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RESEARCH BRIEF OCTOBER 2019

DEMYSTIFYING STEAM: SMALLER BUILDINGS

Our new predictive model sheds light on steam use in smaller multifamily buildings and where to focus on upgrades in the city.

THE CHALLENGE

Forty percent of NYC's carbon emissions come from burning fossil fuels within buildings. We can't achieve our long-term carbon emissions goal without retrofitting or replacing most steam systems in NYC– including those in multifamily buildings smaller than 50,000 square feet. But we have little information about these 53,000 properties, many of which will need to comply with NYC's new Local Law 97.¹

Small and medium properties make up over one-third of NYC's multifamily square footage. Unlike larger buildings (over 50,000 square feet), these properties are not required to conduct energy audits, which means we don't know much about them. Identifying steam systems in these buildings could reveal important trends and enable the city and contractors to better identify buildings for improvements. Therefore Urban Green, with funding from NYSERDA, developed a model to predict whether individual buildings are steam heated or not.²

POTENTIAL SAVINGS

Released in February 2019, our **first report** on steam heat found that 14 percent fuel savings can be achieved by improving a large residential building's steam distribution system. And fuel savings increase to as high as 22 percent if distribution upgrades are made when a boiler is being replaced.

The report approximated the amount of steam in small and medium properties. This new research goes further by providing data-driven and granular estimates on the locations and prevalence of steam heat in NYC's small and medium multifamily building stock.

SMALLER MULTIFAMILY BUILDINGS

Overall, our analysis found that 86 percent of multifamily properties between 5,000 and 50,000 square feet are steam heated: that's over 700 million square feet of residential area in NYC. Steam is even more prevalent in smaller multifamily buildings than larger ones.

We found that age is the strongest indicator of whether a building is steam heated: those constructed after 1968 are significantly less likely to use steam. A building's number of stories, use type, and boiler type are also useful characteristics for predicting heating system type.³ More information about a property gives us more certainty about its heating system.

Proportion of NYC Multifamily Property Area

Multifamily properties larger than 5,000 SF account for 2.3B SF citywide. Over one-third of that area is found in small and medium buildings.



1.8 billion square feet of multifamily building area in NYC are heated by steam.
46,000 NYC multifamily properties between

NYC multifamily properties between 5,000 and 50,000 SF use steam heat.

13,000 steam heated NYC multifamily properties are impacted by LL97.

TACKLING RETROFITS CITYWIDE

These findings confirm that steam heat is pervasive in New York's small and medium buildings. Contractors can now effectively target areas where steam heat dominates, which is critical given the recently passed Local Law 97 of 2019. This law sets carbon emissions caps on buildings larger than 25,000 square feet. According to our model, there are 13,000 medium and large multifamily properties that have steam and are impacted by the law. Most of these buildings will need to reduce their greenhouse gas emissions by 2030.

Additionally, this research gives policymakers a full estimate of the multifamily building area heated by steam in NYC—a staggering 1.8 billion square feet. Heating and hot water are the biggest energy uses and emission sources in the city, and steam boilers are serving those loads in 78 percent of the multifamily building area. Steam systems must be a primary focus for retrofit efforts in NYC as well as New York State where this same methodology could be used to identify steam heated properties and savings opportunities.

The way we approached this has implications beyond our findings here. Machine learning is an area of data science used regularly in other industries but building experts have only just started exploring its potential. This research is a prime example of the capabilities of categorical tree-based modeling methods and their usefulness in identifying building systems without site visits. The process could be applied to other types of retrofits that are needed but lagging behind due to lack of information.



This map reflects aggregated findings from our predictive model. Each region represents an individual zip code, and the color reflects the percentage of steam heated properties within the area. Zip codes with less than 10 small and medium multifamily properties appear in gray due to insufficient data.

Explore your neighborhood: urbangreencouncil.org/steam2



Breakdown by Borough

The proportion of small and medium multifamily properties that are steam heated varies by borough.



Urban Green Council transforms buildings for a sustainable future in New York City and around the world.

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NOTES

- 1. Small and medium multifamily properties are defined as properties between 5,000 and 25,000 SF, and 25,000 and 50,000 SF respectively. Large multifamily buildings are at least 50,000 SF in size.
- 2. We used a tree-based ensemble learning methodology called Random Forest to predict whether individual buildings are steam heated or not (other). This algorithm connects building characteristics to different heating system types by combining the results from many randomly sampled decision trees. These results can be applied to unclassified data to discover more about our buildings.
- Building data was aggregated from a number of sources, including LL84 (Benchmarking), LL87 (Audits), NYC tax lot information (PLUTO) and NYC DEP boiler permitting data (CATS). Note that boilers are not only used for steam heat, but for DHW and hydronic systems as well.
- **4.** Cost savings based on **Demystifying Steam** projected retrofit cost estimates (table 6C, page 28) as well as fuel mix data for relevant zip codes.

THANKS

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