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Cook Islands: 100% renewable energy in different guises

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Abstract

In its approach to delivering a 100% renewable energy target across 12 islands by 2020, the Cook Islands presents a rare insight into how planning requirements of high penetration renewable island systems vary with scale. To support this ambitious plan the Asian Development Bank and the European Union fund the Cook Islands Renewable Energy Sector Project, which will construct up to six solar photovoltaic (PV) power plants with a total installed capacity of about 3 megawatts-peak coupled with battery to store electricity from solar energy.

The first three islands have small, standardized, centralized solutions (solar PV coupled with battery with existing diesel backup). An order of magnitude larger, Aitutaki will be implemented as a centralized solution in two stages, allowing detailed data collection and capacity building. An order of magnitude larger again, Rarotonga requires progressive planning and implementation including distributed generation, advanced control and integration, and sophisticated commercial structures.

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Keywords: high-penetration; Cook Islands; micro-grid

1. Introduction

Micro-grids are a well-established research area in power engineering. The last two decades has produced a vast amount of knowledge on integration and control of renewable energy (RE), with the emphasis on isolated power systems, especially on island systems. Real projects implemented on island

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systems across the globe have reached 100% RE penetration. Successful completion and operation of these systems delivered practical knowledge that could be replicated on other islands.

This paper focuses on common technical hurdles in integration of renewable energy sources in island systems and describes this through the example of the Cook Islands' 100% renewable energy journey.

2. The Cook Islands

Located in the South Pacific Ocean, the Cook Islands has 15 islands, of which 12 are inhabited. Most of the Cook Islands 13,000 permanent residents live on Rarotonga, in the south. Aitutaki has a population of approximately 1,800, and remaining islands are sparsely populated.

Fig 1. Cook Islands Map depicts Northern and Southern Island groupations. All Islands from the Northern group are smaller and have limited requirements for electrical energy. Most of the Cook Islands people live in the Southern Islands. Two largest Islands are Rarotonga (main island) and Aitutaki

The Government of the Cook Islands has a long standing policy commitment of 100% renewable electricity by 2020. Its island power systems can be grouped in three categories – small (under 100kW; 10 islands), medium (under 1MW; Aitutaki), and large (over 1MW; Rarotonga), as shown in Fig 2. Thus it is an ideal candidate for understanding high penetration renewable energy in island grids.

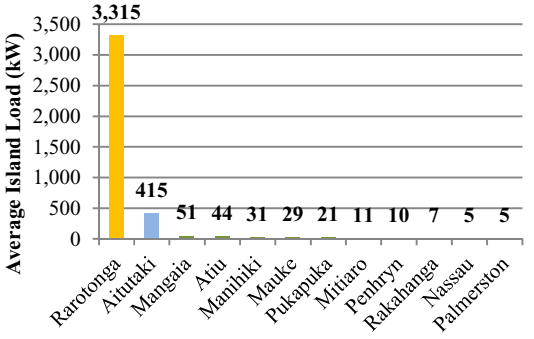

Fig 2. Average load (kW) in the Cook Islands, showing three scales: Rarotonga, Aitutaki, and the other 10 inhabited islands. [Ministry of Finance and Economic Management (MFEM) http://www.mfem.gov.ck/statistics].