When Deep Retrofits Make Sense

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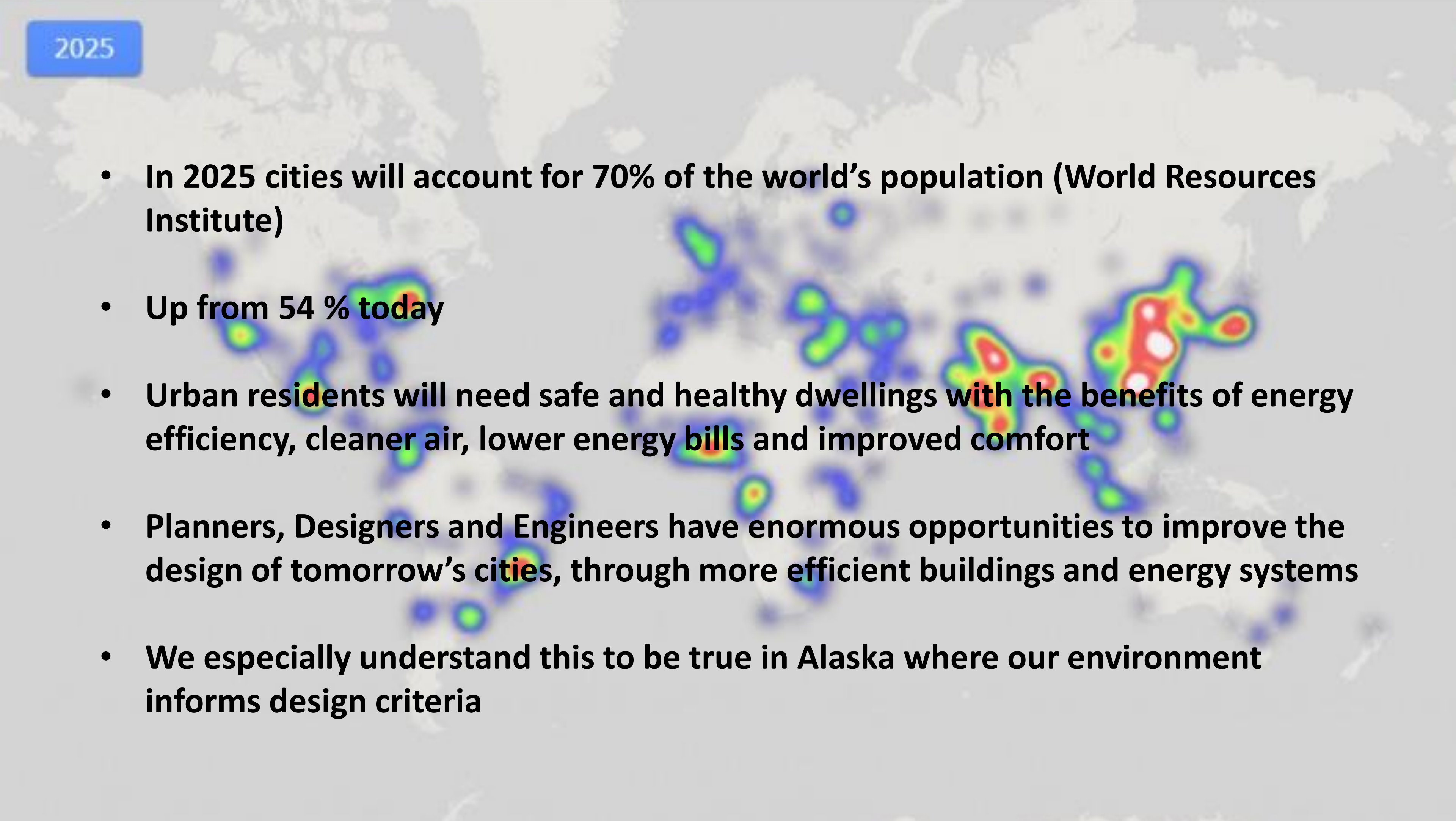
Acknowledgement of Sources

- World Resources Institute
- "The Economics of Renovation"
- ASHRAE
- Rocky Mountain Institute
- McKinsey & Company
- The National Academy of Sciences
- Carnegie Mellon University Center for Building Performance and Diagnostics
- International Living Future Institute



