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U.S. DEPARTMENT OF ENERGY

Do energy costs really affect commercial mortgage default risk? New results and implications for energy efficiency investments

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How are energy and valuation (un)linked?

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

Current practice does not fully account for energy factors in calculation of NOI

- Usually based on historical average cost data, if available
- Does not account for energy use and price volatility during mortgage term

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

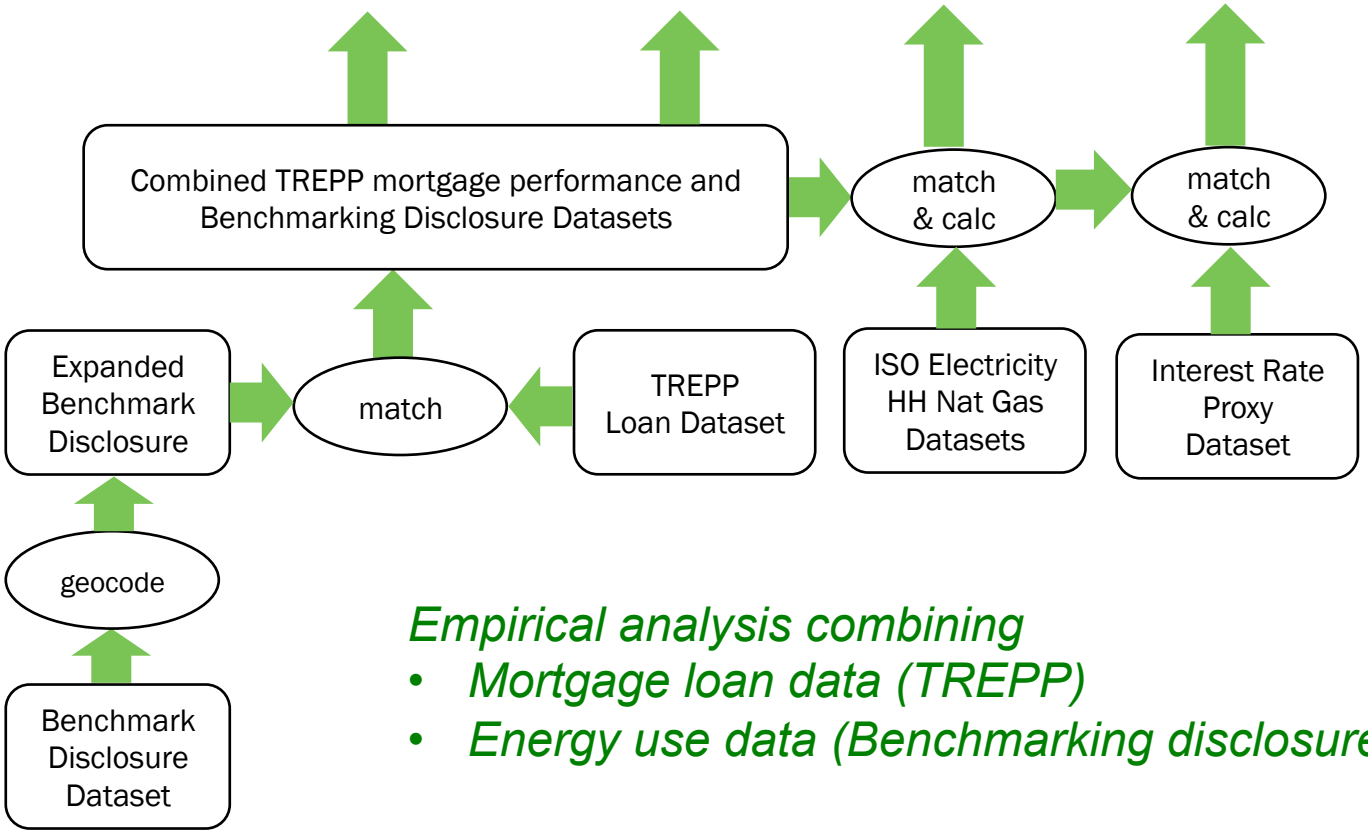
Energy Price Volatility
+/- change over mortgage term
Driven by rate structure, forward prices

Energy risks are not properly assess and energy efficiency is not properly valued.

