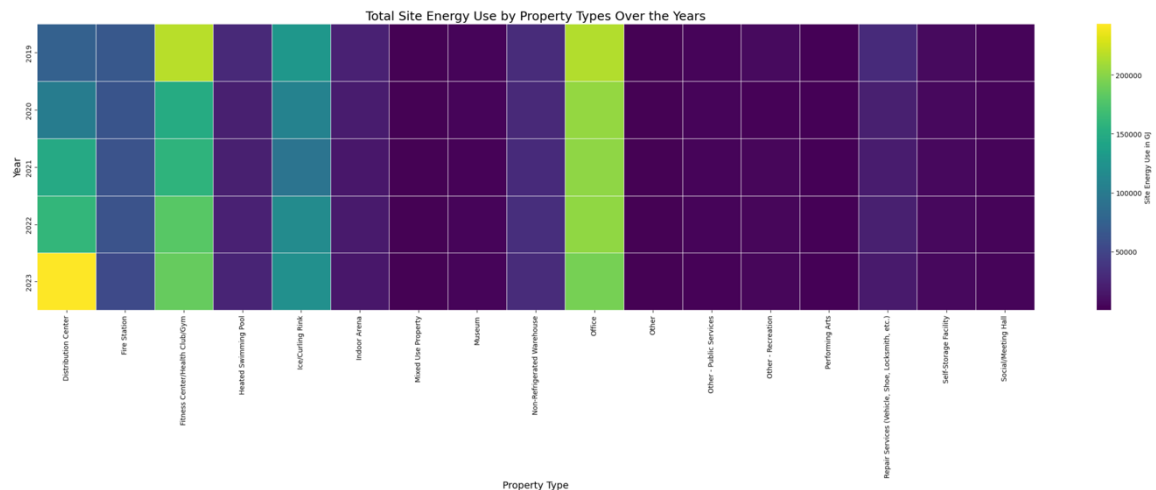


## Report - Data Analysis of Building Energy Benchmarking Data

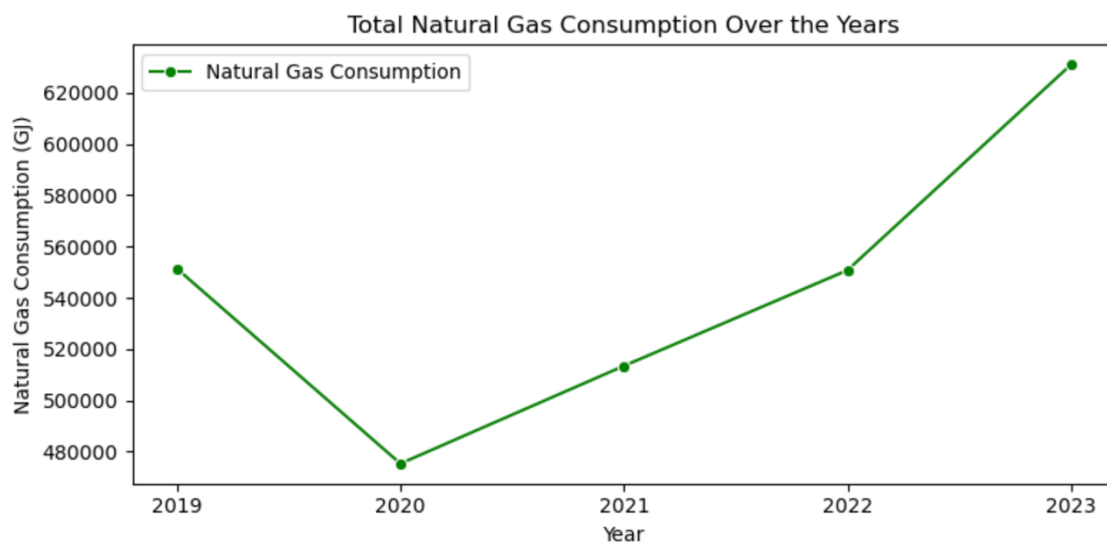
This report presents an analysis of building energy and greenhouse gas emission performance information for a subset of properties owned and operated by the City of Calgary. The dataset is taken from the open data portal of the City of Calgary and contains data from 2019 to 2023. Python, Regular Expressions (Regex), Pandas (for minimal tabular operations), NumPy, and Matplotlib and Seaborn are used to preprocess, analyze, and visualize the data. Regular expressions were used to extract numerical values from text based columns and format the postal codes, site names and address columns. Given below are the insights obtained from the analysis.

