Urban Land Institute

ULI Tenant Energy Optimization Program

# Energy Value Analysis Guide: Design and Construction

## Energy Value Analysis Guide: Design and Construction

The Tenant Energy Optimization process is a proven, replicable approach that integrates energy efficiency into tenant space design and construction and delivers excellent financial returns through energy conservation. This guide describes how to quantify the impact of energy performance solutions in a commercial space. It is intended to help build the market expertise that will be needed to meet the demand for this professional service and to encourage a financing market to support implementation of high-performance projects. By understanding the economics of energy performance, consultants (architects, engineers, contractors, and project managers) will have the ability to define the cost-effectiveness of proposed energy performance options during the design phase to inform a client's decision making.

## Energy Value Analysis: A Primer

**During steps 4 and 5 of the Tenant Energy Optimization process, energy-use modeling and costing analytics are used to test energy performance scenarios and help the project team determine an optimal energy performance package. The value analysis, which combines energy performance and cost savings data, serves to anchor the economic case for energy performance improvements during the tenant's lease cycle.**

The outputs of the energy value analysis include a financial scorecard and a narrative that provide the tenant and its facilities and design teams with the right information to determine tiered packages based on projected energy reduction and net present value (NPV) of energy performance measures (EPMs).[1] The value analysis has three major components:

1. **Energy modeling** measures the impact of various EPMs and compares them to a baseline, code-compliant space. Results are used to recommend measures for building systems, lighting, controls, and plug loads to optimize energy use and can inform early design decisions.
2. **Incremental costing** is performed to determine the additional first cost (if any) required to upgrade from a baseline design element to a high-performing alternative. Determining incremental cost can be difficult, and having consultants on your team who are familiar with this type of analysis is therefore important.
3. **Financial analysis** closely relates capital and operating expenses to each other by quantifying the costs and benefits. It is intended to determine the most cost-effective opportunities for energy savings. An energy performance recommendation—documenting the evaluation process and outcomes of the energy modeling, costing analysis, and the program needs—helps provide a framework for the decision making that will occur in step 6 of the Tenant Energy Optimization process.

The value analysis projections quantify annual and lease-term financial impact, taking into account possible incentives and tax deductions. They also determine the payback period, NPV, and return on investment (ROI) of each measure and package of EPMs. The Value Analysis Tool provides landlords and tenants with opportunities to assess NPV, ROI, and internal rate of return (IRR) as they consider and compare the most cost-effective combination of measures for high-performance buildouts. The analysis will require engagement from the design, facilities, construction, accounting, and management teams.

**How a tenant selects, designs, builds, and occupies space makes a big difference in its energy usage and operating costs. Integrating the Tenant Energy Optimization process with service offerings differentiates design and real estate service providers.** Photo by Timothy Schenck.

1. EPMs are technologies and systems that aim to reduce energy use through efficiency and conservation. These are frequently also referred to as energy conservation measures (ECMs).

### Value Analysis Glossary

**Payback period** is the length of time required to recover the additional costs of an energy-efficient installation. The payback period is derived by taking the incremental first costs of EPMs (as provided by the project's contractor) and dividing that figure by anticipated energy cost savings per year (as ascertained from the energy-modeling phase). Payback period is a significant determinant of whether a tenant should commit to a high-performance buildout, because more expensive projects with longer payback periods will typically require longer investment horizons tied to longer lease terms.

> **For example:** Assume the incremental cost of an EPM package for a tenant space (adjusted for any available utility or government incentives to promote energy efficiency) is $200,000. Modeling shows that $60,000 will be saved per year in energy costs The payback period is 3.3 years ($200,000 ÷ $60,000 = 3.3 years).

**Discount rate** is the amount of return (expressed as a percentage) that the tenant expects to receive on its capital outlays to construct the leased space. The discount rate is an important assumption that underpins other elements of the value analysis. It reflects the interest rate the tenant needs to earn on a given amount of money today to end up with a given amount of money in the future. Often, the discount rate reflects the rate of return that could be earned elsewhere on an investment of similar size and risk and therefore can be used to compare various investment options.

