



ENERGY STAR[®] Design Guidance

Bridging the gap between energy design intent and building performance





Source: Cover and this page photograph courtesy of RB+B Architects, Inc.® and Fred J Fuhrmeister / Time Frame Images.

Kinard Middle School, Fort Collins Schools, Fort Collins, CO, achieved Designed to Earn the ENERGY STAR® recognition in 2005 and has earned ENERGY STAR certification for every year thereafter.

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Introduction

Championing energy at the start of design is critical to achieving a successful energy performance outcome once the building is operating and occupied. This requires going beyond business as usual and minimizing risk by having the owner's commitment and the architect's engagement around a definitive energy performance target.

The conventional design process evaluates energy using a code-compliant prescriptive approach for simple buildings, which specifies equipment pathways for compliance against a baseline equipment package. For more complex buildings, a simulation of the proposed design strategies is modeled against a hypothetical model of a minimally code-compliant version of the design. Either approach focuses the design goal on the percent better than code for system and component efficiencies or the energy cost budget method; however, it does not account for all energy associated with operating the building, such as occupant behavior and its effect on energy use. This undermines the intended performance expectations for the building's actual energy consumption, fuel uses, and greenhouse gas (GHG)

emissions by not providing the whole building energy metrics needed for the design intent to inform actual performance.

Many design projects fall short of meeting the intended energy performance goal once the building is operating and occupied due to lack of a meaningful energy performance goal. Energy efficiency is often evaluated too late in the design process, making it difficult to prioritize, secure buy-in from everyone on the team, investigate cost-effective integrated energy strategies, and prevent value engineering in late-stage design. The lack of clear performance goals, beyond design and construction, leads to poor operational accountability and higher bills and GHG emissions for the building.

USING ENERGY STAR TO POSITION YOU FOR SUCCESS

Establishing a whole building energy target during the design phase—one that can be easily understood and checked against energy bills—is the most cost-effective way to reduce energy use and achieve operational performance goals in buildings. It can help to increase property asset value, meet future mandates for reduced energy and carbon emissions, and provide energy-efficient sustainable buildings.

The ENERGY STAR metrics and tools in this guide are intended to fix this disconnection by establishing energy and carbon performance-based goals early in the design process based on absolute and relative metrics to help prioritize energy efficiency throughout the entire process.

It highlights using ENERGY STAR Target Finder and Portfolio Manager tools to establish an energy target at the start of design, evaluate strategies and then benchmark and track the energy use of the building. It also provides a sequence of best practices and shows how ENERGY STAR metrics can complement energy-related goals for benchmarking ordinances and other green building initiatives.

Using the guide in conjunction with ENERGY STAR tools and resources can position your next design project for achieving energy goals and EPA's Designed to Earn the ENERGY STAR recognition!





ENERGY STAR Tools and Resources

This guide is intended to enhance the design process by helping you prioritize energy efficiency. The materials outlined in this section highlight tools, metrics that complement industry standards, and a sequence of best practices for contract language.

ENERGY STAR LIFECYCLE

The ENERGY STAR lifecycle graphic on page 4 shows which tool to use during each phase of the process. Target Finder can best be used to evaluate energy strategies at the early stages of design, but the results can't be saved.

Portfolio Manager saves energy data in a secure environment that can be edited at any time. And the design energy results reside in the same record as the metered energy data for comparing design intent to actual performance.

ENERGY STAR Specification for Pursuing Energy Efficiency Goals

The Specification document provides language for including energy milestones and goals during all phases of the design process. It provides

instructions for obtaining and stating definitive and measurable targets that can be actualized for the life of a project. The document can be adapted to be included in RFP (Request for Proposal) solicitations and general specifications in contract documents.

Learn more: [ENERGY STAR Specification for Pursuing Energy Efficiency Goals](#)

ENERGY STAR TOOLS

ENERGY STAR provides tools to help you evaluate energy for the lifecycle of the building. Target Finder can be used during design to set whole building energy targets and evaluate whether the estimated design energy meets or exceeds your target. Portfolio Manager has all the capabilities of Target Finder and provides

the ability to benchmark energy performance from utility bills for the operating building and compare energy design intent to actual performance.

ENERGY STAR Target Finder Tool



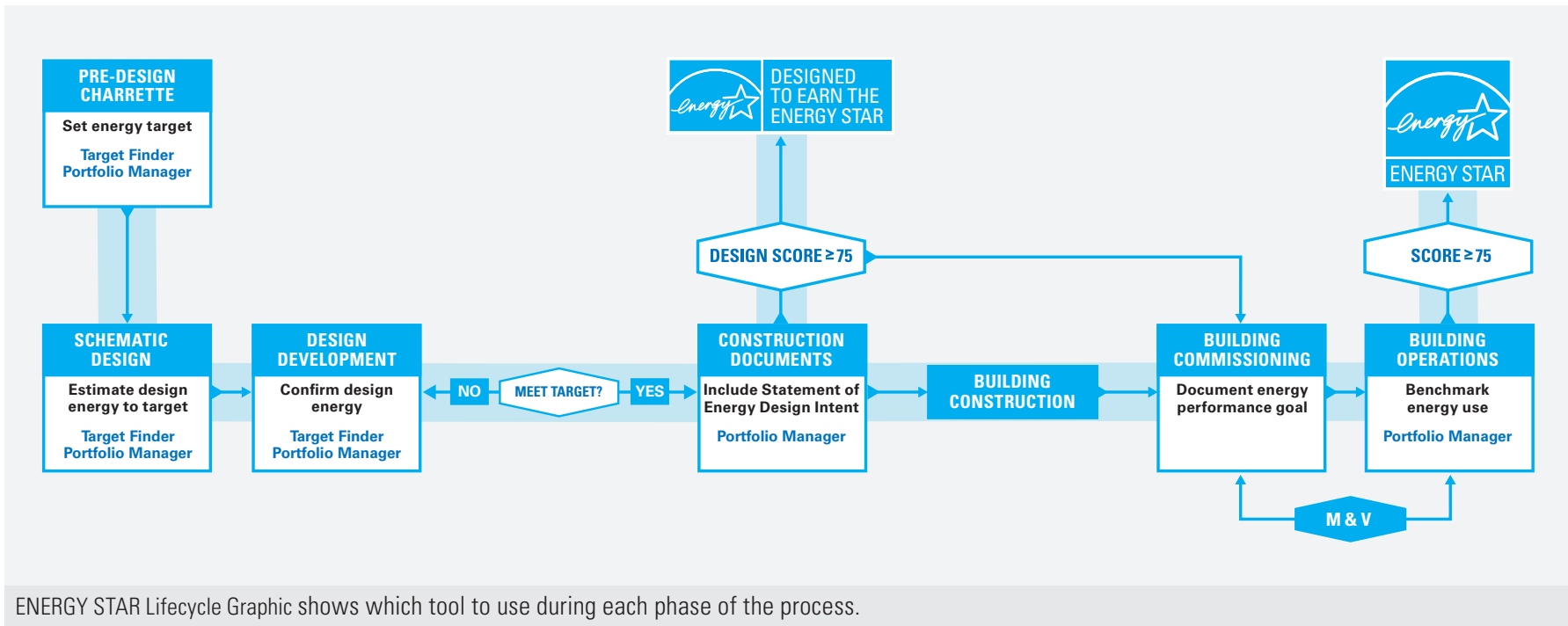
Target Finder was created to make it easy to set realistic energy

targets and compare energy strategies throughout the design process. There is no login, making it quick and easy to evaluate the results of “trade-offs” for different energy strategies for the project.

