CAPTURING VALUE THROUGH PORTFOLIO ENERGY OPTIMIZATION

BEST PRACTICES FOR REAL ESTATE OWNERS AND INVESTORS

BY IAIN CAMPBELL, AMY EGERTER, MICHAEL GARTMAN, GREG HOPKINS, PHILIP KEUHN, AND JAMIE MANDEL

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ABOUT US

ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

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HIGHLIGHTS

HIGHLIGHTS

In a world of economic constraint, portfolio property owners must be able to compare investment opportunities broadly to optimize decision-making and returns. Yet most building efficiency work is focused on retrofitting one building at a time, by definition suboptimizing at the portfolio level. Addressing the needs of this owner class holds the potential to capture a $290 billion opportunity in net present value by bringing building efficiency into the age of the portfolio owner.

Over the past two years, Rocky Mountain Institute (RMI) has been developing tools and processes specifically for portfolio owners, and has been committed to developing and testing best practices for meeting their needs. This report is the product of learning from four client engagements with the City of Chicago; Sanus Connect, Inc.; Morgan Stanley; and Recreational Equipment, Inc. (REI); as well as from partners who contributed to the development of RMI's portfolio analysis toolset. **Results from evaluating REI's stores suggest a four-year payback for a portfolio-wide deep energy retrofit—achieving 39% savings.**

This report describes best practices for portfolio-level energy (and water)[i] project identification and prioritization that real estate investment trusts (REITs), corporations, pension funds, and other real estate portfolio owners can leverage to develop optimized investment strategies.

RMI has encoded these best practices into a software toolset to aid portfolio property owners seeking rigorous financial analysis on a holistic set of energy opportunities across their portfolios. The best practices are described here.

BEST PRACTICES

1. **Evaluate All Potential Investments Using a Common and Holistic Methodology:** Using the same methodology to evaluate a holistic set of energy efficiency, renewable energy generation, energy storage, and demand-response solutions enables results to be compared apples-to-apples and aggregated into a unified, portfolio-wide investment strategy, ensuring funds are deployed to the best possible projects.

2. **Prioritize Investments by Project Economics Instead of Energy Savings:** Accurately prioritizing energy project investments across a portfolio requires evaluating a holistic set of economic factors, including detailed utility rates and business-related considerations such as lease impacts. Variations in these economic factors within portfolios spanning multiple utility territories or states have massive impacts on project viability and prioritization of projects.

3. **Optimize Cash Flows over Time:** Simplified tools that do not consider how cash flows vary over time are not capable of providing sufficiently accurate project recommendations. Incorporating detailed cash flows into an analysis can facilitate evaluation of financing options and help to identify win-win scenarios for both owners and tenants in leased buildings.

4. **Leverage Portfolio Benefits:** Portfolios should not be looked at as only a collection of individual buildings. There are benefits associated with portfolios that can be leveraged to improve project performance and reduce risk, such as reduced implementation costs through bulk purchasing, risk mitigation, and project piloting and staging. Decision makers should look for a tool capable of considering these portfolio benefits in developing recommendations.

[i] Water conservation projects can be evaluated in a manner similar to energy projects, but for simplicity this report focuses on energy projects.

5. **Enable Continuity with Ongoing Work:** Carrying the portfolio screening analysis methodology described in this report into future phases of work, such as validation and project planning, minimizes the potential for redundant work and human error during information collection. Ensuring continuity also allows decision makers to periodically update analyses at an acceptable cost—given the rapidly falling cost of LED lighting, solar photovoltaics (PV), and (more recently) battery storage technologies, this updating is essential for maintaining an optimized investment strategy that reflects current market conditions.

6. **Don't Shy Away from Data:** In many cases, asset data is not organized and accessible at a portfolio level. It commonly resides at the property level, or within multiple departments, such as the leasing office and design department. Populating a centralized database with building asset information can be used for a wide range of purposes, such as energy project analysis, maintenance scheduling, capital planning, due diligence, and other third-party analysis.

01

THE MARKET IS REWARDING INVESTMENT IN ENERGY PROJECTS

THE MARKET IS REWARDING INVESTMENT IN ENERGY PROJECTS

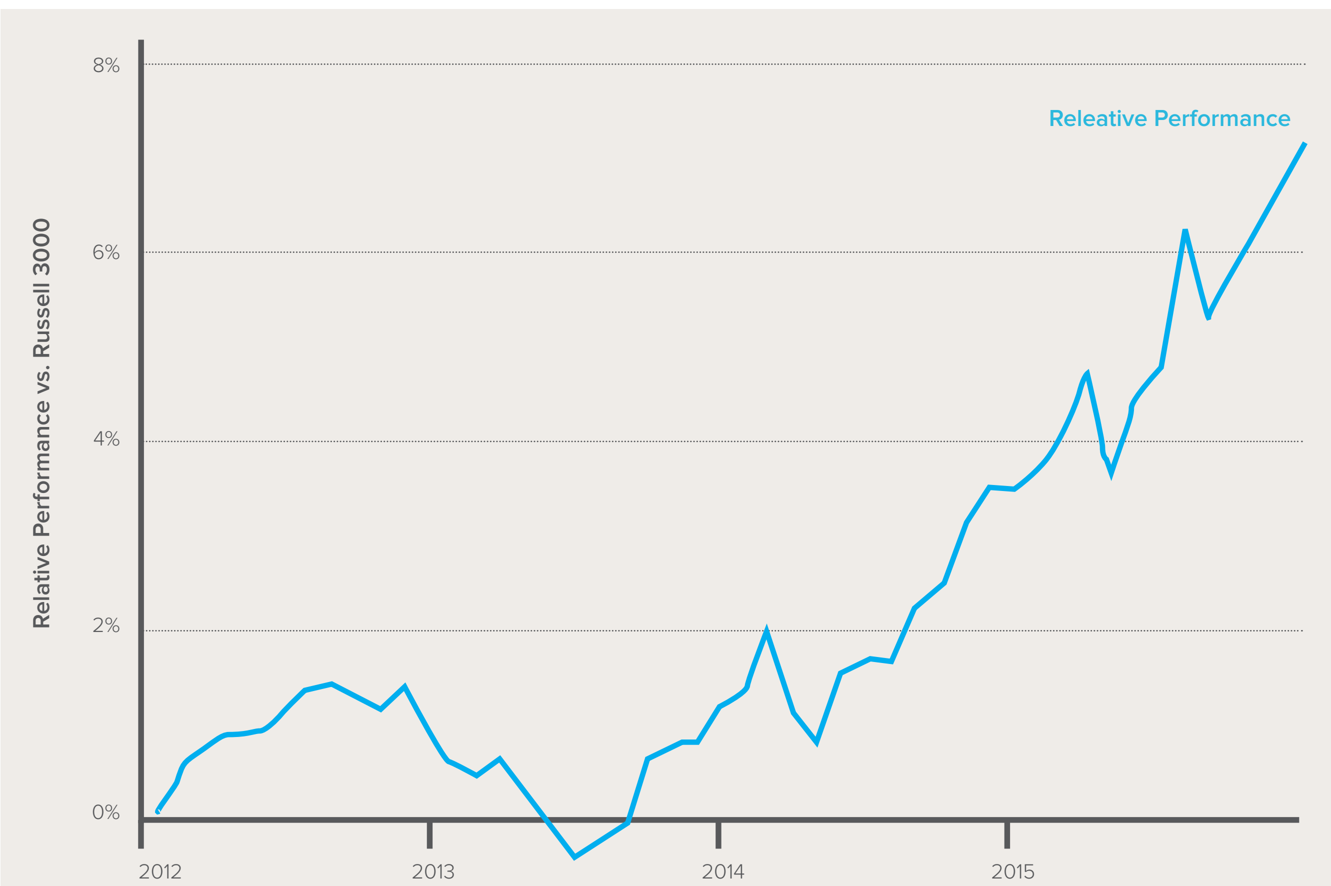
Employee, tenant, and investor expectations are increasing demand for cost-effective building energy projects:[1]

- Low-emission funds outperform the market (see Figure 1)[2] and are supported by reporting systems (e.g., GRESB) that make energy performance and sustainability more transparent to investors.
- 40% of UN Global Compact corporations have quantified energy targets that affect tenant leasing practices,[3] contributing to a 2%–20% rental premium for high-performance buildings.[4]
- 57% of millennials believe it is important for the companies they do business with to operate from an environmentally sustainable building, and 28% would refuse a job based on their employer's environmental impact alone.[5]

Today, portfolio property owners own most commercial buildings. Yet most building efficiency work is focused on single buildings and thus fails to adequately consider the unique priorities, challenges, and opportunities of this owner class. **Reenvisioning building efficiency through the eyes of the portfolio owner holds the potential to capture a $290 billion opportunity in net present value.[6]**

FIGURE 1

LOW-EMISSION FUND PERFORMANCE RELATIVE TO THE RUSSELL 3000



02 PORTFOLIO ANALYSIS

PORTFOLIO ANALYSIS

COMMONLY USED PORTFOLIO ANALYSIS STRATEGIES AND TOOLS FALL SHORT OF INVESTOR NEEDS

Barriers to investment in energy projects are well documented, including a perceived lack of funding for upgrades, insufficient payback, and uncertainty of outcomes.[7] With that said, the nuances of limitations associated with early phases of project identification and evaluation are less well documented. Project experience (see Retrofit Chicago Engagements Provide Market Insights sidebar) and market engagement provide additional specificity, highlighting three needs not addressed with existing approaches:

1. Addressing Multiple Stakeholders

Project investment commonly requires vetting and adoption from a broad set of stakeholders, such as chief financial officers (CFOs), portfolio managers, sustainability and energy managers, facility managers, and building engineers. Each stakeholder has her own priorities and uses her own evaluation criteria. Most existing portfolio analysis tools are biased toward accuracy of energy cost reduction calculations, with less focus on the sort of holistic financial analysis required by stakeholders such as CFOs and portfolio managers. Without incorporating robust financial analysis, it is impossible to appropriately prioritize projects, since it is almost always preferable to prioritize based on holistic economics.

2. Providing a Streamlined and Seamless Experience

Evaluating buildings and measures separately from one another yields an unnecessarily time-consuming process that can potentially introduce inconsistencies. This becomes a substantial barrier when vetting results across a portfolio of buildings and working to combine recommendations into a unified investment strategy. A consistent methodology is needed that incorporates a holistic set of energy efficiency, renewable energy generation, energy storage, demand response, and water solutions and that can consolidate results into a unified portfolio-investment strategy.

3. Developing Momentum and Confidence

The scale associated with large portfolio evaluation makes it challenging to initiate action and, once action is taken, it regularly results in identification of tens or hundreds of millions of dollars in potential investment. Owners must be confident that recommendations are trustworthy to initiate investment.

A remark from a recent project partner summarizes these needs well. His CFO had recently asked him for a proposal to deploy millions in funds for economically viable sustainability projects and, despite 20 years in the industry, he was able to come up with only a fraction of this investment scope with an uncertain return based on studies available to him. This same barrier comes up repeatedly in conversations, highlighting the need for a robust and consistent portfolio approach that yields investable insights.

In search of such an approach, RMI reviewed more than 100 companies providing portfolio-analytics support and identified six regularly occurring methodologies, which are summarized in Table 1. It should be noted that the solutions reviewed were evaluated within

RETROFIT CHICAGO ENGAGEMENTS PROVIDE MARKET INSIGHTS

Retrofit Chicago is an award-winning,[8] city-based energy challenge with more than 80 buildings currently participating, representing an aggregate 50 million-plus square feet. Participants in the challenge commit to reducing energy use by at least 20% within five years of joining the program.

RMI partnered with the City of Chicago and a panel of other nonprofit organizations over a two-year period to support the Retrofit Chicago program. As part of the engagement, RMI provided direct support to a portion of the participants to assist them in achieving their 20% energy reduction goal. These engagements provided direct insights regarding building owners' and managers' needs in making energy project-investment decisions.

the context of delivering portfolio-wide, project-specific economics. Many of the tools evaluated are better suited for other purposes, such as designing utility programs and certification programs, informing code updates, or supporting city-based programs. Additionally, some tools focus on opportunity identification more than evaluation, but because of the need for owners to prioritize investments relative to project economics, the methodologies are evaluated here based on their ability to evaluate economics.

Two key takeaways can be gleaned from the market review. (1) Most remote analytics strategies do not allow for deep enough economic analysis to prioritize projects across a diverse portfolio of buildings. (2) Although on-site evaluation can provide robust economic analysis, it can also lead to a time- and cost-prohibitive process and a library of reports that are difficult to consolidate into a comprehensive, portfolio-wide investment strategy.

Both of the takeaways highlight additional work and uncertainty transferred to the portfolio owner. The preferred methodology is a streamlined remote analytics approach that can be completed quickly and used to prioritize funding across the portfolio based on consistently applied analysis resulting in project-level economics.

TABLE 1

SUMMARY OF PORTFOLIO ENERGY PROJECT EVALUATION METHODOLOGIES

APPROACH TO PROJECT IDENTIFICATION & ANALYSIS		SUMMARY	PORTFOLIO INVESTMENT STRATEGY OUTCOME
A	BENCHMARKING	Whole building energy consumption normalized by dividing by building area (e.g., kBtu/ft^2), which is then compared to similar facilities (e.g., other office buildings).	Whole building evaluation requires additional analysis to identify project investment opportunities. Lack of economic analysis leads to inaccurate prioritization.
B	MONTHLY UTILITY REGRESSION ANALYSIS	Historic utility data plotted relative to heating and cooling degree days to identify heating-specific, cooling-specific, and base-load energy use. These profiles can then be compared to peers similar to the comparison described above in Benchmarking (A).	Similar to Benchmarking (A). Additional fidelity provides better estimation of energy reduction potential, but approach is still limited in project-level economic analysis.
C	UTILITY INTERVAL DATA ANALYSIS	Historic energy consumption data collected on a short interval, such as 15 minutes. Analytics can be used to identify potential opportunities, such as scheduling corrections. Accuracy can be increased through submetering energy use.	Effective at identifying operations and maintenance optimization opportunities, such as scheduling issues. Limited in ability to assess economics associated with broader set of projects, such as equipment upgrades, due to decoupling of energy and asset data.

TABLE 1 (CONTINUED)

SUMMARY OF PORTFOLIO ENERGY PROJECT EVALUATION METHODOLOGIES

APPROACH TO PROJECT IDENTIFICATION & ANALYSIS		SUMMARY	PORTFOLIO INVESTMENT STRATEGY OUTCOME
D	BUILDING AUTOMATION SYSTEM INTERVAL DATA ANALYSIS	Historic operational data collected on a short interval, such as 15 minutes. Analytics can be used to identify sequence of operation optimization opportunities and maintenance issues.	Similar to Utility Interval Data Analysis (C). Adding building automation system data can increase the accuracy and fidelity of recommendations. This methodology can enable asset benchmarking, such as expected versus actual performance of a chilled water system.
E	SIMULATION-BASED ANALYSIS	Physics-based computer simulations capable of calculating building energy consumption and costs. Simulations include nuances about building assets and operations, allowing projects to be isolated and evaluated.	The ability to evaluate energy cost reduction based on asset data provides a direct connection to economic analysis, making this the most promising methodology for meeting building owner's needs.[ii] See the next section in the report for further discussion.
F	ON-SITE EVALUATION	Energy auditing and retrocommissioning. Potential projects identified on-site and data collected to calculate potential energy savings and project economics.	Able to provide robust project identification and economic analysis. Commonly time and cost prohibitive due to on-site visits and custom analysis. Reports can be difficult to consolidate into a comprehensive portfolio-wide investment strategy. Differences in contractors and/or consultants add variability to project evaluation methodology and scope, which can make it challenging to accurately compare investments.

[ii] Simulation-based approaches tend to be less effective at identifying operations and maintenance optimization opportunities, because the analysis is less connected to operations data such as automation system and energy meter trending. With that said, simulation-based approaches can sufficiently identify buildings where interval data analysis is cost-effective. Therefore, the interval data approach can be applied, like other projects, later in the retrofit process.