> **For example:** If a tenant intends to have $1,000 in a year and has $950 in its bank account today, it expects a discount rate on its investment of 5.2 percent over the next 12 months.

**Net present value (NPV)**, expressed in dollars, is a basic metric used in capital budgeting to analyze the profitability of a project (such as a high-performance tenant buildout). It compares the initial cost of a project to the total value of expected future revenues if the project is implemented. Because of the so-called time value of money[2]—particularly relevant here given the multiyear duration of commercial lease terms—NPV takes into account the compounding of the tenant's given discount rate over the duration of the project. A project's NPV reflects the degree to which cash inflow over the life of a project (e.g., dollar savings on utility expenses over the life of a lease resulting from installed EPMs) equals or exceeds the amount of investment capital required to fund the project (e.g., the adjusted incremental cost of installing EPMs in the tenant space). Businesses use NPV as a way of comparing the relative profitability of potential projects to ensure that only the most lucrative ventures are pursued. In general, a package of tenant space measures with a higher NPV indicates that it is more profitable than a competing EPM package with a lower NPV.

> **For example:** Using a 5 percent discount rate, a package that has an incremental first cost of $10,000 and is expected to generate energy savings of $2,000 per year for 10 years has an NPV of $5,443. Using the same discount rate, a package that has an incremental first cost of $20,000 and is expected to result in $3,000 of energy savings per year has an NPV of $3,165. Although both packages are profitable because the NPVs are positive, the first package is expected to provide greater value.

2. The "time value of money" is a core principle of finance, which dictates that the passage of time affects the value of cash flows. Because money earns interest over time, sums deposited in a bank account today are worth more than the same amounts deposited in the future. That is, any amount of money is worth more today than at some future point. See www.investopedia.com/terms/t/timevalueofmoney.asp.

**Return on investment (ROI)**, a figure expressed as a percentage, is another valuation measure that allows various investment options under consideration to be compared to one another. In general, if an investment does not have a positive ROI, or if other scenarios have a higher ROI, then other investment options would be considered. To calculate ROI, the benefit of an investment (net of its initial cost) is divided by how much the investment costs.

> **For example:** Assume that the NPV of a high-performance buildout, in terms of its electricity cost savings, is $750,000 as determined by energy performance modeling experts. The incremental cost of that buildout package, taking into account available government incentives, is $200,000. The project's ROI over the lease term is a favorable 375 percent ($750,000 ÷ $200,000 = 375%).

**Internal rate of return (IRR)** reflects the rate of growth a project is expected to generate. It is a metric that allows investors to avoid wasting money on projects that cannot earn back the cost of their capital.[3] The higher a project's IRR (expressed as a percentage), the more desirable it is to undertake. IRR calculates the discount rate at which the NPV of the project's costs is equal to the expected NPV of the project's benefits. In assessing various scenarios that package EPMs for tenant installations, the most profitable projects—or those that yield the greatest returns on upfront capital costs—will have the highest IRR and represent a solid investment decision.

> **For example:** A package with incremental first costs of $200,000 and expected energy savings of $60,000 per year over the course of a 15-year lease has an IRR of 29.4 percent. If the company's cost of capital is 5 percent, this package would represent a favorable investment for the company.

## The Energy-Modeling Process

**Energy modeling is a computer simulation used by engineers and architects to understand the implications of design on the energy performance of a building or tenant space. Energy modeling is a powerful tool when used early in the integrated design process. It can be used in applying for potential incentives and tax deductions and can support post-occupancy measurement and verification as well as ongoing commissioning.**

The energy modeler should partner closely with the rest of the project team to work through different design scenarios. For the purpose of an energy-efficient tenant buildout, the energy modeling should be performed during the design development and construction document stages.

### Select a Modeling Tool

Many energy-modeling software tools[4] are available on the market today. The suitability of a modeling tool will vary depending on a project's goals and scope, where the project is in the design process, and the tools with which the energy modeler, project engineer, and architect are most familiar. For smaller-scale projects, modeling can be done using an Excel spreadsheet. For larger, more complex projects, more sophisticated modeling software may be useful. The most widely used energy-modeling tool is the eQuest interface for the DOE-2 engine, which is a building energy-use analysis tool with an intuitive, user-friendly interface that provides professional-level results without requiring sophisticated design or modeling experience. In addition, the U.S. Department of Energy provides open-source energy modeling software called EnergyPlus, which uses the OpenStudio interface. To convey streamlined modeling results, the modeler may use the Sample Energy Model Report Template.

