Final Report NYC Building Energy Analysis for PUI2017 Extra Credit <Tarek Arafat, tma353, tma353>

Tarek Arafat[1]

[1]New York University (NYU)

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Abstract

An analysis of energy benchmarking data for multi-family housing in the energy-stressed Consolidated Edison delivery territory known as the Brooklyn Queens Demand Management (BQDM) zone, shows some zip codes with exceedingly high energy use intensity (EUI > 100 kBTU/SF). Because multi-family housing is the most numerous and largest energy using building type within New York. The BQDM area is in need of energy efficiency to provide energy load relief to avoid blackouts. Preventing loss of power posses a significant security and equity impetus to target energy efficiency incentives to the zip codes of 11216 and 11207.

Introduction:

The analytics question focuses on how does the City of New York prioritize resource allocation, market incentives and policy interventions toward building energy efficiency and sustainability goals. The Mayor of New York has signed an executive order (EO 26), to commit to the Paris Climate Agreement and limit global average temperature rise to 1.5 degrees Celsius (City of New York, 2017). NYC has many incentives and initiatives to advance emissions reductions and sustainability; energy efficiency, renewable energy production and climate change resiliency.

In New York, 70% of Greenhouse Gas emissions (GHGs) are derived from energy consumed in buildings. Building energy efficiency improvements results in GHG reductions. The latest benchmarking report released on building energy and water use, analyzes the annual data collected under Local Law 84 (LL84). Overall, reductions have not been substantial within the residential sector and trailing the improvements of the municipal and commercial building sector (City of New York, 2017). The LL84 and LL87 initiatives are among the lever the government is using to build awareness and know how for scaled projects across the City. There are also improved energy codes and goals to install solar PV to offset GHGs.

Consolidated Edison (ConEd) is responsible for distributing the power to most of the buildings in New York City. There are 82 sub-zones that are served by approximately the same number of substations. The aging infrastructure can not always meet the growing demands of certain zip codes. When an area is not effectively served, a blackout can occur. The most stressed area is primarily residential and stretches across the border of Brooklyn and Queens. To avoid spending a projected $1.2 billion on a new substation to meet the growing energy demand, ConEd has instead developed the Brooklyn Queens Demand Management (BQDM) Program and will eventually spend $200 million on efficiency projects and incentives within dozens of zip codes.

To address both the City's climate change goals and the safety and security of residents in the BQDM, this analysis uses the LL84 benchmarked data for multi-family residences in the BQDM area to then accelerate

a hyper focused investment energy efficiency. Thus providing relief for the energy zone that will protect ConEd and the residents in their homes.

Data:

Benchmarking Local Law 84 (LL84 of 2009): NYC has a self-reported annual building energy benchmarking law for buildings over 50,000 square feet (SF). The data is logged in the Environmental Protection Agency's (EPA) ENERGY STAR Portfolio Manager. This tool compares buildings typologies across the nation and is normalized for weather and usage to designate a score based on a ranking percentile. For this analysis a limitation is that many multi-family (MF) buildings are smaller than the 50,000 SF. However, because many people reside in larger MF, there are many residents impacted by the initiatives.

Primary Land Use Tax Lot Output (PLUTO): PLUTO is a publicly available record of tax lot level data of NYC land usage and building information . PLUTO includes land use, geographic data, building characteristics maintained by the Department of City Planning (DCP), the Department of Finance (DOF), the Department of Citywide Administrative Services (DCAS), and the Landmarks Preservation Commission. This file is useful for the shape files that allow LL84 energy data to be mapped across the City.

Data for building energy (LL84) is processed to remove empty data (NaN) and anomalous outliers to prepare it for an appropriate model of performance. LL84 and PLUTO data sets are merged on the common category, Building, Block, Lot (BBL) a common classifier to then be analyzed and explored for models to benchmark the current state of MF performance. The number of buildings are counted to show the most frequent is the multi-family building type (Fig. 1). The data was plotted to view the distribution. A mean of 87 kbtu/SF is found and focus on the poorest performing quartile where EUI is over 100 kbtu/SF (Fig. 2).

