HACKATHON

Pioneering Strategies for Reducing Carbon Emission

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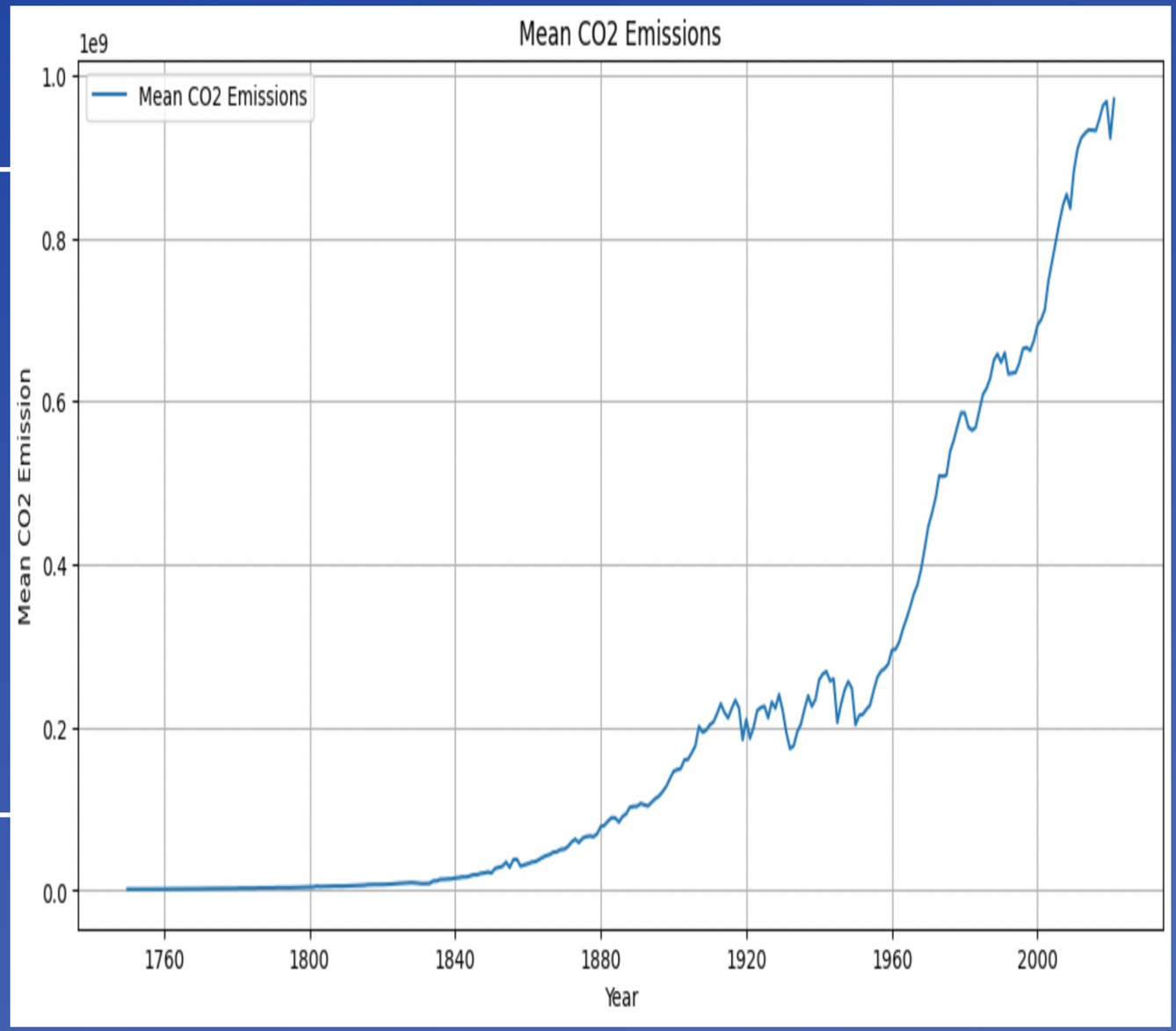
TABLE OF CONTENTS

BACKGROUND

Over the years, there has been a consistent upward trend in global CO2 emissions.