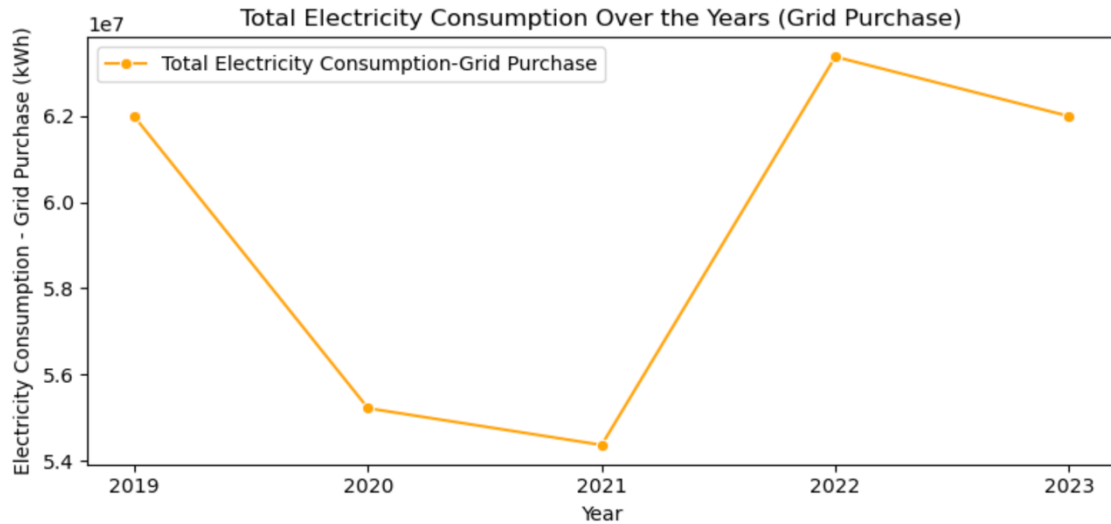
### Total Site Energy Use in GJ by Property Types Over the Years



It is evident from the heatmap that "office" property types are the top energy consumers over 5 years from 2019 to 2023, but the consumption rate is slightly and consistently decreasing. Distribution centres are showing a constant rate of increase in energy consumption with the highest energy demand in the year 2023 indicating increasing energy demand. The energy use by fitness centres and ice/curling rinks varied over the years. All the other property types show constant site energy use patterns.

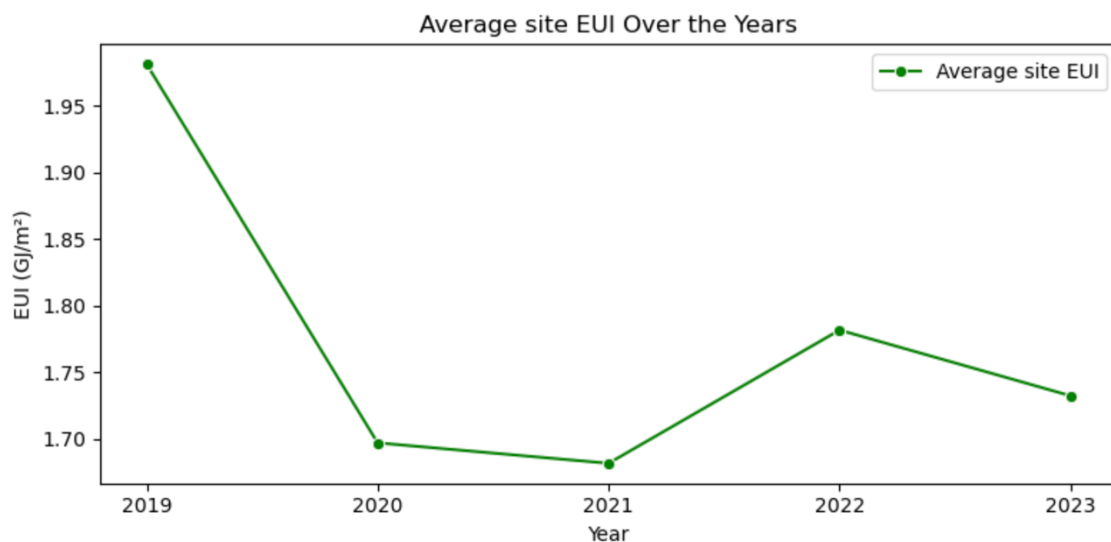
### Natural Gas and Electricity (grid purchase) Consumption over the years (2019 – 2023)





