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MaRS Market Insights

GOING GLOBAL

Colombia

Market Information Report: Colombia

MaRS Advanced Energy Centre
Author: Pallavi Roy
Supervisors: Jesika Briones, Ron Dizy

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EDC

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Colombia electricity sector snapshot

National Interconnected System (SIN): Covers 48% of the territory and 96% of the population

Non-connected zones (ZNI): Covers 52% of the territory with 4 % of the population (approx. 625000) living in the non-connected zone. Diesel is the major source of energy. This area is covered by the Amazon forest or difficult Andean terrain making inter-connections difficult.

Figure 1 Colombia[1]

1 http://www.creg.gov.co/phocadownload/presentaciones/evolucin%20sector%20energtico%20en%20colombia040616.pdf

Table 1 Colombia Electricity Statistics(2015)[1]	
Installed generation capacity	16.514 GW
Electricity generation (2016)	66.6 TWh
Electricity coverage	99.97% of the population
Transmission & distribution losses	12.1%
Environmental targets[2]	Unconditional 20% reduction with respect to Business as Usual (BAU) by 2030 to be increased to 30% with respect to BAU conditional on international support.

Executive summary

The Going Global series provides a 360-degree view of the energy system in priority international markets for export-ready Canadian energy companies. Each report examines not only the energy and electricity landscape of a particular market but also the business environment, the social, political and legal frameworks, and the country's macroeconomic drivers.

In short, the analysis is meant to help companies answer two key questions:

1. Are your capabilities a good fit for the market?
2. What are the opportunities and barriers to doing business, and do the former outweigh the latter?

The current report is an update on the first version of the Colombia report published in 2016 providing a revision of the data and investigating newer drivers and trends. Colombia is an exciting market, open to foreign innovation, sharing good relationships with Canada along with a free trade agreement. The Colombian electricity sector is looking to upgrade infrastructure in order to enhance reliability, and also increase renewable generation. The huge untapped renewable potential, ease of doing business and cordial relations with Canada makes Colombia an exciting market for Canadian cleantech. The main findings are as follows:

2 http://www4.unfccc.int/submissions/INDC/Published%20Documents/Colombia/1/Colombia%20iNDC%20Unofficial%20translation%20Eng.pdf

Key findings

Table 2 Opportunities and Barriers in the Colombian Market

OPPORTUNITIES IN CLEANTECH	BARRIERS TO CLEANTECH
• Government target to double renewable energy generation (non-hydroelectric) by 2020 (from 3.3% to 6.5%) • Huge energy potential for solar, wind and biomass largely under-developed • New renewable energy law (Law 1715) encourages companies to develop renewable technologies (non-hydro resources); mechanisms and incentives still in development • Due to use of old technology, there is significant potential for energy efficiency savings in transportation, industrial, commercial and residential sectors • Small but developing market for smart grid • Huge expansion plan of power transmission networks for the next 15 years, especially to create international inter-connections	• Government procurement policies favour domestic companies • Reliability is valued by the regulator and the government, hence intermittent sources such as solar and wind are at a disadvantage. The surcharge for energy reliability excludes renewable energy sources at present • Financial market limitations: The banking sector has little experience with cleantech and limited financing is available • Incumbent utilities have different levels of adoption of cleantech and companies often find them hard to penetrate • Transmission grid isn't connected to the north eastern area of Colombia which is rich in solar and wind resources
BUSINESS OPPORTUNITIES	**BARRIERS TO BUSINESS**

• One of the easiest Latin American countries in which to do business. Strengths of the market include:
  • Ease of getting credit
  • Protection of minority investment
  • Registration of property
  • Ease of resolving insolvency
• Large local utilities can act as a gateway market to other Latin American countries (e.g. Peru)
• The Colombian Caribbean region is an attractive area for businesses interested in renewable generation
	• Energy infrastructure (including transmission networks) are not adequate and need modernization and expansion
	• Transportation infrastructure is not well developed
	• Complex business tax structure
	• Weak contract enforcement
	• Language and cultural barriers necessitate a local partner

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1 Introduction

A South American country, Colombia is the 53rd largest export economy in the world and the 4th largest in Latin America. Colombia is expected to grow at 2.5% in 2017, double the average for Latin American, which is expected to grow at 1.2%, according to the World Bank.

TABLE 3 Country Facts[3, 4]	
Nominal GDP	292.09 Billion USD
Population	48.23 Million
Total Trade/GDP	38.95%
Currency	Colombian Peso (COP)
Merchandise Imports from Canada	782.80 Million CAD
Canadian direct investment	2,522 Million CAD
Main exports	Crude Petroleum ($25.7B), Coal Briquettes ($7.59B), Refined Petroleum ($2.77B)
Main imports	Refined Petroleum($7.19B), Cars ($2.61B), Computers ($1.98B)
Main trade partners	US, China, Mexico

3 http://www.edc.ca/EN/Country-Info/Pages/Colombia.aspx
4 http://atlas.media.mit.edu/en/profile/country/col/

Electricity sector overview

Colombia has a de-regulated energy market with an independent system operator, XM S.A. E.S.P. (a subsidiary of the state-run energy company, ISA). Within it, under a wholesale system power generation companies and public, private and mixed traders buy and sell energy within a regulatory framework established by the Energy and Gas Regulatory Commission (CREG). The market's current structure was established in 1994 by two national laws: 142 (Public Services Law) and 143 (Electricity Law). The regulatory framework of the electric sector classify electricity sector services into generation, transmission, distribution and commercialization of electricity. While generation and commercialization were determined to have free market competition, transmission and distribution are treated as natural monopolies.

Figure 2 provides a visual snapshot of the electricity market, identifying structure and the key players:

