BUILDING ENERGY MODELING FOR OWNERS AND MANAGERS

A GUIDE TO SPECIFYING AND SECURING SERVICES

ISSUED AUGUST 30, 2013

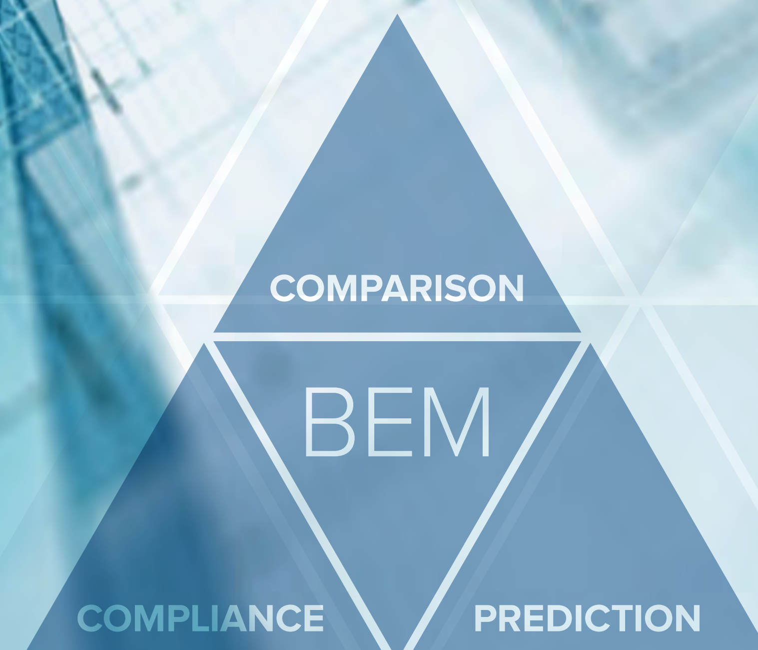

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TABLE OF CONTENTS

TABLE REFERENCES

APPENDIX:

ACKNOWLEDGEMENTS

In March 2011, Rocky Mountain Institute (RMI) invited a group of building energy modeling (BEM) industry experts and stakeholders to convene in Boulder, CO, for a two-day summit. The topic was the current status of BEM and opportunities to more fully realize its potential to support high-performance building design and operation. The event concluded with the development of crosscutting action plans addressing software, best-practice methods, modeler resources, and owner issues.[1] The development of this guide was inspired by the summit discussions. Thank you to those who participated. RMI would also like to thank Fort Collins Utilities; the Poudre School District; the International Monetary Fund; Taylor Engineering; Group 14; Skidmore, Owens, and Merrill (SOM); and YR&G for sharing their insights and materials. Finally, RMI expresses its appreciation to the U.S. Department of Energy (DOE) for funding the guide and the National Renewable Energy Laboratory (NREL) for managing the effort.

FOREWORD

Building Energy Modeling for Owners and Managers : A Guide to Specifying and Securing Services was developed to help owners and managers define and procure modeling services in commercial new construction, renovation, or operation improvement projects. The topics and examples focus on issues relevant to the owner, including the value of modeling, types of services, and solicitation. The BEM concepts developed within this guide yield tips and resources to support successful application.

This guide is presented in three sections:

- ***Section 1: An Introduction to Building Energy Modeling*** provides a brief overview of BEM, including its value, benefits, and common uses.
- ***Section 2: Modeling Services*** outlines service considerations related to timeliness, scope of work, simulation tools, and results.
- ***Section 3: The Contracting Process*** delivers specific resources to aid in contracting modeling services, developing the scope of work, and credentialing service providers.

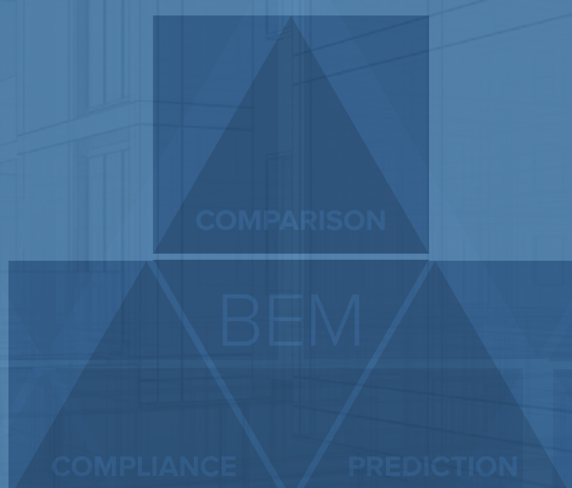
Additional resources complementary to the topic are listed below. They include guides targeting the building design professional that address the integration of modeling services into the design process, as well as modeling service standards and contracting details.

- *An Architect's Guide to Integrated Energy Modeling in the Design Process* (86 pages), American Institute of Architects
  HTTP://WWW.AIA.ORG/PRACTICING/AIAB097932
- *An Owner's Guide to Project Delivery Methods* (35 pages), The Construction Management Association of America
  HTTP://CMAANET.ORG/FILES/OWNERS GUIDE TO PROJECT DELIVERY METHODS FINAL.PDF
- *Energy Modeling: A Guide for the Building Professional* (15 pages), Colorado Governor's Energy Office
  HTTP://ISITES.HARVARD.EDU/FS/DOCS/ICB.TOPIC1136042.FILES/05%20COLORADO%20 ENERGY%20MODELING%20GUIDE.PDF
- *Integrated Project Delivery: Case Studies* (59 pages), American Institute of Architects
  HTTP://WWW.AIA.ORG/ABOUT/INITIATIVES/AIAB082049
- *Retrofit: Integrative Design Checklist* (2 pages), Rocky Mountain Institute
  HTTP://WWW.RMI.ORG/CONTENT/IMAGES/INTEGRATIVEDESIGNCHECKLIST.PDF
- *Standard 209: Energy Simulation for Buildings Except Low-Rise Residential*, American Society of Heating Refrigeration and Air-Conditioning Engineers, [Proposed–expected release June 2014]
- *Using Contracting to Improve Building Project Delivery and Achieve Sustainability Goals* (4 pages), Rocky Mountain Institute
  HTTP://WWW.RMI.ORG/TOOLS_AND_RESOURCES#INTEGRATIVE_DESIGN

[1] BEM SUMMIT REPORTS ARE AVAILABLE AT: HTTP://WWW.RMI.ORG/BEMSUMMIT

SECTION 1

AN INTRODUCTION TO BUILDING ENERGY MODELING



WHAT IS BEM?

Building Energy Modeling (BEM) is the practice of using computer-based simulation software to perform a detailed analysis of a building's energy use and energy-using systems.

WHAT ARE THE BENEFITS?

BEM for new construction or retrofit building projects can reduce operational costs, reduce project first costs, and improve occupant satisfaction.

WHAT IS THE PURPOSE?

BEM can be used to compare project efficiency options, comply with codes or green building certification requirements, predict savings, and inform actual performance.

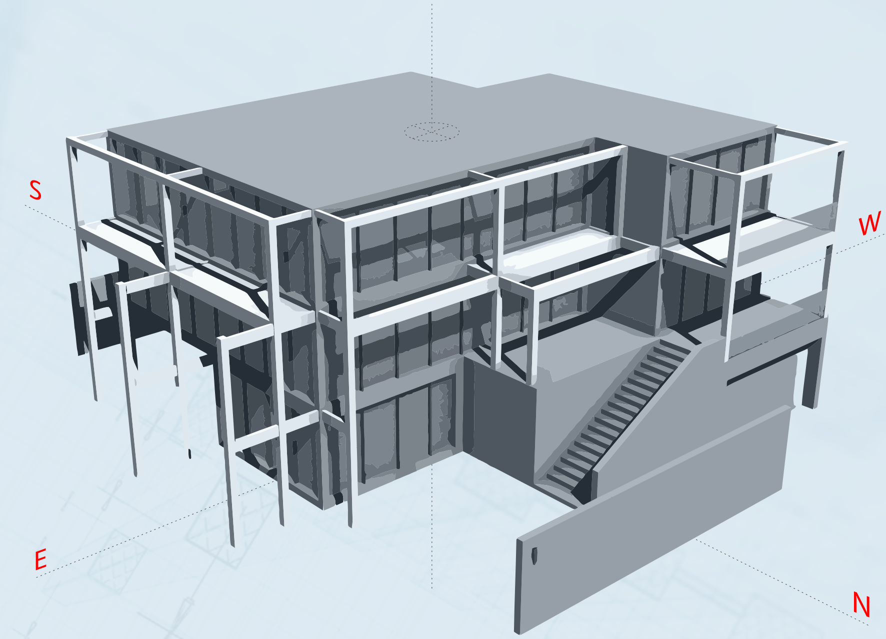
WHAT IS BUILDING ENERGY MODELING?

Building Energy Modeling (BEM) is the practice of using computer-based simulation software to perform a detailed analysis of a building's energy use and energy-using systems.[2] The simulation software works by enacting a mathematical model that provides an approximate representation of the building. An energy modeler will input data to create the building model, including weather, building orientation, geometry, constructions, occupant schedules, and energy-using equipment. The calculation engine solves equations rooted in thermodynamics and building science. A single whole-building simulation can require seconds to hours to run, depending on the level of detail and complexity in the analysis. Results are typically reported for annual performance and include the space cooling and heating loads, daylighting impacts, equipment energy use, resource consumption, energy costs, and other performance-related parameters.

Efficiency improvements can be gained by incorporating recommended items garnered from prescriptive lists into design elements. However, BEM offers an alternative approach that encourages customized, integrated design solutions, which offer deeper savings. Using BEM to compare energy-efficiency options directs design decisions prior to construction. It also guides existing building projects to optimize operation or explore retrofit opportunities. BEM includes whole-building simulation as well as detailed component analysis utilizing specialized software tools that address specific concerns, such as moisture transfer through building materials, daylighting, indoor air quality, natural ventilation, and occupant comfort.

