Introduction

Buildings remain one of the largest consumers of energy - around 40.4% of all energy used in the US. According to census 2010 - 88.7% of population resides in Urban Areas. [1]

In addition, the UN projects 68% of the world population would live in urban areas by 2050. [2]

88% of the domestic water is public-supply, 12% is self supplied. Water and wastewater utilities account for 35% of typical US municipal energy budget. [3] Electricity use accounts for 25-40% of the operating budgets for wastewater utilities and 80% of drinking water processing and distribution. Drinking water and wastewater systems account for 3-4% of energy use in the US, resulting in 45M tons of greenhouse gases annually. [4]

Objectives and Methodology

Hypothesis

1. Energy benchmarking ordinances are essential for improving the environmental performance of existing buildings.
2. Bigger buildings result in higher environmental degradation.

Research questions

1. How effective are NYC's Local Laws (or benchmarking ordinances) in lowering the energy and water consumption, and reducing greenhouse gas emissions of residential buildings in the borough of Manhattan?
2. How does the energy, water and GHG emissions from buildings of different age and size differ?
3. What are the gaps in the existing benchmarking data and visualization used by NYC?

Methods

1. NYC's Energy and Water Performance Map
2. Review of Local Law 84 and 133
3. Review of NYC Energy and Water Use Reports
4. Review of related published articles

Use of descriptive and inferential statistics to identify patterns from the large data set.

Results

Energy Use Intensity (EUI) Trends - 37 Regularly benchmarked buildings, 6.1M SF

The analysis suggests that from 2011 to 2017, average EUI, WUI and GHG emissions from residential buildings have decreased considerably.

GHG Emission Data

The WUI analysis by building age and size indicate that buildings built in the six decades from 1950 to 2009 are the most water intensive. The GHG analysis by building age and size indicate a direct relation of greenhouse gas emissions with building size.

Conclusion & Future Work

1. The analysis of NYC's energy and water performance disclosure data suggests that from 2011 to 2017, average energy use intensity (EUI), average water use intensity (WUI) and average greenhouse gas (GHG) emissions from residential buildings have decreased considerably. Supporting the hypothesis emphasizing on the need of benchmarking ordinances.
2. The EUI analysis by building age and size indicate that buildings built in the six decades from 1950 to 2009 are the most energy intensive. The WUI analysis by building age and size indicate that buildings built in the 1970s are most water intensive. The GHG analysis by building age and size indicate a direct relation of greenhouse gas emissions with building size.
3. Continuous improvements in WUI and GHG emissions were observed. However, it is not clear if the benchmarking laws are the sole reasons behind the improving trends.
4. The data will be used for performing additional correlational studies to suggest retrofit strategies (missing in the existing tool) for buildings of different sizes and ages to improve their energy and water use performance.
5. The assessment of buildings should also include embodied carbon data and indoor environmental quality (IEQ) data. IEQ and Embodied carbon data would help guide retrofit/rehabilitation vs. demolition decisions.
6. 3D building representation couple with future predictions (4th dimension) can enhance user experience letting people take informed decisions.

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References:


Additional references that contributed to this work are cited in the following conference proceedings:


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