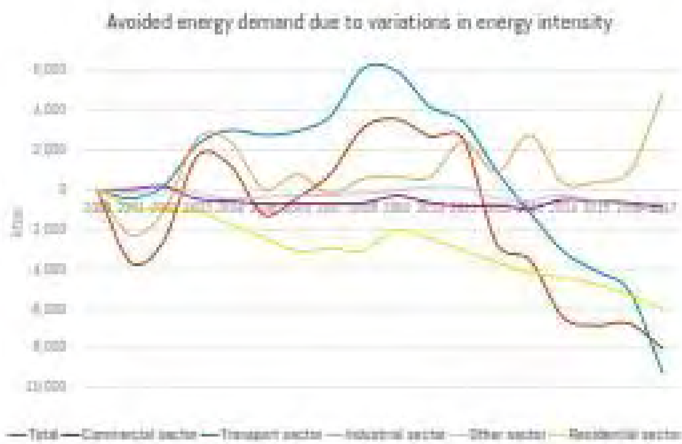


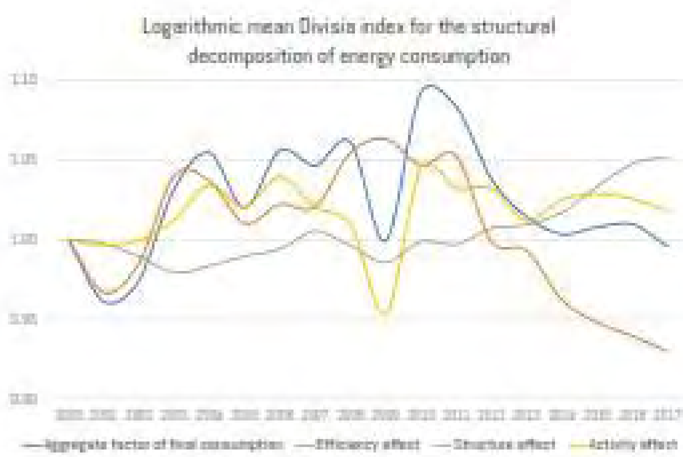
Residential Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

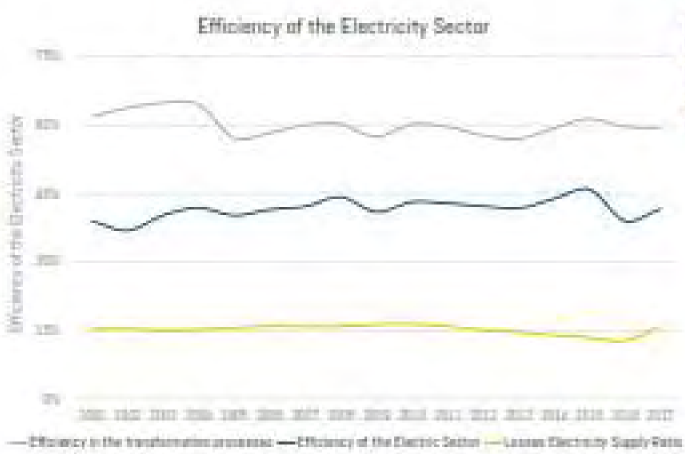

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied petroleum gas per capita
Biomass per capita


Energy intensities
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
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 in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

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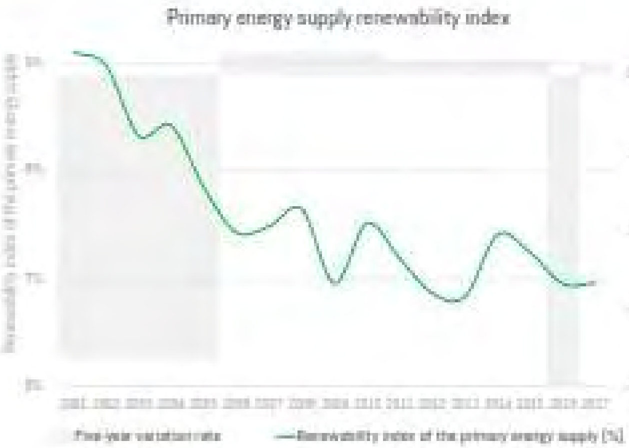
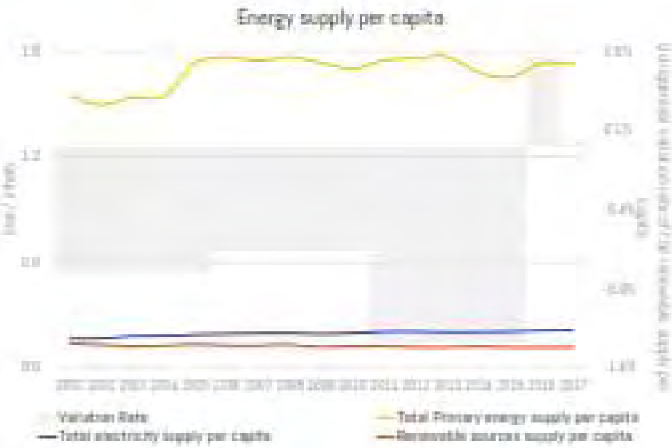
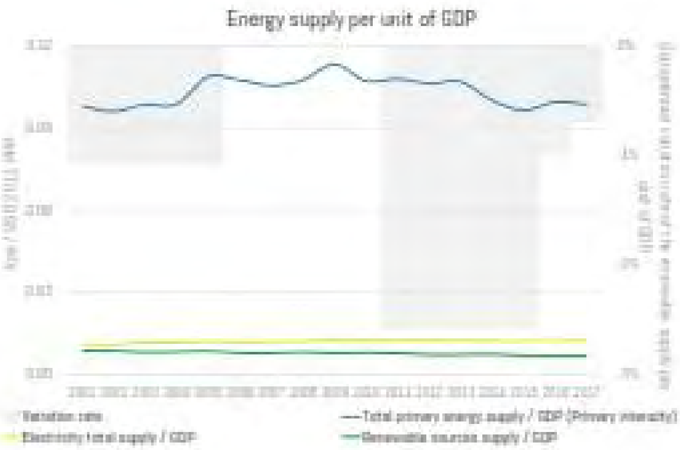
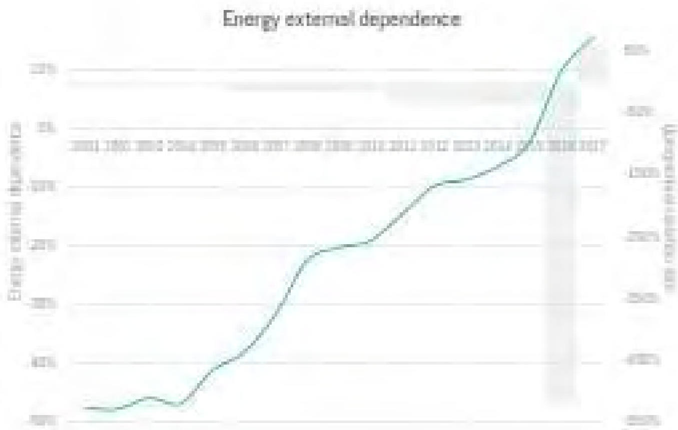
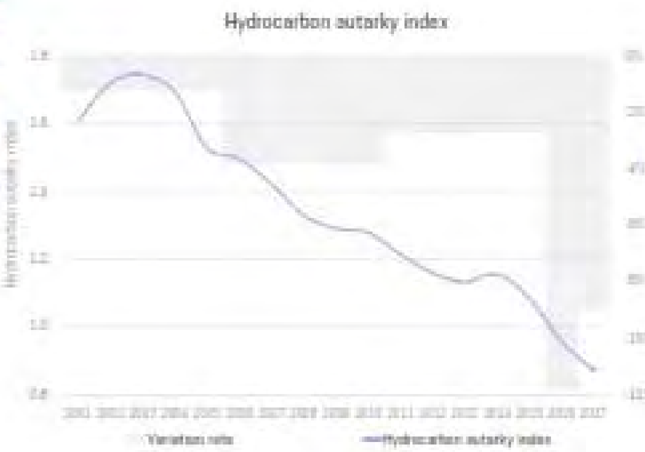

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

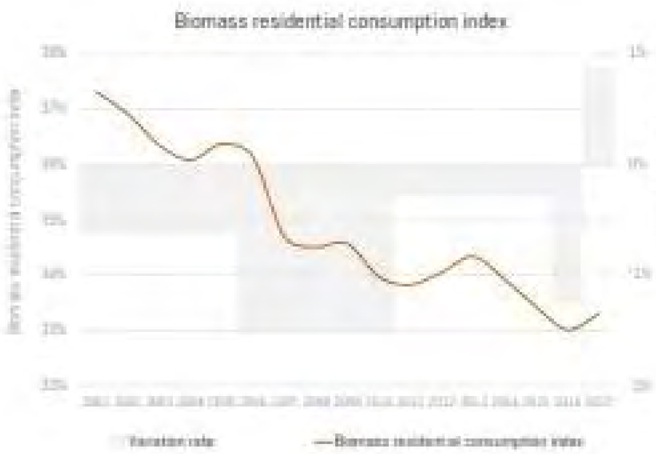

Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita

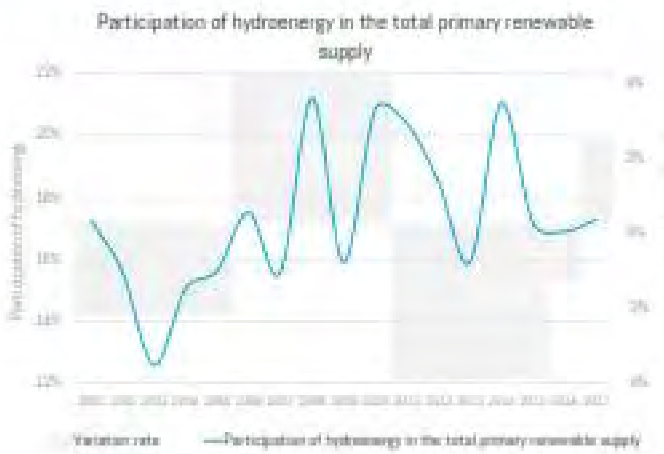

Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP

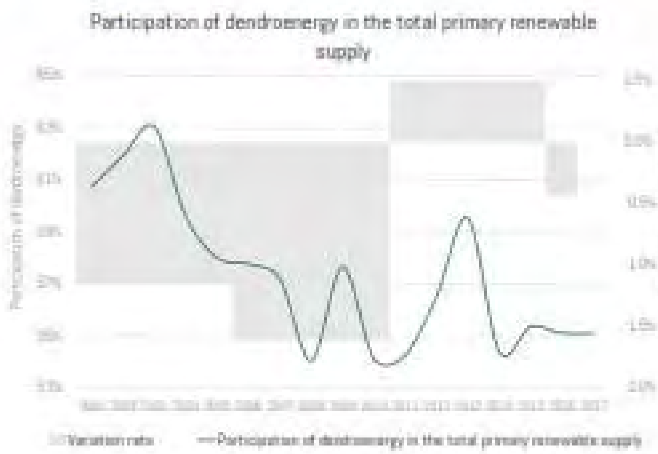

Energy external dependence

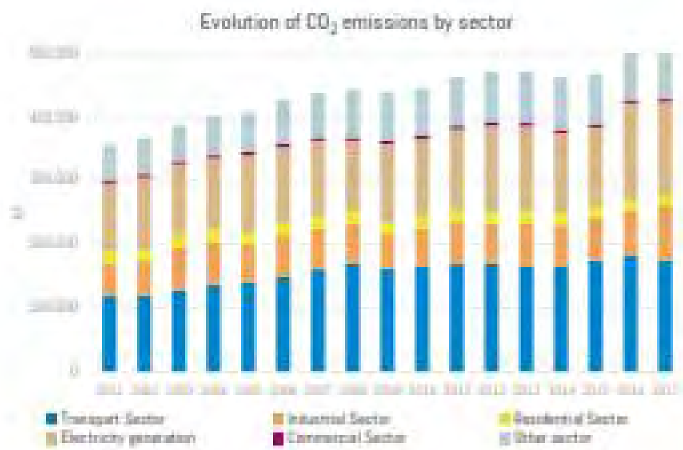
MEXICO

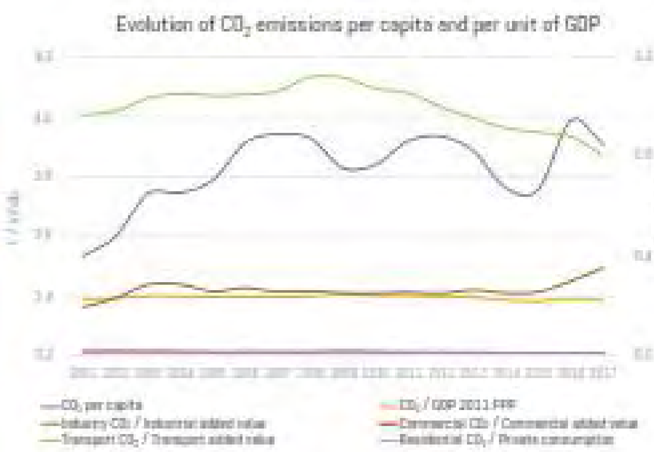

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

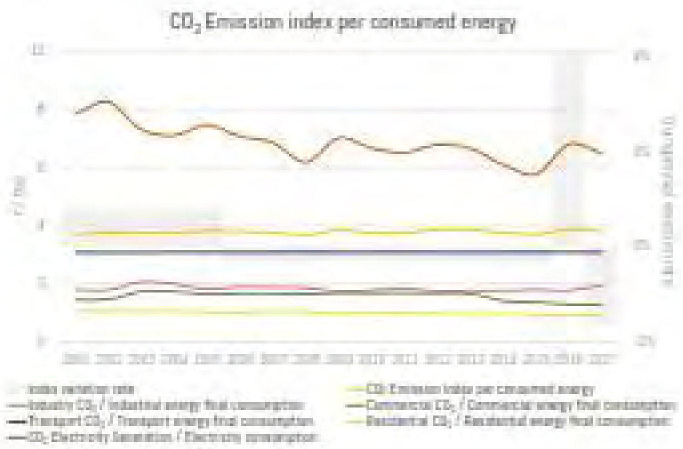

Biomass residential consumption index
Variation rate
Biomass residential consumption index

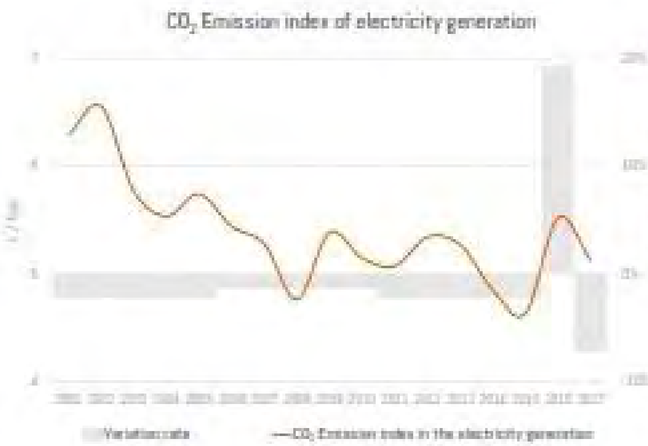

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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

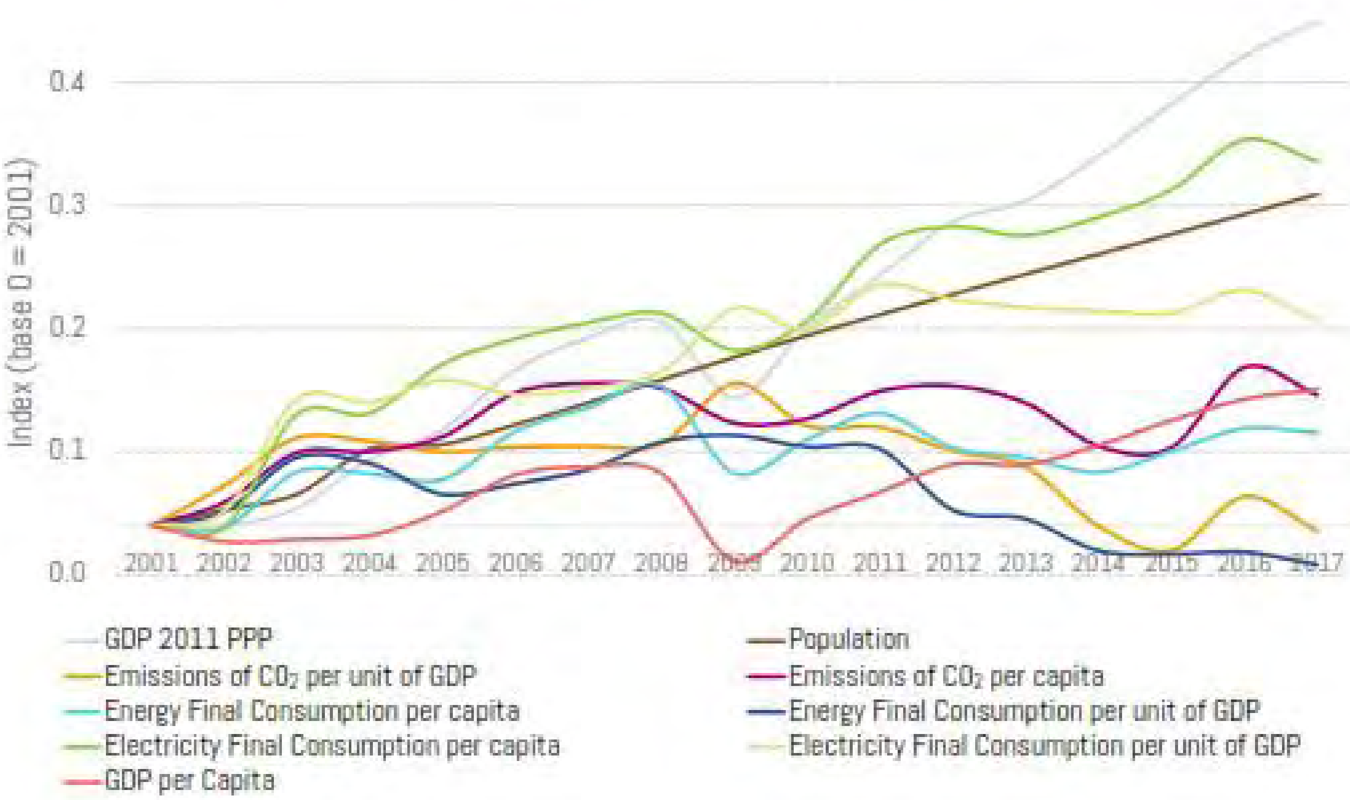

Evolution of CO_2 emissions per capita and per unit of GDP
CO_2 per capita
CO_2 / GDP 2011 PPP


CO_2 Emission index per consumed energy


CO_2 Emission index of electricity generation
Variation rate
CO_2 Emission index in the electricity generation

MEXICO

Summary of the main energy indicators



NICARAGUA

General Information 2017

Population (thousand inhab.)	6,218
Area (km²)	130,370
Population Density (inhab./km²)	48
Urban Population (%)	58
GDP USD 2010 (MUSD)	12,537
GDP USD 2011 PPP (MUSD)	33,087
GDP per capita (thou. USD 2011 PPP/inhab.)	5

Energy Sector

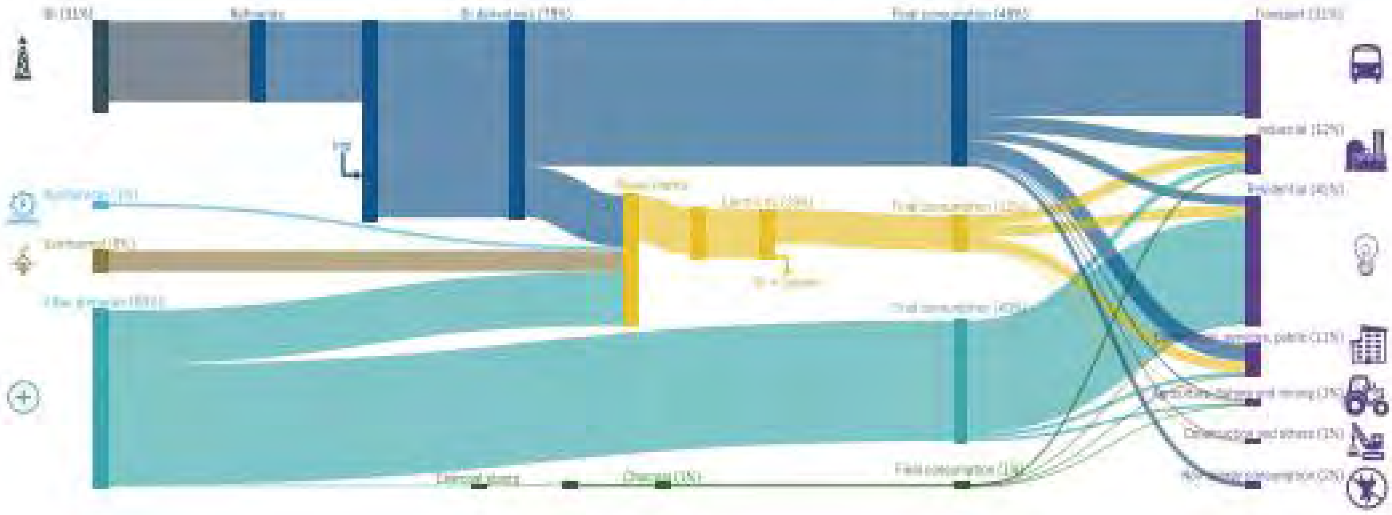
Sector	Mtoe
Final consumption in the Transport Sector	0.80
Final consumption in the Industrial Sector	0.30
Final consumption in the Residential Sector	1.08
Final consumption in the Commercial and Service Sector	0.28
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.12

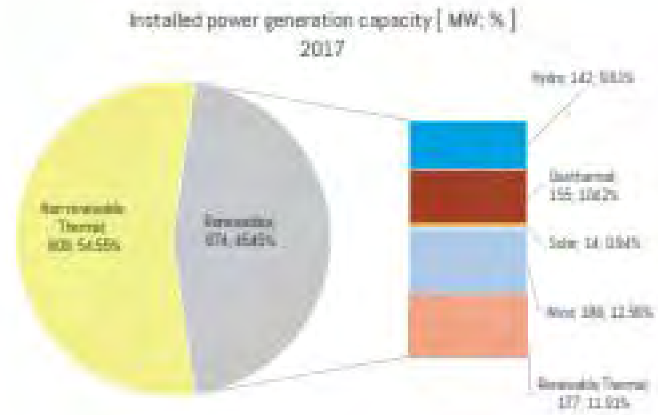
Oil reserves	Natural gas reserves	Coal reserves
Mbbl	Gm³	Mt
n.a.	n.a.	n.a.

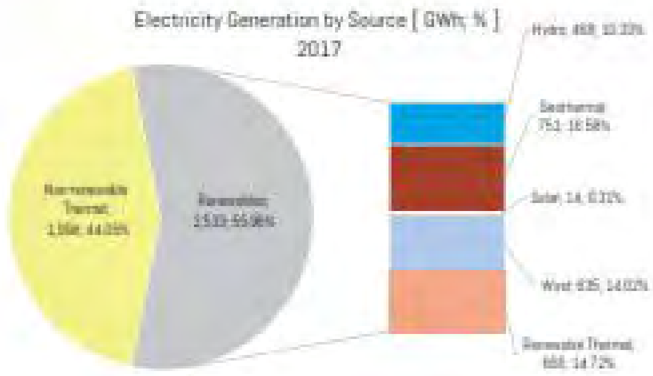
Note: Supply and demand data for 2017 estimated by OLADE.

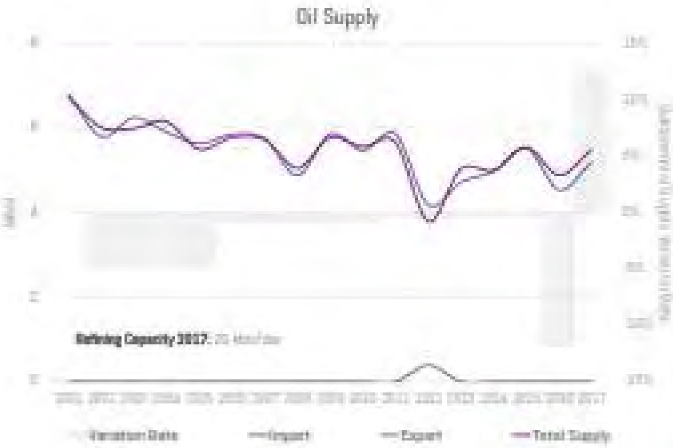
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
555	0.41	94.00	3.50	1.73	1.79	0.03	2.57	20	1.49	0.07 / 0.09

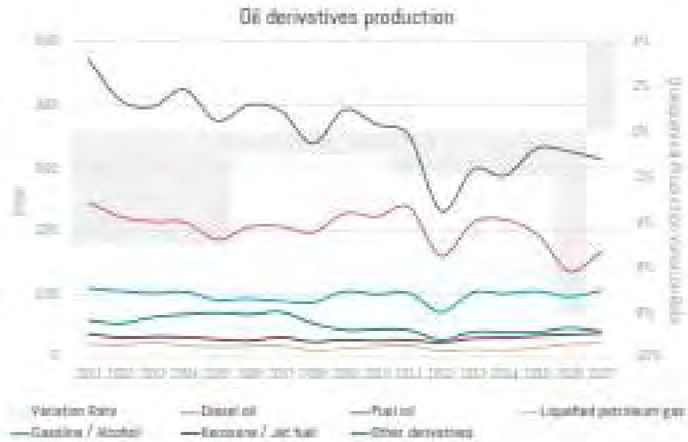
Summarized energy balance 2017




Installed power generation capacity [MW; %]
2017
Non-renewable Thermal 808; 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; %]
2017
Non-renewable Thermal 1,996; 44.05%
Renewables 2,533; 55.95%
Hydro; 468; 10.33%
Geothermal 751; 16.58%
Solar; 14; 0.31%
Wind; 635; 14.02%
Renewable Thermal 666; 14.72%


Oil Supply
Refining Capacity 2017:
Variation Rate
Import
Export
Total Supply


Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

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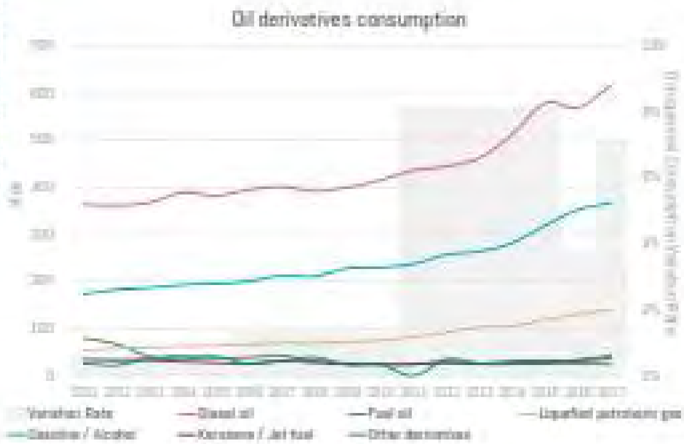
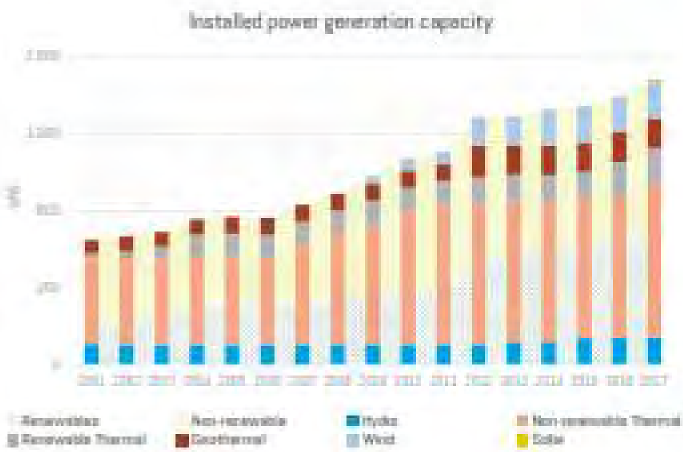
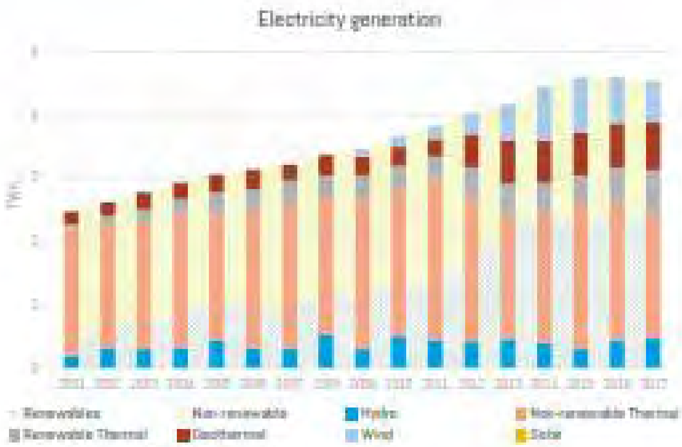
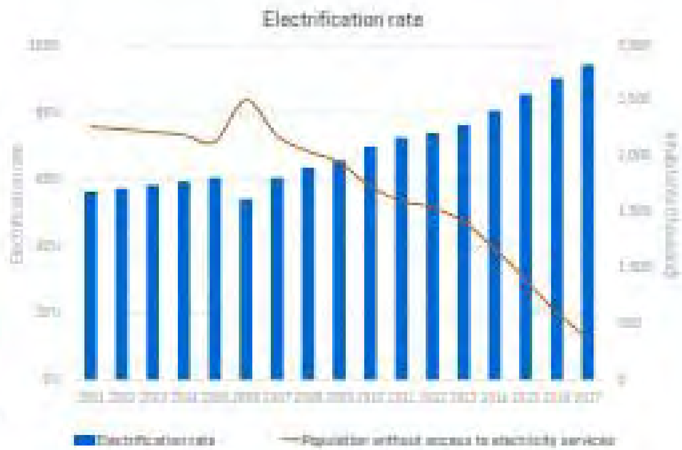
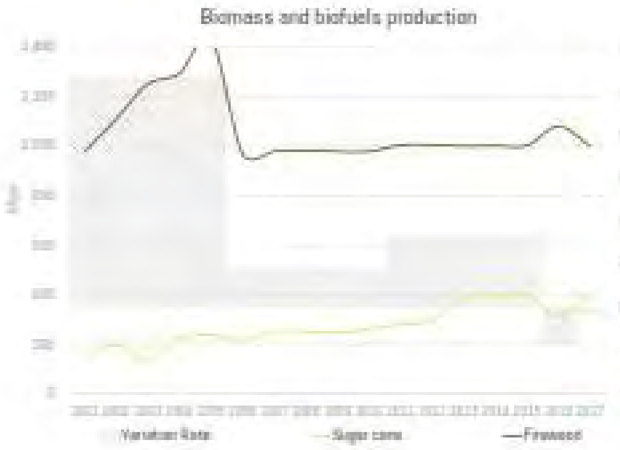
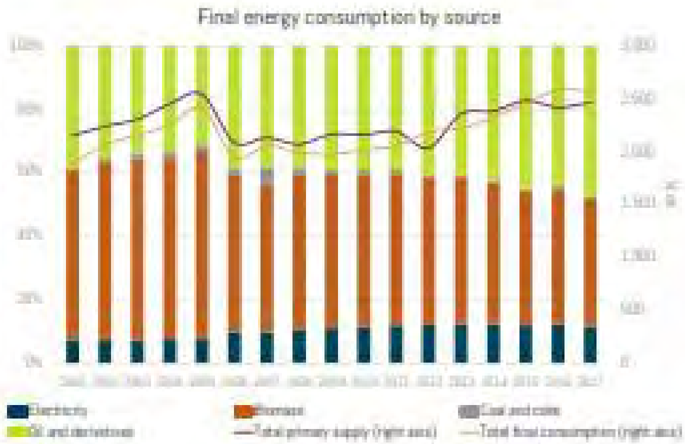

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives


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

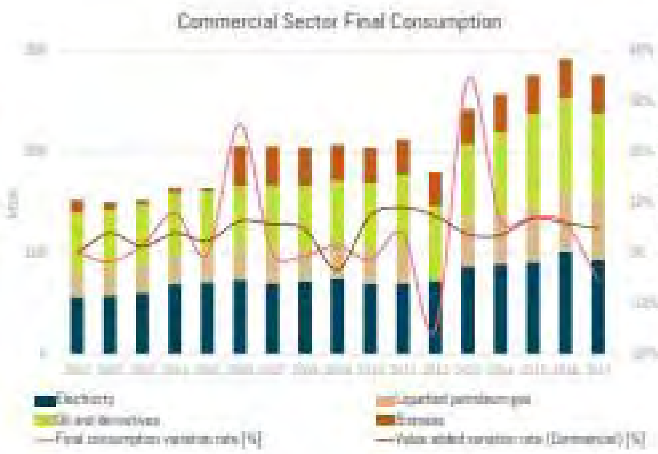

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Geothermal
Wind
Solar


Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Sugar cane
Firewood


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


Industrial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]


Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]

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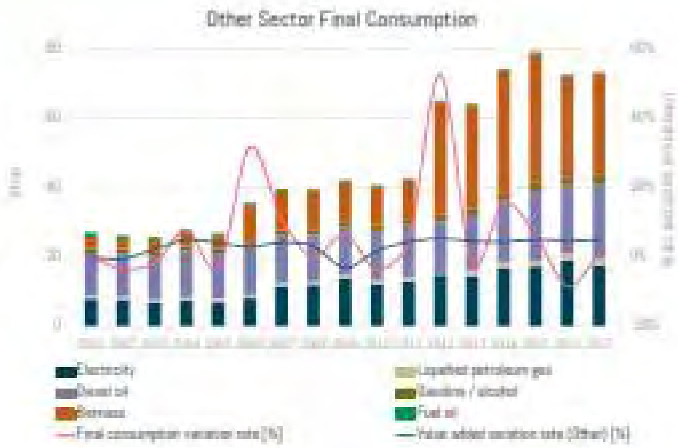
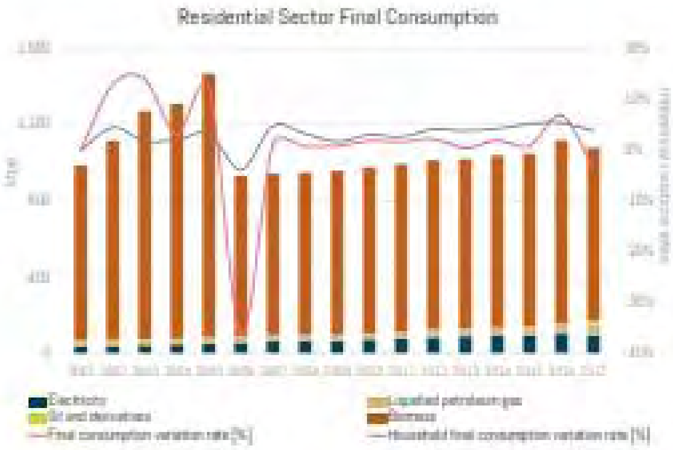
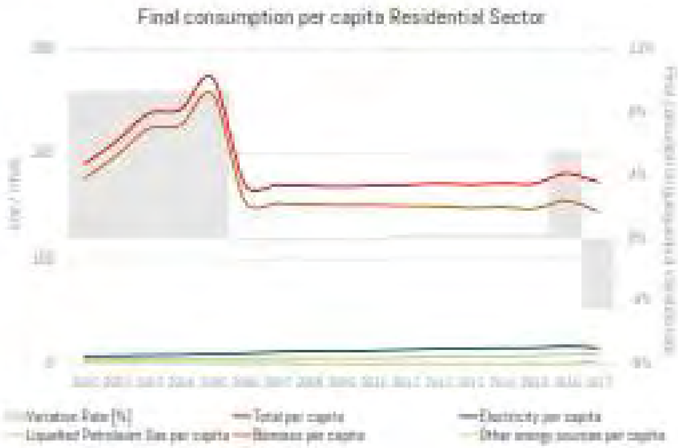
Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]


Other Sector Final Consumption
Electricity
Liquefied petroleum gas
Diesel oil
Gasoline / alcohol
Biomass
Fuel oil
Final consumption variation rate [%]
Value added variation rate (Other) [%]


Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]


Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

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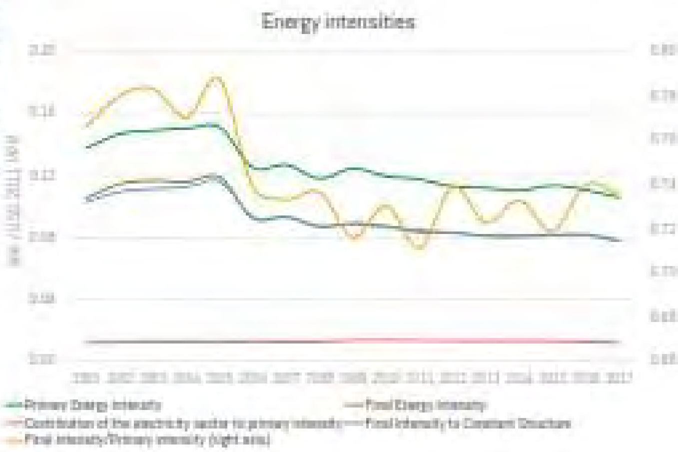
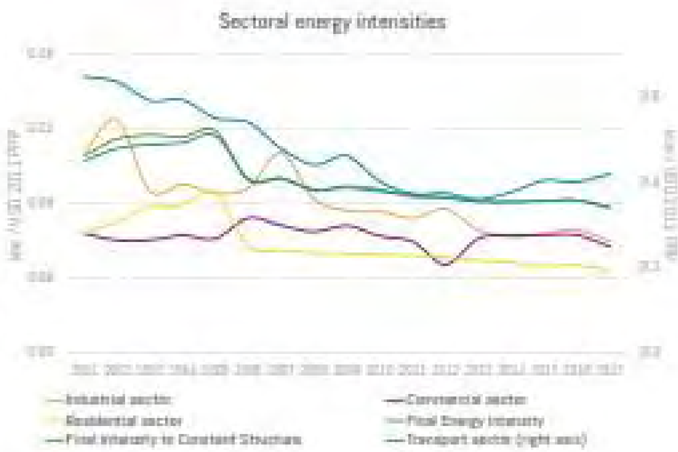
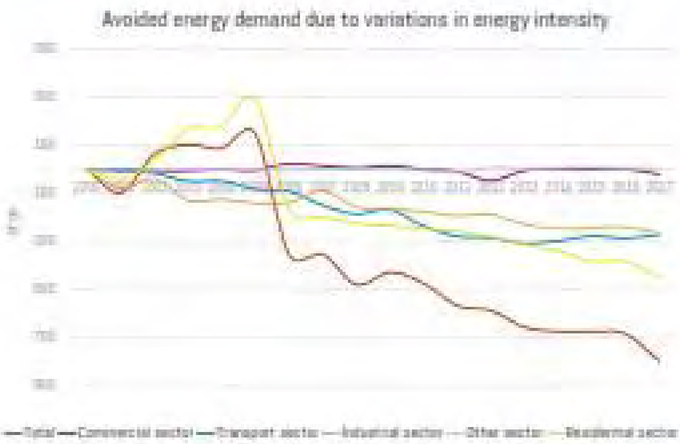
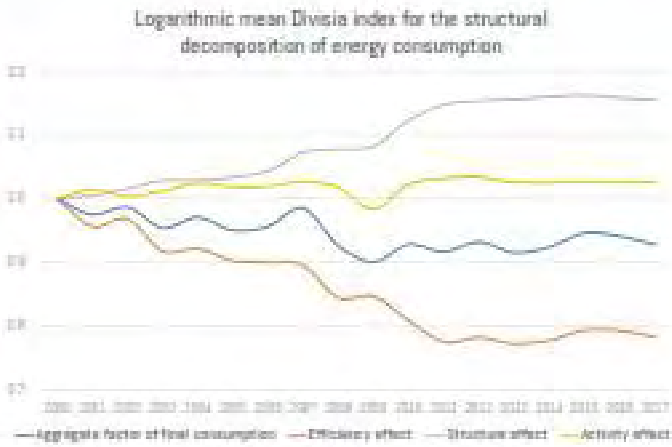
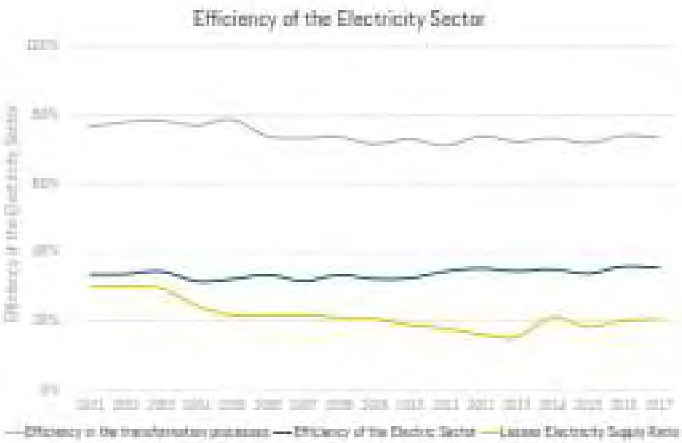
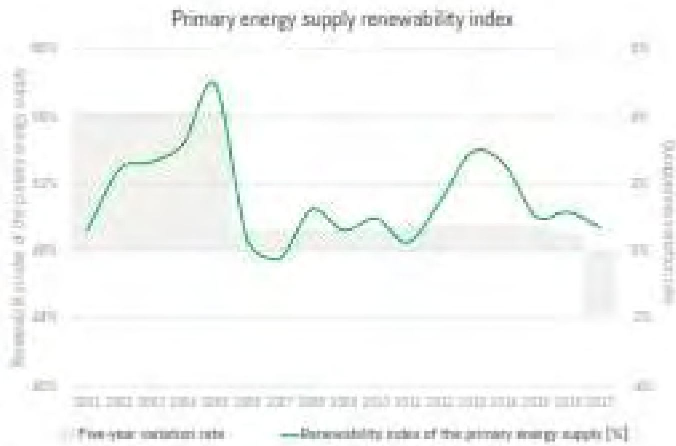

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)

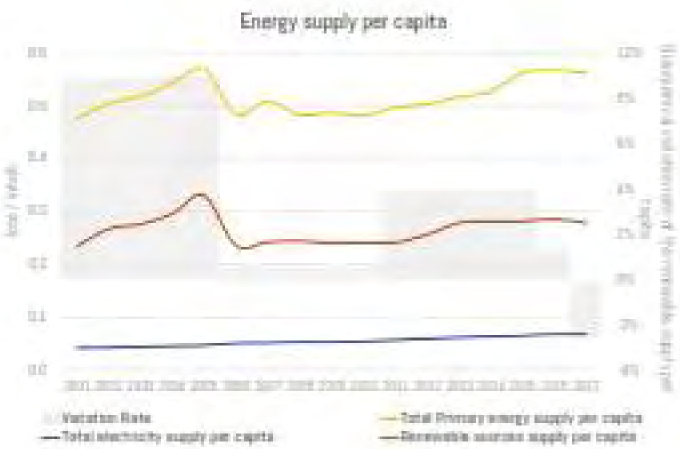

Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final Intensity to Constant Structure
Transport sector (right axis)

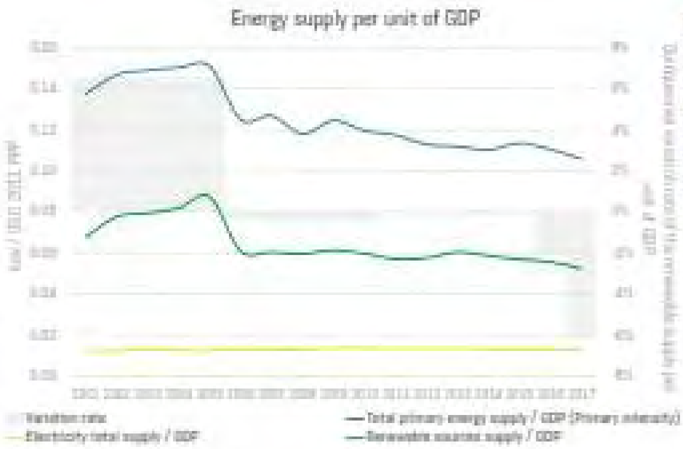

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector


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 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
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

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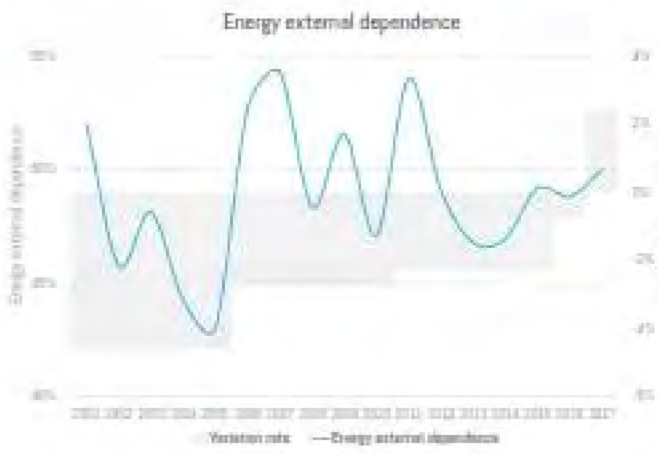
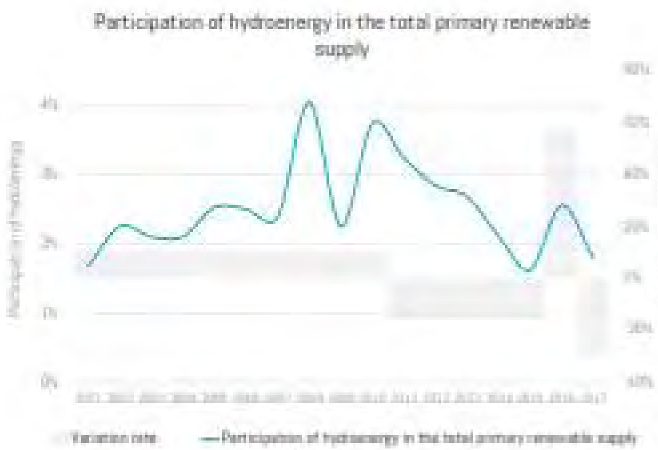
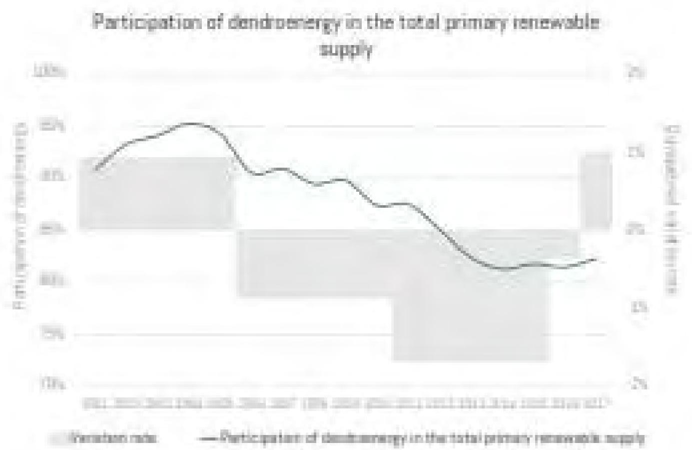

Energy external dependence
Variation rate
Energy external dependence


Biomass residential consumption index
Variation rate
Biomass residential consumption index


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


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

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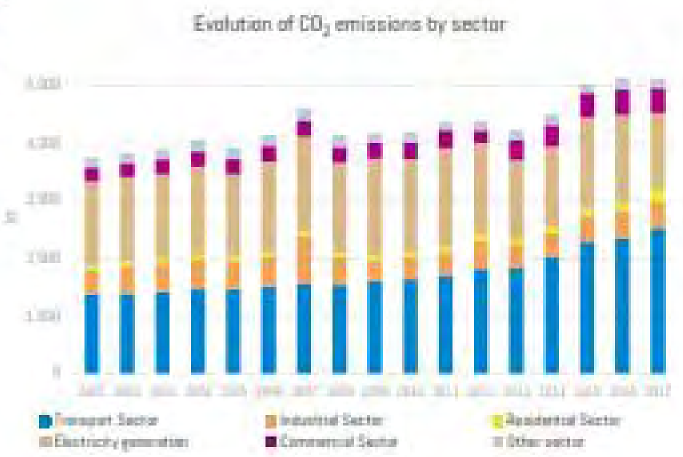
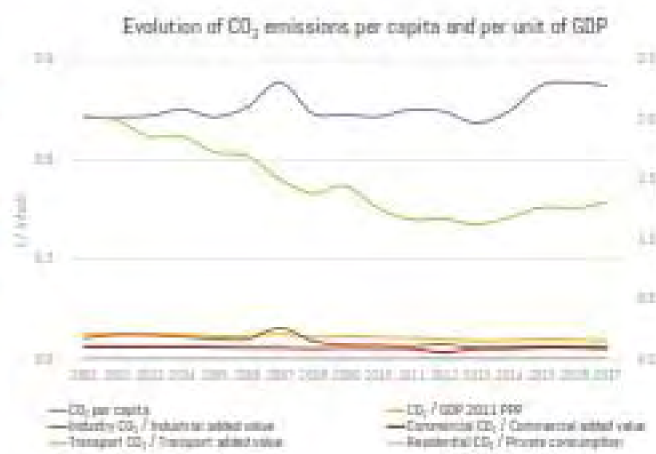
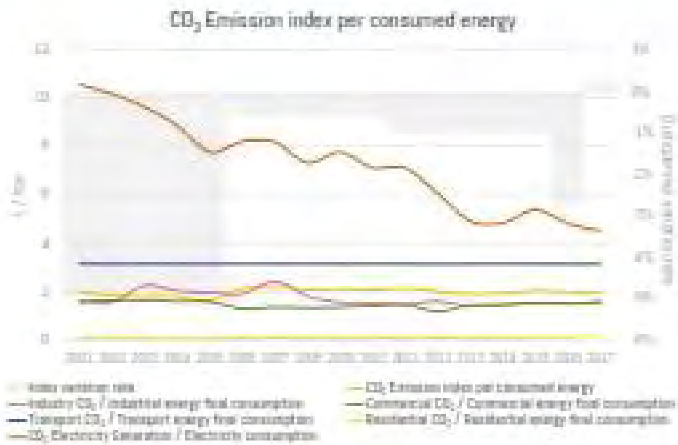
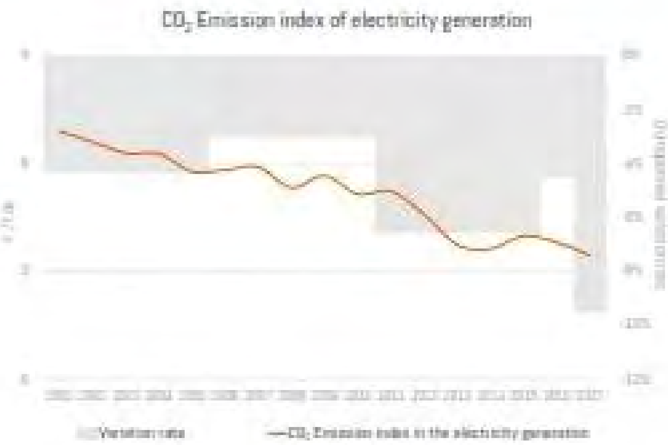

Evolution of CO2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector

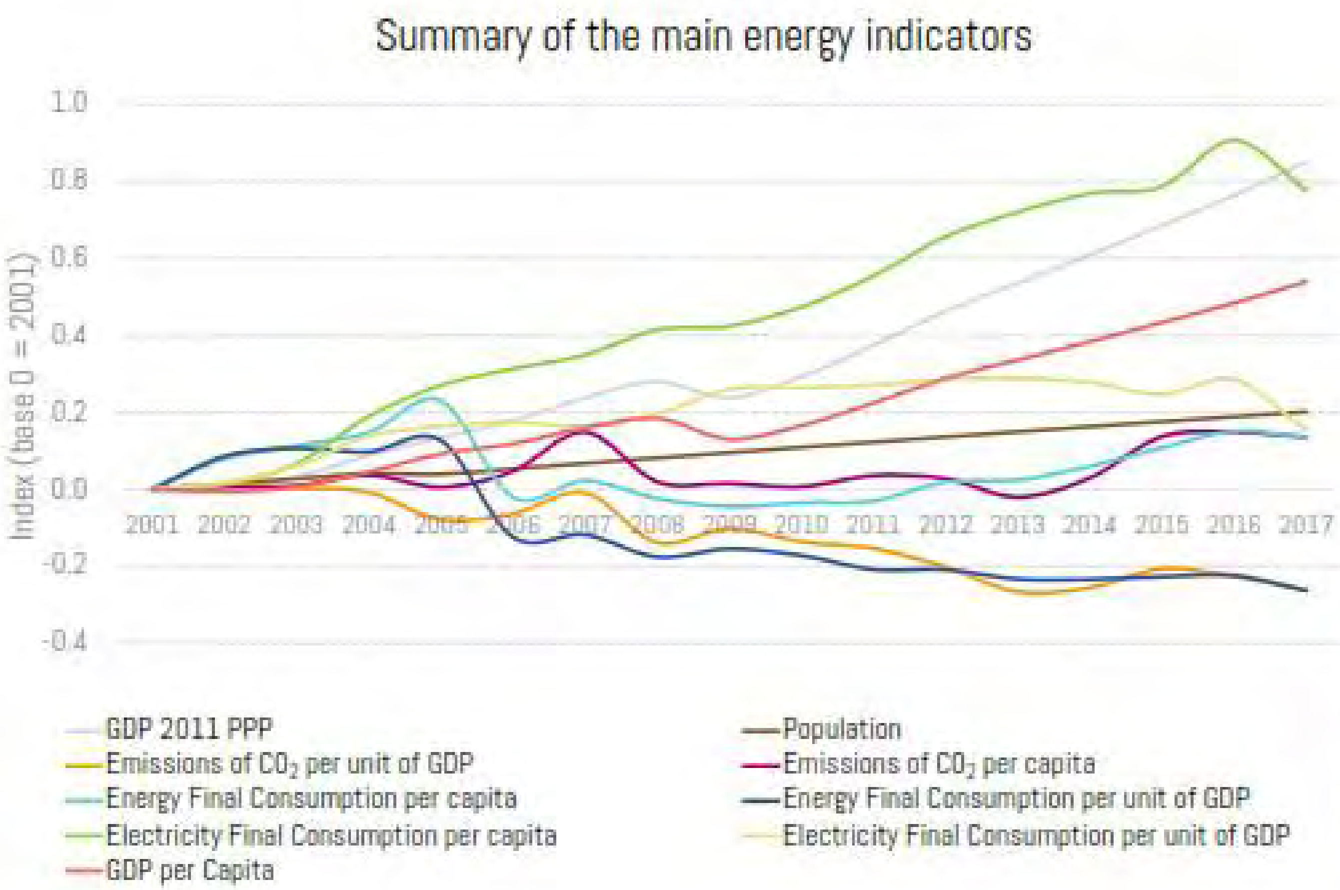

Evolution of CO2 emissions per capita and per unit of GDP
CO2 per capita
CO2 / GDP 2011 PPP
Industry CO2 / Industrial added value
Commercial CO2 / Commercial added value
Transport CO2 / Transport added value
Residential CO2 / Private consumption



CO2 Emission index per consumed energy
Index variation rate
Industry CO2 / Industrial energy final consumption
Transport CO2 / Transport energy final consumption
CO2 Electricity Generation / Electricity consumption
CO2 Emission index per consumed energy
Commercial CO2 / Commercial energy final consumption
Residential CO2 / Residential energy final consumption



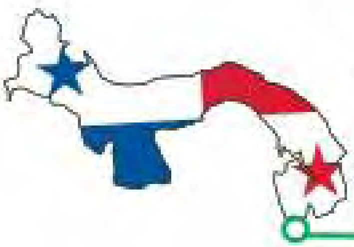
CO2 Emission index of electricity generation
Variation rate
CO2 Emission index in the electricity generation



Summary of the main energy indicators
Index (base 0 = 2001)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

NICARAGUA

PANAMA



General Information 2017

Population (thousand inhab.)	4,054
Area (km²)	75,420
Population Density (inhab./km²)	54
Urban Population (%)	67
GDP USD 2010 (MUSD)	47,497
GDP USD 2011 PPP (MUSD)	91,263
GDP per capita (thou. USD 2011 PPP/inhab.)	23

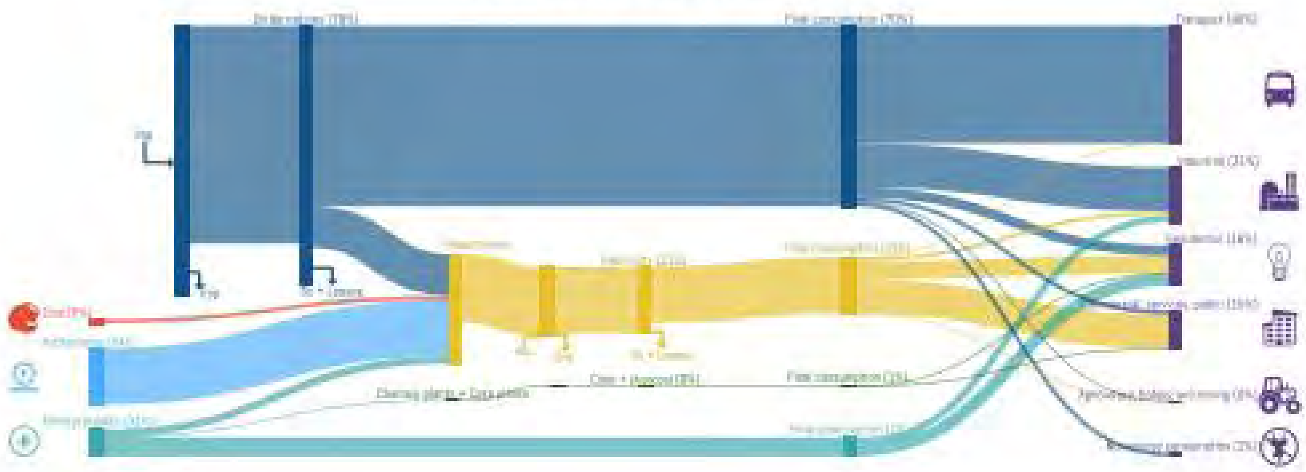
Energy Sector

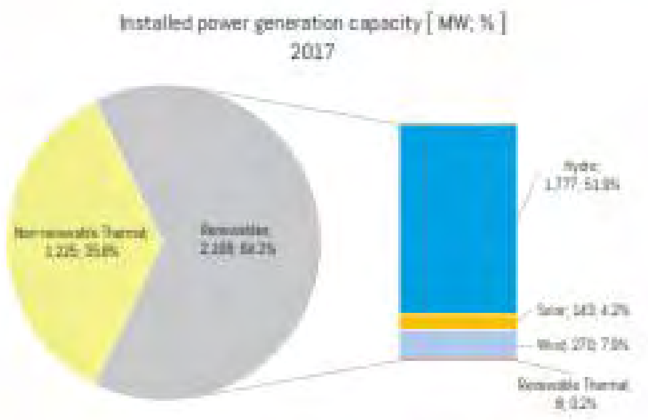
	Mtoe
Final consumption in the Transport Sector	1.83
Final consumption in the Industrial Sector	0.76
Final consumption in the Residential Sector	0.56
Final consumption in the Commercial and Service Sector	0.53
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.07

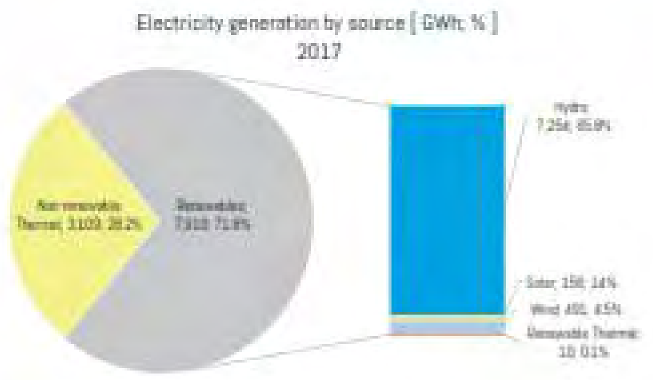
Oil reserves (Mbbl)	Natural gas reserves (Gm³)	Coal reserves (Mt)
n.a.	n.a.	119

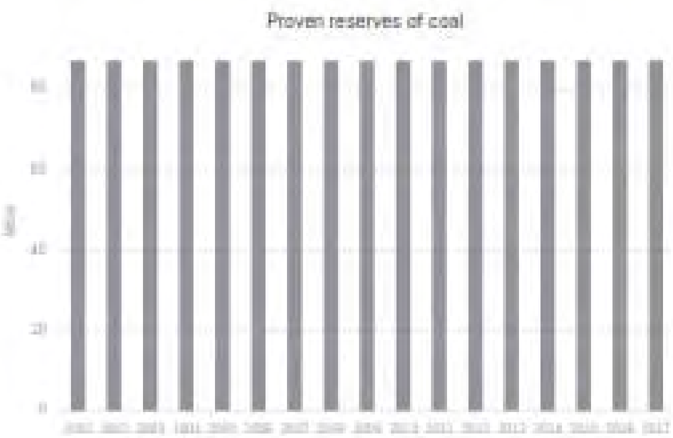
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	2,244
Final energy consumption per capita	toe/inhab.	0.88
Electrification rate	%	92.90
Total energy supply	Mtoe	4.76
Total energy production	Mtoe	1.15
Total energy imports	Mtoe	3.79
Total energy exports	Mtoe	0.73
Total final energy consumption	Mtoe	3.55
Refining capacity	kbbl/day	n.a.
Installed power generation capacity	GW	3.42
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.05 / 0.04

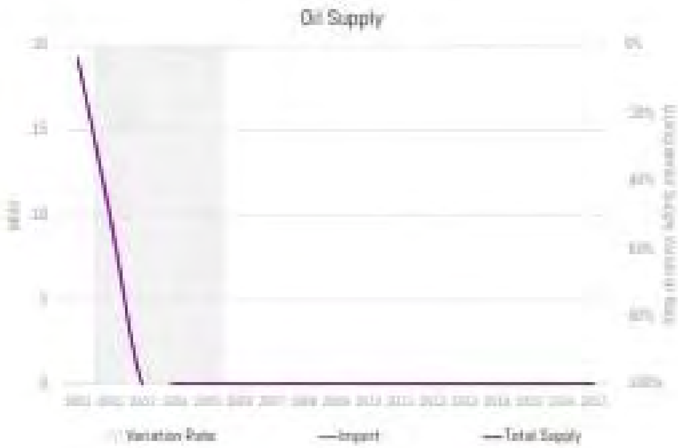
Summarized energy balance 2017



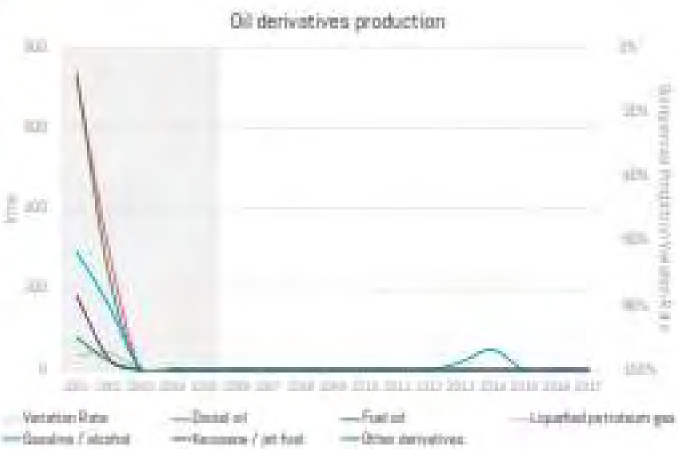

Installed power generation capacity [MW; %]
2017

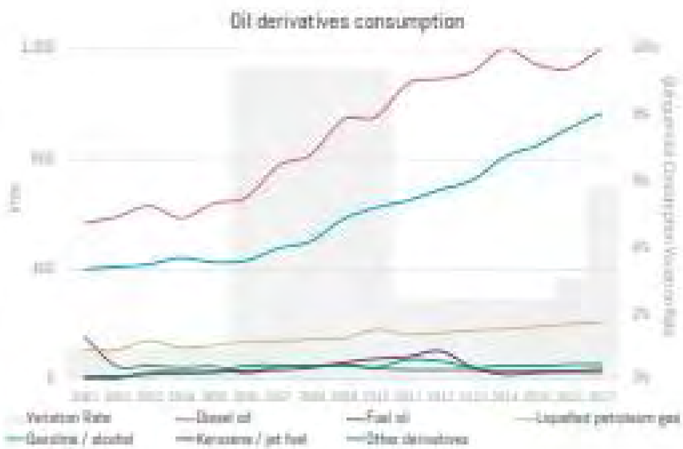

Electricity generation by source [GWh; %]
2017

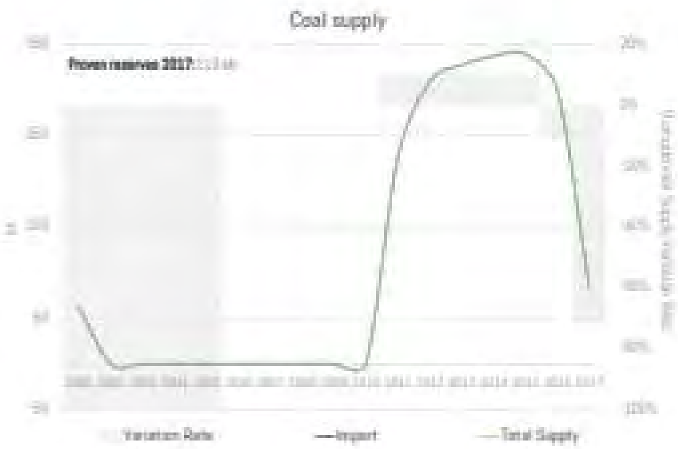

Proven reserves of coal


Oil Supply
Variation Rate
Import
Total Supply

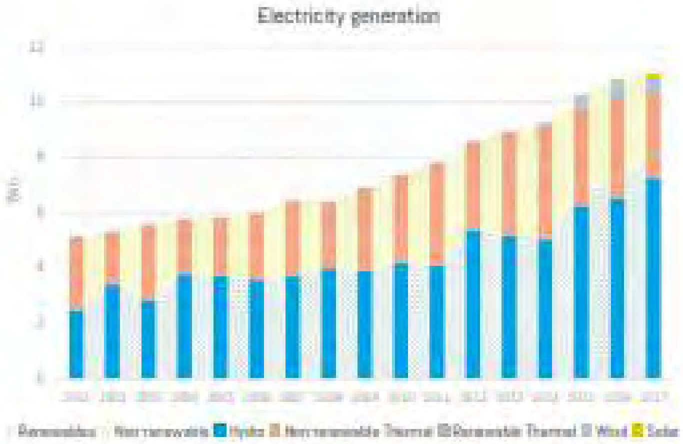
PANAMA

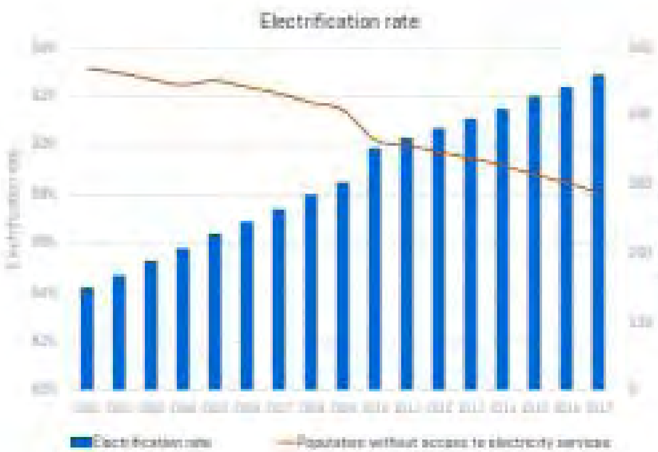

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / alcohol
Kerosene / jet fuel
Other derivatives

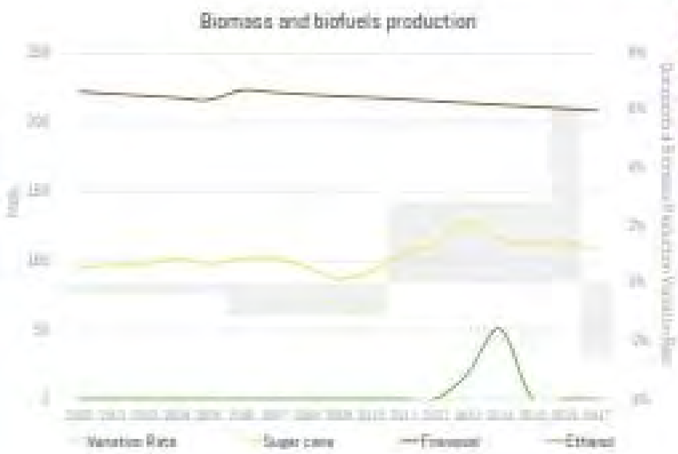

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / alcohol
Kerosene / jet fuel
Other derivatives



In 2003, the Panama S.A. Refinery stopped its operations.







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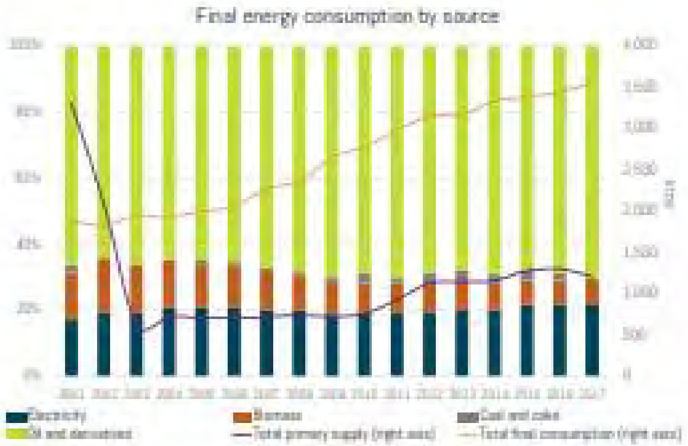
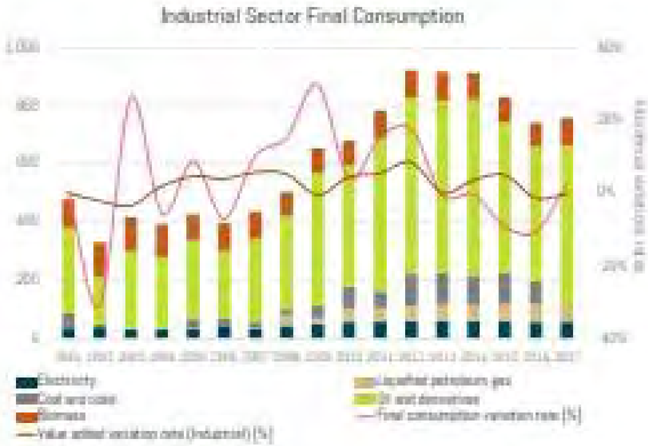
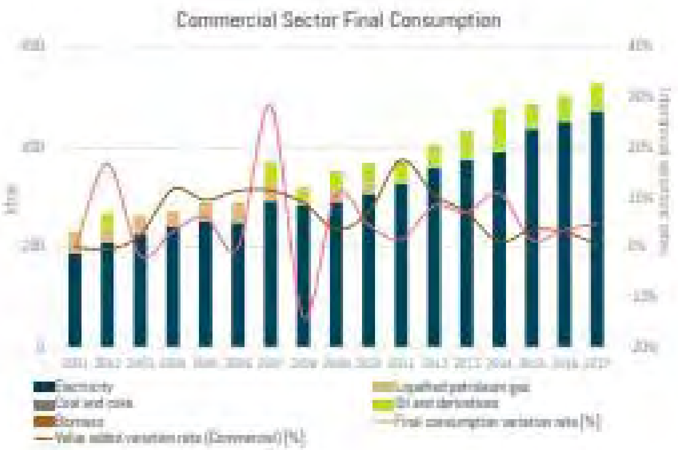
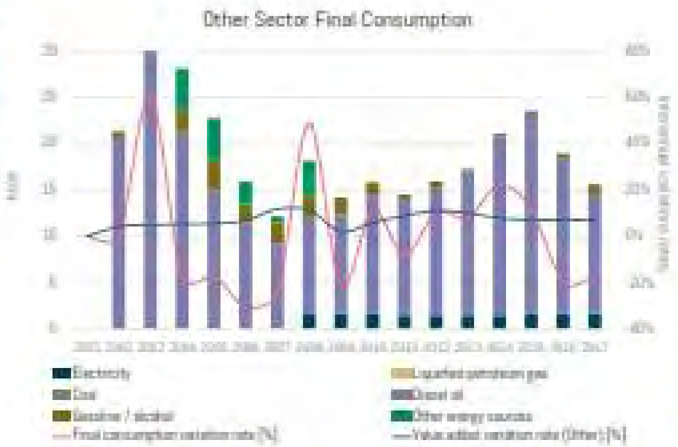

Final energy consumption by source
Electricity
Biomass
Coal and coke
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

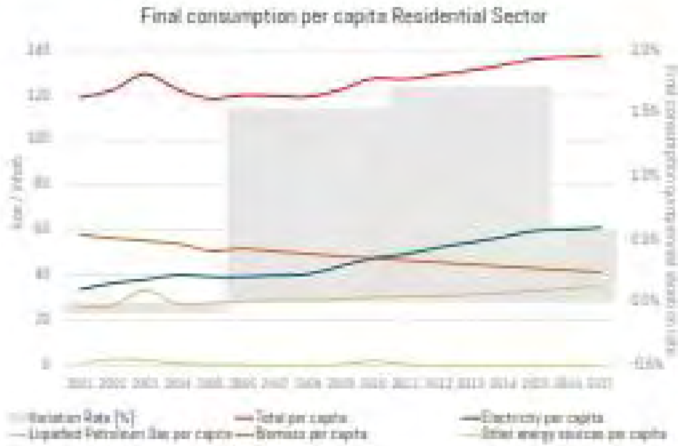

Industrial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

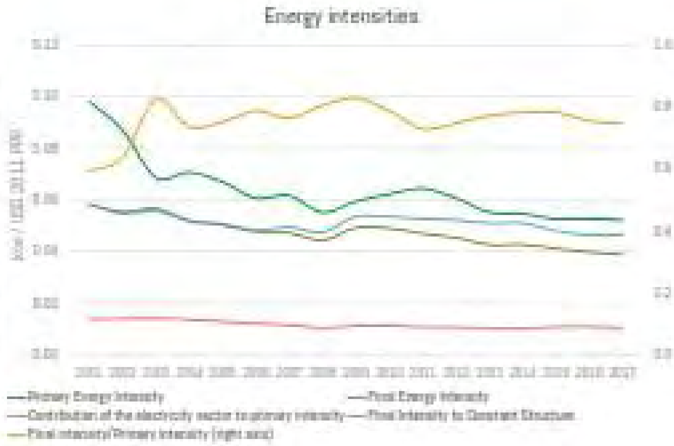

Commercial Sector Final Consumption
Electricity
Coal and coke
Biomass
Value added variation rate (Commercial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]

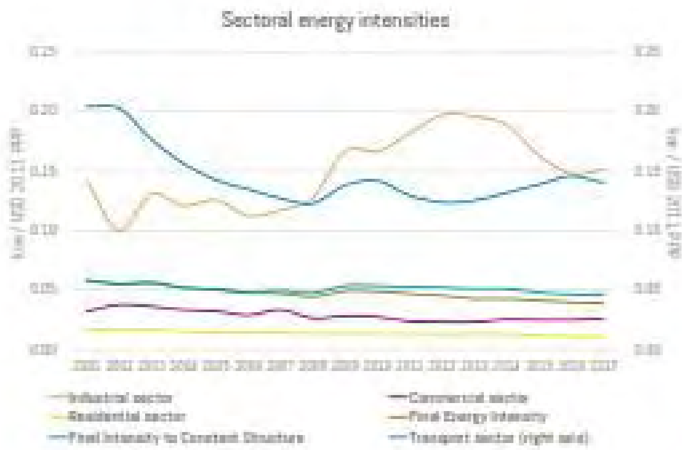

Other Sector Final Consumption
Electricity
Coal
Gasoline / alcohol
Final consumption variation rate [%]
Liquefied petroleum gas
Diesel oil
Other energy sources
Value added variation rate (Other) [%]

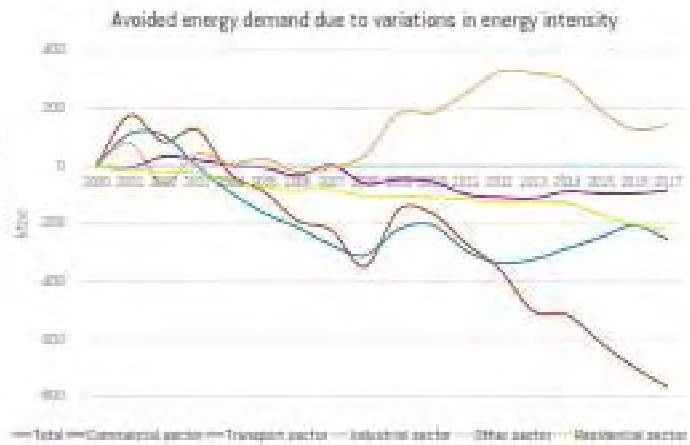

Other Sector Final Consumption
Electricity
Coal
Gasoline / alcohol
Final consumption variation rate [%]
Liquefied petroleum gas
Diesel oil
Other energy sources
Value added variation rate (Other) [%]

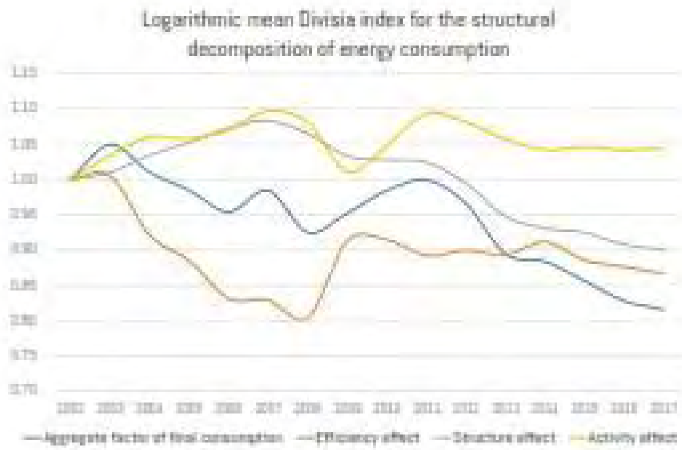

Residential Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]

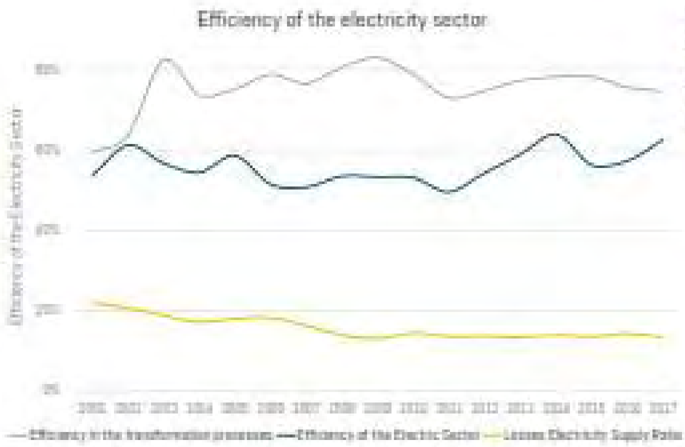

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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
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 in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

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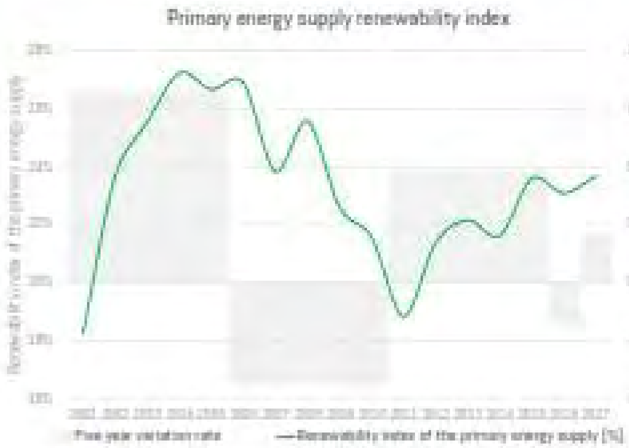

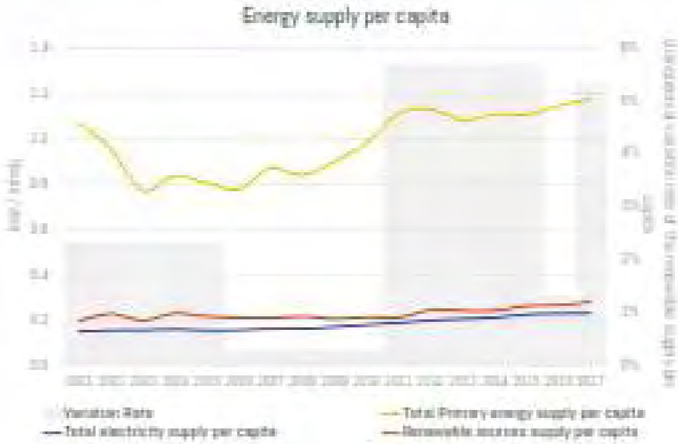

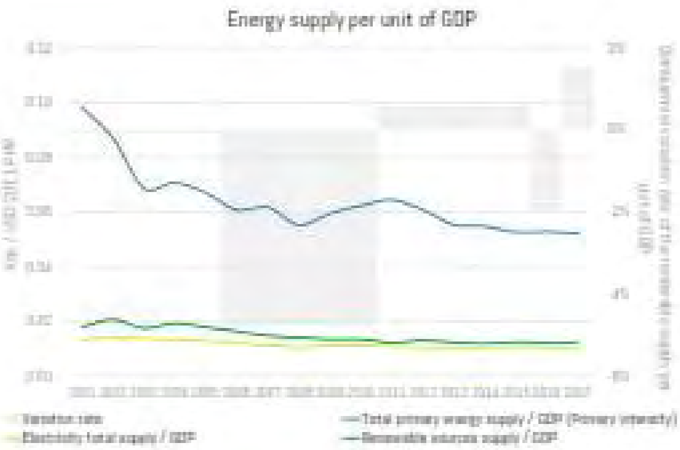

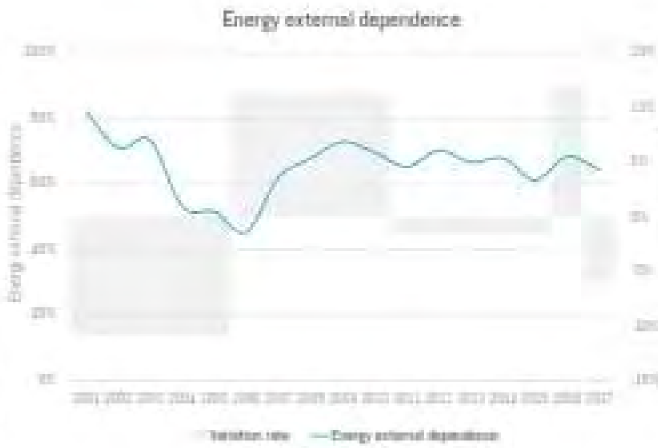

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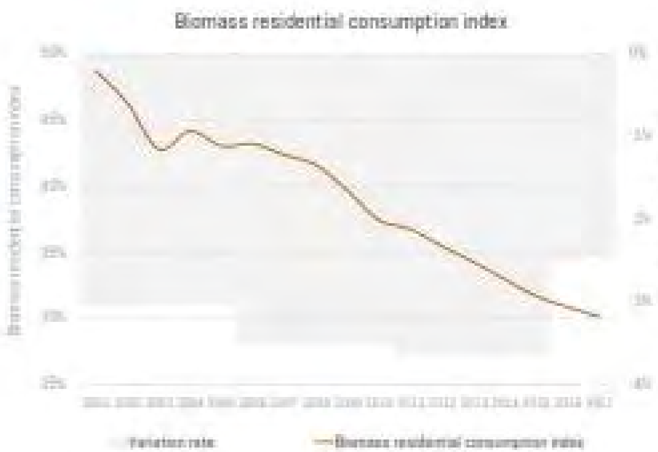
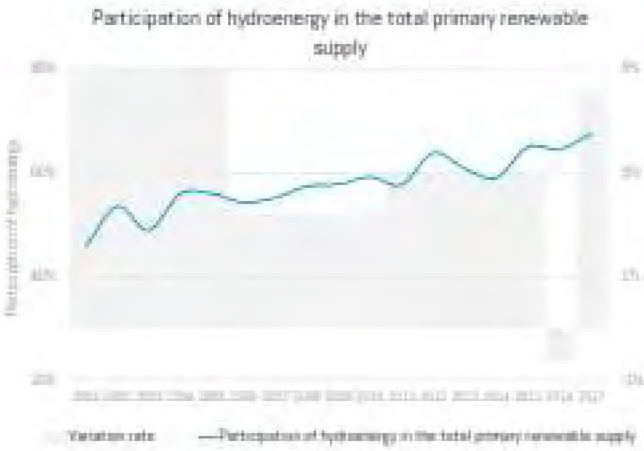
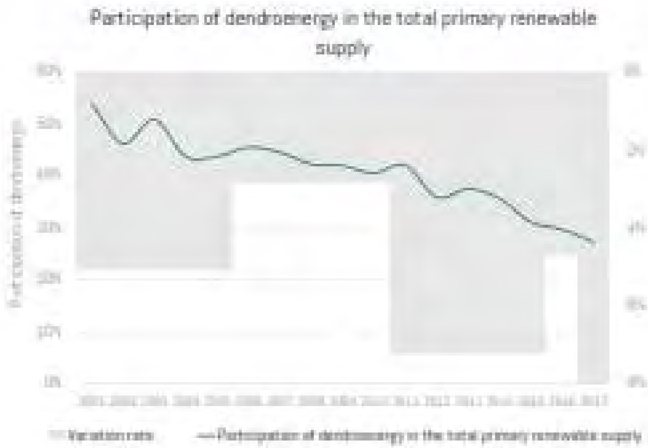
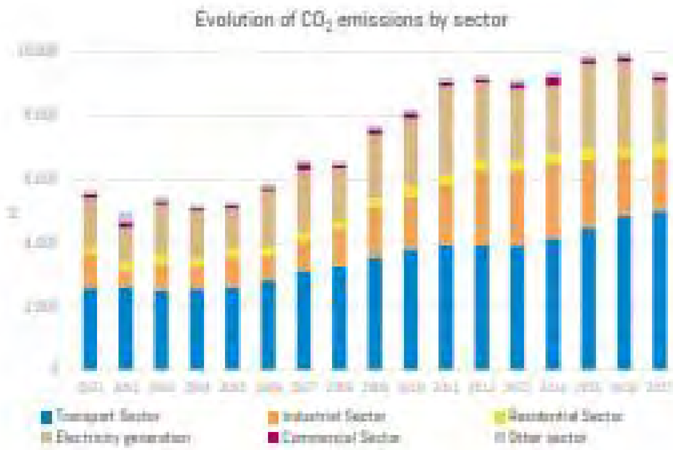
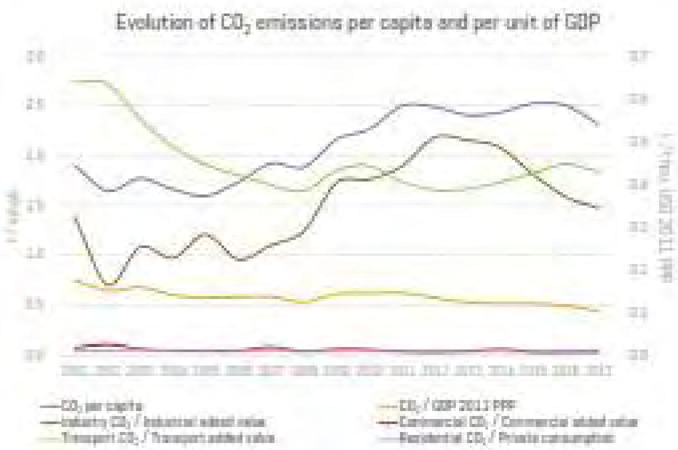
In February 2017, it was inaugurated the Bugaba photovoltaic power plant with an installed capacity of 2.4 MW.