Methodology:

The number of buildings are counted in a bar chart for multi-family building type (Fig. 1). The data was plotted to view the distribution. A mean of 87 kbtu/SF is calculated and focus on the poorest performing in the fourth quartile where the EUI is over 100 kbtu/SF (Fig. 2). The analysis compares peer multi-family buildings aka "typology", to prioritize energy projects and quantify policy interventions. The analysis then merged the LL84 data and the PLUTO shape file using the BBL. The map is made using a geopandas dataframe (Fig. 3). The zip codes of concern (Fig. 4) are defined and used to filter the MF EUI within those problem zip codes (Fig. 5). A table of descriptive statistics summarizes the mean EUI in the zip codes where there is LL84 data (Table 1). The mean for zip codes of 11216 and 11207 show EUI values around or above the 4th quartile.

Conclusion:

The residential sector of buildings is trailing in energy efficiency improvements compared to the municipal and commercial sector according to the latest government benchmarking report. Therefore, prioritized and targeted interventions can be designed for the zip codes of 11216 and 11207. The residents of those zipcodes need efficiency gains in the BQDM to both protect ConEd's delivery of power while also protecting the residents in their homes.

Future work:

To enhance further analysis, a precise spatial geometry of the ConEd sub-zones, currently not available, would narrow the geographic focus. Also to recommend and identify energy efficiency projects in the BQDM, incorporate an analysis of the data collected from building energy audits (LL87 of 2009), an analysis for buildings over 50,000 SF every ten years. The housing in the BQDM may have socioeconomic factors from collected Census data to compare against EUI. This would also allow for a focused initiatives on preserving equity

and economic justice as New York faces climate change stressors that disproportionately impact the poorer social groups.

