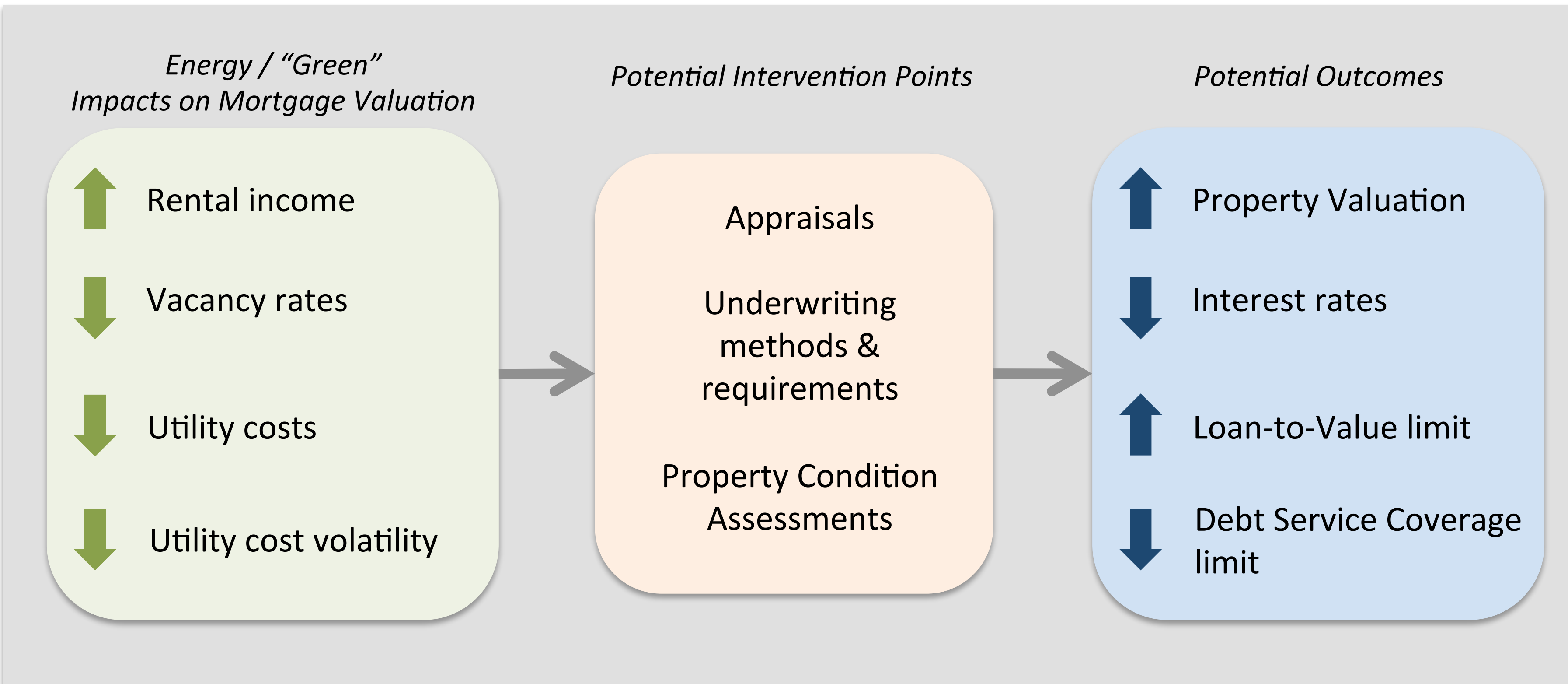
# Energy Factors in Commercial Building Finance

## 2017 Building Technologies Office Peer Review

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# Project Summary

## Timeline:

Start date: October 2015

Planned end date: September 2018

Key Milestones

1. Pilot incorporation of energy factors into underwriting with at least two lenders; 8/31/17
2. Two case studies on Property Condition Assessment energy efficiency module; 6/30/17

## Budget:

### Total Project $ to Date:

- DOE: $800,000
- Cost Share: $0

### Total Project $:

- DOE: Year 3 TBD
- Cost Share: $0

## Key Partners:

| | |
|---|---|
| UC Berkeley Haas School of Business | Institute for Market Transformation |
| Silicon Valley Bank | Colorado Lending Source |
| Ascentium Capital | Unico |

## Project Outcome:

The goal of this project is to ensure that commercial mortgages fully account for energy factors in underwriting and valuation and thereby serve as a scalable channel for energy efficiency investments.