03

PORTFOLIO INVESTMENT STRATEGIES

PORTFOLIO INVESTMENT STRATEGIES

NEW FINANCIAL-CENTRIC TOOLS ARE ENABLING PIONEERING PORTFOLIO INVESTMENT STRATEGIES

To meet the need in the market, an additional approach to portfolio analysis is emerging that leverages energy simulation and holistic economic analysis, which provides the level of rigor required to eliminate uncertainty by providing specific project recommendations and clear, investable cash flows.

The value of this level of rigor—consistent, investable cash flow data for energy efficiency measures—is illustrated by developments in the solar industry. While most energy conservation-measure analysis has remained unstandardized—with a cash flow level analysis needing to wait for a vendor or audit analysis—analysis of project economics associated with solar photovoltaics was standardized and made transparent. Tools like NREL's PV Watts and System Advisor Model made remote analysis of cash flows simple, reliable, and standardized. These improvements to solar project evaluation have led to an uptick in portfolio procurement in solar, as portfolio owners are able to assess solar projects remotely and reliably. In areas where similar analysis has been possible within energy efficiency, for example with LEDs, portfolio procurements of these assets has similarly increased. Consistent, reliable, and transparent remote analysis at the cash flow level is now making it possible to perform evaluations of a holistic set of energy efficiency, renewable energy generation, energy storage, and demand-response solutions. **This emerging capability will allow energy to be treated as an investable asset in the portfolio.**

Several solutions using simulation-based methodology currently exist on the market, including: Helios Exchange, Commercial Building Energy Saver, and Spark. Currently, the solutions available fluctuate in their ability to evaluate project economics and their focus on portfolios versus single buildings. Because of this variability, and because this is an emerging approach that has yet to gain significant market share, RMI has also elected to develop a tool to help drive the market and infuse best practices into energy simulation-based portfolio analysis.

Six best practices have been identified, which are covered in detail below. All of our learnings involved deploying our own software tool and approach, which is part of this family of tools. A detailed description of our approach to the problem is laid out in the RMI's Approach to the Problem section below.

04 BEST PRACTICE 1

BEST PRACTICE 1

EVALUATE ALL POTENTIAL INVESTMENTS USING A COMMON AND HOLISTIC METHODOLOGY

Most of today's offerings for portfolio energy optimization fail to consider a truly holistic set of opportunities for analysis. Owners and investors are forced to cobble together disparate analyses for efficiency or renewable energy opportunities (many of which use conflicting assumptions), or to accept that analyses don't adequately quantify all of the values that their projects are likely to generate. Simply put, if decision makers are unable to identify an analytical procedure that considers a comprehensive set of values and opportunities, they will be unable to truly optimize their portfolio.

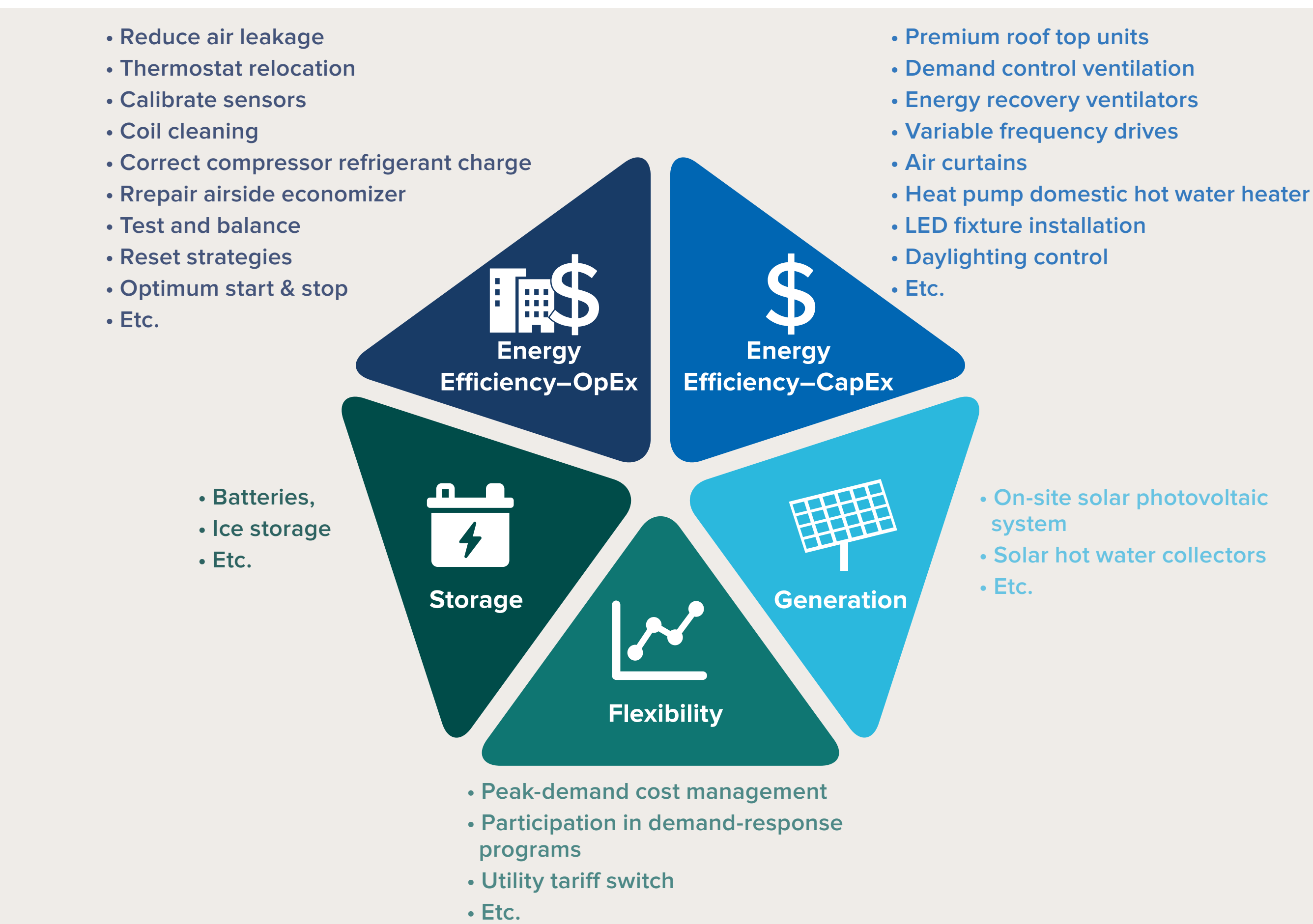
ALL INVESTMENT OPPORTUNITIES

Real estate owners and investors looking to optimize energy performance and capture cost savings have hundreds of opportunities spanning a wide range of industries at their disposal (see Figure 2).

Typically, software solutions are developed to focus on one or a few of these categories—and in many cases these solutions are offered by vendors motivated to demonstrate positive project economics. Many are intended for a subset of a single category, such as the plethora of offerings now available to analyze on-site solar PV installations. Although this specialization

FIGURE 2

SUMMARY OF PORTFOLIO ENERGY PROJECT EVALUATION METHODOLOGIES



can be valuable, especially during the later stages of project deployment, it creates a challenge in understanding how each component fits together within a comprehensive strategy. Finding a platform capable of synthesizing these analyses is essential to developing an optimized investment strategy.

ALL SOURCES OF VALUE

Similarly, many analytical platforms fail to consider all of the sources of value that can be captured by a holistic set of energy investments. Often-ignored value streams include:

- **Net Operating Income (NOI) and Property Valuation:** Energy projects that reduce annual utility costs or otherwise generate revenue have a demonstrable impact on NOI and property value. To illustrate this relationship, RMI compared a hypothetical office property valuation pre- and post-retrofit using national average rent and operating expense (OpEx) figures.[9] The sensitivity table (Table 2) shows how building retrofits impact property value as a function of the depth of savings and the proportion of OpEx that gets reimbursed by tenants, which varies among buildings based on in-place lease structures and occupancy. In-place lease mechanics dictate the extent to which savings accrue to the landlord or tenant(s). With full-service gross leases, where landlords cover all expenses (including utilities), deeper retrofits can increase property value by >10%. With triple-net leases, where tenants pay/reimburse most expenses (including utilities), the effect on NOI can be diluted since reductions in OpEx come with offsetting reductions in OpEx reimbursement income. Many commercial buildings use modified versions of these lease types, falling somewhere on the spectrum in between. Nonetheless, even 1% increases in property value across a large commercial portfolio can add up to millions of dollars in added value, which commonly are larger than project first-costs. This can be particularly beneficial for value-add investment strategies.

TABLE 2

INCREASED NOI AND PROPERTY VALUATION RESULTING FROM REDUCED OPERATING EXPENSES

	PRE-RETROFIT $/SF	POST-RETROFIT $/SF
Base Rent	24.24	24.24
OpEx Reimbursements	5.42	5.07
TOTAL INCOME	**29.66**	**29.31**
Utility Costs	2.16	1.30
Real Estate Taxes	5.21	5.21
Other OpEx	6.18	6.18
TOTAL OPEX	**13.55**	**12.69**
NOI	**16.11**	**16.63**
Cap Rate	6.5%	6.5%
PROPERTY VALUE	**247.85**	**255.82**
Property Value Increase		3.2%

PROPERTY VALUE INCREASES % of Operating Expenses Reimbursed by Tenants					
RETROFIT UTILITY SAVINGS	**0%**	**20%**	**40%**	**60%**	**80%**
10%	2.0%	1.3%	0.8%	0.5%	0.2%
20%	4.0%	2.6%	1.6%	0.9%	0.4%
30%	6.1%	3.9%	2.4%	1.4%	0.6%
40%	8.1%	5.2%	3.2%	1.8%	0.8%
50%	10.1%	6.4%	4.0%	2.3%	1.0%
60%	12.1%	7.7%	4.8%	2.8%	1.2%

Gross Lease ← → **Net Lease**

Note: Line items shown at left reflect 40% OpEx reimbursement and 40% retrofit utility savings; changes to the assumed cap rate do not affect results; analysis assumes no tenant submetering.

- **Operations and Maintenance Impacts:** Many energy investments reduce operations and maintenance (O&M) costs: LED lighting can have double the lifetime of comparable fluorescent lamps, automation systems can replace manual operating procedures, retrocommissioning can stave off equipment replacements. Likewise, some energy cost-saving investments actually result in *higher* O&M costs: solar PV systems require annual cleaning, demand control ventilation precipitates annual CO_2 sensor calibration. Many energy analysis tools avoid quantifying these costs and savings because they require an in-depth understanding of building management practices and contracts, but this omission can skew analysis and result in suboptimal project recommendations.

- **Demand Management:** Utilities nationwide are trending toward a greater focus on demand charges, seasonal rate tiers, and time-of-use rates to better reflect the costs of operating and maintaining grid infrastructure.[10] While virtually all energy analysis platforms estimate energy cost savings, a large number still rely on oversimplified energy rates that fail to adequately account for the value that demand-based tariff structures create for projects that result in decreased demand. Most notably, energy storage technologies (which produce and store energy during periods of low demand and then release energy during periods of high demand) yield no value at all when analysis relies on simple blended energy rates for analysis. This warping, which is common in conventional tools due to the challenge of characterizing complex utility rates, can skew the comparative value of energy projects and result in suboptimal recommendations. The only solution is to utilize an hourly energy simulation capable of utilizing the detailed utility rates that inform your monthly utility bills.

- **Lease Impacts:** Project viability at properties leasing space to tenants can be heavily influenced by lease terms. Incorporating impacts from existing leases ensures these projects are appropriately prioritized relative to projects in nonleased buildings. Additionally, incorporating lease impacts into the analysis can help to identify buildings where energy project investment is being negatively impacted from current lease terms. This insight can create an opportunity to transition to more favorable lease terms over time.

- **Other Values:** High-performance buildings contribute to numerous other value sources, including increased employee productivity and health. Since the publication of RMI's *Deep Retrofit Value Guide* in 2014, a growing body of work (including an ongoing series of studies from Harvard University's School of Public Health and an analytical tool developed by JLL) has supported a correlation between building retrofits and these values. Leading-edge building owners and investors are beginning to consider these sources of value as part of their decision-making criteria for energy investments.

05

BEST PRACTICE 2

BEST PRACTICE 2

PRIORITIZE INVESTMENTS BY PROJECT ECONOMICS INSTEAD OF ENERGY SAVINGS

Most existing energy analysis tools are biased toward maximizing the accuracy of projected energy use or savings. Although accurate energy use and savings projections are certainly important components of portfolio energy analysis, this bias does not reflect the way that decision makers (CFOs, portfolio managers, or others) prioritize and deploy projects for their real estate portfolio. A true portfolio energy optimization requires a holistic financial analysis that matches decision-making criteria in order to ensure that insights and recommendations are not rendered invalid by a lack of complete information.

This best practice suggests a level of depth and specificity that is typically not provided at this phase of analysis. While introducing this specificity early on does require an increase in up-front stakeholder engagement, it allows stakeholders to make more informed decisions and prevents the post-processing and revision of results that can often derail current efforts.

INCLUDE ASSET DATA WITH SUFFICIENT DETAIL TO ENABLE ACTION

Specificity is fundamental to appropriately evaluating project economics. Much of this specificity comes from asset data. Using an LED-fixture retrofit in a Chicago office building as an example, details regarding the fixtures currently installed have a major influence on project economics (see Table 3). Energy cost savings change little between fixture types, but implementation costs fluctuate widely due to variations in fixture and labor costs. In this example, labor costs create the most significant variation, because more 2x2 fixtures than 2x4 fixtures have to be installed for the same light output. This example illustrates that one must have a good understanding of the type of fixtures, in addition to knowing the lamp technology, to appropriately assess the viability of an LED upgrade. This granularity can expand beyond more accurate results. Another natural progression is to evaluate projects with several tiers of investment solutions (see Tiered Solutions Facilitate Optimization sidebar).

INCORPORATE LOCAL ECONOMIC FACTORS INTO ANALYSIS

Energy project investments across a portfolio can only be accurately prioritized by considering a holistic set of economic factors for each project (in conjunction with detailed asset information). Typically, expected returns for an energy project are *more* influenced by drastic regional variations in installation costs, utility policies, and available incentives (as illustrated in Figure 3) than by the expected energy savings of the project.