"ENERGY MODELING CAN HELP OPTIMIZE ALTERNATIVES AND ALLOW THE DESIGN TEAM TO PRIORITIZE INVESTMENT IN THE STRATEGIES THAT WILL HAVE THE GREATEST EFFECT ON THE BUILDING'S ENERGY USE AND OCCUPANT COMFORT."

[GEO p5]



A TYPICAL 3D REPRESENTATION OF A BUILDING MODELED IN A SIMULATION PROGRAM

MOST WHOLE-BUILDING SIMULATION ANALYSIS INCLUDES:

- Typical weather data representing the site
- Building geometry, floor plan, construction materials, components, and systems
- Building divided into effective thermal zones
- Variations in occupancy, lighting, power loads, and set points and equipment operation by day, week, and season
- Instantaneous and delayed heat transfer
- Energy use of equipment and end uses
- Overall building energy use and costs

[2] Building energy modeling (BEM) should not be confused with building informational modeling (BIM). BIM is a digital representation of physical and functional characteristics of a facility that serves as a shared knowledge resource throughout the building life cycle. However, BIM data can be accessed through standard data structures and used to develop BEM input values. This approach streamlines model creation and is starting to be incorporated into BEM software developers.

WHAT BENEFIT DOES BEM PROVIDE?

BEM provides a number of benefits to both new construction and retrofit projects. For example, BEM supports an integrated design process (IDP). Through IDP, outcome-based goals are established and agreed upon by project stakeholders. BEM supplies the team the data needed to make strategic, best-value tradeoffs between upfront project costs and annual building energy costs. The expense of modeling services usually represents a marginal incremental cost to the project, yet can influence significant reductions in annual energy costs. Quantifying performance tradeoffs helps maximize an owner's return on investment for building efficiency, integrated systems, and renewable energy components.

BEM can also be used with existing buildings to check and inform operations. By comparing the results of building energy modeling with the actual performance of a building, owners can identify performance deficiencies. BEM acts as a benchmark against which to compare actual whole-building, system, or equipment-level performance, to ensure everything is working correctly. Resolving inconsistencies between BEM performance and actual performance can reveal deviations from ideal operation and opportunities for improvement.

In general, there are three ways that BEM can provide value to a project and benefit the owner.

1. REDUCED FIRST COSTS

BEM can reduce the first cost of a building by holistically accounting for thermal components, systems, and controls in order to simplify systems and right-size equipment. BEM can also help reduce project change orders and call-backs through the integrated analysis of design elements the team has specified. Finally, BEM can provide the documentation needed to secure financial incentives offered through utility-sponsored efficiency programs.

2. REDUCED OPERATING COSTS

BEM can reduce building annual operating costs by supporting the comparison of design and control options that impact energy consumption. Energy modeling can also help inform life-cycle cost analysis, aiding the selection of more durable and effective materials and systems that may cost more upfront but will save more on energy and maintenance over time.

3. IMPROVED OCCUPANT SATISFACTION

BEM can help identify ways to attain happier, more productive, and more creative employees while reducing absenteeism. Research has quantified the connection between improved occupant satisfaction and a better building envelope, proper air ventilation, daylight, and individual controls. BEM provides the quantitative indicators necessary to achieve greater occupant satisfaction and comfort.

OVERVIEW OF THE VALUE AND BENEFITS FROM BEM

REDUCED FIRST COSTS	REDUCED OPERATING COSTS	IMPROVED OCCUPANT SATISFACTION
Develop synergistic combinations of measures		Decreased vacancy rate
Simplifying systems and reducing infrastructure		Decreased absenteeism
Optimally sizing building systems	Integrated building systems	Increased occupant productivity
Optimizing renewable energy systems	Energy efficient building design	Improved occupant health
Reduced change orders and call backs	Energy efficient building systems	Improved occupant thermal and visual comfort
Secure financial incentives	Lower maintenance costs	Elevated employee recruitment and retention

WHAT IS THE PURPOSE OF BEM?

Incorporating BEM within building efficiency projects has become increasingly common as owners recognize its value for improving existing building performance or supporting the design of high-performance buildings. In addition, BEM may be required for demonstrating performance claims in green building certification programs and local, state, or federal efficiency programs.

BEM can support projects in meeting a myriad of objectives. Common uses for BEM are listed and described in Table 1 (see page 10). The applications are categorized by their general modeling purpose—modeling to compare, modeling to comply, or modeling to predict. The overarching purpose can influence the modeler's focus, scope of work, and required level of effort. Understanding how efforts differ can help an owner define the project modeling scope and secure services needed.

COMPARISONS

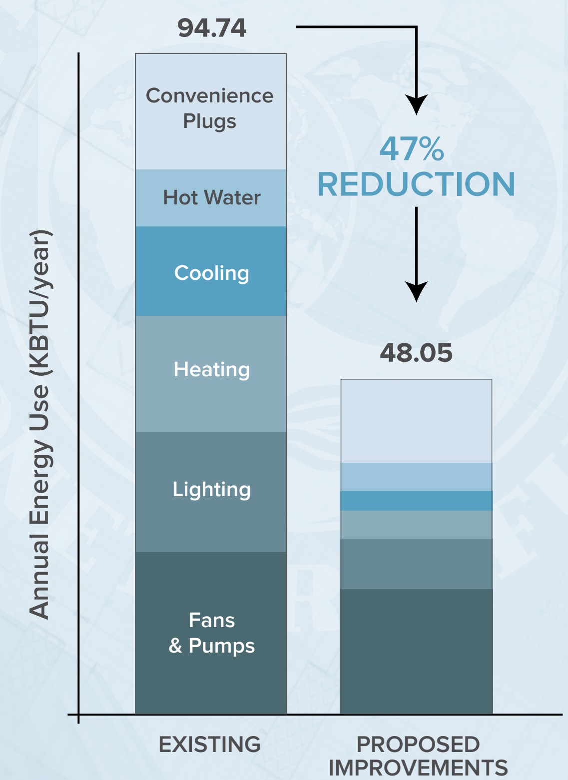
Using BEM to make performance comparisons between designs, components, and/or renewable energy options is at the heart of most modeling efforts. Even if a scope of work includes compliance or prediction elements, it most likely will include performance comparisons.

Comparing performance helps the design team quickly evaluate several design concepts side-by-side. For example, a modeler might simulate the performance of four different fenestration systems to determine the influence of each on energy use, peak demand, energy costs, glare incidences, and daylighting. Of course, comparisons don't have to be limited to singular changes. Improvements can be bundled to create synergistic combinations that reduce space conditioning needs, simplify building systems, and lower first costs.

The objective for developing a comparative model is to use it to estimate savings with sufficient accuracy to support design decision making. To do so, a modeler may focus on characterizing components of interest in detail, yet rely on typical values for other less-critical and less-well-known components. This practice can help reign in service costs while still effectively informing design decisions. However, a model developed for comparative purposes may lack the level of detail needed to accurately predict the actual energy use of the constructed building.

CASE STUDY

Energy modeling was included as part of the planning process for renovating the International Monetary Fund HQ1 building in Washington, DC. The energy use, energy costs, first costs and performance risks were evaluated for four levels of efficient design. The information was used to develop owner requirements, establish a renovation budget, and inform the RFP for the project. The renovation is currently under construction. The energy-efficient design is expected to result in a 50% energy-use reduction. Using modeling during planning helped IMF establish feasible performance goals for the project, which were upheld during design.



THE MOST FUNDAMENTAL USE FOR BEM IS TO COMPARE DESIGNS IN ORDER TO MEET PERFORMANCE GOALS WHILE BALANCING FIRST COSTS WITH OPERATING COSTS.

WHAT IS THE PURPOSE OF BEM? (CONT'D)

COMPLIANCE

As part of compliance modeling, the performance of the design model is checked against the performance of the baseline building model. The baseline model represents a minimally-compliant building as defined by the reference standard adopted by the code or compliance program.

For example, the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) offers points for demonstrating reduced energy costs relative to a baseline. The reference baseline for LEED is defined by the ASHRAE 90.1 Standard.[3] To develop the baseline model, the modeler follows the requirements outlined in Appendix G of ASHRAE 90.1. Some baseline characteristics are dependent on the design model details, such as climate zone, floor area, and number of floors; other characteristics, such as HVAC equipment efficiencies, are specified in the Standard. While the end goal of the LEED modeling is certification, the model can be readily used to compare design options. Thus, the certification modeling effort should often include both comparison and compliance scope.