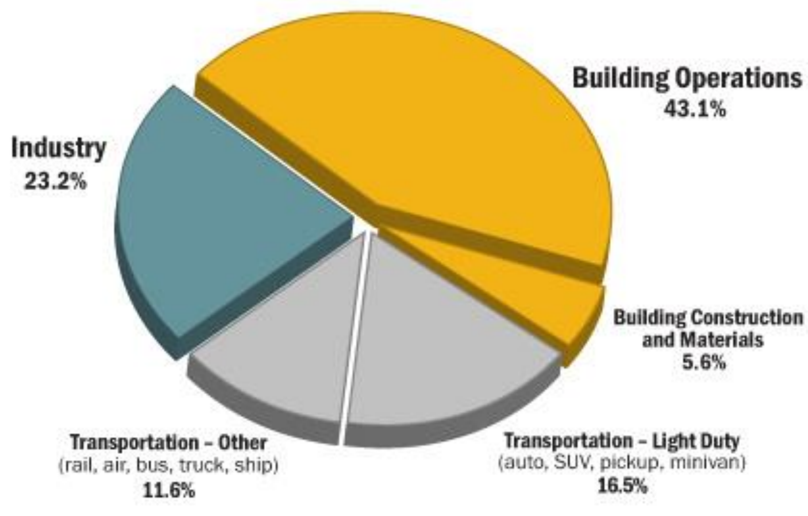
- **In 2025 cities will account for 70% of the world's population (World Resources Institute)**
- **Up from 54 % today**
- **Urban residents will need safe and healthy dwellings with the benefits of energy efficiency, cleaner air, lower energy bills and improved comfort**
- **Planners, Designers and Engineers have enormous opportunities to improve the design of tomorrow's cities, through more efficient buildings and energy systems**
- **We especially understand this to be true in Alaska where our environment informs design criteria**

A recent ASHRAE report states that our nation's buildings account for 40% of our primary energy use.

They are responsible for:

- **72% of the electricity consumption**
- **39% of the total U.S. CO_2 emissions**

CO_2 emissions equal the combined total emissions of Japan, France, and the United Kingdom (total population = 254,635,000 vs 320,206,000 (US))

