

# Cities & building energy policies

## MIT 11.165/477, 11.286J

David Hsu  
Associate Professor  
Urban Studies & Planning  
MIT

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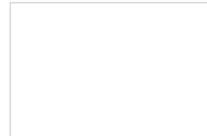
# Environmental policy instruments (May, 2003)

- 1 command-and-control regulation
- 2 charges & special taxes (incl. carbon taxes)
- 3 economic regulation
- 4 standards
- 5 incentives & subsidies (incl. tax credits)
- 6 government insurance
- 7 direct government provision
- 8 government corporations & enterprises
- 9 contracting, purchasing
- 10 social regulation
- 11 vouchers
- 12 tort liability
- 13 public information

# Market transformation & heterogeneity



*What information will cause action?*



Information

Building Owners

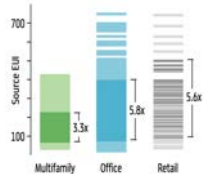
*What determines building energy performance?*

*What buildings should I be compared to?*

Potential Buyers

Investment

*What investments are cost-effective?*



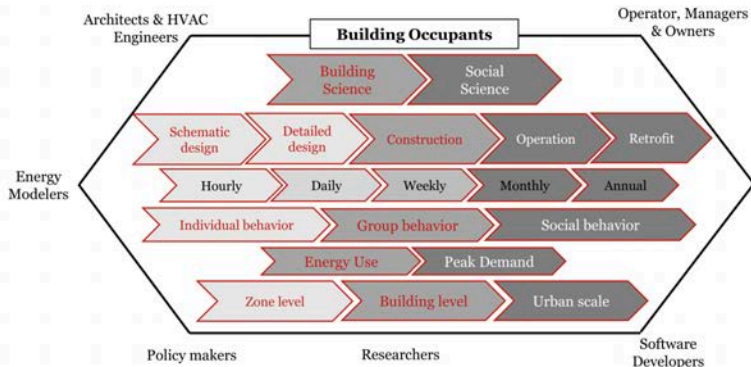


Fig. 1. Spatial, temporal, and contextual fields of application of the behavior research and stakeholders.

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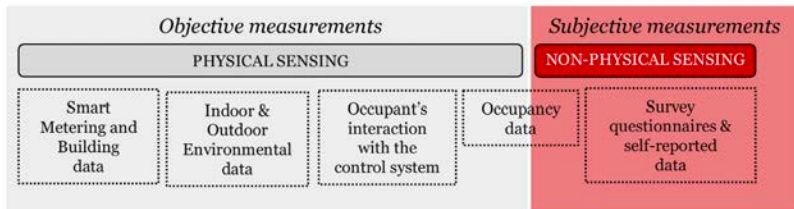


Fig. 4. Schematic of the sensing methodological approach of energy-related occupant behavior in buildings.

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# Today in class: you design a policy!

## Practice → problems

- rooftop solar adoption (Sunter et al, 2019)
- energy consumption & prices (Auffhammer, 2020)
- energy poverty, equity, use (Cong et al, 2022)
- home energy upgrades (Unger and Nadel, 2022)

## Theories & questions → research

- individual, occupants (Hong et al, 2017)
- behavioral theory (Heydarian et al, 2020)
- structural barriers (Blumstein, 1980!)
- population, groups (Hamilton et al, 2013)

## Questions:

- 1 what problem are you trying to solve?
- 2 what research do you need to do?
- 3 what policies do you put in place to understand, solve, engage?

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## Further Opportunities to Reduce the Energy Use and Greenhouse Gas Emissions of Buildings

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David Hsu<sup>1</sup>, Ting Meng<sup>2</sup>, Albert Han<sup>3</sup>, and Daniel Suh<sup>4</sup>

- cities:
  - ▶ taxes: collect 70% of local tax revenue, 30% of state & local taxes
  - ▶ infrastructure: own 50+%, spend 75% of all spending
  - ▶ own utilities: 30% of electric, 60% of water
- departments:
  - ▶ finance, finance, law, fire, power, water, housing, schools
  - ▶ NYC alone: DCAS, DDC, DOB, DOF, OLTPS, NYCHA



# NYC sustainability plans (2005, 2006, 2011)



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# The NYC building sector

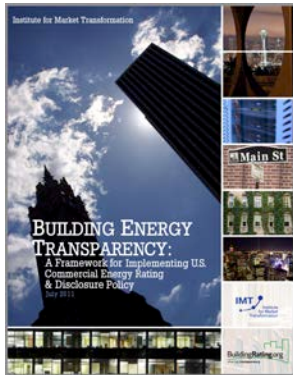
Some of the most valuable real estate in the world.