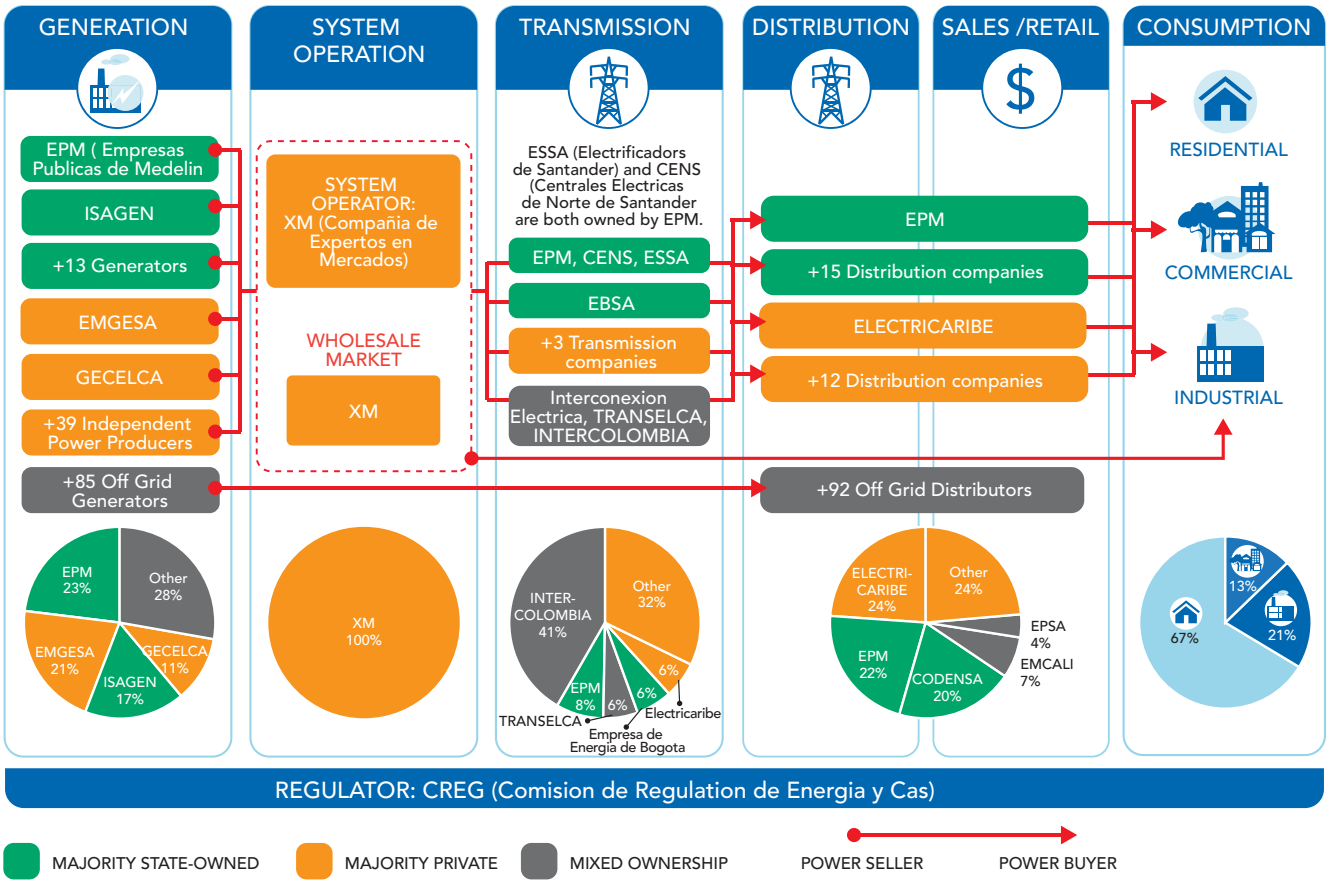


Figure 2 Colombian power sector [5]

5 Bloomberg New Energy Finance

ENERGY GENERATION

Generation is open to competition, and the market determines prices. Generation actors are categorized as follows:

- Generators: actors that carry out energy transactions in the electricity wholesale market, with installed capacity equal or above 20 MW.
- Minor plants: capacity of less than 20 MW. Governed by CREG Resolution - 086 of 1996.
- Self-generators: actors that produce electric energy for their own needs and do not receive back up from the National Interconnected System. Governed by CREG Resolution - 084 of 1996.
- Co-generators: actors that produce energy using a co-generation process and may be or may not be the owner of the co-generation system. Governed by CREG Resolution - 085 of 1996.

Energy is sold through bilateral contracts to the regulated and unregulated markets, energy exchange, secondary frequency regulation service and reliability charges.[6] Currently there are 69 companies in the generation sector.

Currently, half of the generation capacity in Colombia is privately owned, with three main companies, together, representing more than 60% of the total electricity market share (in 2015).[7] Emgesa S.A., ISAGEN and Empresas Publicas de Medellin (EPM) are the three main actors in terms of electricity generation in Colombia.

ENERGY TRANSMISSION

The National Transmission Network (STN) is operated by Empresa de Energia de Bogota (EEB) and has a voltage of 220 kV and 550 kV. Transmission network planning and expansion is coordinated by the UPME (Unidad de Palanacion Minero Energetica). UPME is a special administrative unit of the National Order, of a technical nature, attached to the Ministry of Mines and Energy, governed by Law 143 of 1994 and by Decree No. 1258 of June 17, 2013.[8] There are 11 companies in the transmission sector. Key transmission companies include ISA, TRANSELECA, Empresa de Energia de Bogota (EEB), Empresas Publicas de Medellin (EPM), and Empresa de Energia del Pacifico (EPSA).

ENERGY DISTRIBUTION

Distribution of electric energy is fully regulated under a voltage of 220 kV. CREG establishes and revises the distribution price component every five years. There are 29 companies in the distribution sector in Colombia.

COMMERCIALIZATION

This activity involves the purchase of electricity in the wholesale market and its sale to end-users, whether regulated or not. There are 93 companies present in this space. A complete description of the tasks and responsibilities of the major actors present is outlined in the Appendix included at the end of this report.

There are two markets in the Colombian electricity sector:

1. Bolsa de Energia, a market for short-term deals in which players offer prices and energy availability through daily auctions.
2. The market for long-term contracts, which provides agents with coverage against the volatility of energy prices in the short-term market.

The Colombian power generation market operates under a price supply system with marginal dispatch. The dispatch operates under a day ahead system.[9]

The reliability charge was introduced in 2006, to incentivize generators to produce electricity stably.[10] This was done to safeguard the supply of electricity during drought years, when due to low water levels hydroelectric generation was drastically reduced. This charge along with sport market and contracts helps generators reduce risk and recover costs, and assures them stable income over the next 20 years. It works like a call option, in which generators use assets to guarantee delivery of Firm Energy Obligations (OEF) under scarcity conditions. Firm Energy is defined as the energy that the generator is able to produce, even under scarcity conditions (scarcity conditions occur once spot price > the scarcity price). If generators fulfill their commitments, they receive a premium (reliability charge). This premium is decided through OEF auctions. Auctions have been held in 2008 and 2011, with 14 generation plants under construction.[11] Figure 3 below illustrates the different unique components of the electricity market in Colombia.

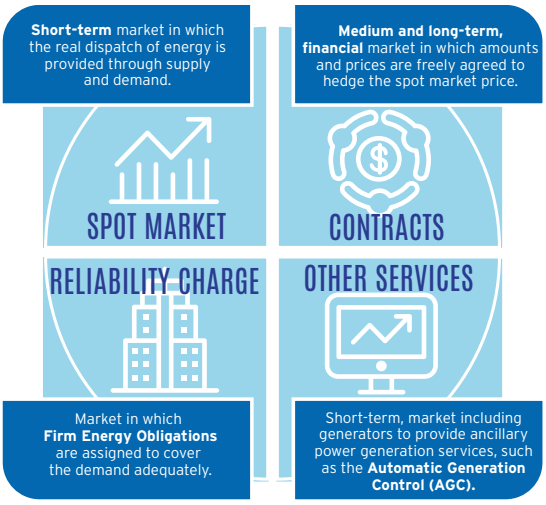


Figure 3 Colombian energy market[9]

6 *http://www.upme.gov.co/Estudios/2015/Integracion_Energias_Renovables/INTEGRACION_ENERGIAS_RENOVANLES_WEB.pdf*
7 *Bloomberg New Energy Finance*
8 *http://www1.upme.gov.co/quienes-somos*
9 *https://www.isagen.com.co/comunicados/capacitacion-analistas-eng.pdf*
10 *http://www.creg.gov.co/cxc/english/que_es/que_es.htm*
11 *http://www.isen.northwestern.edu/events/kemi/jan2013/docs/Diaz.pdf*

MARKET REGULATION DEVELOPMENT TIMELINE

The deregulation of Colombia's energy supply industry began in 1994 with the Electricity Law, following a period of major national blackouts in 1992 and 1993. Adapted from the United Kingdom (UK) model, Colombia has the only price-based electricity market in Latin America (other markets such as Chile and Brazil feature a cost-based scheme). This means pool prices are settled in a bidding process. Market prices have remained low over time; however, regulated (domestic) tariffs and subsidies have created problems for small distribution companies.[12]

Since 1994, with the passing of Laws 142 and 143 (the Public Service and Electricity Laws), the state through CREG has strengthened its regulatory role over the electricity and gas sectors.[13] Since the adoption of reforms, Colombia has avoided service blackouts despite severe droughts during 1997–1998 and 2009–2010. Colombia has also become an electricity exporter to Ecuador and Venezuela.[14]

Following reforms in 1994, customers in the electricity market were divided into two groups: regulated and non-regulated users. Non-regulated users are able to negotiate electricity prices with retailing companies, whereas regulated users must abide by tariffs defined by CREG (CREG Resolution 131, 1998).