The project seeks to:

- **Develop interventions** to properly value and incorporate energy factors in the commercial mortgage underwriting process;
- **Pilot interventions** with lenders and related stakeholders;
- **Disseminate best practices** within the commercial mortgage community.

This project directly addresses CBI strategy #3 in the BTO MYPP.



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# Purpose and Objectives…1

**Problem Statement**:

- Commercial mortgages currently do not fully account for energy factors in underwriting and valuation. As a result, energy efficiency is not properly valued and energy risks are not properly assessed and mitigated.
- Commercial mortgages are a large lever and could be a significant channel for scaling energy efficiency.

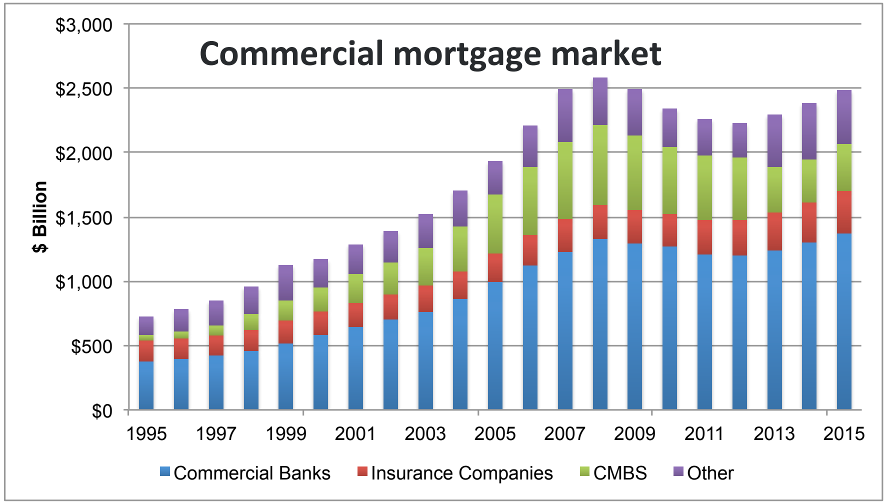
- The project seeks to
  - **Develop interventions** to properly value and incorporate energy factors in the commercial mortgage underwriting process;
  - **Pilot interventions** with lenders and related stakeholders;
  - **Disseminate best practices** within the commercial mortgage community.

This project directly addresses MYPP CBI strategy #3: *Accelerate adoption of energy saving solutions by developing the market infrastructure to enable markets to deliver greater investment in energy efficiency.*

# Purpose and Objectives…2

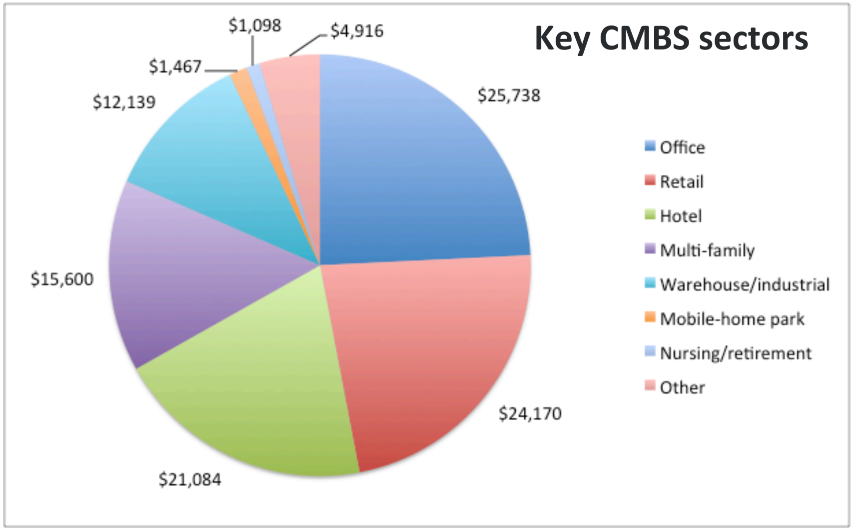
**Target Market**:

- Commercial real estate that is mortgage financed.
- Total size of mortgage market: $2.5 Trillion.
- Total energy usage of five key sectors: 4,812 TBtu site energy (CBECS 2012, RECS 2009)




**Audience**:

- Lenders: Incorporate energy factors in underwriting.
- Borrowers: Create demand for mortgages that consider energy factors.
- Service providers: Include energy factors in Appraisals, Property Condition Assessments.

