Show Me the Value: Understanding the Financial Impacts of High-Performing Buildings

Thursday, July 11th, 2019

9:00 – 10:30 AM

Speakers

Cindy Zhu
Moderator,
DOE

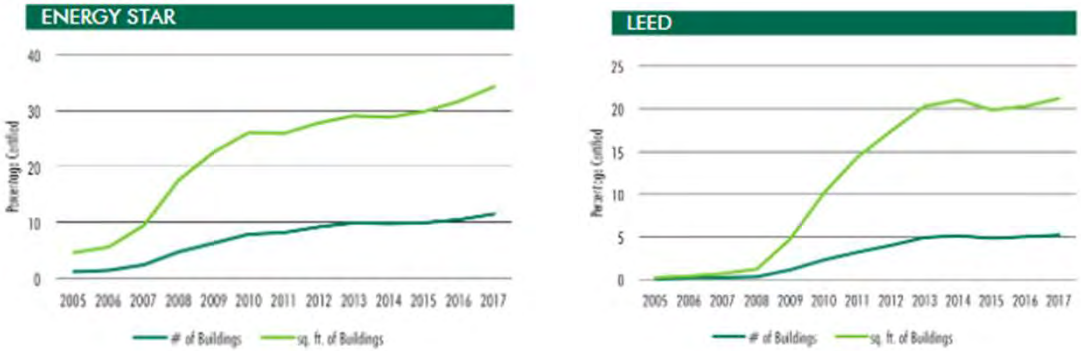
Dr. Rogier Holtermans, University of Guelph

Dr. Avis Devine, York University

Dr. Sofia Dermisi, University of Washington

Green Buildings Challenge

First, some good news:
In 2017, over **40%** of commercial office space in the **top 30 U.S. markets** was certified as **"green" or "efficient"** showing significant, growth from 5% in 2005
Ranking: Chicago, SF, Atlanta



Source: 2018 National Green Building Adoption Index, CBRE

The challenge:

Real estate investors and other stakeholders want to know:

Do energy efficiency and "green features" actually improve the financial value of buildings? By how much? Where? In what types of buildings?

Empirical evidence of financial value is key to sustain and increase demand for and investment in green buildings, beyond just ESG motivations.

Framing the Research Question

Energy/Green Metric
Site energy use or EUI
Source energy use or EUI
Energy cost or cost/sf
ENERGY STAR score
ENERGY STAR label
Green Building Certification (LEED, BOMA 360...)
Green Building Certification level (e.g., LEED Silver, Gold)

?

Financial Value Metric	
Vacancy/Occupancy	Sales Price
Leasing Velocity (absorption, speed of sales, leasing)	Regulatory & Compliance Risk
Tenant Renewals	Insurance (rates, ability)
Tenant Satisfaction	Default Risk
Rental Income and Rent Concessions	Debt Service Coverage Ratio
Marketing Costs	Access to Funding
Utility Costs, Maintenance, OpEx	Interest Rates
Obsolescence	Reserves
Capitalization Rates	

Real Estate Research Institute Special Sustainability RFP

- 12 proposals received, 5 projects selected
- Criteria:
  - Alignment with DOE goals
  - Impact on Commercial Real Estate Industry
  - Feasibility and Interest
  - Quality and Validity

RERI Sponsors

Sustaining Sponsor

Pension Real Estate Association

Sponsors

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National Association of Real Estate Investment Trusts® (NAREIT)
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National Investment Center for the Senior Housing & Care Industry (NIC)
National Multi Housing Council (NMHC)
Principal Real Estate Advisors
PGIM Real Estate
RCLCO
Real Capital Analytics
RealPage, Inc.
SNL Financial LC
TH Real Estate
Trepp, LLC
UBS Global Asset Management
USAA Real Estate Company

Deadline for receipt of proposal to RERI: April 16, 2018 Midnight EDT Proposals and information requests should be e-mailed to:
reri@reri.org
The Real Estate Research Institute
100 Pearl Street, 13th Floor
Hartford, CT 06103
USA
Telephone: (860) 882-5341

2018 Special Request for Research Proposals

Real Estate Research Institute and Lawrence Berkeley National Laboratory (LBNL)

$10,000 - $50,000 Available to fund real estate research

Proposal submission deadline: April 16, 2018

Overview

Lawrence Berkeley National Laboratory (LBNL) has spent the past several years collaborating with the commercial real estate industry to understand research questions that are of particular interest and could provide actionable results for market stakeholders. Having received input from these key stakeholders, LBNL, through RERI, now seeks proposals for funding of research to be undertaken in 2018.

LBNL aims to facilitate research that will provide empirical, quantitative, market-focused research results in areas that have not been sufficiently explored around energy, green building features and financial value. Specifically, the intent is to generate meaningful, actionable results capable of influencing commercial real estate practitioners – such as owners, managers, investors – and encouraging greater investment in energy efficient technologies, retrofits, and buildings.

Logistics

Projects involving researchers from different disciplines or jointly undertaken by academic researchers and industry professionals are strongly encouraged. Proposals may involve research that is underway, but not substantially completed, at the time of application. With the exceptions of university and college settings and academic conferences, partial or completed research cannot be presented to any organization prior to presentation at the RERI Conference. Completed projects must include a two-page executive summary that synopsizes the research thesis, key results and next steps if appropriate. Authors should note that a separate, nontechnical summary that emphasizes implications for industry practitioners or investors with a limited background in quantitative analysis may be created by the LBNL team member/designee of RERI's board/advisory board and posted to the RERI website.

Grants may range from $10,000-$50,000, but we are open to considering smaller or larger proposals for exceptional reasons. Research projects that are funded and successfully completed will be eligible for presentation at the DOE's Better Buildings Summit.

RERI RFP: Five diverse projects

Title	Institutions	Key Metrics
The Impact of Environmental Interventions on CRE Operations	York University Univ. of Guelph	EnergyStar, LEED NOI, OpEx
The Dynamics of Energy Consumption in Commercial Real Estate	Maastricht U. Univ. of Guelph	Bldg. cert., Energy use, EE CapEx,
Effect of Energy Benchmarking and Disclosure on Office Bldg. Marketability	Univ. of Washington	EnergyStar, EUI, occupancy rates
Estimating Office and Residential Building Energy Retrofit Hurdle Rates	NYU, U of Arizona, UNC Chapel Hill, Cambridge Univ.	Energy savings, CapEx IRR
ESG Insights in Public Real Estate Performance	Tilburg Univ, Univ. Of Reading	ESG ratings, REIT returns

Technical Reports Found Here: https://buildings.lbl.gov/cbs/energy-efficiency-and-financial-valuation

Professor Sofia Dermisi

University of Washington

U.S. DEPARTMENT OF ENERGY

Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Hyun Woo "Chris" Lee
Assistant Professor of
Construction Management

Sofia Dermisi
Professor of Real Estate and
Urban Design and Planning

Youngjun Choe
Assistant Professor of
Industrial & Systems Engineering

Luming Shang
PhD candidate
Construction Management

Funded by: Real Estate Research Institute and Lawrence Berkeley National Laboratory (LBNL)

Building Energy Use/Benchmarking and Disclosure

- Energy Benchmarking?
  1. Buildings track their energy use/emissions
     - Energy Star score (1-100)
     - Energy (Kbtu)
     - GHG Emission (kg of CO2e per sft)
  2. Report to city or state entity
  3. Some information is shared with the public

- When did it begin?
  - First enacted in Washington DC in 2008
  - New York since 2009
  - San Francisco since 2011
  - Chicago since 2013

Comparison of U.S. Commercial Building Energy Benchmarking and Transparency Policies