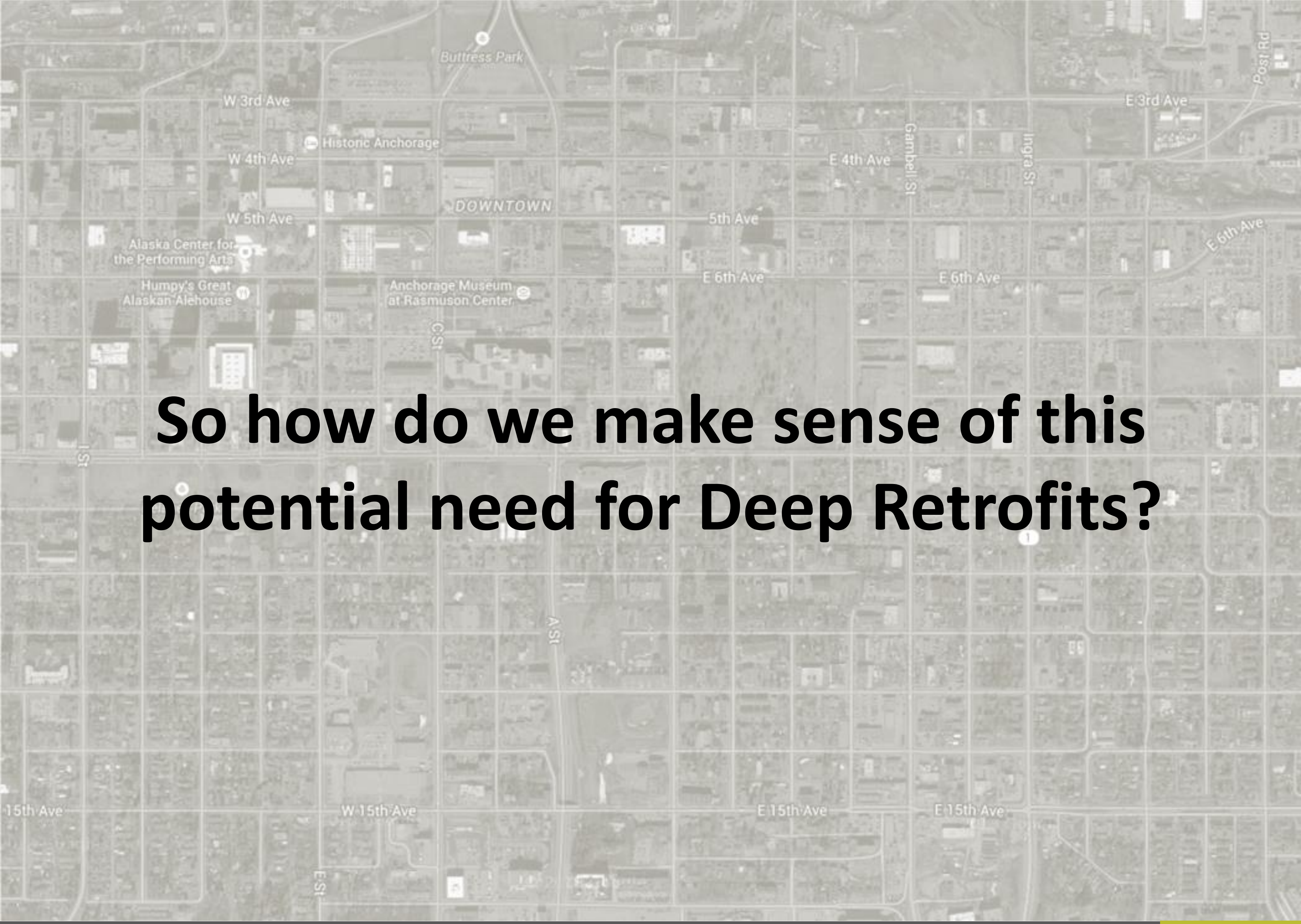


U.S. Energy Consumption by Sector

Approximately 70 to 80% of the buildings standing in 2025 already exist today.

- **These buildings represent an opportunity to decrease energy use**
- **Overcoming the barriers of split incentives and lack of energy information will be necessary and activities associated with the strategies to overcome these barriers are already underway**
- **Deep retrofits of existing inventory provides a platform for managing more sustainable cities in the light of growing population demands.**

So how do we make sense of this potential need for Deep Retrofits?



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Building the Case	Framing and quantifying the value of a deep energy retrofit, and preliminarily building the case.
Managing deep energy retrofits	Key components of the deep energy retrofit process to ensure that project is enacted in a way that limits or eliminates cost premiums, allows risk to be managed, and creates maximum value.
Identifying design opportunities	Provide the retrofit practitioner with instructions for identifying opportunities to reduce energy consumption by end-use.

BUILDING THE CASE

Building the case for a deep energy retrofit is to prove the value of investing in deep energy savings… you must tap into what really motivates decision-makers.

“value” vs. “energy cost savings”

1 Identify the Value Creating Triggers

Deep energy retrofits are more valuable if they are timed in accordance with certain events in a property’s life cycle. Triggers can significantly improve both the economics and convenience of energy improvements.

2 Estimate and Prove Potential Value

Quantify types of value that deep energy retrofits can create for the business or the organization. What can the retrofit create besides energy cost savings? Increased tenant retention or growing the net operating income as a result of the retrofit.

3 Manage and Mitigate Risk

Gain familiarity with perceived risks, such as actual energy use exceeding what was predicted. The careful analysis and implementation of a deep energy retrofit can manage and mitigate these risks effectively.

1 Identify the Value Creating Triggers

Getting a great retrofit result stems from:

- not so much increasing your capital expenditure
- reconsidering how and when to spend your dollars

The incremental cost of pursuing deep energy savings is significantly reduced if you were already planning to spend money on capital improvements, which buildings always require anyway.

Identify the key situations that will improve the value of investment.

In proving the value of investment, you should specify why the timing of your investment maximizes value. To that end, the table below describes the opportunities from timing deep energy savings with different situations.