3. See www.investopedia.com/terms/i/irr.asp.

4. For a list of many available modeling tools and detailed descriptions, see the American Institute of Architects' (AIA) *An Architect's Guide to Integrating Energy Modeling in the Design Process*, www.aia.org/practicing/AIAB097932.

## Create a Baseline Energy Model for the Space

Energy modeling predicts the anticipated annual energy consumption of a building (or a tenant space within a building) based upon various design and operational assumptions. The model typically evaluates the performance of the space over a characteristic one-year period to account for seasonal differences in weather, sunlight, and occupancy. To develop the most accurate prediction of how the space will actually perform, the model also incorporates assumptions regarding operations and maintenance of the space and equipment. The energy-modeling process should be discussed during schematic design and commence at 50 percent design development. The model will compare the projected energy consumption of the tenant space—assuming certain design scenarios (incorporating different EPMs)—against the projected energy performance of a baseline design.

The first step is to model the baseline energy consumption for the space, using existing whole-building parameters and assuming standard compliance with local energy code requirements for the tenant space. The architect, engineer, and energy modeler must discuss the possible baseline options and define the best point of comparison, depending on what data metrics provide the best energy improvement values. In many cases, a tenant's business-as-usual design incorporates above-code design elements, or the base building may have undergone energy efficiency retrofits that affect the anticipated baseline energy consumption of a space. Thus, the modeler may develop an adjusted baseline to account for either a building owner's recent energy capital improvements or a tenant's planned above-code design.

## Model the EPMs

After modeling a baseline design in the software, the team next incorporates separately into the model each individual EPM under consideration in early energy discussions. This step helps the team understand the effect that each specific measure has on the projected energy performance in the tenant space. EPMs may include building envelope, lighting, plug load, server-room energy reduction, and heating, cooling, and ventilation (HVAC) and control strategies. The model output will include energy savings delivered in units of energy (e.g., kilowatt-hours [kWhs] or British thermal units [BTUs]) and energy demand savings (kilowatts [kW]). For a tenant energy model, the primary energy use quantified is electricity.

## Create a Package of EPMs and Perform Iterative Modeling to Determine Its Energy Savings

Using the findings of the individual EPM study, the design team will group sensible sets of measures and prioritize them to

- Reduce loads;
- Increase equipment efficiency; and
- Address occupant behavior through controls or automated technology.

Packages of measures should be grouped and modeled to delineate various levels of energy reduction. Later in the analysis, these packages of EPMs will be evaluated based on their financial implications. Generally, a tradeoff exists between higher levels of energy reduction and NPV. Understanding the interactive effects of measures within a package requires running the model through repeated cycles that incorporate a new EPM with each run, a process called iterative modeling. The results of iterative modeling predict the cumulative effect of implementing a package of EPMs, which accounts for interactions between individual measures that may affect overall energy consumption. For example, a unit of energy saved by using daylight harvesting cannot be saved again through high-efficiency lighting; thus iterative modeling would show less energy savings for this package of EPMs compared with modeling the measures independently.

The output of the model will provide estimated annual energy savings based upon the selected package of measures compared to the modeled baseline scenario, which can be broken out into identified savings for both the tenant space and the base building systems. For example, certain EPMs may reduce the overall demand on the central building systems, including centralized conditioned air, steam, condenser, and chilled water savings. Depending on the utility billing structure in the lease, such savings are likely to accrue to the building owner (or be shared with all of the other tenants in the building). Savings from lighting, plug load, and server-room EPMs typically benefit the tenant directly. As described in the first resource guide, *Project Initiation Guide: Pre-Lease*, the lease must outline who will accrue the financial savings attributable to energy savings.