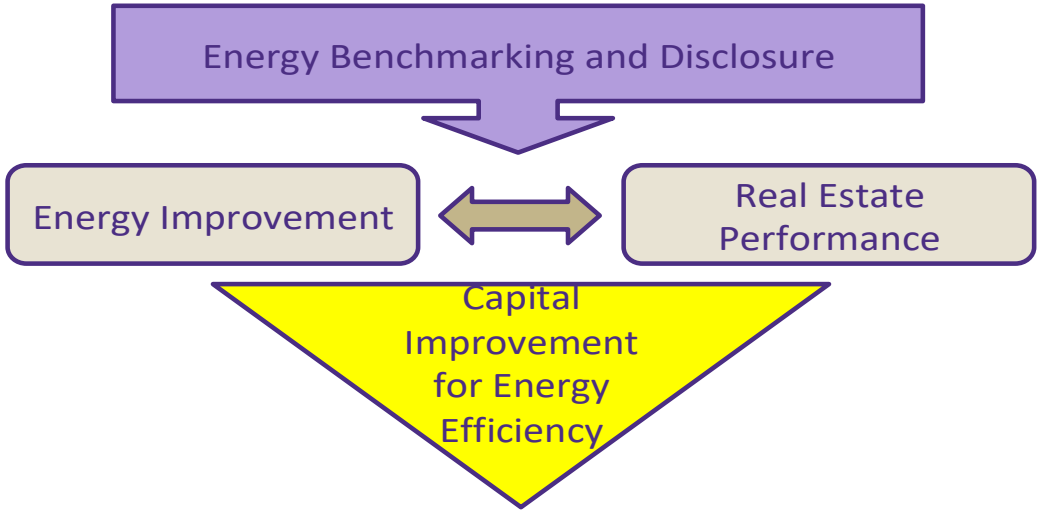
	Legislation	Public Data Available	Policy Impact			Buildings Included	Policy Schedule		Compliance		Additional Elements	
	Jurisdiction	Released	Number of Bldgs	Square Footage	Energy Savings	Types & Sizes	Reporting to Gov't	Transparency	By # of Buildings	By % of Sq. Ft.	Water Tracking	Other Requirements
Cities/Counties	Atlanta	-	2,900	402 million	-	Comm & MF ≥ 50K Comm & MF ≥ 25K	Aug 1, 2015 Jan 1, 2017	(if Energy Star >50) Jan 2017 Sept 2017	-	-	✓	Audits every 10 years
	Austin	-	2,800	113 million	-	Comm ≥ 10K MF ≥ 5 units	Jun 1, Annual	Time of transaction	-	-	-	Audits & mandatory upgrades for high energy use MF buildings
	Berkeley	-	257	13.7 million	-	Comm & MF ≥ 10K Comm & MF ≥ 25K	July 1, 2018 July 2, 2019	TBD TBD	-	-	✓	Periodic/time of sale energy reports for all buildings (timing based on size)
	Boston	Yes	1,600	250 million	-	Comm ≥ 50K MF ≥ 50K/50 units Comm ≥ 35K MF ≥ 35K/35 units	Sep 15, 2014 May 15, 2015 May 15, 2016 May 15, 2017	Oct 1, 2015 Oct 1, 2015 Oct 1, 2016 Oct 1, 2017	-	84% (2014)	✓	Periodic energy assessments and/or actions
	Boulder	-	475	26 million	-	Comm ≥ 50K New Comm ≥ 10K Comm ≥ 50K Comm ≥ 20K	Aug 1, 2016 Aug 1, 2016 Jan 1, 2018 Jan 1, 2020	Mar 1, 2016 Mar 1, 2019 Mar 1, 2021 Mar 1, 2023	100% (2016)	100% (2016)	-	Lighting upgrade; audits & RCx every 10 yrs (must invest in RCx measures w/ ≤2yr payback)
	Cambridge	-	1,100	78 million	-	Comm ≥ 50K MF ≥ 50 units Comm ≥ 25K	May 1, 2015 May 1, 2015 May 1, 2016	Sept 1, 2016 Sept 1, 2016 Sept 1, 2017	95% (2015)	93.5% (2014)	✓	-
	Chicago	Yes	3,500	900 million	10% (2010-15)	Comm ≥ 250K MF ≥ 250K Comm ≥ 50K MF ≥ 50K	Jun 1, 2014 Jun 1, 2015 Jun 1, 2015 Jun 1, 2016	December 2015 Jun 1, 2016 Jun 1, 2016 Mar 1, 2017	84% (2014)	92% (2014)	-	Data verification by licensed professional 1st year & every 3 years
	Denver	-	3,000	360 million	-	Comm & MF ≥ 50K Comm & MF ≥ 25K	Jan 1, 2017 Jan 1, 2018	TBD	-	-	-	-
	District of Columbia	Yes	2,000	357 million	9% (2010-13)	Comm ≥ 50K MF ≥ 50K	Apr 1, Annual	Annually >Apr 1	85% (2013)	-	✓	-
	Evanston, IL	-	167	45.6 million	-	Comm & MF ≥100K Comm & MF ≥ 50K Comm & MF ≥ 20K	Jan 30, 2017 Jan 30, 2018 Jan 30, 2019	TBD	-	-	✓	Data verification by a certified professional 1st year and every 3 years
	Kansas City	-	~1,500	~400 million	-	Comm & MF ≥100K Comm & MF ≥ 50K	May 1, 2017 May 1, 2018	Sept 1, 2018 Sept 1, 2019	-	-	✓	-
	Los Angeles	-	14,000	900 million	-	Comm & MF ≥100K Comm & MF ≥ 50K Comm & MF ≥ 20K	Jul 1, 2017 Apr 1, 2018 Apr 1, 2019	TBD	-	-	✓	ASHRAE level II audit and RCx every 5 years
	Minneapolis	Yes	675	110 million	-	Comm ≥100K Comm ≥ 50K	Jun 1, Annual	Aug 31, Annual	87% (2013)	-	✓	-
	Montgomery Co., MD	-	~1,000	~110 million	-	Comm ≥ 250K Comm ≥ 50K	June 1, 2016 June 1, 2017	Oct 2017 Oct 2018	~75% (2015)	-	-	Data verification by licensed professional 1st year & every 3 years
	New York City	Yes	33,417	2.8 billion	6-14% (2010-14)	Comm & MF ≥ 50K Comm & MF ≥ 25K	May 1, Annual May 1, 2018	Annually on Sept 1 Annually >May 1	84% (2012)	84% (2012)	✓	Audits & RCx (LL 87), lighting upgrades & submetering (LL 88)
	Orlando	-	926	125.6 million	-	Comm & MF ≥ 50K	May 1, 2018	Sep 1, 2019	-	-	-	Energy audit or RCx every five years if ENERGY STAR <50. Benchmarking by qualified benchmarker
	Philadelphia	Yes	2,900	390 million	-	Comm ≥ 50K MF ≥ 50K	Jun 30, Annual Jun 30, 2016	Annually >Jun 30 June 30, 2017	91% (2014)	91% (2014)	✓	-
	Pittsburgh	-	861	164 million	-	Comm ≥ 50K	June 1, 2018	Annually >Jun 1	-	-	✓	-
	Portland, ME	-	284	-	-	Comm ≥ 20K MF ≥ 30 units	May 1, 2018	Sept 1, 2018	-	-	✓	-
	Portland, OR	-	1,024	67 million	-	Comm ≥ 50K Comm ≥ 20K	Apr 22, 2016 Apr 22, 2017	Oct 1, 2017 Oct 1, 2018	-	82% (2015)	-	-
	San Francisco	Yes	2,312	203 million	7.9% (2010-14)	Comm ≥ 10K	Apr 1, Annual	Annually >Apr 1	-	82% (2016)	-	ASHRAE level I/II audits or RCx every 5 years
	Seattle	Yes	3,250	281 million	2.7% (2014-15)	Comm & MF ≥ 20K	Apr 1, Annual	Annually <Dec 31	99.2% (2013)	99.4% (2013)	-	Tune-ups every 5 years for Comm ≥50K
	South Portland, ME	-	-	-	-	Comm ≥ 50 MF ≥ 10 units	May 1, 2018 May 1, 2018	TBD	-	-	✓	Verification every 5 years by professional engineer
	St. Louis	-	900	143 million	-	Comm & MF ≥ 50K	Apr 1, 2018	Aug 1, 2018	-	-	✓	-
States	California	-	20,573	2.4 billion	-	Comm & MF ≥ 50K	TBD	TBD	-	-	-	Mandatory upgrades TBD under AB 758
	Washington State	-	4,600	247 million	-	Comm ≥ 10K	None	Time of transaction	-	-	-	Audits for public buildings with low ratings

Source: https://www.buildingrating.org/graphic/us-commercial-building-policy-comparison-matrix

Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Research Objectives:

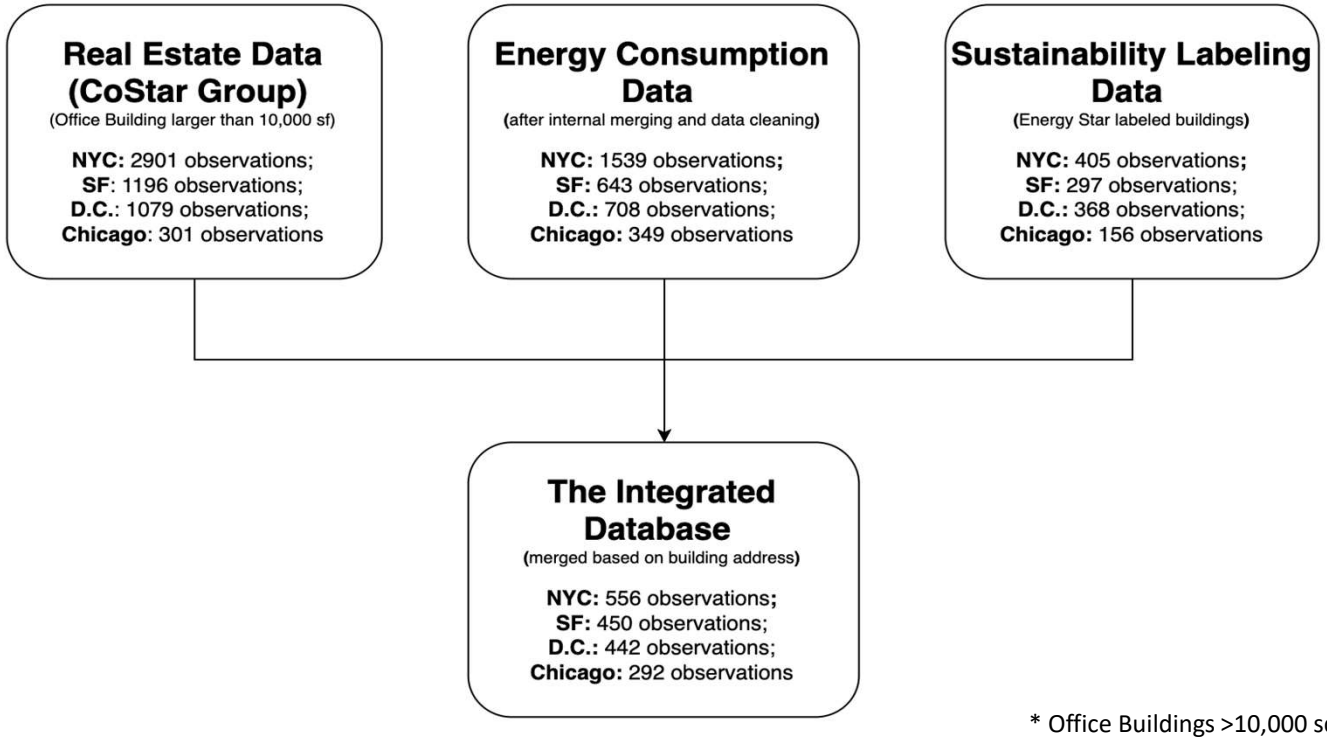
- Assess the effectiveness of benchmarking policy
- Examine if the policy affects the real estate performance of sustainable and less sustainable buildings differently



Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Research Data:

- Three databases (real estate, energy consumption, and energy star label)
- Four target cities (NYC, Washington DC, San Francisco, Chicago)



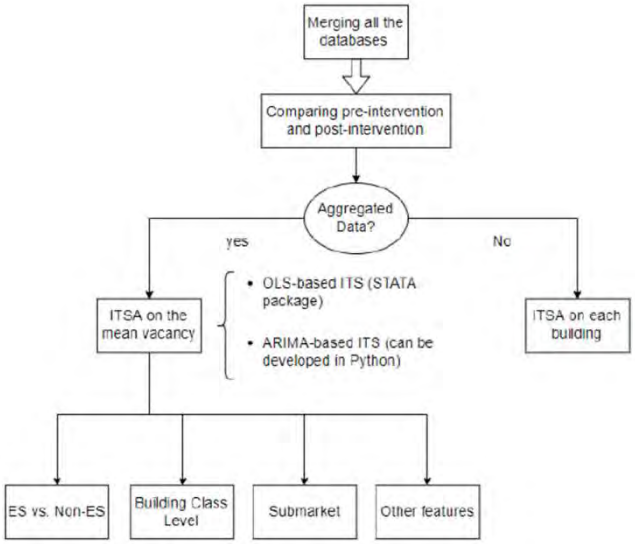
* Office Buildings >10,000 square feet

Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Approach:

- **Did the benchmarking policy affect the real estate performance of office buildings?**

Interrupted Time Series (ITS) Analysis



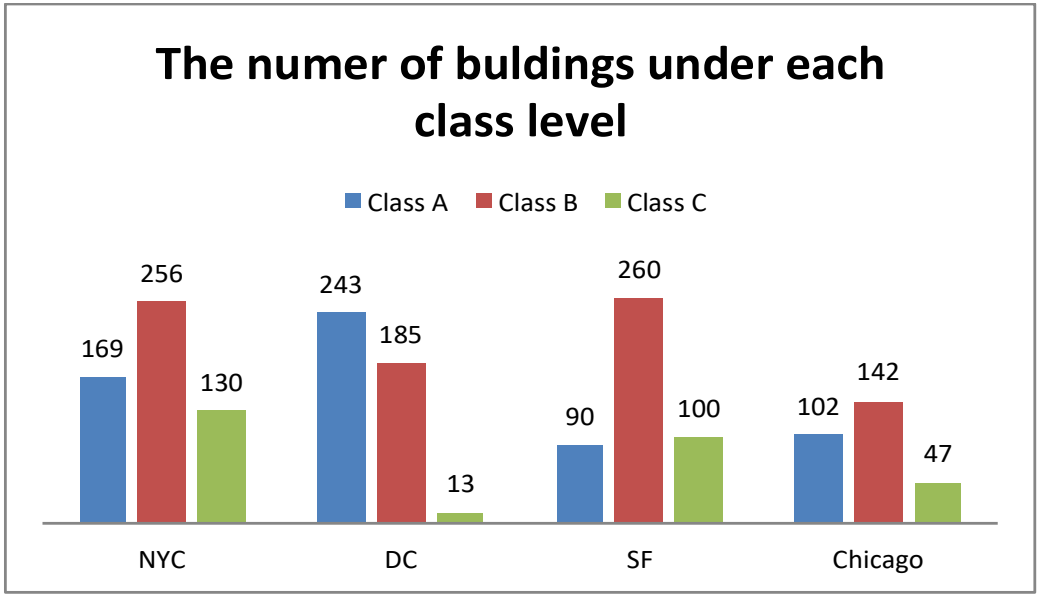
- **Do energy efficient buildings cluster spatially?**

