Introduction

Climate change, population growth, and increasing peak electricity demand highlight the importance of the sustainable use of energy in our communities. Residential and commercial buildings account for almost 40% of the total energy use in the United States, putting building energy efficiency among the main objectives for energy planning and policy. To reinforce their sustainable energy plans, many cities across the United States have adopted energy transparency ordinances in recent years. The data released under these energy benchmarking laws enabled researchers to investigate the performance of residential and commercial buildings. Many studies have been performed based on these data to help municipalities meet their energy efficiency and carbon emission reduction goals. This main goal of this work is to present a review of the energy benchmarking policies across the United States.

By the year 2019, more than 30 jurisdictions in the U.S. has been adopted different types of energy benchmarking laws. Some cities are mandated only public and commercial buildings such as Pittsburgh and Minneapolis, and some cities mandated more building types (public, commercial, and multifamily buildings) such as Boston, New York City, and Los Angeles. Thanks to these disclosure data policies, studying energy consumption in buildings gained interest among researchers. Based on many of these ordinances, the cities are authorized to make building-level data available to the public and it can provide useful detailed building energy information. As an example, in Figure 1 the covered buildings under the City of Chicago benchmarking ordinance are represented.
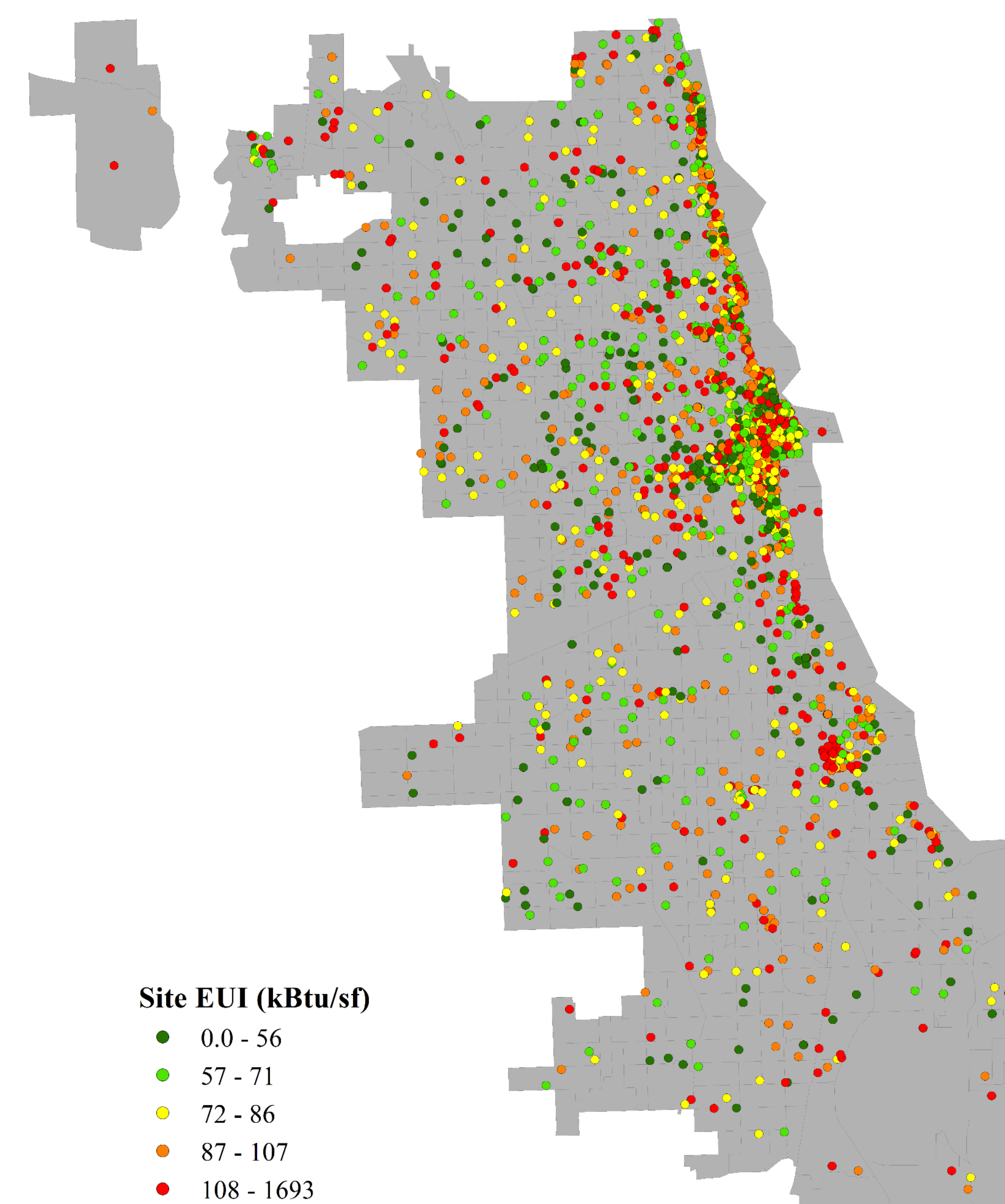

