BUILDING PERFORMANCE SUMMARY
Lewis and Clark State Office Building

STUDY BACKGROUND

The following report summarizes information gathered for the U.S. Green Building Council's (USGBC's) study of the actual energy performance of Leadership in Energy and Environmental Design (LEED) New Construction (NC) buildings. The information in this report comes from data provided by the building owner and from energy modeling information included with the original submittals for LEED certification. The report contents are shown below:

Section I: Building Description

Section II: Energy Performance: Does the building use resources efficiently?

Section III: **Occupant Survey**: Does the building meet the needs of the occupants?

Appendices include definitions of terms and survey details.

SECTION I. BUILDING DESCRIPTION

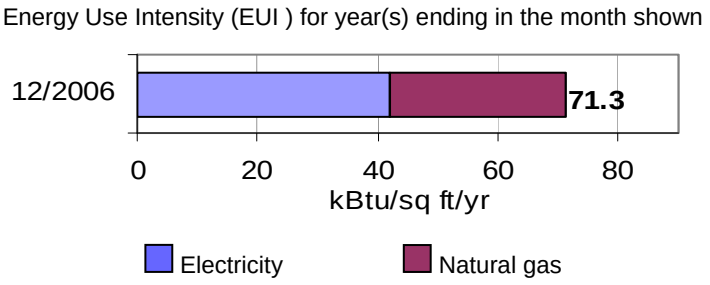
Building	**Lewis and Clark State Office Building**	
Type	Commercial Office	
Address	1101 Riverside Dr Jefferson City, MO	
Year completed	2005	
Size (gross, non-parking, conditioned area)	120,000 square feet	
LEED level / year	**Platinum**	**2006**
Energy optimization points (EAc1)	10 (LEED EA Credit 1 range is 0 to 10)	
Known variations from initial design	None reported	
Occupancy		
Counts	**Staff**	**Computers**
	350	400
Usage	**Typical hrs/week**	**Months/year**
	55	12

Features	
Shell	Increased insulation Reflective roofs Thermal energy storage Insulating glass (i.e. 2 or more panes) Tinted glass High performance glass
HVAC	Underfloor air distribution Energy monitoring systems High efficiency condensing boilers
Ventilation	Natural ventilation Operable windows
Lighting	Daylighting Interior window blinds Exterior window shading
Onsite Renewables	Solar PV Solar hot water heaters

SECTION II. ENERGY PERFORMANCE

Actual usage by fuel

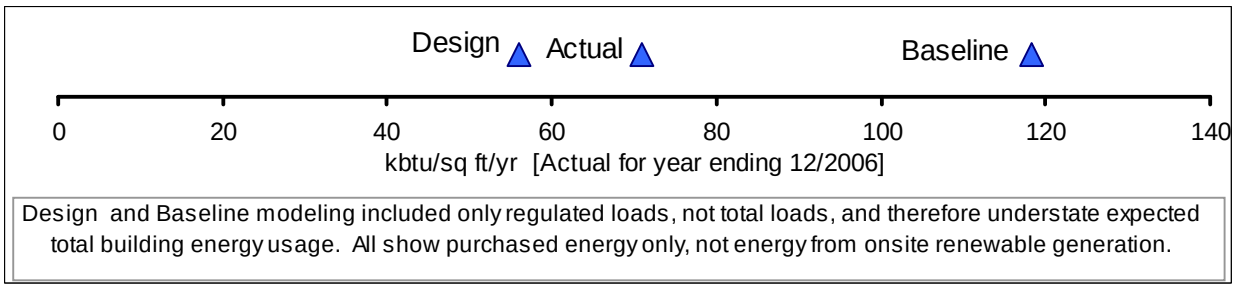
This graph shows total annual energy use by fuel. To add and compare use from a variety of fuels, all reported units (kWh, etc) are converted to thousands of Btus (kBtu). Totals are then expressed as an Energy Use Intensity (EUI) in kBtu/square foot to facilitate comparing with other benchmarks.