Commercial mortgages are a $2.5+ Trillion market and could be a significant channel for scaling energy efficiency.

Analyzing the impact of energy on default rate

Mortgage Default Rate = *f* (EUI, ElecPriceGap, CouponSpread, LTV, Region, …)



Empirical analysis combining

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

Default risk and source EUI

The coefficient estimates for **BOTH** *Source EUI* and *Electricity Price Gap* significant at p<.05 level

	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	
	473 observations R^2 = .1052	

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

Default risk and scaled source EUI

Scaled source EUI = source EUI / NOI per sf

	Coefficient Estimate	Standard Error
Intercept	-0.00538	0.11067
Scaled Source EUI	0.00183***	0.000369
Origination Loan-to-Value Ratio	0.00263**	0.00117
Coupon Spread to 10 Year Treasury	0.00751	0.040
Electricity Price Gap	0.00003**	0.00001
Time to Maturity on Balloon	-0.00203**	0.00068
Origination Year Fixed Effects	Yes	
	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

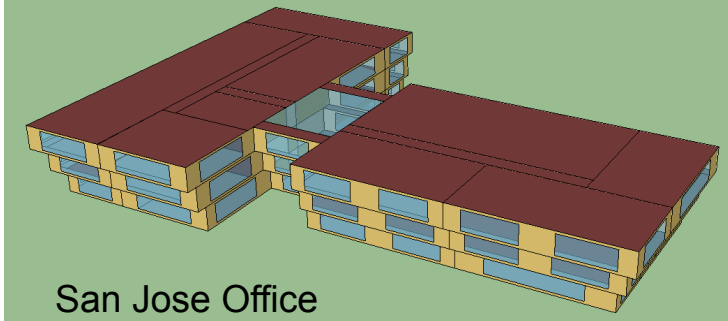
COLORADO LENDING SOURCE

NORTHMARQ CAPITAL

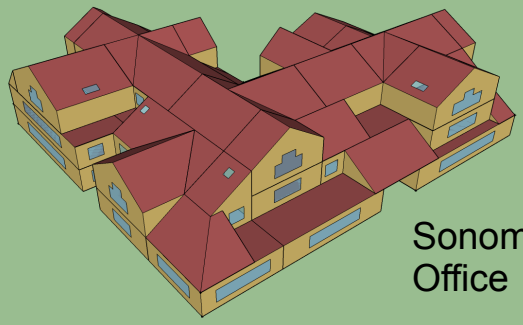
Silicon Valley Bank

Approach

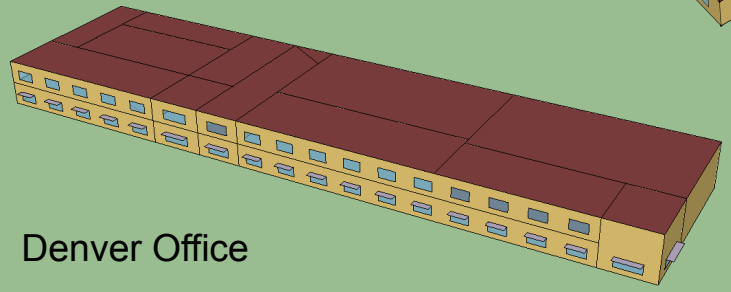
- Compile info from Appraisals, PCAs, other sources.
- Estimate source EUI variations.
  - Simulation and empirical approaches
- Compute elec price gap using price volatility.
- Compute default risk impact due to source EUI and elec price gap.