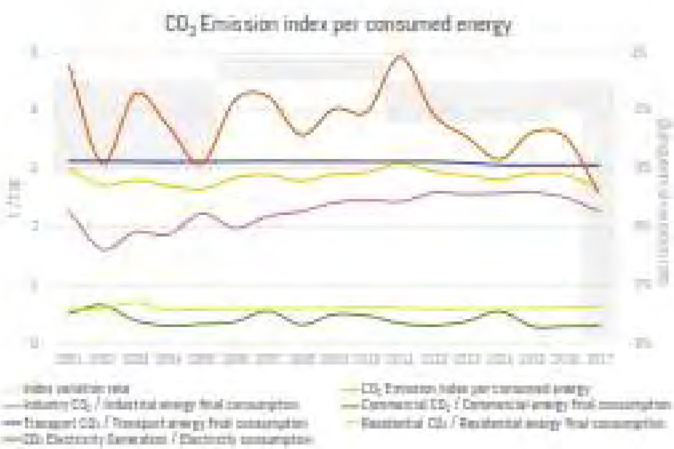


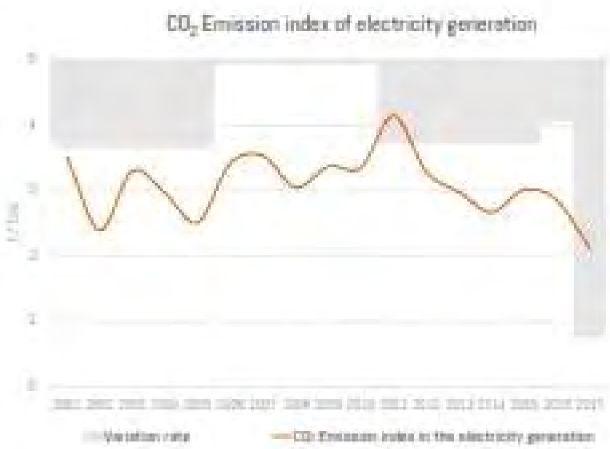

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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


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


CO2 Emission index per consumed energy
Index variation rate
Industry CO2 / Industrial energy final consumption
Transport CO2 / Transport energy final consumption
CO2 Electricity Generation / Electricity consumption
CO2 Emission index per consumed energy
Commercial CO2 / Commercial energy final consumption
Residential CO2 / Residential energy final consumption


CO2 Emission index of electricity generation
Variation rate
CO2 Emission index in the electricity generation

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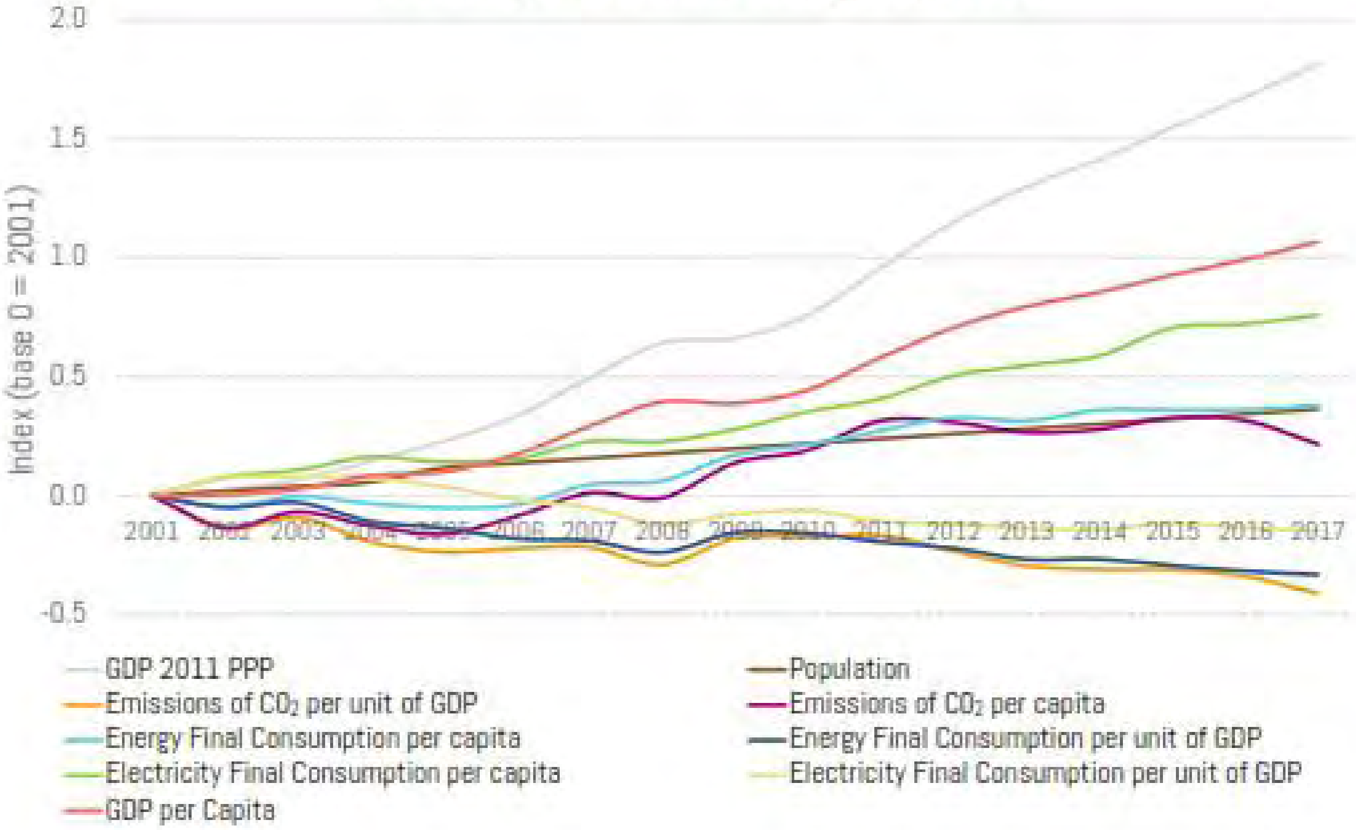
Summary of the main energy indicators



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General Information 2017

Population (thousand inhab.)	6,954 [1]
Area (km²)	406,752
Population Density (inhab./km²)	17
Urban Population (%)	61
GDP USD 2010 (MUSD)	36,168
GDP USD 2011 PPP (MUSD)	60,123
GDP per capita (thou. USD 2011 PPP/inhab.)	9

Energy Sector

Final consumption in the Transport Sector	Mtoe 2.51
Final consumption in the Industrial Sector	Mtoe 1.61
Final consumption in the Residential Sector	Mtoe 1.77
Final consumption in the Commercial and Service Sector	Mtoe 0.19
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.25

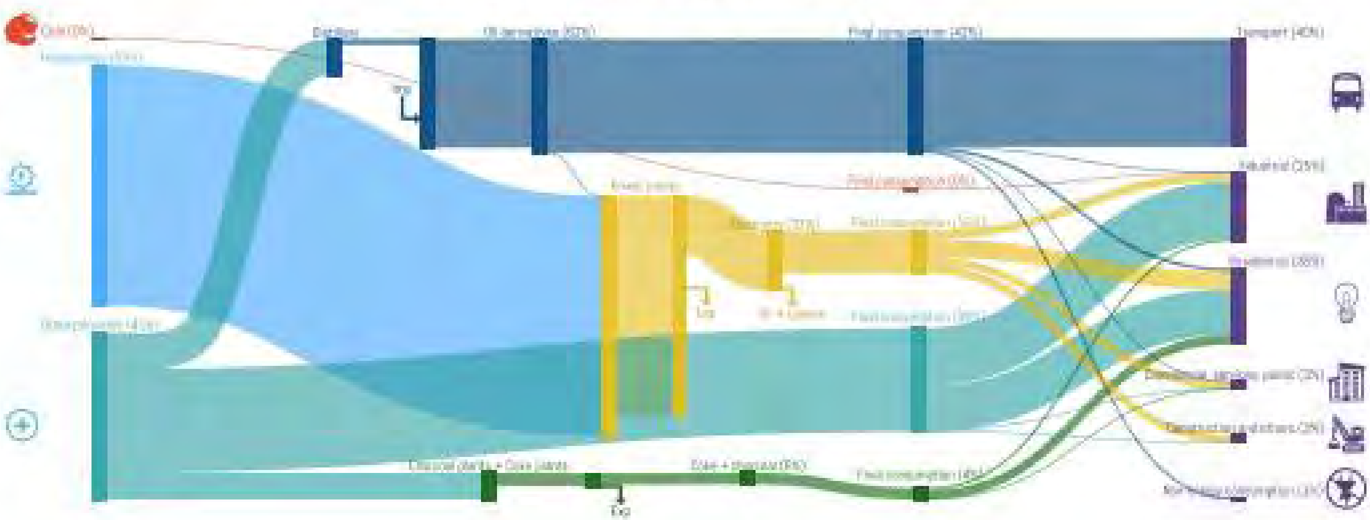
Oil reserves	Natural gas reserves	Coal reserves
Mbbl n.a.	Gm³ n.a.	Mt n.a.

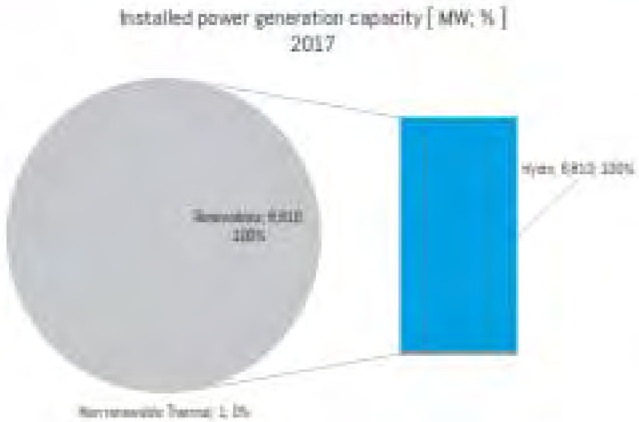
[1] General Direction of Statistics, Survey and Census.
[2] The refinery of «Villa Elisa» is inactive but has not been dismantled, data from the year 2005

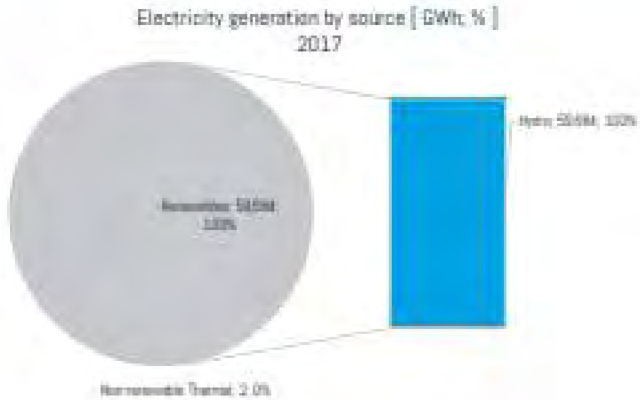
Note: The country updated the density of firewood to 768.9 kg/m³ based on recent studies and was applied to the years of 2016 and 2017.

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	1,662
Final energy consumption per capita	toe/inhab.	0.91
Electrification rate	%	99.27
Total energy supply	Mtoe	8.20
Total energy production	Mtoe	9.95
Total energy imports	Mtoe	2.43
Total energy exports	Mtoe	3.82
Total final energy consumption	Mtoe	6.33
Refining capacity	kbbl/day	7.5 [2]
Installed power generation capacity	GW	8.81
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.14 / 0.11

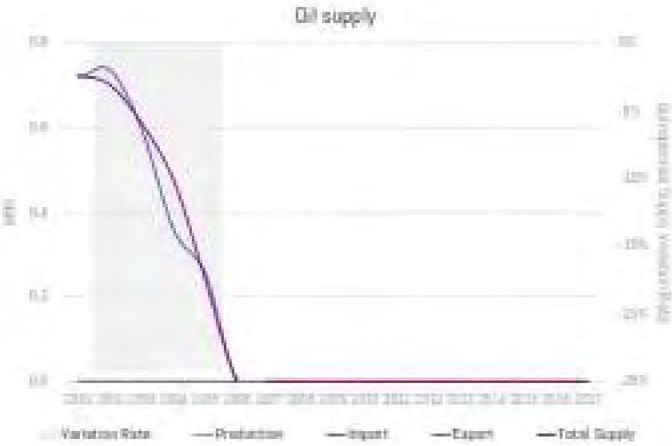
Summarized energy balance 2017







On December 15, 2017, the Maximum Power Demand of the National Interconnected System reached 3,135 MW, which is a historical record.



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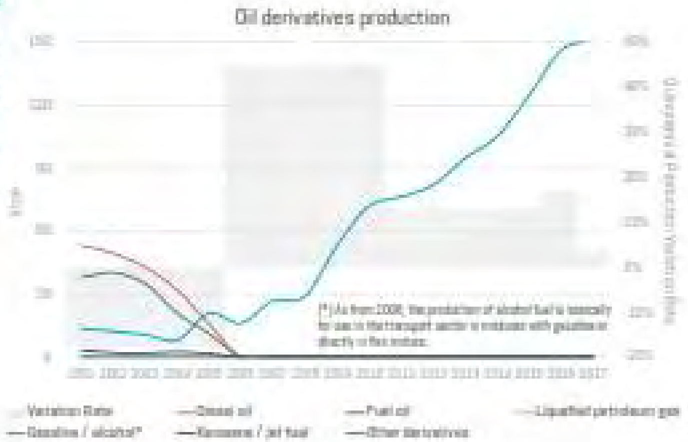
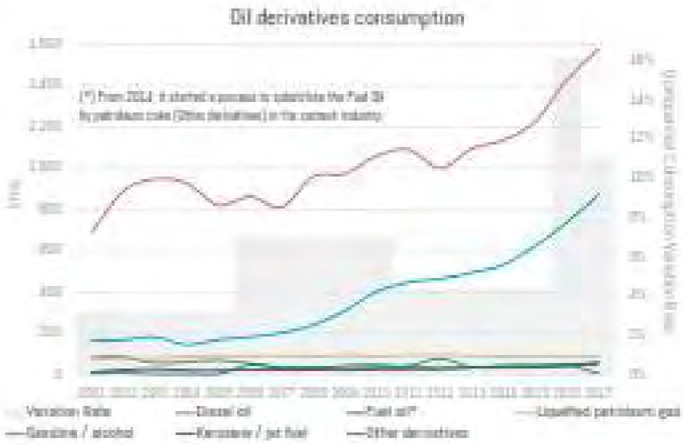
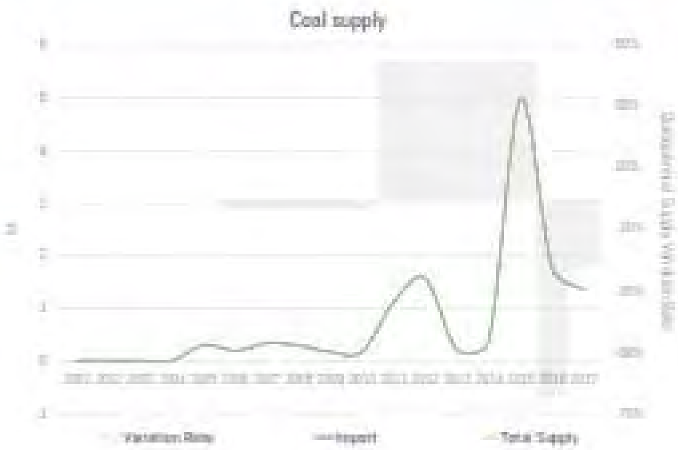
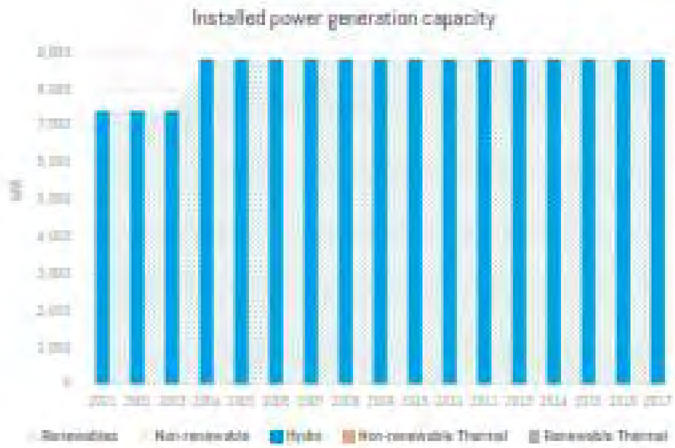
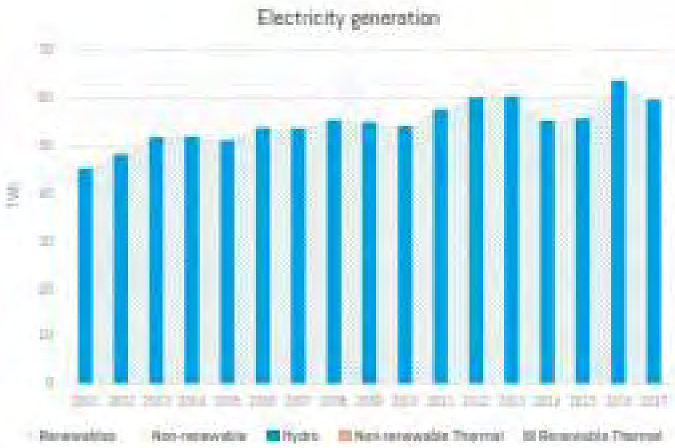


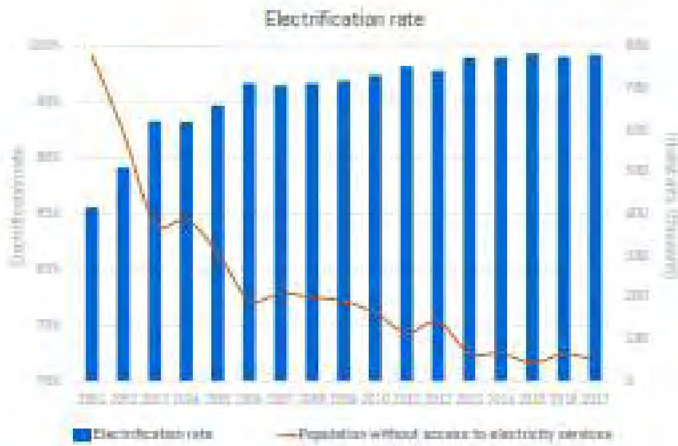


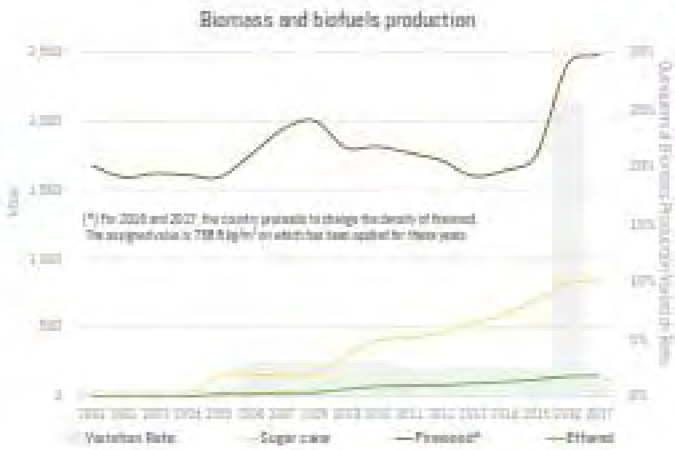
In 2005, the Villa Elisa Refinery closed, on which was owned by the state company PETROPAR with a capacity of 7.5 kbbl/day.











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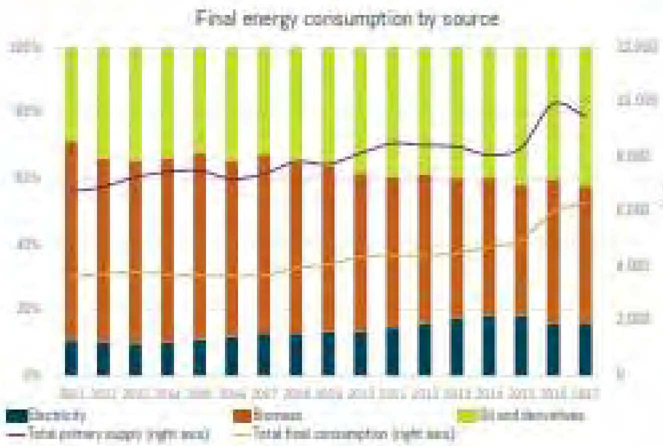
Final energy consumption by source
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)


Industrial Sector Final Consumption
Electricity
Coal coke
Biomass
Value added variation rate (Industrial) [%]
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]


Other Sector Final Consumption
Electricity
Kerosene / jet fuel
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Other) [%]


Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Final consumption variation rate [%]
Gasoline / alcohol
Liquefied petroleum gas
Value added variation rate (Transportation) [%]

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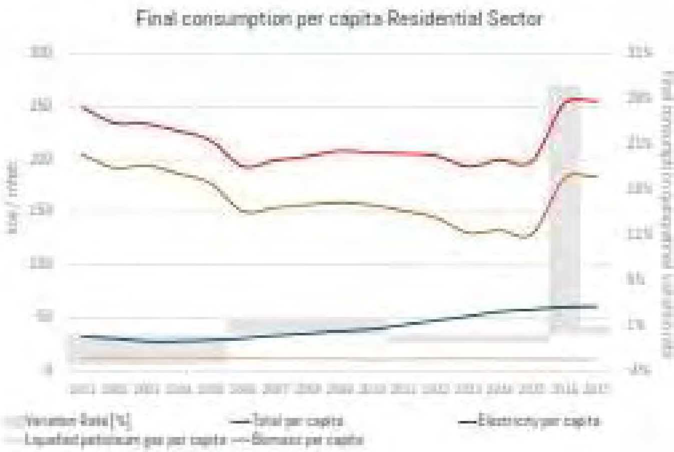
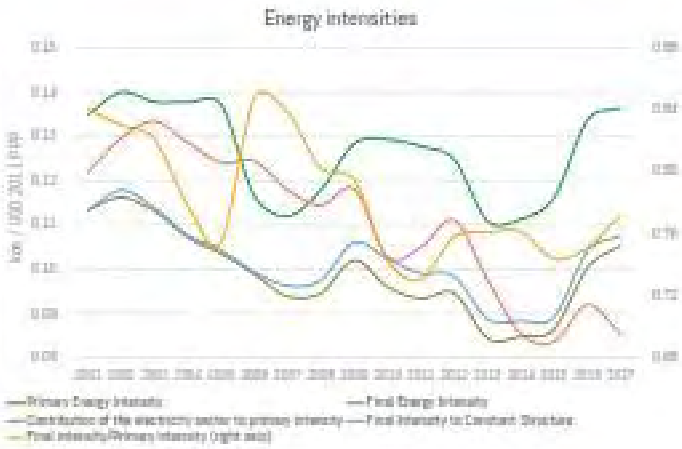
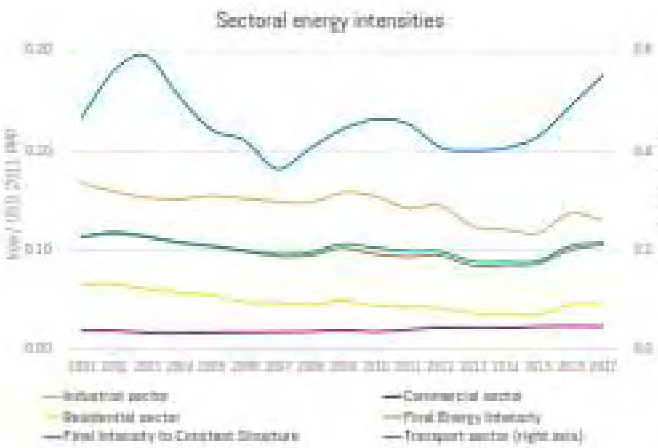
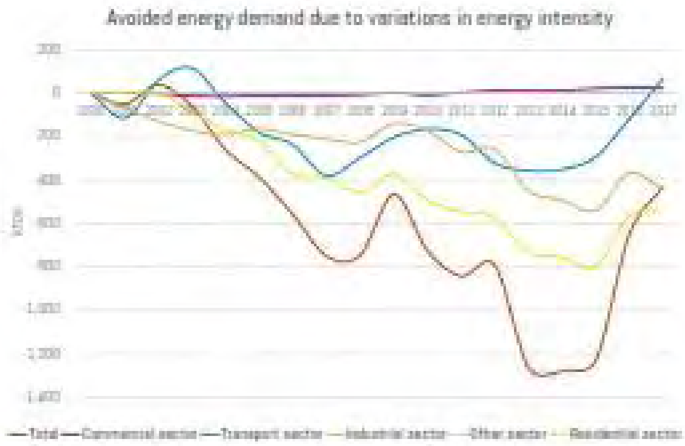
Other Sector Final Consumption
Electricity
Kerosene / jet fuel
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Other) [%]

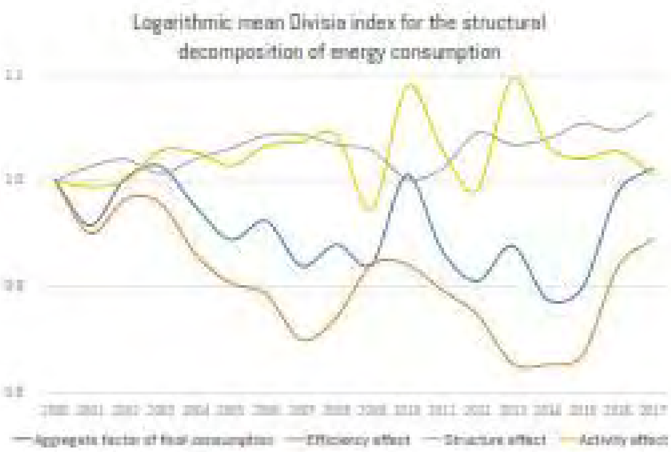

Residential Sector Final Consumption
Electricity
Biomass*
Household final consumption variation rate [%]
Liquefied petroleum gas
Final consumption variation rate [%]

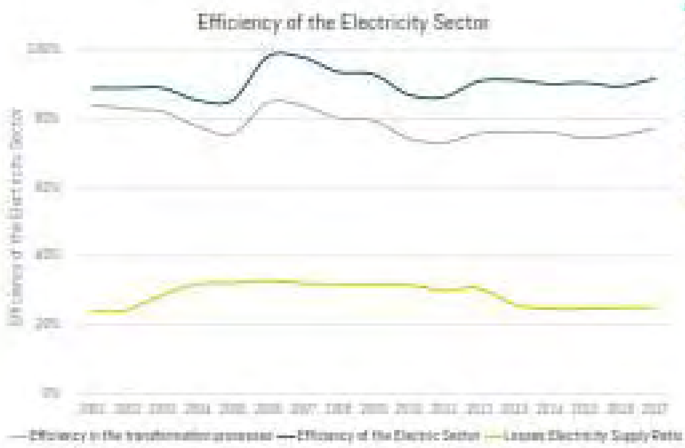

Final consumption per capita Residential Sector
kep / inhab.
Final consumption per capita variation rate
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied petroleum gas per capita
Biomass per capita


Energy intensities
kep / 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
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 Electric Sector
Losses Electricity Supply Ratio

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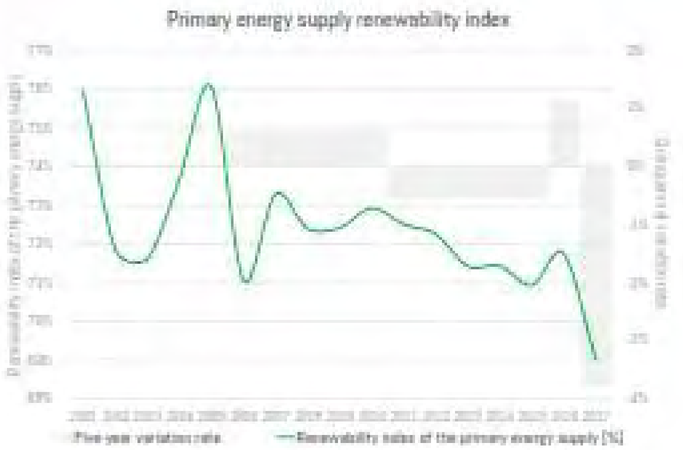

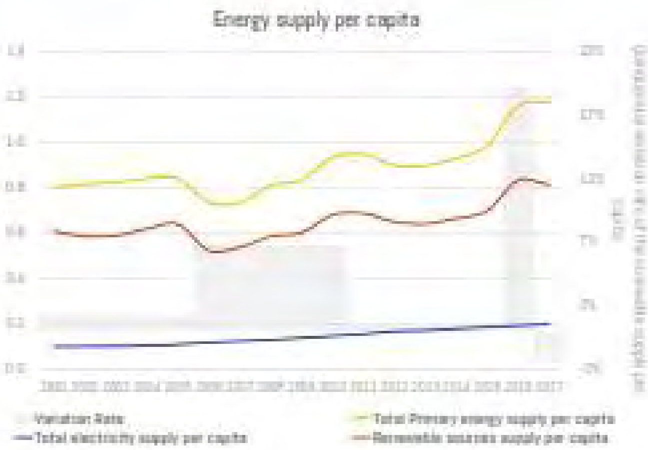

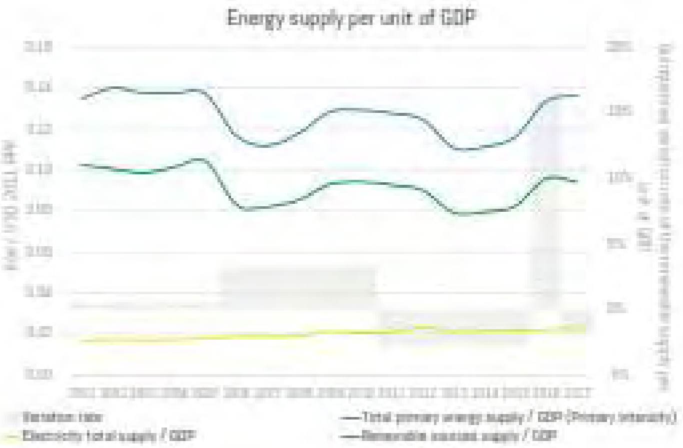

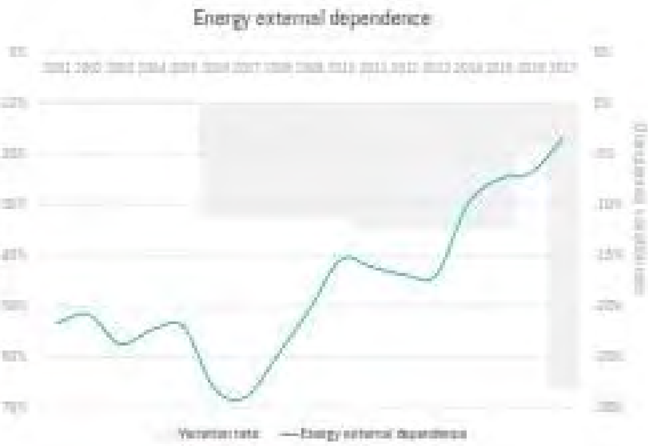

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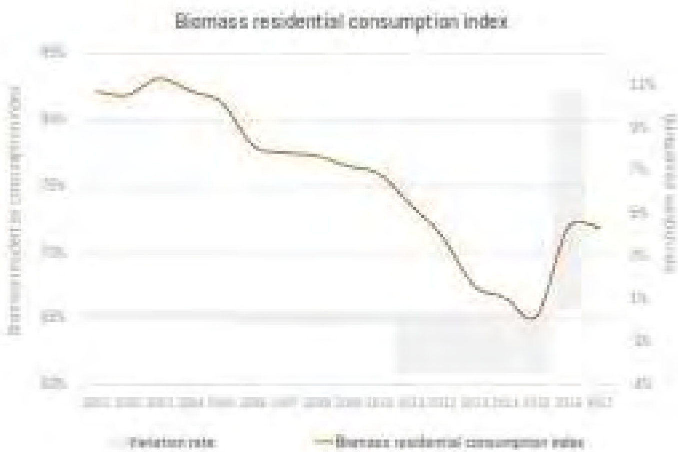
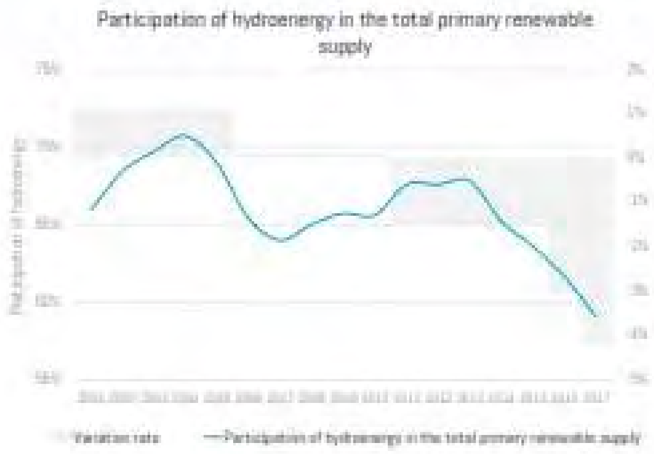
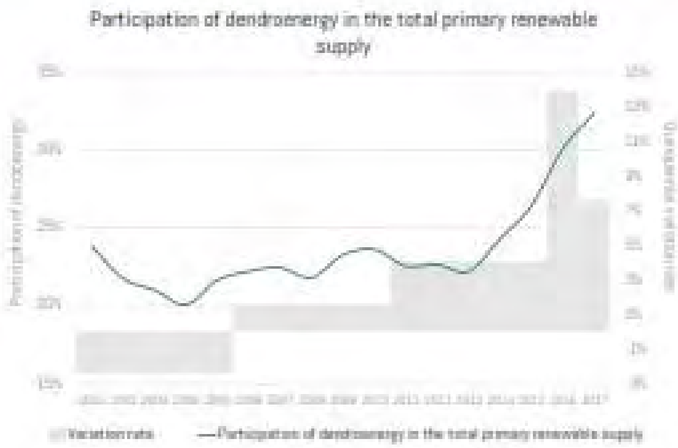
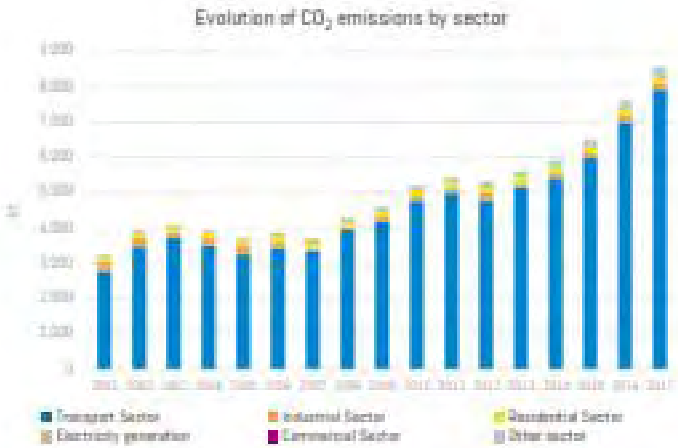
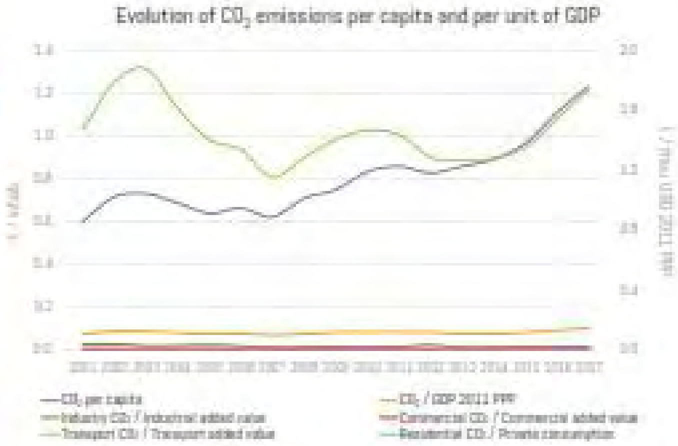
The Juan León Mallorquín 220/23 kV substation was inaugurated, which is located in the Department of Alto Paraná, it will allow the improvement of electric power supply in the East System and it is the influence zone of the C.H. Itaipú.

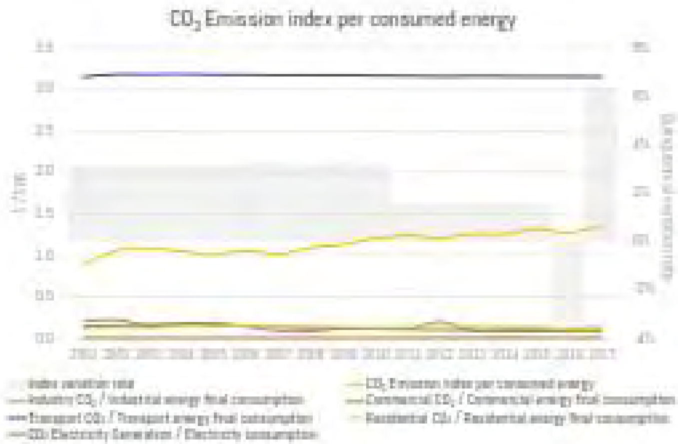


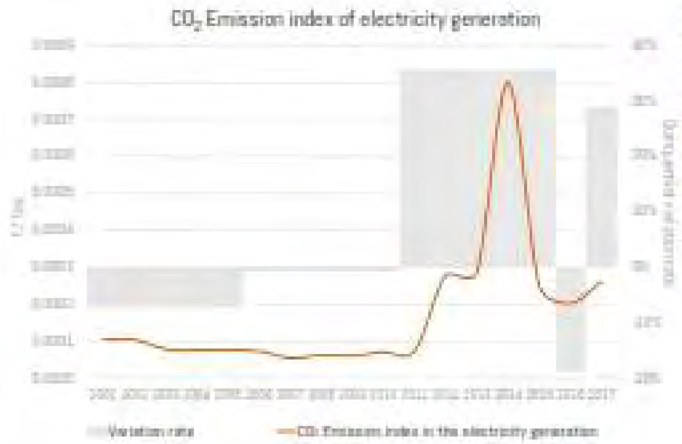

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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

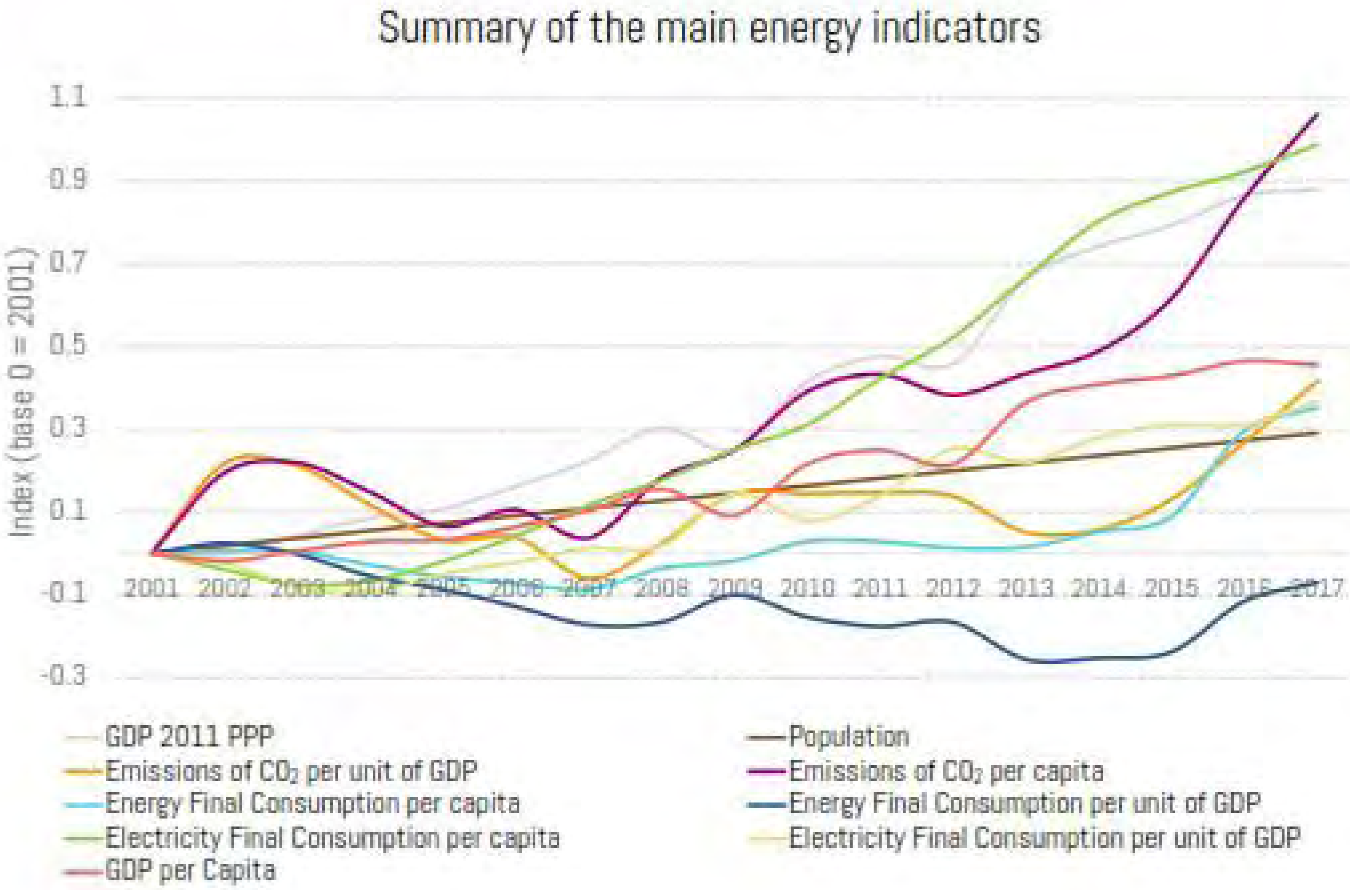

Evolution of CO2 emissions by sector
Transport Sector
Industrial Sector
Residential Sector
Electricity generation
Commercial Sector
Other sector


Evolution of CO2 emissions per capita and per unit of GDP
CO2 per capita
CO2 / GDP 2011 PPP


CO2 Emission index per consumed energy


CO2 Emission index of electricity generation
Variation rate

PARAGUAY


Summary of the main energy indicators
Index (base 0 = 2001)
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
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

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General Information 2017

Population (thousand inhab.)	32,167
Area (km²)	1,285,220
Population Density (inhab./km²)	25
Urban Population (%)	79
GDP USD 2010 (MUSD)	198,546
GDP USD 2011 PPP (MUSD)	393,600
GDP per capita (thou. USD 2011 PPP/inhab.)	12

Energy Sector 2016

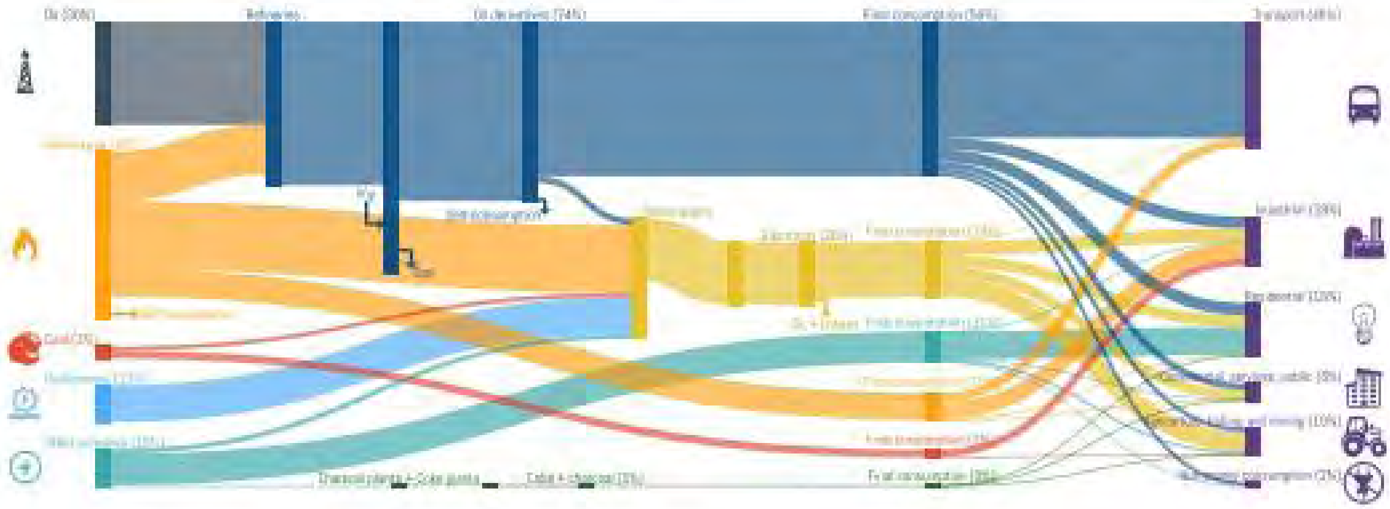
	Mtoe
Final consumption in the Transport Sector	9.05
Final consumption in the Industrial Sector	3.56
Final consumption in the Residential Sector	3.88
Final consumption in the Commercial and Service Sector	1.27
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	2.30

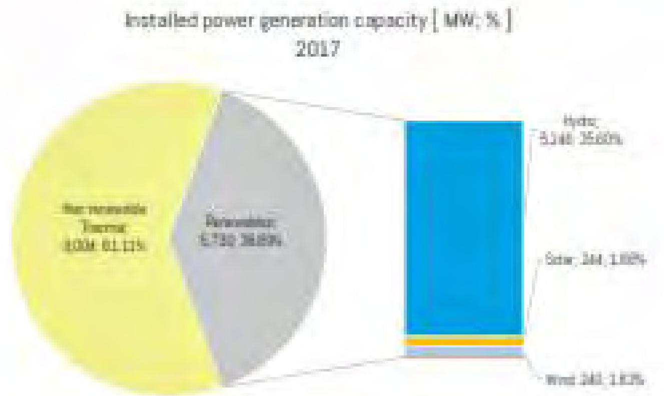
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 435	Gm³ 456	Mt 7

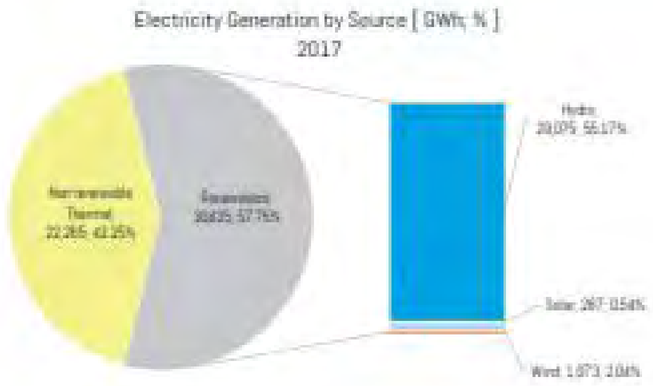
* Data corresponding to 2017 year.

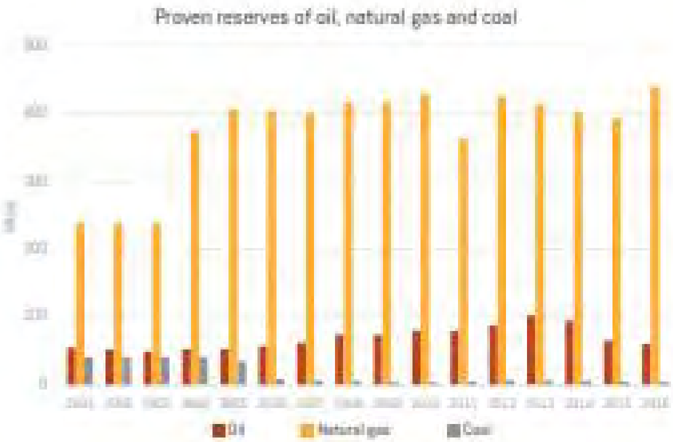
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
1,447	0.62	96.00 *	25.92	30.76	11.25	11.36	19.54	198	14.73 *	0.07 / 0.05

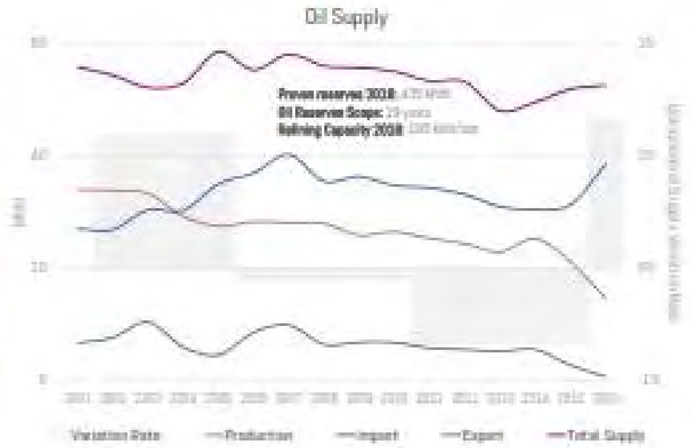
Summarized energy balance 2016

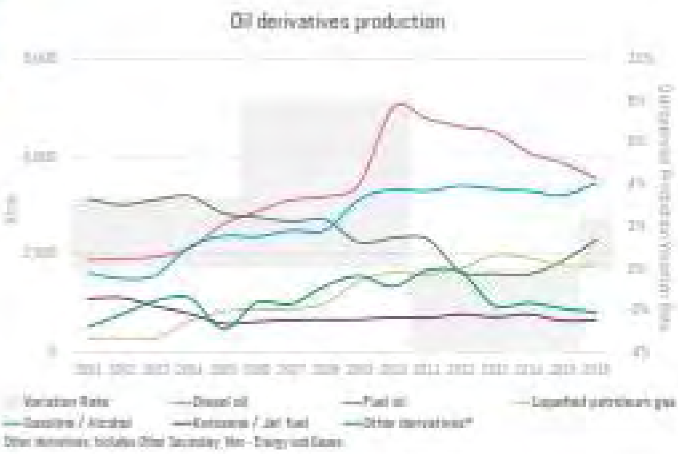


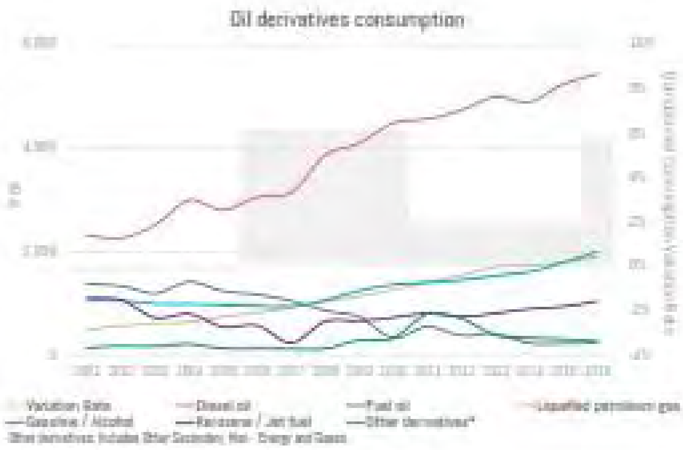

Installed power generation capacity [MW; %]
2017
Solar; 344; 1.88%

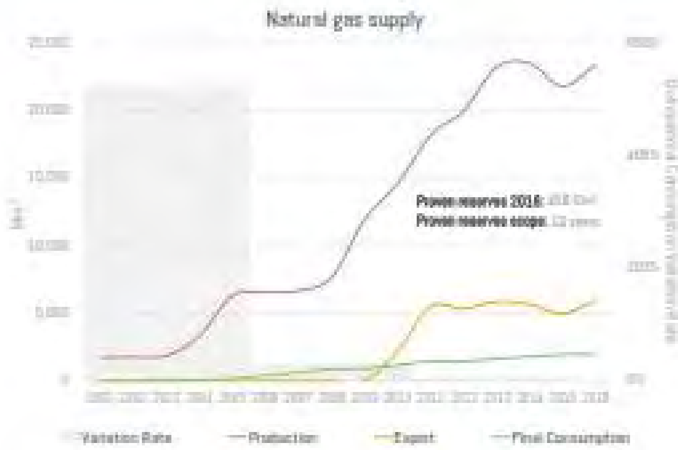

Electricity Generation by Source [GWh; %]
2017
Hydro
Wind 1,073; 2.04%


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

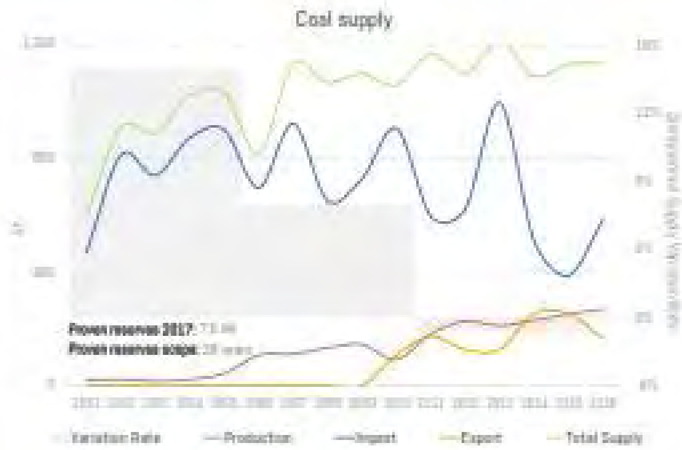

Oil Supply
Variation Rate
Production
Import
Export
Total Supply


Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
Other derivatives: Includes Other Secondary, Non - Energy and Gases

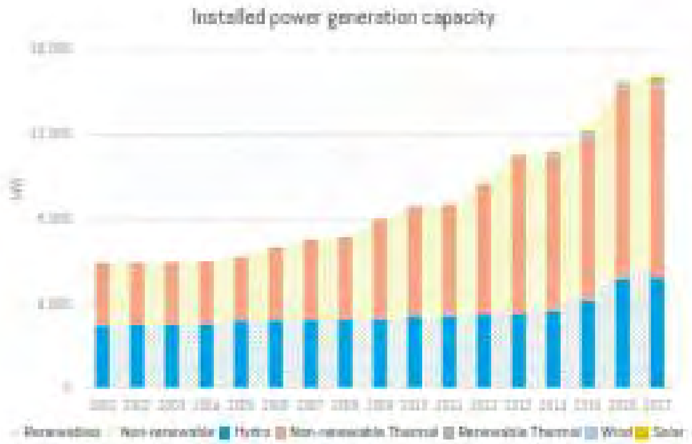

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives*
Other derivatives: Includes Other Secondary, Non - Energy and Gases



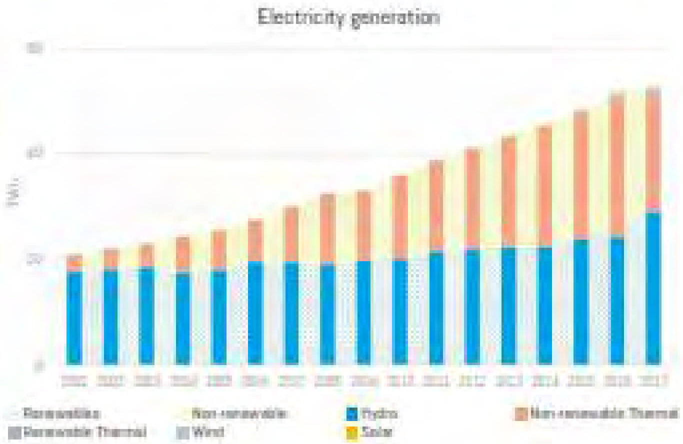
Natural gas supply
Proven reserves 2016:
Proven reserves scope:
Variation Rate
Production
Export
Final Consumption



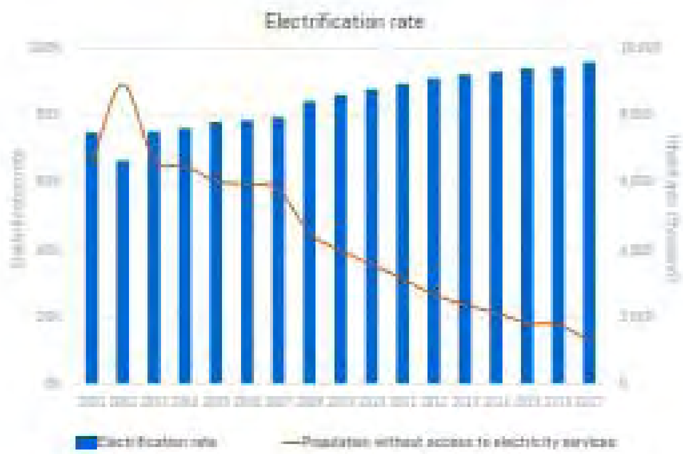
Coal supply
Proven reserves 2017:
Proven reserves scope:
Variation Rate
Production
Import
Export
Total Supply



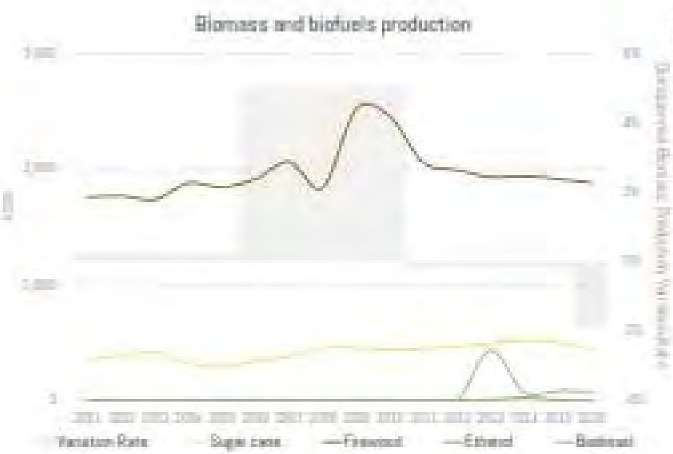
Installed power generation capacity
MW
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Wind
Solar



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



Electrification rate
Electrification rate
Population without access to electricity services



Biomass and biofuels production
Variation Rate
Sugar cane
Firewood
Ethanol
Biodiesel

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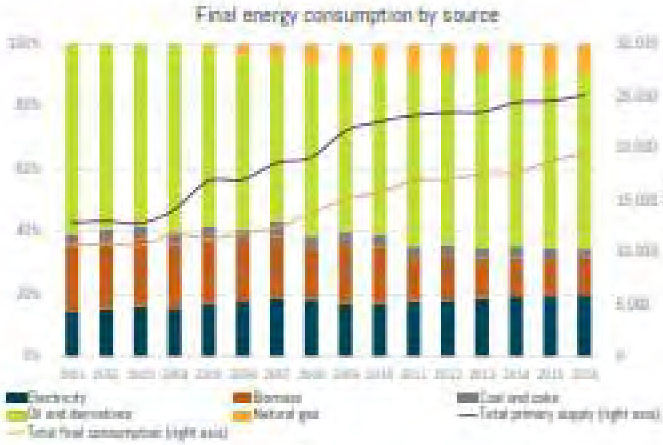
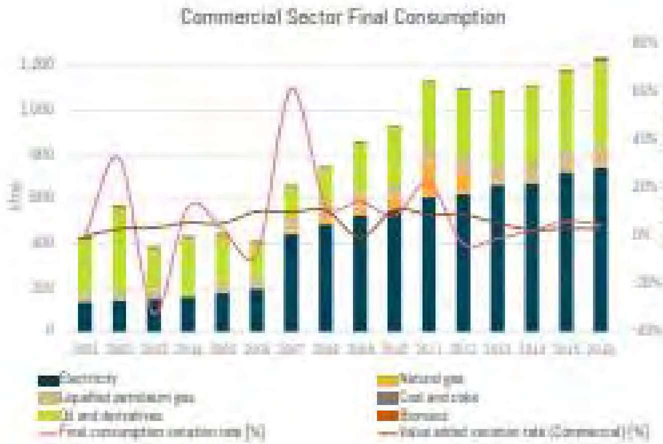
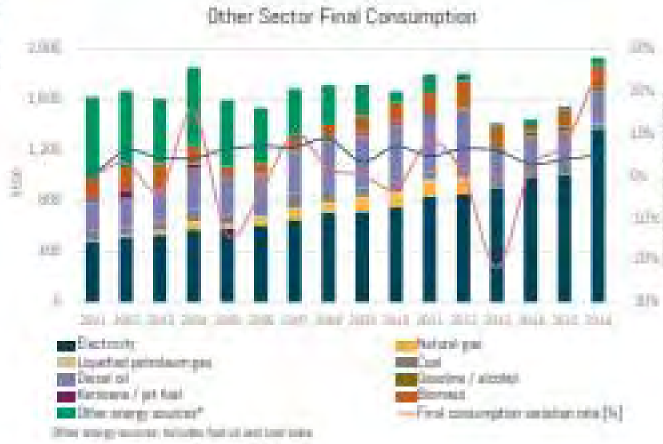

Final energy consumption by source
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)


Industrial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

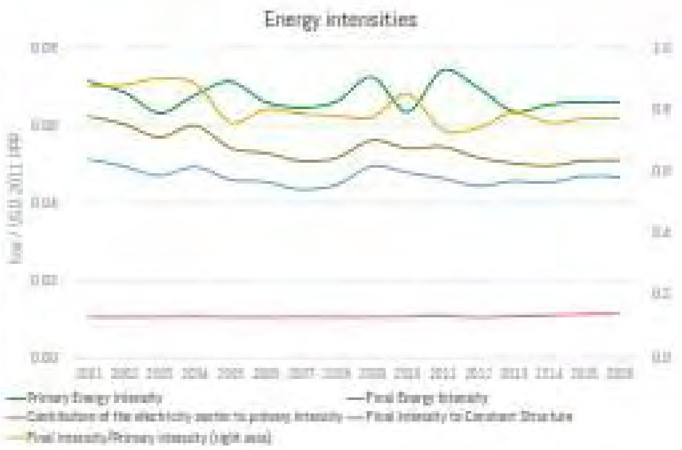

Commercial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

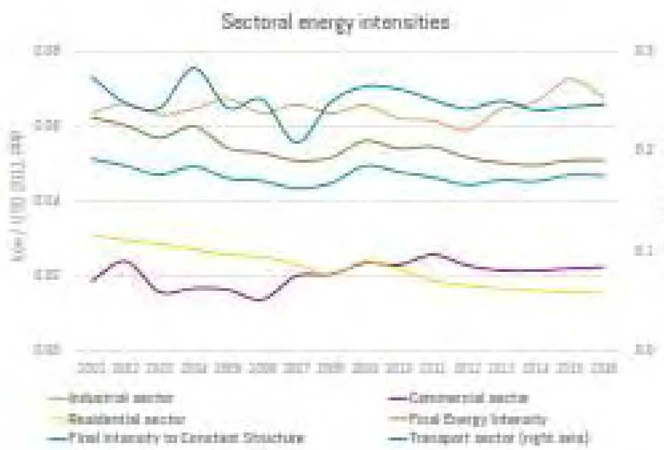

Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Electricity
Liquefied petroleum gas
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

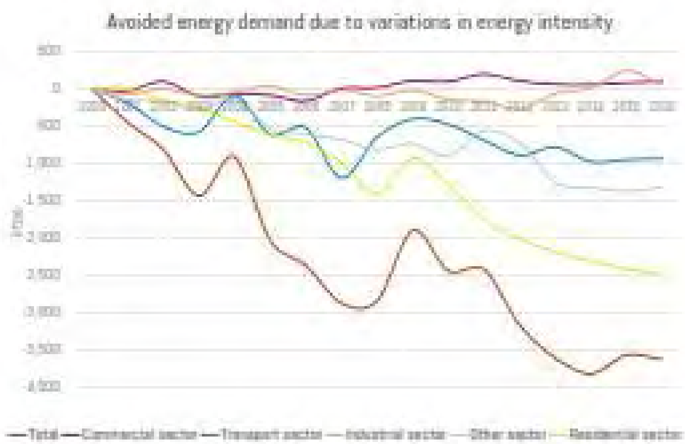

Other Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Biomass
Other energy sources*
Final consumption variation rate [%]

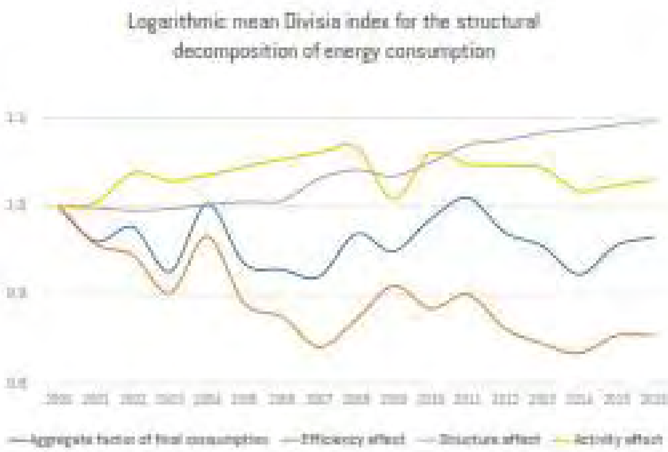

Residential Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Oil and derivatives
Biomass
Final consumption variation rate [%]
Household final consumption variation rate [%]

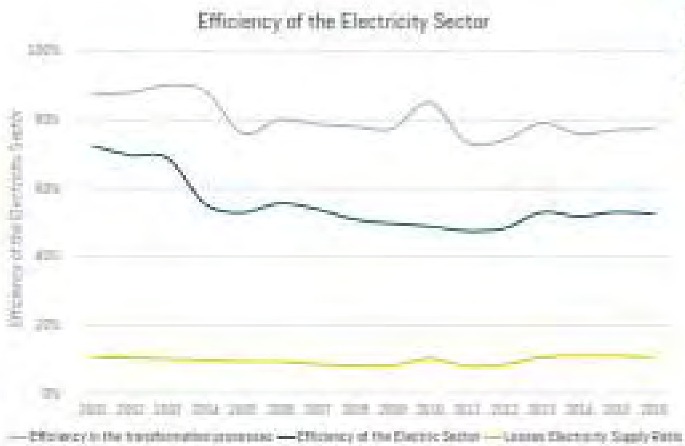

Final consumption per capita Residential Sector
kep / inhab
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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
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 Electric Sector
Losses Electricity Supply Ratio

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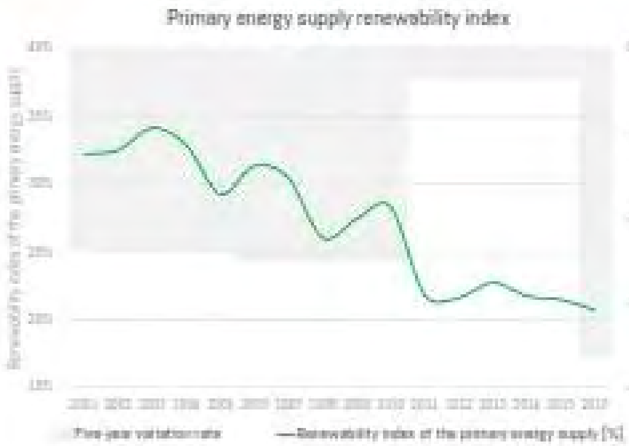
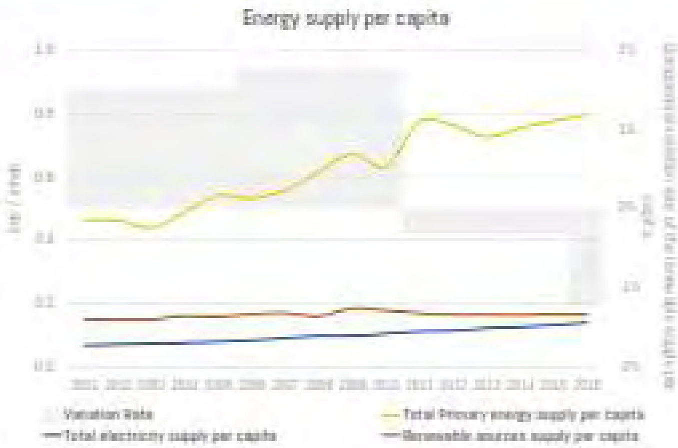
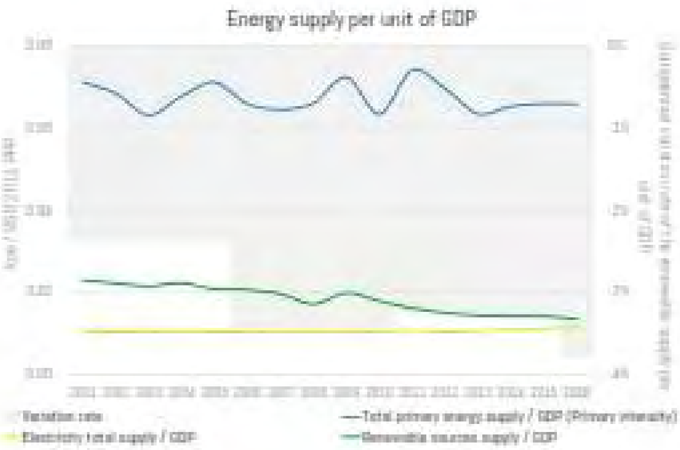
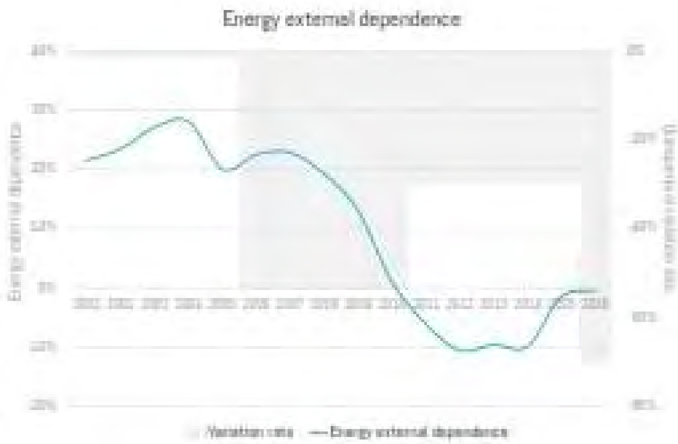

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]


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

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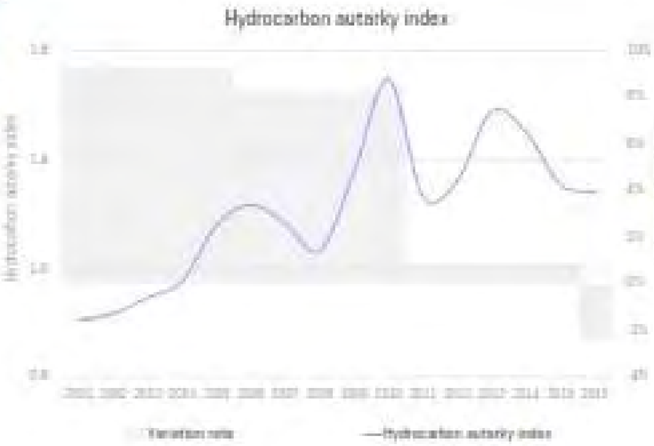
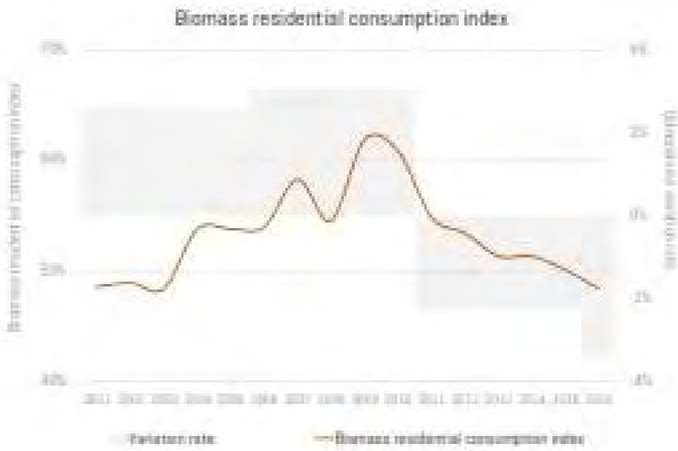
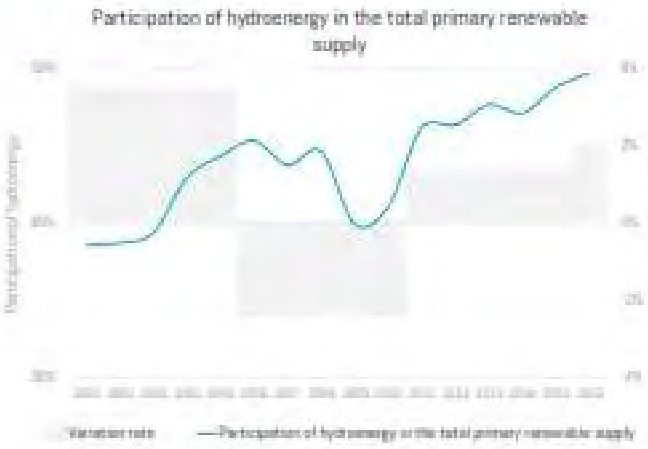
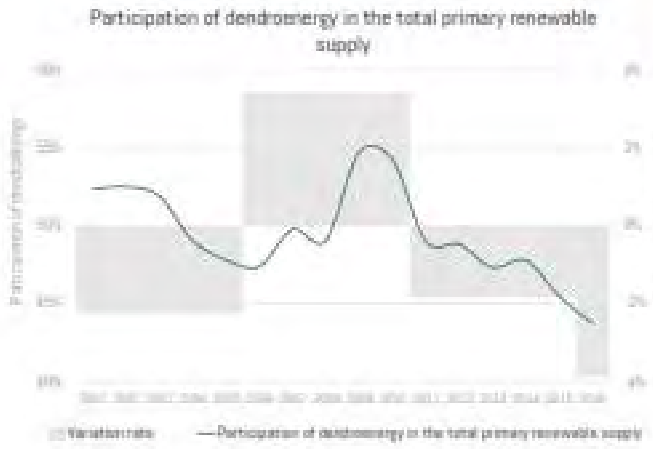
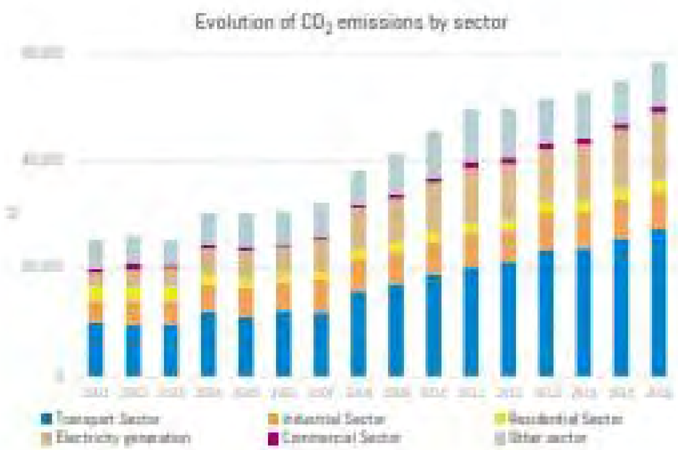
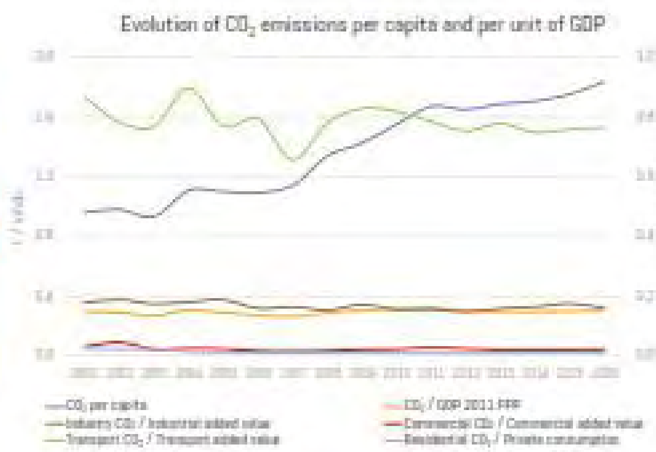

Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

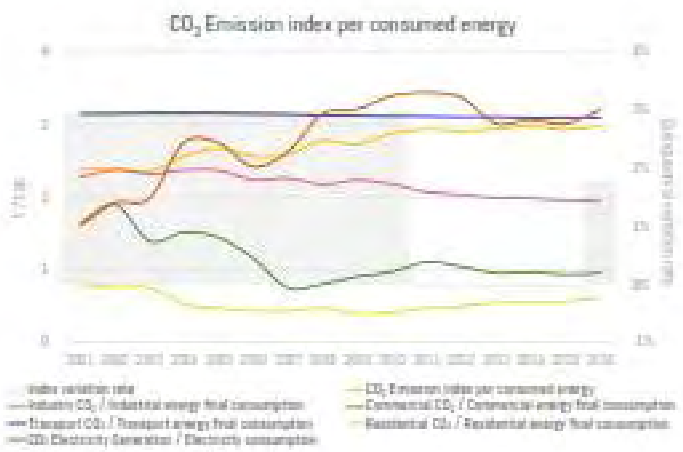

Biomass residential consumption index
Variation rate
Biomass residential consumption index

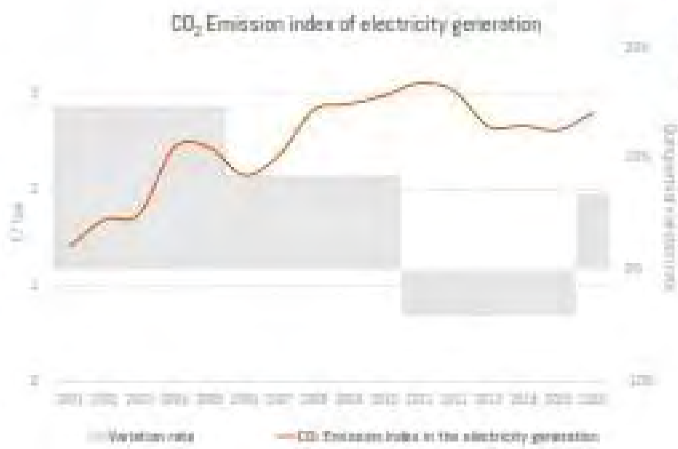

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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


Evolution of CO2 emissions per capita and per unit of GDP
CO2 per capita
CO2 / GDP 2011 PPP


CO2 Emission index per consumed energy
Index variation rate
CO2 Emission index per consumed energy


CO2 Emission index of electricity generation
Variation rate
CO2 Emission index in the electricity generation

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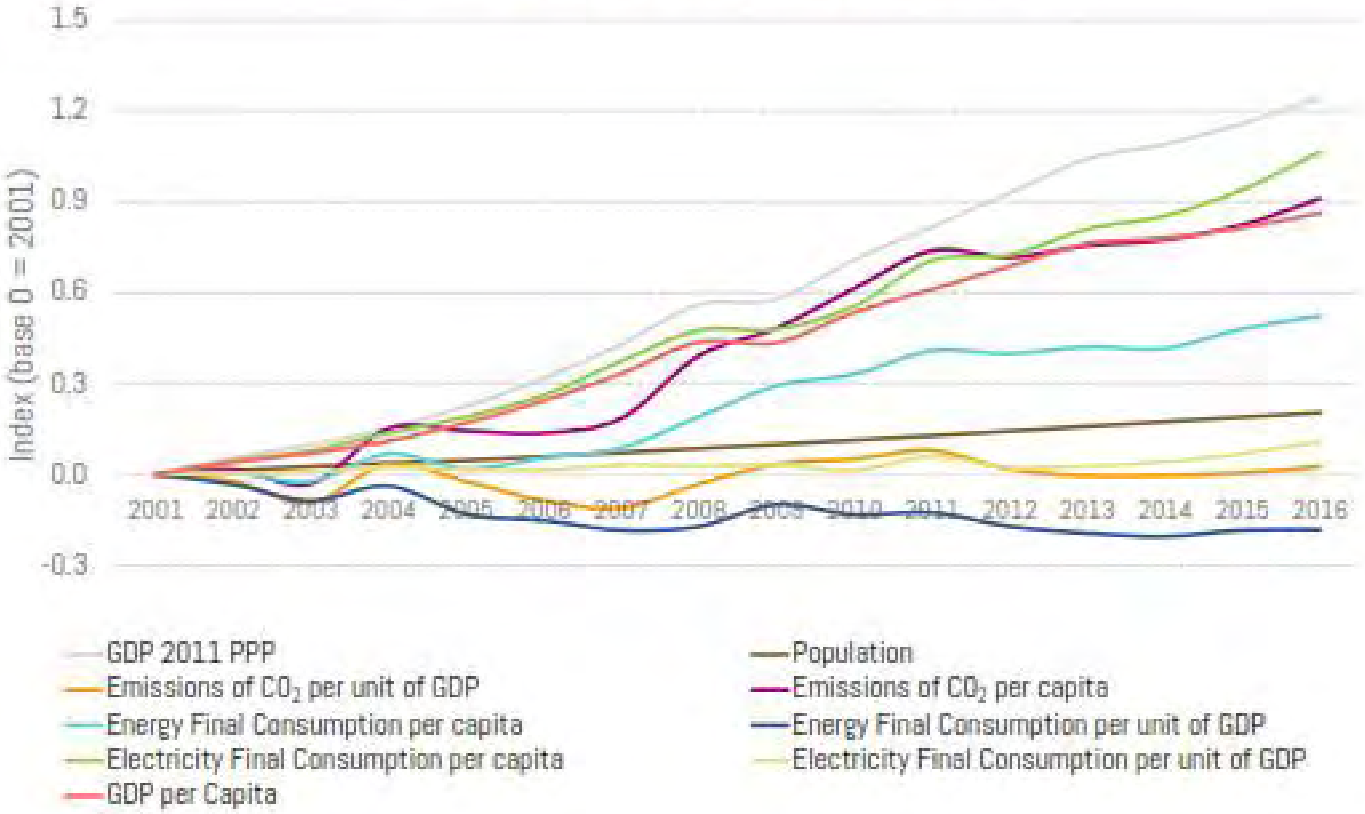
Summary of the main energy indicators



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SURINAME

General Information 2017

Population (thousand inhab.)	552
Area (km²)	163,820
Population Density (inhab./km²)	3
Urban Population (%)	66
GDP USD 2010 (MUSD)	4,595
GDP USD 2011 PPP (MUSD)	7,756
GDP per capita (thou. USD 2011 PPP/inhab.)	14

Energy Sector

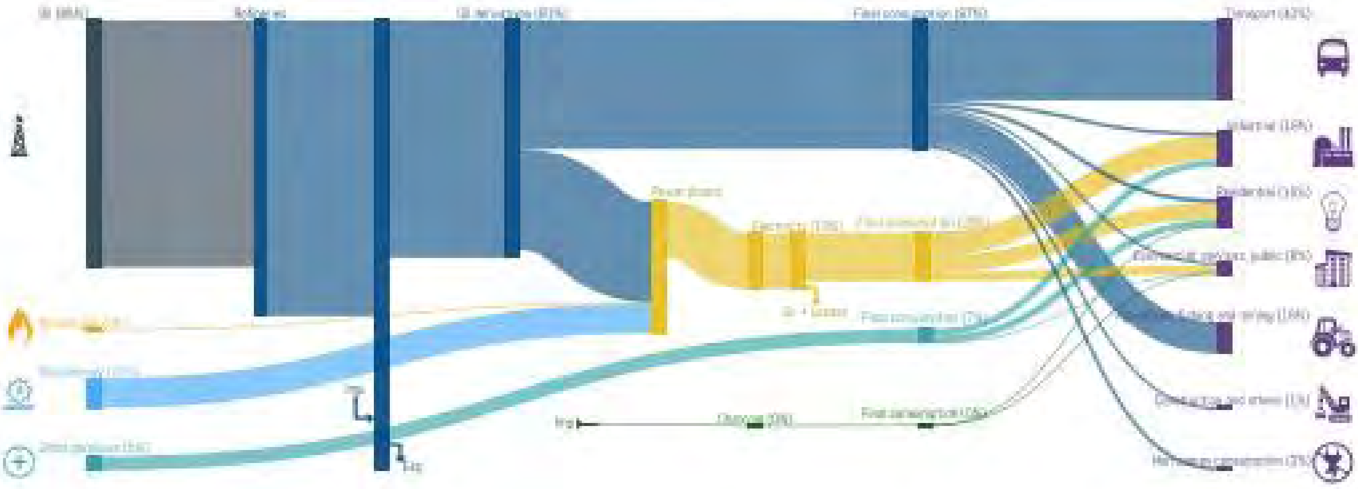
Sector	Mtoe
Final consumption in the Transport Sector	0.25
Final consumption in the Industrial Sector	0.11
Final consumption in the Residential Sector	0.09
Final consumption in the Commercial and Service Sector	0.04
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.12

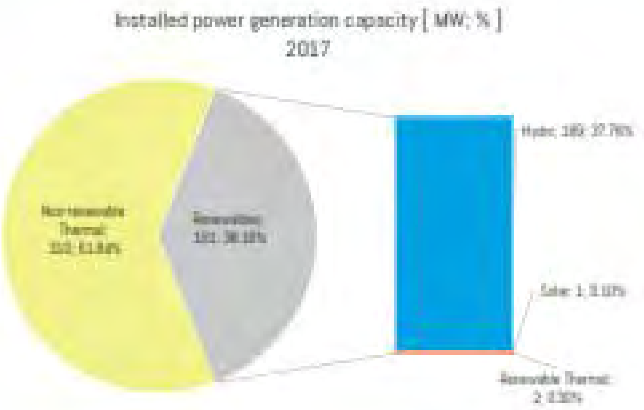
Reserves	Unit	Value
Oil reserves	Mbbl	84
Natural gas reserves	Gm³	n.a.
Coal reserves	Mt	n.a.

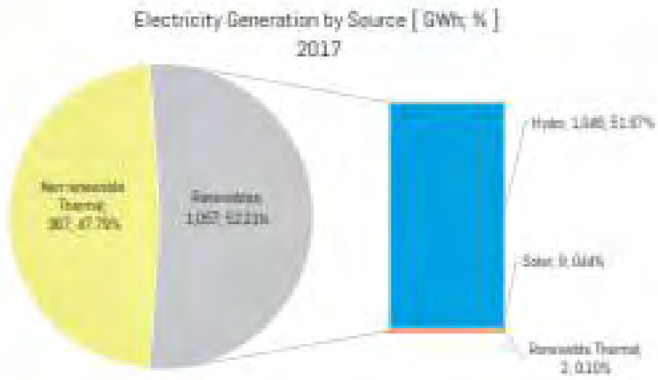
Note: Supply and demand data for 2017 estimated by OLADE.

