Business Case 2.0: New Research Around High Performing Buildings

Thursday 23rd, 2018
10:30am – 12:00pm
Panelists

Paul Mathew
Staff Scientist and Department Head of Whole Building Systems, Lawrence Berkeley National Laboratory

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Real Estate and Financial Markets Lab Director, University of California, Berkeley

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Assistant Professor of Property Management, Virginia Tech

Andrew White
Associate Manager, RE Tech Advisors
Energy and Default Risk in Commercial Mortgages
Paulo Issler
Real Estate & Financial Markets Lab Director
University of California, Berkeley
Acknowledgements

- Holly Carr (U.S. DOE)
- Cindy Zhu (U.S. DOE)
- Philip Coleman (LBNL)
- Jeff Deason (LBNL)
- Tianzhen Hong (LBNL)
- Paulo Issler (UCB)
- Paul Mathew (LBNL)
- Emily McLaughlin (IMT)
- Baptiste Ravache (LBNL)
- Kaiyu Sun (LBNL)
- Nancy Wallace (UCB)
The link between energy and CRE mortgages

- Net Operating Income (NOI): the key financial measure for CRE valuation and mortgage risk
- Energy cost is one of the largest components of Net Operating Income (NOI)
  - Energy prices are highly volatile
  - Poor CRE property management can severely impact energy consumption

Current practice does not fully account for these factors in calculation of Net Operating Income (NOI)
- Usually based on historical average cost data, if available
- Does not account for energy use and price volatility during mortgage term

Key question: How much do these factors “move the needle” for NOI and default risk?
Approach: Impact of energy on default rate

Mortgage Default Rate = \( f(\text{EUI}, \text{ElecPriceGap}, \text{CouponSpread}, \text{LTV}, \text{Region}, \text{more controls}) \)

Empirical analysis combining
- Mortgage loan data (TREPP)
- Energy use data (Benchmarking disclosure)
Default risk and source EUI (cont.)

Office + Retail – Linear probability model

- The coefficient estimates for **BOTH** the *Electricity Price Gap* and *Source EUI* are significant at better than the .05 level of statistical significance

  - The higher the **Source EUI** (the more energy usage per square foot) the higher the likelihood of default
  - The higher the **Electricity Price Gap**, (the larger the difference between the actual and the expected electricity prices since the loan origination), the higher the likelihood of default
# Default risk and source EUI

## Office + Retail – Linear probability model

<table>
<thead>
<tr>
<th></th>
<th>Coefficient Estimate</th>
<th>Standard Error</th>
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</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.40444**</td>
<td>0.18466</td>
</tr>
<tr>
<td>Log Source EUI</td>
<td>0.07335**</td>
<td>0.03129</td>
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<tr>
<td>Origination Loan-to-Value Ratio</td>
<td>0.00258***</td>
<td>0.00096</td>
</tr>
<tr>
<td>Coupon Spread to 10 Year Treasury</td>
<td>0.02188</td>
<td>0.01565</td>
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<tr>
<td>Electricity Price Gap</td>
<td>0.00003***</td>
<td>0.00001</td>
</tr>
<tr>
<td>Time to Maturity on Balloon</td>
<td>-0.00189***</td>
<td>0.00060</td>
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<tr>
<td>Origination Year Fixed Effects</td>
<td>Yes</td>
<td></td>
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</tbody>
</table>

473 observations, $R^2 = .1052$

* * p<0.1; ** p<0.05; ***p<0.01
Default risk and source EUI (cont.)

Analysis using **Scaled Source EUI** – Linear probability model

- Coefficient estimates are significant and robust for three cohorts: all buildings, Office + multiuse + retail, office only.
- Coefficient estimates for electricity price gap significant for all buildings, office + multiuse + retail
- Consistent results for linear probability and logistic regression models.
## Default risk and source EUI (cont.)

**Scaled Source EUI (Office + MU + Retail) – Linear probability model**

<table>
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<tr>
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<td>Intercept</td>
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<td>0.11067</td>
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<tr>
<td>Scaled Source EUI</td>
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<td>0.000369</td>
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<td>Origination Loan-to-Value Ratio</td>
<td>0.00263**</td>
<td>0.00117</td>
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<td>Coupon Spread to 10 Year Treasury</td>
<td>0.00751</td>
<td>0.040</td>
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<tr>
<td>Electricity Price Gap</td>
<td>0.00003**</td>
<td>0.00001</td>
</tr>
<tr>
<td>Time to Maturity on Balloon</td>
<td>-0.00203**</td>
<td>0.00068</td>
</tr>
<tr>
<td>Origination Year Fixed Effects</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

339 observations, $R^2 = .1768$

* $p<0.1$; ** $p<0.05$; *** $p<0.01$
What are the impacts on specific loans?

