

Country Assessment Report

Country/Region name:

Ecuador is situated in north-western South America; bordered by Colombia and Peru. It has a population over 17.3 million and GDP worth \$107.4 billion, with a growth rate of 0.05%¹.

Sources: World Bank (2019) "Ecuador", Washington D. C.: World Bank (Available at: <https://data.worldbank.org/country/EC>).

Generation and demand: (type, MW, TWh)

Electricity Generation in Ecuador is largely characterised by hydroelectric generation, with 77% (Table 1) of the country's electricity being produced by the sector in 2018. Most of the renewable electricity production capacity is installed in the Andes, the largest scale fossil fuel power plants being concentrated on the coastal side of the mountains, and the Amazon basin being mostly powered through small scale fossil fuel electricity production for auto-consumption (due to the isolation of the region from the national grid). Ecuador being an oil producer and part of the Organisation of the Petroleum Exporting Countries (OPEC), most of its fossil fuel electricity generation is oil-produced. In 2018, 87% of the nation's power production and consumption was incorporated to the SNI (Interconnected National System, Ecuador's national grid). The vast majority of the remaining 13% of the total production being produced by oil producing facilities through fossil fuel combustion to cover their own consumption (Table 1).

Transmission System	Fuel Type	Generation Type	2018		2019	
			Production (GWh)	Percentage	Production (GWh)	Percentage
SNI Incorporated	Renewable	Hydroelectric	20,661.59	70.65 %	24,670.79	77.02 %
		Biomass	382.44	1.31 %	77.71	0.24 %
		Photovoltaic	34.77	0.12 %	32.64	0.10 %
		Wind	73.70	0.25 %	423.90	1.32 %
		Biogas	45.52	0.16 %	41.64	0.13 %
	Total Renewable	21,198.02	72.49 %	25,246.68	78.81 %	
	Non-Renewable	Thermal (mostly oil)	4,177.89	14.29 %	2,708.40	8.45 %
Total Non-Renewable	4,177.89	14.29 %	2,708.40	8.45 %		
Total SNI (Grid Incorporated)			25,375.92	86.77 %	27,955.08	87.27 %
Non-Incorporated	Renewable	Hydroelectric	16.40	0.05 %	21.10	0.07 %
		Wind	3.31	0.01 %	5.49	0.02 %
		Photovoltaic	6.56	0.02 %	4.41	0.01 %
	Total Renewable	26.27	0.08 %	31.00	0.10 %	
	Non-Renewable	Thermal (mostly oil)	3,841.38	13.14 %	3,841.38	13.14 %
Total Non-Renewable	3,841.38	13.14 %	4,047.10	12.63 %		
Total (Non-Grid Incorporated)			3,867.66	13.23 %	4,078.10	12.73 %
Total General			29,243.59	100.00 %	32,033.18	100.00 %

Table 1. Electricity production per technology/fuel type (2018-2019).

As illustrated in Figure 1, since 2009, the country's installed capacity has almost doubled, while the annual electricity production has increased from 18 TWh to 29 TWh in that same period. The vast majority of the newly installed capacity during that period is due to newly commissioned hydroelectric power plant (2,032 MW in 2009 against 5,046 MW in 2019). The other types of renewable electricity production (i.e: wind, solar and biogas) are also showing a constant increase since their apparition in 2012 but are still providing a very low percentage of the country's installed capacity.

