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Cost-Aware Energy Management Strategy for Microgrid Systems using Hybrid Optimization Techniques

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***Abstract*—**The increasing integration of renewable energy resources, distributed generation units, energy storage systems, and intelligent loads has transformed conventional microgrids into highly dynamic and complex energy ecosystems. While these advancements improve sustainability and energy independence, they also introduce significant challenges related to energy scheduling, operational cost minimization, resource utilization, and system reliability. Traditional energy management approaches often rely on fixed scheduling policies and single-objective optimization methods, which may be insufficient for handling the uncertainty associated with renewable energy generation and fluctuating load demands. To address these challenges, this paper proposes a Cost-Aware Energy Management Strategy for Microgrid Systems Using Hybrid Optimization Techniques. The proposed framework integrates real-time monitoring, intelligent energy profiling, demand forecasting, renewable energy coordination, battery storage management, and hybrid optimization mechanisms to determine optimal energy allocation strategies under varying operating conditions. The hybrid optimization approach combines the strengths of multiple optimization methods to balance energy supply and demand while minimizing operational costs and maximizing resource utilization. Experimental results demonstrate that the proposed strategy significantly improves energy efficiency, reduces operational costs, enhances renewable energy utilization, and strengthens overall system reliability compared with conventional energy management approaches.

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Keywords—Microgrid Systems, Energy Management, Hybrid Optimization Techniques, Cost-Aware Scheduling, Renewable Energy Integration, Energy Storage Management, Smart Grids.

INTRODUCTION

The increasing demand for sustainable energy utilization, reduced carbon emissions, and reliable electricity supply has accelerated the adoption of microgrid systems as a key component of modern smart energy infrastructures. Microgrids integrate distributed energy resources, renewable energy generation units, energy storage systems, intelligent controllers, and advanced communication technologies to create flexible and self-sustaining energy networks. Unlike conventional centralized power systems, microgrids support localized energy generation and consumption while enabling real-time energy management and operational autonomy. The growing penetration of solar photovoltaic systems, wind energy resources, battery storage units, electric vehicles, and demand-responsive loads has significantly enhanced the capabilities of microgrids; however, it has also increased the complexity of energy scheduling and resource coordination processes. Consequently, intelligent energy management solutions are required to ensure efficient resource utilization while maintaining economic and reliable operation. Effective energy management plays a critical role in determining the overall performance and economic viability of microgrid systems. Renewable energy sources are inherently intermittent and highly dependent on environmental conditions, resulting in fluctuations in energy generation. Simultaneously, energy demand patterns vary continuously according to consumer behavior, operational activities, and seasonal influences. These uncertainties often create imbalances between energy supply and demand, leading to increased operational costs, inefficient resource utilization, excessive reliance on backup generators, and reduced system performance. Traditional energy management approaches generally rely on predefined scheduling rules and static optimization models that may not effectively adapt to dynamic operating environments. As a result, microgrid operators face challenges in achieving cost-efficient operation while maintaining energy reliability and service quality. Recent advances in optimization techniques have provided promising opportunities for improving energy management within smart microgrid environments. Intelligent optimization algorithms can dynamically coordinate distributed energy resources, battery storage systems, and load demands based on real-time operating conditions and economic objectives. Hybrid optimization approaches combine the strengths of multiple optimization methodologies to overcome the limitations associated with individual techniques. These approaches are capable of simultaneously addressing multiple objectives, including operational cost reduction, renewable energy utilization maximization, load balancing, and energy storage optimization. Furthermore, adaptive optimization mechanisms can continuously adjust scheduling decisions according to changing system conditions, thereby improving the overall efficiency and responsiveness of microgrid operations. Despite substantial progress in energy management research, several challenges remain unresolved. Many existing energy management frameworks primarily focus on energy efficiency or renewable energy integration while providing limited consideration for cost optimization across multiple distributed resources. Furthermore, conventional optimization methods often struggle to accommodate uncertainties associated with renewable generation, fluctuating electricity prices, battery degradation, and varying load demands. The absence of adaptive and cost-aware decision-making mechanisms may lead to suboptimal scheduling decisions, increased operational expenses, and inefficient utilization of available resources. Therefore, there is a need for intelligent energy management frameworks capable of integrating multiple optimization strategies to achieve economically efficient and reliable microgrid operation. The proposed framework integrates real-time monitoring, intelligent energy profiling, demand forecasting, renewable energy coordination, battery storage management, and hybrid optimization mechanisms within a unified architecture shown in fig. 1. The framework continuously monitors generation resources, energy storage units, load demands, electricity pricing information, and network operating conditions.