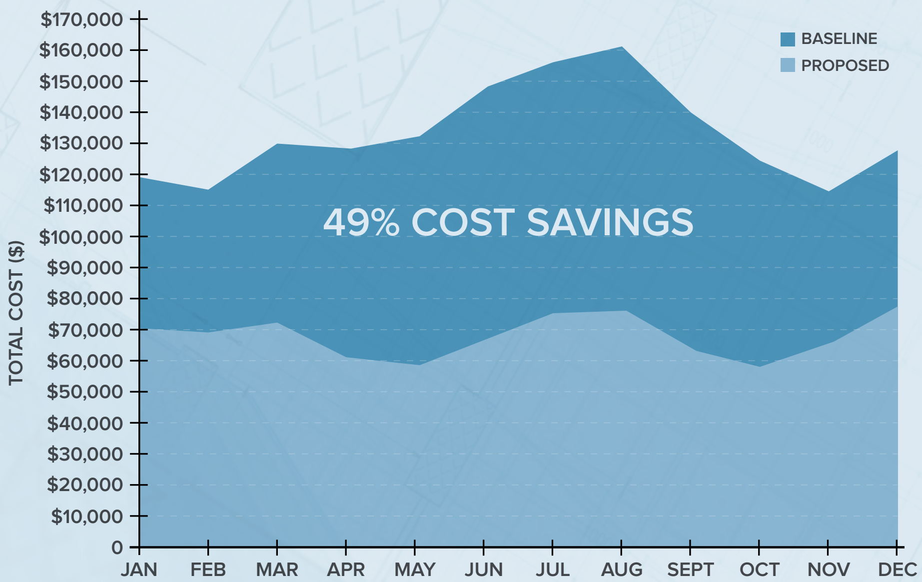
Based on a compliance model conducted by YR&G, the Confluence Building at the Community College of Denver is anticipating a LEED Gold certification level and a 49% reduction in energy costs compared to a baseline building.
Source: Boora Architects

[3]AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC., (2010). ASHRAE STANDARD 90.1. ATLANTA, GA

CASE STUDY

Energy modeling can be a powerful tool for evaluating and comparing first cost investments for architectural and building systems as well as verifying compliance. YR&G starts the compliance process by developing "shoebox" energy models early in the project–during the concept and schematic design phases–to quickly determine how the project can comply with the target energy requirements. This process also allows the team to identify where energy will be used in the building as well as major drivers for energy cost and building loads. Modeling is used throughout the design process to inform decisions and ensure that the project is complying with all required energy codes and local requirements. In the case of Confluence Building at the Community College of Denver, YR&G demonstrated that the proposed design would save 49% on energy costs compared to the certification baseline (LEED Gold certification level).

ESTIMATED MONTHLY ENERGY COSTS COMPARED TO A BASELINE



Source: YR&G

WHAT IS THE PURPOSE OF BEM? (CONT'D)

PREDICTIONS

Detailed building energy models that embed actual building operational information can reflect the building's actual energy use and predict the energy use of the renovated building. To develop a model with this level of accuracy requires time and diligence. For instance, all components or end uses (e.g., elevators, exterior lighting, egress lighting, and parking garage exhaust) need to be included in the model—even if they won't change between design options. The model must also account for actual occupancy and operating schedules, and obtaining representative schedules can be difficult even when the building is in operation. In addition, the weather data used with the model should be based on actual—not typical—conditions.

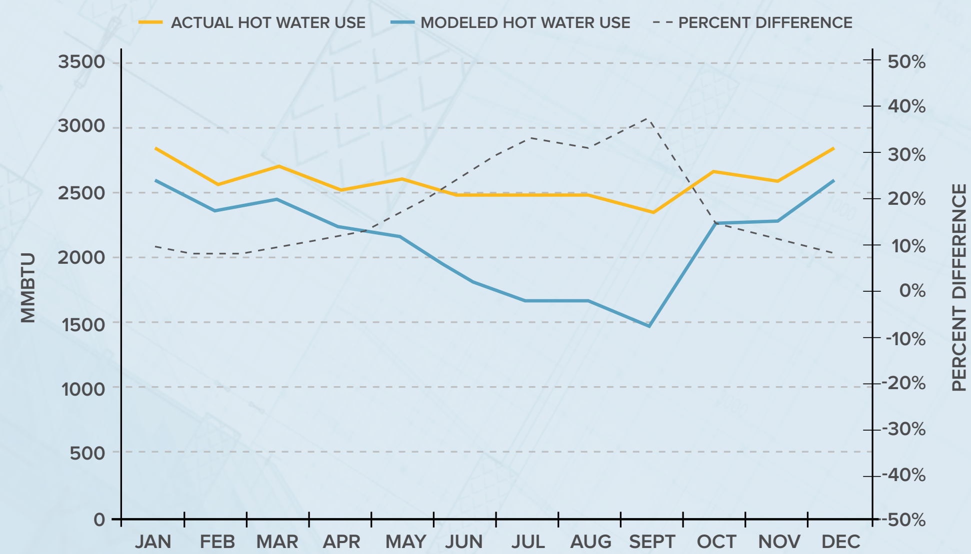
Even with these considerations taken into account, the modeling results may differ from actual performance for legitimate reasons. Most simulation models have to initially assume idealized occupants, equipment, and systems. In reality, energy-efficiency elements may not be properly installed and operation may differ from design. Also, while an existing building model can be calibrated against historical utility billing data, a model developed for a new construction project cannot benefit from historical data. The latter must instead rely on assumed input values for parameters that are not known during design. However, these assumptions can be refined and the model calibrated once the building is built and actual performance data are collected.

Making the connection between design and operation can provide valuable feedback to the design team, modeler, and owner. It helps demonstrate the value of energy-efficiency and renewable energy features. Additionally, through the modeled versus actual performance calibration and reconciliation process, elements that are underperforming can be revealed and rectified. The modeler may also be able to use lessons learned to improve input assumptions in future work to better reflect reality.

CASE STUDY

Taylor Engineering uses energy modeling to support building recommissioning. For example, they spent several months conducting on-site investigations in a 125,000 sq. ft. university lab building that had a $1.5M annual energy bill. They developed a calibrated energy model of the existing building to inform efforts. One issue that the model exposed was the simultaneous heating and cooling occurring in a large air-handling unit (AHU). While not apparent from the building automation system, the AHU heating coil valve had broken–this resulted in hot water flowing uncontrolled across the coil and heating the supply air. To compensate, extra cooling occurred at the unit. Fixing the valve at minor expense resulted in ~$100,000 annual savings.

MONTHLY HOT WATER PROFILE



Source: Taylor Engineering, Alameda, CA

TABLE 1

MODELS ARE DEVELOPED FOR DIFFERENT PURPOSES

OBJECTIVE	DESCRIPTION	PURPOSE		
		Comparison	Compliance	Prediction
Integrated Design Assistance	Assist the integrated design process to effectively direct efforts to meet project performance goals	X		
EEM Evaluation	Evaluate the impact of individual energy efficiency measures (EEMs) affecting the building design	X		
Building Asset Rating	Develop an energy model evaluate the physical characteristics of the building as built and its overall energy efficiency, independent of its occupancy and operational choices	X		
LEED Certification	Adhere to LEED Building Design + Construction (BD+C) requirements for Energy & Atmosphere, Credit 1 - Optimize Energy Performance to determine and document points achieved		X	
Code Compliance	Demonstrate compliance with the commercial building energy code		X	
Commissioning/ Retrocommissioning	Support the testing and integration of installed components and systems during building commissioning			X
Operations Check	Develop a calibrated model representing the existing building to identify operational issues and savings opportunities			X
Measurement & Verification	Develop a calibrated model representing the existing building to establish baseline conditions to support a Measurement & Verification approach			X
Performance Rating	Update the design model to develop a calibrated “In Operation” energy model to determine and report the ASHRAE Building Energy Quotient			X
Outcome-Based Performance	Update the design model to develop a calibrated model to check and reconcile outcome-based targets with actual energy use			X
Integrated Project Delivery	Update the design model to develop a calibrated energy model of the in-operation building to establish performance targets are met per the integrated project delivery contract agreements			X

SECTION 2

MODELING SERVICES

ROLE

The energy modeler's role is to continually advocate for high performance. The timely delivery of key modeling tasks and an early use of modeling offer the best value to a project.

TIMELINESS

The goal is to keep the model as simple as possible while still maintaining sufficient accuracy to meet project objectives. Key tasks should be correctly timed to help the team effectively prioritize efforts.

SIMULATION SOFTWARE

The building performance simulation enacts a mathematical model that provides an approximate representation of the real world.

ROLE

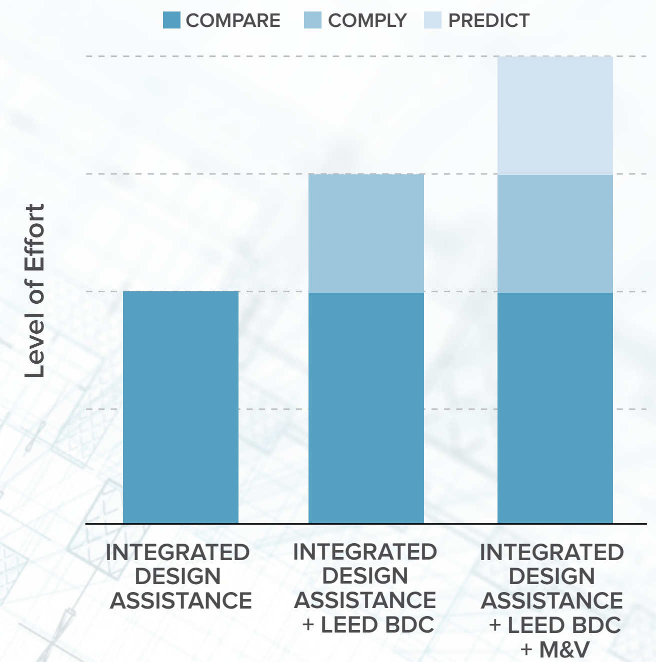
Understanding modeling services allows an owner to identify scope requirements and secure the services they need. The topics developed in this section—the role of the modeler, the timeliness of tasks, and costs—will help build this awareness. An overview of modeling software is also provided.

As indicated in Section 1, the scope of modeling services varies depending on the purpose, which strongly influences the modeling focus. Table 2 provides an overview of the scope of key modeling tasks, categorized by purpose and project timeline. For many projects, the purpose may fall into more than one category. For example, LEED BD+C projects use modeling to document the proposed design savings relative to a baseline building (comply). However, for many LEED projects, the modeling scope is expanded to include integrated design assistance to evaluate cross-cutting solutions and design refinements to boost performance (compare). Some LEED BD+C projects also include measurement and verification procedures that rely on energy modeling. In these instances, the design model is updated to reflect actual conditions and calibrated against utility billing data. This creates an operating model that reflects actual performance, supports M&V, and provides an indication of anticipated performance (predict).