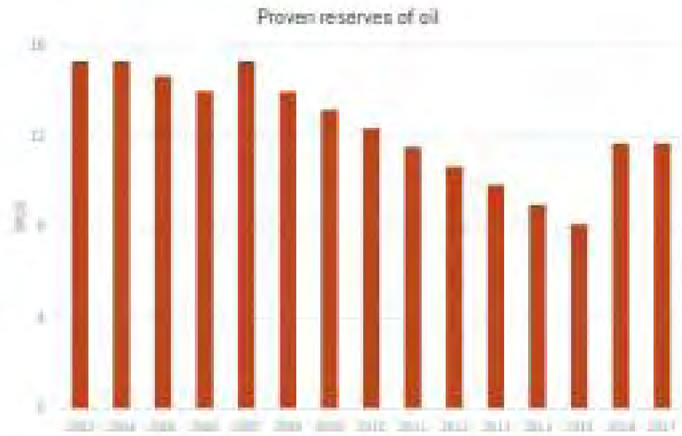
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	3,212
Final energy consumption per capita	toe/inhab.	1.08
Electrification rate	%	90.34
Total energy supply	Mtoe	0.71
Total energy production	Mtoe	0.92
Total energy imports	Mtoe	0.46
Total energy exports	Mtoe	0.66
Total final energy consumption	Mtoe	0.60
Refining capacity	kbbl/day	15
Installed power generation capacity	GW	0.50
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.09 / 0.08

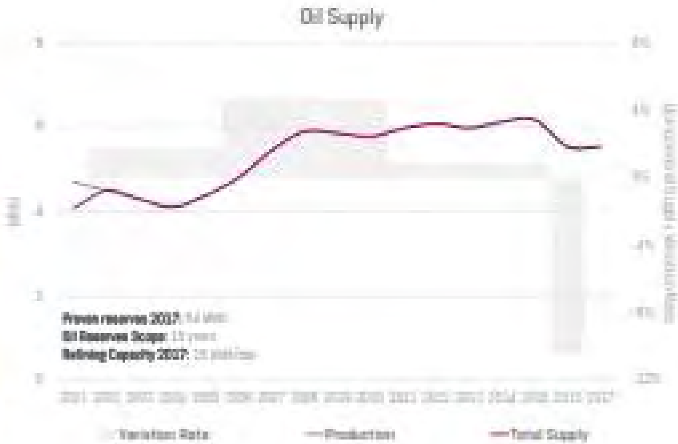
Summarized energy balance 2017



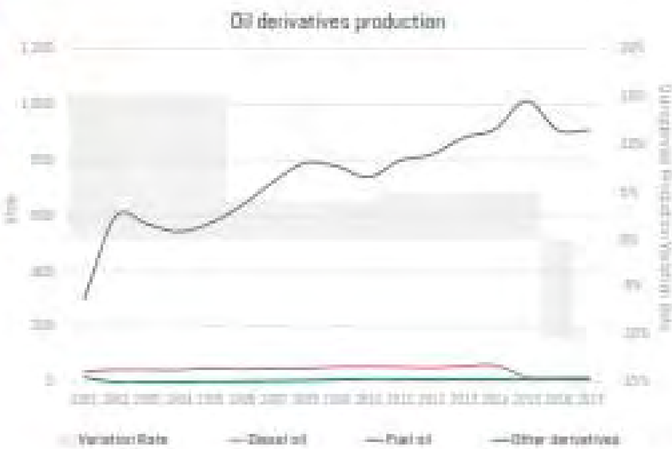

Installed power generation capacity [MW; %]
2017
Renewable Thermal

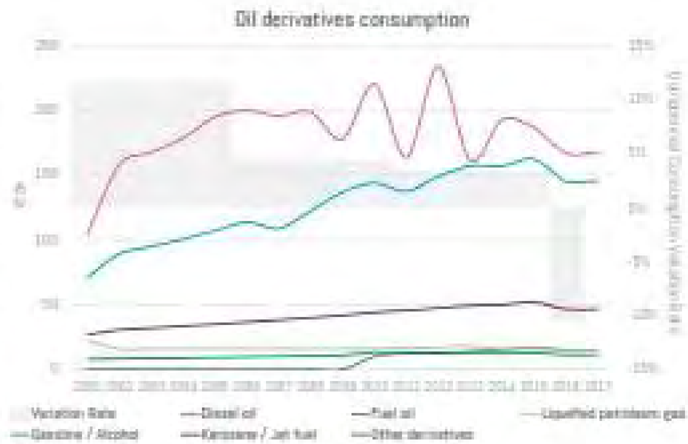

Electricity Generation by Source [GWh; %]
2017
Renewable Thermal

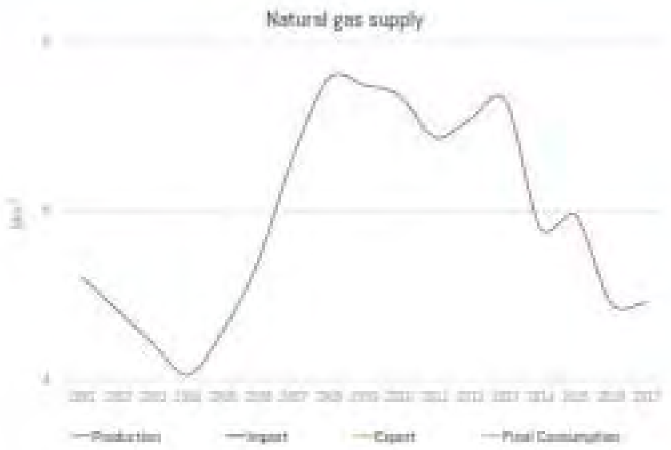

Proven reserves of oil

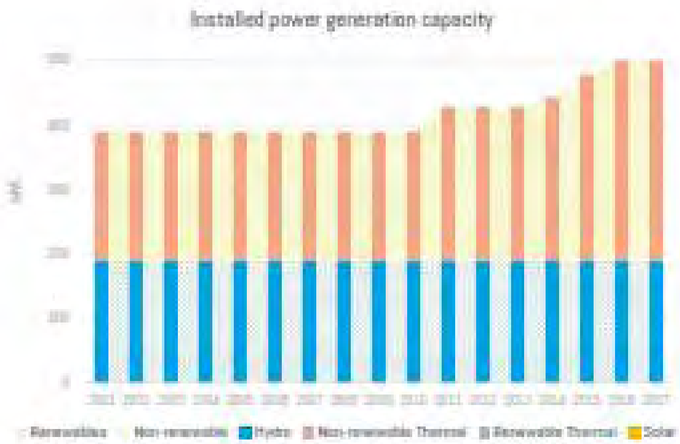

Oil Supply
Variation Rate
Production
Total Supply

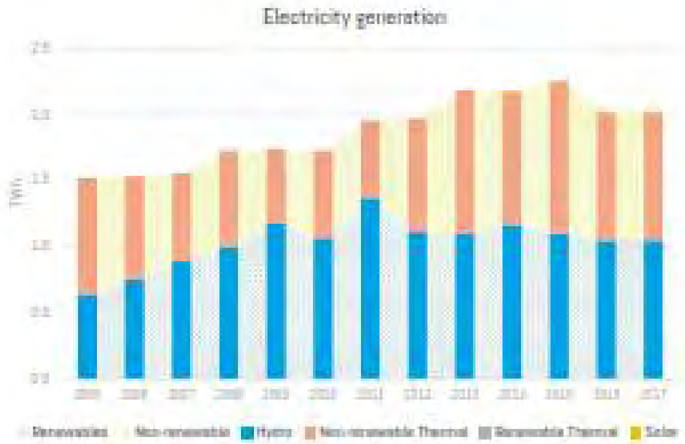
SURINAME

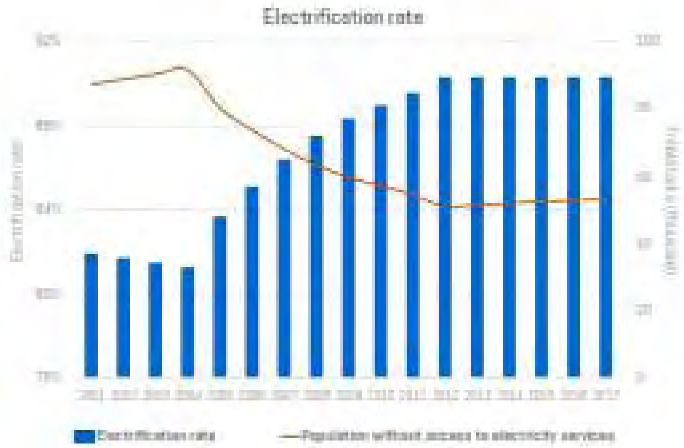

Oil derivatives production
Variation Rate
Diesel oil
Fuel oil
Other derivatives

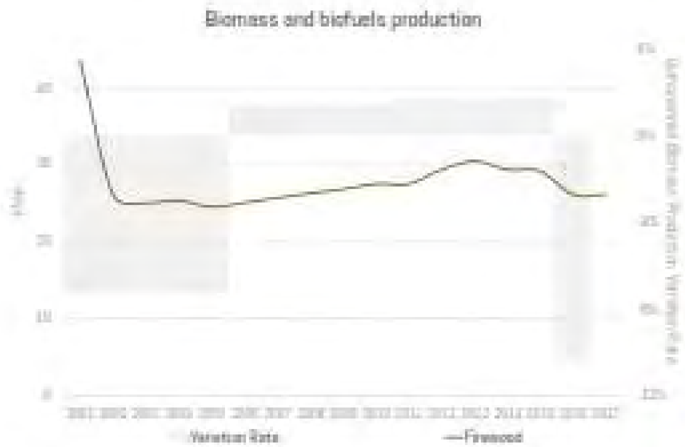

Oil derivatives consumption
Variation Rate
Diesel oil
Fuel oil
Liquefied petroleum gas
Gasoline / Alcohol
Kerosene / Jet fuel
Other derivatives

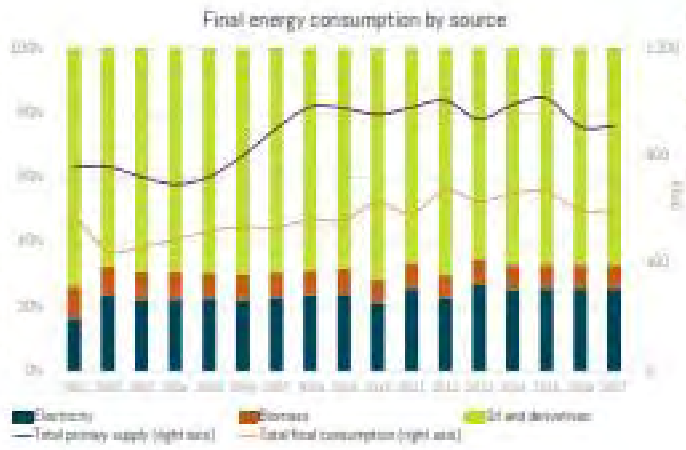

Natural gas supply
Production
Import
Export
Final Consumption


Installed power generation capacity
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Solar

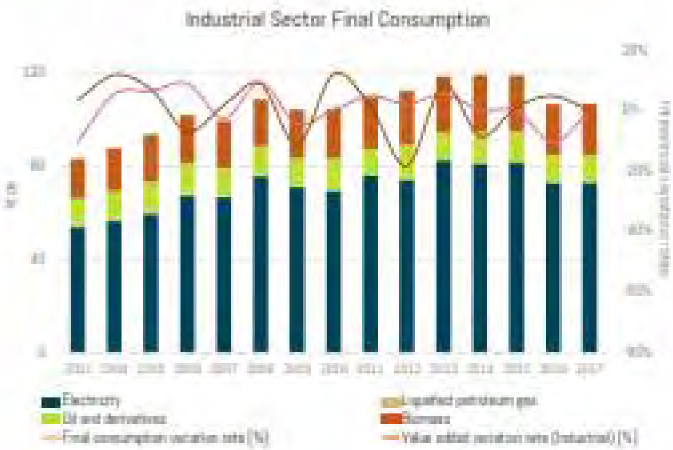

Electricity generation
TWh
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Renewable Thermal
Solar

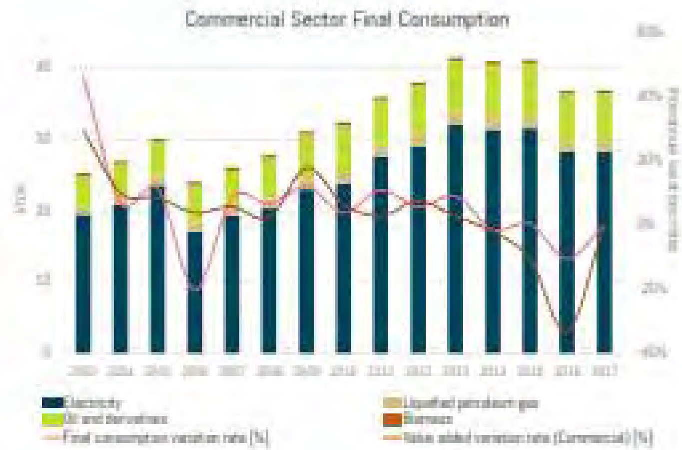

Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Firewood

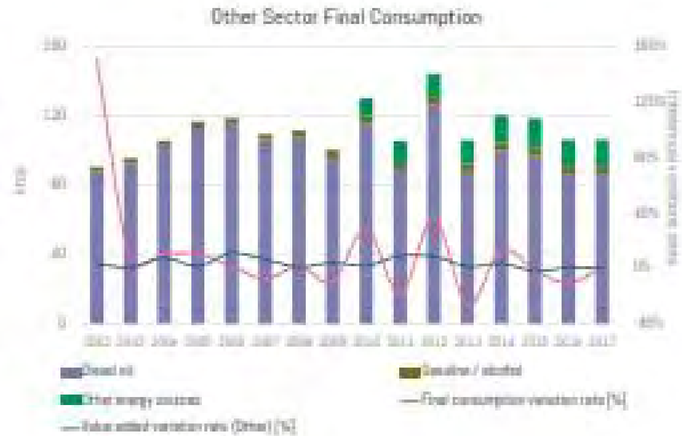

Final energy consumption by source
Electricity
Biomass
Oil and derivatives
Total primary supply (right axis)
Total final consumption (right axis)

SURINAME


Industrial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Industrial) [%]

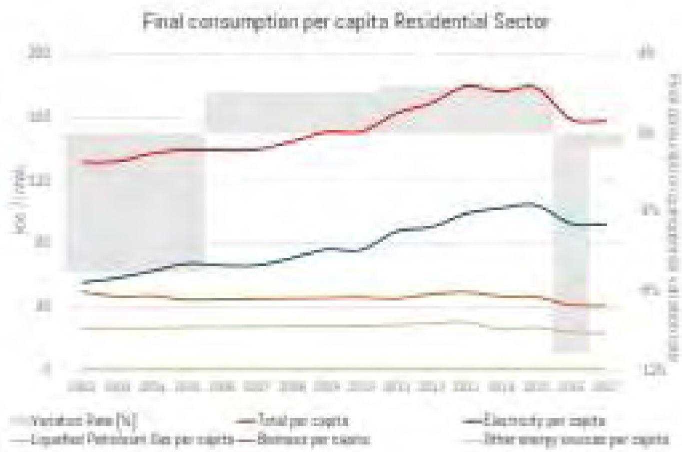

Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]

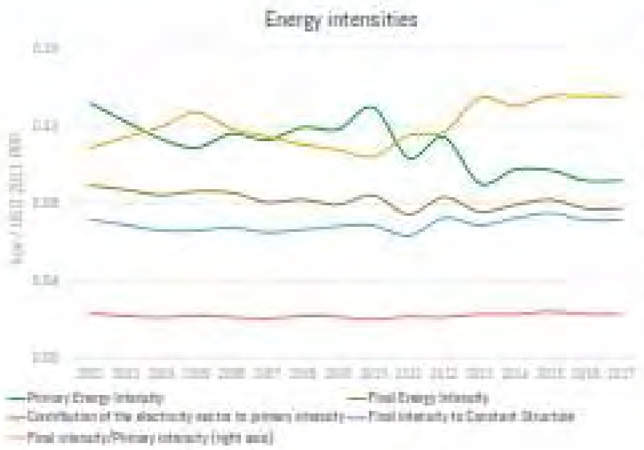

Transport Sector Final Consumption
Diesel oil
Kerosene / jet fuel
Value added variation rate (Transportation) [%]
Gasoline / alcohol
Final consumption variation rate [%]

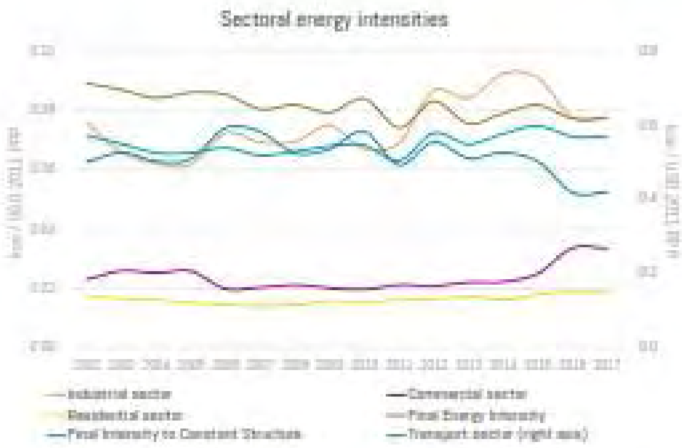

Other Sector Final Consumption
Diesel oil
Gasoline / alcohol
Other energy sources
Final consumption variation rate [%]
Value added variation rate (Other) [%]

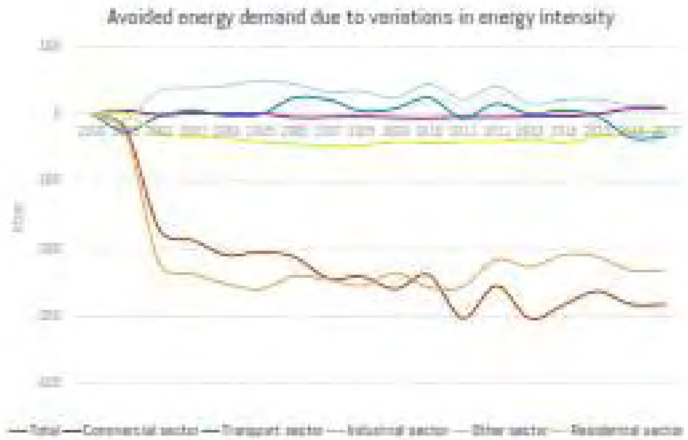
SURINAME

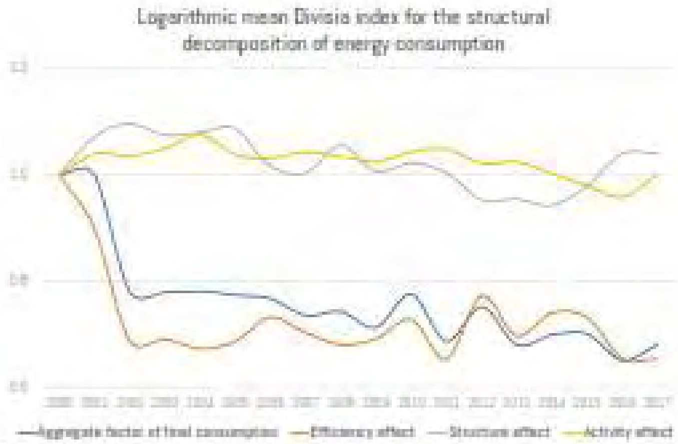

Residential Sector Final Consumption
Biomass
Liquefied petroleum gas
Final consumption variation rate [%]
Oil and derivatives
Electricity
Household final consumption variation rate [%]

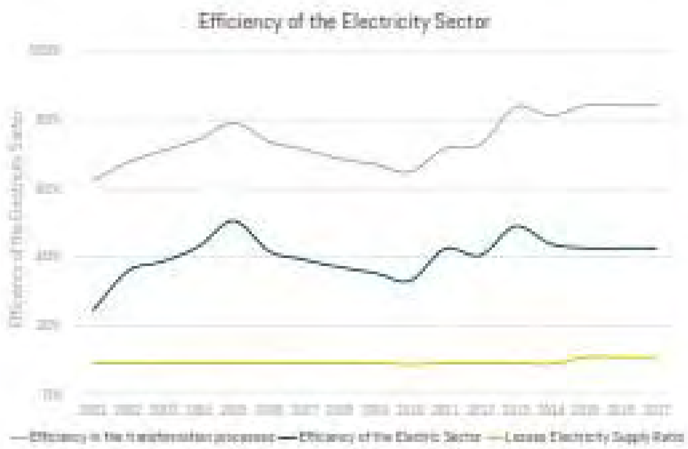

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Biomass per capita
Other energy sources per capita

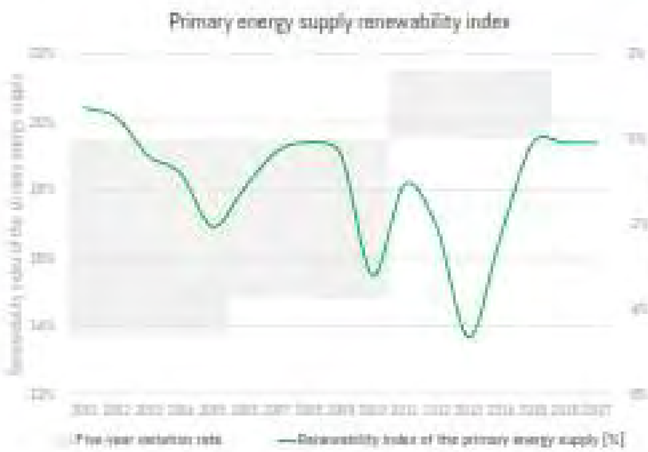

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final Intensity to Constant Structure
Final intensity/Primary intensity (right axis)


Sectoral energy intensities
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

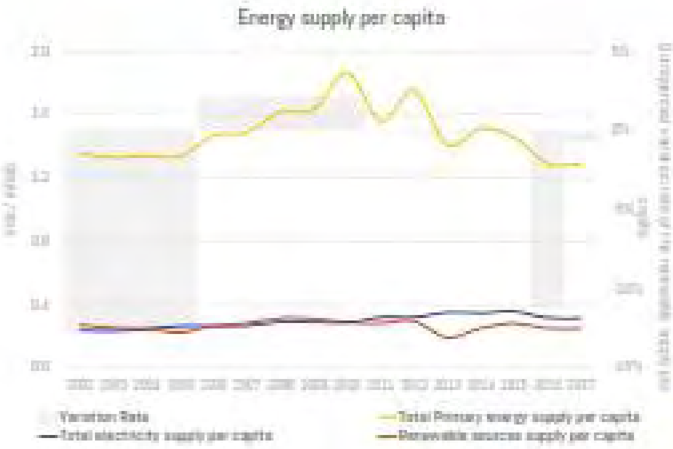

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect


Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Ratio

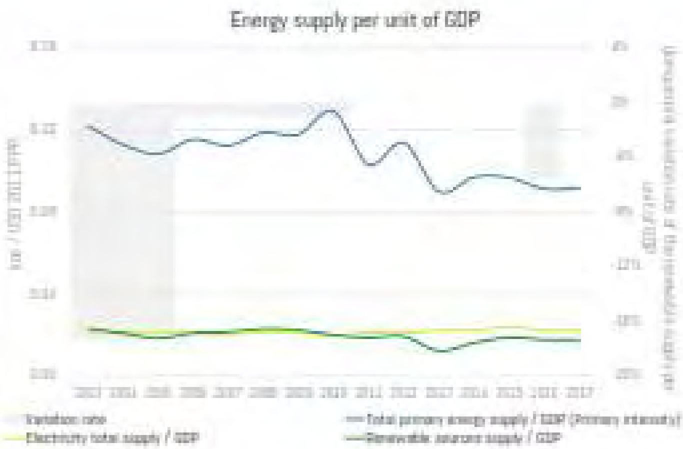

Primary energy supply renewability index
Five-year variation rate
Renewability index of the primary energy supply [%]

SURINAME

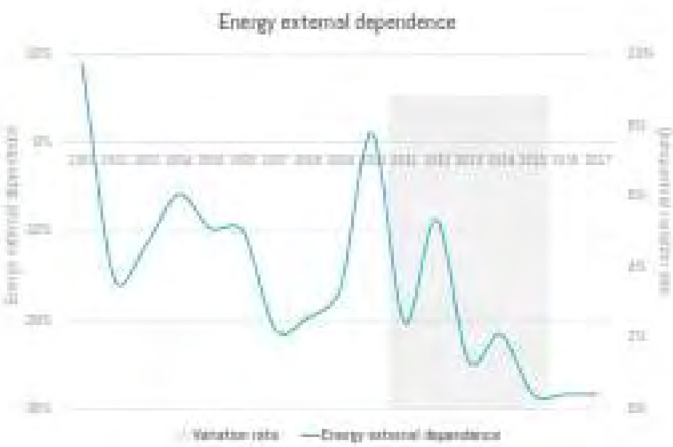
SURINAME



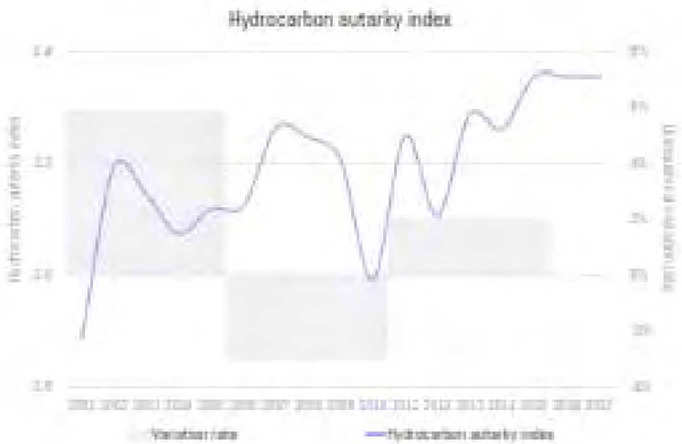
Energy supply per capita
Variation Rate
Total Primary energy supply per capita
Total electricity supply per capita
Renewable sources supply per capita



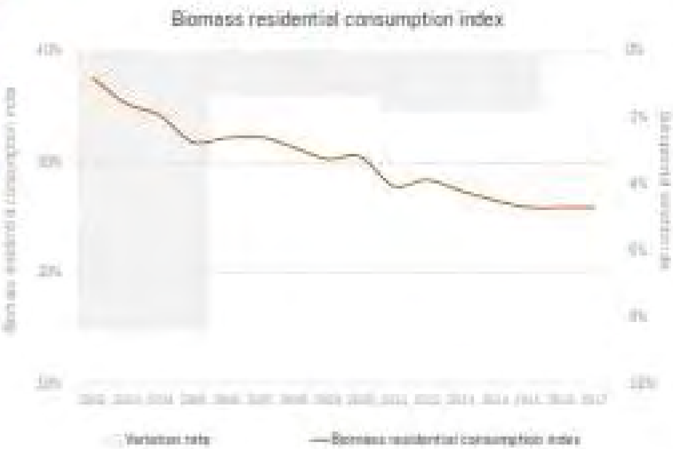
Energy supply per unit of GDP
Variation rate
Total primary energy supply / GDP (Primary intensity)
Electricity total supply / GDP
Renewable sources supply / GDP



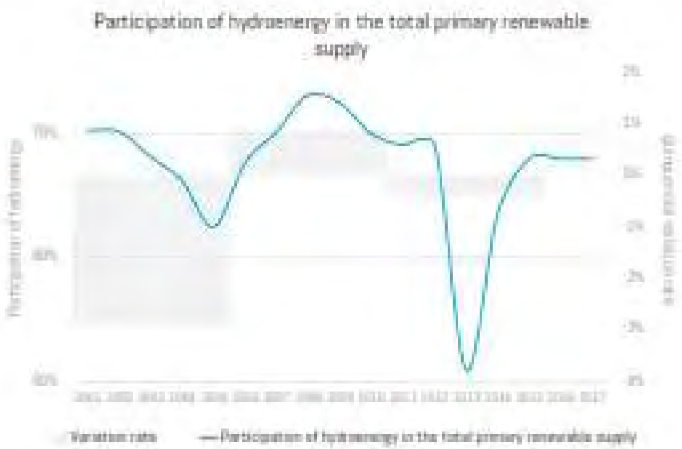
Energy external dependence
Variation rate
Energy external dependence



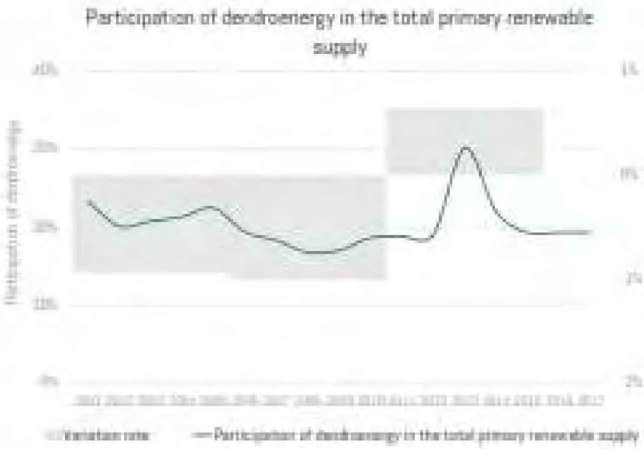
Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

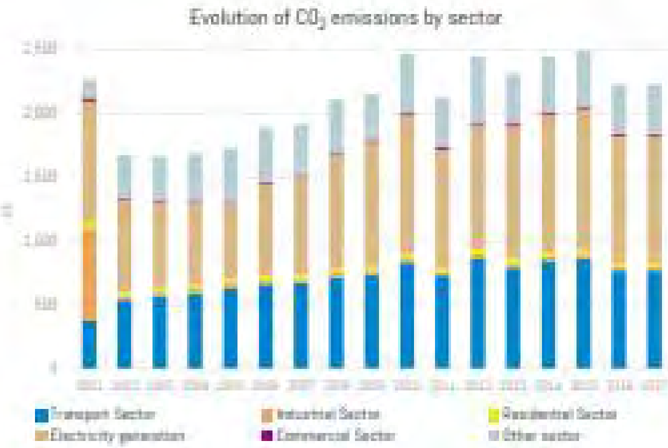


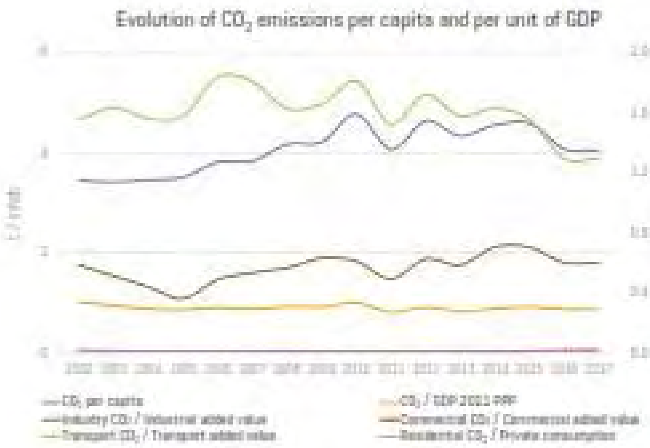
Biomass residential consumption index
Variation rate
Biomass residential consumption index

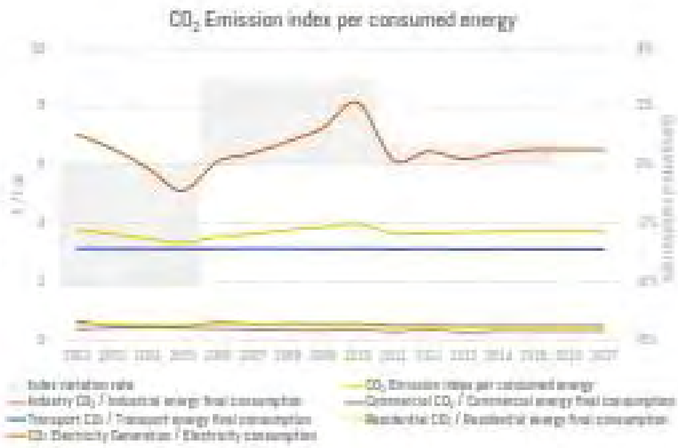


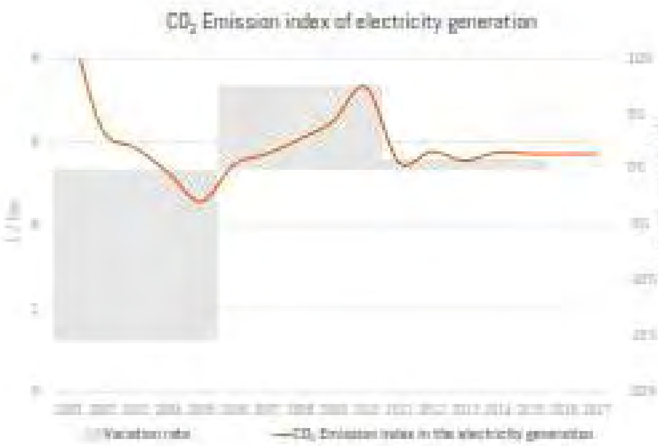
Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply

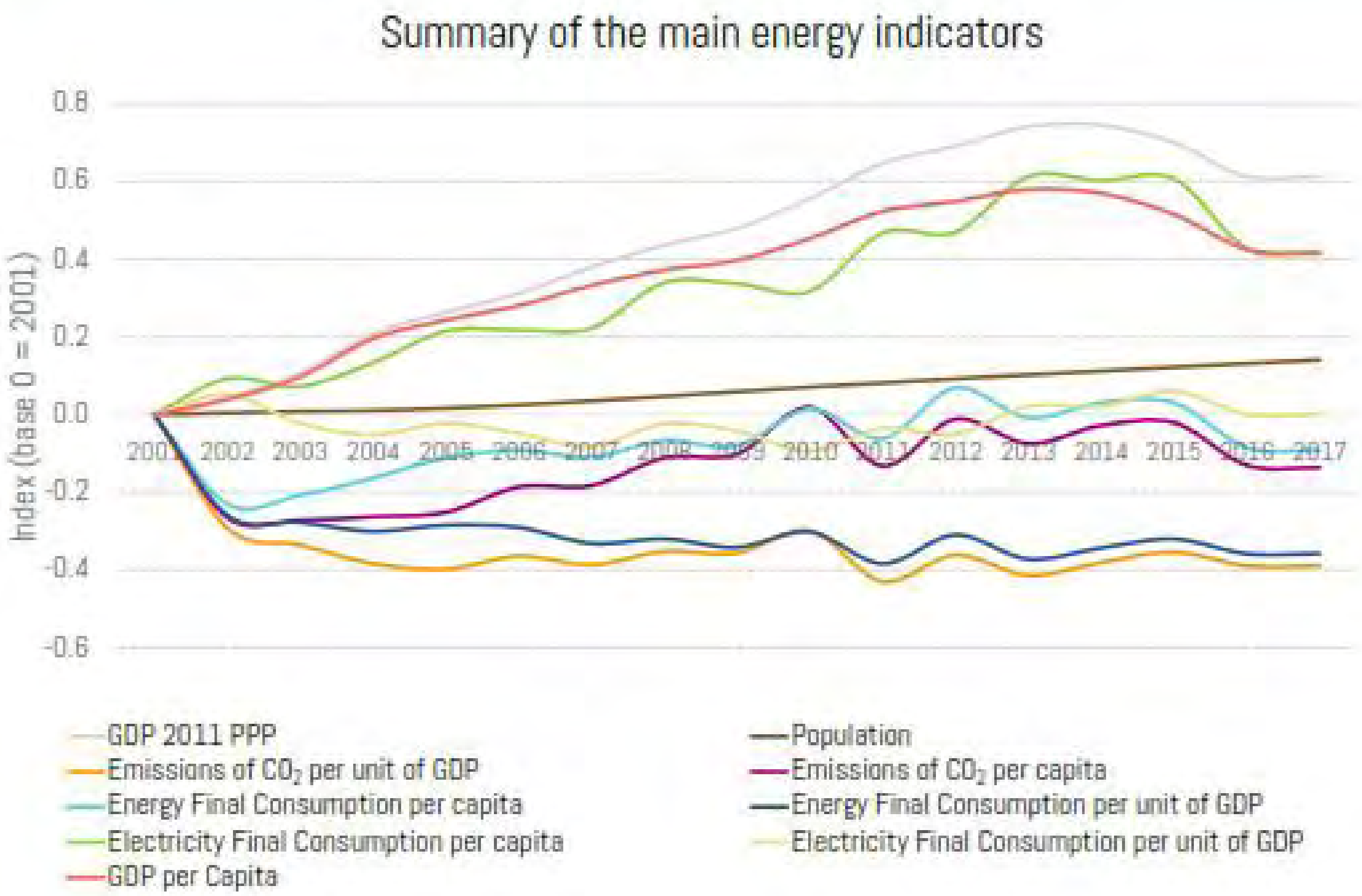

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2001)
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

TRINIDAD AND TOBAGO

General Information 2017

Population (thousand inhab.)	1,369
Area (km²)	5,130
Population Density (inhab./km²)	267
Urban Population (%)	8
GDP USD 2010 (MUSD)	20,959
GDP USD 2011 PPP (MUSD)	39,390
GDP per capita (thou. USD 2011 PPP/inhab.)	29

Energy Sector

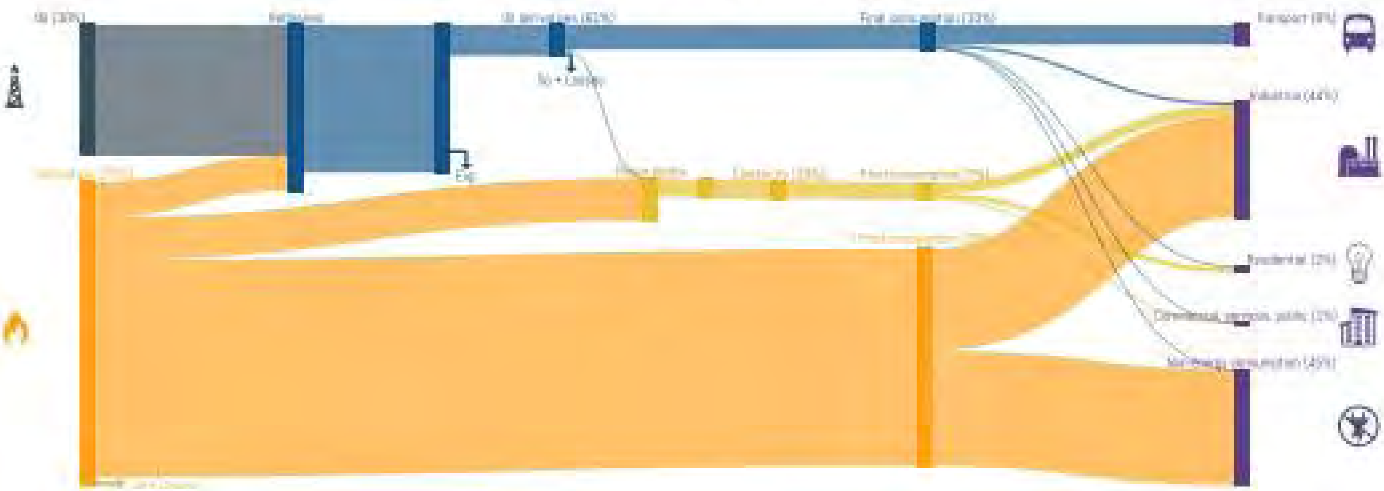
Final consumption in the Transport Sector	Mtoe 1.01
Final consumption in the Industrial Sector	Mtoe 5.94
Final consumption in the Residential Sector	Mtoe 0.33
Final consumption in the Commercial and Service Sector	Mtoe 0.10
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 5.97

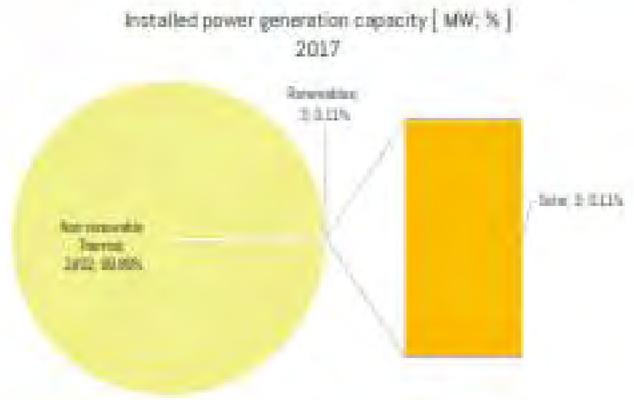
Oil reserves	Natural gas reserves	Coal reserves
Mbbl 393	Gm³ 260	Mt 0

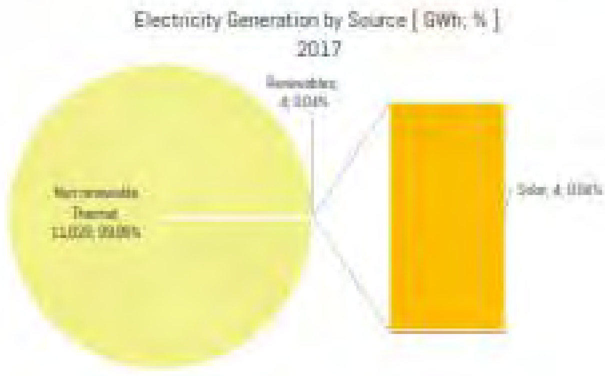
Note: Supply and demand data for 2017 estimated by OLADE.

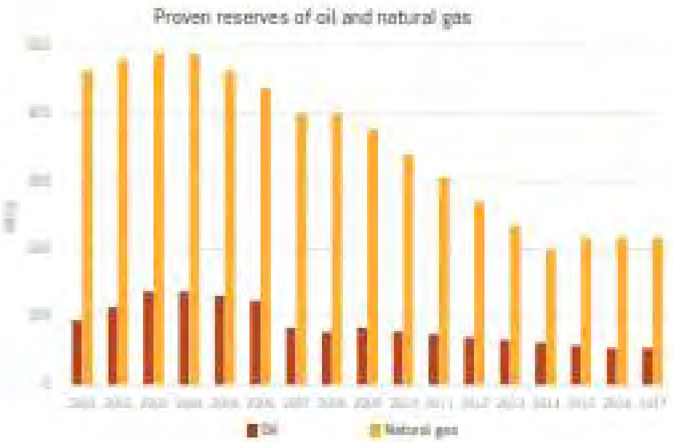
Electricity consumption per capita	Final energy consumption per capita	Electrification rate	Total energy supply	Total energy production	Total energy imports	Total energy exports	Total final energy consumption	Refining capacity	Installed power generation capacity	Primary energy intensity and final energy intensity
kWh/inhab.	toe/inhab.	%	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	kbbl/day	GW	koe/USD 2011 PPP
7,610	9.75	99.00	16.21	32.43	4.49	19.36	13.35	190	2.40	0.41 / 0.34

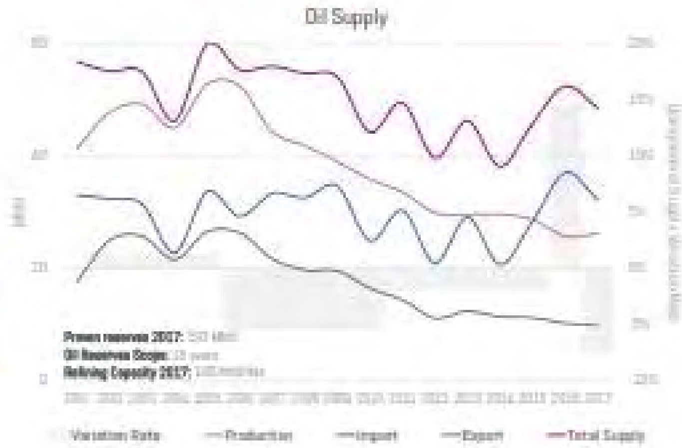
Summarized energy balance 2017



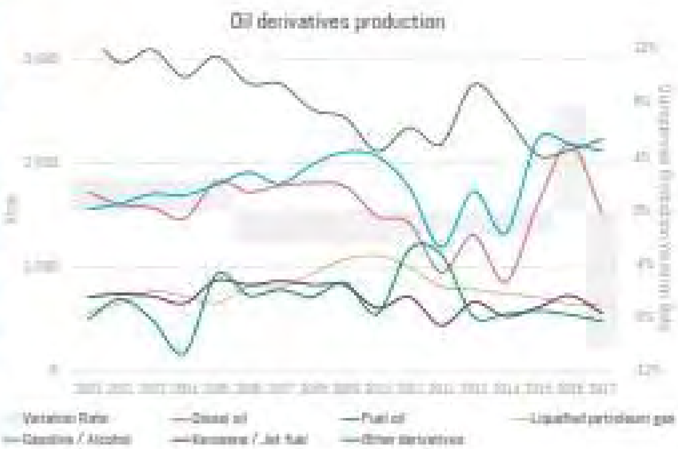


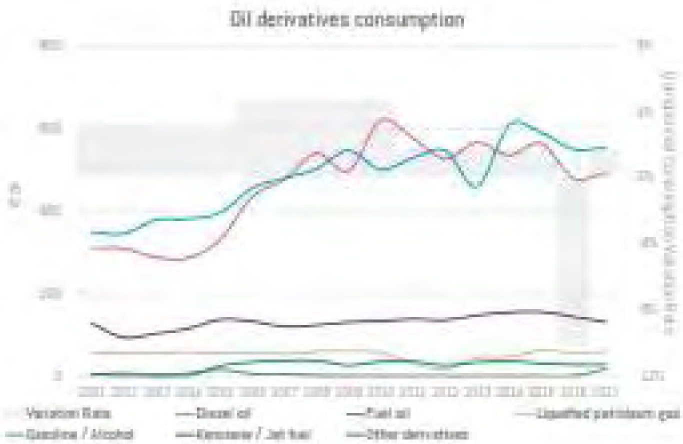


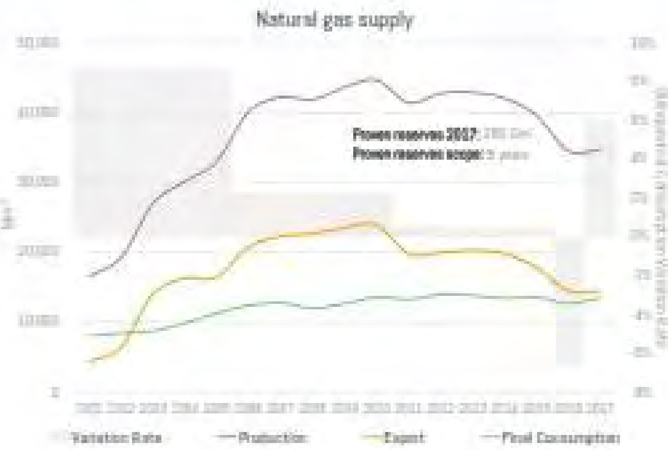


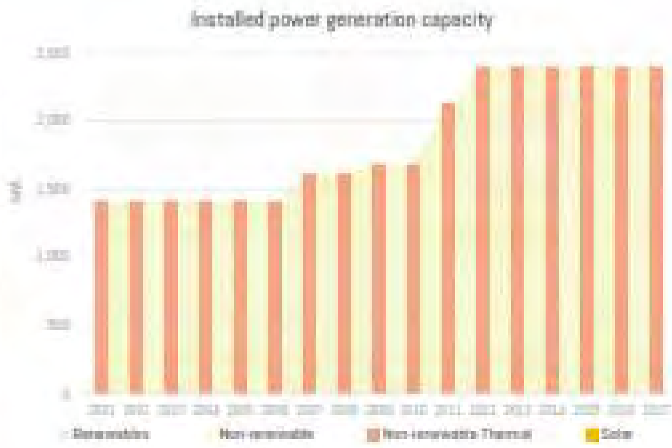


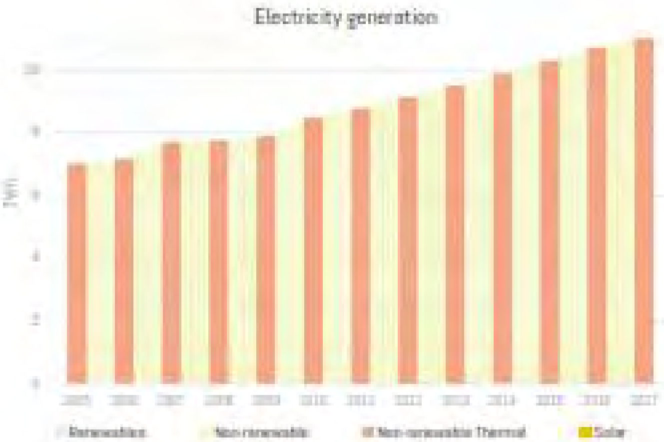
TRINIDAD AND TOBAGO

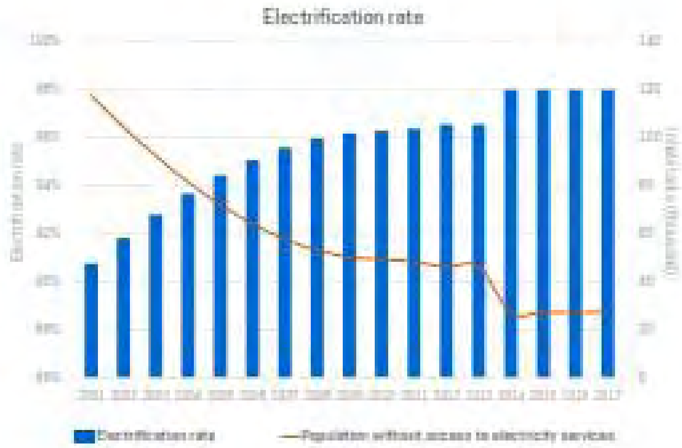


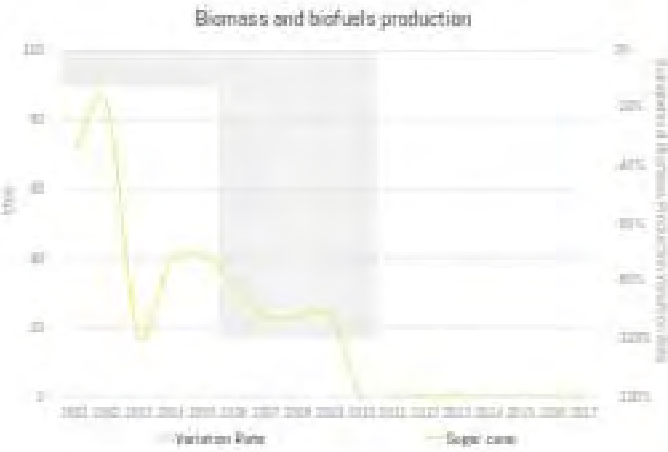


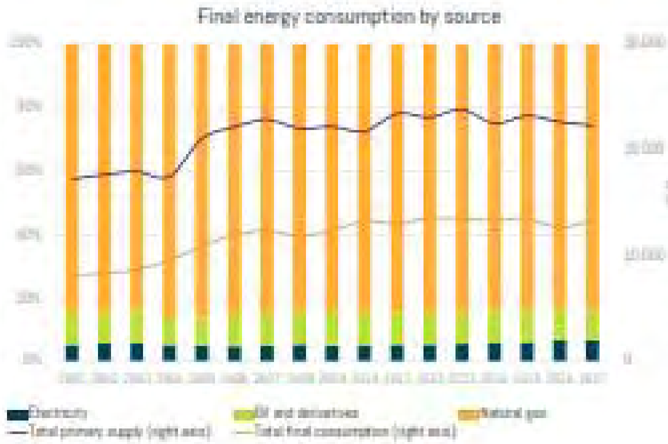




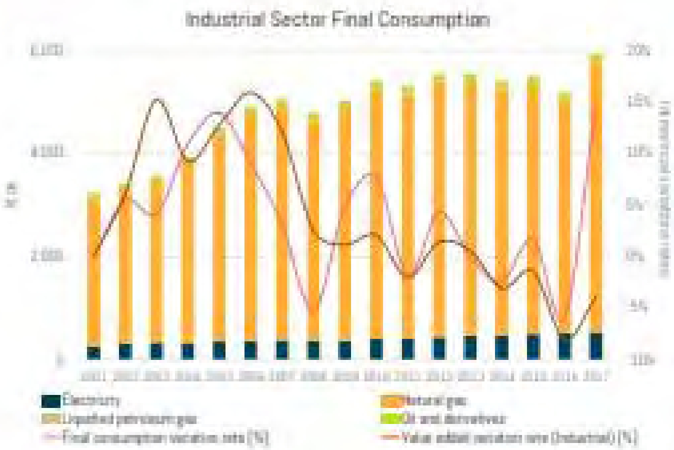


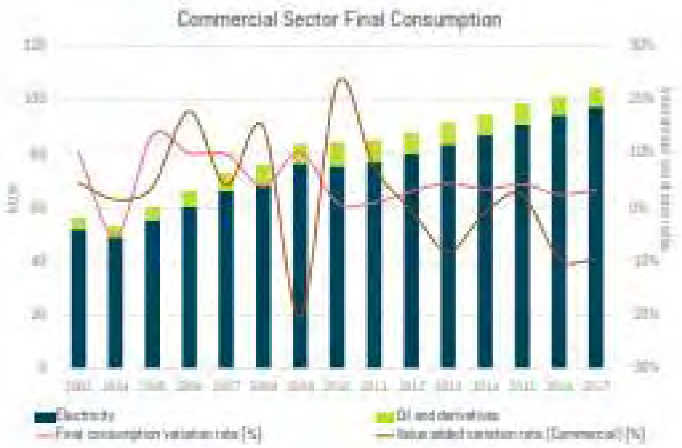






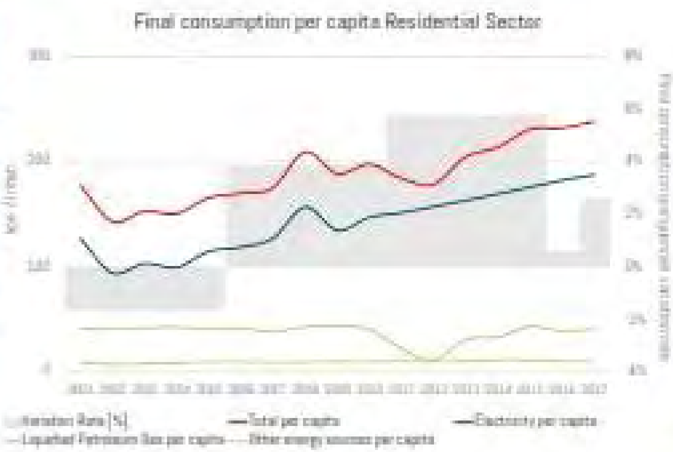
TRINIDAD AND TOBAGO

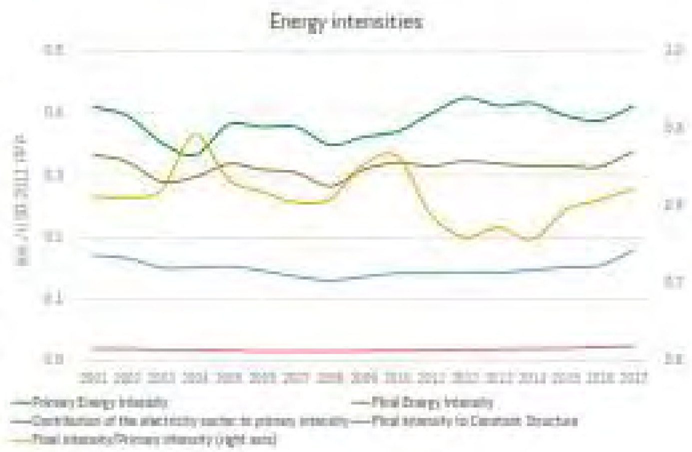

Industrial Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]
Value added variation rate (Industrial) [%]

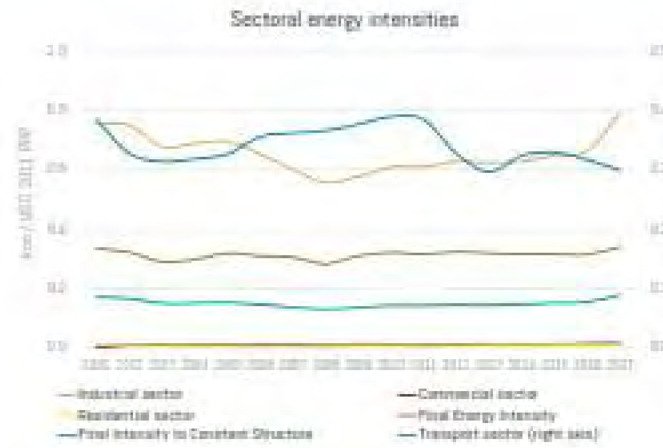

Commercial Sector Final Consumption
Electricity
Oil and derivatives
Final consumption variation rate [%]
Value added variation rate (Commercial) [%]

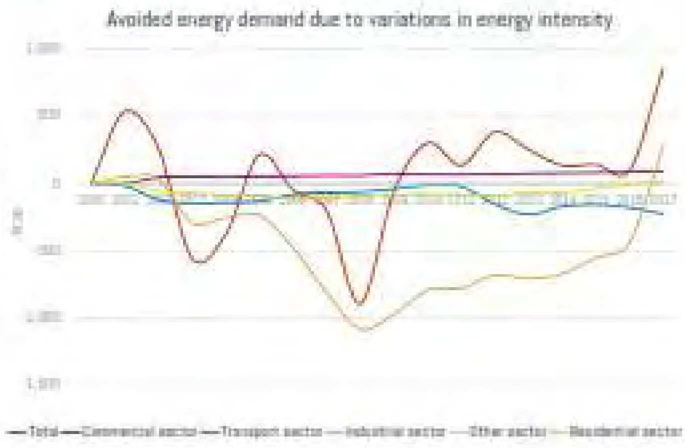

Transport Sector Final Consumption
Diesel oil
Gasoline / alcohol
Kerosene / jet fuel
Final consumption variation rate [%]
Value added variation rate (Transportation) [%]

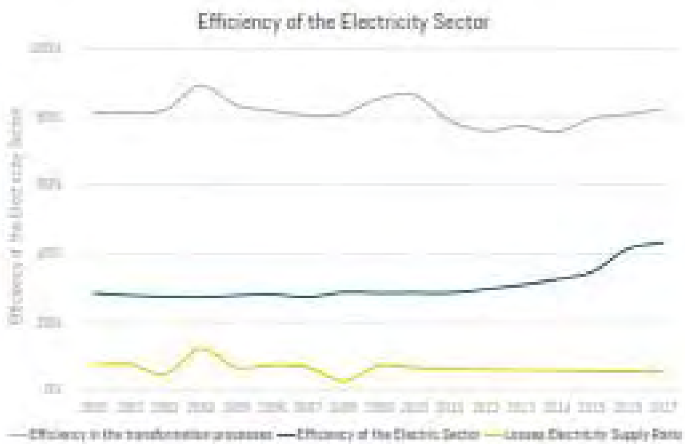

Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Oil and derivatives
Final consumption variation rate [%]
Household final consumption variation rate [%]

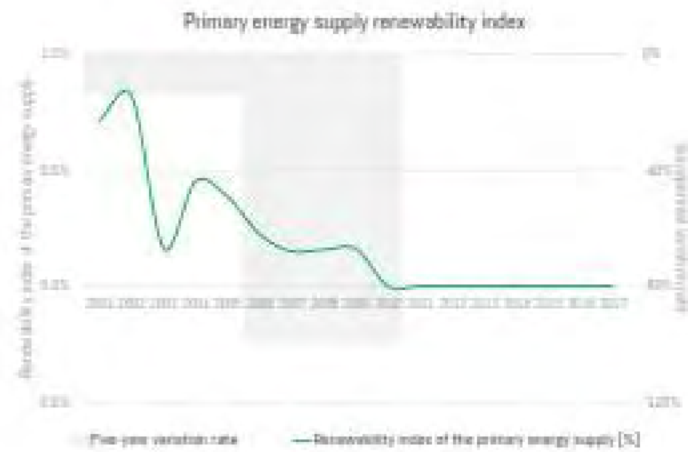

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Liquefied Petroleum Gas per capita
Other energy sources per capita

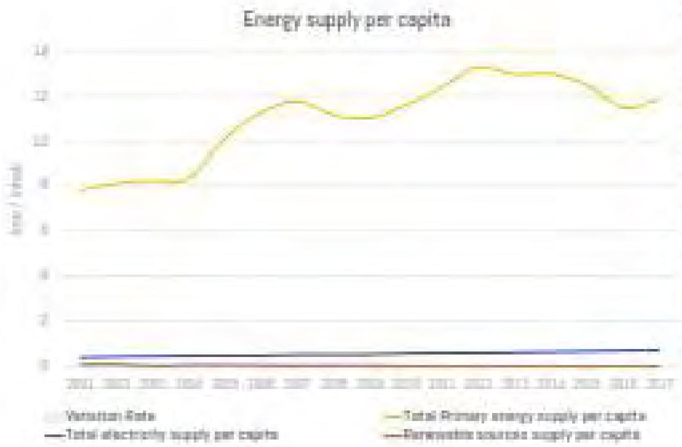

Energy intensities
Primary Energy Intensity
Final Energy Intensity
Contribution of the electricity sector to primary intensity
Final intensity to Constant Structure
Final intensity/Primary intensity (right axis)



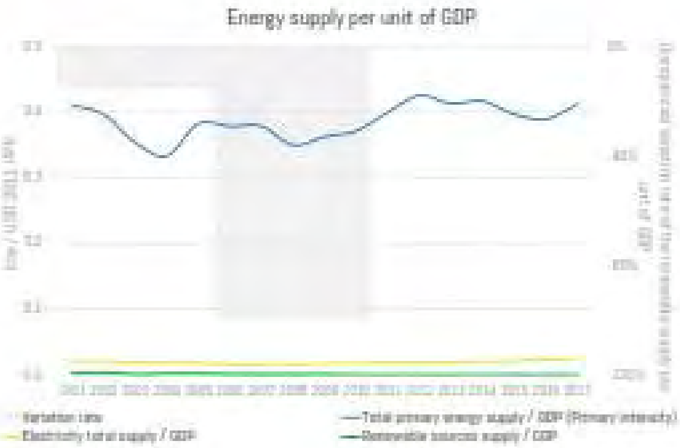


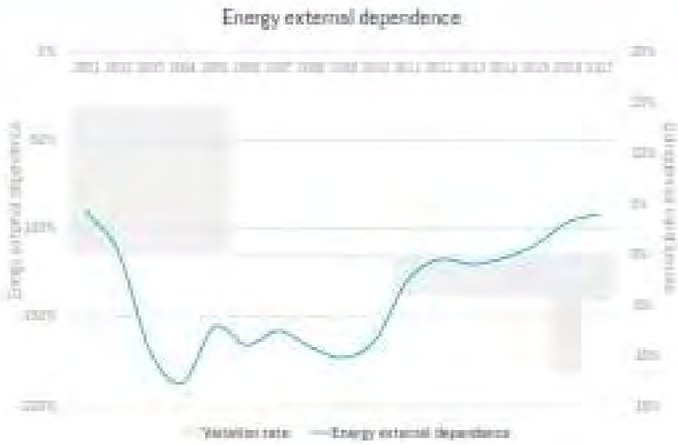


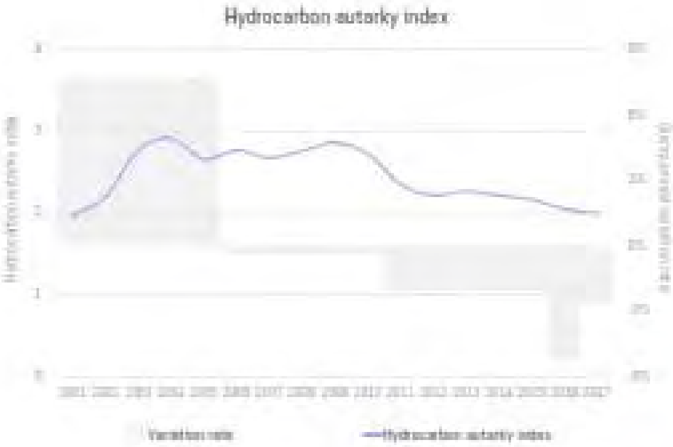


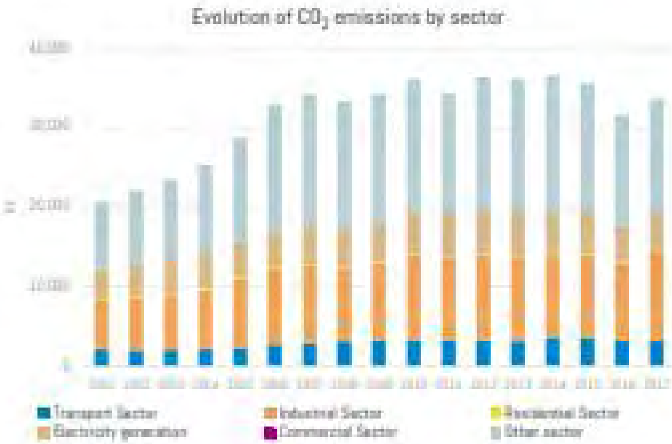


TRINIDAD AND TOBAGO

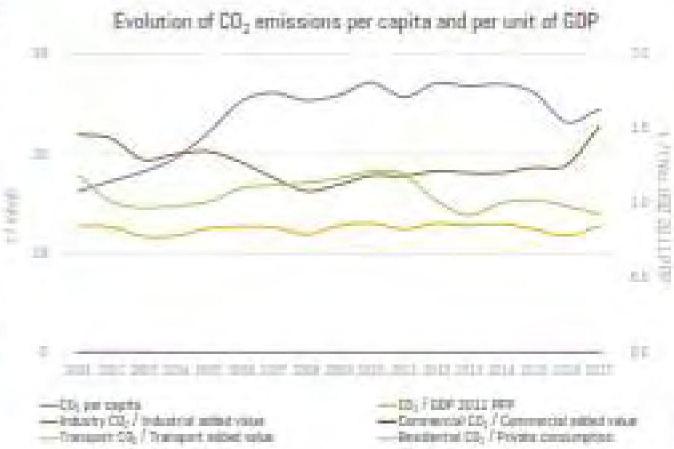


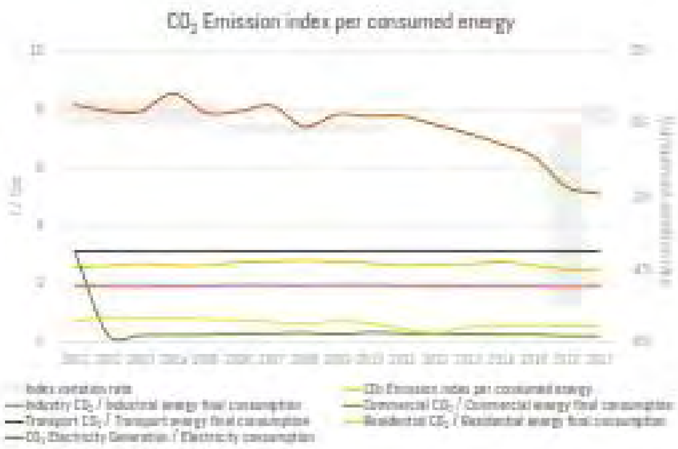


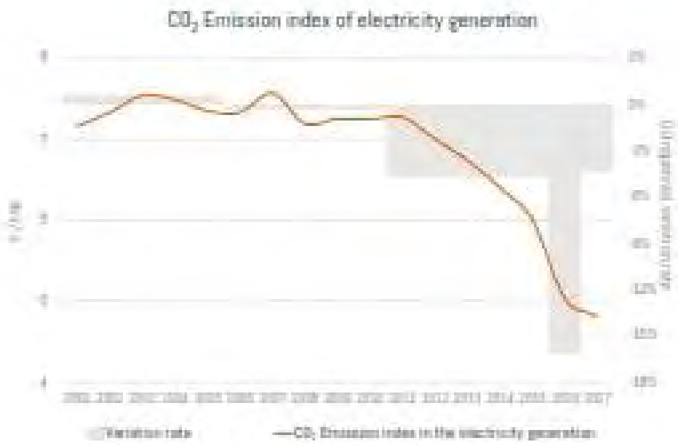




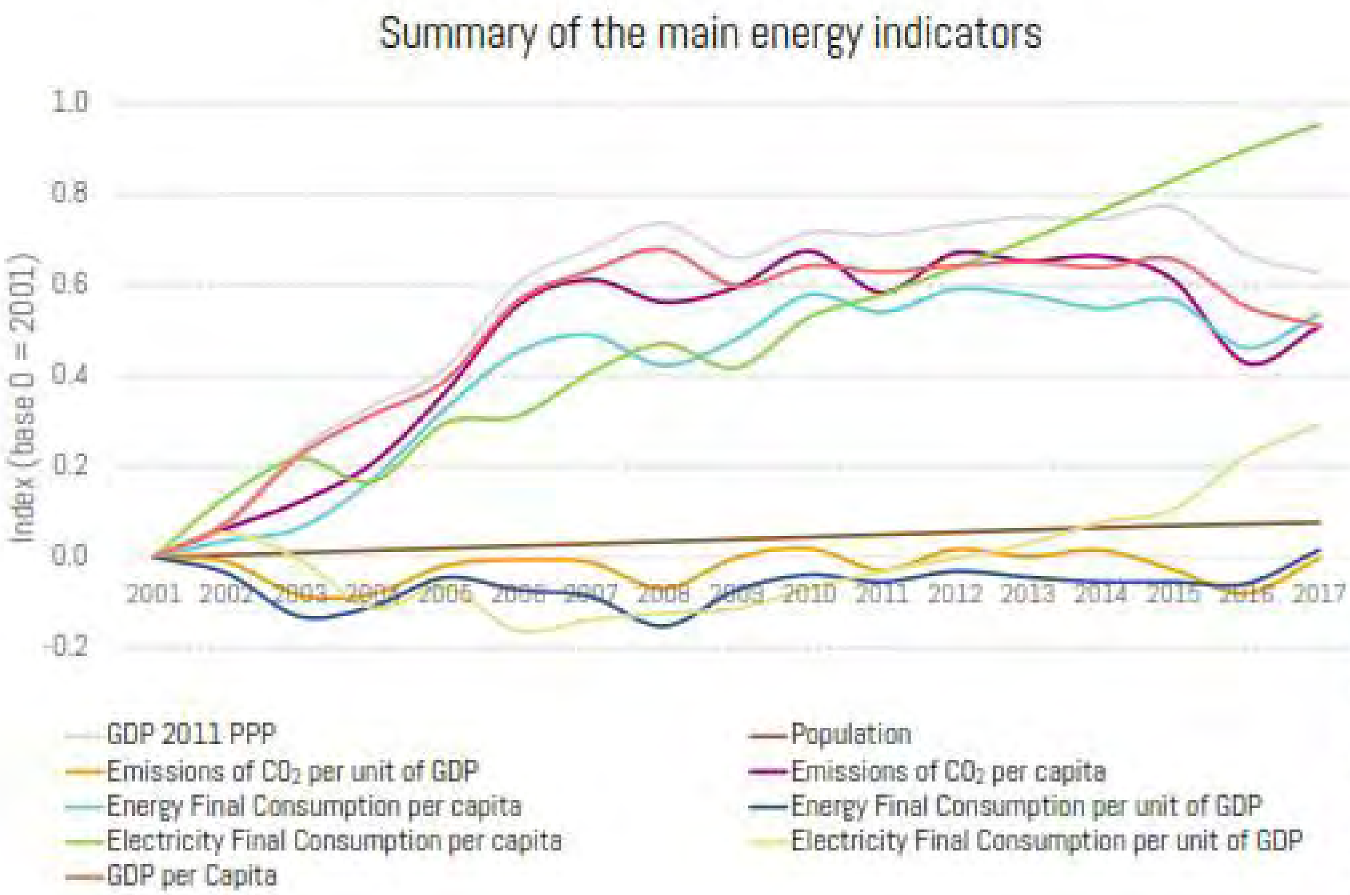
TRINIDAD AND TOBAGO







CO2 Emission index of electricity generation
Variation rate
CO2 Emission index in the electricity generation



Summary of the main energy indicators
Index (base 0 = 2001)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

URUGUAY

General Information 2017

Population (thousand inhab.)	3,493
Area (km²)	176,215
Population Density (inhab./km²)	20
Urban Population (%)	95
GDP USD 2010 (MUSD)	49,649
GDP USD 2011 PPP (MUSD)	71,041
GDP per capita (thou. USD 2011 PPP/inhab.)	20

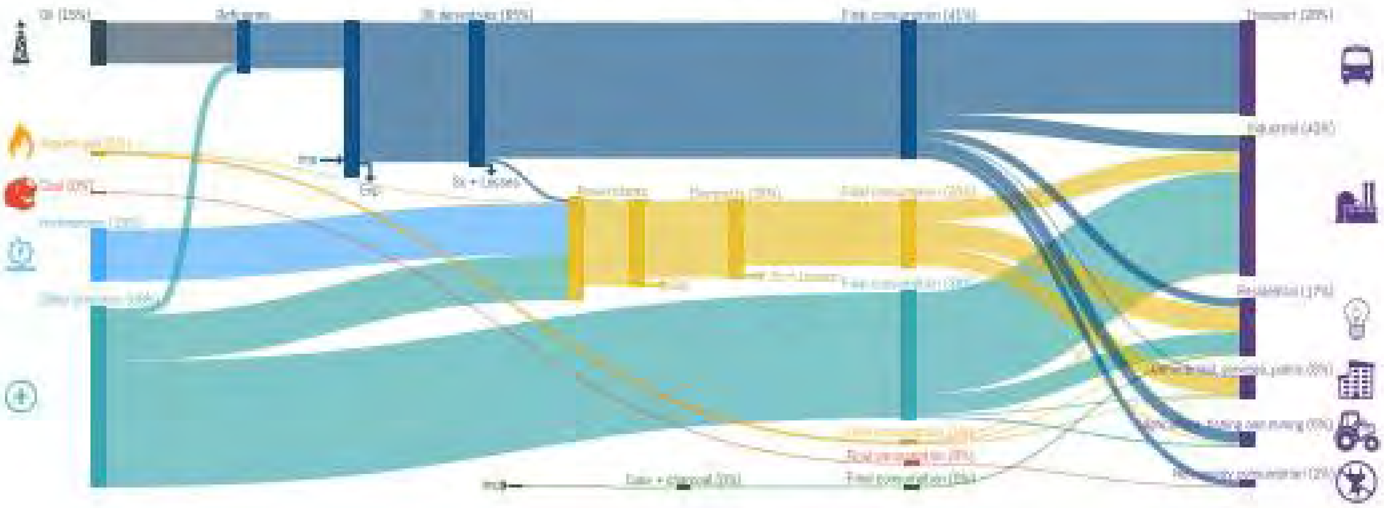
Energy Sector

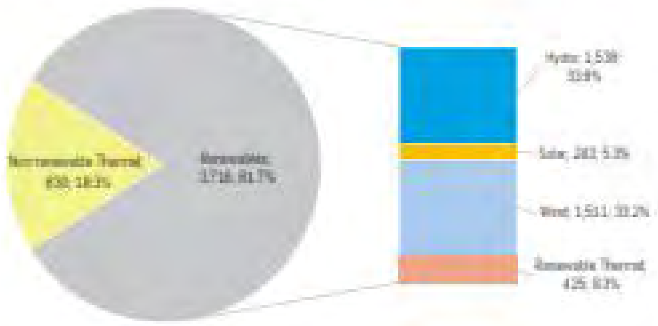
Final consumption in the Transport Sector	Mtoe 1.31
Final consumption in the Industrial Sector	Mtoe 1.99
Final consumption in the Residential Sector	Mtoe 0.81
Final consumption in the Commercial and Service Sector	Mtoe 0.30
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	Mtoe 0.33

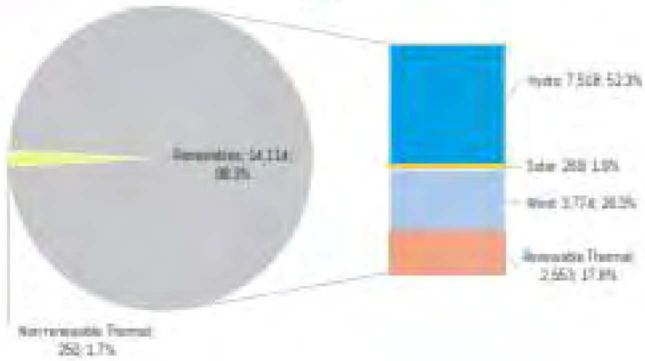
[1] Exports include international bunker.
[2] Includes non-energy consumption

Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	3,110
Final energy consumption per capita	toe/inhab.	1.36
Electrification rate	%	99.77
Total energy supply	Mtoe	5.23
Total energy production	Mtoe	3.80
Total energy imports	Mtoe	2.14
Total energy exports	Mtoe	0.33 [1]
Total final energy consumption	Mtoe	4.74 [2]
Refining capacity	kbbl/day	50
Installed power generation capacity	GW	4.55
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.07 / 0.07

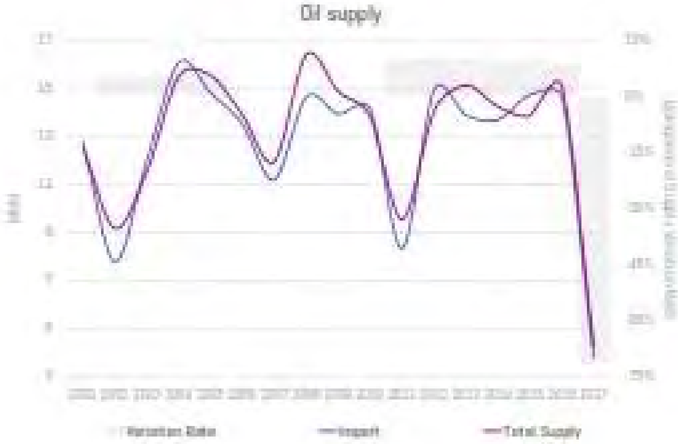
Summarized energy balance 2017







Between February 20 and September 30, 2017, a technical stop was executed for the maintenance of the La Teja Refinery Units.



