Analyzing Energy Disclosure Data in the Urban Context

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Energy disclosure and its importance

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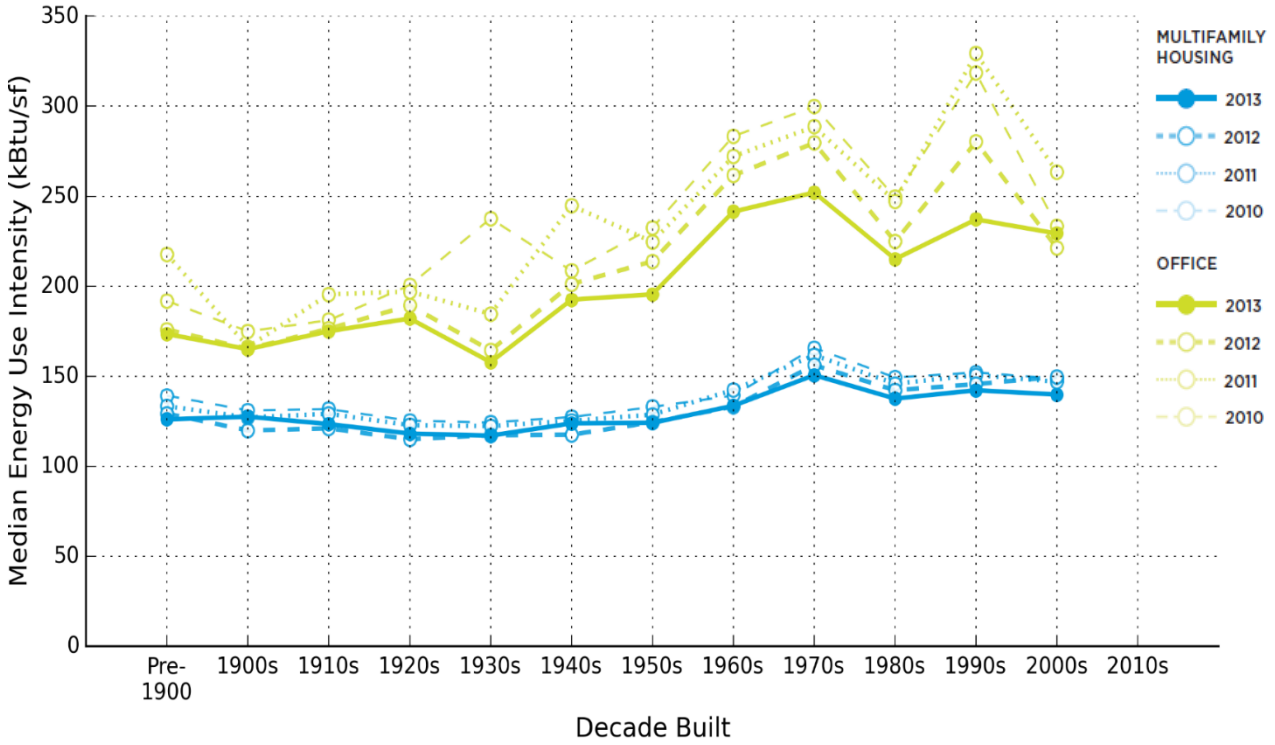
  - Benchmarking and peer-comparison



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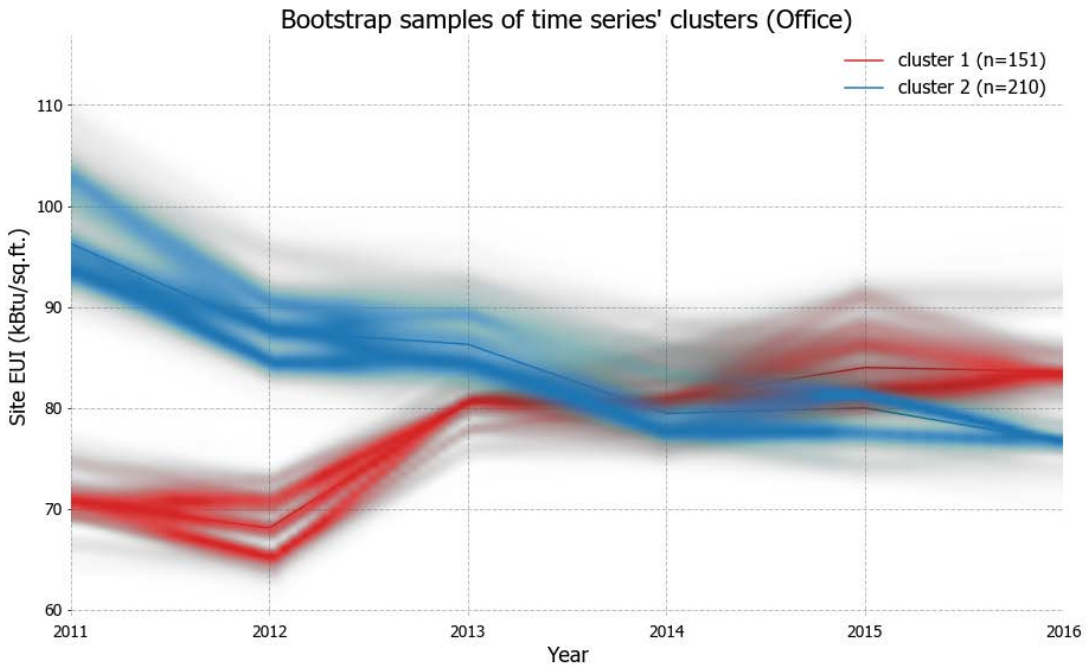

