Do Central Heat Pump Water Heater Systems Offer a Viable Option for Multifamily Domestic Hot Water Heating?

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Introduction

This summary details the evaluation of a commercial Heat Pump Water Heater (HPWH) system that replaced an aging gas boiler at the St. Francis Manor, a 128-unit senior living apartment building in Sacramento, CA. The project's objective was to evaluate the performance of the newly installed HPWH and determine the energy, emissions, and cost savings resulting from the fuel-switching measure. The original 1.4 million Btu/h gas boiler system was replaced with a system featuring a Nyle C125A HPWH as the primary heat source, supported by a Rinnai CU199e-N backup gas water heater and two storage tanks.

Methodology

System performance was evaluated using monitored data collected from May 2021 through May 2022. ADM Associates monitored system fuel inputs and heat output by installing thermocouples for temperature measurements and current transformers for electrical power measurements at various locations. As the original boiler was demolished prior to the start of data collection, a direct pre-installation and post-installation comparison was not possible. Therefore, the performance of the new HPWH system was compared against a hypothetical baseline of a standard gas water heater with an assumed 70% efficiency.

Key Findings

The evaluation demonstrated that the HPWH system is a successful and highly efficient replacement for the traditional gas boiler. The system was found to be approximately three times more energy-efficient than the original boiler system. This superior efficiency resulted in significant savings across emissions and operational cost. The analysis showed major greenhouse gas reductions. Over the one-year study period, the HPWH system produced an estimated 54% less CO_2 than the original boiler system would have, avoiding over 20 metric tons of CO_2 annually. This resulted in an estimated annual energy cost savings of $2,233 when compared to the baseline gas system. Based on an incremental capital cost of approximately $22,000 for the HPWH system over a comparable gas system, the simple payback period from energy cost savings is estimated to be around 10 years.

Conclusions and Lessons Learned

The St. Francis boiler replacement demonstrates that central HPWH systems are a viable and effective technology for decarbonizing domestic hot water in multifamily buildings. The project successfully reduced GHG emissions and energy costs while meeting tenant hot water needs. However, the study also provided a critical lesson in system design. During a winter cold snap, the primary HPWH unit experienced a technical issue and went offline. The gas-fired backup heater was unable to provide sufficient hot water to the building on its own during this period, highlighting that resilient system design with properly sized backup capacity is essential for ensuring

consistent operation, especially in commercial applications. This underscores the need for experienced engineering when implementing HPWH retrofits.