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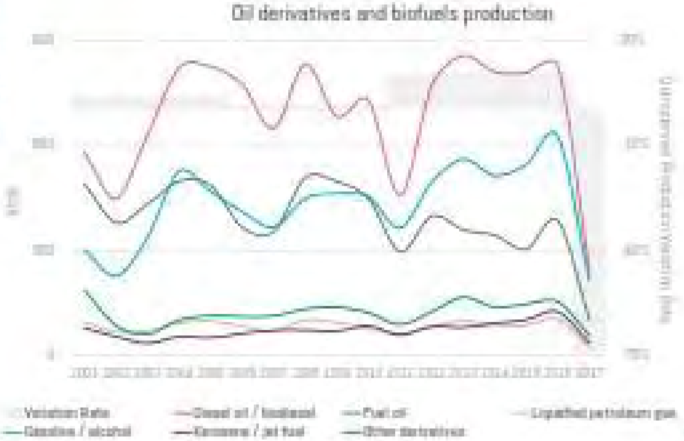
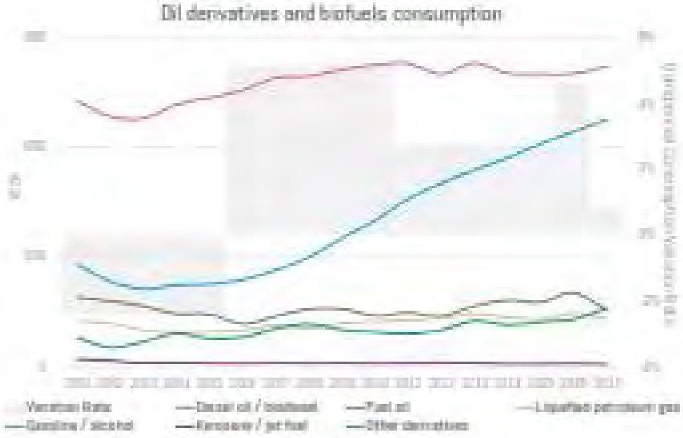
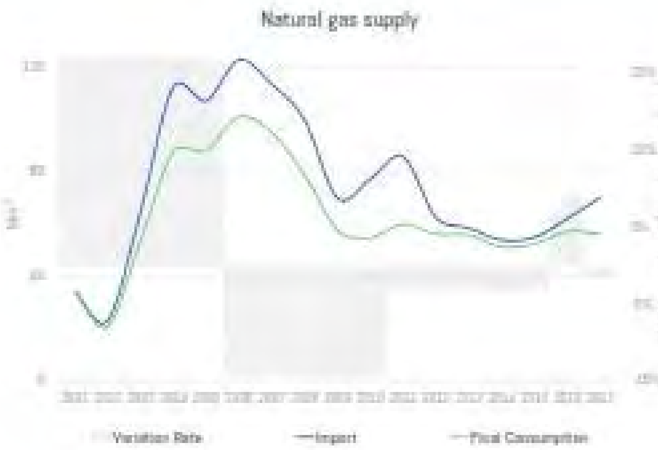
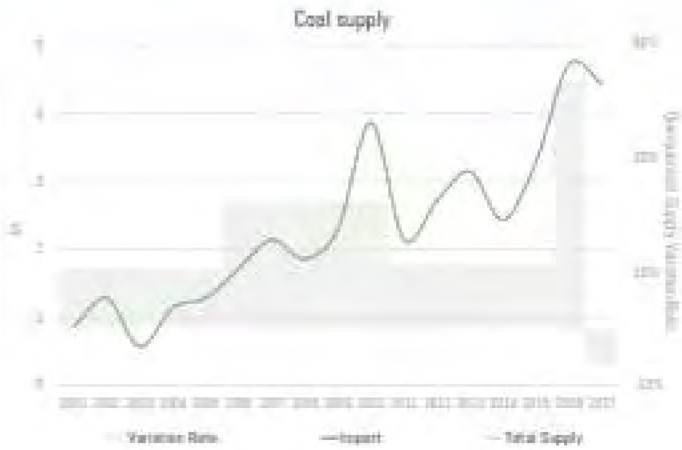
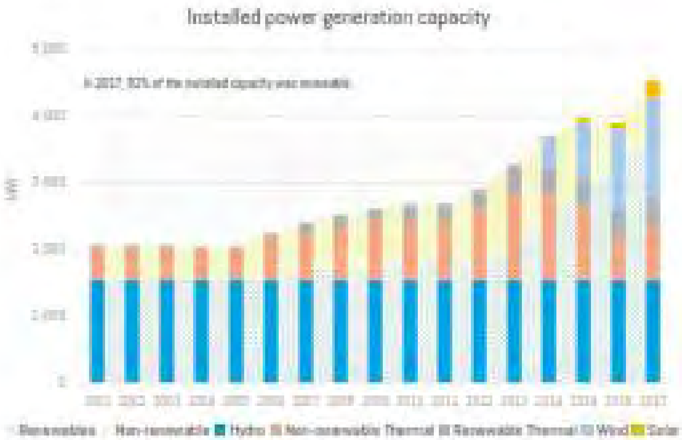
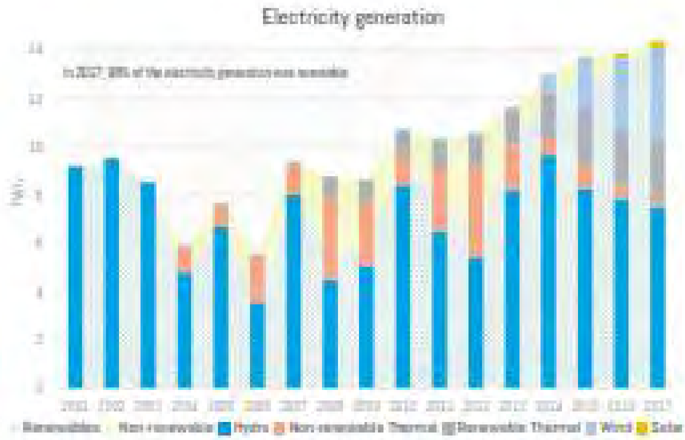


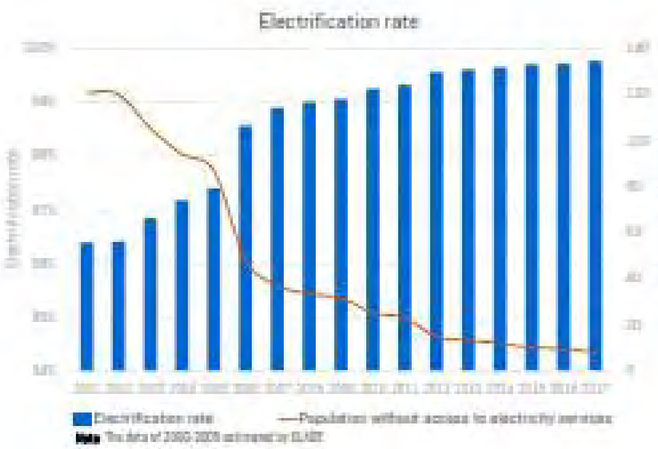


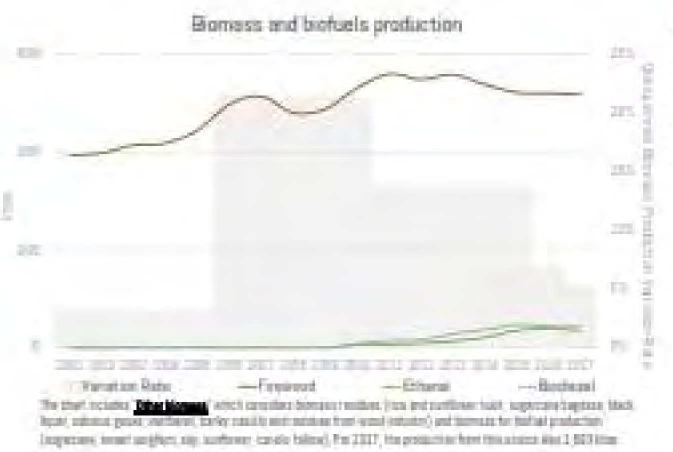

Natural gas supply
Variation Rate
Import
Final Consumption


Coal supply
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
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Firewood
Ethanol
Biodiesel

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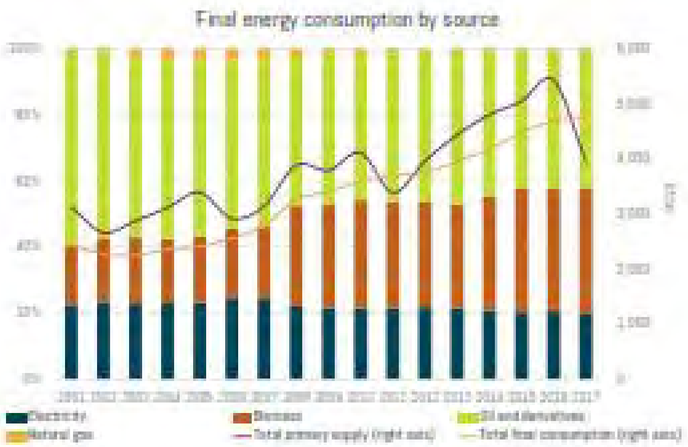
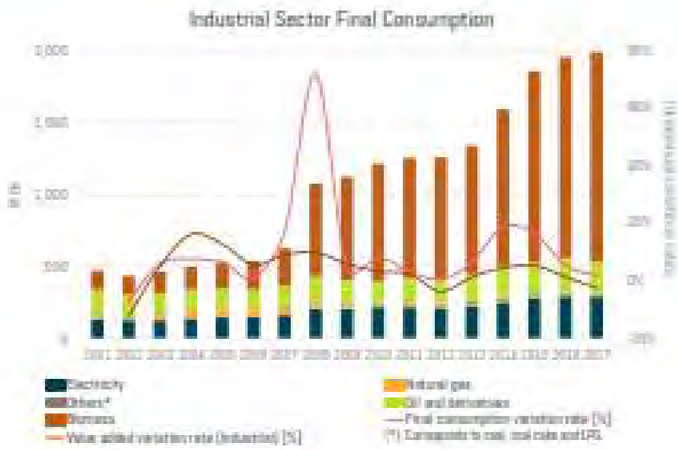
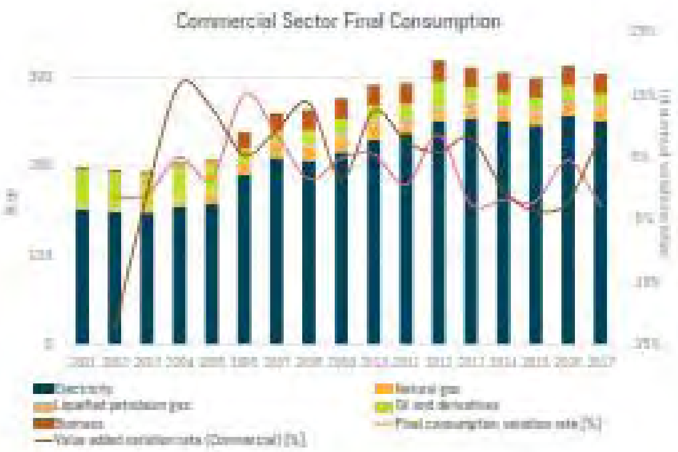
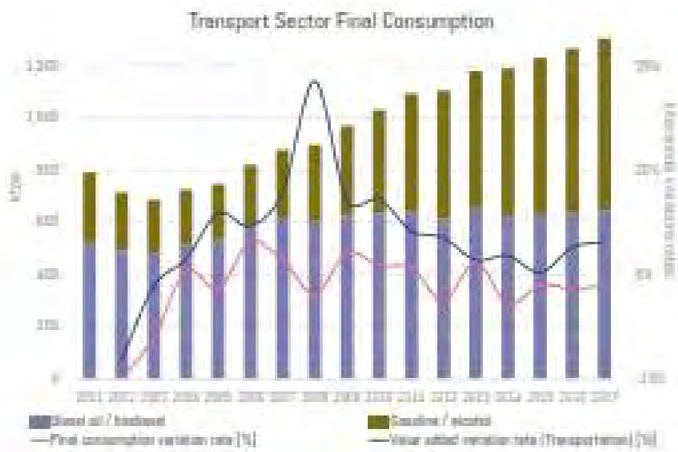

Final energy consumption by source
Electricity
Natural gas
Biomass
Total primary supply (right axis)
Oil and derivatives
Total final consumption (right axis)


Industrial Sector Final Consumption
Electricity
Others*
Biomass
Value added variation rate (Industrial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]
(*) Corresponds to coal, coal coke and LPG


Commercial Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Value added variation rate (Commercial) [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]


Transport Sector Final Consumption
Diesel oil / biodiesel
Final consumption variation rate [%]
Gasoline / alcohol
Value added variation rate (Transportation) [%]

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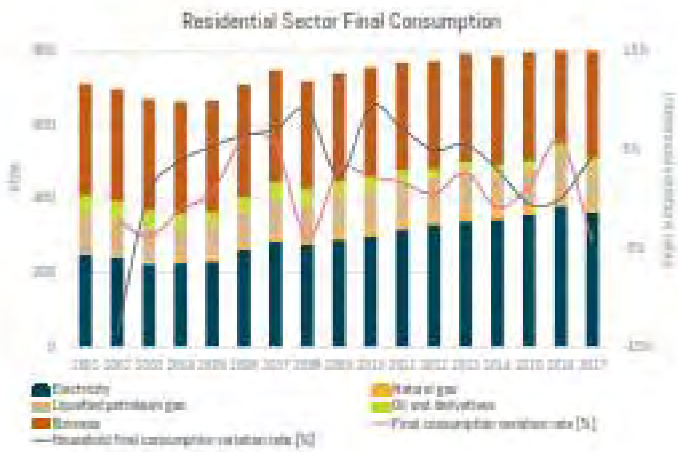
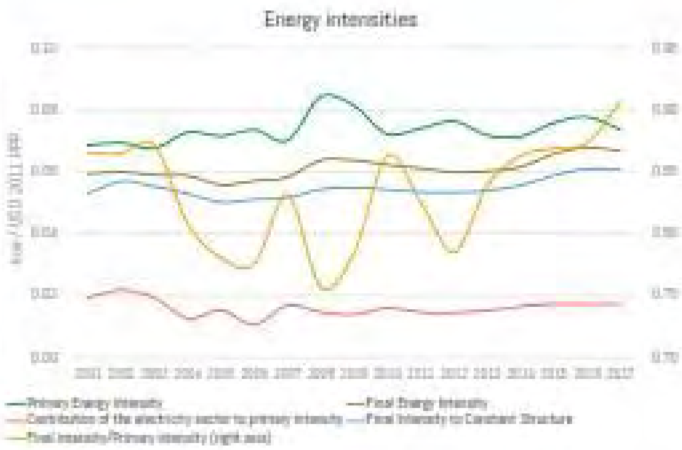
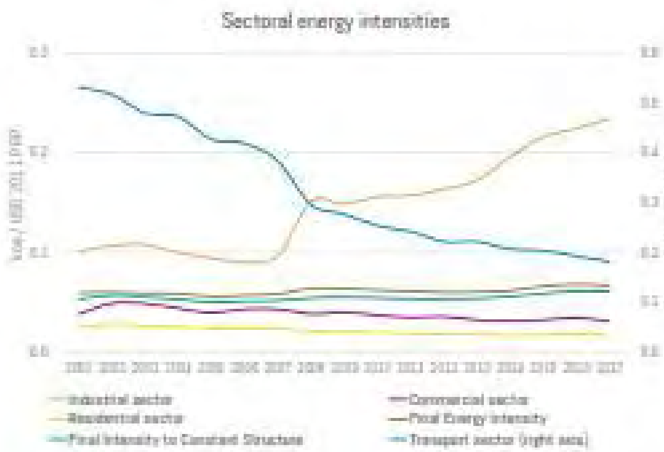
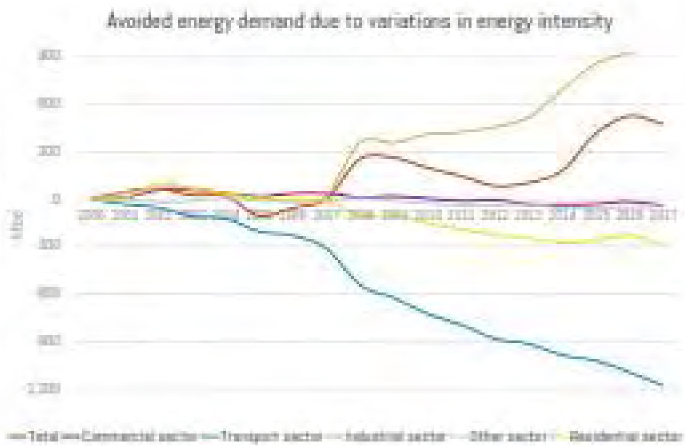
Other Sector Final Consumption*
Electricity
Diesel oil / biodiesel
Biomass
Value added variation rate (Other) [%]
Liquefied petroleum gas
Gasoline / alcohol
Final consumption variation rate [%]

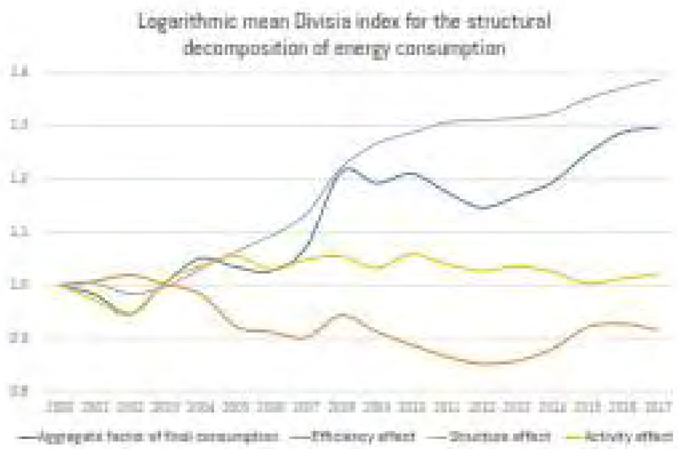

Residential Sector Final Consumption
Electricity
Liquefied petroleum gas
Biomass
Household final consumption variation rate [%]
Natural gas
Oil and derivatives
Final consumption variation rate [%]

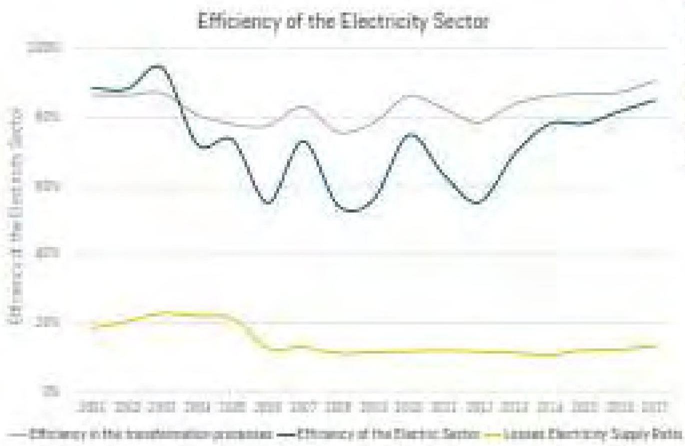

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied petroleum gas per capita
Biomass per capita
Other energy sources per capita


Energy intensities
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
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 Electric Sector
Losses Electricity Supply Ratio

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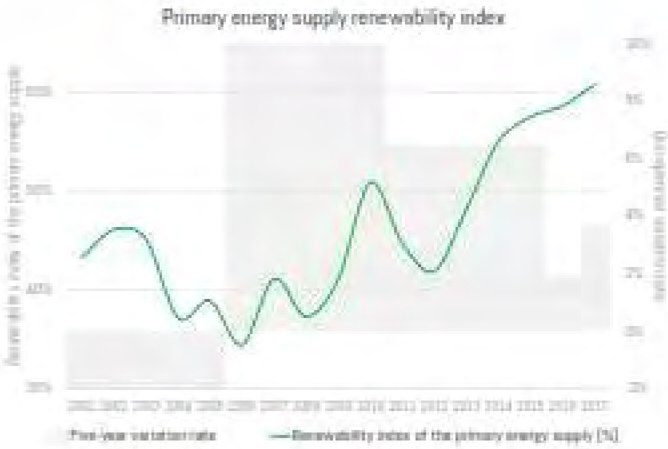

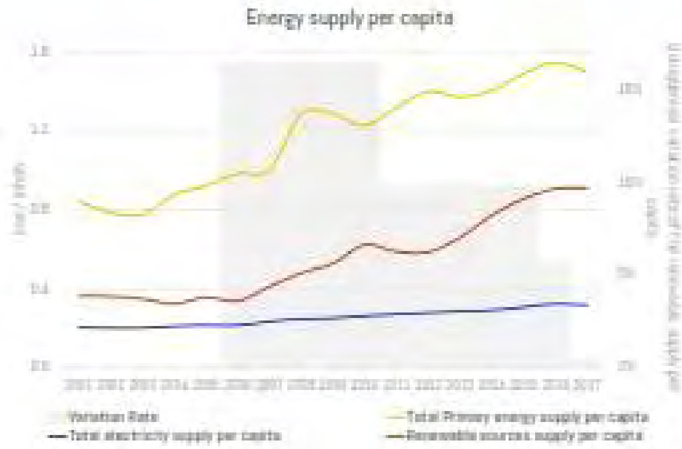

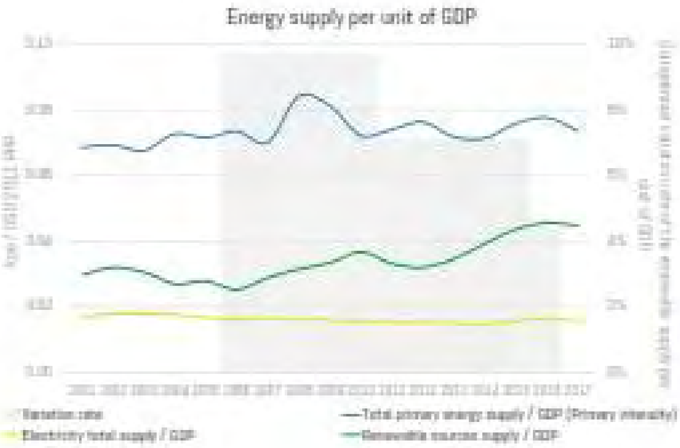

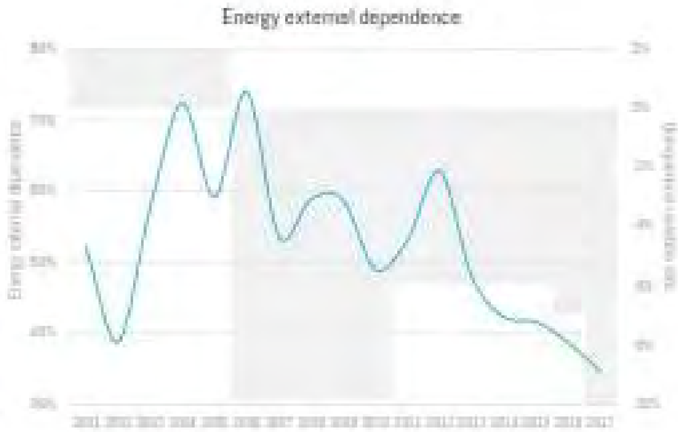

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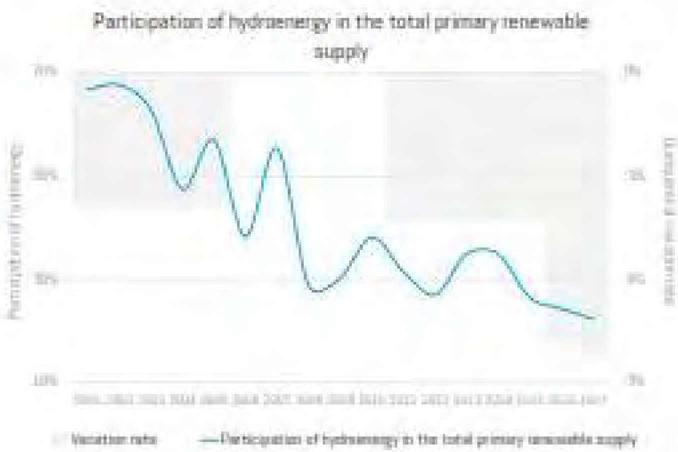
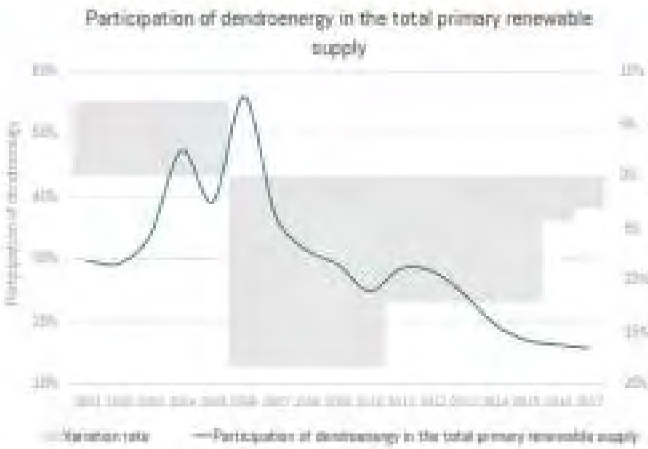
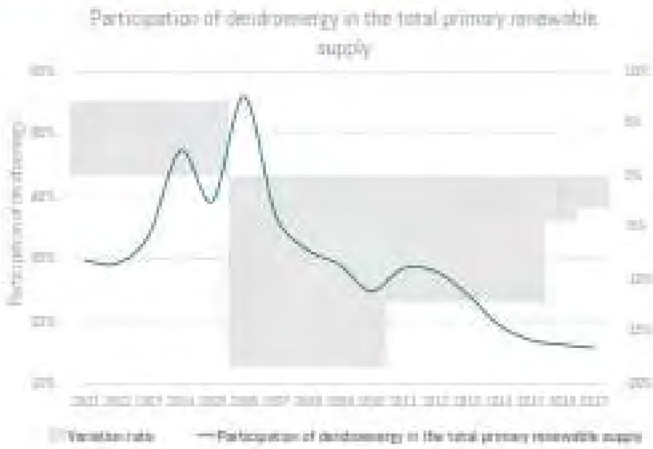
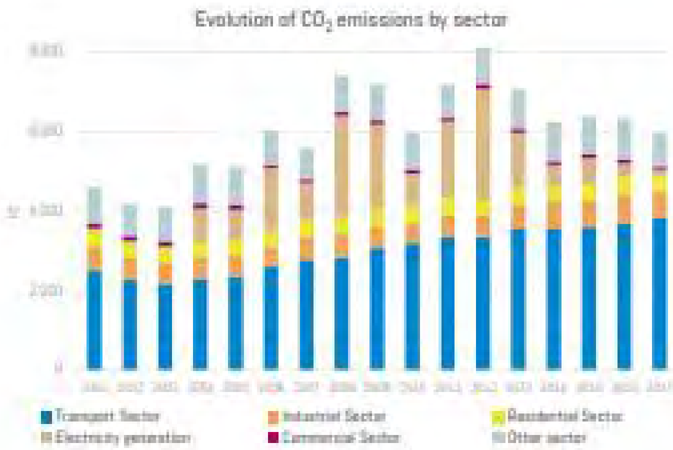
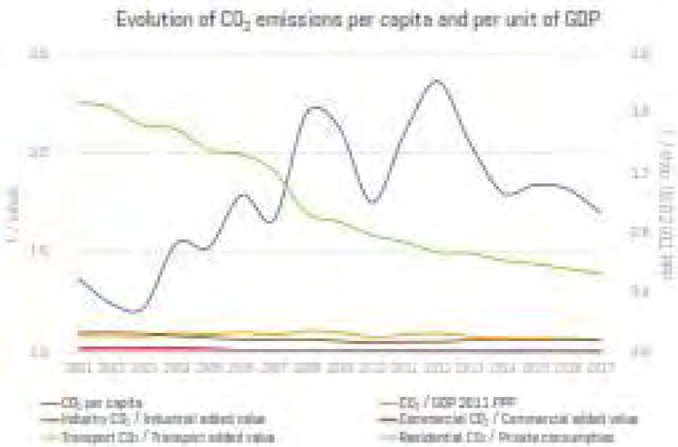
In 2017, electricity generated from solar photovoltaic sources exceeded electricity generated from fossil fuels.

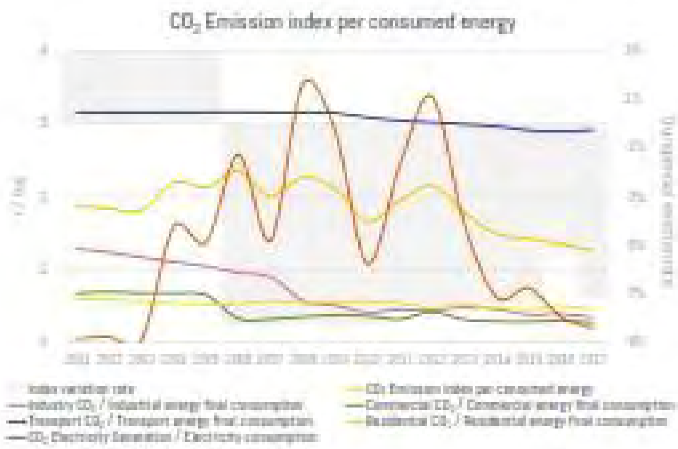


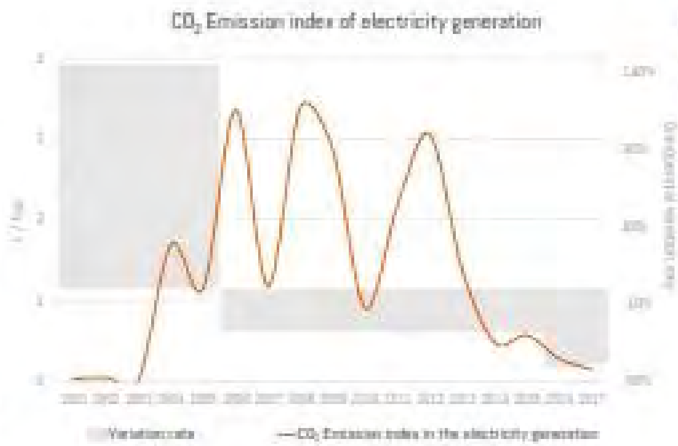

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply

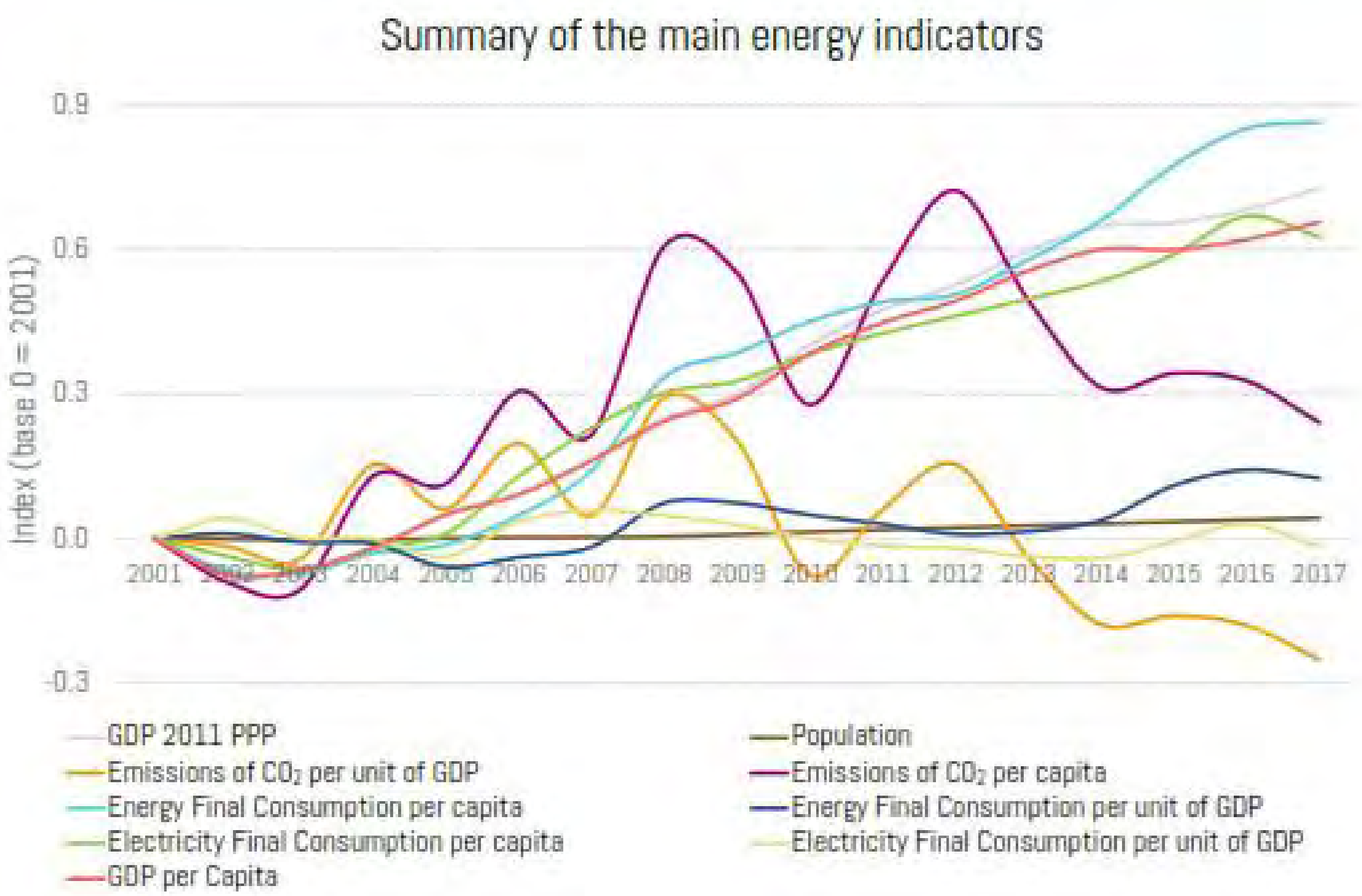

Participation of dendroenergy in the total primary renewable supply
Variation rate
Participation of dendroenergy in the total primary renewable supply


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


Evolution of CO_2 emissions per capita and per unit of GDP
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
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
Variation rate
CO_2 Emission index in the electricity generation


Summary of the main energy indicators
Index (base 0 = 2001)
0.9
0.6
0.3
0.0
-0.3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
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

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General Information 2016

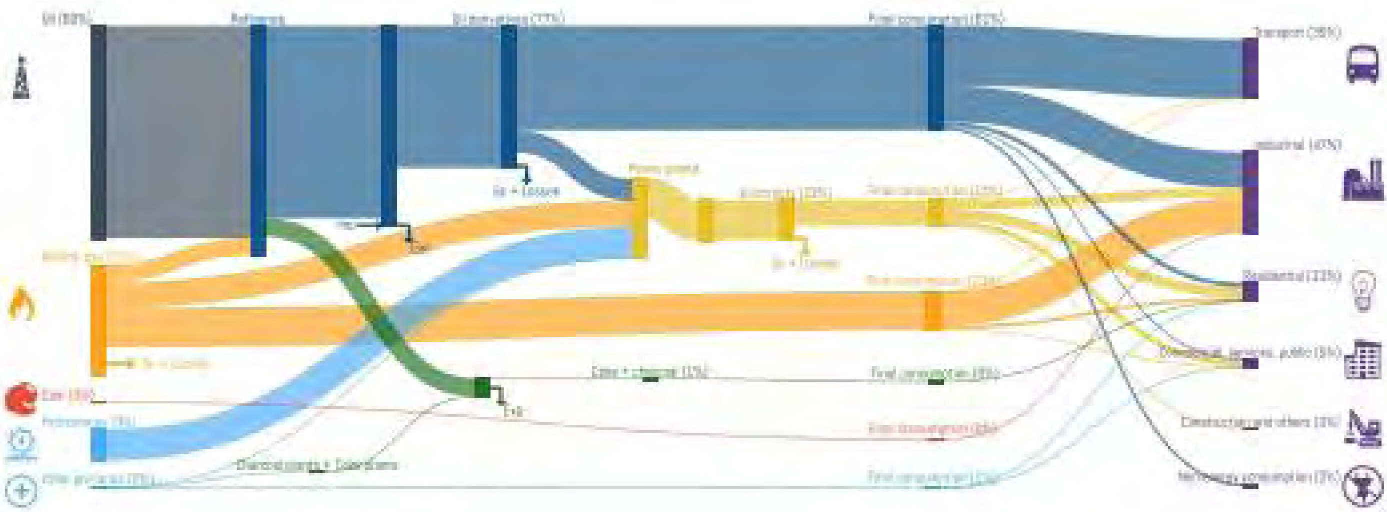
Population (thousand inhab.)	30,936
Area (km²)	912,050
Population Density (inhab./km²)	34
Urban Population (%)	89
GDP USD 2010 (MUSD)	218,679
GDP USD 2011 PPP (MUSD)	568,222
GDP per capita (thou. USD 2011 PPP/inhab.)	18

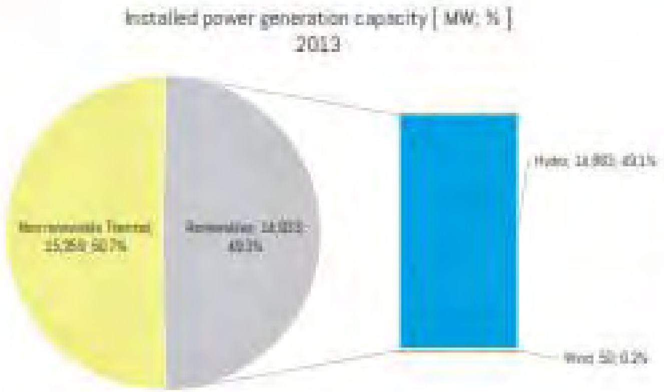
Energy Sector 2013

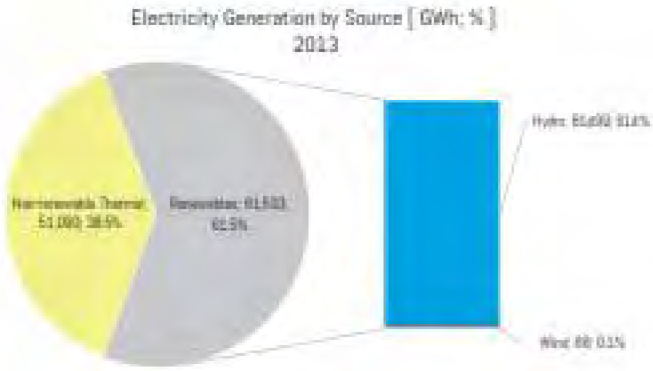
	Mtoe
Final consumption in the Transport Sector	16.72
Final consumption in the Industrial Sector	22.57
Final consumption in the Residential Sector	5.42
Final consumption in the Commercial and Service Sector	2.39
Final consumption in the Agriculture, Livestock, Fishing, Mining, Other and Non - Energy Consumption	0.85

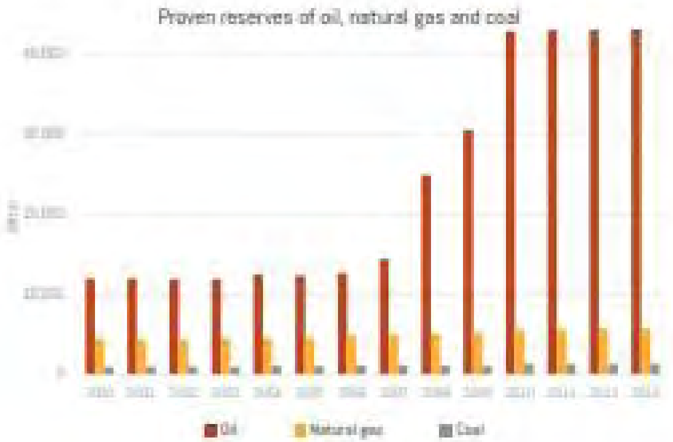
Indicator	Unit	Value
Electricity consumption per capita	kWh/inhab.	2,918
Final energy consumption per capita	toe/inhab.	1.61
Electrification rate	%	99.90
Total energy supply	Mtoe	79.43
Total energy production	Mtoe	191.17
Total energy imports	Mtoe	5.29
Total energy exports	Mtoe	123.82
Total final energy consumption	Mtoe	47.95
Refining capacity	kbbl/day	1,303
Installed power generation capacity	GW	30.29
Primary energy intensity and final energy intensity	koe/USD 2011 PPP	0.18 / 0.09

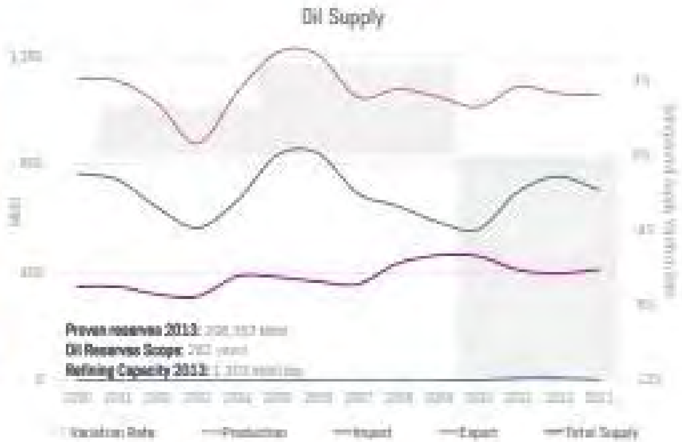
Summarized energy balance 2013




Installed power generation capacity [MW; %]
2013


Electricity Generation by Source [GWh; %]
2013


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


Oil Supply
Proven reserves 2013:
Oil Reserves Scope:
Refining Capacity 2013:

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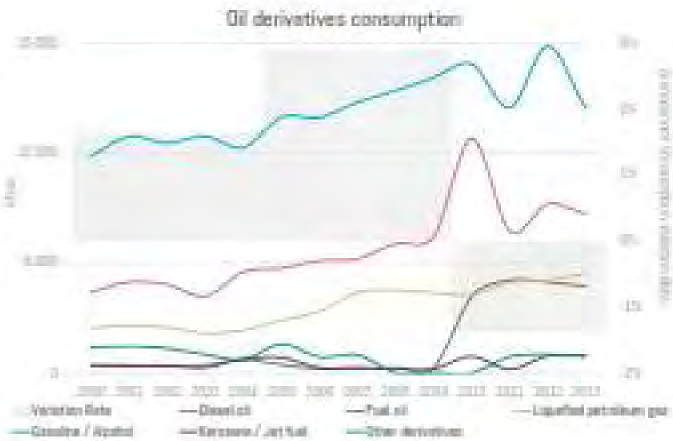
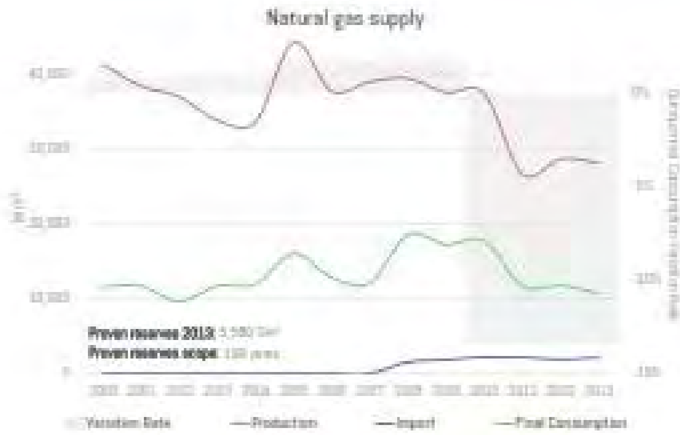
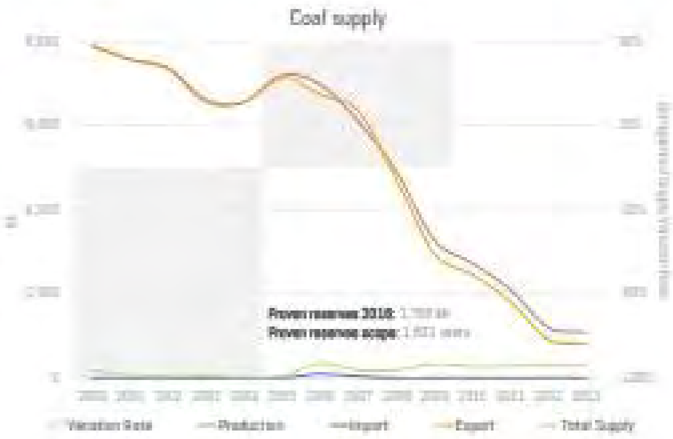
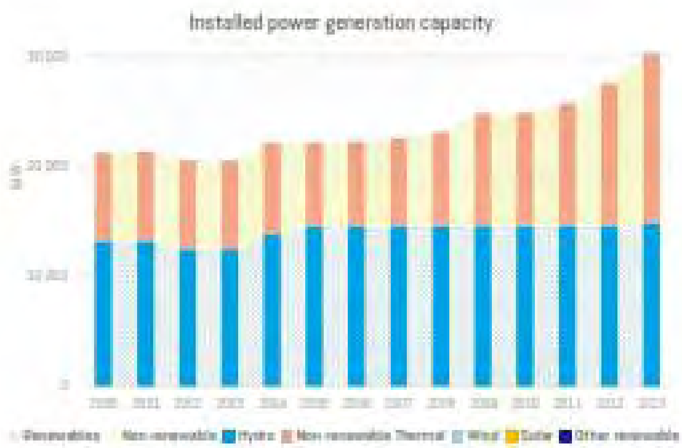
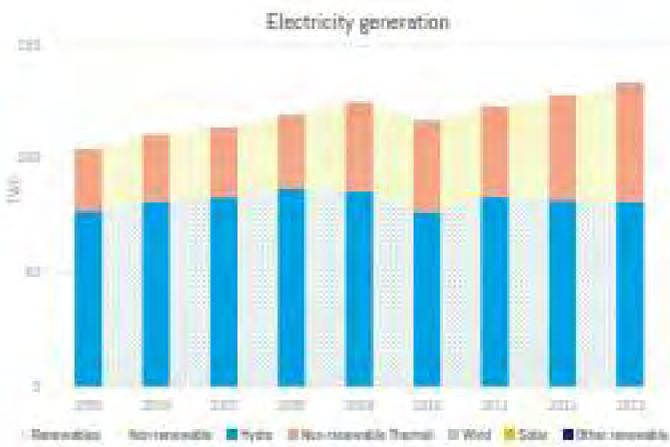
Oil derivatives production

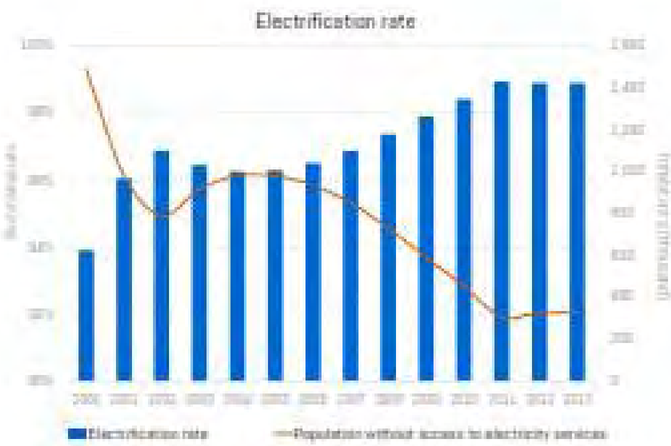

Oil derivatives consumption

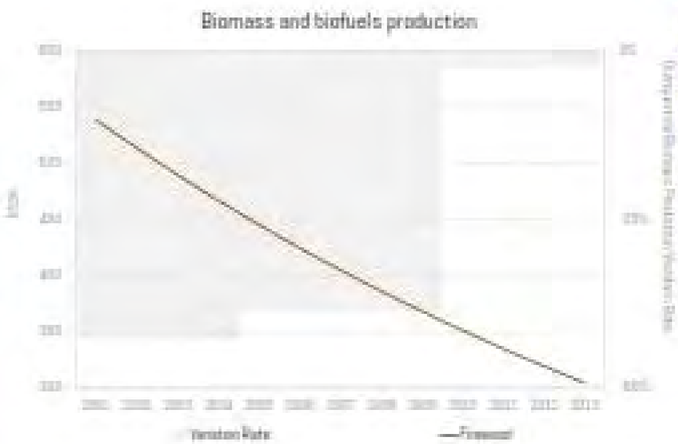

Natural gas supply
Proven reserves 2018:
Proven reserves scope:
Variation Rate
Production
Import
Final Consumption


Coal supply
Proven reserves 2018:
Proven reserves scope:
Variation Rate
Production
Import
Export
Total Supply


Installed power generation capacity
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Wind
Solar
Other renewable


Electricity generation
Renewables
Non-renewable
Hydro
Non-renewable Thermal
Wind
Solar
Other renewable


Electrification rate
Electrification rate
Population without access to electricity services


Biomass and biofuels production
Variation Rate
Firewood

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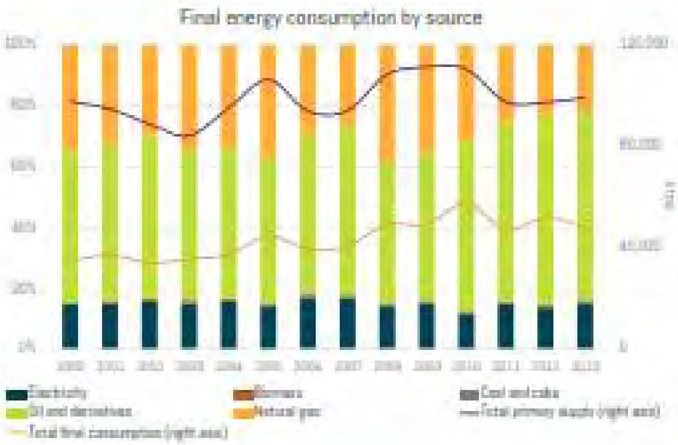
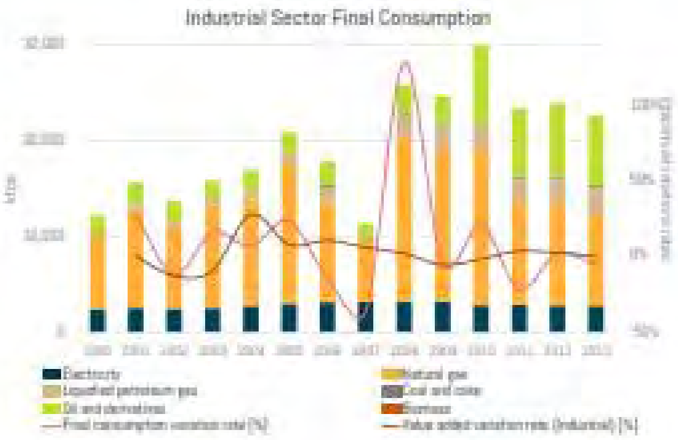
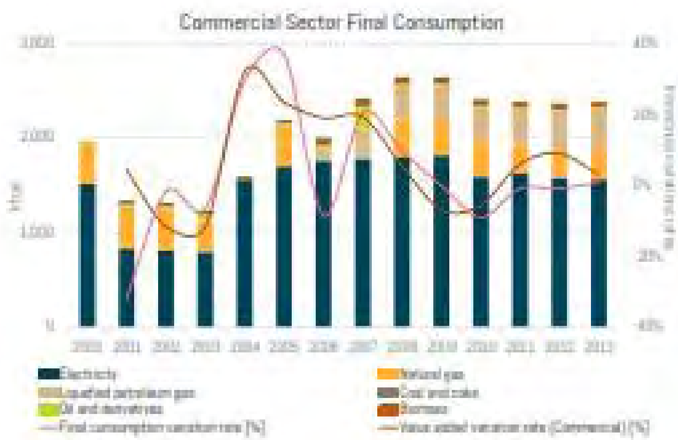
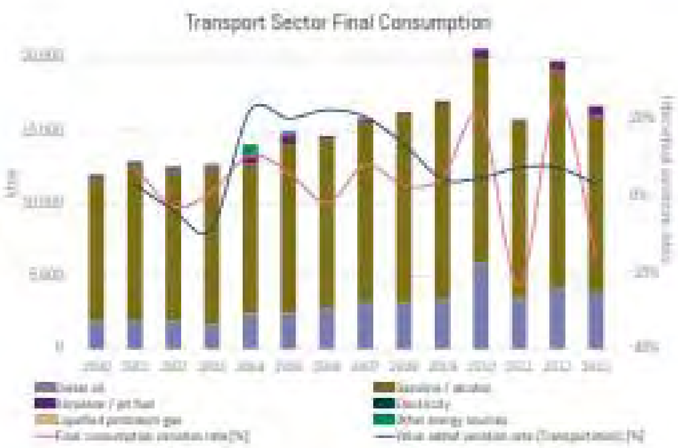

Final energy consumption by source
Electricity
Biomass
Coal and coke
Oil and derivatives
Natural gas
Total primary supply (right axis)
Total final consumption (right axis)


Industrial Sector Final Consumption
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
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
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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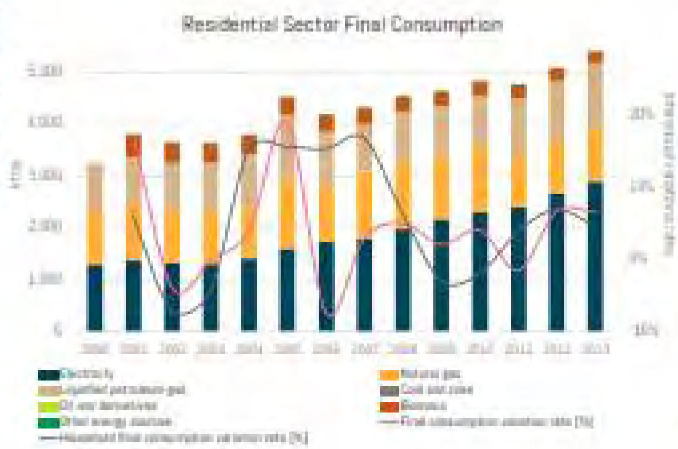
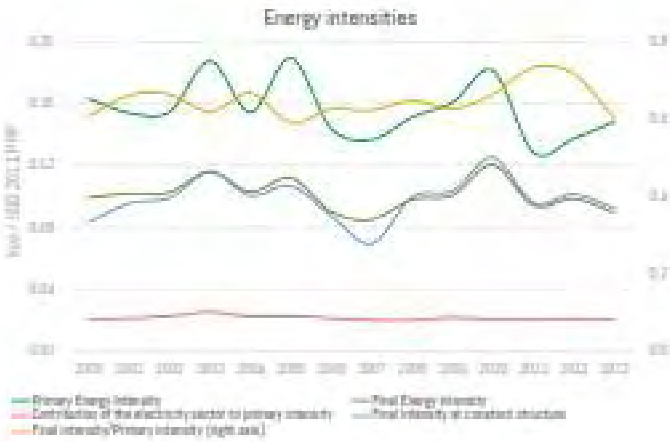
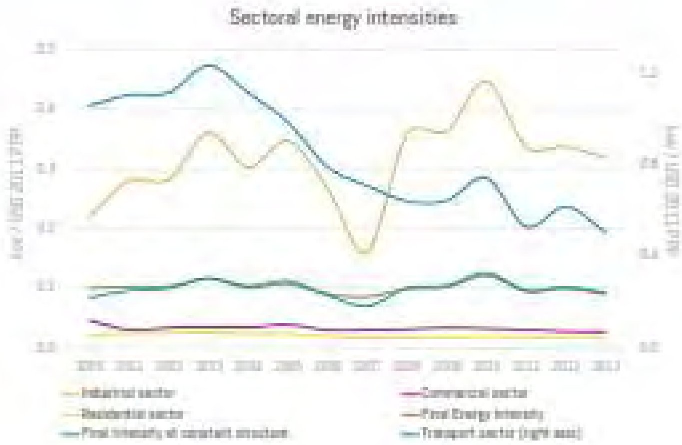
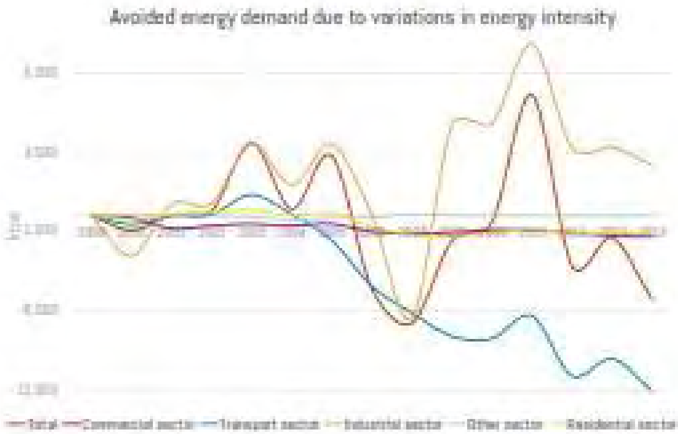
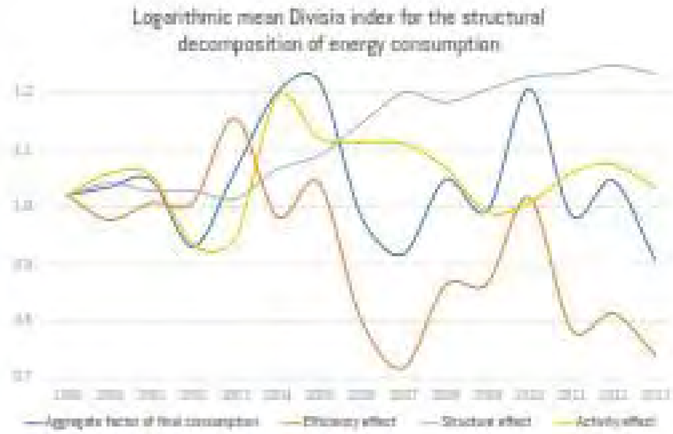

Residential Sector Final Consumption
Electricity
Natural gas
Liquefied petroleum gas
Coal and coke
Oil and derivatives
Biomass
Other energy sources
Final consumption variation rate [%]
Household final consumption variation rate [%]

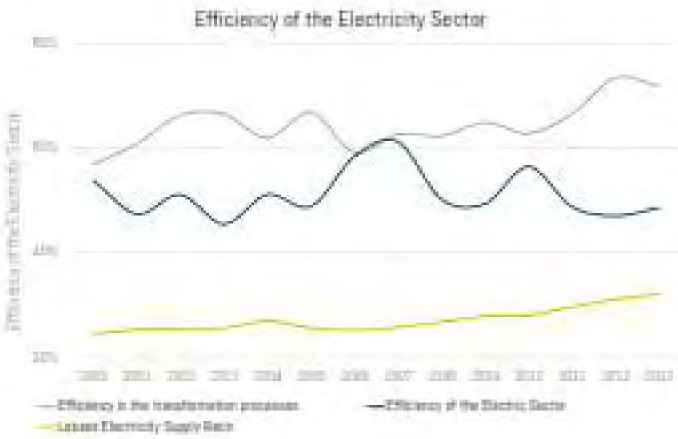

Final consumption per capita Residential Sector
Variation Rate [%]
Total per capita
Electricity per capita
Natural gas per capita
Liquefied Petroleum Gas per capita
Biomass per capita

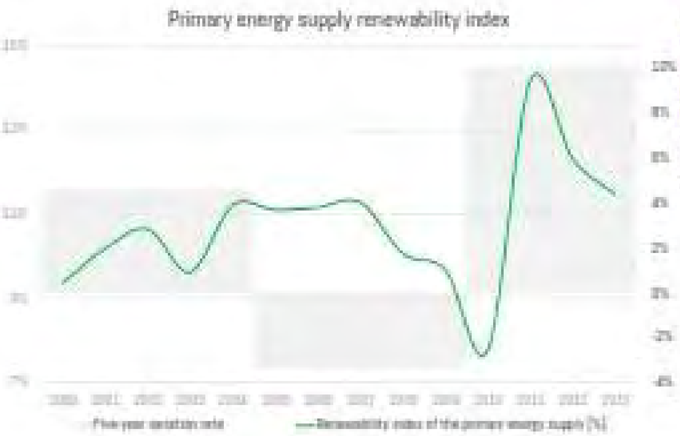

Energy intensities
Primary Energy Intensity
Final Energy intensity
Contribution of the electricity sector to primary intensity
Final intensity at constant structure
Final intensity/Primary intensity (right axis)


Sectoral energy intensities
Industrial sector
Commercial sector
Residential sector
Final Energy Intensity
Final intensity at constant structure
Transport sector (right axis)

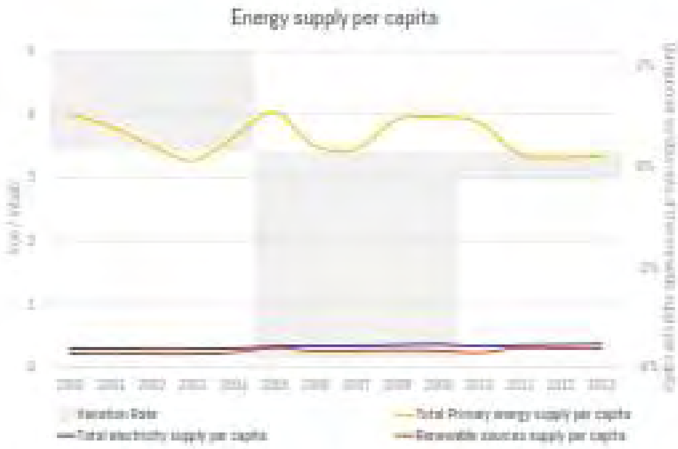

Avoided energy demand due to variations in energy intensity
Total
Commercial sector
Transport sector
Industrial sector
Other sector
Residential sector

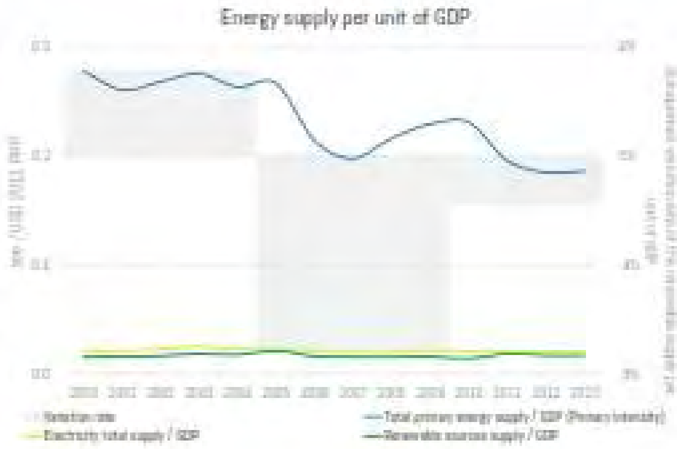

Logarithmic mean Divisia index for the structural decomposition of energy consumption
Aggregate factor of final consumption
Efficiency effect
Structure effect
Activity effect

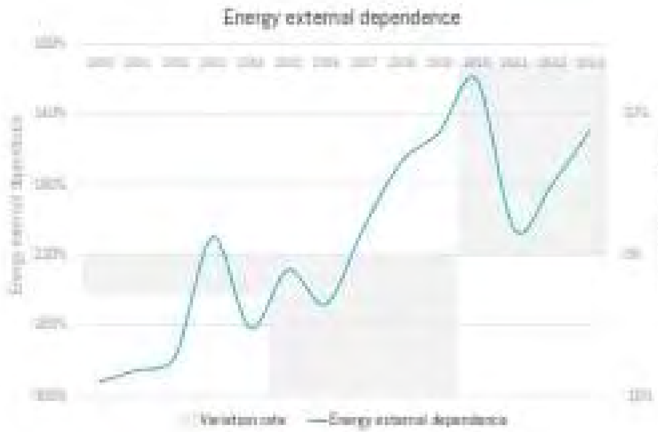

Efficiency of the Electricity Sector
Efficiency in the transformation processes
Efficiency of the Electric Sector
Losses Electricity Supply Basis

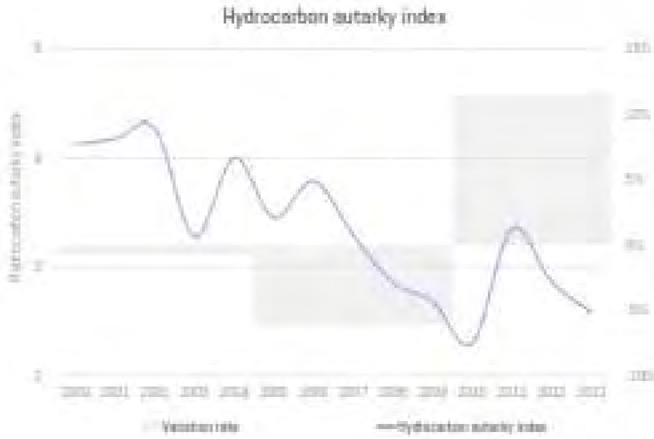

Primary energy supply renewability index
Five year variation rate
Renewability index of the primary energy supply (%)

VENEZUELA


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


Hydrocarbon autarky index
Variation rate
Hydrocarbon autarky index

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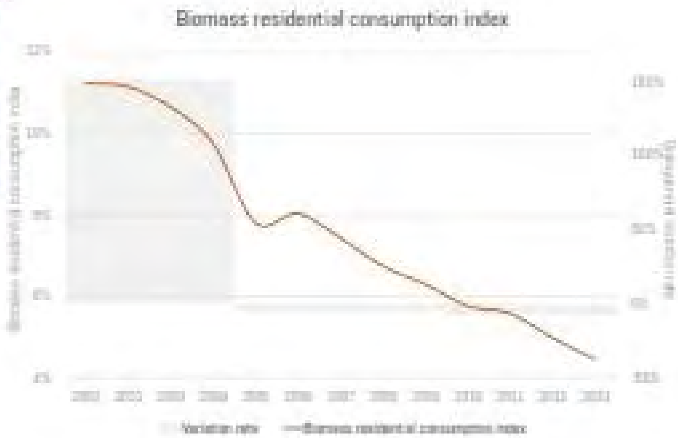
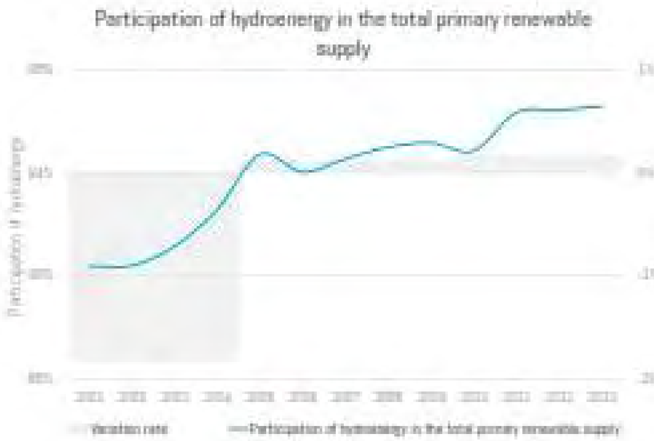
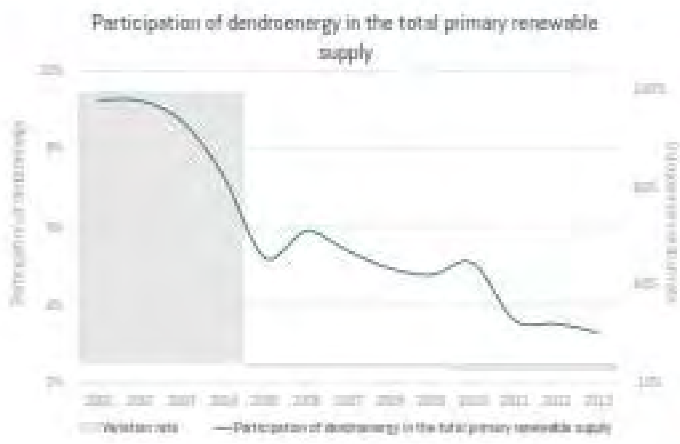
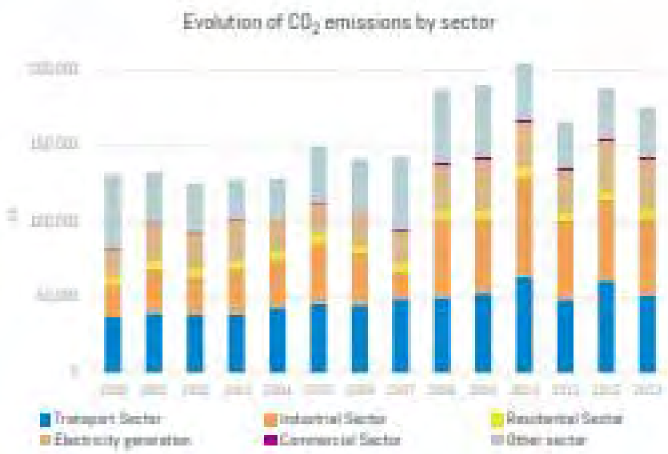
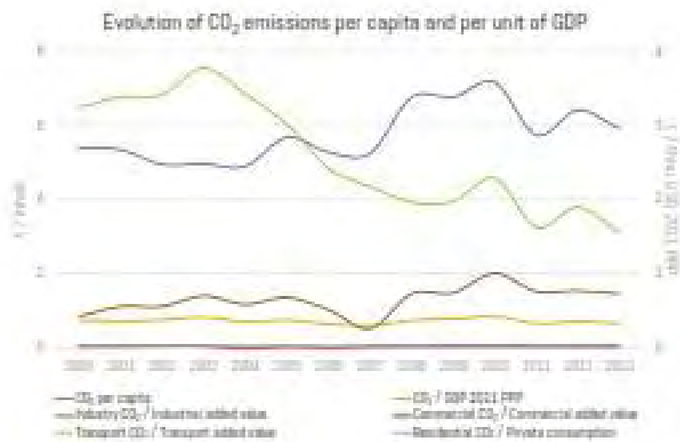
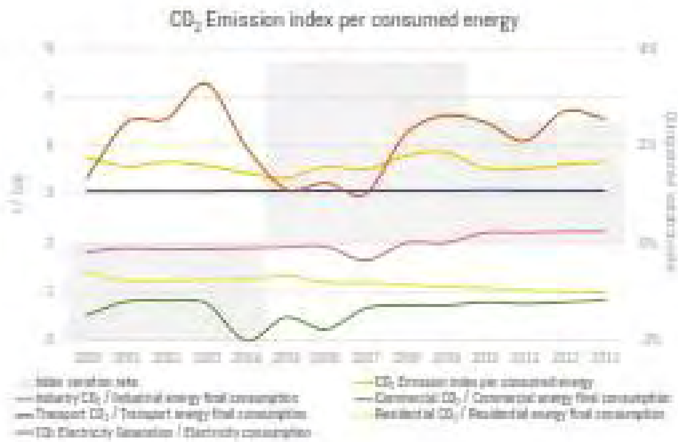

Biomass residential consumption index
Variation rate
Biomass residential consumption index

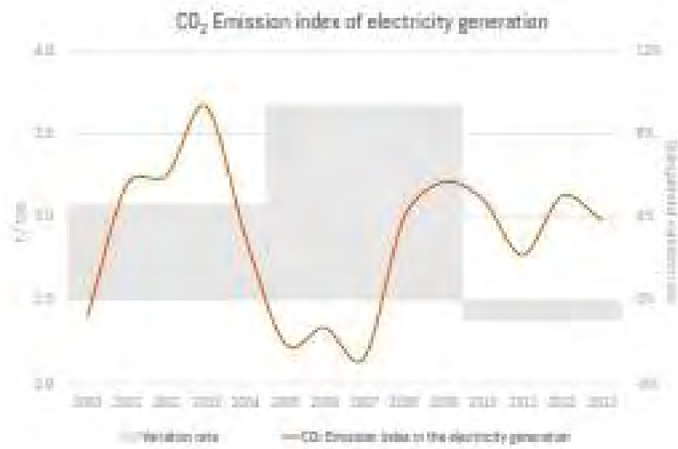

Participation of hydroenergy in the total primary renewable supply
Variation rate
Participation of hydroenergy in the total primary renewable supply


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


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


Evolution of CO2 emissions per capita and per unit of GDP
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
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
Variation rate
CO2 Emission index in the electricity generation

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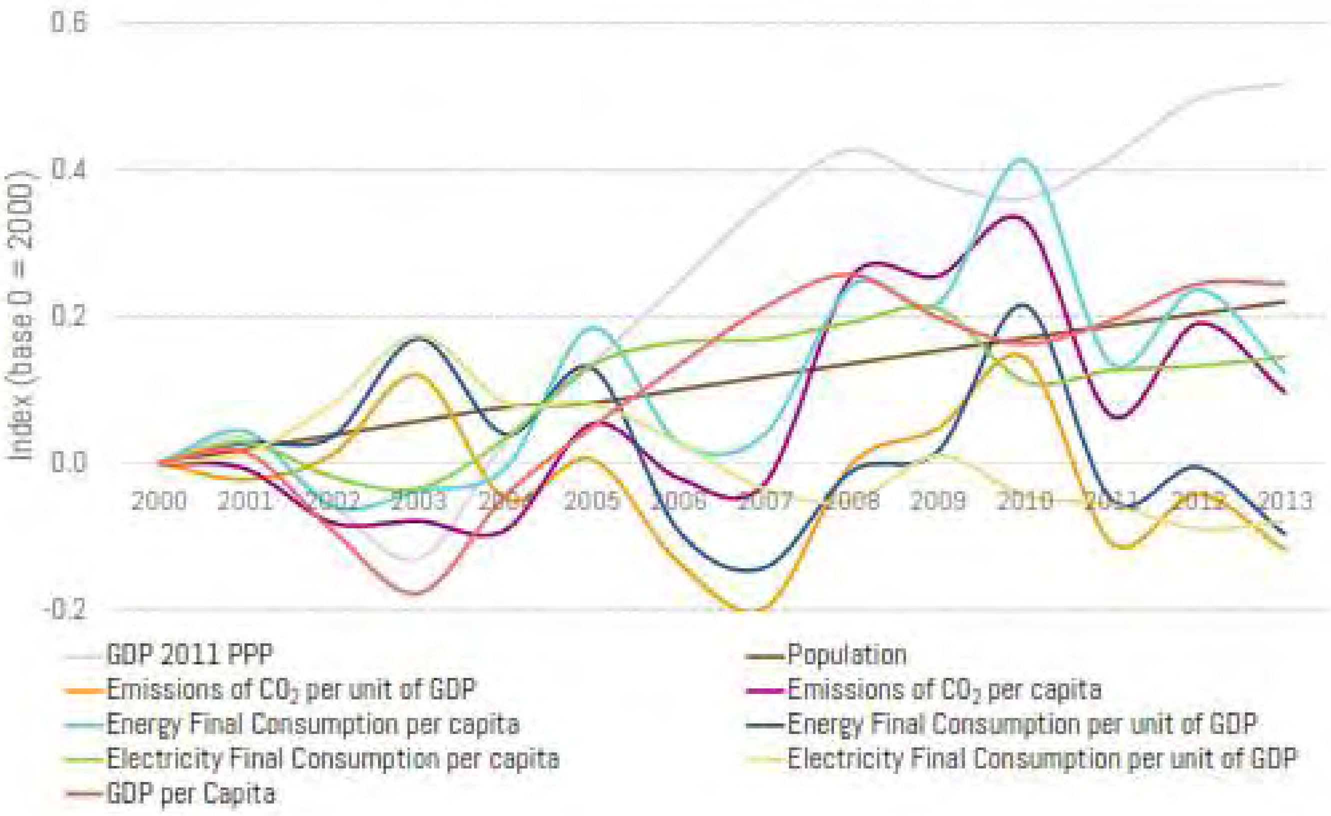
Summary of the main energy indicators



Legislation, regulation and energy policy

Legislation, regulation and energy policy 2017

1. *INSTITUTIONAL*

Adoption of policies, plans, programs and the creation of institutions

Argentina created the Federal Energy Council (CFE), conceived as an advisory body on energy development at the national level, chaired by the Minister of this State Agency, and composed of a representative from each of the jurisdictions and the Presidents and Vice-Presidents of the Energy Commissions of both Chambers of the National Congress, with the coordination of an Executive Secretariat. The CFE is competent to act as the Advisory Board of the National Executive Power and the provinces, including the development of specific programs to promote alternative energies and energy efficiency, tariff coordination, investment projects of national or provincial interest, to ensure the normal functioning of the Energy Regulating Entities, etc. Additionally, the Federal Energy Agreement was formalized between the National Government, 20 provinces and the Autonomous City of Buenos Aires, aimed at promoting the implementation of energy policies that guarantee the supply security at the national level. The aforementioned instrument establishes commitments in the area of coordination, formulation and implementation of energy policy with a view to achieving a more reliable, inclusive, competitive and environmentally sustainable energy sector. On the other hand, and with the purpose of rationalizing and making more efficient the public management of the energy sector, limiting the participation of the State to those works and services that cannot be duly assumed by the private sector, the conformation of the Argentina Energy Roundtable (Integración Energética **Argentina** S.A) was approved, with the merger by absorption of EBISA by ENARSA. The absorbing company will assume the functions of commercialization of electric energy from the binational hydroelectric plants Salto Grande and Yacyreta, and the interconnections with Uruguay, Brazil and Paraguay. In addition, the exploration and exploitation of deposits of solid, liquid and/or gaseous hydrocarbons and the distribution, marketing and industrialization of their products and derivatives will be within the scope of the new company. Furthermore, the regulation instructs the Ministry of Energy and Mining to get rid of the shareholdings of certain power plants.

In order to meet the goals, set forth in the State's Political Constitution in the field of energy development, **Bolivia** created the Ministry of Energy separated from the Ministry of Hydrocarbons. The new state body is focused on the development of alternative and renewable energies. For this purpose, its hierarchical structure is composed of two Vice-Ministers: High Energy Technologies (lithium, nuclear energy) and Electricity and Alternative Energies. The referred measure implies the structural reorganization of the Ministry of Hydrocarbons. Also, the National Strategic Public Company of Bolivian Lithium Deposits – YLB was created, under the Ministry of Energy, to replace the National Management of Evaporite Resources. YLB will be responsible for carrying out the activities of all the productive chain: prospection, exploration, exploitation, profit or concentration, installation, implementation, launching, operation and administration of evaporite resources, inorganic chemistry complexes, industrialization and commercialization; it will develop the basic chemistry processes of its evaporite resources with a hundred percent (100%) State participation for production and marketing. Additionally, lithium and potassium are declared as strategic elements, whose development will be carried out by Bolivian Lithium Deposits (YLB). On the other hand, modifications to the Hydrocarbon Law were made in matters of structure and attributions of YPFB, instituting the Executive President as the highest executive authority and determining that the Presidency of the Board of Directors will be exercised by the Minister of Hydrocarbons.

Brazil approved the National Policy on Biofuels (RenovaBio), focused on a threefold objective: to create tools to fulfil the commitments set out in the Paris Agreement; to promote the expansion of biofuel production and to ensure supply predictability. RenovaBio traces a strategy that recognizes the role of all types of biofuels (ethanol, biodiesel, biomethane, biokerosene, etc.) in the Brazilian energy matrix, creating an individual certificate for the producer, designed to highlight how much each industry member contributes to reduce GHG emissions and institutes the so-called Decarbonization Credits (Decarbonization Credit or CBIO), as a financial asset, subject to negotiation in the Stock Exchange and issued by producers from the sales of biofuels.

In order to adapt its governance to international standards with regard to the requirements in the field of direction and management for public companies, **Chile** approved the establishment of a new corporate governance structure for the Oil National Company, which implies the appointment of two directors by the President of the Republic, in addition to four other directors who will be elected by Senior Public Management. In addition, employees of the state oil company will propose a position in the Board of Directors. On the other hand, the regulation which establishes the conditions, characteristics, deadlines, stages and the procedure that will govern energy planning for long-term that the Ministry of Energy must develop for the different energy scenarios of expansion of the generation and consumption in a planning horizon of at least thirty years, was adopted. Likewise, in compliance with what is established in the energy resource development axes that form the National Energy Policy, specifically regarding the contribution to the efficient and sustainable use of firewood, with focus in the south central zone of the country, the Conversion Table of Energy from Wood was established which contains, in a format accessible to the merchants of firewood and the public in general, indicators regarding heat energy delivered by the firewood per species, humidity percentage and sales format.

Colombia approved "The Natural Gas Supply Transitional Plan" which includes the construction of the Pacific Regasification Plant, the Buenaventura - Yumbo Gas Pipeline, the Yumbo - Mariquita Bidirectional, the Mariquita-Guandalay Loop 10", the Barrancabermeja - Ballena Bidirectional, Barranquilla-Ballena Bidirectional and El Cerrito-Popayan Compressors. The aforementioned projects will begin operations between 2020 and 2021.

Costa Rica approved a comprehensive reform of the Energy Subsector's Organization Regulation, in force since 2010, aimed at guaranteeing its adequacy to the changes established in the regulations related to the organization of the Executive Power, the legislation of rural electrification and municipal public services, the new integration of the Energy Subsector and the provisions of the Republic's Comptroller General's Office on the efficiency and effectiveness in the allocation of energy sources for power generation. On the other hand, the operating regulations of the Secretariat for Sectoral Planning of Environment, Energy, Seas and Land-use Planning (SEPLASA), support and technical advice body of adhered to the Governing Minister and to the sectoral authorities in the efficient and effective management of the sector, under the principles of competitiveness, sustainability and equality.

Honduras created the Secretariat of State in the Office of Energy (SEN), adhered to the Sectoral Cabinet of Economic Development, as the governing institution of the national energy sector and regional and international energy integration, with the responsibility of proposing to the National Energy Council the National Energy Strategy and the policies related to the comprehensive and sustainable development of the energy sector; as well as formulating, planning, coordinating, executing and evaluating the strategies and policies of the energy sector. To this end, the Directorate General for Energy and its agencies adhered to the Undersecretariat of Energy of the Secretariat of State in the Offices of Energy, Natural Resources, Environment and Mines were abolished.

Mexico approved the Organic Statutes that establish the structure, basic organization and functions of the different areas that integrate Pemex Ethylene and Pemex Exploration and Production. Both productive companies of the State subsidiaries of Petróleos Mexicanos, with own legal status and patrimony, subject to the central management, strategic direction and coordination of Petróleos Mexicanos, that have as purpose to generate economic value and profitability for the Mexican State through the production, distribution and marketing of derivatives of methane, ethane and propylene, on their own or through third parties, and by the exploration and extraction of petroleum and solid, liquid or gaseous hydrocarbons in the national territory, in the country's exclusive economic area and abroad, respectively. It also approved the Organic Statute that establishes the structure, basic organization and functions of the different areas that integrate the Federal Commission of Electricity, productive company of the State of exclusive property of the Federal Government, with own legal status and patrimony, technical, operative and of management autonomy, which aims at the development of business, economic, industrial and commercial activities, related to the public service of transmission and distribution of electrical energy, generating economic value and profitability for the Mexican State as its owner. Furthermore, the internal regulations defining the structure and establishing the organization and operation of the Energy Regulatory Commission, a body of the Centralized Federal Public Administration, as a Coordinated Regulatory Body in Energy Matters were approved. Created by constitutional mandate under the reforms approved in 2013 and endowed with technical, management and operational autonomy and legal status for the exercise of the powers and the fulfillment of affairs commanded by the Law of Coordinated Regulatory Bodies in Energy Matters, in order to promote the efficient development of the industry, to promote competition in the sector, to protect the interests of the users, to provide adequate national coverage and to attend to the reliability, stability and security in the supply and the provision of the services.

In order to promote the implementation and widespread and strengthened use and of renewable energies in order to achieve sustainable development, **Paraguay** approved the provisions of the International Renewable Energy Agency IRENA, adopted in Bonn in January 2009. On the other hand, the Paraguayan Committee of the World Energy Council was created, in charge of exercising the national representation before the WEC, to study the potential of national energy resources, carry out studies about energy consumption, etc.

With the publication of the Law of Organization and Functions of the Ministry of Energy and Mines, **Peru** formalized the creation of the Vice-Ministry of Hydrocarbons, in charge of formulating, coordinating, executing and supervising sustainable development policy in this area. The aforementioned legislation determines that the basic structure of the Ministry of Energy and Mines will be composed of a higher management, formed by the Minister and Vice-Minister of Electricity, the Vice-Minister of Hydrocarbons, the Vice-Minister of Mines and the Secretary General. Additionally, and valuing the need to optimize the efficient development of the Peruvian electricity market through the corresponding revision and adjustment of the current regulatory design, the creation of a Multisector Working Group was approved, dependent on the Ministry of Energy and Mines, in charge of formulating proposals to improve the normative framework of the electricity sub-sector. It was also approved by decree, the Regulation of Organization and Functions of the Ministry of the Environment, which establishes the new organizational structure and the functions of the entity. The measure responds to the need to fill limitations of administrative and functional order, which presented the regulation approved in 2008 about gaps with respect to the legal instruments approved later.

In line with the process of reform and modernization of the State, the **Dominican Republic** approved a new organizational structure of the Ministry of Energy and Mines, adapted to the changes of the environment and aimed at fulfilling efficiently and effectively its mission and the important corresponding role in the implementation of the State's National Development Plan.

Uruguay approved, via decree, the National Guidelines for Land Management and Sustainable Development which are binding for public institutions exercising jurisdictions with territorial incidence. The aforementioned guidelines are aimed at promoting the diversification of the energy matrix, guiding and regulating the localization of the derived uses and infrastructures, universalizing access and attending their compatibility with productive and cultural activities. Likewise, the hierarchy of the use of renewable energies in urban category and suburban soil category was established, by means of small and medium scale electric generation and thermal utilization, among others. Among the guidelines for non-agricultural use in rural category, it includes the promotion of indigenous energies, especially renewables and energy generation with minimal environmental impact. For this purpose, the orderly location of productive activities and energy generation in areas of preferential use should be promoted, considering compatibility with other activities. It is determined that the exploitation of the non-renewable natural resources of the subsoil should be made rationally according to its strategic characteristics for the local and regional economic development with social and environmental responsibility.

2. *ELECTRICITY*

2.1 Generation, transmission and distribution

The National Electricity Regulatory Agency in **Argentina** approved the Minimum Contents Guide of the Public Safety System of the Electric Energy Transport Companies, which specifies the criteria to meet the requirements that ensure levels of risks consistent with applicable rules and regulations, in order to ensure that the undertakings covered by this provision comply with their obligation to install, operate and maintain their electrical installations in concordance with the protection of public security.

Bolivia approved reforms to the electricity law in force since 1994; in accordance with the amendments, a new clause for declaring the expiration and revocation of concessions and renewal of licenses are incorporated when the administrative intervention to the electrical distribution company establishes that the intervened system does not hold the conditions to guarantee the continuity of supply, through affecting the fundamental right of access to the electricity service, among other measures designed to ensure continuity of service in optimal conditions.

Brazil approved the law on the calculation of the value added of hydropower for the purpose of distributing the proceeds of the tax collection on the circulation of goods and services that belong to the municipalities. Additionally, it modified the regulations for the extension of thermal power generation concessions established in 2013. The reforms determine that the deadlines for the aforementioned concessions may be extended for one time, for a period of up to 20 years. It also established regulations for extensions of concessions and hydroelectric power generation authorizations established in 2013, with the effect of concessions and authorizations for the use of hydraulic potential with installed capacity greater than 5MW and less than or equal to 50MW may be extended for one time. The extension shall be granted for a period of thirty years. New provisions on the tendering of distribution and transmission concessions associated with transfer of control of legal entities providing the public electric service, established in 2013, were also approved. On the other hand, reforms were carried out on the concession and commercialization of electric energy, related to: specification of the amounts necessary for the attention of its potentially free consumers and those that are framed as special consumers in the statements relating to auctions, promotion by ANEEL on the tender in the auction modality for the contracting of electric energy by the distribution agents of the SIN, amount of replacement and recovery of market, maximum reverse voltage calculation, etc. Additionally, the regulation of the Law on Electric Energy Service of Isolated Systems and the transmission facilities of international interconnections of the National Interconnected System was amended. Within the framework of the reforms, the electricity distribution agents must submit to the Ministry of Energy and Mines annually the planning of the attention of the markets in the Isolated Systems, for a five-year horizon. In order to participate in the tender, the selling agents must submit proposals for an energy and power supply solution, which will be technically pre-qualified by the Energy Research Company (EPE). The tender must seek to reduce the total cost of the generation in the Isolated Systems and the need for reimbursement of the Fuel Consumption Account (CCC).

Chile reformed the regulation on energy supply tenders to satisfy the consumption of regulated customers of the concession companies of the public energy distribution service. The modifications basically are to the deadlines established for the different stages associated with the design and coordination of the tendering processes, with a view to ensuring that their development is in line with other tariff processes established in the General Law of Electrical Services. On the other hand, in order to ensure that, without prejudice to the corresponding sanctions, all incident or failure, occurred in electrical installations that are not intended to provide the public service distribution, which causes end users outages of supply, generates the corresponding compensations. For this, the Regulation that rules the determination and payment to be carried out by the generating companies, transmitters or those operating facilities for the provision of complementary services or energy storage systems to the end users was approved, subject or not to price regulation, affected by the respective failure or event that causes supply unavailability. Furthermore, through resolution, the terms and conditions of application of the open access regime were established, a mechanism established by the General Law of Electrical Services with the purpose of guaranteeing access to the transmission system to the various users interested in transporting energy and power through the installations of the backbone transmission and sub-transmission systems, under technical and economic not discriminatory conditions between all users, through payment of the corresponding compensation.

Ecuador issued the regulation that establishes the administrative procedure for the imposition of penalties for offences established in the Organic Law of the Public Service of Electric Energy of application by the Agency of Regulation and Control of Electricity (ARCONEL) to electric companies, the National Electricity Operator (CENACE), consumers and third parties. The imposition of these penalties does not exclude from actions of the corresponding criminal and civil liability. On the other hand, it was issued the regulation that fixes the annual contributions of the companies participating in the electrical sector for the operation of the National

Electricity Operator, CENACE. The aforementioned instrument determines the aspects to be considered for the calculation of the contributions of the companies participating in the electrical sector subject to contributions for the operation of the CENACE. The income of the companies participating in the electricity sector subject to contributions for the operation of the CENACE, to be considered for the calculation of the contributions, correspond to: income by sale of energy in regulated contracts; sale of non-conventional renewable energy; sale of energy through bilateral contracts; short-term transactions; revenue by transmission rate, revenue from sales of energy surplus in regulated contracts; sale of non-conventional renewable energy surpluses; sale of surplus through bilateral contracts; revenue from the sale of energy to end-users associated with the cost of distribution; fees for large consumers; fees for the consumption of self-generated companies; sale of energy produced by embedded generation plants; and, sale of energy by the general public lighting service.

El Salvador made reforms to the General Electricity Law, aimed at resolving the partial declaration of unconstitutionality presented in 2008 with the objective of strengthening the public supervision and state control by establishing that given the public nature of the goods used, the power of concessioning out an activity that has as a physical support and unavoidable the exploitation of a demanial good requires parliamentary authorization, continuing the General Superintendence of Electricity and Telecommunications (SIGET) as an entity responsible for supervising and monitoring the execution and fulfilment of the conditions of the concessions for the exploitation of hydraulic and geothermal resources.

In order to promote the distributed generation, **Nicaragua** approved the reforms to the Electrical Industry Law. On the basis of the modifications, the generators of electric energy for self-consumption are authorized to sell their surpluses to Disnorte - Dissur and at the same time the distributor is authorized to buy this energy. In addition, it is established that the economic agents dedicated to the distribution will be able to sign contracts of purchase and sell of electric energy with the Generator, Distributed Generator and Large Consumers; likewise, they will be allowed to buy in the opportunities market and to import electrical energy. Within the framework of the reforms and additions, the use of bidirectional meters that allow the distributed generator to inject to the distribution network the excess of energy and have the possibility to pay only the difference for the consumption, will be supported.

Paraguay, via decree, approved the Master Plan of generation, transmission, distribution and telematics of the short and medium term of the National Electricity Administration ANDE, planned for the period 2016-2025. The referred document presents a synthesis of the technical planning studies carried out with a view to determining the set of necessary works in the National Interconnected System (SIN) for the generation of electric power by promoting energy sovereignty. The projects are aimed at accompanying the growth of demand, to provide a service under technically acceptable conditions according to the criteria and planning assumptions adopted.

Valuing the new characteristics of the current energy scenario of the country, **Uruguay** suspended the exhortation made to UTE in 2015, in order to carry out a competitive hiring procedure for the purpose of awarding one single special contract of purchase and sale of electric energy associated to a generating plant that produces it from biomass in the national territory. For this purpose, it is established that only those who offer to install power generating plants that use biomass as a primary source of energy can participate in the competitive procedure.

2.2 Marketing, consumption and subsidies

Argentina published the law that guarantees the permanent and free supply of electrical energy to electro-dependent people, who need constant electrical energy supply and at adequate levels of tension for the operation of their medical equipment to avoid risks in their life or health, or to keep the cold chain from their medications. For this purpose, the distribution company will deliver to the electro dependent person a generator set or suitable equipment free of charge, including associated operating costs.

Bolivia approved amendments and additions to the provisions in force for which the monthly payment of Unregulated Consumers to have available payment for the Wholesale Electricity Market Stabilization Fund - MEM, of an amount equal to sixty percent (60%) per concept of purchase of electricity according to Documents of Economic Transactions, which will be applied gradually. In this regard, it modifies the Regulation of Prices and Tariffs determining that the amount of the fee attributable to consumption will be calculated as the difference between the value of the total fee and the amount of the fee attributable to the generators, which will be added to the fee attributable to generators that are members of the group of companies of ENDE Corporation included ENDE Headquarters.

Assessing the need to update the requirements, conditions and qualification of Large Consumers, and in order to harmonize their participation with the principles defined in the Organic Law of the Public Service of Electric Energy, **Ecuador** issued new regulation of characteristics and procedures for the qualification of large consumers in the national electricity sector, including their obligations and responsibilities. The aforementioned regulation is of compulsory compliance for the CENACE, the electric distribution companies, the transmitter and large consumers.

Mexico published in the official journal the Cost of Opportunity Handbook, a market practice instrument that aims to establish the principles of calculation, instructions, rules, guidelines, examples and procedures that should be observed by the market participants and the National Energy Control Center (CENACE) for the determination of opportunity costs related to limited energy resources.

Assessing that the financial projections of the National Electricity Administration, ANDE, indicate the need for: having adequate tariffs to cover the costs of operating the service (including other financial obligations of the company), to solve the inadequacy of profitability that has affected the quality of the service of electric energy for lack of investment and; whereas the tariff levels of the specifications in force since the year 2002 do not reflect the structure of current costs generating economic distortions, **Paraguay** approved the decree by which the National Electricity Administration is authorized to carry out the rebalancing of the tariffs for the electric energy service. Additionally, electricity tariffs were approved to be applied by the National Electricity Administration (ANDE) to the electro-intensive industries, with supply voltage levels of 220 kV; and 66 kV. The aforementioned tariffs were structured by assessing that the planning of the expansion of the electrical system established the convenience of supply for the electro-intensive industries at the specified voltage levels, from the technical-economic point of view, which makes it necessary to update the tariff structure defined in 2011 and 2016, taking into account the current conditions of the National Interconnected System, the Electric Energy Market, the Master Plan for Generating and Transmitting and the contracting power and energy.

Peru published the law that eliminates the Charge for Strengthening Energy Security (CASE) that was affecting the cost of the electric service and ordered the return of the aforementioned amount to the users of the energy service, within the framework of the termination of the contract of the South Peruvian Gas Pipeline; in this way, this collection is left without effect, in addition to the application of the Charge by Energy Security System in Hydrocarbons (SISE Tariff) and the Regulated Security Rate (TRS) established in 2016.

With the aim of continuing to encourage energy efficient consumption in the industry, valuing the presence of conditions to implement a program similar to the one promoted in 2015, and given the existence of important industrial sectors of the national economy with a ratio of electricity expenditure on GDP (Gross Production Value) that does not reach the 5% established in the promotional measure, but with a significant electricity expenditure in its cost structure, **Uruguay**, via decree called on the National Administration of Electric Power Plants and Transmissions (UTE) to implement a program of commercial benefits for companies or industrial establishments with at least one year of operation at the date of approval of the decree, consisting of a monthly discount to the charge for energy without VAT, associated with the maintenance or increase of physical production. On the other hand, assessing the desirability of promoting the support to the milk production chain, taking advantage of the energy availability and recognizing the vital importance of this sector for the productive capacity of the country, Uruguay, via decree called on the National Administration Electric Power Plants and Transmissions (UTE), to implement a program of commercial benefits for milk producers and companies or entities of the milk production chain which includes a monthly discount on the energy charge without VAT. The aforementioned program includes 4 levels of application of discounts on the equivalent energy charge.

2.3 Rural electrification or universalization of electricity

Assessing the need for the urgent adoption of standards aimed at promoting the electrification of rural areas of the country, especially those most affected by armed conflict, necessary to ensure and facilitate the actual implementation of the Final Agreement in order to obtain the effective realization of the right to the peace, **Colombia** determined, by decree, provisions for the National Plan of Rural Electrification (PNER). The aforementioned will have to take into account the different solutions applicable in terms of energy, the needs reported by the territorial entities and communities, and the socio-environmental conditions of households, as well as alternatives of individual or collective electrification. In accordance with the above-mentioned legal instrument, the elaboration and adoption of a National Rural Electrification Plan for the Non-Interconnected Zones (ZNI) and the National Interconnected System (SIN) to allow the management, operation and sustainable maintenance of energy solutions that are built for their use.

Costa Rica, via decree, formalized and declared of public interest the Intersectoral Plan for the implementation of mechanisms from the electrical sector to support vulnerable social groups, an instrument that constitutes the framework for contributing effectively with the general policies to alleviate poverty by establishing a preferential electric tariff focused on vulnerable social groups that are properly identified and located through poverty reduction programs developed by the Joint Social Welfare Institute (IMAS).

3. *HYDROCARBONS*

3.1 Exploration, exploitation and transformation

Argentina included in the functions established for the Federal Energy Council, the accompaniment to the oil policy designed by the National Executive Power, favoring the development of control of the committed investments procedures and criteria to periodically evaluate the continuity of the exploitation, promoting and coordinating with the provinces the sustainable development of the hydrocarbon resources by unconventional techniques. This, while following principles of information transparency, logistic optimization, competition and environmental care, and promoting the development of hydrocarbon potential in the continental sea through a specific plan that encourages exploration and eventually offshore production.

Bolivia approved the new Regulations for Hiring Oil Operations within the framework of Oil Service Contracts, responding to the need to update, supplement and extend the scope established for the purpose in the regulation approved in the year 2009. The new regulation is aimed at ensuring the development of the projects of thermoelectric generation, hydro-electric generation, alternative energies and the expansion of the transmission envisaged in the "Economic and Social Development Plan 2016-2020 within the Framework of the Integral Development for Living Well", of compulsory execution for the Executive Body and its public companies.

Brazil approved changes in the tax treatment that institute a special regime for exploration, development and production of oil, natural gas and other fluid hydrocarbons. The reforms are aimed at ensuring the maintenance of the tax rules in force in the 14th round of tenders in the concession regime and in the 2nd and 3rd rounds of shared production, carried out by the National agency of Oil, Natural Gas and Biofuels (ANP), as well as to ensure a safe legal environment for future investments in the country. The new legislation incorporates partially the amendments proposed by the National Congress on matters of deduction of the basis for calculating Income Tax of legal businesses (IRPJ) and Social Contribution on Net Profit (CSLL) of investments carried out in the exploration and production phases of oil and natural gas, thus allowing the investments made in exploration and production to be immediately deductible in the same exercise of their performance. Furthermore, regulations on the right of preference of Petróleo Brasileño S.A.-Petrobras to act as operator of the consortiums formed for exploration and production of oil blocks to be contracted under the shared production regime have been approved.

Colombia regulated and added tax provisions related to the incentive for the increase of investments in hydrocarbons and mining. According to the new regulations, the guidelines, criteria and eligibility parameters are established for the granting of the tax refund certificate (CERT) corresponding to a percentage of the value of the increase. Also, in order to promote a safe and responsible development of the sector, technical criteria for offshore exploratory drilling of hydrocarbons were established, with compulsory enforcement for all operators who, within the framework of a contract or agreement signed with Ecopetrol S. A. or with the National Agency of Hydrocarbons (ANH), or those who do the same, for the exploration and exploitation of offshore hydrocarbons, to forward drilling activities of stratigraphic, exploratory or delimitation wells, including the development of tests or other techniques to confirm the presence of hydrocarbons under the seabed in shallow, deep or ultra-deep waters of the Colombian territory. Additionally, to ensure the normative development of the Final Agreement through the implementation of tax incentives aimed at bridging the gaps of socio-economic inequality in the areas most affected by the ZOMAC armed conflict, amendments to the Tax Reform Act of 2016 were approved for the purposes of including companies engaged in mining and the exploitation of hydrocarbons in the form of work payment through taxes, with priority for projects running in municipalities located in the ZOMAC areas that are coincident with those where Development Plans with a Territorial Approach - PDT are being implemented. The payment for works corresponds to a mechanism of works for taxes conceived as a form of extinction of the tax obligations, which allows paying a part of income tax and complementary taxes by means of a contribution for the development of feasible and priority projects of social transcendence.

With the objective of standardizing the information given by the Public and Private Companies of Exploration and Exploitation of Hydrocarbons to the Secretariat of Hydrocarbons, based on the "Petroleum Resources Management System" methodology, **Ecuador** issued via resolution the instructions for the delivery of Information on Reserves and Hydrocarbon Resources applicable to all public and private companies of exploration and exploitation that carry out hydrocarbon activities in the country.

Considering that during the OPEC Meeting N° 171 held in Vienna in November 2016, it was decided to adjust the crude oil production of its member countries to 32,500 kbbl/day from 1 January 2017 with a duration of six months, extendable, taking into account the conditions prevailing in the international oil market, **Venezuela** decided to adjust the production of crude oil to a reduction of 95 kbbl/day of crude oil among PDVSA S.A., its subsidiaries and joint enterprises. The aforementioned resolution is mandatory for those who perform primary hydrocarbon activities in the country.

