**Energy Transition in the Amazon Region: challenges and opportunities for decarbonization**

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Brazil has an extensive National Interconnected System (SIN) which is responsible for serving almost of the entire country's electricity demand, whose consumption reached 509 TWh in 2022. Around 11% of national consumption is concentrated in the Legal Amazon area, which covers the entire northern region of the country (Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins), and the states of Mato Grosso (in the central-west) and part of Maranhão (in the northeast), covering around 60% of the national territory and 14% of the population. Per capita consumption in the North region is only 72% of the Southeast.

The Amazon region contains important hydropower plants, which account for around 25% of the country's hydropower park, including Tucuruí (8.3 GW) and the recent Belo Monte (11.2 GW), Jirau (3.7 GW) and Santo Antônio (3.5 GW) structuring projects. The region is an exporter of electricity, helping to meet demand from other regions and providing flexibility to accommodate variable renewable energy supply.

The Legal Amazon also concentrates most of the isolated energy systems, which account for around 0.6% of national consumption. In addition to remote and sparse areas, isolated systems cover denser regions, including the entire state of Roraima, the only one not connected to the SIN. Despite the marginal size of consumption not connected to the SIN, its supply cost is high and emissions from diesel generation reached around 11% of the interconnected system's emissions in 2022.

Despite being a middle-income developing country, with an extensive territorial dimension and vast regions of low population density, Brazil has already achieved universalization of electricity services. Launched in 2004, the Light for All Program was an important vector in this process. Despite its success, there are still two major challenges facing the country's electricity system: replacing the dominant fossil fuel (diesel) generation in isolated systems; and guaranteeing access to electricity for more than 400,000 families still without access.

The isolated systems in Brazil have around 3 million consumers, with fossil fuels predominating in the supply solutions. The isolated systems are made up of around 251 locations isolated from the national interconnected system, served by nine distributors, encompassing around 3 million consumers. With a predominance of the residential sector, the isolated systems encompass remote locations with low demand and even cities with a higher population concentration, such as Boa Vista in Roraima.

The total installed capacity in the isolated systems reached 1.2 GW in 2022, of which 80% was diesel-fired thermal power plants, 14% natural gas, 5% biomass and around 0.5% hydropower plants; diesel generation accounted for 65% of generation in 2022 and natural gas 26%. The total load of the isolated systems is expected to fluctuate around 4 TWh per year between 2022 and 2026.

The cost of generation in isolated systems reached around R$ 10.7 billion in 2022. Considering consumption of around 4 TWh, the average cost of generation is R$2,777/MWh. A substantial part of this cost is subsidized by consumers in the national interconnected system.

The region is also facing significant economic and social challenges, including high rates of electricity theft at low voltage, which jeopardizes the economic and financial sustainability of distributors. At the end of the 2010s, companies that had remained under the control of Eletrobras were tendered to the private sector, attracting new groups to operate in the region.

Understanding the energy demand in the Amazon in its various dimensions - economic, social, technical, and environmental - is crucial in the search for a just energy transition, with guaranteed access to safe, sustainable and affordable energy. The region will host COP 30 in 2025, which will take place in Belém do Pará. Alongside the challenges of preventing deforestation and seeking to preserve biodiversity, the country must not fail to structure and promote the energy transition in the region.

The privatization of Eletrobras in 2021 defined the contribution of R$ 295 million annually for a period of ten years, adjusted for inflation, to be used in the program to structurally reduce generation costs in the Legal Amazon. At least 20% of this amount must go towards actions to ensure the navigability of the Madeira River and 10% of the Tocantins River, which reduces the volume of these resources for structural cost reduction to 70%. The initial motivation was to reduce costs by developing renewable energy projects, as well as interconnecting isolated and remote locations. However, the law is vague and the use of resources for structural cost reduction can be applied to current expenses with transitory effects.

Implementing renewable solutions in isolated systems can help to reduce the total cost of generation and its subsidies, as well as providing clean energy to remote locations. The development of micro-grids can unlock the development of renewable energy in isolated systems, favoring the replacement of polluting and inefficient fossil sources and overcoming the historical paradigm of interconnection as a single solution for service.

The aim of this paper is to present the main characteristics of the energy currently consumed in the Amazon, in terms of composition, costs and emissions in relation to the Brazilian average. The paper will present the current challenges and opportunities for decarbonization in the region, focusing on the public policies available and the resources already defined. Finally, it will propose in general terms a way of taking advantage of the resources allocated to reducing structural generation costs, multiplying the capital already committed through other forms and sources of funding.