ENERGY STAR Target Finder metrics and features

- Energy use intensity (site and source energy)
- Percent better than national median

ENERGY STAR Lifecycle Graphic



- Annual energy use (site and source energy)
- Annual energy cost
- Annual greenhouse gas emissions (source energy)
- 1-100 ENERGY STAR design score for eligible property types
- Statement of Energy Design Intent (SEDI) document
- Allows saving the project to the Portfolio Manager tool

Learn more: [ENERGY STAR Target Finder](#)

Default Values for Property Use Details

Default values are available in both tools but only for some property types eligible for an ENERGY STAR score. [Property Use Details for Property Types](#) provide input values for the tool to calculate results when design estimates are not available. However, default values should **always** be substituted with more realistic values for the intended use of the property for calculating an energy design target, score or comparing the design energy to the target.

It is important to provide the most accurate estimates for the use details when calculating an ENERGY STAR score for the tool to provide meaningful results. All use details associated

with calculating the score are distinguished by a “blue star” on the input screen.

The use detail inputs affect energy use intensity (EUI), total energy use, and score results. Some use details have a greater impact on energy than others. Try different values for inputs to see how use details affect the energy target.

Fuel Mix and Energy Cost Default Values

Defaults also are available in both tools for energy fuel mix and energy cost for all property types.

Fuel mix default values are based on energy consumption typical from the ZIP Code™ entered

in the tool. The fuel mix changes if the estimated design energy is different from what is typical. For example, the typical fuel mix for Washington, DC, is roughly 30 percent natural gas and 70 percent grid electricity. If the design energy constitutes an all-electric building, the Design Target and Percent Better Than Median will recalculate using all-electric energy.

Energy cost default values are updated annually based on the ZIP Code where your property will be located. If you are unable to provide fuel costs for your property design, both tools will provide the estimated fuel costs for the energy type(s).

Learn more: [Fuel Mix and Energy Cost Default Values](#)

ENERGY STAR Portfolio Manager Tool



Track energy bills in the Portfolio Manager tool using the same record

used to catalog the design energy. This provides a one-stop repository for all energy associated with the property and a comparison between design intent and operating performance. Document best practices, lessons learned, and energy benchmarks, and share them with the design team to inform strategies for future projects. See the Target Finder section for the description of default values for Property Use Details and Fuel Mix and Energy Costs.

ENERGY STAR Portfolio Manager metrics and features

- Saves information in a secure and private account
- Energy use intensity (site and source energy)
- Percent better than national median
- Annual energy use (site and source energy)
- Annual energy cost
- Annual greenhouse gas emissions
- 1-100 ENERGY STAR score
- Generates a document of:
 - Statement of Energy Design Intent
 - Statement of Energy Performance
 - Energy Score Card

- Saves design project energy data in the same record as the existing building
- Saves metered energy data
- Compares energy design estimates to actual energy data
- Shares data with others
- Executes the application for ENERGY STAR certifications:
 - Designed to Earn the ENERGY STAR
 - ENERGY STAR certification for buildings
- Generates custom reports

Learn more: [ENERGY STAR Portfolio Manager](#)

Metrics Comparison for Energy Design Intent and Operational Performance

Metric	Design Project	Design Target	Median Property	Property Measurement in Use
ENERGY STAR score (1-100)	89	75	50	90
Source EUI (kBtu/ft ²)	83.7	103.7	138.0	80.9
Site EUI (kBtu/ft ²)	41.4	51.2	65.1	38.1
Source Energy Use (kBtu)	8,494,808.4	10,522,436.1	13,868,145.2	8,126,505.3
Site Energy Use (kBtu)	4,195,735.2	5,196,216.4	6,535,592.3	3,829,749.5
Energy Cost (\$)	2,836,273.53	3,513,263.65	146,590.55	85,899.63
Total GHG Emissions (Metric Tons CO ₂ e)	350.4	434.0	565.6	331.5

The table from Portfolio Manager shows the energy lifecycle for the property, including estimated design energy, design target, percent better than the median property, and the measured performance of the operating building.

Complement sustainability and benchmarking initiatives

Supplement sustainability goals, green building rating initiatives, and energy benchmarking disclosure ordinances using ENERGY STAR whole building energy metrics based on actual performance data. You can generate reports from ENERGY STAR tools and document energy performance goals to supplement requirements for these initiatives.

Green building rating and certifications

Green building rating initiatives, such as Leadership in Energy and Environmental Design (LEED), Green