3.2 Storage, transport, marketing and consumption

With the aim of optimizing the utilization of the local refining park and sustaining the production of crude oil of national origin, **Argentina** created, effective until December 31st, 2017, the Register for operations of import of crude oil and its derivatives. It os in charge of inventorying crude oil import operations and their derivatives subject to authorization such as: crude petroleum oils, crude oils from bituminous minerals, aviation petrol, petrol (except for aviation) and diesel (diesel oil). The methodology for the determination of the authorized volumes shall be based on the insufficient supply of crude oil of national origin of similar characteristics to those requested to be imported by the interested company; the insufficient additional processing capacity of local refineries with crude oils of national origin; and the insufficient supply of derivatives subject to registration. In order to ensure the supply of fuels to power stations in an uninterrupted manner, the obligation to register imports carried out by Compañía Administradora del Mercado Mayorista Eléctrico Sociedad Anónima (CAMMESA) for the supply of the power plants whose main function is the technical distribution of the Argentine Interconnection System (SADI) is exempted.

In order to ensure that the margins for refined products are determined by analytical methods and criteria that ensure continuity of service, enabling operators, under a rational, prudent and efficient administration, to perceive the sufficient revenue to cover their operating costs and obtain adequate and reasonable performance, in addition to encouraging the expansion of process and service units to ensure energy security, **Bolivia** repealed the provision determining the income adjustment mechanism for the marketing of reconstituted crude oil and white petrol, calculated by the Regulatory Entity. It was created with the objective of balancing the revenues of refineries with the processing capacity to less than or equal to 5 kbbl/day, considering that it did not fulfill the function for which it was created. On the other hand, and in order to adapt the current energy regulation to the new State role in the control of the hydrocarbon production chain, the new Regulation was approved for the establishment of technical and legal conditions for the design, construction, operation, maintenance and abandonment of liquid hydrocarbon storage plants. The new regulatory body adapts to the current technical, operational and safety conditions, taking into account that the storage activity of liquid hydrocarbons is constituted a public service aimed at contributing to the satisfaction of the energy needs of the population and of the industry oriented to national development.

Brazil made modifications aimed at reducing the contribution aliquots for the Social Integration Program (PIS) and the Public Employee Asset Development Program (PASEP), as well as the contribution to the Financing of Social Security (COFINS) due to incidents on the importation and marketing of gasoline, diesel oil, LPG, aviation kerosene and alcohol.

In order to guarantee the supply of fuels in the border zone, as well as the implementation of strategies with the Public Force and other institutions for the proper control in the distribution of these derivatives, Colombia established, via resolution, the methodology applicable for the determination of maximum volumes of liquid fuels excluding VAT and exempt of tariffs and national tax on petrol and ACPM in the municipalities recognized as border zones and its distribution to service stations registered in the Fuel Information System (SICOM). The Code of Measurement of Liquid Fuels was also approved to guarantee the measurement of quantity and the traceability of the quality parameters in the deliveries and receipts carried out by the agents of the liquid fuel distribution chain up to the final consumer. The referred code applies to liquid fuels derived from petroleum, biofuels and their blends; and as part of the measurement and traceability it was determined the rules and regulations to be applied to the technical and metrological instruments used in the distribution chain.

Ecuador reformed the tariff structure of oil terminals in the field of international traffic and cabotage by Gross Registry Tons GRT of the ship and for each maneuver involving the harbour, corresponding to each particular case, as it indicates in the structure and tariff levels. For the purposes of this tariff, the general tariff for maneuver shall be considered for each of the following: anchorage, berthing, unmooring, tying to another, untying, sailing, mooring and unmooring to piers, buoys or single-buoys as the case may be. For the purposes of this fee, any of the above maneuvers does not include the cost of ground transportation from the harbour, from the residence or office to the pier, or the cost of shipping from the dock to the shipping site and vice versa. But it does include all the rest of the services such as telephone or radio communications and administrative procedures. It is also levied by the use of the anchorage for non-commercial operations in areas destined by the Superintendence, to any ship in international traffic and cabotage that are not conducting commercial operations and in the following cases: Where a ship's damage obliges a repair to be more than 5 days in port, when the shippers or consignees so request and the ship does not carry out the loading, unloading or transfer of hydrocarbons, during their stay at the terminal, when they are legally prevented from operating, when the ship requests the supply of goods, spare parts, materials and water in an additional way and when a ship that takes fuel for its machines requests the authorization of entry or departure of personnel to the ship.

Mexico made modifications and additions to the Regulation of the Law of Revenues for Hydrocarbons. According to the reform, the Secretariat of Finance and Public Credit (SHPC) is entitled to establish the minimum values and, where appropriate, the maximum of the variables for awarding contracts, in order to maximize the income that the State perceives in the time that the activities of exploration and extraction of hydrocarbons are being carried out. The SHCP may also establish that the dissemination of the values are made in the act of presentation and opening of proposals, keeping the corresponding values in closed envelope, in the presence of public attester and under the strictest reserve. However, the SHCP may disclose the values in advance of the presentation and opening of proposals, so that they may be disclosed in the relevant electronic media no later than 10 working days before the date established in the tender for the act of presentation and opening of proposals.

Assessing the need to consider a policy of gradual liberalization of the fuels market, petroleum derivatives, Paraguay approved modifications and extensions to the decree by which the price of sale to the public of naphtha is fixed up to 85 octanes, and of the Type III diesel fuel (Type C), and established restrictions on the importation of virgin naphtha and naphtha up to 85 octane and diesel oil with more than 50 ppm of Sulphur. To this effect the restriction is set on the import of Diesel/Gasoil Type 1 (Type A) and Diesel/Gasoil Type 111 (Type C). The virgin naphtha and the naphthas in all its varieties or specifications are established as a product of free import and commercialization in the national territory. The free commercialization in the national territory, in conformity with the laws and regulations, of the Diesel/Gasoil Type I (Type A) and of the Diesel/Gasoil Type 111 (Type C), to be imported according to the provisions of this decree was determined. It is stipulated that, of the total imports of the product, 36% at least must be imported by Petróleos Paraguayos (PETROPAR). Marketing is prohibited within the national territory, of Diesel/Gasoil with more than 50ppm of Sulphur, being established two types of Diesel/Gasoil for import and marketing: 1) Type I (Type A), up to 1 ppm of Sulphur, and 2) Type 111 (Type C), from 11 and up 50 ppm Sulphur. The obligation is instituted for all Fuel Distributing Companies, having at least one naphtha service muzzle of up to 85 octanes, in all service stations operating under its flag; as well as the obligation, for all the Distribution Companies, to have at least one fuel muzzle of Diesel/Gasoil type III (Type C), in all the service stations that operate under its flag.

Peru approved changes to the Regulations for the Transport of Hydrocarbons by Pipeline in force since 2007. The reforms are focused on considering the possibility that, before the completion of a concession for the transport of hydrocarbons by pipeline, the new public tender can be carried out through a specialized entity of the State, in which case the deadlines for the designation of the consulting entity that carries out the valuation of the concession, as well as for the elaboration of the same to be carried out by the specialized entity itself.

3.3 Oil and oil derivatives

Due to the need to maintain the conditions of the T95 parameter in order to strengthen the reliability in the supply of diesel at the national level, as well as to update the viscosity and polyaromatic content parameters on the basis of international references, **Colombia** modified the quality criteria of diesel fuel (ACPM) and biofuels for use in diesel engines as a component of the mixture of combustion processes.

Ecuador approved the regulation establishing the necessary provisions and procedures for obtaining the feasibility authorization for the emplacement of new distribution centers for petroleum derivatives and their blends with biofuels in the different market segments. On the other hand, and valuing the need to create a specific legal framework that simplifies the procedures for regulating the marketing activities of Agricultural Oil (Spray oil) on the grounds that PETROECUADOR EP has ceased to produce the product in mention, and because its use is of vital importance to the various stakeholders in the agricultural sector, it issued the Regulation for authorization of processing, import and marketing activities (storage and transportation) of agricultural oil (Spray oil). Reforms were also made to the Rule of petroleum derivatives price regulation in force since 2005. The changes stipulate that the sale price in the Jet Fuel terminal will be calculated monthly by PETROECUADOR EP, based on the weighted average cost plus the costs of transport, storage, marketing, a margin that can define the indicated public company and the taxes that are applicable. In case of not having the price of import of the Jet Fuel, it will be calculated based on the international marker used for this product, plus the freight, the insurance and the other costs related to the import. The referred retail price will be compared with the final consumer sale prices at the international airports of the border countries, defined by PETROECUADOR EP, and the highest price will be established.

In order to ensure compliance with characteristics, specifications and quality standards of liquid fuels and other products derived from hydrocarbons; **Peru**, via decree, established the obligatory fulfillment of various Peruvian Technical Standards related to other products derived from hydrocarbons, including those related to the petrochemical industry.

3.4 Natural Gas

To achieve greater speed and efficiency in management, **Argentina** approved the decree that empowers the Ministry of Energy and Mining to grant authorizations for the export of natural gas. In accordance with the aforementioned decree, export agreements involving the construction of new facilities and/or new connections to pipelines, or the use of any existing systems, or other transport alternatives, shall be approved by the Ministry of Energy and Mining, previous intervention of the Entity. Likewise, the authorizations issued by the Ministry of Energy and Mining may anticipate the export of Gas surpluses to the quantities established therein, provided that they are subject to interruption when domestic supply problems exist. In this case, it will not be necessary to obtain the approval of each surplus export in the authorization, only to present to the entity, for informative effects, the respective contract of which it must arise the condition of interruption and the absence of compensation in the event of such interruption. On the other hand, and with the aim of tending to rationalization and efficiency in consumption, and achieve equality among users of different public services, in particular the distribution of natural gas by networks, adjustments were made to the scheme of the social tariff for gas service by networks in such a way that the beneficiaries of this rate have access to discounts in the final liquidation of the service equivalent to 100% of the gas price over a specified maximum consumption block -base consumption block-, and a discount equivalent to 75% of the gas price over a surplus consumption block of up to the same volume of the base consumption block. Distribution service providers were also instructed to implement a 10% bonus in the price of Natural Gas by networks and Undiluted Propane Gas by networks for all categories of residential users who record savings in their consumption equal to or greater than 20% over the same period in the year 2015. Furthermore, in order to encourage the investments needed to increase gas reserves and local production levels, as well as the development of infrastructure of the public transportation and distribution services of natural gas, and to maintain the chain of payments related to the operation and maintenance of the public service of distribution of natural gas by networks, it was approved the procedure for the compensation of the lower revenue that the Licensees of Natural Gas Distribution Service by networks received from its users, as a product of: the application of benefits and/or bonuses to the users resulting from the current regulation on tariffs of the distribution service of natural gas by networks and the higher costs of the GNNC with respect to those established for their recognition in the tariffs. The aforementioned compensation procedure shall also apply to sub-distributors who purchase natural gas directly from natural gas producers and/or marketers.

Responding to the need to strengthen the programs of conversion and maintenance of NGV equipment, and requalification and replacement of NGV cylinders executed by the EEC-NGV, **Bolivia** made modifications to the Supreme Decree of 2010 that created the Agency Executor of Conversion to Vehicular Natural Gas -EEC-NGV, as public de-concentrated institution dependent on the Ministry of Hydrocarbons and Energy, current Ministry of Hydrocarbons. The reforms are directed at the establishment of verification and restriction actions for the correct use of NGV conversion equipment and CNG cylinders; the implementation of the programs of conversion and maintenance of NGV equipment, and of requalification and repositioning of cylinders for NGV. On the other hand, assessing that the price of Natural Gas for the Ammonia-Urea Plant was not contemplated in the current regulations, criteria was included for the determination of Natural Gas prices for commercialization in the domestic market. On the basis of additions, the price of Natural Gas for use during the pre-commissioning, commissioning and implementation stages until the commencement of the commercial operation of the Ammonia-Urea Plant, it will be equal to the lowest price set for direct consumers; the price of Natural Gas for use as fuel of the Ammonia-Urea Plant shall be equal to the lowest price established for direct consumers and; the price of Natural Gas consumed as raw material (Industrialization Gas), for the process in the Ammonia-Urea Plant, will be established on the basis of the methodology approved by the Ministry of Hydrocarbons, contemplating a direct indexing at international prices for products to be marketed and/or similar products or substitutes; correlation with international prices of the raw materials involved in the different production processes; maximum limit for the price of Natural Gas for the domestic market established by the Hydrocarbons Act; lower limit equal to the lowest price set for direct consumers. It is noted that the contribution of each field to meet the demand for Natural Gas in the domestic market, which comprises all-natural gas that is used within the national territory without any distinction, will be determined by Yacimientos Petrolíferos Fiscales Bolivianos – YPFB directly.

Chile approved amendments to the Law of Gas Services, aimed at the establishment of procedures and methodologies for the valorization of gas installations, the determination of the capital cost rate (TCC), and the pricing and indexing mechanisms for gas service; contemplating instances of participation of public and private market agents. Additionally, it includes the Panel of Experts, as a special technical Tribunal for the resolution of disputes between companies and involved public bodies, arising from discrepancies relating to the methodology and calculation of TCC, the results corresponding to the annual profitability of companies, etc. In matters of tariff composition, the reform determines that this will result from the sum between the value of the gas at the beginning of the distribution system (VGISD), considering the prices of the contract of purchase of gas, plus the value of the other costs to transport the gas to the distribution facilities; and of the Distribution Added Value (VAD), which includes the indispensable costs for the concessionaire to be able to provide the gas service efficiently. Likewise, the power is given so that the concessionaire of distribution, subject to regulated regime of tariffs, can act before the Court of Defense of the Free Competition requesting that the existence of conditions of competition be declared, so that the freedom of price regime is reinstated. On the other hand, the maximum permissible profit margin is reduced for the concessionaires of distribution from five to three percentage points, whose minimum floor remains at 6%, calculated on the basis of the TCC. Also, the necessary procedural rules were established to implement the right of customers and consumers with residential gas service to change the gas distribution company. For the purposes of the aforementioned provisions, the distribution companies must deliver, within the time limits, all the information necessary to make the change of the gas distribution company, whether being the same companies, as with respect to the customers and consumers. They must also ensure that the quality of the gas service and the necessary safety conditions are not affected by the change procedure, in order to avoid risks for people or objects.

On the basis of the obligation of the Single Joint Information System (SUIC), for vehicles converted or dedicated to Compressed Vehicular Natural Gas (VCNG) and valuing the importance of maintaining an efficient control over the agents of the chain of Distribution of Vehicular Natural Gas for (VNG); **Colombia** approved the implementation of the CVNG information module in the Fuel Information System (SICOM), and determined the agents and actors involved, as well as their reporting obligations. Additionally, in compliance with the mechanisms established to ensure the national supply of natural gas, the information corresponding to the Natural Gas Production Declaration was published via resolution for the period 2017-2026 certified by the producers and marketers, analyzed, adjusted and consolidated by the Ministry of Mines and Energy. On the other hand, and valuing that for security reasons it is necessary to adjust the regulations applicable to international standards and other technical requirements, in order to guarantee the adequate delivery of the compressed natural gas distribution service, the Technical Regulations for service stations that supply compressed natural gas for vehicle use were issued.

3.5 LPG

Ecuador made modifications to the regulation of marketing activities of LPG, under which are included the grounds for suspension of operation of the subject of control, their facilities and/or means of transport if any, the verification of infringements to the Hydrocarbons Law and its Regulations; in cases of alteration of the weight of the LPG packaged, alteration of the official price, in dispensing LPG, sale of LPG to homes by part of distribution warehouses located in collection centers, non-compliance with the origin-destination indicated in the reference guide, of the means of transport of LPG that must have permits of operation by the Agency of Regulation and Control of Hydrocarbons (ARCH), collection of values by exchange of cylinders for domestic LPG of different brands.

Given the need to regulate the process of importing LPG, in order to adequately guarantee to the consumer and all those involved in the import process, the minimum quality conditions that it must meet, **Paraguay** approved the decree by which the provisions that declare the obligation of the application of the Paraguayan Technical Norms INTN concerning the fractionation, distribution, transport and commercialization of LPG are modified and expanded, further establishing the pre-licensing regime for import and its minimum quality requirements.

With the aim of adapting all the regulations related to the activities of wholesale marketing, transport, packaging, reloading and distributing of LPG to the new provisions of the Regulation of Minimum Ratios and Packaging Replacement Fund of LPG containers, **Uruguay** approved modifications to the decree regulating the requirements of reusable LPG containers. The reforms are aimed at contributing to the proper and regular functioning of the LPG market, through the provision of the necessary infrastructure to provide guarantees of security of supply, allowing to evaluate the number of vehicles that will carry out the distribution of the containers and the installed storage quantity in the collection points.

4. RENEWABLE SOURCES

Incentives

In **Argentina**, the law approving and declaring of national interest the Regime of Promotion to the Distributed Generation of Renewable Energy destined to the self-consumption integrated to the public electricity network became applicable. Considering as objectives energy efficiency, the reduction of losses in the interconnected system, the potential cost reduction for the electrical system as a whole, environmental protection and the protection of users rights in terms of equality, non-discrimination and free access to the services and facilities of transport and distribution of electricity. For this purpose, every user of the distribution network has the right to install equipment for distributed generation up to an equivalent power to that which has contracted with the distributor for its demand. For the purposes of law enforcement, any project for the construction of national public buildings should contemplate the use of some system of distributed generation from renewable sources, according to the exploitation that can be carried out in the zone where it is located, with a preceding environmental impact study, if it corresponds. Likewise, in order to implement the Distributed Generation Promotion Regime for distributed generation, the Regime of Promotion of the National Industry for the National Manufacture of Systems, Equipment and Supplies for Distributed Generation from renewable sources, FANSIGED, is created; under the Ministry of Production, of application at the national level with validity of 10 years extendable for an equal term. The aforementioned scheme includes among its activities the research, design, development, investment in capital goods, production, certification and installation services for the distributed generation of energy from renewable sources; and is integrated by incentives and benefits, including the tax credit certificate on investment in research and development, design, capital goods, certification for manufacturing companies; accelerated amortization of earnings tax, for the acquisition of capital goods for the manufacture of equipment and supplies for distributed generation; the anticipated return of the value added tax for the acquisition of the aforementioned goods; access to financing among others. In addition, within the framework of the law approving the Regime of Promotion to the Distributed Generation of renewable energy integrated into the public electricity network, the Trust Fund for the Development of Distributed Generation (FODIS) was created as an administrative and financial trust, aimed at the application of trust assets to the granting of loans, incentives, guarantees, the realization of capital contributions and acquisition of other financial instruments, all destined to the implementation of systems of distributed generation from renewable sources. The national State, through the implementing authority, is designated as trustor and trustee of the Fund and the public bank selected by the trustor as trustee. Also, through the creation of the Federal Energy Council, measures were established to promote the integral development of the country's hydroelectric potential and the research and development of other sources of energy such as geothermal, tidal, hydrogen and others, which can become alternatives to diversify the matrix and mitigate climate change. Finally, to simplify the verification of the fulfillment of the legal obligations established in the regulation of the law that establishes the "Regime of National Promotion for the Use of Renewable Sources of Energy Destined to the Production of Electric Energy", for large users in terms of complying with a percentage of the total consumption of electricity, for energy from renewable sources, the obligation to certify the subscription of contracts or to present self-generation or co-generation projects to the implementing authority was replaced by the verification of the effective consumption of renewable energy.

In order to guarantee the total application of the law regulating the payment of the electric tariffs of the residential generators, **Chile** approved the regulation that determines the requirements that users or final customers must meet, subject to pricing. Which for their own consumption they must provide their own electrical power generation equipment by non-conventional renewable means or efficient cogeneration facilities, to connect the power generation device to the distribution networks and inject the surplus energy into these, through the respective electrical connections, whose installed capacity does not exceed 100 kW and meet the other requirements established. The above-mentioned regulation also includes measures to be taken for the purpose of protecting the security of people and property and the security and continuity of supply; the technical and safety specifications to be met by the equipment required to carry out the injections; the mechanism for determining the costs of the adjustments to be made to the network; and the installed capacity permitted by each end user and by the set of such users in the same distribution network or in a certain sector thereof. On the other hand, the procedure for the registration of new and operating biogas plants was established. The aforementioned provision applies to any biogas plant, where anaerobic digestion processes of organic waste are carried out, from the stage of reception and management of the substrate to the use, consumption or burning of the produced biogas, including the artifacts that combust the referred gas; any plant that uses, consumes or burns biogas from landfills or other organic waste disposal systems; any biogas plant supplying networks of transport and/or distribution of gas by network; and any biogas plant where such fuel is used as a supply in energy generation and/or cogeneration plants. The regulation establishing the minimum safety requirements to be fulfilled by biogas plants, in the stages of design, construction, operation, maintenance, inspection and final term of operations, which will perform indistinctly the activities of reception, preparation and storage of substrate; production, storage, transfer, treatment, supply, use or consumption of biogas, and other related activities, as well as the obligation of the natural and legal persons involved in such activities in order to perform them in a safe manner. were also approved. The aforementioned normative body implied modifications to the Regulation of Gas Installers.

In **Cuba**, the Decree-Law N° 345, "The Development of Renewable Sources and the Efficient Use of Energy" was signed with the aim of increasing the participation of renewable energy sources in the generation of electricity up to 24% by the year 2030, and to advance the progressive substitution of fossil fuels, and the stimulation of the investment to the energy production from renewable sources through the establishment of incentives. The aforementioned decree envisages tariff exemptions for the importation of components and equipment necessary for the implementation of the projects. For the purposes of applying the decree, the local electric company Unión Eléctrica will buy all surplus energy from the generators of renewable sources other than self-consumed under a scheme of net measurement.

In order to guarantee the rational and efficient use of energy resources, promoting the adoption of clean technologies for the generation of electric energy, **Nicaragua** dictated the regulation of renewable distributed generation for self-consumption, which establishes the requirements, criteria, procedures, methodologies and administrative, technical and commercial responsibilities to be met by the electric energy distribution companies and the natural or legal persons who have or foresee the installation of electrical power generation of renewable type for self-consumption connected to a distribution system. The aforementioned regulation establishes a mechanism of remuneration of the surplus of the energy injected to the network of each distributed generation unit. Also, assessing that one of the fundamental pillars for the socioeconomic development of the country is the change of the energy matrix by means of the promotion of programs, projects and actions aimed at ensuring the increase of the generation of electricity with renewable sources and in order to guarantee a policy that marks the guidelines in the prices of purchase and sale of energy and power in this type of generation, **Nicaragua** approved the price ceilings without reference indexing for the development of generation projects with renewable sources.

Uruguay, through decree, called upon the National Administration of Power Plants and Transmissions to admit the certificates of national component of the investment issued by the Industry Chamber of Uruguay, linked to contracts of purchase and sale of energy from renewable sources that are not included in the framework of appeals made by the Executive Power on the basis of the provisions of Decree N° 78 of 2016.

Paraguay amended the decree regulating the Law on the promotion of biofuels given the need to establish adjustments in relation to the quality controls of the marketed biodiesel and advance the accreditation by the National Accreditation Body (ONA), for laboratories that carry out the tests for biodiesel established in the corresponding Paraguayan standard.

Under the principles of procedural economics, celerity and simplification of formalities aimed at ensuring agile and effective public administration, **Panama** updated the procedure for obtaining certification recognizing the use of tax incentives established by law for natural or legal persons who construct, operate or maintain solar plants and/or installations for the generation of electricity or heat or acquire equipment or parts for their operation.

5. *ENERGY AND ENVIRONMENT*

Pollution, emissions and climate change

In compliance with the legal precept of customs which determines that the importation or entry into the national territory of harmful goods for the environment, health and life will not be permitted, **Bolivia** made amendments and incorporations to the regulation for the import of motor vehicles, application of effective repentance and the policy of incentives and disincentives. This, by applying the Tax on Specific Consumptions (ICE), in force since 2006, aimed at dealing with the generation of modification practices and alteration of the original characteristics of motor vehicles, in order to adapt them to tariff subheadings not affected by prohibition or payment of ICE, by complementing the subheadings subject to the referred tax, as well as the restrictions established for the importation of motor vehicles, including chassis with built-in motor.

With the aim of guaranteeing security and transparency, as well as contributing inputs to the decision-making in government actions related to climate change, **Brazil**, via decree, constituted the National Emission Registration System (Sirene), with the objective to guarantee the availability of the results of the Brazilian Inventory of

Anthropogenic Emissions of Sources and Eliminations by Greenhouse Gas Sinks not Controlled by the Montreal protocol and other emissions accounting initiatives, such as annual estimates of greenhouse gas emissions in Brazil.

In order to reduce emissions from pollutant sources, mainly fine particulate matter (PM2.5), both directly and by its precursors (NOx and SO_2), which have a negative impact on people's health, **Chile** made amendments to the emission standards of pollutants applicable to motor vehicles and established procedures for its control. Additionally, through resolution, the environmental supervision program for the application of the tax levied on air emissions of particulate matter, oxides of nitrogen, Sulphur dioxide and carbon dioxide in accordance with the provisions of the corresponding tax legislation was established.

Ecuador issued the Organic Code of the Environment, aimed at guaranteeing the right of people to live in a healthy and ecologically balanced environment, as well as to protect the rights of nature for the envisioning of the Good Living or Sumak Kawsay. The provisions of the aforementioned legal instrument govern the rights, duties and environmental guarantees contained in the Constitution, as well as the instruments that strengthen its exercise, which must ensure sustainability, conservation, protection and restoration of the environment, without prejudice to the establishment of other laws on this subject to ensure the same purposes. The rules contained in this Code, as well as the regulations and other technical provisions related to this matter, are compulsory for all entities, bodies and dependencies comprising the public sector, natural and legal persons, communes, communities, peoples, nationalities and collectives, which are permanently or temporarily in the national territory. The regulation on the exploitation of non-renewable natural resources and of all the productive activities that are governed by their respective laws must observe and comply with the provisions of this new normative body with regard to environmental management. The codification of the Environmental Management Law is repealed.

Mexico approved the Regulation of the Energy Transition Law, which establishes the provisions to regulate the mechanisms and procedures aimed at ensuring the implementation of the law in the field of sustainable energy use, clean energies and reducing pollutant emissions from the electrical industry.

Peru approved the Environmental Protection Regulation for the Transport Sector which aims to regulate the environmental management of the activities, projects and/or services of competence of the transport sector according to the purpose of ensuring that these are executed safeguarding the right of people to live in a balanced and appropriate environment. This, as established by the Political Constitution of Peru and in agreement with the criteria and principles of environmental management established in the General Environmental Law and its regulations. Additionally, the partial regulation of the Environmental Management Law was approved in relation to crimes against natural resources, as defined in the Criminal Code, determining the procedure relating to informed report and competent authority for its formulation.

In **Uruguay** the law prohibiting for a period of 4 years the use of the hydraulic fracturing procedure (Fracking) for the exploitation of unconventional hydrocarbons, came into force. During the prohibition period, it is aimed to collect and analyze existing knowledge on the possible reserves of non-conventional hydrocarbons, on the fracking procedure and horizontal drilling by evaluating its possibilities and consequences as established in the constitutional precept related to environmental protection. For these purposes, a National Commission for Scientific and Technical Evaluation (CNECT) is created within the scope of the Ministry of Industry, Energy and Mining. The Commission in its action shall take into account the international commitments made by Uruguay in the field of energy, environmental and climate change policy.

6. ENERGY EFFICIENCY

Assessing the relevance of the energy consumption of the motor systems, the Ministry of Energy of **Chile** set a minimum standard of energy efficiency for Three-Phase Induction Electric Motors, elaborating a preliminary technical report with a proposal of minimum energy efficiency standard and a timeline for its implementation. The aforementioned regulations established a period of 12 months for the implementation of the minimum efficiency standard and a period of 36 months from the fulfillment of the previous dateline to evaluate the results of the standard and analyze its eventual modification. Likewise, with the aim of offering the user the option to compare appliances of similar characteristics, in terms of energy consumption and other related parameters, thus promoting the acquisition of efficient equipment, established the elaboration and determined the structure of energy consumption labels for the commercialization of clothes dryers, televisions and dishwasher. Additionally, the definitive technical specifications of the energy consumption label of instantaneous hot water appliances for domestic use by means of gaseous fuels (gas water-heaters), were approved via resolution.

Colombia approved by decree the procedure for the application of the differential rate of 5% in the purchase of new refrigerators for replacement by the purchaser. The aforementioned differential rate applies throughout the national territory to natural or legal persons that import, produce or commercialize refrigerators in the national territory and manage the replacement of domestic use refrigerators for refrigeration and/or freezing of food. It shall also apply to all purchasers of new refrigerators belonging to a household whose housing is of stratum 1, 2 or 3, in accordance with the provisions of the tax statute. The measure, in addition to protecting the environment, is focused on reducing an important part of the energy subsidy consumption of low strata for refrigeration. In order to grant a transition to ensure its effective application, modifications and clarifications to the Technical Regulation on Labelling RETIQ were made. Under these reforms, certain equipment for domestic and commercial refrigeration imported or manufactured prior to the approval of the RETIQ are exempt from the application of the aforementioned regulation and provisions related to training of vendors and promoters are carried out, among other measures related with the process of labelling of energy efficiency at the national level.

For the purpose of guaranteeing consumers the access to products that meet the technical and energy efficiency characteristics that make it possible to contribute significantly to the achievement of the national carbon neutrality targets established for 2021 and valuing that refrigeration equipment represents 34.4% of a household's electric consumption, **Costa Rica** approved the Technical Regulation, which establishes the maximum values of electric energy consumption of household refrigerators, freezers operated by hermetic compressor that are manufactured, imported, used and marketed in the national territory. This, aimed at ensuring compliance with the established limits requiring the demonstration of the conformity of these products by submitting certificates. The importation and marketing of refrigerators exceeding these limits is prohibited.

For the purpose of formalizing and sustaining energy efficiency initiatives through the implementation of policies, directives, guidelines and procedures in general, aimed at recognizing and encouraging natural or legal persons, producers and importers, to introduce in the market electrical equipment with the best levels of energy efficiency, **Ecuador** issued the scheme of the Maximum Energy Efficiency Badge (DMEE) and established the guidelines and recommendations for its endorsement. This, for all electrical equipment which, after a conformity assessment process, comply with the requirements established for said purpose. The provisions contained in the aforementioned instrument are of general and compulsory application for the officials of the Ministry of Electricity and Renewable Energy involved in the implementation and development of the DMEE Initiative, and for natural or legal persons producers and/or importers of equipment that consume electric energy, which demonstrate the best and highest levels of energy efficiency, and which voluntarily apply to obtain the Maximum Energy Efficiency Badge (DMEE). The DMEE is a purchase guidance for the user, which helps to recognize in an agile and comprehensible way, the machines that offer the least energy consumption. The receivers of the DMEE must exceed 70% of the evaluation score specified in the Base Document. The DMEE will be a tool to stimulate energy efficiency by stimulating the transformation of the market towards the commercialization of efficient equipment.

In **Mexico**, the official standard, Energy Efficiency and safety requirements for the user in room type air conditioners, which sets the specifications and test methods of the Relationship of Combined Energy Efficiency (REEC) and waiting mode, as well as the user safety specifications and test methods applicable for verification became applicable. The referring normative body also determines the type of information to be included in the energy efficiency label, which, in addition to marking, must carry the appliances subject of this provision. This applies to new air conditioners, with or without heating, with air-cooled condenser and with cooling capacity of up to 10600 W, nationals and foreigners being marketed nationwide. For room type air conditioners operating in heating mode and without heating in the same unit (reverse cycle), the REEC specifications only apply for their cooling mode. It does not apply to split room type air conditioners known as mini-split. Likewise, the official standard establishing the minimum efficiency limits for general-purpose lamps came into force for lighting in residential, commercial, services, industrial and public lighting sectors, such as: incandescent, halogen incandescent, linear fluorescent, discharge in high intensity and mixed light, to be imported, manufactured, and/or marketed within the national territory. The field of application of this official Mexican standard is excluding lighting lamps with a specific Mexican standard in energy efficiency, and other specific characteristics such as black light, anti-bug, infrared among others. Additionally, the official standard establishing the minimum values of energy efficiency in operation, the maximum electrical power limits in non-load or vacuum mode, the test methods for evaluation and the specifications of the minimum information to be marked on the external power supplies (EPS) that are intended to convert the alternate current (AC) electric voltage line to a single level of electric voltage of direct current (DC) fixed output simultaneously and with a maximum output power higher or equal than 250.0 W, as well as those with a switch that allows the user to manually choose between various levels of electrical output voltage. This, being physically determined by design and independent of the product; whether being imported, manufactured, marketed, as well as those that are distributed or supplied for promotional purposes; either individually or as part of an end-use product within the national territory.

In compliance with one of the strategic priorities of the National Energy Policy, the Law of Energy Efficiency came into force in **Nicaragua**. Said law establishes the legal framework to promote the rational and efficient use of the energy, in order to guarantee the supply of energy, promote the competitiveness of the national economy, protect and improve the quality of life of the population, while contributing to the protection of the environment. The aforementioned legislation declares of national interest the rational and efficient use of energy, as an essential element for the sustainable development of the nation and of vital importance for the implementation of the country's Energy Efficiency Policy.

In order to comply with the treaties, laws and regulations ruling the matter, **Panama** approved the Technical Regulation establishing the minimum level of the Relationship of Seasonal Energy Efficiency (REEE) that all split type air conditioners with variable refrigerant flow, free discharge and no air ducts must meet, defining the requirements to be included in the information label for the public. The procedure to evaluate the conformity of the aforementioned equipment and the penalties for the breach of the established rule is included. Additionally, the technical regulations for energy efficiency for room type, central, package or split type air conditioners were approved, which set the corresponding minimum rates, provisions for labelling and test methods.

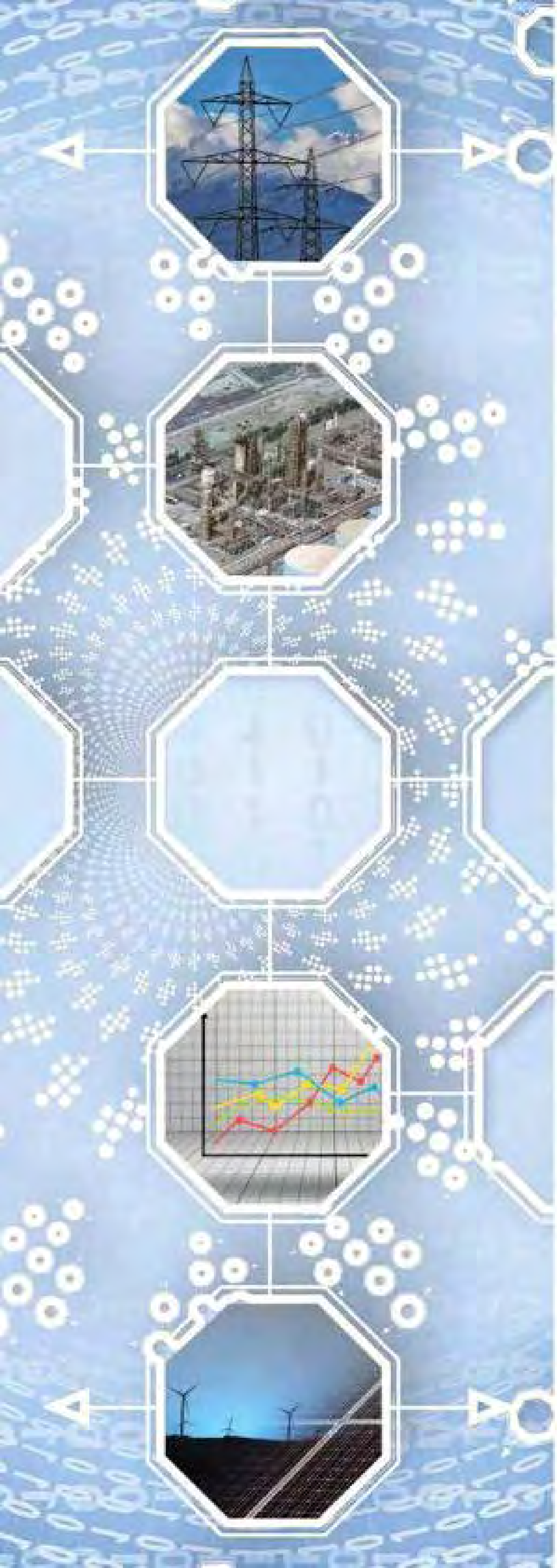
7. INTERNATIONAL AGREEMENTS, INTEGRATION AND INTERCONNECTIONS

Bolivia ratified the Framework Agreement signed in August 2015 with the Government of the Republic of Paraguay for the provision of natural gas, liquefied natural gas, liquefied petroleum gas and other petroleum derivatives, in order to promote the export of these hydrocarbons and derivatives, within the framework of article 367 of its Political State Constitution as to the priority in the supply of the domestic demand and the fulfillment of its other contractual commitments. On the other hand, the Government of the Republic of Paraguay will promote the importation of surplus Natural Gas (NG), Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG) and other petroleum derivatives, from the Plurinational State of Bolivia. The purchase and sale operations subject to the agreement will be executed by Yacimientos Petrolíferos Fiscales Bolivianos (YPFB) and Petróleos Paraguayos (PETROPAR). The Framework Agreement will last 20 years, and can be extended for the same term.

Chile enacted the agreement signed with the Federal Republic of Germany on the project "Reduction of emissions by the use of cogeneration plants in the commercial and industrial sectors in Chile", focused to contribute to the protection of the climate and to the sustainable development in the Republic of Chile through the promotion of measures for the mitigation of greenhouse gas emissions and adopted within the framework of the Basic Convention on Technical and Economic Cooperation, signed between the same Parties in the year 1995. During said cooperation framework the agreement signed with the Federal Republic of Germany on the project "Renewable energies for self-consumption in Chile", adopted by Diplomatic notes in 2017, was enacted. On the other hand, the regulation setting the requirements and the procedure applicable to requests for international exchanges of electrical services was approved via decree. The referred instrument determines that any person, natural or legal, national or foreign, may request exchange permits, and to do so they must submit an application to the Ministry of Energy. Among other provisions, it is established that the operating conditions laid down in the exchange permit shall ensure the most economical operation of the whole facilities of the electrical system and ensure compliance with the standards of safety and quality of the electrical service.

The Congress of **Colombia** approved the Paris Agreement adopted in December 2015 within the framework of the Conference of the Parties to the United Nations Convention on Climate Change (COP 21).

Ecuador ratified the Paris Agreement adopted in December 2015 within the framework of the Conference of the Parties to the United Nations Convention on Climate Change (COP 21), signed by the national government on 26 July 2016.



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 has been working continuously on planning and energy forecasting through the development of tools and mechanisms that contribute to its Member Countries' decision-making; this topic is one of the priority axes for the current management.

In this regard, from the Direction of Studies, Projects and Information, it has been considered relevant to identify how different international and other relevant organizations forecast the future of energy sector through the development of prospective studies (or Outlooks) with the aim of promoting sectoral planning.

This document collects and harmonizes the results from various prospective studies in order to provide comparable information on the behavior and historical evolution related to the supply and demand of energy for the period of 2016-2040 at the global level and disaggregated by every five years. The information published by various organizations including OLADE has been compiled and processed.

As a summary, some relevant results derived from this compilation work, carried out with information published at the global level as well as the regional level. In the global scale, the cumulative average variation rate of **primary energy consumption between** 2016 and 2040 of the 12 prospective studies analyzed is 1.12% per year, going from 13,933 Mtoe in 2016 to 18,030 Mtoe in 2040. Fossil fuels will continue its leading role in primary energy consumption in 2040 although nuclear, hydro and renewable energies grow faster. As a result, the share of oil and coal decreases while that of natural gas and renewable energies increases.

For the **final energy consumption**, electricity has the highest cumulative variation rate among the sources of final energy between 2016 and 2040 followed by natural gas, while coal has the lowest value. **Power generation** records a cumulative average variation rate of 1.98% for the six prospective studies, going from 24,732 Mtoe to 39,052 Mtoe. Considering CO2 emissions, six prospective studies indicate that it will increase until 2030 with an average of 1.03% per year and only two of them (Exxon Mobil, 2018, EQUINOR, 2018) predict that the emissions will decrease little by little after 2030 (**Figure 4.19**), an average of -0.05% per year. Despite this, the cumulative variation rate is much less than that of past 25 years as energy efficiency increases and other low-carbon fuels such as natural gas and renewables are used. The cumulative average variation rate of the six prospective studies is 0.88% per year.

For **the Latin America and the Caribbean (LAC)** region, the average variation rate of **primary energy consumption** between 2016 and 2040 of seven prospective studies is 1.93% per year, 755 Mtoe to 1,172 Mtoe. Natural gas contributes the most to the growth of primary energy consumption in LAC and this tendency is similar to the global situation.

The cumulative average variation rate of **final energy consumption** of five prospective studies is 2.06% per year, going from 563 Mtoe in 2016 to 899 Mtoe in 2040, while that of **power generation** is 2.73 % per year, going from 1,430 TWh in 2016 to 2,658 TWh in 2040.

2. RESEARCH PROCESS

2.1 Collection of Prospective Studies

To compare energy forecasts developed by different organizations, first, all the available studies were collected, identifying the periodicity and issues they address; after this process these were classified into five categories: (i) Global energy forecast studies (24); (ii) Regional energy forecast studies (46); (iii) Fuel forecast studies (28); (iv) Prospective studies including sustainable development and climate change variables (9); (v) Studies made by research institutions (2).

In total, 109 prospective studies were collected and the following selective criteria was applied:

a) Related to the base year, year 2016 served as reference in order to reflect the most current situation possibly
b) Similarity of variables that can be analyzed

With this base, 13 prospective studies were selected for this research, and the list of them is as following:

1. World Energy Outlook 2017 - International Energy Agency (IEA, 2017)
2. International Energy outlook 2017 - U.S. Energy Information Administration (DOE – EIA, 2017)
3. 2018 Outlook for Energy – Exxon Mobil (2018)
4. IEEJ Outlook 2018, Institute of Energy Economics, Japan (IEEJ, 2017)
5. BP Energy Outlook 2018 (BP, 2018)
6. World Oil Outlook 2017, Organization of the Petroleum Exporting Countries (OPEC, 2017)
7. GECF Global Gas Outlook 2017, Gas Exporting Countries Forum (GECF, 2017)
8. World Energy Scenarios 2016 – World Energy Council (WEC, 2016)
9. World Energy Scenarios 2017, Latin America and the Caribbean Energy Scenarios (WEC, 2017)
10. Food, Water, Energy, Climate Outlook 2016 – Massachusetts Institute of Technology (Chen, H. and Ejaz Qudsia, 2016)
11. Global and Russian Energy Outlook 2016 – The 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 presents descriptions of the author organizations of the Outlooks to be analized:

1. International Energy Agency (IEA)
   It is an intergovernmental organization created after the 1973 oil crisis. It seeks to coordinate the energy policies of its member countries in order to ensure reliable energy.[1]
2. U.S. Energy Information Administration (EIA)
   It is an analysis and statistics agency of the United States. The EIA is responsible for collecting, analyzing, and disseminating energy information to promote policymaking.[2]
3. ExxonMobil Corporation
   It's an American oil company, initially founded as Standard Oil Company in 1870. Its activities include the exploitation, elaboration and marketing of petroleum products and natural gas.[3]
4. The Institute of Energy Economics, Japan (IEEJ)
   Was created to carry out research activities in the area of environment and energy economy.[4]

1. https://en.wikipedia.org/wiki/International_Energy_Agency
2. https://en.wikipedia.org/wiki/Energy_Information_Administration
3. https://en.wikipedia.org/wiki/ExxonMobil
4. https://eneken.ieej.or.jp/en/about/purpose.html

5. British Petroleum (BP)
It is a multinational oil and gas company headquartered in London, and it is the third most important private company worldwide.[5]
6. The Organization of the Petroleum Exporting Countries (OPEC)
It is an intergovernmental organization founded in 1960 in Baghdad, Irak and dedicated to the oil market.[6]
7. The Gas Exporting Countries Forum (GECF)
It is an intergovernmental organization of 11 of the world's leading natural gas producers, GECF members together control over 70% of the world's natural gas reserves.[7]
8. World Energy Council (WEC)
It is an organization headquartered in London, its mission is to promote the sustainable supply and use of energy.[8]
9. Massachusetts Institute of Technology (MIT)
It is a private research university located in Cambridge, Massachusetts (United States), mainly dedicated to teaching and research.[9]
10. Energy Research Institute of Russian Academy of Sciences (ERIRAS)
It is an institute created to develop the contents of the Energy Program of the USSR, in order to propose solutions to different topics of world concern, especially in the field of energy and has eight departments for scientific research.[10]
11. Greenpeace
It is an environmental NGO founded in 1971 in Vancouver, Canada, and the objective is to protect and defend the environment.[11]
12. EQUINOR
It is a Norwegian multinational energy company headquartered in Stavanger, focused mainly on oil and wind energy with operations in 36 countries; initially it was founded with the name Statoil.[12]

2.2 Finding common variables

Each outlook contains information of energy forecasting for different issues, highlighting the following:

- Primary/Final energy consumption by fuel/region/sector
- Import/Export of fuels and prices
- Supply of energy by fuel/region/sector
- Energy investment or investment needs by fuel/region/sector
- Power generation by fuel/region/sector
- Production of fuels
- CO_2 (greenhouse gas) emissions
- Energy Efficient
- Installed capacity for the power generation

Para definir las variables a analizar, se estableció que por los menos sean consideradas en 4 de los 13 estudios prospectivos analizados; derivado de esto se obtuvieron 6 variables mundiales y 4 para ALC y se detallan en la Tabla 2.1.

5. https://en.wikipedia.org/wiki/BP
6. https://en.wikipedia.org/wiki/OPEC
7. https://en.wikipedia.org/wiki/Gas_Exporting_Countries_Forum
8. https://en.wikipedia.org/wiki/World_Energy_Council
9. https://en.wikipedia.org/wiki/Massachusetts_Institute_of_Technology
10. https://en.wikipedia.org/wiki/Energy_Research_Institute_of_Russian_Academy_of_Sciences
11. https://en.wikipedia.org/wiki/Greenpeace
12. https://en.wikipedia.org/wiki/Equinor

Table 2.1 List of common variables

Six global common variables	
1.	Global primary energy consumption by energy source (12 outlooks)
2.	Global final energy consumption by fuel type (4 outlooks)
3.	Global final energy consumption by sector (4 outlooks)
4.	Global power generation by energy source (6 outlooks)
5.	Global natural gas production (4 outlooks)
6.	Global CO_2 emissions (5 outlooks)
Four LAC common variables	
7.	LAC primary energy consumption by energy source (6 outlooks)
8.	LAC final energy consumption by fuel type (4 outlooks)
9.	LAC final energy consumption by sector (4 outlooks)
10.	LAC power generation by energy source (5 outlooks)

Source: Own elaboration.

2.3 Data collecting

Each outlook has different scenarios which are called in different ways, which is why, scenarios with characteristics as similar as possible were selected. Thus, base scenarios ("business-as-usual" or BAU) were used, meaning those with trending nature that do not add more counterfactual hypotheses that those already happening from trends and in force policies. The purpose of using these scenarios is to obtain results that are as comparable as possible. Despite this, and given that in each outlook a different simulation model is used, there might be differences in the way the diverse forecasts are made. The objective of this work is to show the general results obtained from each study, with the aim of providing a comparability framework that allows to know how each of them conceives the future evolution of said general results and not of comparing models with each other.

Likewise, the units were standardized by converting all the available information to Million tonnes of oil equivalent (Mtoe); Terawatt hour (TWh) for variables associated to power generation and Millions of tonnes (Mt) for emissions.

For the time periods, each outlook may have different periods. Given that the period 2016 - 2040 was used as reference, the values were extrapolated by every five years. Which is why the interannual variation rates through the cumulative average variation rate were calculated:

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

where:

$$\overline{VR^{t}_{t+n}} = \text{Cumulative average variation rate between } t+n \text{ and } t$$
$$M_t = \text{Amount or value in time } t$$
$$M_{t+n} = \text{Amount or value in time } t+n$$

Thus, the variation rate for the whole period TT between t and t + n can be calculated through the following equation:

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

Being both rates expressed as percentages.

3. *USED HYPOTHESES*

Most of the outlooks consider some socioeconomic variables such as population and GDP for the analysis to build each scenario. Table 3.1 and 3.2 show the period, scenarios, and growth rate used in each outlook.

Table 3.1 Main hypotheses of each outlook global scale

	Period	Scenario	GDP growth rate (% p.y.)	Population growth rate (% p.y.)
IEA (2017)	2016 – 2040	Current Policy	3.4	0.9
DOE – EIA (2017)	2015 – 2050	Reference	2.8	0.8
ExxonMobil (2018)	2016 – 2040	Baseline	2.8	*0.95
IEEJ (2017)	2015 – 2050	Reference	2.7	0.8
BP (2018)	2016 – 2040	**ET	3.25	*0.89
OPEC (2017)	2015 – 2040	Reference	3.5	0.7
GECF (2017)	2016 – 2040	Reference	3.4	*0.89
WEC (2017)	2015 – 2060	**Modern jazz	3.3	0.7
MIT (2016)	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)	2015 – 2050	**Rivalry	1.9	*0.82

Source: Data reported by each international organization.
** Own estimation.*
*** ET - 'the Evolving Transition' scenario.*
Modern jazz – Suppose the highly productive world, with rapid economic growth.
Rivalry - It assumes a volatile geopolitical environment, with less environmental regulation.

Table 3.2 Main hypotheses of each outlook – LAC

	Period	GDP growth rate (% p.a.)	Population growth rate (% p.a.)
IEA (2017)	2016 – 2040	2.8	0.7
ExxonMobil (2018)	2016 – 2040	2.8	**
IEEJ (2017)	2015 – 2050	2.7	0.8
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 (2015)	2016 – 2040	2	1.14

Source: Data reported by each international organization.
** Own Estimations own from the Modern jazz scenario (rapid economical growth).*
***For the case of ExxonMobil, population data are not shown which is why it wasn't possible to calculate growth rates.*

AIE: *LAC- OLADE Member Countries plus Antigua and Barbuda, Aruba, Bahamas, Barbados, Bermuda, British Virgin Islands, Caiman Islands, Falkland Islands, French Guiana, Guadalupe, 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 - Countries of the AIE.*
OLADE: *LAC – Argentina, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad & Tobago, Uruguay and Venezuela.*

4. GLOBAL RESULT ANALYSIS

4.1. Primary energy consumption

Each outlook has different definition about primary energy consumption. For example, IEA and GECF have the same definition, representing domestic demand only and excluding production from pumped storage and marine (tide and wave) plants for the part of hydroenergy. In the case of BP, it excludes traditional biomass. WEC, brings a conception of total primary energy supply. Table 4.1 shows primary energy consumption of different organizations.

Table 4.1 Global primary energy consumption by organization

Mtoe	2016	2020	2025	2030	2035	2040
IEA	13,760	14,690	15,690	16,896	18,182	19,299
EIA	14,563	15,120	15,873	16,578	17430	18410
EXXONMOBIL	13,806	14469	15,335	16,063	16,630	17,025
IEEJ	13,929	14,609	15,656	16,559	17,537	18,369
BP	13,276	14,278	15,375	16,317	17,160	17,983
OPEC	14,244	15,105	16,224	17,202	18,069	18,818
GECF	14,185	14,965	15,802	16,574	17,186	17,734
WEC	14,089	14,794	15492	16,086	16,360	16,660
MIT	12,696	13,109	14,140	15,141	16,052	16,948
ERIRAS	14,067	14,680	15,507	16,252	16,949	17,576
GREENPEACE	14,774	15,740	16,920	18,130	19,298	20,300
EQUINOR	13,913	14,791	15,950	16,700	16,966	17,249

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 cumulative variation rate of global primary energy consumption for each organization.

Table 4.2 Variation rate of global primary energy consumption

Annual variation rate 2016-2040 (%)					
IEA	EIA	EXXON	IEEJ	BP	OPEC
40.25	26.41	23.31	32.83	35.46	32.11
GECF	WEC	MIT	ERIRAS	GREENPEACE	EQUINOR
25.02	18.18	33.49	24.94	37.40	23.97
Annual cumulative average variation rate 2016-2040 (%)					
IEA	EIA	EXXON	IEEJ	BP	OPEC
1.48	1.02	0.92	1.24	1.33	1.22
GECF	WEC	MIT	ERIRAS	GREENPEACE	EQUINOR
0.98	0.73	1.26	0.97	1.39	0.94

Source: Data reported by each international organization.

The cumulative average variation rate between 2016 and 2040 of the twelve outlooks is 1.12% per annual, going from 13,933 Mtoe in 2016 to 18,030 Mtoe in 2040. The highest expectation is 1.48% per year of IEA and the lowest is 0.73% of WEC.

4.1.1 Primary energy consumption by fuel type

The following are the results for the main primary energy sources:

Oil

The highest annual cumulative average variation rate is 0.97% of IEEJ and the lowest is 0.40% of ERIRAS and the average rate of the twelve outlooks is 0.71% per year.

Most part of the increase of oil consumption is due to non-OECD countries mainly China and India corresponding to the rise of population and industry. For example, ExxonMobil indicates that the growth will come from commercial transport and chemical products sectors and that "Asia Pacific will account for nearly 65 % of the increase in global liquids demand to 2040, surpassing the combined liquids demand of North America and Europe by 2050" (ExxonMobil, 2018, p. 34).[13]

Every outlook predicts that oil will continue to have the highest share among all the fuels until 2040 (**Figure 4.2**) while all the graphs except EQUINOR show that the share of oil decreases. IEEJ predicts that "its share of primary energy consumption will fall due to fuel switching to natural gas and progress in energy efficiency in the transport sector" (IEEJ, 2017, p. 33).[14]

Natural gas

The highest annual cumulative average variation rate is 1.94% of IEA and the lowest is 0.93% of EQUINOR and the average rate of the twelve outlooks is 1.62% per year.

13. "2018 Outlook for Energy: A View to 2040", Exxon Mobil, 2018, 34p.
14. "IEEJ Outlook 2018 – Prospects and challenges until 2050", IEEJ, 2017, 33p.

Natural Gas contributes the most to the growth of primary energy consumption in almost every outlook except BP (BP expects that contribution of renewable energy will be larger, **Figure 4.5**). OPEC expects that at the global level, the largest contribution to future energy demand is projected to come from natural gas. This is because natural gas is a key alternative source for less CO_2 emissions and useful in every sector.

There are several more reasons why the share of natural gas grows. For instance, BP expects that "natural gas grows strongly, supported by broad-based demand, strong increases in low-cost supplies, and continuing expansion of supplies of liquefied natural gas (LNG) increasing the availability of gas globally" (BP, 2018, p. 81).[15] Also GECF reports that "a growing urban population will require more gas-powered electricity and growing extraction of unconventional natural gas reserves in the US and China will dramatically increase natural gas demand" (GECF, 2017, p. 45).[16]

Coal

The highest annual cumulative average variation rate is 1.50% of GREENPEACE and the lowest is -0.96% of WEC and the average rate of the twelve outlooks is 0.33% per year.

Coal was the second most consumed fuel in 2016. This trend changes gradually because coal will be substituted by natural gas and renewable energies. But it still remains significant in 2040 as well. The share of coal decreases gradually in all outlooks except GREENPEACE (**Figure 4.2**).

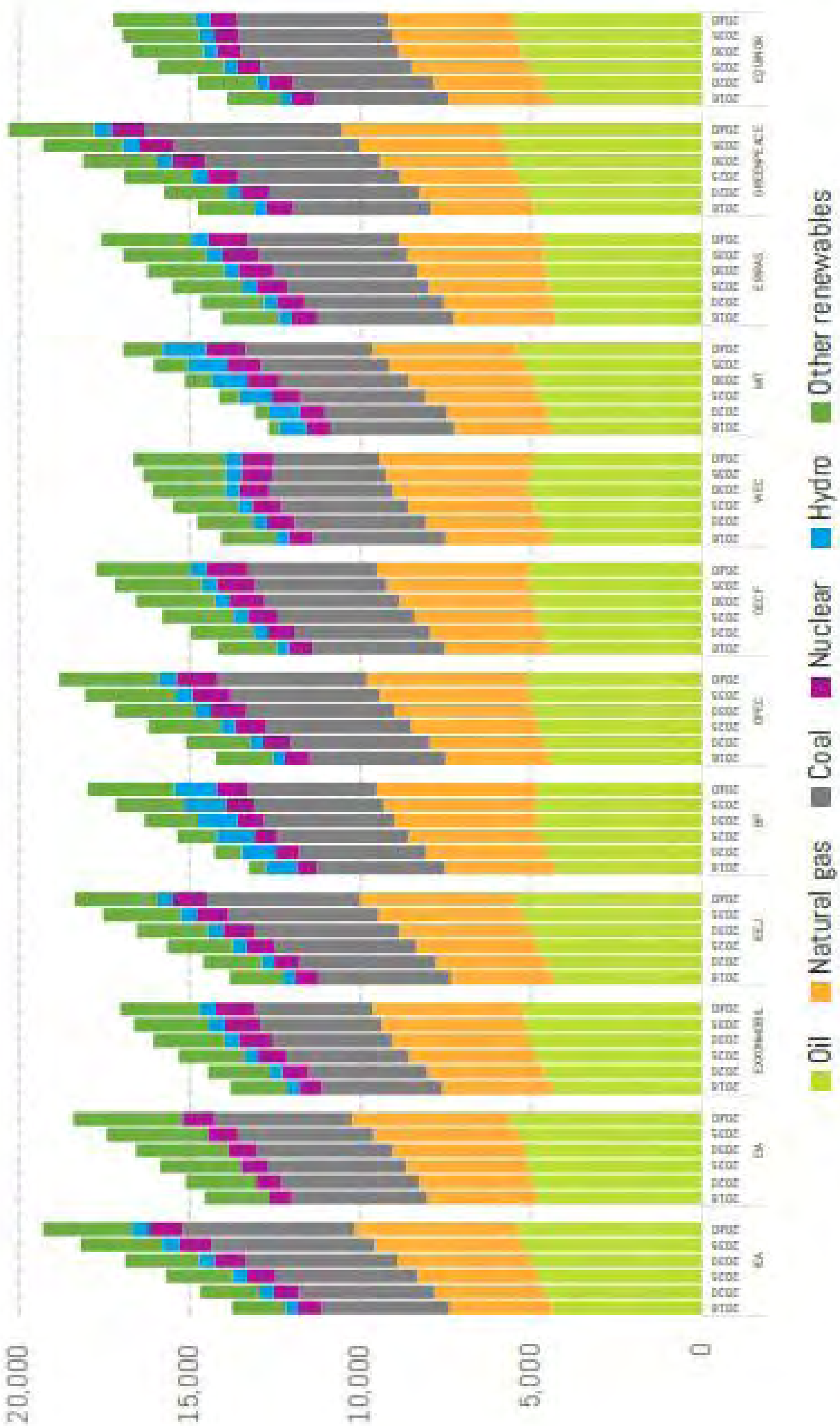
IEA shows the highest cumulative average variation rate in primary energy consumption. At the same time, it shows an optimistic prediction about the future of coal, which is different from predictions of other outlooks. The share of coal is 27.3% in 2016 and slightly reduces to 26.1% in 2040 while total amount of coal in primary energy consumption increases continuously.

In contrast, EIA predicts that "Worldwide coal consumption remains roughly the same between 2015 and 2040 with decreasing consumption in China and the United States offsetting growth in India" (DOE - EIA, 2017 p. 64).[17]

In some outlooks such as ExxonMobil, GECF and WEC, it is expected that the amount of coal as a primary energy source in 2040 would be less than that of 2016. In the case of WEC, **Figure 4.3**, it shows the decline compared to other samples. About this point of view, WEC forecasts that "this is because coal production is dominated by China and India throughout the period. Coal will peak in 2020 in China at 2,080 Mtoe, and decline at a rate of 2.4% from 2020 to 2060. By 2060, coal will decline by more than 1,000 Mtoe in Chinese primary energy. This coupled with continued declines in North America, Europe and the rest of Asia, which lead to a global coal decline of 2.3% per yerar from 2030 to 2060" (WEC, 2016, p. 49).[18]

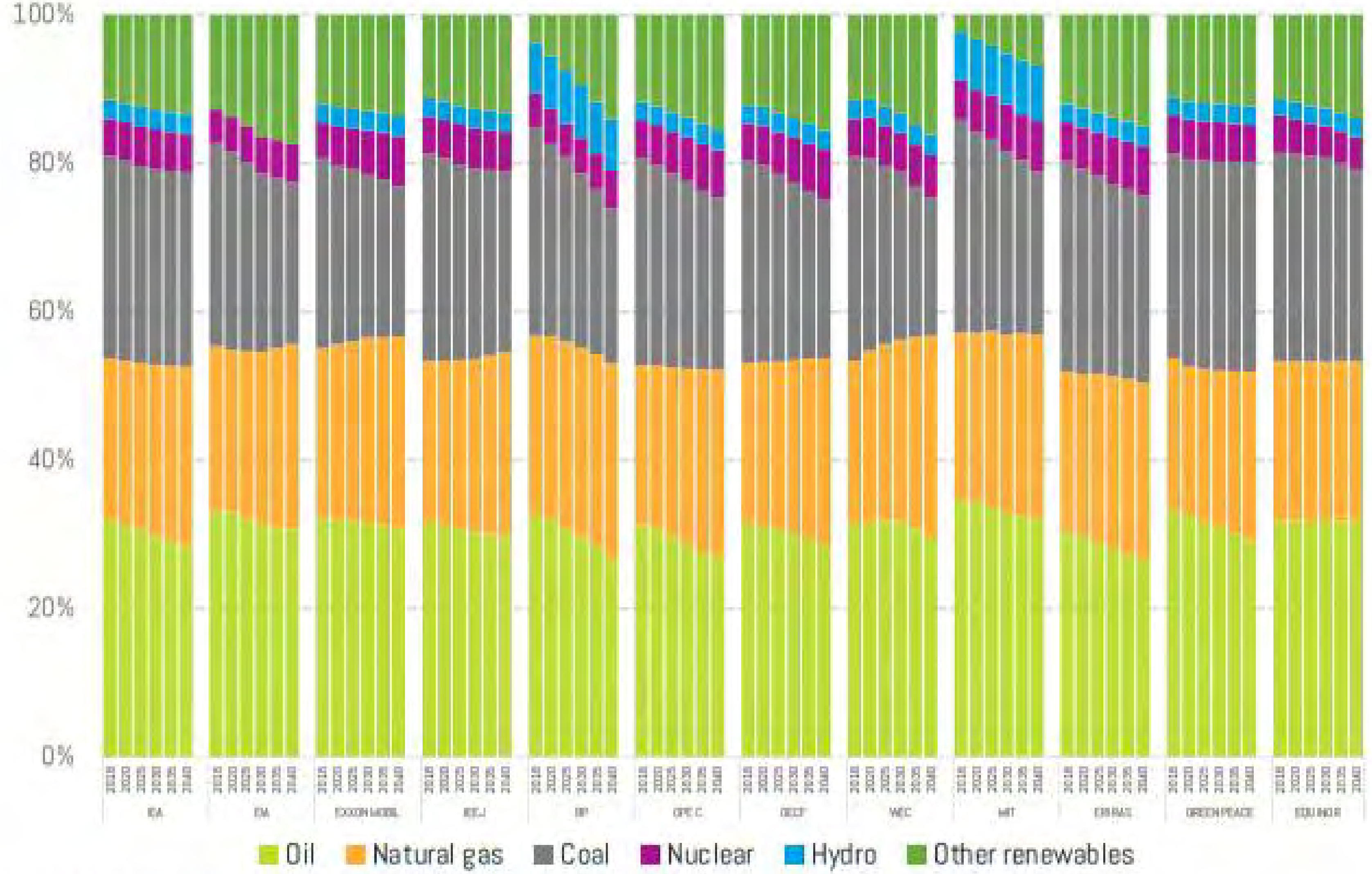
15. "BP Energy Outlook", BP, 2018, 81p.
16. "Global Gas Outlook", GECF, 2017, 45p.
17. "International Energy Outlook 2017", US DOE/EIA, 2017, 64p.
18. "World Energy Scenarios 2016 – The grand transition", WEC, 2016, 49p.

Figure 4.1 Global primary energy consumption by energy source



Source: OLADE own figure 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 global primary energy consumption by energy source



Source: OLADE own figure based on data reported by international organizations

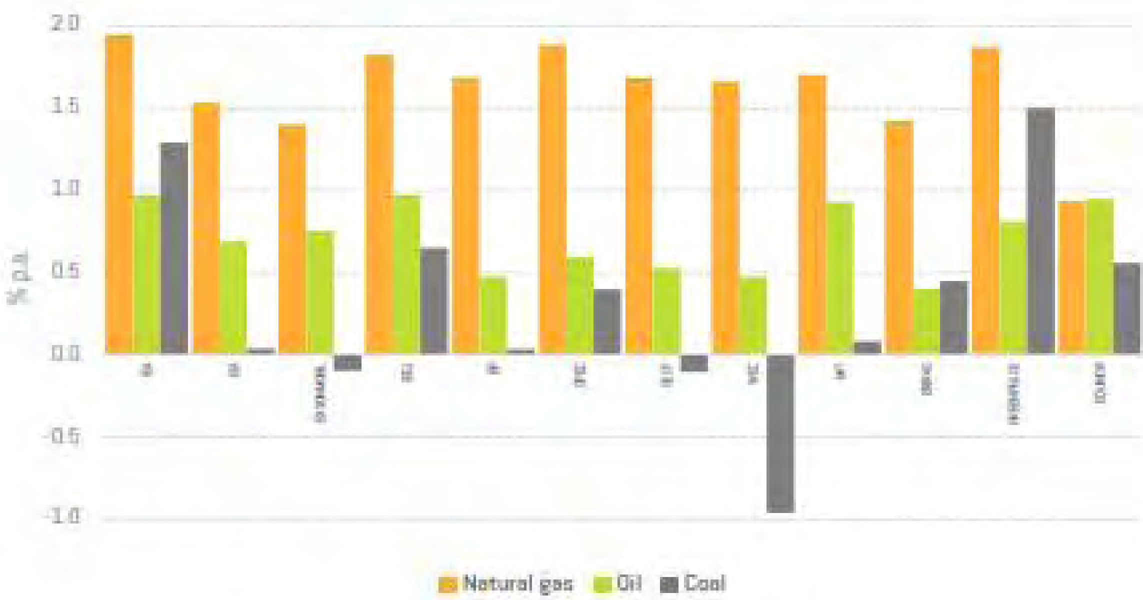
Definition: IEA, EXXONMOBIL, OPEC, GECF, GREENPEACE, EQUINOR _ Primary energy demand

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 global primary energy consumption
(fossil fuels 2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.

Hydro

The highest annual cumulative average variation rate is 1.90% of MIT and the lowest is 1.18% of GECF and the average rate of the eleven outlooks is 1.47% per year.

During 2016-2040, hydro has the lowest share of primary energy consumption in almost every outlook analyzed except BP and MIT.

Hydroenergy has more restriction over environmental issues compared to other sources. When it comes to the growth of hydropower, BP mentions that "Growth in hydropower is more broadly based across developing economies. China contributes with the largest increase supported by growth in both South and Central America and Africa" (BP, 2018, p. 101).

Nuclear

The highest annual cumulative average variation rate is 2.42% of MIT and the lowest is 0.31% of EQUINOR and the average rate of the twelve outlooks is 1.72% per year.

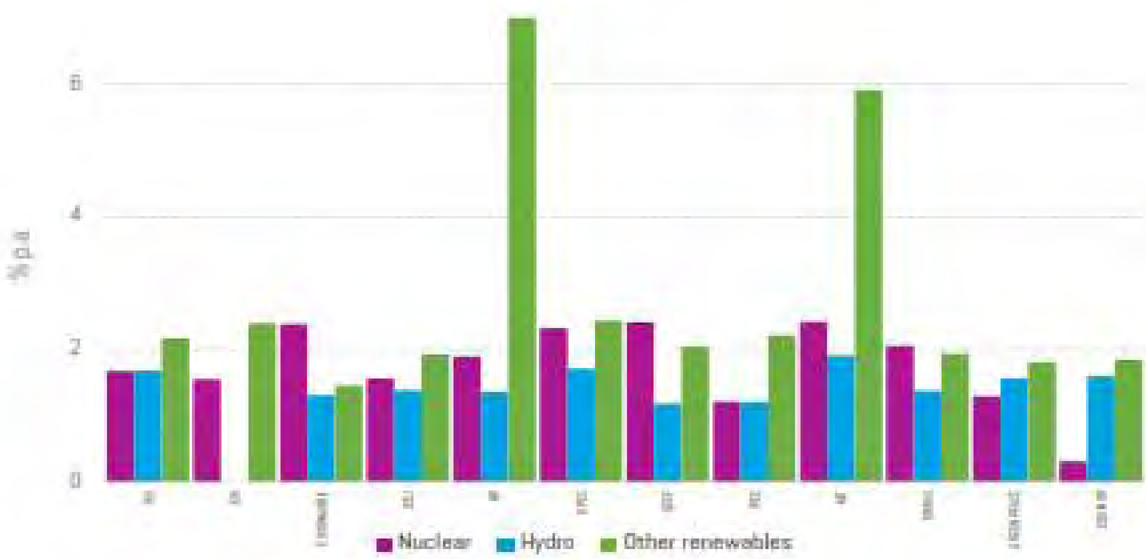
IEEJ forecasts that "the nuclear power generation growth will center on emerging countries that require massive amounts of electricity to sustain their stable economic growth" (IEEJ, 2017, p. 39). EQUINOR also mentions that "currently we see a slight revival of investments in nuclear generation capacity, driven to a large extent by government pledges to reduce CO_2 emissions, in addition to energy security concerns" (EQUINOR, 2018, p. 54)

Other renewables

The highest annual cumulative average variation rate is 7.28% of BP and the lowest is 1.46% of ExxonMobil, and the average rate of the twelve outlooks is 2.76% per year.

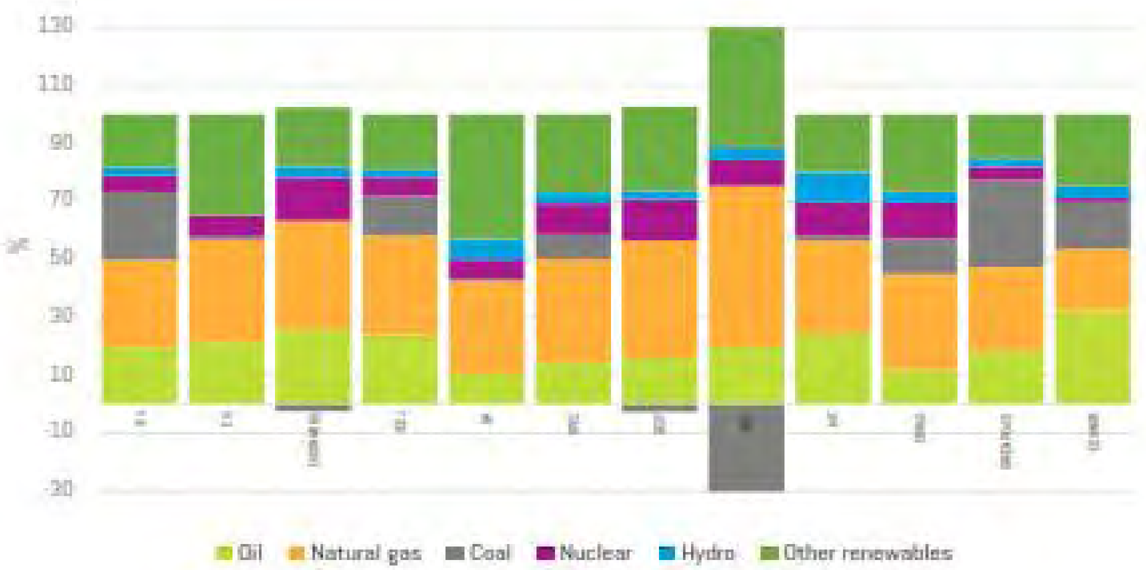
BP (2018) affirms that "renewable energy will be the fastest growing energy source, accounting for 40% of the increase in primary energy consumption. The energy mix by 2040 is the most diversified ever seen" (**Figure 4.4**). At the same time the outlook mentions that "this is enabled by the increasing competitiveness of wind and solar power and aided by a gradual rise in carbon prices and continued regulation supporting a shift to lower carbon energy" (BP, 2018, p. 95)

Figure 4.4 Variation rate of global primary energy consumption (non-fossil fuels 2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.

Figure 4.5 Contribution to growth of global primary energy consumption (2016-2040)



Source: OLADE own elaboratione based on data reported by international organizations.

4.2 Final energy consumption

IEEJ reports that "between 1990 and 2015, annual growth in final energy consumption came to 1.6% against the annual real GDP growth rate of 2.8%. In non-OECD, final energy consumption grew at an annual rate of 2.4% due primarily to a higher annual economic growth of 4.7%, increasing production in energy-intensive industries and population growth" (IEEJ, 2017, p. 41).

Table 4.3 shows the prediction of global total final energy consumption from each outlook.

Table 4.3 Global total final energy consumption

Mtoe	2016	2020	2025	2030	2035	2040
IEA	9,496	10,184	10,943	11,799	12,664	13,419
IEEJ	9,509	10,035	10,741	11,348	12,032	12,617
WEC	9,841	10,554	11,179	11,713	12,054	12,358
GREENPEACE	9,379	9,999	10,799	11,597	12,327	12,964

Source: *Data reported by each international organization.*

4.2.1 By type of fuel

Four outlooks (IEA, IEEJ, WEC, GREENPEACE) offer information about final energy consumption by fuel. The following analysis is made for the main sources of the final energy consumption:

Oil and oil derivatives

The highest annual cumulative average variation rate is 1.20% of IEA and the lowest is 0.51% of WEC and the average rate of the four outlooks is 0.95% per year. the oil and oil derivatives are the most used source for final energy consumption in 2016 and this is the same until 2040 in every outlook. The share of oil among fuels is the largest but it will decrease little by little with an increase of natural gas and electricity.

IEEJ states that "oil and oil derivatives consumption will increase as a result of growth in the non-OECD transport and non-energy use sectors. Vehicle ownership will rapidly expand mainly in China, India and other non-OECD Asian countries, as motorization makes progress in line with income growth" (IEEJ, 2017, p. 44).

Natural Gas

The highest annual cumulative average variation rate is 2.15% of IEA and the lowest is 1.50% of WEC and the average rate of the four outlooks is 1.74% per year.

The use of natural gas for final energy consumption will increase gradually until 2040, showing the second largest cumulative variation rate among five fuels. Its share will increase as well, but it will stay within 15-19% during the research period.

According to **IEEJ**, "natural gas consumption will substantially expand in China's residential sector and the Middle East's industry sector. The Chinese residential sector still uses coal and biomass including firewood and will switch from them to city gas in consideration of air pollution problems. The Middle East will promote domestic natural gas utilization to earn foreign currencies from oil exports and will expand petrochemical plants using natural gas to generate jobs" (IEEJ, 2017, ps. 44 – 45).

Coal

The highest annual cumulative average variation rate is 0.78% of IEA and the lowest is 0.09% of WEC and the average rate of the four outlooks is 0.49% per year.

Coal has the smallest share among fuels for final energy consumption and its share will stay within 8-12% in every outlook until 2040. Its cumulative variation rate is the lowest as well, comparing with other sources.

Electricity

The highest annual cumulative average variation rate is 2.43% of IEA and the lowest is 1.92% of WEC and the average rate of the four outlooks is 2.21% per year.

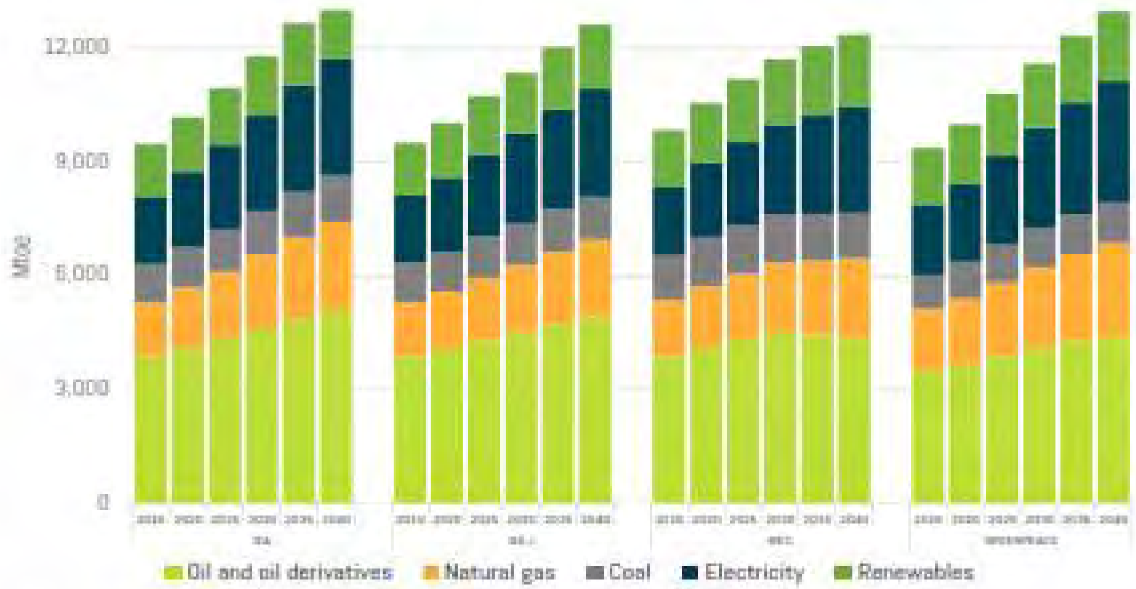
In every outlook, electricity is shown as a source having the largest contribution to the growth of final energy consumption. The average share of electricity for the contribution to the growth among four outlooks is 36.2%.

As the economy grows, needs for electricity also grows. In this point of view IEEJ analyzes that "Asia will promote electricity consumption growth including China, India and ASEAN, as well as the Middle East and emerging countries like Brazil. In any country or region, electricity infrastructure development both in rural and urban areas and in the penetration of electrical home appliances like air conditioners and televisions under growing income will include electricity consumption growth" (IEEJ, 2017, p. 45).

Renewables

The highest annual cumulative average variation rate is 1.06% of WEC and the lowest is 0.86% of GREENPEACE, and the average rate of the four outlooks is 0.91% per year.
According to the IEA, "the contribution of direct and indirect renewable energy to total final energy consumption will increase from 9% in 2016 to 13% in 2040, approximately 900 Mtoe. Almost half of the increase comes in the form of heat, while the renewable share of transport fuels will only increase from 3% to 4% by 2040" (IEA, 2017, p. 298).

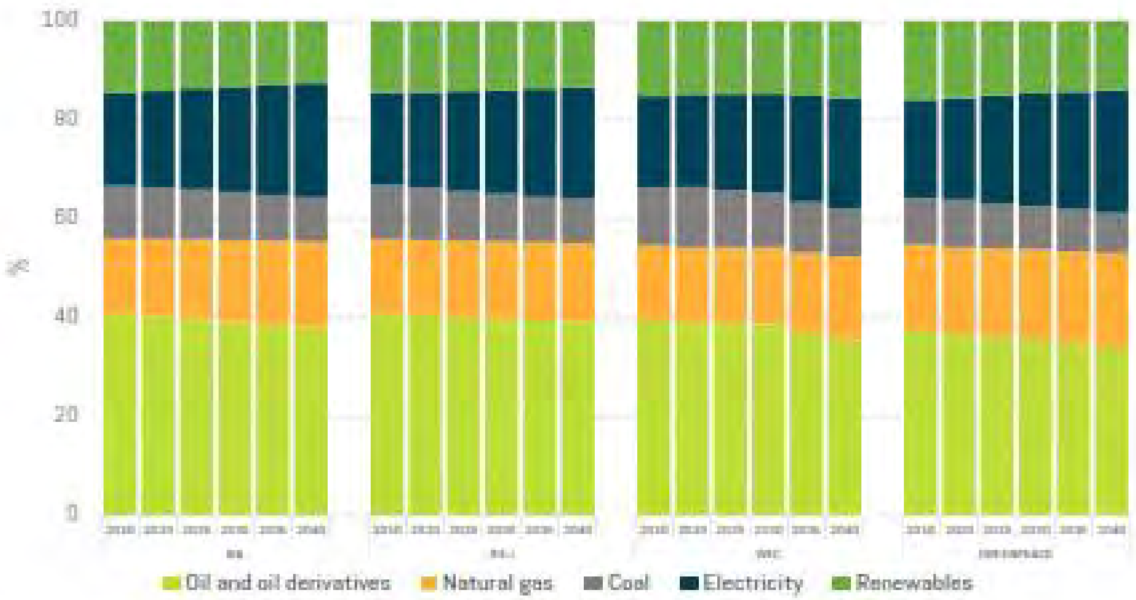
Figure 4.6 Global Final energy consumption by fuel type



Source: OLADE own elaboration 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).

COMPARATIVE PROSPECTIVES

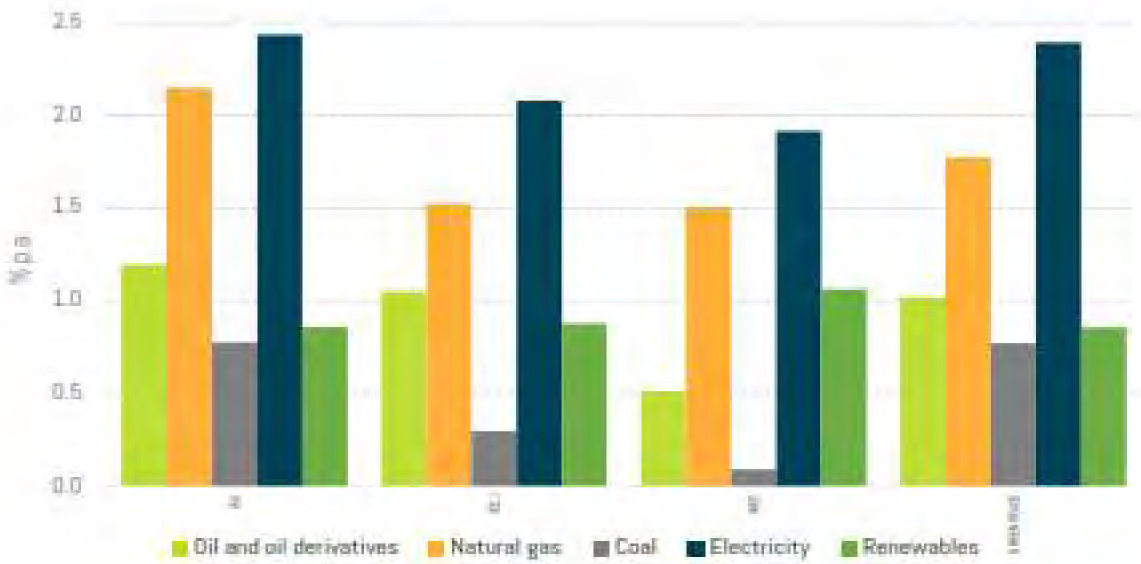
Figure 4.7 Share of global Final energy consumption by fuel type



Source: OLADE own elaboration 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).

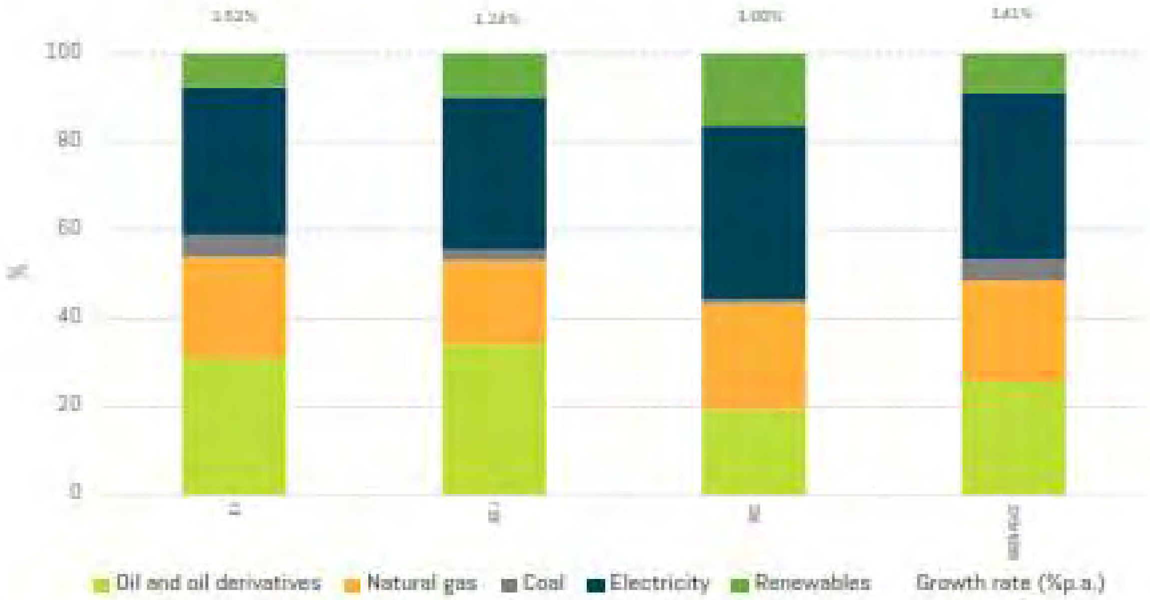
These outlooks have similar tendencies. For example, electricity has the highest cumulative average variation rate among the energy sources of final energy between 2016 and 2040 followed by natural gas, while coal has the lowest value in all outlooks (**Figure 4.8**).

Figure 4.8 Variation rate of global final energy consumption by fuel type (2016-2040)



Source: OLADE own elaboration 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).

Figure 4.9 Contribution to growth of global final energy consumption by fuel typ (2016-2040)



Source: OLADE own figure 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 signify annual cumulative average variation rate of total final energy consumption predicted in each outlook.

4.2.2 By sector

Definitions of economic sectors are defined separately in each outlook. IEA defines the industry sector as the fuel used within the manufacturing and construction industries. Key industry branches include iron and steel, chemical and petrochemical, cement, pulp and paper. Use by industries for the transformation of energy into another form or for the production of fuels is excluded and reported separately under other energy sector. Consumption of fuels for the transport of goods is reported as part of the transport sector, while consumption by off-road vehicles is reported under industry.

The transport sector is defined as: fuels and electricity used in the transport of goods or persons within the national territory regardless of the economic sector within which the activity occurs. This includes fuel and electricity delivered to vehicles using public roads or for use in rail vehicles; fuel delivered to vessels for domestic navigation; fuel delivered to aircraft for domestic aviation; and energy consumed in the delivery of fuels through pipelines. Fuel delivered to international marine and aviation bunkers is presented only at the world level and is excluded from the transport sector at the domestic level.

When it comes to the other sectors, it includes buildings, residential (Energy used by households including space heating and cooling, water heating, lighting, appliances, electronic devices and cooking equipment), etc. For the non-energy use sector, it includes fuels used for chemical feedstocks and non-energy products. Examples of non-energy products include lubricants, paraffin waxes, asphalt, bitumen, coal tars and oils as timber preservatives (AIE, 2017, p. 743 – 747).

GREENPEACE defines industry as following: consumption in the industry sector includes the following subsectors (energy used for transport by industry is not included, see under "transport") e.g. iron and steel industry; chemical industry; non-metallic mineral products e.g. glass, ceramic, cement etc.; transport equipment; machinery; mining; food and tobacco; paper, pulp and print; wood and wood products (other than pulp and paper); construction; textile and Leather.

The transport sector includes all fuels from transport such as road, railway, aviation, domestic navigation. Fuel used for ocean, coastal and inland fishing is included in "other sectors". Other sectors cover agriculture, forestry, fishing, residential, commercial and public services. Non-energy use sector covers use of other petroleum products such as paraffin waxes, lubricants, bitumen etc.

In 2016, the four outlooks show that the consumption of the residential sector will surpass that of transport sector. However, in 2040, IEEJ forecasts that the transport sector will have the greatest consumption.

Final energy consumption shows a different tendency in OECD and non-OECD countries. IEEJ also mentions, "from 2015 to 2050, final energy consumption will follow a downtrend in OECD as a slight increase in the buildings and industry sectors is offset by a fall accompanying vehicle fuel efficiency improvements in the transport sector. In non-OECD, final energy consumption will increase rapidly in each of the buildings, industry, and transport sectors" (IEEJ, 2017, p. 43)

Industry

The highest annual cumulative average variation rate is 1.70% of IEA and the lowest is 1.07% of IEEJ, and the average rate of the four outlooks is 1.40% per year.