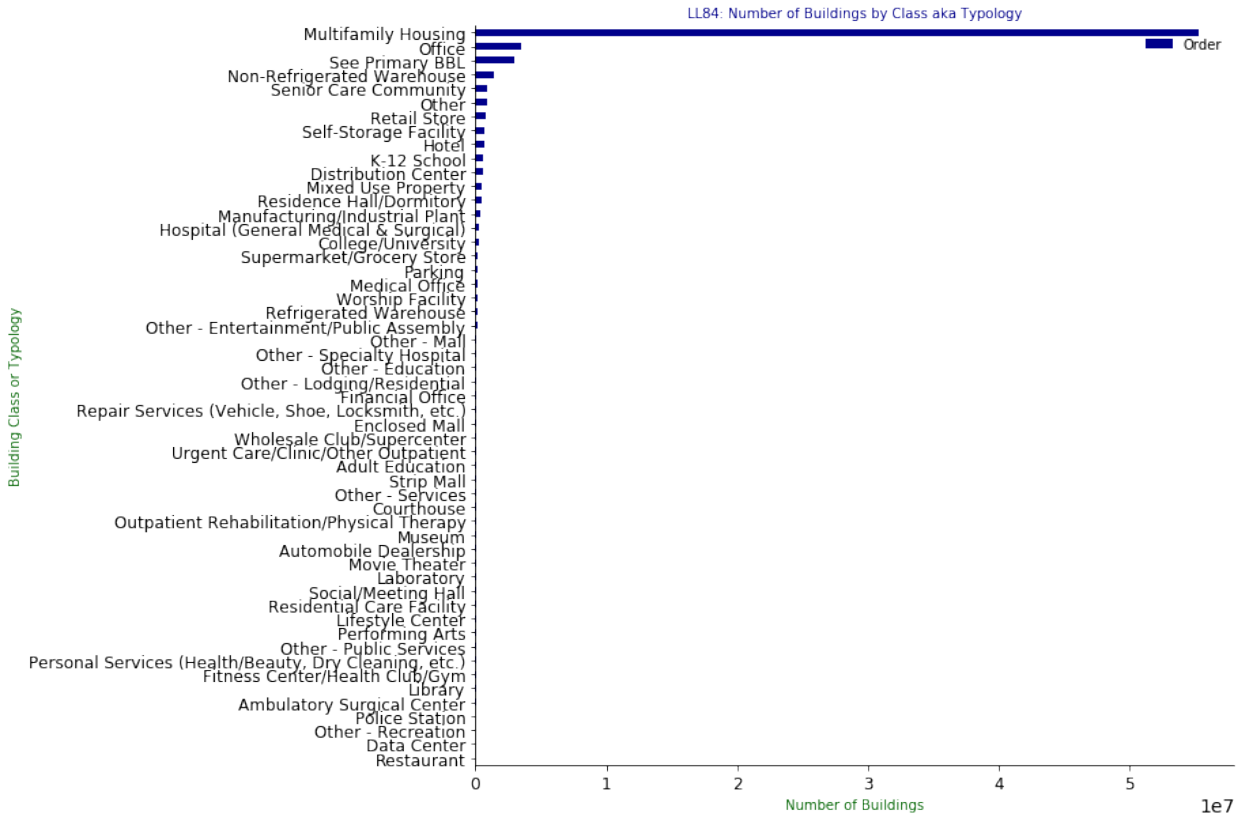

Figure 1: Multi-Family housing is the most numerous

References:

City of New York. (2017). Aligning New York City with the Paris Climate Agreement. July 2017. New York: City of New York. Retrieved from: http://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/1point5-AligningNYCwithParisAgrmtFORWEB.pdf

City of New York. (2017). New York City Local Law 84 Benchmarking Report: October 2017. New York: City of New YorkU.S. Environmental Protection Agency (EPA), "ENERGY STAR Portfolio Manager Technical Reference: Greenhouse Gas Emissions." (2013.) Retrieved from: portfoliomanager.energystar.gov/pdf/reference/Emission

The City of New York, Mayor's Office of Sustainability, "Energy and Water Use Report" (October, 2017.) Retrieved from: http://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/UGC-Benchmarking-Report-101617-FINAL.pdf

The City of New York, Mayor's Office of Sustainability, "Inventory of New York City Greenhouse Gas Emissions in 2015." (April, 2017.) Retrieved from: http://www.dec.ny.gov/docs/administration_pdf/