Rising CO2 levels are a major driver of global climate change and its associated effects.

International cooperation is critical to achieving meaningful reductions in emissions.



DATASET

NYC Open Data on Energy Usage

https://opendata.cityofnewyork.us/data/

```
(2000, 249)
```

	property_id	property_name	parent_property_id	parent_property_name	year_ending	nyc_borough_block_and_lot	nyc_building_identification	ac
0	21205224	Astoria Blvd Property	Not Applicable: Standalone Property	Not Applicable: Standalone Property	2021-12-31T00:00:00.000	4006520042	4538607	
1	2665352	Stellar - 70 West 93rd Street	20599688	Stellar - Campus West 93rd Street	2021-12-31T00:00:00.000	1-01206-0001	1031627	
2	2665400	Stellar - 28-50 West 97th Street	Not Applicable: Standalone Property	Not Applicable: Standalone Property	2021-12-31T00:00:00.000	1-01832-0043	1055265	W
3	2665405	Stellar - 310 Greenwich St	Not Applicable: Standalone Property	Not Applicable: Standalone Property	2021-12-31T00:00:00.000	1-00142-0025	1083157;1083235;1083237;1083240;1083241;108324...	G St
4	2665415	Stellar - 87 Hamilton Place	Not Applicable: Standalone Property	Not Applicable: Standalone Property	2021-12-31T00:00:00.000	1-02072-0039	1061772	

5 rows × 249 columns

DATA PROCESSING

01 Convert into Numeric Values

```
   18  df_cleaned.isna().sum()
   19
[254]  ✓  0.0s

...  /var/folders/2c/cd06n1c95mv7lsfybtv2zt1w0000
     A value is trying to be set on a copy of a s

     See the caveats in the documentation: https:
       df_cleaned.fillna(df_cleaned.median(), inp

     property_id                          0
     postal_code                          0
     largest_property_use_type_1          0
     year_built                           0
     number_of_buildings                  0
     occupancy                            0
     national_median_energy_star          0
     site_eui_kbtu_ft                     0
     weather_normalized_site_eui          0
     national_median_site_eui             0
     site_energy_use_kbtu                 0
     weather_normalized_site_energy       0
     weather_normalized_site              0
     source_eui_kbtu_ft                   0
     weather_normalized_source            0
     national_median_source_eui           0
     source_energy_use_kbtu               0
     weather_normalized_source_1          0
     natural_gas_use_kbtu                 0
     natural_gas_use_therms               0
     electricity_use_grid_purchase        0
     electricity_use_grid_purchase_1      0
     weather_normalized_site_3            0
     electricity_use_grid_purchase_2      0
     electricity_use_grid_purchase_3      0
     ...
     longitude                            0
     community_board                      0
     council_district                     0
     census_tract                         0
     dtype: int64
```

02 Set Threshold for NaN Values

03 Fill NA with Median to Proceed

The # of NAs are set to be 0 across all columns

TRADITIONAL OLS

Sorted out independent variables that appear to have strong relationship with CO2 emission amounts

1) Number of Buildings
2) Year Built
3) Occupancy
4) Property Gross Floor Area
5) Weather Normalized Site (EUI)
6) Site Energy Use