Most part of the growth of the industry sector will come from developing countries. For example, IEEJ expects the growth "as many non-OECD countries achieve high economic growth and shift from agriculture and other primary industries to manufacturing industries" (IEEJ, 2017, p. 43)

Transport

The highest annual cumulative average variation rate is 1.54% of IEA and the lowest is 0.91% of WEC, and the average rate of the four outlooks is 1.27% per year.

Fuels for transport will be diversified with development of technology such as electric vehicles (EVs). IEEJ reports that "the transport sector's energy consumption will decline at 0.5% per year in OECD due to vehicle fuel efficiency improvements, while increasing at 1.9% per year in non-OECD as the effects of the vehicle ownership expansion outdo fuel efficiency improvements" (IEEJ, 2017, p. 44)

Others

The highest annual cumulative average variation rate is 1.39% of IEEJ and the lowest is 0.66% of WEC, and the average rate of the four outlooks is 1.16% per year.

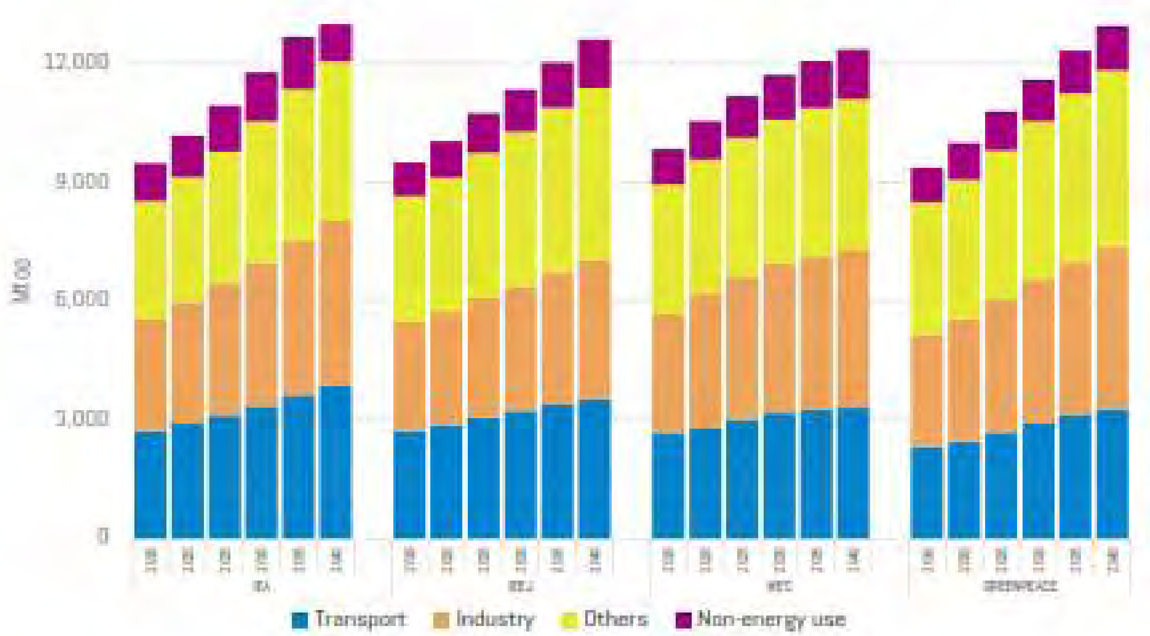
This sector normally includes residential and commercial consumption. WEC reports that "the growing availability of Smart Grids, Smart Meters, and Smart Appliances gives consumers more information and autonomy to do more with less energy and quantifies the value of investment. As a result, this sector's energy demand use grows at a moderated pace" (WEC, 2016, p. 45).

Non-energy use

The highest annual cumulative average variation rate is 1.61% of IEA and the lowest is 1.06% of GREENPEACE, and the average rate of the four outlooks is 1.45% per year.

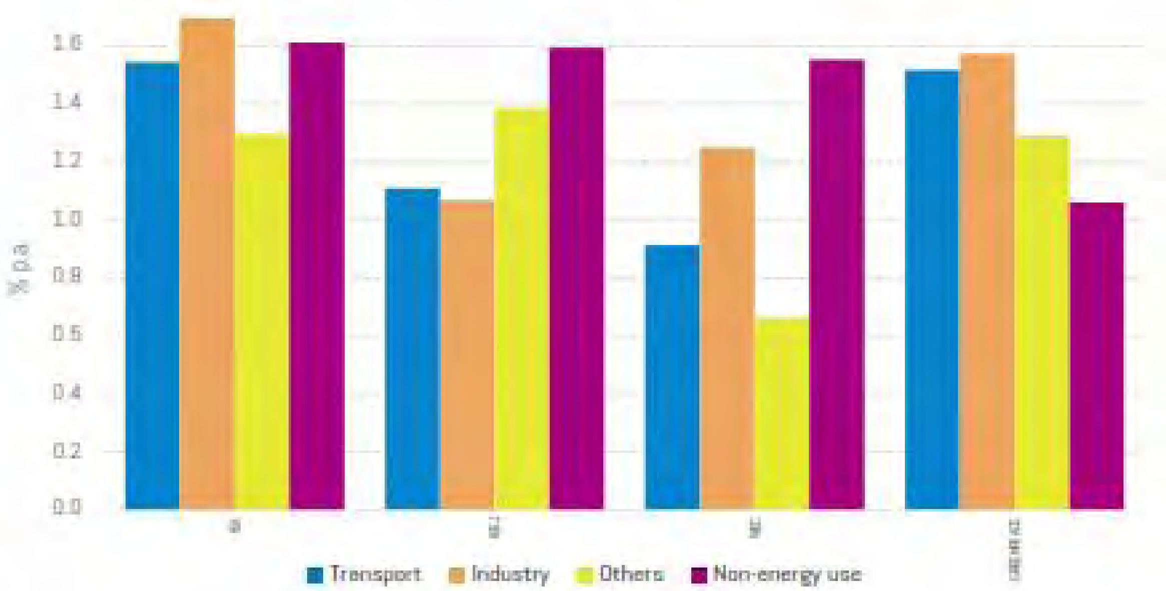
The growth is coming from demand for chemicals of developing markets such as China and India (WEC, 2016, p. 45).

Figure 4.10 Global final energy consumption by sector



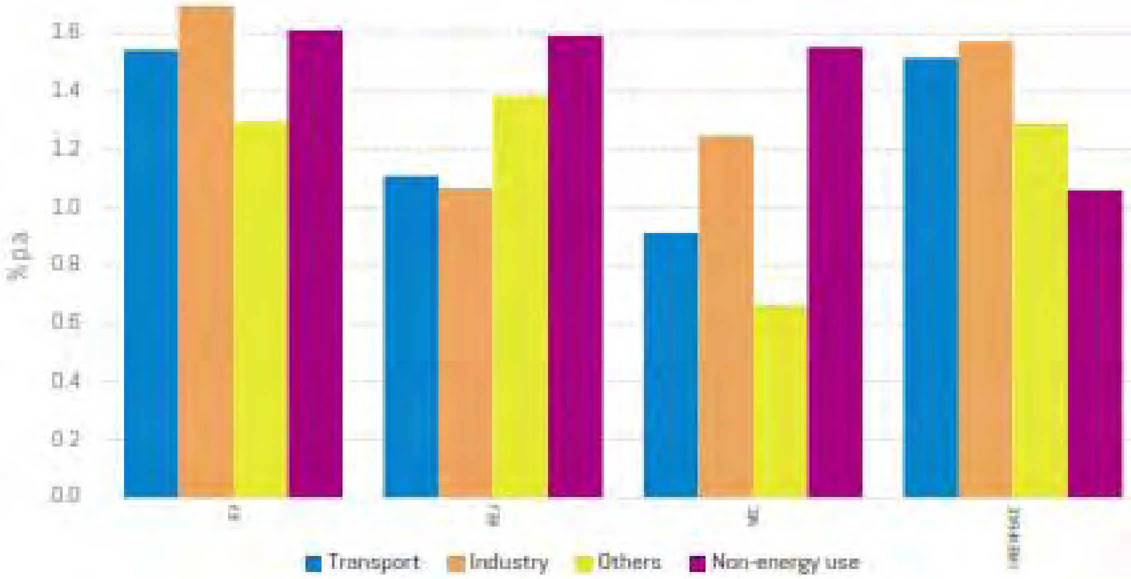
Source: OLADE own elaboration based on data reported by international organizations.
Others include: buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 4.11 Share of global final energy consumption by sector



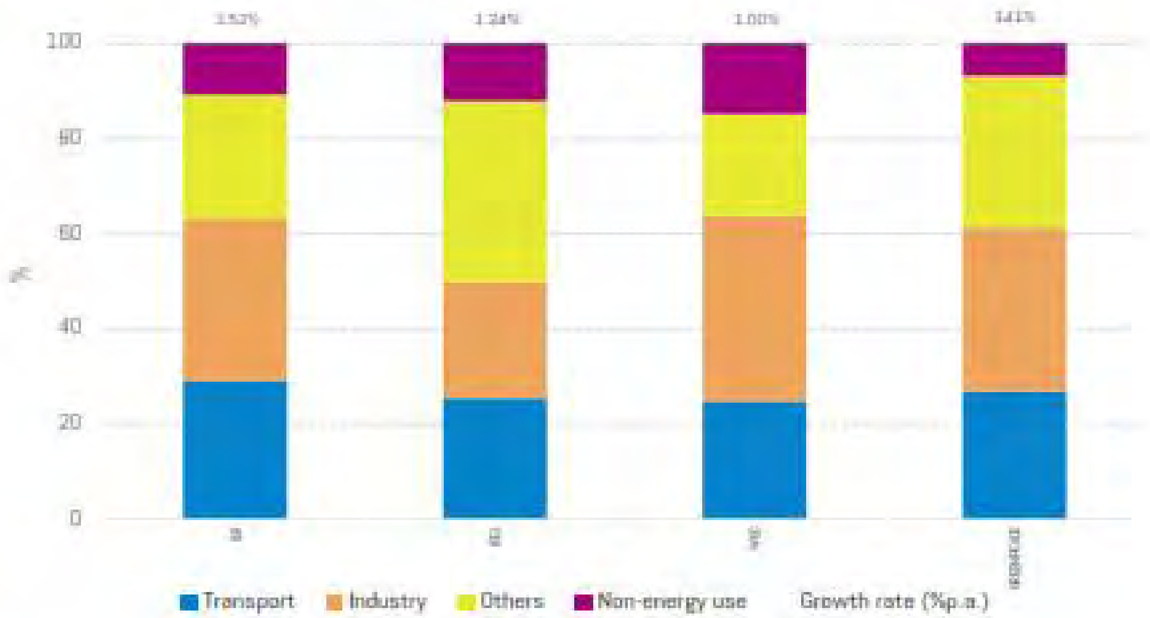
Source: OLADE own elaboration based on data reported by international organizations.
Others include: buildings (residential, commercial) for IEA, IEEJ, WEC; agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 4.12 Variation rate of global final energy consumption by sector (2016-2040)



Source: OLADE own elaboration 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 growth of global final energy consumption by sector (2016-2040)



Source: OLADE own elaboration 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 signify annual cumulative average variation rate of total final energy consumption predicted in each outlook.

COMPARATIVE PROSPECTIVES

4.3 Power generation

Six outlooks (IEA, IEEJ, WEC, MIT, ERIRAS, GREENPEACE) offer information about power generation by fuel. The average variation rate between 2016 and 2040 is 1.98 % for the six outlooks, going from 24,732 TWh in 2016 to 39,052 TWh in 2040.

Table 4.4 shows the data of global power generation by organization.

Table 4.4 Global power generation

TWh	2016	2020	2025	2030	2035	2040
IEA	24,765	27,523	30,724	34,583	38,667	42,322
IEEJ	24,764	26,966	30,099	32,963	36,195	39,096
WEC	24,982	27,124	29,578	32,151	34,886	37,724
MIT	22,913	24,508	26,967	29,406	31,675	33,947
ERIRAS	25,219	27,424	30,215	32,791	35,126	37,218
GREENPEACE	25,749	28,492	32,374	36,256	40,353	44,009

Source: Data reported by each international organization.

4.3.1 By energy source

Every outlook expects that total power generation will increase approximately 1.99% per year during the forecast period 2016-2040. Although each outlook shows different tendency when it comes to the fuels, the main growth is concentrated in the developing countries of Asia, Africa, and Middle East.

The following is an analysis for the power generation by energy source.

Oil and oil derivatives

The highest annual cumulative average variation rate is 0.71% of MIT and the lowest is -3.12% of WEC, and the average rate of the six outlooks is -1.48% per year.

Almost every outlook except MIT forecasts that oil use for power generation will decrease as well as its share (Figure 4.15). IEEJ indicates that "the share for oil will trend down in developed countries as well as in the oil-rich Middle East" (IEEJ, 2017, p. 61).

Natural gas

The highest annual cumulative average variation rate is 3.27% of WEC and the lowest is 2.40% of ERIRAS, and the average rate of the six outlooks is 2.71% per year.

Natural gas will remain as the second largest fuel for power generation until 2040. It also has the second highest cumulative variation rate among six fuels. Three outlooks (IEEJ, MIT, ERIRAS) predict that natural gas will contribute the most to the growth of power generation until 2040, with an average of 33.8% comparing the six outlooks.

IEEJ expects that "as technological development allows combined cycle gas turbines (CCGTs) to diffuse, with gas turbines used to adjust for variable renewable power generation, a shift to natural gas for power generation will make progress" (IEEJ, 2017, p. 60). However, "the role of gas in electricity generation will differ greatly across the regions of the world, because of its regional pricing which affects the competitiveness of gas-fired generation" (ERIRAS, 2016, p. 46).

Coal

The highest annual cumulative average variation rate is 2.41% of GREENPEACE and the lowest is -1.08% of WEC, and the average rate of six outlooks is 0.92% p.a.

WEC forecasts that coal use for power generation will decrease gradually because it will be substituted to others such as natural gas and renewables. The other outlooks predict that power generation by coal will maintain its leading role globally by the end of the forecast period, although the share of coal will decline.

According to IEEJ, "in non-OECD, coal's share of total electricity generation will remain the largest", while "renewable energy's share of total electricity generation in 2030 will be over 30%, replacing the natural gas share as the largest one in OECD" (IEEJ, 2017, p. 61).

Hydro

EIA and GREENPEACE do not include information of hydroenergy.

The highest annual cumulative average variation rate is 1.65% of MIT and the lowest is 1.21% of WEC, and the average rate of the four outlooks is 1.41% per year.

"The number of hydroelectric power stations will grow at a very restrained rate and its overall share will decline slightly" (ERIRAS, 2016, p. 46) . However, EIA predicts that "hydropower's share of renewable generation falls from 71% in 2015 to 53% in 2040 as resource availability in OECD countries and environmental concerns in many countries limit the number of new mid-and large-scale hydropower projects" (DOE – EIA, 2017, p. 82).

Nuclear

The highest annual cumulative average variation rate is 2.05% of ERIRAS and the lowest is 1.24% of WEC, and the average rate of the six outlooks is 1.63% per year.

IEEJ reports that "nuclear power plants construction will make progress as a measure to ensure energy security and mitigate climate change. However, nuclear power generation growth will fail to exceed electricity demand growth through 2050. The nuclear share of power generation will thus fall" (IEEJ, 2017, p. 61).

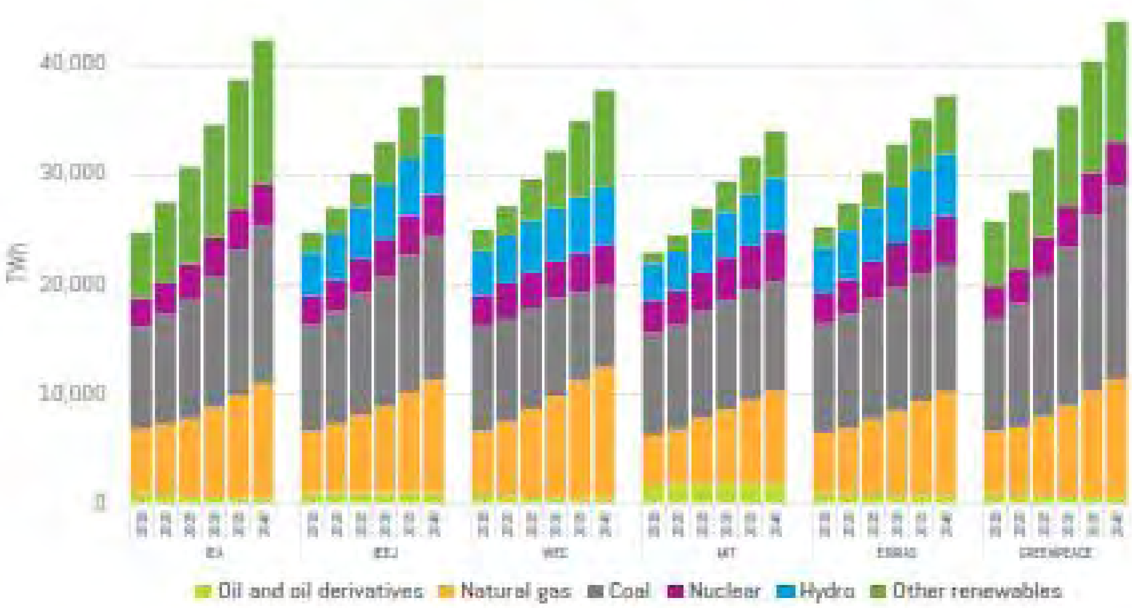
Renewables

The highest annual cumulative average variation rate is 6.91% of WEC and the lowest is 2.74% of GREENPEACE, and the average rate of the six outlooks is 4.84% per year.

In every outlook, renewables show the highest cumulative variation rate (**Figure 4.16**) "as technological improvements and government incentives in many countries support their increased use" (DOE – EIA, 2017, p.80). The total share of renewables almost doubles in 2040 compared to 2016 in every outlook.

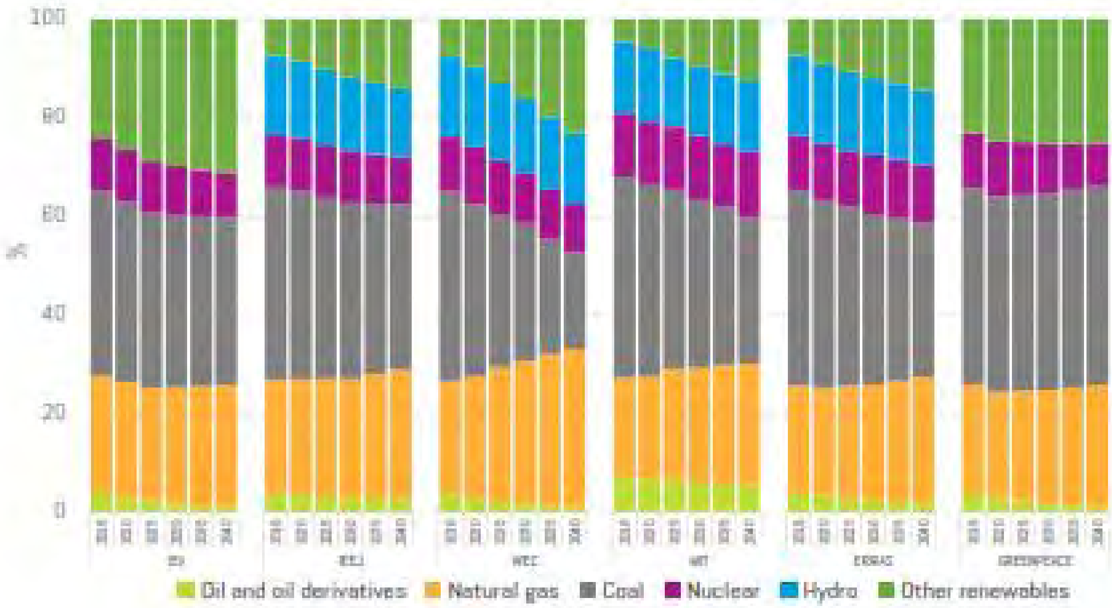
The share of solar and wind keep increasing as fuels for power generation as "these technologies become more cost competitive over time" (DOE – EIA, 2017, p. 82).

Figure 4.14 Global power generation by energy source



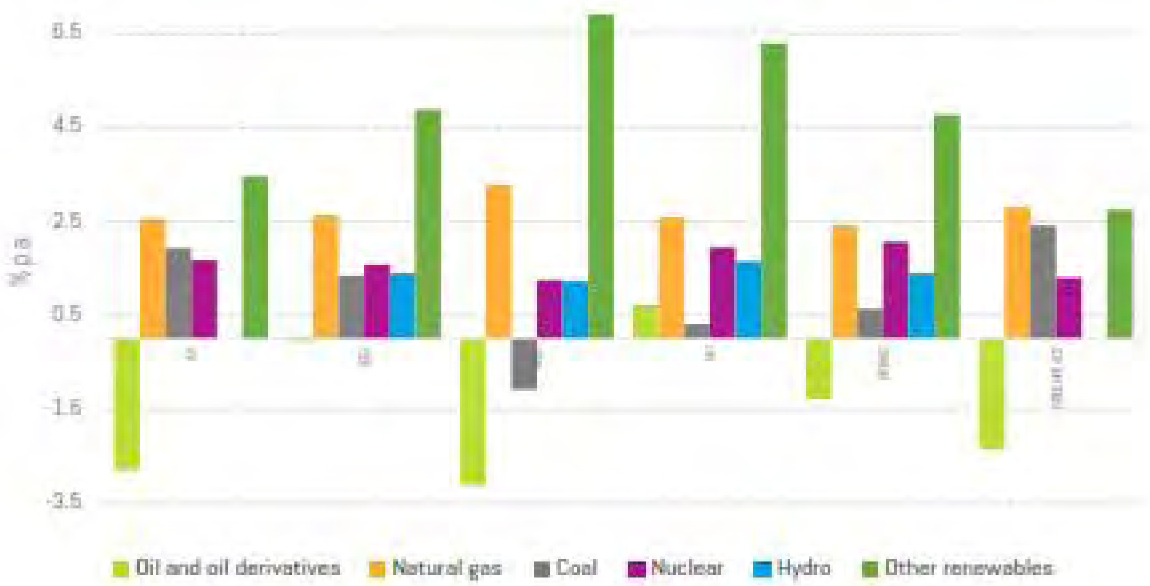
Source: OLADE own elaboration based on data reported by international organizations.

Figure 4.15 Share of global power generation by energy source



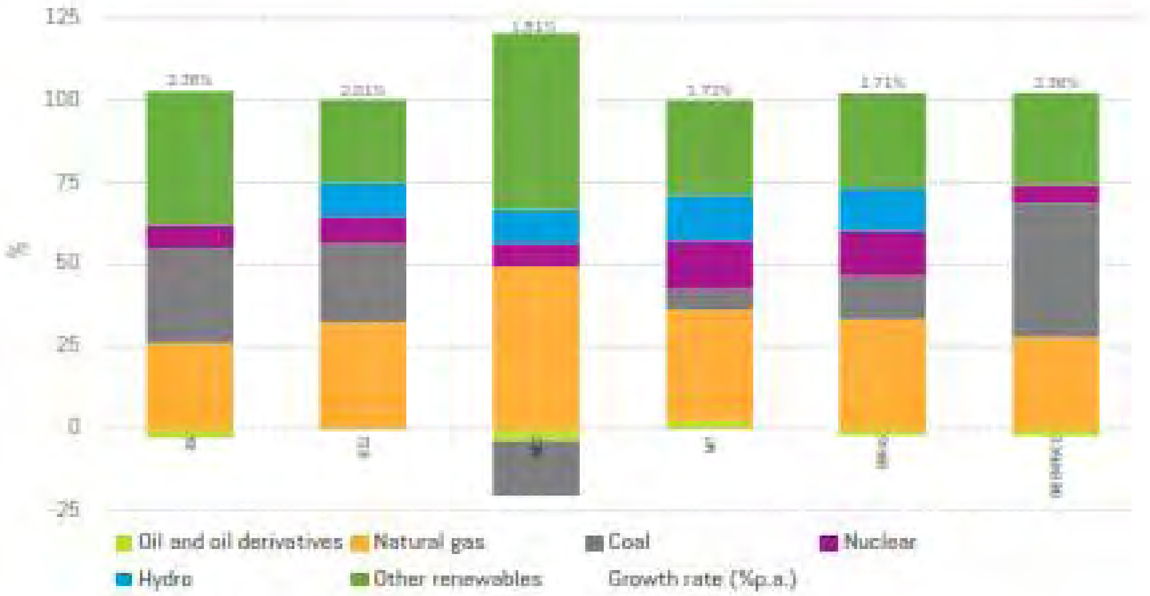
Source: OLADE own elaboration based on data reported by international organizations.

Figure 4.16 Variation rate of global power generation by energy source (2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.

Figure 4.17 Contribution to growth of global power generation by energy source (2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.
The numbers above the bars signify annual cumulative average variation rate of total power generation predicted in each outlook.

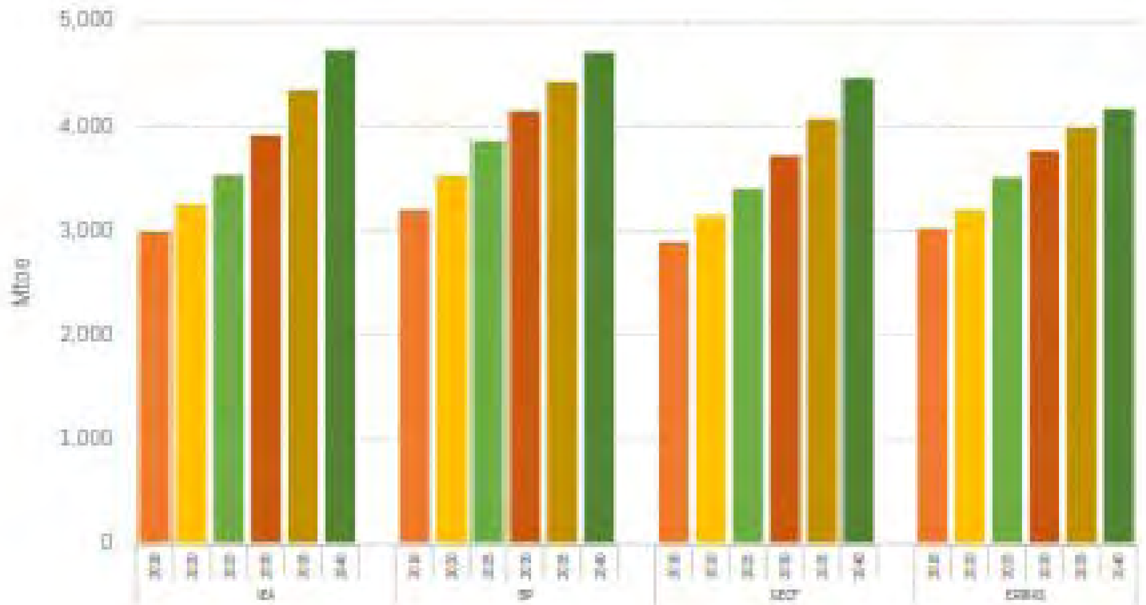
4.4 Natural gas production

Production of natural gas keeps increasing because of its lower carbon emissions. IEA predicts that "production of natural gas will expand globally by 1,685 bcm over the next 25 years, reaching over 5,300 bcm in 2040. The United States, Russia and Iran are the three largest gas producers today, a ranking that remains unchanged over the forecast period although China comes close to that of Iran by 2040" (IEA, 2017, p. 346).

BP reports that "the US and the Middle East (Qatar and Iran) contribute to over half of the production. By 2040, the US accounts for almost one quarter of global gas production, ahead of both the Middle East and CIS (each accounting for around 20%)" (BP, 2018, p. 81).

ERIRAS indicates that "the most rapid growth in shale gas production will be in the period to 2025. By this time, production volumes will have increased to almost 700 bcm, of which 600 bcm will come from the USA. In later years, shale gas production in the USA will stabilize and in 2030 – 2035 will pass its peak as the most attractive reserves are exhausted (as was the case with production of liquid hydrocarbons from shale fields in the USA). After 2025, global shale gas production will expand, due to production from other countries: it is forecast that production will increase in Canada, Mexico, and Argentina (to 175 bcm), in the countries of Asia (to 100 bcm), and in Africa to (25 bcm). Because of geological, economic, and political limitations, shale gas production volumes in Europe and the CIS will not exceed 20 bcm" (ERIRAS, 2016, p. 118).

Figure 4.18 Global natural gas production



Source: OLADE own figure based on data reported by international organizations.

4.5 CO_2 emissions

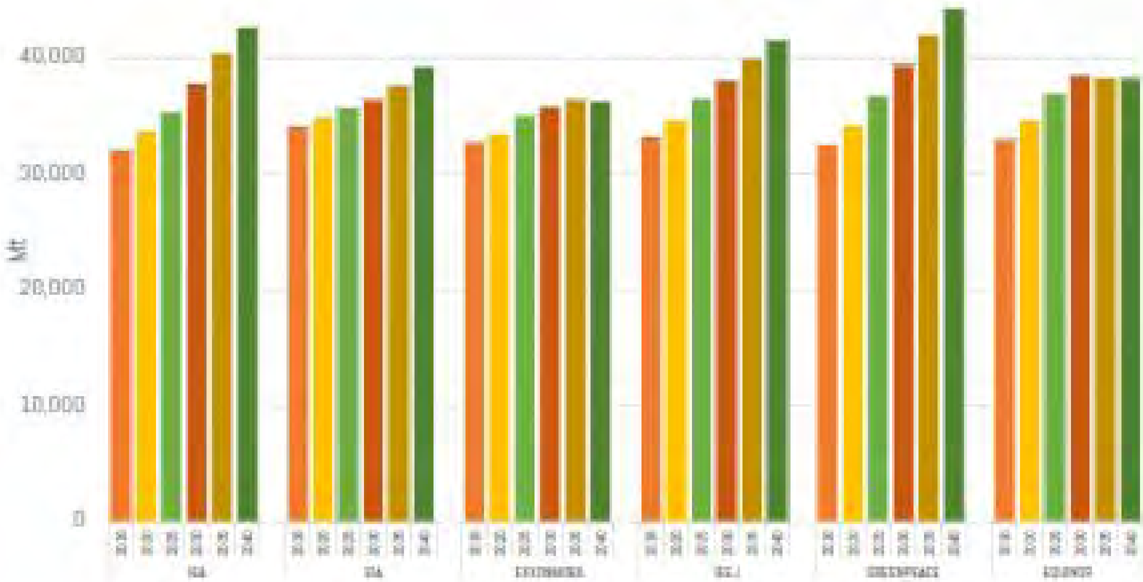
All the outlooks show that global CO_2 emissions will increase until 2030 an average of 1.03%. Only two of them (ExxonMobil, EQUINOR) predict that the emissions will decrease little by little after 2030 (**Figure 4.19**). However, the growth rate is even less than that of past 25 years as energy efficiency increases and other less-carbon fuels such as natural gas and renewables rise.

Exxonmobil, which shows the lowest cumulative variaton rate, reports that "global CO_2 emissions will be likely to peak by 2040, at about 10% above 2016 levels. Combined CO_2 emissions in Europe and North America fall about 15% by 2040 versus 2016. China contributed about 60% of the growth in emissions from 2000 to 2016. Emissions outside North America, Europe and China will rise about 35% from 2016 to 2040, with the share of global emissions reaching 50% by 2040" (ExxonMobil, 2018, p. 30).

There exist optimistic predictions about future of CO_2 emissions. For example, IEA expects lower projection than that of last year's outlook. "This reduction is largely due to further policy pushes in India and China" (IEA, 2017, p. 79). Also IEA mentions that "CO_2 emissions from natural gas, a relatively lower emitting fossil fuel used in many applications, grows across all regions between 2015 and 2040 as natural gas prices remain relatively low throughout the projection period" (IEA, 2017, p. 140).

Exxonmoibl reports that "improving energy efficiency across economies (energy use per unit of GDP) helped slow the growth in emissions, while CO_2 intensity of energy use remained constant. As economic growth continues to drive CO_2 emissions through 2040, efficiency gains and a shift to a less CO2-intensive energy will each help substantially moderate emissions" (ExxonMobil, 2018, p. 31).

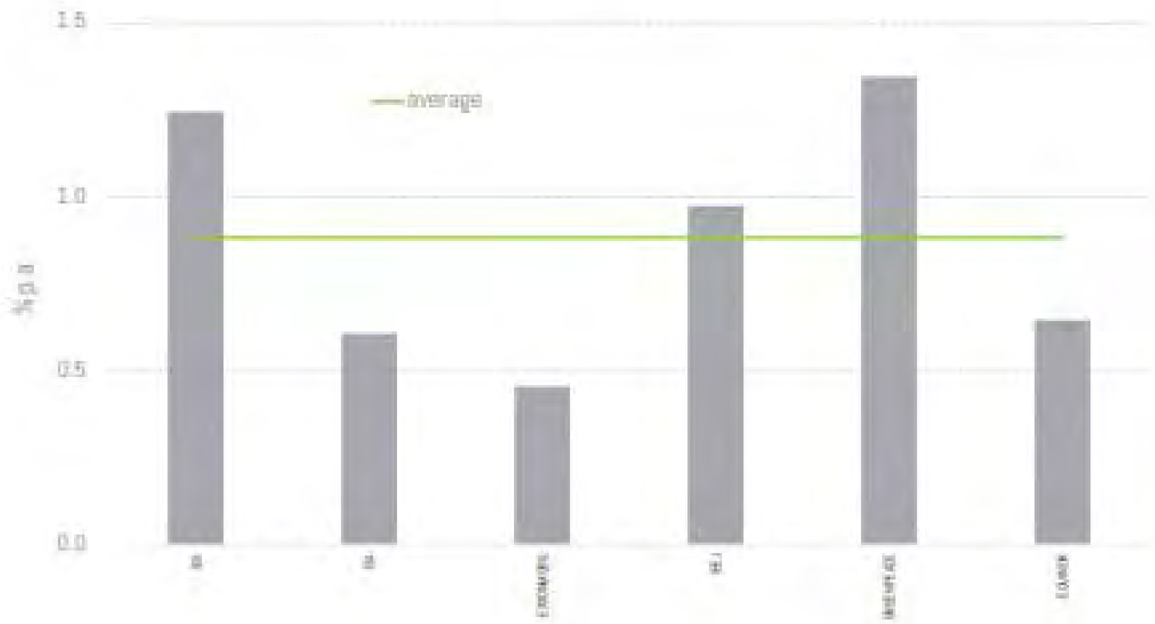
Figure 4.19 Global CO_2 emissions



Source: OLADE own elaboration based on data reported by international organizations.

The highest annual cumulative average variation rate is 1.35% of GREENPEACE and the lowest is 0.46% of ExxonMobil, and the average rate of the six outlooks is 0.88% per year (**Figure 4.20**).

Figure 4.20 Variation rate of CO_2 emissions
(2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.

5. COMPARABLE RESULTS CORRESPONDING TO LATIN AMERICA AND THE CARIBBEAN

5.1 Primary energy consumption

According to the report of Inter-American Development Bank (IADB), "the six-largest economies of the region (Brazil, Mexico, Argentina, Venezuela, Chile and Colombia) are set to continue to dominate the region's energy consumption trend. More than 83% of the total increase in primary energy consumption through 2040 is predicted to come from these countries" (IADB, 2016, p. 22).

5.1.1 By fuel type

Seven outlooks (IEA, ExxonMobil, IEEJ, WEC, ERIRAS, GREENPEACE and OLADE) offer information about primary energy consumption of LAC by energy source. Average variation rate of primary energy consumption from 2016 to 2040 of the six outlooks is 1.93 % per year going from 755 Mtoe to 1,172 Mtoe.

Table 5.1 presents data on primary energy consumption for Latin America and the Caribbean by each of the outlooks.

Table 5.1 LAC primary energy consumption

Mtoe	2016	2020	2025	2030	2035	2040
IEA	664	706	752	823	916	1,000
EXXONMOBIL	695	742	799	862	927	990
IEEJ	865	928	1,014	1,091	1,182	1,262
WEC	729	780	853	919	1,001	1,076
ERIRAS	709	737	792	855	919	977
GREENPEACE	754	813	899	983	1,067	1,142
OLADE	870	952	1095	1261	1486	1757

Source: Data reported by each international organization.

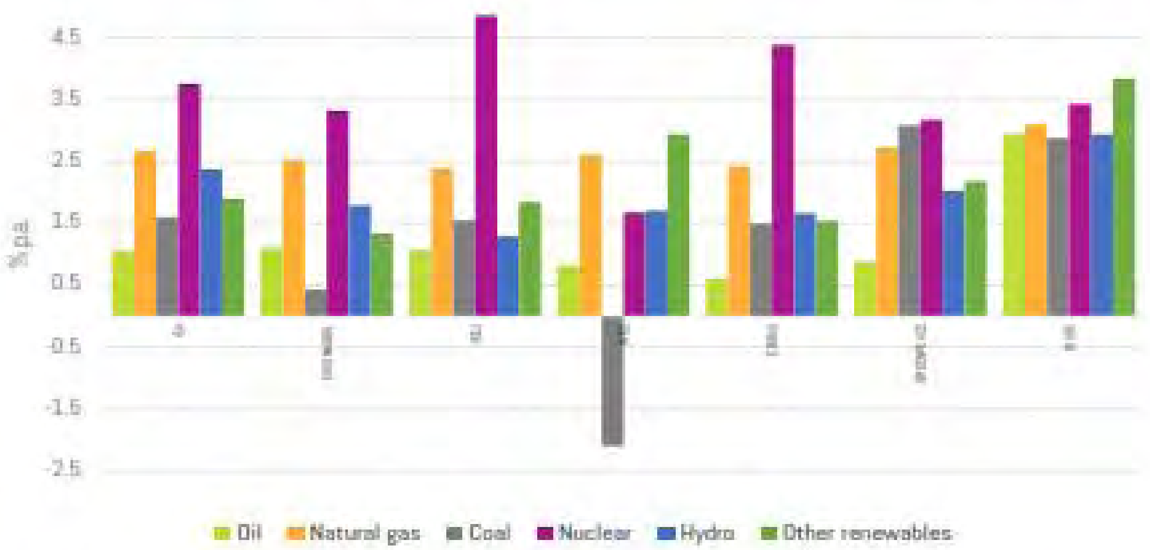
The following description is made for the sources of the primary energy consumption:

Oil

The highest annual cumulative average variation rate is 2.94% of OLADE and the lowest is 0.61% of ERIRAS, and the average rate of the seven outlooks is 1.21% per year.

Still in 2040 oil will keep its leading role in primary energy consumption but the cumulative average variation rate among fuels is the lowest (**Figure 5.1**) and the share decreases continuously in every outlook. Nevertheless, it contributes a lot to the growth of primary energy consumption in LAC, maintaining its second or third place among fuels.

Figure 5.1 Variation rate of LAC primary energy consumption by energy source (2016-2040)



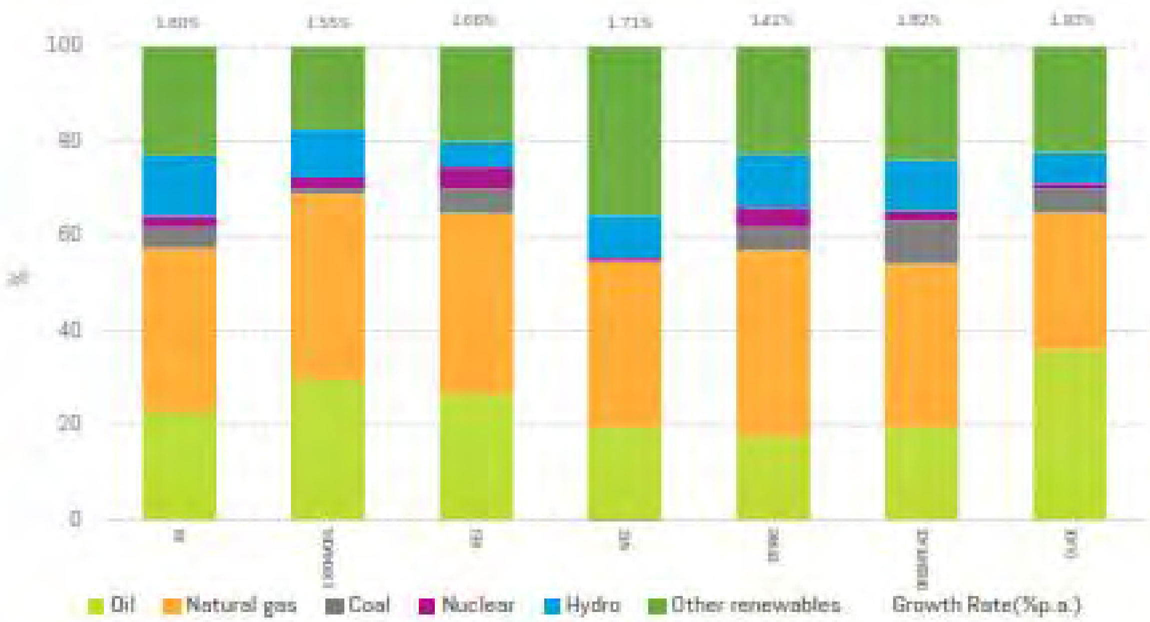
Source: OLADE own elaboration based on data reported by international organizations.

Natural gas

The highest annual cumulative average variation rate is 2.85% of OLADE and the lowest is 2.39% of IEEJ, and the average rate of the seven outlooks is 2.60% per year.

Natural gas will continue to be the energy source with the greatest contribution to the growth of primary energy consumption in LAC. Comparing **Figures 4.5 and 5.2**, we can demonstrate that this trend is maintained both globally and regionally. Its cumulative variation rate is the second highest among energy sources in six outlooks (except GREENPEACE). The first place is nuclear, but considering that its absolute amount is very slight compared to that of natural gas, we can conclude that natural gas will be the most affecting source to the growth of primary energy consumption in this region.

Figure 5.2 Contributions to growth of LAC primary energy consumption by energy source (2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.
The numbers above the bars signify annual cumulative average variation rate of LAC primary energy demand predicted in each outlook.

Coal

The highest annual cumulative average variation rate is 3.09% of GREENPEACE and the lowest is -2.10% of WEC, and the average rate of the seven outlooks is 1.028% p.a.

WEC forecasts that in 2040 the use of coal for primary energy is less than that of 2016. Other outlooks foresee increase of coal use but the share of coal among all the fuels is small compared to other fossil fuels and renewables (**Figure 5.3**) because "the role of coal in LAC outside of Colombia and Chile will also be limited" (WEC, 2017, p. 40).

Hydro

The highest annual cumulative average variation rate is 3.27% of OLADE and the lowest is 1.29% of IEEJ, and the average rate of the seven outlooks is 2.01% per year.

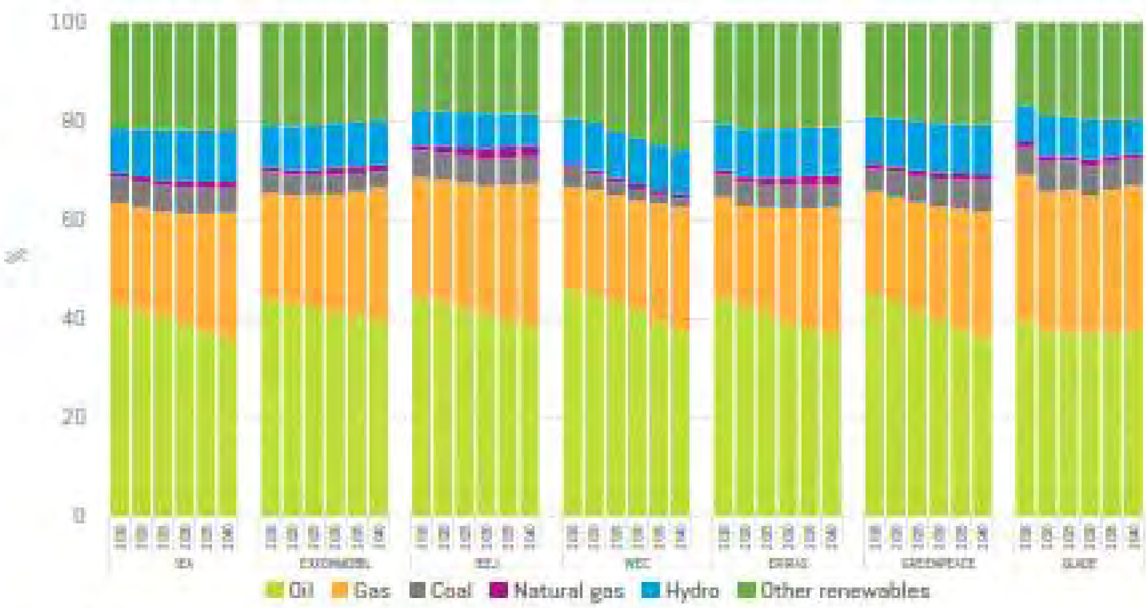
The hydroenergy in the primary energy consumption occupies the fourth place in importance of participation and as shown in **Figure 5.4** it shows that during the study period there will be a greater increase, however, its participation decreases by a greater gas penetration especially in the 2040 according to WEC.

Nuclear

The highest annual cumulative average variation rate is 4.86% of IEEJ and the lowest is 1.67% of WEC, and the average rate of the seven outlooks is 3.51% per year.

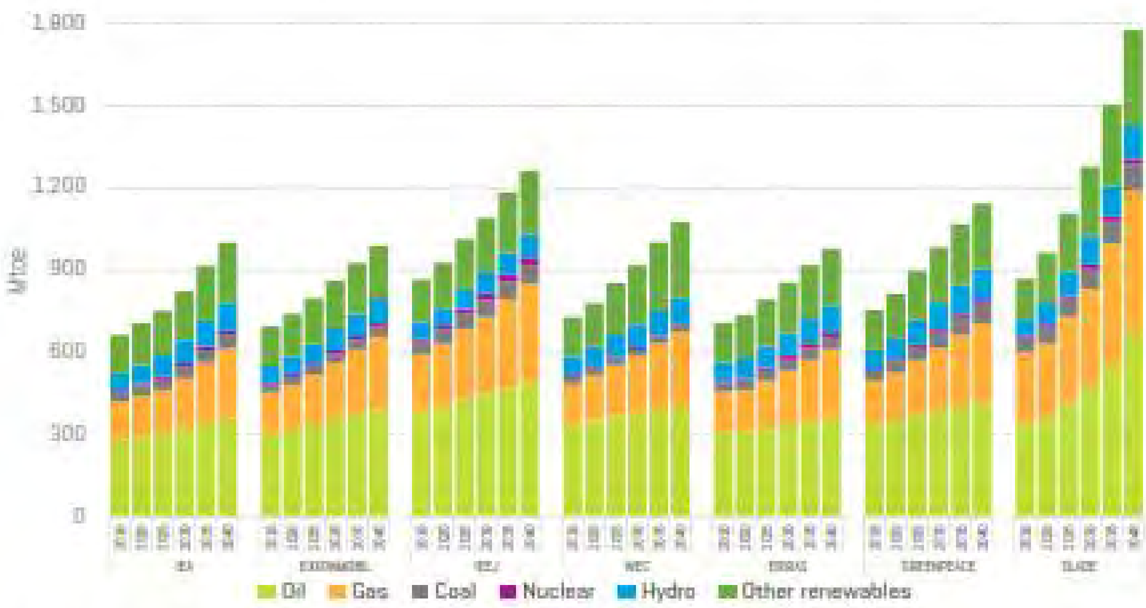
Nuclear energy has a very limited role in LAC region in 2016 and this is not changed until 2040 neither. The share of nuclear in primary energy consumption always shows the smallest in all of the outlooks during the given period (**Figure 5.3**).

Figure 5.3 Share of LAC primary energy consumption by energy source



Source: OLADE own elaboration based on data reported by international organizations.

Figure 5.4 LAC primary energy consumption by energy source



Source: OLADE own elaboration based on data reported by international organizations.

Renewables

The highest annual cumulative average variation rate is 2.94% of WEC and the lowest is 1.33% of ExxonMobil, and the average rate of the seven outlooks is 2.22% per year.

WEC forecasts that renewable sources will contribute the most to the growth of primary energy consumption in LAC, and the other outlooks predict significant contribution as well, with an average of 24.29% for six outlooks. In the case of WEC, it is expected that the share of renewable will surpass that of natural gas in 2040; other outlooks do not have outstanding change, maintaining its share in a range of 18% to 22%.

Biomass has an important role in LAC especially in Brazil. For example, WEC predicts that "biomass demand will surpass oil demand to be the largest primary energy source in Brazil by 2050" (WEC, 2017, p. 37).

5.2 Final energy consumption

"Although higher economic growth, abundant and cheap energy supplies drive the final energy consumption increase, the LAC countries continue to diversify their economies beyond commodity exports and create manufacturing and services sectors. Technologies also make industrial activity more efficient, while the growing penetration of renewables helps to enable more efficient conversion" (WEC, 2017, p. 33).

Table 5.2 shows the data of final energy consumption for each of the analyzed outlooks.

Table 5.2 LAC Final energy consumption

Mtoe	2016	2020	2025	2030	2035	2040
IEA	496	532	572	624	691	751
IEEJ	620	663	722	773	837	892
WEC	545	582	639	690	745	794
GREENPEACE	529	590	658	726	771	847
OLADE	625	688	782	898	1,040	1,213

Source: Data reported by each international organization.

Five outlooks (IEA, IEEJ, WEC, GREENPEACE and OLADE) offer information about final energy consumption of LAC by fuel or sector. Average variation rate of final energy consumption from 2016 to 2040 of the five outlooks is 2.06%, going from 563.0 Mtoe to 899.4 Mtoe.

The following description is made for the sources of the final energy consumption:

5.2.1 By fuel type

Oil and oil derivatives

The highest annual cumulative average variation rate is 2.96% of OLADE and the lowest is 0.75% of WEC, and the average rate of the five outlooks is 1.54% per year.

Oil and its oil and oil derivatives maintain its leading role for the final energy consumption during the research period even though its share decreases continuously since the share of other sources such as natural gas and electricity increases. Nevertheless, two outlooks (IEA, IEEJ) predict that oil will contribute the most to the growth of final energy consumption until 2040.

Natural gas

The highest annual cumulative average variation rate is 3.40% of WEC and the lowest is 1.81% of IEEJ, and the average rate of four outlooks is 2.66% per year.

Natural gas has the second smallest amount among five fuels for the final energy consumption. However, in WEC, it shows the highest cumulative variation rate among sources between 2016 - 2040. Moreover, in the same outlook it is predicted that natural gas contributes the most to the growth of final energy consumption in the same period. Therefore, it is expected that the share of natural gas would be larger than that of electricity after 2040, according to the data of WEC.

Coal

The highest annual cumulative average variation rate is 4.26% of GREENPEACE and the lowest is -0.34% of WEC, and the average rate of the five outlooks is 1.98% per year.

LAC does not use coal as much as other sources for the final energy consumption (natural gas, oil and oil derivatives, electricity, etc.). For example, the average share of coal among five fuels in 2016 was only 2.20% and it will be 2.35% in 2040, a very slight increase. WEC forecasts that the use of coal for the final energy consumption will decrease while GREENPEACE predicts the opposite, 4.26% of growth per year. However, the absolute amount of coal is too small, in other words, the contribution to the growth is very slight.

Electricity

The highest annual cumulative average variation rate is 3.78% of OLADE and the lowest is 2.33% of WEC, and the average rate of the five outlooks is 2.86% per year.

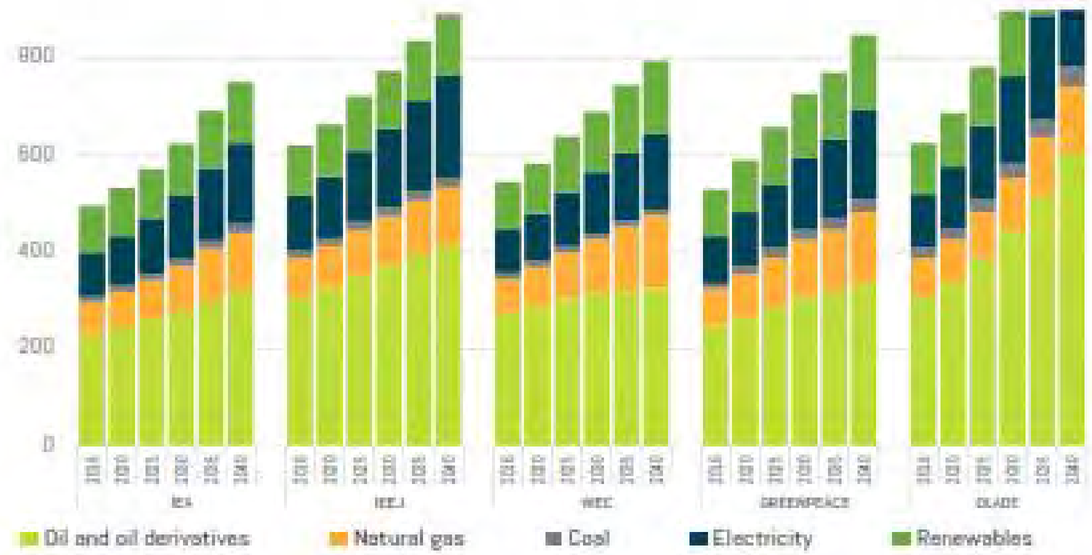
GREENPEACE reports that "due to economic growth, increasing living standards and electrification of the transport sector, overall electricity demand is expected to increase despite efficiency gains in all sectors. Electricity will become the major renewable 'primary' energy, not only for direct use for various purposes but also for the generation of synthetic fuels for fossil fuels substitution" (GREENPEACE, 2015, p. 104).

Renewables

The highest annual cumulative average variation rate is 2.18% of OLADE and the lowest is 0.95% of IEEJ, and the average rate of the five outlooks is 1.65% per year.

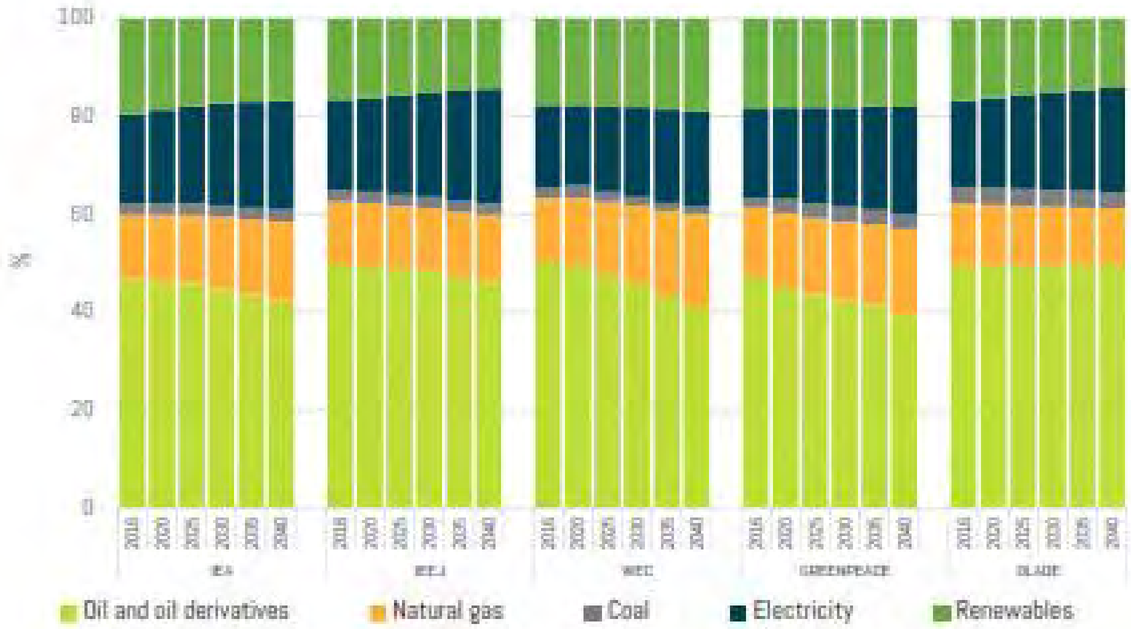
According to IEA, in Brazil, "the share of direct and indirect renewable use in final energy consumption will rise from 39% in 2016 to 45% in 2040, compared with a global progression from 9% to 16% over the same period" (IEA, 2017, p. 24).

Figure 5.5 LAC final energy consumption by fuel type



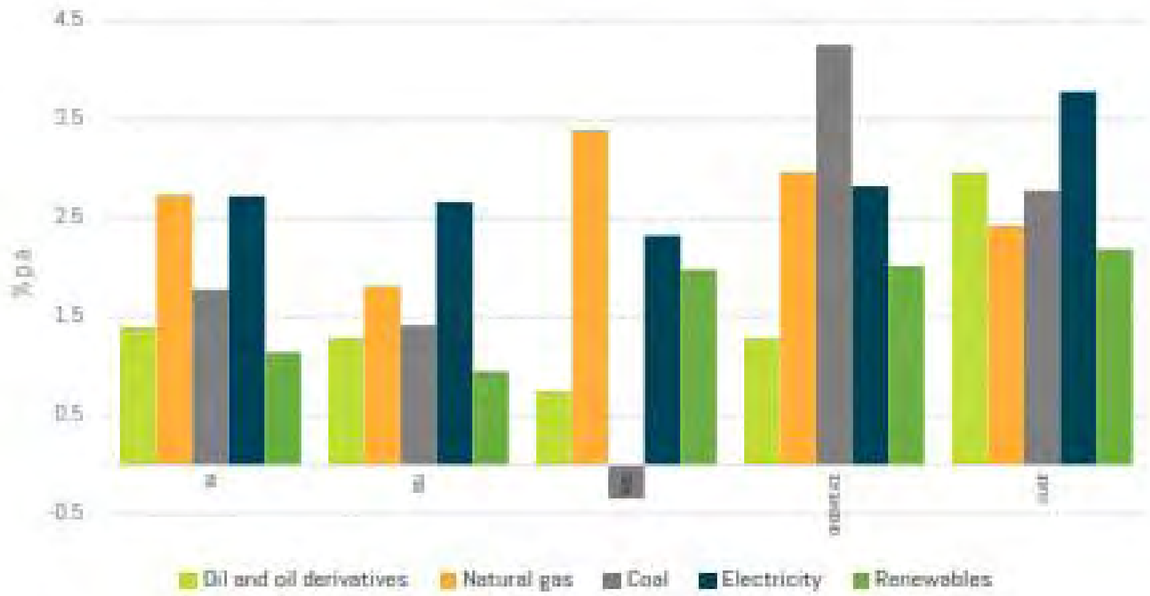
Source: OLADE own elaboration based on data reported by international organizations.
Renewables include: bioenergy, heat and others (IEA) heat, hydrogen and others (IEEJ) heat, biomass, biofuels and others (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

Figure 5.6 Share of LAC final energy consumption by fuel type



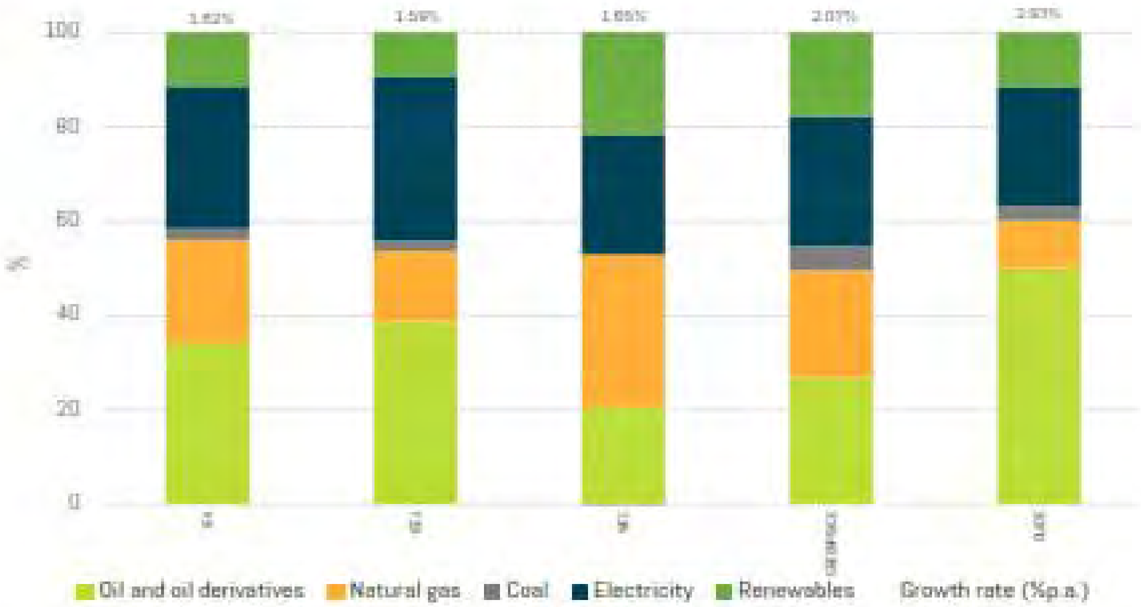
Source: OLADE own elaboration based on data reported by international organizations.
Renewables include: bioenergy, heat and others (IEA) heat, hydrogen and others (IEEJ) heat, biomass, biofuels and others (WEC) solar, biomass, geothermal, hydrogen and others (GREENPEACE).

Figure 5.7 Variation rate of LAC final energy consumption by fuel type (2016-2040)



Source: OLADE own elaboration 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).

Figura 5.8 Contributions to growth of LAC final energy consumption by fuel type (2016-2040)



Source: OLADE own elaboration 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 signify annual cumulative average variation rate of LAC final energy consumption predicted in each outlook.

5.2.2 By sector

In a scenario of GREENPEACE, it is expected that "as a result of energy-related renovation of the existing stock of residential buildings, the introduction of low energy standards and 'passive climatization' for new buildings, as well as highly efficient air conditioning systems, enjoyment of the same comfort and energy services will be accompanied by much lower future energy demand" (GREENPEACE, 2015, p. 104).

The following description is made for the sectors of the final energy consumption:

Transport

The highest annual cumulative average variation rate is 3.33% of OLADE and the lowest is 1.29% of WEC, and the average rate of the five outlooks is 1.91% per year.

According to a report of IRENA, "Transport represents a larger share in Latin America than in the OECD, due mainly to a less efficient vehicle fleet and to a different modal composition (e.g., a lower share of rail transport)" (IRENA, 2016, p. 36).

"Due to population increase, GDP growth and higher living standards, energy demand from the transport sector is expected to increase in the reference scenario by around 61% to 11,030 PJ/y (264 Mtoe) in 2050" (GREENPEACE, 2015, p. 111).

Industry

The highest annual cumulative average variation rate is 2.68% of OLADE and the lowest is 1.52% of IEEJ, and the average rate of the five outlooks is 2% per year.

The industry is the second largest economic sector in the final energy consumption, using 713.88 Mtoe in 2016 to 1083.83 Mtoe in 2040, with a total increase of 51.93%. Four of five outlooks (IEA, WEC, GREENPEACE and OLADE) expect that the industry will contribute the most to the growth of final energy consumption.

Others

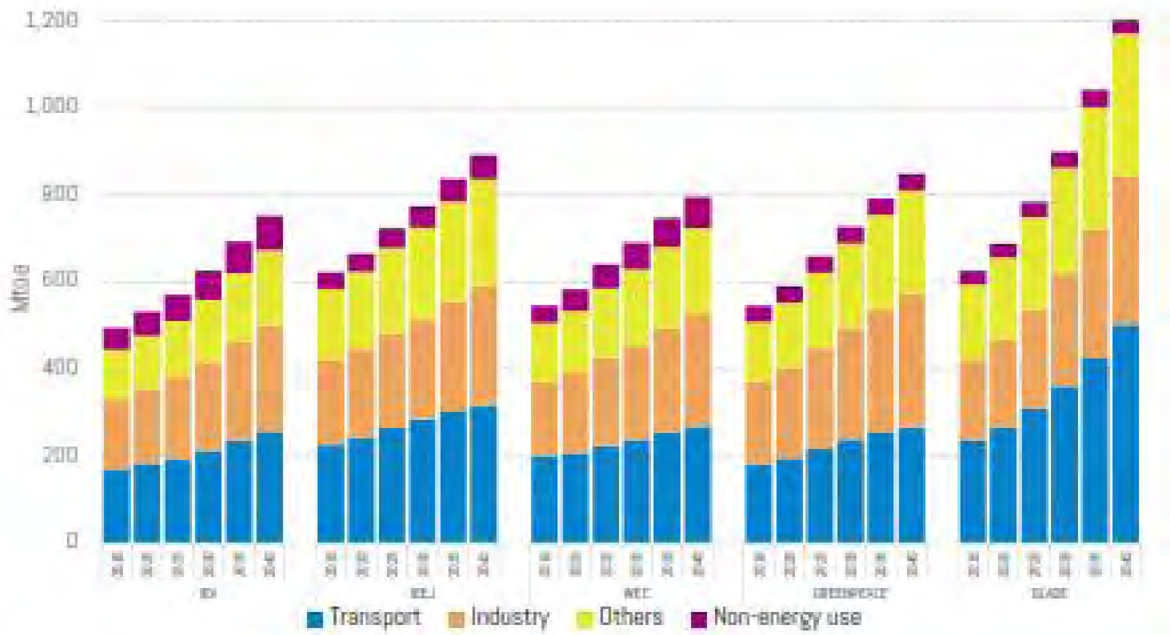
The highest annual cumulative average variation rate is 2.83% of OLADE and the lowest is 1.65% of WEC, and the average rate of the five outlooks is 2.09% per year.

This sector is the third largest economic sector in the final energy consumption, using 550.81 Mtoe in 2016 to 853.65 Mtoe in 2040, with a total increase of 54.98%. GREENPEACE reports that this sector has the highest cumulative variation rate among the sectors of final energy consumption.

Non-energy use

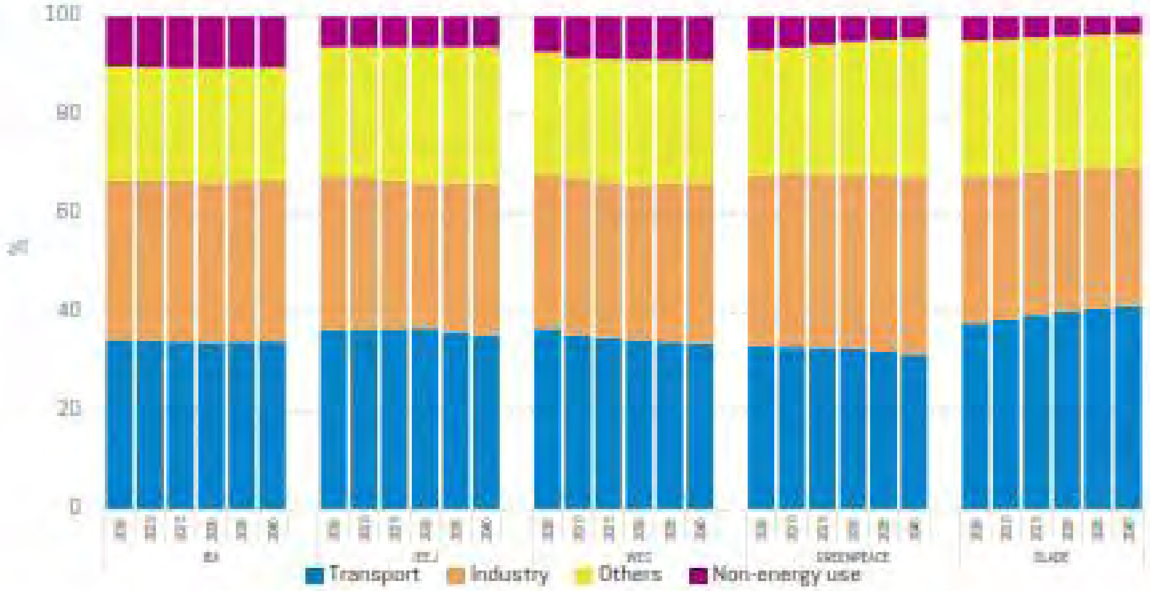
The highest annual cumulative average variation rate is 2.59% of WEC and the lowest is 0.07% of GREENPEACE, and the average rate of the five outlooks is 1.53% per year.
This sector is the smallest economic sector in the final energy consumption, using 164.49 Mtoe in 2016 to 240.81 Mtoe in 2040, with a total increase of 46.40%.

Figure 5.9 LAC final energy consumption by sector



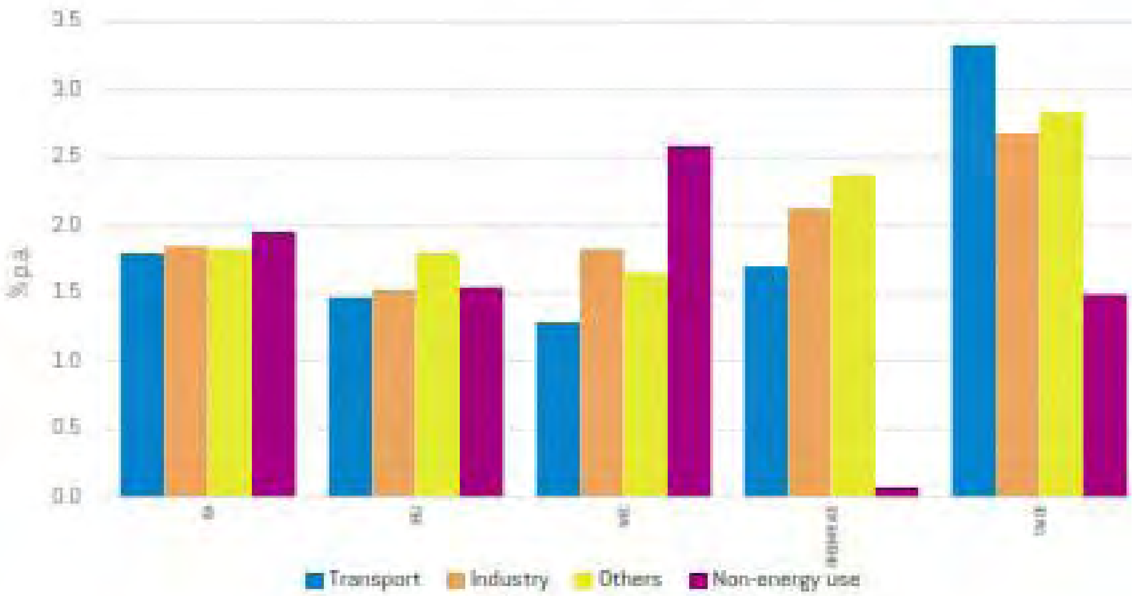
Source: OLADE own elaboration based on data reported by international organizations.
Others include: buildings (residential, commercial) for IEA, IEEJ, WEC agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 5.10 Share of LAC final energy consumption by sector



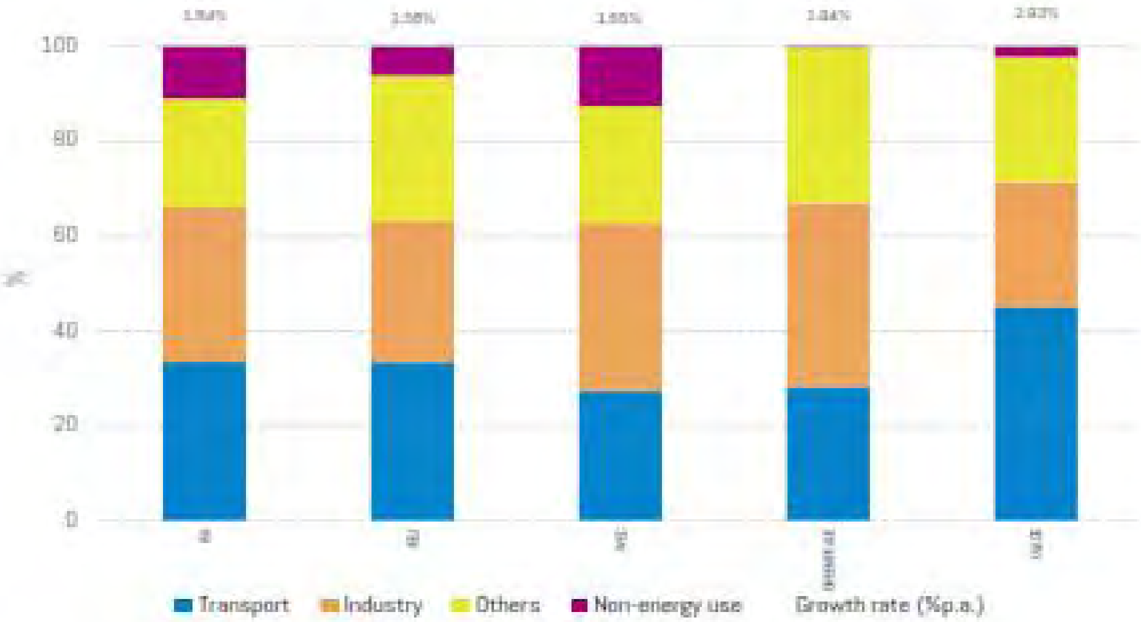
Source: OLADE own elaboration based on data reported by international organizations.
Others include: buildings (residential, commercial) for IEA, IEEJ, WEC agriculture, forestry, fishing, residential, commercial and public service for GREENPEACE.

Figure 5.11 Variation rate of LAC final energy consumption by sector (2016-2040)



Source: OLADE own elaboration 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 Contributions to growth of LAC final energy consumption by sector (2016-2040)



Source: OLADE own elaboration 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 signify annual cumulative average variation rate of LAC final energy consumption predicted in each outlook.

5.3 Power generation

Six outlooks (IEA, IEEJ, WEC, ERIRAS, GREENPEACE and OLADE) offer information about power generation of LAC. Average variation rate of power generation from 2016 to 2040 of four outlooks is 2.73%, going from 1398 TWh to 2437 TWh.

Table 5.3 shows the power generation of LAC.

Table 5.3 LAC power generation

TWh	2016	2020	2025	2030	2035	2040
IEA	1,299	1448	1,630	1,869	2,138	2,387
IEEJ	1,635	1,808	2,066	2,314	2,616	2,908
WEC	1,332	1,425	1,637	1,870	2,062	2,245
ERIRAS	1,325	1,411	1,577	1,747	1,914	2,072
GREENPEACE	1,401	1,567	1,818	2,067	2,332	2,574
OLADE	1,596	1842	2,196	2,623	3,141	3,761

Source: Data reported by each international organization.

According to IADB, "it is expected that more than 80% of the projected growth come from the six largest economies in the region. Brazil (37%) and Mexico (19%) alone would account for more than half of the electricity needs of the region in 2040. Total electricity requirements in Brazil would increase by 96%, while Mexico's needs would increase by 87%" (IADB, 2016, p. 26).

5.3.1 By type of fuel

The following description is made for the sources of the power generation:

Hydro

The highest annual cumulative average variation rate is 3.28% of OLADE and the lowest is 1.29% of IEEJ; and the average rate of the four outlooks is 1.98% per year.

Only four outlooks (IEEJ, WEC, ERIRAS and OLADE) offer the information about the share of hydro in power generation. Hydro power is the most dominant fuel for power generation in LAC and this is the same in 2040 according to WEC and ERIRAS.

However, the cumulative variation rate of hydroenergy is lower than that of nuclear, natural gas and renewables. According to WEC: "hydroenergy contribution to new electricity generation will slow down due to environmental and social concerns and so its share of electricity generation will decline after 2030" (WEC, 2017, p. 63).

Natural gas

The highest annual cumulative average variation rate is 4.44% of GREENPEACE and the lowest is 3.01% of ERIRAS, and the average rate of five outlooks is 3.75% per year.

Natural gas shows the second largest share among six fuels for the power generation in LAC. IEEJ forecasts that it will contribute the most to the growth of the power generation. Other five outlooks predict significant contribution as well, with an average of 34.85% for the six outlooks.

"Although natural gas plays a transitional role to meet the electricity demand growth, fossil fuel share of the electricity will decrease from 37% in 2016 to 23% in 2040" (WEC, 2017, p. 35).

Renewables

The highest annual cumulative average variation rate is 8.64% of OLADE and the lowest is 2.48% of GREENPEACE, and the average rate of the six outlooks is 5.17% per year.

Beyond 2030, it is expected that wind, solar, and other renewables will be the dominant factor of power generation growth. WEC forecasts that "beyond 2030, new power generation growth in LAC will be dominated by wind/solar/others and so the share of electricity generation will increase dramatically from 2% in 2014 to 19-29% in 2060" (WEC, 2017, p. 63). Also Bloomberg New Energy Finance (BNEF) expects "wind and solar currently account for around 4% of generation capacity. This is expected to reach 37% by 2040, by which around 90% of the region's electricity will come from new energy sources – including big hydro and nuclear as well as solar and wind" (BNEF, 2017).

A report co-worked by IADB and Atlantic Council predicts a bright future of renewable energy in LAC. "While new technologies that reduce the cost of extracting natural gas may enable a second wave of energy production, growth in the renewable energy sector, driven primarily by Southern Cone economies, could enable Latin America and the Caribbean to be powered primarily by renewable sources by 2040" (IADB, 2016, p. 142).

Oil and oil derivatives

The highest annual cumulative average variation rate (in absolute value) is -3.37% pf WEC and the lowest is -0.69% of IEEJ, and the average rate of the six outlooks is -2.12% per year.

Six outlooks expect that oil use for power generation will decrease gradually in average from 160.6 Mtoe in 2016 to 100.4 Mtoe in 2040, because of the increase of natural gas and renewable sources for the power generation. The share of oil also declines in every outlook, in average from 11.47% in 2016 to 4.05% in 2040.

Coal

The highest annual cumulative average variation rate is 3.70% of GREENPEACE and the lowest is -3.36% of WEC, and the average rate of the six outlooks is 1.27% per year.

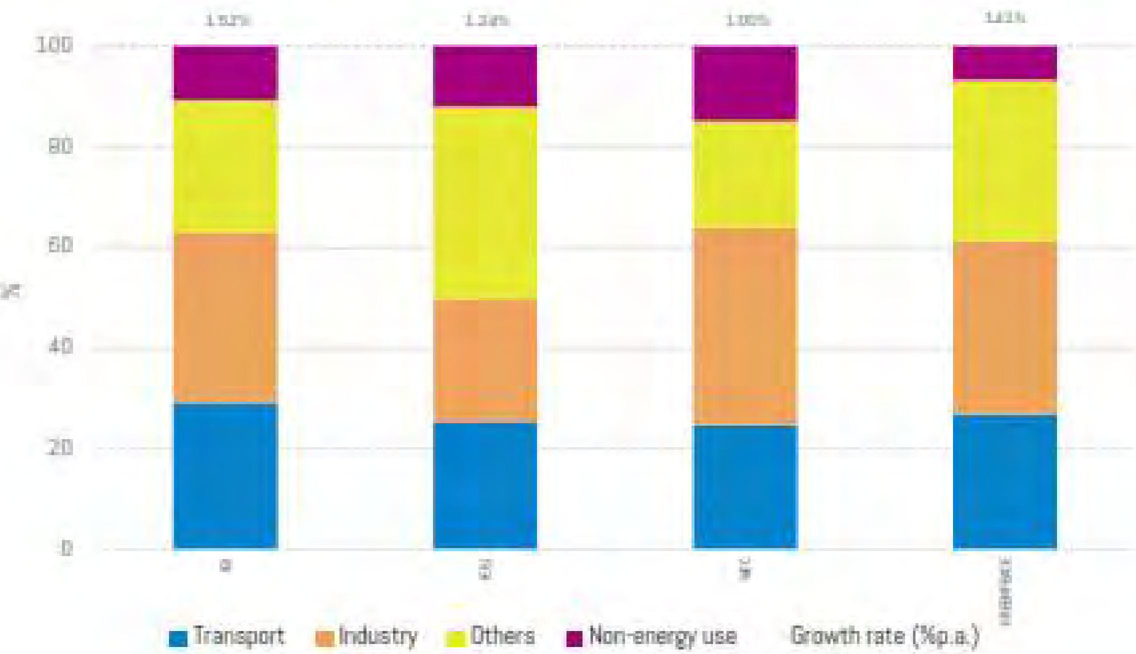
LAC does not use coal as much as other sources such as hydro, natural gas and oil and oil products. For example, the average share of coal among six fuels in 2016 was only 5.02% and it will decrease to 4.09% in 2040. WEC and ERIRAS forecast that the use of coal for the power generation will decrease while GREENPEACE predicts the opposite, 3.70% of growth per year. However, the absolute amount of coal is too small, in other words, the contribution to the growth is very slight.

Nuclear

The highest annual cumulative average variation rate is 4.97% of IEEJ and the lowest is 1.68% of WEC, and the average rate of the six outlooks is 3.52% per year.

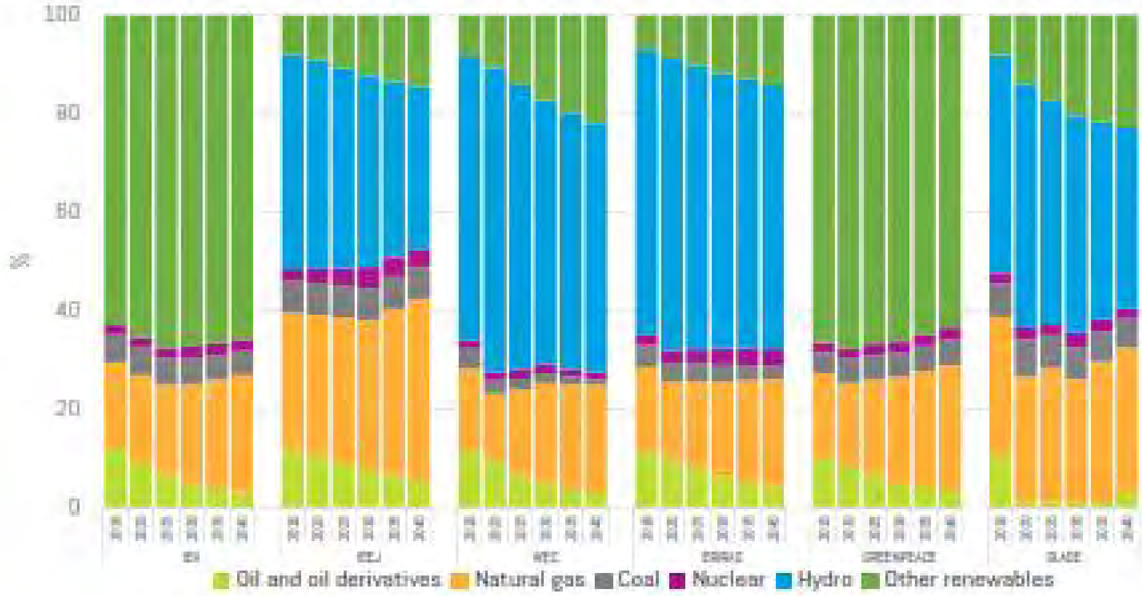
The share of nuclear energy for power generation remains the lowest in every outlook and the whole period. Comparing with the global scale (Figure 4.14), we can see that Latin America does not develop nuclear plants a lot. This is because Latin America countries already have plentiful natural resources including fossil fuels and hydroenergy. Thus, Latin American countries do not have strong motivation to develop nuclear power.

Figure 5.13 LAC Power generation by energy source



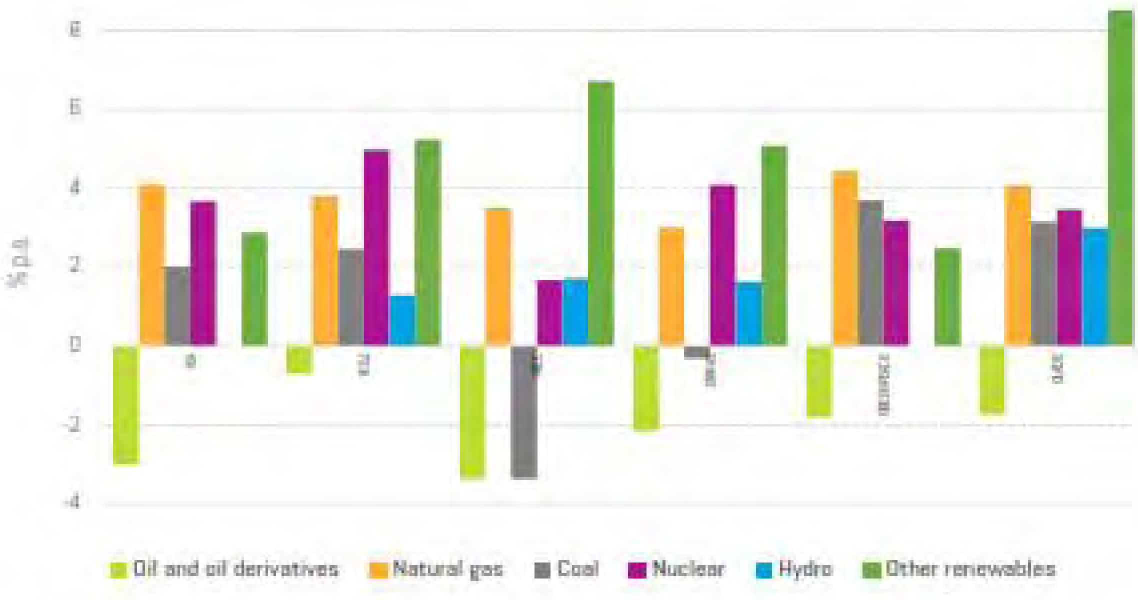
Source: OLADE own elaboration based on data reported by international organizations.

Figure 5.14 Share of LAC Power generation by energy source



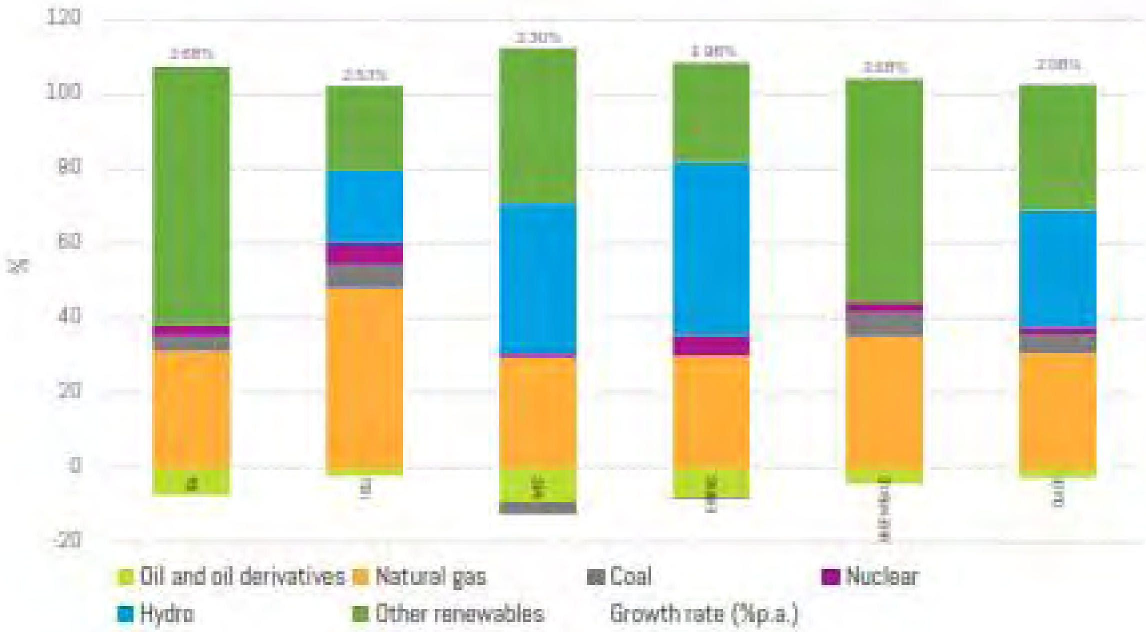
Source: OLADE own elaboration based on data reported by international organizations.

Figure 5.15 Variation rate of LAC power generation by energy source (2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.

Figure 5.16 Contribution to growth of LAC power generation by energy source (2016-2040)



Source: OLADE own elaboration based on data reported by international organizations.
The numbers above the bars signify annual cumulative average variation rate of LAC power generation predicted in each outlook.

6. FINAL COMMENTS

The exercise carried out throughout this work had the purpose to group the results from various recently published prospective studies (outlooks), aiming to compare them with each other and provide a situation picture in which the variability margins raised by said studies are known as a whole, at least in a first approximation.

Certainly, the raised exercise has some serious limitations that must not be lost to sight at the moment of considering the obtained results. Each of the analyzed studies draw from a set of particular techno – economic hypotheses. They are based in the utilization of different simulation models, some of which may be of optimization, simulation, partial or general balance, sectoral or integrated, or, simply econometrics. Even the used models for each institution might be calibrated with different exogenous variables or be fed by energy information coming from different sources. These considerations must be taken into account that, as is stated, poses serious limitations to the comparability that is pretended to be carried out.