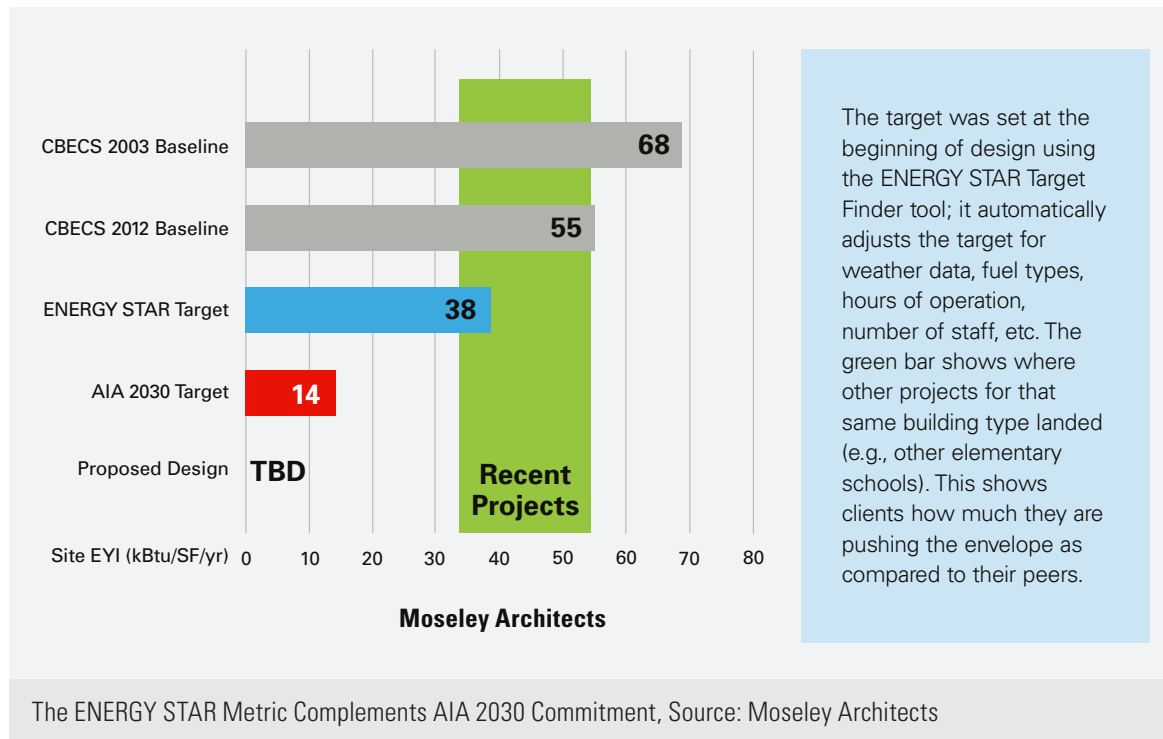
Globes, and Collaborative for High Performance Schools (CHPS), evaluate energy efficiency against an energy code using prescriptive paths and/or carbon equivalent requirements against a baseline to earn certification. Energy in commercial buildings, once operating, is not measured by a percent better than code, but instead by the amount of energy used by systems and occupants. For example, using metrics from ENERGY STAR tools to supplement energy codes can help you more accurately account for all energy associated with equipment use and occupant behavior in the building. Setting a

performance target for design can help align goals to achieve the desired energy outcomes once the building is operating. Including whole building energy performance metrics from ENERGY STAR Target Finder or Portfolio Manager in contract documents make it easy to communicate goals to stakeholders.

Benchmarking and disclosure ordinances

A growing number of state and local benchmarking ordinances require existing buildings to use ENERGY STAR Portfolio Manager to collect energy data and submit the building's energy performance to the jurisdiction for disclosure to the public. Though most jurisdictions have not mandated design targets, it would be prudent to align energy design intent with benchmarking requirements and document the expected ENERGY STAR score when applicable and/or an EUI target. Because these laws hold the building owner accountable, it's important to start by meeting or exceeding the energy design intent of green buildings to achieve the desired goal once the building is occupied.

The ENERGY STAR metric complements AIA 2030 Commitment





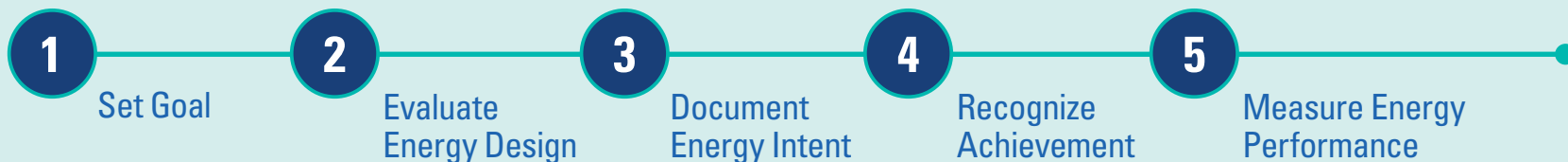
ENERGY STAR Design Guidance

This guide will help you during the design process to set an energy target, evaluate energy strategies, document energy intent, and get recognized by EPA. It also highlights how to benchmark energy use for the building, once built and operating, to determine if design intent achieved operational performance.

Download the [Energy Design Guidance Checklist](#) for a summary of each step in the process to ensure that all actions are executed to implement energy efficiency strategies and achieve goals.

ENERGY DESIGN GUIDANCE

Follow the steps below to meet energy goals and achieve Designed to Earn the ENERGY STAR recognition for projects.



1

SET GOAL

Designing buildings is a complex undertaking and having clear and definitive goals is critical to achieving successful outcomes. Minimize risk by seeking owner commitment and the architect's engagement around energy performance goals early and often. Include the following activities to ensure that energy is at the forefront of design:

Assemble a multi-disciplinary team

Include representatives from all aspects of the project and adopt an integrated design approach. Designate an energy champion and prioritize energy to ensure that it remains at the forefront throughout the design process. The team evaluates energy efficiency measures and determines the best strategies to achieve goals. Each member of the team brings a unique perspective to the process and their decisions will affect energy during design and well after the building is occupied. The design team may vary by project size and budget, and can include the following personnel:

- Building owner/developer
The building owner or developer provides

the functions of the building, establishes the energy goals and budget for the project, and is responsible for the building's operation and energy management once it is completed.

- Tenant/employees
A tenant representative provides insight regarding occupant activities and needs, and space build-out details for determining energy requirements.
- Architect/engineer/energy consultant
Energy efficiency no longer depends solely on efficient mechanical and lighting systems. The design team considers a variety of energy efficiency strategies, such as bioclimatic design, passive heating and cooling, and daylighting strategies to reduce energy demand.
- Construction manager/contractors and suppliers
The construction manager directs the project team with energy efficiency as a priority. The energy intent is conveyed to design consultants, contractors, and suppliers to ensure that the systems and products are

designed, specified, and implemented to meet the project's energy efficiency goals.

Contractors and suppliers are responsible for providing systems and products that are specified to meet the energy efficiency goals.

- Commissioning agent
The commissioning agent (CxA) participates in the design, construction, and operational processes. The CxA ensures that energy performance goals are linked to the design intent of the building and monitors conformance with project specifications for energy performance, and ensures that the building is operated as intended.
- Operations and maintenance personnel
Operations and maintenance staff ensure that building systems are operated and maintained properly and efficiently.

Conduct a design charrette

Discuss energy strategies and goals and get buy-in from the team, include energy objectives pertinent to the design concepts, and include the following:

- An energy target that is attainable, measurable, and easy to communicate to all members of the team as outlined below under “Set an energy target.”
- Energy-focused design concepts that consider the environment, climate, building orientation, passive strategies, renewable energy, electrification, occupant behavior, and other features that will impact performance of the building.
- A plan for delivering a top-performing, energy-efficient building, including scope of work, project budget, and schedule that account for implementing energy efficiency strategies and achieving the energy goal.
- A metering strategy and plan tailored to the specific building requirements and the objectives of key stakeholders (e.g., building systems, tenant billing, and energy reporting). See [Establish a Metering Plan](#) in the Appendix.