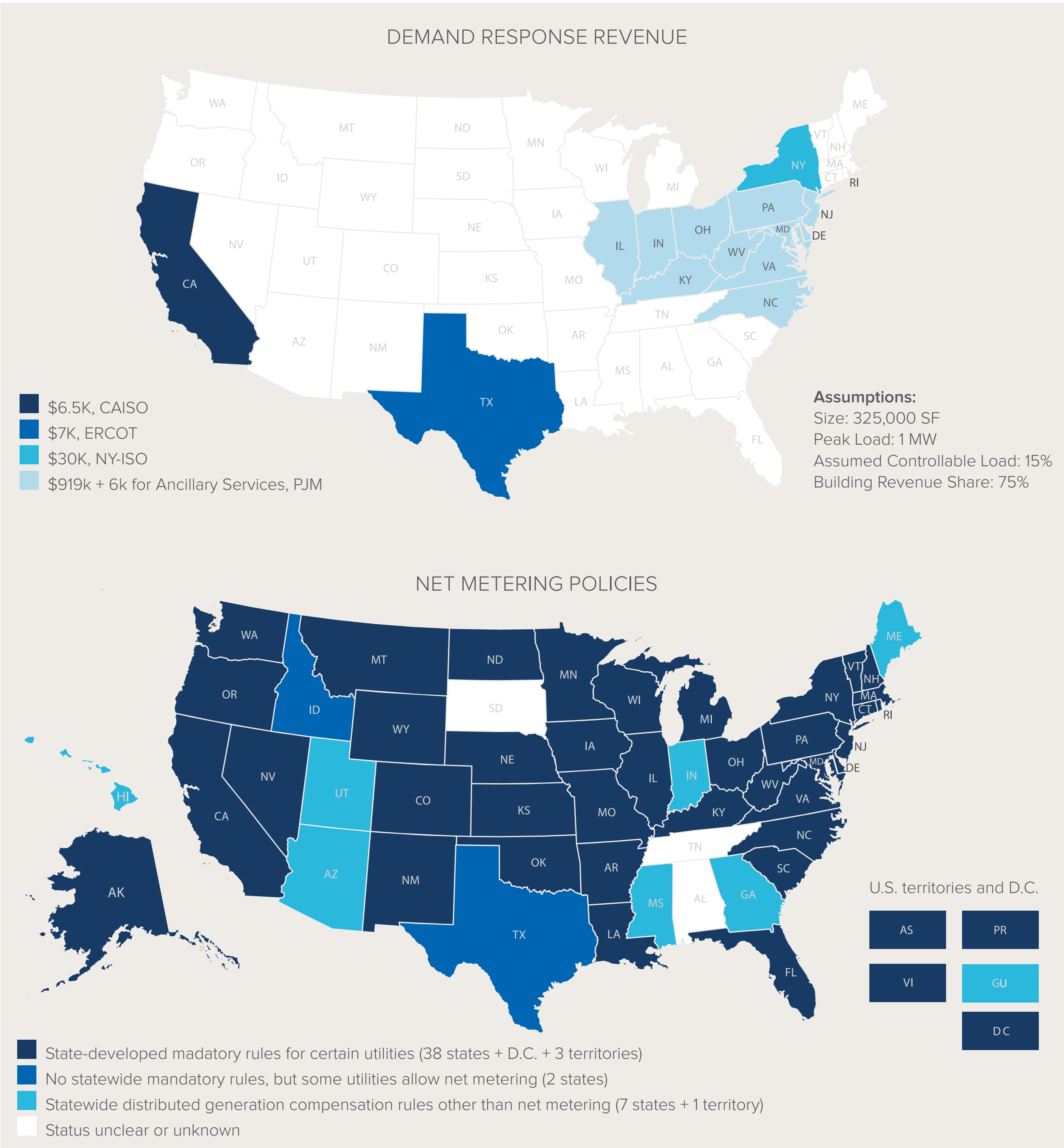
TABLE 3

WIDE-RANGING PROJECT ECONOMICS FOR AN LED RETROFIT DUE TO FIXTURE TYPE

		T5s	T8s	T12s
2X2 TROFFER	2-Lamp	17.7 yrs	14.7 yrs	13.1 yrs
	3-Lamp	12.1 yrs	9.4 yrs	8.1 yrs
	4-Lamp	8.5 yrs	6.5 yrs	5.6 yrs
2X4 TROFFER	2-Lamp	9.8 yrs	7.6 yrs	6.2 yrs
	3-Lamp	5.8 yrs	4.4 yrs	3.5 yrs
	4-Lamp	3.9 yrs	2.9 yrs	2.3 yrs

FIGURE 3

EXAMPLES OF REGIONAL VARIATIONS IN ECONOMIC FACTORS

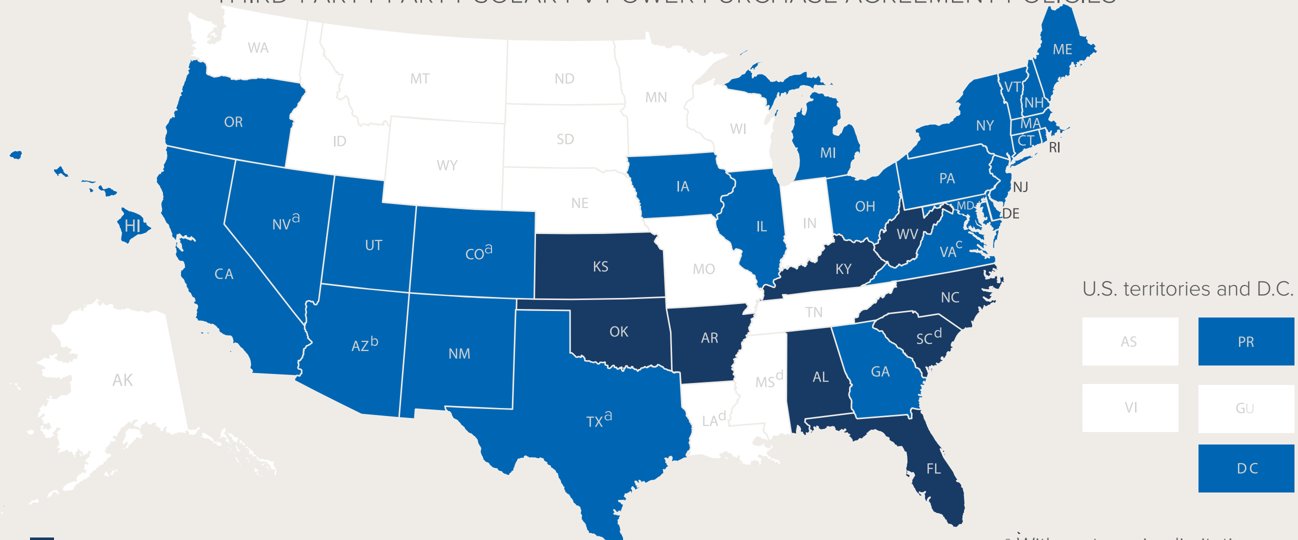


Sources: Demand Response Revenue, RMI; Net Metering Policies, http://www.dsireusa.org/resources/detailed-summary-maps/

FIGURE 3 (CONTINUED)

EXAMPLES OF REGIONAL VARIATIONS IN ECONOMIC FACTORS

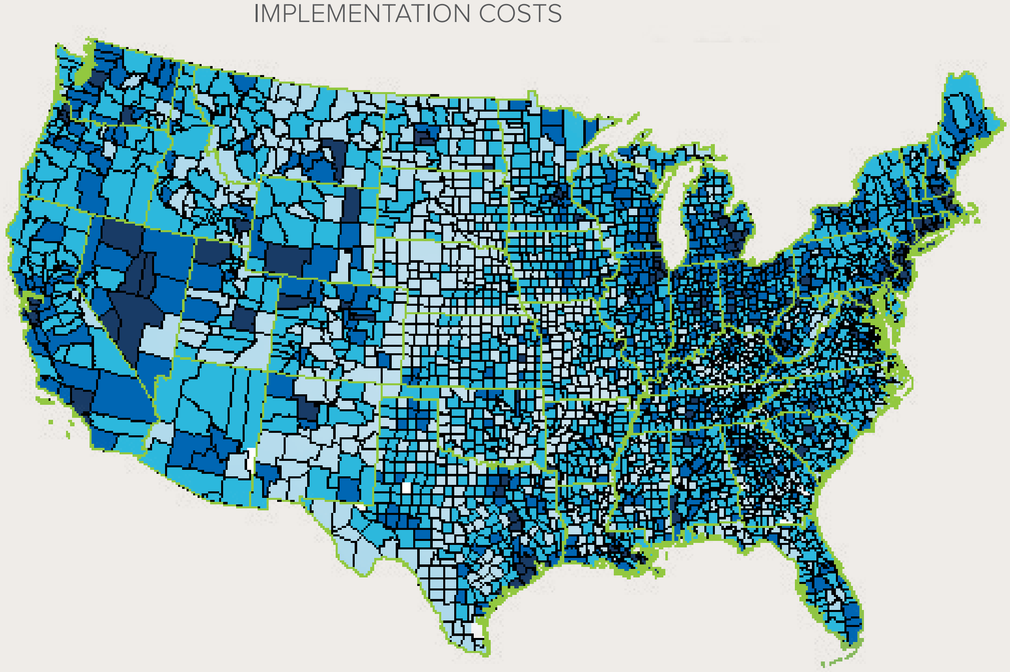
THIRD-PARTY PARTY SOLAR PV POWER PURCHASE AGREEMENT POLICIES



- Apparently disallowed by state or otherwise restricted by legal barriers
- Authorized by state or otherwise currently in use, at least in certain jurisdictions
- Status unclear or unknown

[a] With system size limitations
[b] Limited to certain sectors
[c] Limited capacity
[d] Solar leases explicitly allowed

IMPLEMENTATION COSTS



Annual Wages (1994)

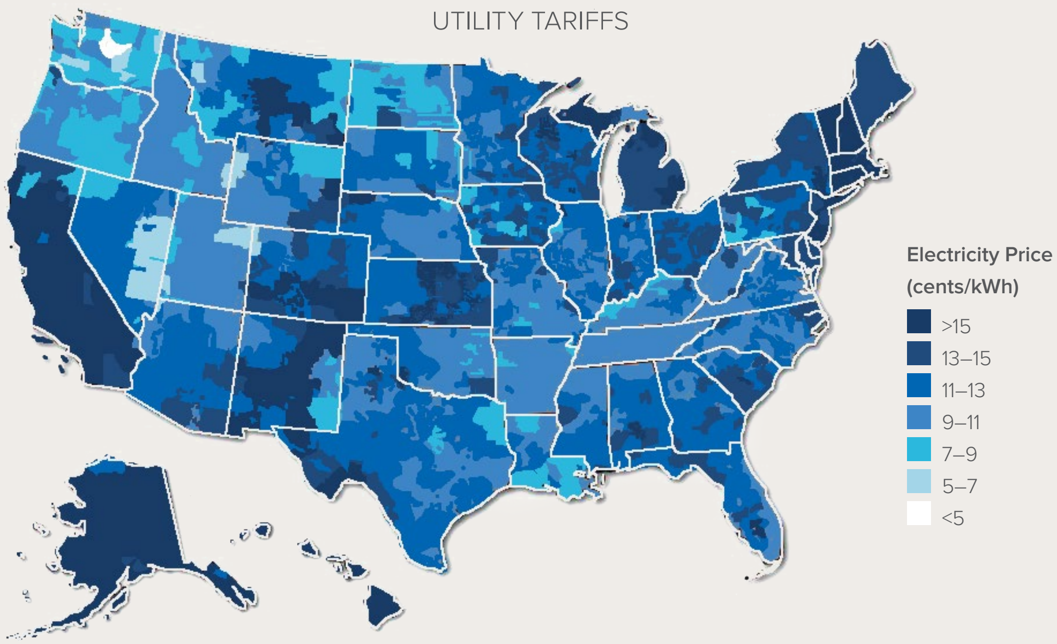
- State borders
- $6,000–16,000
- $17,000–21,000
- $20,000–22,000
- $23,000–47,000
- No Data

Sources: Third-Party Solar PV Power Purchase Agreement Policies, http://www.dsireusa.org/resources/detailed-summary-maps/; Implementation Costs, http://www.edgetech-us.com/Map/MapLbrCost.htm

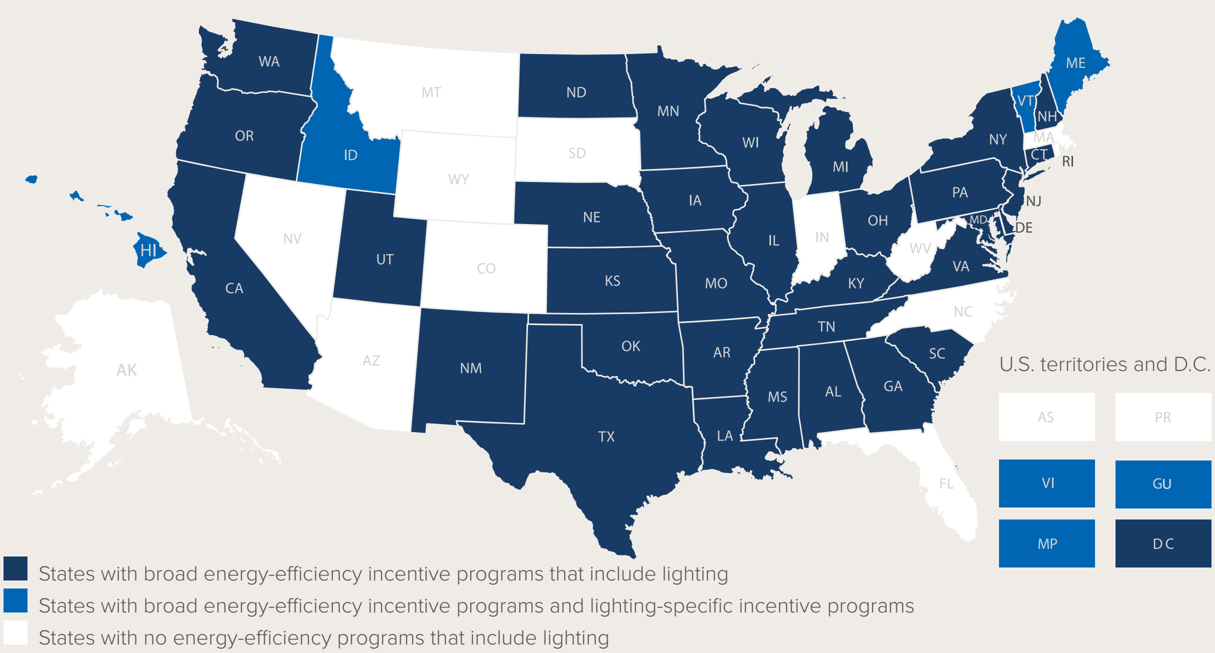
FIGURE 3 (CONTINUED)

EXAMPLES OF REGIONAL VARIATIONS IN ECONOMIC FACTORS

UTILITY TARIFFS



ENERGY-EFFICIENT LIGHTING INCENTIVES

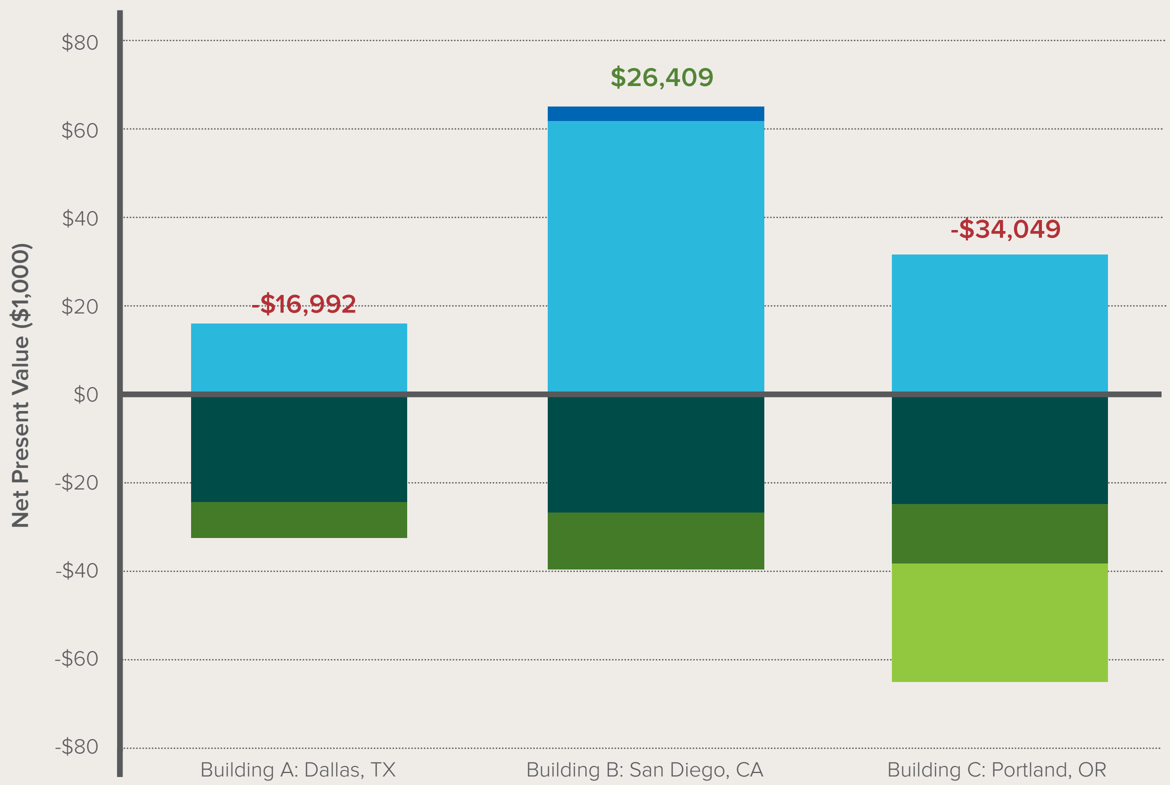


Sources: Utility Tariffs, https://openei.org/wiki/File:2013_Electricity_Price.jpg; Energy-Efficient Lighting Incentives, http://www.ncsl.org/research/energy/energy-efficient-lighting.aspx

Figure 4 illustrates the impact these regional variations can have on the analysis of a prospective LED installation being considered at identical buildings in three different locations. In the example provided, it is assumed that the exact same number of fixtures will be installed at each location and the project will save virtually equal amounts of energy at each location. Even with these simplifications, the economic performance of the three projects varies substantially and for different reasons, illustrating the difficulty of extrapolating results from a project in one location to other buildings within a portfolio.