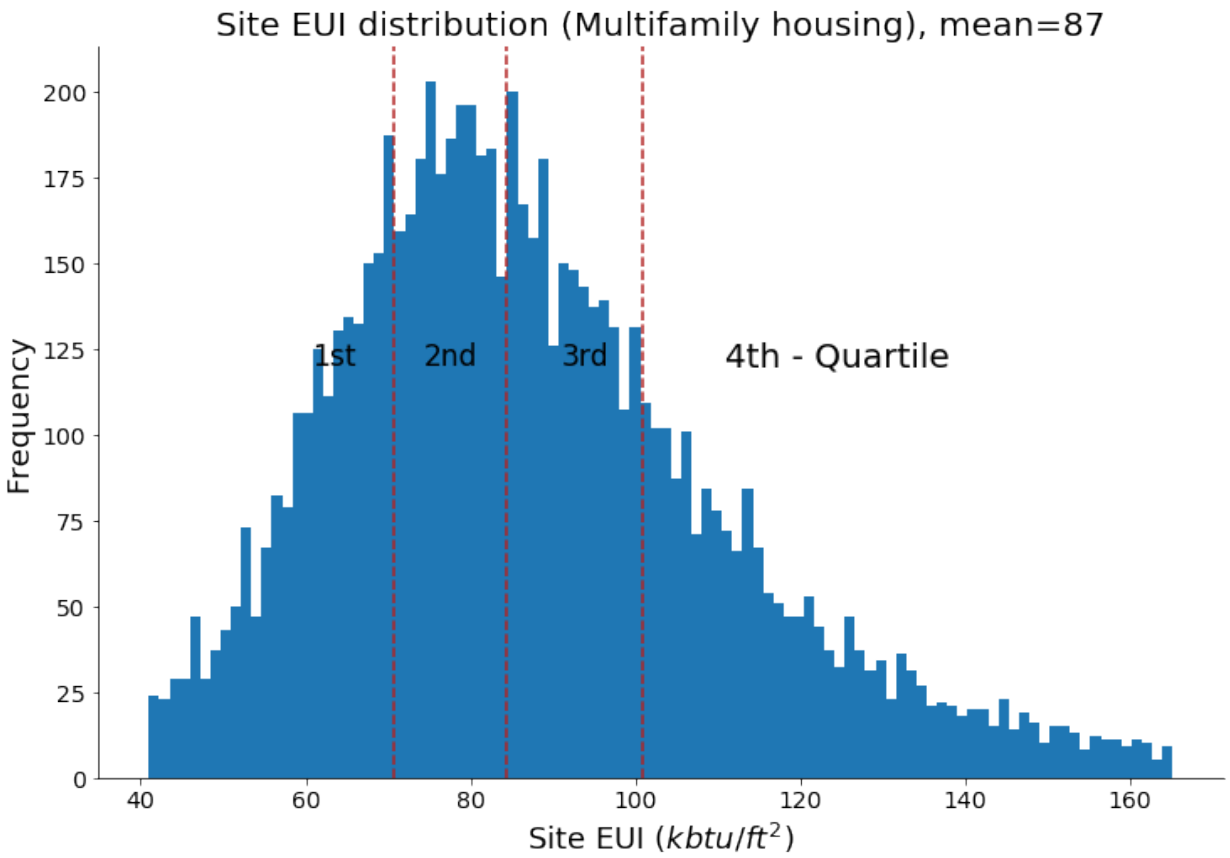

Figure 2: Poorer Performers are in the 4th Quartile, > 100 EUI

Zip Code	Mean within each
11203	75.21
11205	83.71
11206	81.49
11207	93.56
11211	80.07
11212	77.94
11213	78.06
11216	102.01
11221	89.19
11222	62.6
11225	89.43
11233	67.93
11237	69.43
Mulit-family Citywide mean	87
Multi-family 4th Quartile	100

Table 1: EUI by zip code in partial BQDM zone, 11216 has mean EUI = 102 kBTU/SF, a poor performer in the 4th quartile, recommend deeper analysis and program starting with 11216