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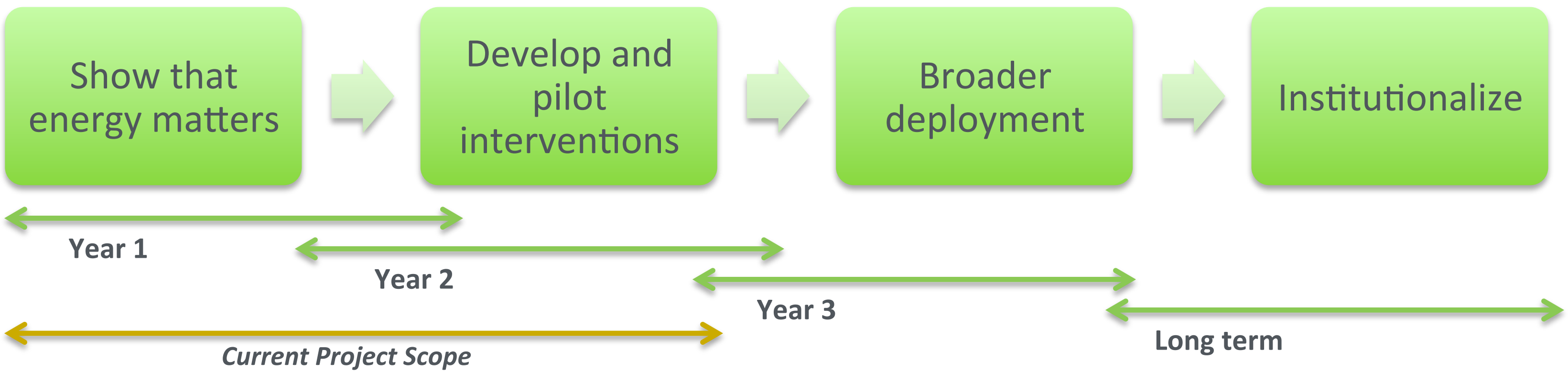
# Purpose and Objectives…3

**Impact of Project**:

*Energy factors are <u>fully and routinely</u> incorporated in commercial mortgage valuation, accelerating demand for buildings with lower energy risk.*




| *Key Outputs* | | | | |
|---|---|---|---|---|
| | Analysis of energy impacts on mortgage valuation | Pilot case studies on actual mortgage loans | Best practices protocols for lenders and owners | Industry Standards |

*Fully aligned with **CBI logic model:***

*Objective: Accelerate market adoption*

*Short-term outcome: Market has tools and data to understand, manage and value EE*

*Mid-term outcome: Array of stakeholders incorporate EE into financial transactions*

# The link between energy factors and valuation

Energy directly affects Net Operating Income (NOI) used in valuation.