SITUATION	OPPORTUNITY
Adaptive reuse, market repositioning, or Modernization	Repositioning an existing building will require significant capital expense to which the cost of a deep retrofit would be incremental and likely small in comparison.
Roof, window or other major envelope Replacement	Planned roof, window and other major envelope replacements provide opportunities for significant improvements in daylighting and efficiency at minor incremental cost, providing the leverage for a deep retrofit that reduces loads and potentially the cost of replacing major equipment such as HVAC and lighting.
HVAC, lighting or other major equipment Replacement	Major equipment replacements provide opportunities to address envelope and other building systems as part of a deep energy retrofit. After reducing thermal and electrical loads, the marginal cost of replacing the major equipment with much smaller equipment can be negative.
Upgrades to meet code	Life safety upgrades may require substantial disruption and cost, enough that the incremental investment and effort to radically improve the building efficiency becomes not only feasible but also profitable.
New Acquisition or Refinancing	New acquisition or refinancing at historically low interest rates can put in place attractively financed building upgrades as part of the transaction, upgrades that may not have been possible at other times.
Fixing an "energy hog"	There are buildings with such high energy-use or high energy-prices that deep retrofits have compelling economics without leveraging any of the factors above.
Major occupancy Change	Tenant moving a significant number of people or product into a building or major turnover in square footage presents a prime opportunity for a deep retrofit, for three reasons. First, a deep retrofit can generate interior layouts that improve energy and space efficiency, and can create more leasable space through downsizing mechanical equipment. Second, ownership can leverage tenant investment in the fit-out. Thirdly, tenant disruption can be minimized.
Energy management planning	As part of an ongoing energy management plan for a group of buildings, the owner may desire a set of replicable efficiency measures. These measures can be developed from the deep retrofit of an archetypical building and applied to a larger set of similar buildings.




2 Estimate and Prove Potential Value

- In a 2009 report, McKinsey & Company estimates the U.S. can reduce 28% of the commercial and residential building energy consumption by 2020, saving $1.2 trillion at only $500 billion cost.

- The National Academy of Sciences states in a 2009 report that the U.S. can save 32% of commercial building energy use by 2030. Rocky Mountain Institute estimates the U.S. can reduce at least 38% (up to 69%) of energy consumption in buildings by 2050 for a $1.4 trillion profit.

Further substantiating investment in building efficiency is all the value beyond energy cost savings. The values beyond energy cost savings provided by a deep energy retrofit often make the difference between an owner deciding to go ahead with a project and not.

“value” vs. “energy cost savings”

Financial Analysis Approach

1. Order-of-magnitude estimates for the financial analysis. - These estimates provide enough detail for getting an up-front sense of the opportunity in deep energy retrofits.

2. The predominant financial analysis method for energy retrofits is simple payback analysis based on energy cost savings alone. (Don’t Do It!) - It leaves out all the other non-energy-cost values that benefit building owners and occupants.

“value” vs. “energy cost savings”

Use traditional discounted cash flow analysis over the time period that you intend to hold the building. Enable the following value-variables of the deep energy retrofit to be adjusted for sensitivity analyses:

- Operation Expenditure Savings ($/square foot/year)
- Value Beyond Energy Costs Savings (can be quantified in $/square foot/year)
- Gross Capital Cost ($/square foot)
- Avoided Capital Cost ($/square foot)

Haines 2015 Facility Planning Report - Analysis Com

Capital Improvement Project (CIP) Priority Identification							
Building Name	Public Service Priority	Public Building Priority	Public Spending Priority	Assessment Condition	Numeric Condition Value	Programmatic Adequacy	Numeric Adequacy Value
ublic Safety	1	1	1	Poor	1	Poor	1
uman Resources	3	5	5	Poor	1	Borderline	2
dmin	4	4	6	Good	3	Poor	1
ool	5	6	4	Fair	2	Borderline	2
isitor	8	7	8	Fair	2	Borderline	2
hilkat	6	3	2	Fair	2	Borderline	2
useum	7	8	7	Fair	2	Borderline	2
r. Center	2	2	3	Good	3	Satisfactory	3
	1 = Highest	1 = Highest	1 = Highest		1 = Lowest		1 = Lowest

* =

** = Lower score may be

Comparative Information Of Potential Long Term Facility Costs							
Building Name	Existing Area Requiring Remodel	Additional Program Area Required	Remodel w/ Required Area	Replacement w/ Current Program Area	Replacement w/ Required Program Area	Area Available (SF)	Area Required (SF)
ublic Safety	$3,461,500	$1,297,200	$4,758,700	$6,960,800	$8,258,000	12600	14968
uman Resources	$250,000	$256,000	$506,000	$1,428,000	$1,684,000	4080	3413
dmin	$0	$45,000	$45,000	$1,420,800	$1,465,800	3550	3552
ool	$2,268,000	$1,690,000	$3,958,000	$8,160,000	$9,850,000	13600	16403
isitor Center	$231,250	$427,500	$658,750	$400,000	$827,500	1000	1995
hilkat	$4,941,000	$650,000	$5,591,000	$12,138,000	$12,788,000	20230	28075
useum	$1,457,500	$1,007,500	$2,465,000	$3,105,000	$4,112,500	6900	9077
r. Center	$40,000	$63,000	$103,000	$853,200	$916,200	2844	2996

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Operation Expenditure Savings

Reducing energy cost is typically the biggest driver of operational cost savings and it is perhaps the most commonly cited value of a deep energy retrofit. For organizations that occupy a large amount of square feet of space, reducing energy cost can have a significant impact on the bottom line.