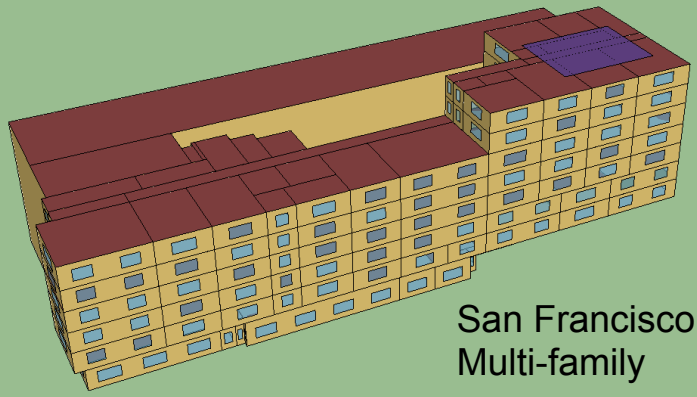
San Jose Office



Sonoma Office

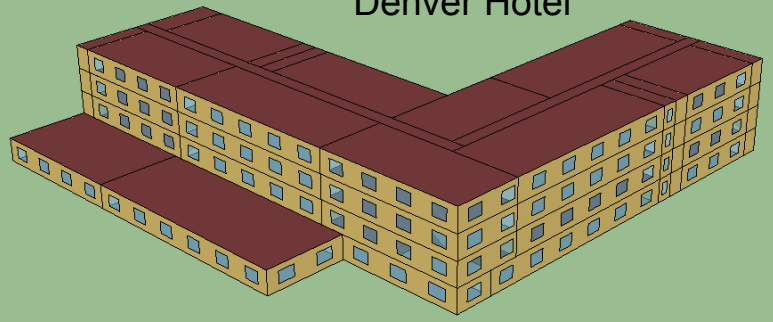


Denver Office



San Francisco Multi-family

Denver Hotel



A wide range of operational factors affect year-to-year energy use variations

Facilities management

Economizer settings

VAV box minimum flow setting

Supply air temperature reset

Static pressure reset

Chilled water/Hot water supply temperature reset

Condenser water temperature reset

Chiller /boiler sequencing

…

Occupant behavior

Lighting controls

Window operation

Thermostat setpoints/setback

Local heating/cooling equipment

Plug in equipment

Maintenance

Damper/ valve check

Filter change

Coil cleaning

…

Weather

Vacancy rates

Denver Office - Range of practice

Factor	Good practice	Average practice	Poor practice
Lighting controls	Daylight-dimming + occ sensor	Occ sensor only	Timer only
Plug load controls	Turn off when occupants leave	Sleep mode by itself	No energy saving measures
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 hour WD	16 hour WD
HVAC schedule	optimal start	2hr +/- Occupant sch	n/a
Thermostat settings	68°F heating, 78°F cooling Setback: 60 - 85	70°F heating, 76°F cooling Setback: 68 - 80	72°F heating, 74°F cooling No setback
Supply air temp reset	Reset base on warmest zones	Reset based on 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

