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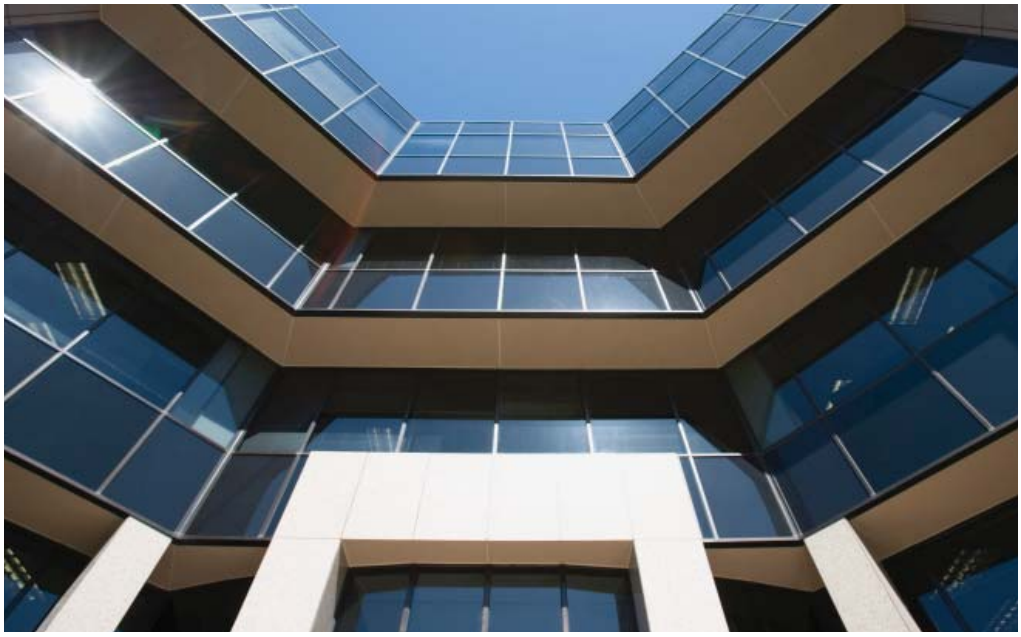
WHITE PAPER

The Advantages of BIM for Government Building Performance Analysis



Contents

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Introduction

Buildings account for nearly half of all energy consumption and annual greenhouse emissions in the United States. It is little wonder that improving the resource efficiency of buildings is a cornerstone of sweeping energy usage reform, sustainability efforts, and economic stimulus packages.

Because of the vast inventory of buildings within their control, federal, state, and local government agencies have an unprecedented opportunity to play a leadership role in the stewardship of our natural resources. Deliberate and cost-effective renovations to government buildings can generate substantial environmental, financial, and societal benefits—from reducing energy consumption to creating new jobs.

The sheer number of buildings can make conducting comprehensive building performance analysis and implementing energy savings projects a daunting task. Dated or non-existent building plans and incomplete energy consumption histories make it difficult to predict future performance throughout the life of a proposed renovation project, or to evaluate and compare proposals from energy service companies (ESCOs). There are also the political challenges of garnering stakeholder support and building consensus between legal, procurement, and finance departments during contract negotiations. To help navigate these challenges, the Federal Energy Management Program and the Energy Services Coalition provide methodologies, tools, and best practices to accelerate and improve the overall processes.

Fortunately, new technologies make this once overwhelming prospect manageable—especially when compared to traditional 2D drafting tools. When applied to existing buildings, 3D building information modeling (BIM) technologies can help you capture the building geometry and characteristics needed to conduct various aspects of energy performance analysis and support contracting processes. For example, you can create a basic BIM model to support energy and investment grade audits.

Government departments responsible for implementing energy savings projects can work independently or enter into energy savings performance contracts (ESPCs) offered by ESCOs. BIM is an invaluable tool for evaluating ESPCs and ensuring that building owners make sound investment decisions that balance performance and risk over multiyear projects and contracts.

This paper will provide an overview of how you can use a basic BIM model and BIM analysis tools to assess building performance, prioritize investments, and evaluate proposals to reduce operational costs, conserve energy, reduce water consumption, and improve building air quality.