**Detailed Energy Modeling Inputs and Assumptions**

| General geometry | Building envelope | Internal loads and schedules | HVAC systems and schedules[5] |
|---|---|---|---|
| Building shape and orientation | Window dimensions | Anticipated occupancy | System type |
| Principal building function | Glazing sill and head height | Lighting power density | Sizes |
| Total floor area | Window-to-wall ratio | Daylight and occupancy sensors | Distribution type |
| Number of floors | Shading geometry | Plug-load power density | Thermostat setpoint and setback |
| Thermal zoning of floors | Windows and skylights | Exterior lighting peak power | Ventilation and outdoor air requirements |
| Floor-to-ceiling height | Wall, roof, and foundation construction/makeup | Elevators | Economizers and energy recovery |
| | Interior partitions | Occupancy schedule | HVAC fan operation schedule |
| | Infiltration assumptions | Lighting schedule | Heating schedule of operation |
| | | Plug-load schedule | Cooling schedule of operation |
| | | Exterior lighting schedule | Minimum outdoor air schedule |

## Perform Measurement and Verification

When construction is complete and the space is occupied, the team should implement a measurement and verification (M&V) process. The M&V process should begin after equipment has been commissioned, all occupants are settled in the space, and a facility operations process is established. The M&V process requires the collection of actual energy consumption from meters and localized weather data, as well as verification of occupancy and operational assumptions, to calibrate the original energy-modeling tool. Once the model is calibrated, the team may use the tool to check that ongoing energy performance is in line with the projections of the model and then make informed operational adjustments in the space, if necessary. If the building owner maintains an energy model to assess whole-building energy performance, the tenant's energy model and ongoing energy use analysis may be incorporated into the master model for improved tracking of tenant energy use. Further information on this step can be found in the third resource guide, *Measurement and Verification Guide: Post-Occupancy*.

5. In more detailed analyses, the modeler will also need fan efficiency, pump type/efficiency, cooling tower type/efficiency, service water type/efficiency/volume/T-setpoint, and service hot water schedule of use.

## Evaluation of the Financial Implications of EPMs

**Cost is a critical component in evaluating the financial implications of incorporating various EPMs into a tenant buildout project. When designing an energy-efficient space, the team will frequently consider EPMs that are not stand-alone design features, but rather changes to a standard design that increase energy efficiency. Therefore, it is important to determine the additional sums (net of cost avoidance from reducing loads and equipment) that will be incurred when implementing a high-performance design compared to the relevant baseline budget. This difference is referred to as the incremental cost.**

The party best positioned to perform the EPM incremental costing analysis will typically be the tenant's general contractor, but in some cases the tenant may choose to retain a third-party costing consultant. Engaging subcontractors for accurate incremental costs, as well as a mechanical, electrical, and plumbing design team for incremental energy savings, is critical for accurate financial analysis. Including the development of incremental costs for energy measures as part of general contractor and construction manager scope in the request for proposals stage is highly recommended to ensure proper expertise and support for the project team.

### Determine the Baseline Cost

To determine the incremental cost of each EPM, the team must first determine the baseline cost for the equivalent design as outlined above. Depending on the tenant's design intent, business-as-usual construction budget, and timing of the analysis, the baseline budget may be one the following:

- Cost of a standard, code-compliant design, if no design is yet in place; or
- Project costs per a business-as-usual budget, if the tenant plans to implement quality or performance standards above a basic code-compliant design as part of the tenant's typical design prototype or design already in progress.

Ensuring that the costing baseline is consistent with the energy-modeling baseline is important, so that the projected energy savings accurately map to an associated incremental cost. Therefore, the design used to estimate the baseline costs should be consistent with the design used in the energy model. For example, if the team uses a code-compliant baseline to model energy savings from an EPM, the incremental costing should also use a code-compliant design to establish the baseline cost. However, if the energy model uses an adjusted baseline that accounts for above-code design features or quality standards, the incremental costing should use the project as-designed drawings and specifications as a baseline.

### Determine the Incremental Cost

To begin the incremental costing process, the project team must provide the general contractor with the following information:

- Architectural, electrical, and mechanical drawings as designed by the architect;
- Specifications for all relevant equipment included in the as-designed drawings;
- Energy modeling report, including descriptions of proposed EPMs;
- Any additional information, specifications, or details the team has about proposed EPMs; and
- Any relevant base building information.

