


# Chapter 11

## Hybrid Renewable Energy Integration in Energy as a Service Grid: Optimizing Energy Investment in Green Economy

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### ABSTRACT

*The Energy as a Service (EaaS) model is an entirely novel approach for accelerating the widespread adoption of renewable energy solutions with low carbon emissions. A hybrid renewable energy system combines two or more distinct types of electricity producing sources, such as solar PV panels, wind turbine generators, hydro plants, and/or fossil fuel-based generators, to generate electricity. By facilitating dynamic energy transactions and demand-responsive solutions, hybrid EaaS networks accelerate the transition to low-carbon economies, ensuring long-term sustainability and grid resilience. This research highlights technological advancements*

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*and implementation strategies for maximizing the potential of renewable systems within EaaS networks. The findings contribute to the development of scalable and adaptable business models for future energy ecosystems, optimizing affordability and accessibility for global energy markets sustainability.*

## **INTRODUCTION**

Hybrid renewable energy integration offers a novel method of distributing sustainable energy while enhancing energy performance and accessibility (Iweh, Gyamfi, Tanyi, & Effah-Donyina, 2021). Decentralized energy systems are a revolutionary transition alternative to centralized energy generating systems for the production and distribution of energy. It is based on distributed renewable energy sources like solar panels, wind turbines, hydro systems, and battery storage, which allow towns, businesses, and individuals to produce and use power on their own or in micro-grid networks. Conventional models of electricity generation and consumption are changing to more adaptable, service-oriented structures in which customers are no longer required to directly own energy assets. One such new paradigm is Energy as a Service (EaaS), a creative business model that, instead of making significant infrastructure investments, enables users whether they be companies, industries, or residential consumers to access renewable energy through subscription-based, pay-per-use, or performance-driven contracts (Asuni, Matthew, et al., 2025). At the same time, the integration of hybrid renewable energy systems in grid networks is gaining momentum as a viable approach to ensure energy reliability and efficiency. Hybrid energy sources such as solar photovoltaic (PV), wind power, hydropower, biomass, and battery energy storage systems (BESS) offer complementary generation profiles, helping to mitigate intermittency issues associated with standalone renewable sources, (Asuni et al., 2025). The integration of hybrid energy systems within EaaS frameworks thus creates a more resilient and adaptable energy infrastructure, allowing for dynamic energy transactions, demand-side optimization, and decentralized grid interactions.

A strategic approach that strikes a balance between sustainability, profitability, and long-term resilience is necessary to maximize energy investment in a green economy (Qin, Wang, Xu, & Hussain, 2024). It means using energy-efficient technology to optimize resource use while giving priority to renewable energy sources like solar, wind, and hydropower. Policies that promote sustainable investments, such as tax breaks, subsidies, and carbon pricing schemes that account for the actual environmental costs of fossil fuels, must be put in place by both public and private entities. Making sure technological innovation delivers cost reductions is a crucial component of energy investment optimization. Reliance on fossil fuels is

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