FIGURE 4

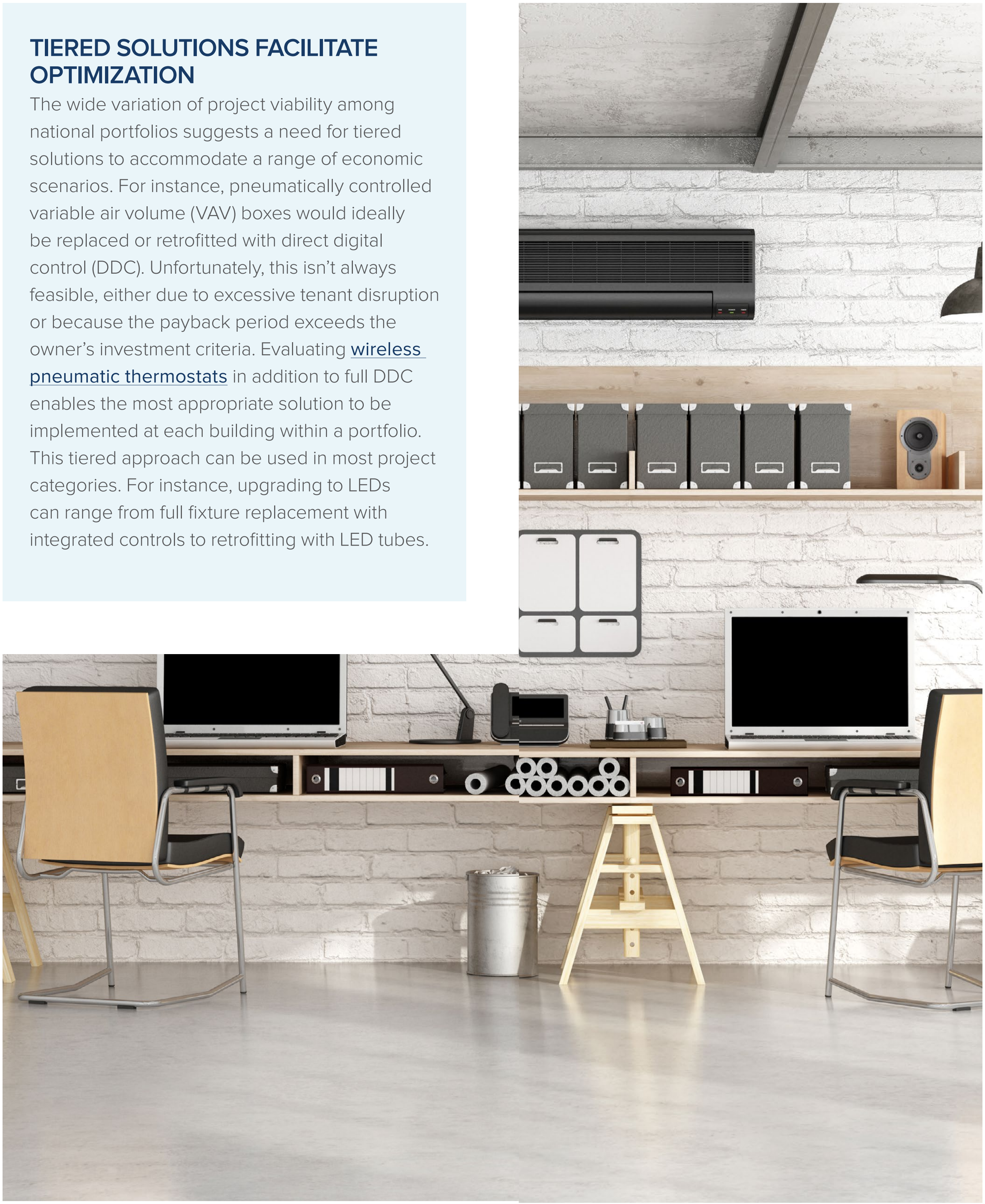
LOCATION-BASED IMPACTS ON LED FIXTURE RETROFIT ECONOMICS



PROJECT NPV	A: -$16,992	B: $26,409	C: -$34,049
Material Cost	Relatively consistent across three locations, varying less than 4%.		
Labor Cost	Building A's labor costs 30% lower than other locations.		
Energy Cost Savings Over 7 Years	Energy savings equal for the three locations, but energy cost savings varies by as much as 70% due to wide variation in utility tariffs.		
Incentives	Available for Building B, but not A or C.		
Lease Degradation	Building C pays pro rate costs for utilities, therefore much of the energy savings is eroded to other tenants.		

TIERED SOLUTIONS FACILITATE OPTIMIZATION

The wide variation of project viability among national portfolios suggests a need for tiered solutions to accommodate a range of economic scenarios. For instance, pneumatically controlled variable air volume (VAV) boxes would ideally be replaced or retrofitted with direct digital control (DDC). Unfortunately, this isn't always feasible, either due to excessive tenant disruption or because the payback period exceeds the owner's investment criteria. Evaluating wireless pneumatic thermostats in addition to full DDC enables the most appropriate solution to be implemented at each building within a portfolio. This tiered approach can be used in most project categories. For instance, upgrading to LEDs can range from full fixture replacement with integrated controls to retrofitting with LED tubes.



06 BEST PRACTICE 3

BEST PRACTICE 3

OPTIMIZE CASH FLOWS OVER TIME

Energy project investment decisions are influenced by factors beyond the return on investment associated directly with a given project. For instance, it is important to ensure attractive cash flows for both owners and tenants (see Consideration of Tenant and Owner Cash Flow sidebar). Reducing operating costs can also impact net operating income, property valuation, and investment returns. These considerations do not need to be supplemental. They can be incorporated into the prioritization process.

CONSIDER AVAILABLE FINANCING STRATEGIES

Numerous opportunities are available for financing energy efficiency improvements, including traditional loans, property-assessed clean energy (PACE), Green Bank loans, and innovative, technology-specific financing approaches such as Lumens as a Service. Renewable energy systems are particularly ripe for financing through power purchase agreements (PPAs) or system leasing. The categorization of financing can vary depending on structure from capital lease to service agreement, and characterization of repayments within tenant leases will also vary depending upon specific lease language. The optimal strategy depends on the owners' appetite for capital expenditures and their ability to recover payments under the tenant leases. Because available financing treatments have varying impacts on different energy investments, addressing this complexity with post-processing steps can skew or invalidate an initial opportunity identification and prioritization process. Financing must be considered in the first steps of this process to ensure optimal results. Owners may also be able to access more favorable terms when seeking to finance portfolio-wide energy efficiency and renewable energy projects, rather than financing these efforts on a building-by-building basis.

EVALUATE TENANT ECONOMICS IN LEASED BUILDINGS

Financial benefits to owners can be further improved if leases provide for charging back capitalized project costs to tenants (amortized over their useful life). In addition to reduced operating expenses, certain properties may be good candidates for revenue-generating energy projects such as installing rooftop solar PV arrays via power purchase agreements (PPAs) and/or participating in the local utility's demand response program. Each of these factors can increase a property's net operating income and—after applying a market capitalization rate—translate into a higher valuation, enhancing overall investment returns.

CONSIDERATION OF TENANT AND OWNER CASH FLOW

During the spring of 2017, RMI partnered with Morgan Stanley Real Estate Investing to evaluate an investment property, Lafayette Tower in Washington, D.C. The property is a 241,000 gross square foot, high-rise, multitenant office building constructed in 2009, and the first certified LEED Platinum office building in Washington, D.C. The facility has consistently performed well above average in terms of energy and water efficiency, continues to be Energy Star certified, and has received several upgrades since construction for improved efficiency. RMI's work included remotely identifying and evaluating potential energy and water projects and then performing an on-site validation to confirm and refine the remote analysis. Project evaluation included holistic financial analysis of each project identified.

FIGURE 5

LAFAYETTE TOWER IN WASHINGTON, D.C.

Image courtesy of Clark Construction

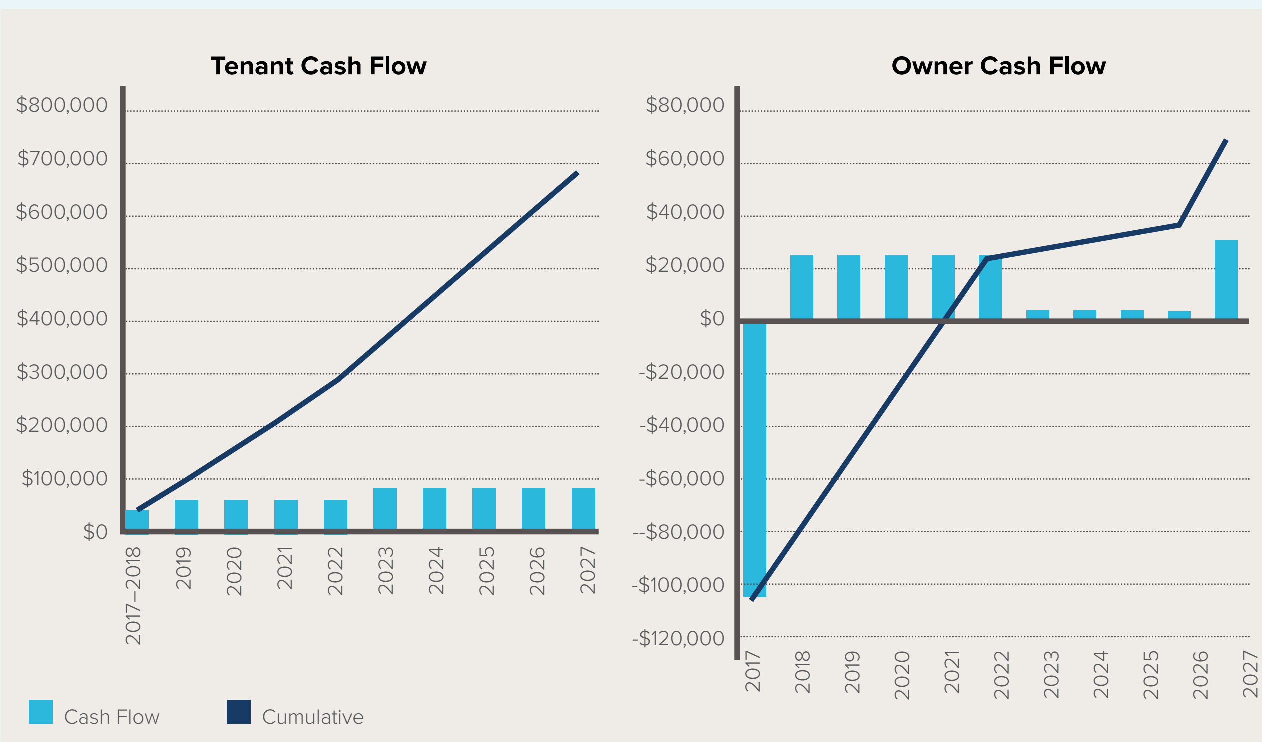
RMI's process uncovered eight energy projects yielding a 15% energy cost-savings potential at Lafayette Tower. Given the high performance of this building before RMI's analysis, this outcome validated the need for a recurring evaluation of a comprehensive suite of cost savings opportunities. The recommended solar PV and LED projects exemplify this insight: although both projects had been identified as cost-prohibitive as recently as 2014, rapidly declining cost curves yielded a different result only two years later.

This project also exemplified the importance of considering a holistic set of factors influencing project economics, including (but not limited to) the impact of lease terms on project economics. Because the property was a multitenant class A office building, viable projects had to generate value and meet the requirements of both the building owner and its tenants within the framework of a complex set of lease terms and resultant cash-flow dynamics. The project analysis showed that the triple-net leases shifted the majority of the cost and benefit to tenants, which caused a cash-flow issue that could only be resolved by capitalizing a portion of the projects that could be qualified as capital expenditures under the building's lease terms. This solution allowed tenant operating expenses to be maintained at or below current levels, while allowing the building owner to benefit from interest payments for deployed capital and projected higher rents at lease renewal, as illustrated in Figure 6. A power purchase agreement was also evaluated for capturing value from a rooftop solar PV installation.

Ultimately, the analysis revealed that the projects could achieve a 13% unlevered internal rate of return (IRR) for the owner and a 47% unlevered IRR for the tenants. In the context of portfolio analysis, neglecting these complexities introduces significant error when prioritizing projects across buildings with a diversity of lease structures. RMI's experience suggests that when decision makers are provided with a set of recommendations that require post-processing to adequately address these complexities (as is the case with most existing opportunity-identification tools and processes), viable opportunities are often abandoned entirely.

FIGURE 6

BUNDLED PROJECT CASH FLOWS FOR BOTH OWNER AND TENANTS



07

BEST PRACTICE 4

BEST PRACTICE 4
LEVERAGE PORTFOLIO BENEFITS

Portfolios should not be looked at only as a collection of individual buildings. There are benefits associated with portfolios that can be leveraged to improve project economics and reduce risk.

BULK PURCHASING

Identifying projects that can be deployed in many of the buildings within a portfolio allows material and installation costs to be negotiated more aggressively. RMI has worked with lighting and HVAC vendors able to provide discounts exceeding 25% when quantities hit a critical mass. While portfolio managers are well accustomed to bulk savings when broadly deploying a technology across a portfolio, most existing opportunity identification tools that optimize technology deployment fail to adequately account for the cost benefit of increased adoption. A proper optimization requires analysis to find the correct balance between targeted deployment at high-value locations and broadscale deployment to capture cost savings.

RISK MITIGATION

When hundreds of diverse projects are deployed as part of a single investment strategy, the failure of any individual project does not doom the investment as a whole. In addition to this passive risk distribution inherent in large project portfolios, risk can also be actively mitigated. As with any investment portfolio, real estate portfolio owners are able to mitigate risk by diversifying energy investments by combining more conservative opportunities with higher-risk and return endeavors.

PROJECT PILOTING AND STAGING

The advantage of a portfolio investment lens can be further realized by utilizing a staged deployment approach. Decision makers can prioritize hundreds or thousands of projects by expected return and deploy these projects over a number of months or years, yielding a number of advantages:

- **Low-Risk Pilots:** Projects can be piloted at locations selected to maximize expected return and/or minimize risk. This minimizes the possibility of a failed project, allows lessons learned from deployment to be disseminated to other locations, and builds momentum and confidence in the investment strategy.

- **Positive Cash Flow:** The lowest-cost, highest-return investments can be captured immediately to support positive cash flows. Returns from these investments can even be deposited into a revolving fund to support higher-cost, longer-payback projects.

- **Streamlined On-Site Validation:** Portfolio owners can use the deployment of high-return projects to refine the analysis inputs of lower-return projects. This strategy can be leveraged to reduce on-site validation costs and reduce risk for high-capital cost projects.

- **Adaptation over Time:** Deployment of projects based on economic return allows investors to adapt their strategy based on lessons learned as projects are implemented and current projects near the investor's economic threshold. For example, if providers are able to capture only 80% of expected tax incentives on low-risk projects, decision makers can adjust the deployment of higher-risk projects accordingly.