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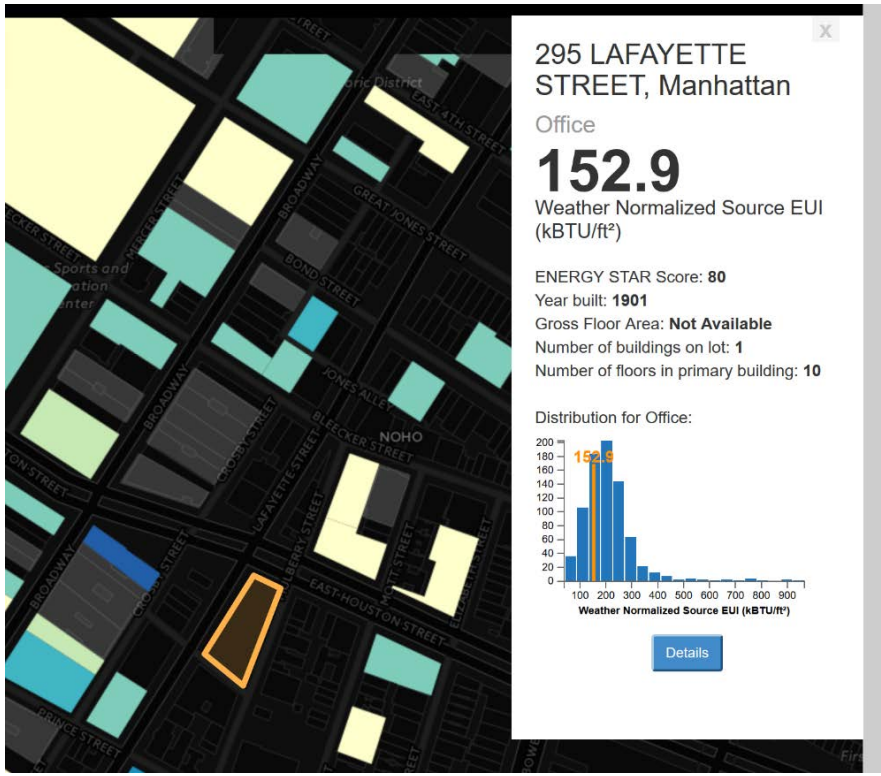

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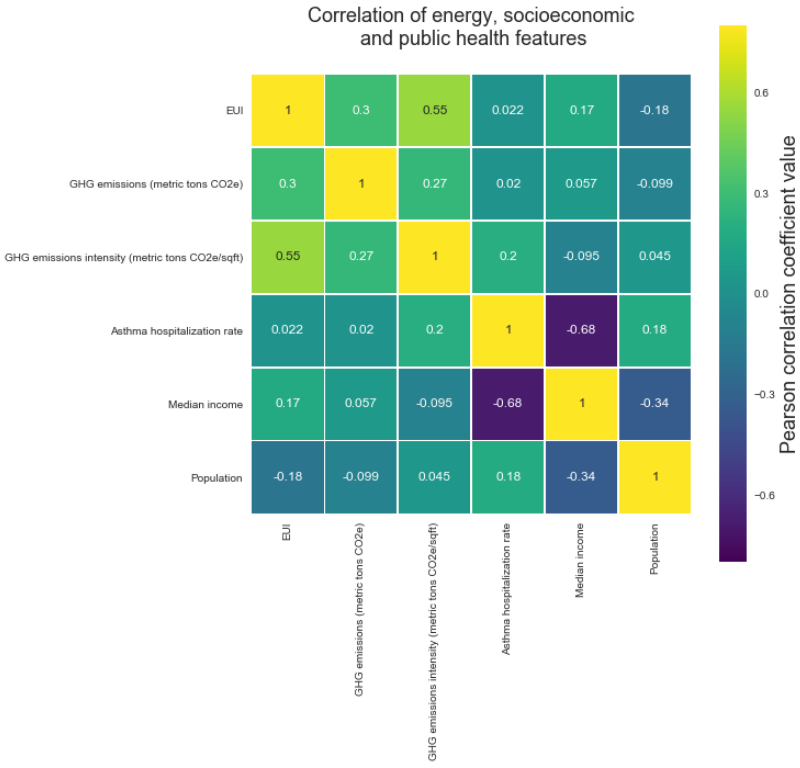