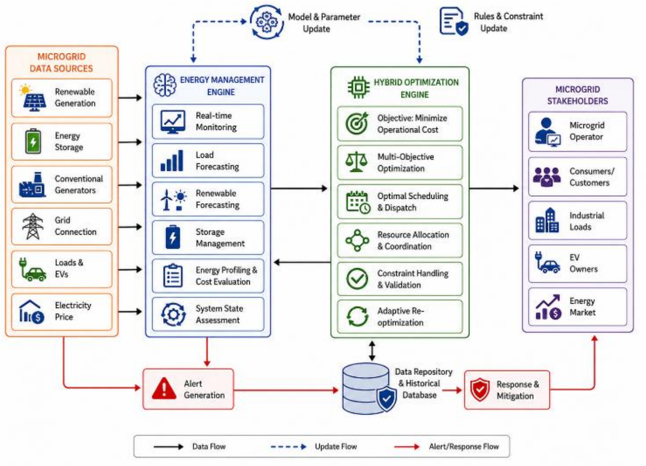

Fig. 1. Conceptual Overview of Cost-Aware Energy Management Strategy for Microgrid Systems Using Hybrid Optimization Techniques

By integrating intelligent monitoring, adaptive scheduling, renewable energy coordination, and hybrid optimization within a unified framework, the proposed strategy aims to improve energy efficiency, reduce operational expenditures, enhance renewable energy utilization, and strengthen microgrid reliability. The hybrid optimization mechanism enables continuous adjustment of energy allocation strategies according to real-time system conditions, thereby supporting sustainable and economically efficient microgrid operation. Furthermore, the framework facilitates effective coordination among distributed energy resources, storage systems, and load demands, ensuring balanced energy management across diverse operating scenarios. The main contributions of this paper are as follows:

1. A cost-aware energy management framework that continuously monitors generation resources, storage systems, electricity pricing information, and load demands within smart microgrids.

2. A hybrid optimization mechanism for dynamic energy scheduling and resource allocation aimed at minimizing operational costs while maximizing energy utilization efficiency.

3. An adaptive decision-making model that coordinates renewable energy resources, battery storage systems, and consumer loads under varying operating conditions.

4. A comprehensive performance evaluation demonstrating improvements in operational cost reduction, renewable energy utilization, energy efficiency, load balancing, and overall microgrid reliability.

The remainder of this paper is organized as follows. Section II presents the literature review related to microgrid energy management and optimization techniques. Section III describes the proposed Cost-Aware Energy Management Strategy and its hybrid optimization methodology. Section IV discusses the experimental setup and performance evaluation results. Finally, Section V concludes the paper and outlines future research directions.