08 BEST PRACTICE 5

BEST PRACTICE 5
ENABLE CONTINUITY WITH ONGOING WORK

PROJECT IMPLEMENTATION PHASES

To minimize the cost and complexity of deploying energy projects, the portfolio screening process described in this report can be incorporated with future phases of project development as one streamlined process. Using a common platform for all project phases minimizes redundant data collection processes and the potential for human error.

Figure 7 illustrates a simple project delivery process. Table 4 notes how each of the four steps in this process can benefit from analytical continuity stemming from preliminary opportunity identification and prioritization.

FIGURE 7

MASS-CUSTOMIZED ENERGY PROJECT-DELIVERY PROCESS

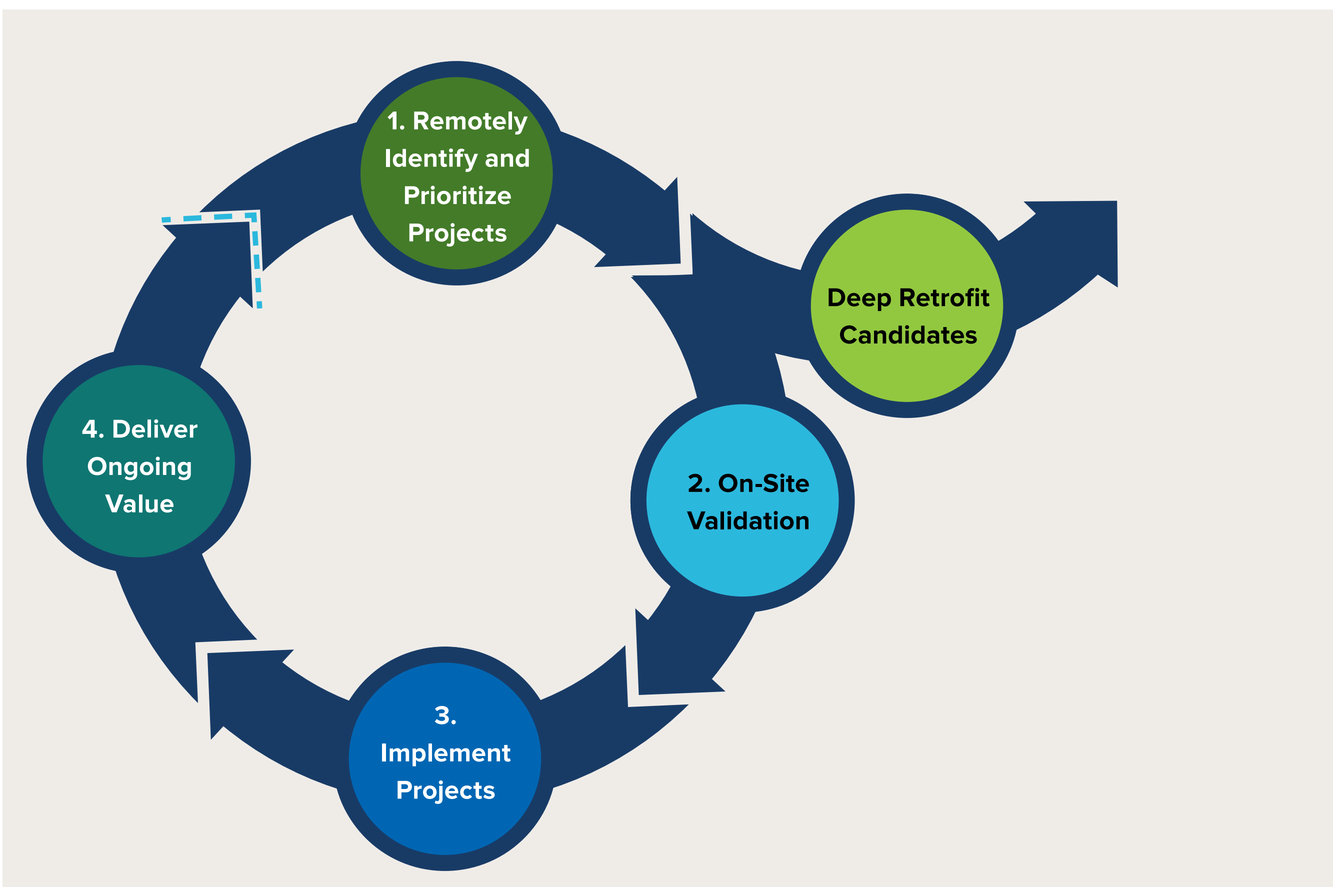


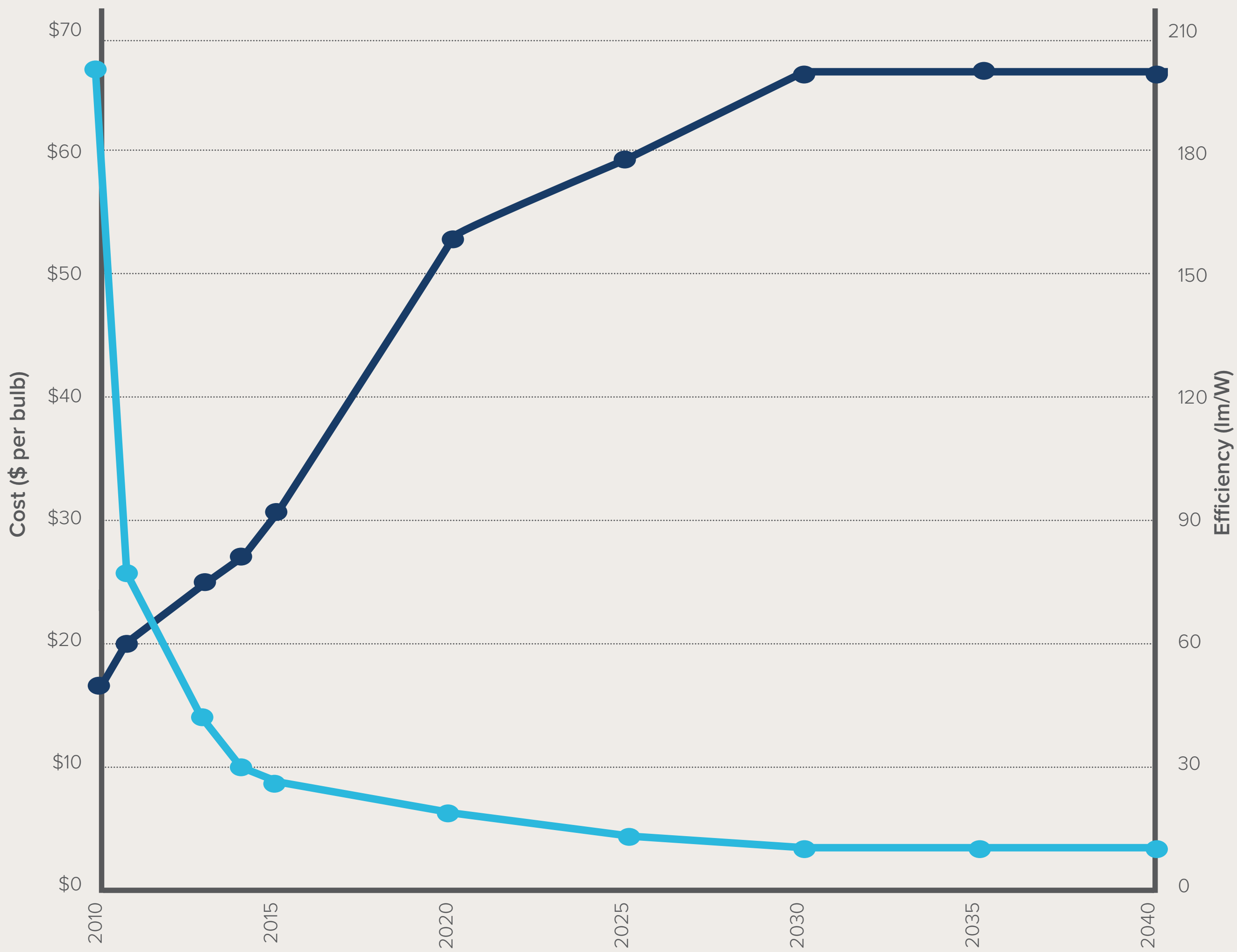
TABLE 4

SUMMARY OF DELIVERY PROCESS STEPS AND POTENTIAL CONTINUITY WITH PORTFOLIO ANALYSIS

PROCESS STEP	POTENTIAL CONTINUITY
1. Remotely Identify and Prioritize Projects: The focus of this guide. Identify and prioritize potential energy and water projects applicable to each building within the portfolio. Filter and prioritize projects relative to owner's economic criteria or environmental targets in order to secure project approval and funding. Note: In RMI's delivery process, this stage also identifies buildings ripe for deeper savings through a custom intervention.	N/A
If a Property Is a Deep Retrofit Candidate: Properties that are positioned for deeper energy savings through custom analysis and redesign are beyond the scope of the mass-customized portfolio analysis described in this report. Commonly, these properties receive extensive envelope upgrades and complete system replacements, which can be economically feasible due to major equipment reaching the end of its useful life, or properties being refreshed or repositioned.	Identification of deep retrofit projects. Highlighting mechanisms that can be used to improve project economics, such as leveraging planned equipment replacements to take advantage of incremental costs, or the ability to reduce equipment capacities.
2. On-Site Validation: Validate remotely collected information from previous phase for sensitive variables and refine analysis accordingly. Depending on building and portfolio characteristics, consider retrocommissioning buildings to capture high ROI improvements while on-site. Finalize project plans.	Leveraging the analytics platform used in Phase 1 allows all existing information to be carried forward, resulting in more targeted on-site data collection that is focused on refining sensitive analysis variables. This targeted approach reduces cost and interruption relative to a traditional audit.
3. Implement Projects: Leverage mass procurement and streamlined installation by deploying to multiple locations. Establish a robust commissioning process for implemented projects and refine analysis on an ongoing basis as more project information becomes available.	Pilot projects, as identified in Phase 1, represent an important opportunity for refined analysis of future projects. Project teams can log the real-world issues that degrade investments (e.g., unforeseen implementation costs), ensuring that future deployment decisions remain informed.
4. Deliver Ongoing Value: Leverage software for automated commissioning, demand response, and advanced measurement and verification (M&V 2.0) to maximize energy cost saving, ensure persistence, and ensure accurate reporting of results.	Project performance data collected by the monitoring platform provides an opportunity to refine the portfolio analysis assumption for future projects.

FIGURE 8

LED COST REDUCTIONS AND PERFORMANCE IMPROVEMENTS OVER TIME



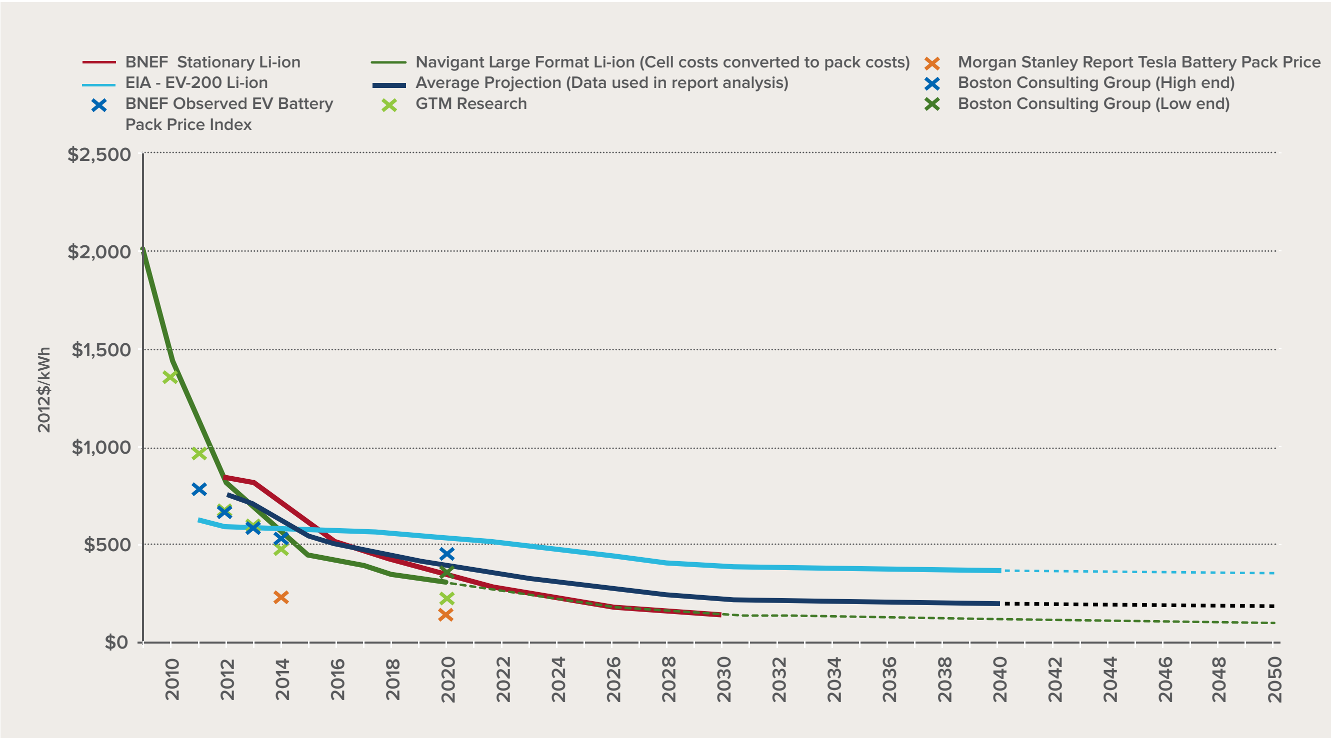
Source: Adapted from EIA.gov (2014)

PERIODICALLY REVISIT PORTFOLIO ANALYSIS

Over time, situations that can impact investment strategies change. A key driver for revisiting the portfolio analysis is falling technology prices. LEDs serve as an example, with radical reductions in cost and increases in quality occurring in the past two decades (see Figure 8). Between 2010 and 2015, LED costs declined by 87% while performance increased by 92%, and these trends are expected to continue over the next 15 years.

FIGURE 9

BATTERY COST REDUCTIONS OVER TIME



Similar patterns exist for energy storage. RMI analysis shows battery costs rapidly declining, with a 70%-plus cost decrease between 2010–2015 (see Figure 9).[11]

Falling technology cost is only one variable within the constantly changing equation, albeit commonly the most sensitive. Changes in property hold periods, tenancy, economic goals, existing building conditions, utility rates, incentives, and tax programs all change over time. Being able to quickly refresh the portfolio investment strategy ensures that money is being deployed as effectively as possible under current market conditions.

BEST PRACTICE 6

BEST PRACTICE 6
DON'T SHY AWAY FROM DATA

Real estate portfolio owners typically suffer from a lack of organized and accessible asset data. Evaluating a project at the level of detail recommended in this report requires a comprehensive understanding of the attributes of each building (e.g., light fixture types or lease terms). This information is commonly stored at the property, within multiple departments (such as the leasing office and design department), or not at all. Even when it is stored, a lack of upkeep can make it unreliable.

Many portfolio-level energy project-analysis approaches emphasize streamlined data collection using a minimal number of inputs, which have been developed due to this lack of data. But these approaches are commonly difficult to put into action, because the asset data needed to accurately calculate project economics is missing. (See Is Benchmmarking Effective for Developing National Portfolio Investment Strategies? sidebar.)

Rather than attempting to avoid the use of data, portfolio owners must view this data as an opportunity to harness multiple value streams. A centralized database populated with building asset information can be used for a wide range of purposes beyond energy project analysis, including maintenance scheduling, capital planning, due diligence, and other third-party analysis. From this perspective, the asset database itself may become the key value driver, with portfolio analysis being just one of many benefits stemming from the newly accessible information.