Impact of energy use variations: Denver office

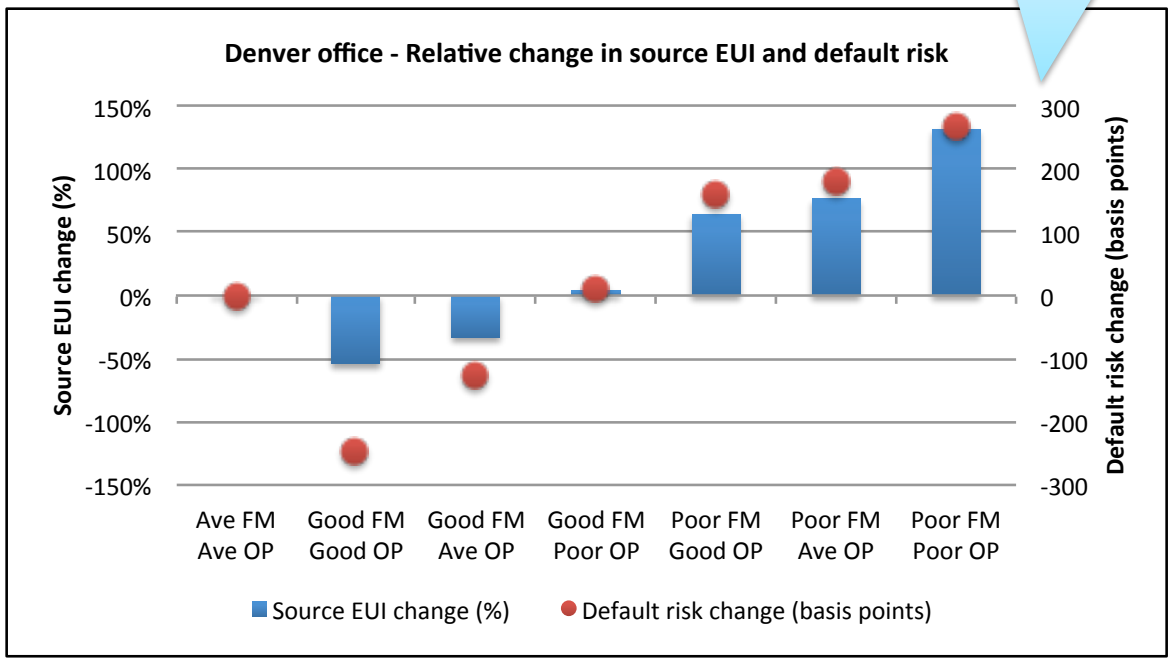
Facilities Management (FM):

- HVAC schedule
- Thermostat setback
