Independent Statistics & Analysis
U.S. Energy Information Administration

Country Analysis Brief: Ecuador

Last Updated: October 5, 2017

Overview

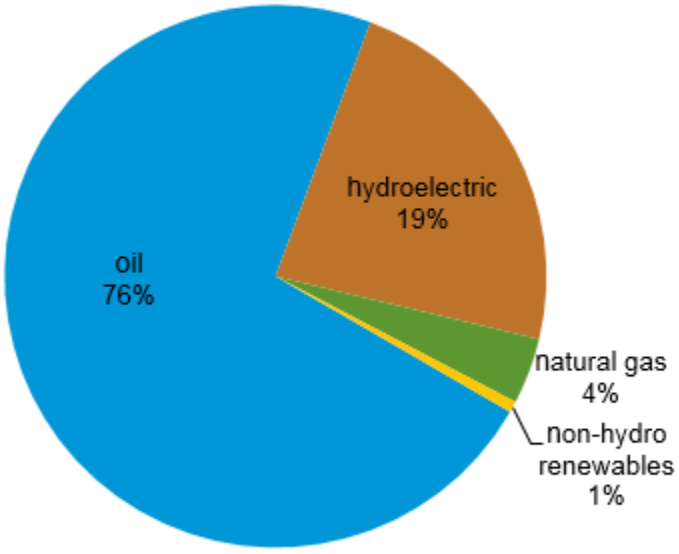
Ecuador's energy mix is dominated by oil, although its challenging investment environment and lack of domestic refining capacity limit oil revenues.

Figure 1. Map of Ecuador

Source: CIA's World Factbook

Ecuador's energy mix is largely dependent on oil, which represented 76% of the country's total energy consumption in 2016 (Figure 2).[1] Hydroelectric power was the second-largest energy source. Natural gas and nonhydro renewable fuels account for the remainder of Ecuador's energy mix.

Figure 2: Total primary energy consumption in Ecuador, by type (2016)



Source: *BP Statistical Review of World Energy 2017*

Ecuador, a member of the Organization of the Petroleum Exporting Countries (OPEC), produced about 548,000 barrels per day (b/d) of petroleum and other liquids in 2016.[2] The oil sector accounts for more than half of the country's export earnings and about 25% of public sector revenues (See also OPEC Revenues Fact Sheet).[3]

Resource nationalism and debates about the economic, strategic, and environmental implications of oil sector development are prominent issues in the politics of Ecuador and the policies of its government. Ecuador has a challenging investment environment prompted by government initiatives to increase the share of crude oil revenue for the country, which has contributed to near-stagnant oil production as output has stayed relatively constant over the past 10 years. A lack of sufficient domestic refining capacity to meet local demand has forced Ecuador to import refined products, limiting net oil revenue.

Acknowledging its heavy reliance on the oil sector in the current uncertain oil price conditions, Ecuador released its *National Energy Agenda 2016-2040* in October 2016 that is designed to transition Ecuador's energy sector to a more diversified energy matrix. The *Agenda* defines five major strategic objectives:

1) An integrally planned, fair and inclusive energy sector
2) A diversified, renewable, and sustainable energy matrix
3) Energy sovereignty and security with quality energy supply for all the population
4) Energy efficiency
5) Regional energy integration and contribution to sustainable global energy development[4]

The policy roadmap expects hydropower to increase from 58% of electricity generation in 2015 to 90% in

2017, contributions from nonconventional renewable energy, and more efficient thermoelectric plants.[5]

Petroleum and other liquids

Ecuador has the third-largest oil reserves in South America

As of January 2017, Ecuador had 8.3 billion barrels of proved crude oil reserves, the same as in the previous year. Ecuador has the third-largest oil reserves in South America after Venezuela and Brazil.[6] Most of Ecuador's oil reserves are in the Oriente Basin located in the Amazon.

Sector organization

Ecuador's hydrocarbon resources are exclusively owned by the state, and state-owned oil companies account for most of the production.

