California Energy Commission Natural Gas Research & Development Program

Demonstration and Assessment of Natural Gas Heat Pumps for Integrated Water Heating and Air-Conditioning in Restaurants

"A robust field demonstration and market assessment of a prototype integrated natural gas heat pump system for commercial hot water and space cooling in California."

Project Description

This project focused on a field and market evaluation of an integrated, single-effect, absorption natural gas heat pump (GHP) system prototype. The prototype GHP systems were placed in two full service restaurants in the Los Angeles Basin. Data from the field and previous laboratory assessments was utilized to build a cost calculator and develop both a white paper and design guide to support effective adoption of this technology in the future. A market assessment was also conducted to identify opportunities for and barriers to market adoption.

Key Findings

- **The integrated gas heat pump system showed strong energy and cost savings across both restaurants.** The annual natural gas savings amounted to 47-57% for the gas heat pump system, equating to 3,070 and 5,296 therms at the two restaurant sites. When looked at more broadly as part of the larger water heating system, including the existing gas water heaters on-site used for pre-heating, the energy savings system-wide totaled 14-25%. Operating cost savings of 63% were seen between the two sites.
- **Carbon dioxide (CO2) emissions reductions were likewise notable.** As compared to the baseline tank-type gas water heaters on-site, the gas heat pump system resulted in a reduction of greenhouse gas emissions by 46-48%, equating to 44,610 lbs/year and 82,330 lbs/year, respectively for the two sites.
- **Contractors and business owners expressed a strong interest in this new technology class, with some reservations that must be addressed.** This assessment explored contractor and foodservice industry perspectives about the technology and widened the net of potential applicable markets by surveying the laundromat/commercial laundry, multifamily, and senior living sectors for their interest in and impressions about the technology. Respondents showed a strong interest in the technology, with approximately half of all respondents from the restaurant, laundromat, and apartment/senior living sectors selecting the heat pump system during a trade-off exercise comparing it with current commercialized water heating systems. The two host site participants were also surveyed and noted the increased effort associated with integrated gas heat pump system installation, but also highlighted the system's reliability maintaining hot water demand and its supplemental cooling, described by one participant as "quite amazing".
- **Right-sizing the system for an individual restaurant's needs is critical.** The project team highlighted challenges with under/over-sizing and identified a 30-60% "sweet spot" for gas heat pump sizing relative to the estimated peak hot water load.

Benefit for California

- Individual field host sites showed annual energy savings of 3,070 therms/yr and 5,296 therm/yr, respectively, and about 44,610 lbs CO2/yr and 82,330 lbs CO2/yr. The system yielded annual operating cost savings of $2,873 and $6,245 for the two sites.
- Based on the current distribution of gas water heating product types in California and their respective efficiencies, a 10% market penetration of the integrated gas heat pump system could yield annual natural gas savings of 13.6 million therms and a reduction of 80,000 metric tonnes of CO_2.

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