**Energy Use Volume**
Electricity kWh/kW, fuel therms, etc.
*Driven by bldg. features, operations, climate*

**Energy Price**
$/kWh, $/kW, $/therm
*Set by rate structure*

**Energy Use Volatility**
+/- change over mortgage term
*Driven by bldg operations, weather variation*

**Energy Price Volatility**
+/- change over mortgage term
Driven by rate structure, forward price curves

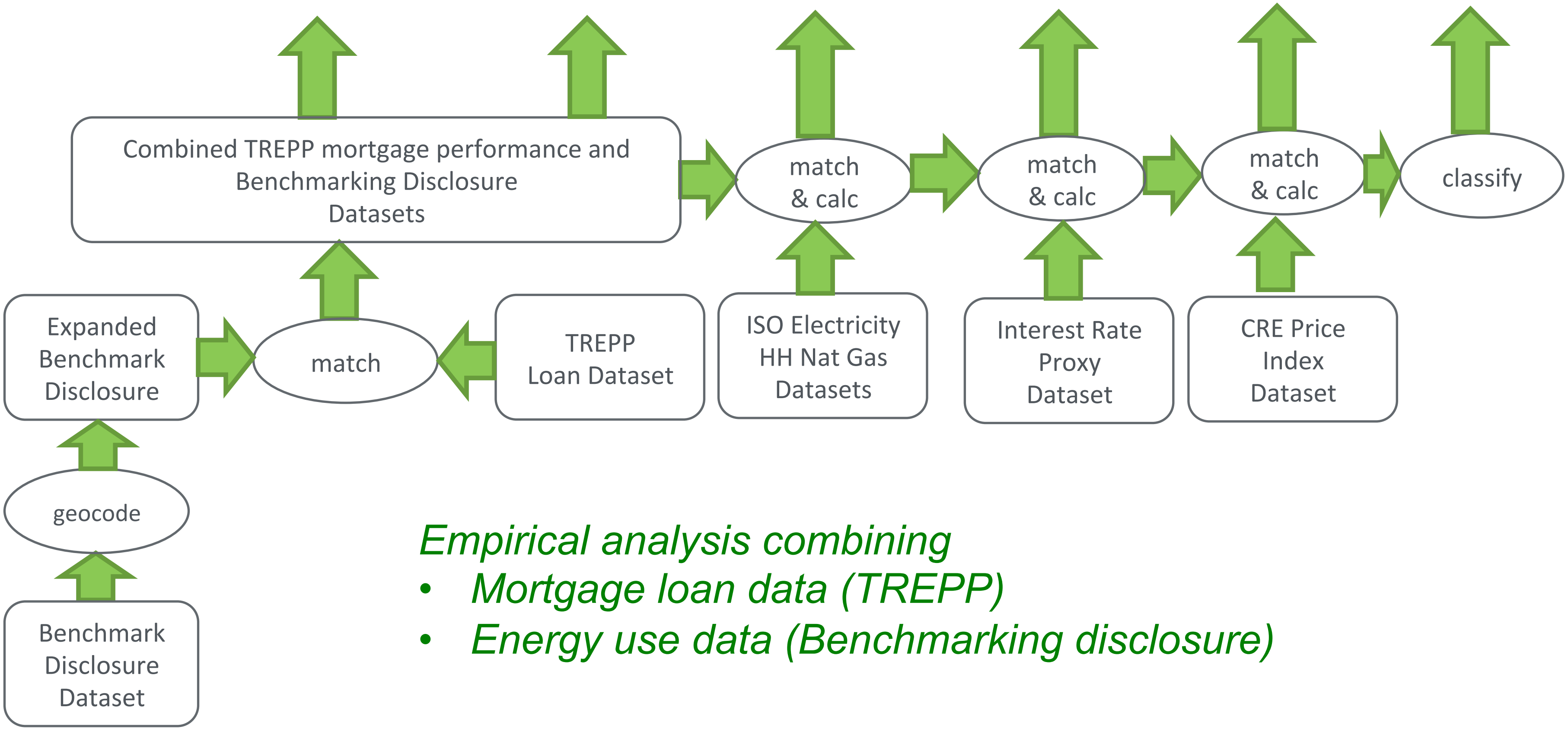
Current practice does not fully account for these factors in calculation of Net Operating Income (NOI)

- 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* (EUI, EnergyPriceGap, CouponSpread, LTV, Region)




*Empirical analysis combining*

- *Mortgage loan data (TREPP)*
- *Energy use data (Benchmarking disclosure)*



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# Result: Default risk and source EUI

| | Coefficient Estimate | Standard Error |
|---|---|---|
| Intercept | -0.40444** | 0.18466 |
| Log Source EUI | 0.07335** | 0.03129 |
| Origination Loan-to-Value Ratio | 0.00258*** | 0.00096 |
| Coupon Spread to 10 Year Treasury | 0.02188 | 0.01565 |
| Electricity Price Gap | 0.00003*** | 0.00001 |
| Time to Maturity on Balloon | -0.00189*** | 0.00060 |
| Origination Year Fixed Effects | Yes | |
| | N = 473<br>R2 = .1052 | |

* p<0.1; ** p<0.05; ***p<0.01

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



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# Approach: Impacts of energy use volatility

