HEAT RECOVERY FROM BUILDING VENTILATION SYSTEMS

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1. Introduction

Ventilation-related heat losses represent a major energy inefficiency in buildings. Heat recovery technologies, such as heat exchangers and TEG-integrated units, allow the extraction and reuse of thermal energy from exhaust air streams. These systems can reduce ventilation heat losses by **40–60%** and significantly improve HVAC performance. Their effectiveness depends on correct sizing, installation, and coordination with building thermal loads [1-4].

2. Scopus

The purpose of this study is to analyse heat recovery technologies for ventilation systems and evaluate their energy, environmental, and occupant comfort benefits.

3. Methodology

Thermal flow simulations were conducted for an 8,000 m² office building, evaluating different heat exchanger types (Fig. 1). Temperature and airflow data were collected, and combined thermoelectric generator (TEG) and absorption chiller configurations were assessed qualitatively for their contribution to electricity generation and cooling performance [2,3].

4. Results

The implementation of heat recovery technologies significantly improved the building's energy performance. HVAC energy consumption was reduced by **35–50%**, while supply air temperatures increased by **8–12°C**, leading to a reduction in heating demand of up to 40% [1,2].Thermoelectric generators (TEGs) installed in ventilation ducts contributed **1–3%** of the building's electricity demand, utilizing waste heat from exhaust air streams. Additionally, absorption chillers supported the cooling system, increasing cooling performance by **15–20%** [3]. Environmental impacts were also significant: CO_2 emissions decreased by **20–25%**, indicating a substantial reduction in the building's carbon footprint [4]. Occupant comfort improved by **10–12%**, as a result of more stable indoor temperatures and enhanced ventilation efficiency [1,2].Overall, the study demonstrates that ventilation heat recovery, combined with TEGs and absorption chillers, provides notable energy savings, improved indoor environmental quality, and reductions in emissions, highlighting the importance of proper design, installation, and coordination with building thermal loads.

5. Conclusions

Ventilation heat recovery is essential for energy-efficient building operation. Combined with TEGs and absorption chillers, it provides:

-Significant energy savings (35–50% reduction in HVAC consumption),

-Improved indoor environmental quality and occupant comfort,

-Reduced carbon footprint (20-25% lower CO_2 emissions),

-Enhanced utilization of recovered heat for cooling and electricity generation.

-Correct design, installation, and integration with building loads are crucial to maximize these benefits.

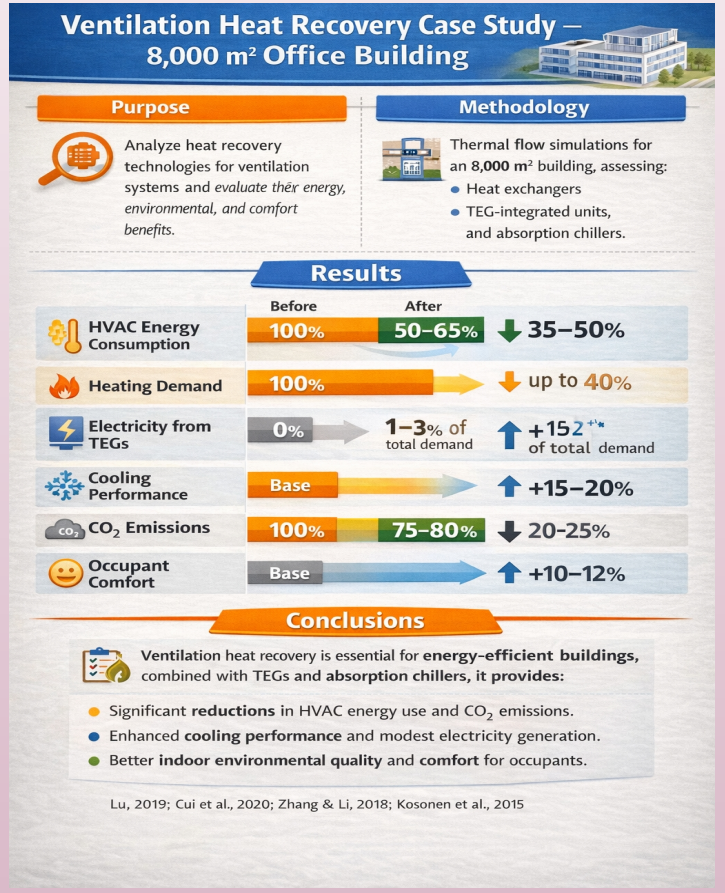

Fig. 1. Ventilation Heat Recovery Case Study – 8,000 m² Office Building.

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