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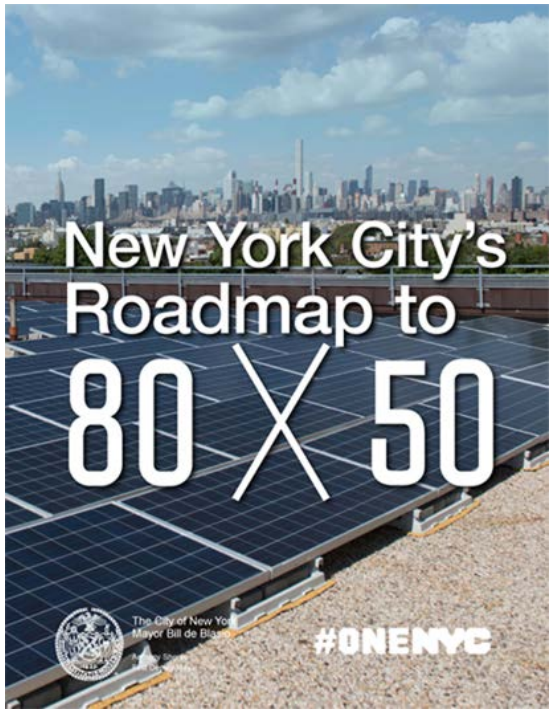
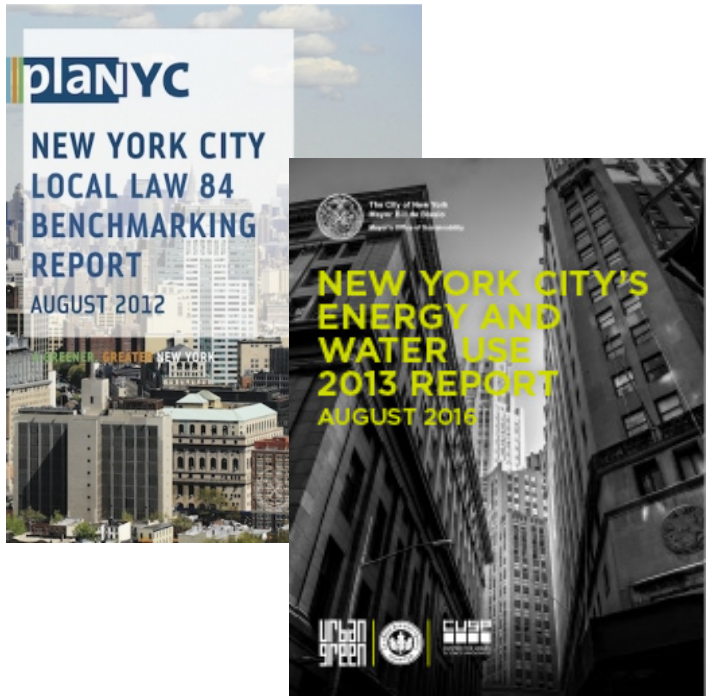
  - Infer large scale energy consumption

NYC's Local Law 84

- Part of NYC 80X50 plan
- All properties >50,000 sq.ft. to annually report their energy usage (more than 15,000 buildings)





LL84 data

- Property info (*BBL, Address, Coordinates, Typology*)

- Energy info (*Total consumption, Energy use intensity, GHG emissions*)

- Occupancy (*Number of units, Operating hours, Worker density*)

Problems with the data

- Self-reported
- Lack of knowledge/definitions
  - Building size
  - Operating hours
- Typical data entry errors
  - Misreported units, etc.
- Annual aggregation creates problems
  - Occupancy, etc.