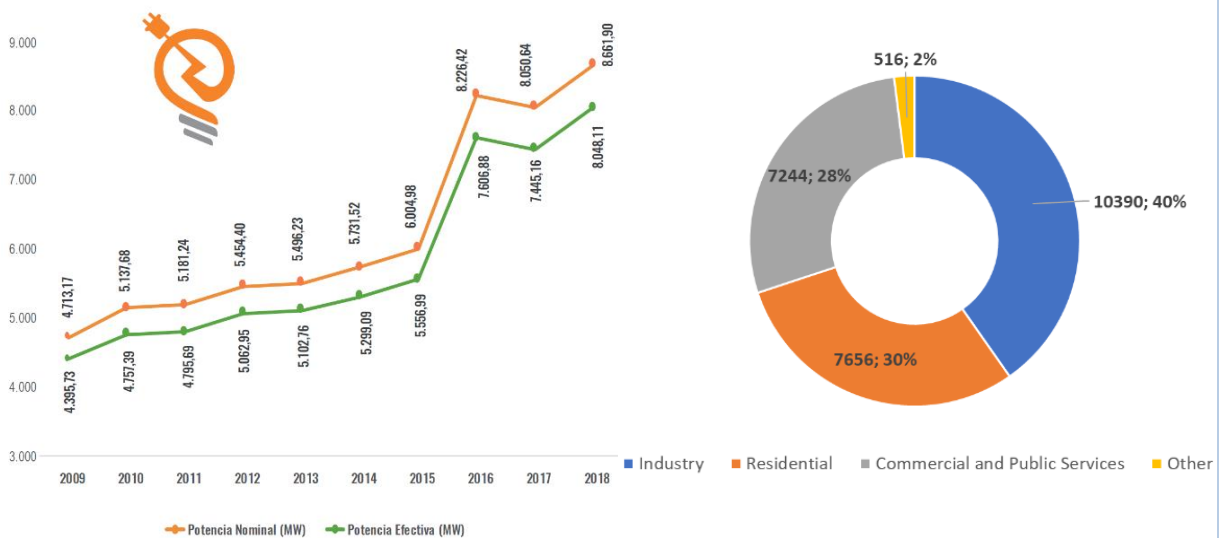


Figure 1. Evolution of Ecuador's installed production capacity between 2009 and 2018.

Figure 2. Electricity demand (GWh) by sector (2019).

The electricity demand is very much localised in the two regions surrounding the main cities of Quito and Guayaquil, whether from industrial (40%), residential (30%) or commercial sector (28%) as shown in Figure 2. The total electricity demand in the country was equal to 24 TWh for clients connected to the SNI and has been growing constantly since 2008 (Figure 1).

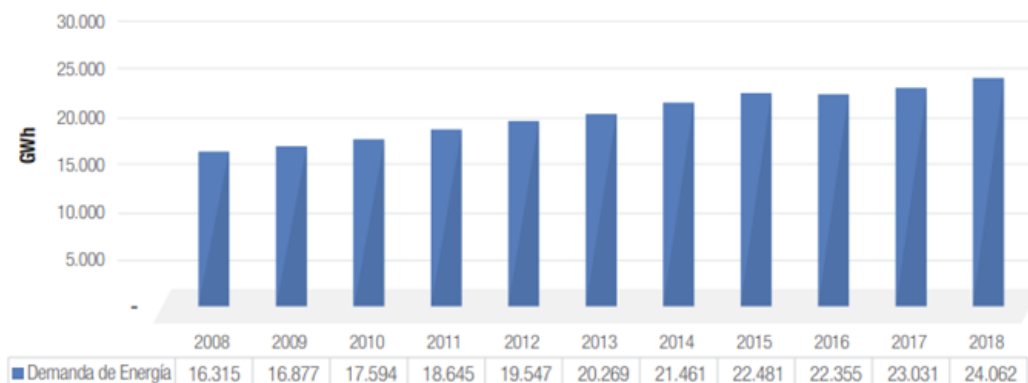


Figure 1. Annual electricity demand at the SNI between 2008-2018.

Sources:

- Agencia de Regulación y de Control de Electricidad (2020), Estadística Anual y Multianual del Sector Eléctrico Ecuatoriano, 2018.
- Ministerio de Energía y recursos naturales no renovables (2020), Balance energético Nacional, 2019.

- Transformación y situación actual del sector eléctrico, Plan Maestro de Electricidad (2020). Available at: <https://www.recursosyenergia.gob.ec/wp-content/uploads/2020/01/2.-TRANSFORMACION-Y-SITUACION-ACTUAL-DEL-SECTOR-ELECTRICO.pdf>
- IEA (2017), Country Analysis Brief. Available at: https://www.eia.gov/international/content/analysis/countries_long/Ecuador/Ecuador.pdf

Electrical interconnection and import/export:

As highlighted in Figure 5, Ecuador’s National Transmission System (SNT) is interconnected with the Colombian and Peruvian Grid, and the country is a small net exporter of electricity to both Colombia and Peru (total export of 1,827 GWh in 2019). The Andean Electrical Interconnection System (SINEA), formed in 2011, created an Andean power corridor.

Interconnections		MW	%
Interconnection	Colombia	540	83%
	Perú	110	17%
Total Interconnections		650	100%

Table 2. Ecuador’s physical interconnection capacity with other countries (2020).