Breakdown:

- Impact: 75% of all GHG emissions come from buildings
- Sector size: 1M total buildings in NYC
- New vs. existing: 85% of all buildings in NYC in 2030 already exist
- Large vs. small:
  - ▶ 2% of all buildings > 50K sf
  - ▶ Half of all NYC sf
  - ▶ 48% of all energy use (?)
  - ▶ commercial, indust., institutions, multi-family residential, mixed-use

Q: How do you know which buildings to implement energy efficiency in?

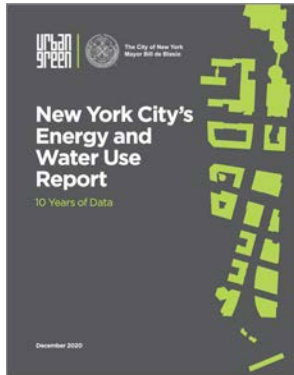
# Data → Reports!



Cliff Majersik, Andrew Burr, Caroline Keicher, David Leipzig, **Institute for Market Transformation**



Laurie Kerr, John Lee, Hilary Beber, Donna Hope, Stacy Lee, Jenny Cooper, **City of New York, OLTPS**; David Hsu, Constantine Kontokosta, Adam Hinge, Alexandra Sullivan



Sean Brennan, Adam Schiabor, Sheena Thiruselvan, Chris Anjesky, John Mandyczk, **Urban Green Council**

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# NYC building policies

## Key points:

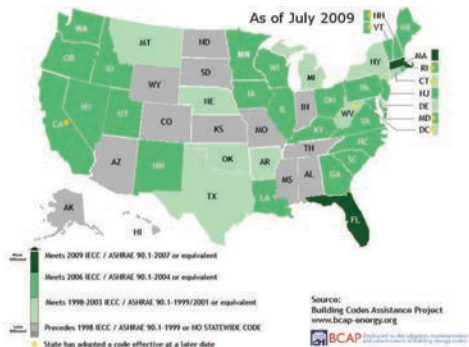
- many owners were already doing these things
- City of NY has jurisdiction over buildings (DOF, DOB)!

## Greater Greener Buildings Plan (GGBP):

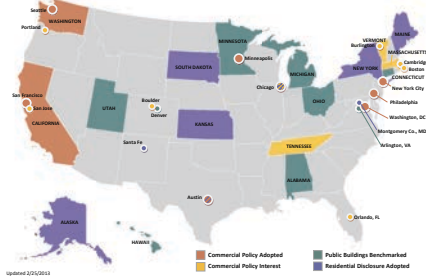
- New York City Energy Efficiency Corporation (NYCEEC)
- LL85 (2009): NYC energy conservation code (NYCECC)
- LL88 (2009): lighting & sub-metering
- **LL84 (2009): benchmarking**
- LL87 (2009): energy audits & retro-commissioning
- LL33 (2017): letter grades for building performance
- LL97 (2019): carbon budgets for buildings

# Energy efficiency in buildings (DOE)

Codes (new & retrofit):



Disclosure laws (existing):



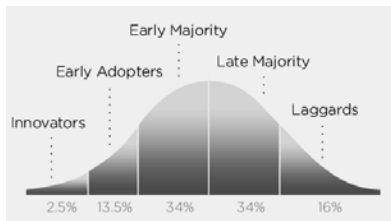
Source: Institute for Market Transformation, 2013

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# Buildings

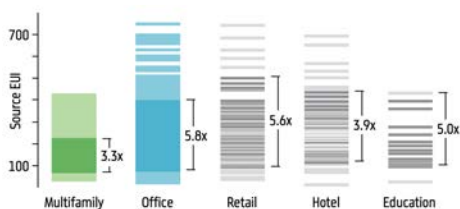
Codes and benchmarking affect new construction and existing buildings, respectively.

Source: Everett Rogers' Diffusion of Innovation Curve, Wikipedia



Variation among otherwise similar buildings requires better targeting of policies.