Comparison to initial LEED modeling

The graph below compares actual energy use to the modeled energy use from the building's submittal for LEED certification. The "Baseline EUI" represents a building without efficiency measures, in other words a similar but "just to code" building. The "Design EUI" is for the initially modeled building with all planned energy efficiency measures.

Actual energy usage at or below the Design EUI is a rough indicator that the building is performing as expected. However, a number of outside factors may also affect this result. Those factors can include differences between initial assumptions and actual conditions for: as-built structure and systems, occupancy level, activities conducted in the building, and building operating and maintenance practices.



National benchmarks

Energy Star is a program of the U.S. EPA that scores actual commercial building energy usage relative to the actual use of similar buildings nationwide, adjusting for weather variations and basic operating conditions of each building.

Scores, within a range of 1 to 100, represent the percentage of existing buildings that perform less efficiently than the rated building. For example, the score of 77 indicates that this building uses less energy per square foot than 77% of similar buildings.

The score here is an estimate only. See the Considerations section of the Appendix for further explanation of Energy Star requirements for official certification of an Energy Star building.

Best possible → 100

Median → 50

Lowest → 1

Your score is based on energy usage for the year ending 12/31/2006

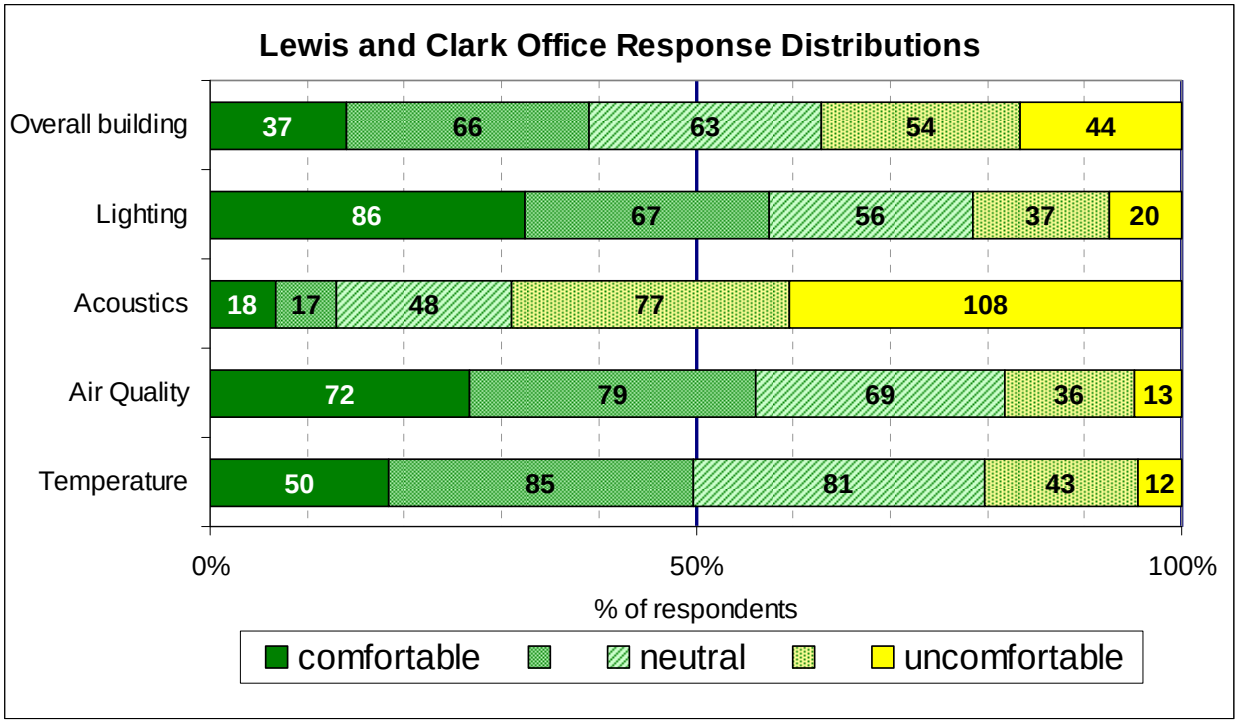
SECTION III. Occupant Survey

An online survey conducted from 3/26/2007 to 4/6/2007 gathered perceptions of the building's comfort from those who work in the facility. For the overall building and four major comfort dimensions, the graph below shows the percentage of respondents reporting each comfort level.