12 http://www.sciencedirect.com/science/article/pii/B9780080450308500199
13 http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=785784&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F39%2F17037%2F00785784.pdf%3Farnumber%3D785784?
14 http://www.eprg.group.cam.ac.uk/wp-content/uploads/2014/02/1403-PDF.pdf

Figure 4 details the timeline of the development of the Colombian electricity sector:

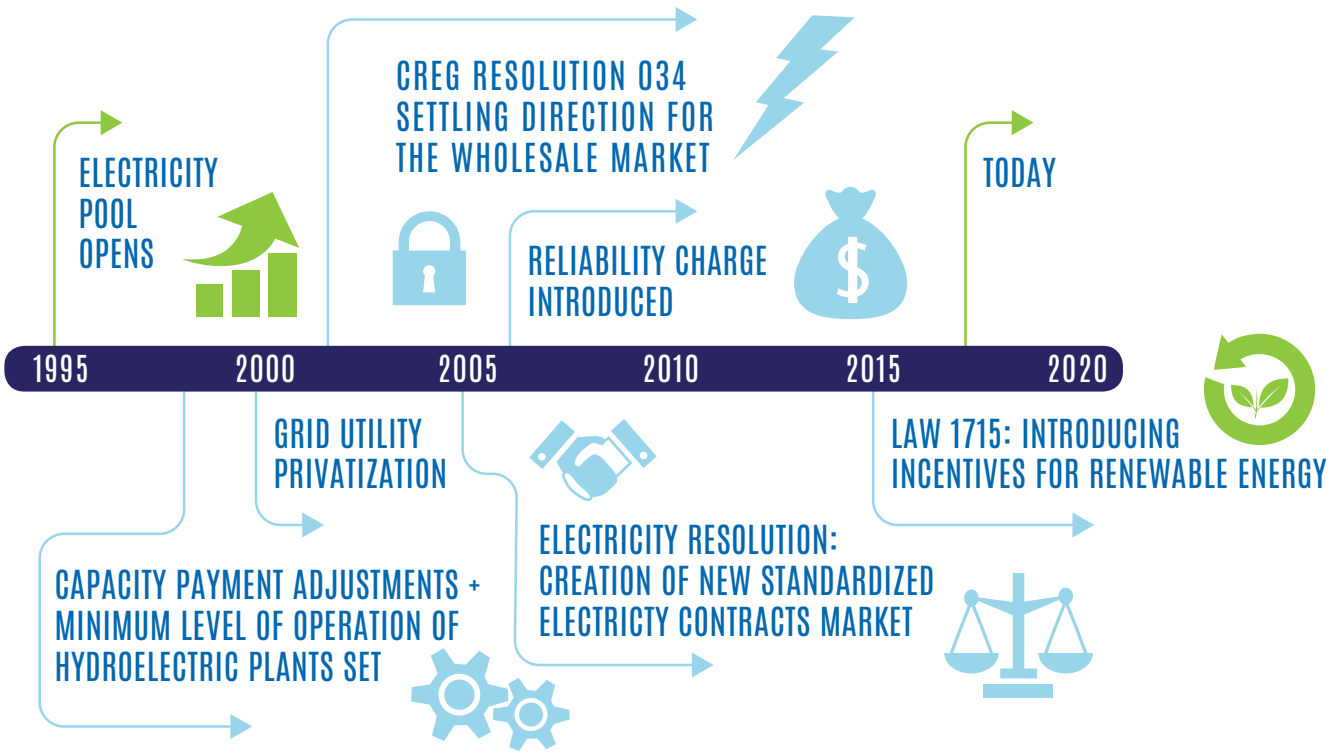


Figure 4 Colombian electricity sector major milestones timeline

2 Security of energy supply

SUPPLY & DEMAND

TOTAL ENERGY:

Colombia produces more energy than it consumes (as can be seen in Figure 5). Colombia is a net exported of energy, currently South America's largest coal producer, and third-largest oil producer after Venezuela and Brazil. In 2015, Colombia was the world's fifth-largest coal exporter. The country is also a significant oil exporter, ranking as the fifth-largest crude oil exporter to the United States in 2015.[13] Colombia's energy consumption is heavily dependent on fossil fuels (as illustrated by figures 6 and 8) both in terms of primary energy consumption and electricity production.

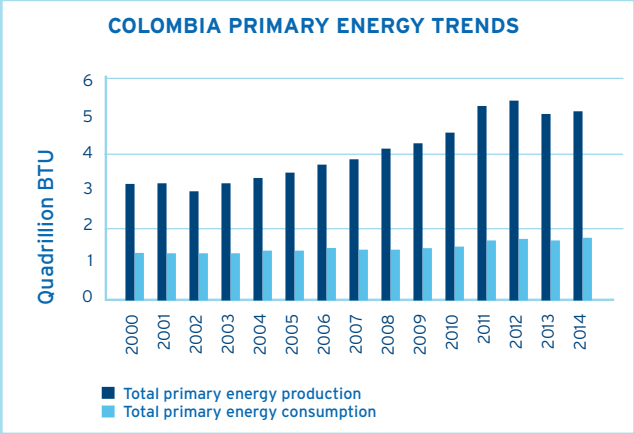


Figure 5 Colombia primary energy trends, 2000-2014[15]

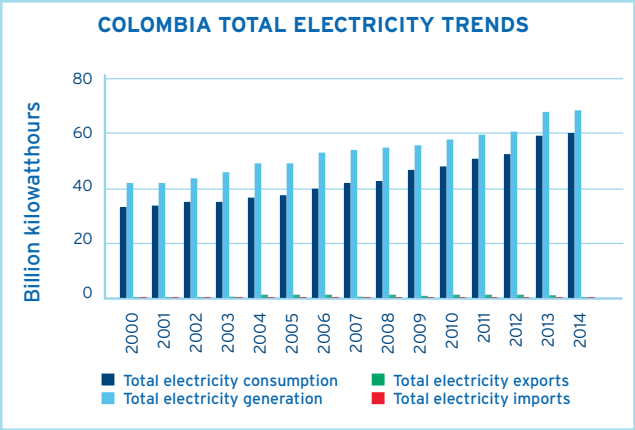


Figure 6 Colombia electricity trends, 2000-2014[15]

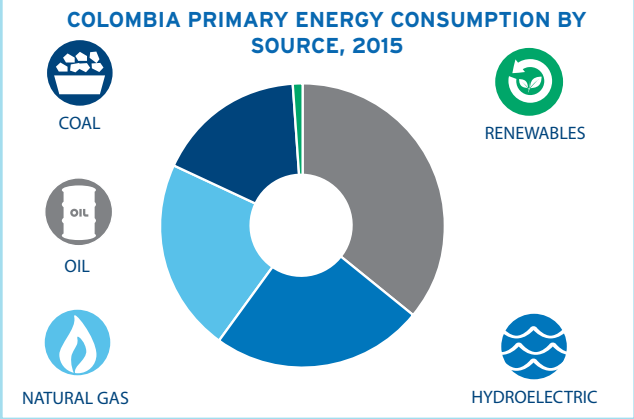


Figure 7 Colombia primary energy consumption by source, 2015[16]

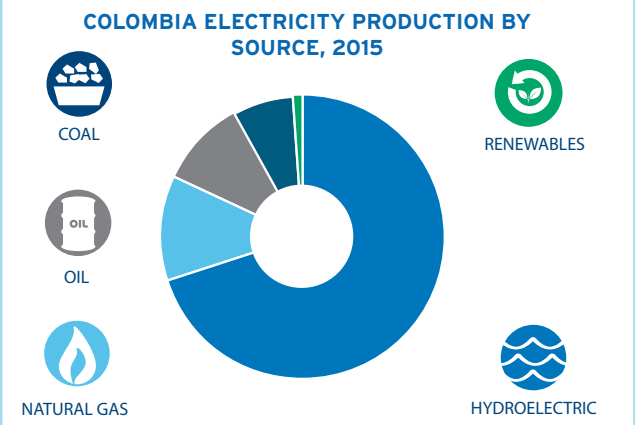


Figure 8 Colombia electricity production by source, 2015[16]

TOTAL ELECTRICITY:

Colombia also produces surplus electricity and is a net exporter of electricity. It has regional electric network connectedness, which allows for imports and exports of electricity. It is a net exporter of more than 700 GWh of electricity due to its connectedness with Ecuador, Peru and Venezuela (and a planned expansion of transmission lines to Panama), accounting for less than 10% of the power generated.