The Call to Improve Building Performance

Government organizations are in a unique position to be leaders in sustainable design and improving building performance. Every day, government buildings use substantial amounts of energy, water, raw materials, and other natural resources, and generate waste and pollution. Because of this sizeable environmental footprint, buildings—and building management—are the focus of a wide range of mandates. The goal of these directives is to increase building performance and thereby minimize energy consumption, reduce water and wastewater infrastructure demands, improve air quality, and create smaller overall carbon footprints. Unlike during the energy crisis of the 1970s, technology now exists to help improve building performance and help focus limited capital investments on the projects that will generate the highest environmental and economic return.

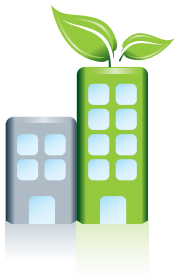
Let's start with a quick review of some of the major legislative mandates, executive orders, sustainability initiatives, and economic stimulus plans that encourage building operators to renovate and improve building performance:

- The **Energy Policy Act of 2005 (EPACT 2005)** focuses on energy efficiency, water conservation, and improving accountability for federal buildings.
- The **Energy Independence and Security Act of 2007 (EISA 2007)** requires a steep reduction in fossil fuel energy usage, encourages the use of cost-effective solar hot water heaters, and extends the lifecycle cost period of capital improvement projects .
- **Executive Order 13423 - Strengthening Federal Environmental, Energy, and Transportation Management** requires agencies to reduce energy consumption by 3 percent per year and water consumption by 2 percent per year through 2015 and reduce greenhouse gas emissions.
- **Leadership in Energy and Environmental Design (LEED)** evaluates green building criteria in five major categories: site design, indoor environmental quality, and the efficient use of energy, materials, and water.

Finally, the economic stimulus package, The American Recovery and Reinvestment Act, singles out improving the performance of government buildings as a way to jumpstart job creation and long-term growth. The Plan aims to modernize more than 75 percent of federal buildings, saving taxpayers billions of dollars on energy bills over the years. Federal and local stimulus plans underscore the need to have government building renovation projects identified and shovel-ready as soon as the funds become available.

Using BIM to evaluate LEED projects

Use a basic BIM model and analysis tools to help you evaluate the cost and energy benefits of typical LEED certification projects, such as modifying windows to better use natural lighting; deploying next-generation energy-conserving motion sensors in all conference rooms and offices; or using waterless urinals and dual flush, low-flow toilets in restrooms.



Using BIM to Develop a Building Modernization Program

The mandate is clear. But the task of developing a comprehensive and prioritized modernization plan to convert a substantial inventory of large, dated government buildings into sustainable, energy-efficient structures can be overwhelming. You need a pragmatic and cost-effective way to analyze building performance and rank projects and renovations—across a portfolio of heterogeneous, geographically dispersed buildings—based on economic and environmental goals. Leveraging BIM with performance analysis tools can help.

BIM allows you to more quickly and easily create a basic building model to help simulate the performance and cost of renovations. The digital model includes data components that represent building elements and characteristics—such as materials, weight, thermal resistance, and other physical properties—that contribute to building performance. With BIM, you can analyze and assess the energy performance of individual buildings. Then evaluate, compare, and rank the environmental and financial impact of proposed renovations. With a more comprehensive understanding of the relative performance of the property portfolio, you can recommend and prioritize an overall building modernization program, and focus detailed design efforts and construction on the projects with the greatest impact. BIM is a practical approach, whether evaluating a single office building, dozens of educational or healthcare buildings, a network of 5,000 federal buildings, or defense installations around the globe.

Starting with a basic building model, you can analyze, compare, or audit potential renovation projects based on your own financial or environmental criteria. BIM technology and analysis tools allow you to compare renovation options within a building. For example, what generates a better economic and energy-efficient return: installing higher R-value wall insulation, or modifying a heating system? BIM can also be used for project comparisons between buildings, such as determining which buildings in your portfolio would benefit the most from an HVAC upgrade. Leveraging basic building information, BIM allows you to make evidence-based decisions in a cost-effective manner.

Getting started with BIM is easier than you might think. Use BIM to help improve the energy efficiency and performance of your buildings by following these five basic steps:

1. Collect basic building information—including wall, floor, roof, and ceiling dimensions—on each building within the portfolio.
2. Create basic BIM models for each building in the portfolio. You can generate a complete BIM model—including floor plans, elevations, sections, and 3D views—from the most basic building dimensions in just a few hours.
3. Analyze building models for environmental and economic performance. Facilitate smarter, more sustainable performance by analyzing and simulating a wide range of options. For example, in the area of optimizing solar effects, use BIM models and analytic tools to evaluate sun position, solar radiation, shading, and daylight alternatives.
4. Compare and then prioritize projects or investment alternatives based on conservation objectives, such as water or fossil fuel usage, or financial goals. For example, evaluate the economic and environmental return on upgrades to mechanical, electrical, and plumbing (MEP) systems.
5. Select and act on top priority projects.