Survey counts

300	total invitations sent
279	respondents
93%	response rate

Percentage of total respondents, by comfort level



The section lengths within each bar show the percentage distribution of responses by comfort level. The numbers indicate respondent count.

The comfort dimensions of lighting, temperature, and air quality all showed approximately 80% of respondents comfortable or neutral.

- The amount of daylight was the single most positive lighting attribute. Glare from windows was the most often-cited source of lighting discomfort.
- For temperature, 75 – 80% of respondents were comfortable or neutral for most questions. The most common source of discomfort was temperatures that were too warm.

Acoustics represented the greatest discomfort source, with approximately 70% of respondents reporting discomfort. Dissatisfaction appeared to come from noise from adjoining spaces and general background noise

Appendix B contains more detail on survey results.

APPENDIX A: DEFINITIONS AND CONSIDERATIONS

Acronyms and Definitions

ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers. ASHRAE maintains standards for building equipment and performance. In particular, their specifications for building systems efficiency are often used as the basis of building codes and as the Baseline standard for LEED energy modeling.
Btu	British thermal unit. A general unit of energy. Here are some equivalents with a few other common energy units: 1000 Btu = 1 kBtu 0.293 kWh (kilo-Watt hours) 0.01 therms 1.055 mega-Joules (millions of Joules)
Conditioned area	The portion of a building that is heated and cooled, excluding unconditioned space such as unheated storage or parking.
Energy Star	A program of the U.S. EPA to certify products and buildings that meet energy efficiency standards. The Energy Star program for commercial buildings gives buildings a 1 – 100 score based on actual energy use. The score indicates the approximate percentage of similar buildings that use more energy per square foot than the rated building.
EUI	Energy Use Intensity. Annual building energy use per square foot. Expressed, in this report, in units of kBtu/sq ft/year.
HVAC	Heating, Ventilation, and Air Conditioning systems
LEED	Leadership in Energy and Environmental Design. The most widely used and accepted green building rating and benchmark system in the U.S... Maintained by the USGBC.
LEED Level	Certified, Silver, Gold, or Platinum: designating increasing scores (better ratings) on the LEED scale of green building.
LEED submittal	Information provided to the USGBC to obtain LEED certification. The LEED submittal information used in this report is from EA credit 1 energy modeling showing how much less energy the building is expected to use than would a similar building with no energy efficiency measures, i.e. built just to code. For most buildings in this report, "code" level energy use was approximated by ASHRAE 90.1 – 1999. This report uses the following terms to describe the levels of energy use modeled: Term — Alternative LEED term — Definition Baseline building — Budget — Energy use of a similar but "just to code" Design — Design — Energy use of a proposed building as designed, including all planned energy efficiency measures.
PV	Photo-voltaic, solar-generated electricity
Regulated loads	Energy end-uses covered by ASHRAE 90.1 building standards, and considered in determining the number of LEED energy optimization points (EA credit 1) that a building receives. Regulated loads do *not* include plug loads (i.e. things plugged in to power outlets) or other miscellaneous equipment. Thus, regulated loads may be significantly less than the total energy used in a building.
Unregulated loads	Energy end-uses that are not regulated by ASHRAE 90.1 standards. (See "regulated loads") These typically include energy uses that are associated with the activities of the occupants of the building as opposed to basic building lighting and HVAC systems.
USGBC	U.S. Green Building Council. An organization focused on promoting environmentally responsible, sustainable buildings. Develops and maintains the LEED rating system for green buildings.

Considerations

Energy Star Scores: The Energy Star scores provided in this report are preliminary estimates based on information submitted for the study. Scores of 75 or higher may qualify for an official Energy Star certification. The following actions and verifications would be needed to formally obtain such a certification.

- Make sure the year covered by the reported energy usage ends no more than 120 days before the certification date.
- Have a Professional Engineer verify the reported energy usage, other reported characteristics such as building usage, occupancy, and thermal comfort of the building, as specified in Energy Star's *Professional Engineers' Guide*.

