

Economics of Rural Renewable Energy Technologies

Introduction

Pacific Island Countries face an enormous challenge in promoting rural electrification. This is demonstrated by the fact that 70% of the region's population still lacks access to electricity. Access to modern energy services is an essential pre-requisite for sustainable development. Given the small and dispersed markets, and large distances involved, the cost of supplying electricity to rural households in Pacific Islands is extremely high. It is therefore important to ensure that the most cost-effective options are considered for promoting rural electrification in the region.

In 2006, SOPAC conducted an economic study to assess the economic and financial viability of a number of technologically proven renewable energy options including solar photovoltaic (PV) home systems, wind-hybrid systems, biofuel-powered generators and micro-hydroelectric systems for rural electrification in Pacific Island Countries. Using case studies from various Pacific Islands, the most cost-effective means of supplying electricity to rural communities was assessed by comparing the life-cycle costs of a particular renewable energy technology with the costs of supplying electricity with a diesel generator over the estimated life of a project. The renewable energy projects examined as part of this study included O'ua Island, which is part of the Ha'apai Solar Electrification Project in [Tonga](#), the Mangaia Wind Power Project in the [Cook Islands](#), the Welagi and Vanua Balavu Biofuel Projects in [Fiji](#), and the Bulelavata Micro Hydroelectric Project in the [Solomon Islands](#). In the majority of cases, renewable energy technology options were found to be the least-cost options for supplying electricity to households located in remote and sparsely populated Pacific Island settings.

Executive Summary

There is an important and growing economic niche for renewable energy systems within the energy sector. This is demonstrated by the fact that over that past few years, the use of renewable energy technologies has expanded rapidly. In 2005, renewable energy technologies, including hydropower, accounted for 17% of global energy production.

Renewable energy technologies provide a cost-effective source of electricity in rural areas where distances are large, populations are small, and demand for energy is low. This is a market that, traditionally, has been very difficult for developing country governments to serve in a cost-effective manner. As a result, a large proportion of households living in rural areas still lack access to modern forms of energy. However, access to basic energy services has been identified as a necessary condition for the achievement of many of the Millennium Development Goals. This is because access to energy can promote improved outcomes in the areas of

health, education, and economic development.

Pacific Island Countries face a particularly difficult challenge when it comes to rural electrification. As a result of the unique geographical situation in the Region, where long distances separate sparsely populated areas, and markets are too small to achieve cost savings through economies of scale in electricity production, the costs of supplying electricity to rural areas are enormous. This has resulted in a situation where approximately 70% of the Region's population still lacks access to electricity. In addition, Pacific Island Countries, despite their abundance of renewable energy resources, remain almost completely dependent on imported fossil fuels for meeting their energy needs. Imported petroleum products account for an average of 40% of countries' gross domestic products. With rising petroleum prices, and growing trade deficits, the current situation is likely to be unsustainable in the future.

As part of this study, four rural electrification projects were selected in order to assess the cost-effectiveness of a particular renewable energy technology option in a rural Pacific Island setting. First, the island of 'O'ua, which is part of the Ha'apai [Solar](#) Electrification Project in Tonga, was examined in order to compare the cost-effectiveness of individual solar home systems compared with a village diesel generator for supplying basic household electricity services. Using least-cost analysis, it was determined that a 75 Wp power solar home systems would provide the least-cost means of supplying electricity compared with a diesel system.

Next, again using least-cost analysis, it was determined that micro-hydroelectricity was the least-cost option, compared with diesel generators, for supplying electricity to Bulelavata Village, a rural community located in the Western Province of the Solomon Islands.

Using the wind-hybrid system on the island of Mangaia, in the Cook Islands, as a case study, benefit-cost analysis was used to compare the benefits, measured in terms of diesel fuel savings, with the costs of integrating wind turbines into the current electricity production system. Since the fuels savings envisioned under the project have largely failed to materialize, it was determined that the wind-hybrid system was not a cost-effective option for electricity production on the island.

Finally, the biofuel pilot projects on the islands of Taveuni and Vanua Balavu, in Fiji, were examined in order to compare the costs of electricity production using coconut oil versus diesel fuel. It was determined that although, in theory, coconut oil could present a more cost-effective option for powering village generators compared with diesel fuel, supply constraints and high labour costs at the micro-economic level, prevent this from occurring in practice.

It is important to highlight that there is not one technology that is least-cost, and it is very much dependent on local conditions, and renewable resource availability. Also, hours of service and power availability vary considerably between different energy options. The results from the study, which indicate that renewable energy technologies are the least-cost option for rural

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electrification, depend critically on the fact that shipping costs are high, which makes diesel fuel expensive, populations are small and per capita demand for energy is low, which does not allow for economies of scale in energy production.

Based on the results from this study it is recommended that governments actively promote the use of renewable energy technologies, where they present the most cost-effective options, for expanding access to basic electricity services in the Pacific Region.

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