Most of Latin America could achieve 100% renewable energy by 2035: Insights from the Colombian case

Isaac Dyner[1], Enrique Ángel[2], Yorley Palacios[1], Jorge A. Parra[3]
Universidad Jorge Tadeo Lozano[1], Universidad EIA[2], Universidad Autónoma de Bucaramanga[3]
Colombia

Abstract

Although all countries are progressing toward the electricity transition, most still have a long way to go, and only a few have achieved 100% renewable energy. Latin America is uniquely positioned to lead the global transition toward a carbon-free electricity supply, given that its energy mix has been dominated by hydroelectricity for decades, and also the rapid integration of abundant solar and wind technologies. However, maintaining a fully renewable energy supply in the long term presents significant challenges, as existing hydroelectric facilities will be insufficient to adequately address the intermittency issues arising from the large-scale adoption of wind and solar sources over time. There are a number of renewable options available that could complement the more intermittent sources to achieve a more reliable electricity supply. For example, upgrading existing hydroelectric facilities, including the addition of pumped-storage solutions, and harnessing biomass as 'secure' energy sources. Additionally, the use of batteries should be considered, as they are becoming increasingly cost-effective due to rapid technological advancements, along with geothermal energy, which is emerging as a viable option.

A specific Latin American country may serve as a case study for assessing the hypothesis that achieving 100% clean power by 2035 and beyond will support substantial and sustainable economic growth. This paper evaluates the feasibility of achieving a fully green electricity supply using a simulation model that captures the most relevant characteristics of the Colombian power system. The key findings indicate that, under alternative scenarios, certain energy sources—whether intermittent or not—can provide a cost-effective and secure 100% renewable electricity supply as early as 2035. Policy should aim to make the region more competitive by using its renewable energy resources for economic activities such as tourism, eco-tourism, and other sustainable industries, including call centres and large computer-based activities. The feed-back cycle is completed as food production becomes more efficient through the use of hydrogen-based fertilizers and chemicals. All these elements are incorporated parsimoniously in the system dynamics model that has been constructed to evaluate the proposed hypothesis. This research may support the electricity transition in countries that are hydroelectricity-based, particularly those in the developing world.

Key words: Energy transition, modelling, renewables, Latin America

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