IS BENCHMARKING EFFECTIVE FOR DEVELOPING NATIONAL PORTFOLIO INVESTMENT STRATEGIES?

Energy benchmarking tools (e.g., Energy Star Portfolio Manager) are a common starting point for building owners to better understand the energy use across their portfolio, and to subsequently identify poorly performing buildings as a starting point for energy projects. Results can be used for sustainability reporting, city-based programs, disclosure ordinances, and similar efforts.

Benchmarking is attractive because only a small number of commonly known inputs (e.g., energy consumption and building area) are required to quantify building performance and compare to peer buildings. However, when benchmarking is evaluated for its ability to guide portfolio owners toward an effective energy project investment strategy, the approach is less compelling because economics (which can have significant implications for project prioritization) are neglected.

Table 5 compares the results of evaluating and prioritizing a portfolio of buildings using benchmarking (via Energy Star Portfolio Manager) against the results of the analysis approach detailed in this report for a representative portfolio of 97 retail buildings. Comparing results yields two key insights into the comparative value of a standard energy benchmarking process:

- **Benchmarking provides only a building-level performance metric, and does little to identify or evaluate potential energy projects**. If this approach is used, an additional step is required to understand investment potential.

- **There is little correlation between building performance and project-level investment potential.** Of the 25 projects with the highest net present value identified through the

RMI analysis approach, only three were located at the worst-performing buildings identified through benchmarking. Prioritizing energy projects by starting with the lowest-performing properties in this portfolio would not result in an optimal deployment of funds.

TABLE 5

COMPARISON OF PROJECT-LEVEL ECONOMIC PRIORITIZATION TO ENERGY BENCHMARKING

BENCHMARKING LOWEST PERFORMING BUILDINGS			
PROPERTY ID	CITY	ENERGY STAR SCORE	SOURCE EUI (kBtu/f²)
BJ	San Francisco	27	234.9
DQ	Jacksonville	42	256
CD	Greensboro	43	168.7
CQ	Chicago	43	240.7
DX	Southlake	43	175.2
BZ	Austin	46	183.9
CW	Las Vegas	47	184.3
BR	Houston	48	153.2
CY	Oxnard	49	126.6
D	Bloomington	50	228.6
CB	Pineville	51	157.1
BU	Plano	52	142.5
AM	Northville	53	150.2
AJ	Houston	55	176.6
CU	Pittsburgh	60	183.5
CC	Santa Monica	61	136.7
AQ	Brentwood	62	149.0
CL	Asheville	62	151.5
CM	Schaumburg	62	174.6
DS	McLean	62	152.6
AX	Fremont	63	123.2

PRIORITIZATION BASED ON PROJECT ECONOMICS			
PROPERTY ID	CITY	MEASURE NAME	NPV
BJ	San Francisco	Premium RTU Replacements, with ASHP (incremental cost)	$294,920
J	San Jose	Solar PV	$253,600
DJ	Dubin	Solar PV	$190,532
CH	Marina	Solar PV	$159,273
BC	Corte Madera	Solar PV	$154,864
CG	Fresno	Solar PV	$125,626
A	Berkeley	Solar PV	$114,875
CN	Stockton	Solar PV	$105,369
V	San Carlos	Advanced LED Upgrade (General Retail)	$102,140
AI	Atlanta	Solar PV	$99,808
DE	Carle Place	Solar PV	$95,401
CX	San Antonio	Solar PV	$93,775
F	Tustin	Advanced LED Upgrade (General Retail)	$93,722
I	Sacramento	Advanced LED Upgrade (General Retail)	$88,460
M	Reading	Advanced LED Upgrade (General Retail)	$85,635

TABLE 5 (CONTINUED)

COMPARISON OF PROJECT-LEVEL ECONOMIC PRIORITIZATION TO ENERGY BENCHMARKING

BENCHMARKING LOWEST PERFORMING BUILDINGS			
PROPERTY ID	CITY	ENERGY STAR SCORE	SOURCE EUI (kBtu/f^2)
BF	Buford	63	143.6
CJ	Charlotte	63	145.9
DJ	Dublin	63	135.1
C	Manhattan Beach	64	138.5

PRIORITIZATION BASED ON PROJECT ECONOMICS			
PROPERTY ID	CITY	MEASURE NAME	NPV
DI	New York	Premium RTU Replacements (incremental cost)	$85,389
V	San Carlos	Premium RTU Replacements (incremental cost)	$83,630
AX	Fremont	Solar PV	$77,999
AD	Concord	Solar PV	$74,190
BS	Rancho Cucamonga	Solar PV	$70,679
CH	Marina	Advanced LED Upgrade (General Retail)	$67,754
BO	Huntington Beach	Solar PV	$67,329
BD	Santa Rosa	Advanced LED Upgrade (General Retail)	$66,523
DV	Flagstaff	Solar PV	$64,927
A	Berkeley	Basic LED Upgrade (Back of House & Storage)	$64,063

10 RMI'S APPROACH TO THE PROBLEM

RMI'S APPROACH TO THE PROBLEM

Portfolio energy project-investment strategies based on holistic economic analysis have yet to achieve significant market penetration, despite a massive potential for impact and revenue generation. Because of this, Rocky Mountain Institute, through its Portfolio Energy Optimization (PEO) initiative, has elected to develop a novel solution. (See Software Platform Framework sidebar.)

Two unfulfilled market needs drove this decision:

- **Sufficient Specificity:** All tools identified in this market segment are designed to be web-based with direct owner interaction. This approach provides fast and low-cost results, but limits the amount of data that can be collected to maintain a user-friendly experience. To provide more specific and actionable results, more data from the client is required. Therefore, RMI is focused on developing a consulting-based model supported by software. Our approach involves the collection of data beyond what is typical in this class of models but, in addition to allowing us to test a wider set of hypotheses, we've found that the organization of relevant asset and energy data can be helpful to clients even apart from the energy analysis.

- **Portfolio-Centric Insights:** Although multiple buildings can be evaluated with a single account using existing tools, RMI is focused on developing a single portfolio-wide report than can be used directly to develop an investment strategy without aggregating multiple single-building reports. The key outcome from this shift in approach is a comprehensive list of projects that can be sorted and filtered based on a range of economic and sustainability factors (e.g., net present value [NPV]). Another approach is to cluster projects relative to a national deployment strategy, such as using a national vendor that will implement a given set of projects.

SOFTWARE PLATFORM FRAMEWORK

Figure 10 provides a high-level overview of the main components and inputs of RMI's portfolio analysis platform and how the analysis flows from energy modeling to energy cost savings to economic analysis.

FIGURE 10

RMI PORTFOLIO ANALYSIS TOOL OVERVIEW

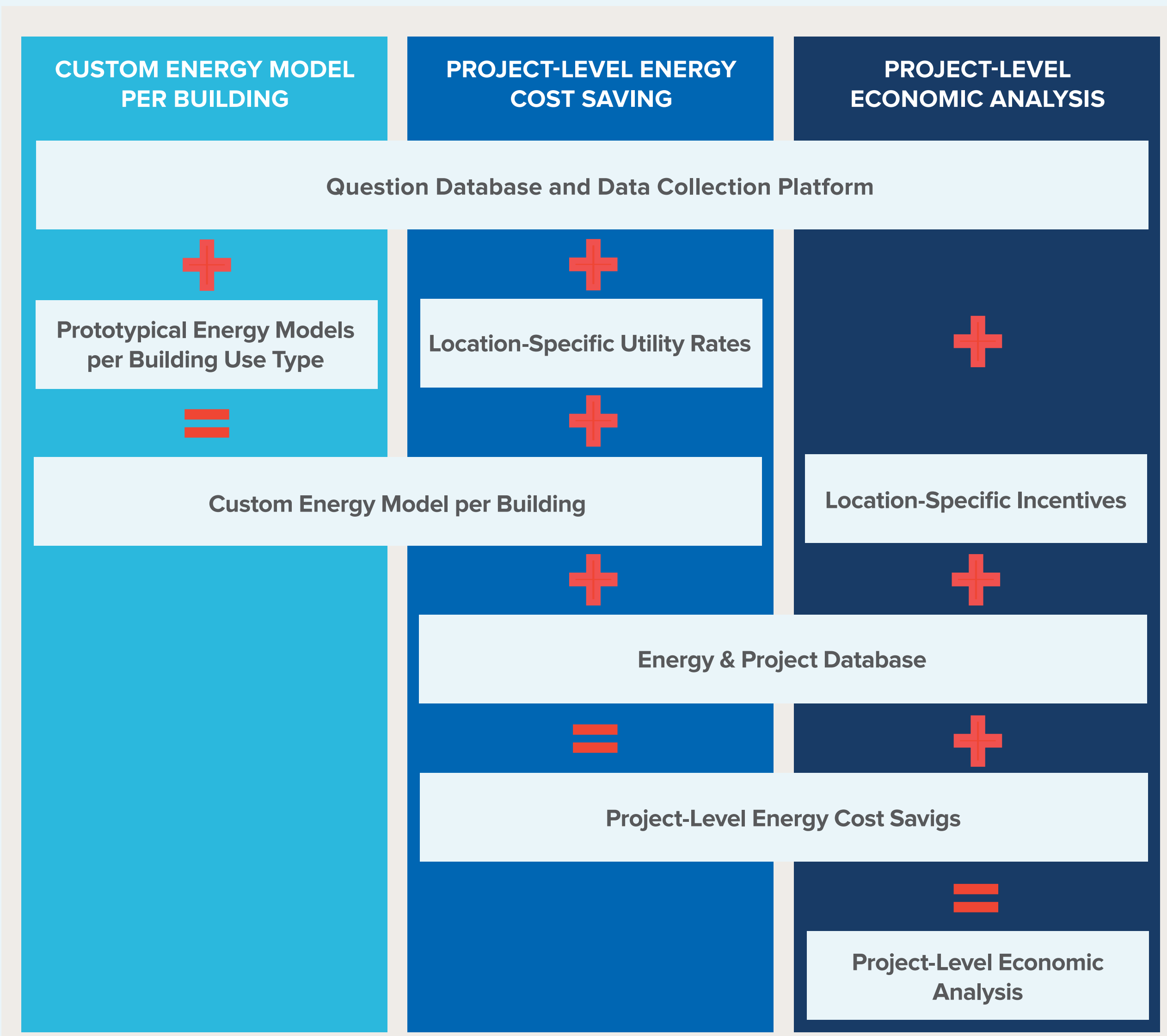


TABLE 6
AUTOMATION ASSISTANCE COMPANIES

A SPECIAL THANK YOU TO THE FOLLOWING COMPANIES FOR THEIR ASSISTANCE WITH AUTOMATION	
Microsoft	During their fourth annual, week-long hackathon, a Microsoft team from Dublin developed a custom economic analysis tool designed to automatically pull data from thousands of energy simulations and evaluate the economic viability of each project.
bigladder SOFTWARE	Big Ladder Software provided support for integrating its open-source Params/Modelkit software, which uses templates and scripts to quickly generate EnergyPlus simulations. The team also assisted in writing custom Ruby scripts to connect Params/Modelkit to RMI's databases to automatically generate simulations.
blueprint	Blueprint, from the University of California Berkeley, is currently working with RMI to develop a web-based data collection platform that will leverage interdependencies to ensure irrelevant questions are not asked and will allow responses to directly feed into RMI's analytics.

LEVERAGING AUTOMATION AND MASS CUSTOMIZATION

Harnessing automation and low-cost cloud computing to efficiently collect data and eliminate rudimentary manual tasks facilitates low-cost, high-rigor portfolio energy analysis.[iii] Harnessing the power of automation is especially important for a large portfolio project, when much of the effort devoted to one building in a portfolio can be replicated and copied to the rest of the portfolio.

Automated and mass-customized aspects of RMI's offering include:

- **Online data mining:** Weather files, local cost trends, utility tariffs and rebates, and a variety of other data points necessary for a holistic portfolio analysis are available online from trusted authorities (e.g., the Department of Energy and its Energy Information Administration), often at low or zero cost. Application programming interfaces (APIs) allow software to automatically pull up-to-date information from online resources and insert that information into an analytical procedure at the click of a button.

- **Client data collection and hosting:**[iv] Accurate analysis requires detailed asset information, such as equipment data, operating schedules, and tenancy and lease structures, which is commonly held by multiple parties. An automated platform facilitates delegation of questions to appropriate parties, progress tracking, and standardization of questions across the portfolio. A database of precontemplated, dynamically selected, and sequenced questions mapped to analysis-tool inputs ensures consistent

[iii] For example: scripts reduced the time required to identify critical variables for a given project through sensitivity analysis from approximately 12 hours to 4.5 minutes.

[iv] Through a pilot project, RMI found that it is possible to collect information remotely for portfolio-screening purposes. The pilot project involved a large multitenant office building with central systems, and RMI was able to find over 75% of savings remotely that were later validated through an on-site visit.

and streamlined interactions as well as a thorough collection of analytics inputs. (See Leveraging a Precontemplated Database of Questions sidebar.) Once the data is collected, it is hosted and shared with clients for recurring portfolio energy analysis as well as other purposes, such as capital planning.

- **Parametric analysis:** When data inputs across a wide range of tools and data sources are parameterized to facilitate rapid editing, providers can harness sensitivity analysis to determine the relative value of each input and subsequently identify a cost-optimal path for delivering sufficient accuracy to clients. RMI also sees the potential for using parametric analysis to quantify (and mitigate) uncertainty, an essential piece of information for decision makers and project financiers. (See Streamlining Data Collection Using Sensitivity Analysis sidebar.)

- **Standardized analysis building blocks:** Pre-engineered frameworks for energy simulation and economic analysis allow the vast majority of work to be completed before project initiation, with client engagement focused on quickly customizing inputs to match a given portfolio. For low-sensitivity variables, the database also contains standard assumptions for a given building type.

The outcome of combining these elements is the capability to pull together a comprehensive data set, analyze 30–60 measures across a national portfolio, and generate accurate cash flows per measure by building. From this, portfolio-wide investment strategies can be developed.

LEVERAGING A PRECONTEMPLATED DATABASE OF QUESTIONS

In 2016, RMI supported Sanus Connect, Inc. in developing a mass-customized retrocommissioning (RCx) and fault-detection and diagnostics (FDD) program for one of the world's largest property management firms. Because of the large number of optimization and repair opportunities (e.g., steam trap repair) within scope, the project focused on developing a mass-customized questionnaire capable of rapidly validating hundreds of opportunities for deployment (rather than developing advanced energy analytics to quantify the value of each opportunity). RMI and Sanus worked jointly to create a tablet-based, conditional data-collection approach to identify or rule out opportunities in bulk by addressing property characteristics, operations and maintenance, and retrocommissioning functional testing. The data collection platform allows site visits to be substantially shortened by allowing questions to be divided among multiple people and by facilitating a clear flow throughout the day, ensures all data required for the analysis is collected, and provides a mechanism for future process refinements.