National oil company (NOC) Petroecuador was merged with state exploration and production company (E&P) Petroamazonas in 2012 to consolidate and optimize Ecuador's hydrocarbon production. In 2013, Petroamazonas took ownership of Operaciones Rio Napo, a joint venture between Petroecuador and Petroleos de Venezuela (PdVSA), Venezuela's state-owned oil company.[7] These companies account for more than 80% of Ecuador's oil production.[8] The remaining production is attributed to fields operated by international oil companies (IOCs), Repsol (Spain), Eni (Italy), Tecpetrol (Argentina's state-owned company), and Andes Petroleum, which is a consortium of the China National Petroleum Corporation (CNPC, 55% share) and the China Petrochemical Corporation (Sinopec, 45% share). Ecuador's Ministry of Non Renewable Natural Resources is responsible for energy policy decisions, while the Hydrocarbons Regulation and Control Agency regulates the oil sector.

Hydrocarbon resources are exclusively owned by the state, and Ecuador limits foreign investment in the oil sector. Foreign oil and natural gas companies are allowed to enter into service contracts that offer a fixed per-barrel fee for their exploration and production activities. The move away from production-sharing agreements to service contracts has increased the government's share of revenue and state oil production.

Since 2009, Ecuador has agreed to several oil-for-loan deals with China that explicitly guarantee oil exports to China in exchange for loans. The loans also require Ecuador to invest a share of the loaned amount into projects involving Chinese companies. Some of these funds have been applied to the development of hydroelectric complexes and other energy-related projects. China has also made large-scale loans to Ecuador that coincided with oil supply agreements.[9]