- For most office buildings energy cost is $2–3 per square foot per year
- Healthcare properties are one of the most expensive types, usually at $11

Building maintenance costs are another form of operation expenditure, and tend to be highly variable. Ask the facility manager of your building for an estimate of the energy and maintenance costs.

A deep energy retrofit will likely save 25–50% of the current annual energy cost.

Energy Star Rating	Recommended Energy Cost Savings Estimate
Greater than 75	25%
50–75	35%
Less than 50	50%

Value Beyond Energy Cost Savings for the Occupant, Enterprise, and Investor

The value beyond energy cost savings is the least common source of value to be quantified, but often is a key driver during decision-making.

“value” vs. “energy cost savings”

A deep energy retrofit includes envelope, passive design, and other measures that not only increase energy efficiency but also improve other performance factors such as thermal comfort and visual acuity.

Increasing building performance can produce value such as improved occupant health, organizational reputation, and property value.

Deep energy retrofits:

- Install measures that improve building performance
- Create value for the occupant, enterprise, and investor

Deep Energy Retrofit Measures

Envelope
- Insulation
- Windows
- Air tightness
- Roof Color

Passive Design
- Natural ventilation
- Daylighting
- Landscaping

Electric Lighting
- Fixtures upgrade
- Controls Redesign

Plug Loads & Misc.
- Efficient equipment
- Controls

Heating, Cooling, & Ventilating
- Demand control ventilation
- Digital controls
- Balance air & water
- Chiller upgrade

Building Performance

- Thermal Comfort
- Active occupant environmental Control
- Indoor air Quality
- Visual acuity and comfort
- Green building rating or score
- Views to the outdoors
- Space efficiency
- Space flexibility

Value

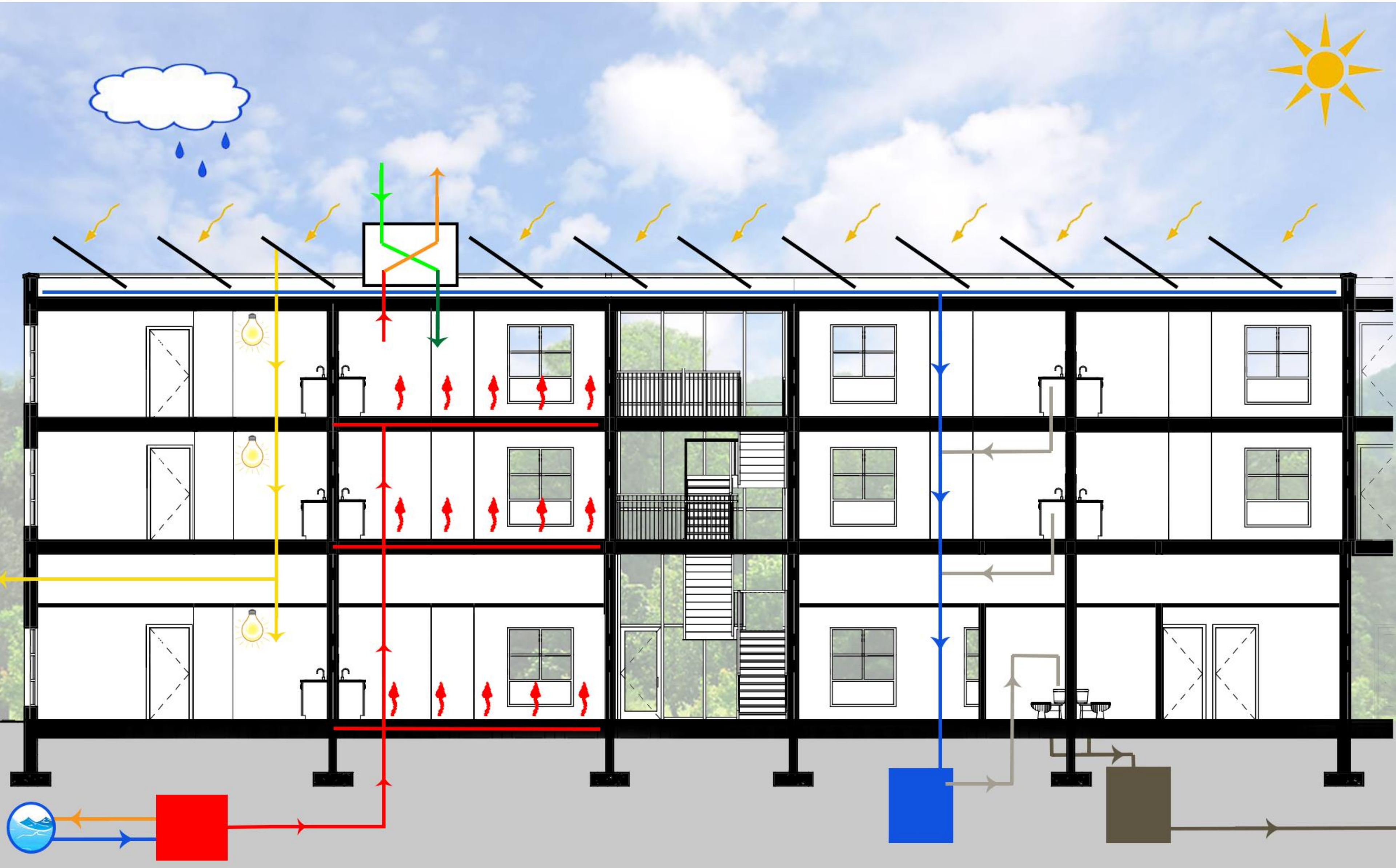
Reduction in cost
- Lower maintenance cost
- Lower health cost (absenteeism, health care)
- Lower employee recruiting and churn costs