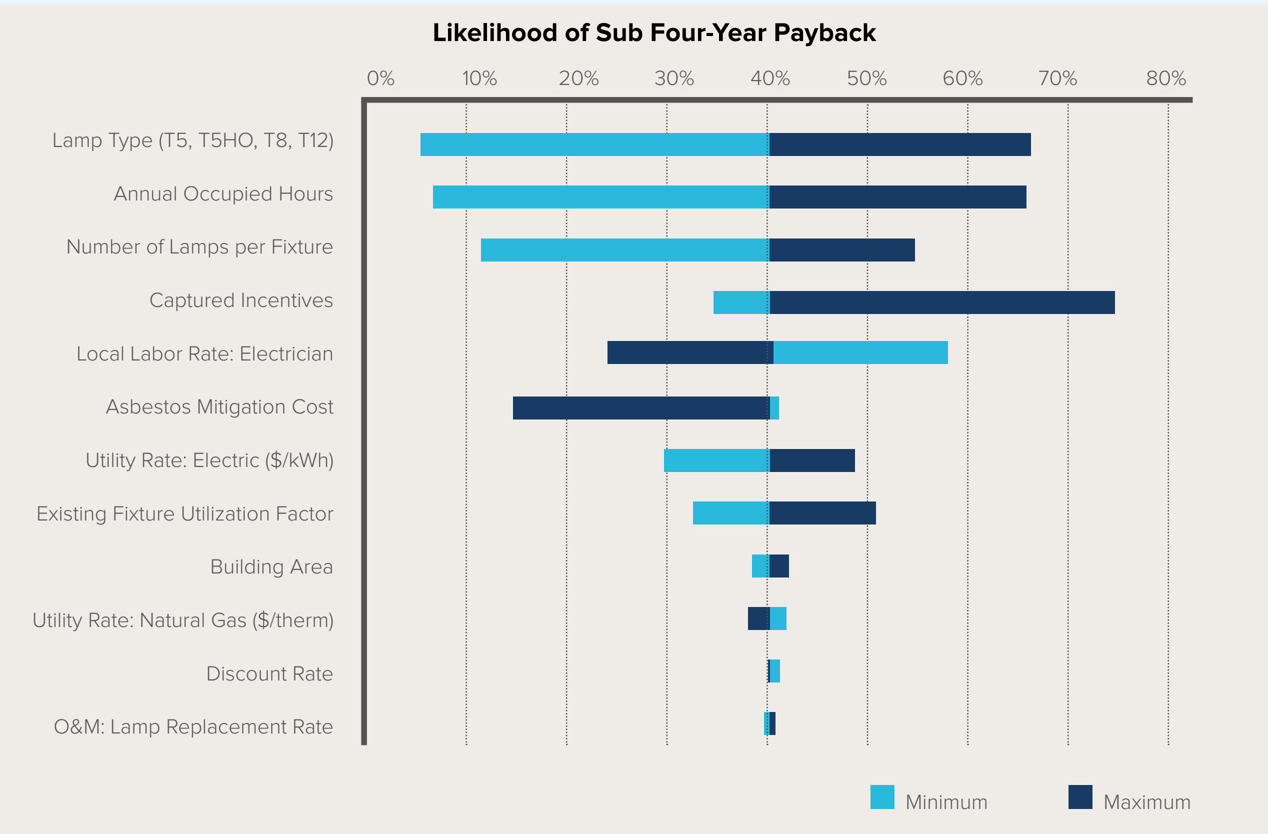
STREAMLINING DATA COLLECTION USING SENSITIVITY ANALYSIS

Energy simulation and economic analysis requires a broad array of inputs, many of which are specific to a given property. Collecting this data can become burdensome due to the sheer number of questions that need to be answered to guide analysis. Sensitivity analysis can be used to mitigate this problem by identifying the variables with the most pronounced impact on project economics in order to prioritize data collection. It is important to note that this sensitivity analysis must be performed according to the impact on the project economics that decision makers are interested in (e.g., expected payback) rather than the impact on expected energy savings.

An example for a modeled LED-troffer replacement is provided in Figure 11. Note that a number of variables typically assumed to be essential for their impact on energy savings (e.g., utilization factor) are exceeded by the impact of economic variables (e.g., incentive eligibility or the potential cost of asbestos mitigation) when sensitivity analysis focuses on project economics instead of energy savings.

FIGURE 11

RESULTS OF AN LED TROFFER-REPLACEMENT SENSITIVITY ANALYSIS



RECREATIONAL EQUIPMENT, INC. CASE STUDY

The following case study highlights results from Rocky Mountain Institute's first national portfolio analysis, which was performed for outdoor-equipment retail co-op Recreational Equipment, Inc. (REI). The results allowed REI to develop a portfolio retrofit-investment strategy with portfolio-wide cost and energy-cost savings estimates (see Figure 12) as well as project-level details enabling investment using pilot projects.

REI has long emphasized sustainability and donates millions of dollars each year to support conservation efforts. This commitment extends to the sustainability of its facilities. In 2016, REI opened a third distribution center, in Goodyear, AZ, which operates at net-zero energy due to efficiency upgrades and a 2.2 MW solar PV installation (Figure 13). REI has also retrofitted its data center to reduce cooling energy by 93%, saving 2.2 million kilowatt hours each year. The co-op is now designing a new headquarters campus in Bellevue, WA, with similar sustainability attributes.

Several REI stores have been designed with an energy focus, with on-site solar installed at more than 25 locations and a number of stores utilizing exemplary high-efficiency design components, including LED lighting, daylight capture, and demand-control ventilation. REI's Boulder, CO, location was used as a test bed for many of these technologies. However, despite the impressive progress noted at a number of individual stores, REI had not taken a portfolio-wide approach to investing in projects, until now.

Kirk Myers, a senior manager of sustainability at REI, saw the opportunity to optimize the energy

FIGURE 12

REI PORTFOLIO ANALYSIS RESULTS SUMMARY

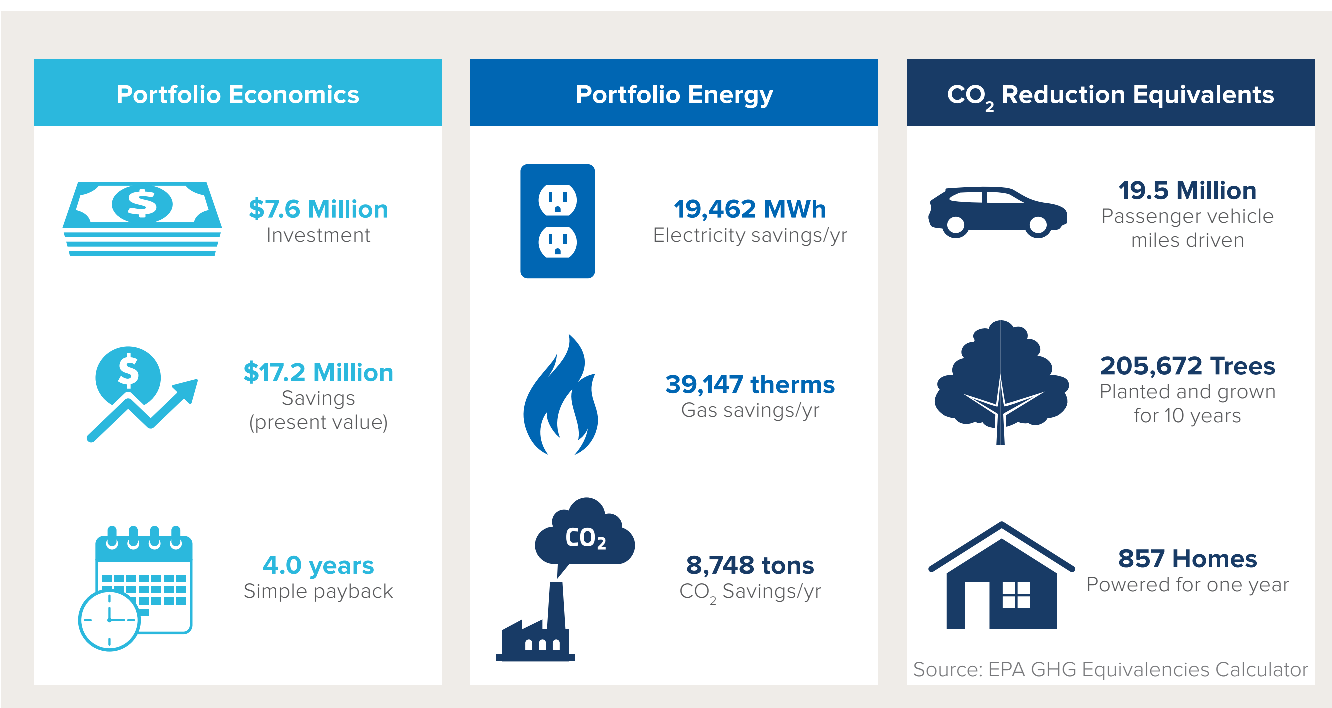


FIGURE 13

REI'S DISTRIBUTION CENTER IN GOODYEAR, AZ

Image courtesy of REI

performance of his portfolio of stores and engaged RMI. For Myers, however, the goal of this engagement spanned well beyond its direct impact. He said:

> Our retail locations may use the majority of REI's energy, but we have to think outside our four walls to drive real change to protect the outdoors for generations to come. We want to show our customers how they can better protect the natural environment that they so enjoy. We want to show our competitors a process they can use to reduce their own energy use. We want to show real estate owners what's possible. If we can use RMI's process to minimize our environmental footprint while enabling and guiding others to follow our lead, that's how we'll really win.

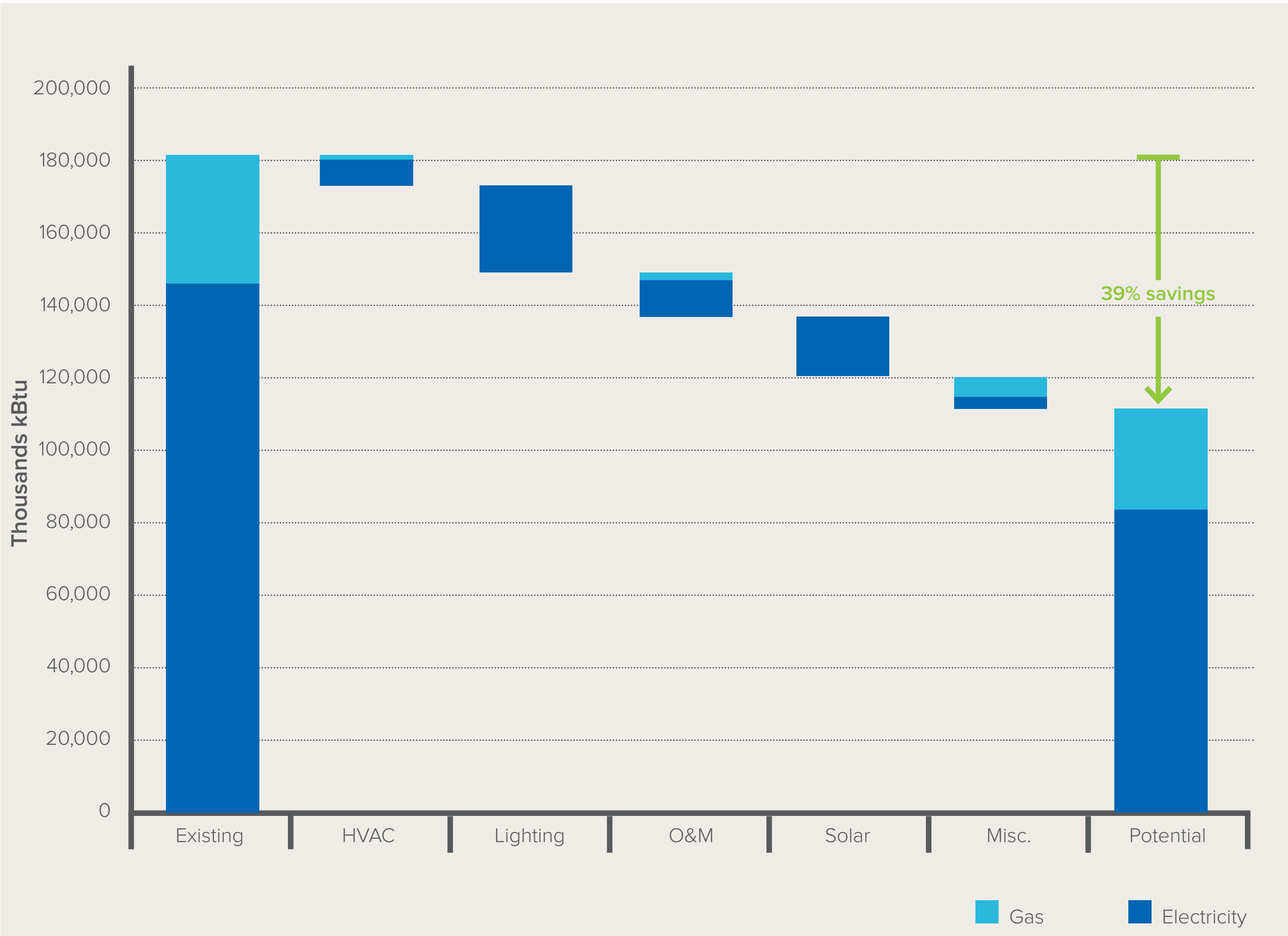
Analysis was performed for 134 REI stores, accounting for 3.82 million square feet of conditioned space across the country. Thirty-four potential projects, including energy efficiency, renewable energy production, energy storage, and water efficiency measures, were evaluated at each store.

Results of the analysis suggests that REI can cut energy use in its stores by up to 39%, while meeting its economic goals of a 10-year simple payback and NPV positive projects (see Figure 14).[v] This is particularly significant because REI stores already perform better than industry standards, with an average Energy Star score above 75. Interestingly, by filtering projects that exceed REI's economic criteria on an individual project basis, the portfolio-wide bundle of recommended investments is projected to result in a much shorter, four-year simple payback.

Figure 15 summarizes the potential NPV of all viable projects per store. The highest-potential store can capture over 70 times the value of the lowest-potential store, due primarily to the variations in locational economic factors.

[v] 5% discount rate over the shorter of either (i) a 15-year period or (ii) the anticipated life of project.

FIGURE 14
PORTFOLIO-WIDE ENERGY REDUCTION POTENTIAL



The results presented here will allow REI to direct available funds toward a suite of projects that maximize the retailer's return on investment and avoid the suboptimal investments suggested by less-sophisticated portfolio optimization strategies, all without the need for a series of time- and cost-prohibitive on-site building audits. Future phases of project deployment will continue to inform REI's ongoing energy leadership while allowing RMI to further refine and improve the processes detailed in this report.