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.

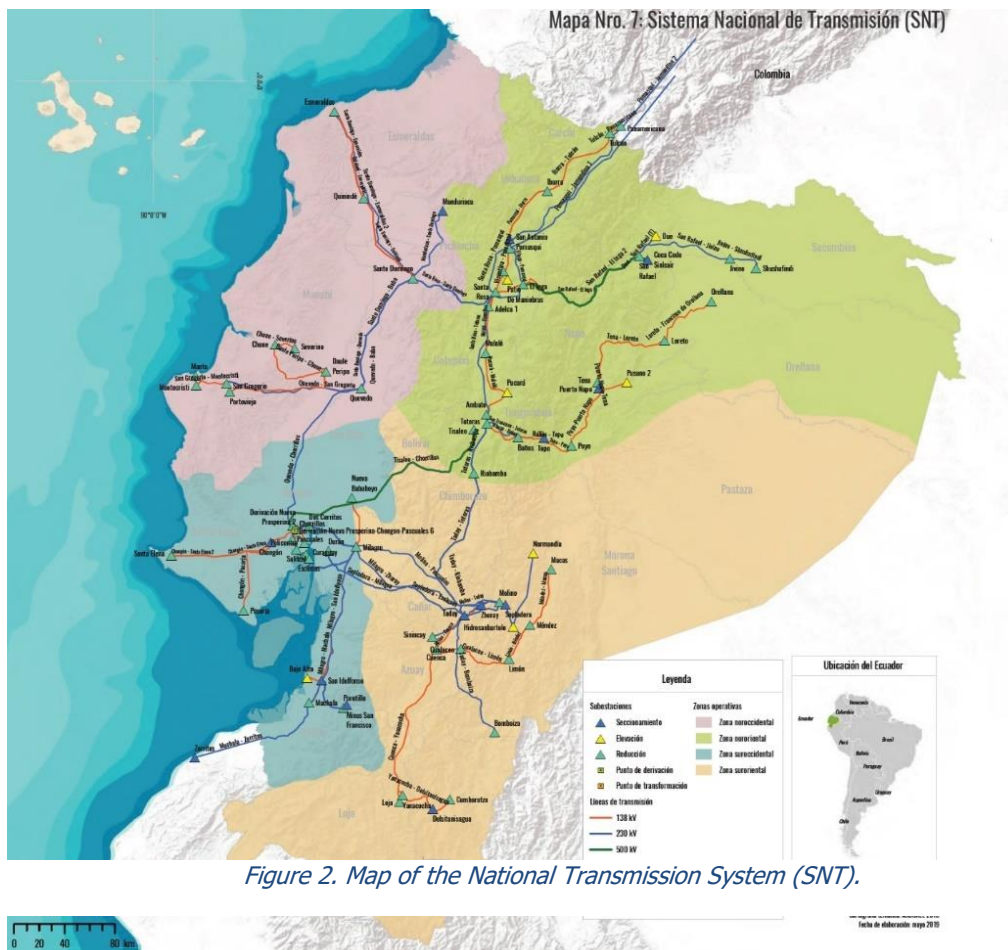


Figure 2. Map of the National Transmission System (SNT).

Sources:

- Agencia de Regulación y de Control de Electricidad (2020), Estadística Anual y Multianual del Sector Eléctrico Ecuatoriano, 2018. Available at: <https://www.regulacionelectrica.gob.ec/boletines-estadisticos/>
- Ministerio de Energía y recursos naturales no renovables (2020), Balance energético Nacional, 2019.
- IEA (2017), Country Analysis Brief. Available at: https://www.eia.gov/international/content/analysis/countries_long/Ecuador/Ecuador.pdf