A coordinated, multi-disciplinary approach to building energy efficiency should be embedded into the project team's workflow. ***The energy modeler's role is to represent the energy performance implications of project decisions.*** The modeler uses the building model to inform the design or operation. The work is iterative—assumptions are updated and detail added as the design progresses or as on-site data becomes available. In each design iteration, modelers check the simulated performance against the project performance goals. The energy modeling effort enables the team to focus its time effectively and maintain the performance-related aspects of the project.

To exploit the full capability of building energy modeling, the project's energy dialogue should be deliberate. The modeler should take an active role in project meetings, help establish performance targets, and provide technical expertise regarding integrated design solutions. The modeler needs to be provided with project documentation and details, including change orders, in order to stay abreast of issues related to performance and maintain the energy model.

MODEL PURPOSE IMPACTS SCOPE



Source : RMI

TO BE EFFECTIVE, THE MODELER NEEDS TO:

- *WORK ALONGSIDE THE PROJECT TEAM TO DEFINE, TARGET, AND UPHOLD PERFORMANCE OBJECTIVES*
- *MODEL EARLY AND OFTEN*
- *CONTRIBUTE TO AND COLLABORATE IN DEVELOPING THE TECHNICAL SOLUTION*
- *STAY ABREAST OF PROJECT DETAILS*

TABLE 2

MODELING PURPOSE AND ASSOCIATED TASKS

EARLY DESIGN	Comparison	x	• Perform climate analysis • Develop concept model • Evaluate siting, massing, and geometry • Evaluate passive design options • Explore options to reduce space loads • Help develop performance targets • Develop technical potential model*
	Compliance		
	Prediction		
DESIGN DOCUMENTS	Comparison	x	• Refine concept model • Refine model input values • Evaluate EEMs and integrated design solutions • Check performance against targets • Assist in system selection and right-sizing of systems • Inform value engineering decisions • Update model based on design changes • Support the final selection of EEMs
	Compliance	x	• Develop baseline and proposed design building models • Start compliance documentation for baseline model and proposed design model • Update baseline and proposed design models as design progresses and report on compliance status and issues • Use modeling as needed to support the resolution of compliance issues
	Prediction		
CONSTRUCTION DOCUMENTS	Comparison	x	• Check that energy efficiency features are included and properly characterized in construction documents (CDs) • Finalize performance and savings estimates • Check performance against targets, share results with team and owner • Document the final model, assumptions, input values, supporting calculations, results, and savings estimates
	Compliance	x	• Check that energy efficiency features are included and properly characterized in construction documents (CDs) • Finalize baseline model and proposed design model • Complete compliance documentation for baseline model and proposed design model
	Prediction		
CONSTRUCTION	Comparison	x	• Use modeling to support commissioning efforts and provide information regarding expected performance of equipment and systems
	Compliance	x	• Respond to reviewers comments as needed regarding compliance documentation (e.g., LEED NC EAc1 submittals)
	Prediction		
OPERATION	Comparison		
	Compliance	x	• Analyze and complete compliance documentation for outcome-based compliance programs
	Prediction	x	• Gather utility bills and actual performance data • Update the proposed design model to reflect actual building components, equipment, systems, and operation • Calibrate updated model to measured data • Compare modeled total, end-use, system, and equipment performance against actual performance • Investigate discrepancies • Reconcile differences to inform the model and/or identify underperformance

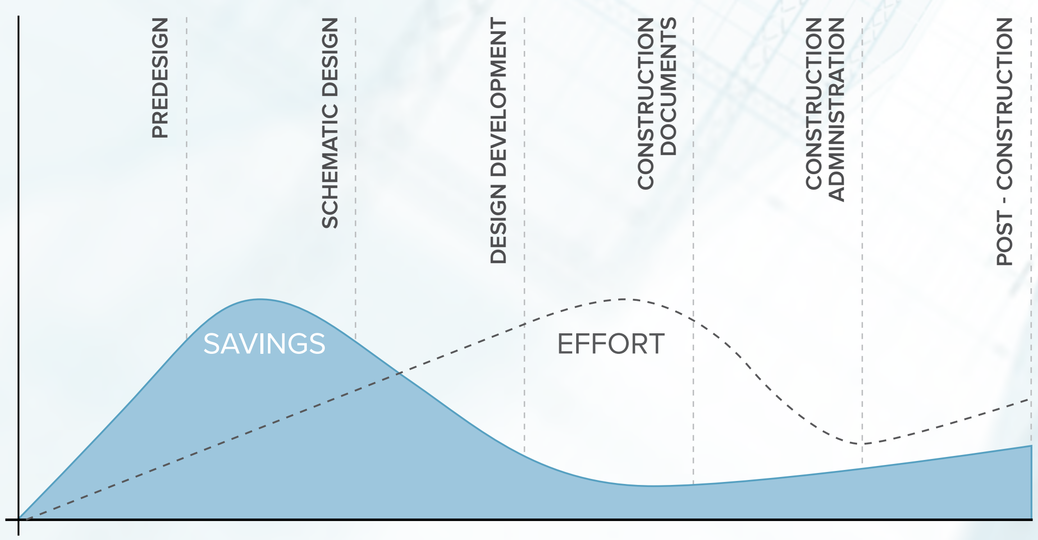
*A design model comprised of a synergistic combination of performance improvement utilizing the best commercially available technologies, not constrained by cost or constructability. It is used to quantify stretch goals and ideally provide a starting point for the proposed design.

TIMELINESS OF TASKS

Early use of modeling offers the best value to a project. Developing an early understanding of energy use helps steer the project toward a successful conclusion. Early in the design process, the building design is still flexible. Impactful, holistic solutions that cut across the architectural form, construction materials, space layout, and mechanical systems can be more easily incorporated. Adding these considerations later in the process can be costly and time consuming.

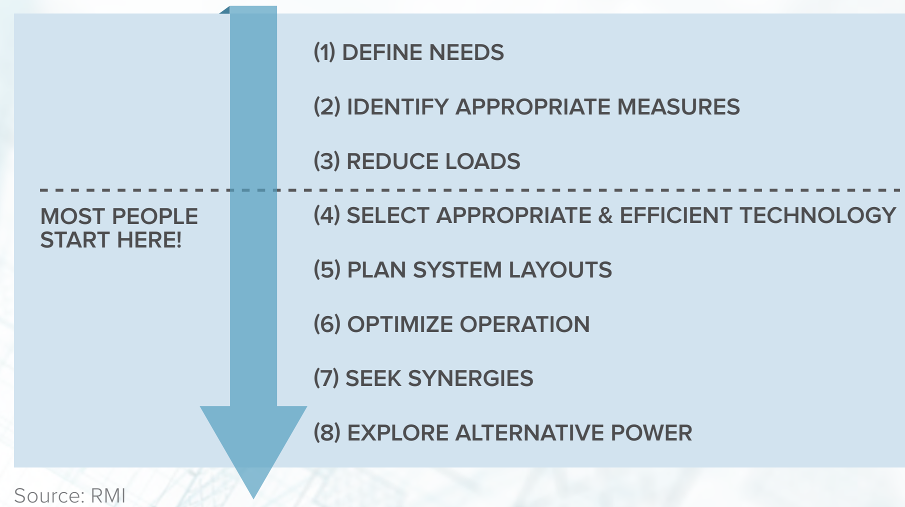
As already mentioned in Section 1, there is a timeliness for commencing building modeling. There is also an optimal timeliness associated with the sequencing of modeling tasks, as Table 2 (see page 13) indicates. To be most effective, the modeler utilizes available project information to promptly and progressively inform decisions most important to the project at the time. RMI has outlined an effective sequencing process, which is termed "the right steps in the right order" (see graphic on right). The "right steps" process is rooted in the concept that saving energy at the building end use results in the greatest savings at the resource, such as utilities. This is due to compounding inefficiencies in equipment, systems, and distribution that occur along the way.

DEGREE OF EFFORT VS. POTENTIAL ENERGY SAVINGS



Source: USGBC

RIGHT STEPS IN THE RIGHT ORDER



Source: RMI

Several steps in the process warrant more detailed explanation. The first step involves examining the level of service specified as part of the project. Often, project programming requirements overstate service needs. For example, many projects include high luminance requirements for ambient lighting. A more efficient approach that achieves the same end result is to reduce ambient light levels and add task lighting focused directly on the work plane. This approach provides lumens to the areas that most require it.

Once the minimum level of required service is established, efficiency technologies are considered in order to minimize space loads. This minimizes mechanical system requirements and maximizes the ability for passive strategies (like passive solar heating, natural ventilation, and daylighting) to satisfy space-conditioning needs. The mechanical system is laid out to minimize distribution losses and facilitate inclusion of energy-saving features (e.g., energy heat recovery). The design is optimized through smart control strategies and equipment sequencing. With loads reduced and systems down-sized, well laid out, and controlled, the energy systems may have lower capital costs as well as lower annual energy costs.

Renewable energy systems are considered last since energy efficiency is generally a more cost-effective investment. This approach helps minimize the system size of the more costly renewable system. In addition, planned building improvement projects offer a base capital cost, to which performance considerations can be added at a nominal incremental cost. Thus, planned building construction, addition, and refurbishment are opportunities for improving performance that should not be missed.

TIMELINESS OF TASKS (CONT'D)

MODELING COSTS

Building modeling tasks and scope are dictated by the modeling purpose, which affects the required level of effort and costs. Other influences on costs include project size, complexity, resolution of the analysis, supplemental modeling, and aggressiveness of the performance targets. For example, base modeling services that cover design assistance and LEED BD+C components can typically range from $20,000 to $50,000. Average modeling costs for projects participating in a utlity-sponsored design assistance program is $22,000 (average size 100,000 sq.ft.).