FIGURE 15

POTENTIAL NPV OF ALL VIABLE PROJECTS PER STORE

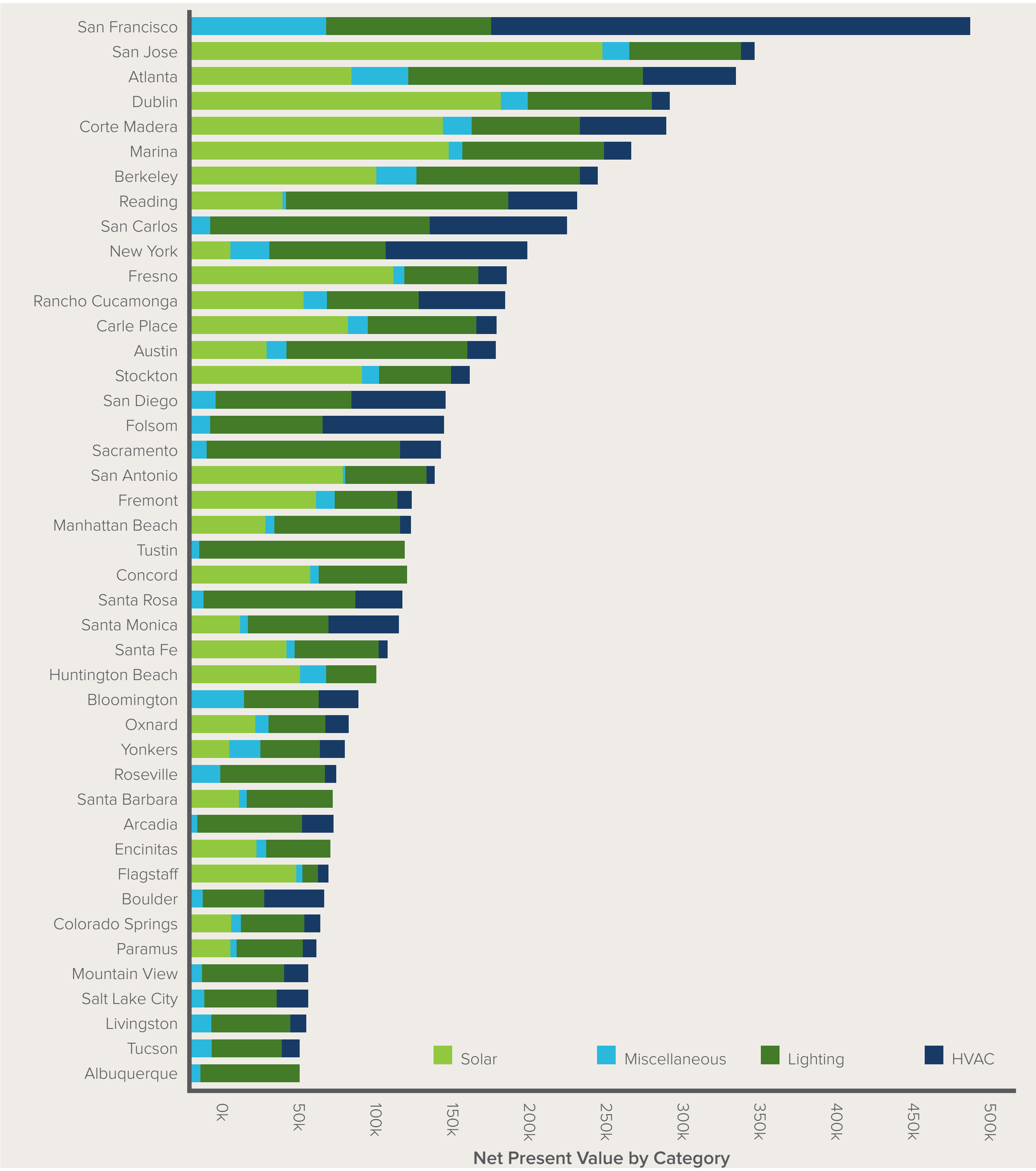


FIGURE 15 (CONTINUED)
POTENTIAL NPV OF ALL VIABLE PROJECTS PER STORE

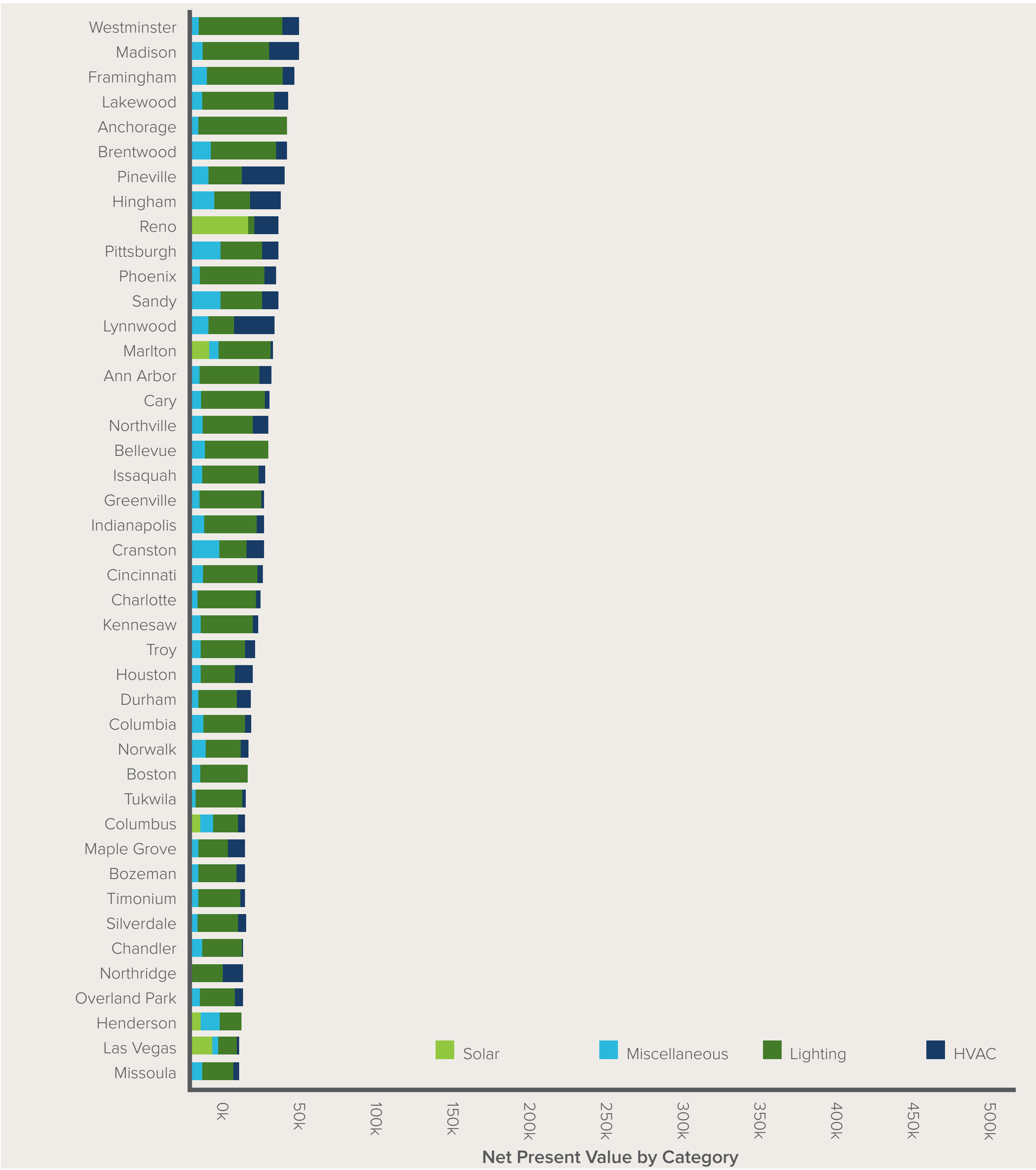
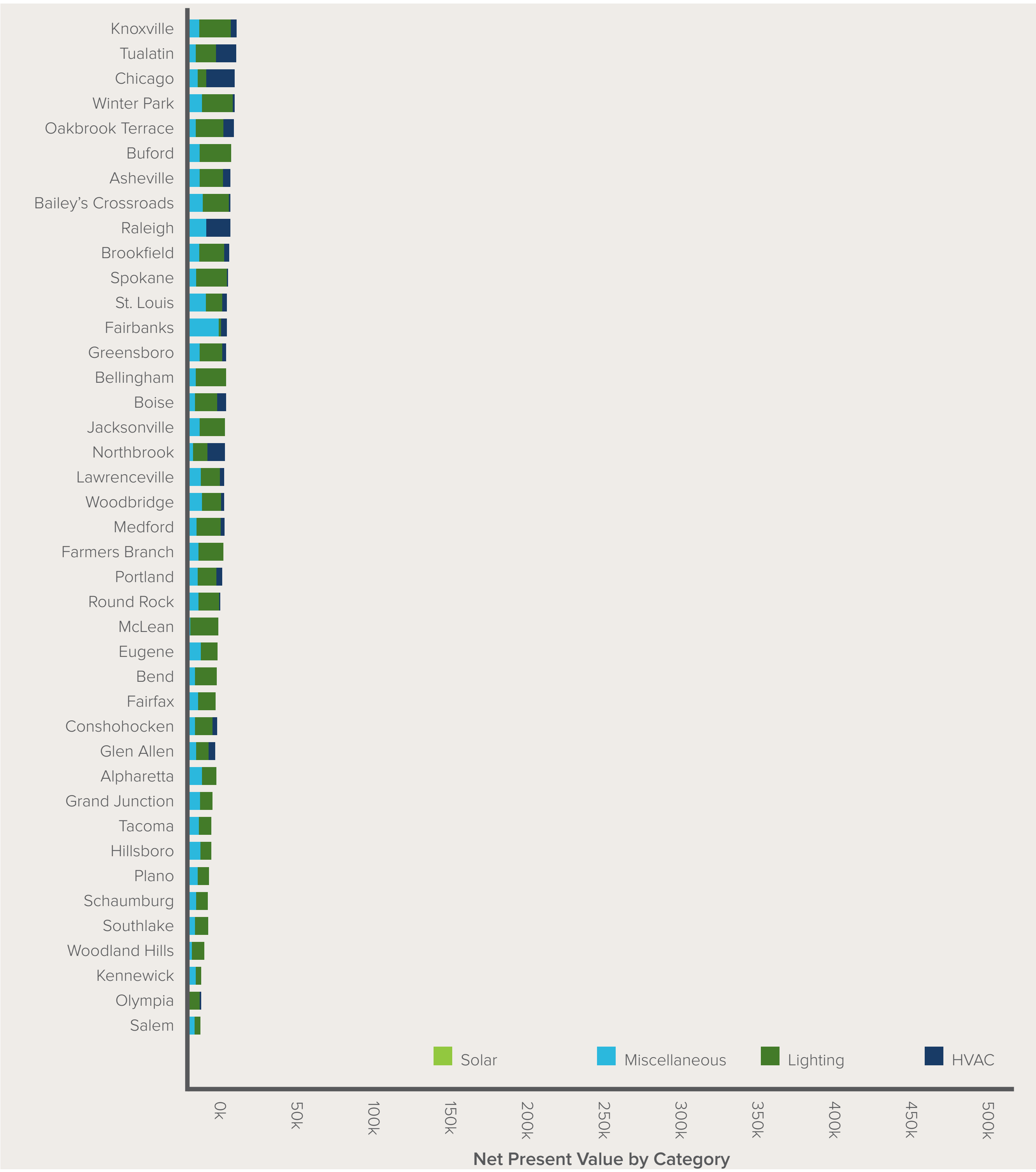


FIGURE 15 (CONTINUED)

POTENTIAL NPV OF ALL VIABLE PROJECTS PER STORE



PLATFORM DEVELOPMENT NEXT STEPS

Significant progress has been made toward the goals outlined in this report. A functional tool has been developed and RMI plans to continue to expand its functionality and refine both the analytics as well as the client experience. By continuing development of the platform while maintaining transparency about our work, RMI will continue to support a rapid increase in the adoption of existing building retrofits.

TABLE 7

RMI PORTFOLIO ANALYSIS TOOL DEVELOPMENT SUMMARY

Currently functional	Software platform capable of automatically generating simulations and calculating project economics from client-specific databases Big box retail and large office "seed model" complete, and associated energy projects defined
In progress	Streamline data collection with web-based platform Expand to other building-use types such as warehouses and hotels
Continuous improvement	Ongoing consulting-based portfolio analysis partnerships Expand and refine project database Further automate Develop tools to assist in converting analytical outputs into investment strategy

11 CONCLUSION

CONCLUSION

Retrofitting portfolio-owned buildings in the United States represents a $290 billion net present value opportunity and is a vital part of creating a clean, prosperous, and secure low-carbon future. To unleash this opportunity, portfolio owners and investors must be able to quickly and easily access clear, actionable guidance on how to optimize the energy performance of their building stock. Advancements in data analytics and automation are enabling a level of rigor and breadth that was not previously cost-effective.

This report is intended to highlight best practices and provide guidance for owners and investors looking to optimize the energy performance of their real estate portfolios. Decision makers can ensure that they are harnessing their share of this $290 billion opportunity by (1) evaluating all potential investments using a common and holistic methodology, (2) prioritizing projects based on project economics instead of energy savings, (3) optimizing cash flows over time, (4) leveraging portfolio benefits, (5) enabling continuity with ongoing work, and (6) committing to collect necessary asset data. We believe that these best practices stand to inform and accelerate a new era of high-performance buildings enabled by portfolio energy optimization.

This work, and the work of others in the field, is removing the information barriers associated with investing in energy optimization. Developing the truly streamlined solution being demanded by the market will require an ongoing industry-wide effort. Join us!

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ENDNOTES

ENDNOTES

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[2] BlackRock Investment Institute, *Adapting Portfolios to Climate Change*, 2016.

[3] UN Global Compact and Accenture, *A New Era of Sustainability*, 2010.

[4] Rocky Mountain Institute, *Deep Retrofit Value Guide*, 2013.

[5] TD Bank, *Environmental Attitudes Survey*, 2014.

[6] McKinsey, *US energy savings: Opportunities and challenges*, 2010.

[7] Institute for Building Efficiency, Energy Efficiency Indicator Survey, 2014

[8] Midwest Energy Efficiency Alliance's (MEEA) 2015 Inspiring Efficiency Impact Award; C40 Cities Bloomberg Philanthropies Awards 2017 Cities4Energy - U.S.

[9] Values taken from the BOMA International 2017 Office Benchmarking Report

[10] Rocky Mountain Institute, *A Review of Alternative Rate Designs*, May 2016.

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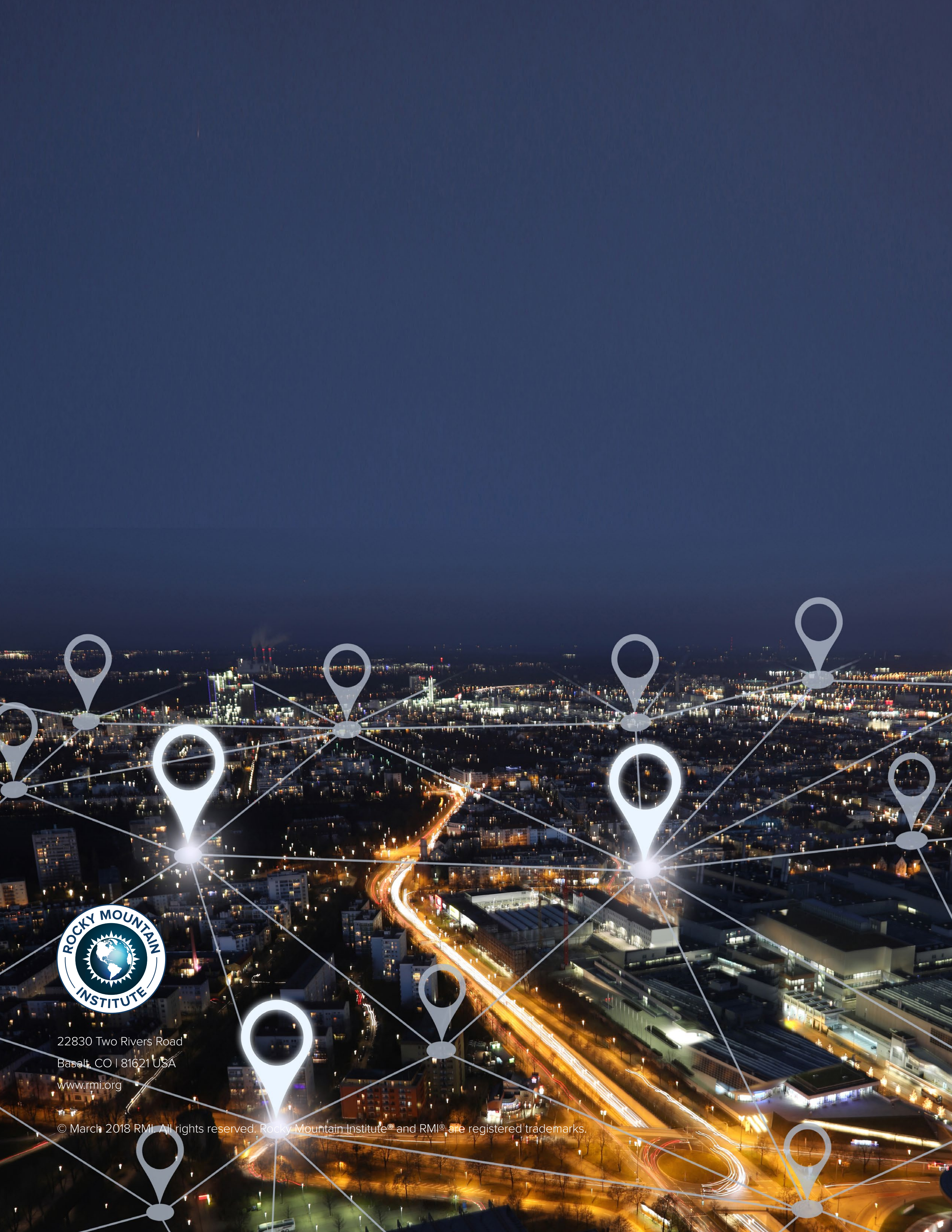

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