I. LITERATURE SURVEY

Recent studies have explored various approaches involving artificial intelligence, hybrid optimization algorithms, blockchain technologies, real-time control systems, and energy-aware scheduling mechanisms to improve energy utilization, reduce operational expenses, and enhance system reliability. This section reviews existing literature related to cost-aware energy management, optimization techniques, intelligent scheduling, and energy-efficient resource allocation. Cai et al. [1] proposed the TEMP framework, a cost-aware two-stage energy management strategy for electric vehicles empowered by blockchain technology. The study integrated blockchain-enabled transaction mechanisms with intelligent charging and discharging management to optimize energy costs while maintaining secure energy trading operations. The framework demonstrated improved economic performance and energy utilization efficiency; however, its primary focus was on electric vehicle ecosystems rather than comprehensive microgrid energy management involving multiple distributed energy resources and storage systems. Nadeem et al. [2] developed an AI-driven energy cost optimization framework for mixed-use buildings utilizing machine learning techniques and renewable energy integration. The proposed system analyzed consumption patterns and renewable energy availability to minimize energy expenditure while maintaining operational efficiency. The results highlighted the effectiveness of AI-based optimization in reducing energy costs; however, the framework was designed specifically for building energy management and did not address the broader operational requirements of distributed microgrid environments. Tamma et al. [3] introduced a cost-aware scheduling framework in hybrid cloud-fog environments using the Earthworm Optimization Algorithm. The study focused on optimizing resource allocation and minimizing execution costs through intelligent scheduling mechanisms. Although the proposed optimization strategy achieved significant performance improvements, its application domain was limited to cloud-fog computing environments and did not consider energy management challenges associated with renewable energy systems and microgrid operations. Qi et al. [4] proposed SHIELD-EB, a sustainable hybrid evolutionary-boosting framework for carbon, wastewater, and cost-aware datacenter management. The framework combined evolutionary optimization techniques with intelligent decision-making models to improve sustainability and operational efficiency. The results demonstrated substantial reductions in resource consumption and operational costs. However, the framework was primarily developed for datacenter infrastructures and lacked mechanisms for renewable energy coordination and distributed energy resource management. Yuan et al. [5] presented a mobility and cost-aware inference acceleration algorithm for edge intelligence environments. The proposed method optimized computational resource allocation while considering mobility constraints and operational costs. The study demonstrated improved performance and reduced execution expenses in edge computing systems. Nevertheless, the optimization objectives were centered on computational efficiency rather than energy management and cost optimization in smart microgrid systems. Shayeghi et al. [6] developed a hydrogen-oriented cost-aware dispatch model for renewable energy source-coupled systems under stepped carbon trading constraints. The framework optimized energy dispatch strategies while balancing economic and environmental objectives. The results indicated improvements in operational cost reduction and carbon emission management. Despite these advancements, the proposed model primarily focused on hydrogen-integrated renewable energy systems and did not incorporate adaptive hybrid optimization strategies for comprehensive microgrid energy management. Kumar et al. [7] proposed an AI-based load balancing algorithm for enhancing energy efficiency in cloud computing environments. The framework utilized intelligent resource allocation and workload distribution mechanisms to reduce energy consumption and improve system performance. The results confirmed the effectiveness of AI-driven optimization for achieving energy-efficient operations. However, the study addressed computational infrastructures rather than distributed energy systems and microgrid resource scheduling challenges. Cheng et al. [8] introduced a cost-aware optimization framework for large language model deployment based on hybrid genetic reinforcement learning. The proposed approach combined genetic algorithms and reinforcement learning techniques to optimize resource allocation and reduce deployment costs. The study demonstrated the effectiveness of hybrid optimization strategies in complex decision-making environments. Although the framework validated the advantages of hybrid optimization methodologies, its application was limited to artificial intelligence deployment scenarios rather than energy scheduling and microgrid management. Burda et al. [9] proposed a mixed-integer real-time control framework for building energy supply systems. The study employed mathematical optimization techniques to manage energy generation, storage, and consumption in real time. Experimental results demonstrated improved operational efficiency and energy utilization. However, the framework focused on individual building energy systems and did not address large-scale microgrid environments with distributed renewable resources and dynamic market conditions. Sharma et al. [10] presented an AI-based energy-efficient load balancing algorithm for cloud datacenters. The proposed model utilized intelligent workload distribution and adaptive optimization techniques to reduce energy consumption while improving overall system performance. The results demonstrated significant gains in operational efficiency; however, the framework was developed for cloud computing infrastructures and did not specifically target energy management challenges within microgrids. Feng et al. [11] developed SAT-GAV, an electricity-cost-aware resource placement strategy for datacenters. The framework optimized resource allocation decisions based on electricity pricing information to reduce operational expenditures. The study highlighted the importance of cost-aware optimization in dynamic operating environments. Nevertheless, the resource placement strategy was designed for computational systems and lacked mechanisms for coordinating renewable energy resources and battery storage units within microgrid architectures. Chen et al. [12] proposed a cost-aware charging pile location optimization framework integrating greedy algorithms and genetic algorithms. The study focused on minimizing infrastructure deployment costs while maximizing service coverage for electric vehicle charging stations. The hybrid optimization approach demonstrated superior performance compared to traditional methods. Although the framework validated the effectiveness of combining multiple optimization techniques, its primary application was infrastructure planning rather than real-time microgrid energy management. Sharma et al. [13] investigated energy-efficient protocols and AI-driven optimization strategies for sustainable green networking in 6G communication systems. The proposed framework utilized intelligent optimization mechanisms to reduce energy consumption and improve resource utilization across communication networks. The findings demonstrated the potential of AI-driven optimization for enhancing sustainability and operational efficiency.