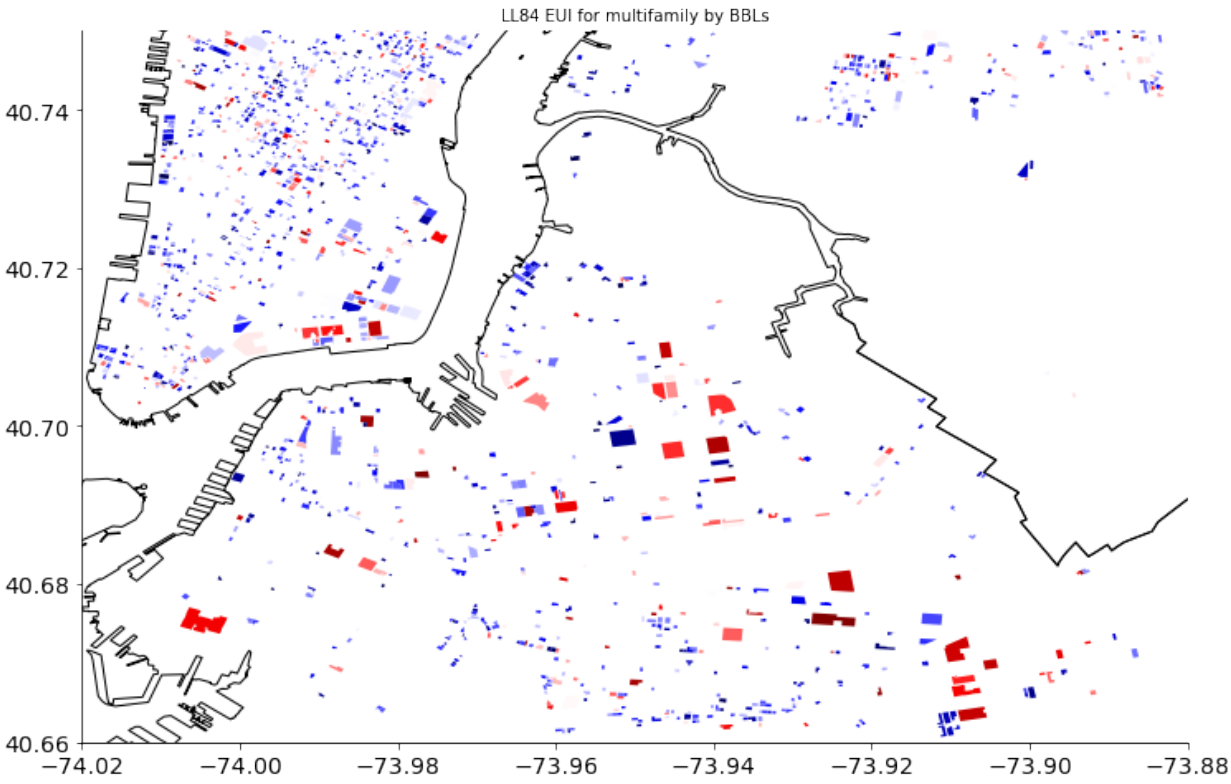

Figure 3: LL84 Benchmarked Multi-family, buildings are shown by BBL, Red = higher EUI, Blue = lower EUI

nycghg.pdf

Consolidate Edison Brooklyn Queens Demand Management. Retrieved from:

https://www.coned.com/en/save-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-residential-customers/residential-neighborhood-program

Another $1.2 Billion Substation? No Thanks, Says Utility, We'll Find a Better Way. Retrieved from:

https://insideclimatenews.org/news/04042016/coned-brooklyn-queens-energy-demand-management-project-solar-fuel-cells-climate-change

GitHub Repository:

https://github.com/tma353/PUI2017_tma353/tree/master/PUI%20Extra%20Credit

LL84 Data:

https://data.cityofnewyork.us/Environment/Energy-and-Water-Data-Disclosure-for-Local-Law-84-/rgfe-8y2z

NYC Borough Contours Map:

