# energy retrofits

## brooklyn, ny

geographic information systems
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fall 2021

*nyc buildings emit* **two-thirds**
*of the city's greenhouse gases*
*by way of energy consumption*



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# introduction

As the most populous city in the United States, New York City is home to the highest building square footage. Posing a challenge to climate change mitigation, buildings emit two-thirds of New York's greenhouse gases by way of energy consumption from lighting, appliances, heat, and hot water, according to the NYC Urban Green Council. Over the past several years, New York City has enacted several policy measures in an effort to mobilize the city's decarbonization efforts – most notably Local Law 97, passed in 2019 as a part of New York City's Green New Deal to dramatically reduce emissions created by the city's largest buildings (>25,000 square feet) by 40% by 2030 and 80% by 2050 (80X50).

Emissions reduction progress has been a focal point for the city throughout the 21st century, with the decade between 2005-2016 highlighting a 15% reduction in CO2 emissions, but renewed mobilization in the building sector is necessary to meet the 80X50 goal. Current challenges to mitigation via Local Law 97 include high short-term cost to building owners, high time cost of enforcement, outsize burdens for buildings with high-emitting tenants, a building's ability to purchase decarbonization offsets, and the failure to encourage building electrification. In an effort to improve the efficiency of building decarbonization in New York City, our project seeks to streamline the identification process of large residential and commercial buildings which a) are in the greatest need of an energy-retrofit, b) have the highest potential decarbonization impact in context and c) have the ability to further clean energy equity.

But first, a few key terms:

**clean energy equity** represents the inclusion and participation of underserved communities in clean energy programs.

**source EUI**, the measure by which we quantified energy use, is is source energy divided a the property's gross floor area.

# research question

Considering Brooklyn's current energy use patterns and the building & neighborhood characteristics tailored to energy retrofit programming...

***where*** might retrofit efforts be targeted across residential and commercial buildings in brooklyn to enhance energy equity?

*residential*

*commercial*

# scope & limitations

## scope

While there are over 50,000 buildings over 25,000 square feet in New York City, the scope of this study is limited to privately-owned buildings over 25,000 square feet and city-owned buildings over 10,000 square feet in the borough of Brooklyn during the calendar year of 2020. By selecting a borough that has a mix of high-energy and low-energy consumption neighborhoods, we aim to find a trend that will help us identify target buildings or neighborhoods for retrofitting efforts.

The goal of this project is to identify sites for residential and commercial retrofits and pinpoint neighborhoods in which to push energy efficiency incentives. Building traits that we analyze to aid in identifying our targets include building type, size, usage, and age.

## limitations

By using the Energy and Water Data Disclosure for Local Law 84, we are limited to self-reported energy consumption by building owners of a fraction of the buildings in Brooklyn. We are unclear how the energy usage is measured in each building and the quality of these energy audits. Unlike Manhattan, where there is a high density of buildings over 25,000 square feet, Brooklyn has a mix of large and small buildings, therefore limiting the data as privately-owned buildings under 25,000 square feet do not need to report their energy consumption. Another limitation of this study is the methods and evaluation used in the decision layers constructed for the multi-layer decision models. We use several building and demographic traits to aid in the creation of our model, however there could be other factors, such as quality of building envelope, that could affect energy consumption and equity.

# methdods

## methodology framework

In order to pinpoint where energy retrofit efforts should be targeted for both residential and commerical buildings in Brooklyn, we crafted decision layer analyses in two phases, per building use.

*First*, with the goal of advancing energy equity for residential structures, we based our analysis on six (6) decision criteria: source Energy Use Intensity (EUI), building age, median household income, percent female population, percent minority population and population density.

*Second*, on the commercial and manufacturing side, we based our analysis on three (3) decision criteria: source EUI, building age and high emitting industry profile.

*Lastly*, both decision maps were examined in terms of their decision scores for the selection of the top three (3) retrofit targets.

## datasets

**Energy and Water Data Disclosure**
Mayor's Office of Climate & Sustainability, 2021

**American Community Survey**
U.S. Census, 2019

**Brooklyn Census Tracts**
TIGER/LINE, 2019

# decision 1 residential

## CONTEXT

The following decision layer analysis for residential properties – multi-family housing, residence halls and senior living communities – unveils Brooklyn's top three buildings where retrofits will improve energy emissions and enhance energy equity.