Source: NYC 2013 Year Two LL84 report



# The market for energy efficiency

For the past 40 years, a "gap" in investments in energy efficiency

- under-investment compared to significant potential returns
- neither engineers nor economists explain this particularly well: is this rational or irrational?



Blumstein et al, 1980, *Energy: "Overcoming Social and Institutional Barriers to Energy Conservation"*

- misplaced or split incentives
- lack of, or mis-information
- existing customs, regulation
- market structure
- availability of financing, capital
- myopia



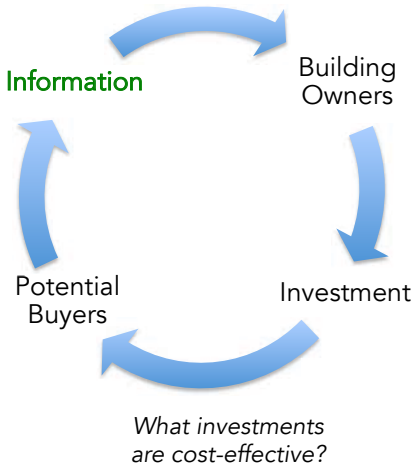
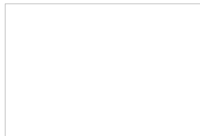
**All of these vary greatly by individuals (heterogeneity), but how we do identify them?**



# Market transformation & heterogeneity

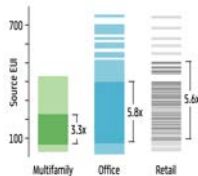
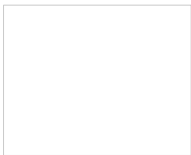


*What information will cause action?*



*What determines building energy performance?*

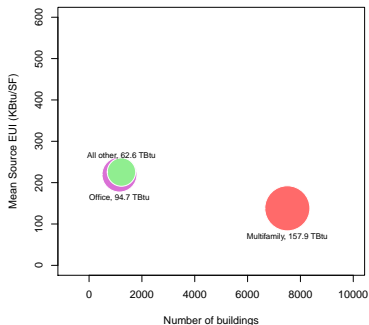
*What buildings should I be compared to?*



# Buildings

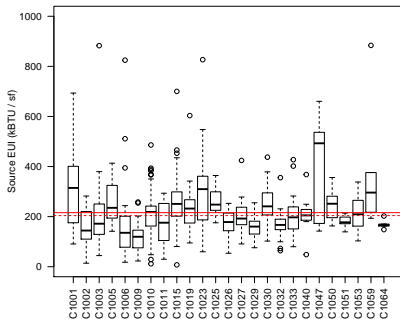
Different property types comprise very different portions of total energy.

Source: Hsu (2012), NYC LL84 report



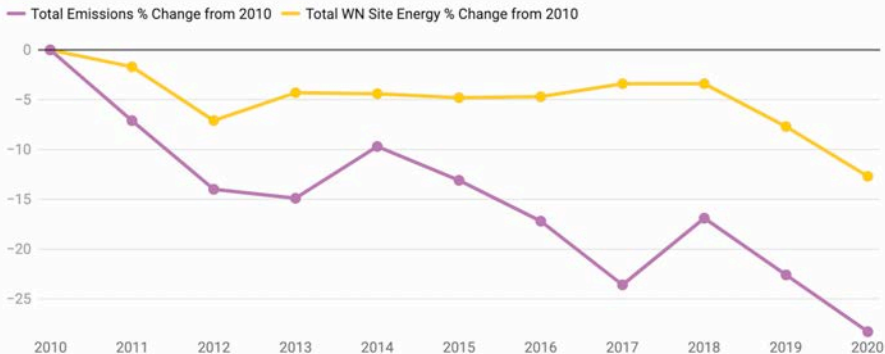
Industry and market structure can affect both measurement and performance.