- SAT control
- VAV min flow control
- Economizer controls
- Lighting controls

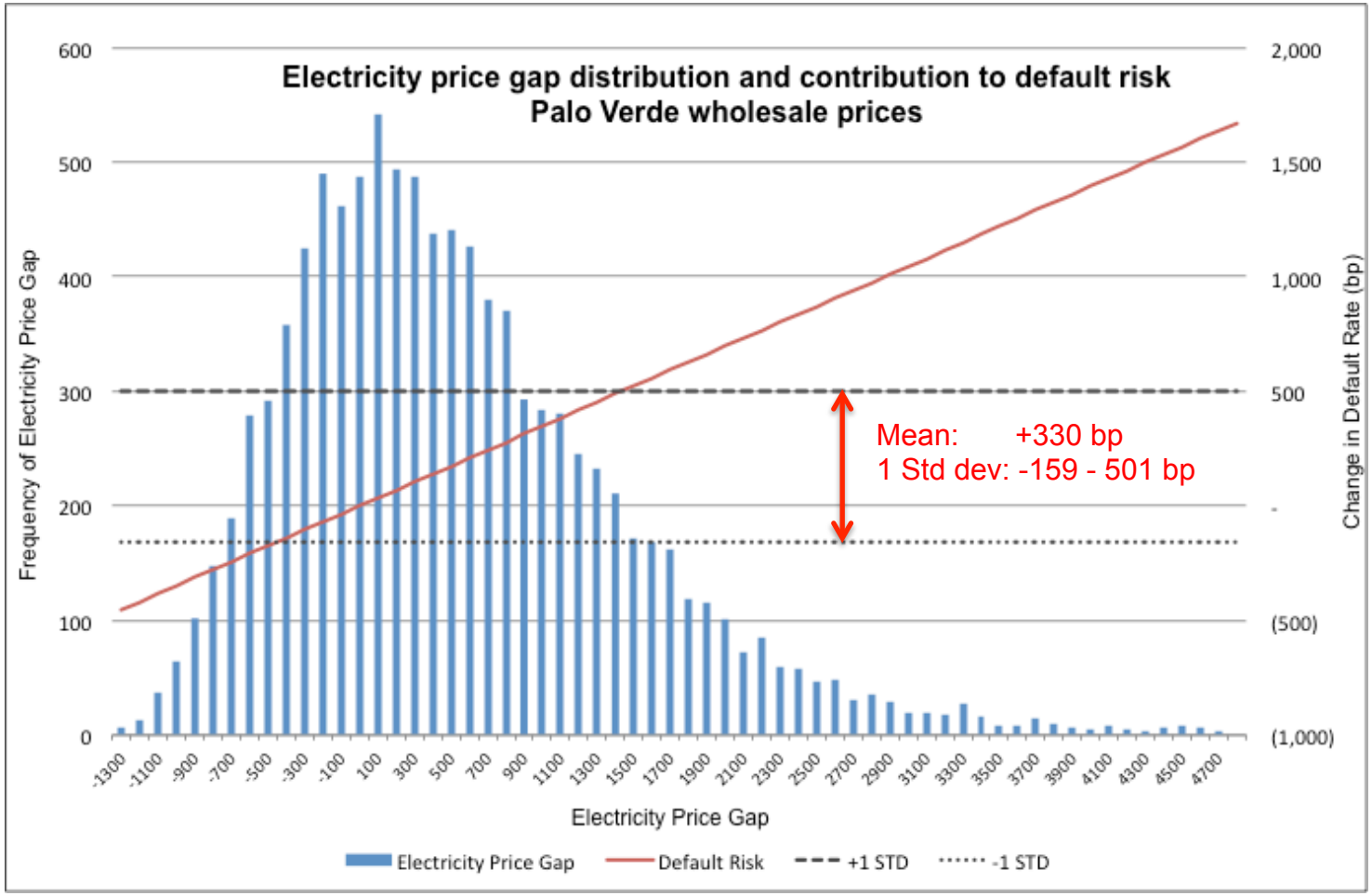
Occupancy factors (OP):

