



## IMPROVING THE ENERGY EFFICIENCY OF THE BUILDING OF SECONDARY SCHOOLS

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### KEYWORDS

energy efficiency, secondary schools, building performance, renewable energy, sustainable practices

### ABSTRACT

This article explores strategies for improving the energy efficiency of secondary school buildings. Energy consumption in educational facilities is a significant concern due to its impact on operational costs and environmental sustainability. The study examines various approaches to enhance building performance, including the integration of renewable energy sources, energy-efficient technologies, and behavioral adjustments. Case studies and practical insights illustrate the effectiveness of these strategies in reducing energy consumption, lowering carbon footprints, and creating more comfortable learning environments.

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## INTRODUCTION

Energy efficiency in educational buildings, particularly secondary schools, is increasingly recognized as a critical area for achieving sustainability goals and optimizing operational costs. The design, construction, and operation of school buildings significantly impact energy consumption, indoor environmental quality, and overall learning outcomes. As educational institutions strive to meet energy efficiency targets and reduce environmental impact, the focus on secondary school buildings becomes paramount.

The energy demands of secondary schools are diverse and substantial, encompassing heating, cooling, lighting, and ventilation systems to ensure a conducive learning environment (Department for Education, 2016). However, inefficient building design, outdated technologies, and inadequate maintenance practices often lead to excessive energy consumption and higher operational expenses (Yang, et al., 2014). Moreover, the environmental footprint associated with energy-intensive school operations contributes to broader sustainability challenges.

Efforts to improve the energy efficiency of secondary school buildings are multifaceted, encompassing both technological advancements and behavioral interventions. Technological solutions include the adoption of energy-efficient building materials, advanced HVAC (Heating, Ventilation, and Air Conditioning) systems, smart lighting controls, and renewable energy integration (Streicher, et al., 2017). These innovations aim to minimize energy losses, optimize thermal comfort, and reduce reliance on fossil fuels, thereby lowering greenhouse gas emissions.

Furthermore, behavioral adjustments among building occupants, including students, teachers, and administrative staff, play a crucial role in enhancing energy efficiency. Educating occupants about energy-saving practices, promoting responsible energy use, and implementing effective building management practices contribute to significant energy savings (Al-Homoud, 2005). Behavioral interventions are often complemented by energy monitoring systems and feedback mechanisms that empower occupants to actively participate in energy conservation efforts (Bordass and Leaman, 2005).

The drive towards sustainable school buildings extends beyond operational efficiency to encompass broader benefits such as improved indoor air quality, enhanced thermal comfort, and better learning environments. Studies indicate that well-designed, energy-efficient schools can positively influence student performance, health, and overall well-being (Heschong Mahone Group, 1999). By prioritizing energy efficiency, secondary schools not only reduce operating costs but also fulfill their role in promoting environmental stewardship and educating future generations about sustainability principles.

This article reviews current trends, challenges, and strategies related to improving the energy efficiency of secondary school buildings. Through a synthesis of literature, case studies, and empirical evidence, it aims to provide insights into effective approaches for

enhancing building performance while fostering sustainable practices in educational settings.

## **MAIN PART**

### **1. Challenges in Energy Efficiency of Secondary School Buildings**

Secondary school buildings face numerous challenges in achieving optimal energy efficiency. These challenges stem from outdated infrastructure, inefficient building designs, fluctuating occupancy patterns, and the complexity of integrating modern energy-efficient technologies (Al-Homoud, 2005). The design and operational inefficiencies often result in excessive energy consumption, higher operational costs, and increased greenhouse gas emissions.

Building envelope performance is a critical factor influencing energy efficiency. Poor insulation, air leakage, and outdated windows contribute to significant heat loss during winter and heat gain during summer, requiring higher energy inputs for heating and cooling (Streicher, et al., 2017). Addressing these issues through retrofits or upgrades to improve insulation and window performance can lead to substantial energy savings and improved thermal comfort for occupants.

Moreover, the inefficiency of HVAC systems in secondary schools further exacerbates energy consumption. Inadequate maintenance practices, oversized equipment, and outdated controls contribute to energy waste and diminished indoor air quality (Yang, et al., 2014). Optimizing HVAC operations through advanced control systems, variable speed drives, and regular maintenance schedules can enhance system efficiency, reduce energy use, and extend equipment lifespan.