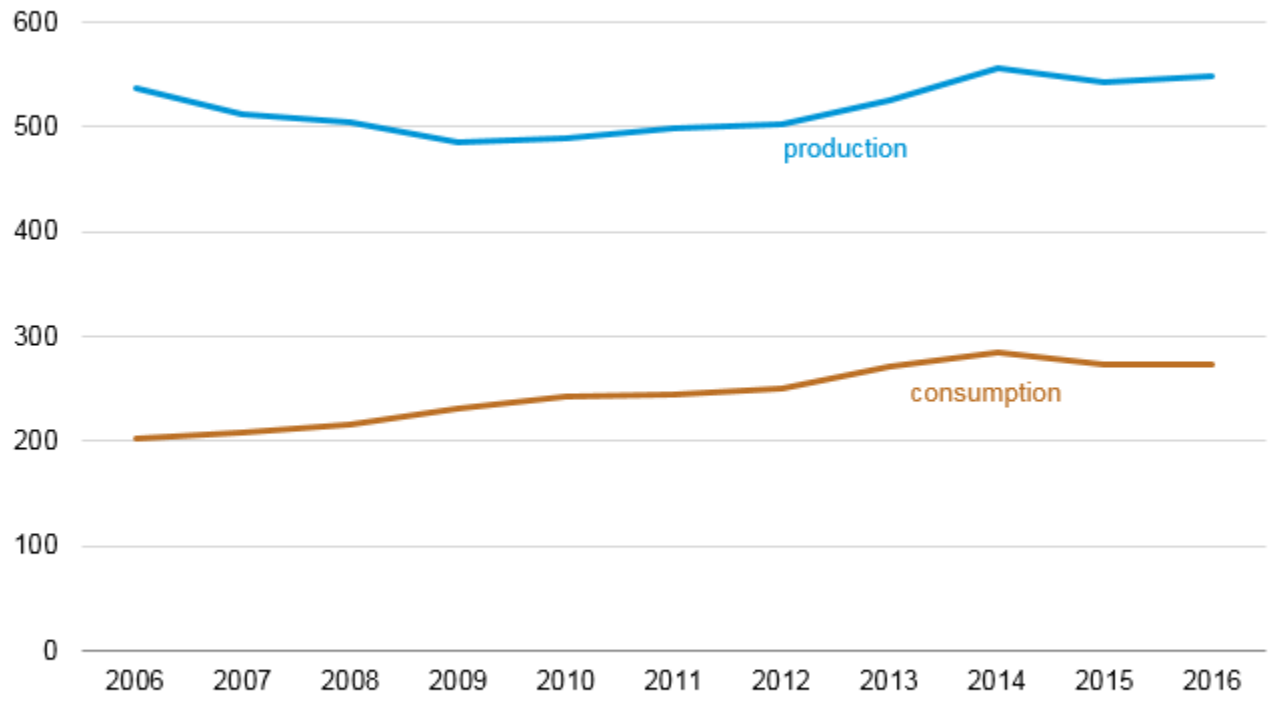
Exploration and production

Ecuador is the fifth-largest oil producer in South America. Substantial oil reserves are located in the Ishpingo-Tambococha-Tiputini (ITT) fields in Yasuni National Park. Production began at the Tiputini field in September 2016.

Ecuadorian crude is produced in the Amazon in the eastern part of the country and transported via pipeline over the Andean mountains to the port of Esmeraldes. Ecuador's most productive oil blocks are located in the northeastern part of the country. Shushufindi and Auca are the country's two most prolific oil fields. Ecuador produces two grades of oil: the 24°API Oriente, which accounts for two-thirds of total exports and main feedstock for domestic refineries; and Napo, which is a heavier grade at 19°API.

Crude oil production increased in 2004 shortly after the opening of the Oleoducto de Crudos Pesados (OCP) pipeline, which removed a chokepoint on heavy crude oil transportation in the country. However, production subsequently leveled off as a result of natural decline, the lack of new project development, and operating difficulties at existing, mature oil fields. The inauguration of the Panacocha field in the Ecuadorean Amazon in 2014, the first new expansion of production since 2007, accounted for the increase in production in that year, but crude oil output has fallen since then. Ecuador's crude oil production averaged 548,000 b/d in 2016, a slight decrease from the country's previous peak level of 557,000 b/d in 2014 (Figure 3).

Figure 3: Ecuador's petroleum and other liquids production and consumption
thousand barrels per day



Source: U.S. Energy Information Administration
Note: 2016 data is estimated

The Ishpingo-Tambococha-Tiputini (ITT) fields, also known as Block 43, in the Yasuní National Park hold an estimated 4 billion barrels of oil reserves.[10] The Tambococha-Tiputini fields are estimated to hold half of Ecuador's total oil, with the third field (Ishpingo) holding the rest. The Ecuadorean government placed a moratorium on oil extraction from these fields between 2007 and the summer of 2013 to protect

biodiversity and to avoid dislocation of two isolated indigenous cultures. Subsequently, the development of hydrocarbon resources in the ITT fields was deemed of national interest and restarted. Petroamazonas estimates that Block 43 will hit peak production of 300,000 b/d within six years.[11]

In September 2016, Petroamazonas started pumping oil at the Tiputini field, adding approximately 30,000 b/d to oil production.[12] Tambococha is the next field slated to be developed, with production scheduled to come online by the end of 2017. Drilling in Ishpingo is scheduled to begin in 2018.[13]