More information about Energy Star for buildings can be found at the Energy Star website: https://www.energystar.gov/index.cfm?c=business.bus_bldgs

LEED Energy Modeling: The focus of this modeling is the anticipated difference between the designed building and a similar building built just to code. (See the LEED submittal definition on the prior page.) That difference determines the building's anticipated energy savings for LEED purposes.

As noted in the Energy Performance section of this report, assumptions made at the design stage may not reflect the final construction, systems, operation, or occupancy of the building. If a building is using more or less energy than the design model, the first question to answer may be whether material differences in these "as-built and operated" factors may partially explain that difference.

Questions sometimes also arise if an Energy Star score or other measure of actual building efficiency does not seem consistent with the number of LEED NC Energy Optimization points achieved by the building. Here are just a few of the possible reasons for such a difference:

- As noted above, the LEED points are based on modeled savings, in relation to code, at the design stage. Energy Star measures actual energy use after the building is occupied and determines the score in relation to actual energy use of similar buildings.
- LEED points are based on regulated loads (building systems and lighting only), while Energy Star (and most other reports of EUIs) include *all* energy uses in a building.

The LEED points are based on anticipated energy *cost* savings (in relation to code), while Energy Star is based on energy usage *amounts*. A unit of energy supplied by one fuel, such as electricity, may be more or less expensive than an equivalent unit of energy supplied by a different fuel, such as natural gas. Thus percentage savings in energy cost can differ from the percentage savings of energy use, and the difference will depend on fuel mix and energy prices.

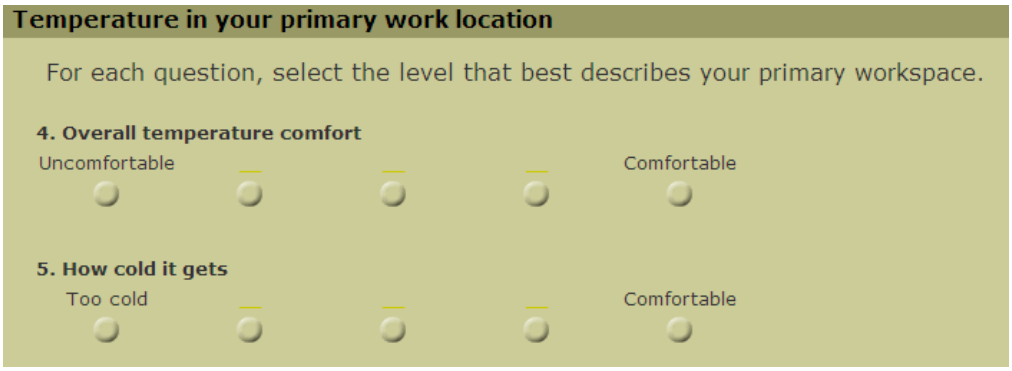
APPENDIX B: OCCUPANT SURVEY DETAIL

This section shows more detail from your occupant survey responses.