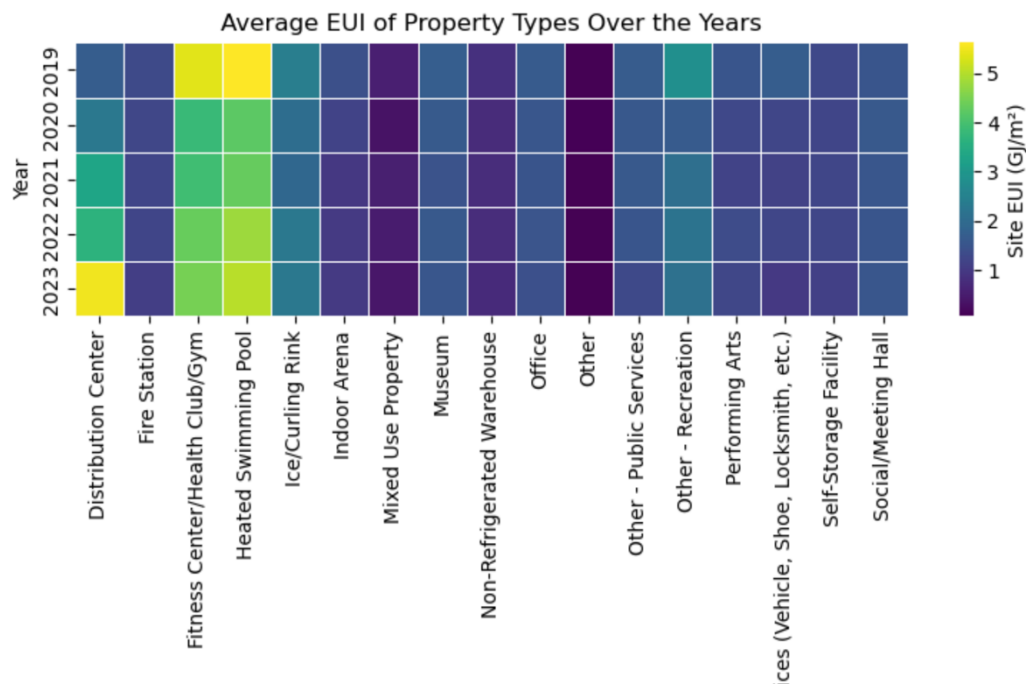
From the plots, it is clear that there is a steep decrease in the energy consumption was seen in the time period 2019 to 2020. The natural gas consumption saw a steady increase from the year 2020 whereas electricity consumption (purchased from the power grid) saw a slight decline from 2020 to the next year. The electricity consumption has remained inconsistent over the years. Increasing demand for natural gas should be addressed appropriately.

#### Average Site EUI (2019 – 2023)



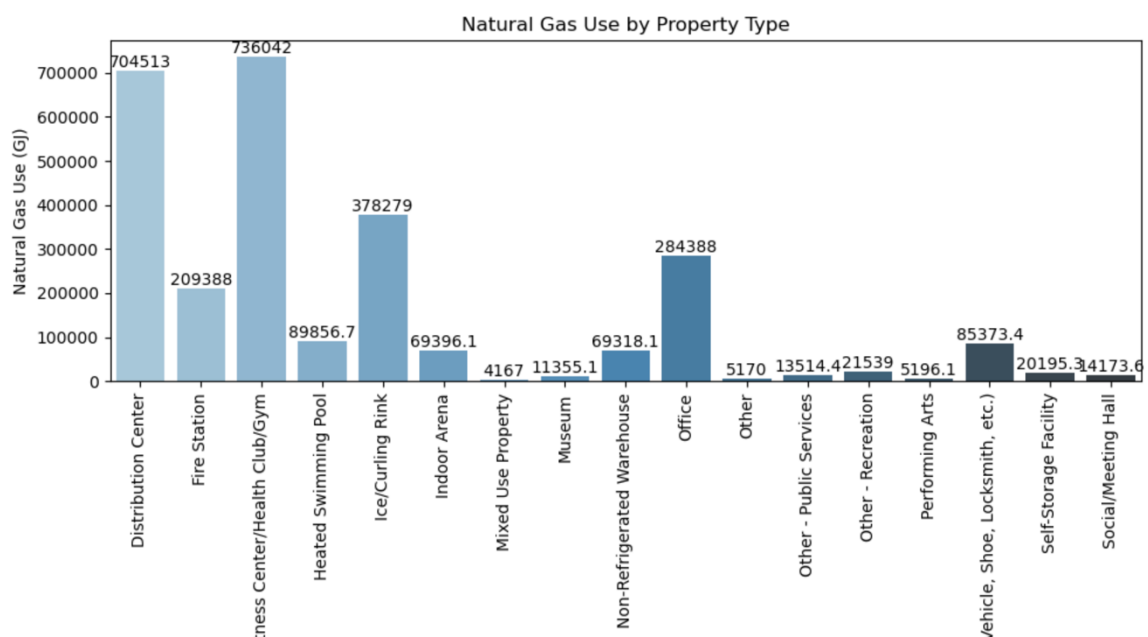
The average energy efficiency has seen a significant rise (low EUI) in the 2019 and has been varying over the next three years. From 2022 to 2023 the energy efficiency has increased slightly. Reduced efficiency should be addressed properly by promoting more efficient energy resources.