Collaborate with lenders to:

1. Demonstrate impact of energy use and price on specific mortgage loans
2. Develop recommendations

**Approach**

- Compile info from Appraisals, PCAs, other sources.
- Estimate source EUI variations.
  - Simulation and empirical approaches.
- Compute electricity price gap using forward curves.
- Compute default risk impact due to source EUI and electricity price gap.
Case Studies

- San Jose Office
- Sonoma Office
- Denver Office
- San Francisco Multi-family
- Denver Hotel
# Denver Office – energy use and default risk

Facilities Management factors:
- HVAC schedule
- Thermostat setback
- Supply air temp control
- VAV min flow control
- Economizer controls
- Lighting controls

*Levels: good, average, poor*

<table>
<thead>
<tr>
<th>Case</th>
<th>Facilities mgmt factors</th>
<th>Occupancy Factors</th>
<th>Source EUI change (%)</th>
<th>Default risk change (bp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Good</td>
<td>Good/Low</td>
<td>-54%</td>
<td>-248</td>
</tr>
<tr>
<td>2</td>
<td>Good</td>
<td>Ave</td>
<td>-33%</td>
<td>-127</td>
</tr>
<tr>
<td>3</td>
<td>Ave</td>
<td>Ave</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Good</td>
<td>Poor/High</td>
<td>+4%</td>
<td>+12</td>
</tr>
<tr>
<td>5</td>
<td>Poor</td>
<td>Good/Low</td>
<td>+64%</td>
<td>+158</td>
</tr>
<tr>
<td>6</td>
<td>Poor</td>
<td>Ave</td>
<td>+76%</td>
<td>+181</td>
</tr>
<tr>
<td>7</td>
<td>Poor</td>
<td>Poor/High</td>
<td>+132%</td>
<td>+268</td>
</tr>
</tbody>
</table>
Denver Office – energy price and default risk

Electricity price gap distribution and contribution to default risk
Palo Verde wholesale prices

- Frequency of Electricity Price Gap
- Change in Default Rate (bp)
- Electricity Price Gap
- Default Risk
- +1 STD
- -1 STD
## Case Studies – summary of risks impacts

Compare to TREPP average default rate of 800bp

<table>
<thead>
<tr>
<th>Building</th>
<th>Source EUI variation (%)</th>
<th>Default rate variation (bp)</th>
<th>Default rate variation relative to TREPP avg (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver Office</td>
<td>-54% to +132%</td>
<td>-248 to +268</td>
<td>-31% to +34%</td>
</tr>
<tr>
<td>Sonoma Office</td>
<td>-40% to +183%</td>
<td>-161 to +331</td>
<td>-20% to +41%</td>
</tr>
<tr>
<td>San Jose Office</td>
<td>-62% to +119%</td>
<td>-308 to +249</td>
<td>-39% to +31%</td>
</tr>
<tr>
<td>Denver Hotel</td>
<td>-11% to +17%</td>
<td>-37 to +49</td>
<td>-5% to +6%</td>
</tr>
<tr>
<td>San Francisco Multi-family</td>
<td>-20% to +26%</td>
<td>-72 to +74</td>
<td>-9% to +9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wholesale price region</th>
<th>Default rate variation (bp)</th>
<th>Default rate variation relative to TREPP avg (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver area</td>
<td>+159 to +501</td>
<td>+20% to +63%</td>
</tr>
<tr>
<td>Northern California</td>
<td>-49 to +705</td>
<td>-6% to +88%</td>
</tr>
</tbody>
</table>
Case Studies – business impact

"These results showing the impact of energy on default risk are clearly meaningful. I don’t currently consider energy efficiency when making a loan and seeing this makes me think I would want to ask about it”

"I would like to apply these findings but would want an easy way to use it. A simple score or ratio for energy risk would be good. In fact, I would be interested to pilot test it."

Keith Hanley, Silicon Valley Bank
Looking Ahead
Looking Ahead – our vision

To have energy factors fully and routinely incorporated in commercial mortgage valuation, accelerating demand for buildings with lower energy risk.