As of 2015, Colombia had a total installed capacity of 16.5GW. In that year, large hydro represented 63% of the 66.5 TWh generated and 60% of the installed capacity, with natural gas as the second most used source, at 25% of generation and 12% of the capacity. Non-hydro clean energy accounted for less than 5% of generation. Since the majority of its installed generation capacity is from hydropower, Colombia has faced electricity insecurity in recent years due to droughts caused by the El Nino effect.

The demand for energy and electricity is on the rise in Colombia. According to UPME, the annual potential growth of the electric power demand is expected to be 3.1%.[17] Residential and commercial sectors along with the mining and industrial sectors are going to be big drivers of this demand.

15 *IEA. Accessed at https://www.eia.gov/beta/international/analysis.cfm?iso=COL*
16 *BP statistical review of world energy workbook. Accessed at http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html*
17 *http://www.siel.gov.co/siel/documentos/documentacion/Demanda/UPME_Proyeccion_Demanda_Energia_Electrica_Octubre_2016_version2.0.pdf*

RENEWABLE GENERATION

The majority of Colombia's renewable electricity generation is large hydro, with only 3.3% coming from non-hydroelectric sources. The Colombian government seeks to nearly double that number by 2020, as well as increase the amount of renewable energy in the total energy mix. As some Canadian provinces are at similar stage regarding dependence on hydroelectric generation, Colombia's situation presents opportunities for Canadian companies with expertise and technology suited to a similar energy mix. Colombia has substantial untapped solar and wind potential as can be seen in in Figure 10. However, the renewable energy development in Colombia has been slow.

At present, most of Colombia's non-hydro renewable power is from wind and biomass resources. Colombia's focus on renewables started early but was concentrated on palm oil based biofuels.[18] Solar and wind have seen development only in the past 5 years. Colombia has significant solar power resources because of its location in the equatorial zone, but the country sits in a complex region of the Andes where climatic conditions vary. As Colombia gets an average solar irradiance of 194 W/m^2 or 4.5 kWh/m^2, and the area with the best solar resource is the Guajira Peninsula, with 6 kWh/m^2 of radiation, photovoltaic solar systems are increasingly cost effective.

Solar systems can be very suitable for applications in rural areas, where energy demands are dispersed and modest, and grid connection is often more costly. Also, projects under 20 MW in size have priority to gain access to the grid. The spot price is roughly US$100/MWh. There is significant wind potential as well, with average wind speeds in the order of 9 m/s. There is substantial biomass potential, in the order of 450,000 TJ/year from waste biomass.[19]

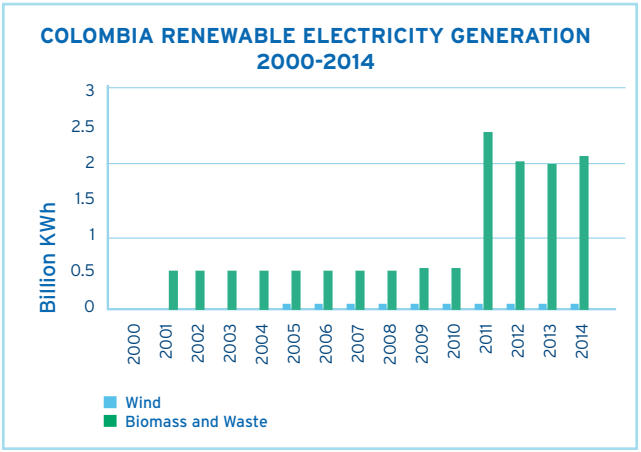
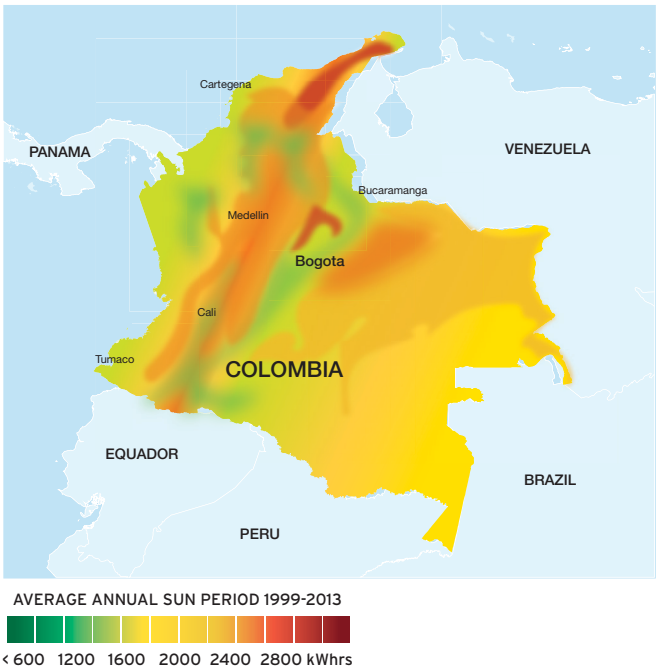


Figure 10 Renewable energy generation, 2000-2014[15]



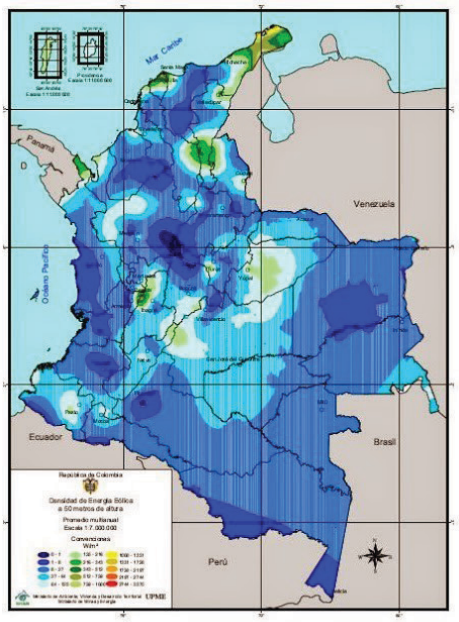


Figure 11 Solar and wind potential in Colombia,[20, 21]

18 http://carlosstjames.com/renewable-energy/what-colombia-needs-to-jumpstart-renewable-energy-investment/
19 http://www.upme.gov.co/Estudios/2015/Integracion_Energias_Renovables/INTEGRACION_ENERGIAS_RENOVANLES_WEB.pdf
20 http://solargis.com/products/maps-and-gis-data/free/download/colombia
21 http://www.evwind.es/2015/04/20/colombia-has-an-estimated-wind-power-potential-of-21-gw/51605

Main findings:

Colombia is heavily dependent on fossil fuels for its total energy needs, with electricity generation focused on thermal and hydroelectric sources. Colombia produces more energy than it consumes, making it a net exporter of fossil fuels, namely coal and crude. As economic growth and energy demand are expected to continue to expand, Colombia will likely need to invest in other sources of energy to ensure a secure supply. Recognizing this, the government has launched initiatives to promote the deployment of non-hydroelectric renewables, such as biofuels and solar. The El Nino effect impacting water supply and creating a periodic energy crisis is also another reason Colombia is interested in alternative sources of electricity generation.

Opportunities lie in the areas of:

- Off-grid renewable generation such as solar, wind and biomass along with natural gas based cogeneration facilities
- Energy efficiency in industrial and residential sectors, this opportunity arises from the use of old technology in Colombia

Challenges for renewables:

- Reliability is valued by UPME and CREG, hence intermittent sources such as solar and wind are at a disadvantage
- No subsidies are provided for renewable generation
- Local utilities at present don't sign renewable energy power purchasing agreements and have different levels of adoption of renewable technology

3 Quality and resilience of electricity supply

ELECTRICITY PRICES

Colombia's residential energy prices are among the most expensive in Latin America, higher than Chile, Brazil and Peru. This is due in large part to its residential energy tariff which is the most expensive in Latin America at US$192.25 per MWh as compared to US$188.19 per MWh in Chile, US$141.52/MWh in Peru, and US$132.4/MWh in Brazil. Industrial prices are similarly high, though they are lower than in Chile. Both residential and industrial prices are significantly higher than in Canada.