Site EUI (kBtu/sf)
- 0.0 - 56
- 57 - 71
- 72 - 86
- 87 - 107
- 108 - 1693

Figure 1. Spatial distribution of building energy benchmarking data in City of Chicago

Technical Approach

Among the all jurisdictions that adopted energy benchmarking laws, some of them didn't have available data at the time of the study, and the data for some others was not mature enough to be considered for review. This study investigated the disclosed energy benchmarking data of 8 big cities (Austin, Boston, Chicago, Kansas, Los Angeles, Seattle, Washington D.C., New York City) across the U.S. which encompasses a total number of more than 27,000 and buildings. Each city has its own policy and criteria for mandating the buildings to disclose their energy data e.g. City of Chicago mandated commercial, industrial, and residential buildings larger than 50,000 s.ft. while other cities have different criteria. We have processed the released energy datasets and compared the variables that are covered by each policy. Finally, the study investigates whether the released datasets caused by the energy disclosure policies are useful enough to push toward more sustainable energy use in the buildings.

Results

The variables reported by benchmarking policies in different cities across the United States are shown in the table 1, the current energy disclosure policies report the general information like building energy use intensity, gross floor area, property type, etc. however, one of the important variables which is occupancy rate is missing in most of the benchmarking data. Moreover, the operational energy use of buildings is mostly related to the occupant behavior, facilities system, architectural and engineering design aspects (e.g. passive design, thick envelope, insulation material, windows type, and external shading devices.), and these variables are neither available in the urban scale nor provided by the current benchmarking data.

Table1. Variables reported by buildings based on energy benchmarking data

Data Type	Variable	City							
		Austin	Boston	Chicago	Kansas City	Los Angeles	Seattle	Washington D.C.	New York City
Building Characteristics	Building Age	√	√	√	√	√	√	√	√
	Location	√	√	√	√	√	√	√	√
	Property Use Type	√	√	√	√	√	√	√	√
	Gross Floor Area	√	√	√	√	√	√	√	√
	Facility System	×	×	×	×	×	×	×	×
	Passive Design	×	×	×	×	×	×	×	×
	Thick envelope	×	×	×	×	×	×	×	×
	Insulation Type	×	×	×	×	×	×	×	×
	Window types	×	×	×	×	×	×	×	×
	External shading device	×	×	×	×	×	×	×	×
Occupant Behavior	Level of Occupancy	×	×	×	×	√	×	×	√
	Lighting System Control	×	×	×	×	×	×	×	×
	HVAC System Control	×	×	×	×	×	×	×	×
	Window Control	×	×	×	×	×	×	×	×
Energy Consumption	Electricity Use	×	√	√	×	×	√	√	√
	Steam Use	×	×	×	×	×	×	√	×
	Natural Gas Use	×	√	√	×	×	√	√	√
	Total Energy Use	√	√	√	√	√	√	√	√
	Water Use	×	√	×	√	√	×	√	√

Discussion

Although implementing such building energy disclosure policies provided the data for some aspects of building energy use, to support the urban energy decision making by buildings' data, we need to have data available for both operational energy use and embodied energy use. However, from the embodied energy use perspective, the current available data doesn't provide the important variables in urban scale.

Another concern regarding the benchmarking data is the accuracy of the reported data, because most of the benchmarking data are self-reported. Although some variables like gross floor area in Washington D.C. data are verified by the tax report documents, most of the benchmarking data haven't been verified and it may cause inaccuracy in any decision or planning based on the benchmarking data.