Determining incremental costing is a collaborative process among the energy modeler, the project engineer, and the general contractor. Because having a project pay for two full sets of drawings (one baseline and one high performance) is usually not realistic, estimates to install the EPMs must be based on the design in the energy model, likely specifications, and the engineer's best information.

Using the design drawings, specifications, and EPM information, the contractor will obtain construction bids from the various subcontractors involved. The estimates should isolate the cost of each individual EPM, even if its impact is spread across several trades, to allow the project team to individually analyze the incremental cost of each measure. The direct construction costs should first be identified and isolated, and then markups should be applied to the differential cost. The incremental cost of an EPM should net out avoided costs from reducing energy loads and equipment from any additional sums required to install energy cost-saving equipment. See the example costing below.

| Example item | Rate | Estimate |
|---|---|---|
| Estimated direct construction cost for baseline design[a] | | $5,000 |
| Estimated direct construction cost for EPM[a] | | $7,500 |
| **Incremental cost without markups[b]** | | **$2,500** |
| Local tax on materials only[c] | 8.75% | $110 |
| Design contingency | 8% | $200 |
| General contractor general conditions and fees[d] | 10% | $250 |
| Bonds and -insurance[e] | 2% | $50 |
| **Incremental cost with markups[f]** | | **$3,110** |

Notes:

a. Includes estimated subcontractor overhead, profit, and fee. Does not include local sales tax.

b. Includes incremental cost without markups between the baseline design and high-performance design.

c. Includes local sales tax on materials only. Assumes 50 percent of the incremental cost is materials and a tax rate of 8.75 percent.

d. General contractor's general conditions/management costs and fee.

e. Payment and performance bond and general contractor's liability and builder's risk insurance.

f. Total estimated incremental cost including markups between the baseline design and high-performance design.

## The Financial Analysis Process

**With incremental costs of individual EPMs ascertained, a financial analysis quantifies the costs and benefits of packaged EPMs and how they correlate to landlords' and tenants' budgets for both capital and operating expenses. The Value Analysis Tool has been developed to aid in these calculations.**

The financial analysis includes the following steps:

**Identify and populate user inputs:** The project team consultants must gather objective user inputs based on the leasing document, energy-modeling report, contractor costing analysis, utility rates, and the tenant's own investment expectations.

| User input | Likely source |
|---|---|
| Baseline energy consumption (kWh) | Energy model |
| Modeled energy reduction (kWh) | Energy model |
| Total area, tenant space (sq ft) | Lease document |
| Lease period (years) | Lease document |
| Utility base rate ($/kWh) | Utility company or building owner |
| Utility escalation rate (%/year) | Industry projections |
| Incremental first cost of EPMs ($) | Contractor costing |
| Energy efficiency incentives ($) | City, state, and federal programs; utility companies |
| Discount rate (%) | Tenant |

**Identify all qualifying energy efficiency incentives:** Various entities may offer financial incentives for pursuing energy efficiency measures. These may range from tax deductions and credits to grant and voucher programs that provide discounts on equipment or offer energy modeling and other related services for free. Project teams can identify available programs in their state through U.S. Department of Energy website (http://energy.gov/savings) and consult the following for additional information:

- City, state, and federal programs; federal tax deduction section 179D (energy-efficient commercial buildings deduction) may allow accelerated depreciation ($0.30 to $1.80 per square foot of tenant buildout);
- Utility companies; and
- State energy offices.

**Input EPM-specific information and EPM package information:** Once all user inputs have been entered into the Value Analysis Tool, the team can determine annual energy use reductions, annual energy cost savings, and simple payback projections for both individual EPMs and various packages of EPMs.

**Determine and calculate evaluation metrics:** Guided by the preceding objective user inputs, the project team consultants should then consider evaluation metrics that guide the tenant in determining the financial soundness of its investment alternatives.

| Evaluation metric | Likely range |
|---|---|
| Adjusted payback period (net of incentives) | 3 to 5 years |
| Return on investment | >20% |
| Internal rate of return | >Discount rate |

Once all inputs have been populated, use the Value Analysis Tool to calculate the evaluation metrics, which should include adjusted payback period, ROI, NPV, and IRR. These metrics help frame the decision regarding which EPMs should be implemented and should be considered in the context of the corporate targets and project-specific goals that were outlined earlier in the process.