Revenue Growth
- Higher occupancy rates
- Higher rents
- Increased employee productivity
- Improved marketing & sales

Improved Reputation and Leadership
- Recruiting best employees or tenants
- Employee or tenant satisfaction and retention
- Public relations/brand management
- Retain "social license" to operate

Compliance with Internal and External Policies/ Initiatives
- Meet needs of Global Reporting Initiative, Corporate Social Responsibility, Carbon Disclosure Project
- Meet responsible investment fund requirements
- Meet growing Securities and Exchange Commission regulations

Reduced Risk to Future Earnings
- Reduced risk from energy disclosure mandates
- Limit exposure to energy/water price volatility
- Overall reduced potential loss of value due to functional obsolescence
- Reduced legal risks—sick building syndrome and mold claims, etc.



Gross Capital Cost

The gross capital cost of a deep energy retrofit can vary dramatically because it is often coupled with a major renovation for non-efficiency purposes, and project teams rarely disaggregate the cost for efficiency from the rest of the project. However, a recent study shows that a deep energy retrofit of a standard 500,000 gross SF office building would cost between $25/SF and $150/SF (The Economics of Renovation).

Energy Use	Energy Reduction (kBtu/SF/yr)	Capital Cost ($/SF)
Plug Load	6-15	0
Lighting	6-8	3-5
Ventilation	4-5	2-5
Cooling	10-25	10-75
Heating	3-10	10-75
Total	30-50	25-150+

3 Manage and Mitigate Risk

As a case for a deep energy retrofit, an in-depth study of risk is not needed. However, it is helpful to have an understanding of where the common risks are and how they can be managed and mitigated. Risk stems everywhere from the efficiency technologies themselves to the process of selecting and implementing efficiency measures.

Risk Description	Level	Potential Mitigation Plans
Actual energy use may exceed predicted	High	• Predictive modeling • Create measurement & verification plan • Implement post-construction commissioning
Occupant behavior, energy use	High	• Engage occupants during analysis process via design charrettes and meetings • Test improvements among certain groups before full rollout
Occupant impacts, performance	High	• Ensure measures are similar to the ones in the studies you referenced • Include occupant input for the selection of retrofit measures
Design is not constructed accurately	High	• Implement post-construction commissioning
Energy price flux	Med	• Conduct sensitivity analysis to understand how energy prices impact the financial return • Obtain long-term energy supply contract
Newer, more technology	Med	• Research all alternatives prior to the go-ahead • Provide flexibility to upgrade during operation
Owner behavior, No corporative management	Low	• Train the operators • Include operators in the design process