Bullitt Center's Energy Performance

Introduction

In 2007 Congress created a Zero Net Energy Commercial Buildings Initiative with a goal of achieving a market transition to Zero Net Energy for new commercial buildings by 2030. The Bullitt Center will meet that goal in 2013.

The Bullitt Center will achieve extraordinary levels of energy efficiency through integrated architectural and engineering design, cutting edge technology and components, carefully selected building materials, and conscious choices by tenants who care about their environmental footprints. These elements will reduce the six-story building's annual energy requirement to the point where it can be provided by a solar array on the building's roof.

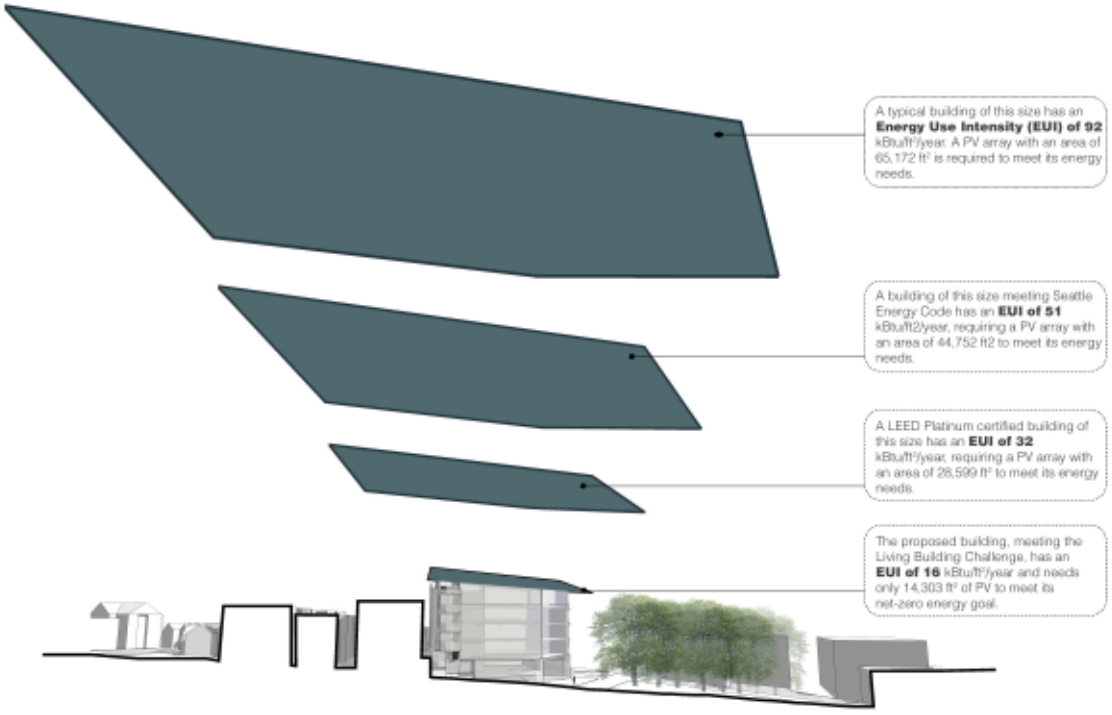

Figure 1. Matching Energy Use to on-site Generation Capacity

Building Design Strategies

High performance envelope
The building envelope greatly exceeds the Seattle Building Code requirements, using a triple-glazed curtainwall system that originated in Germany and will now be produced locally. The well-insulated walls have been designed to eliminate thermal bridging and dramatically reduce air infiltration.

Building massing and orientation, as well as glazing selection, control heat gain. To the extent possible on a compact, 5-sided urban site, major glazing areas face south and north to improve daylighting and solar control. The building's windows (which open and close automatically in response to conditions outside) were selected for optimal control of heat loss and solar gain while maintaining superb visibility for daylighting.

Analysis shows that increasing the thermal performance of the envelope beyond current levels would have little overall impact on energy use in the proposed building.

Closed-loop geothermal system and Ventilation
The Center's very modest heating and cooling loads are met by ground source heat pumps and on-site geothermal wells. Water loops provide comfortable radiant heating and cooling to the office spaces. Ventilation is provided through a dedicated 100% outside air unit with an air-to-air heat exchanger, so that incoming fresh air is pre-conditioned by outgoing air.