- Develop range of scenarios with different energy factor risks
  - Different building types and asset efficiency levels
  - Range of building types, locations, asset efficiency, operations

For each scenario:

- Determine energy consumption and price volatility.
  - Use combination of empirical and simulation approaches
- Use empirical model coefficients to determine default risk for each scenario



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# Scenario analysis: Range of practice for operational factors

| Factor | Good practice | Average practice | Poor practice |
|---|---|---|---|
| Lighting controls | Daylight-dimming + occ | Occ only | Timer only |
| Plug load controls | Turn off when occupants leave | Sleep mode by itself | No energy saving measures |
| HVAC schedule | optimal start | 2hr +/- Occupanct sch | n/a |
| Thermostat settings | 68°F for heating and 78°F for cooling Setback: 60 - 85 | 70°Ffor heating and 76°F for cooling Setback: 68 - 80 | 72°F for heating and 74°F for cooling No setback |
| Supply air temp reset | SAT reset base on warmest zones | SAT reset based on the stepwise function of outdoor air temperature | Constant supply air temperature |
| VAV box min flow settings | 15% of design flow rate. | 30% of design flow rate. | 50% of design flow rate. |
| Economizer controls | Enthalpy | dry bulb | none/broken |
| Chilled water supply temp reset | Reset chilled water temperature based on cooling demand. | Linear relationship with outside air temp (OAT). | No reset with constant year-round. |
| Chiller sequencing | Kick on the lag chiller when the lead chiller reaches its peak efficiency. | Kick on the lag chiller when the chilled water temperature cannot be maintained. | Always running two chillers |
| Hot water supply temp reset | Reset the hot water supply temperature according to heating load. | Linear relationship with OAT. | No reset with constant year-round. |
| Boiler sequencing | Kick on the lag boiler when lead boiler reaches its peak efficiency. | Kick on the second boiler based on OAT. | No sequencing and always running two boilers. |
| Plug load intensity | 0.4 W/sf | 0.75 W/sf | 2.0W/sf |
| Occupant density | 400 sf/per | 200 sf/per | 130 sf/per |
| Occupant schedule | 8 hour WD | 12 Hr WD | 16 Hr WD |





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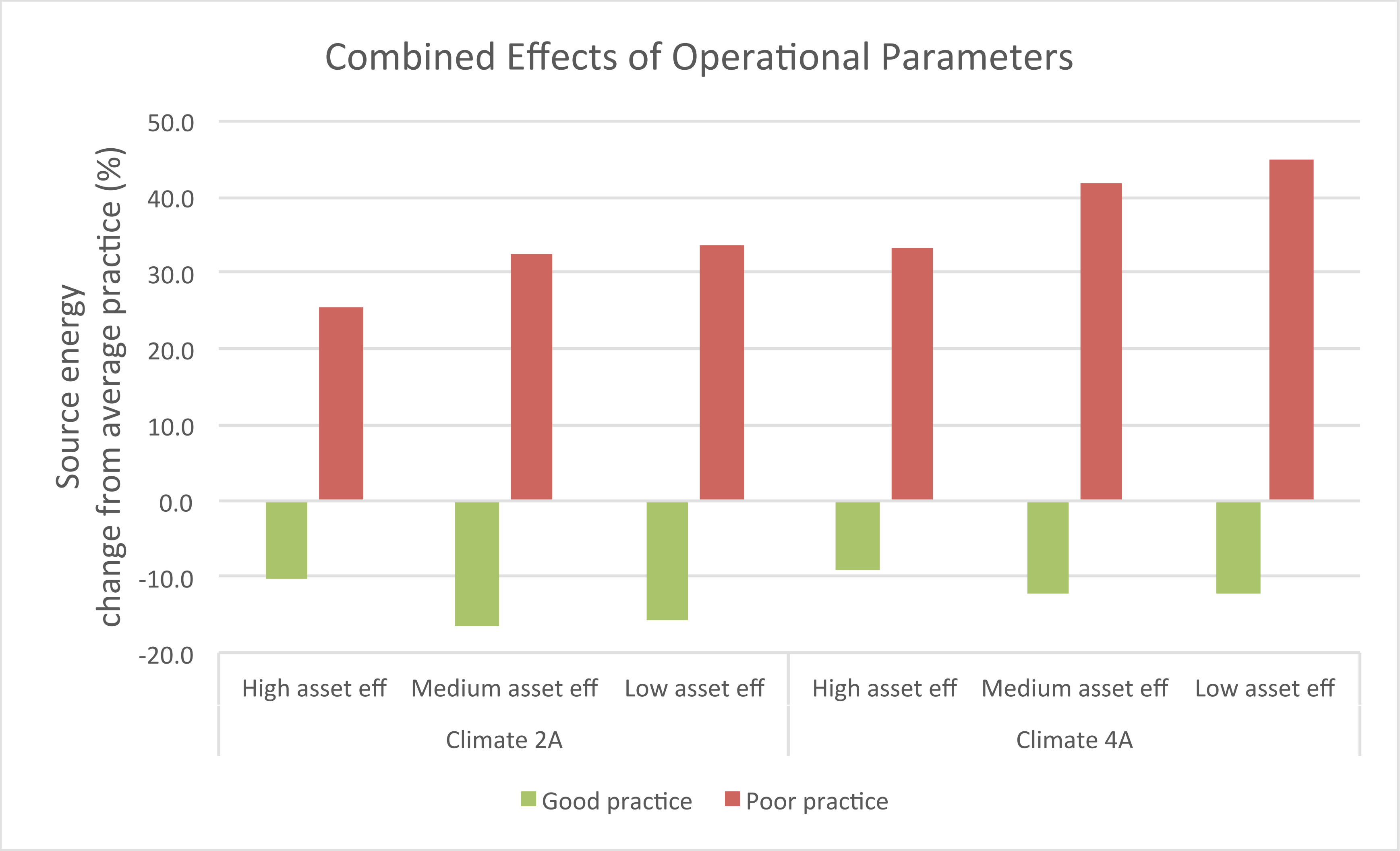
# Energy use variation due to operation factors