Set an energy target

Use ENERGY STAR Target Finder and Portfolio Manager tools for whole building energy metrics to establish an EUI and total annual energy target for a specified building type (e.g., K–12 schools, office buildings, warehouses, grocery stores). See [Improve the Predictive Power of Design Energy Estimates](#) in the Appendix. The tools only provide targets for U.S. and Canadian properties.

- **1-100 ENERGY STAR score:** Targets are established by selecting an ENERGY STAR design score from 1 to 100. The score will provide a corresponding EUI and total annual energy use target for [eligible property types](#). See [how the 1-100 ENERGY STAR score is calculated](#).
- **Percent better than median:** Specify a percentage better than the national median goal using the tools. Targets are established by selecting from zero to 100 percent better than the median property; selecting zero is roughly the equivalent of the median, or an ENERGY STAR design score of 50, for applicable property types. There are more than 80 other [property types](#) available to select from in the tools.
- **Performance-based energy target:** Determine a performance-based target for similar building types. Use the average EUI or total annual energy use of the buildings as a baseline or specify a percentage above the baseline to establish an energy target. If you have properties benchmarked in Portfolio Manager, use the tool to group similar buildings and determine a benchmarked-based performance target.

TIPS

The 1-100 ENERGY STAR score shows how estimated design energy compares to similar buildings from a national energy consumption survey of existing buildings.

Substitute default values for property use details with realistic inputs for the intended use of the property when calculating an energy design target.

Institute a plan to install individual meters for all utilities specific to the project as identified by building stakeholders for tenant billing and energy reporting, etc.

Energy in commercial buildings, once operating, is not measured by the percent better than code, but instead by the amount of energy it is using! Set an energy design target that aligns with the operational performance goal.

2

EVALUATE ENERGY DESIGN

The greatest opportunity for cost-effective energy measures occurs earlier in the design process. Consider investigating key strategies and integrating energy efficiency features into the design to meet your energy target. Perform periodic energy analyses as the design develops to understand how much energy your project is anticipated to use.

Schematic design

Assessing performance is an iterative process that continues throughout the design. Evaluating

energy during schematic design provides critical information on which features will help achieve the goal. For example, building orientation and siting will have a significant impact on energy, and may be cost prohibitive and time intensive to change later in the design process.

Design features that impact energy should be evaluated holistically and often during schematic design. Modeling tools are available that provide parametric analysis at the early stages of the design and are used in conjunction with

TIPS

Effective energy analysis of commercial building design includes:

- Regional weather and climate data
- Building size
- Operating characteristics (e.g., number of workers, hours of operation, months in operation)
- Total annual energy use from all fuel sources (e.g., electricity, natural gas, steam, chilled water)
- Regulated load assumptions, such as equipment and systems
- Non-regulated load assumptions, such as plug loads and process loads
- HVAC design and operating schedules
- Synchronizing energy with indoor air quality requirements
- Lighting systems and operating schedules
- Equipment efficiency data from manufacturers
- Right-sizing systems
- Passive design strategies
- Minimizing “value” engineering that results in a lower first cost while increasing operational expenses

Comparing energy use of HVAC systems to the ENERGY STAR design score



Source: Moseley Architects

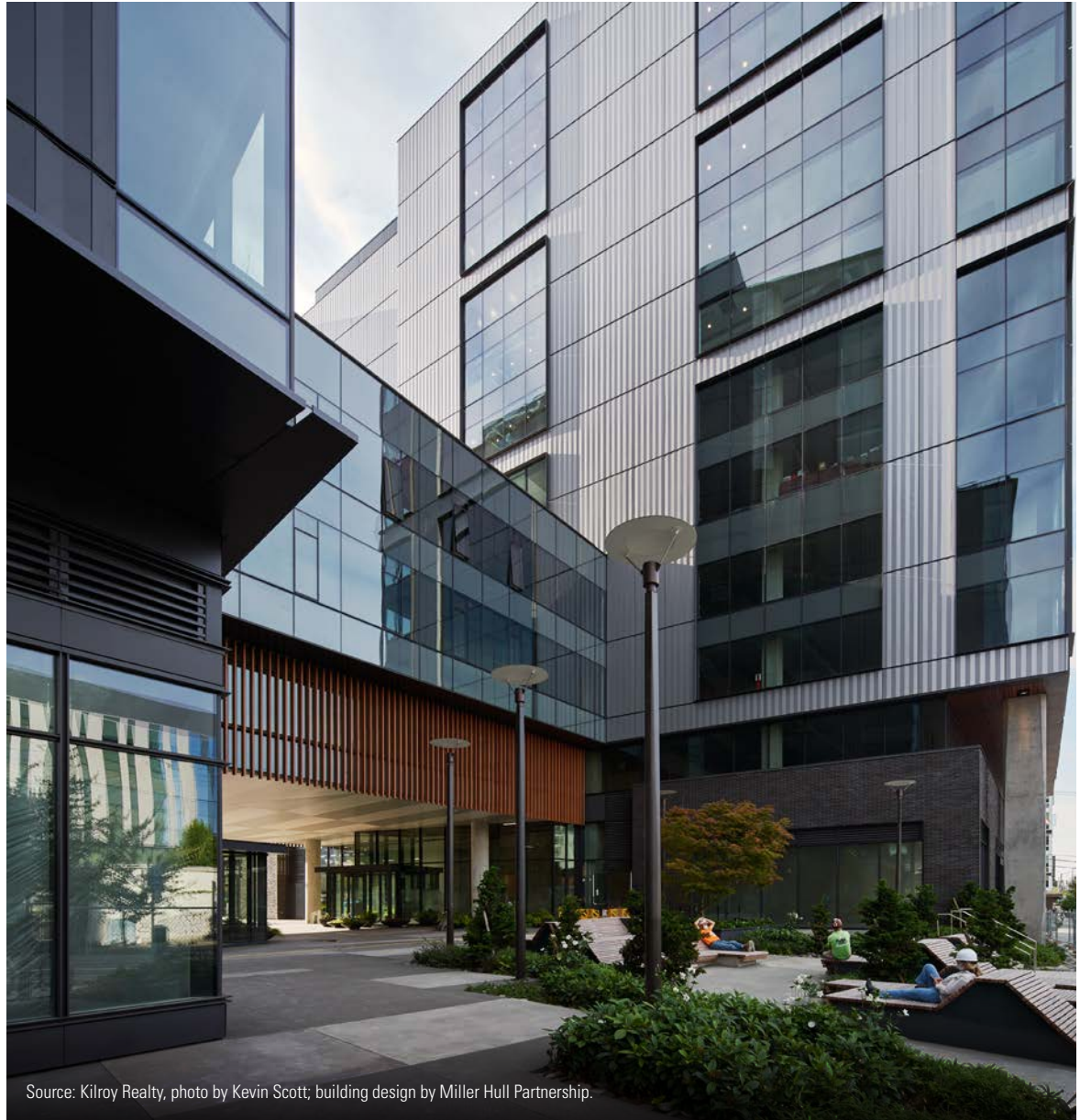
ENERGY STAR Target Finder and Portfolio Manager tools to determine whether the project is on track to meet the target.