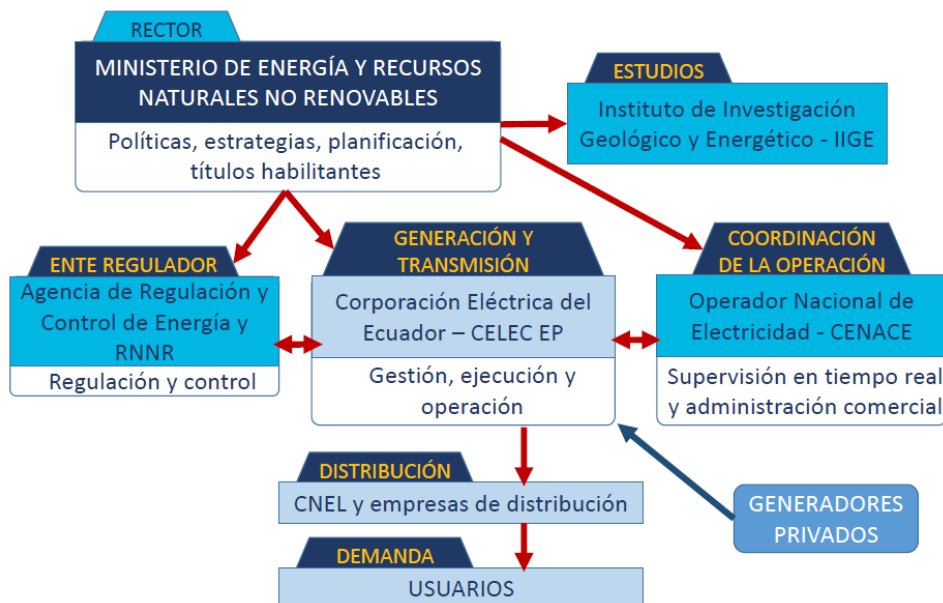
Electricity market structure:

Electricity is considered as a public service in Ecuador, and as such major power generation infrastructure, except for selected renewable plants, and the national power transmission grid are managed by the state-owned corporation **CELEC** (Ecuador Electricity Corporation). CELEC is also engaged in import, and export of electricity and of operation and planification of systems not incorporated to the Interconnected National Grid. The transmission business unit of CELEC is called **Transelectric**. Distribution companies are divided in 11 geographic business units of **CNEL** (National Electricity Corporation), another state-owned corporation.

On the other hand, large-scale consumers with demand greater than 1 MW have the right to subscribe power purchase agreements with generators.

Ecuador's National Centre of Energy Control (**CENACE**), now dependant of the **MERNNR**, is the national electricity operator of the SNI.

The figure below summarizes the general governance of the energy sector in Ecuador:



As highlighted in Table 3, the publicly owned power production CNEL EP still supplies the majority (62%) of the electricity consumed by regulated clients in Ecuador, with a tendency of this historically highly centralised industry to become more and more liberalised. The production sector is still highly centralised, with the publicly held CELEC still owning more than 80% of Ecuador's total installed capacity in 2018, leaving only 17% of the nation's power generation to IPPs. However, the total

installed capacity increased by 111% for the private sector and 79% for the public sector between 2009 and 2018, showing a favourable trend for the development of Independent Power Producers (IPPs).

Company	Residential	Industrial	Commercial	Public Lighting	Total	Company %
CNEL EP	4,325.90	3,169.30	2,379.36	2,456.25	12,330.81	62%
Other suppliers	3,074.41	1,922.38	1,451.19	1,221.83	7,669.82	38%
Total	7,400.31	5,091.68	3,830.56	3,678.08	20,000.62	100%
Sectorial %	37%	25%	19%	18%	100%	

Table 3. Total sales of Electricity per sector and per energy supplier (2018).

Sources:

- Organismos del sector Electrico del Ecuador (2016). Available at: <https://prezi.com/non4k6zdsbxk/organismos-del-sector-electrico-del-ecuador/>
- IEA (2017), Country Analysis Brief. Available at: https://www.eia.gov/international/content/analysis/countries_long/Ecuador/Ecuador.pdf
- Agencia de Regulacion y de Control de Electricidad (2020), Estadística Anual y Multiannual del Sector Electrico Ecuatoriano, 2018. Available at: <https://www.regulacionelectrica.gob.ec/boletines-estadisticos/>
- Asociación Ecuatoriana de Energías Renovables y Eficiencia Energética (2021).

Renewable energy market potential:

About 77% of the total renewable electricity production in Ecuador is produced through hydro (See Figure 4).

