Vol (02) _Issue (12) ISSN: 2456-9348
Impact Factor: 4.520

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

MANAGEMENT IN RENEWABLE ENERGY BASED INTEGRATED HEAT AND POWER SYSTEMS: HOTEL MANAGEMENT APPLICATION

Sunita Chahar
EED, RTU, Kota
Kishor Kumar Ola
MBA, RTU, Kota

ABSTRACT

This paper explores the role of Energy Management in Renewable Energy-based Integrated Heat and Power (RECHP) systems tailored for hotel management applications. In the contemporary landscape, hotels are increasingly adopting sustainable energy solutions, with RECHP systems emerging as a popular choice. The development stages of these systems involve the integration of advanced technologies, including control algorithms, creating hybrid configurations that enhance overall efficiency and reliability. The popularity of these systems is attributed to their energy efficiency, cost savings, environmental sustainability, and improved energy resilience. The discussion concludes by emphasizing the growing momentum of energy management in RECHP systems for hotel management, anticipating further advancements and widespread adoption in the hospitality industry.

Keywords:
Hospitality industry, Renewable Energy Sector, National Clean Energy Fund, Financing system

---

INTRODUCTION

Energy management in renewable energy-based integrated heat and power (RECHP) systems involves optimizing the generation, distribution, and utilization of energy to maximize efficiency and meet specific operational goals. These systems typically integrate multiple renewable energy sources, such as solar, wind, or biomass, to generate both electricity and useful heat [1-4].

Early studies laid the groundwork for integrating renewable sources into integrated heat and power systems, emphasizing efficiency and sustainability. Recent research delves into diverse energy management tactics, ranging from demand-side management to optimization techniques. The incorporation of smart grid technologies and energy storage solutions is examined to address the intermittency of renewable, enhancing system reliability. Optimization models, including mathematical programming and machine learning algorithms, are developed to find optimal operational schedules, considering economic feasibility and environmental impact. Furthermore, the interaction between RECHP systems and energy-efficient building design is explored, highlighting the potential synergy between sustainable energy production and consumption. Economic assessments, environmental evaluations, and discussions on barriers and challenges contribute to a comprehensive understanding of the field[5-6]. Future directions focus on cutting-edge technologies, such as artificial intelligence, innovative energy storage solutions, and the role of decentralized microgrids, signaling a dynamic and evolving landscape in RECHP system management

1. Key aspects of energy management in RECHP system:

Following are the key aspects of energy management in renewable energy source based integrated heat and energy system-

1. Resource Optimization: Assessing the availability of renewable resources (solar radiation, wind speed, biomass availability) to optimize the utilization of each energy source based on its specific characteristics.
2. Load Forecasting: Predicting the electrical and thermal load demands to plan and schedule the operation of the RECHP system efficiently.
3. Storage Integration: Incorporating energy storage solutions, such as batteries or thermal storage, to store excess energy during periods of high generation and discharge it during high demand, ensuring a continuous and stable power supply.
4. Smart Grid Integration: Connecting the RECHP system to a smart grid for real-time communication and coordination, allowing for better responsiveness to demand fluctuations and grid conditions.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

5. Control Strategies: Implementing advanced control strategies, such as predictive control algorithms, to optimize the operation of the RECHP system by adjusting the output based on load forecasts, energy prices, and system constraints.
6. Heat Recovery: Maximizing the recovery and utilization of waste heat generated during electricity production for heating applications, increasing overall system efficiency.
7. Efficiency Monitoring: Continuous monitoring and analysis of system performance to identify areas for improvement and ensure that the RECHP system operates at its highest possible efficiency.
8. Economic Considerations: Evaluating the economic viability of the RECHP system by considering factors such as initial investment costs, operational and maintenance costs, and potential revenue streams from electricity sales or incentives.
9. Environmental Impact: Assessing the environmental benefits of the RECHP system, such as reduced greenhouse gas emissions and overall carbon footprint.
10. Regulatory Compliance: Ensuring compliance with local regulations and standards related to renewable energy generation and distribution.

Effective energy management in RECHP systems requires a holistic approach that considers technical, economic, and environmental aspects to achieve optimal performance and contribute to a sustainable energy future.

Integrated Heat and Power (RECHP) generation, also known as cogeneration, plays a crucial role in the current energy landscape, offering a more efficient and sustainable approach to electricity and thermal energy production. RECHP generation has evolved through various stages of development, and its popularity continues to grow as a key contributor to energy efficiency, resilience, and sustainability in the current energy landscape. Ongoing advancements and supportive policies further position RECHP as a viable and attractive solution for diverse energy needs.