Design development

Perform energy analyses of various design strategies, mechanical systems and components, lighting, and other end-use equipment, including process and plug loads, to understand their impact on energy. Model all anticipated energy use of the building. Account for whole building energy use by accurately reflecting real-life activity and energy use for the operating building. Compare design energy estimates to the target and national median. Use realistic values for simulating energy to gain confidence that the design project will achieve the ENERGY STAR or the desired performance goal.

If the design does not meet or exceed the target, continue investigating efficiency strategies until the target is achieved. Use the Target Finder or Portfolio Manager tools at each stage throughout the process to account for whole building energy use results. Specify ENERGY STAR certified products that deliver superior energy efficiency without trade-offs in performance or functionality.

Learn more: [ENERGY STAR Product Finder](#)



Source: Kilroy Realty, photo by Kevin Scott; building design by Miller Hull Partnership.

3

DOCUMENT ENERGY INTENT

Contract and construction documents

Once design energy meets or exceeds the target, state the intended target in contract documents.

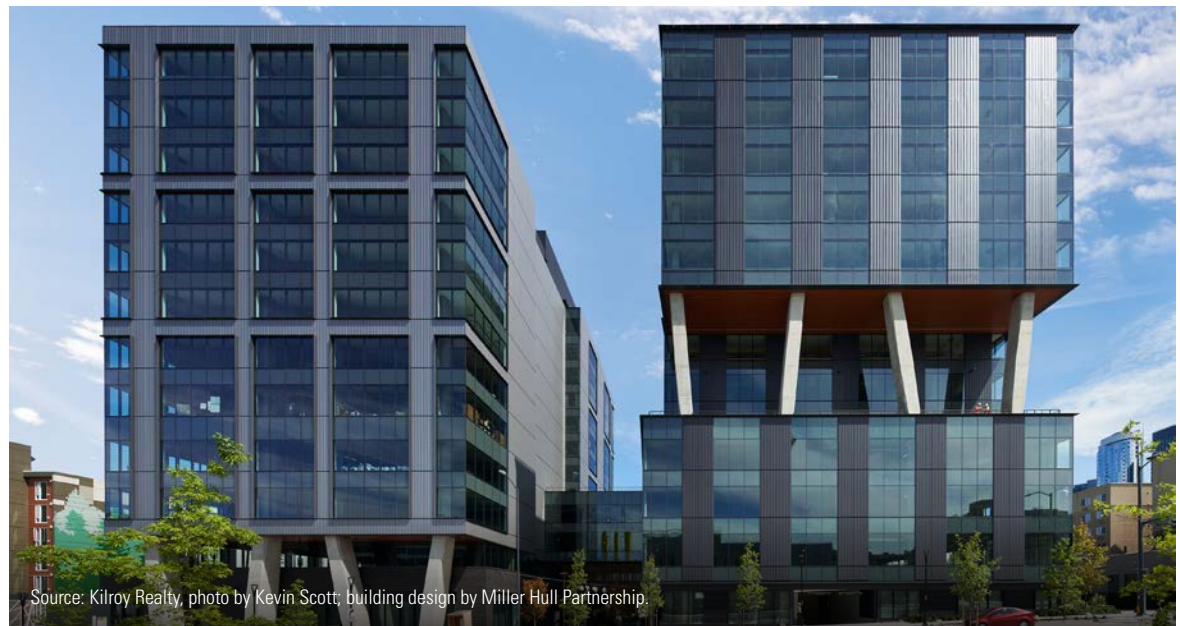
The construction document phase consists of preparing the drawings and establishing specification requirements for constructing the project. The contract documents should include the energy target, a detailed account of energy efficiency strategies, technologies, and how energy specifically relates to each component, and construction methods.

- Include energy goals in specification documents, such as the [ENERGY STAR Specification for Pursuing Energy Efficiency Goals](#).
- Include the ENERGY STAR Statement of Energy Design Intent generated by Portfolio Manager or Target Finder to document the intended energy use goal. For eligible projects, use this document to apply for EPA's Designed to Earn the ENERGY STAR recognition.

- Include manufacturers' technical literature for energy systems and components, and contact information for technical representatives associated with specific energy efficiency products and materials.
- Supplement the literature with the design team's summaries of intended operation and energy use. Explain the anticipated functions of

features to assist the construction team in understanding the desired outcome.

- Seek incentives and recognition for meeting the energy performance goal. Local utility companies may offer rebates to offset costs. [Find rebates, incentives, and financing services for energy projects](#).



4

RECOGNIZE ACHIEVEMENT

Designed to Earn the ENERGY STAR is awarded at completion of the contract document phase (and up until the building starts generating energy bills) for commercial new construction projects that meet EPA eligibility criteria to receive a 1-100 ENERGY STAR design score of 75 or higher. There is no fee to apply for and receive recognition from EPA. The application is executed by the architect of record (AOR) and submitted to EPA for approval and provides third-party verification that the design project achieved ENERGY STAR certification.

Apply for Designed to Earn the ENERGY STAR certification

Eligibility and application overview

- Achieve a 1-100 ENERGY STAR design score of 75 or higher for total annual estimated energy use for commercial new construction projects.
- Verify information on the Statement of Energy Design Intent (SEDI) document generated from Portfolio Manager.
- Apply to EPA for Designed to Earn the ENERGY STAR certification.

Receive additional recognition on the ENERGY STAR website for the project.

- Submit an [ENERGY STAR Design Profile](#) with the application to be posted on the website.

For detailed instructions, see [How to apply for the Designed to Earn the ENERGY STAR](#).

Benefits for organizations

- See list of [projects and architects to achieve Designed to Earn the ENERGY STAR](#).

Architect of record

The AOR is eligible to join the ENERGY STAR partnership once an application is approved for Designed to Earn the ENERGY STAR certification. The AOR is provided with:

- Use of ENERGY STAR partner logo for company marketing materials.
- Access to all graphics and logos through the ENERGY STAR Partner online portal.

Steps to Apply for the Designed to Earn the ENERGY STAR



- A competitive advantage with clients for delivering an ENERGY STAR recognized building design.
- Associate with the brand recognized for energy efficiency by more than 90 percent of American households and businesses.
- Be featured in ENERGY STAR publications and on the website.
- Be eligible to apply for ENERGY STAR Partner of the Year award.