To establish the right level of detail for a particular project and determine a justifiable cost of services, several factors should be considered. First, the feasibility of modeling should be established. Rules for when not to model a building or system include:

- The cost of the simulation exceeds anticipated savings
- The building or system of interest is too complex, can't be modeled accurately in currently available software, or is easier/cheaper to test by performing direct measurements

SHOW ME THE MONEY

Group14 Engineering provided modeling services for the 735,000 ft^2, 1960s-built Fallon Federal Building. The scope included conducting an on-site survey; developing a calibrated model; and using the model to inform design and complete LEED BD+C documentation. The modeling services involved 300 hours of labor and cost $35,000. The bundle of improvements identified for the project had savings resulting in lower energy use by 35% and **SAVINGS OF ~$635K IN ANNUAL COSTS.** The bundle implementation costs were estimated at $2.4M. The economic analysis revealed a **3.8-YEAR SIMPLE PAYBACK** and a roughly $5M net-present-value projected over 15 years. The modeling fee represented a nominal incremental amount to the total cost of the project—only decreasing the net present value of the investment by 0.07%.

Source: Streamlining Energy Simulation to Identify Building Retrofits, ASHRAE Journal, November 2011, pp 32-42.

The level of detail and associated service costs for modeling may be influenced by the following factors:

- Existing or anticipated building or system energy costs
- Targeted annual energy cost savings
- Identification of performance uncertainty and risk of underperformance
- Green building certification, tax credits, or other programs requiring modeling
- Necessity of modeling to support meeting the performance targets (e.g., achieving a net-zero-capable building versus a minimally-code-compliant design)
- Increased health, comfort, and well-being of tenants and their relationship to productivity, absenteeism, lease rates, and churn
- Increase in building asset value due to high performance

IN COMPARING DIFFERENT PROPOSALS FOR THE SAME MODELING SCOPE OF WORK, THE OWNER SHOULD CONSIDER:

- *THE LEVEL OF ACCURACY FOR TRANSLATING ACTUAL OR DESIGN DATA INTO MODEL INPUTS*
- *THE EXTENT TO WHICH DEFAULT VALUES WILL BE USED IN THE MODEL*
- *THE PROPOSED WHOLE-BUILDING SIMULATION SOFTWARE*
- *THE PROPOSED USE OF SPECIALIZED SUPPORT TOOLS FOR STUDYING DAYLIGHTING, NATURAL VENTILATION, OCCUPANT COMFORT, RENEWABLES, ETC.*

TIMELINESS OF TASKS (CONT'D)

PRESCRIPTIVE VS. PERFORMANCE-BASED DESIGN SOLUTIONS

Following a prescriptive performance path for incorporating efficiency is an affordable approach for smaller projects that might not be able to justify the cost of energy modeling. In recognition of this, the USGBC provides both performance-based (whole-building modeling) and prescriptive (design checklist) options for earning points through the new LEED New Construction (NC) Energy & Atmosphere Credit for Optimized Energy Performance. These options are outlined below for LEED 4. As indicated by their differences in point allocation, projects can earn substantially more points through a whole-building modeling approach. This reflects the customized, holistic solutions that can result from modeling efforts and the substantial performance improvements that can be gained.

LEED 4 EAC2: OPTIMIZE ENERGY PERFORMANCE

Approach	Option 1 Performance	Option 2 Prescriptive
Reference	Whole-building energy simulation, ASHRAE 90.1 2010 Appendix G	Climate-specific design strategies outlined in ASHRAE 50% Advanced Design Guides, ASHRAE 90.1–2004*
Points	1 – 18 EAc2 points	1 – 6 EAc2 points
Savings	6–50% New 4–48% Existing	Not specified, but corresponds with: 6–16% New 4–14% Existing

*Requires installing subset (typically addresses ~12/20 categories of recommendations listed in Chapter 4, ASHRAE 50% Advanced Energy Design Guider for Small and Medium Offices, Medium to Large Box Retail Buildings, or Large Hospitals).

CASE STUDY

Stu Reeve, District Energy Manager for the Poudre School District in Fort Collins, CO, had the option to follow the prescriptive approach for the 63,000-square-foot Bethke Elementary School to achieve LEED for Schools Gold. Because developing high-performance buildings is important to the district, he opted for the performance-based modeling approach. Under the LEED 2.2 rating system, this qualified the project to earn up to 10 Optimized Energy Performance points instead of the 5 permitted through the prescriptive option. The project demonstrated 41.9% energy cost savings and earned 9 Optimized Energy Performance points. The school has lived up to its high expectations. In its first 12 months of operation, Bethke consumed 42 KBTU/ft^2 per year at a cost of \$0.58/ft^2—earning it an ENERGY STAR rating of 99.

SIMULATION SOFTWARE

Modelers can use whole-building simulation tools at different levels. They can vary the level of input by relying more or less on the software default conditions. They can also translate more or less project information to develop model input values. Modelers can also use specialized tools to support the process and/or inform the whole-building simulation. ***In general, the goal is to keep the model as simple (and affordable) as possible while still maintaining sufficient accuracy to meet project objectives.*** The owner should be aware of these practices in order to better understand work proposals that include modeling. Different firms may propose different approaches with different associated costs for the same project. While they may be working towards the same end goal, their level of detail may vary. A brief description of the technical side of building performance modeling is provided below to help the owner appreciate these differences.

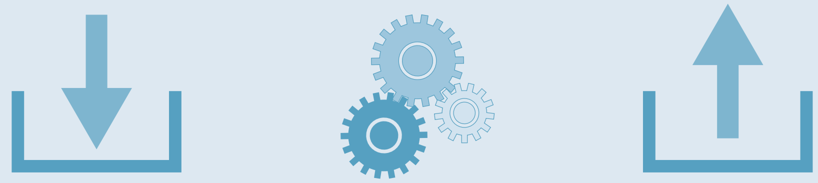
SOFTWARE TOOLS

In this guide, building energy modeling is considered to include a whole-building analysis that uses simulation software to perform at least 8,760 hourly calculations to determine annual performance: one energy calculation for every hour of an entire year. Specifically, the building performance simulation enacts a mathematical model that provides an approximate representation of the real world. Building simulation software tools typically are comprised of a user interface for specifying input values, a calculation engine, and an interface for delivering results. They also may include a 3-D geometry import feature and/or automatically generate compliance documentation.

In addition to performing whole-building analysis, a modeler may also perform detailed studies within or outside the whole-building simulation software. A partial list of tools commonly used to support building modeling services is listed in Table 3 (see page 18). The table represents only a small subset since there are hundreds available for evaluating energy efficiency, renewable energy, and sustainability in buildings.[4]

[4]THE U.S. DOE ENERGY EFFICIENCY & RENEWABLE ENERGY BUILDING TECHNOLOGIES OFFICE MAINTAINS A LIST OF OVER 400 BUILDING SOFTWARE TOOLS. FOR MORE INFORMATION SEE HTTP://APPS1.EERE.ENERGY.GOV/BUILDINGS/TOOLS_DIRECTORY/

IN ITS SIMPLIEST FORM, AN ENERGY MODEL IS...



A set of inputs and default variables

(Building geometry/ massing/form, system type, operation schedules, ect.)

A calculation engine

(DOE-2, EnergyPlus, Apache, ect.)

The result or output the program delivers

(Performance comparison graphs, compliance reports, ect.)

Source: AIA – An Architect's Guide to Integrating Energy Modeling Into the Design Process. Page 39.