Radiant floor heating and cooling with passive cooling and natural ventilation
Operable shading systems are designed for glare control to further mitigate solar heat gain. Operable windows provide free cooling and ventilation when ambient conditions are right

Daylight dimming and efficient lighting design
Lighting loads in office spaces have been limited to 0.4 Watts per square foot, less than half the 0.9 W/ ft^2 currently allowed under the Seattle code. Automatic controls will dim or turn off the LED lights when daylight provides adequate illumination.

Aggressive reduction of plug loads
Plug loads for office equipment, such as computers, monitors, servers, printers, and copiers, will be limited to a maximum of 0.8W/ft^2 (and this will be significantly reduced by plug load occupancy sensors).This is approximately half the 1.5W/ ft^2 typical for new office buildings, but it still allows for a computer-intensive environment. Tenants will employ the most efficient state-of-the-art equipment that meets their professional needs.

Energy Performance Modeling and Results

A complex modeling approach was used to project energy use in the building so as to confirm net-zero-energy operation. The primary energy model was developed in EQuest to project the final energy use, but this model was integrated with other models and calibrated using other design tools.

Comfort and airflow analysis was done in TAS. The airflow model was used to evaluate indoor and outdoor temperatures, and estimate the extent to which people were comfortable and needed cooling. The airflow model was also used to project whether

windows would be open or closed during each hour of the year, and these data points were input directly into the energy model.

Daylight modeling was used to support the design of a space that could be daylit for most of the occupied hours in a year. Once the design was set, the daylight model was used to generate performance metrics that were then used to calibrate the EQuest daylighting calculations to ensure the energy model was adequately estimating lighting energy consumption.

Net zero energy design requires predicting actual energy use. This is in contrast to a comparative approach used in green rating systems such as LEED or in code compliance, where the proposed design is compared to the same building built to a baseline code or standard. As a result, the design team needed to make sure the modeling for this project was robust enough to have confidence in the predicted energy use. Sensitivity analyses were used to study what was important for energy use.

Based on the efforts above, the design team estimated end use energy consumption as shown in Table 1 and graphically displayed in Figure 2. The building heating, cooling, ventilating and pumping energy combined are only 3.96 kBtu/SF-yr, or approximately one-quarter of the total building energy use. Another quarter is for electric lighting and domestic hot water. The remainder is what has typically been called "plug loads," but which is actually devices that plug into receptacles and which is not typically addressed by energy codes or green building standards.

Table 1. Projected Annual End Use Energy Breakdown

Lights	53,000 kWh
IT Server	20,000 kWh
Computers, Monitors, Printers, Copiers and other misc equipment	104,000 kWh
Space Heating	6,000 kWh
Space Cooling	5,600 kWh
Pumps (includes pumps to run water treatment system at about 5000 KWH/yr):	21,000 kWh
Ventilation fans	12,000 kWh
Elevator	7,000 kWh
Domestic HW	7,800 kWh
TOTAL	236,400 kWh

note: multiply kWh values by 3.412 to convert to kBtu

The resulting EUI (Energy Use Intensity) for the project is as follows:

- Gross Floor Area in square feet: 52,000 SF
- Energy Use, as EUI (Energy Use Intensity): 16 kBtu/SF-yr
- Baseline 2030 EUI, from Target Finder: 92 kBtu/SF-yr
- Savings over 2030 Baseline: 83%