**Example: Value Analysis Tool Showing User Inputs and Value Analysis**

| User inputs | | Value analysis | |
|---|---|---|---|
| Baseline energy consumption | 912,000 kWh | Lease period energy savings | $487,191 |
| Modeled energy reduction | 310,445 kWh | Adjusted incremental first cost | ($171,000) |
| Total area, tenant space | 95,000 sq ft | Adjusted payback period | 3.6 years |
| Lease period* | 10 years | NPV | $158,223 |
| Utility base rate | $0.15/kWh | ROI | 93% |
| Utility escalation rate | 1%/year | IRR | 25% |
| Incremental first cost of EPMs | ($210,900) | | |
| Energy efficiency incentives | $39,900 | | |
| Discount rate | 7.0% | | |

*Consider possible extensions to the initial lease period.

**Apply for all registered energy efficiency incentives in accordance with the selected package of measures:** Once a decision has been made as to which package of EPMs will be implemented, the tenant should apply for any applicable incentives. Under many incentive programs, the energy modeling and value analysis processes will allow the tenant to qualify for a higher level of financial incentives. The team should calculate the adjusted incremental first cost by subtracting the energy efficiency incentives from the incremental first cost. Calculating the evaluation metrics without incentives first is important to ensure the project is viable even if incentives are denied or lost.

## You've Analyzed Your Space: Now What?

**Performing a value analysis is only one part of the 10-step Tenant Energy Optimization process.**

Once the value analysis has been conducted and the tenant has decided which package of EPMs to implement, the energy project team can then begin to develop a post-occupancy plan and begin the construction process, ensuring that selected EPMs are built out as planned.

The Tenant Energy Optimization process is detailed in an overview and three-part series of resource guides, which advise building owners, tenants, brokers, and service providers looking to capture the economic, environmental, and competitive advantages of energy-efficient space.

☑ **Overview**
**10-Step Tenant Energy Optimization Process**

☑ **Resource Guide I**
**Project Initiation Guide: Pre-Lease**

☑ **Resource Guide II**
**Energy Value Analysis Guide: Design and Construction**

☐ **Resource Guide III**
**Measurement and Verification Guide: Post-Occupancy**

## About the Urban Land Institute

The mission of the Urban Land Institute is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. Established in 1936, the Institute today has more than 39,000 members worldwide representing the entire spectrum of the land use and development disciplines. ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

## About the Center for Sustainability

The ULI Center for Sustainability is dedicated to creating healthy, resilient, and high-performance communities around the world. Through the work of ULI's Greenprint Center for Building Performance, the ULI Urban Resilience Program, and other initiatives, the Center advances knowledge and catalyzes adoption of transformative market practices and policies that lead to improved energy performance and portfolio resilience while reducing risks caused by a changing climate.


## Acknowledgments

### Case Study Participants

The foundation of ULI's Tenant Energy Optimization Program is a ten-step process that, when implemented in ten pilot fit-out projects, yielded impressive energy and cost savings. Pilot projects applying this process were carried out in tenant spaces occupied by Bloomberg L.P., Coty Inc., Cushman & Wakefield, Estée Lauder Companies, Global Brands Group, LinkedIn, New York State Energy Research and Development Authority (NYSERDA), Reed Smith LLP, Shutterstock, and TPG Architecture. Case studies documenting their experiences were written to inform tenants, building owners, real estate brokers, project managers, architects, engineers, contractors, and energy consultants.

### Project Director

ULI's Tenant Energy Optimization Program builds on the energy efficiency retrofit project conducted at the Empire State Building under the direction of Wendy Fok, principal of OpDesigned LLC. From 2011 to 2016, Fok led the development of a portfolio of tenant buildouts to create a financial and design template to incorporate energy efficiency in tenant spaces. Fok has been a key contributor to the standards set forth in the Energy Efficiency Improvement Act of 2015 (S. 535), which created the national Tenant Star framework. A registered architect, she received her degree from the University of Texas at Austin with real estate executive education from Harvard Business School.

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