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# Energy use variation and default risk – scenario analysis

| Case | Source EUI (kBtu/sf.yr) | Change in default risk (absolute) | % Change in default risk (relative to TREPP avg) |
|---|---|---|---|
| Baseline | 200 | - | - |
| Poor operational practice | 260 *(+30%)* | +0.0084 | **+ 10.5%** |
| Good operational practice | 180 *(-10%)* | -0.0034 | **- 4.25%** |

*See BB webinar for more detailed results:*
https://betterbuildingssolutioncenter.energy.gov/webinars/commercial-mortgages-energy-factors-and-default-risk





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# Approach: Pilot interventions

## Mortgage Underwriting

***Objective:*** *Demonstrate how default risk and valuation change with inclusion of energy use and price volatility for specific mortgage loans.*

1. Develop method for evaluating and incorporating energy use and price volatility.
2. Base case: Estimate default risk and valuation based on current practice, using average historical energy cost data.
3. Test case: Estimate default risk and valuation incorporating energy use and price volatility.
4. Publish pilot case study and recommendations

## Property Condition Assessments (PCA)

***Objective:*** *Assess how energy audit information can be used to inform the property acquisition and financing process.*

1. Develop use cases and proposed EE audit scope for PCA
2. Test case: Analyze how audit information was used in property acquisition and financing process and impacts on price, reserve requirements, loan amount, terms. Compare to base case of no audit info.
3. Revise use cases and audit scope
4. Publish case study and recommendations.

# Key Issues & Distinctive characteristics

**Key Issues**:

- Mortgage process has high stakes and many touch points. Energy-related interventions must be minimally disruptive.
- Cannot expect lenders to develop energy expertise – need simple metrics, process and risk management strategies.

**Distinctive Characteristics**:

- Engagement with lenders on issues they care about i.e. valuation and default risk.
- Establishing <u>empirical</u> link between energy and default risk.
- Pilots/case studies with actual loans



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# Progress and Accomplishments

**Accomplishments**:

**Show that energy matters for mortgage valuation**

- ✓ **Demonstrated statistically significant empirical link between energy factors and default risk.** (slide 8)
  - ✓ First time for commercial bldgs
- ✓ **Demonstrated impact of energy use volatility on default risk.** (slide 12)

**Develop and Pilot Interventions**

- ✓ **Developed methodology for pilots**
- ✓ **2 lenders signed up for underwriting pilot and have provided data**
  - ✓ **2 Office buildings**
  - ✓ **1 hotel**
  - ✓ **1 multi-family**
- ✓ **2 organizations committed to PCA pilot**

**Market Impact**:

- Project is still in the pilot phase - no direct measurable market impacts yet.
- Over 40 stakeholders engaged in dialogue about mortgage energy risk management (most for the first time) including over 10 lenders.