Hot Spot Analysis

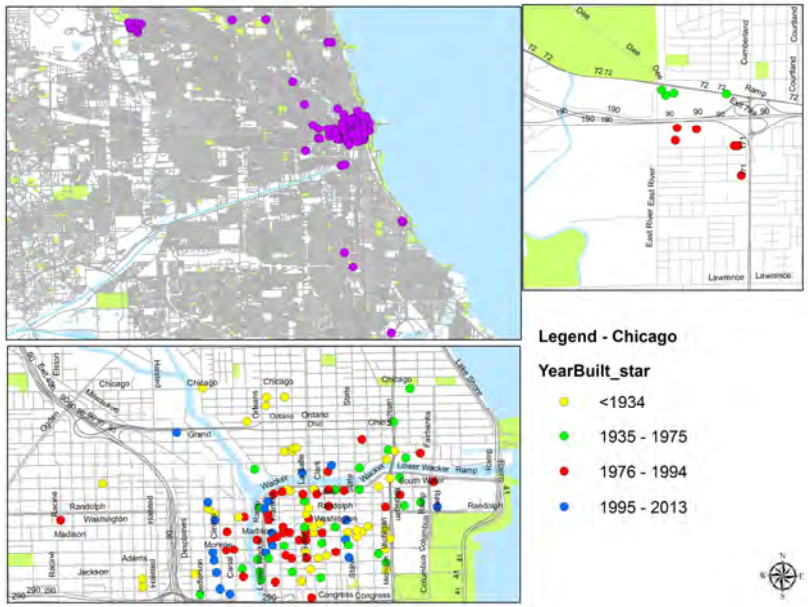
Effect of Energy Benchmarking and Disclosure on Office Building Marketability

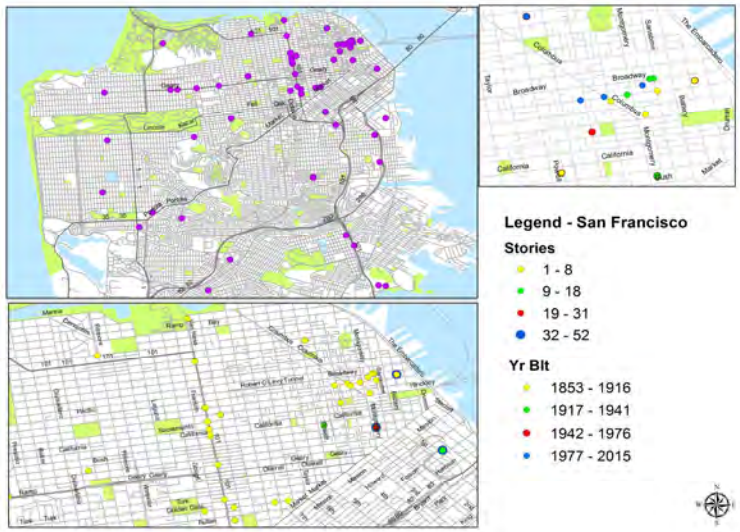
Table 1. The summary of the integrated database

City	Time Frame of Real Estate Data	Year of the Policy Implementation	Number of the ES Buildings	Number of non-ES Buildings	Total Number of Buildings
NYC	1994 - 2017	2009	160	396	556
D.C.	1993 - 2017	2008	254	188	442
SF	1997 - 2017	2011	144	306	450
Chicago	1996 - 2017	2013	145	147	292



Spatial distribution of matched buildings





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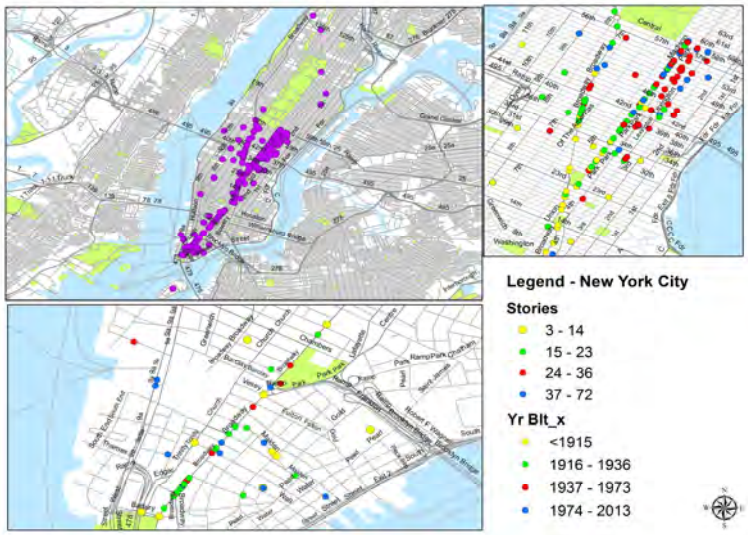
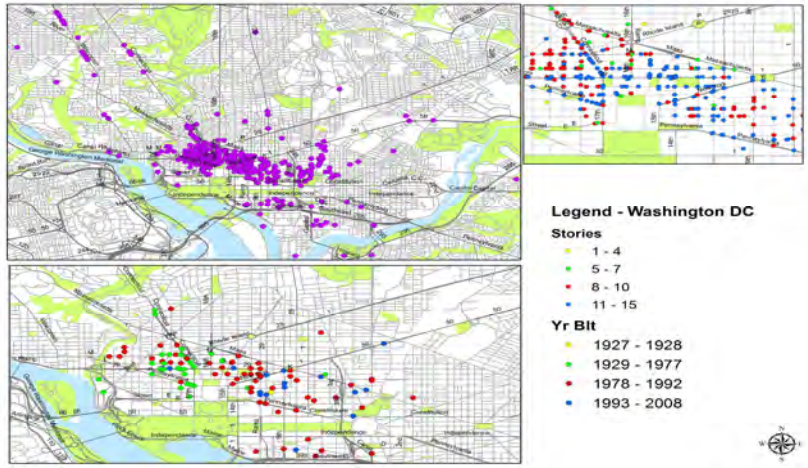
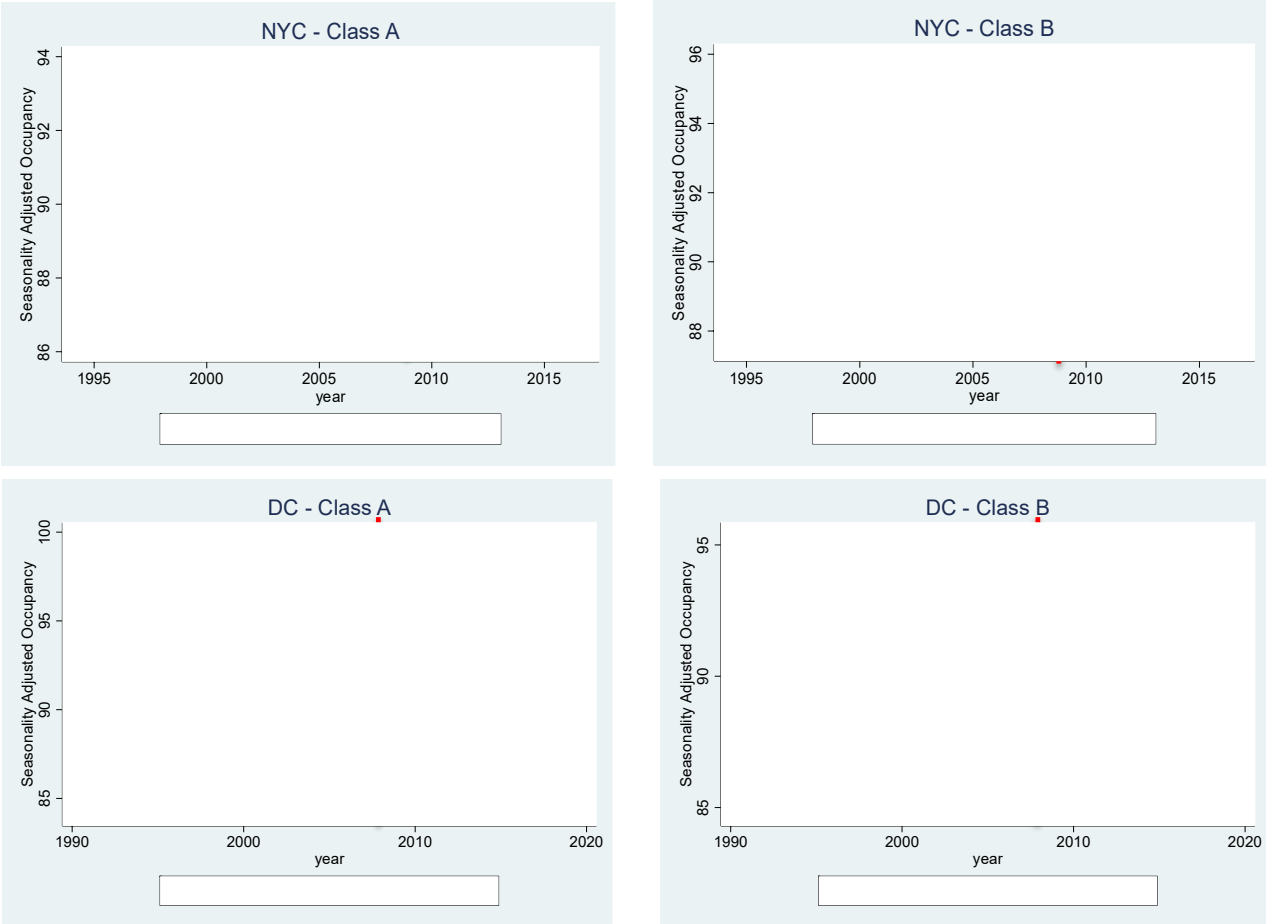




Effect of Energy Benchmarking and Disclosure on Office Building Marketability

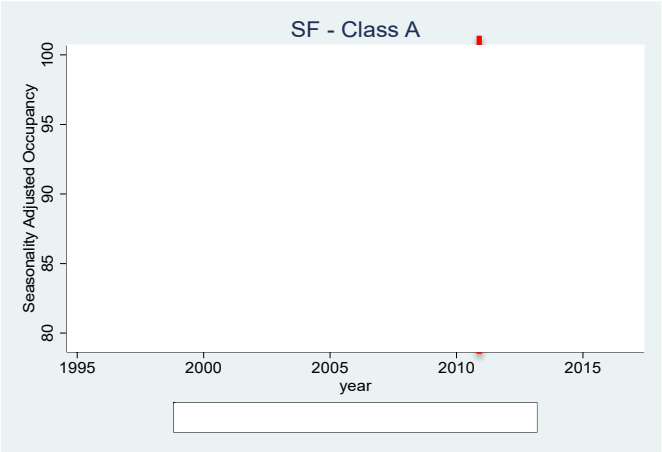
Occupancy trend of ES group vs. non-ES group – Class A & B