OLS Regression Results

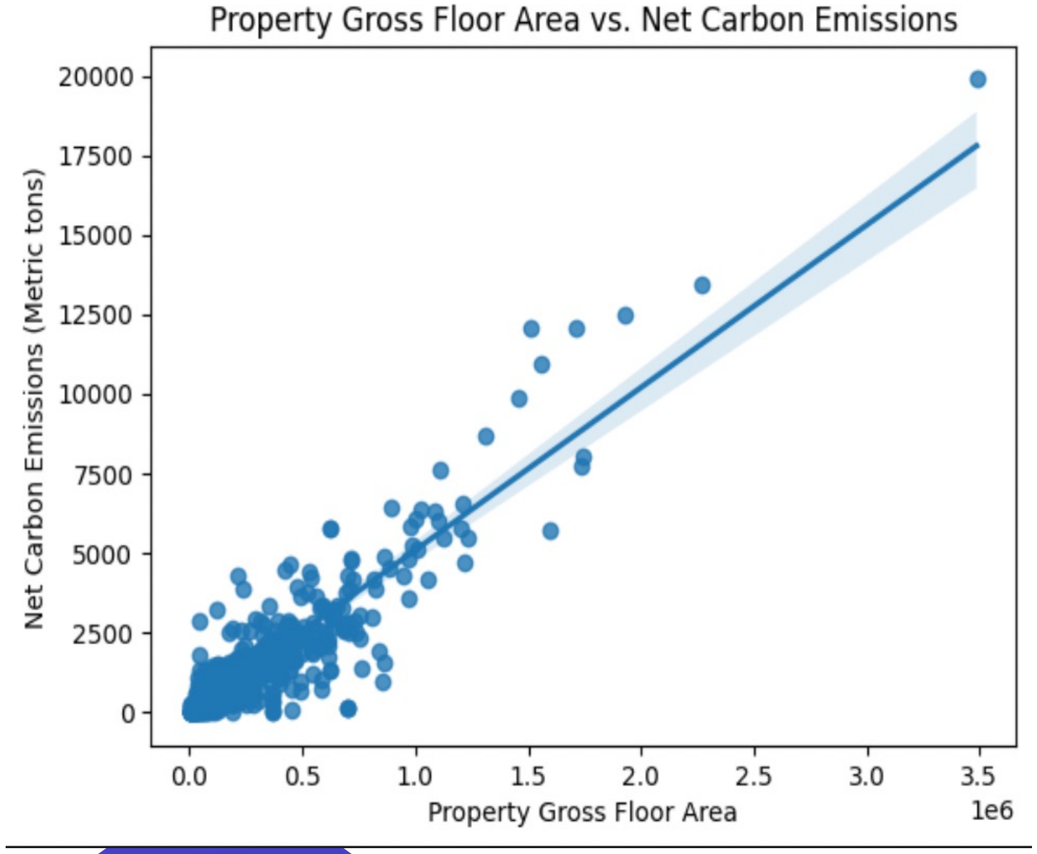
Dep. Variable:	Net Carbon Emissions (Metric tons)	R-squared:	0.981
Model:	OLS	Adj. R-squared:	0.981
Method:	Least Squares	F-statistic:	1.391e+04
Date:	Sat, 07 Oct 2023	Prob (F-statistic):	0.00
Time:	21:52:43	Log-Likelihood:	-10359.
No. Observations:	1600	AIC:	2.073e+04
Df Residuals:	1593	BIC:	2.077e+04
Df Model:	6		
Covariance Type:	nonrobust		