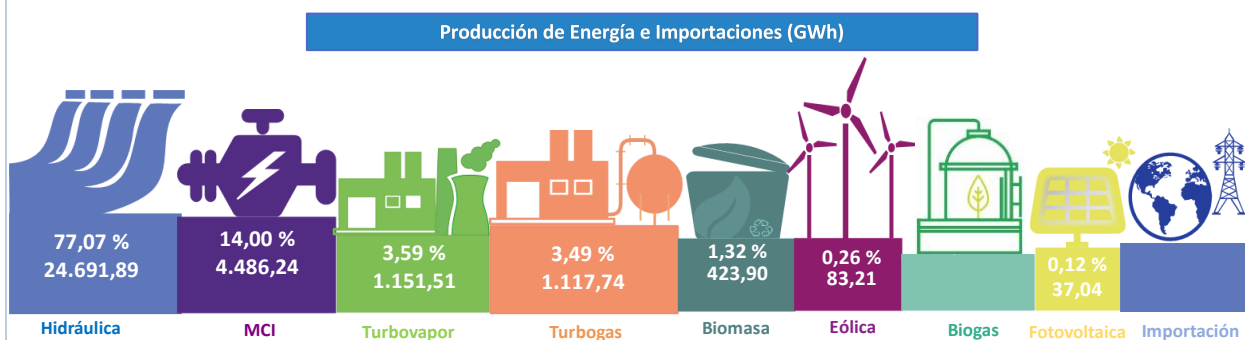


Figure 3. Share of electricity production per type of fuel (2020)

The estimated hydroelectrical potential described as economically feasible in Ecuador reaches 22,000 MW of installed capacity in 11 different hydrolic basins. This represents more than 4 times the current installed capacity in the country and could cover more than its total electricity demand.

In 2008, the national Pre-Investment Institute funded geothermal energy pre-feasibility studies. The 2010 Geothermal Plan for Ecuador identifies 16 areas of potential interest for future developments, with a theoretical potential of 6,000 MWe. This energy source has surprisingly not yet been harnessed in a country with a very high volcanic activity, but several sites are currently under investigation for potential large scale development.

Another promising source of energy production is wind power with a total potential installed capacity estimated at 1,691 MW, which would produce, taking into account installation in the windiest areas of the country an annual production of 2,869 GWh. The "Plan Maestro de Energia" estimates the potential achievable installed capacity achievable on the short term to 884 MW, generating an annual average of 1,518 GWh. This represents more than 15 times the current wind electricity production in Ecuador.

Given its geographical situation, Ecuador possesses very promising annual average solar radiation of 4.5 kWh/m²/day, making photovoltaic power production a strong opportunity, especially for small scale electricity production.

The Electricity Master Plan Update for 2018-2027 considers 500 MW in new NCRE renewable: 100 MW in 2 wind projects (Villonaco 2 y 3), 200 MW in 1 PV project (El Aromo) and a further 200 MW NCRE group of smaller projects. All of these to be developed under private financing and tendering processes for licence permits that include construction and operational periods depending on technology. Selected projects will be granted a PPA with CELEC (Ecuador's state-owned utility) during the complete licence period.

Sources:

- Agencia de Regulación y de Control de Electricidad (2020), Estadística Anual y Multianual del Sector Eléctrico Ecuatoriano, 2018.
- Ministerio de Energía y recursos naturales no renovables (2020), Balance energético Nacional, 2019.
- Expansión de la Generación, Plan Maestro de Electricidad (2020). Available at: <https://www.recursoyenergia.gob.ec/wp-content/uploads/2020/01/4.-EXPANSION-DE-LA-GENERACION.pdf>

Historical support or development of renewables in the country/region:

The National Plan for Good Living 2013-2022 (PNBV-SENPLADES 2013-2017) established a target of reaching 60% renewable energy generation capacity by 2017, putting a special emphasis on hydropower and bioenergy. This plan was largely executed through the construction of a large fleet of hydro-electric power plants by the publicly owned CELEC in the last decade.

Direct public investment of USD 4.96 billion in hydropower from 2013 to 2021 is considered by the Electrification Master Plan 2013-2022, as approved by Resolution CONELEC 041/13. The country also invested in wind power through the 16.5 MW wind farm in Villonaco. Due to environmental concerns, the government created the Galapagos Island Zero Fossil Fuels initiative that considers two wind farms, two PV projects and two hybrid PV-biofuel-battery project for the island.