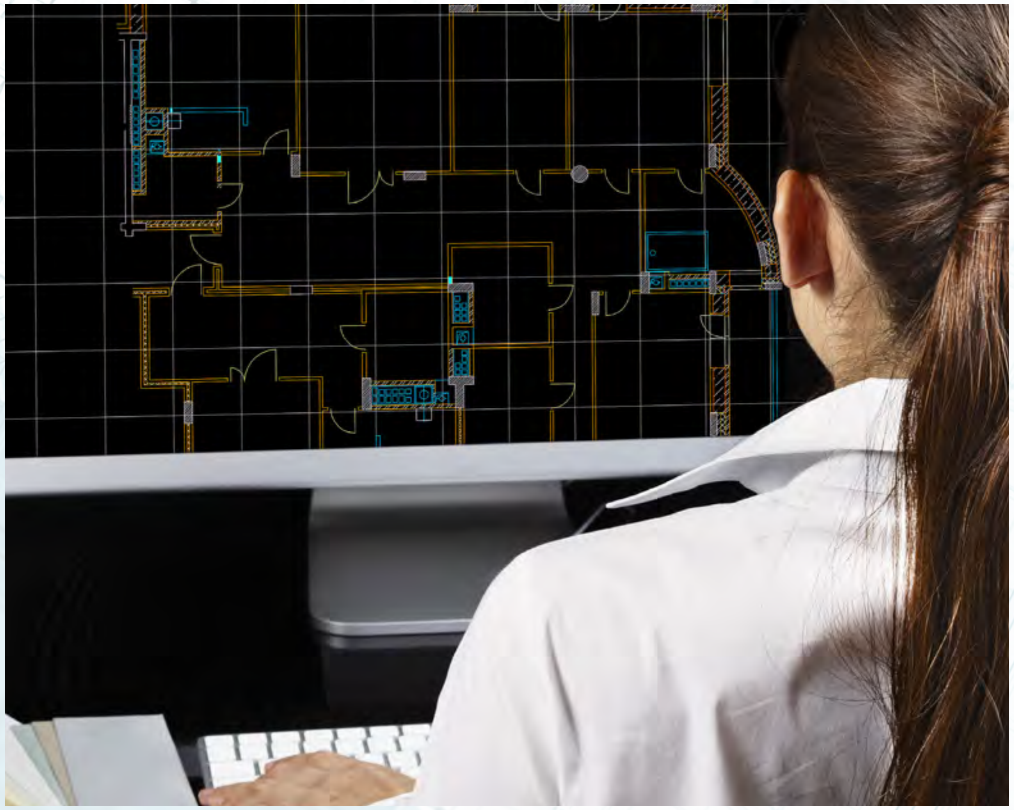


TABLE 3

COMMONLY USED BEM SOFTWARE TOOLS AND THEIR PURPOSE

TOOL CATEGORY	PURPOSE	EXAMPLES OF SOFTWARE
Whole Building Energy	Whole-building energy modeling and simulation, integrated design assistance, commercial code compliance, LEED compliance, federal commercial-building tax deductions	EnergyPlus (DesignBuilder, AECOSim, EnergySimulator, OpenStudio, Simergy), DOE-2.1E (VisualDOE), DOE-2.2 (eQUEST, Green Building Studio), IESVE, HAP, TRACE 700
Site/Solar/ Climate	Climate data (temperature, humidity, solar, wind), climate analysis, psychrometric chart, climate-specific strategies	Climate Consultant, ECOTECT
Passive Design	Solar architecture, thermal mass, shading, natural ventilation, load calculations	SUNREL, ECOTECT
Indoor Air Quality	Computational fluid dynamics (CFD), airflow, indoor air quality, ventilation, thermal comfort	CONTAM, FLOVENT, ANSYS Fluent
Envelope Systems	1-D/2-D/3-D heat transfer, thermal products, glass, windows, frames, fenestration, moisture migration	Optics, Window, Frame, Therm, WUFI
Lighting and Daylighting	Electric light energy use, daylight simulations, active daylighting controls, sensor placement, rendering	DAYSIM, AGI32, IES VE, SPOT, Radiance
HVAC Equipment and Systems	Load calculations, equipment and control modeling, equipment sizing	HAP, TRACE 700, TRNSYS
Renewable Energy	Solar thermal, solar electric, wind	F-Chart, PV Watts, HOMER

SIMULATION SOFTWARE (CONT'D)

MODEL DATA REQUIREMENTS

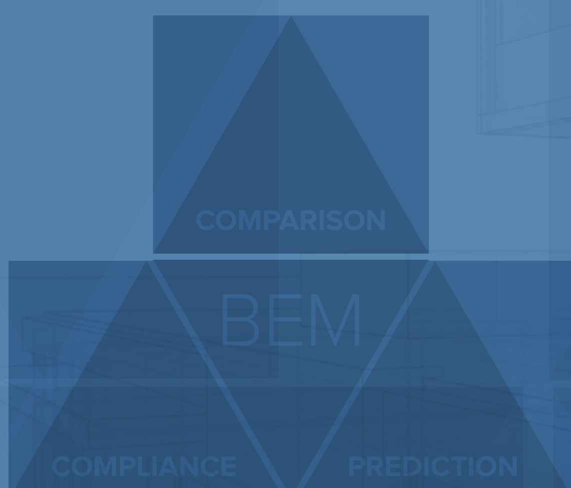
Early in a project, a modeler can create a basic simulation to perform checks and conduct sensitivity studies. For instance, for new construction projects the modeler will evaluate the impact of building shape and size on the site during early design. As the project progresses, it is important that the model is updated with specifics and additional detail. To keep up to date, the modeler should be present at initial and coordination team meetings, participate in the design charrette, receive project construction documents, and converse with the mechanical engineer and/or operator assigned to the project. This will ensure that the energy modeler has the most accurate and up-to-date data available.

The owner should also provide data to support the modeling effort. The information can be prepared as part of the project solicitation materials. It can also be provided initially and throughout the project as stakeholders approve project details. Information relevant to modeling that the owner can provide include:

- Project objectives and performance targets
- Location and site description
- Utility rate schedules
- Building function and programming
- Number of floors, floor-to-floor height
- Room data sheets
- Anticipated number of occupants and occupancy schedule
- Anticipated plug load (a,k.a. miscellaneous load) power density
- Description of existing building, systems, and equipment
- Available measured data for existing building, systems, and equipment
- Test and balance reports
- Facility assessment studies
- Building energy consumption (for energy modeling this is the projected energy consumption) per total gross floor area: kBtu/ft^2

SECTION 3

THE CONTRACTING PROCESS



CONTRACT TYPES

While modeling is effective for evaluating design and operation improvements under many types of contract arrangements, it is well-aligned with those that specify energy performance goals.

CREDENTIALING SERVICE PROVIDERS

Mastering building energy modeling and effectively delivering services requires time and practice. Efforts to credential an energy modeler should account for: core knowledge, tool experience, and project experience.

SOLICITING SERVICES

An RFP for modeling services should include information about the building and purpose for the model, to help the energy modeler better understand the scope of the project and therefore provide a more accurate proposal.

CONTRACT TYPES

The type of contract used to procure services can impact the project team's motivation and ability to meet performance targets. A brief review of contract options and their implications are provided below.

DESIGN-BUILD

In a design-build contract, a single entity is hired to be responsible for both the project design and construction, combining performance risk into one contract. In the design-build process, the contractor proposes a design to be built to meet specified performance and usability requirements within a fixed budget.

DESIGN-BID-BUILD

In a design-bid-build contract, the owner relies on "prescriptive" plans and specifications to define the scope of work. The owner contracts the design team separately from the construction team. Once the design services are complete, a bid is made to build what is specified on the drawings and specifications.

CONSTRUCTION MANAGEMENT AT RISK

Construction management at risk (CMAR or CM at-risk) is a project delivery method in which a construction manager (CM) assumes the construction performance risk of a project. The CM acts as a consultant to the owner throughout the design phase of the project and as a contractor during the construction phase. Often times the CM agrees to deliver the project within a guaranteed maximum price (GMP).

INTEGRATED PROJECT DELIVERY

Integrated project delivery (IPD) is distinguished by a multi-party contractual agreement between the project stakeholders to work collaboratively throughout the project. At a minimum, these include the owner, design professional, and builder. The risk and reward for each entity is shared because in an IPD, stakeholder success is dependent on project success. One of the focuses of the IPD process is to harness the ideas and talents of all participants early in the project so that informed decisions can be made early to maximize their value.

CASE STUDY

The Research Support Facility (RSF) is located at the National Renewable Energy Laboratory (NREL) in Golden, CO. Completed in June 2012 and built at a total project cost of $80 million, the 220,000-square-foot RSF houses 885 people, offices, and a data center. The LEED Platinum project met its aggressive energy performance target of =< 35 KBTU/ft^2 per year with ~50% of the annual energy costs compared to a minimally code-compliant building (based on ASHRAE 90.1 2004 standard).

An energy model of the building was used to set energy performance goals and ensure that performance expectations were met throughout design and construction. The NREL building researchers adopted the design model for use during operation to reconcile measured versus modeled performance, serve as an operator training resource, and guide building operation.

A design-build delivery combined with performance-based requirements proved to be a winning contract combination for meeting the project's critical goals. This required extensive upfront planning to develop the performance specifications that describe what the building should do. This collaborative approach encourages the design-builder to come up with innovative solutions that meet the owner's stated goals. A key to success was the inclusion of an award fee, which kept the team wanting to stay fully engaged with NREL/DOE and motivated to perform superior work. See "The Design-Build Process for the Research Support Facility" for more information.

IMPLICATIONS

Contracts that specify outcome-based goals promote accountability and encourage team collaboration. Including performance as a goal alerts team members to its importance and directs them to uphold it alongside other contract obligations. Contracts that also include financial awards offer further motivation for meeting performance goals and informing decisions based on modeling results. Thus the contract types most conducive to achieving performance goals are IPD or CMAR and design-build contracts that specify performance requirements.

While modeling is effective for evaluating design and operation improvements under many types of contract arrangements, it is particularly well-aligned with those that integrate design, construction, and operation, and that award the achievement of outcome-based goals. In some instances (e.g., buildings with interacting systems), one may not be able to reliably evaluate building performance without modeling.

ADDITIONAL CONSIDERATIONS

It is also an option for the owner to hire the modeling services firm directly. In this case, the modeling contract would be based on a consulting services agreement. Of course, the broader project scope would still need to be addressed through one of the contract types outlined above.

If the owner hires the modeler, the owner will have more direct control of the services but will need to provide administration and oversight. A benefit for owners to hire modelers is the assurance that the modeler will represent their interests. The modeling firm is not a stakeholder in any other aspect of the project, which reduces the potential for a conflict of interest. However, it can be a tradeoff since work efficiencies can be gained by combining roles. Table 4 (see right) outlines additional considerations regarding the modeler's affiliation.

In addition, it is standard industry practice for the modeling firm to own the model as their own intellectual property. This may make it more challenging to acquire it and use the model for purposes outside the contract scope. The owner may have better control of the model post-contract if they hire the modeling firm directly.