Building owners/developers

Receiving Designed to Earn the ENERGY STAR certification signals to investors, state and local officials, and the public that the property, once built and operated, is intended to perform among the Nation's top 25 percent of buildings. Top reasons why owners benefit is because their buildings are intended to:

- Cost less to operate,
- Reduce their carbon footprint,
- Fulfill energy benchmark requirements (where applicable),
- Increase rental and occupancy rates and property asset values, and
- Achieve their energy performance goal and earn ENERGY STAR certification.

Marketing and promotional materials

Designed to Earn the ENERGY STAR certification mark

The certification mark may be used on collateral and materials promoting the approved Designed to Earn the ENERGY STAR certified projects. Using the mark requires adhering to strict ENERGY STAR brand guidelines. See using the [ENERGY STAR brand guidelines](#).

Press release/internal communication/social media

Promote designs that achieved Designed to Earn the ENERGY STAR certification. Issue a press release, internal memo, or posts on social media to share the accomplishment with clients, the project team, employees, prospective tenants, legislative officials, community groups, and the media.

- Sample press release: [Project has achieved Designed to Earn the ENERGY STAR](#)

Design profile for the ENERGY STAR website

Share best practices on creating designs that achieved ENERGY STAR certification and get recognition on the EPA website.

- Designed to Earn the ENERGY STAR: [Sample building design profile](#)

TIP

Use the Designed to Earn the ENERGY STAR certification mark on collateral promoting your achievement in advertisements, case studies, architectural drawing title block, banners and signage at the construction site, and on other promotional materials.



Designed to Earn the ENERGY STAR graphic and description from the ENERGY STAR brand book.

5

MEASURE ENERGY PERFORMANCE

Commission the building

Once the building is turned over for occupancy, start the commissioning process by verifying that the building functions as intended and conveying the intended performance to the building management team.

Commissioning activities

- Refer to commissioning activities in the project contracts.
- Communicate design intent during commissioning to ensure that the energy goal is met.
- Use ENERGY STAR Portfolio Manager to measure and track the building's energy performance as soon as energy bills are generated.
- Finalize and transfer technical documents to the building's operations and maintenance staff, include manufacturers' literature for systems and components and associated energy use.
- Supplement the technical literature with summaries of intended operation. Provide additional explanations for innovative design features.

Benchmark energy performance

Benchmarking energy performance is where all activities done during design, construction, and commissioning come together and are key to understanding performance, consumption, and whether the energy goal was achieved. Begin benchmarking at building startup and as measurement and verification routines are performed to ensure that systems are fine-tuned to meet occupant needs and the building is operating as intended.

Learn more: [Use Portfolio Manager for benchmarking any type of building](#)

Earn ENERGY STAR certification for the building

Earning ENERGY STAR certification is the pinnacle of success! These buildings save energy, save money, and help protect the environment by generating fewer greenhouse gas emissions than typical buildings.

The eligibility criteria are similar to achieving ENERGY STAR for the design, except that performance is measured by how much and how

efficiently the building uses energy. Certification is awarded to commercial properties that meet EPA eligibility criteria and there is no fee to apply.

ENERGY STAR certification overview

- Receive an ENERGY STAR score of 75 or higher for the building's total annual energy use.
- Verify energy data on the Statement of Energy Performance.
- Submit the application through Portfolio Manager for ENERGY STAR certification.

For existing buildings, see [How to apply for ENERGY STAR certification](#).

ENERGY STAR Tenant Space

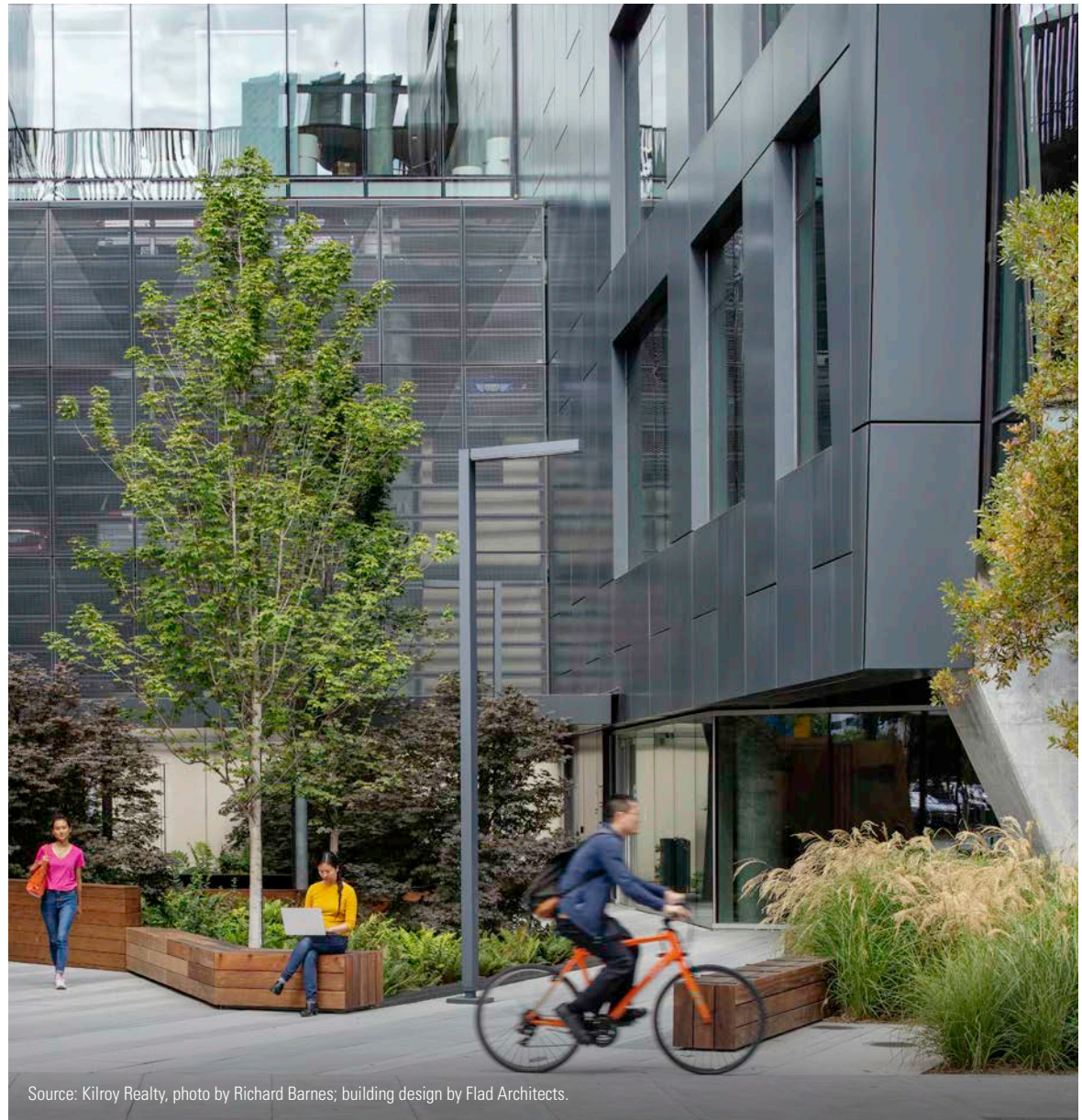
Use ENERGY STAR Tenant Space to improve energy efficiency by measuring and managing energy use in leased office space to lower energy bills and GHG emissions from commercial buildings. Tenants who lease office space in U.S. properties may be eligible to earn recognition from EPA and can contribute to enhancing overall building energy performance.