## INDICATORS

EUI
x3

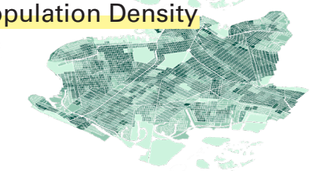
Building Age

Median HHI

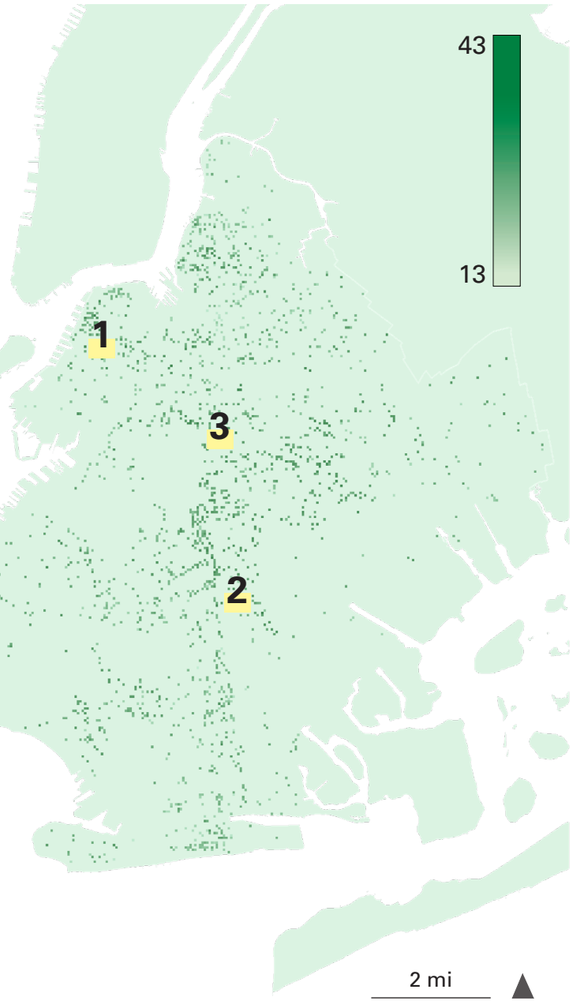
% Female

% Minority

Population Density
x2



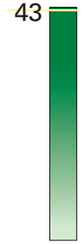
## DECISION MAP




## SITE SELECTION

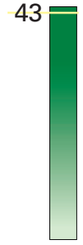
### 1 Hoyt Street
452 Fulton Street, Brooklyn, NY

Building Type: Residence Hall / Dormitory
Year Built: 1925
Source EUI: 227 kBtu/ft²
Total GHG: 742 MTCO2e




### Morris Lieberman
3402 Avenue I, Brooklyn, NY

Building Type: Multifamily Apartment
Year Built: 1926
Source EUI: 142 kBtu/ft²
Total GHG: 204 MTCO2e




### Monastery Senior
715 Saint Johns Pl, Brooklyn, NY

Building Type: Multifamily Senior Housing
Year Built: 1915
Source EUI: 191 kBtu/ft²
Total GHG: 266 MTCO2e

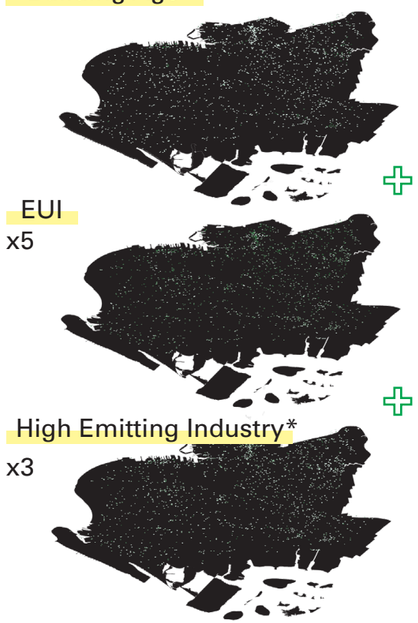
# decision 2 commercial

## CONTEXT

The following decision layer analysis for commercial + manufacturing properties – offices, stores, power plants, hospitals, etc. – unveils Brooklyn's top three buildings where retrofits will improve the borough's energy emission landscape.