II. PROPOSED METHODOLOGY

The proposed methodology integrates real-time energy monitoring, intelligent energy profiling, demand forecasting, hybrid optimization, adaptive scheduling, and performance evaluation to improve the economic and operational performance of smart microgrids. The framework is designed to address challenges associated with renewable energy intermittency, dynamic electricity pricing, fluctuating load demands, battery storage constraints, and inefficient resource allocation while maintaining system reliability and sustainability.

A. *Smart Microgrid Monitoring and Data Acquisition*

The first layer of the proposed framework consists of smart microgrid components responsible for generating, consuming, storing, and monitoring electrical energy. These components include solar photovoltaic systems, wind turbines, battery energy storage systems, distributed generators, smart meters, electric vehicles, residential consumers, commercial facilities, and industrial loads. These entities continuously generate operational data related to power generation, energy consumption, battery state-of-charge, electricity prices, voltage levels, and network operating conditions. The collected information is transmitted to the energy management platform for real-time analysis and decision-making. Various operational parameters including renewable energy availability, load demand fluctuations, battery storage capacity, electricity tariff variations, power quality indicators, and equipment status are continuously monitored. This real-time monitoring process provides an updated view of the microgrid operating environment and serves as the foundation for intelligent scheduling and optimization decisions.

B. *Intelligent Energy Profiling and Demand Forecasting*

The second component of the framework focuses on intelligent energy profiling and demand forecasting. Each energy generation source, storage unit, and consumer load is continuously evaluated to determine its current operational condition and expected future behavior. The profiling process utilizes multiple parameters including generation capacity, historical consumption patterns, renewable energy forecasts, battery charge levels, load priorities, and electricity pricing information. Machine learning-based forecasting models analyze historical and real-time data to predict future energy demand and renewable energy generation availability. These forecasts enable the framework to anticipate potential energy deficits, surplus generation conditions, and peak demand periods. The intelligent profiling mechanism generates dynamic energy profiles representing the operational characteristics of each microgrid component.

C. *Hybrid Optimization-Based Energy Scheduling*

The third stage of the proposed methodology introduces a hybrid optimization engine for cost-aware energy scheduling and resource allocation. Unlike traditional scheduling methods that utilize single optimization techniques, the proposed framework combines multiple optimization approaches to exploit their complementary strengths and achieve superior performance. The hybrid optimization mechanism evaluates available renewable generation resources, battery storage capacities, distributed generation units, electricity market prices, and forecasted load demands. The optimization objective is to minimize total operational costs while maximizing renewable energy utilization and maintaining energy supply reliability. The framework prioritizes renewable energy resources due to their lower operating costs and environmental benefits.