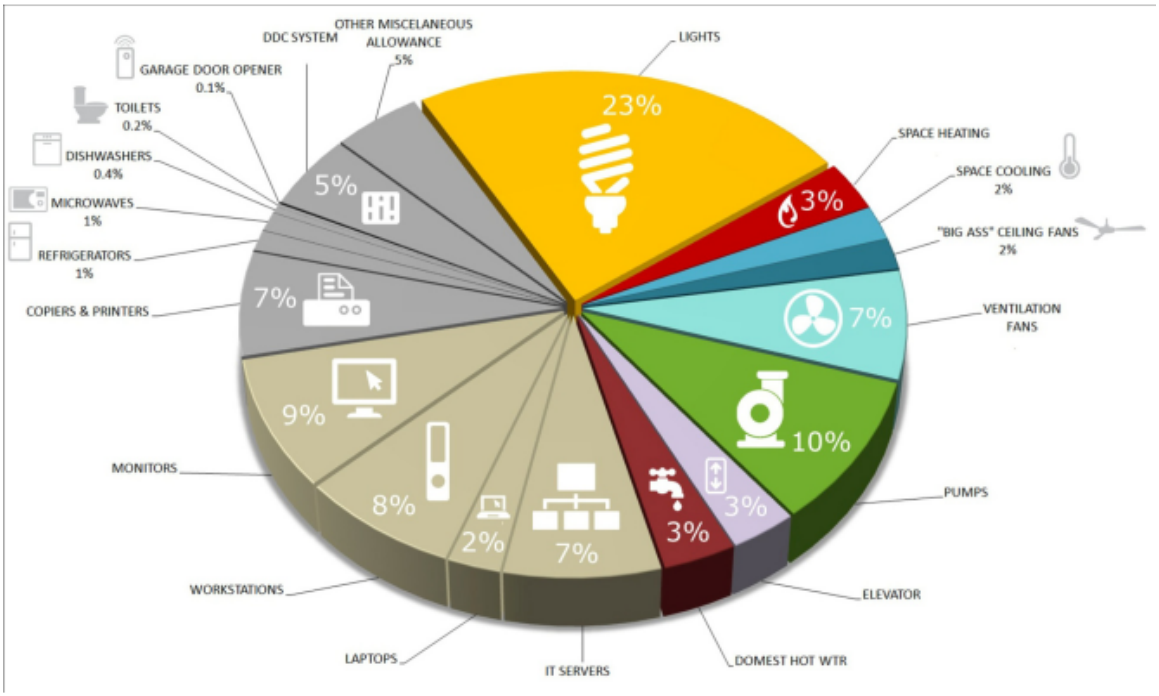

Figure 2. End Use Energy Breakdown

Comparisons with Other High-performing Buildings

There is a lack of good data on high-performing buildings in North America, but from the data that is available it appears the Bullitt Center will perform at the forefront of energy efficiency.

The U.S. Department of Energy (DOE) “Zero Energy Building” database currently contains no comparable buildings. The only urban commercial building is a single-story, 6,500 square foot lighting consultancy on the outskirts of San Jose, CA. The other net zero buildings are nature centers, recreation centers, and classroom buildings, all but two of which (a 3,500 square foot tennis club and a 2,200 square foot instructional facility) have higher EUIs than the Bullitt Center. (http://zeb.buildinggreen.com/)

In the DOE “High Performance Building” database, the Bullitt Center is significantly more efficient than any comparably sized urban commercial building currently listed. (http://eere.buildinggreen.com/mtxview.cfm?CFID=104739059&CFTOKEN=76487704)

While the design team is confident in taking these many steps to push the limits of building performance, this is not a competition with winners and losers. All the buildings in these databases have taken important strides in the right direction, and while the Bullitt Center plans to take yet another step forward, it is expected to be surpassed soon in this vibrant, creative field.

ENERGY STAR® Statement of Energy Design Intent (SEDI)[1]

The Bullitt Center

N/A

ENERGY STAR® Design Score[2]

Primary Property Function: Office

Gross Floor Area (ft^2): 52,000

Estimated Date of Certification of Occupancy: _____

Date Generated: January 23, 2014

1. This form may be used to apply for the ENERGY STAR Designed to Earn. This form was generated from Portfolio Manager's target finder: http://www.portfoliomanager.energystar.gov/targetfinder.
2. The ENERGY STAR Score is based on total source energy. The scale is 1-100. A score of 75 is the minimum to be eligible for the ENERGY STAR.

Property & Contact Information for Design Project

Property Address	**Project Architect**	**Owner Contact**
The Bullitt Center 1501 East Madison Street Seattle, Washington 98122	____ _____ , (____)____-_____ _____	____ _____ , (____)____-_____ _____
Property ID: 3954312	**Architect Of Record**	**Property Owner**
	_____ _____ _____, ____ _____ (____)____-_____	_____ , (____)____-_____

Estimated Design Energy

No estimated energy information provided.