The Benefits of Using BIM to Improve Building Performance

Applying BIM to analyze existing governmental buildings also helps deliver a plethora of economic, environmental, and societal benefits—that go far beyond complying with mandates. Analysis using a BIM model can identify ways to reduce resource consumption, increase on-site renewable opportunities, build consensus, review investment grade audits, increase the public's confidence, and improve employee morale.

Reduce resource consumption—Smart and sustainable building renovations leverage modern, more efficient technology, systems, and controls designed to reduce the consumption of energy, water, and materials.

- **Energy:** Use BIM analysis tools to help analyze heating and cooling requirements, identify daylighting opportunities, and select major building equipment that may reduce energy use. Incorporate local weather and electric grid data to estimate building energy consumption and carbon emissions.
- **Water:** Renovate buildings to reduce water usage or to utilize more reclaimed water. Analyze potable and nonpotable supply options for occupants and building processes. Evaluate stormwater systems and simulate the performance of collection systems, ponds, and culverts.
- **Materials:** Select recycled or renewable materials or finishes during building renovations. Consider incorporating recycling centers and other sustainable practices that cut down on waste.

Increase on-site renewable opportunities—Changes in temperature, precipitation, and weather patterns can affect rainwater, stormwater, and snowmelt amounts, and alter water supplies from year to year. A coordinated, consistent BIM model can help design systems that minimize water use, protect existing wetlands, and focus on net-zero water usage. With more sustainable designs, you can encourage the use of recycled water for irrigation of landscaping, minimize contaminants in wastewater, and investigate the feasibility of capturing, recycling, and reusing water on-site—reducing the costs and impact on your water and wastewater systems.

Build consensus—Using BIM analysis and visualization tools can greatly increase the impact and clarity of presenting proposed modifications to stakeholders and decision makers in legal, procurement, and finance departments. Allow reviewers to perform virtual walk-throughs or see the modifications occurring over a timeline, so they can improve their understanding of the project and build consensus on how to address risks. For example, a 3D model site plan may quickly help identify whether a building renovation would affect access roads in a way that makes the proposed renovation impractical. Provide evidence-based answers to financers to reduce financing costs and improve the project payback.

Review investment grade audits—An energy services company (ESCO) can perform an in-depth analysis of a building or properties, design an energy-efficient solution, and install the required elements. Energy savings performance contracts (ESPCs) improve the energy efficiency of government buildings and commit you to a defined payback period. However, it is still the responsibility of the government agency or department to perform due diligence on proposals to protect the constituents' best interests. Before signing an ESPC, use BIM to perform internal reviews of ESCO proposals to confirm key predictions and assumptions. For example, use a virtual walk-through of the proposed renovations—or submit the design into energy analysis tools—to increase your confidence in predicted performance levels and reduce the uncertainties associated with these long-term contracts.

Increase public confidence in stewardship—Making smart investments in building improvements increases the public perception of your ability to act as a good steward of public funds. BIM analysis tools can help you more quickly identify where limited dollars should be spent, adding integrity and legitimacy to the process. For example, presenting cost-effective sustainable design alternatives at public hearings helps generate an understanding of the design and renovation process while promoting public trust.