D. *Adaptive Resource Coordination and Cost Management*

Once optimal schedules have been generated, the framework performs adaptive resource coordination to ensure efficient implementation of scheduling decisions. During microgrid operation, renewable energy outputs, battery storage conditions, electricity market prices, and consumer demand levels are continuously monitored. Any deviations between forecasted and actual operating conditions are immediately identified and analysed. The adaptive coordination mechanism dynamically adjusts energy allocation strategies whenever significant changes occur within the system. For example, unexpected reductions in renewable generation or sudden increases in load demand trigger real-time schedule modifications to maintain economic and reliable operation. Similarly, fluctuations in electricity pricing influence battery charging and energy purchasing decisions.

E. Reliability Assessment and System Stability Evaluation

The reliability assessment module identifies potential operational risks such as energy shortages, excessive battery depletion, load imbalance conditions, and network instability. If reliability degradation is detected, corrective actions are automatically initiated through the adaptive scheduling mechanism. These actions may include resource reallocation, battery reserve activation, load shifting, or supplementary energy procurement from external sources. This continuous reliability monitoring ensures that operational cost minimization objectives do not compromise system stability or service quality.

F. Performance Evaluation and Comparative Analysis

The final stage of the methodology evaluates the effectiveness of the proposed Cost-Aware Energy Management Strategy using multiple operational and economic performance metrics. The evaluation considers operational cost reduction, energy efficiency, renewable energy utilization, battery storage effectiveness, load balancing performance, electricity purchasing cost, and system reliability. The performance of the proposed framework is compared with conventional energy management systems, rule-based scheduling approaches, and existing optimization-based microgrid management techniques. Cost-related metrics assess the framework's ability to minimize overall energy expenditures, while operational metrics evaluate energy utilization effectiveness and system stability.

III. RESULT AND ANALYSIS

The proposed framework was compared with conventional energy management systems, rule-based scheduling approaches, and existing optimization-based energy management methods. The evaluation focused on measuring operational cost reduction, energy efficiency, renewable energy utilization, battery storage performance, and system reliability. Experimental results demonstrate that the integration of hybrid optimization techniques significantly improves economic performance while maintaining reliable and sustainable microgrid operation.

A. System Configuration and Experimental Environment

The simulation environment was designed to emulate a large-scale smart microgrid consisting of solar photovoltaic systems, wind energy generators, battery energy storage systems, distributed generators, electric vehicles, residential consumers, commercial buildings, and industrial loads. The implementation was carried out using an Intel Core i7 processor with 16 GB RAM running Ubuntu Linux. The simulation framework was developed using Python along with optimization and data analysis libraries including NumPy, Pandas, Matplotlib, SciPy, and Scikit-Learn. The microgrid environment consisted of more than 500 distributed energy resources and consumer nodes generating continuous energy production and consumption data. Multiple operating conditions including low-demand, medium-demand, and high-demand scenarios were considered.

B. Comparative Cost Optimization and Energy Efficiency Analysis

As Management Strategy achieved the highest energy efficiency and operational cost reduction while maintaining superior system reliability compared to existing approaches. The hybrid optimization mechanism effectively coordinates renewable generation resources, battery storage units, and consumer loads to minimize electricity procurement costs and maximize energy utilization efficiency.

TABLE I. COMPARATIVE PERFORMANCE OF MICROGRID ENERGY MANAGEMENT FRAMEWORKS

Energy Management Framework	**Energy Efficiency (%)**	**Reliability Index (%)**	**Operational Cost Reduction (%)**
Conventional Energy Management	83.4	85.2	13.7
Rule-Based Scheduling Approach	88.6	90.4	20.3
Existing Optimization Framework	93.1	95.1	27.8
Proposed Hybrid Optimization Framework	98.3	98.7	38.5