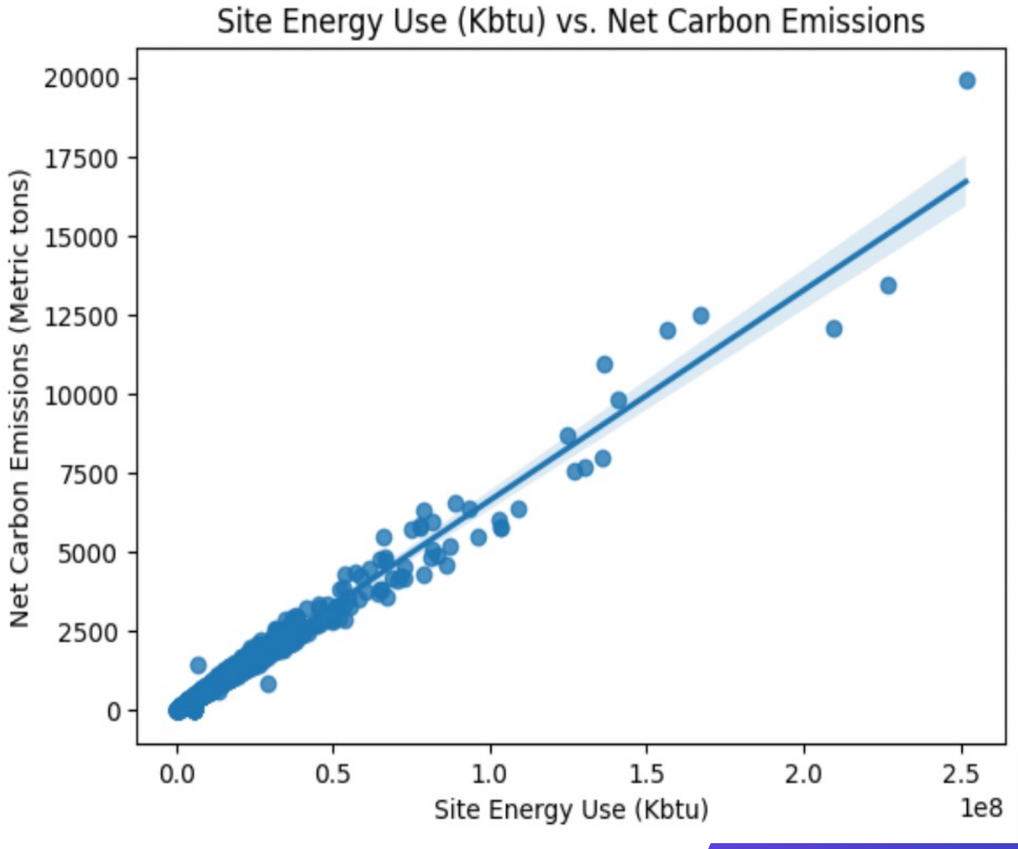
	coef	std err	t	P>|t|	[0.025	0.975]
const	120.6097	243.937	0.494	0.621	-357.862	599.081
Numer of Buildings	-1.5140	0.901	-1.680	0.093	-3.282	0.254
Year Built	-0.0378	0.122	-0.309	0.757	-0.278	0.202
Occupancy	-0.9278	0.400	-2.317	0.021	-1.713	-0.143
Property Gross Floor Area	0.0009	4.47e-05	20.094	0.000	0.001	0.001
Weather Normalized Site (EUI)	2.9986	0.405	7.400	0.000	2.204	3.793
Site Energy Use (Kbtu)	5.6e-05	5.44e-07	103.025	0.000	5.49e-05	5.71e-05

Omnibus:	1334.690	Durbin-Watson:	1.940
Prob(Omnibus):	0.000	Jarque-Bera (JB):	392306.513
Skew:	2.943	Prob(JB):	0.00

