Improving Program Performance:
Focused Measurement and Verification of Condensing Boilers

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Overview and Purpose

The New York State Energy Research and Development Authority (NYSERDA) commissioned a concentrated measurement and verification study to determine whether condensing boilers installed with assistance from NYSERDA's gas efficiency programs were achieving the efficiencies and savings expected by program administrators. Engineers measured boiler combustion and heat exchanger efficiency in a variety of applications and loading conditions and recommended changes to improve program performance and increase the operating efficiency of condensing boilers. In this study, the causes of boiler underperformance were identified.

Methodology

Measurement and verification was performed to determine the in-field operating efficiency of fourteen boilers. A sample of sites was selected to ensure diversity by application type (domestic hot water vs. space heating), NYSERDA program (commercial and residential new construction vs. existing facilities), installation contractor, and boiler size. Multiple site visits were made during which spot measurements of key parameters such as stack emissions, temperatures, and condensate flow rate were performed, and logging equipment was installed to capture the boiler load and stack temperature over a 2-week period. Sensible boiler combustion efficiency was directly logged over a 1-week period at one site. Extrapolated annual efficiency and energy use estimates accounted for both the sensible and latent efficiency of the metered boilers. The calculation of latent efficiency and condensate measurement is an unusual element of engineering M&V, making the results of this study distinctive.

Results

With the exception of one out-of-tune outlier, eleven of the boilers ran at average annual efficiencies of 86% to 89% and three of the boilers ran at average annual efficiencies of 90% or higher. Those boilers with efficiencies between 86% and 89% did not regularly condense the stack gas vapor, resulting in lower efficiencies than those expected by program administrators. Those boilers with annual efficiencies of 90% or higher maintained return water temperatures low enough to regularly condense the stack gas vapor and did so through a combination of one or more of the following: aggressive supply water temperature reset strategies, knowledgeable maintenance staff, and/or direct domestic hot water heating applications. This poster details the analysis methodology, assumptions, and key results of the study that was performed.