



# 7<sup>th</sup> INTERNATIONAL WORKSHOP ADVANCES IN CLEANER PRODUCTION

“CLEANER PRODUCTION FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS”

## Dynamic Modeling and Simulation of an Hybrid Renewable Energy System in Colombia

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### Abstract

The hybrid system switched to the production of electric energy allows supplying the energy demand in Non-Interconnected Zones, contributing both to the improvement in the reduction of greenhouse gas emissions and to the rational use of energy. A comparative analysis of the performance of these systems was supported out in this study for four sites in the Colombian Caribbean region, using a dynamic model programmed in Matlab, which integrated the equations of a Southwest Wind Power Inc. wind turbine. AIR 403, a proton exchange fuel cell (PEM), an electrolyzer, a solar panel and a charge regulator based on PID controllers to manipulate oxygen and hydrogen flows in the cell. The transient responses of the cell voltage, current, and power have obtained for the demand of 200 W for changes in solar radiation and wind speed for all days of the year 2013 in the Ernesto Cortissoz airport, Puerto Bolívar, Alfonso López airport and Simón Bolívar airport, by regulating the flow of hydrogen and oxygen into the fuel cell. The maximum contribution of power generation from the fuel cell was presented for the Simón Bolívar airport in November with a value of 158,358W (9.45%). While the minimum has shown in Puerto Bolívar with 18,141W (3.745%), which allowed to evaluate the changes in the complementarity of these energies for this system. Finally, the simulations of the hybrid energy system allowed us to select Puerto Bolivar's location as the most efficient for the hybrid system's operation because the high potential of wind and solar energy makes it possible to have low consumption of hydrogen and oxygen flow.

*Keywords: Fuel cell, PID control, Hybrid energy system, Caribbean region, simulation.*