Energy consumption v. efficiency v. performance

- Consumption
  - Electricity and fuel use converted to kBtu
  - International metric typically kWh
- Efficiency
  - Typical metric – kBtu/sq.ft. (kWh/sq.m.)
  - Weaknesses – occupancy density, other controls
- Performance
  - Ratio of actual v. predicted energy efficiency based on statistical models using multiple building, energy, occupancy, and physical characteristics

Measuring performance

- Energy Star model for Office

$$y = \alpha + \beta_1 \log CWorker Density + \beta_2 \log COpHours + \beta_3 PCDensity + \beta_4 \log FloorArea + \beta_5 HDD + \beta_5 CDD + \varepsilon$$

Where:

logCWorkerDensity = the natural log of the number of workers in the building per 1,000 square feet (centered on the mean value for the sample)

logCOpHours = the natural log of the average weekly operating hours for the building (centered on the mean value for the sample)

PCDensity = the number of personal computers per 1,000 square feet[2]

logFloorArea = the natural log of the gross floor area of the buildings

HDD = number of annual Heating Degree Days

CDD = number of annual Cooling Degree Days

Understanding energy performance

Building quality correlated with higher energy intensity

Lot location and envelope exposure

Older building relative efficiency holds when controlling for other factors

Occupants key drivers of energy consumption – need to better understand tenant types/uses

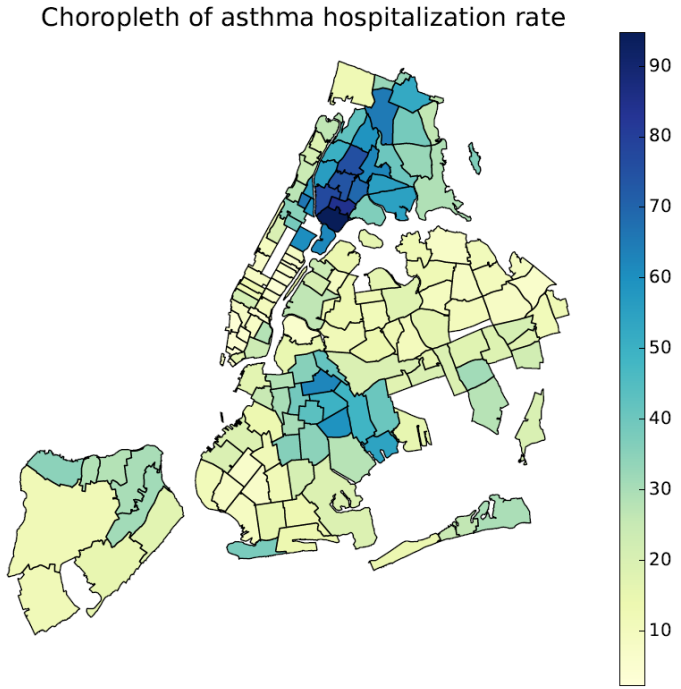
Raises questions about proliferation of glass curtainwall systems