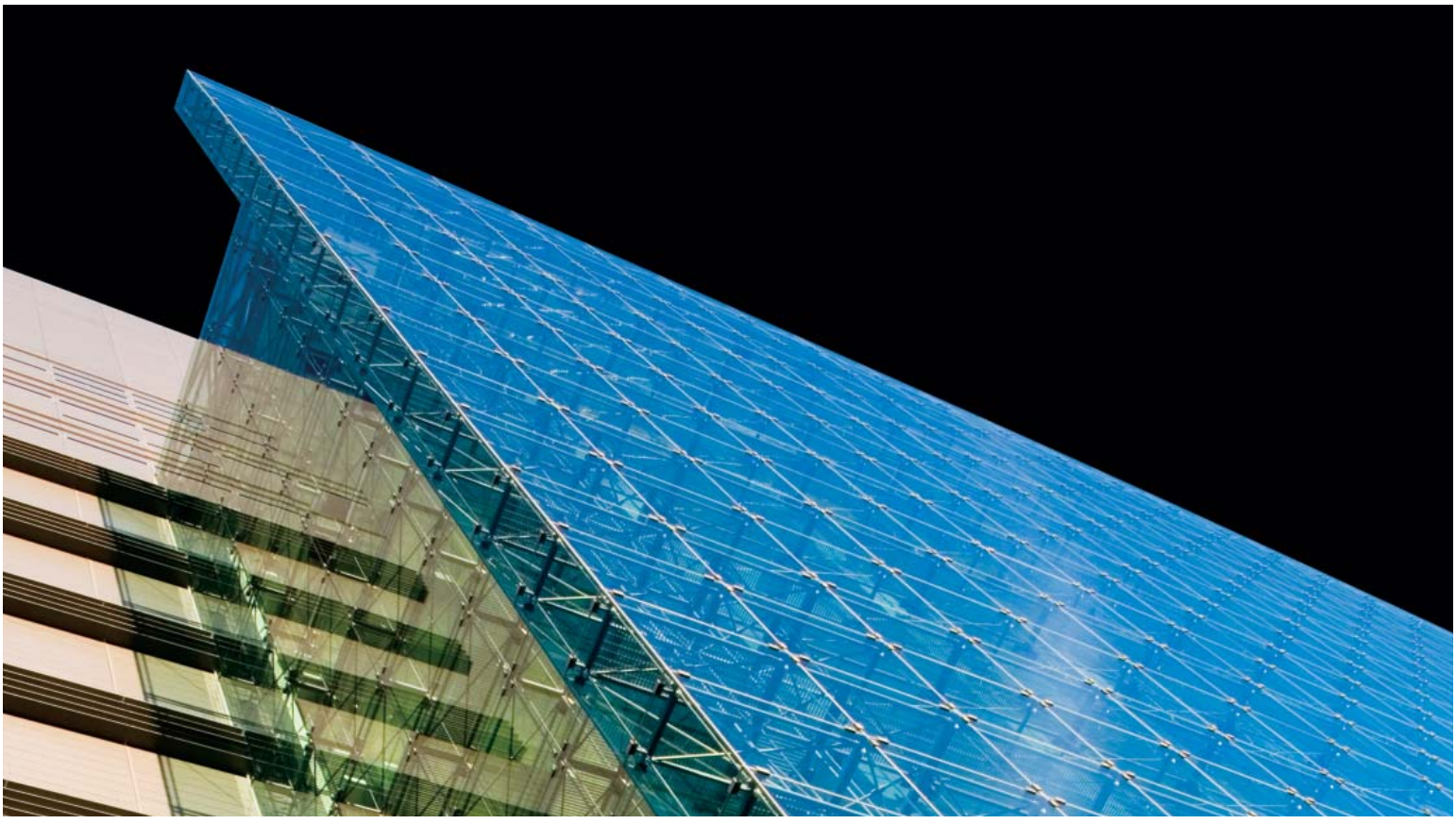
Improve employee productivity—BIM can help identify opportunities for increasing the use of natural lighting or flow of fresh air within the interior spaces of a building. Use BIM to visualize and simulate the impact of a lobby atrium or better ventilation on building performance—while also taking into account the positive and intangible benefits these improvements can have on employee morale. For example, job satisfaction is commonly linked to increased productivity, higher retention rates, and fewer sick days.

Conclusion

Whether your property portfolio consists of office buildings, conference centers, maintenance facilities, healthcare operations, warehouses, storage depots, or aircraft hangars, conducting building performance modeling and analysis can generate significant benefits. Government agencies need clear, consistent, and evidence-based building analysis that sufficiently details predicted performance. By requiring the use of BIM in audit agreements, RFQs/RFPs, and energy performance contracts, government agencies will more accurately understand predicted performance and related risks over the multiyear lifecycle of the project.

The ability to create a basic BIM model—and then use the model to help analyze the cost and benefit trade-offs of proposed projects within a building and throughout the property portfolio—is key to building performance analysis. Innovative design products support BIM, making it a cost-effective way to evaluate, prioritize, and audit proposed building renovations.

For more details on how to create an appropriate BIM model for energy performance evaluations, review "Creating Models for Performance Analysis on Existing Buildings." available at www.autodesk.com/BIM.



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