From 2000–2015, Ecuador had a feed-in tariff system to support renewable electricity deployment. The feed-in tariff evolved over time in terms of duration, rates and technologies included. In 2013, Regulation CONELEC 001/13 removed solar PV from the feed-in tariff and set overall technology-specific capacity limits for wind, biomass and biogas, CSP, ocean energy and geothermal installations eligible for the tariff. In 2014, Resolution CONELEC 014/14 maintained the feed-in tariff only for biomass and biogas, with differentiated rates for the first time, and for hydropower smaller than 30MW. These historical Tariffs are shown in Table 3.

Grid access was facilitated by the feed-in tariff regulations, which mandated preferential dispatch for renewables. In 2008, Regulation CONELEC 013/08 established preferential dispatch for renewable electricity, up to a maximum of six per cent of operative installed capacity. In 2012, Resolution

CONELEC 102/12 exempted hydro, biomass and geothermal from the preferential dispatch limit. Since 2011 (CONELEC 004/11) renewable energy projects receiving the feed-in tariff must contribute an amount (per kWh generated) to social and community development projects (Estado del Buen Vivir).

Several projects such as the Villonaco II and Villonaco III wind projects (totalizing 110 MW), as well as the El Aromo photovoltaic plant (200 MW), have been awarded a 25-year operation licence in 2019, and gives good hope of further development of unconventional energy.

	2000*	2002*	2004*	2006*	2011	2013 [§]	2014 ^{§§}
CONELEC Regulation	008/00	003/02	004/04	009/06	004/11	001/13	001/13c***
Tariff ^{§§§} (USD /MWh) ^{§§§§}							
Wind	100.5	100.5	93.1	93.9	91.3	117.4	X
Solar PV	136.5	136.5	283.7	520.4	400.3	X	X
CSP	X	X	X	X	310.2**	257.7	X
Biomass ³	102.3	102.3	90.4	96.7	110.5 (<5MW) 96.0 (>5MW)	110.8	96.7
Ocean	X	X	X	X	447.7**	324.3	X
Biogas	102.3	102.3	90.4	96.7	110.5 (<5MW) 96.0 (>5MW)	110.8	73.2
Geothermal	81.2	81.2	91.7	92.8	132.1	138.1	X
Hydro 30-50MW	X	X	X	X	62.1	65.1	X
Hydro 10-30MW	X	X	X	X	68.8	68.6	65.8
Hydro 5-10MW	X	X	50.0	50.0	71.7	78.1	65.8
Hydro <5MW	X	X	58.0	58.0	71.7	78.1	65.8
<p>* Max Power per project was 15MW for all technologies except for small hydro. ** Added in 2012 by <u>CONELEC Resolution 017/12</u> *** As modified by Resolution CONELEC 014/14 [§] Max total installed capacity per technology: wind - 100 MW; solar CSP -10 MW; ocean - 5 MW; biomass and biogas (combined) – 100 MW; geothermal – 200 MW; small hydro – no limit. ^{§§} Max total installed capacity per technology: biomass and biogas (combined) – 100 MW; small hydro – no limit. ^{§§§}The Galapagos Islands had differentiated tariffs, for the last feed-in tariff in force it was: Biomass USD 106.4/MWh, Biogas USD 80.5/MWh. ^{§§§§} All amounts expressed in USD in original legislation</p>							

Table 4. Ecuador Historical Feed-In Tariffs.

Sources:

- IRENA (2015), Renewable Energy Policy Brief: Ecuador. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Ecuador.pdf?la=en&hash=C1F46A560D0E8FF6655216BC36410A6D41B98B21

Description of renewables support mechanisms:

Since the 31st of December 2016, Feed in Tariffs are not available anymore in Ecuador.

However, Ecuador's Master Plan for Electricity (PME) 2018-2027 outlines energy initiatives led by the Ministry of Energy and Non-Renewable Natural Resources (MERNNR) and announced a series of support mechanisms and investments for non-conventional renewable energy production projects. The "Bloque ERNC [200 MW]" initiative is a public tender currently aiming to award licenses to implement around 30 projects by the private sector. The eligible technologies are: wind, photovoltaic, small and mid-scale hydro, biomass, and biogas. The incentives given to private investment in such projects are:

- Exemption from the Overseas Remittance Tax on currencies for capital and raw material goods.
- Exemption from the Overseas Remittance Tax on currencies for imports of goods, service acquisition, financing and dividends.
- 12 years exemption from the Income Tax for any investment taking place out of the urban jurisdictions of Quito and Guayaquil (8 years exemption). In case of the investment taking place in vulnerable or priority zones, the exemption is set to 15 years.