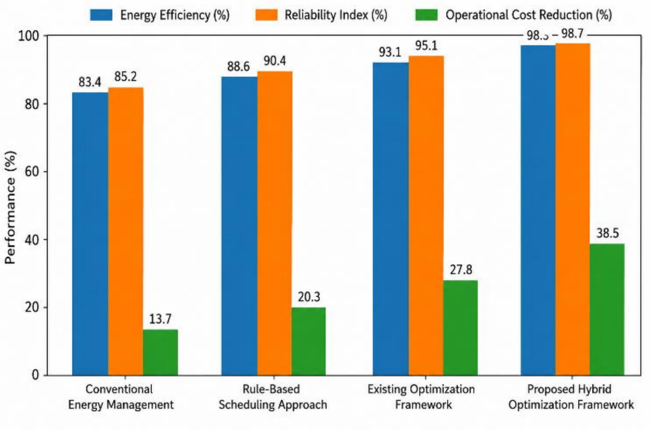

Fig. 2. Comparative Energy Efficiency, Reliability, and Cost Reduction Analysis of Microgrid Energy Management Frameworks

Fig. 2 demonstrates that the proposed framework consistently outperforms conventional energy management approaches by achieving superior energy efficiency, higher reliability, and significantly greater operational cost savings. The hybrid optimization engine dynamically adapts scheduling decisions according to real-time operating conditions, thereby improving economic performance and resource utilization.

C. Renewable Energy Utilization and Storage Performance Analysis

The renewable energy utilization and storage efficiency evaluation examines the capability of the proposed framework to effectively coordinate renewable generation resources and battery storage systems under varying operating conditions, as shown in TABLE II.

TABLE II. COMPARATIVE RENEWABLE ENERGY UTILIZATION, LOAD BALANCING, AND STORAGE PERFORMANCE ANALYSIS

Framework	**Renewable Energy Utilization (%)**	**Load Balancing Efficiency (%)**	**Battery Storage Efficiency (%)**
Conventional Energy Management	77.5	80.1	75.6
Rule-Based Scheduling	84.3	87.2	82.7
Existing Optimization Framework	90.7	92.6	89.4
Proposed Hybrid Optimization Framework	97.6	98.2	96.8

The proposed framework achieved the highest renewable energy utilization, load balancing efficiency, and battery storage performance among all evaluated approaches. The hybrid optimization mechanism intelligently prioritizes renewable energy resources while optimizing battery charging and discharging schedules according to demand patterns and electricity pricing conditions.

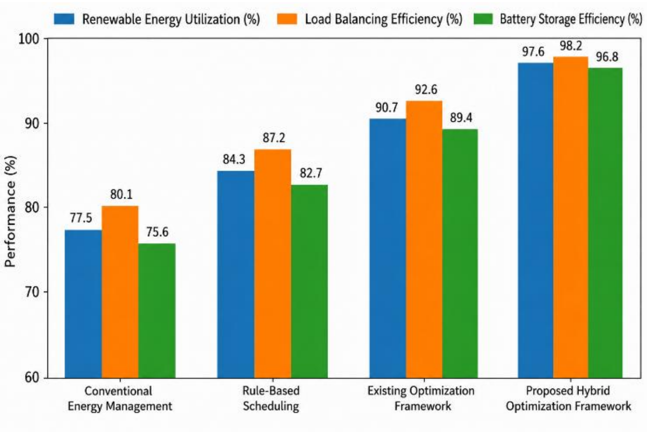

Fig. 3. Comparative Renewable Energy Utilization and Battery Storage Performance Analysis

Fig. 3 illustrates that the proposed framework effectively maximizes renewable energy contribution while maintaining balanced energy distribution and efficient storage utilization across different operating scenarios.

D. Electricity Cost and Demand Management Analysis

The electricity cost analysis evaluates the ability of the proposed framework to minimize energy procurement expenses under different load demand conditions and dynamic electricity pricing environments, as shown in TABLE III.

TABLE III. ELECTRICITY COST MANAGEMENT PERFORMANCE UNDER DIFFERENT LOAD CONDITIONS

Load Condition	**Conventional Cost (USD/day)**	**Existing Optimization Cost (USD/day)**	**Proposed Hybrid Framework Cost (USD/day)**
Low Demand	1,250	1,040	890
Medium Demand	2,180	1,860	1,520
High Demand	3,760	3,210	2,540
Peak Demand	4,820	4,110	3,180
Load Condition	Conventional Cost (USD/day)	Existing Optimization Cost (USD/day)	Proposed Hybrid Framework Cost (USD/day)

The proposed hybrid optimization framework consistently achieved the lowest electricity procurement cost across all load conditions. The intelligent scheduling mechanism effectively shifts energy consumption toward lower-cost periods while maximizing the utilization of locally generated renewable energy. Battery storage resources are strategically utilized during peak pricing periods, thereby reducing dependence on expensive grid electricity.