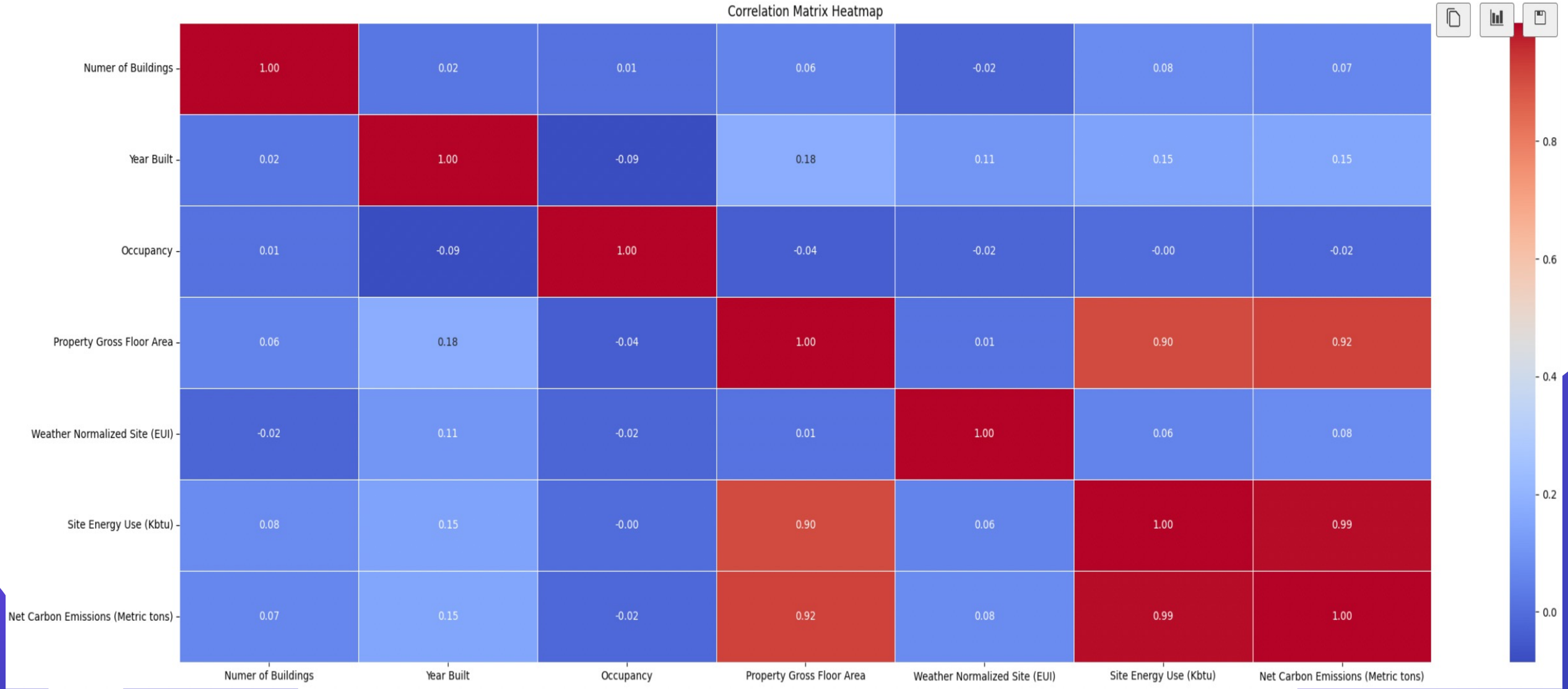
TRADITIONAL OLS

Two Most Relevant Variables that Can Contribute to CO2 Emission:
1) Property Gloss Floor Area 2) Site Energy Use (Kbtu)