Show that energy matters → Develop and pilot interventions → Disseminate best practices → Institutionalize

Scope of current effort:
- Analysis of energy impacts
- Case studies on actual mortgage loans
- Protocols and tools for lenders and owners

Long term:
- Industry Standards
Recommendations

**Lenders:**
- Ask owners to provide info on energy cost range.
  - Account for variations in energy use and energy price.
  - Could be done as part of Property Condition Assessment.
  - Can reference ASTM standard
- Incorporate energy risk factor into underwriting and terms
  - e.g. Interest rate discount for lower risk
- Offer additional loan proceeds for EE investments

**Owners:**
- Ask lenders to account for energy efficiency when setting mortgage terms.
- Provide data on energy costs to lender.
  - Historical and anticipated
  - In appraisal and/or PCA
Thank you
Money Matters: Exploring the Financial Impacts of Green Certifications in the Multifamily Rental Sector

Erin A. Hopkins, Ph.D., CAPS, LEED Green Associate Assistant Professor of Property Management
Overview of Research

- **Sample**: 153 properties from 2 of National Multifamily Housing Council’s 2016 50 Largest Apartment Managers
- **Green-certified**: 22.88% of properties (35 properties)
- **Methodology**: Multiple Regression Analysis
- **Controls**: Location, Fitness Center, Pool, Outdoor Common Area, Walk Score, # of Unfurnished Apartments, Average Apartment Unit Size, Age, Building Mix
- **Limitations**: Building class not directly taken into account
<table>
<thead>
<tr>
<th>Certification</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin Energy Green Building® (AEGB) Rating System</td>
<td>3</td>
</tr>
<tr>
<td>ENERGY STAR®</td>
<td>1</td>
</tr>
<tr>
<td>Florida Green Building Coalition (FGBC)</td>
<td>1</td>
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<tr>
<td>GreenPoint Rated</td>
<td>4</td>
</tr>
<tr>
<td>LEED®</td>
<td>16</td>
</tr>
<tr>
<td>National Green Building Standard™ (NGBS)</td>
<td>11</td>
</tr>
</tbody>
</table>
Properties by City

Summary Statistics of City Data
n=153

- Atlanta: 8
- Austin: 4
- Charlotte: 4
- Chicago: 6
- Dallas: 14
- Denver: 3
- Fort Lauderdale: 1
- Houston: 3
- Los Angeles: 19
- Olive Branch: 3
- Plano: 1
- Portland: 7
- San Diego: 4
- San Francisco: 3
- San Mateo: 2
- Scottsdale: 6
- Seattle: 1
- St. Petersburg: 2
- Sunnyvale: 2

Legend:
- Summary Statistics of City Data Green Bldgs
- Summary Statistics of City Data Non-Green Comparables
Summary Statistics of Green vs. Non-Green Properties

n = 153

<table>
<thead>
<tr>
<th>Area</th>
<th>Green</th>
<th>Non-Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness Center</td>
<td>97%</td>
<td>89%</td>
</tr>
<tr>
<td>Pool</td>
<td>71%</td>
<td>69%</td>
</tr>
<tr>
<td>Outdoor Common Area</td>
<td>100%</td>
<td>93%</td>
</tr>
<tr>
<td>Mixed-Use Property</td>
<td>31%</td>
<td>24%</td>
</tr>
</tbody>
</table>
Summary Statistics of Green vs. Non-Green Properties

\( n = 153 \)
Findings

- Total Rents Collected: 10.47%
- Total Maintenance: 12.54%
- Property Insurance: 13.19%
- Total Expenses: 13.11%

Higher rents *and* expenses.
## Financial Impacts of Green

**Dependent Variable**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Per Square Foot</th>
<th>Per Apartment</th>
<th>Per Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Rents Collected</td>
<td>$ 2.47</td>
<td>$ 2,189</td>
<td>$ 551,683</td>
</tr>
<tr>
<td>Subtotal Maintenance</td>
<td>$ 0.20</td>
<td>$ 178</td>
<td>$ 44,843</td>
</tr>
<tr>
<td>Property Insurance</td>
<td>$ 0.05</td>
<td>$ 42</td>
<td>$ 10,601</td>
</tr>
<tr>
<td>Total Expenses</td>
<td>$ 1.12</td>
<td>$ 990</td>
<td>$ 249,535</td>
</tr>
</tbody>
</table>
Discussion