Trade

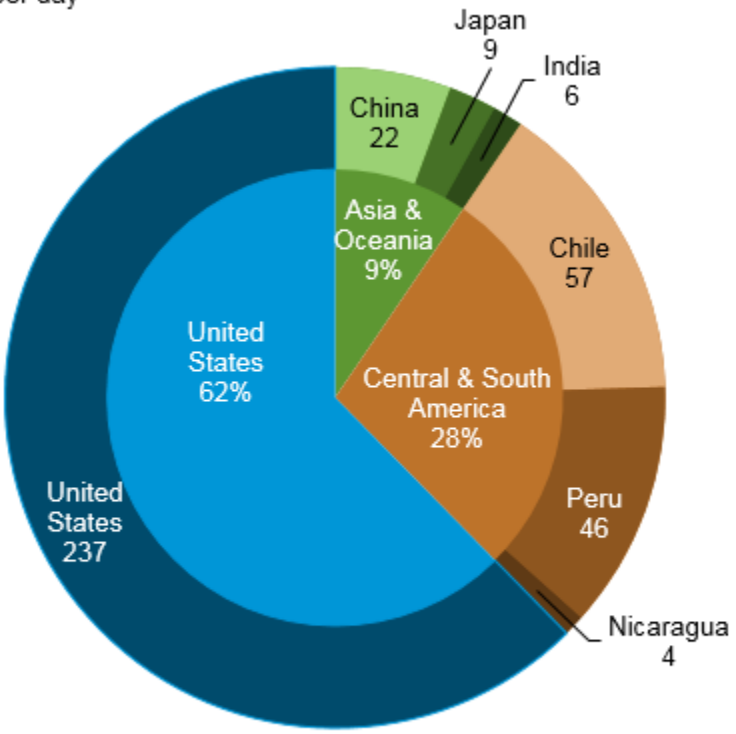
Ecuador exports approximately 70% of the crude oil it produces, and is the third-largest supplier of crude oil imports to the U.S. West Coast behind Saudi Arabia and Canada.

According to the latest annual data from Global Trade Tracker, Ecuador exported 380,000 b/d of crude oil in 2016. Crude oil is Ecuador's top export commodity, accounting for about 33% of Ecuador's export revenue in 2016.[14] Ecuador was the third-largest source of foreign oil for the U.S. West Coast (Petroleum Administration for Defense District V).[15] Consequently, Ecuador is a regionally significant source of oil for the U.S. West Coast, which is isolated from other parts of the continental United States because of few overland pipelines.

In 2016, the United States received the most of Ecuador's oil exports, importing 237,000 b/d or 62% of total exports (Figure 4). Chile, Peru, and China were also among the top importers of Ecuadorean crude oil.

Figure 4. Ecuador's crude oil exports by destination, 2016

thousand barrels per day



Source: U.S. Energy Information Administration based on Ecudorian export statistics and partner country import statistics, Global Trade Tracker

As a result of insufficient domestic refining capacity, Ecuador is an importer of petroleum products, despite its production of crude oil and petroleum liquids. In general, Ecuador exports heavy refined products, such as fuel oil, and imports lighter products, including gasoline, diesel, and liquefied petroleum gas (LPG). According to the latest annual data available, Ecuador imported approximately 122,000 b/d of petroleum products in 2016.[16]

Pipelines

Ecuador's pipeline infrastructure is old and capacity not fully utilized.

Ecuador has two major crude oil pipeline systems (Table 1). The older and more widely used pipeline is the 310- mile Sistema Oleducto Trans-Ecuatoriano (SOTE) which transports light to medium crude oil (Oriente crude). Ecuador's second-largest oil pipeline is the Oleducto de Crudos Pesados (OCP), originally designed for heavy crude oil (Napo crude). Approximately 70% of the country's crude oil travels through SOTE, with the remainder transported through OCP.

The 300-mile OCP flows mostly parallel to the SOTE pipeline. The OCP's completion doubled Ecuador's oil pipeline capacity and facilitated increased production. In 2013, Ecuador and Columbia signed a binational agreement to use OCP's spare capacity to transport southern Colombia oil to the Ecuadorian port of Esmeraldas. In June 2017, after almost 14 years of transporting only heavy crude oils, the OCP began transporting medium/light crude oils separately from heavy crude oils. This crude oil is largely

produced from the Chaza Field in Colombia.[17]

Ecuador has one transnational pipeline, which is the 190-mile Oleoducto Transandino pipeline (OTA) (Table 1). The 20,000 b/d OTA pipeline that connects Ecuador's oil fields with the southern Colombian port of Tumaco.