Nonetheless, we consider that the fact of being able to visualize the general and common results of several studies that forecast a set of similar variables, is of great usefulness to estimate, although qualitatively, the terms that each outlook raises for the presentation for their results. Thus, providing them to the energy community in a common and quantitative frame, of easy comparability and access. This eases the possibility of generating an overview, general and robust, regarding the forecasted trends of the future evolution of the world and Latin America and the Caribbean.

Energy prospective for Latin America and the Caribbean

Energy prospective for Latin America and the Caribbean (2016-2040)

1. INTRODUCTION

Below are the main results of the prospective study of LAC's energy sector, developed by OLADE, for the period 2016-2040, considering a Current Policy Scenario (CPS), which corresponds to the evolution of the Energy Matrix of different sub-regions of LAC and the region as a whole, according to the official policies of energy development, from the 27 member countries of OLADE, reflected in the expansion plans elaborated and published by the national entities, responsible for energy planning in each of these countries. The present study can be considered an update of the prospective regional energy plan prepared for the period 2015-2030, elaborated by OLADE with the financial support of EUEI PDF, published in the document "Energy Policy and NDCs in Latin America and the Caribbean" in November 2018 (OLADE, 2018).

For the purpose of the study, the LAC region has been divided into 4 sub-regions and 2 countries analyzed individually. This division is detailed below:

- Brazil
- Mexico
- Central America (Costa Rica, El 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, Dominican Republic, Granada, Guyana, Haiti, Jamaica, Surinam and Trinidad & Tobago)

As a computer tool for the prospective study, the Simulation and Analysis Model of the Energy Matrix (SAME) was used, developed by OLADE and whose description is detailed in Annex III.

It is worth mentioning that for the present study, information that was available at the sieLAC during the first quarter of 2018 was used, hence the data presented below for the period 2005 - 2016 may differ from those presented in the chapter where the energy profiles of the countries are exhibited. In the latter case, the information was updated in the 3rd and 4th quarter of 2018.

2. GENERAL PREMISES OF THE CURRENT POLICY SCENARIO (CPS)

The general premises used for the construction of the Current Policy Scenario (CPS) are the following:

- For the forecast of the final energy consumption, from the different energy sources and in the different socio-economic sectors, the average annual growth rates presented in the plans of expansion of the energy sector available in the Countries were used, or if not available, were obtained by linear logarithmic regressions of historical series from the last 10 years (2005-2015), attained from OLADE's Energy Information System (sieLAC).

- In cases where expansion plans contemplate more than one scenario of forecast of consumption, the one defined as average, recommended, or reference scenario was considered.

- The electricity supply is projected on the basis of the installation/withdrawal timetables of installed capacity, presented in the countries' expansion plans, through a simulation of dispatch in order of merit of the available capacity of each technology, for each year of the forecasted period. For those years of this period that surpass the horizon considered in the expansion plans, the timetables were extended preserving the identified installation trends in said plans.

- The dispatch order of the electric supply technologies in each sub-region, responds mainly to an economic criterion, but also by considerations of environmental and technological type, the renewable energies are prioritized in said dispatch. Meaning that the technologies that generally occupy the base of the monotonous load curves[1], such as the nuclear, the geothermal and the hydroelectric, have the first positions in the order of dispatch. Then, by an environmental criterion, priority is given to wind, solar and biomass, so that these technologies, with renewable sources, can be used to their maximum available capacity; subsequently, it gives way to technologies powered by fossil fuels, in order of operative costs: power plants of mineral coal, natural gas and diesel and fuel oil. Finally, the dispatch closes with imports of electricity, with the exception of Brazil, where the importation of electricity produced by the Paraguayan component of the Itaipu Binational Hydroelectric Power Plant, is considered base energy.

- For the other sources of energy, the dispatch of the different supply components is made based on the technical coefficients, calculated by the SAME Model from the energy balance of the base year (2016).

3. MAIN RESULTS OF THE ENERGY PROSPECTIVE STUDY (2016-2040), CPS SCENARIO

3.1 Brazil

3.1.1 Forecast of the final energy consumption

Table 3.1. Forecast of the final energy consumption in Brazil (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	102	115	136	160	190	226	3.4%
Natural gas	12	13	15	16	19	21	2.3%
Coal and coke	10	12	13	15	17	20	2.7%
Biomass	62	66	74	83	94	107	2.3%
Electricity	42	49	58	69	82	97	3.6%
TOTAL	229	255	295	343	402	472	3.1%

Source: Based on the ten-year energy expansion plan 2016-2026 (PDE 2026).

The evolution of Brazil's final consumption matrix in structural terms for the CPS Scenario, reflects a greater participation of oil and oil products, however, there is also an increase in the use of electricity (**Figure 3.2**), being the source with greater average annual growth rate during the forecast period (3.6%).

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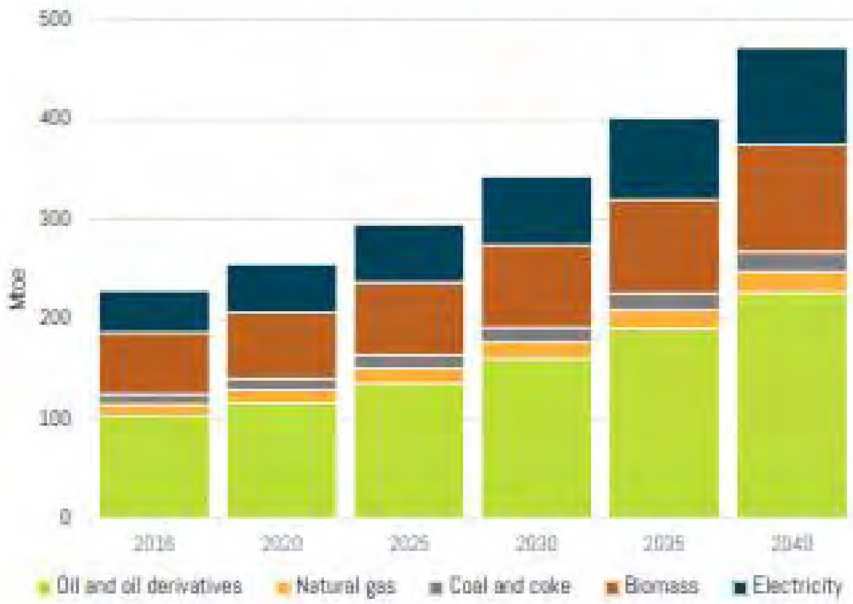
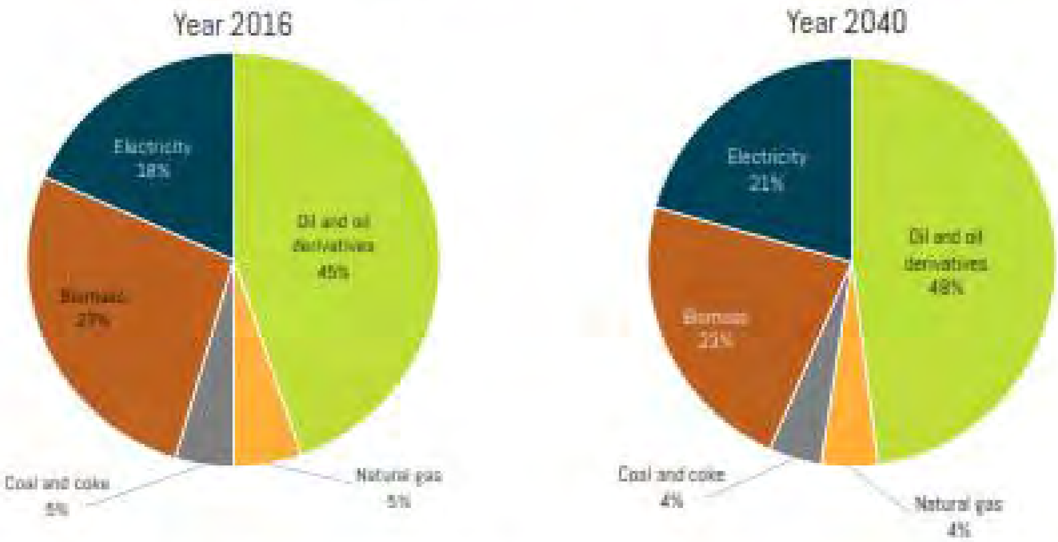
1. The monotonous load is a curve that presents, for a certain period, the distribution of the demand of power in time, in descending order; and it is used to characterize the load and establish the dispatch policy of the electricity generation.

Figure 3.1. Forecast of the final energy consumption in Brazil



Source: Forecast based on the ten-year energy expansion plan 2016-2026 (PDE 2026).

Figure 3.2. Evolution of the final energy consumption matrix in Brazil



Source: Forecast based on the ten-year energy expansion plan 2016-2026 (PDE 2026).

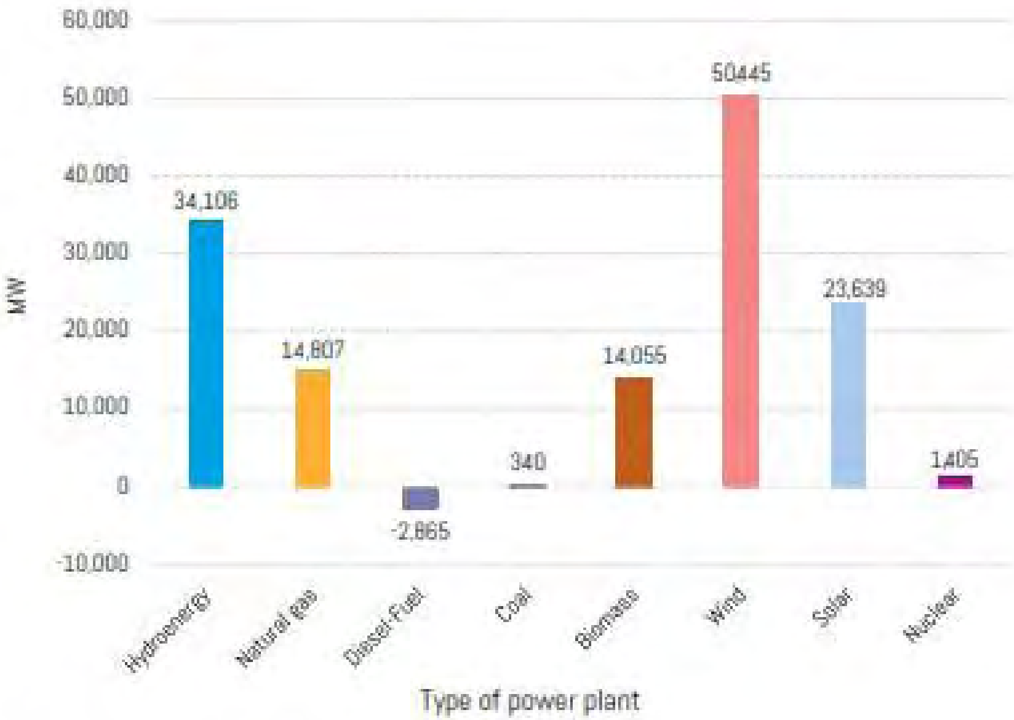
Table 3.2. Forecast of the electric domestic demand in Brazil (GWh)

	2016	2020	2025	2030	2035	2040	t.p.a.
Final consumption	489,456	562,485	669,615	797,589	950,536	1,133,418	3.6%
Own consumption	29,378	33,748	40,175	47,853	57,030	68,002	3.6%
Losses	99,434	114,245	136,004	161,996	193,061	230,205	3.6%
Total domestic demand	618,268	710477	845,794	1,007,438	1,200,626	1,431,626	3.6%

Source: Forecast based on the ten-year energy expansion plan 2016- 2026 (PDE 2026).

3.1.2 Forecast of electricity generation

Figure 3.3. Additional installed capacity in Brazil during the forecast period



Source: Forecast based on the "Ten-Year Energy Expansion Plan of Brazil 2016-2026"

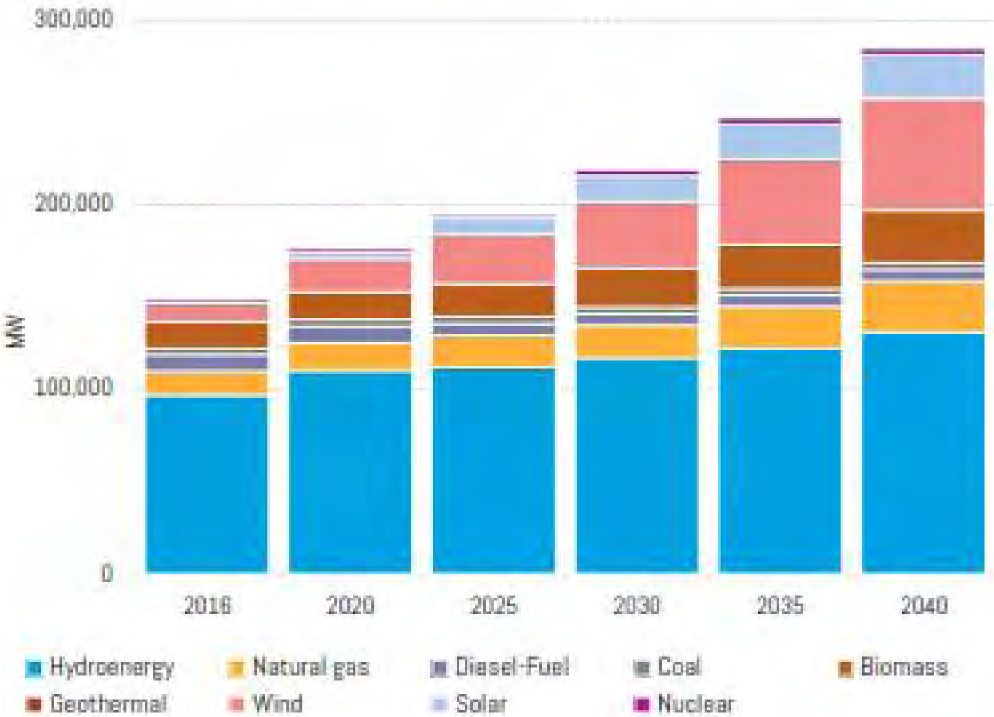
During the forecast period (2016-2040), in Brazil it is necessary to install 135.9 GW of additional power generation capacity, of which the largest fraction corresponds to wind and hydroelectric plants, as seen in **Figure 3.3**.

Table 3.3. Forecast of installed capacity in Brazil (MW)

	2016	2020	2025	2030	2035	2040
Hydroenergy	96,930	110,079	112,208	117,037	122,037	131,037
Natural gas	12,965	15,105	17,189	17,772	22,772	27,772
Diesel-Fuel	8,889	8,889	6,230	6,024	6,024	6,024
Coal	3,389	3,729	3,729	3,729	3,729	3,729
Biomass	14,337	15,033	17,824	20,792	23,792	28,392
Wind	10,129	17,749	26,770	38,574	46,574	60,574
Solar	85	3,724	8,724	13,724	18,724	23,724
Nuclear	1,990	1,990	1,990	3,395	3,395	3,395
TOTAL	148,715	176,298	194,664	219,047	247,047	284,647

Source: Forecast based on the "Ten-Year Energy Expansion Plan of Brazil 2016-2026"

Figure 3.4. Forecast of installed capacity in Brazil



Source: Simulation results.

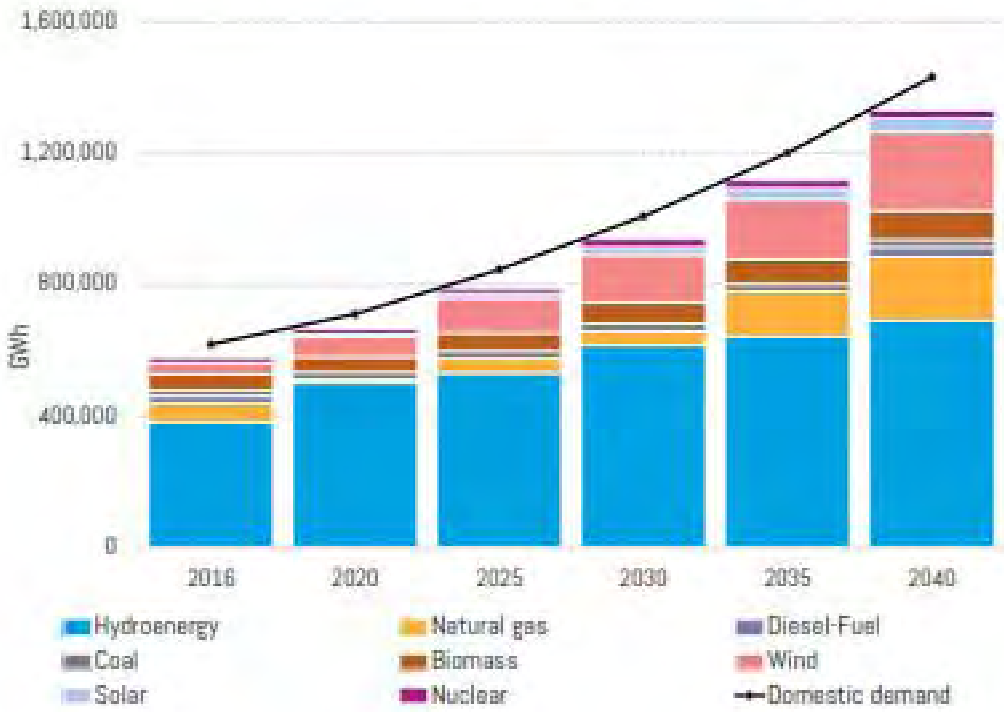
According to the installation/withdrawal timetable implemented, the installed capacity of electricity generation in Brazil increases by 91% during the forecast period, with a clear penetration of the NCRE (biomass, wind and solar), going from a 17% in the base year, to near 40% by the year 2040.

Table 3.4. Forecast of electricity generation in Brazil (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	380,963	501,430	530,786	615,144	641,424	688,728
Natural gas	56,493	9,208	43,554	41,873	136,822	195,192
Diesel-Fuel	22,946	0	0	0	0	29,548
Coal	18,046	23,258	23,258	23,258	23,258	23,258
Biomass	49,651	46,756	56,437	64,668	73,998	88,305
Wind	33,493	62,193	105,528	144,175	183,595	238,783
Solar	85	6,525	15,285	24,045	32,805	41,565
Nuclear	15,867	14,744	14,744	25,153	25,153	25,153
TOTAL GENERATION	577,543	663,113	788,591	938,315	1,117,055	1,330,532

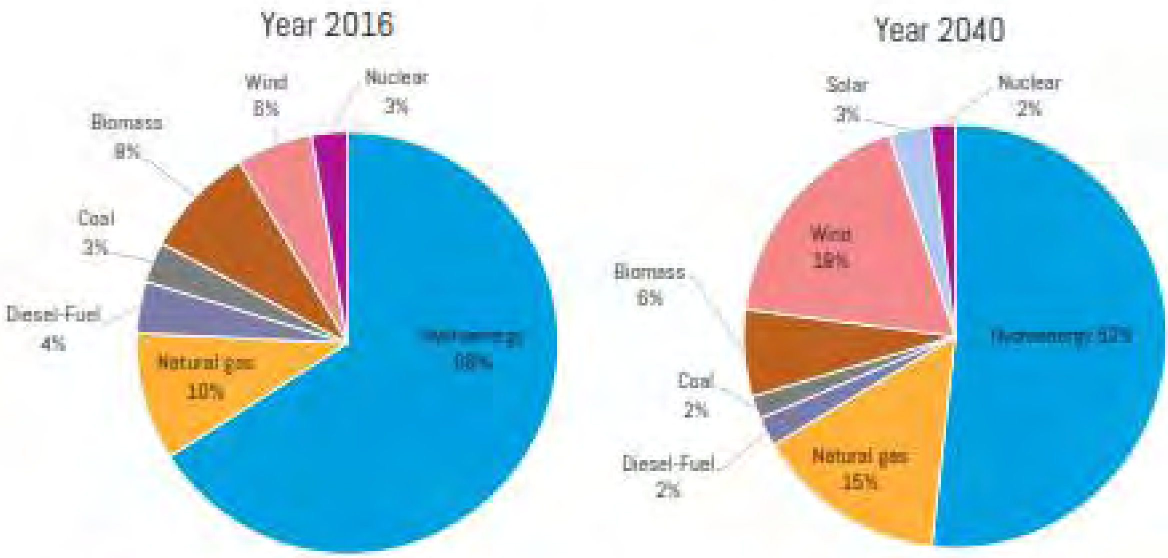
Source: Simulation results.

Figure 3.5. Forecast of electricity generation in Brazil



Source: Simulation results.

Figure 3.6. Evolution of the structure of the electricity generation matrix in Brazil



Source: Simulation results.

As shown in **Figure 3.5**, Brazil continues to be a net electricity importer throughout the forecast period, maintaining imports mainly from the generation of the Itaipu Bi-National Plant belonging to Paraguay, although it could also receive energy from Bolivia, Peru, Argentina and Uruguay.

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Figure 3.6 demonstrates the great relevance that wind energy has in the horizon of the study, by becoming the second most important resource for electricity generation, following hydropower.

3.1.3 Forecast of the total energy supply

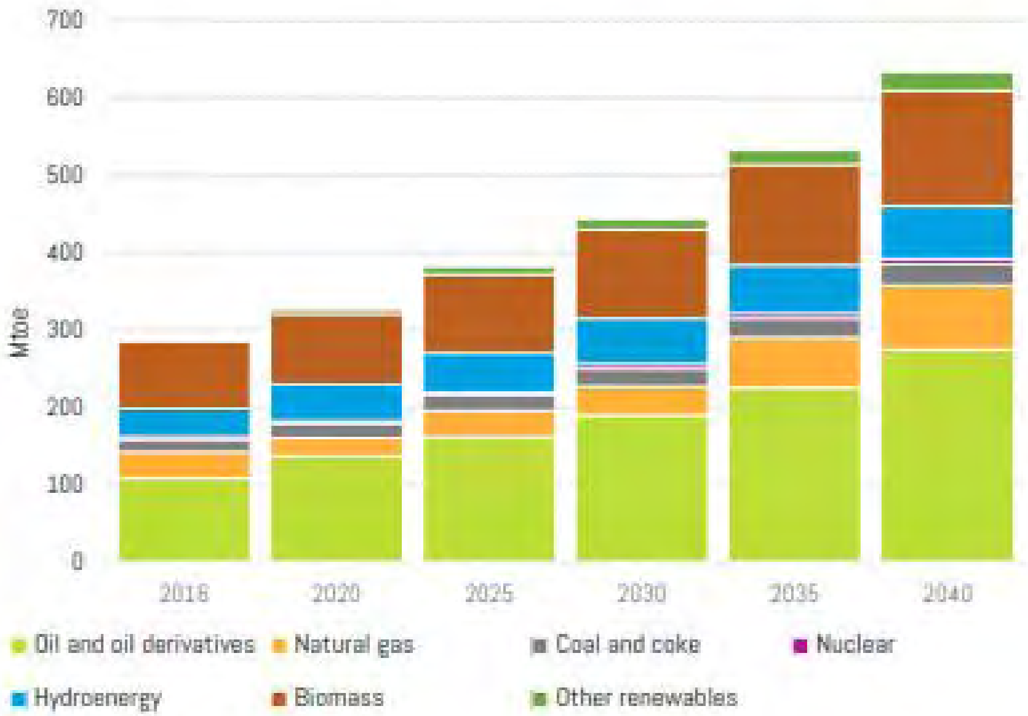
Table 3.5. Forecast of the total energy supply in Brazil (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	108	137	161	190	225	275	4.0%
Natural gas	34	23	34	38	65	83	3.8%
Coal and coke	16	18	20	22	24	28	2.3%
Nuclear	4	4	4	7	7	7	1.9%
Hydroenergy	36	47	51	59	62	68	2.6%
Biomass	87	91	102	115	130	149	2.3%
Other renewable	0	6	10	14	19	24	7.3%
TOTAL	285	327	382	444	532	634	3.4%

Source: *Simulation results.*

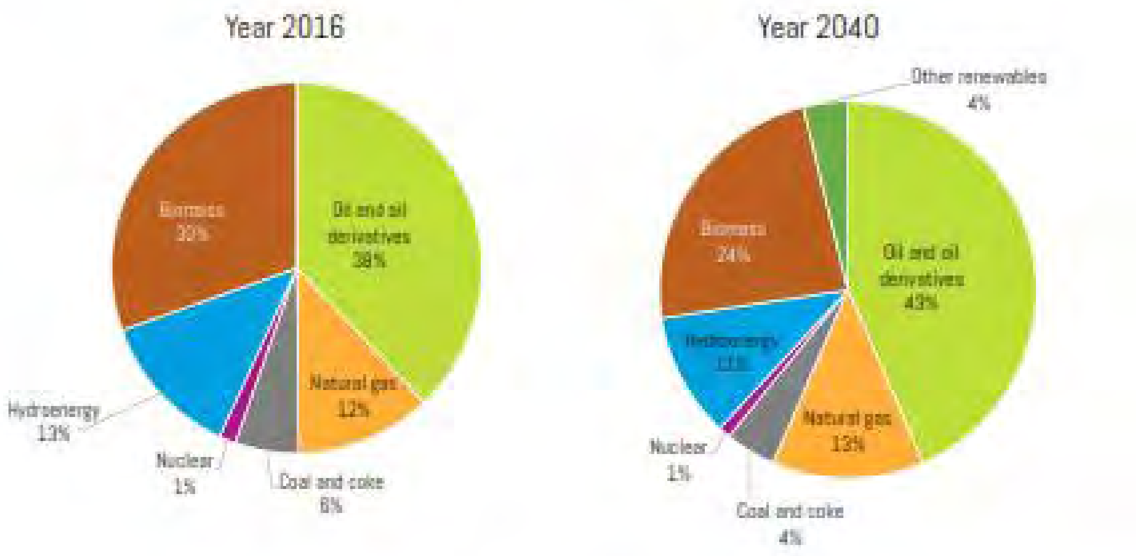
With a 3.4% annual average growth, the total energy supply during the projection period in Brazil exceeds 100% of total increase compared to the base year (see **Table 3.5**).

Figure 3.7. Forecast of the total energy supply in Brazil



Source: *Simulation results, CPS scenario.*

Figure 3.8. Evolution of the total energy supply matrix in Brazil



As can be seen in **Figure 3.8**, the total energy supply matrix does not undergo significant structural changes during the forecast period, since the predominance of hydrocarbons (oil and oil products and natural gas) and biomass continues. Although the increase in the participation of NCRE as wind and solar (other renewables) is very important in the electricity generation matrix, its participation is marginal, in the matrix of total energy supply, even at the end of the forecast period, reaching just about 4%.

3.2 Mexico

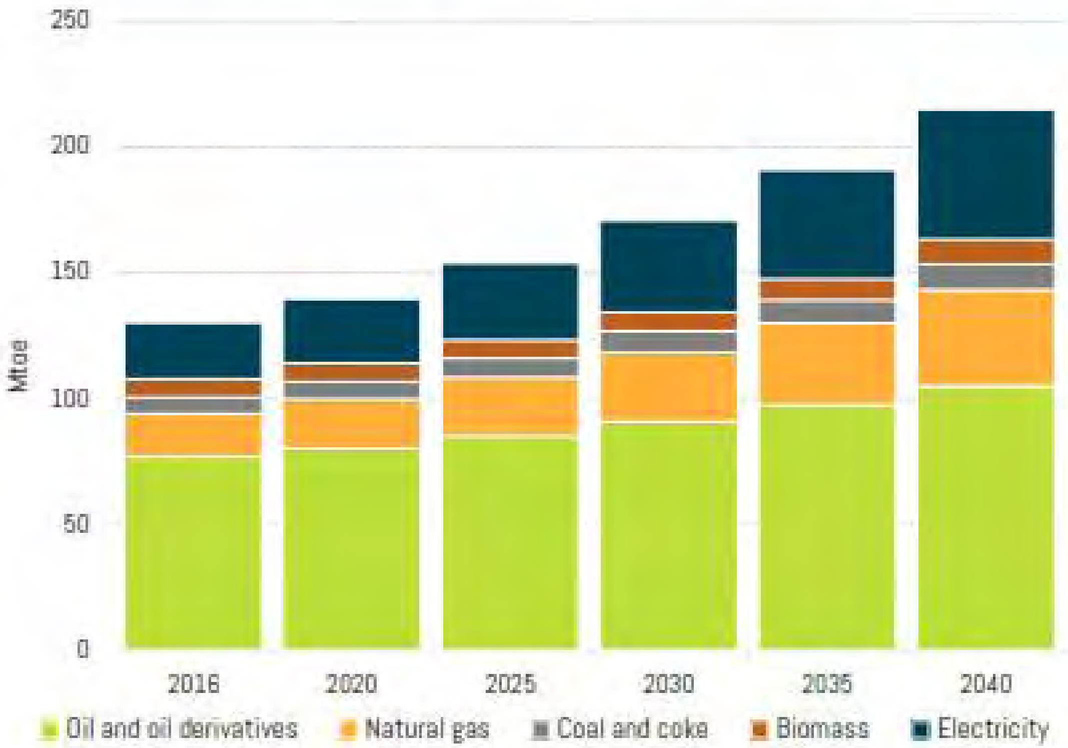
3.2.1 Forecast of the final energy consumption

Table 3.6. Forecast of the final energy consumption in Mexico (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	77	80	85	91	98	105	1.3%
Natural Gas	17	20	23	27	32	38	3.4%
Coal and coke	6	7	8	8	9	10	1.9%
Biomass	7	7	7	8	9	10	1.3%
Electricity	22	26	31	36	43	52	3.5%
TOTAL	130	140	154	171	191	215	2.1%

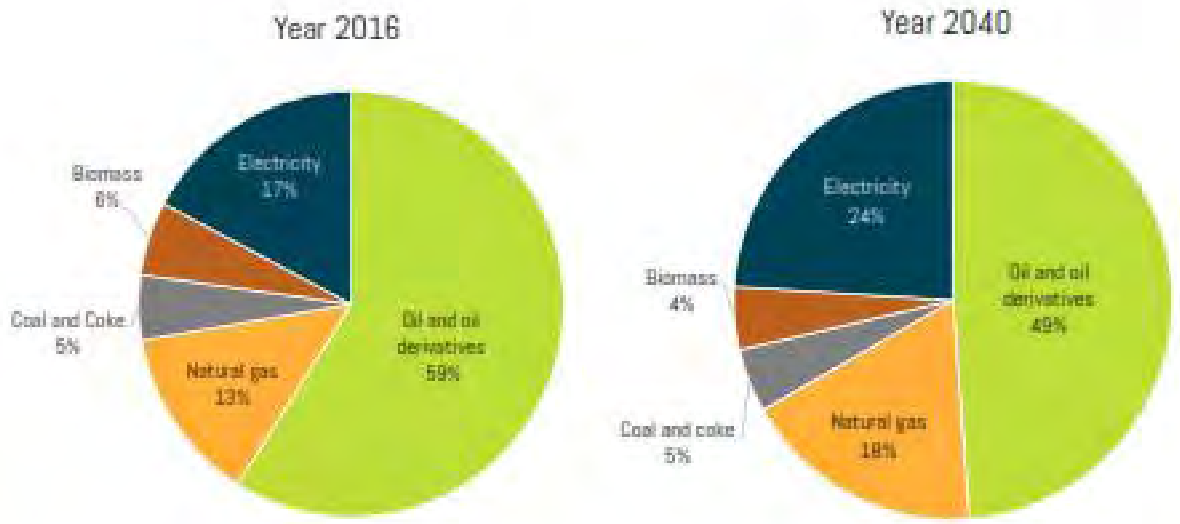
Source: Forecast based on the document "Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016)

Figure 3.9. Forecast of the final energy consumption in Mexico



Source: Forecast based on the document.
"Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016).

Figure 3.10. Evolution of the final energy consumption matrix of Mexico



Source: Forecast based on the document.
"Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016).

Given that electricity and natural gas are the fastest growing sources of energy consumption, their matrix share increases, while oil sources lose ground, as seen in **Figure 3.10**.

Table 3.7. Forecast of the domestic demand for electricity of Mexico (GWh)

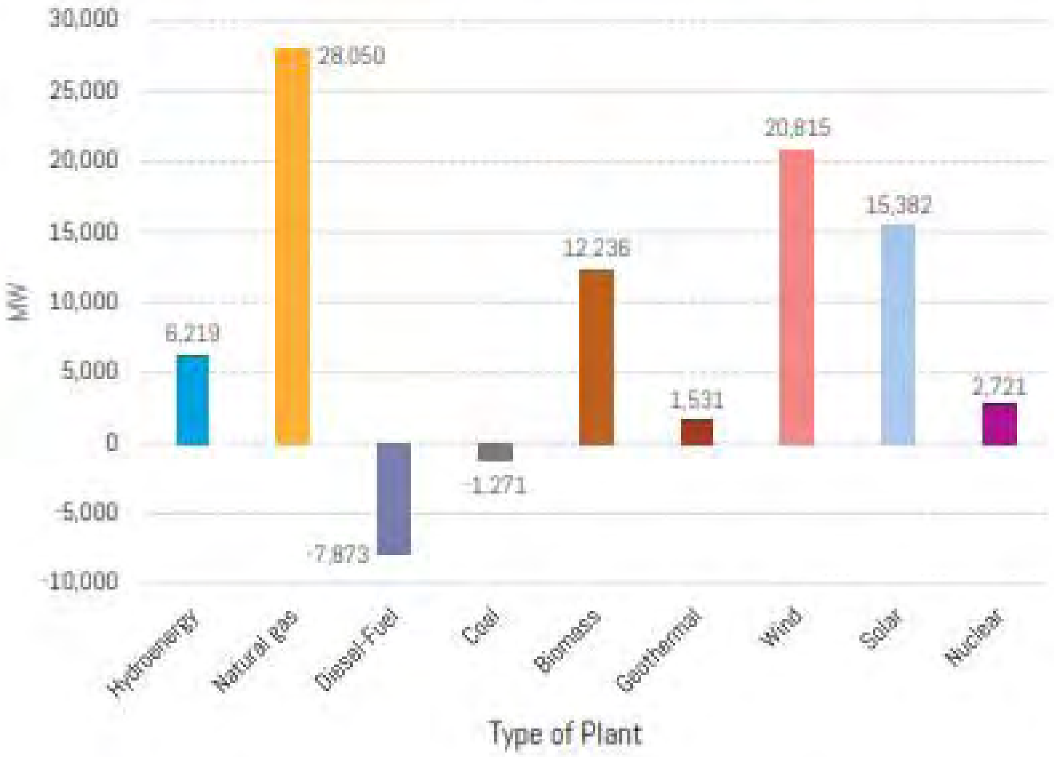
	2016	2020	2025	2030	2035	2040	t.p.a.
Final consumption	260,226	299,093	355,993	423,788	504,571	600,842	3.5%
Own consumption	14,774	16,965	20,182	24,037	28,619	34,080	3.5%
Losses	40,406	46,435	55,269	65,795	78,337	93,283	3.5%
Total domestic demand	315,405	362,493	431,455	513,620	611,527	728,205	3.5%

Source: Forecast based on the expansion plan of the electricity sector of Mexico.

Electricity's domestic demand in Mexico is driven mainly by the industrial and residential sectors. With an average annual growth rate of 3.5%, this consumption increases to a total of 131% compared to the base year during the forecast period.

3.2.2 Forecast of electricity generation

Figure 3.11. Additional installed capacity in Mexico during the forecast period



Source: Forecast based on the document.
"Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016).

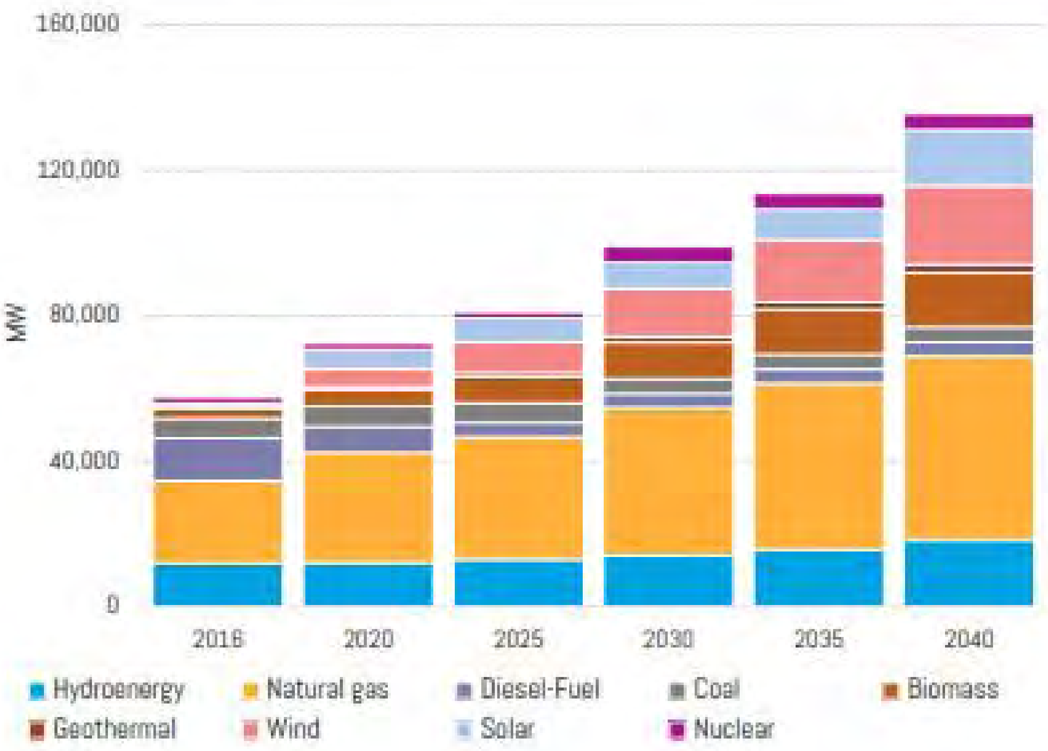
It is estimated that Mexico will install additional 77,810 MW of power generation during the forecast period. The country's expansion plans show a strong boost to electricity generation with the use of natural gas, adding a total of 28,050 MW of this technology during the forecast period (see **Figure 3.11**). In the same way there is also a large increase in the installed capacity of NCRE, especially wind, followed by solar and biomass.

Table 3.8. Forecast of installed capacity in Mexico (MW)

	2016	2020	2025	2030	2035	2040
Hydroenergy	12,092	12,174	13,044	14,111	15,811	18,311
Natural Gas	22,625	30,295	33,696	40,675	45,675	50,675
Diesel-Fuel	11,695	7,135	3,868	3,822	3,822	3,822
Coal	5,378	5,507	5,507	4,107	4,107	4,107
Biomass	2,676	4,522	7,081	9,912	12,412	14,912
Geothermal	974	854	1,193	1,685	1,905	2,405
Wind	699	4,888	8,439	13,226	17,156	21,514
Solar	6	5,432	6,586	7,192	8,388	15,388
Nuclear	1,608	1,608	1,608	4,329	4,329	4,329
TOTAL	57,653	72,415	81,010	99,059	113,605	135,463

Source: Forecast based on the document "Transition Strategy to Promote the Use of Cleaner Technologies and Fuels" (SENER, 2016).

Figure 3.12. Forecast of installed capacity in Mexico



Source: Simulation results.

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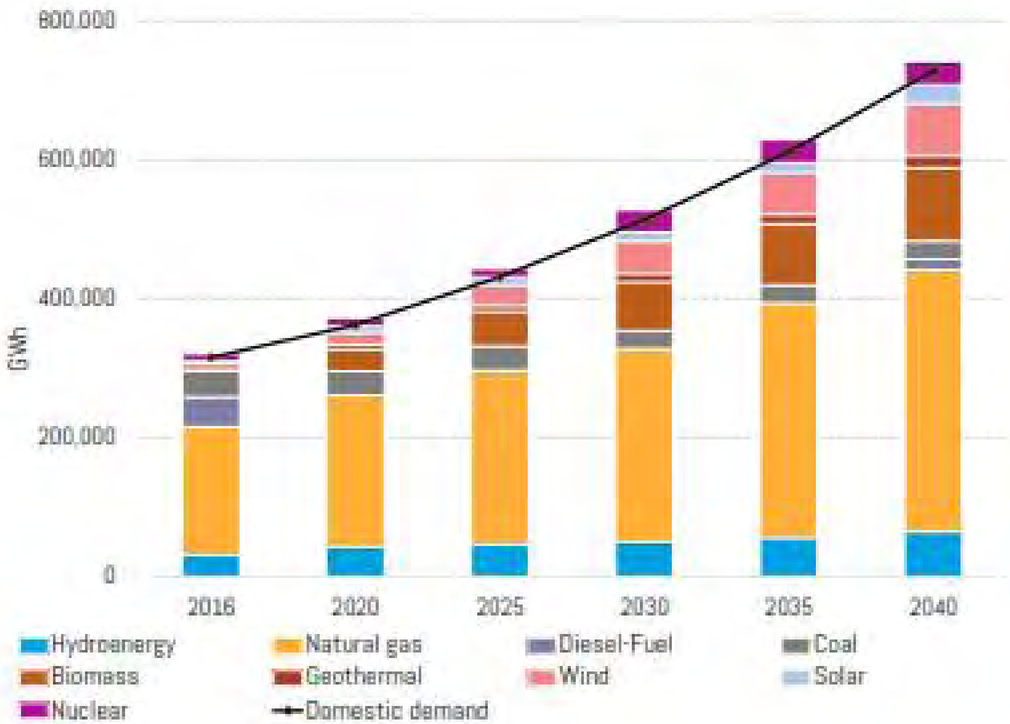
Table 3.9. Forecast of the generation of electricity in Mexico (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	30,387	42,659	45,707	49,446	55,403	64,163
Natural Gas	195,066	218,051	250,898	278,594	338,387	377,324
Diesel-Fuel	43,082	0	171	0	0	15,402
Coal	37,074	34,736	34,736	25,906	25,906	25,906
Biomass	5,861	32,086	50,244	70,332	88,071	105,810
Geothermal	6,034	6,057	8,391	11,953	13,514	17,062
Wind	2,462	17,128	29,571	46,344	60,115	75,386
Solar	13	9,517	11,539	12,600	14,696	26,960
Nuclear	10,569	12,255	12,255	32,992	32,992	32,992
TOTAL GENERATION	320,546	372,489	443,513	528,169	629,084	741,004

Source: Simulation Results.

Figure 3.13. Forecast of electricity generation in Mexico



Source: Simulation Results.

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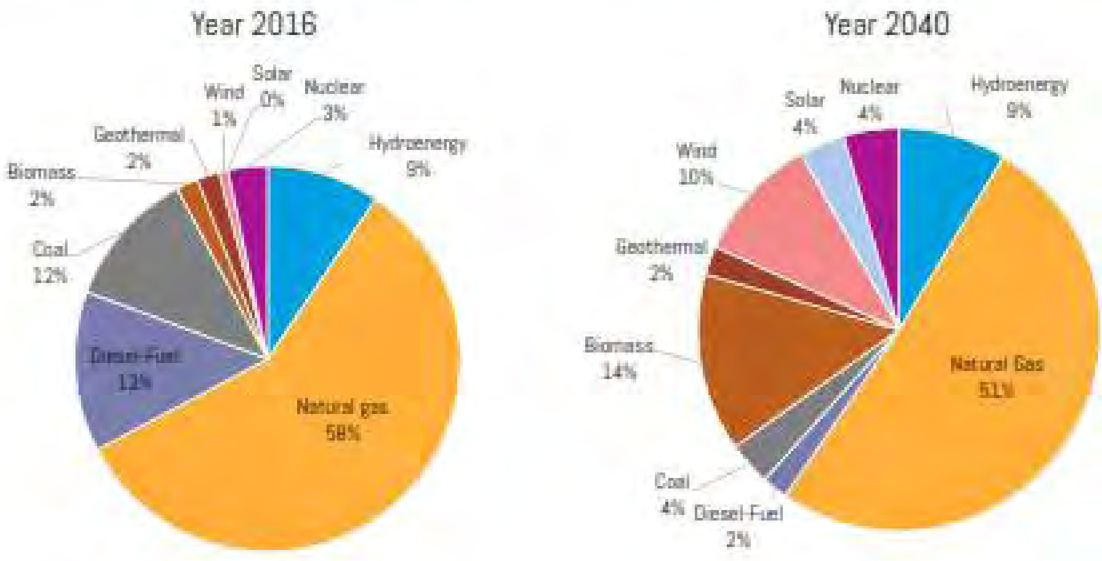
Figure 3.14. Evolution of the structure of the matrix of power generation in Mexico



Source: Simulation Results, CPS Scenario

As can be seen in **Figure 3.13**, Mexico has sufficient generation capacity to self-supply its domestic energy demand (final consumption + own consumption + losses), and even shows a slight supply surplus, which reflects the export capacity of Mexico to its neighboring countries, especially of the Central America sub-region such as Belize and Guatemala.

On the other hand, in **Figure 3.14**, we can see the evolution of the Mexican electricity generation matrix in the forecast period, which highlights the substitution of Diesel-fuel thermoelectric technology, due to the greater penetration of NCRE, such as wind, biomass and solar. It is also worth highlighting that Mexico is betting on the expansion of its thermonuclear park, for the last years of the forecast period, which is reflected in the increase in the percentage participation of this technology in the electricity production matrix.

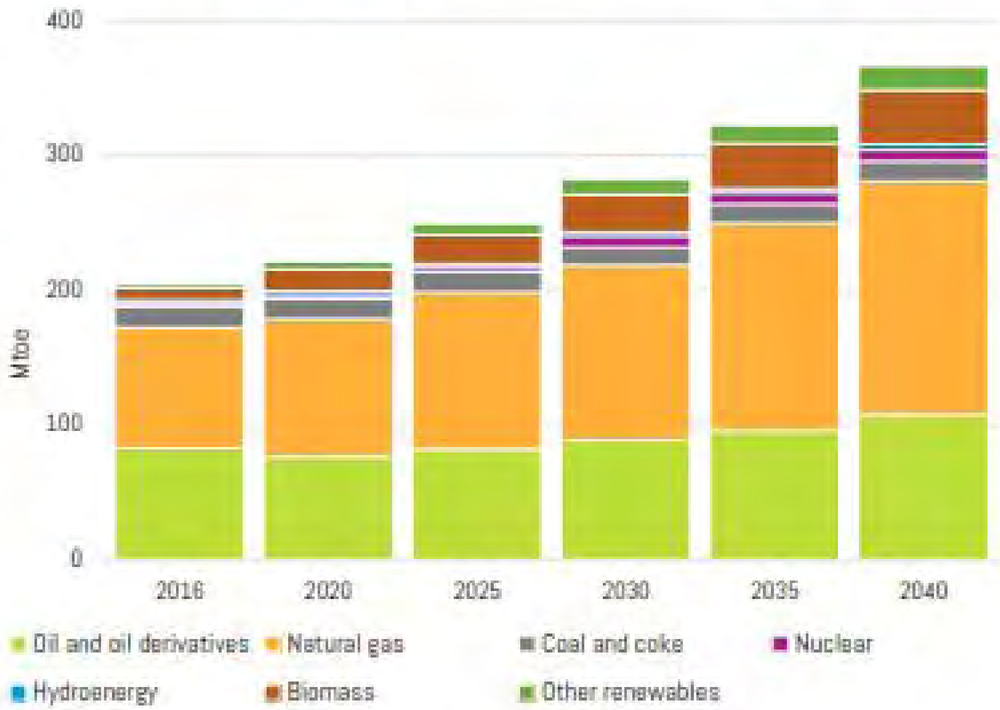
3.2.3 Forecast of the total energy supply

Table 3.10. Forecast of the total energy supply in Mexico (Mtoe)

	2018	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	82	78	82	89	96	108	1.1%
Natural Gas	90	103	117	130	154	173	2.8%
Coal and coke	15	15	15	13	14	15	-0.1%
Nuclear	3	3	3	8	8	8	4.9%
Hydroenergy	2	3	3	3	3	4	3.0%
Biomass	9	16	22	28	34	40	6.5%
Other renewables	3	6	8	11	14	18	7.3%
TOTAL	205	221	249	282	323	368	2.5%

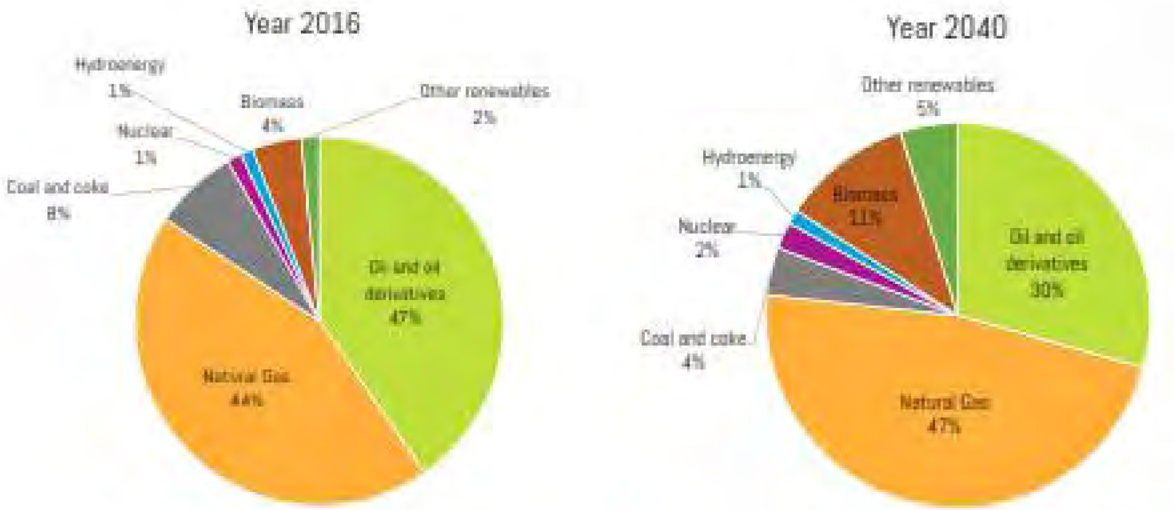
Source: Simulation Results.

Figure 3.15. Forecast of the total energy supply in Mexico, CPS Scenario



Source: Simulation Results

Figure 3.16. Evolution of the total energy supply matrix in México



Source: Simulation Results

As for the evolution of the total energy supply, as presented in **Figure 3.16**, a greater penetration of natural gas throughout the forecast period is observed, consolidating itself as the predominant source of energy in Mexico's total energy supply matrix. The NCRE, specifically wind energy, solar energy and geothermal, present a very important breakthrough in the primary energy supply thanks to its increased participation in electricity generation.

3.3 Central America

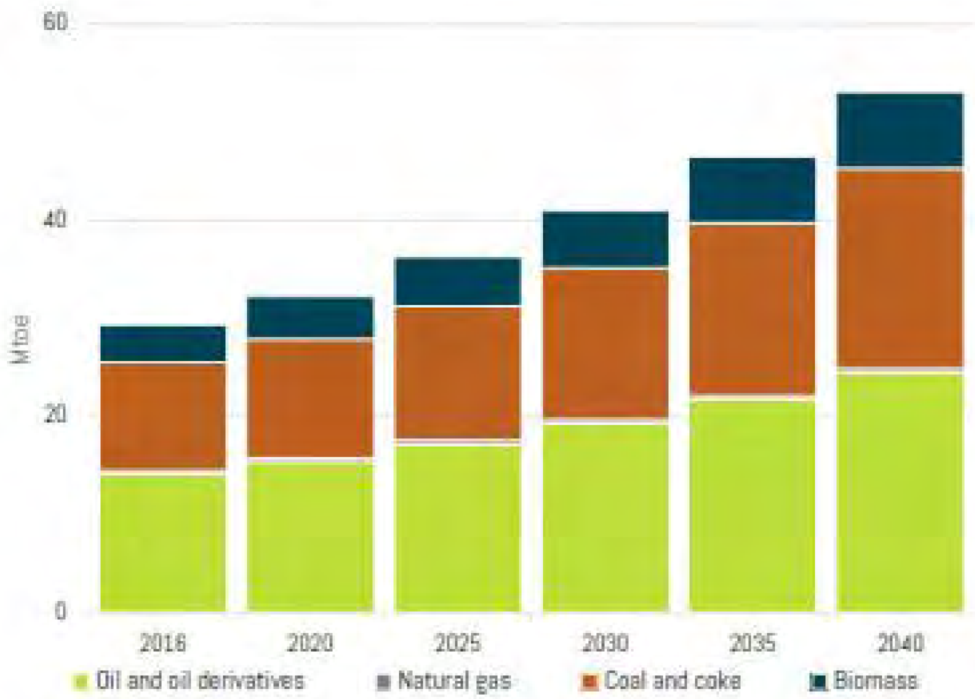
3.3.1 Forecast of the final energy consumption

Table 3.11. Forecast of the final energy consumption in Central America (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	14	15	17	19	22	24	2.30%
Coal and coke	0,37	0,38	0,39	0,40	0,40	0,41	0.40%
Biomass	11	12	14	15	18	20	2.60%
Electricity	4	4	5	6	7	8	3.00%
TOTAL	29	32	36	41	46	53	2.50%

Source: Forecast based on the referential expansion plans of the Central American countries.

Figure 3.17. Forecast of the final energy consumption in Central America



Source: Forecast based on the referential expansion plans of the Central American countries.

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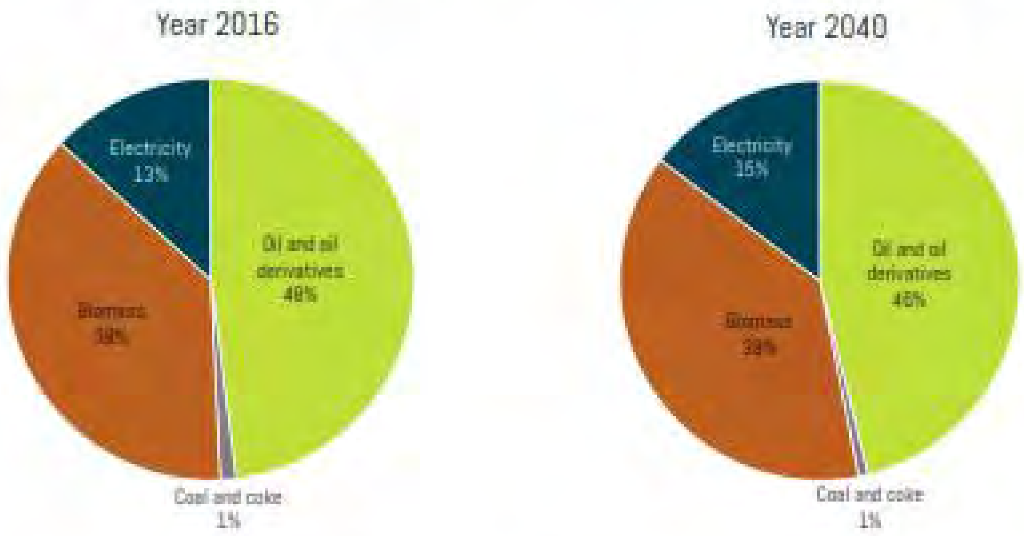
Figure 3.18. Evolution of the final energy consumption matrix in Central America



Source: Forecast based on the referential expansion plans of the Central American countries.

In the CPS Scenario, the final consumption matrix of the Central American Sub-Region is still dominated by oil and oil derivatives and biomass consumption throughout the forecast period, however, electricity gains ground by being the source with the highest average annual growth rate as seen in **Table 3.11**.

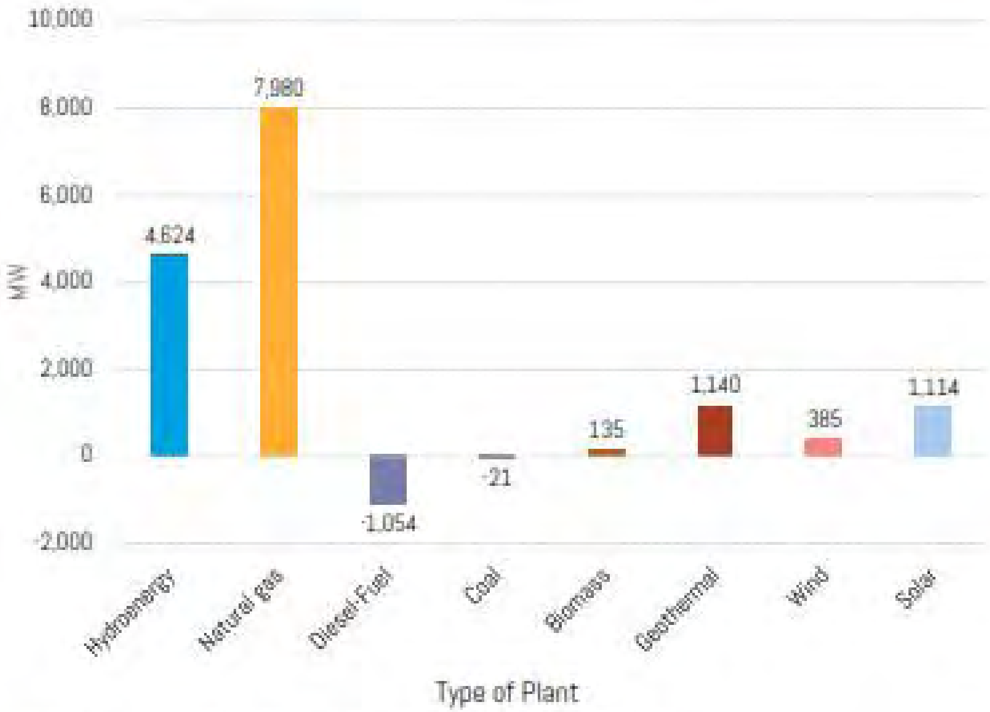
Table 3.12. Forecast of the domestic demand for electricity, Central America (GWh)

	2016	2020	2025	2030	2035	2040	t.p.a.
Final consumption	44,954	50,434	58,292	67,444	78,113	90,556	3.0%
Own consumption	2,106	2,362	2,729	3,158	3,658	4,240	3.0%
Losses	7,332	8,226	9,507	11,000	12,740	14,769	3.0%
Total domestic demand	54,391	61,021	70,529	81,602	94,510	109,566	3.0%

Source: Forecast based on the referential expansion plans of the Central American countries.

3.3.2 Forecast of electricity generation

Figure 3.19. Additional installed capacity in Central America during the forecast period



Source: Forecast based on the referential expansion plans of the Central American countries.

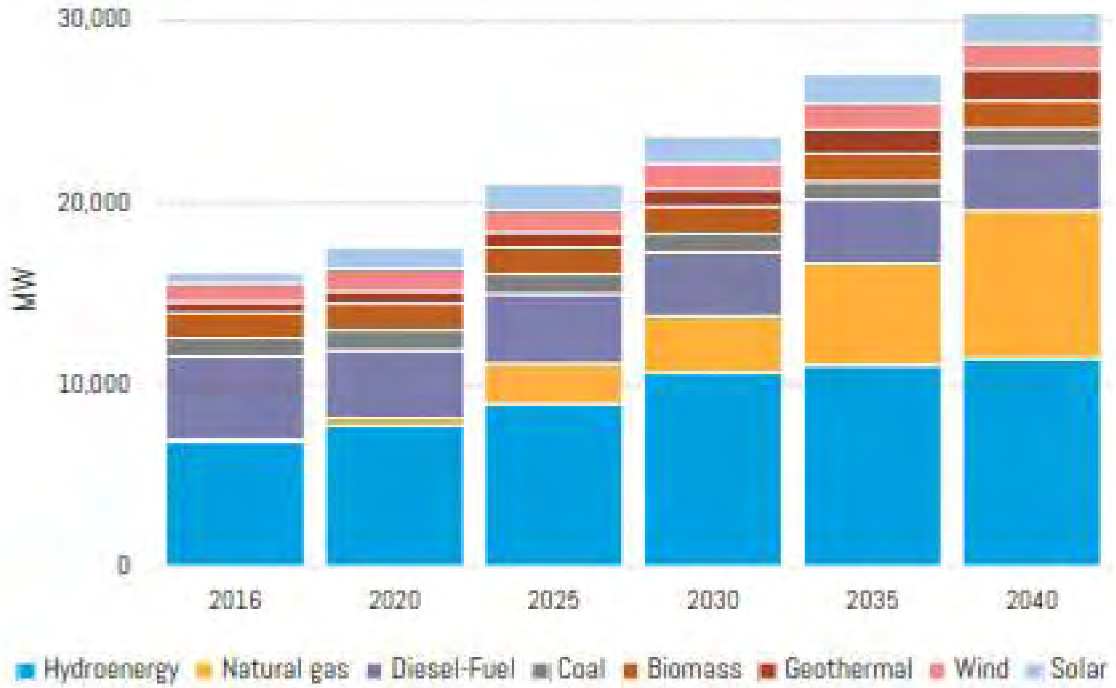
As for the supply of electricity, the Central American countries will continue to expand their hydroelectric generation park, complemented with natural gas plants and harnessing NCRE as biomass, geothermal, wind and solar (see **Figure 3.19**). The countries that plan to make use of natural gas for electricity generation are El Salvador, Honduras, Nicaragua and Panama, through projects, mainly of combined cycle, whose input will be imported gas in the form of LNG. During the forecast period, the installation of a net additional capacity of 14,303 MW in the Central American Sub-Region is estimated.

Table 3.13. Forecast of installed capacity in Central America (MW)

	2016	2020	2025	2030	2035	2040
Hydroenergy	6,823	7,710	8,941	10,643	11,045	11,447
Natural Gas	147	447	2,227	3,127	5,627	8,127
Diesel-Fuel	4,562	3,730	3,813	3,508	3,508	3,508
Coal	1,023	1,092	1,092	1,002	1,002	1,002
Biomass	1,391	1,471	1,482	1,526	1,526	1,526
Geothermal	599	689	809	939	1,339	1,739
Wind	1,035	1,235	1,235	1,420	1,420	1,420
Solar	584	1,165	1,435	1,500	1,599	1,698
TOTAL	16,165	17,540	21,034	23,666	27,067	30,468

Source: Simulation results based on the expansion plans of the electricity sector.

Figure 3.20. Forecast of installed capacity in Central America



Source: Simulation results based on the installation/withdrawal timetables.

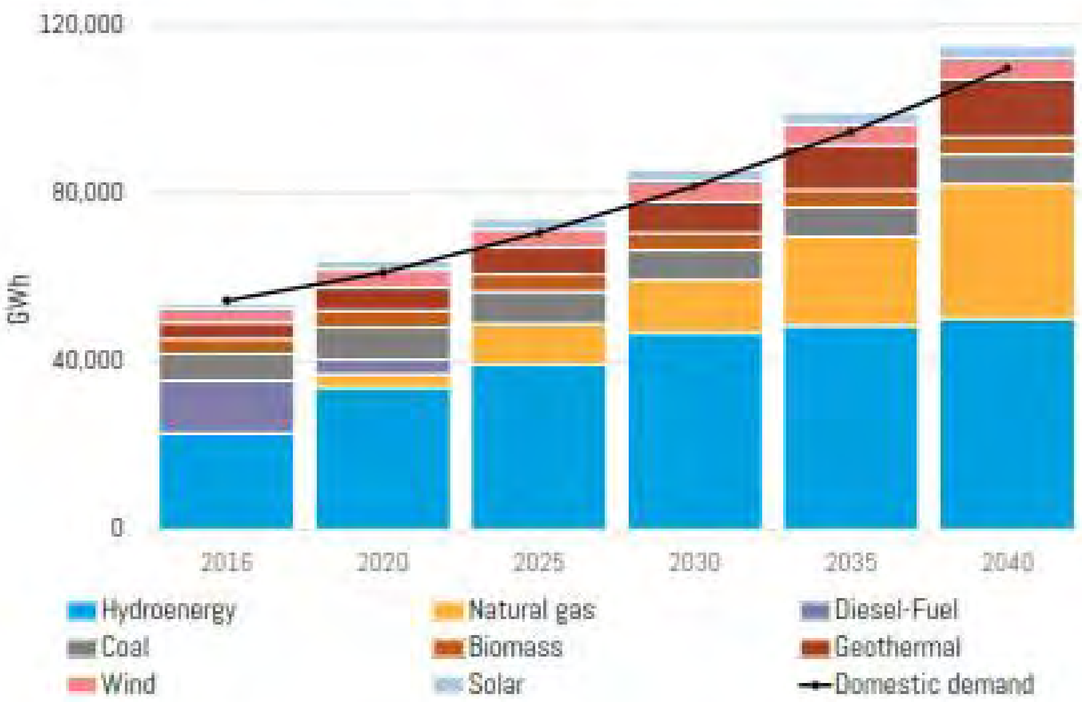
With the "installation/withdrawal" timetables considered for the Central American Sub-Region, the total capacity of power generation is increased by 88% during the forecast period. It is important to highlight that the natural gas technology, having almost zero participation in the base year, becomes the second most important technology in the year 2040, following hydroelectric, contributing with about 27% of the total installed capacity in that year (**Figure 3.20**).

Table 3.14. Forecast of the generation of electricity in Central America (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	22,864	33,772	39,161	46,616	48,377	50,139
Natural Gas	9	3,133	9,769	12,662	21,176	31,942
Diesel-Fuel	12,537	3,483	0	0	0	0
Coal	6,271	7,653	7,653	7,022	7,022	7,022
Biomass	3,597	3,994	4,024	4,144	4,144	4,144
Geothermal	3,842	5,435	6,381	7,406	10,559	13,713
Wind	3,291	4,329	4,329	4,977	4,977	4,977
Solar	1,158	2,042	2,514	2,629	2,802	2,976
TOTAL GENERATION	53,570	63,839	73,830	85,475	99,059	114,913

Source: Simulation Results.

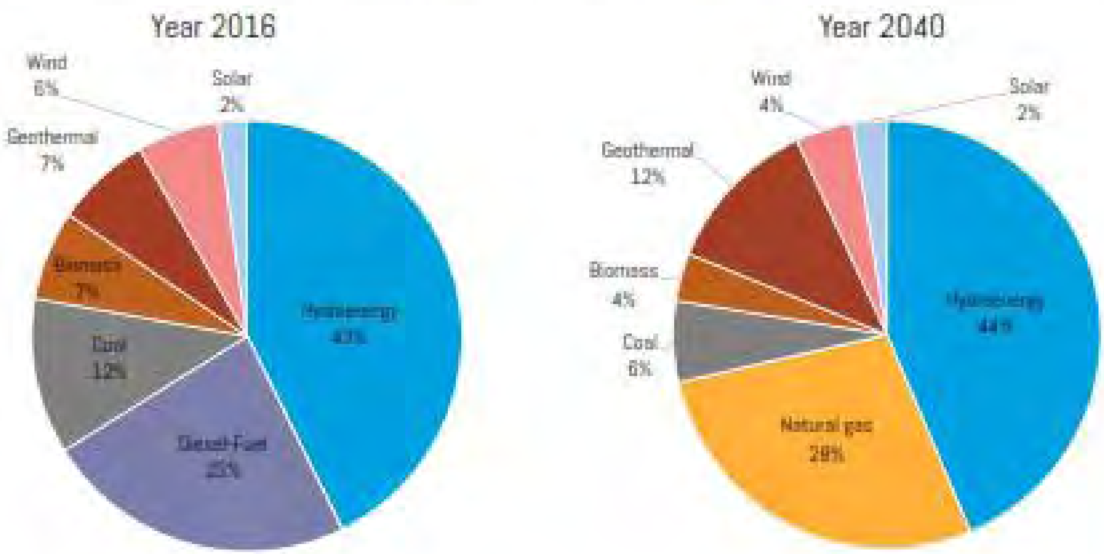
Figure 3.21. Forecast of electricity generation in Central America



Source: Simulation Results.

It can be noted that Central America as a Sub-Region is self-sufficient in the production of electricity during the entire study period. Although in the base year there is importation of electricity in Belize coming from Mexico, in the forecast period this importation disappears, since such energy could be perfectly supplied by countries that are members of the Sub-Region, and even develop some energy exporting capacity that could have North America or South America as a destination.

Figure 3.22. Evolution of the electricity generation matrix in Central America



Source: Simulation Results.

According to the evolution of the installed capacity, it can be seen in the charts of **Figure 3.22**, that natural gas becomes the second most important source in the electricity generation matrix of the Central American Sub-Region by the year 2040, displacing oil and oil products, while renewable sources, such as hydroenergy and geothermal increase their percentage share in said matrix.

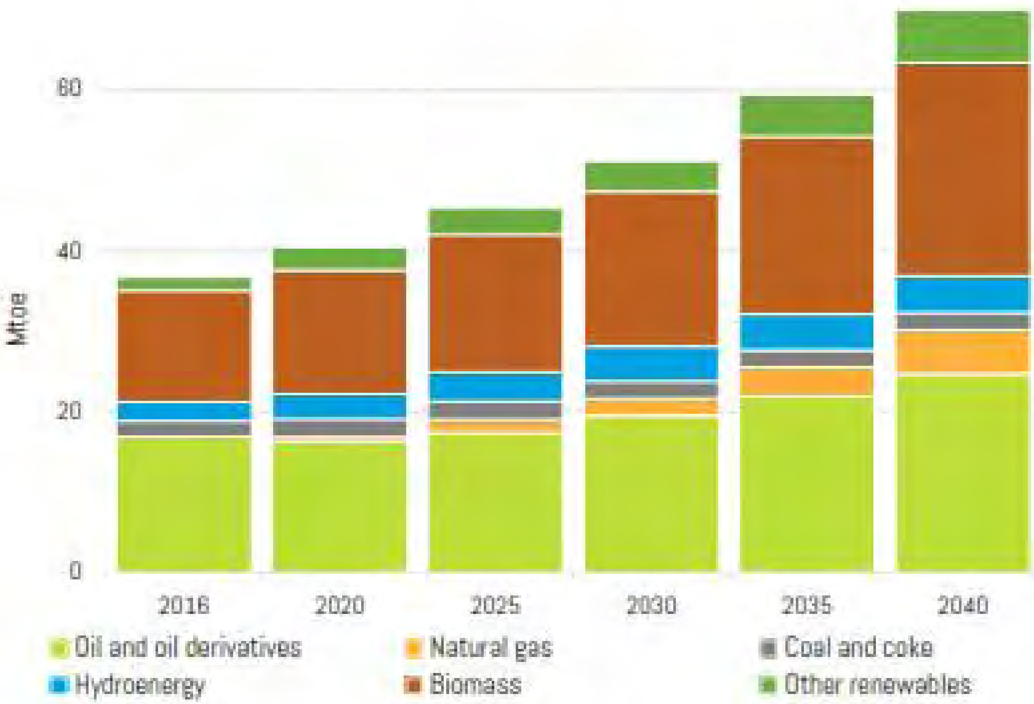
3.3.3 Forecast of the total energy supply

Table 3.15. Forecast of the total energy supply in Central America (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	17	16	17	19	22	25	1.6%
Natural Gas	0	1	2	2	4	5	38.2%
Coal and coke	2	2	2	2	2	2	0.5%
Hydroenergy	2	3	4	4	4	5	2.8%
Biomass	14	15	17	19	22	27	2.7%
Other renewables	2	3	3	4	5	7	5.9%
TOTAL	37	41	45	51	59	70	2.7%

Source: Simulation Results.

Figure 3.23. Forecast of the total energy supply in Central America



Source: Simulation Results.

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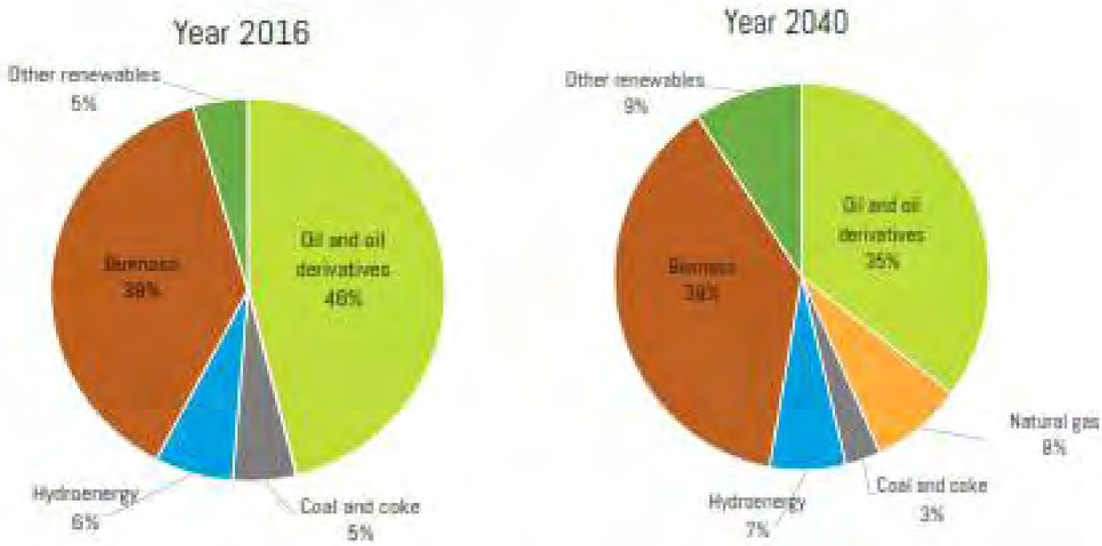
Figure 3.24. Evolution of the total energy supply matrix in Central America



Source: Simulation Results.

The evolution of the total energy supply presented in **Figure 3.24**, shows that the oil and oil derivatives and biomass continue to dominate the forecast horizon, however, natural gas, hydropower and other renewables (geothermal, wind and solar) displace a part of oil and oil products and coal.

3.4 Andean Zone

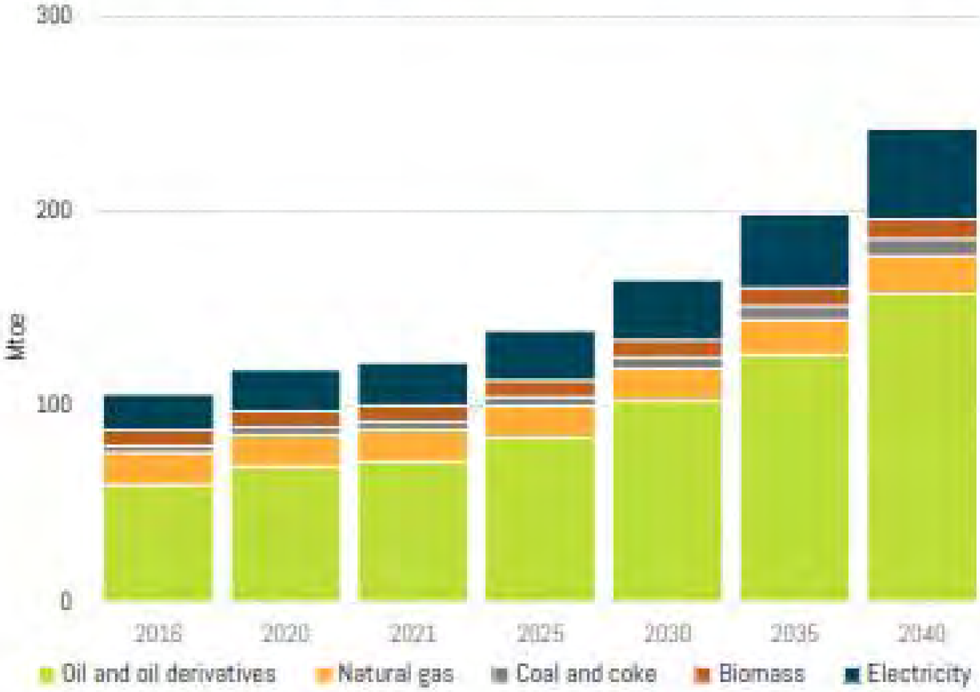
3.4.1 Forecast of the final energy consumption

Table 3.16. Forecast of the final energy consumption in the Andean Zone (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	60	70	84	103	127	158	4.1%
Natural Gas	17	16	16	17	18	20	0.7%
Coal and coke	3	4	5	6	7	9	4.2%
Biomass	8	8	8	8	9	10	0.7%
Electricity	18	21	25	31	38	46	4.0%
TOTAL	107	119	139	165	199	243	3.5%

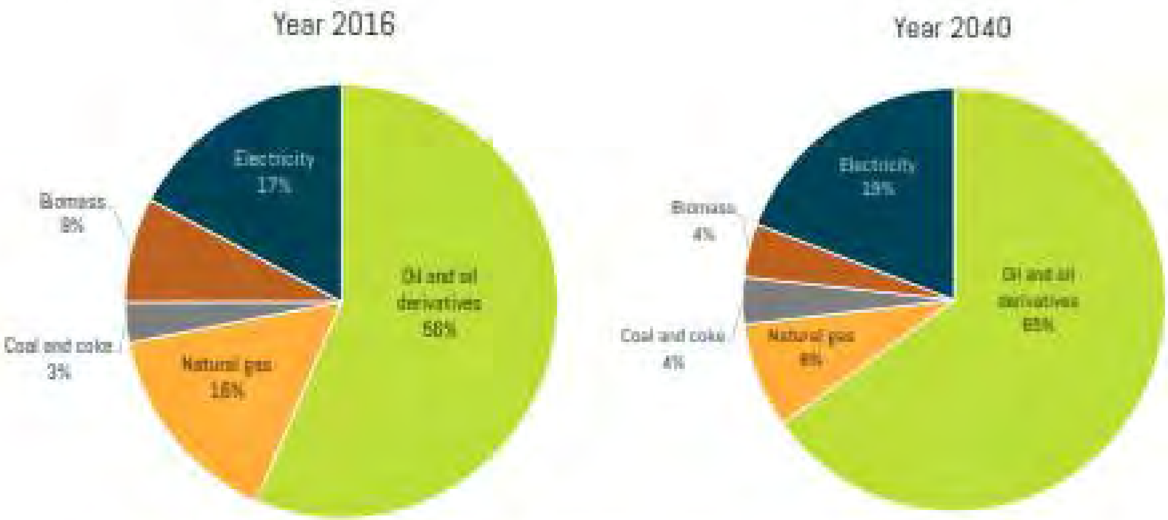
Source: Forecast based on the referential expansion plans of the Andean countries.

Figure 3.25. Forecast of the final energy consumption in the Andean Region



Source: Forecast based on the referential expansion plans of the Andean countries.

Figure 3.26. Evolution of the final energy consumption matrix in the Andean Zone



Source: Forecast based on the referential expansion plans of the Andean countries.

In the evolution of the final consumption matrix in the CPS Scenario, oil and oil products and electricity have high annual average growth rates, which allow them to gain more percentage share in the matrix, at the cost of a reduction in the participation of natural gas and biomass. (**Figure 3.26**).

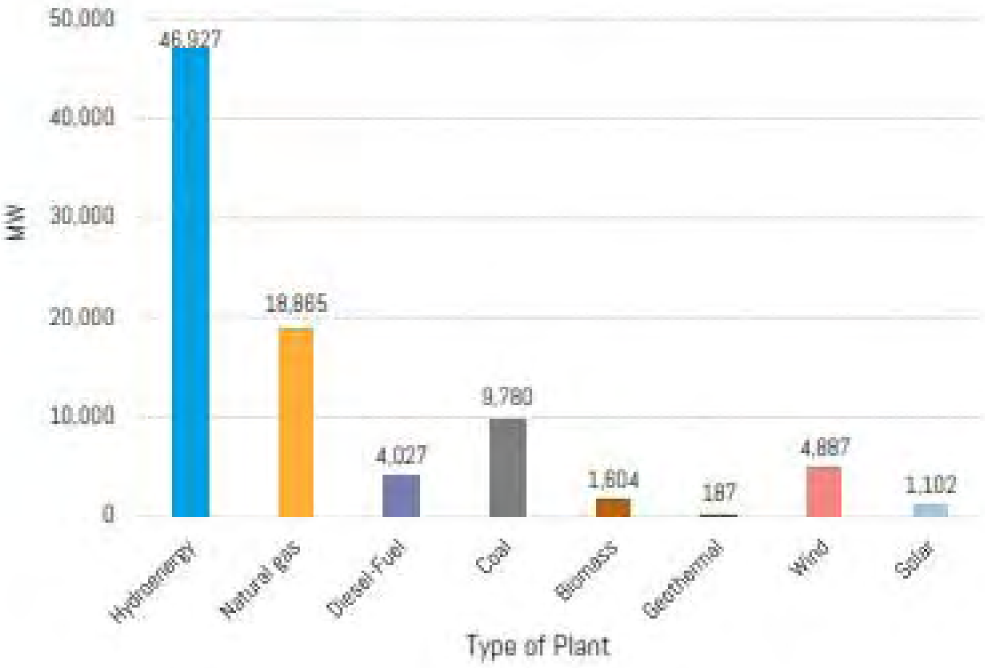
Table 3.17. Forecast of the domestic demand for electricity (GWh)

	2018	2020	2025	2030	2035	2040	t.p.a.
Final consumption	213,265	246,111	296,459	359,802	439,701	540,784	4.0%
Own consumption	8,189	9,465	11,401	13,837	16,909	20,797	4.0%
Losses	53,750	62,029	74,720	90,682	110,819	136,295	4.0%
Total domestic demand	275,204	317,604	382,590	464,320	567,430	697,876	4.0%

Source: Forecast based on the expansion plans of the electricity sector of the Andean countries.

3.4.2 Forecast of electricity generation

Figure 3.27. Additional installed capacity in the Andean Zone, during the forecast period



Source: Forecast based on the expansion plans of the electricity sector the Andean countries.

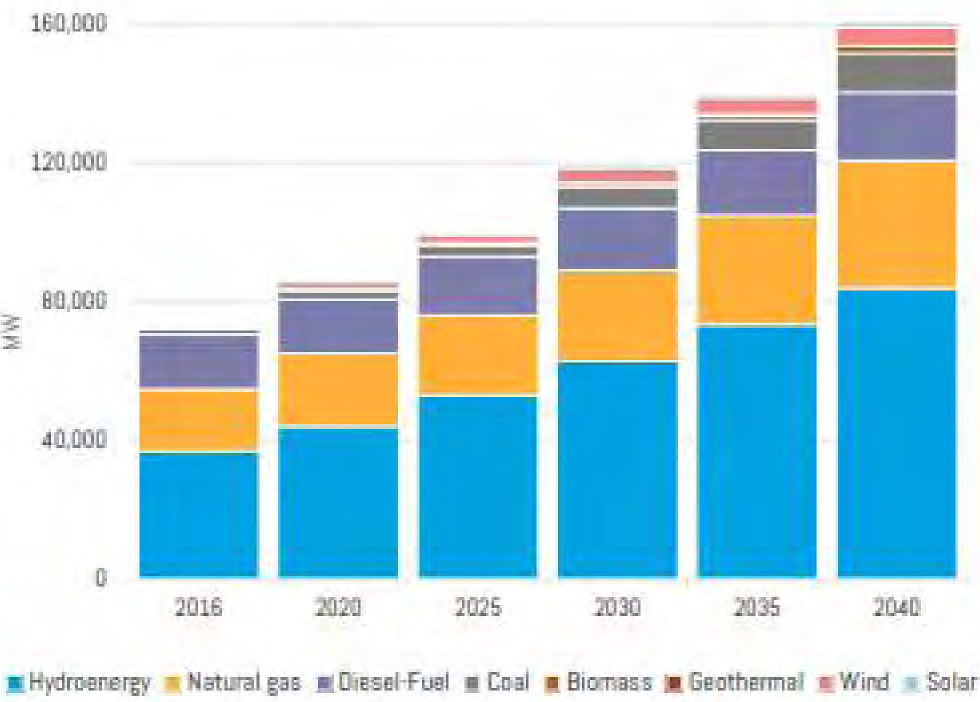
From the simulation of the CPS Scenario, for the Andean Zone, we obtain a total capacity increase installed during the forecast period of 87,378 MW, highlighting the great interest to increase the use of water resource, of which this sub-region has a high unexploited potential, complementing this expansion mainly with natural gas and coal plants. Of the NCRE group, wind and biomass stand out, as can be seen in **Figure 3.27**.

Table 3.18. Forecast of installed capacity in the Andean Zone (MW)

	2016	2020	2025	2030	2035	2040
Hydroenergy	36,874	43,941	52,971	62,741	73,271	83,801
Natural Gas	17,890	21,032	23,057	26,240	31,499	36,755
Diesel-Fuel	15,625	15,629	16,898	17,919	18,795	19,653
Coal	1,604	2,399	3,051	6,090	8,737	11,384
Biomass	341	613	761	1,001	1,472	1,944
Geothermal	0	51	180	187	187	187
Wind	362	1,978	2,327	4,194	4,721	5,249
Solar	129	550	619	963	1,097	1,231
TOTAL	72,826	86,191	99,865	119,336	139,769	160,203

Source: *Simulation results.*

Figure 3.28. Forecast of installed capacity in the Andean Zone



Source: *Simulation Results.*

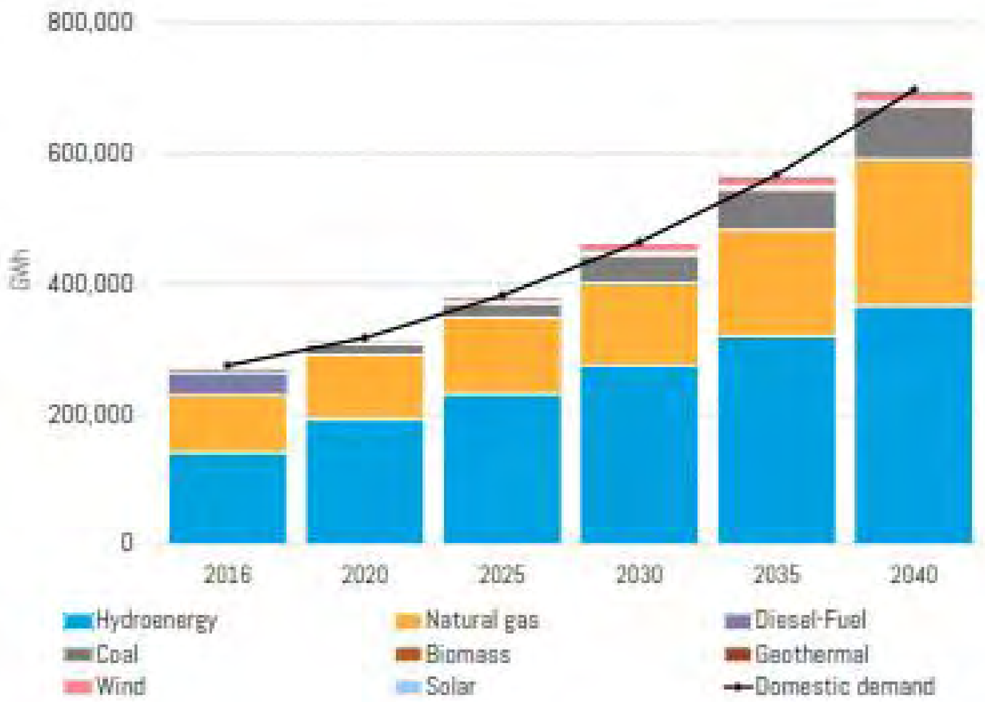
In general, the total power generation capacity for the sub-region is increased by 120% in the forecast period, with an increase in the participation of NCRE sources, mainly wind, as can be seen in **Figure 3.28**.

Table 3.19. Forecast of the generation of electricity in the Andean Zone (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	141,955	192,463	232,012	274,806	320,927	367,049
Natural Gas	89,690	98,928	117,025	128,936	162,126	224,709
Diesel-Fuel	33,897	0	0	0	0	0
Coal	7,952	16,814	21,384	42,677	61,229	79,781
Biomass	1,198	1,771	2,201	2,893	4,257	5,621
Geothermal	0	404	1,419	1,474	1,474	1,474
Wind	1,244	6,925	8,155	14,696	16,543	18,390
Solar	279	964	1,095	1,686	1,921	2,156
TOTAL GENERATION	275,196	318,169	383,279	465,167	568,477	699,178

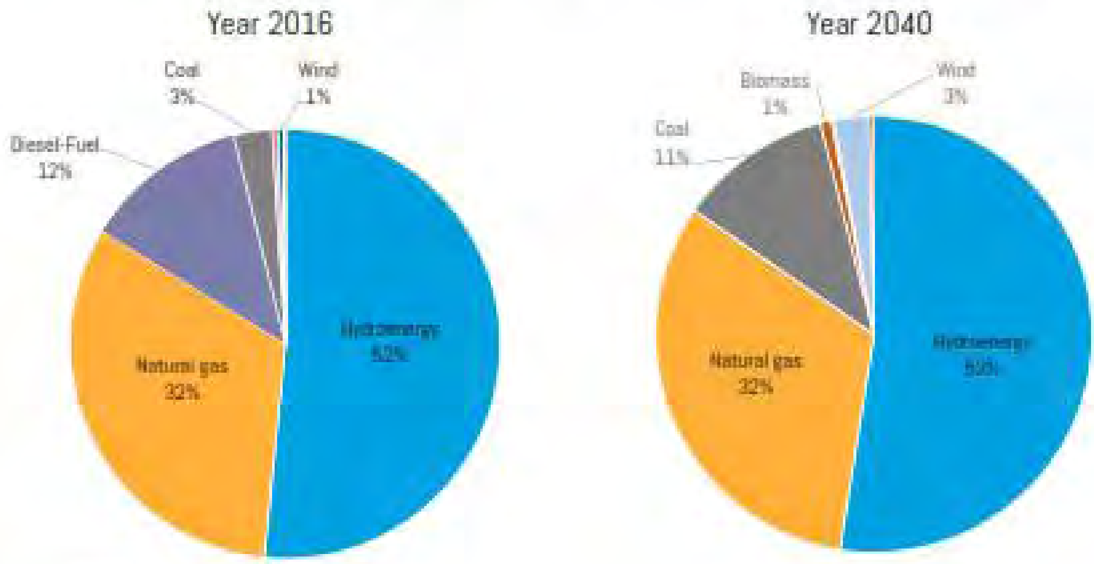
Source: Simulation Results.