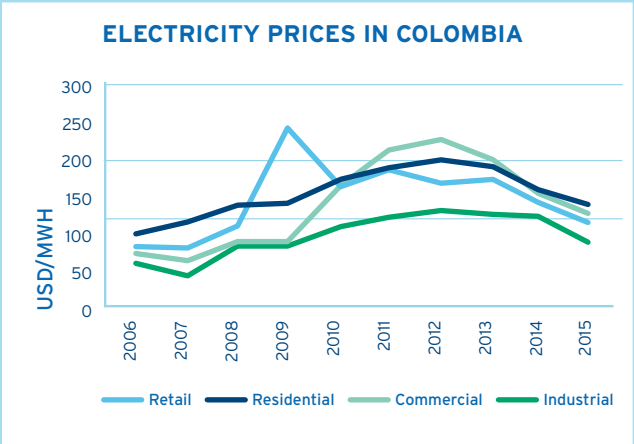


Figure 11 Electricity prices in Colombia[22]

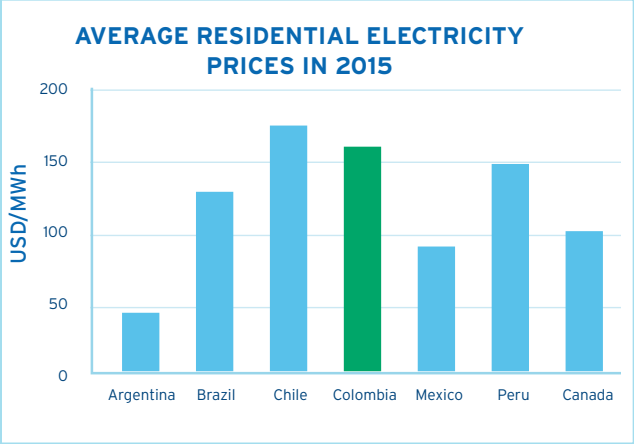


Figure 13 Average residential electricity prices in Colombia compared to other countries[21]

NETWORK CONNECTEDNESS

Colombia has about 14, 000 km of transmission and more than 450, 000 km of distribution network, which covers only 48% of the territory. The remaining 52 % is the unconnected zone. Lack of adequate transmission networks is a challenge in Colombia, especially as areas rich in renewable resources are remote and unconnected.

For example La Guajira is reportedly the Colombian region with the best natural resources for wind and solar power generation; the government estimates that the region has a potential of 3,500MW of wind and 2,500MW of solar. However, the area is isolated from the country's main power grid, representing a clear obstacle for the development of projects that are planned for the region. In February 2016, the Colombian government launched a tender for the construction of a USD700mn transmission line to connect La Guajira region. Ultimately, Peruvian holding Graña y Montero was awarded this project in September. Today, this project is known as "Anillo de la Guajira" (Guajira´s Ring). For the construction of this project, Morelco (Graña y Montero's subsidiary in Colombia) will lead a consortium that will also include the following companies: Consultores Unidos, DV Ingeniería y Enterprise Management Services.

Colombia's network is connected to its neighbours in a limited fashion. Some transactions take place with Ecuador, Peru and Venezuela. The governments of Colombia and Panama have announced plans to build 614 km of transmission lines to connect the two countries' power grids, with an estimated transmission capacity of 300 MW and the option to expand this to 600 MW.[23] While operations have been delayed, it is estimated that the system will launch in 2018.

The National Transmission System (STN) connects electricity generators to traders, and is regulated by the CREG. The government-controlled Interconexion Electrica S.A. (ISA) is the only energy transporter in Colombia with national coverage. [24] It has one of the largest transmission networks in Latin America, including direct connections that link Colombia to Venezuela, Ecuador and in the future to Panama.

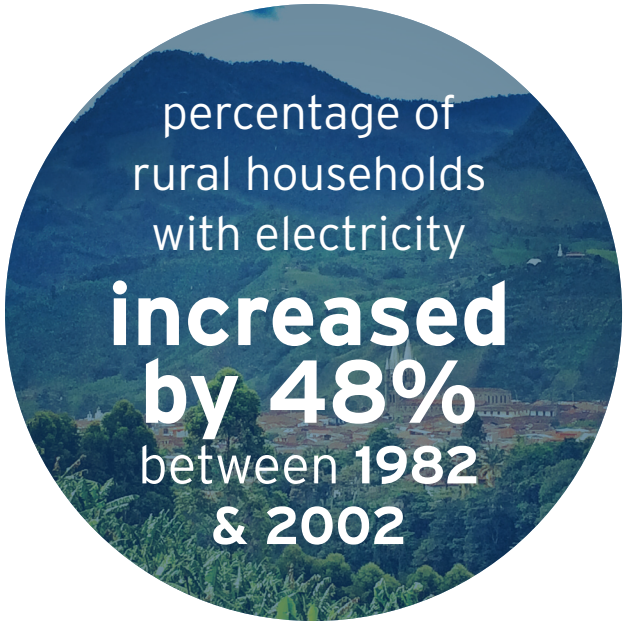
22 *Bloomberg New Energy Finance*
23 *https://www.arcgis.com/home/item.html?id=1d6717c8b86d4124ac151e7f2f899c15*
24 *http://www.isa.co/en/Pages/paises/colombia.aspx*

RELIABILITY/QUALITY

Although nearly 97% of Colombians have access to electricity, they experience frequent interruptions especially in the Colombian-Caribbean region. Electricity market losses in Colombia are moderately high compared to other developing countries. Although losses have fallen since deregulation, attacks by guerrilla forces aimed at the electricity system have caused disruption and losses in the past decade. With the peace process ongoing, this situation is getting better.

Power interruptions have traditionally been an issue in Colombia. Though the length of electricity interruptions has improved as a result of new regulations set by CREG in 2008. A 2014 study found that electricity distribution efficiency in Colombia has improved since 2008, and that energy losses and the length of service interruptions have decreased, despite significant annual demand growth rates (which reflects new customers).[25] However, this improvement in service quality has come at a price: the tariff per kWh has also increased over during this time and the proportion received from distribution costs has also increased relative to other components of the tariff.[26]

Moreover, non-interconnected zones of the country have very limited service—generally less than eight hours per day. In these remote, non-interconnected zones, producing a kWh of electricity could cost as much as US $0.50. Although reliability is improving in urban cores due to regulatory incentives, it still lags behind international standards. According to UPME, in 2013 SAIDI was 29.47, and SAIFI was 41.49.[27]



EXPOSURE TO SEVERE WEATHER

The World Risk Index measures a country's vulnerability and exposure to severe weather, disaster risk and environmental degradation. According to the World Risk Report (2016), relative to other countries Colombia has a medium level of exposure to natural hazards including earthquakes, storms, floods, droughts and sea level rise. Colombia ranked 83rd out of 171 countries. The main natural hazards to which Colombia is exposed are volcanic eruptions in the highlands (the last one occurring in 2010), occasional earthquakes, and periodic droughts and floods, e.g. the 2017 floods in Colombia have been devastating with more than 200 deaths.

Due to El Niño and La Niña events and the country's high reliance on hydropower, Colombia has historically experienced energy shortages every three to five years. [28] Colombia has a relatively high adaptive capacity, which is related to its ability to adapt to future natural events and climate change. However, it also has a relatively high lack of coping capacity due to weak governance and material security. The following are the details of Colombia's scores per the 2016 World Risk Report:[29]

- Exposure = 13.84% (medium): Related to exposure of population to natural hazards, earthquakes, storms, floods, droughts and sea level rise
- Vulnerability = 46.62% (medium): Sum of susceptibility, lack of coping capacities and lack of adaptive capacities
- Susceptibility = 26.35% (medium): Measures public infrastructure, nutrition, income and economic framework.
- Lack of coping capacity = 74.65% (high): Measures governance, medical care and material security
- Lack of adaptive capacity = 48.84 (low): Related to future natural events and climate change

TRANSMISSION AND DISTRIBUTION LOSSES

In 2013, Colombia's electricity losses in transmission and distribution amounted to approximately 12%, reduced from previous highs of around 20% experienced in the early 2000s.[25] This is lower than the Latin American average of 15%. Power losses contribute to high prices, and are overwhelmingly concentrated in distribution. Colombia's pricing scheme promotes a reduction in transmission and distribution losses by rewarding over-performance and penalizing underperformance. The regulator has established a cap on losses that can be passed on to consumers through tariffs, meaning utilities have to cover additional losses.[30]

