


Chapter 8

Digital Age Applications of Multi-Criteria Decision-Making for Sustainability

Chandarani Kashinath Sutar

 <https://orcid.org/0009-0005-5969-4515>

Rajarshi Rananjay Singh Institute of Management and Technology, Amethi, India

Deependra Singh

Rajkiya Engineering College, Mainpuri, India

K. S. Verma

Rajkiya Engineering College, Mirzapur, India

S. P. Singh

Rajkiya Engineering College, Ambedkar Nagar, India

ABSTRACT

Designing a sustainable electrification power grid for remote areas in developing countries is a significant challenge. Governments are increasingly prioritizing the energy sector by implementing new policies and green energy corridors. However, many studies on renewable and hybrid energy systems overlook crucial factors like technology, economical business survey, environment concern, and social (TEES) factors, which are vital for rural energy solutions. This chapter introduces a framework incorporating decision analysis, focusing on the availability of renewable local sources while in view of TEES aspects for power projects. Various energy alternatives are evaluated, and optimal combinations are assessed through decision

DOI: 10.4018/979-8-3373-2737-2.ch008

analysis. A case study in Himachal Pradesh uses real meteorological data to verify and analyses the effectiveness of the proposed methodology. Conclusions shows that methodology, using Particle Swarm Optimization (PSO), leads to optimized energy systems with significant benefits, especially for power grid networks.

INTRODUCTION

Optimizing of hybrid energy systems is a critical task because of varying performance characteristics of different renewable sources. Remote and isolated communities, particularly those in rural areas, often face significant barriers to effective electrification. In India, for example, around 40% of the population lives in such rural villages, where access to reliable power remains a major issue. The growth of these rural areas has the potential to positively impact both local development and national GDP. While designing of a sustainable renewable energy system requires consideration of multiple important factors. It includes technical, economical, concern towards environment and social (TEES) aspects.

A transparent and robust framework is necessary for addressing the needs of energy supply of this type of standalone communities, which focuses priority on the end-user. This research chapter gives emphasis towards development of a systematic framework. It integrates optimized energy system model which is based on TEES decision analysis methods. The ultimate aim is economical and less reliance on fossil fuels for generation of electricity. At the outset, different renewable energy alternatives are assessed using decision analysis methods, considering multiple factors across various scenarios. The optimal combinations of renewable energy sources are subsequently determined through an optimization approach. A new and unique method to optimize a combined energy from renewable sources will be demonstrated. This methodology is implemented in rural regions to showcase its effectiveness, utilizing meteorological data.

BACKGROUND

In various isolated regions and communities depend on standalone diesel generators for electricity production. Although this DG method is widely used, it presents major difficulties such as high upkeep costs, costly fuel consumption, and significant environmental harm. These generators lead to both economic and environmental decline, highlighting the necessity for a sustainable, dependable, and optimized hybrid renewable energy system. However, many current hybrid energy optimization

32 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/digital-age-applications-of-multi-criteria-decision-making-for-sustainability/386332

Related Content

Computer Mediated Speech Technology: Perceptions of Synthetic Speech and Attitudes Toward Disabled Users

John W. Mullennix and Steven E. Stern (2008). *Handbook of Research on Computer Mediated Communication* (pp. 831-844).

www.irma-international.org/chapter/computer-mediated-speech-technology/19790

Democratization and the Politics Behind Korean E-Government

James C. Schopf (2012). *International Journal of Information Communication Technologies and Human Development* (pp. 10-24).

www.irma-international.org/article/democratization-politics-behind-korean-government/74059

Telecommunication Business Information System and Investment Ecosystem in a Growing Economy: A Review of Telecom Investment in Nigeria

Ugochukwu Okwudili Matthew, Jazuli S. Kazaure, Ohabuiro John and Khalid Haruna (2021). *International Journal of Information Communication Technologies and Human Development* (pp. 1-20).

www.irma-international.org/article/telecommunication-business-information-system-and-investment-ecosystem-in-a-growing-economy/274841

Online Counselling for Children and Young People: Using Technology to Address the Millennium Development Goals in Kenya

Susan Pattison, Terry Hanley and Aaron Sefi (2012). *Online Guidance and Counseling: Toward Effectively Applying Technology* (pp. 135-151).

www.irma-international.org/chapter/online-counselling-children-young-people/68036

Knowledge Communication with Shared Databases

Joachim Kimmerle and Ulrike Cress (2008). *Handbook of Research on Computer Mediated Communication* (pp. 424-435).

www.irma-international.org/chapter/knowledge-communication-shared-databases/19763