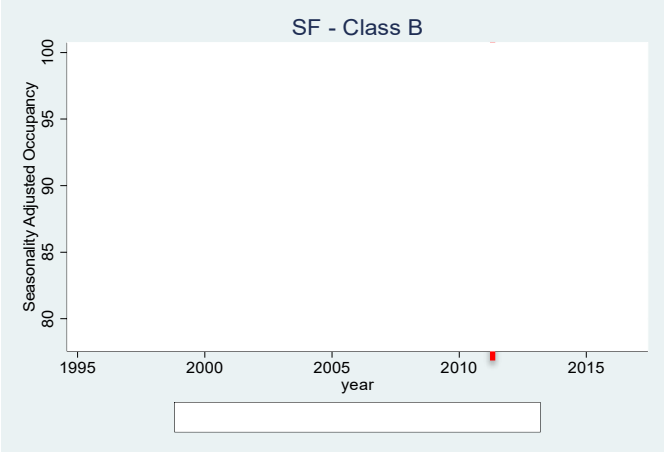


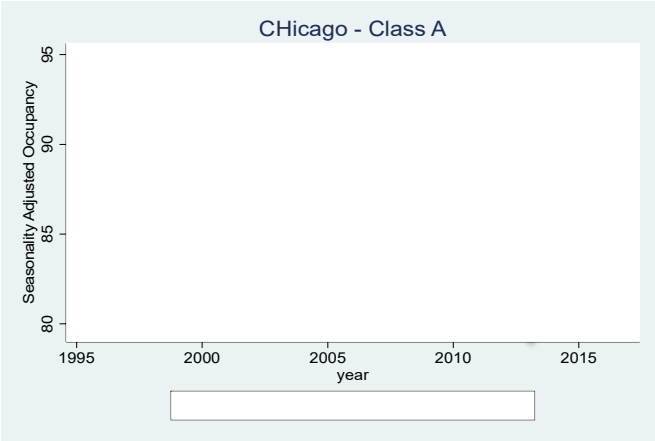
Disclosure implementation years: DC - 2008, NYC - 2009, SF - 2011, Chicago - 2013

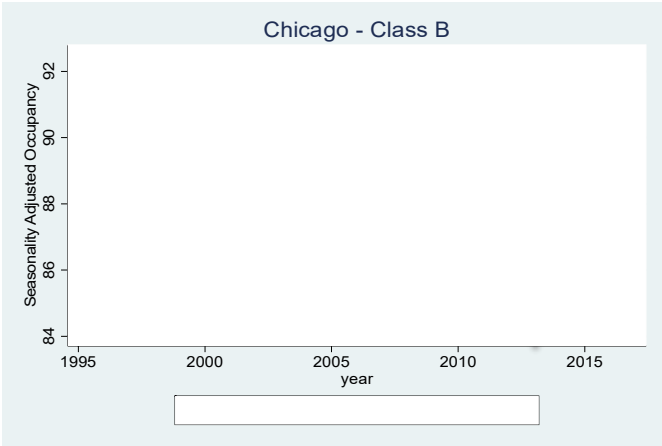
Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Occupancy trend of ES group vs. non-ES group – Class A & B







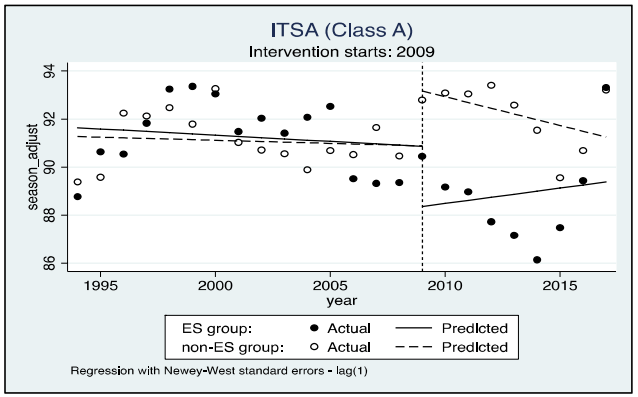


Disclosure implementation years: DC - 2008, NYC - 2009, SF - 2011, Chicago - 2013

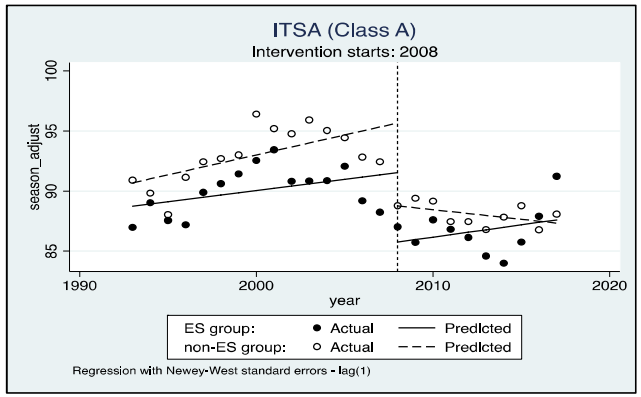
Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Key findings (based on mean occupancy)

New York City



Washington D.C.



NYC:

- An immediate decline of occupancy after the policy for the ES group in contrast to an immediate increase for the non-ES group.
- A slightly increasing trend of the ES group in contrast to a decreasing trend for the non-ES group occupancy.

DC:

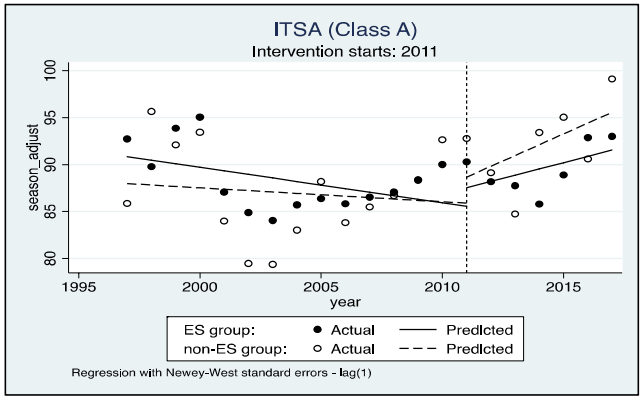
- An immediate decline of occupancy after the policy for both groups.
- After implementation, the ES group shows an increasing trend, but the non-ES group shows a slightly decreasing trend.

Disclosure implementation years: DC - 2008, NYC - 2009, SF - 2011, Chicago - 2013

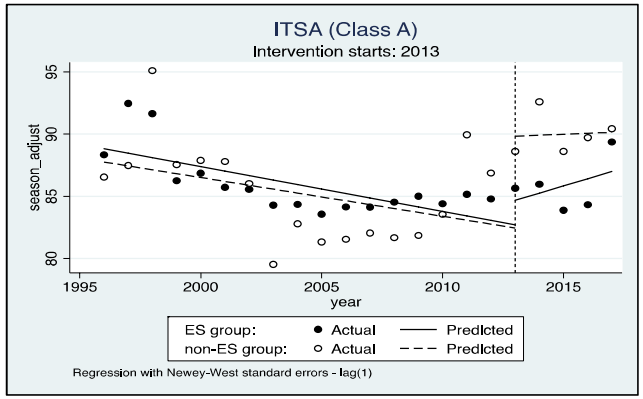
Effect of Energy Benchmarking and Disclosure on Office Building Marketability

Key findings (based on mean occupancy)

San Francisco



Chicago



SF:

- After implementation, both groups exhibited an increasing trend of occupancy.
- There is no difference in the trend between two groups, which implies the policy impact on the two group is at the same level.

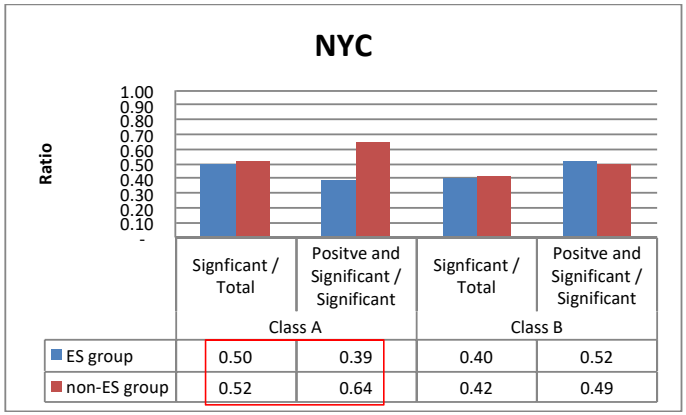
Chicago:

- An immediate increase of occupancy after implementation for both groups
- The ES group shows a continuous increase, but the non-ES group does not.

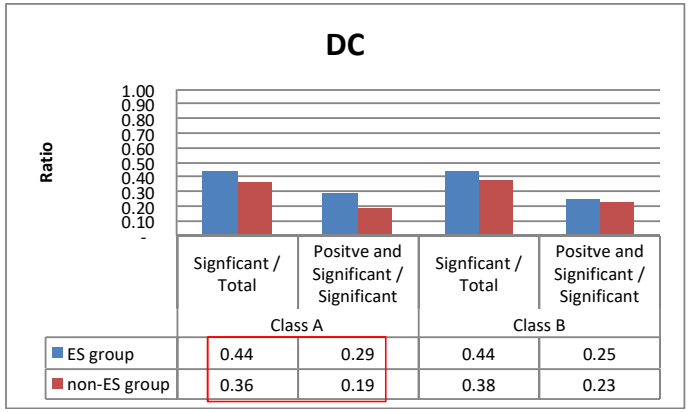
Disclosure implementation years: DC - 2008, NYC - 2009, SF - 2011, Chicago - 2013

Effect of Energy Benchmarking and Disclosure on Office Building Marketability

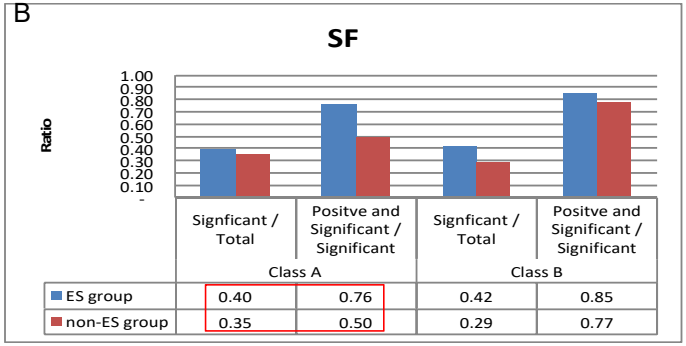
Key findings – single group ITS (based on each building instead of on the aggregated data)

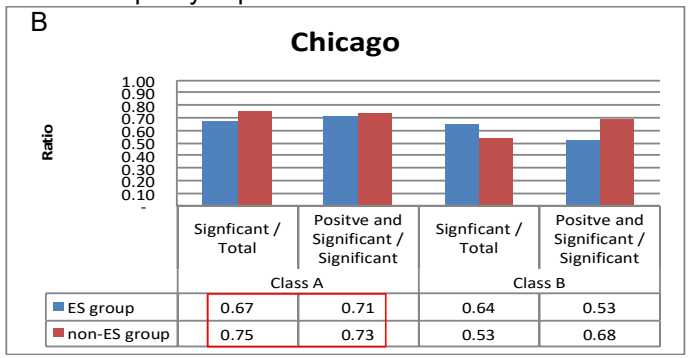


50% of ES buildings experience an occupancy increase after the policy implementation for class A & 40% for class B



44% of ES buildings experience an occupancy increase after the policy implementation for class A & 44% for class B