Sources:

- Proyectos Bloque ERNC (2020), Proyectos Energéticos Ecuador. Available at: <https://proyectos.recursosyenergia.gob.ec/index.php>

Responsible government department: (include key contacts)

- **MERNNR** (Ministry of Energy and Non-Renewable Resources) is the governmental entity in charge of pushing forward the development and sustainable use of energetic and mining resources, with environmental and social responsibility. It is the governmental entity in charge of the regulation and planning of the entire power sector of the country, and hence carries the responsibility of promoting renewable energy. This entity is responsible for satisfying the electricity needs of the country through creating adequate legislation, policies, and development plans. The electricity supply chain must follow the principles of obligatoriness, uniformity, efficiency, accessibility, regularity, continuity, and quality.
- **ARCERNR** (Agency of Regulation and Control of Energy and Non-Renewable Natural Resources) – **Used to be ARCONEL**² (Electricity Regulation and Control Agency): Administrative and technical entity in charge of regulating and control of any activity related with the public electricity services, pushing forward the interest of the end-user. Audits and controls actors from the electricity market to ensure compliance with Government Regulation, including environmental legislation. The agency also acts as a technical consulting entity advising the MEER in the elaboration of regulations and tariffs for the electricity public services.

Existing/Planned energy legislation: (is there a CPO)

Ecuador's new Electricity Law (LOSPEE), adopted 16 January 2015, explicitly states the objective of promoting renewable energy sources and energy efficiency, and makes the state the key actor in the electricity industry. Non-Conventional Renewable Energy (NCRE) include biomass, wind, solar, geothermal, tidal and small hydro (currently less than 50 MW). LOSPEE establishes that when the government delegates to private companies, MERNNR must select the company through a Public Selection Process guided by national interests but does not prescribe details for the process. The law also provides for preferential regulations for renewable energy, in particular prioritizing rural-electrification projects.

Currently, the private initiative can participate only on an exceptional basis in small to medium renewal energy source projects authorised by the government by way of concessions. Nevertheless, owing to the national treasury's lack of financial resources, the government is promoting a significant change in the authorities' criteria in order to propel the private sector's participation by offering more financially attractive conditions.

² Republic of Ecuador, on May 6, 2020, ordered the merger of the Mining Regulation and Control Agency, the Electricity Regulatory and Control Agency, and the Hydrocarbon Regulatory Agency (Executive Decree 1036).

LOSPEE requires that MERNNR creates an Electricity Sector Master Plan and National Energy Efficiency Plan. Ecuador's Master Plan for Electricity (PME), under the guidelines of the National Development Plan, optimizes the use of power generation resources taking advantage of the energy potential based in renewable sources, encourages efficient use and energy saving, providing a service with the highest coverage, quality, and safety. The Electricity Master Plan presently in place for the sector is valid until 2025 and is mandatory for every sector of the economy.

In 2019, the Energy Efficiency Law was published to support its development in the country. Under this law, the MERNNR needs to create a national plan for energy efficiency (PLANEE) and update it every two years, in the framework of the LOSPEE.

The list of energy legislation in Ecuador can be found on the ARCONEL website at:
<https://www.regulacionelectrica.gob.ec/regulaciones/>

Environmental legislation for renewable energy:

Ecuador's 2008 Constitution explicitly states that the government will promote the use of clean and alternative energy sources. In addition, the Electric Law of 2015 explicitly states an objective of promoting renewable energy sources, including solid-waste biomass.

Sources:

- IRENA (2015), Renewable Energy Policy Brief: Ecuador. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Ecuador.pdf?la=en&hash=C1F46A560D0E8FF6655216BC36410A6D41B98B21

Existing/Planned energy certificate systems: (purpose, extent)

The recently published Energy Efficiency Law of 2019 includes the possibility of consumers to obtain energy savings certificates related to energy efficiency projects in their processes. However, it is not clear yet if these certificates will include the procurement of renewable energy as it still needs to be defined in the respective bylaw.

Extent of engagement with government:

Open.

Response from Government in relation to attribute tracking systems:

In the meeting held with the personnel from the **ARCERNR** and the I-REC representative in LATAM in October 1st 2021, it was confirmed that there is no existing energy attribute tracking system in Ecuador at the moment.