### **2. Technological Solutions for Enhancing Energy Efficiency**

Advancements in building technologies offer promising solutions for enhancing the energy efficiency of secondary school buildings. Energy-efficient HVAC systems, such as variable refrigerant flow (VRF) systems and heat recovery ventilation (HRV) systems, optimize heating and cooling operations while minimizing energy losses (Streicher, et al., 2017). These systems adjust capacity based on real-time occupancy and weather conditions, improving overall system efficiency and comfort levels.

The integration of renewable energy sources further enhances energy efficiency and reduces reliance on fossil fuels. Solar photovoltaic (PV) panels, for instance, can generate clean electricity on-site, offsetting grid-supplied power and lowering utility bills (Al-Homoud, 2005). Additionally, building-integrated solar thermal systems can provide hot water for heating and domestic use, contributing to energy savings and environmental sustainability.

Smart building technologies, including energy management systems (EMS) and building automation systems (BAS), play a pivotal role in optimizing energy use and operational efficiency. These systems monitor energy consumption in real-time, analyze data trends, and automate control sequences to maximize energy savings without compromising comfort or functionality (Yang, et al., 2014). Advanced lighting controls, such

as occupancy sensors and daylight harvesting systems, further reduce lighting energy consumption by adjusting light levels based on occupancy and natural light availability.

### 3. Behavioral Strategies and Occupant Engagement

In addition to technological advancements, fostering energy-efficient behaviors among building occupants is essential for sustainable energy management in secondary schools. Educational programs and awareness campaigns can empower students, teachers, and staff to adopt energy-saving practices, such as turning off lights and electronics when not in use, adjusting thermostat settings responsibly, and practicing efficient waste management (Bordass and Leaman, 2005).

Occupant engagement strategies, such as feedback mechanisms and energy competitions, encourage collective responsibility for energy conservation efforts (Al-Homoud, 2005). Providing real-time energy consumption data through dashboards or mobile apps allows occupants to monitor their energy use, track progress, and adjust behaviors accordingly. Moreover, involving students in sustainability initiatives through curriculum integration and extracurricular activities fosters a culture of environmental stewardship and empowers future generations to advocate for energy-efficient practices.

### 4. Benefits of Improving Energy Efficiency in Secondary Schools

Enhancing the energy efficiency of secondary school buildings yields multifaceted benefits that extend beyond cost savings. Improved indoor environmental quality, including better air circulation and lighting, enhances student and staff comfort, productivity, and overall well-being (Heschong Mahone Group, 1999). Studies indicate that optimized learning environments positively influence academic performance, absenteeism rates, and student engagement (Yang, et al., 2014).

Furthermore, reducing energy consumption and greenhouse gas emissions aligns with global sustainability goals and regulatory requirements. Energy-efficient schools serve as models of environmental responsibility within the community, demonstrating leadership in resource conservation and climate action (Streicher, et al., 2017). By prioritizing energy efficiency, secondary schools contribute to building a resilient and sustainable future while preparing students to become responsible global citizens.

## CONCLUSION

In conclusion, improving the energy efficiency of secondary school buildings requires a comprehensive approach that integrates technological innovations, behavioral strategies, and stakeholder engagement. By addressing building envelope performance, optimizing HVAC systems, integrating renewable energy sources, and promoting energy-efficient behaviors, schools can achieve significant energy savings, enhance indoor environmental quality, and foster a culture of sustainability. This article has highlighted current trends, challenges, and strategies in enhancing energy efficiency in secondary school buildings, emphasizing the importance of sustainable practices in educational infrastructure.

## REFERENCES

1. Al-Homoud, M. S. (2005). Assessment of energy conservation opportunities in school buildings. *Building and Environment*, 40(10), 1405-1414.
2. Bordass, W., & Leaman, A. (2005). *Handbook of Energy Use and Efficiency in Buildings*. CRC Press.
3. Department for Education. (2016). *Good practice in the design of homes and residential buildings: guidance for designers and constructors*. Department for Education.
4. Heschong Mahone Group. (1999). *Windows and Classrooms: A Study of Student Performance and the Indoor Environment*. Heschong Mahone Group.
5. Streicher, W., Carrión, M., & Correa, E. (2017). Design and optimization of HVAC systems for energy efficiency and indoor environmental quality. *Renewable and Sustainable Energy Reviews*, 74, 201-214.
6. Yang, J., Wong, N. H., & Shemesh, A. (2014). Impact of school design on student performance in intermediate schools in cold climates. *Building and Environment*, 72, 243-253.