Different motivations for paying higher rent may be in play

• Assume efficient operations will offset the higher rent
• Philanthropic motives
• Prestige motives
• Green buildings tend to be newer...more likely to offer the more sought-after amenities and finishes
• Tend to be in higher-income areas...likely have higher rents
Higher Operating Expenses a Surprise

Does not align with much of the existing research…but no research on effects of green certification on total operating expenses within multifamily rental sector

Many of the certifications represented in this study focus on the design phase of the property vs. the operations and maintenance phase

And although promotion of sustainability is on the rise in the multifamily housing sector, staff may remain unfamiliar with the unique operations and maintenance of green buildings
**Final Thoughts**

<table>
<thead>
<tr>
<th><strong>Apartment homes represent $1.3 trillion to the U.S. economy, and 5 million new rental households are expected by 2023</strong> (National Multifamily Housing Council, 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upfront capital constraints, regulatory issues, knowledge limitations, and marketing concerns may diminish the attractiveness of multifamily rental green building certification if not properly managed</strong></td>
</tr>
<tr>
<td><strong>Most studies focus on office sector and/or strictly rents or property value</strong></td>
</tr>
<tr>
<td><strong>This study begins to look at the multifamily rental sector and offer a more comprehensive analysis</strong></td>
</tr>
<tr>
<td><strong>Further research is needed with larger datasets to understand effects of green certification on income statement components in the apartment industry as NOI ultimately determines property market value</strong></td>
</tr>
<tr>
<td><strong>Optimism that this study can be the impetus for further research contributions on the financial, environmental, and resident satisfaction impacts of green practices and certifications on the multifamily rental sector</strong></td>
</tr>
</tbody>
</table>
Contact information
Erin A. Hopkins
erinz1@vt.edu

Acknowledgements:
• Todd Feist, Sustainability Program Manager at The Institute of Real Estate Management (IREM®) for his assistance with this research project
• Yardi and IREM® for the grant awarded to support this research
• The two property management companies for sharing their data
New DOE-driven Research Around High Performing Buildings

AUGUST 23, 2018

ANDREW WHITE
ASSOCIATE MANAGER
awhite@retechadvisors.com
Context Setting – DOE Research Effort
What are the impacts of energy efficiency and high-performance building features on financial performance of commercial real estate?

2015-2016
- Research design, working group, pilot study, data lab

2017
- Connect to Real Estate Research Institute (RERI), Literature review and gap analysis,

2018
- Research agenda, request for proposals, research project selection and execution

What are the impacts of energy efficiency and high-performance building features on financial performance of commercial real estate?
RERI’s mission is to encourage and reward research on real estate as an investment and as an asset class that is both academically rigorous and of value to the institutional real estate investment profession. In addition, RERI serves to provide a forum through which the real estate academic, professional, and regulatory communities can interact, facilitating the exchange of insights amongst these stakeholders.
Literature Review: Objectives

- Build upon DOE’s Review of Studies in the Market
  - Focus explicitly on peer-reviewed papers
- Gap analysis of existing research to identify:
  - Questions that have already been sufficiently proven
  - Holes in existing body of research
- Academic Input
  - Guidance on which studies to include
  - Suggestions for how to conduct analysis
<table>
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<tr>
<th></th>
<th>LEED</th>
<th>ENERGY STAR label</th>
<th>ENERGY STAR score</th>
<th>Energy use</th>
<th>BREEAM</th>
<th>Energy Performance Certificate (UK)</th>
<th>BOMA BEST</th>
<th>Walkability</th>
<th>Non-energy green features</th>
<th>Other</th>
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<td>Tenant satisfaction</td>
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<td>Default rate</td>
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<td>Debt service coverage ratio</td>
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<td></td>
<td></td>
<td>1</td>
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<tr>
<td>Worker productivity</td>
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<tr>
<td>Other</td>
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<td>4</td>
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<td></td>
<td>1</td>
<td>4</td>
<td>2</td>
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</table>
There is considerable evidence that green building certifications correlate with increased economic value, primarily via higher rents and sales prices.

- How do we move beyond certification to analyze performance?
- Correlation vs. Causation
  - What is driving added value? Is it green features and efficiency, the green labels themselves, or other desirable features often included in certified buildings?

Panel studies could help reduce some of the uncertainty and noise.