## INDICATORS

Building Age

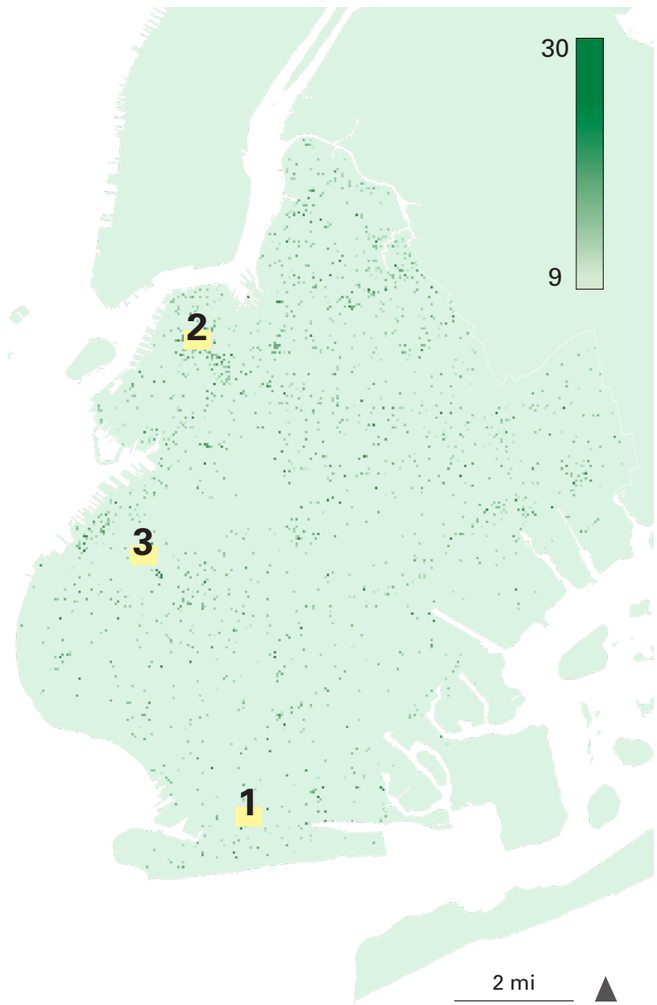


EUI
x5

High Emitting Industry*
x3

* High-Emitting Industry Decision Layer includes building use cases: Energy/Power Station, Manufacturing/Industrial Plant, Hospital, Supermarket/Grocery Store & Other -Technology/Science

## DECISION MAP



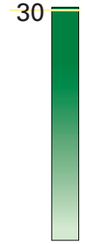

## SITE SELECTION

1

### Warbasse Power Plant

2701 W 6th St, Brooklyn, NY

Building Type: Energy / Power Station
Year Built: 1965
Source EUI: 10,673 kBtu/ft²
Total GHG: 34,337 MTCO2e

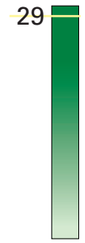



2

### Verizon CO/GLC 35102

360 Bridge St, Brooklyn, NY

Building Type: Technology/Science
Year Built: 1923
Source EUI: 721 kBtu/ft²
Total GHG: 4104 MTCO2e

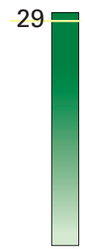



3

### Maimonides Medical Center: Ambulatory Care

948 48th St, Brooklyn, NY

Building Type: Hospital
Year Built: 1919
Source EUI: 624 kBtu/ft²
Total GHG: 637 MTCO2e



# results + closing thoughts

## results

This project uncovers which residential and commerical buildings in Brooklyn will, through retrofits, most impact the borough's energy landscape. In tandem, we also notice the general and unsurprising trend that the highest energy consumers out of our two analysis types are commerical and manufacturing properties. As illustrated to the right, only 30 of the top 20% highest emitting buildings are residential - the rest commerical + manufacturing.

Additionally, out of these high-emitting commerical buildings, a few repeated owners jump out as potential industry-defining targets to incentivize and pinpoint for retrofits. Among these, Verizon's telecommunications CO/GLC centers contribute to a large body of the top commerical retrofit decision scores, making the company a key stakeholder in the future of the borough's energy emissions reduction landscape.

We also discover that building age does negatively impact source EUI, however primarily for commerical buildings. As visualized on the right in the 'Trend Highlight' chart, we notice that building age exhibits a moderate negative relationship with commerical source EUI.