Table 1: Major Ecuadorean crude oil pipelines

Name	Operational date	Route	Design capacity (thousand b/d)
SOTE	1972	Esmeraldes-Lago Agrio	360
OCP	2003	Esmeraldes-Lago Agrio	450
OTA	1970	Lago Agrio (Ecuador) - Tumaco (Columbia)	20
Total capacity			830

Source: IHS EDIN (Energy Infrastructure & Markets Database)

Downstream

Ecuador has three commercial oil refineries with a combined capacity of 175,000 b/d.

According to the *Oil & Gas Journal*, Ecuador had three commercial oil refineries with a combined capacity of 175,000 b/d. All three refineries are operated by Petroindustrial, a subsidiary of Petroecuador (Table 2).[18] In 2016, Ecuador consumed 274,000 b/d. Ecuador's consumption has remained flat since its peak of 284,000 b/d in 2014.

In March 2016, Petroecuador announced the completion of the long-awaited Esmeraldas refinery rehabilitation that allowed the refinery to run at 100% of its nameplate operational and production capacity and reduced emissions levels to conform to national and international standards. In addition the rehabilitation has allowed Ecuador to reduce imports of gasoline by 17%, diesel by 15%, and LPG by 10%. Following its rehabilitation, the refinery has expanded its diesel and gasoline production by 270,000 gallons/year and now meets 27% of Ecuador's domestic demand for LPG, according to Petroecuador.[19]

Table 2: Oil refineries in Ecuador

Refinery	Capacity (000 bbl/d)	Location
Esmeraldas	110	Esmeraldas
La Libertad	45	Santa Elena Peninsula
Shushufindi	20	Sucumbíos
Total capacity	175	

Source: *Oil & Gas Journal*

Natural gas

Ecuador has relatively small proved natural gas reserves and a limited natural gas market

According to the *Oil & Gas Journal,* Ecuador had an estimated 385 billion cubic feet (Bcf) of proved natural gas reserves as of January 2017. The country's natural gas production was 18 Bcf in 2016.[20] Ecuador's low natural gas utilization rates are mainly the result of a lack of infrastructure needed to capture and market natural gas.

Located in the Gulf of Guayaquil, the offshore Amistad field is Ecuador's primary natural gas project and is operated by state-run Petroamazonas, a unit of Ecuadoran state oil company Petroecuador. The field was discovered in 1970 but did not begin producing until 2002. In 2003, it was estimated to hold 173 Bcf of proved natural gas reserves. In 2012, the non-producing northern part of the field was reevaluated, and according to Petroamazonas, could contain significantly more than originally estimated.[21] Amistad's natural gas production flows to the Machala facility, a 130-megawatt (MW) onshore, natural gas-fired power plant that supplies electricity to the Guayaquil region.

Exploration activities are mostly conducted by Petroamazonas, although Andes Petroleum, ENAP, and PdVSA also participate in exploration.

Electricity

In 2016, hydroelectricity accounted for 58% of the country's electricity generation. The other primary source of electricity supply is oil-powered conventional thermal power plants.

Sector Organization

Corporación Eléctrica del Ecuador (CELEC) is the state-owned holding company engaged in the generation, transmission, distribution, commercialization, and import and export of electric power. CELEC has a portfolio of hydroelectric, thermal, and renewable energy projects. CELEC was created in 2010 by