Full results presented at ACEEE Summer Study:
- Raising the Rent Premium: Moving Green Building Research Beyond Certifications and Rent
- Cindy Zhu, Andrew White, Paul Mathew, Jeff Deason, Philip Coleman
Research Agenda: Core Question

“How does <energy/green metric> affect <financial value metric>?”

<table>
<thead>
<tr>
<th>Energy/Green Metric</th>
<th>Financial Value Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site energy use or EUI</td>
<td>Vacancy/Occupancy</td>
</tr>
<tr>
<td>Source energy use or EUI</td>
<td>Leasing Velocity (absorption, speed of sales, leasing)</td>
</tr>
<tr>
<td>Energy cost or cost/sf</td>
<td>Tenant Renewals</td>
</tr>
<tr>
<td>ENERGY STAR score</td>
<td>Tenant Satisfaction</td>
</tr>
<tr>
<td>ENERGY STAR label</td>
<td>Rental Income and Rent Concessions</td>
</tr>
<tr>
<td>Green Building Certification (LEED, BOMA 360...)</td>
<td>Marketing Costs</td>
</tr>
<tr>
<td>Green Building Certification level (e.g., LEED Silver, Gold)</td>
<td>Utility Costs, Maintenance, OpEx</td>
</tr>
<tr>
<td></td>
<td>Obsolescence</td>
</tr>
<tr>
<td></td>
<td>Capitalization Rates</td>
</tr>
</tbody>
</table>

|                                                          | Sales Price                                |
|                                                          | Regulatory & Compliance Risk               |
|                                                          | Insurance (rates, ability)                |
|                                                          | Default Risk                               |
|                                                          | Debt Service Coverage Ratio               |
|                                                          | Access to Funding                          |
|                                                          | Interest Rates                             |
|                                                          | Reserves                                  |
Proposal Reviews

- 12 proposals received, 5 projects selected
- Criteria:
  - Department of Energy goals
  - Impact on Commercial Real Estate (CRE) Industry
  - Feasibility and Interest
  - Quality and Validity
Beyond Environmental Building Certification: The Impact of Environmental Interventions on Commercial Real Estate Operations

- Jim Clayton, Avis Devine (York University) and Rogier Holtermans (University of Guelph)
- Analyzing four types of energy efficiency interventions on financial components that impact property-level NOI
  - How do interventions impact different aspects of building operations, and their subsequent financial impact?
The Dynamics of Energy Consumption in Commercial Real Estate

- Piet Eichholtz and Nils Kok (Maastricht University) and Rogier Holtermans (University of Guelph)

- Three key questions:
  - How is environmental building certification related to commercial building energy consumption?
  - How does aging affect the energy consumption of the commercial building stock?
  - To what extent do specific energy efficiency investments affect energy consumption in commercial real estate?
Effect of Energy Benchmarking and Disclosure on Office Building Marketability

- Sofia Dermisi, Chris Lee, and Youngjin Choe (University of Washington)
- Exploring the effect of disclosure policies on office building marketability while assessing potential links between market performance of sustainable assets:
  - Before and after the disclosure policies while considering market cycles
  - Before and after ENERGY STAR and/or LEED certification
- Markets included: San Francisco, Washington DC
Sustainable Insights and Public Real Estate Performance, GRESB Effects in REIT Markets

- Dirk Brounen (Tilburg University) and Gianluca Marcato (Reading University)
- Analyzing the adoption of GRESB within the public real estate markets and predicting a potential impact of GRESB scores on REIT returns
Estimating Office and Residential Building Energy Retrofit Hurdle Rates and Risk Arbitrage in Energy Efficiency Investments

- Constantine Kontokosta (New York University), Franz Fuerst (Cambridge University), Gary Pivo (University of Arizona), & Jacob Sagi (UNC Chapel Hill)

- Utilizing NYC data to empirically model:
  - the spread between the premium for labeled (energy efficient) buildings and the cost to retrofit an under-performing building to meet the same standard, which will allow us to understand how much of the observed premium is attributable to energy efficiency, and how much can be assigned to other perceived benefits (marketing, construction quality, etc.)
  - the hurdle rate for energy retrofit investments, using actual audit data and permitted renovation work.
Next Steps

- Collecting data for continued Data Lab analysis
- Presenting Research findings:
  - Interim research results – IPC Research Symposium (October)
  - Greenbuild Session (November)
  - RERI Research Conference (April)
  - Final research results – Better Buildings Webinars, Summit 2019 (TBA)

- Work with DOE: case study and data analysis opportunities abound!