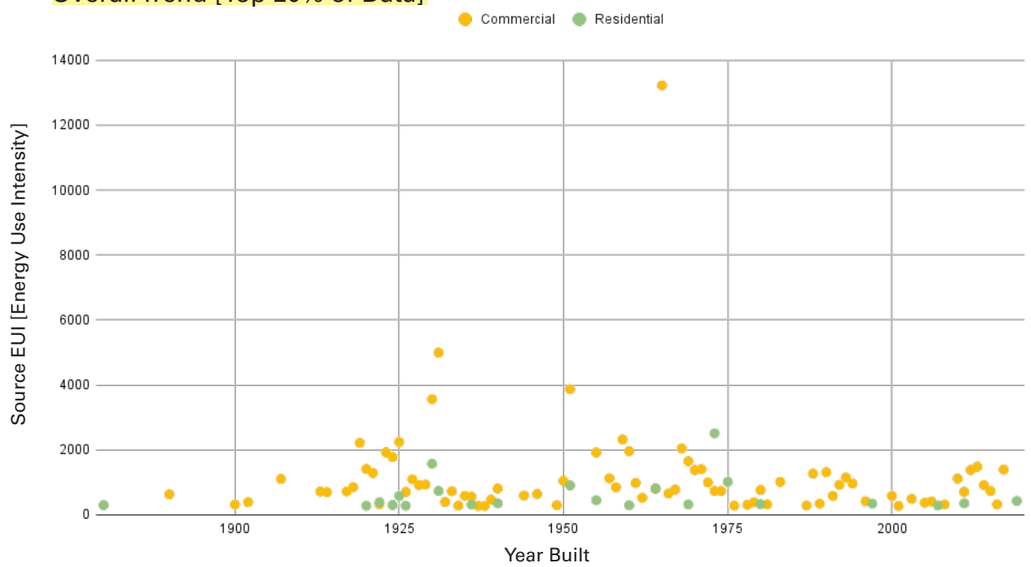
## closing thoughts

We encourage NYC's Offices of Sustainability and Buildings to continue to push for energy retrofits as a means of energy emissions reduction. We hope this report will help operationalize an efficient process for the City to indentify key buildings & stakeholders to target for retrofit efforts.

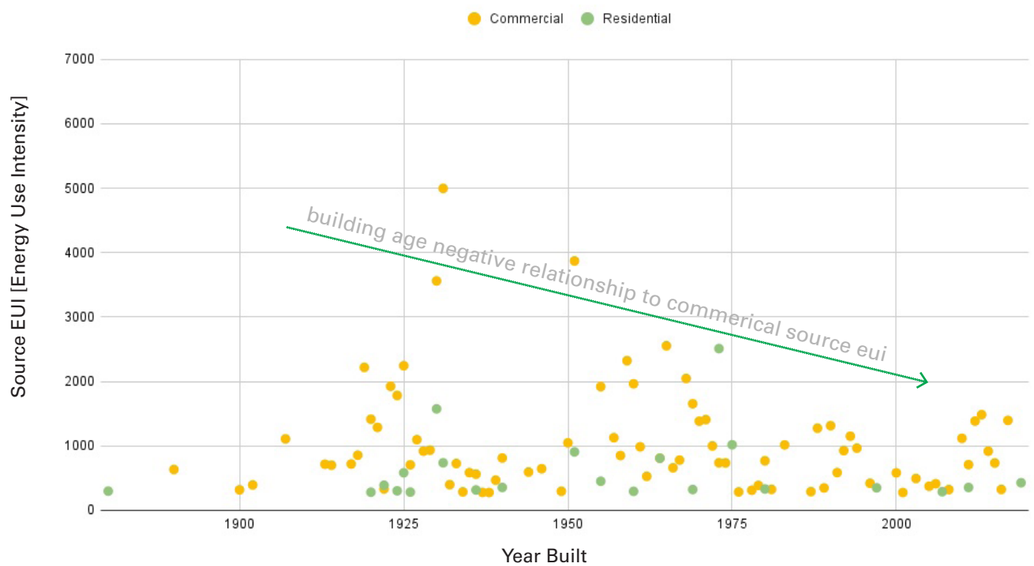
### BUILDING SOURCE EUI BASED ON YEAR BUILT

*buildings aggregated per year built by type

Overall Trend [Top 20% of Data]




Trend Highlight



# appendix

## datasets


1 Mayor's Office of Climate and Sustainability. 2021. **Energy and Water Data Disclosure for Local Law 84 2021** (Data for Calendar Year 2020) [dataset]. https://data.cityofnewyork.us/Environment/Energy-and-Water-Data-Disclosure-for-Local-Law-84-/usc3-8zwd

2 US Census Bureau. **2019 TIGER/Line Shapefiles** "2019 NYC Census Tract (Clipped to Shoreline)" [shapefile]. https://www1.nyc.gov/site/planning/data-maps/open-data/census-download-metadata.page

3 US Census Bureau. 2019. **American Community Survey 5-Year Estimates** (Brooklyn, NY) [dataset]. https://data.census.gov/cedsci/table?q=United%20States&g=0500000US36047%241400000&tid=ASMAREA2017.