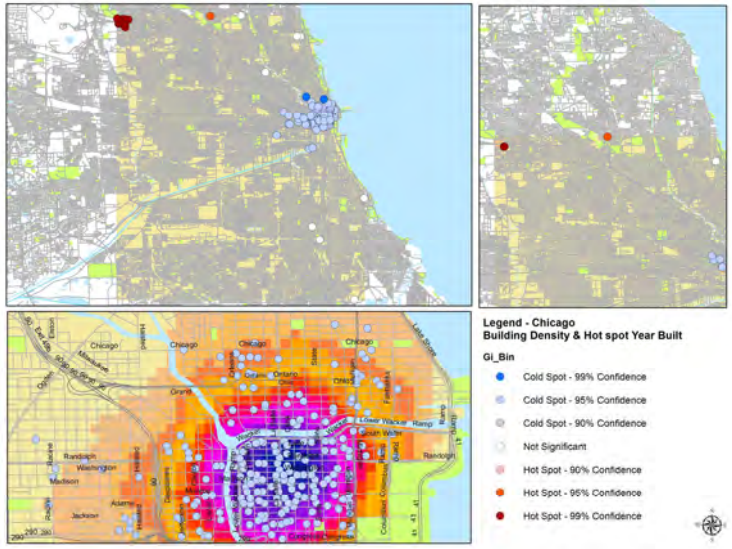


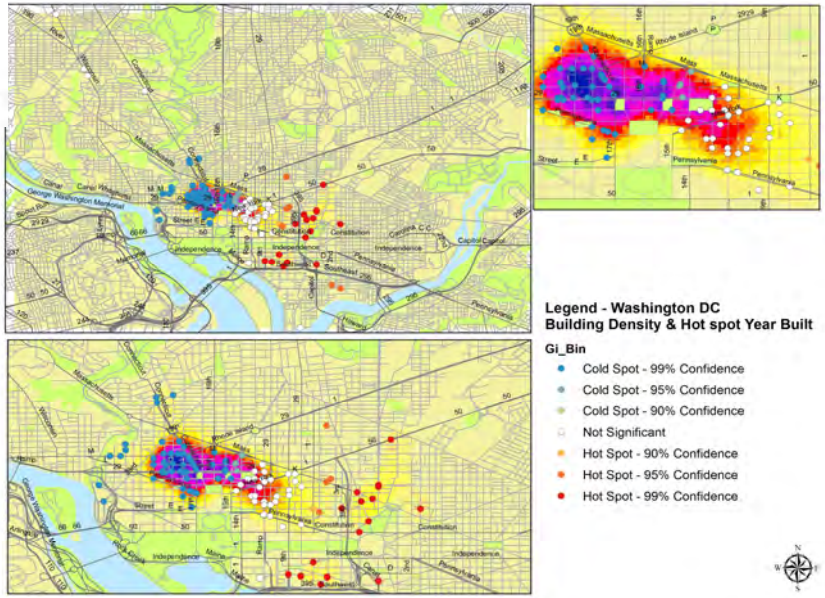


Overall class A and B trends:

- Class A: The groupings of NYC with DC as well as SF with Chicago are maintained with the former showing a slower occupancy increase than the latter.
- Class B: In contrast to all cities, DC maintain a small ratio of occupancy increases.

Hot spot analysis





Conclusion

- The energy policies may not immediately affect the real estate performance of office buildings. However, after the energy policy implementation, the real estate performance of energy-efficient buildings exhibits continuously increasing trends (evidence from the ITSA result of all of the four cities).

- The results, are mixed with NYC's and Chicago's, showing a statistically significant difference in the trends of real estate performance between ES buildings and non-ES buildings after the policy implementation, which implies that the policy may affect the two types of buildings differently.

- The results of Washington DC and NYC exhibited a decline after the policy implementation. This effect can also have its roots in the financial crisis as the implementation happened in 2008 and 2009. More analyses are needed to account for the confounding effects (e.g., including control-group cities without disclosure policies in the analyses).

Disclosure implementation years: DC - 2008, NYC - 2009, SF - 2011, Chicago - 2013

Professor Rogier Holtermans

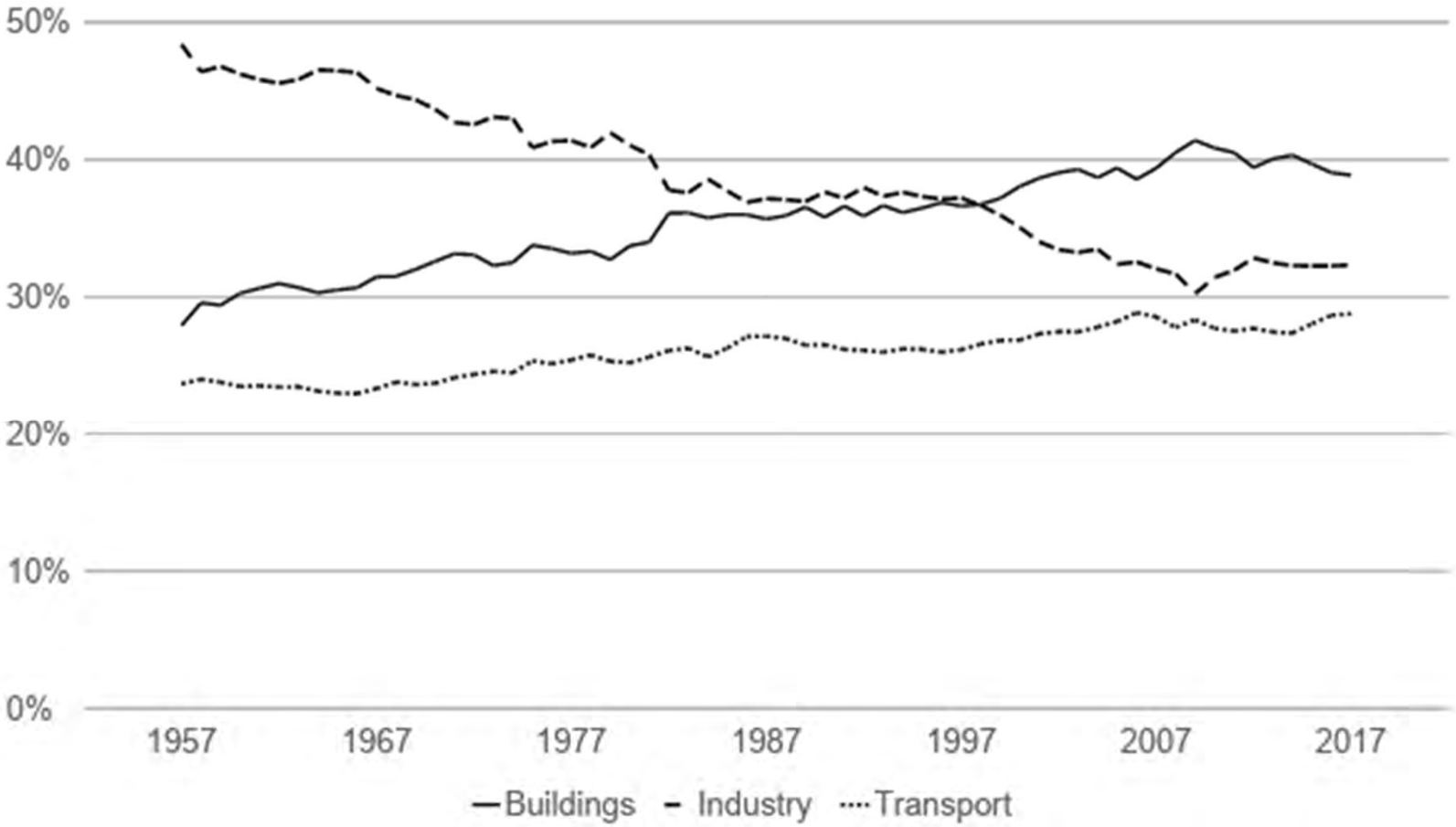
University of Guelph

U.S. DEPARTMENT OF ENERGY

Environmental Performance of Commercial Real Estate: New Insights into Energy Efficiency Improvements

Piet Eichholtz[a], Rogier Holtermans[b] and Nils Kok[a]

[a]Maastricht University, the Netherlands
[b]University of Guelph, Canada

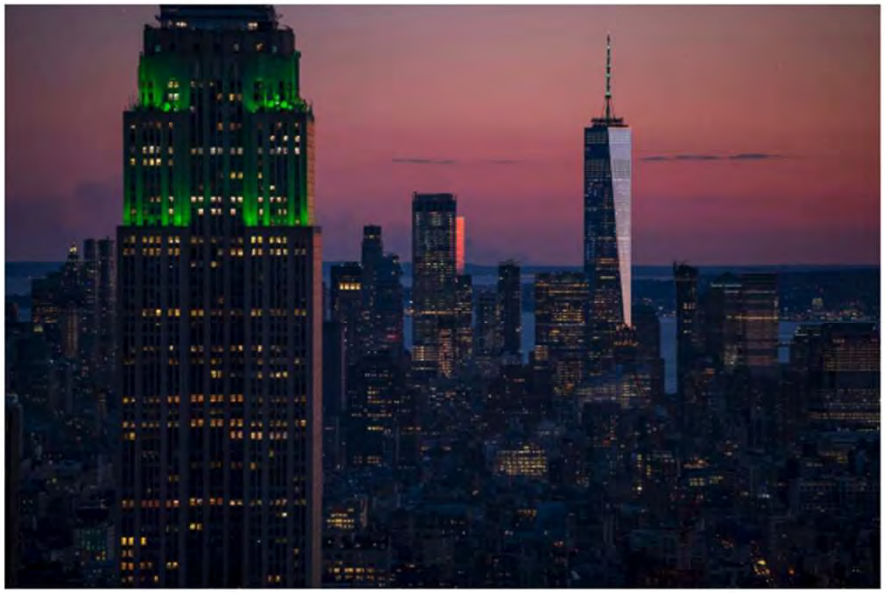


Built environment consumes 40% of energy in the United States (*source: EIA*)