Source: Hsu (2012), NYC LL84 report



## Benchmarked Emissions and Energy Trends, 2010–2020

Emissions and energy have fallen for two straight years for regularly benchmarked properties



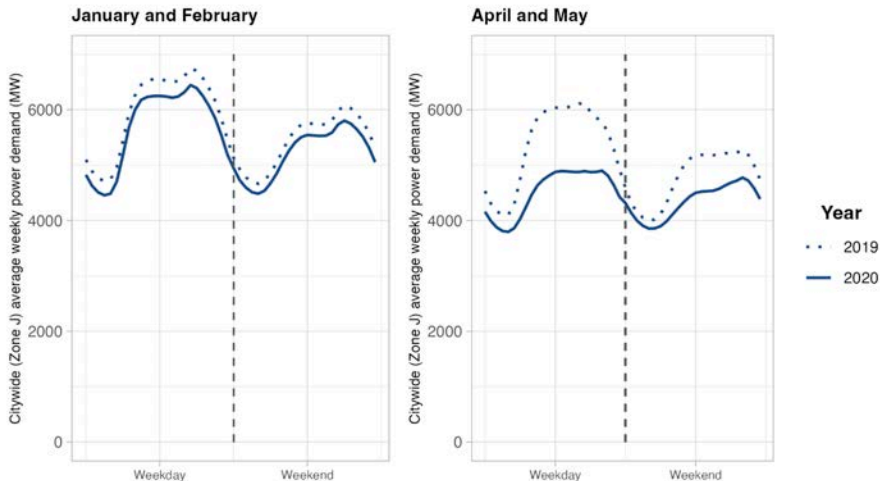
Source: Data: LL84 2010-2020 filtered for properties that regularly submitted data across eleven years; N = 2,930; \* WN = Weather Normalized • [Get the data](#) • Created with [Datawrapper](#)

Urban Green Council, 2022 update

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# New York City on Pause

Citywide electricity consumption in 2019 and 2020 followed a similar weekly pattern in January and February, but then dramatically diverged in April and May.



Source: NYISO

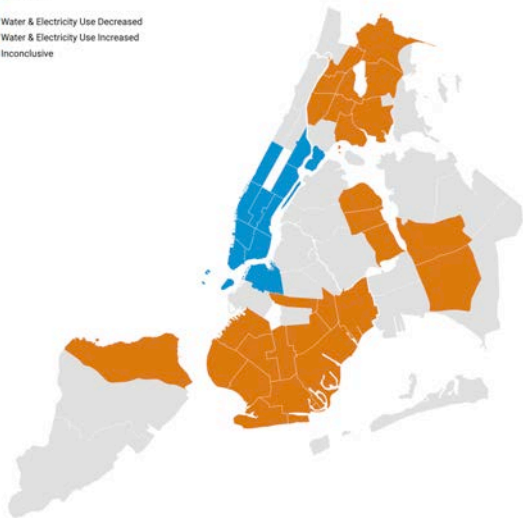
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## Less Water, Less Power, Fewer People?

Change in weather normalized electricity and water usage for multifamily housing by Community District between 2019 and 2020

- Water & Electricity Use Decreased
- Water & Electricity Use Increased
- Inconclusive

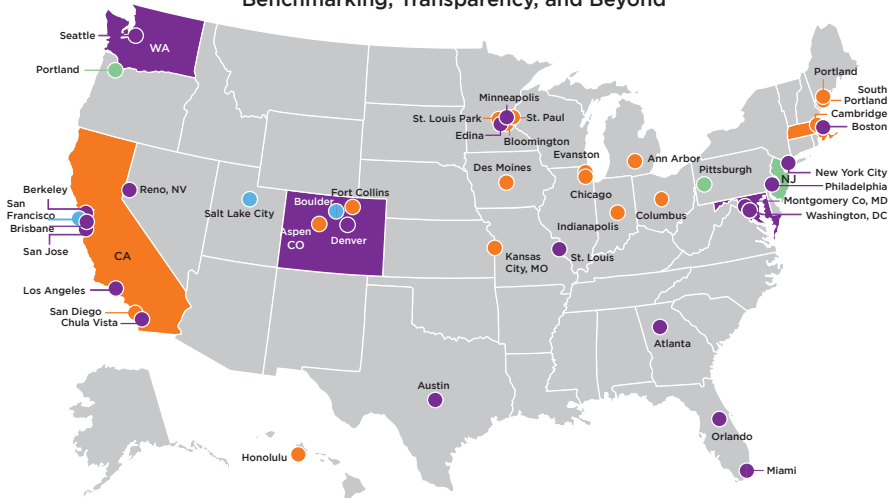


Get the data - Created with Datawrapper

Urban Green Council, 2022 benchmarking update

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# U.S. City, County, and State Policies for Existing Buildings: Benchmarking, Transparency, and Beyond