## lit review


1 "80x50 Buildings Partnership" *Urban Green Council*, August 2018, https://www.urbangreencouncil.org/sites/default/files/blueprint_for_efficiency_80x50_bp.pdf.

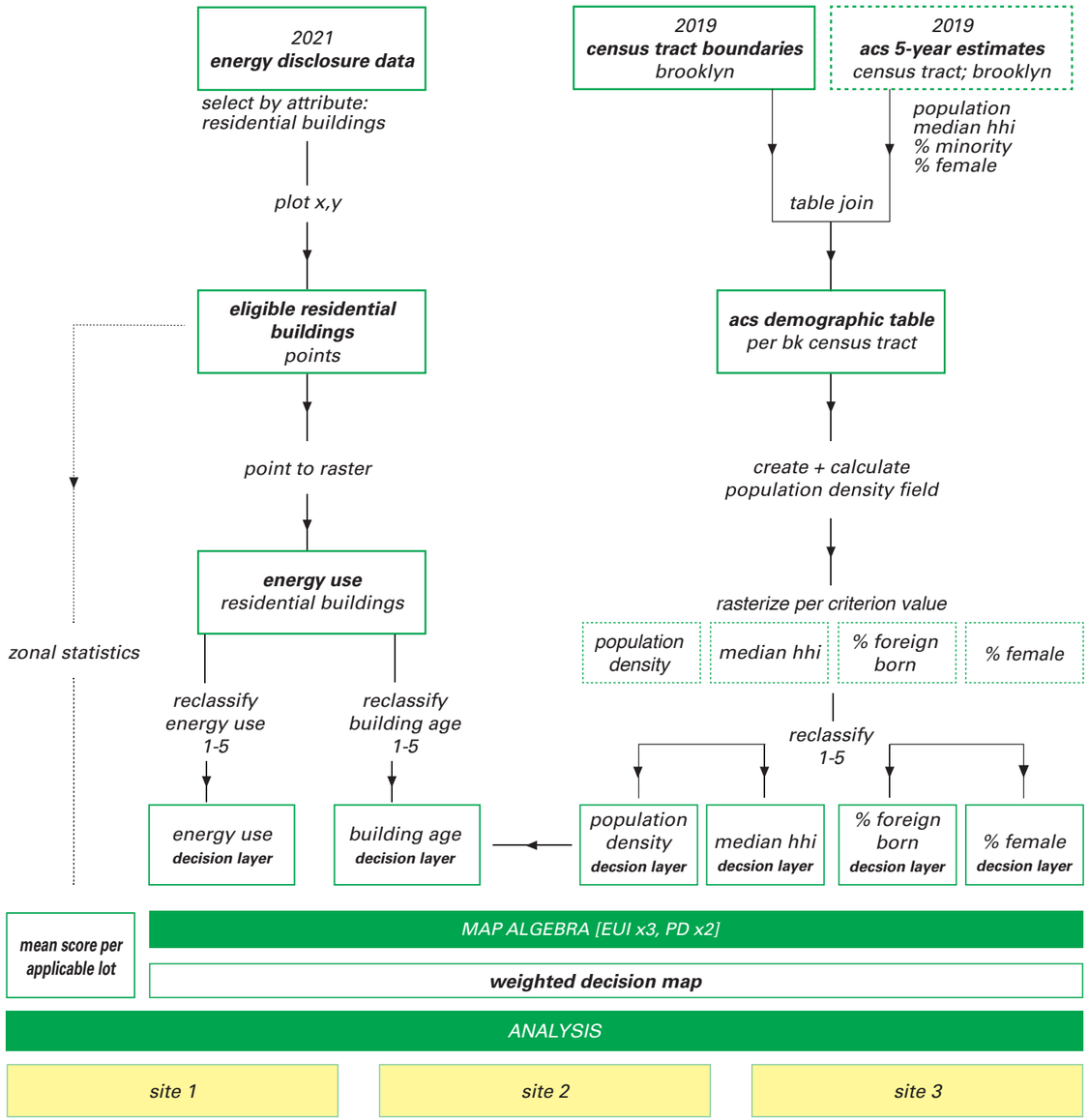
2 "Equity in Energy." *U.S. Department of Energy's Office of Economic Impact and Diversity*, 2021, https://www.energy.gov/diversity/equity-energytm.

