

Colombia - SHP and framework conditions

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This paper gives a brief overview to the hydropower sector of Colombia, one of the target countries included into the HYPOSO project sponsored by the European Commission. Paper is divided into 6 chapters. As follows:

1. Key Facts

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|--|---------------------------|
| Population | about 48.2 million |
| Area | 1,142,000 km ² |
| Access to electricity | 97 % |
| Installed hydro capacity | 11,771 MW |
| Share of generation from hydropower | 86 % |
| Hydro generation | 58.3 TWh |
| Economically feasible hydro generation potential | 140 TWh/year |
| Small hydropower potential | ca 5,000 MW |
| Small hydropower installed capacity | 955 MW |

Colombia is in the north of South America and is crossed in the south of the country by the equator line.

2. Topography and hydropower potential

The country is crossed by the Andean mountains chain, which stretches from north to south, almost along the whole length of the country, divided into three parallel branches, so called Cordilleras. Between the Cordilleras there are high plateaus and fertile valleys which are crossed by the country's major river systems.

Colombia's huge water resources include 9,139 river basins which have been evaluated and grouped into six hydrological areas, divided into sixteen hydrological regions, and a total of 56 hydrological zones. There are many important rivers in Colombia. The major ones are: Amazon, Magdalena, Cauca, Caquetá, Putumayo, Guaviare, Meta and the Atrato Rivers.

Colombia has the second largest hydropower potential in Latin America, after Brazil and the sixth largest in the world. The gross theoretical hydropower potential of Colombia is about 1,000 TWh/year, of which 200 TWh/year is technically feasible and about 140 TWh/year economically feasible

3. Power generation overview

Colombia has a rich endowment of energy sources and the country is heavily reliant on installed hydropower capacity

In 2018, the total installed electricity generation capacity reached 17700 MW with following source distribution:

- Hydropower: 11770 MW (66.6%)
- Thermal power: 5300 MW (30%)
- Wind/solar and Biomass: 600 MW (3.4%)

According to capacity range, Hydropower is subdivided as follows:

- Large Hydro (>100 MW): 10830 MW (92%)
- Medium Hydro (20 to 100 MW): 498 MW (4.2%)
- Small Hydro (<20 MW): 442 MW (3.8%)

Annual hydro power generation was 60,620 GWh/year, which was 84.1 % of the national power production in 2018. This includes 56, 193 GWh/year from large plants (78.0 %) and 4,427 GWh/year (6.1 %) from medium and small hydro plants

4. Electric sector overview

Companies involved in the supply of electricity in Colombia have been grouped into four categories, according to their main activity, as follows: Generation, transmission, distribution, and commercialization. Each individual company can carry out one, several, or all above activities, but must be registered individually into each category. The number of companies registered in each category (by 2017) are as follows.

- Generation: 87
- Transmission: 13
- Distribution: 37
- Commercialization: 109

They are supervised by the Energy Regulatory Agency (CREG)

About 65 % of the hydro capacity is privately owned. Three main utilities EPM (public), *Emgesa* (mixed capital) and ISAGEN (private) account for 75 % of installed hydropower capacity.

There are 12 main companies involved in the generation of electricity in Colombia. They generate 90.3 % of the total electricity produced in the country, while the remaining 9.7 % is produced by 75 smaller companies

5. SHP framework and market analysis

The exploitation of Colombian hydro potential dates back to 1900, when a power plant of 1.86 MW was built to supply electricity to Bogota, the largest city and the capital of Colombia.

In 2019, there were 940 MW of medium and small hydro capacity in operation, with 530 MW of these connected to the national grid

Small hydropower plants are owned and operated mainly by small municipal entities, natural persons, and rural industries. The whole interconnected system is operated centrally by a governmental institution which runs the national energy bourse. Additionally, there is a Colombian Government Institute responsible for the implementation of small hydropower and other renewable energies projects in non-interconnected zones

In Colombia and the neighboring countries SHP lobbying and other activities are implemented by the Latin American Center on Small Hydropower - CELAPEH - a non-profit organization founded by six Colombian and international institutions. CELAPEH's main goal is to promote SHP development in Latin America, especially in the rural areas, to provide environmentally sound electrical energy to the communities living in such areas. Main tasks aiming to reach this goal include:

- Technical and financial pre-feasibility studies for public and private stakeholders of SHP projects.
- Promoting execution of feasible SHP projects by searching and managing, as appropriate, required technical and financial resources;
- Coordinating and managing execution of SHP projects upon request from public, private and institutional project stakeholders.
- Creating and running, with support of the Latin American and international institutions, a training center for SHP, equipped with physical and operational facilities as required to train people involved in design, construction, operation and maintenance of SHP stations and, at a future step, carry out applied research and technology development in regard with SHP;
- Providing the Latin American governments and public institutions with advice and support to formulate and implement policies aimed to foster rural electrification programs based on renewable energy sources and specially on the small hydro potential.

Fostering SHP development in Latin America has been a hard way, for several reasons, like:

Legal, environmental, and regulatory frameworks, focused on traditional expansion model based on large power stations and high voltage interconnection lines, imposing complex, expensive and unnecessary requirements on SHP projects. However, some improvements have been introduced to simplify construction of small-scale renewable energy projects, including SHP

Specific financing funds or institutions for SHP are not available.

There are many credit sources: public institutions, international institutions, private investors, commercial banks. Loans cover average 70 % of required investment. 30 % must be own capital. However, major part of SHP project owners does not have enough resources to cover pre-investment costs, even for less than 30 % share of investment. Most SHP projects are not bankable. However, for SHP projects following financing schemas are starting to be used:

- For private developers, own resources, commercial loans and investors participation
- PPA and public development funds for public project developers
- Government funds and international development agencies for mini and micro power stations at isolated areas to benefit poor rural communities

Additionally, there is a government fund in Colombia to finance energy solutions (as much as possible based on RES) to the poorest and most isolated communities outside the interconnected zones. However, funding rules require the benefitted communities to dispose of a certain level of organization and resources, which in many cases cannot be provided.

Other barriers to SHP development include:

- Lack of political and economical incentives to SHP development
- Lack of manufacturing capacity for SHP components
- Lack of SHP specific expertise
- Poor capacity building facilities and programs for design and construction of SHP plants and associated works.
- Lack of physical facilities for SHP equipment testing and applied research

6. Future prospects

Despite the untapped large hydropower potential and the developed atlas of hydropower potential in the country, comprehensive data regarding small hydropower potential is not available. Large numbers of potential sites have not been evaluated (or even identified) because they are mostly located in the upper parts of basins, with very difficult access. Furthermore, there are numerous abandoned hydropower plants in Colombia. HYPOSO project will provide useful tools to identify, evaluate and select the most promising sites.

On the other hand, concerns about the environmental impact of hydropower, especially large-scale hydroelectric plants, are likely to put a halt on further developments in SHP sector. Again, HYPOSO project and other relevant activities leading to get social understanding of differences between large and small hydro will help to achieve community's acceptance of SHP

Last, but not least, climate change, sustainable development objectives and energy transition, among other issues, will strongly foster SHP development during the coming years

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