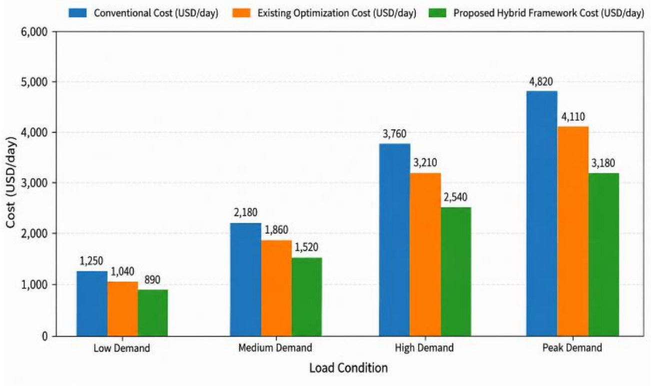

Fig. 4. Comparative Electricity Cost Analysis Under Different Load Demand Scenarios

The results in fig. 4. indicates that the proposed framework significantly improves economic performance by reducing overall energy expenditure while maintaining uninterrupted energy supply and operational reliability.

IV. Conclusion and Future Scope

This paper presented a Cost-Aware Energy Management Strategy for Microgrid Systems Using Hybrid Optimization Techniques that integrates intelligent monitoring, demand forecasting, renewable energy coordination, battery storage management, and adaptive scheduling within a unified optimization framework. The proposed strategy effectively addresses the challenges associated with fluctuating energy demand, renewable energy intermittency, dynamic electricity pricing, and resource allocation by utilizing hybrid optimization mechanisms to determine economically efficient energy scheduling decisions. The performance evaluation demonstrated that the proposed framework significantly improves energy efficiency, renewable energy utilization, load balancing capability, battery storage effectiveness, operational cost reduction, and overall system reliability compared with conventional energy management approaches. Furthermore, the adaptive nature of the framework enables continuous adjustment of scheduling decisions according to changing operational conditions, thereby supporting resilient and sustainable microgrid operation. The scalability analysis also confirmed the framework's capability to maintain high performance under increasing numbers of distributed energy resources and consumer loads. In future work, the framework can be enhanced through the integration of advanced machine learning and deep reinforcement learning techniques for autonomous decision-making and self-adaptive energy scheduling. The incorporation of edge computing and IoT-enabled real-time analytics can further improve response times and operational efficiency.

References

[1] T. Cai *et al.*, "TEMP: Cost-Aware Two-Stage Energy Management for Electrical Vehicles Empowered by Blockchain," in *IEEE Internet of Things Journal*, vol. 11, no. 23, pp. 38246-38261, 1 Dec.1, 2024, doi: 10.1109/JIOT.2024.3445601.

[2] F. Nadeem, M. Zaery, S. M. Amrr, S. M. S. Hussain and M. A. Abido, "AI-Driven Energy Cost Optimization for Mixed-Use Buildings Using Machine Learning and Renewable Integration," *2025 IEEE International Conference on Energy Technologies for Future Grids (ETFG)*, Wollongong, Australia, 2025, pp. 1-6, doi: 10.1109/ETFG61999.2025.11401097.

[3] C. R. Tamma, S. Shamsheer, R. Venigalla, C. Akash, S. S. A. Begum and S. K. Medishetti, "Cost Aware Scheduling in Hybrid Cloud-Fog Environment Using Earthworm Optimization Algorithm," *2024 International Conference on Advancement in Renewable Energy and Intelligent Systems (AREIS)*, Thrissur, India, 2024, pp. 1-9, doi: 10.1109/AREIS62559.2024.10893670.

