Optimization Model for the Sizing of Renewable Energy Solutions for Non-Interconnected Areas - Case Study in Chocó, Colombia

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Abstract

Access to electricity is essential for the economic growth and welfare of every population. Despite this, 15% of the world population does not have access to electricity. In Colombia, 52% of the national territory, where around 2 million people live (5% of the population), is considered non-interconnectable due to its remoteness or difficult access from the main population centers (non-interconnectable zone). The communities that live in non-interconnectable zone are characterized by being extremely poor and have a precarious supplying of electricity needs. This is generally through fossil fuels, which offer a contaminating, intermittent, unreliable and high-cost service for these communities. Currently, renewable energies offer an opportunity for the development of this type of population, because they allow the electricity generation at low cost and in the places of consumption (what is known as distributed generation).

The objective of this research is to develop a tool for energy solutions planning for communities in non-interconnectable zones in order to achieve optimal solutions and evaluate different configurations of electricity generation systems for a community, suggesting both its size and the mix of energy more appropriate to supply the demand with the lowest possible cost. The proposed model allows to consider different mixtures of technologies (renewable, fossils and batteries), the randomness of the climatic variables that are indispensable for renewable energies, such as solar radiation, wind speed and water inputs, and the costs involved.

To test the model, a case study is presented in an isolated community called Playa Potes, located in Bahía Solano, in the department of Chocó, Colombia. The results of the model suggest that the installation of a solar photovoltaic plant of 26 kW, accompanied by a battery bank, would be sufficient to meet the energy needs of the population 24 hours a day and under uncertain climatic conditions, taking into account the cost.

Keywords: *Linear Programming, Rural electrification, Renewable Energies, non-interconnected areas.*