Demand-side market potential or strategic nature of market development:

Ecuador has set ambitious renewable energy target by 2027, which is achievable due to its immense potential for renewable energy production, Ecuador seems like a strategic country for I-REC to be operating in. Moreover, the country's energy demand is still growing and the electrification of some parts of it still largely underway. The lack of trust in governmental support from foreign investor due to

an ever-changing legislation in the past decade also creates a real need for a trusted system to incentivise renewable energy production.

From a geographical standpoint, consolidating the I-REC market in Ecuador would ensure a continuity in policy, making sure all countries with grid interconnections in South America eligible for I-REC. Ecuador has the political will and the renewable resources to become a net exporter of renewable energy. With the presence of I-REC in the country, this could be achieved in a highly competitive way.

Several foreign power production companies such as the Spanish Solarpack (solar PV) and the Chinese Sinohydro Corporation and Exim Bank (hydro) are already investing massively in large scale renewable energy production projects. The RE100 reports a 127 GWh national electricity consumption by RE100 with only 10 companies reporting their electricity data. Out of this volume, the share of renewable electricity among RE100 members in this market reaches a mere 2%.

Sources:

- RE100 Annual Report 2020. Available at: <https://www.there100.org/growing-renewable-power-companies-seizing-leadership-opportunities>

Analysis of political disruptions or market risks:

While the country hosts high hydropower capacity and continues to build new hydroelectric plants, only recently has the government significantly expanded support for other low-carbon energy sources.

The fact that the US\$ 400 per MWh feed-in tariff from 2011 got cut to US\$ 160 a year later crushed investor confidence and resulted in the cancellation of 17 PPA assigned solar projects. It remains to be seen whether the government can restore investor confidence, specifically with regard to assuring investors it will not backtrack on policy support as it has done in the past.

Corruption in Ecuador can be an important obstacle for foreign investment. Recent scandals involve former president being convicted after pleaded guilty as part of a network accused of accepting \$7.5 million in bribes in exchange for public contracts. Various organizations have accused the government of corruption in the construction of eight hydroelectric plants and several public officials from Petroecuador have been proven guilty of accepting \$4.4 million bribery.

Sources:

- IRENA (2015), Renewable Energy Policy Brief: Ecuador. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_RE_Latin_America_Policies/IRENA_RE_Latin_America_Policies_2015_Country_Ecuador.pdf?la=en&hash=C1F46A560D0E8FF6655216BC36410A6D41B98B21

Analysis of regulatory risks including linkages with carbon markets and support systems:

Ecuador presented its updated NDC in 2019, which intends to reduce its emissions in the energy sector by 20.4-25 percent below the business-as-usual scenario, with a potential reduction of 37.5-45.8 percent contingent on availability of resources and support offered by the international community. With the support of international donors (The Nature Conservancy, IRENA, FAO, World Bank, Euroclima+, GIZ), the Government has been active preparing sectoral implementation plans for priority sectors for adaptation (mainly public health and productive infrastructure) and for a low-emission and

climate-resilient green economic recovery plan. Once finished, these will be shared with the NDC Partnership and integrated into Country Engagement work.

The National Adaptation Plan (PLANACC), one of 43 flagship climate projects in the country, provides a common framework to advance adaptation planning and implementation in six priority sectors identified in the Climate Change National Strategy. It will also serve as a baseline to develop a new NDC by 2025—a process that Ecuador expects to launch in 2023.

As a highly vulnerable country, adapting to the effects of climate change is a top priority in Ecuador’s development agenda.

Sources:

- NDC Partnership. Available at: <https://ndcpartnership.org/countries-map/country?iso=ECU>

Current environmental reporting in energy:

To our knowledge, there is no environmental reporting systems operating in Ecuador at the moment.

In the context of the NDC Partnership, IRENA, with support from the ARCERNNR, is developing a energy related GHG emissions calculation module. A reporting platform is to be implemented for industry, agriculture and waste sectors as part of the Measurement, Reporting and Verification (MRV) initiative.

Mechanisms in place to support the reliable verification and issuance of I-RECs:

The I-REC Central or Local Issuer, in the first instance, would be in charge of verifying the device information provided by their owners or their relevant agents (registrants).

Since there is no public information available regarding individual devices production, official data provided from CENACE to the generator would be the recommended means of verification.

Local organizations of importance and their opinion on local I-REC market development:

Any other relevant information:

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Contributors	
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