- Occupant density
- Occupant schedule
- Plug load density
- Plug load controls

Compare to TREPP average default rate of 800bp



Impact of energy price variations: Denver



Five case studies show material impacts

Compare to TREPP average default rate of 800bp

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

Wholesale price region	Default rate variation (bp)	Default rate variation relative to TREPP avg (%)
Denver area	+159 to +501	+20% to +63%
Northern California	-49 to +705	-6% to +88%

"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."

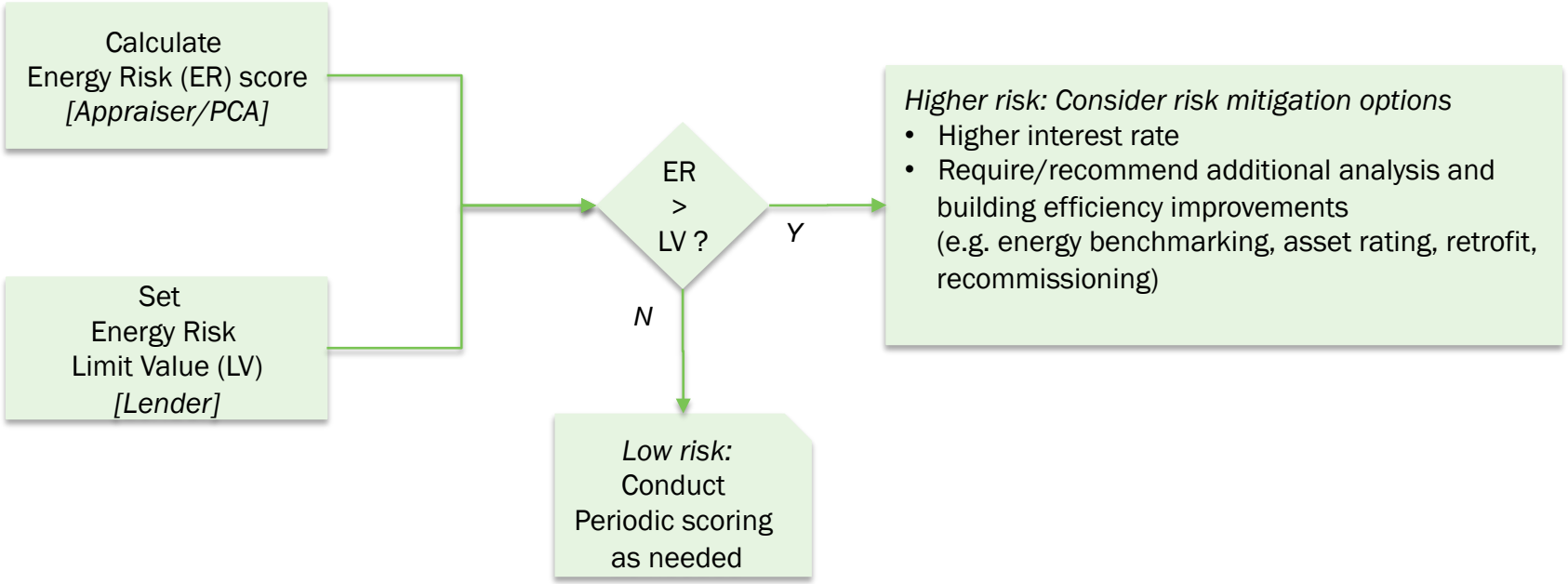
Keith Hanley, Silicon Valley Bank

Toward an Energy Risk Score for Mortgages

- Characterize default risk impact due to level and potential increase in energy cost relative to NOI.

Uses:

- Screen for higher energy risk
- Incentivize low energy risk building



Actions you can take now

Lenders:

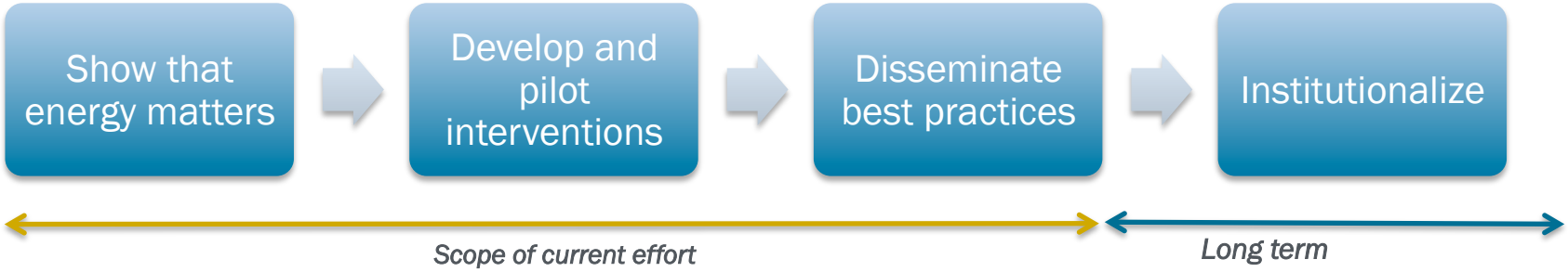
- **Ask owners to provide info on energy cost range.**
  - Could be done as part of Property Condition Assessment.
  - Can reference ASTM standard 2797
- **Incorporate energy risk factor into underwriting and terms**
  - e.g. Interest rate discount/premium, mitigating measures
- **Offer additional loan proceeds for EE investments**
  - e.g. similar to Fannie Mae Green Rewards program

Borrowers:

- **Ask lenders to account for energy efficiency in mortgage terms.**
- **Provide data on energy costs to lender.**
  - Historical and anticipated
  - In appraisal and/or PCA

Looking Ahead

Vision:
Energy factors are fully and routinely incorporated in commercial mortgages, accelerating demand for buildings with lower energy risk.



Analysis of energy impacts

Case studies on actual mortgage loans

Protocols and tools for lenders and owners

Industry Standards

Thank You

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