2. Attractive option: An Integrated heat and power generation development[7-8]-

The development of integrated heat and power (RECHP) generation is an attractive prospect as it goes beyond the production of electricity alone, offering increased system efficiency. RECHP, also known as cogeneration, is a strategy that simultaneously produces electricity and harnesses the waste heat generated during the process for useful applications such as heating or cooling. This integrated approach results in several advantages:

1. Increased Efficiency: Traditional power generation systems often waste a significant amount of heat energy. RECHP systems, by contrast, capture and utilize this waste heat, significantly improving overall efficiency and reducing energy losses.
2. Cost Savings: The utilization of waste heat for heating or cooling purposes can lead to cost savings in comparison to separate systems for electricity and heat generation. It enhances the economic viability of the overall energy production process.
3. Energy Independence: RECHP systems contribute to increased energy independence by providing a decentralized and distributed energy generation model. This can enhance resilience against grid failures and disruptions.
4. Reduced Environmental Impact: The enhanced efficiency of RECHP systems translates into reduced fuel consumption and lower greenhouse gas emissions per unit of useful energy produced. This aligns with sustainability goals and environmental regulations.
5. Flexibility in Fuel Sources: RECHP systems can be designed to operate with various fuel sources, including natural gas, biomass, or renewable resources like solar and wind. This flexibility allows for adaptation to different energy landscapes and availability of resources.
6. Improved Reliability: The decentralized nature of RECHP systems, integrated with the ability to operate independently or in conjunction with the grid, enhances reliability. They can provide a reliable source of power and heat even during grid outages.
7. Waste Heat Utilization: The recovered waste heat can find applications in industrial processes, district heating, or other thermal applications, contributing to overall energy savings and resource efficiency.
8. Optimized Energy Use in Industries: Industries with a continuous demand for both electricity and heat, such as manufacturing or chemical processing, can particularly benefit from RECHP systems by optimizing energy use and reducing dependency on external energy sources.

Therefore, the attractiveness of RECHP lies in its ability to maximize energy utilization, reduce waste, and provide a more resilient and sustainable energy solution compared to conventional power generation methods.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

3. Integrated heat and power generation development in hotel management[7-9]

The development of Integrated heat and power (RECHP) generation in hotel management offers a range of benefits, aligning with the industry's energy efficiency and sustainability goals. Here are several advantages of implementing RECHP systems in the context of hotel management:

1. Energy Efficiency: RECHP systems in hotels can simultaneously produce electricity and capture waste heat generated during the process. This captured heat can be utilized for space heating, hot water, and other thermal applications, significantly improving overall energy efficiency.
2. Cost Savings: By harnessing waste heat for heating purposes, hotels can experience cost savings on their energy bills. RECHP systems can help in reducing reliance on traditional grid electricity and heating sources, leading to economic benefits.
3. Reliable Power Supply: Hotels require a continuous and reliable power supply for various operations, including guest services, heating, cooling, and lighting. RECHP systems, with their ability to operate independently or in conjunction with the grid, provide a reliable and resilient source of energy.
4. Environmental Sustainability: RECHP systems contribute to the reduction of greenhouse gas emissions by optimizing energy use and minimizing waste. This aligns with the growing emphasis on environmental sustainability and can enhance the hotel's reputation as an environmentally conscious establishment.
5. Grid Independence: Hotels incorporating RECHP systems gain a degree of independence from the grid. During grid outages or peak demand periods, the RECHP system can continue to provide essential power and heat, ensuring uninterrupted services for guests.
6. Flexibility in Fuel Sources: RECHP systems can be designed to operate with various fuel sources, including natural gas, biofuels, or renewable resources. This flexibility allows hotels to choose environmentally friendly options and adapt to changing energy landscapes.
7. Compliance with Regulations: Many regions have regulations and incentives encouraging the adoption of energy-efficient technologies. Implementing RECHP systems can help hotels comply with such regulations, potentially leading to additional benefits or incentives.
8. Optimized Operation in Peak Demand: Hotels often experience peak energy demand during specific times of the day. RECHP systems can be strategically operated to meet these peak demands efficiently, reducing the need to purchase expensive electricity during high-demand periods.
9. Community Relations: Demonstrating a commitment to sustainable and energy-efficient practices can enhance a hotel's image and contribute to positive community relations. Guests increasingly value eco-friendly accommodations, and RECHP can be part of a broader sustainability initiative.

The integration of heat and power generation in hotel management not only addresses energy efficiency and cost considerations but also aligns with broader trends in environmental responsibility and sustainable business practices within the hospitality industry.

4. Current scenario, development stages, popularity and adoption of energy management in renewable energy-based integrated heat and power (RECHP) systems [7-12]

4.1 Current scenario

Integration of Renewable Sources: In the current scenario, there is a significant focus on integrating renewable energy sources into RECHP systems. This involves combining the benefits of RECHP with the sustainability of renewables, such as solar, wind, or biomass, to enhance overall system efficiency.

Smart Grid Integration: Energy management in RECHP systems now often involves integration with smart grids. This enables better control, monitoring, and optimization of electricity generation and distribution, allowing for dynamic adjustments based on demand and availability of renewable resources.

Advanced Control Systems: Modern RECHP systems utilize advanced control systems that incorporate real-time data analytics and machine learning algorithms. These systems optimize the operation of the RECHP unit by adjusting parameters based on variables like energy demand, weather conditions, and grid requirements.

Demand Response Strategies: Energy management strategies in RECHP systems consider demand response mechanisms, allowing them to adapt to fluctuating energy demands. This flexibility is essential for optimizing the use of renewable resources and ensuring efficient energy delivery.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

4.2 Development Stages:

Early Development: The initial development of RECHP systems focused on utilizing waste heat from industrial processes. Early stages involved large-scale applications in industrial settings where both electricity and heat were needed.