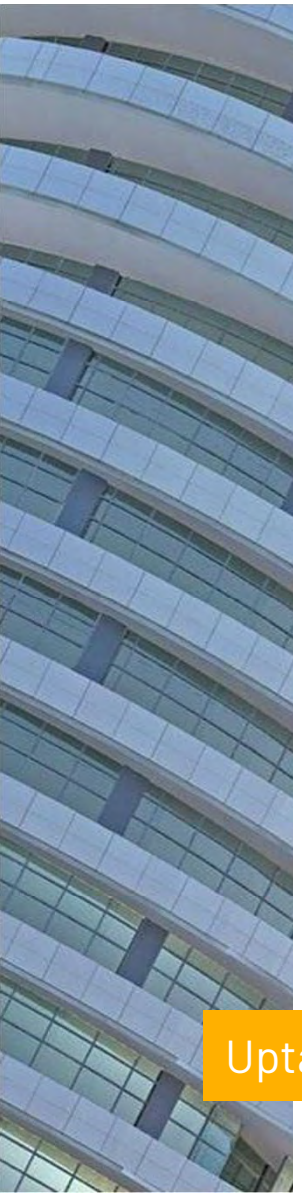
The New York Times

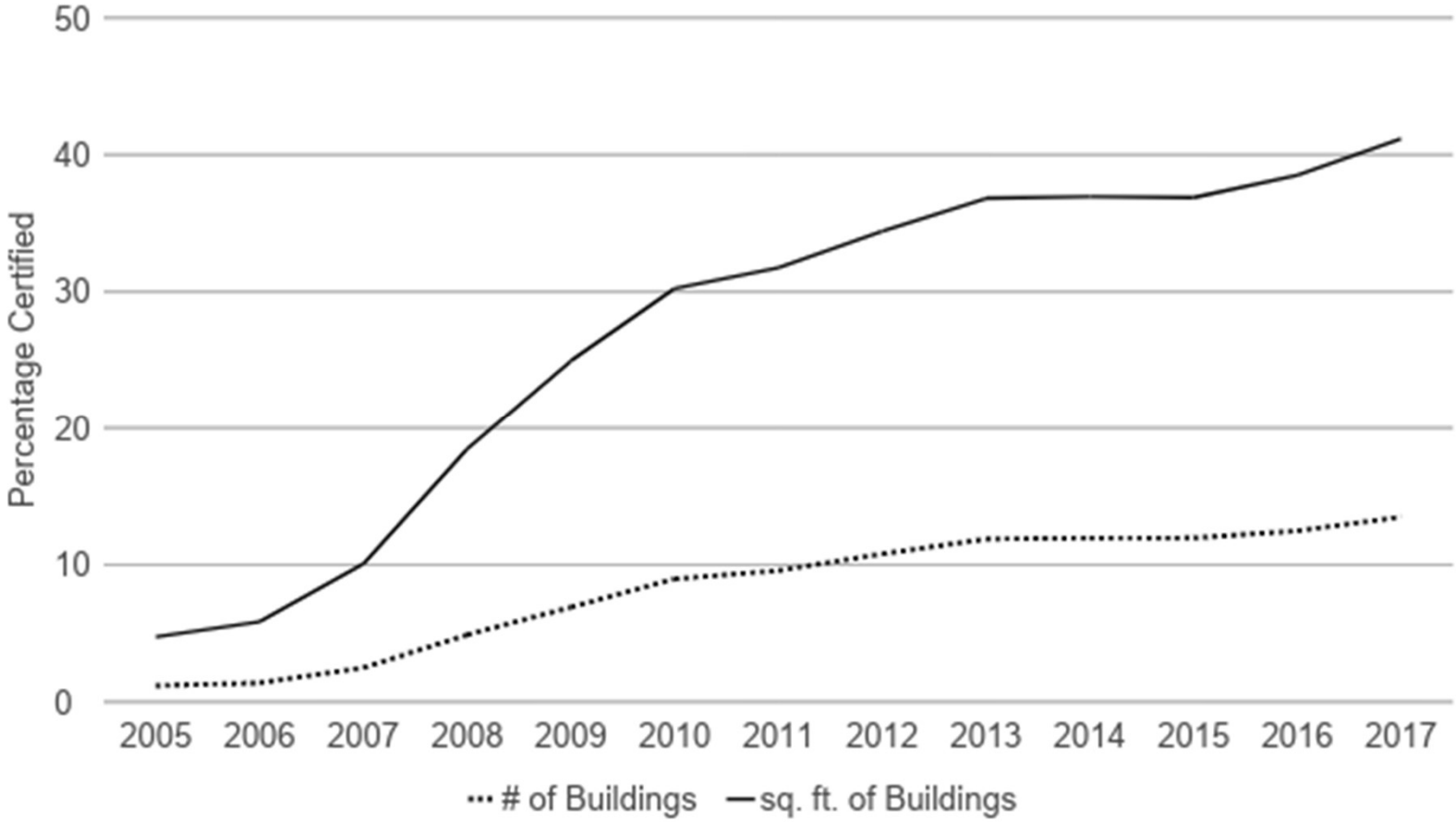
Big Buildings Hurt the Climate. New York City Hopes to Change That.

To fight climate change, the city is forcing the buildings, like the Empire State Building and Trump Tower, to reduce greenhouse gas emissions.

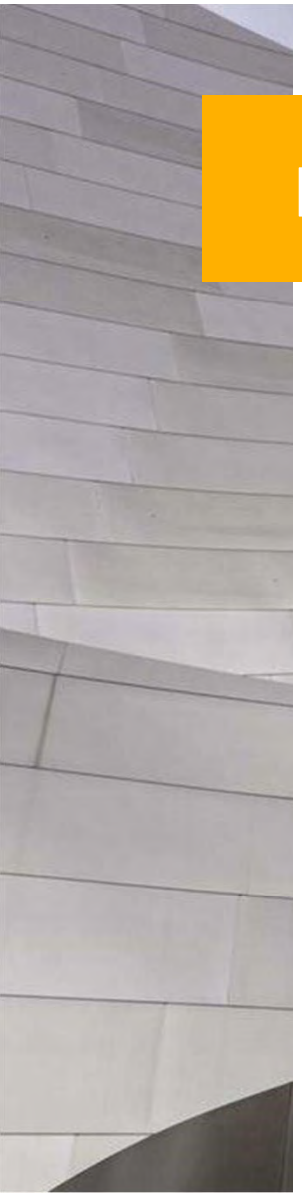


Buildings like the Freedom Tower and the Empire State Building could face fines of up to millions of dollars per year if they do not significantly reduce emissions by 2030.
Karsten Moran for The New York Times





Uptake of LEED and Energy Star increased significantly since 2005



But research is scant…

Previous research has mostly focused on single-family housing

- Aggregate energy consumption of CRE is comparable
- CRE is more lumpy – small effects may have large implications

Main interest is threefold:

1. To understand the general determinants and dynamics of the energy performance of commercial real estate
2. To understand how environmental building certification is related to commercial building energy consumption
3. To understand how specific energy efficiency investments affect commercial building's energy consumption

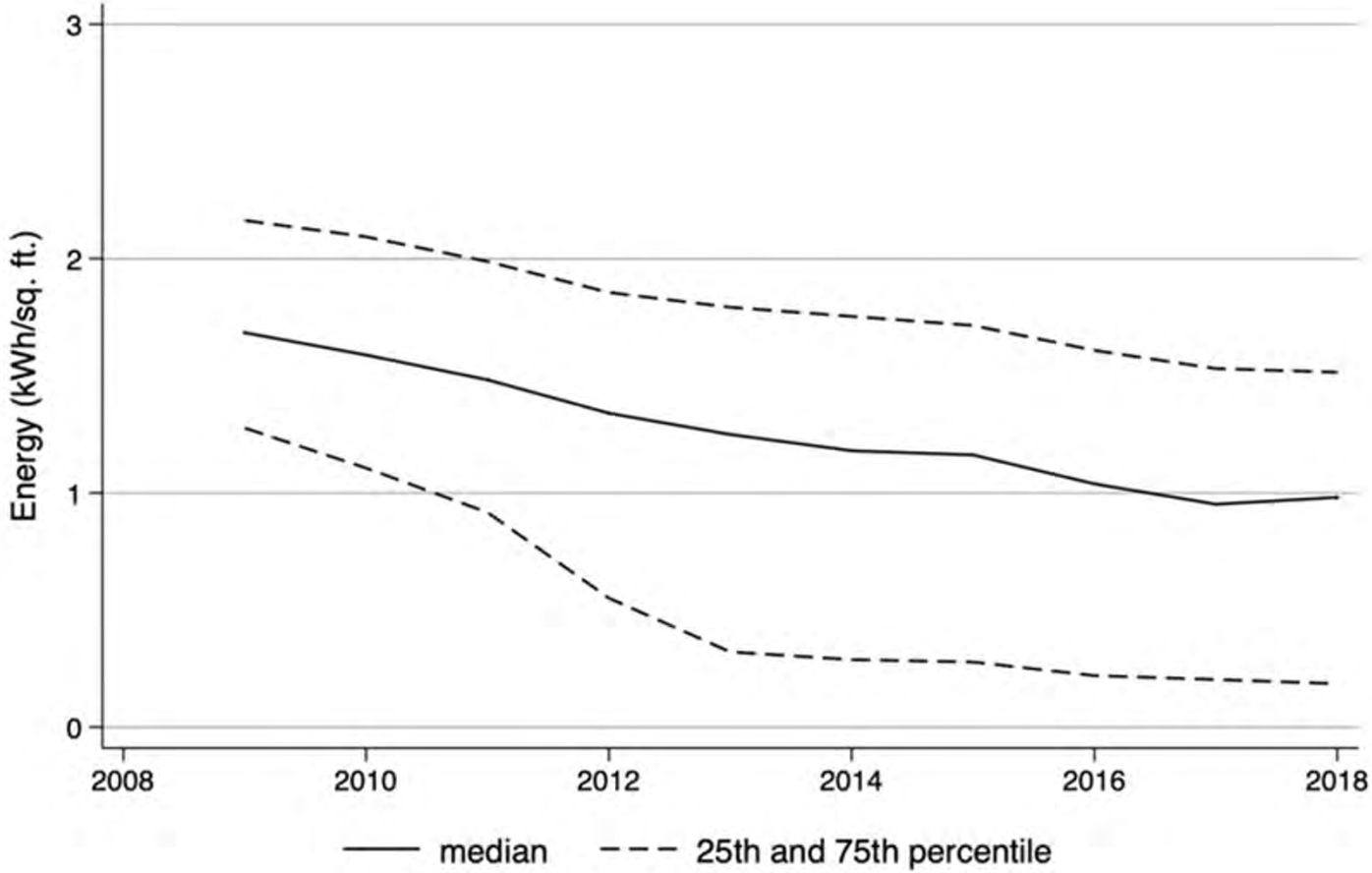
Data and approach

Information on energy consumption in CRE is hard to obtain

- Partner with Measurabl: proprietary set of longitudinal data on some 26,000 buildings, covering the 2009-2018 period
- Information on monthly energy consumption
- U.S. Green Building Council's LEED certification program
- Interventions aimed at improving the environmental performance (GRESB and CDP)

Explaining building energy consumption over time

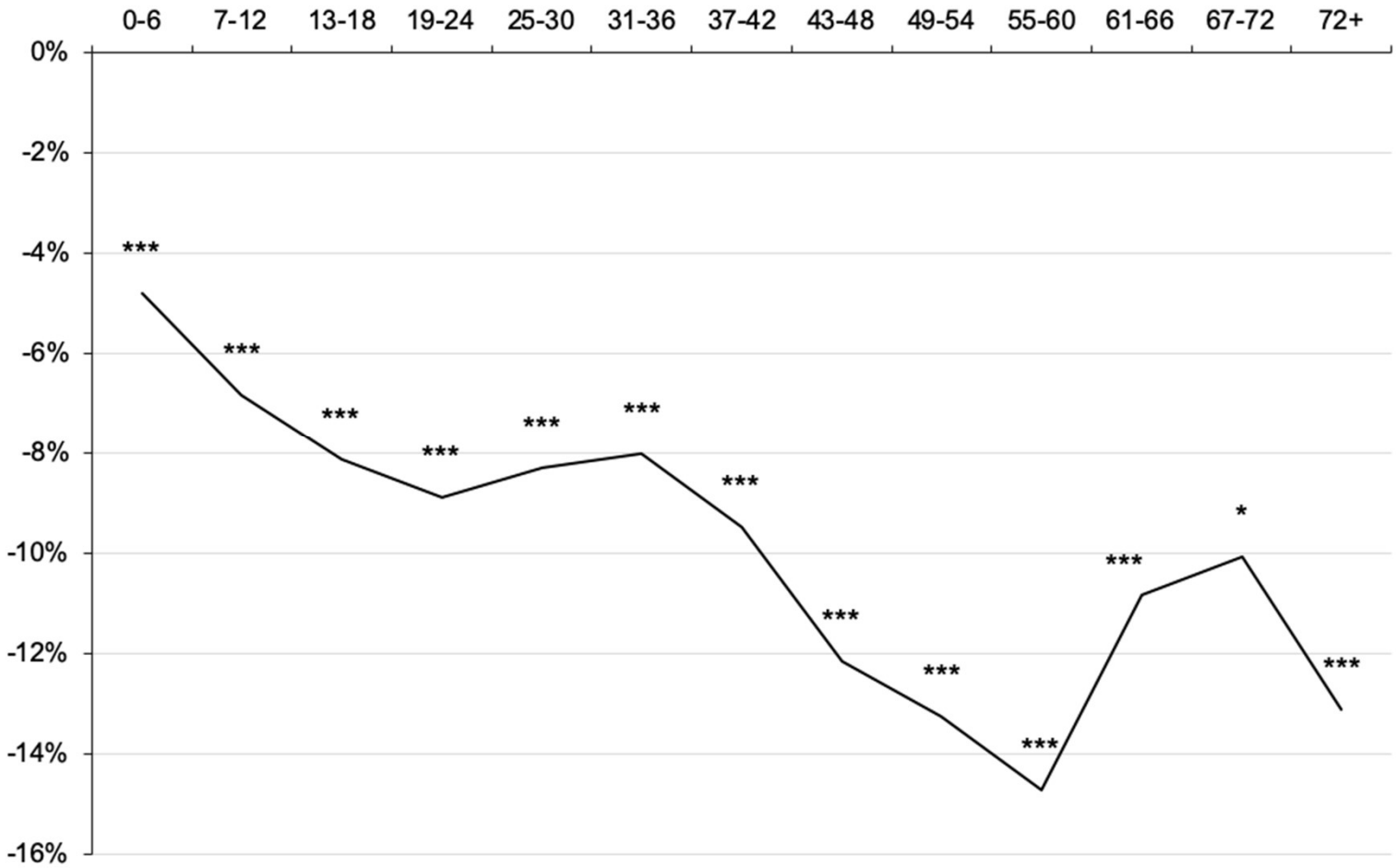
- How do certification and interventions affect energy consumption?
- Fixed effects to control for quality differences (building and month)
- Control for climatic conditions (heating and cooling degree days)