25 *http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=CO*
26 *http://www.eprg.group.cam.ac.uk/wp-content/uploads/2014/02/1403-PDF.pdf*
27 *http://www.upme.gov.co/Estudios/2016/SmartGrids2030/4_Parte4_Anexo1_Proyecto_SmartGrids.pdf , pp. 48*
28 *http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=785784&url=http%3A%2F%2Fieeexplore.ieee.org%2Fiel5%2F39%2F17037%2F00785784.pdf%3Farnumber%3D785784?*
29 *http://weltrisikobericht.de/wp-content/uploads/2016/08/WorldRiskReport2016.pdf*
30 *http://www10.iadb.org/intal/intalcdi/PE/2014/14933.pdf*

SMART GRID OVERVIEW

There is a rising interest in smart grid in Colombia. UPME along with the Inter-American Development Bank has created a Smart Grid Vision 2030 document, detailing the development of smart grids in Colombia in the next few years. The vision identifies the following technology groups as priority for a smart grid:[31]

1. Advanced metering infrastructure
2. Advanced Distribution Automation
3. Distributed Energy Resources
4. Distributed energy systems - electric vehicles
5. Asset management

Decree #2469 issued in 2014[32] set in place regulation for net metering in Colombia, to promote efficient management schemes in the electricity sector. This allows self generators to sell off their surplus energy to others and get compensated fairly. This decree has jumpstarted the smart meter and smart grid integration in Colombia.

There have been a few smart grid related pilots in Colombia such as Colombian utility Empresas Municipales de Cali (EMCALI) deploying Innovari's grid optimization platform within its service area of 600,000 electricity customers in the municipality of Cali.[33]

31 Smart Grids Colombia: Vision 2030. Accessed at http://www1.upme.gov.co/sala-de-prensa/fotonoticias/smart-grids-colombia-vision-2030-mapa-de-ruta-para-la-implementacion-de
32 http://www1.upme.gov.co/sgic/?q=content/minminas-publica-el-proyecto-de-decreto-por-el-cual-se-establecen-los-lineamientos-de
33 http://www.innovari.com/innovaris-international-expansion-continues-latin-american-project-launch/

Major findings:

Though power losses have decreased significantly in the past few years and are now below the average for Latin America and the Caribbean, they are still higher than OECD countries such as Canada. Also, issues concerning high prices combined with challenges to the quality and resilience of the supply may lead consumers to seek alternative energy sources and home energy management systems to reduce their costs. Although these technologies are not yet popular in Colombia, increasing market presence and initiatives undertaken by the government and other organizations are leading to increasing awareness and interest. Smart grids are also of interest to the government who are looking to attract investment in the sector. Cleantech that facilitates access, builds resilience, and reduces costs may provide solutions for Colombian consumers, utilities, government, and other actors in the electricity system. Canadian cleantech companies will have much to offer this growing market as opportunities arise in the short and long term.

4 Environmental sustainability

Colombia commits to reduce its greenhouse gas emissions by 20% with respect to the projected Business-as-Usual Scenario (BAU) by 2030. Subject to the provision of international support, Colombia could increase its ambition from 20% reduction with respect to BAU to 30% with respect to BAU by 2030.

Though Colombia is party to the Kyoto Protocol, as an Annex II (developing) country they are not required to make carbon emissions reduction commitments. Without such a commitment, there is less pressure to invest in renewable energy for environmental sustainability. However, to reach existing targets as well as meet unmet demand and secure the energy supply, increases in smart grid and other cleantech deployment will be required.

NATIONAL STRATEGY FOR RENEWABLES

Currently, renewable energy represents 3.3% of electricity generation in Colombia. Colombia has set a target of 6.5% on-grid and 30% off-grid non-large hydro renewable power consumption by 2020. Colombia also has blending mandates of 10% for ethanol in gasoline and biodiesel in conventional diesel. [34] Other priorities include setting up a strategy of low carbon development, including goals to reduce greenhouse gas emissions.[35]

There have been no major advances in the use of renewable energy in the country in the past few years. Progress has likely been hindered by insufficient government incentives and a lack of general awareness of the potential of various renewable energies. In 2014, however, the government passed Law 1715, which is designed to advance the integration of non-conventional renewable energy sources into the national energy system. As the law recently came into effect, specific incentives and mechanisms to promote investment, research, and deployment of cleantech in the electricity market are still being developed. Some tax incentives for renewable are mentioned below:

TAX EXEMPTIONS FOR RENEWABLES

Decree #2143 came out in late 2015 and addressed tax incentives for renewables law #1715. The following changes were introduced:[36]

- Small hydroelectric projects (< 20 MW) receive tax exemption
- Sales made by generation companies (wind, biomass or agricultural waste), are exempt from income tax for 15 years
- The value added tax (VAT) of 16% is eliminated on capital equipment relating to renewable energy projects
- Capital equipment is exempt from import duties
- Accelerated depreciation allowance on capital equipment
- And a 50% reduction on taxation in the first five years of the project (Colombia's corporate tax rate is a hefty 30%).

Colombia's GDP has grown at an annual average rate of 3.6% over the past two decades, with a corresponding increase in greenhouse gas (GHG) emissions. Although the overall energy intensity of Colombia's economy has decreased, certain sectors are still inefficient users of energy, e.g. the transportation sector which accounts for 45% of Colombia's total energy demand, compared to a world average of 31%.[37]

34 http://global-climatescope.org/en/country/colombia/#/details
35 http://www.energycharter.org/what-we-do/publications/colombia-energy-investment-report/
36 http://carlosstjames.com/renewable-energy/what-colombia-needs-to-jumpstart-renewable-energy-investment/
37 https://www-cif.climateinvestmentfunds.org/country/colombia

Major findings:

Colombia's climate and renewable energy targets are less ambitious than other markets in Latin America, such as Chile. By 2025, the government seeks to nearly double the share of non-hydroelectric renewable generation in the mix, from 3.3% to 6.6%. They are also striving for a 20% reduction in carbon emissions by 2020 (from 2007 levels). These objectives are outlined in the National Energy Commission's "National Energy Strategy: 2012–2030." There are many initiatives underway in the energy sector to achieve these goals, including the deployment of smart meters and tax incentives for renewable energy technologies. Significant investment and increased deployment of cleantech will be required to achieve these goals. The renewable energy law was released in 2014, and the mechanisms of implementation are still being developed. However, there have been only a few major advances in the use of renewable energy in Colombia. This is largely a result of insufficient government incentives and a lack of information on the potential of various renewable energies. Thus, tangible outcomes for Canadian companies are unclear, but the law does signal a shift towards a renewable energy future that should present new market opportunities.

5 Business environment

QUALITY OF BUSINESS ENVIRONMENT

According to World Bank, Colombia ranks at 53 out of 190 countries for doing business, dropping two spots from 2016. Transparency International ranks Colombia 83rd out of 168 countries in its Corruption Perception Index of 2015. Though Colombia isn't the easiest country to do business in, starting a business was made easier recently with the streamlining of registration procedures for new businesses. However, Colombia is considered one of the easiest countries to start a business in, within Latin America. Cities such as Medellin also offer benefits to foreign companies that build factories and establish offices in their jurisdiction. Although Colombia has had issues with political unstability compared to most countries in the region, there are many policies in place that enable a good business environment for foreign investors. This, combined with the Canada-Colombia free-trade agreement,[38] fosters an attractive investment climate for Canadian companies.

