Title: **Invisible No Longer: Cost-Effective Methods for Determining Gas End Use Load Shapes**

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Abstract: In the Northeast, continued cheap natural gas prices, population growth, and the desire to switch from delivered fuels to natural gas has led to dramatic increases in natural gas demand over the past decade. Therefore, utilities are seeking to understand how customers use their gas appliances seasonally and on winter peak days to design effective energy efficiency and gas demand response programs. These results can be used to improve understanding of annual consumption of gas equipment and peak gas demand reductions associated with delivering gas energy efficiency programs.

This study presents a novel approach to measuring residential gas end-use loads where interval meters are unavailable, using emerging measuring equipment technologies and efficient, nested sampling. The two-phase approach began with a pilot study over the 2019-2020 heating season to test new methods for gas end use data collection, disaggregate end use gas consumption from whole home gas data, and estimate typical annual consumption, hourly consumption, and gas peak demands by end use. The second, larger phase of the study is designed to augment the sample to provide the necessary confidence and precision requirements, with all data collection and analyses completed after the 2020-2021 heating season.

In the pilot phase, the team installed new types of meters to collect high-frequency whole home gas readings on a sample of 74 homes. For a subset of 20 homes, the team piloted various end use gas equipment proxy data collection including exhaust flue surface temperature loggers, gas solenoid valve loggers, and circuit-level and plug-in electrical meters. The team used a combination of two methods to estimate gas end use annual and peak day consumption: a rigorous proxy-based disaggregation for the subset of homes with gas proxy meters, and a lower-cost disaggregation using only the whole home gas metered data for the larger sample of homes. The team then used the results from the proxy-based disaggregation to derive adjustments for the larger sample of homes with whole home disaggregation results to improve statistical rigor. This study design and approach is applicable in other states, regions, and countries.

Based on learnings from the pilot study, phase two will add 10 additional metered sample points and will collect metered data through the upcoming 2020-2021 heating season. The results will be reported in May 2021. Key deliverables include weather-normalized annual gas end use consumption and gas peak day consumption for all major gas end uses in the home, including space heating equipment (furnaces and boilers), water heaters, clothes dryers, and all other gas end uses. The team will also explore methods for applying the gas consumption and peak demand results from this study to other utility jurisdictions with similar climate through weather normalization and utility bill adjustment factors, providing a reasonably accurate result at a lower study cost.