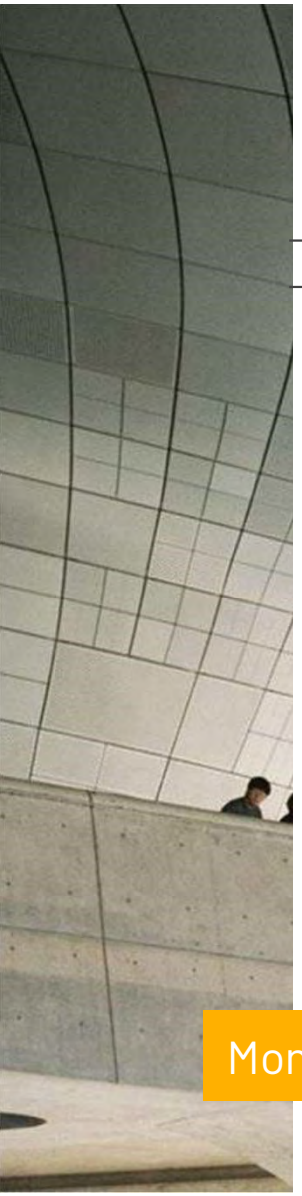
Median energy consumption in commercial real estate decreased by 42%

	(1)	(2)	(3)
LEED (1=yes)	-0.082***		
	[0.014]		
LEED level (1=yes)			
Certified		-0.105***	
		[0.023]	
Silver		-0.111***	
		[0.019]	
Gold		-0.061***	
		[0.017]	
Platinum		-0.123*	
		[0.072]	
LEED program (1=yes)			
Operations and Maintenance (EBOM)			-0.097***
			[0.013]
Building Design and Construction (BDC)			-0.133***
			[0.042]
Core and Shell (CS)			0.111**
			[0.054]
Cooling degree days	0.430***	0.430***	0.431***
(monthly in thousands)	[0.019]	[0.019]	[0.019]
Heating degree days	0.405***	0.405***	0.405***
(monthly in thousands)	[0.012]	[0.012]	[0.012]

LEED certification and energy consumption (office only)



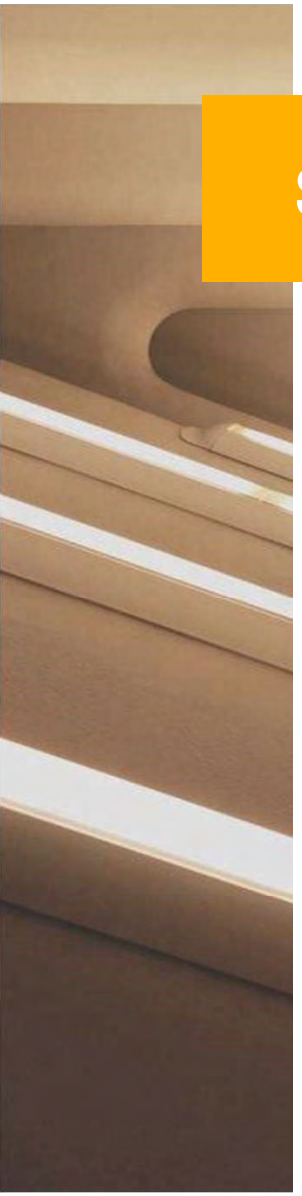
LEED certification tenure (in months)



Building improvements aimed at energy efficiency reduce energy consumption by 8 to 11%, combined effect more than 15%

	(1)	(2)	(3)	(4)	(5)	(6)
Intervention category (1=yes)						
CDP – Energy-efficiency: Building Services	-0.081***					
	[0.017]					
GRESB – HE Equipment and Appliances		-0.084***				
		[0.018]				
Lighting			-0.087***			-0.074***
			[0.020]			[0.022]
HVAC				-0.095***		-0.034
				[0.021]		[0.025]
Building Controls					-0.114***	-0.083**
					[0.038]	[0.039]
Cooling degree days	0.419***	0.419***	0.419***	0.418***	0.418***	0.419***
(monthly in thousands)	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]
Heating degree days	0.497***	0.497***	0.497***	0.497***	0.498***	0.497***
(monthly in thousands)	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]	[0.013]

Monthly median energy consumption for U.S. offices (kWh per sq. ft.)



Summary and implications

Findings:

- We observe a 42% reduction in energy use over the past decade
- On average, energy consumption is reduced by 6% post-certification
- Interventions improve the energy efficiency of buildings by 8 to 12%

Implications:

- Commercial real estate has been responsive to policy efforts and scrutiny of investment community
- Environmental building certification seems to lead to actual reductions in energy consumption
- Investments in environmental building improvements have the desired supply-side effect, leading to increased energy efficiency

Professor Avis Devine

York University

U.S. DEPARTMENT OF ENERGY

Beyond Building Certification:
The Impact of Environmental Interventions on CRE Operations

Jim Clayton, Avis Devine & Rogier Holtermans

Schulich School of Business | York University

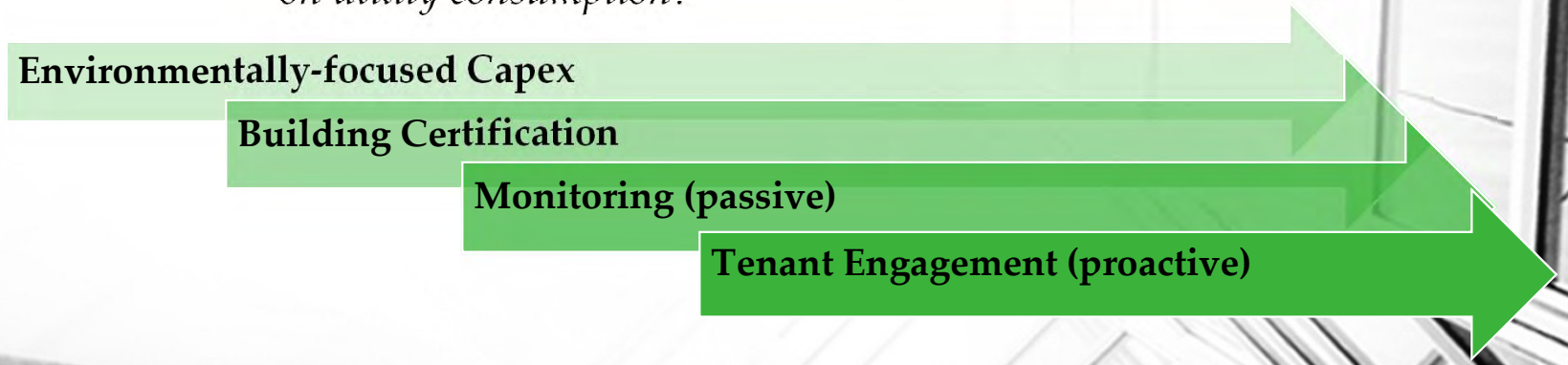
Gordon S. Lang School of Business and Economics | University of Guelph

Motivation & Research Question

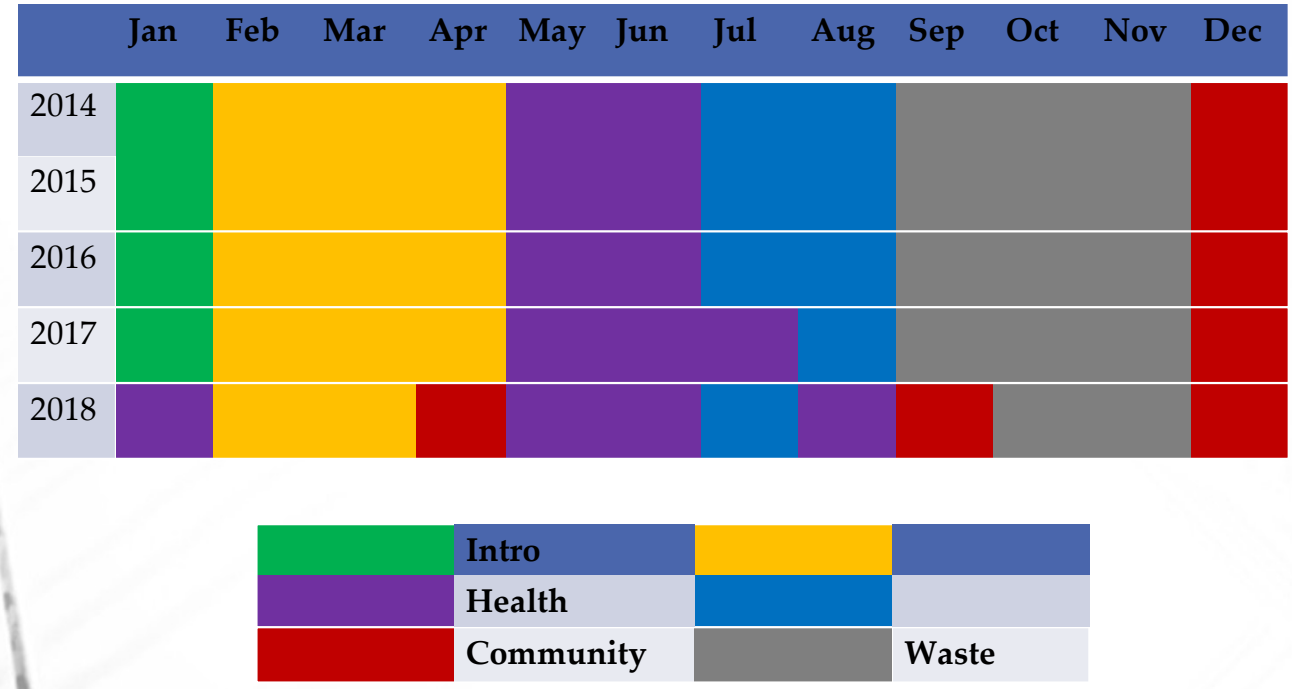
- Most research to-date targets the impact of environmental building certification
  - Rent and occupancy rate premiums; decreased risk, lower cost of debt
- Focus on the Building's impact; what about the **Users**?

Research Question:

What is the impact of environmentally-focused building interventions on utility consumption?