Efficiency Improvements: Over the years, development stages have seen a continuous focus on improving the efficiency of RECHP systems. Technological advancements in components like turbines and heat exchangers have contributed to higher overall system efficiency.

Diversification of Applications: RECHP systems have evolved beyond industrial applications to include diverse sectors such as commercial buildings, residential complexes, and district energy systems. This diversification reflects the adaptability and scalability of RECHP technology.

Decentralized Energy Systems: The current trend involves the development of decentralized energy systems where small-scale and micro RECHP units are deployed. These decentralized systems contribute to localized energy solutions and enhance energy resilience.

4.3 Popularity and Adoption:

Environmental Sustainability: The increasing popularity of RECHP in renewable energy stems from its alignment with environmental sustainability goals. By integrating renewable sources, RECHP systems contribute to reducing carbon emissions and promoting cleaner energy.

Policy Support: Many countries provide policy support and incentives to encourage the adoption of RECHP systems. Financial incentives, regulatory frameworks, and favorable policies play a crucial role in driving adoption.

Energy Resilience: RECHP systems are gaining fame for their ability to enhance energy resilience. The integrated generation of electricity and heat, coupled with the flexibility to operate independently or in conjunction with the grid, makes them resilient during disruptions.

Economic Viability: The economic viability of RECHP systems, especially when incorporating renewable sources, makes them attractive for businesses and industries. Reduced energy costs, potential revenue from excess electricity, and long-term economic benefits contribute to their popularity.

Energy management in RECHP systems has evolved with a focus on sustainability, efficiency, and adaptability. The current scenario reflects a dynamic landscape with advanced control strategies, integration with smart grids, and a growing popularity driven by environmental, economic, and resilience considerations. Ongoing developments are expected to further enhance the role of RECHP systems in the renewable energy transition.

CONCLUSION

In conclusion, energy management in renewable energy-based Integrated Heat and Power (RECHP) systems holds significant promise for hotel management applications. The integration of renewable sources, advanced control systems, and the ability to provide both electricity and heat make RECHP systems a valuable solution for enhancing energy efficiency and sustainability in hotels. The current trend of decentralized energy systems and the adoption of RECHP in various sectors indicate its adaptability and positive impact. As hotels strive for greater energy resilience, reduced environmental impact, and economic benefits, RECHP systems present an attractive and viable option. Continued advancements and policy support are expected to further solidify the role of RECHP in optimizing energy usage for hotel management, contributing to a cleaner and more efficient hospitality sector.

REFERENCES

[1] S. Aggarwal and P. Nijhawan, “Review on solar and wind power potential in India,” India Int. Conf. Power Electron. IICPE, vol. 2016-November, 2016.

[2] Jacobsson, Staffan, and Anna Bergek. "Transforming the energy sector: the evolution of technological systems in renewable energy technology." Industrial and corporate change 13, pp. 815-849, 2004.

[3] Karagiorgas, Michaelis, Theocharis Tsoutsos, Vassiliki Drosou, Stéphane Pouffary, Tulio Pagano, Germán Lopez Lara, and José Manuel Melim Mendes. "HOTRES: renewable energies in the hotels. An extensive technical tool for the hotel industry." Renewable and Sustainable Energy Reviews 10, no. 3,198-224,2006.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

[4] Ásványi, Katalin, Katalin Juhász-Dóra, Melinda Jászberényi, and Gábor Michalkó. "Literature review of renewable energy in the tourism industry." Journal of Environmental Management & Tourism 8, no. 2 (18),476,2017.

[5] Bohdanowicz, Paulina, Angela Churie-Kallhauge, Ivo Martinac, and David Rezachek. "Renewable energy for sustainable tourism." In International Conference for Renewable Energy and Energy Education, Havana, Cuba. 2001.

[6] Dalton, G. J., D. A. Lockington, and T. E. Baldock. "Feasibility analysis of renewable energy supply options for a grid-connected large hotel." Renewable energy 34, no. 4, 955-964, 2009.

[7] Wu, DaWei, and RuZhu Wang. "Combined cooling, heating and power: A review." progress in energy and combustion science 32, no. 5-6, 459-495, 2006.

[8] Liu, Mingxi, Yang Shi, and Fang Fang. "Combined cooling, heating and power systems: A survey." Renewable and Sustainable Energy Reviews 35,1-22, 2014.

[9] Kirk, David. "Environmental management for hotels." 2010.

[10] Bohdanowicz, Paulina. "Environmental awareness and initiatives in the Swedish and Polish hotel industries—survey results." International journal of hospitality management 25, no. 4,662-682,2006.

[11] Cho, Heejin, Amanda D. Smith, and Pedro Mago. "Combined cooling, heating and power: A review of performance improvement and optimization." Applied Energy 136,168-185,2014.

[12] Deng, J., R. Z. Wang, and G. Y. Han. "A review of thermally activated cooling technologies for combined cooling, heating and power systems." Progress in energy and combustion science 37, no. 2,172-203,2011.