TABLE 4

MODELER AFFILIATION AND ITS POTENTIAL IMPLICATIONS

AFFILIATION	BENEFITS	POSSIBLE CONCERNS
Specialized consulting firm	• May be devoted solely to performance modeling and use of specialized support tools resulting in stronger qualifications, directly relevant experience, and greater staffing resources • May push the team to think beyond their usual design solutions • Sole focus is to uphold performance goals	• Are not typically involved in regular project team meetings • Must request and receive needed information from other project team members • May need to prove their value to the team to gain acceptance • Proposed solutions may be impractical
Project architect	• Project data are readily accessible • May be involved in regular project team meetings • May have strong knowledge of strategies involving building materials and building fabric	• May limit options in order to align them with firm's design experience • May have less experience with engineering and building science • May have less experience with a variety of simulation tools
Project mechanical engineer	• Project data are readily accessible • May be involved in regular project team meetings • May have strong knowledge of strategies involving mechanical systems • Will have task overlap in calculating building loads to size equipment	• May limit options in order to align them with firm's design experience • May use mechanical sizing software instead of more robust simulation tools • May have less experience with a variety of simulation tools

CREDENTIALING SERVICE PROVIDERS

Background knowledge important for building energy modeling includes building science, mechanical systems, and renewable energy systems. Simulation software tools can be complex. Mastering them requires time and practice. Knowledge about building performance and software tools is combined most effectively through a best-practice modeling process. This involves being timely with tasks. It also requires balancing level of effort with needed accuracy and project value. Efforts to credential an energy modeler should account for core knowledge, tool experience, and project experience. Suggestions for demonstrating these qualifications are outlined below. Specific examples are also provided in the appendix.

- Lead energy modeler holds a professional certification specific to simulation modeling (ASHRAE BEMP or AEE BESA)
- Assigned personnel have demonstrated experience with software tools to be used and project building type
- Assigned personnel have demonstrated success in past projects with similar objectives supported by modeling (e.g., LEED BD+C EAc1 baseline development and submittal completion, net-zero-energy building design, or using modeling to inform operation and support measurement & verification (M&V))
- Firm has internal quality assurance procedures for checking model input and model results
- Firm can provide descriptions of completed similar projects

SOLICITING SERVICES

The information and guidance provided within this document support developing effective requests for modeling services. An example of a comprehensive request for services is provided in the appendix. It provides language that encompasses different purposes for modeling over the building life cycle. The scope can be pared down to best meet a specific project's needs.

GENERAL INFORMATION

In any RFP, include information about the building to help the energy modeler better understand the scope of the project and provide a more accurate proposal. The information should include:

- Building purpose
- Building size (or an estimate)
- Building location
- Schedule for the building's design and construction
- Building energy and sustainability goals
- Project budget

PURPOSE

The owner's objectives for securing modeling services should be clearly defined. Modeling can be used for different purposes (e.g., compare, comply, and/or predict), which dictates the level of effort and approach. Specifying the purpose will align the proposed scope with needs. Refer to Table 1 for typical uses for modeling.

APPROACH

This RFP section lists specific analyses for the project that are of particular interest. There are multiple ways to satisfy objectives. These items alert the modeler to approaches, technologies, or particular studies to include in order to guide solutions.

BEST-PRACTICE PROCESS

The best-practice table (Appendix Table 1) outlines the relationship between key modeling tasks and project timeline. While the project size and objectives may not justify including all components, identifying a best-practice approach establishes a foundation for services. Responding firms must use their professional judgment to propose a scope around these principles that provides the best value to the owner. The table will prompt all proposers to start from the same place.

NOMINAL REQUIREMENTS

This section lists the basic requirements for providing services. It directs the modeler to follow current industry practices as indicated by reference guidelines and standards, which promote consistency. It outlines requirements for whole-building simulation software. It also identifies personnel and firm credentials. Suggested language to specify these requirements are included in the appendix.

PROPOSAL FORMAT

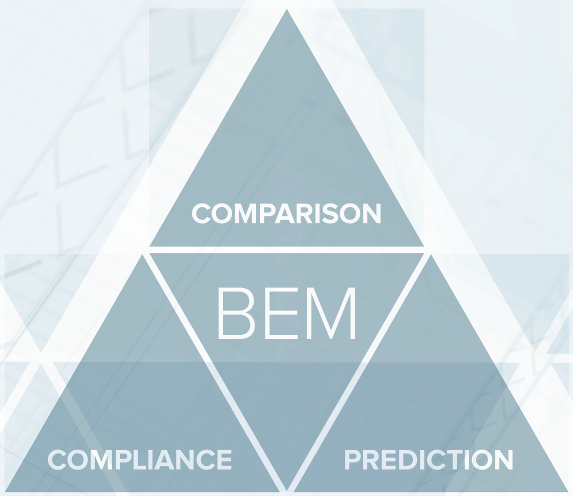
This section of the RFP outlines the desired form and content for the response. As part of this section, suggested methods for qualifying proposers and requesting the scope of work are illustrated in the appendix. In general, information presented in this guide should help owners differentiate firms according to their qualifications and proposed services to make a strong selection.

PROPOSAL EVALUATION

The RFP should describe the proposal evaluation process to help proposers best direct their efforts. The example provided in the appendix indicates qualities and priorities that are important for modeling services.

APPENDIX

REQUEST FOR PROPOSAL FOR BUILDING ENERGY MODELING SERVICES[1]



[1] ACKNOWLEDGEMENT AND THANKS TO FORT COLLINS UTILITIES AND THE POUDRE SCHOOL DISTRICT FOR SHARING THEIR PROCUREMENT MATERIALS WITH US TO INFORM THIS TEMPLATE.

This document serves as a template and comprehensive example of a request for proposal for securing building simulation performance modeling services for a fictional building. It is designed to help a building owner articulate the services they desire. It also directs the response format to facilitate proposal comparison to reveal distinguishing features. The template content can also be added to more broadly focused RFPs to address modeling service considerations.

An editable version of this Appendix can be downloaded here.

GENERAL INFORMATION

Denver Energy Center (DEC) is requesting proposals from qualified firms to provide building energy modeling services for the *Center's new headquarters office building*. The modeling services requested will begin during the early design stages and continue through post-construction into occupancy and operations. Please do not provide detailed pricing. *DEC* will negotiate price with the selected consultant.

Include a description and details about the project here. Outline basic project details in the table below.

BUILDING DETAILS	
Building Purpose	Office
Size	21,400 s.f.
Location	Denver, Colorado
Schedule	12 months for design 8 months for construction
Sustainability goals	Listed below
Budget	$4.1 million

The performance goals established for the project, include:

OVERALL TARGETS	• An Energy Use Intensity (EUI) < 35 KBTU/sf/yr • Complies with the Energy and Security Act of 2007
COMPARATIVE	• 65% reduction in GHG emissions compared to existing offices • 50% energy cost reduction from ASHRAE 90.1-2010
CERTIFICATIONS	• LEED BDC Platinum • EnergyStar score > 95
END-USE SPECIFIC	• 80% reduction in electric light energy due to active daylight controls • 100% of heating from waste heat and solar thermal

REQUESTED SERVICES

PURPOSE

DEC seeks energy modeling services to support the design, commissioning, performance verification, and on-going operation of their new headquarters building. The specific objectives to be met through modeling include:

- Assist the integrated design process to effectively direct efforts to meet project performance goals
- Evaluate the impact of individual energy efficiency measures affecting the building design, construction materials, space layout, passive strategies, equipment, or mechanical systems
- Develop an energy model to determine and report the ASHRAE Building Energy Quotient for the "As Designed" building under standard conditions as defined by the program requirements
- Adhere to LEED BD+C requirements for Energy & Atmosphere, Credit 1 -Optimize Energy Performance to determine and document points achieved
- Use building energy modeling to demonstrate compliance with the commercial building energy code
- Support the testing and integration of installed components and systems during building commissioning
- Develop a calibrated model representing the existing building to identify operational issues and savings opportunities
- Develop a calibrated model representing the existing building to establish baseline conditions to support an Option D M&V approach
- Update the design model to develop a calibrated energy model to determine and report the ASHRAE Building Energy Quotient for the "In Operation" building under standard conditions as defined by the program requirements
- Update the design model to develop a calibrated model to check and reconcile outcome-based targets with actual energy use
- Update the design model to develop a calibrated energy model of the in operation building to establish performance targets are met per the integrated project delivery contract agreements

REQUESTED STUDIES

In support of meeting the objectives above, *DEC* desires the following elements be included as part of the analysis:

- Conduct studies for three daylight design options and assess their ability to provide daylight autonomy, visual comfort, and lighting energy savings. Support integrated project design and delivery, using modeling to inform the design process
- Incorporate passive solar heating strategies into the building design, evaluate their net benefit, and identify potential visual and thermal comfort issues
- Evaluate state-of-the-art technologies and controls for drastically reducing electric lighting and plug loads
- Identify the cost point ($/kWh saved) that balances the cost of efficiency against renewable energy systems
- Assess the benefits of using solar thermal versus solar electric to satisfy space heating loads
- Propose three mechanical system design options for their first costs and performance impacts, and integrate with other systems
- Complete life-cycle cost assessment for top three building designs. Use the economic model to compare return on investment and impact on carbon reduction
- Identify key monitoring points for monitoring and tracking performance, as well as supporting the M&V Plan
- Post-construction, develop the as-built, calibrated model and compare predicted performance results against the design model. Assess differences and share findings with DEC and the design team

BEST-PRACTICE PROCESS

Appendix Table 1 (see next page) lists modeling tasks and deliverables that contribute to a best-practice modeling process. The proposed modeling services provided should be rooted in the process while aiming to balance the level of effort with the value it provides to the project.