## Energy Efficiency - Property Types



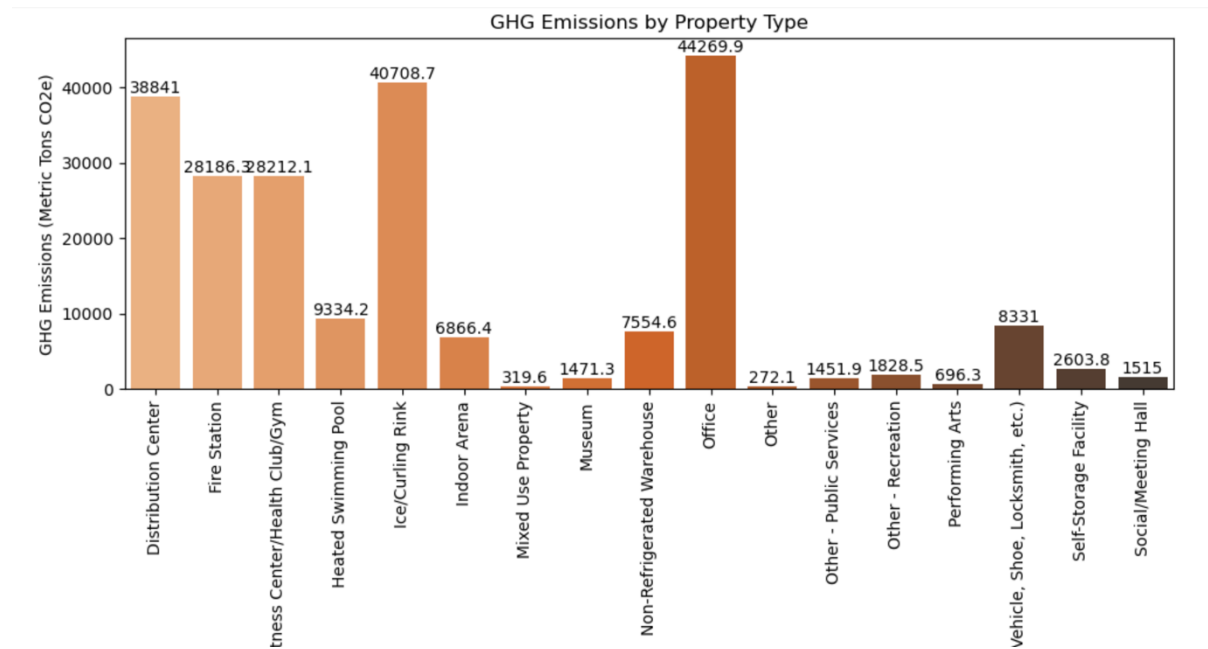
Distribution sites are showing higher average EUI values over time indicating falling energy efficiency. The energy efficiency of fitness centres improved in 2020 but then again faced a drop over the next two years. Heated swimming pools are showing consistent improvement in energy efficiency. The properties listed under 'other' category are the most energy efficient followed by mixed use property type. Proper measures are to be taken to address the dropping efficiency levels.

## Natural Gas Consumption by Property Types



Over the analysis period from 2019 to 2023, health clubs and distribution centres are the dominant consumers of natural gas followed by ice curling rinks and offices. Proper resources should be allocated to these property types so that they can use more environment friendly and renewable energy sources.

### Total GHG Emissions by Property Type



Offices, Ice/Curling rinks and Distribution centres are the top GHG emitters followed by fire stations and fitness centres. We can observe that the GHG emissions are related to the natural gas consumption. To reduce the GHG emissions, other alternative resources must be used.