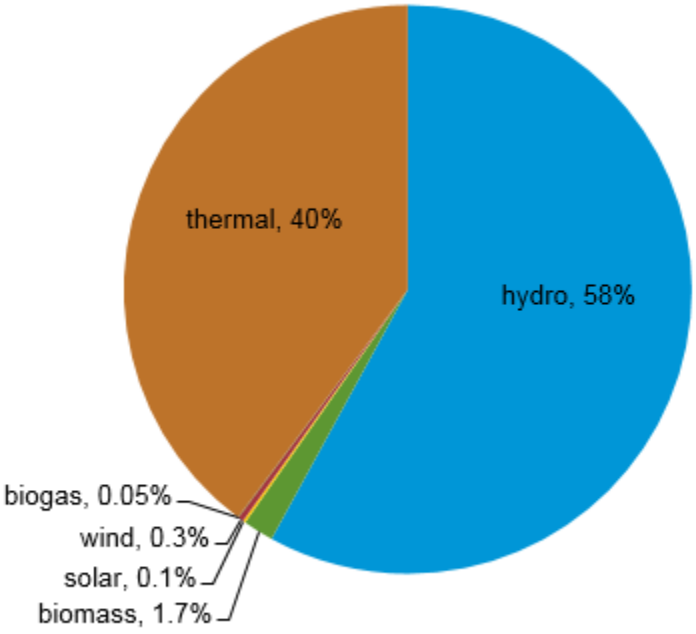
an executive decree that incorporated CELEC S.A. and Hidroeléctrica Nacional S.A. CELEC S.A. was formed in 2009 as a result of a merger between Electroguayas S.A., Hidroagoyán S.A., Hidropaute S.A., Termoesmeraldas S.A., Termopichincha S.A., and Transelectric S.A.

Unidad de Negocios Celec EP Transelectric (Transelectric) is the transmission unit of CELEC. Transelectric is responsible for operating the country's transmission system that includes 45 substations, 1,841 kilometers (km) of 230 kilovolt (kV) lines and 1,868 km of 138 kV lines, and has an installed transformation capacity of 8,918 mega volt ampere (MVA), and ensures open access for wholesale power market participants to transmission networks.

The state power distribution holding company, Corporación Nacional de Electricidad (CNE), is Ecuador's largest energy corporation. The company is primarily engaged in the generation, distribution, and marketing of electricity, as well as the operation and maintenance of 10 substations and transmission line connections.

More than 200 power plants are operating in Ecuador, of which 89 provide power to the National Interconnected System. In 2016, Ecuador generated 27,314 gigawatt hours (GWh) of electricity, or 14% of energy consumption.[22] Hydroelectricity accounted for 15,833 GWh of the country's generation, or 58% of total generation. The other large source of electricity supply is Ecuador's suite of conventional thermal power plants, which in Ecuador mostly burn oil (Figure 5).[23]

Figure 5: Electricity generation, by fuel type (2016)



eia Source: Electricity Regulation and Control Agency (ARCONEL)

Most of Ecuador's hydro capacity is located in Azuay province in the south-central highlands. The nation's

largest hydro facility, Coca Codo Sinclair, came online in November 2016, with 1.5 GW of capacity. Paute-Molino had been the country's largest hydroelectric complex at almost 1.1 GW of capacity. Five other hydropower projects are in an advanced stage of construction. As of June 2017, the government estimates that Minas San Francisco was 96% complete, Mazar Dudas was 87%, Toachi-Pilatón was 95% complete, Delsitanisagua was 86% complete, and Quijos was 47% complete.[24] They are spread across the country, and CELEC plans to start all operations by 2018 (Table 3).

Table 3: Planned hydroelectric power plant projects

Plant	Expected start date	Generating capacity (MW)
Minas San Francisco	2017	275
Toachi-Pilatón	2018	254
Delsitanisagua	2017	180
Quijos	2017	50
Mazar Dudas	2017	21
Total		780

Source: CELEC, Ministerio de Electricidad y Energia Renovable

Ecuador has transmission grid interconnections with Colombia and Peru, and the country is a small net importer of electricity. The country's electricity grid, however, does not reach all Ecuadoreans. Of total electric consumption, the residential sector accounts for approximately one-third of electricity consumption, similar to the industrial sector.[25]

The Andean Electrical Interconnection System (SINEA), formed in 2011, created an Andean power corridor.[26] Ecuador and Peru recently advanced plans to further integrate their power grids through the Connect 2020 program that provides policy support to develop the regulatory framework for cross-border power trade and transactions and financing for physical interconnections.