APPENDIX TABLE 1

MODELING PROCESS

PROJECT TIMELINE	BEM ACTIVITIES
Pre-design	• Evaluate siting, massing, and geometry • Develop a "technical potential" model* • Hold a Technical Potential/Goal Setting Workshop • Document and submit pre-design analysis, findings, and recommendations
Early Design	• Evaluate efficiency measures contributing to an integrated design solution following the "right steps in the right order" by: examining service requirements, reducing space loads, considering passive strategies, selecting systems, planning layout, fine-tuning controls, and sizing renewables • Develop the "implemental minimum" and compare against other options • Update model based on current design documents and refinements • Document and submit performance assessment, model assumptions, approach and details, and design recommendations
Design Development	• Assist in system selection and right-sizing equipment • Refine control strategies and sequence of operation • Inform value engineering decisions • Update model based on current design documents and refinements • Document and submit project attributes, performance assessment, model assumptions, approach and details, and design recommendations
	• Develop minimally-compliant/reference baseline model • Update baseline model as design progresses; initiate completion of compliance documentation; assess and report compliance status • Identify and resolve compliance issues
Construction Documents	• Check that energy efficiency features are included and properly characterized in construction documents • Finalize model, check performance against targets, share results, reconcile shortcomings • Document and submit project attributes, performance assessment, model assumptions, approach, and details
	• Finalize minimally-compliant/reference baseline model • Complete and submit compliance documentation
	• Develop and submit a "Calibration Plan" • Support the development of the M&V Plan • Assist in establishing points for data collection post-construction based on model calibration and M&V needs
Construction	• Use modeling to support commissioning efforts; provide data as needed describing anticipated performance of equipment and systems
	• Respond to issues regarding design-based compliance submittals
Operations	• Create the as-built model by updating the proposed design model to reflect installed components and actual operation • Calibrate the updated model to measured data • As required, compare modeled total, end-use, system, and equipment performance against actual performance to investigate discrepancies • Reconcile differences to inform the model and/or identify underperformance • Develop plan to resolve remaining discrepancies • Share findings with project team, building operators, managers, and owner

*A design model comprised of a synergistic combination of performance improvement utilizing the best commercially available technologies, not constrained by cost or constructability. It is used to quantify stretch goals and ideally provide a starting point for the proposed design.

NOMINAL REQUIREMENTS

REFERENCE GUIDELINES AND STANDARDS

Refer to the following guidelines and standards to inform model assumptions and methods:

- DOE/NREL/RMI Building Energy Modeling for Practitioners (available summer 2014)
- ASHRAE Standard 209: Energy Simulation Aided Design for Buildings Except Low-Rise Residential Buildings (expected release summer 2014)
- Environmental Defense Fund Investor Confidence Project, Energy Efficiency Protocol – Large Commercial v.1.1 (EPP-LC); retrieved at http://www.eeperformance.org/large-commercial1.html
- ASHRAE Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings (compliance reference version)
- COMNET Commercial Buildings Energy Modeling Guidelines and Procedures Manual; retrieved at http://www.comnet.org/
- ASHRAE Standard 62.1: Ventilation for Acceptable Air Quality (most current version)
- ASHRAE Standard 55: Thermal Environmental Conditions for Human Occupancy (most current version)
- International Performance Measurement & Verification Protocol (IPMVP) Volume 1 (most current version); retrieved at: http://www.evo-world.org/

SOFTWARE TOOLS

The whole-building modeling shall be completed using simulation software that meets the requirements specified in ASHRAE 90.1 (current version) Appendix G, Section G2 - Simulation General Requirements. Exceptional calculations shall be conducted for strategies that: a) cannot be directly modeled in the simulation software, b) are based on schedule changes, or c) are based on plug load reductions. Additional specialized software programs can be used to perform supporting studies.

QUALIFICATIONS

DEC seeks firms that have the following qualifications:

- ASHRAE Building Energy Modeling Professional (BEMP) or AEE Certified Building Energy Simulation Analyst (BESA)
- LEED AP
- A minimum of five model reviews by GBCI for LEED BD+C projects
- Engineering, architecture or other technical degree for the modeling, project management, and QA staff
- At least three years of modeling experience on a variety of building types and sizes

The following qualifications are not required but are preferred:

- ASHRAE High Performance Design Professional (HPDP) Certification
- Certified Energy Manager (CEM)
- Licensed Professional Engineer (P.E.)

PROPOSAL FORMAT[2]

In responding to the RFP, please provide the following:

1. Cover Letter
2. Overview of Firm and financial stability
3. Experience
    - Number and types of buildings modeled over what time period
    - Simulation programs and supporting tools used
    - Mechanical systems and process loads modeled
    - Case studies of projects that involve: informing design, LEED certification EAc1 modeling, existing building calibration, operational modeling. As part of the project descriptions, please include: baseline/actual/modeled energy use intensity, peak load reduction, and percent cost savings.
    - Description of modeling quality control and internal review procedures
4. Proposed Modeling Tasks and Deliverables

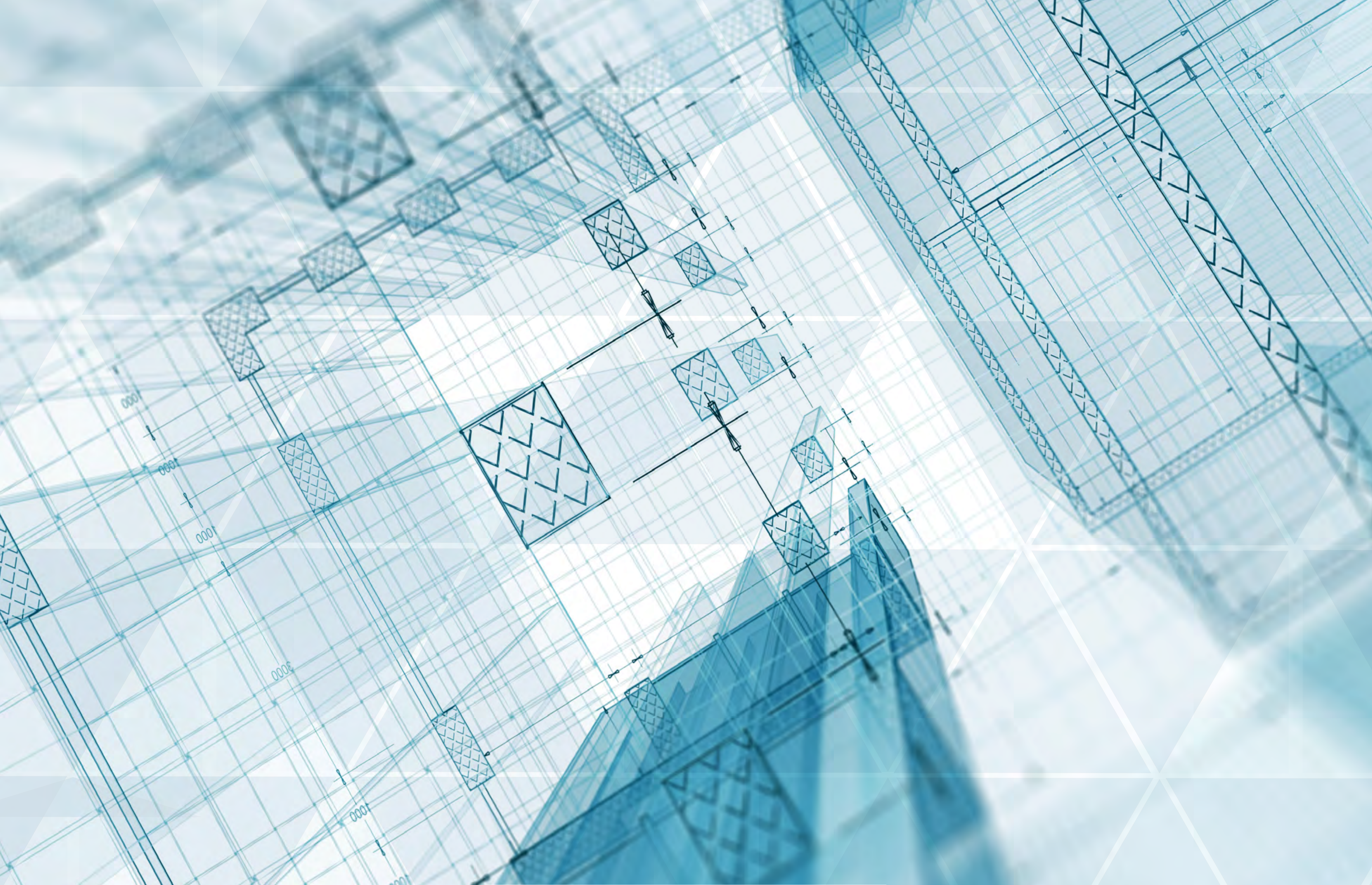
    Using Appendix Table 1 for reference, provide a description of the tasks and process that you propose to follow in delivering services. The proposed work should reflect a balance between modeling level-of-effort, accuracy, and ability to meet project objectives. Discuss the value proposition for the tasks proposed. Mention the software tools that will be used for the whole-building and any specialized analyses proposed.

PROPOSAL EVALUATION[3]

Proposals will be evaluated on the following criteria. The rating scale shall be from 1 to 5; from poor to outstanding, respectively. At the discretion of *DEC*, the firms submitting top-rated proposals will be invited for an interview session.

WEIGHTING FACTOR	CATEGORY	CRITERIA
25%	Scope of Proposal	Do the proposed scope and methods show an understanding of project objectives, best-practice process, and value proposition?
25%	Assigned Personnel	Does the assigned modeling team have the required skills and experience? Is the project sufficiently staffed?
20%	Availability	Will the team be available to meet regularly during design and be available to resolve issues on short notice? Can the work deliverables be submitted in accordance with the needs of the project timeline? Are other qualified staff available to assist in meeting the project schedule if required?
10%	Motivation	Is the firm interested and capable of doing the work within the required time frame?
20%	Firm Capability	Does the firm have the necessary buildings-related experience to meet the requirements of the RFP?

[2,3] ADAPTED FROM THE CITY OF FORT COLLINS, FINANCIAL SERVICES PURCHASING DIVISION, REQUEST FOR PROPOSAL 7497 BUILDING ENERGY MODELING SERVICES RELEASED MARCH 2013



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