Preface

Island countries are extremely vulnerable to the risks of climate changes. These island nations will suffer an uneven share of the global consequences when climate change accelerates. Furthermore island countries are highly reliant on imported fossil fuel (diesel and petroleum), which are not only major contributors to greenhouse gas emissions but are also very expensive. The new concepts and ideas to develop renewable energy (RE) based power grid in Island countries will reduce fossil fuel consumption and assist the transition to a low-carbon economy but to achieve that RE based power grid, a number of issues need to be addressed.

In Island countries, a number of small islands do not enjoy the comfort of trouble-free electrical grid because they are either weakly connected or completely separated from the grid. On the other hand, they need to have access to renewable energies abundant in their surroundings, while keeping their tourism, agriculture, and landscape capital intact. Guidelines for the inclusion of such installation into existing built environments as well as natural contexts are needed.

The obstacles to the fast adoption of renewable energy sources (RES) in such areas are of many types and known since long time and implementation of such technologies are even more complex in Island countries. This book identifies challenges, solution, and opportunities of RES implementation in Island countries and provides guideline for future smart grid.

Chapter "Possibilities and Challenges of Implementing Renewable Energy in the light of PESTLE & SWOT Analyses for Island Countries" of this book discusses two different decision-making techniques: one of them is PESTLE analysis (political, economic, social, technological, legal and environmental) which can be used in energy planning and for business analysis and second, SWOT analysis (strengths, weaknesses, opportunities and threats) which has been utilized to incorporate strategic analysis and for decision-making. The overall chapter presents a holistic idea of prospects and contests of implementing renewable energy in various islands.

Chapter "Utilization and Optimization of Diesel Generation for Maximum Renewable Energy Integration" presents informed consideration of the issues surrounding existing generation, prompting the audience to identify residual value

across these assets, and in return identifies a pathway for improved RES integration. To prevent the increase of carbon emission, the use of quick renewable energy such as PV system and simple solutions considered the clean energy to keep both the population and environment safe are described in Chapter "Optimal Control System of Under Frequency Load Shedding in Microgrid System with Renewable Energy Resources". A comprehensively examination on the commercially available and emerging mitigation methods with a framework that systematically explores the full range of technical methods for PV in distribution network have been explained in Chapter "Power Quality Impacts and Mitigation Measures for High Penetrations of Photovoltaics in Distribution Networks". The strategies of sliding mode control for grid tied and off grid photovoltaic system with multilevel inverters for islanding regions are the main targets of Chapter "Grid-connected and Off-Grid Solar Photovoltaic System". A detailed overview of feasibility design and control strategy of a flywheel energy storage system (FESS) with suitable structure in order to increase reliability and stability of the power in the RES is explained in Chapter "Feasibility Study and Design of a Fly-wheel Energy System in a Micro-grid for Small Village in Pacific Island State Countries". Small-scale energy microgrid with battery-based energy storage system (ESS) enabled with solar–wind hybrid renewable energy system is discussed in Chapter "Energy Storage Systems in Solar-Wind Hybrid Renewable Systems" and the performance has been validated through simulation studies under islanded conditions. The frequency variation issues in presence of PV and wind generation systems have been shown and use of storage systems for dynamic grid support is analyzed in Chapter "Frequency Stability Improvement in Weak Grids by Storage Systems". The specific power converters for storage systems grid interfacing are studied with reference to superconducting magnetic energy storage (SMES), FESS, supercapacitors, and batteries with different case studies also presented in Chapter "Frequency Stability Improvement in Weak Grids by Storage Systems".

Energy trends in an Island and possible cases with solution to that have been presented in Chapter "Identifying Energy Trends in Fiji Islands". Chapter "Energy Grid Management, Optimization and Economic Analysis of Microgrid" proposes a non-dominated sorting genetic algorithm (NSGAII) for the multi-objective optimal operation management (MOOM) for distributed microgrid. Chapter "Energy Management of AC-Isolated Microgrids Based on Distributed Storage Systems and Renewable Energy Sources" presents the frequency and voltage regulation and the energy management strategy for an AC islanded microgrid based on distributed energy storage and RES. To satisfy the load demand of an island Chapter "Optimal Design and Energy Management of a Hybrid Power Generation System Based on Wind/Tidal/PV Sources: Case Study for the Ouessant French Island", focused on a typical hybrid power generation system using wind energy, marine energy (tidal current), and PV in Ouessant French island which has also taken under scope with another set of energy generator combination from hybrid diesel, MCT, and battery system for power supply and power management and presented in Chapter "Hybrid Diesel/MCT/Battery Electricity Power Supply System for Power Management in Small Islanded Sites: Case Study for the Ouessant French Island". An optimal

power flow of battery, wind, and PV in a hybrid system in South Africa has been presented in Chapter "Optimal Power Flow of a Battery/Wind/PV/Grid Hybrid System: Case of South Africa" with reduced operation cost and allows consumers to generate substantial income by selling power to the grid.

The aim of this book is to identify the challenges, solutions, and opportunities of the design and assessment of realistic state-of-the-art smart energy grids (SEG) to store and regulate diversified energy sources such as photovoltaic, wind, ocean energy, and other renewable energy productions in order to meet the electrical energy needs of Island countries.

In summary, this book contains current energy situation of Island countries with technical analysis, weather data analysis, availability of renewable sources, and socioeconomic structure supported by various data table, system structure design, simulation, and case studies.

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