Learn more: [ENERGY STAR Tenant Space](#)

Comparing energy design intent to building performance

Once the building is commissioned and fully occupied, energy use can be tracked in Portfolio Manager using the same record used to input design estimates. The “Design” tab displays design energy estimates and actual energy use side-by-side in tables and graphs. These comparisons can be viewed for an individual property or for a group of properties using the custom report feature.

For properties that earn the ENERGY STAR, architects and building owners/developers can gain a competitive advantage by showing that they achieved a superior energy performing building.



Source: Kilroy Realty, photo by Richard Barnes; building design by Flad Architects.

Designed to Perform: ENERGY STAR certified K–12 schools

Loudoun County Public Schools (LCPS) located in Virginia are committed to achieving performance goals that received Designed to Earn the ENERGY STAR and ENERGY STAR certification for its energy design intent and operating energy performance.

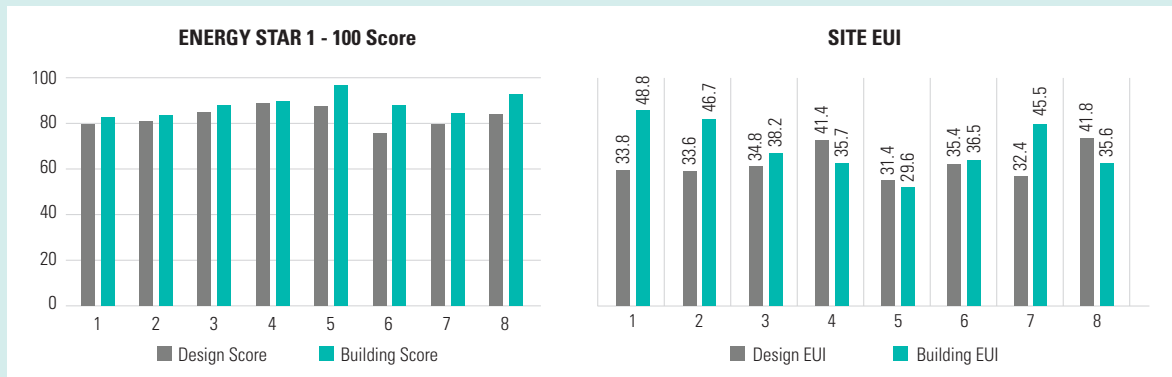
LCPS engaged its architecture teams by specifying energy targets early in design to meet or exceed an ENERGY STAR score of 75 or higher for nearly 20 schools starting in 2011. More than half of the schools are built and operating and have earned ENERGY STAR certification. The remaining projects are either under construction or awaiting sufficient energy data to complete school certification.

The projects and buildings shown in the graphic all achieved an ENERGY STAR score of 75 or higher with an average design score of 82; while the average school score was 88 averaging 7 percent better than the design score. On the other hand, the average design EUI was 36 and the average building EUI score was 40. The school EUI is 10 percent higher than design EUI, but in most cases, LCPS exceeded its design goal and many schools performed better than designed!

The graphs do not represent weighted averages, which partially accounts for the EUI being slightly higher for the operating schools while achieving



Brambleton Middle School, LCPS. Source: MTF Architecture; Photo by Eric Taylor



The graphs display ENERGY STAR scores and EUIs for eight design projects and the operating schools using data downloaded from the ENERGY STAR Portfolio Manager tool.

higher scores. See the Appendix for [Improve the Predictive Power of Design Energy Estimates](#), which explains why design estimates can vary from

operations and how ENERGY STAR tools can help specify targets and evaluate energy performance during design and operations.

Source: Waxpool Elementary School, LCPS, photo by Chris Cunningham Photography; building design by Moseley Architects.



Appendix

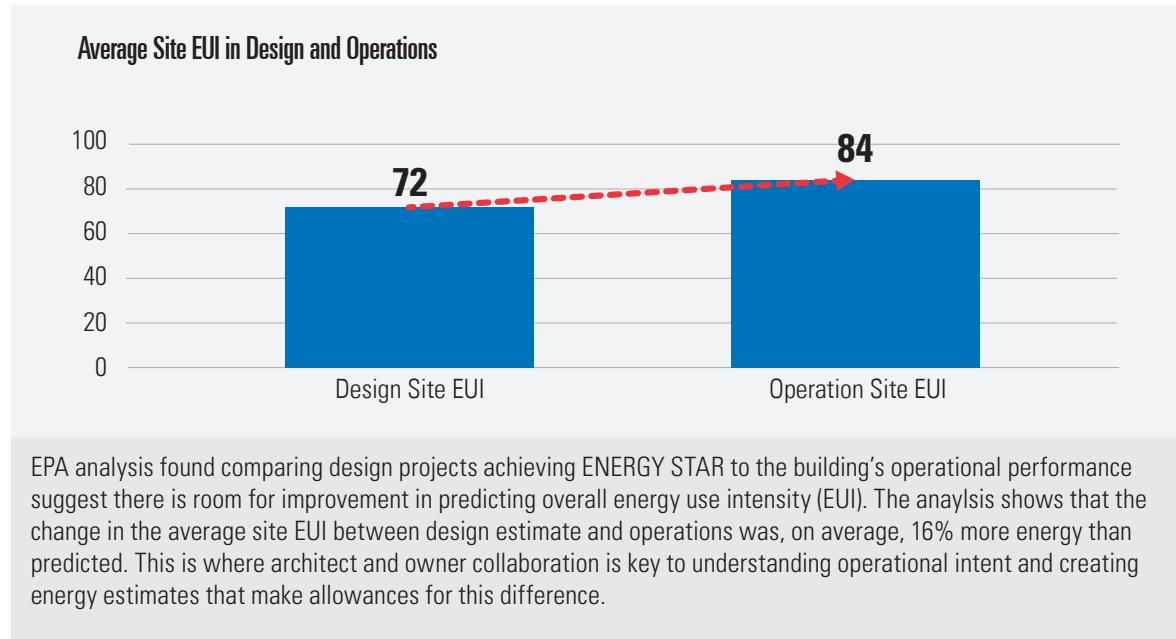
- **Improve the Predictive Power of Design Energy Estimates**
- **Establish a Metering Plan**
- **Energy Performance-based Procurement**

Improve the predictive power of design energy estimates

Discuss the expected building operating patterns early in the design process to develop realistic building use details for the number of workers, number of computers, operating hours, etc. Adhere to Property Type and Property Use Details as defined by ENERGY STAR when entering data in the Portfolio Manager/Target Finder tools.