Tenant Engagement: ForeverGreen



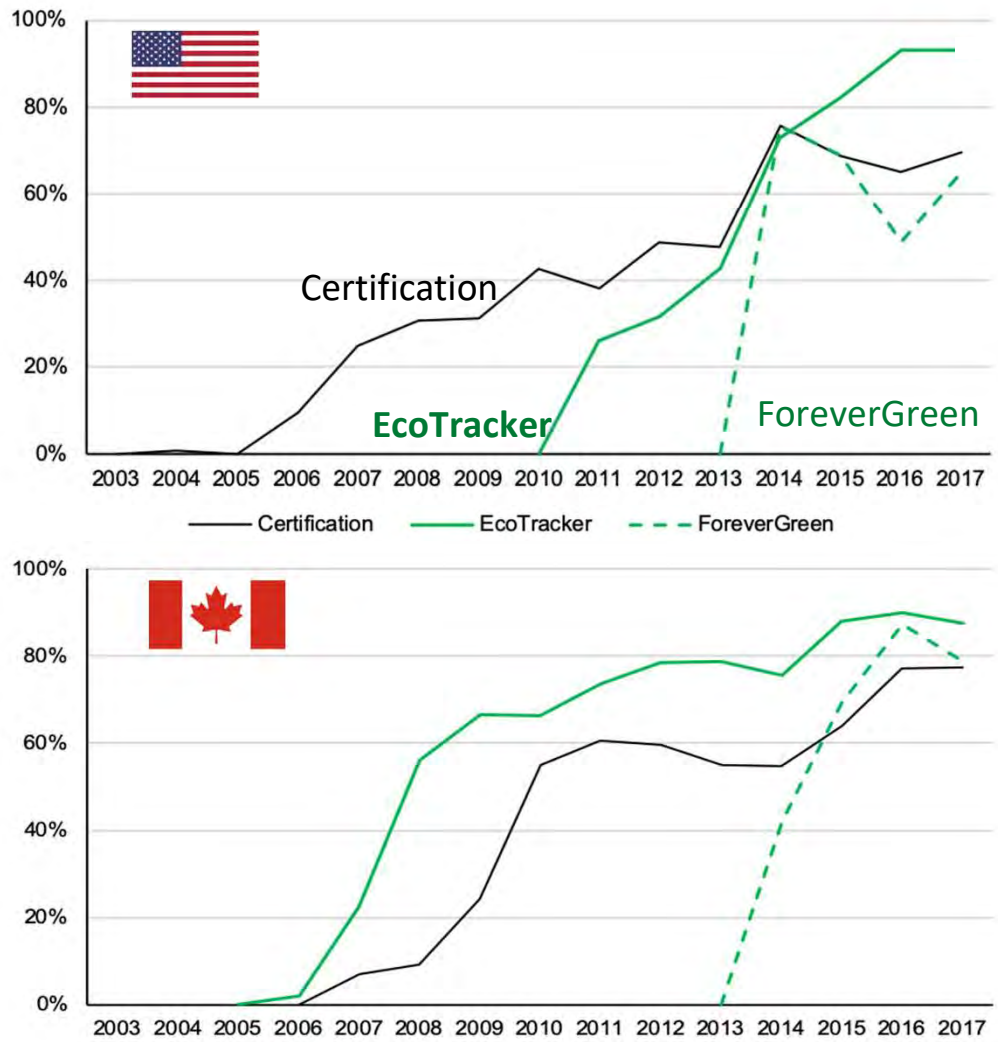
Data & Methods

The Sample

- Partnered with Bentall GreenOak
- 261 office buildings in the U.S. (145) and Canada (116)
- 15 years of monthly observations (25,704 building-months)
- Graphs: Intervention adoption over time

The Approach

- Stringent fixed effects modeling, with controls for external factors

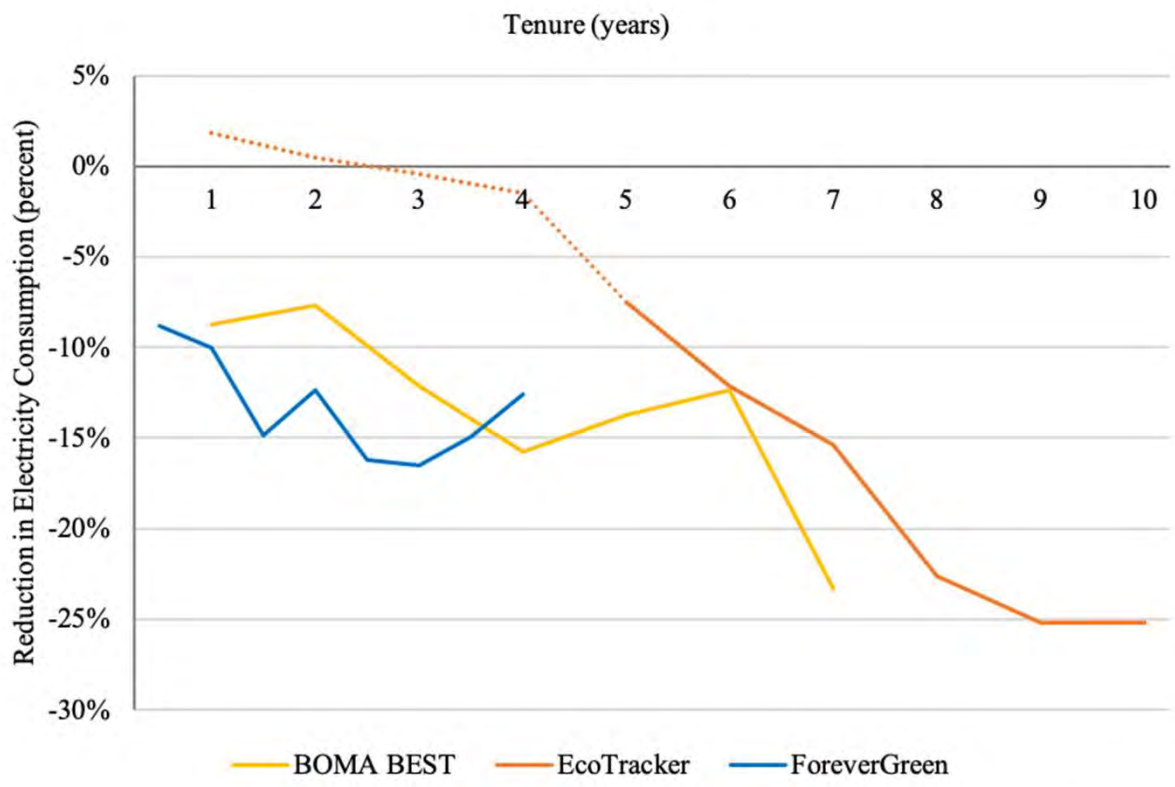


Intervention Tenure Impact on Electricity Consumption

- Regression coefficients from fixed effects models
  - All results highly statistically significant except for dotted line

Findings

- Notable decrease in all categories
- ForeverGreen is a relatively static benefit
- EcoTracker has a "burn in" period

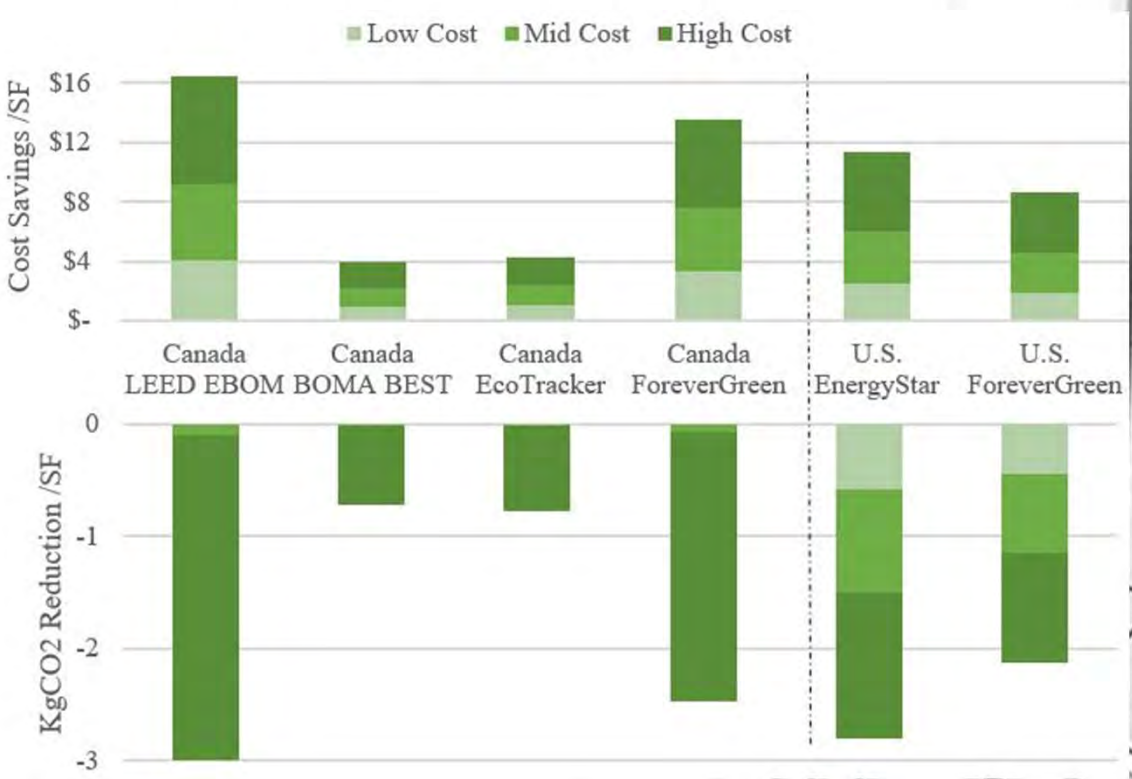


Cost Analysis: Dollars and Carbon Dioxide

- Graph: Cost estimates in local currency (upper), CO2 (lower)
  - Using significant regression results
  - Broken into terciles by cost
  - Based on 2018 actuals ($) & federal government estimates (CO2)

Example: ForeverGreen in Canada

- $3-6/occupied SF saving
- Offset up to 2.4 Kg CO2
- Cost: negligible



Environmental Capex Results: Subcategory Analysis

Dependent variable electricity consumption in natural log form, scaled by occupied square foot

Restricted to buildings that report in the system (smaller sample)

Example: Operational Change in Canada

- Average one-time cost: $0.02/occ SF
- Average savings: $1.69-$3.07/occ SF

	(1)	(2)	(3)	(4)
CAPEX Subcategory:				
Operational Change	-0.082*		0.030	
Lighting Retrofit		-0.082**		-0.076**
BOMA BEST only	0.003	0.013		
LEED EBOM only	-0.097*	-0.104**	0.044	0.027
BOMA BEST & LEED EBOM	-0.091**	-0.090*		
Energy Star only			-0.064*	-0.082**
Energy Star & LEED EBOM			-0.050**	-0.052**
LEED D&C	-0.004	0.006	-0.171***	-0.181***
EcoTracker	-0.073**	-0.071**	0.027	0.026
ForeverGreen	-0.095**	-0.081**	-0.066**	-0.053**
Occupancy & Degree Days	yes	yes	yes	yes
Month & Bldg fixed effects	yes	yes	yes	yes
Number of bldg-months	3,872	3,872	2,393	2,393
Number of buildings	36	36	27	27
Adj. R-squared	0.683	0.685	0.928	0.929

Summary

- **All forms of interventions lower electricity consumptions, even when controlling for other interventions**
  - Strong results in Canada, weaker in U.S. but with stronger model fit
- **Environmentally-focused capex decreases electricity consumption, often at a far smaller cost than expected savings**
  - Particularly for calibration of systems and adjustments to lighting
- **Building certification remains key, but certification alone does not optimize savings**

The collective impacts of design, operating efficiency, and maintenance of equipment, along with an effective strategy to engage and help tenants understand and reduce energy consumption, interact to shape a buildings' bottom line.

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