TABLE 2 EASE OF DOING BUSINESS INDICATORS[39]

Topics	2016 Rank
Overall	55
Starting a Business	61
Dealing with Construction Permits	34
Getting Electricity	74
Registering Property	53
Getting Credit	2
Protecting Minority Investors	13
Paying Taxes	139
Trading across Borders	121
Enforcing Contracts	174
Resolving Insolvency	33

38 http://international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/colombia-colombie/fta-ale/background-contexte.aspx?lang=eng
39 www.doingbusiness.org/data/exploreeconomies/colombia/

THE MOST SIGNIFICANT BARRIERS TO DOING BUSINESS IN COLOMBIA INCLUDE:

Table 3 Colombia important considerations for doing business	
Framework for government procurement	Colombia has struggled with the requirements of the existing government procurement framework, which calls for open bidding in public tenders. With the current system, the process can lack transparency, fairness and competitive bidding for many tenders.
Legal services	Only firms licensed under Colombian law may provide legal services. Foreign law firms can operate in the country by forming a joint venture with a Colombian law firm and operating under its lawyers' licenses.
Restrictions on foreign providers of professional services	Economic needs tests are required when foreign providers of professional services operate temporarily. Residency requirements restrict trans-border trade of certain professional services, including architecture, engineering and urban planning.
Commercial presence	A commercial presence is required to bid on Colombian government contracts.
Restrictions on foreign nationals as employees	For firms with more than ten employees, no more than 10% of the general workforce and 20% of specialists may be foreign nationals.
Insurance	Insurance companies are restricted from offering policies to underwrite risk on government-sponsored infrastructure projects as Colombian regulations do not recognize insurance policies as equivalent to bank guarantees.
Intellectual property protection	Colombia has been on the Special 301 Report "Watch List" since 1991, which reflects the country's ongoing challenges in the enforcement of intellectual property rights.
Customs duties	Customs duties have been consolidated into three tariff levels: • 0% to 5% percent on capital goods, industrial goods and raw materials not produced in Colombia • 10% on manufactured goods, with some exemptions • 15% to 20% on consumer and "sensitive" goods
Payment of taxes	The hours needed annually to prepare, file and pay the corporate income tax, value-added tax (sales tax), and labour taxes are extremely high at 239 hours, compared to an OECD average of 175.

CLEAN ENERGY INVESTMENT

To capture the potential for accelerating economic development while reducing GHG emissions in line with its national development strategies, Colombia developed an investment plan, which was endorsed in March 2010 and revised in May 2013, that will tap US$ 150 million in financing from the CIF's Clean Technology Fund (CTF) for a range of urban transport and energy efficiency projects, as well as renewable energy. The fund is expected to mobilize an additional US$2.34 billion in public and private co-financing over the next ten years.[40] However, after seeing substantial growth post 2010, the clean energy investments have stalled since 2014.

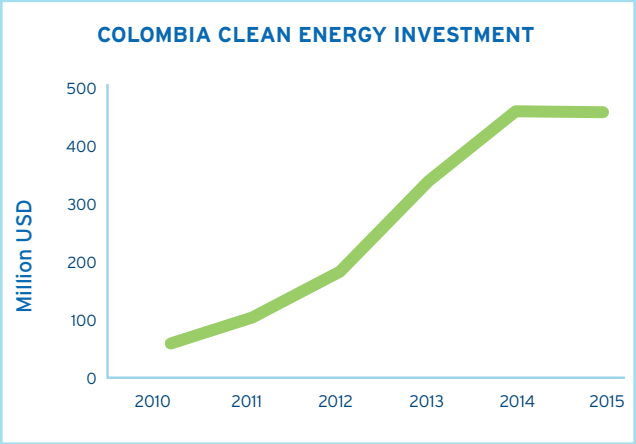


Figure 14 Colombia clean energy investment, 2010-2015[41]

The Colombian government actively encourages foreign direct investment (FDI), with foreign investment receiving the same treatment as investments made by Colombian nationals. The annual level of foreign direct investment—notably in the oil and gas sectors—reached a record high of $16.8 billion in 2013, a 7% increase over 2012, and equivalent to 4.5% of the country's GDP.[42] Of the total FDI, 46.7% of inflows were to the mining sector, 15.9% to manufacturing, 10.4% to transport and communications, and 9.4% to commerce.[43] The Ministry of Trade, Industry and Tourism is responsible for formulating foreign investment policy along with the Ministry of Finance and Public Credit. All foreign direct investment that involves the establishment of a commercial presence in Colombia requires registration with the Superintendent of Corporations ("Super Sociedades") and the local chamber of commerce. Colombian law regulates the number of foreign personnel in several professional areas, such as architecture, engineering, law and construction. For firms with more than 10 employees, no more than 10% of the general workforce and 20% of specialists can be foreign nationals.

CANADA-COLOMBIA RELATIONS

After many years of being focused on domestic developments, Colombia is promoting itself as being open for business and as a global partner for co-operation, within trade, investment, security, technology, education and energy. President Santos' administration has significantly expanded Colombia's international engagement, both bilaterally and multilaterally.

Colombia is Canada's fourth-largest export market in South America. Canada's merchandise exports to Colombia totalled $716.8 million in 2013 and included machinery, cereals, motor vehicles, vegetables, paper and paperboard. Imports from Colombia reached $691.3 million in 2013 and included coal, crude petroleum, coffee, cut flowers, fruit and sugar. Bilateral merchandise trade between Canada and Colombia reached $1.4 billion in 2013.

Colombia is Canada's fifth-largest trading partner in Latin America and the Caribbean (excluding Mexico). Canadian direct investment in Colombia reached nearly $2.5 billion at the end of 2015, making Colombia the fifth-largest investment destination in South and Central America.

The Canada-Colombia Free Trade Agreement, as well as parallel agreements on labour co-operation and the environment, came into force on August 15, 2011.[44] In May 2010, Canada and Colombia also signed an agreement regarding annual reports on human rights and free trade between the two countries.[45]

POLITICAL STABILITY AND DOMESTIC SECURITY

Colombia suffered a 10-year civil war, started in 1948 by the assassination of liberal leader Jorge Gaitan. This was followed by a guerrilla movement, concentrated in the rural areas, fighting against the great inequality in Colombia. Of these groups, the Revolutionary Armed Forces of Colombia–People's Army (FARC) and the smaller Ejercito Nacional de Liberacion (ELN) emerged as the major guerrilla groups.[46] These groups in recent years have been involved in narcotics trade and kidnapping. They have also damaged infrastructure in rural parts of the country.

Peace talks between FARC and the Colombian government were successful, and a deal was struck after a failed referendum in October, 2016.[42] The Amnesty law was finally approved by Colombia's congress, protecting FARC rebels laying down arms from prosecution for minor crimes committed during the country's 52-year war. About 7,000 FARC fighters are expected to lay down their arms over the next six months.[47]

40 https://www-cif.climateinvestmentfunds.org/country/colombia
41 http://global-climatescope.org/en/country/colombia/#/details
42 https://www.cia.gov/library/publications/the-world-factbook/geos/co.html
43 http://www.securities.com/emis/sites/default/files/EMIS%20Insight%20-%20Colombia%20Power%20Sector%20Report.pdf
44 http://www.ec.gc.ca/caraib-carib/default.asp?lang=En&n=FFEF249E-1
45 http://international.gc.ca/trade-commerce/trade-agreements-accords-commerciaux/agr-acc/colombia-colombie/fta-ale/background-contexte.aspx?lang=eng
46 http://www.bbc.com/news/world-latin-america-36605769
47 https://www.theguardian.com/world/2016/dec/29/colombia-approves-amnesty-deal-for-thousands-of-farc-rebels

Major findings:

The electricity sector is privatized and open to foreign investment. Canada and Colombia share cordial relations and are party to bilateral trade agreements. Colombia is an attractive market in Latin America, which is fast rising in ranks in various positive indicators of doing business. In the past decade it has also shown growth rates higher than rest of the Latin American and Caribbean regions. Colombia's legal framework facilitates business development, promotes foreign investment and guarantees stability for investors and the country encourages FDI. However, there are concerns of corruption and also disruption from guerrilla fighters, especially in the rural areas. The latest government efforts at a peace treaty signals an improvement in that situation and a stable domestic environment in Colombia's future.

6 Conclusion

Currently the Colombian energy sector is focused on the following issues:

- To attract greater investment in the electricity sector
- To promote unconventional renewable resources such as solar, wind, biomass, small hydropower, and geothermal energy, aiming to achieve universal energy access and more security in the system
- To develop transmission and distribution networks
- To advance inter-regional electric integration, developing projects such as the Interconnection Colombia–Panama (operational by 2018) and the Andean Electrical Interconnection System among Ecuador, Peru and Chile (operational by 2022).