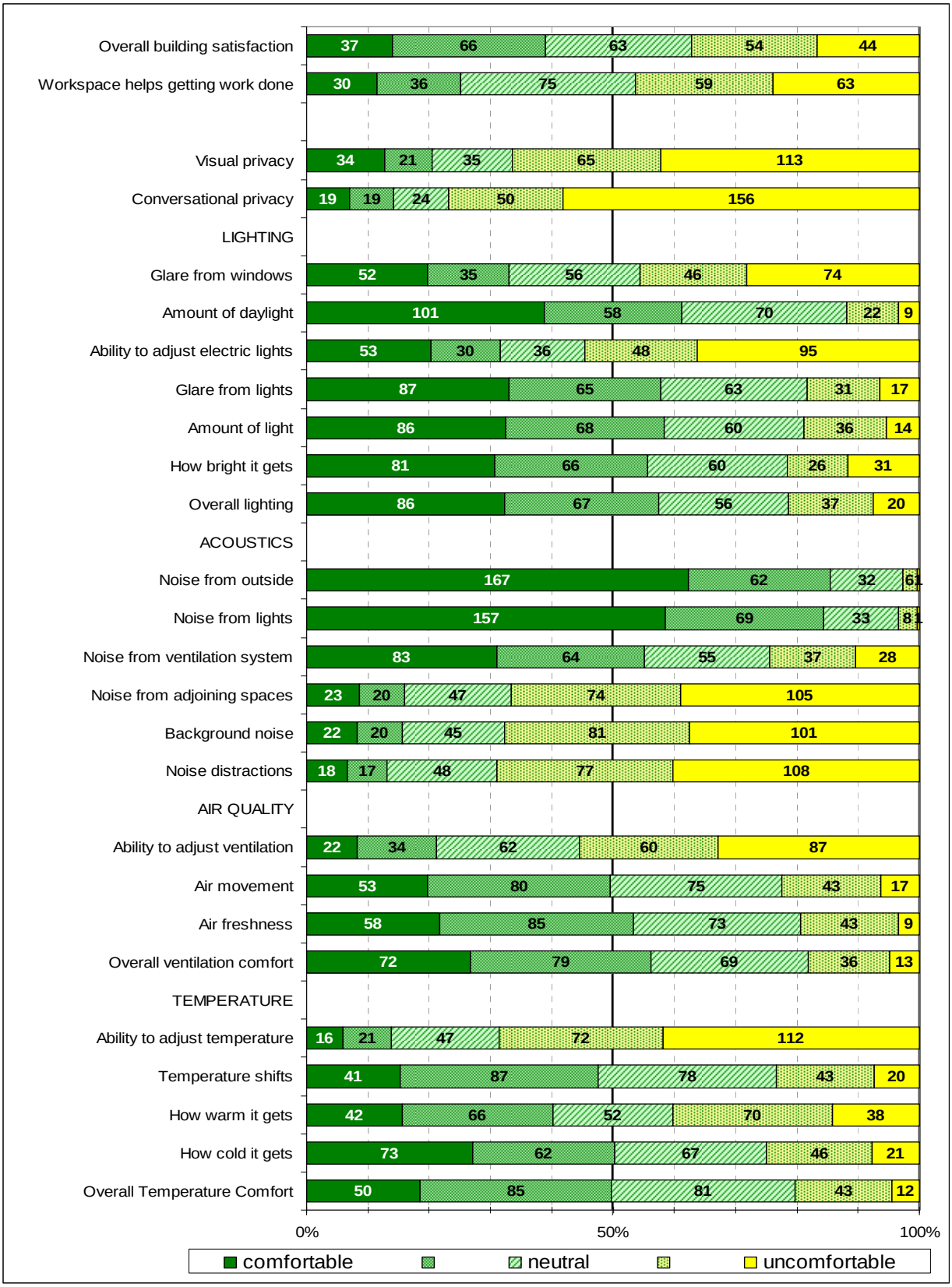
Survey conducted:	3/26/2007 to 4/6/2007
Invitations sent to:	300 staff
Response count:	279
Response rate:	93%

Response distributions: The following page shows the response distribution of each multiple-choice question in the survey. The section lengths within each bar show the percentage distribution of responses by comfort level. The numbers indicate respondent count. In general, longer solid green and light green bars on the left side indicate better comfort conditions.

All multiple-choice questions used a 5-point scale for responses in a format similar to this example:



The generic legend at the bottom of the chart on the next page shows the end-point labels "uncomfortable to "comfortable," which are representative of most of the question options. As illustrated above, some questions used a different wording for the "uncomfortable" end of the scale, for greater clarity. A few questions used other labels more appropriate to the information being elicited. Because of space considerations, those other differences are listed here, rather than on the following chart.

- Control Questions, such as Ability to Adjust Electric Lights, Ventilation, or Temperature used a scale ranging from "Poor or no controls" to "Works well"
- The question about whether the workspace helps getting work done used a scale ranging from "makes work more difficult" to "makes work easier."
- The question about the overall building satisfaction used a scale ranging from "dissatisfied" to "satisfied."

Response Distributions for Lewis and Clark State Office Building