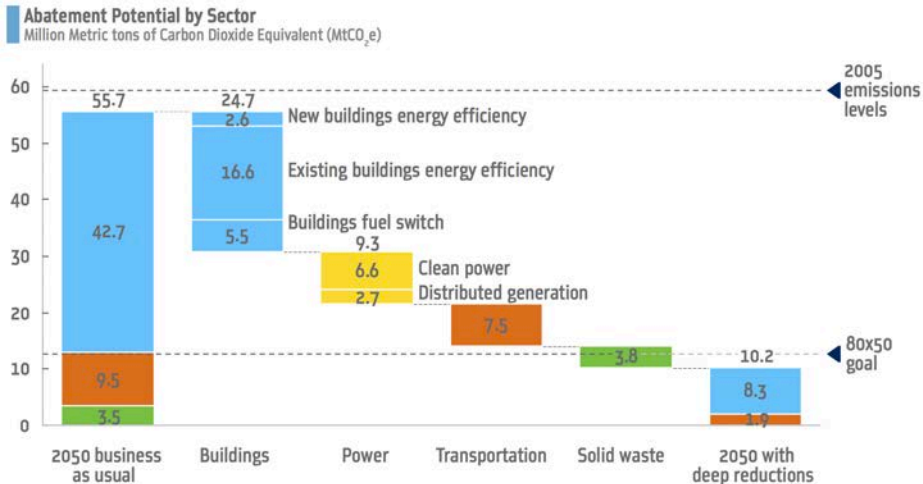


- Benchmarking required for public and commercial buildings
- Benchmarking required for public, commercial, and multifamily buildings
- Benchmarking and additional actions required for public and commercial buildings
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# NYC's Pathways to Deep Carbon Reductions (Dec. 2013)

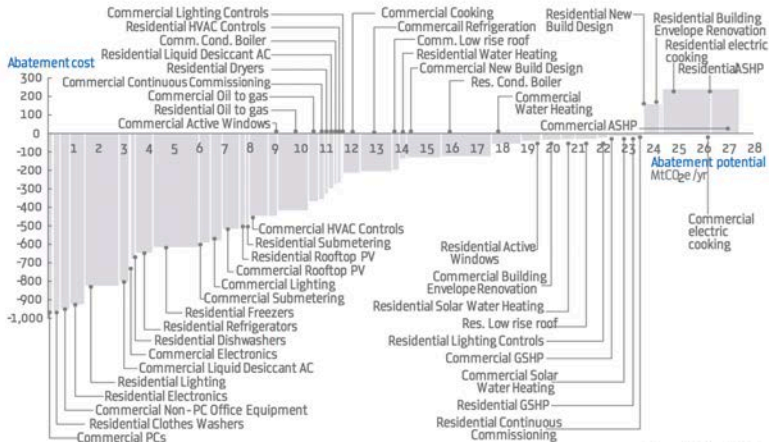


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# NYC's Pathways to Deep Carbon Reductions (Dec. 2013)

2050 Marginal Abatement Cost Curve for Buildings Sector

\$/tCO<sub>2</sub>e



Source: NYC Mayor's Office

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## HIGHLIGHTS

- Affects buildings greater than 25,000 square feet
- Sets increasingly stringent limits on carbon emissions per square foot in 2024 and 2030
- Flexibility to comply through renewable energy credits and/or emissions offsets
- Allows some affordable housing to choose low-cost energy-saving measures instead of emissions limits
- New Office of Building Energy and Emissions Performance at Department of Buildings
- Strong advisory board to help refine emissions metrics and limits
- Carbon trading study and implementation plan
- Penalties for non-compliance and variances for financial hardship

## LL97: carbon budgets for buildings

With the Urban Green Council, I analyzed the economic and employment effects in 2019:

<b>Summary</b>	<b>2024</b>	<b>2030</b>	<b>TOTAL</b>	
Output	\$2,980.8	\$24,659.2	\$27,639.9	million
Earnings	\$3,972.8	\$32,866.3	\$36,839.1	million
Employment	21,711	179,612	201,323	jobs
Value added	\$1,659.1	\$13,725.7	\$15,384.8	million

Thank you!

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