Though Colombia has a lot of renewable potential, it has seen relatively slow development when compared to neighbouring countries of Chile and Brazil. Main factors for limited renewables include:[48]

- Dependence on hydroelectricity due to abundance of water resources
- Reliability concerns with intermittent nature of renewables
- Lack of transmission infrastructure
- Lack of subsidies for renewables

As a fossil fuel and hydroelectric dominated country, Colombian government has only recently started realizing the need for renewable generation. The Colombian government has fewer policies that are directly supportive of cleantech deployment and energy innovation than other Latin American countries such as Chile. On the other hand, it actively encourages and seeks foreign direct investment from countries such as Canada.

The government is also interested in FDI in transmission and distribution networks, to not only develop more power lines and connect areas of generation with demand, but also to introduce smart grid related technology. Smart grid regulation has recently been adopted, along with a few pilots. Future opportunities are expected in this area.

However, due to the lack of financial incentives for renewables and private financing options available within Colombia, Canadian companies need to be well-funded to enter the market. Despite the lack of finance available, the market opportunities for cleantech are growing as a result of consumer demand and government interest.

Furthermore, based on the considerations analyzed in previous sections, such as decreasing fossil fuel reserves and increasing consumer demand for an efficient and secure energy supply, it is clear that Colombia's energy system could benefit from integration of advanced energy technologies.

The lack of adequate transmission to transfer renewable energy generated in remote regions to the centers of demand, is another challenge for large scale renewable generation. Thus, until new power transmission lines enable the development of utility-scale wind and solar power, the distributed generation sector will offer the biggest opportunities in the country. This is because around 52% of the country's territory is not connected to the power grid. In particular, there is potential for the deployment of solar photovoltaics (PV) in isolated areas of the country, which often benefit from favourable levels of solar irradiation, making PV systems economically viable.

Colombia is one of the easiest countries to do business in Latin America. Colombia shares cordial relations with Canada and is interested in associating with Canadian firms. This reflects the sharply increasing awareness of Canada as a source of technology and quality products. This perception owes much to the very high profile of Canadian companies active in Colombia such as Talisman Energy, Pacific Rubiales, Nexen, Scotiabank, Continental Gold, McCain Foods, Iasalle College, Brookfield Asset Management, SNC-Lavalin and Norton Rose, as well as many others. Innovative Canadian companies are encouraged to further explore the market.

48 *https://www.iamericas.org/documents/Renewables_in_Colombia.pdf*

Appendix

NON-GOVERNMENTAL INSTITUTIONS IN THE ELECTRICITY SECTOR

Institution	Description
Energy Regulatory Gas Commission (CREG)	This utilities regulator was established in 1994 through Laws 142 and 143. It establishes tariffs for regulated users (those with power demands under 0.1 MW and a monthly consumption below 55 MWh).
Interconexion Electrica S.A. (ISA)	Headquartered in Medellin, Colombia, this state-owned transmission company was formed under Ministry of Mines and Energy in 1967. Prior to 1999, ISA was responsible for the entire expansion of the national transmission system (STN). ISA operates and maintains: • 40,805 km of transmission & distribution lines in Colombia, Peru, Bolivia and Brazil • International interconnections with Venezuela, Ecuador and Peru It is responsible for: • Operation planning, coordination, supervision and control of the national interconnected system (SIN) • The administration of the Commercial Settlement System in the wholesale energy market • The settlement and clearance of charges for the use of SIN's grids • Customized solutions for energy transmission lines and substations and the assembly of fibre-optic networks
ISAGEN S.A.	This mixed public utility company was created in 1995 when ISA was split into two entities.
Ruta N	Ruta N is a centre of business and innovation in Medellin, Colombia. It was created as a public join venture between Medellin's City Hall, business group EPM (a state owned utility company in Colombia) and UNE (Colombian telecommunications company owned by EPM) in 2011, to streamline the city's innovation ecosystem, promoting the development of innovative, technology-based businesses, to increase the competitiveness of the city and the region.
Agencia Nacional de Hidrocarburos (ANH)	Agencia Nacional de Hidrocarburos is a government agency that is responsible for regulating and managing Colombia's oil and gas resources, with the aim to generate power and state revenues from these resources. It was given the role of administrator and regulator of national hydrocarbon resources in 2003, following the restructuring of the Colombia hydrocarbon sector.[49]

49 http://www.anh.gov.co/en-us/la-anh/paginas/historia.aspx

GOVERNMENT INSTITUTIONS IN THE ENERGY SECTOR

Ministry	About	Responsibilities	Programs
Ministry of Mines and Energy (MinMinas) Industry sector: Energy—includes mining, electrical energy, hydrocarbons and nuclear	The Ministry formulates and adopts policies for the sustainable use of mining and energy resources in order to contribute to the economic and social development of the country	• Administering non-renewable natural resources in Colombia to ensure their best and greatest use • Directing this use and related regulations • Guaranteeing the supply of natural resources and safeguarding their preservation, their restoration and the country's sustainable development—in accordance with the evaluation, follow-up and environmental management criteria that have been indicated by the relevant environmental authority	• Program of Rational and Efficient Use of Energy and Non-Conventional Sources in Colombia (PROURE) • Program of Normalization of Electrical Networks (PRONE) • Regulatory Commission for Gas and Energy (CREG)
Mining and Energy Planning Unit (UPME)	Attached to the Ministry of Mines and Energy, the UPME administers and co-ordinates planning between public and private entities in the energy sector	• Planning the development and use of mining and energy resources • Researching and providing the information required for policy formulation and decision-making by the Ministry of Mines and Energy	• Program of Rational And Efficient Use Of Energy and Non-Conventional Sources In Colombia (PROURE)
Ministry of Environment and Sustainable Development (MinAmbiente) Industry sectors: Integrated water management resources, Marine affairs and aquatic resources, Climate change	The Ministry is the lead manager of the environment and renewable natural resources	• Defining the national environmental policy • Promoting the recovery, conservation, protection, planning, management, use and exploitation of renewable natural resources to ensure sustainable development and to ensure the right of all citizens to enjoy and inherit a healthy environment	• National Environmental Policy • National Policy for Integrated Water Resource Management • National Plan for Training on Integrated Water Management Resources

KEY SMART GRID ORGANIZATIONS

Organization	Description
Colombia Inteligente	Colombia Inteligente is an initiative to help develop smart grids in Colombia. It was set up by XM (Power System and Market Operator), CIDET (Electrical Sector Research Center), COCIER (Colombian branch of CIER), CNO (National Operation Council), CAC (Commercialization Advisor Committee) and CINTEL (Communications Research Center). It brings together companies and entities (including utilities) to establish a framework as well as policies and strategies for the development of the electrical sector. Where applicable, it favours strategies and solutions oriented toward the smart grid.
XM	XM is an ISA subsidiary that specializes in "real-time systems" management, which includes the planning, design, optimization, commissioning, operation, and administration or management of transactional systems or technology platforms that involve the exchange of value-added information and markets for goods and related services. XM currently applies its expertise primarily in the electricity sector, but also works in the transportation and financial sectors.[50]
Colombian Council for Efficient Energy	This non-profit organization was created with the purpose of fostering activities related to energy efficiency and to build relevant awareness and knowledge within the country in order to promote more efficient and rational use of energy in all sectors.
Colombia Energy Institute	The Colombia Energy Institute is dedicated to providing specialized services in consulting and technical training in the energy sector.

50 *http://www.xm.com.co/Pages/QuienesSomos.aspx*

marsdd.com/aec

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The information provided in this report is presented in summary form, is general in nature, current only as of the date of publication and is provided for informational purposes only.

MaRS Discovery District, @April, 2017. For more information, please contact:

Pallavi Roy
Associate
Advanced Energy Centre
proy@marsdd.com

Jesika Briones
Manager-International Programs
Advanced Energy Centre
jbriones@marsdd.com