TRADITIONAL OLS



MACHINE LEARNING

01 KNN REGRESSOR

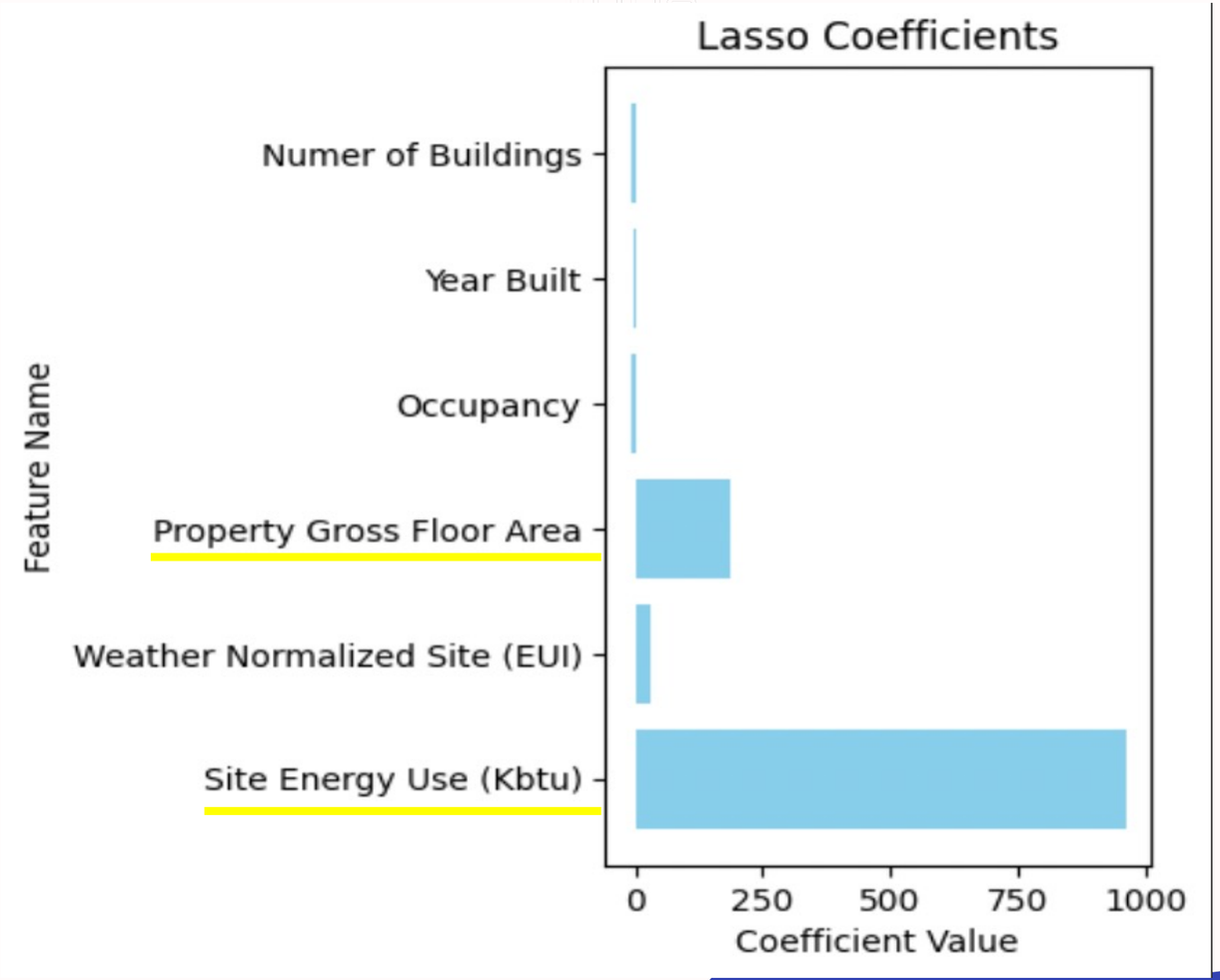
```
Training Set'S MSE: 103138.29061525
Test Set'S MSE: 418225.091404
Training-set score: 0.949
Test-set score: 0.942
```

02 LINEAR REGRESSSOR

```
Training Set'S MSE: 32801.12761232202
Test Set'S MSE: 45497.975063494756
Training-set score: 0.981
Test-set score: 0.978
```

03 LASSO

```
Training Set'S MSE: 32798.52653356789
Test Set'S MSE: 45485.813396932834
Number of features used: 6
Training-set score: 0.981
Test-set score: 0.978
```



AND PREDICTION

- The LASSO regression model demonstrates superior performance, boasting an impressive accuracy score of 0.978 when incorporating all six explanatory variables.
- Notably, it's the two variables that particularly stood out in the traditional OLS model, Property Gross Floor Area & Site Energy Use, showcasing the most substantial contribution to enhancing its predictive accuracy.

THANK'S FOR WATCHING