In 2017, state transmission company Transeletric awarded two projects to winners of a bidding round. The 230/69kV Quevedo-San Gregorio-San Juan de Manta transmission project was awarded to Chinese company Xian Electric Engineering and the 30kV Milagro-Babahoyo expansion project was awarded to Spanish company TSK Electrónica y Electricidad. These projects will provide transmission as new capacity comes online, such as the Coca Codo Sinclair plant that began operations in 2016.[27]

In May 2017, Transelectric launched operations of the Chorrillos substation as part of the country's 500 kV Transmission System project. [28] The 500 kV Transmission System comprises 602 km of transmission lines operating at 500 kV, linking four new substations: San Rafael, located near the Coca Codo Sinclair power station; El Inga in the vicinity of Quito; Tisaleo, in the center of the country; and Chorrillos, in the vicinity of Guayaquil. This system incorporates cutting-edge technology and modern systems that are new technologies in the country. The system is complemented by 287 km of 230 kV lines. [29]

Notes

- Data presented in the text are the most recent available as of October 4, 2017.
- Data are EIA estimates unless otherwise noted.

[1] BP, "Statistical Review of World Energy 2017"
[2] US Energy Information Administration (Accessed June 8, 2017)
[3] Central Intelligence Agency, "*The World Factbook: Ecuador*" (Accessed June 5, 2017)
[4] BN Americas, "Ecuador unveils 2016-40 national energy agenda" (Accessed July 18, 2017)
[5] Ministerio Coordinador de Sectores Estrategicos, "Agenda Nacional de Energia 2016-2040," page 30
[6] Oil & Gas Journal, "Worldwide Look At Reserves And Production" (January 1, 2017)
[7] BN Americas, "Petroecuador inks Río Napo transfer deal" (Accessed July 18, 2017)
[8] BN Americas, "Ecuador to expand block 43 activity" (Accessed July 18, 2017)
[9] Reuters, "SPECIAL REPORT-How China took control of an OPEC country's oil" (Accessed November 26, 2013)
[10] Newsbase Round-Up Global, Issue 78, September 2016, "First oil from Ecuador's ITT project" (Accessed July 18, 2017)
[11] Energy Intelligence, "World Crude Oil Handbook, 2017"
[12] Oil Price, "Can Lenin Solve Ecuador's Oil Crisis?" (Accessed July 18, 2017)
[13] Newsbase Round-Up Global, Issue 78, September 2016, "First oil from Ecuador's ITT project"
[14] Banco Central de Ecuador, Table 3.1.1 Exports by main product
[15] US Energy Information Administration, "PAD District Imports by Country of Origin" (Accessed July 18, 2017)
[16] Organization of Petroleum Countries (OPEC), 2017 OPEC Annual Statistical Bulletin, page 71
[17] OC Ecuador, "OCP enters a new phase with the transportation of Columbia's segregated crude oil" (Accessed August 3, 2017)
[18] Oil & Gas Journal, "Worldwide Refining Capacity Detail," (Accessed January 1, 2015)
[19] Oil & Gas Journal "Petroecuador restarts Esmeraldas refinery" (Accessed July 27, 2017)
[20] Organization of Petroleum Countries (OPEC), 2017 OPEC Annual Statistical Bulletin, page 124
[21] Worldoil.com, "Ecuador expects to raise block 6 gas output by 61% next year" (Accessed July 29, 2017)
[22] Agencia de Regulación y Control De Electricidad, "Estadística Anual y Multianual del Sector Eléctrico Ecuatoriano 2016," page 16
[23] Agencia de Regulation y Control de Electricidad, Annual Production (Accessed July 18, 2017)
[24] Ministerio de Electricidad y Energia Renovable, (Accessed July 28, 2017)
[25] Corporación Eléctrica del Ecuador (CONELEC), "PLAN MAESTRO DE ELECTRIFICACIÓN 2013 - 2022," page 23
[26] US Department of State (Accessed July 28, 2017)
[27] Ministerio de Electricidad y Energia Renovable, (Accessed July 28, 2017)
[28] BN Americas, "Chinese, Spanish firms land Ecuador transmission work" (Accessed July 28, 2017)
[29] Ministerio de Electricidad y Energia Renovable, (Accessed July 28, 2017)