**Lessons Learned**:

- To engage lenders effectively, don't sell efficiency - sell risk management.

# Project Integration and Collaboration

**Project Integration**:

- Actively working with lenders and owners on actual loans.
- Continued outreach to additional lenders and owners.
- Dissemination to targeted audiences (see below)

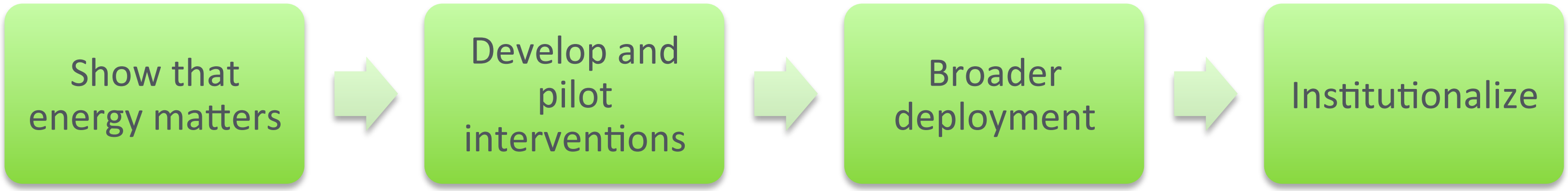
**Partners, Subcontractors, and Collaborators**:

*Additional lenders pending confirmation*

**Communications**:

- ACEEE paper
- BBA Webinar
- MSCI  Real Estate Investment Seminar
- Mortgage Bankers association (planned)
- ACEEE finance forum (planned)
- Better Buildings Summit (planned)
- Scotsman Guide for Mortgage Originators (planned)

# Next Steps and Future Plans




- Need to continue to strengthen the empirical link between energy factors and mortgage valuation.
  - Lenders care about actuarial data
  - Larger datasets
  - More fine-grained analysis by location and building type

- Complete underwriting pilots
- Complete PCA pilots
- Develop case studies for dissemination
- Technical Report

- Develop strategy for broader deployment of best practices and industry standards (longer term)

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# REFERENCE SLIDES

# Project Budget

**Variances**: None.
**Cost to Date**: ~40K (Oct 2016-Jan 2017)
~10% of total budget (note: spend rate was low in Q1 as we were waiting for data from partners, which is now in place. Spend rate will increase starting Feb.)

**Additional Funding**: None.

| Budget History | | | | | |
|---|---|---|---|---|---|
| FY 2016 (past) | | FY 2017 (current) | | FY 2018 (planned) | |
| DOE | Cost-share | DOE | Cost-share | DOE | Cost-share |
| 400K | 0 | 400K | 0K | TBD | |

# Project Plan and Schedule

| Project Schedule | | |
|---|---|---|
| Project Start: Oct 2015 | | Completed Work |
| Projected End: Sep 2018 | | Active Task (in progress work) |
| | | Milestone/Deliverable (Originally Planned) |
| | | Milestone/Deliverable (Actual) |

| | FY2016 | | | | FY2017 | | | |
|---|---|---|---|---|---|---|---|---|
| Task | Q1 (Oct-Dec) | Q2 (Jan-Mar) | Q3 (Apr-Jun) | Q4 (Jul-Sep) | Q1 (Oct-Dec) | Q2 (Jan-Mar) | Q3 (Apr-Jun) | Q4 (Jul-Sep) |
| **Past Work** | | | | | | | | |
| Literature review | | | | | | | | |
| Scoping Report | | | | | | | | |
| Demonstrate impact of energy factors to lenders | | | | | | | | |
| Develop darft scope for EE module for PCAs | | | | | | | | |
| **Current Work** | | | | | | | | |
| Identify pilots | | | | | | | | |
| Document underwriting pilot case studies | | | | | | | | |
| Document PCA pilot case studies | | | | | | | | |