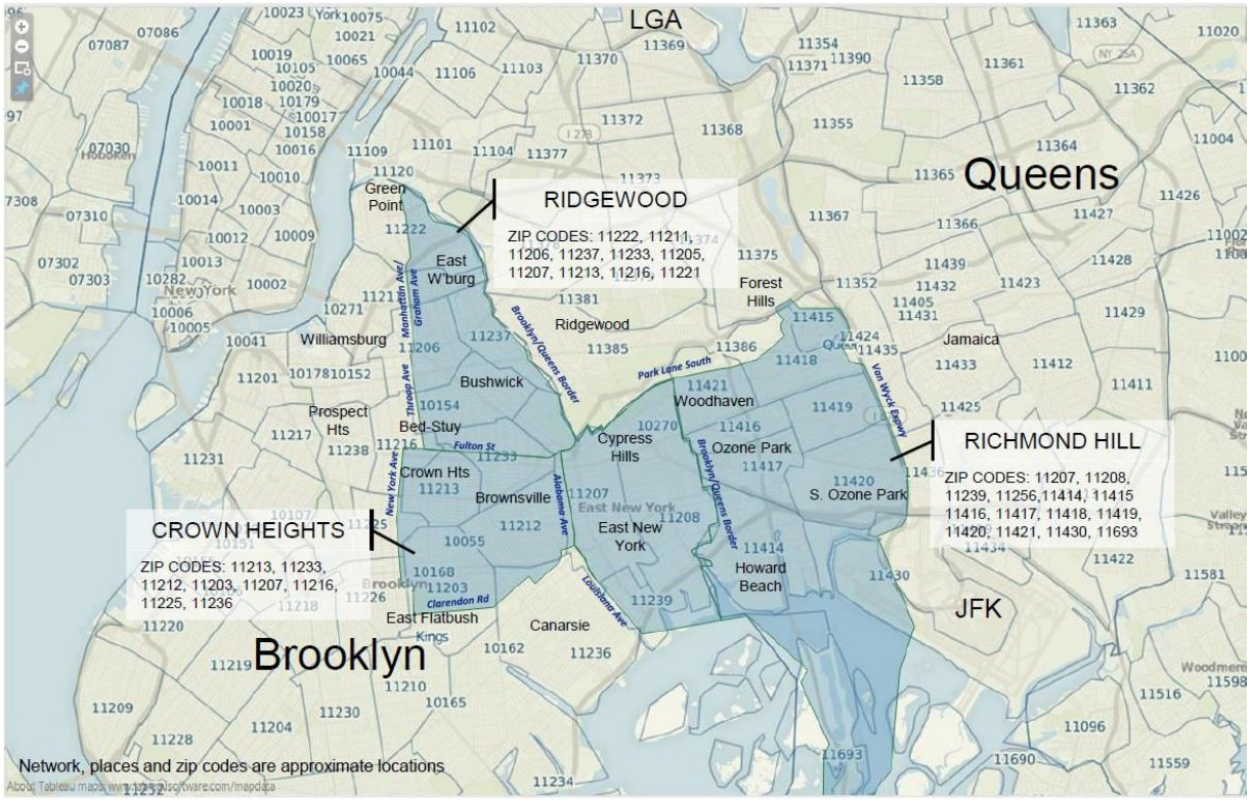

Figure 4: BQDM by zipcodes, ConEd will spend $200 million in efficiency rather than $1.2 billion on a new substation, without energy reductions there is a high risk of blackouts

https://www1.nyc.gov/site/planning/data-maps/open-data/districts-download-metadata.page

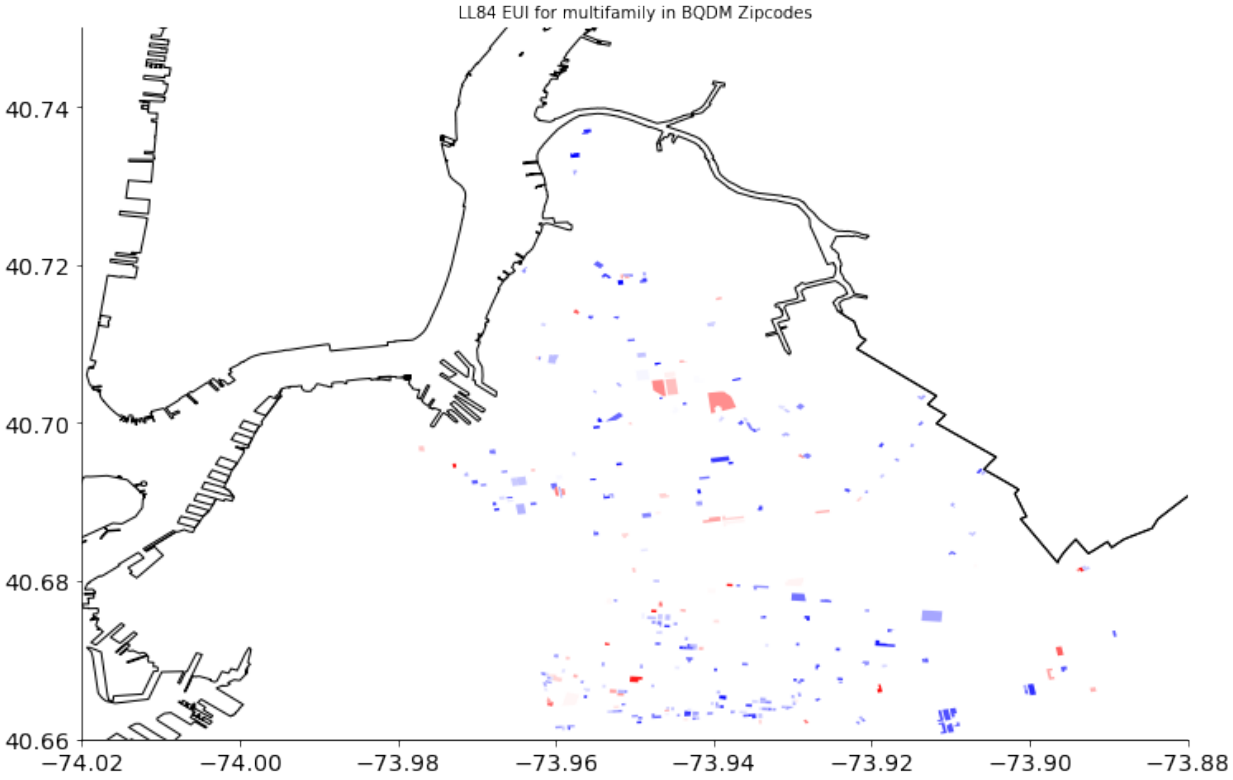

Figure 5: Benchmarked Multi-family residences in the BQDM zipcodes, Red = higher EUI, Blue = lower EUI, energy efficiency initiatives can target the red