Figure 3.29. Forecast of electricity generation in the Andean Zone



Source: Simulation Results.

Figure 3.30. Evolution of the electricity generation matrix in the Andean Zone



Source: Simulation Results.

The high hydroelectric potential of the Andean Zone, coupled with the expansion of the use of natural gas and NCRE, guarantees the sub-region's self-sufficiency in the production of electricity during the entire study period (**Figure 3.29**).

As can be seen in **Figure 3.30**, by the year 2040, coal becomes the third most important source of the sub-region's electricity matrix, displacing the use of oil and oil derivatives (Diesel-fuel), while hydroenergy increases its participation in the matrix and natural gas is maintained with a similar participation to the year 2016.

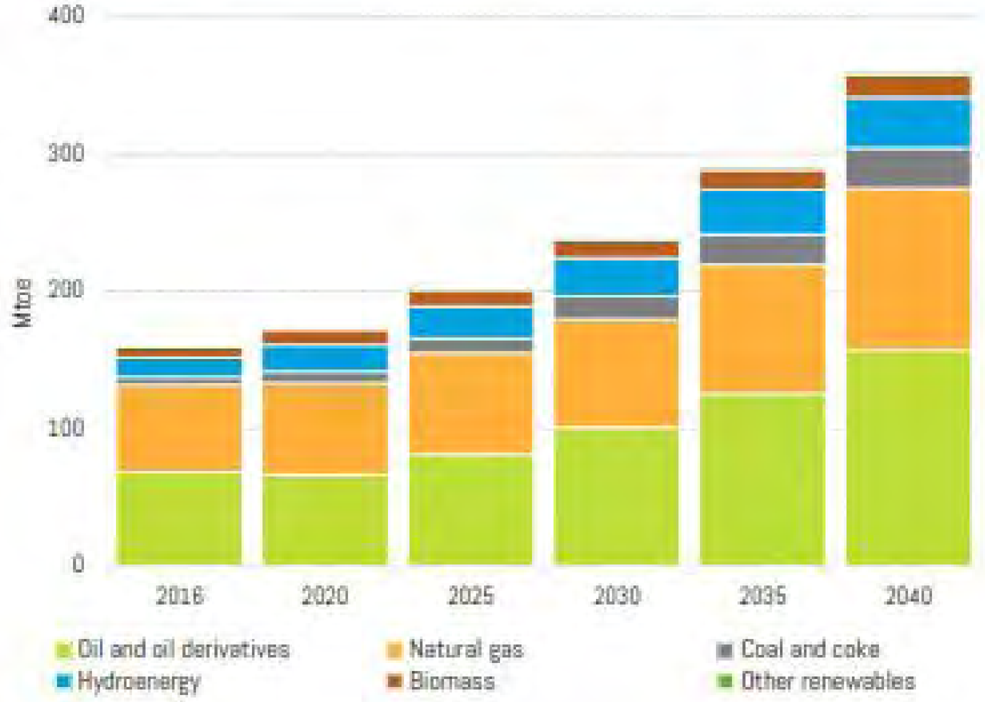
3.4.3 Forecast of the total energy supply

Table 3.20. Forecast of the total energy supply in the Andean Zone (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	69	67	81	101	126	157	3.5%
Natural Gas	64	67	74	79	94	118	2.6%
Coal and coke	6	8	11	17	22	29	7.0%
Hydroenergy	14	19	23	28	32	37	4.0%
Biomass	8	11	12	13	15	18	2.9%
Other renewables	0	1	1	2	2	2	11.1%
TOTAL	161	173	203	239	291	360	3.4%

Source: Simulation Results.

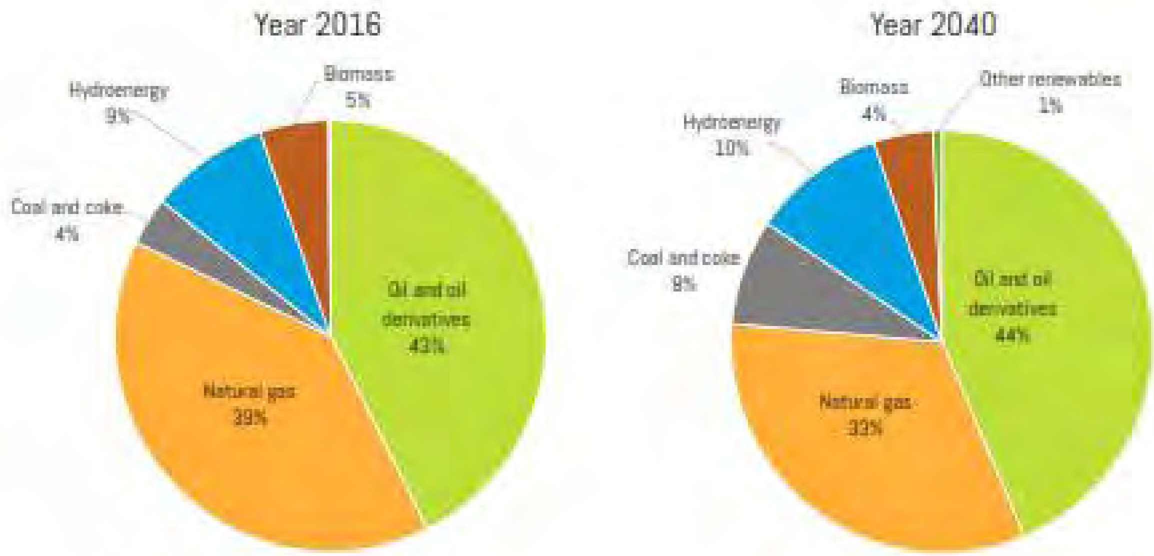
Figure 3.31. Forecast of the total energy supply in the Andean Zone



Source: *Simulation Results.*

As for the total supply of energy, as can be seen in **Table 3.20** and **Figure 3.31**, oil, oil derivatives and natural gas are maintained as the dominant energy sources in the sub-region throughout the period of forecast, while there is a gradual growth of hydroenergy and other renewables, including biomass. The total energy supply in the Andean Zone grows 124% compared to the year 2016, at an average annual increase rate of 3.4%.

Figure 3.32. Evolution of the total energy supply matrix in the Andean Zone



Source: *Simulation Results.*

As observed in **Figure 3.32**, the participation of oil and oil products in the total energy supply matrix is almost maintained, while hydroenergy and coal gain ground to natural gas.

3.5 Southern Cone

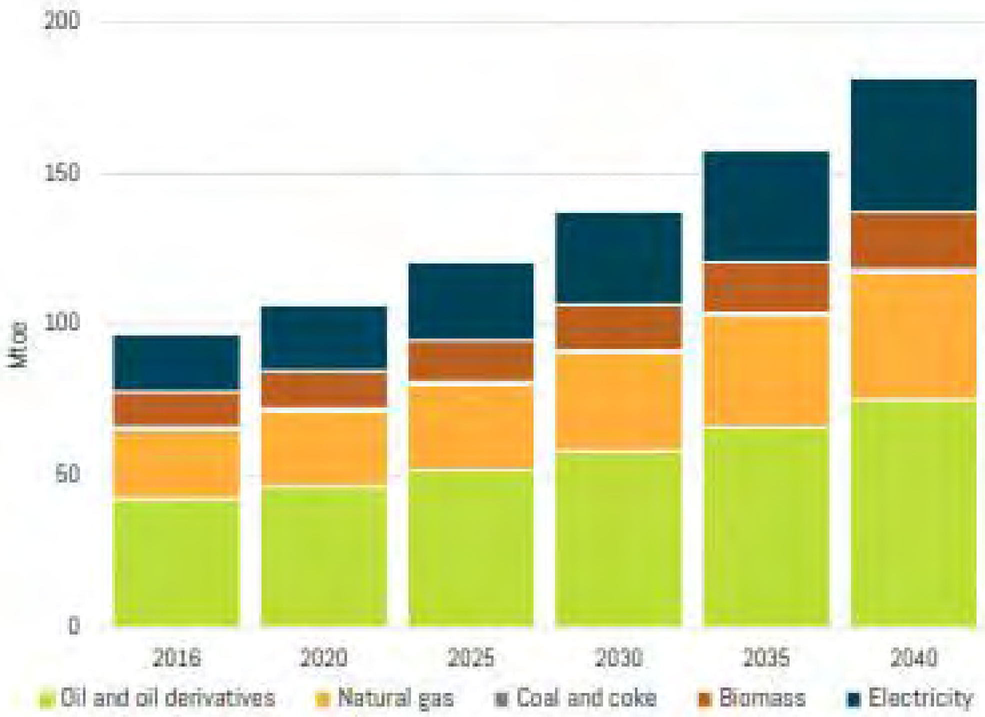
3.5.1 Forecast of the final energy consumption

Table 3.21. Forecast of the final energy consumption in the Southern Cone (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	43	46	52	58	66	75	2.4%
Natural Gas	23	25	28	32	37	42	2.6%
Coal and coke	1	1	1	1	1	1	0.7%
Biomass	12	12	14	15	17	19	2.0%
Electricity	19	22	26	31	37	44	3.6%
TOTAL	97	106	121	138	158	182	2.7%

Source: Forecast based on the referential expansion plans of the countries of the Southern Cone.

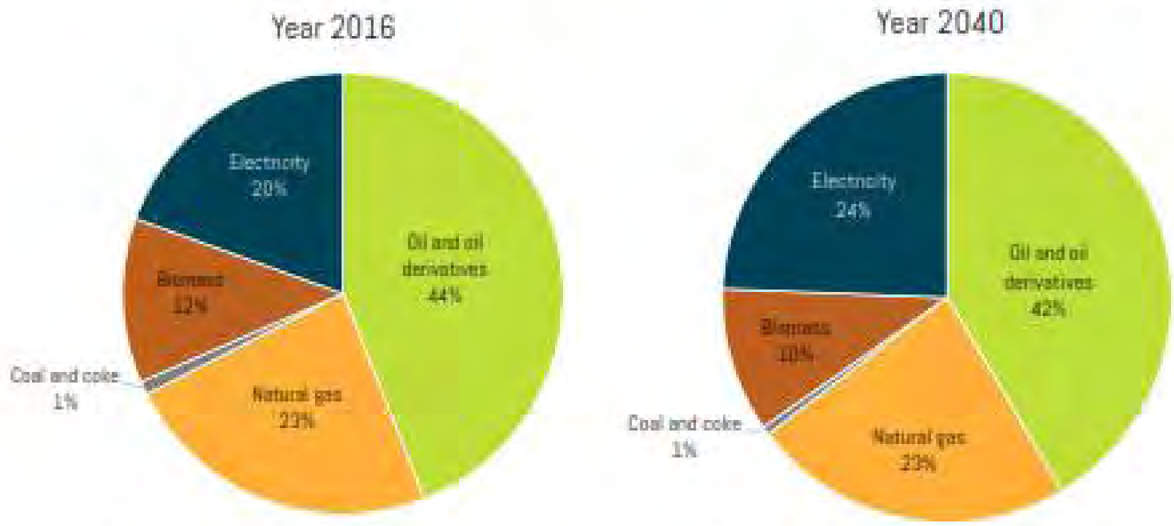
Figure 3.33. Forecast of the final energy consumption in the Southern Cone



Source: Forecast based on the referential expansion plans of the countries of the Southern Cone.

The final energy consumption matrix of the Southern Cone during the study period is dominated by oil and oil products (see **Figure 3.34**). However, the greater penetration of electricity slightly shifts the participation of oil and oil products. Electricity gains percentage share by going from 20% in the base year to 24% in the year 2040.

Figure 3.34. Evolution of the final energy consumption matrix in the Southern Cone



Source: Forecast based on the referential expansion plans of the countries of the Southern Cone.

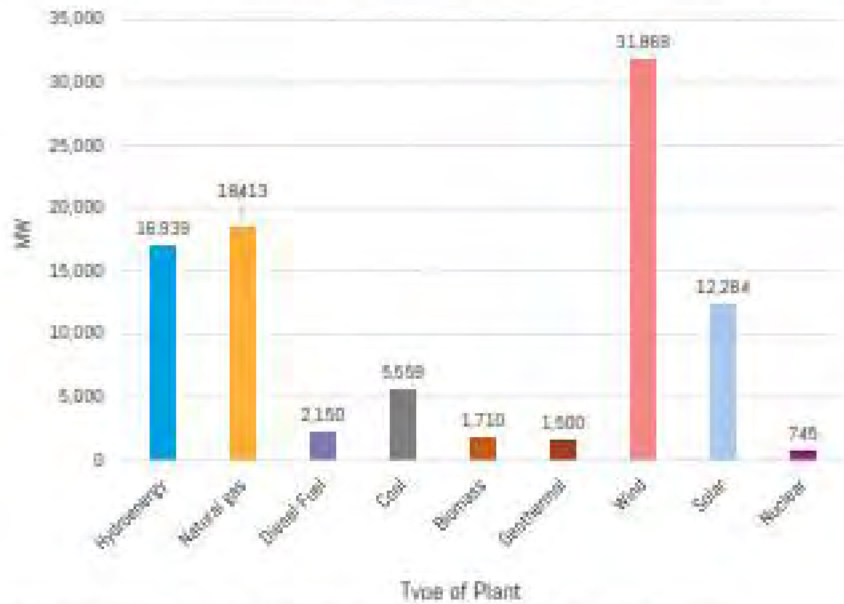
Table 3.22. Forecast of the domestic demand for electricity in the Southern Cone (GWh)

	2016	2020	2025	2030	2035	2040	t.p.a.
Final consumption	219,205	251,603	299,555	357,598	428,197	514,562	3.6%
Own consumption	9,109	10,462	10,456	14,870	17,806	21,397	3.6%
Losses	31,366	36,007	42,870	51,176	61,280	73,639	3.6%
Total domestic demand	259,680	298,072	354,881	423,644	507,282	609,598	3.6%

Source: Forecast based on the referential plans for expansion of the countries of the Southern Cone.

3.5.2 Forecast of electricity generation

Figure 3.35. Additional installed capacity in the Southern Cone, during the forecast period



Source: Forecast based on the referential plans for expansion of the countries of the Southern Cone.

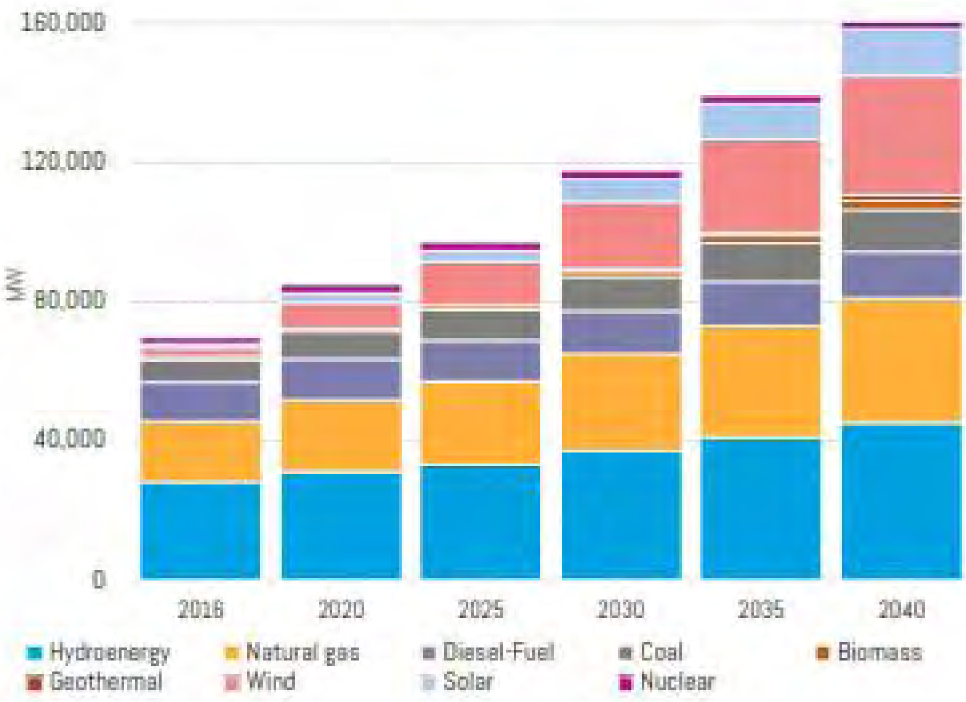
During the forecast period, the installed capacity of power generation in the Southern Cone has a total increase of 91,169 MW, being wind the resource with the most expansion, as can be seen in **Figure 3.25**. The additional capacity of hydroenergy and natural gas plants are also relevant.

Table 3.23. Forecast of installed capacity in the Southern Cone (MW)

	2016	2020	2025	2030	2035	2040
Hydroenergy	29,246	31,254	33,285	37,185	41,195	45,185
Natural Gas	17,480	20,673	23,893	27,893	31,893	35,893
Diesel-Fuel	11,089	11,638	11,738	12,238	12,738	13,238
Coal	6,540	7,779	8,859	9,939	11,019	12,099
Biomass	941	951	1,151	1,651	2,151	2,651
Geothermal	0	0	0	500	1,000	1,500
Wind	2,440	7,379	12,709	18,309	26,809	34,309
Solar	1,231	2,775	3,015	6,515	10,015	13,515
Nuclear	1,755	2,500	2,500	2,500	2,500	2,500
TOTAL	69,722	84,950	97,151	117,731	139,311	160,891

Source: Simulation results.

Figure 3.36. Forecast of installed capacity in the Southern Cone



Source: Simulation results.

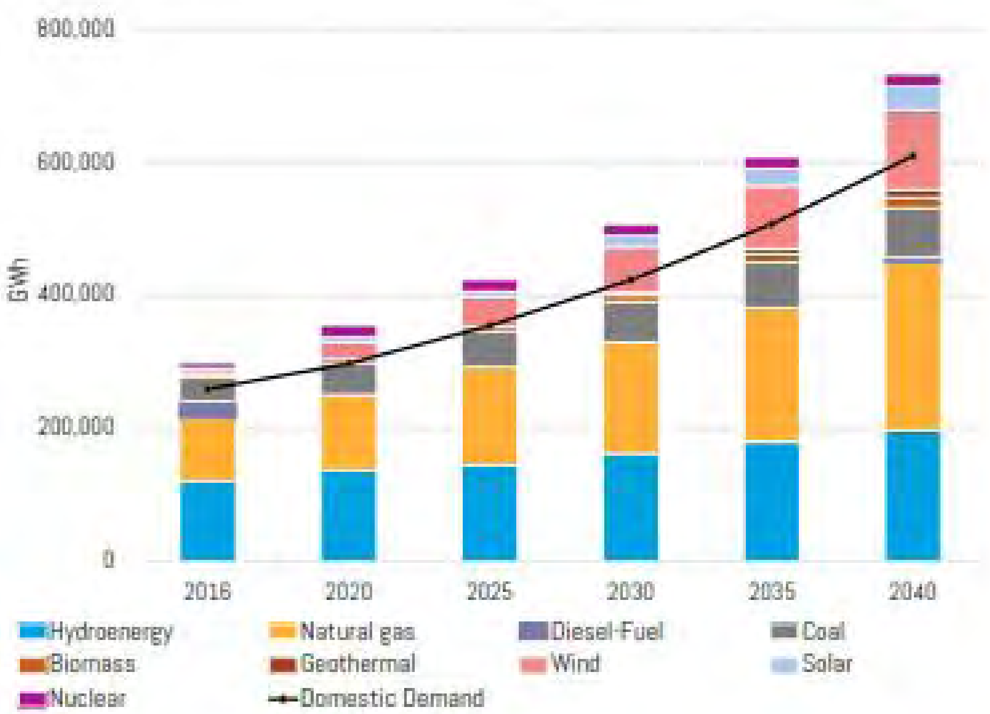
Between 2016 and 2040, the generation capacity of the Southern Cone sub-region is increased by 131%. It should be noted that wind energy in the year 2040 will have the third most important installed capacity following hydraulic and natural gas thermal plants (see Figure 3.36), it is also worth mentioning the significant increase in photovoltaic capacity, mainly in countries like Chile and Argentina.

Table 3.24. Forecast of the generation of electricity in the Southern Cone (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	121,284	136,892	145,789	162,870	180,390	197,910
Natural Gas	94,415	114,600	147,122	167,267	201,945	251,542
Diesel-Fuel	26,202	0	0	0	0	7,854
Coal	35,326	47,703	54,325	60,948	67,571	74,193
Biomass	5,489	5,663	6,855	9,833	12,811	15,790
Geothermal	0	0	0	3,942	7,884	11,826
Wind	5,792	25,857	44,533	67,660	93,940	120,220
Solar	2,721	7,293	7,924	17,122	26,320	35,518
Nuclear	8,176	17,520	17,520	17,520	17,520	17,520
TOTAL GENERATION	299,405	355,528	424,067	507,162	608,380	732,372

Source: Simulation Results.

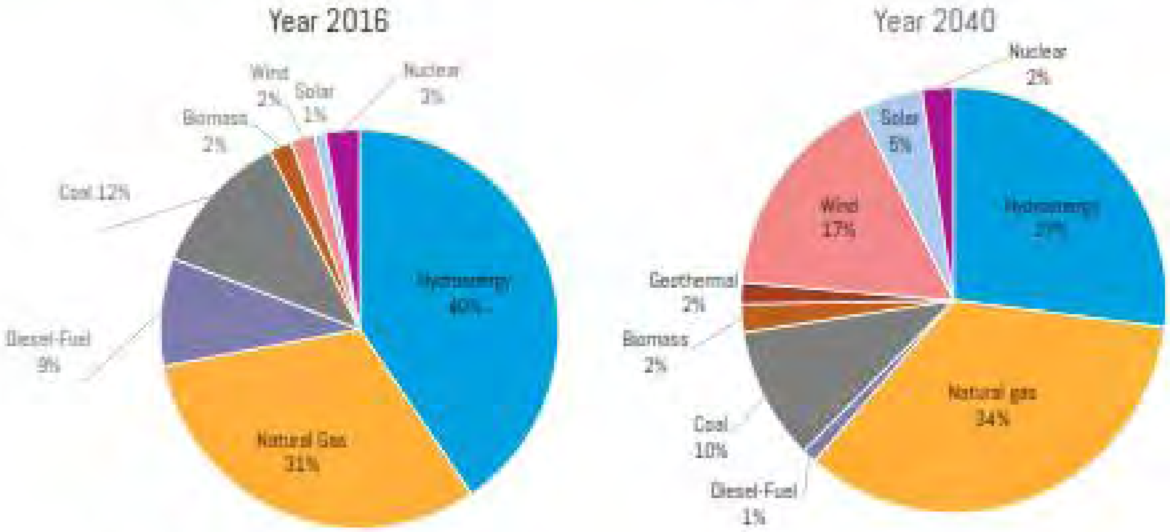
Figure 3.37. Forecast of electricity generation in the Southern Cone



Source: Simulation Results.

As can be seen in **Figure 3.37**, the sub-region improves its status as a net exporter of electricity, being able to add more exportable energy to the natural external market of the sub-region constituted by Brazil.

Figure 3.38. Evolution of the electricity generation matrix in the Southern Cone, CPS Scenario



Source: Simulation Results.

According to the simulated expansion timetable, the electricity generation matrix of the Southern Cone, evolves towards a greater participation of NCRE like wind, solar, biomass and geothermal, which together represent an important 26% of the total generation in the year 2040, compared to the 5% of the base year (**Figure 3.38**). It should be noted that the contribution in geothermal would correspond to Chile, which is the first South American country that has already started the exploitation of this renewable resource.

3.5.3 Forecast of the total energy supply

Table 3.25. Forecast of the total energy supply in the Southern Cone (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	47	45	51	57	64	75	2.0%
Natural Gas	52	60	71	81	94	112	3.2%
Coal and coke	10	12	14	16	17	19	2.7%
Nuclear	2	5	5	5	5	5	3.2%
Hydroenergy	7	7	6	6	6	6	-0.5%
Biomass	18	19	21	25	30	35	2.9%
Other renewables	0	3	5	8	13	17	36.0%
TOTAL	136	150	173	198	230	269	2.9%

Source: Simulation Results.

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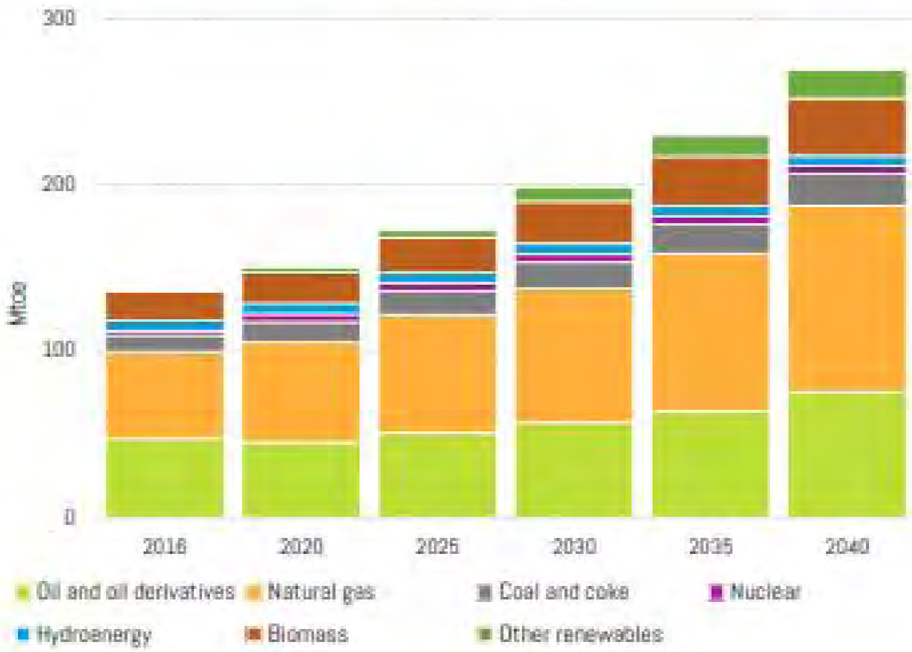
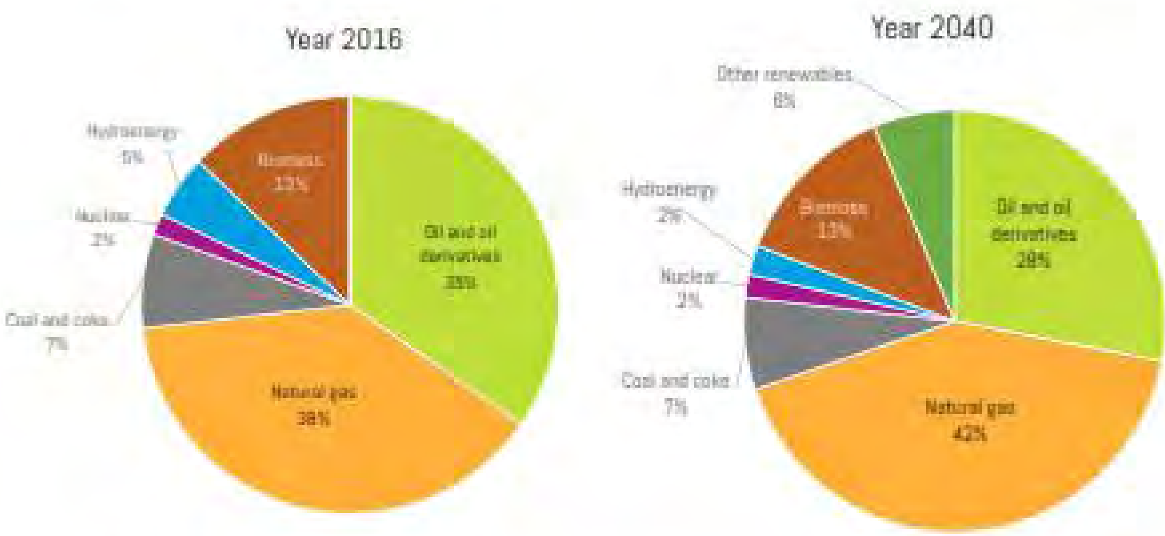
Figure 3.39. Forecast of the total energy supply in the Southern Cone



Source: Simulation Results.

Figure 3.40. Evolution of the total energy supply matrix in the Southern Cone



Source: Simulation Results.

The evolution of the total energy supply shows the importance of natural gas in the sub-region surpassing even oil and oil products during the whole study period. The "Other renewables" that gathers wind, geothermal and solar energy has the highest annual average growth rate (36%), and although its participation remains marginal compared to that of conventional sources, it experiences an important growth by going from 0.01% in the base year to a 6% in the year 2040.

3.6 The Caribbean

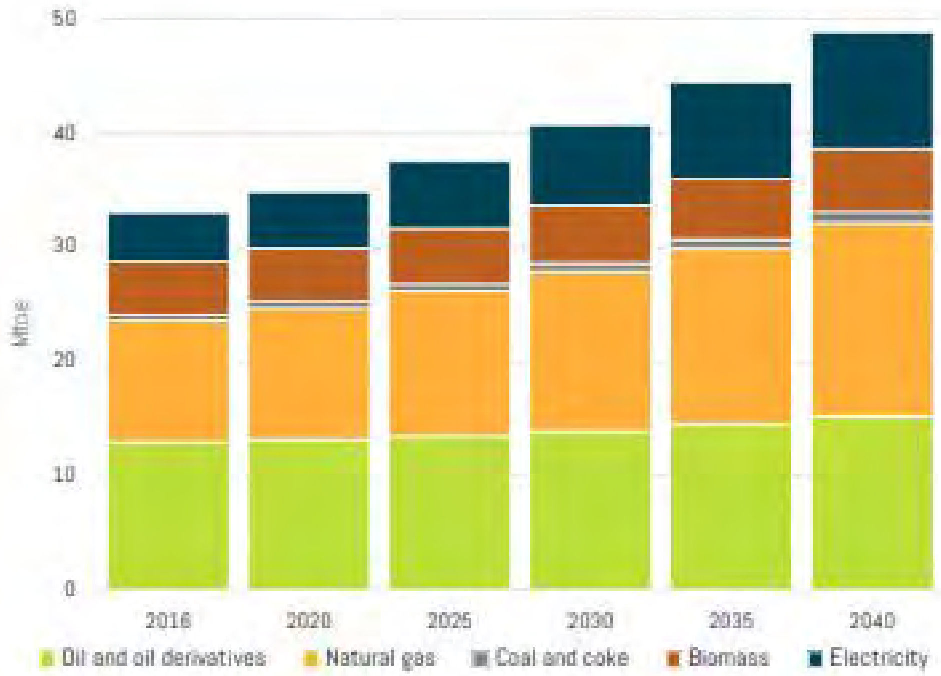
3.6.1 Forecast of the final energy consumption

Table 3.26. Forecast of the final energy consumption in the Caribbean (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	13	13	13	14	14	15	0.7%
Natural Gas	11	12	13	14	15	17	1.9%
Coal and coke	0	1	1	1	1	1	3.0%
Biomass	5	5	5	5	5	6	0.7%
Electricity	4	5	6	7	8	10	3.7%
TOTAL	33	35	38	41	44	49	1.6%

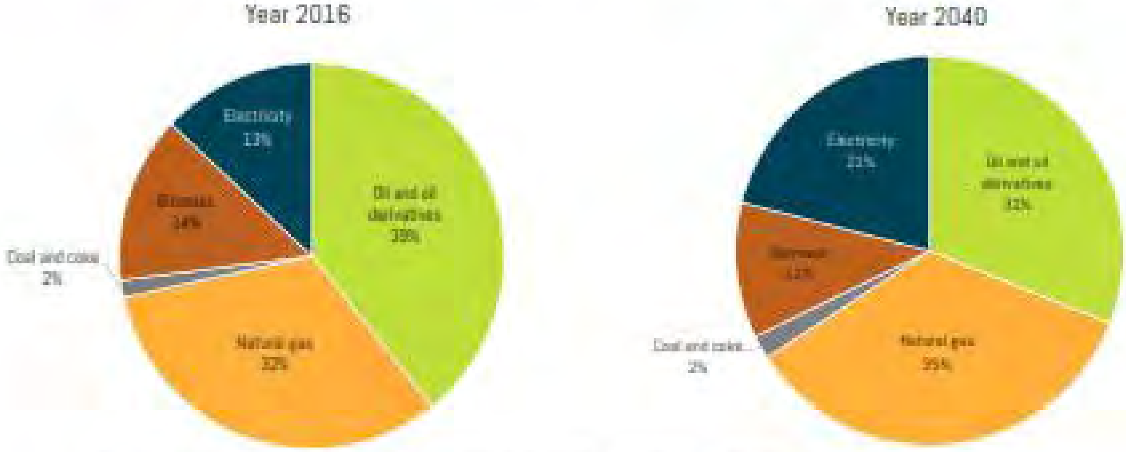
Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

Figure 3.41. Forecast of the final energy consumption in the Caribbean



Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

Figure 3.42. Evolution of the final energy consumption matrix in the Caribbean



Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

In the matrix of final consumption in the Caribbean, electricity and natural gas, increase their percentage share, gaining ground over oil and oil products and biomass, as can be seen in **Figure 3.42**.

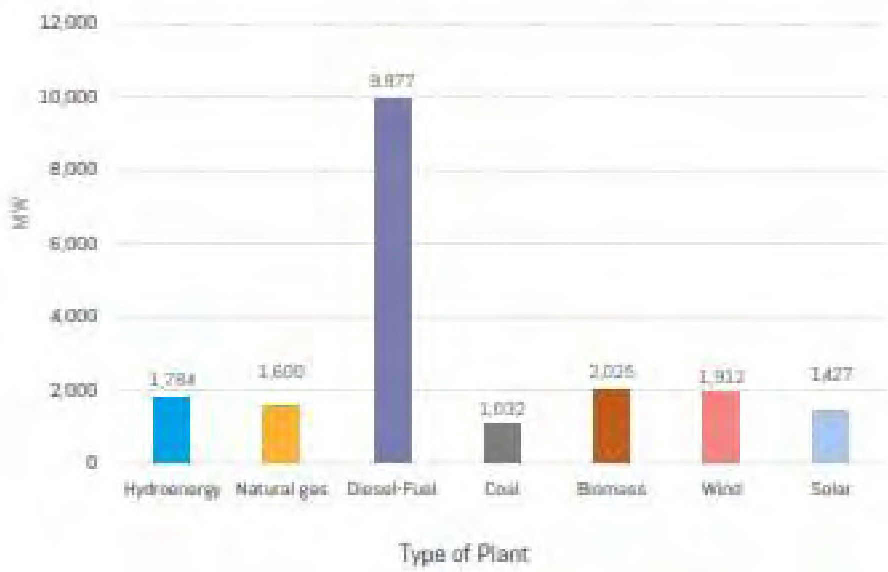
Table 3.27. Forecast of the domestic demand for electricity in the Caribbean (GWh)

	2018	2020	2026	2030	2035	2040	t.p.a.
Final consumption	49,990	57,292	68,269	81,779	98,464	119,135	3.7%
Own consumption	1,918	2,201	2,623	3,142	3,783	4,578	3.7%
Losses	8,304	9,517	11,340	13,584	16,355	19,789	3.7%
Total domestic demand	60,213	69,010	82,232	98,505	118,603	143,502	3.7%

Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

3.6.2 Forecast of electricity generation

Figure 3.43. Additional installed capacity in the Caribbean, during the forecast period



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In the expansion timetables of the power generation capacity of most of the countries of the Caribbean, Diesel-fuel conventional thermal projects are still relevant. That is why of the additional 19,757 MW to be installed in the period of forecast, about 50% correspond to this type of plants. However, the Dominican Republic and Trinidad and Tobago opt for large coal and natural gas projects to support the supply in the forecast period. Such is the case of the Dominican Republic, where the most important electricity generation project in its timetable corresponds to the coal-fired power plant of Punta Catalina, which with its two phases programmed to start operation in 2018 and 2019, have an additional total of 832 MW to their generator park. This plant will be supplied by coal imported from Colombia. Trinidad and Tobago plans to install additional 1,000 MW natural gas plants during the study period.

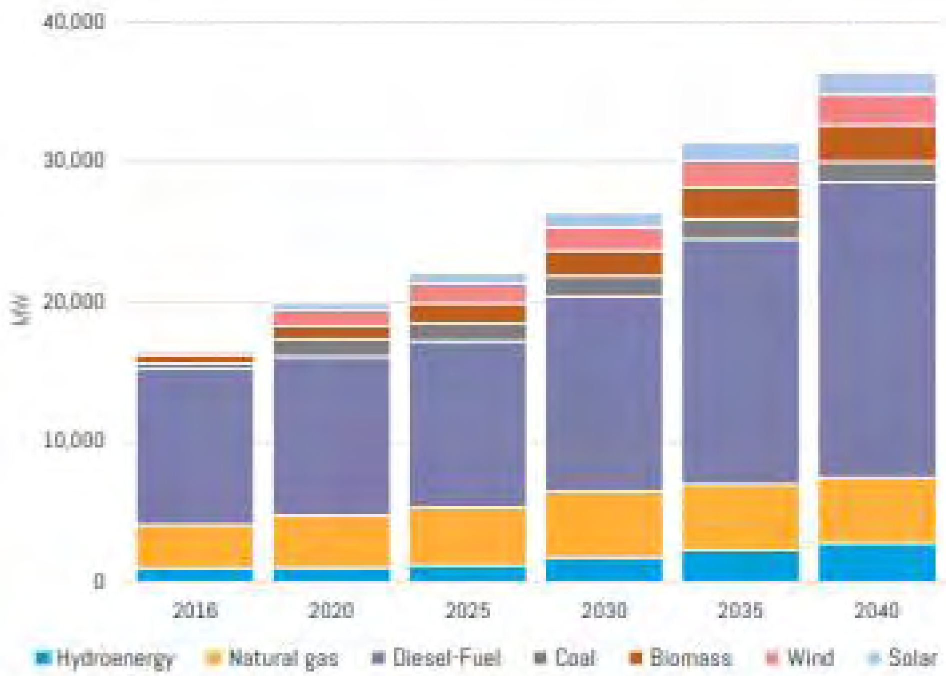
As for NCRE, the most important capacity additions in the sub-region, correspond to biomass, wind and solar, standing out Cuba for its greater focus towards these technologies (**Figure 3.43**).

Table 3.28. Forecast of installed capacity in the Caribbean (MW))

	2016	2020	2025	2030	2035	2040
Hydroenergy	963	1,004	1,189	1,747	2,247	2,747
Natural Gas	3,110	3,710	4,110	4,710	4,710	4,710
Diesel-Fuel	11,124	11,376	11,902	13,931	17,516	21,101
Coal	415	1,247	1,247	1,447	1,447	1,447
Biomass	609	934	1,434	1,834	2,224	2,634
Wind	247	1,123	1,409	1,659	1,909	2,159
Solar	150	508	758	1,047	1,312	1,577
TOTAL	16,618	19,902	22,049	26,375	31,375	36,375

Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

Figure 3.44. Forecast of installed capacity in the Caribbean



Source: Forecast based on the referential expansion plans of the countries of the Caribbean.

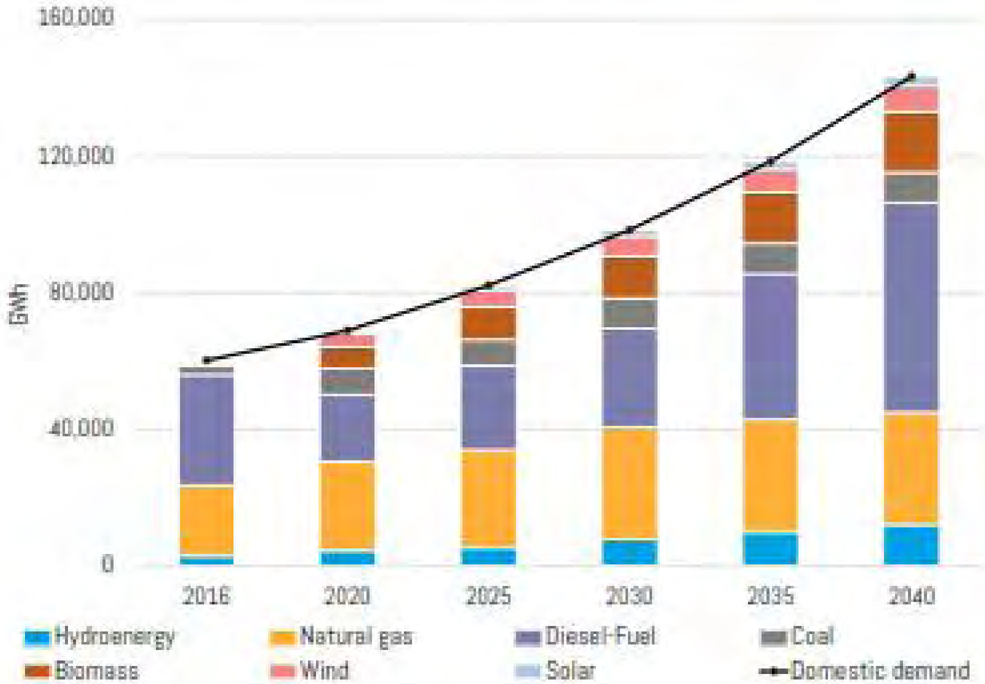
According to the installation/withdrawal timetables of power plants formulated by the countries of the Caribbean, the capacity of power generation in the sub-region would increase by 119% up to the year 2040. It is worth noting that while in the base year, NCRE had a modest participation in the sub-region with a 6% of the total capacity; this participation reaches 18% by the year 2040.

Table 3.29. Forecast of the generation of electricity in the Caribbean (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	2,838	4,398	5,208	7,653	9,843	12,033
Natural Gas	20,721	26,001	28,804	33,009	33,009	33,009
Diesel-Fuel	32,423	19,845	24,643	28,963	42,835	61,507
Coal	2,764	7,645	7,645	8,872	8,872	8,872
Biomass	814	6,292	9,661	12,356	15,051	17,747
Wind	547	3,936	4,938	5,814	6,690	7,566
Solar	105	890	1,328	1,834	2,299	2,763
TOTAL GENERATION	60,211	69,007	82,228	98,501	119,598	143,496

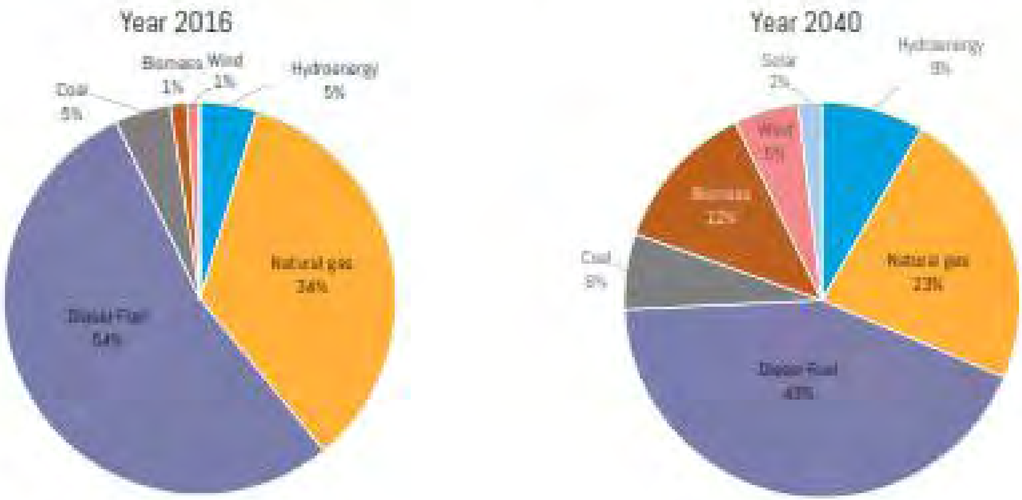
Source: Simulation results.

Figure 3.45. Forecast of electricity generation in the Caribbean



Source: Simulation results.

Figure 3.46. Evolution of the electricity generation matrix in the Caribbean



Source: Simulation results.

Of the simulation carried out in the study period, based on the demand of electricity forecasted and the availability of installed capacity for each year, the evolution of electricity generation is obtained, shown in **Figure 3.46**. As can be seen, NCRE as biomass, wind and solar gain relevance in the generation matrix, displacing hydrocarbons. Coal also acquires greater participation due to the Punta Catalina project in the Dominican Republic. The renewable fraction of the electricity generation matrix is significantly improved going from a 7% in the base year to a 28% in the year 2040.

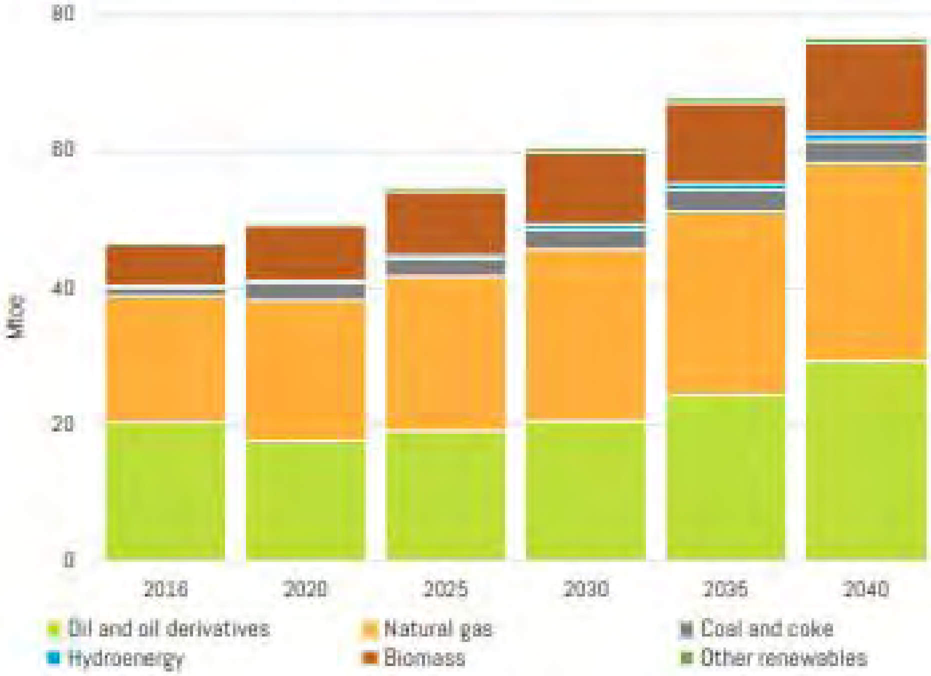
3.6.3 Forecast of the total energy supply

Table 3.30. Forecast of the total energy supply in the Caribbean (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	20	18	19	21	24	29	1.5%
Natural Gas	19	21	23	25	27	29	1.9%
Coal and coke	1	2	3	3	3	3	4.3%
Hydroenergy	0	0	1	1	1	1	6.2%
Biomass	6	8	9	11	12	13	3.2%
Other renewables	0	0	1	1	1	1	11.4%
TOTAL	47	50	55	61	68	77	2.1%

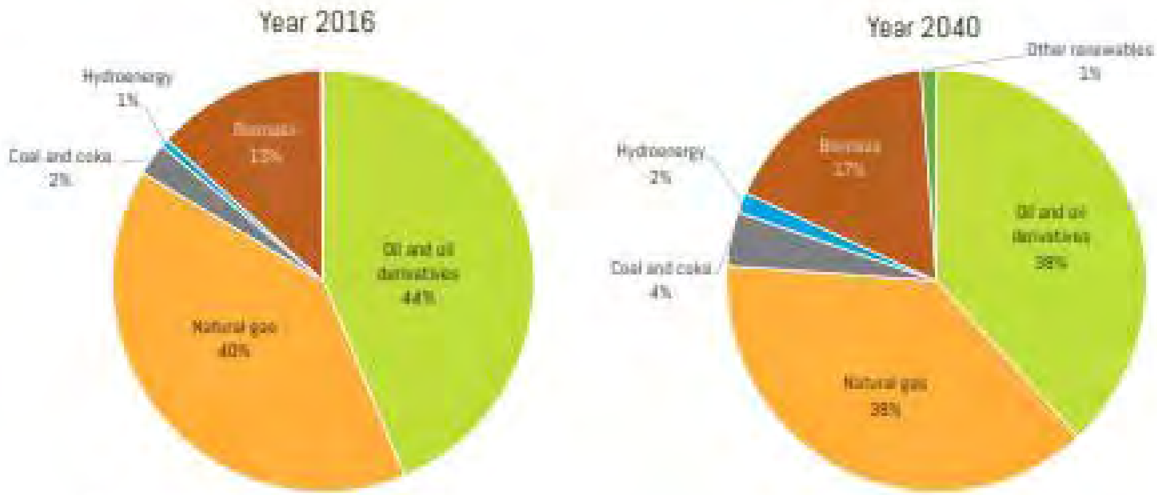
Source: Simulation results.

Figure 3.47. Forecast of the total energy supply in the Caribbean



Source: Simulation Results.

Figure 3.48. Evolution of the total energy supply matrix in the Caribbean, CPS Scenario



Source: Simulation Results.

Most like the electricity generation matrix, in the evolution of the total energy supply for the Caribbean sub-region, the partial substitution of the use of oil and oil products by coal and renewable sources is observed, where prevails a greater supply from biomass. With regard to hydroenergy, this source maintains a very marginal participation in the energy supply matrix during the entire study period.

3.7 Latin America and the Caribbean (LAC)

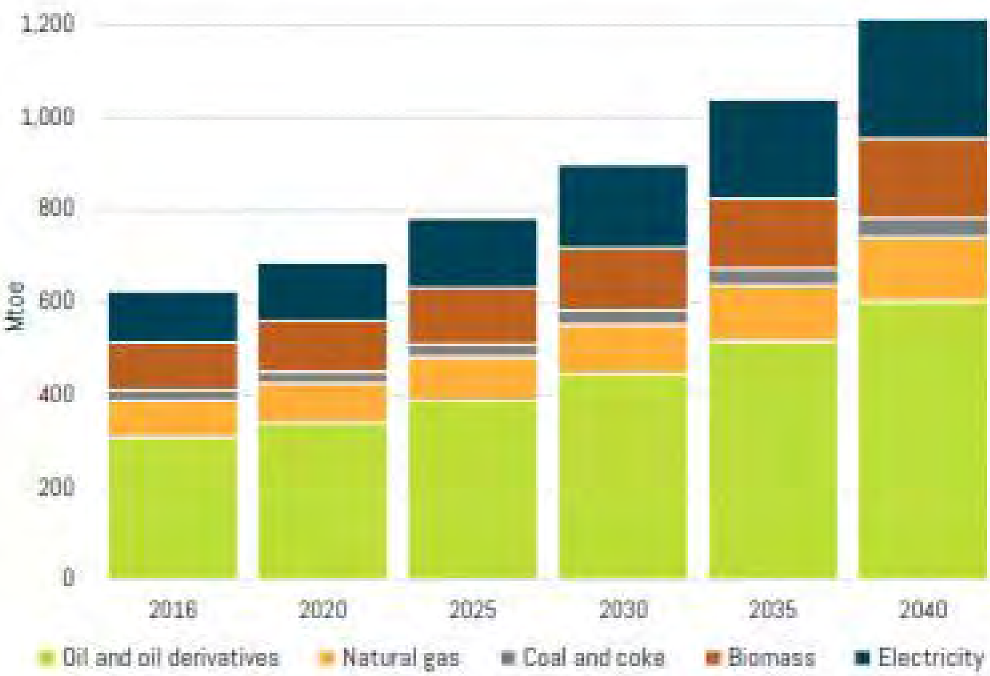
3.7.1 Forecast of the final energy consumption

Table 3.31. Forecast of the final energy consumption in LAC, CPS Scenario (Mtoe)

	2018	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	309	340	387	446	517	604	2.8%
Natural Gas	80	86	95	107	121	139	2.3%
Coal and coke	22	24	27	31	36	41	2.7%
Biomass	105	111	122	135	151	172	2.1%
Electricity	110	126	150	190	215	258	3.6%
TOTAL	625	688	782	898	1,040	1,213	2.8%

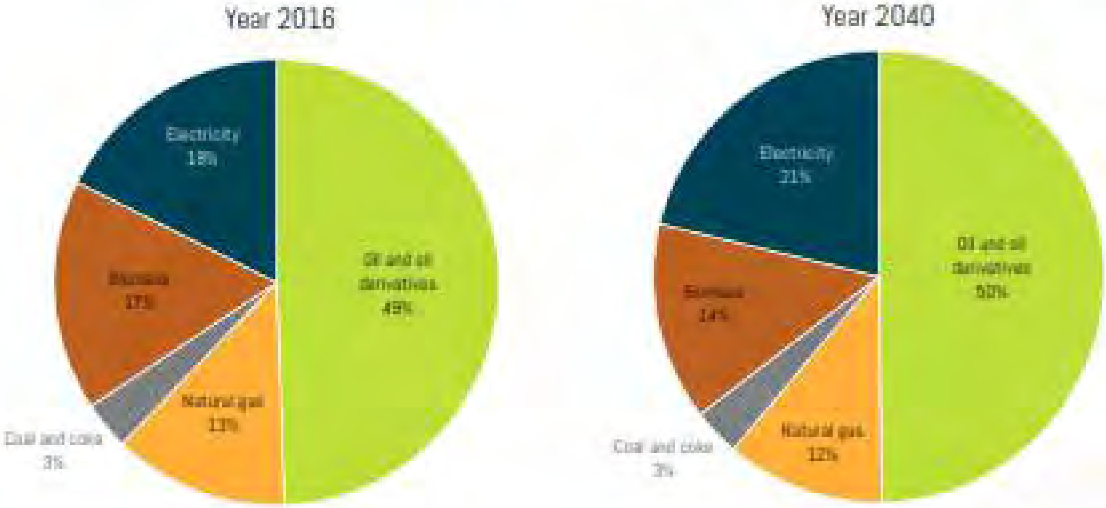
Source: Simulation Results.

Figure 3.49. Forecast of the final energy consumption in LAC



Source: Simulation Results.

Figure 3.50. Evolution of the final energy consumption matrix in LAC, CPS Scenario



Source: Simulation Results.

In the evolution of the final consumption matrix of LAC, the greater penetration of electricity and oil and oil derivatives stands out, displacing the consumption of biomass, which corresponds mainly to the residential consumption of firewood (**Figure 3.50**).

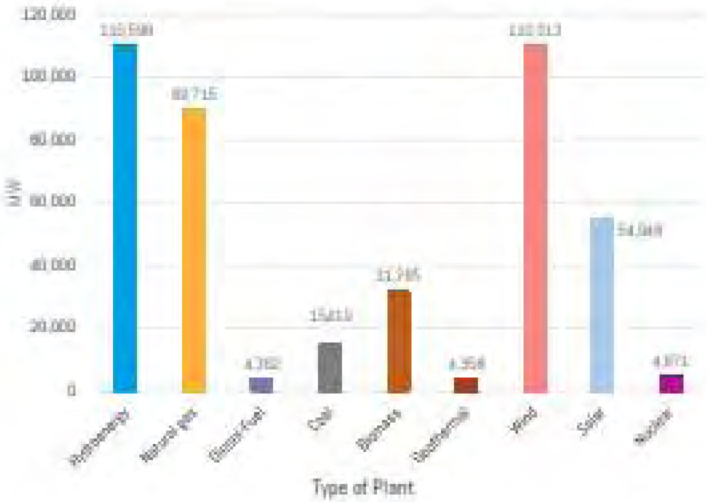
Table 3.32. Forecast of the domestic demand for electricity in LAC (GWh)

	2016	2020	2025	2030	2035	2040	t.p.a.
Final consumption	1,277,096	1467,018	1,748,193	2,098,000	2,499,582	2,999,297	3.6%
Own consumption	65,474	75,202	89,577	106,898	127,805	153,094	3.6%
Losses	240,591	276,457	329,709	394,233	472,591	567,981	3.6%
Total domestic demand	1,583,161	1,818,678	2,167,480	2,589,130	3,099,979	3,720,372	3.6%

Source: Simulation Results.

3.7.2 Forecast of electricity generation

Figure 3.51. Additional installed capacity in LAC, during the forecast period



Source: Simulation Results.

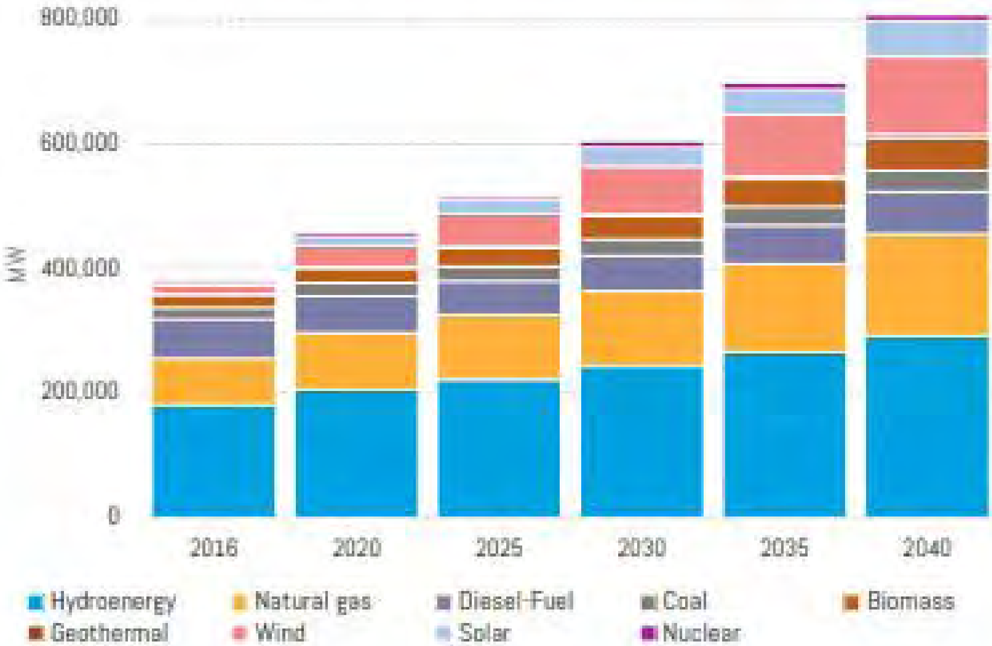
As observed in **Figure 3.51**, the technologies of electricity generation that will predominate in the installation timetable of new capacity during the period of study for LAC are hydraulic, wind and natural gas power plants.

Table 3.33. Forecast of installed capacity in LAC (MW)

	2018	2020	2025	2030	2035	2040
Hydroenergy	181,929	206,163	221,639	243,464	265,596	292,529
Natural Gas	74,217	91,262	104,172	120,417	142,175	163,932
Diesel-Fuel	62,984	58,397	54,447	57,442	62,394	67,346
Coal	18,350	21,754	23,496	26,315	30,042	33,769
Biomass	20,294	23,523	29,733	36,715	43,587	52,059
Geothermal	1,473	1,594	2,172	3,311	4,431	5,831
Wind	14,913	34,251	52,890	76,393	98,590	125,225
Solar	2,185	14,155	21,137	30,941	41,135	57,133
Nuclear	5,353	6,098	6,098	10,224	10,224	10,224
TOTAL	381,698	457,296	515,774	605,213	698,174	808,047

Source: Simulation Results.

Figure 3.52. Forecast of installed capacity in LAC



Source: Simulation Results.

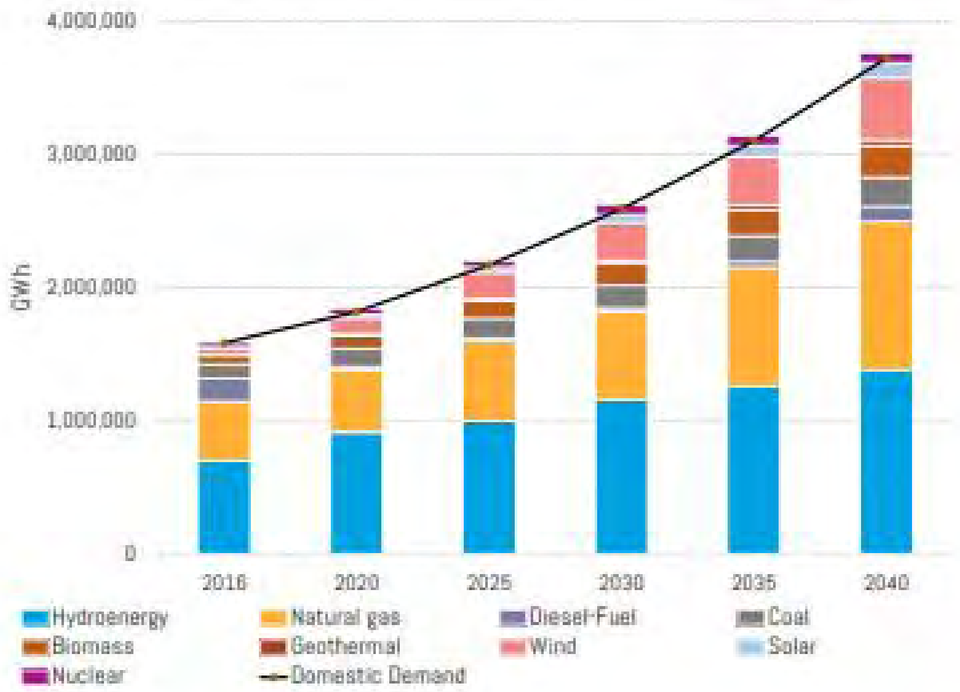
As observed in **Table 3.33** and **Figure 3.52**, the installed power generation capacity in LAC will maintain a larger hydraulic fraction during the entire study period. However, it is evident the increasing relevance of natural gas and NCREs such as wind, biomass and solar.

Table 3.34. Forecast of the generation of electricity in LAC (GWh)

	2016	2020	2025	2030	2035	2040
Hydroenergy	700,291	911,614	998,663	1,156,534	1,256,364	1,380,020
Natural Gas	445,384	468,919	597,171	660,359	893,464	1,113,717
Diesel-Fuel	171,077	23,328	24,815	28,963	42,835	114,310
Coal	107,432	137,810	149,002	168,683	193,858	219,032
Biomass	66,609	96,562	128,421	164,225	198,333	237,417
Geothermal	9,976	11,995	16,190	24,775	33,431	44,075
Wind	46,829	120,368	197,054	283,667	365,860	465,321
Solar	4,361	27,230	39,674	59,916	80,942	111,937
Nuclear	34,611	44,518	44,518	75,665	75,665	75,665
TOTAL GENERATION	1,586,470	1,842,144	2,195,508	2,622,788	3,140,652	3,761,494

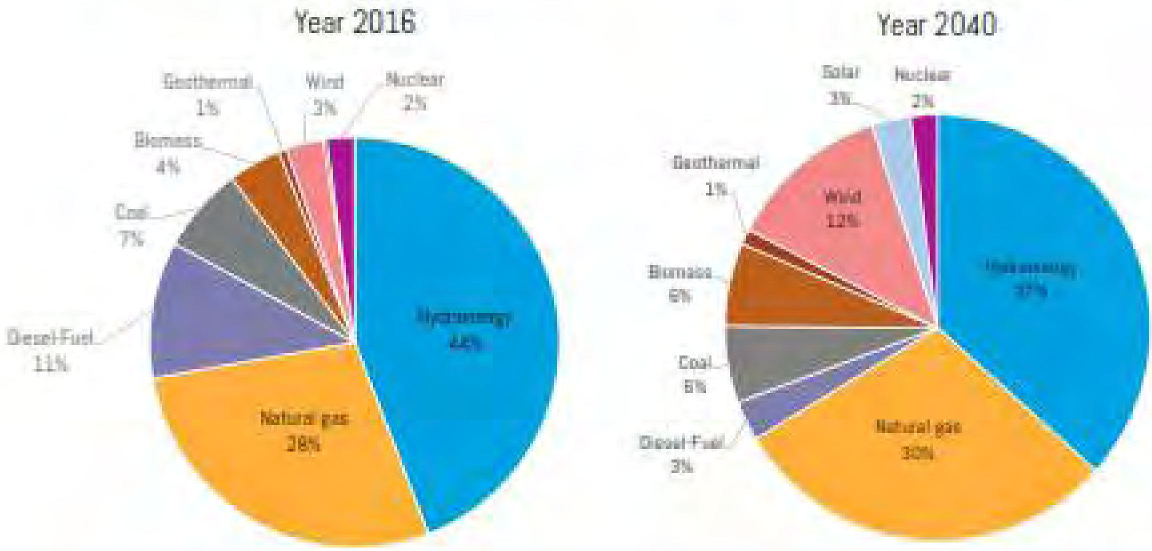
Source: Simulation Results.

Figure 3.53. Forecast of electricity generation in LAC



Source: Simulation Results.

Figure 3.54. Evolution of the electricity generation matrix in LAC, CPS Scenario



Source: Simulation Results.

Electricity generation in LAC will continue to be dependent mainly on hydror and natural gas; however, the most relevant aspect in the evolution of the matrix is the evident increase of participation of the NCRE, which contributes to improve its index of renewable energy from 52% in the base year to 59% in the year 2040 (see **Figure 3.54**).

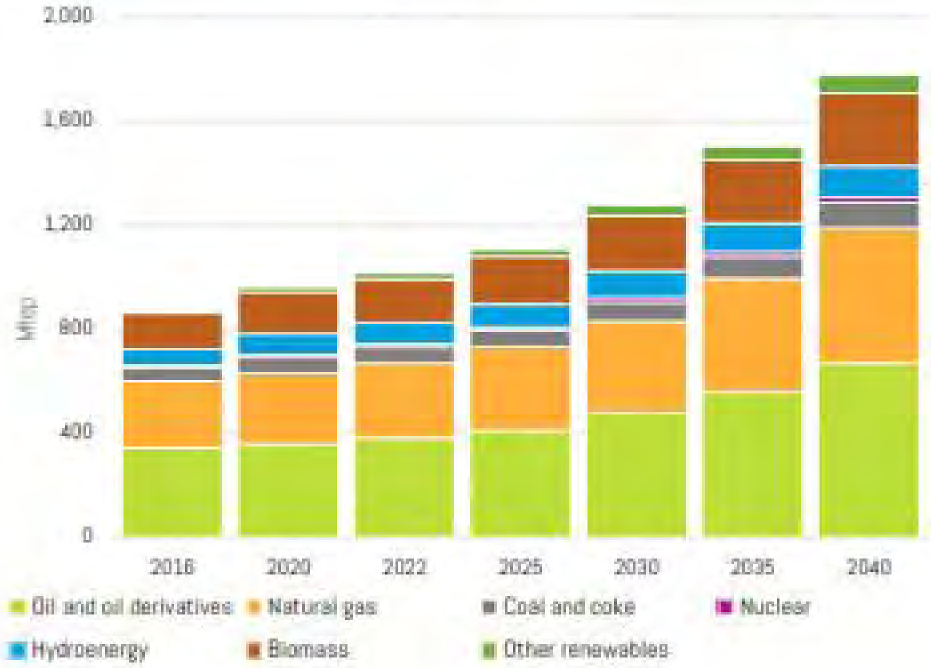
3.7.3 Forecast of the total energy supply

Table 3.35. Forecast of the total energy supply in LAC (Mtoe)

	2016	2020	2025	2030	2035	2040	t.p.a.
Oil and oil derivatives	343	359	412	476	557	670	2.8%
Natural Gas	258	274	320	355	438	521	3.0%
Coal and coke	50	58	64	73	83	96	2.8%
Nuclear	9	12	12	20	20	20	3.3%
Hydroenergy	62	80	87	101	110	121	2.8%
Biomass	142	161	183	211	242	280	2.9%
Other renewables	5	19	28	41	53	68	11.4%
TOTAL	870	962	1,107	1,276	1,503	1,776	3.0%

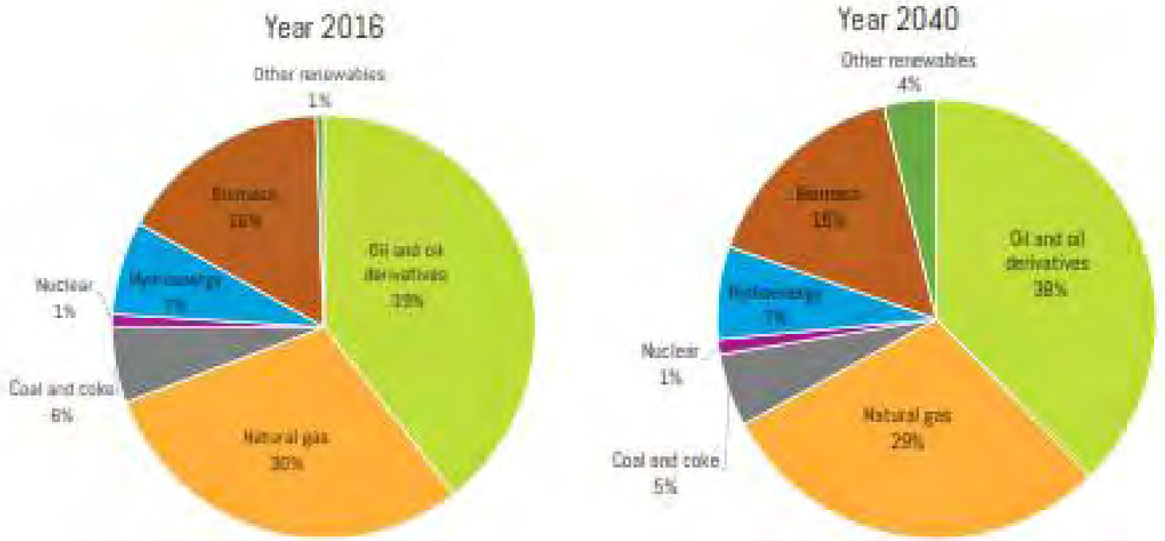
Source: Simulation Results.

Figure 3.55. Forecast of the total energy supply in LAC



Source: Simulation Results.

Figure 3.56. Evolution of the total energy supply matrix in LAC



Source: Simulation Results.

LAC's total energy supply matrix presents little variation during the forecast period, as far as conventional sources are concerned. The predominance of hydrocarbons and biomass is maintained. However, the increase in the participation of "Other renewable sources" can be noticed, thanks to the penetration of technologies such as wind, solar and geothermal in the electricity generation (**Figure 3.56**).

4. CONCLUSIONS

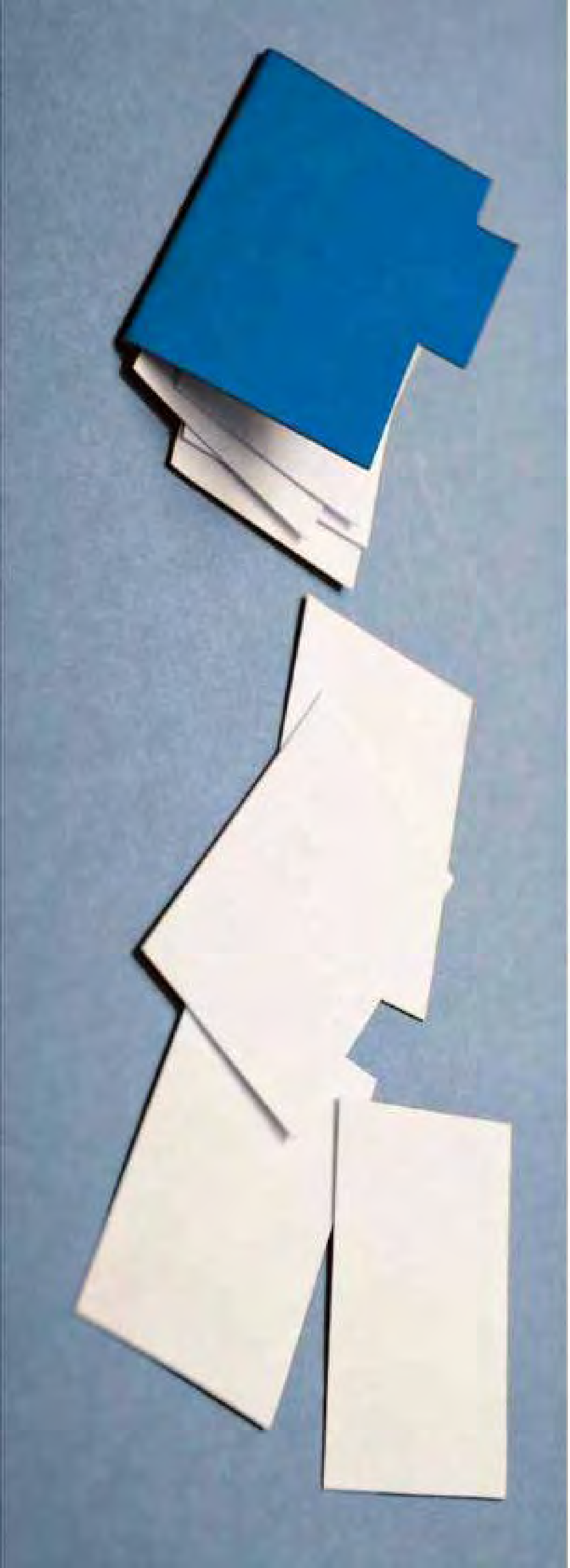
The energy prospective exercise carried out for the different sub-regions of LAC, for the period 2016-2040, under the premises of the current policy scenario (CPS), allows to obtain the following main conclusions:

- The source that presents the fastest growth of its final consumption, in the different sub-regions, with the only exception of the Andean Region, is electricity. This growth is driven, mainly by the increase of electricity service coverage and the economic development of the countries, which allow an improvement in the human development index of the population.

- The evolution of electricity generation matrices, both sub-regional and regional, are characterized by a clear trend to the greater use of renewable sources, mainly taking advantage of the considerable potential existing in the region of hydroenergy, wind energy, biomass and solar energy.

- Although the penetration of NCRE, in the electricity generation matrix, is evident in most of the analyzed sub-regions, its participation is still marginal at the total energy supply matrix level, maintaining the predominance of hydrocarbons, especially oil and oil products.

- Although alternative energy sources are increasingly becoming more economically competitive and are pushing their way bluntly in some countries in the region, still a 24-year term seems to be very short for them to displace fossil fuels in a meaningful way.



Annexes and bibliography

ACPM	Fuel Oil for Engines
ACRF	Analytical Centre for the Government of the Russian Federation
LAC	Latin America and the Caribbean
AMCHAM	American Chamber of Commerce (Nicaragua)
ANARSE	National Energy Regulation Authority
ANDE	National Electricity Administration
ANEEL	Brazilian National Electric Energy Agency
ANH	National Hydrocarbons Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
ARCH	Agency of Regulation and Control of Hydrocarbons
ARCONEL	Agency of Regulation and Control of Electricity
BP	British Petroleum
BPTT	Backpropagation through time
AC	Alternating Current
CAMMESA	Wholesale Electric Market Management Company
CAN	Andean Community of Nations
CANREL	Andean Committee of Regulatory Entities and Regulatory Bodies for Electricity Services
CASE	Charge for Strengthening Energy Security
DC	Direct Current
CCC	Fuel Consumption Account
CCUS	CO_2 Capture, Use and Storage Technology
CDEC	Economic Load Dispatch Centers
CELEC	Electric Corporation of Ecuador
CEMCCUS	Mexican Center of Capture, Use and Storage of Carbon Dioxide or CO_2
CENCE	National Center of Energy Control
CENACE	National Electricity Operator

CERT	Tax Refund Certificate
CFE	Federal Energy Council
CNECT	National Commission for Scientific and Technical Evaluation
COFINS	Contribution to the Financing of Social Security
CONACYT	National Council of Science and Technology
COP	Conference of the Parties to the United Nations Convention on Climate Change
CSLL	Social Contribution on Net Profit
DMEE	Maximum Energy Efficiency Badge
DPD	Dominican Power Partner
DQO	Commercial Operations
EAU	United Arab Emirates
EBISA	Emprendimientos Energéticos Binacionales S.A.
EEC-GNV	Entidad Ejecutora de Conversión a Gas Natural Vehicular
EGPPA	Enel Green Power Panama
EIA	Energy Information Administration
EITI	International Council of Extractive Industries Transparency Initiative
EMEP	Energy Efficiency and Management Program
ENARSA	Energía Argentina S.A.
ENDE	Empresa Nacional de Electricidad (Bolivia)
ENEE	National Electric Energy Company
EPE	Energy Research Company
EPN	National Polytechnic School
ERIRAS	The Energy Research Institute of the Russian Academy of Sciences
ESER	Rural Electrical Services Company
ESPOL	Escuela Politécnica del Litoral
ETED	Dominican Company of Electric Transmission
EV	Electric Vehicles

ACRONYMS

FAE	External Power Supplies
FANSIGED	Fabricación Nacional de Sistemas, Equipos e Insumos para Generación Distribuida
FODIS	Trust Fund for the Development of Distributed Generation
GEA	Guyana Energy Agency
GECF	Gas Exporting Countries Forum
ICE	Costa Rican Electricity Institute
IDB	Inter-American Development Bank
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics, Japan
IMAS	Joint Social Welfare Institute
INER	National Institute For Energy Efficiency and Renewable Energy
INTN	National Institute of Technology and Standardization
IRENA	International Renewable Energy Agency
IRPJ	Income Tax of legal businesses
MEER	Ministry of Electricity and Renewable Energy
MEM	Wholesale Electricity Market
MEM	Ministry of Energy and Mines
MER	Regional Electric Market
MIT	Massachusetts Institute of Technology
MoE	Ministry of Education
MoIP	Ministry of Indigenous People Affairs
MSET	Ministry of Science, Energy and Technology
OECD	Organization for Economic Co-operation and Development
OLADE	Latin American Energy Organization
ONA	National Accreditation Body
ONG	Non-Governmental Organization
OPEC	Organization of the Petroleum Exporting Countries

PASEP	Public Employee Asset Development Program
PCJ	Petroleum Corporation of Jamaica
PDT	Development Plnas with Territorial Approach
PDVSA	Petróleos de Venezuela, S.A.
PETROPAR	Petróleos Paraguayos
PIS	Social Integration Program
PLANEE	Energy Efficiency National Plan
PME	Electricity Master Plan
PNER	National Plan of Rural Electrification
PNUD	Programa de las Naciones Unidas para el Desarrollo
PSA	Production Sharing Agreement
PSR	Regasification Satellite Plant
REEC	Relationship of Combined Energy Efficiency
REEE	Relationship of Seasonal Energy Efficiency
RETIQ	Technical Regulation on Labelling
CSR	Corporate Social Responsibility
SADI	Argentine Interconnection System
SAME	Modelo para la Simulación y Análisis de la Matriz Energética (OLADE)
SEDESOL	Secretariats of Social Development
SEN	National Electrical System
SENER	Secretariat of Energy
PES	Primary Energy Supply
SEPLASA	Secretariat for Sectoral Planning of Environment, Energy, Seas and Land-use Planning
SHPC	Secretariat of Finance and Public Credit
SIC	Central Interconnected System
SICOM	Fuel Information System

SIEPAC	Electrical Interconnection System of the Central American Countries
sieLAC	Energy Information System of Latin America and the Caribbean
SIGET	General Superintendence of Electricity and Telecommunications
simLAC	Energy Planning Tools for latina America and the Caribbean
SIN	National Interconnected System
SING	Large North Interconnected System
SIRENE	National Emission Registration System
SNE	National Secretariat of Energy
SUIC	Single Joint Information System
TCC	Capital Cost Rate
TRB	Gross Registered Tons.
TRS	Regulated Security Rate
UCN	Central University of Nicaragua
UERS	Rural and Sub-Urban Electrification Unit
UNIDO	United Nations agency for the Industrial Development
UPME	Energy Mining Planning Unit
USAID	United States Agency for International Development
UTE	National Administration of Electric Power Plants and Transmissions
VAD	Distribution Added Value
VBP	Gross Value of Production
VGISD	Value of the Gas at the beginning of the Distribution System
WEC	World Energy Council
YLB	National Strategic Public Company of Bolivian Lithium Deposits
YPFB	Yacimientos Petrolíferos Fiscales Bolivianos
ZNI	Non-Interconnected Zones
ZOMAC	Areas Worst Affected by the Armed Conflict

bbl	American barrels
bcm	Billion cubic meters
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
GEI	Greenhouse Gas Emissions
LPG	Liquified pretoleum gas
Gm^3	Billions of cubic meters
GN	Natural Gas
CNG	Compressed Natural Gas
CNGV	Compressed Natural Gas Vehicle
LNG	Liquefied Natural Gas
NGV	Natural Vehicular Gas
GW	Gigawatt
GWh	Gigawatt hour
GWh / year	Gigawatt hour per year
inhab.	Inhabitants
inhab. / km^2	Inhabitants per square kilometer
kbbl	Thousands of American barrels
kbbl / day	Thousands of barrels per day
kboe	Thousands of barrels of oil equivalent
koe	Kilogram of oil equivalent
koe / hab.	Kilogram of oil equivalent per habitant
koe / USD	Equivalent kilogram of oil per US dollar
koe / USD 2011 PPP	Kilogram equivalent of oil per dollar of GDP Purchasing Power Parity at constant prices 2011
km	kilometers
km^2	Square kilometers

kt	One thousand metric tons
ktoe	Thousands of tons of oil equivalent
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt hour
kWh / hab.	Kilowatt hour per habitant
kWh / month	Kilowatt hour per month
kWh / m^2	kilowatt hour per square meter
m	Meter
m.s.n.m.	Metres above sea level
m^3	Cubic meters
Mbbl	Million of American barrels
Mbbl / day	Million of barrels per day
Mboe	Million of barrels of oil equivalent
Mboe / day	Million of barrels of oil equivalent per day
mil USD 2011 PPA / hab.	Thousands of dollars of GDP Purchasing Power Parity at constant prices 2011 per capita
Mm^3	Million of cubic meters
Mm^3 / day	Million of cubic meters per day
MP2	Fine Particular Material
Mt	Millions of tons
$MtCO_2e$	Millons of tons of carbon dioxide equivalent
Mtoe	Millions of tons of oil equivalent
MUSD	Millions of US dollars
MVA	Megavolt-ampere
MW	Megawatt
MWh	Megawatt hour

NOx	Nitrogen Oxides
SO_2	Sulphur Dioxide
t / hab.	Ton per habitant
t / toe	Metric ton per ton oil equivalent
TCF´s	Trillion Cubic Feet
tCO_2	Tonnes of carbon dioxide
tep / hab.	Tonnes of oil equivalent per habitant
TWh	Terawatt hour
USD / kW	Dollars per kilowatt
W	Watt
Wt	Weight

ANNEX II

CONVERSION FACTORS USED BY OLADE'S MEMBER COUNTRIES (YEAR 2017)

Original Units	kbbl	Mm³	kt	GWh	GWh	kg	kt	GWh	kbbl	kbbl	kbbl	kbbl	kbbl	kt	kt	kbbl
A: boe x 10³	Oil	Natural Gas	Coal	Hydroenergy	Geothermal	Nuclear	Firewood	Electricity	LPG	Gasoline	Kerosene/Jet Fuel	Diesel Oil	Fuel Oil	Coke	Charcoal	Alcohol
Argentina	1.0186	6.2127	5.1681	0.6197		110.1698	1.4915	0.6197	0.7010	0.8604	0.9583	1.0015	1.0604	4.6998	5.0440	0.6096
Barbados	1.0015	5.9806						0.6196	0.6701	0.8604	0.9583	1.0015	1.0604			
Belize	1.0660	6.6084		0.6196			3.2035	0.6196	0.6976	0.9530	1.0286	1.0598	1.1491		4.9718	
Bolivia	1.0015	5.9806	5.0439	0.6196			2.5940	0.6196	0.6668	0.8605	0.9583	1.0015	1.0604	4.6998	4.9718	
Brazil	1.0366	6.1855	3.4573	0.6181		71.6957	2.2282	0.6181	0.6968	0.9000	0.9206	0.9691	1.0716	4.9598	4.6433	0.6424
Chile	1.0581	6.6721	5.0440	0.6197			2.4002	0.6197	0.7604	0.9866	1.0300	1.0300	1.0800	5.0000		
Colombia	1.0476	6.1400	4.9498	0.6196			2.9246	0.6200	0.6981	0.9175	0.8109	0.9760	0.9898	3.4548	4.6829	0.5826
Costa Rica	0.9987		5.2630	0.6200	0.6200		3.0669	0.6200	0.6992	0.8938	0.9408	0.9887	1.0660	4.6138	4.6861	
Cuba	1.0015	6.3604	5.7645	0.6196			2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604	4.6998	4.9718	
Dominican Republic	1.0015	5.9806	5.0439	0.6196			2.5939	0.6196	0.6843	0.8630	0.9583	1.0015	1.0604	4.6998	4.9723	
Ecuador	1.0015	5.9806		0.6196			2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604			
El Salvador				0.6196	0.6196		2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604		4.9718	
Grenada							2.5940	0.6196	0.6701	0.8604	0.9583	1.0015			4.9718	
Guatemala	0.9929	5.9806	5.0439	0.6196	0.6196		2.5940	0.6196	0.6701	0.8613	0.9463	0.9929	1.0665	4.6998	4.9718	
Guyana							2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604		4.9718	
Haiti				0.6196			2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604		4.9718	
Honduras			5.0439	0.7598			2.5940	0.6196	0.6701	0.8711	0.9583	1.0087	1.0462	4.6998	4.9718	
Jamaica	1.0015	5.9806	5.0439	0.6196			2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604		4.9718	
Mexico	1.0643	7.4907	5.0520	0.6196	0.6196	566.0643	2.4048	0.6196	0.7147	0.9240	1.0182	1.0397	1.1306	5.2132		
Nicaragua	1.0059			0.6197	0.6197		2.3086	0.6197	0.6975	0.8906	0.9840	0.9857	1.0679	0.5009	2.7864	
Panama			5.2690	0.6196			2.6940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604	4.9100	4.8926	
Paraguay			5.0201	0.6197			2.5940	0.6196	0.6889	0.8801	0.9461	0.9920	1.0680		4.9719	0.5967
Peru	0.9973	6.9149	5.0439	0.6197			2.5940	0.6197	0.6845	0.8791	0.9584	0.9944	1.0693	4.6115	4.7016	
Suriname	1.0015	5.9806		0.6196			2.5940	0.6196	0.6701	0.8604	0.9583	1.0015	1.0604		4.9718	
Trinidad & Tobago	1.0015	5.9806						0.6196	0.6701	0.8604	0.9583	1.0015	1.0604			
Uruguay	1.0076	5.9816	5.0440	0.6196			1.9486	0.6196	0.6520	0.8557	0.9599	0.9863	1.0997	4.6998	5.4042	0.5604
Venezuela	1.0391	7.3463	5.4029	0.6072			2.5219	0.6072	0.7368	0.9890	1.0850	1.1408	1.2058	5.0621	5.6252	

COAL IMPORTS

Argentina	10³ t =		5.1681	10³ boe
Brazil	10³ t =		3.4573	10³ boe
Peru	10³ t =		5.2601	10³ boe
	10⁶ m³	Refinery Gas =	7.9861	10³ boe
	10⁶ m³	Coken Oven Gas =	3.0263	10³ boe
Other	10⁶ m³	Blast Furnace Gas =	0.6465	10³ boe
	10⁶ m³	Gas Works Gas =	2.8620	10³ boe
	10⁶ m³	Biogas =	3.9630	10³ boe
	10⁶ m³	Biogases =	1.3114	10³ boe

CONVERSION TABLE FOR ENERGY UNITS

	boe	toe	tec	Tcal	TJ	10³ BTU	MWh	kg LPG	m³ Nat. Gas	cf Nat. Gas
boe	1	0.13878	0.1982593	0.00139	0.00581	5,524.66	1.61394	131.0616	167.2073	5,917.1598
toe	7.205649	1	1.4285668	0.01	0.04184	39,810.22	11.62962	944.3830	1,204.8371	42,636.9763
tec	5.04390	0.6999925	1	0.007	0.029288	27,866.65	8.14067	661.0616	843.3769	29,845.8621
Tcal	720.56490	100	142.85668	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	277.9214	22,571.316	28,796.2988	1,019,048.19
10³ 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
m³ 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

* 1bbl LPG = 0.0761 boe; * 1bbl LPG = 0.1589 m³ = 5.6146 cf; * 1m³ LPG = 532.4 kg; * 1 cf = 0.028317 m³

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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