[4] S. Qi, H. Moore, D. Milojicic, C. Bash and S. Pasricha, "SHIELD-EB: Sustainable Hybrid Evolutionary-Boosting Framework for Carbon, Wastewater, and Cost-Aware Datacenter Management," in *IEEE Access*, vol. 14, pp. 40878-40898, 2026, doi: 10.1109/ACCESS.2026.3674066.

[5] X. Yuan *et al.*, "Mobility and Cost Aware Inference Accelerating Algorithm for Edge Intelligence," in *IEEE Transactions on Mobile Computing*, vol. 24, no. 3, pp. 1530-1549, March 2025, doi: 10.1109/TMC.2024.3484158.

[6] H. Shayeghi, B. Mohamadi, P. Zare and N. Bizon, "Hydrogen-Oriented Cost-Aware Dispatch Modeling of RES-Coupling Systems Under Stepped Carbon Trading Constraints," *2025 17th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)*, Targoviste, Romania, 2025, pp. 1-7, doi: 10.1109/ECAI65401.2025.11095580.

[7] M. Kumar, K. K. Gautam, V. Sharma, B. Samania, T. K. Vashishth and S. Chaudhary, "Enhancing Cloud Computing Performance: A Novel Approach for Optimizing Energy Efficiency through AI- Based Load Balancing Algorithm," *2025 International Conference on Intelligent Computing and Knowledge Extraction (ICICKE)*, Bengaluru, India, 2025, pp. 1-6, doi: 10.1109/ICICKE65317.2025.11136754.

[8] S. Cheng, J. Zheng and Y. Li, "JointCloud LLM Inference Deployment Framework: A Cost-Aware Optimization Approach Based on Hybrid Genetic Reinforcement Learning," *2025 5th International Conference on Artificial Intelligence and Industrial Technology Applications (AIITA)*, Xi'an, China, 2025, pp. 1615-1618, doi: 10.1109/AIITA65135.2025.11047742.

[9] A. Burda, D. Bitner, F. Bestehorn, C. Kirches and M. Grotjahn, "Mixed-Integer Real-Time Control of a Building Energy Supply System," in *IEEE Control Systems Letters*, vol. 7, pp. 907-912, 2023, doi: 10.1109/LCSYS.2022.3229159.

[10] V. Sharma, A. Chaudhary, S. Kumari, T. K. Vashishth, K. Choudhary and P. Chauhan, "Design and Evaluation of AI-Based Energy-Efficient Load Balancing Algorithm in Cloud Data Centers," *2025 IEEE 1st International Conference on Recent Trends in Computing and Smart Mobility (RCSM)*, Bhopal, India, 2025, pp. 1-6, doi: 10.1109/RCSM67767.2025.11506712.

[11] H. Feng, X. Xu, L. Chen and J. Li, "SAT-GAV: A Electricity-Costs Aware Resources Placement Strategy for Data Centers," *2024 IEEE International Symposium on Parallel and Distributed Processing with Applications (ISPA)*, Kaifeng, China, 2024, pp. 1445-1452, doi: 10.1109/ISPA63168.2024.00195.

[12] J. Chen *et al.*, "Study on the Optimization of Charging Pile Location Selection——Cost-Aware Algorithm Integrating Greedy Algorithm and Genetic Algorithm," *2025 IEEE 9th Conference on Energy Internet and Energy System Integration (EI2)*, Jilin, China, 2025, pp. 2629-2637, doi: 10.1109/EI268505.2025.11425550.

[13] V. Sharma, T. K. Vashishth, S. Teotia, B. Samania, M. Kumar and S. Kaushik, "Energy-Efficient Protocols and AI-Driven Optimization for Sustainable Green Networking in 6G Communication Systems," *2026 1st International Conference on Artificial Intelligence & Machine Learning in Communication and Power Systems (AIMLCPS)*, Berhampur, India, 2026, pp. 1-6, doi: 10.1109/AIMLCPS68702.2026.11542465.