3 "New York City's Energy and Water Use Report." *Urban Green Council*, December 2020, https://www.urbangreencouncil.org/sites/default/files/2020_nyc_benchmarking_report.pdf.

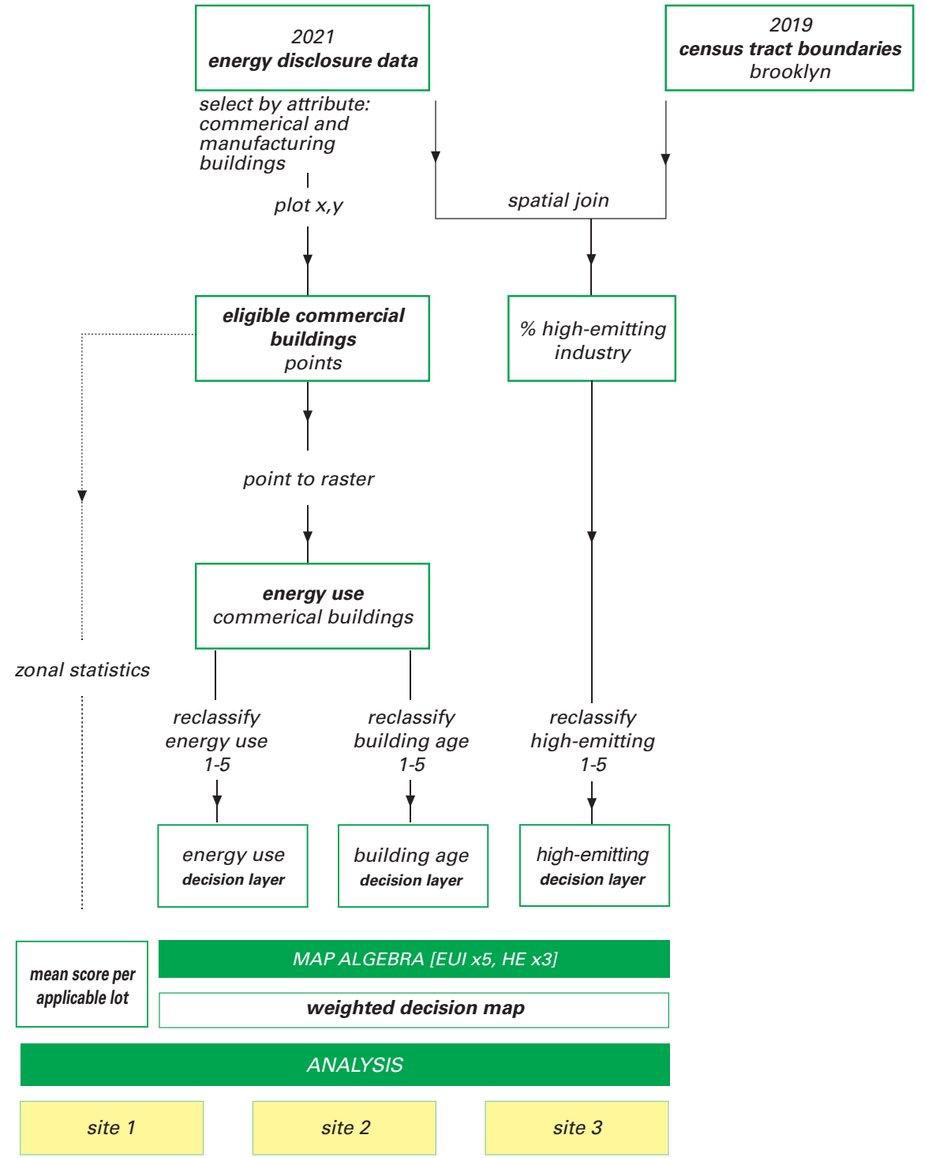
4 "NYC Building Emissions Law Summary: Local Law 97." *Urban Green Council*, July 2020, https://www.urbangreencouncil.org/sites/default/files/2020.07.09_urban_green_building_emissions_law_summary_revised_11.17.2020.pdf.

# methodology

*part 1: residential*




*part 2: commerical + manufacturing*



*nyc has over 1 million buildings, that's over 1 million opportunities to reduce energy consumption*

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