

30538 Final Project: Group 33

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Table of contents I

Research Question

Research Method And Coding Instructions

Results

Further Discussion for Furture Work

Research Question

Policy Background

- ▶ Over recent years, unprecedented climate changes, particularly extreme heat, have affected regions across the globe.
- ▶ In the United States, extreme heat has scorched much of the country, rapidly increasing heat-related deaths.
- ▶ This alarming trend highlights the urgent need for effective response measures.

Chicago's Climate Policy

- ▶ In 2008, Chicago adopted the Chicago Climate Action Plan (CCAP), which aimed to reduce the city's greenhouse gas emissions by 25% compared to 1990 levels by 2020.
- ▶ Initially, adaptive strategies were implemented, such as the installation of green roofs and reflective roofs on buildings.
 - ▶ These measures aimed to reduce heat absorption, enhance urban cooling, and provide immediate relief from rising temperatures.
 - ▶ However, the city recognized these actions as temporary solutions.
- ▶ In 2020, Chicago launched the Chicago Retrofit Roadmap, a three-year project to reduce carbon emissions at their source.

Our Research Question:

To evaluate the effectiveness and necessity of Chicago's evolving climate policies, our research seeks to answer the following questions:

- ▶ Did the 2008 CCAP continually reduce Chicago's greenhouse gas emissions before 2020?
- ▶ Can the Chicago Retrofit Roadmap further reduce carbon emissions and provide sustainable long-term solutions?

Research Method And Coding Instructions

Research Design

- ▶ To address the research questions, we aimed to uncover trends in greenhouse gas emissions, electricity usage, and natural gas consumption in Chicago.
- ▶ We used data visualizations to evaluate the impact of the 2008 Climate Action Plan (CCAP) before 2020 and the Chicago Retrofit Program after 2020.

Dataset Selection

- ▶ Due to limited public data, we used the Chicago Energy Benchmarking Report, which contains self-reported energy data from existing buildings, collected annually since 2014.
- ▶ Our analysis focused on data from 2017 to 2022 to easily divide trends into three years before and after 2020.

Challenge

- ▶ The dataset only contained 8,113 parcel-level observations—about 1% of Chicago's buildings
- ▶ Data inconsistencies occur, such as missing or incorrect values, which required substantial preprocessing to ensure accurate results.
- ▶ **Solution**
 - ▶ we concentrated on **identifying overarching trends**, using an efficiency metric derived from the available data.

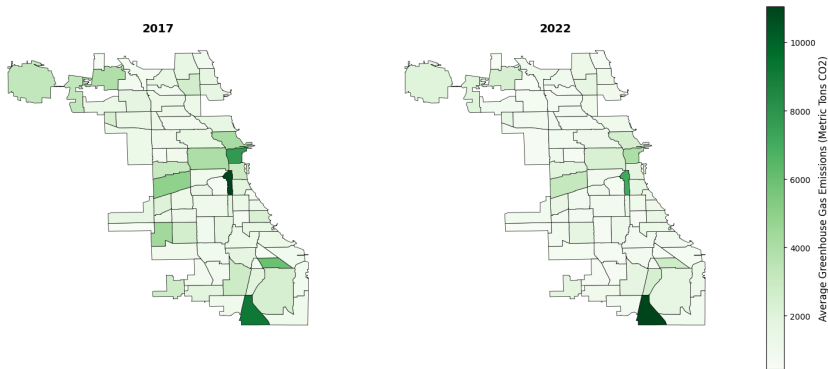
Results

Geometric Maps

Since we are focusing on the overall change, we generated 3 color-coded geometric maps of the intensities greenhouse gas emissions, gas consumption, and electricity consumption in Chicago communities for 2017 and 2022 to observe the differences.

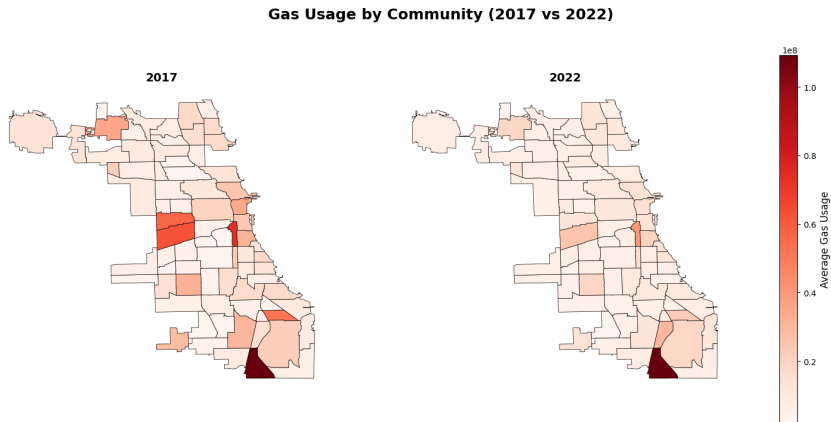
greenhouse gas emissions

Greenhouse Gas Emissions by Community (2017 vs 2022)



- ▶ The decreasing trend suggests that the 2008 CCAP and the Chicago Retrofit Roadmap initiatives to curb emissions have been somewhat effective.

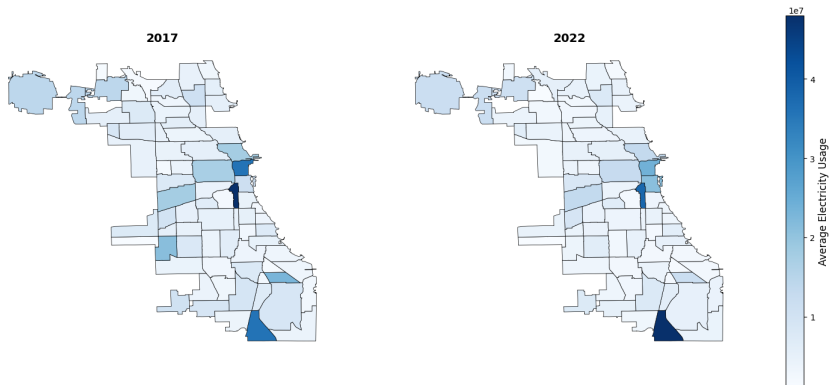
gas consumption map



- Similar results can also be drawn from gas and electric consumption.

electric consumption map

Electricity Usage by Community (2017 vs 2022)



► Similar results can also be drawn from gas and electric consumption.

Three Shiny Apps

To further observe these trends, we built three shiny apps to explore energy efficiency patterns across the 77 communities and 24 property types in Chicago.

Further Discussion for Furture Work

Furture Work

For future improvements:

- ▶ we plan to expand our dataset to include more building types and data beyond 2022 to further explore the impact of the Chicago Retrofit Roadmap.
- ▶ Additionally, we aim to acquire historical data from 1990 to assess whether the 2020 levels of emissions and energy usage are indeed 25% of those in 1990, as outlined in Chicago's climate goals.
- ▶ Furthermore, we need to develop a more sophisticated model to better distinguish the effects of the 2008 CCAP and the Chicago Retrofit Roadmap, ensuring that we can accurately attribute observed changes to each initiative.

This will help us more precisely evaluate the effectiveness of these policies and provide more targeted recommendations for future climate action.