Estimated Design Use Details

Office	
Gross Floor Area	52,000 Sq. Ft.
Percent That Can Be Cooled	50 % or more
Percent That Can Be Heated	50 % or more
Number of Computers	175
Number of Workers on Main Shift	175
Weekly Operating Hours	70

Design Energy and Emission Results

Metric	**Design Project**	**Median Property**	**Estimated Savings**
ENERGY STAR Score (1-100)	**N/A**	50	N/A
Energy Reduction (from Median)(%)	**N/A**	0	N/A
Source Energy Use Intensity (kBtu/ft2/yr)	**0**	230	230
Site Energy Use Intensity (kBtu/ft2/yr)	**0**	91	91
Source Energy Use (kBtu/yr)	**0**	12,006,800	12,006,800
Site Energy Use (kBtu/yr)	**0**	4,768,400	4,768,400
Energy Costs ($)	**0**	88,843	88,843
Total GHG Emissions (MtCO2e)	**0**	441	441

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ENERGY STAR® Portfolio Manager®

Portfolio Manager

- Help

Target Finder Results

Based on the information you have provided, we have calculated metrics to help you understand the energy efficiency associated with your current design and/or target (jump to the detailed table below). For a print out of this information, you can download your Statement of Energy Design Intent.

Score for Your Design

N/A
Your design does not meet the requirements to calculate a score. Learn more about ENERGY STAR scores.

Download Your Statement of Energy Design Intent (SEDI)
This document provides an overview of your design and metrics. It is also used for Designed to Earn the ENERGY STAR applications.

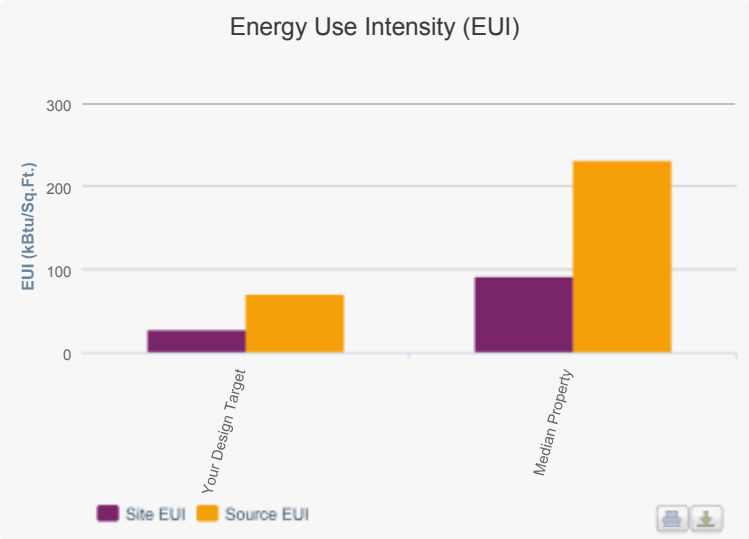
Download & Print Statement

About this Property's Design

Target:	Target ENERGY STAR Score: 100
Uses:	Office (100.0%)
Energy Types:	Energy Not Entered *Assumed Mix Based on State & Property Type*: Electric - Grid (70.2%) Natural Gas (29.8%)

Edit


Enter estimated energy use for your design to see how it compared to your target and typical properties similar to yours.



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Metrics Comparison for Your Design and/or Target

Metric	Property Estimate at Design	Design Target*	Median Property*
ENERGY STAR score (1-100)	Not Available	100	50
Source EUI (kBtu/ft²)	Not Available	68.8	230.9
Site EUI (kBtu/ft²)	Not Available	27.3	91.7
Source Energy Use (kBtu)	Not Available	3,577,427.2	12,006,800.0
Site Energy Use (kBtu)	Not Available	1,421,326.0	4,768,400.0
Energy Cost ($)	Not Available	26,481.75	88,843.50
Total GHG Emissions (MtCO2e)	0.0	131.7	441.8

* To perform calculations for your design target, we use the fuel mix that you've entered for your design energy estimates. If you have not entered estimated design energy, we'll use the average for your state. To perform calculations for the national median, we will assume the fuel mix and operational details of your property measurement in use, if available. Otherwise, we will use your design estimates.

Save Your Design?

By saving your design in Portfolio Manager, you can continue to work with your design and eventually track energy consumption after the property has been constructed and is in use.

- I want to create an account in Portfolio Manager and save my design
- I already have an account in Portfolio Manager and want to save my design