Techno-Economic Analysis of Hybrid Energy Systems for Increased Energetic Resiliency of Underrepresented Communities in Rural Texas

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Abstract

The threat of climate change caused from the consumption of fossil fuels has forced energy producers to find alternative ways to meet the ever-growing demand of the world's population. This work is focused on the design and optimization of a hybrid renewable energy system in Brazos County, Texas using the Hybrid Optimization of Multiple Electric Renewables (HOMER) Pro software. A system containing a Wind Turbine/Photovoltaic Cells or Solar Panels/Fuel Cells/battery storage/hydrogen tank was designed and tested to meet a commercial load for an outpatient clinic in College Station, Texas. The results were evaluated based off net present cost, levelized cost of energy, operation and management cost, greenhouse emissions, and renewable penetration. It was discovered that the architecture containing the Wind Turbine/Fuel Cells/reformer/battery storage/hydrogen tank resulted in the overall lowest cost of energy per kWh, the lowest renewable penetration, zero carbon emissions, and met the load demand in excess. The implications of this are a competitive cost of energy below the national commercial average, reduced greenhouse emissions from the energy system, and a more resilient system.