Input building-specific use detail estimates, and not default values, when modeling and simulating energy use.

- The largest driver in the difference between the design and operational ENERGY STAR score is energy use intensity (EUI). EPA found that the change in the estimated site EUI between design and operations, on average, used 16.4 percent more energy than predicted. Conversely, the reverse was true for the ENERGY STAR design scores, which were, on average, 8 points higher than operating building scores.
- Creating a buffer for design estimates is prudent when modeling energy for the expected building performance, allowing for operational deficiencies, increased plug loads, and the learning curve for staff and occupants to settle into an operational routine.



Use relevant assumptions for occupancy and operations schedules for different building types.

- Understand that the approach for estimating the number of workers for offices may differ from the approach for estimating the number of workers for retail/supermarket.

Consider developing a range of energy performance estimates based on a range of building use activities.

- Develop a moderate operations estimate.
- Develop a full-capacity estimate.

Continue communicating after the design project is built and operating.

- Investigate the differences between design energy estimates and operational outcomes.
- Apply lessons from previous projects to build better estimates for future projects.

Establish a metering plan

As with all building systems, the most cost-effective time to implement the metering system for a building is during its design. Create a metering strategy tailored to the specific requirements and objectives of the building stakeholders, for example, tenant billing and energy reporting, etc. Plan to install individual meters for all utilities and consider the type of metering that is best for the project.

The project requirements will dictate the type of metering that is best for the project: building-level, system-level, or a combination of both. Install sub-meters on a building-by-building basis with one meter measuring every utility entering the building; water, electricity, and natural gas will all have separate meters. For large or complex buildings, building-level metering may not be sufficient to conclusively reveal which systems are consuming resources and could be enhanced by system-level meters.

System-level meters track the energy and water usage of specific systems within the building to see precisely how resources are being consumed. Sub-meters should be installed on energy and/or water-intensive systems, including heating, ventilation and air conditioning; plug loads and irrigation, etc.

Another metering consideration are those for onsite renewable energy systems. These systems have become more prevalent in commercial buildings

over the past decade and continue to grow. This trend necessitates the need for reliable information on how much energy generated by these systems is being consumed by the building. The plan should include metering that accurately reports onsite renewable energy production, consumption and export for benchmarking and other performance indicators to understand the building's efficiency and for selecting the right mix of cost-effective strategies to achieve deep emissions reductions.

Learn more: [Commercial Buildings and Onsite Renewable Energy](#)

A successful metering plan can provide more precise energy data for developing energy design targets, as well as for benchmarking annual building energy consumption in tools such as the ENERGY STAR Portfolio Manager to help guide decisions for investments in energy efficiency to achieve performance goals.

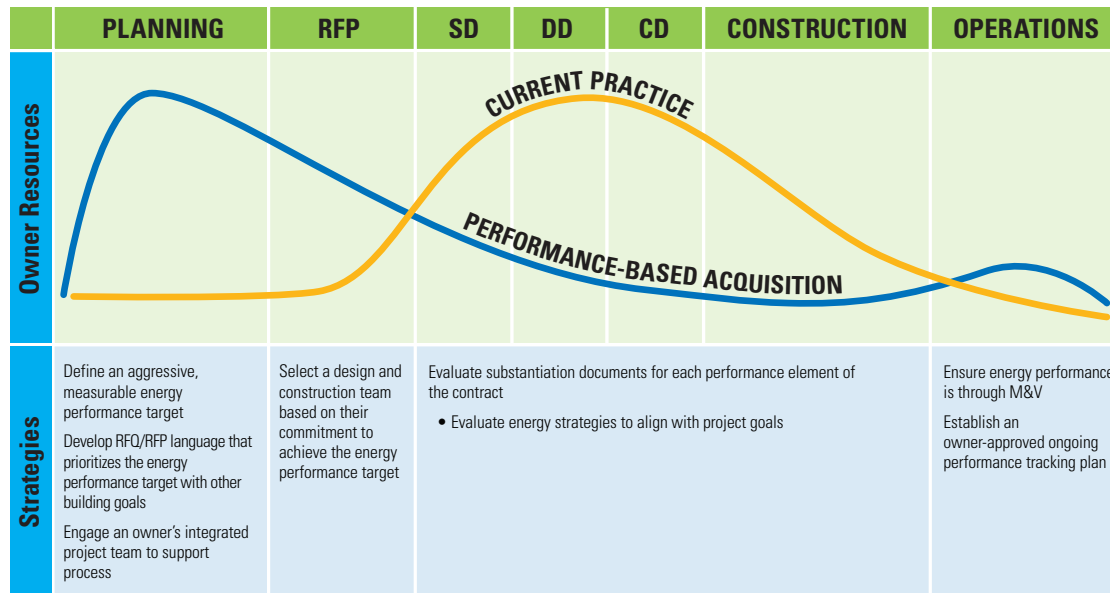


Energy performance-based procurement

The performance-based energy curve from the 2016 American Council for an Energy-Efficient Economy (ACEEE) Summer Study paper, “Accelerate Performance Empowers Owners: Case Studies,” University of Chicago, shows how considering energy early in design helps align strategies that

support energy, greenhouse gas emission, and cost reduction goals while focusing on important concepts such as maintainability, comfort, and the energy performance of the building.

Performance-based energy curve



Source: Verified! How Performance-Based Procurement Can Boost New Construction Program Savings and Empower Building Owners, 2016 ACEEE Summer Study on Energy Efficiency in Buildings

TIPS

Energy performance-based procurement steps, includes:

- Set a firm project budget during planning.
- Specify a whole building EUI target.
- Align project metrics with performance criteria and prioritizing goals:
 - Mission-critical – Critical to project success and absolutely required
 - Highly desirable – Contribute to project success and owner satisfaction
 - Supplemental – Highly beneficial when included in the solution
- Assemble RFP document.
- Invite design and construction teams to propose solutions that meet goals.
- Select a team, in part, that demonstrates the ability to meet the EUI target.
- Review energy analysis throughout the project lifecycle.
- Establish a measurement and verification plan to assess energy performance for building operation.



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