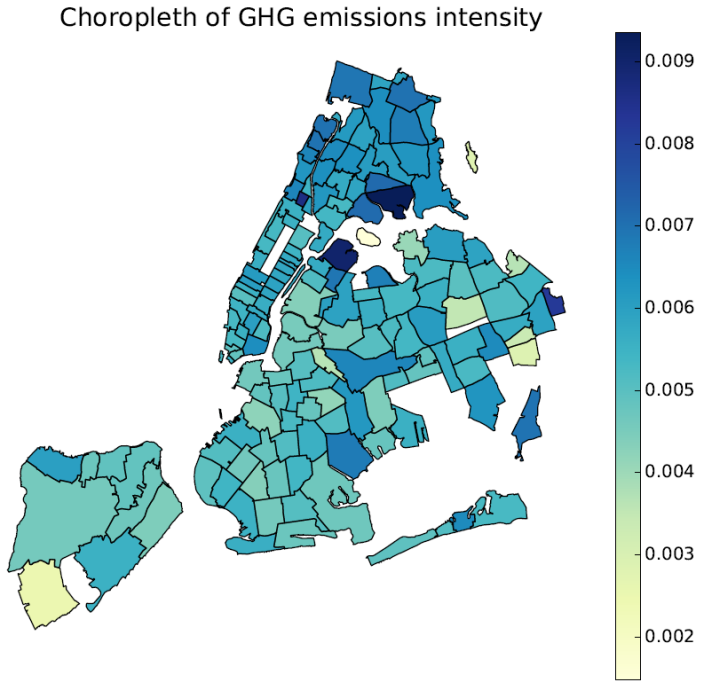
	Full Sample		*Class A Only*		*Class B Only*	
Number of obs	635		229		288	
F(25, 609)	17.05		F(23, 205) = 8.98		F(22, 265) = 7.11	
Prob > F	0.000		0.000		0.000	
R-squared	0.334		0.370		0.226	
Building Quality	*Coef.*					
Class B	-0.008					
Class C	-0.269	***				
Physical Characteristics						
Floor Area >200k <1M sq.ft.	-0.039					
Floor Area >1M sq.ft.	-0.083					
Number of Floors	0.010	***				
As-built Floor Area Ratio	-0.014	***				
% Air Conditioned Space	0.000					
Inside Lot	-0.091	***				
Building Age						
Built 1991 to 2010	0.401	***				
Built 1971 to 1990	0.091					
Built 1951 to 1970	0.030					
Built 1931 to 1950	0.011					
Renovated Since Built	0.013					
Occupancy and Use						
Operating Hours (log)	0.288	***				
Operating Hours (quadratic)	-0.00002	**				
Worker Density (log)	0.085	***	0.083	**	0.133	***
% Data Center	3.441	***	9.611	***	3.942	***
% Leased	0.000		0.000		0.003	
Construction Type						
Masonry	-0.070	**	0.095	*	-0.130	***
Reinforced Concrete	0.007		-0.019		0.059	
Energy and Eco-Labels						
Electric (>50% of total consumption)	0.057		-0.027		0.039	
District Steam (>50% of total consumption)	0.004		0.010		-0.252	
LEED Certified	0.134		0.084		0.046	
Energy Star Labeled	-0.104	***	-0.141	***	-0.156	***
LEED Certified & Energy Star Labeled	-0.200	**	-0.166	**	*omitted*	
Constant	4.207	***	4.476	***	4.254	***

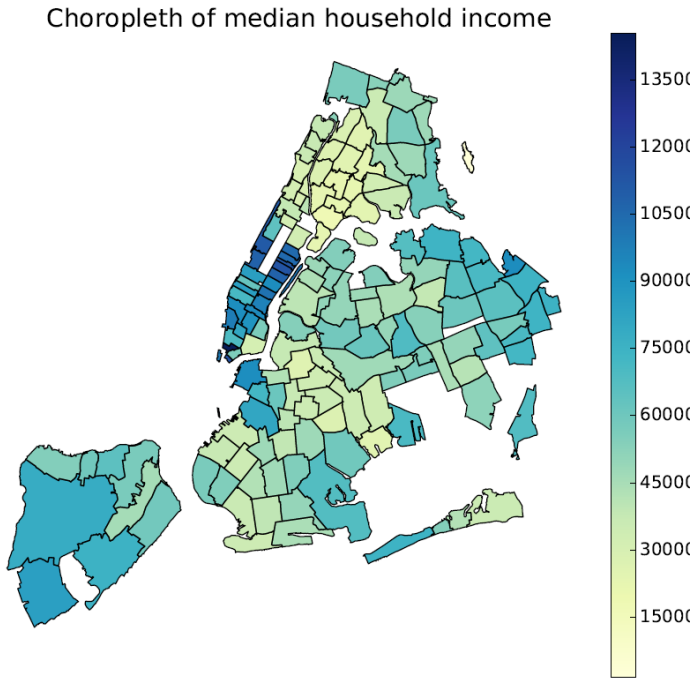
NYU Center for Urban Science + Progress

Kontokosta, C. E. (2015). A market-specific methodology for a commercial building energy performance index. The Journal of Real Estate Finance and Economics, 51(2), 288-316.

Energy, health, and society







Useful material

- Energy benchmarking report
  http://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/UGC-Benchmarking-Report-101617-FINAL.pdf
- Building performance index

  Kontokosta, Constantine E. "A market-specific methodology for a commercial building energy performance index." *The Journal of Real Estate Finance and Economics* 51, no. 2 (2015): 288-316. https://link.springer.com/article/10.1007/s11146-014-9481-0
- Socio-economic relationships with energy consumption

  Ma, Jun, and Jack CP Cheng. "Identifying the influential features on the regional energy use intensity of residential buildings based on Random Forests." *Applied Energy* 183 (2016): 193-201. http://www.sciencedirect.com/science/article/pii/S0306261916311941

Summary

- Energy disclosure • Insights • Solutions to urban problems

- For the assignment:
    - Metric for understanding energy performance and peer building comparison

    OR

    - Social impacts of building energy/emissions. Relationships between asthma hospitalization rates-neighborhood income-energy use