

**Optimizing Urban Ecosystem Services:
The Bullitt Center Case Study**

STUDY HIGHLIGHTS

KEY FINDING

Just six of the Bullitt Center’s green features will produce up to \$18.5 million in benefits to society over the life of the building.

By ignoring such benefits, current regulatory and financial systems penalize green buildings and reward inefficient ones.

BENEFITS

| Feature | Annual benefit | One-time benefit | Present Value (at 4% discount rate) |
|---------------------------------|-----------------------|-------------------------|--|
| Site transportation | \$32,005 | \$0 | \$2,930,000 |
| Rainwater capture and reuse | \$9,665 | \$20,650 | \$910,000 |
| Composting toilets | \$7,450 | \$0 | \$680,000 |
| Energy efficiency | \$112,027 | \$0 | \$10,270,000 |
| Solar energy | \$35,776 | \$0 | \$3,280,000 |
| Forest Stewardship Council wood | \$0 | \$368,824 | \$370,000 |
| TOTAL | \$196,923 | \$389,474 | \$18,450,000 |

The valuations are highly sensitive to two factors:

- The discount rate applied to benefits in the future. The chart above assumes a rate of 4%, which the authors consider a more realistic discount rate for social benefits than current standard commercial discount rates.
- The social cost of carbon, which is an estimate of the economic damages associated with emission of one metric ton of carbon dioxide. This study used a social cost of carbon of \$200, which is based on work by leading researchers – Frank Ackerman and Elizabeth Stanton (LINK: http://www.e3network.org/papers/Climate_Risks_and_Carbon_Prices_executive-summary_full-report_comments.pdf)

BACKGROUND

The term “ecosystem services” emphasize the role of ecosystems in providing fundamental life support systems (food, water, air, etc.) to the human species.

Before the current Bullitt Center study, ecosystem services were typically calculated for the activities of “pristine” wild ecosystems or relatively undisturbed large-scale rural areas. This research was grounded in the terminology and science of both ecology and economics, which are often incompatible with the terminology and frameworks of architecture, urban and regional planning, engineering, landscape architecture, interior design, and other design professions.

The Bullitt Center study seeks to not only quantify values but also extend the way ecosystem services are valued and modeled in the built environment.

There are significant consequences to ignoring the potential for the built environment to produce and deliver ecosystem service benefits. Removing nature from an urban landscape, or failing to maintain that urban landscape in harmony with the ecosystem that encompasses it, reduces the resilience and sustainability of those communities.

With an ever-increasing majority of people living in urban areas, the ability of these systems to provide quality of life over time is inextricably linked to our ability to integrate ecosystem services into our urban planning and design practices.

As we move from reliance on ecosystem services toward reliance on centralized technology solutions, we introduce a greater level of fragility into our urban areas.

Every time we make an urban design decision, we make a trade-off between comprehensive, resilient solutions, such as stormwater filtration spread across the landscape, and targeted, often-brittle solutions, such as combined sewer overflow systems.

Biophilic urbanism – urban design that reflects humans’ innate need for nature in and around and on top of our buildings – can make significant contributions to a range of national, state, and local government policies, including climate change mitigation and adaptation.

Potential benefits include reducing the heat island effect, reducing energy consumption for thermal control, enhancing urban biodiversity, improving well being and productivity, and improving water cycle management. Effective planning and policy can underpin adoption of biophilic urbanism.

As the first multi-story, mixed-use building in a dense urban neighborhood to aspire to the Living Building Challenge, the Bullitt Center offers an unprecedented opportunity to communicate the value of ecosystem services in an urban context. The quest to reduce externalities from the built environment while maintaining high population densities, community resilience, and quality of life requires a careful balancing of ecosystem services and technology within our urban planning and design.

SITE TRANSPORTATION BENEFITS

This valuation examines the decrease in carbon dioxide emissions and associated climate impact from the Bullitt Center's site selection strategy and decision to provide on-site parking for bicycles only.

| | |
|---|---|
| Baseline impact for a building with Seattle's average transportation mode share* | 5.431 kg CO ₂ per person per day |
| Impact for the Bullitt Center based on a questionnaire administered by the University of Washington | 3.655 kg CO ₂ per person per day |
| Avoided impact | 1.777 kg CO ₂ per person per day |
| Total person days per year (240 workdays for 136 full-time occupants, weekend visits, events and tours) | 90,075 |
| Avoided impact | 160 metric tons of CO ₂ |
| Value of avoided impact (at \$200 per metric ton of CO ₂) per year | \$32,005 |
| Present value over 250 year lifetime of the building (at 4% discount rate) | \$2,930,000 |

*Modal Split for Bullitt Center vs. Seattle

| | Bullitt Center | Seattle Average |
|-------------|-----------------------|------------------------|
| Bus | 26.0% | 35.7% |
| Solo driver | 30.2% | 32.7% |
| Carpool | 7.8% | 8.4% |
| Walk | 22.0% | 6.3% |
| Bike | 14.0% | 3.3% |
| Other | 0.0% | 13.6% |

RAINWATER CAPTURE AND REUSE

This valuation examines the benefits associated with capturing, treating, reusing and infiltrating rainwater back into the ground. This process reduces the amount of stormwater runoff and absorbs pollutants that would otherwise end up in Puget Sound.

| | |
|--|-----------|
| One-time benefit of avoided impact on stormwater system | \$20,650 |
| Annual benefit (based on Seattle Public Utilities rates and estimated internal operating costs for stormwater treatment) | \$9,665 |
| Present value over 250 year lifetime of the building (at 4% discount rate) | \$910,000 |

COMPOSTING TOILETS

This valuation examines the benefits associated with composting human waste, providing a source of compost and reducing wastewater treatment.

| | |
|--|-----------------|
| Compost produced per year | 5,792 pounds |
| Avoided water use/discharge per flush | 1.5375 gallons |
| Avoided water use/discharge per year | 313,742 gallons |
| Value of compost produced and water use/discharge avoided per year | \$7,400 |
| Net present value over 250 year lifetime of the building (at 4% discount rate) | \$680,000 |

ENERGY EFFICIENCY

This valuation examines the benefits associated with reduced energy use and reduced carbon emission due to energy efficiency measures at the Bullitt Center.

| | Carbon emissions | Energy use |
|--|---|------------------------------------|
| Baseline impact for the same size Seattle code building (EUI = 64) | .00880 metric tons CO ₂ per square foot per year | 18.76 kWh per square foot per year |
| Bullitt Center impact (EUI = 16**) | .00234 metric tons CO ₂ per square foot per year | 4.69 kWh per square foot per year |
| Avoided impact per unit | .00646 metric tons CO ₂ per square foot per year | 14.07 kWh per square foot per year |
| Total avoided impact | 323.47 metric tons of CO ₂ | 704,367 kWh |
| Value (at \$200 per metric ton of CO ₂ and Seattle City Light rates) per year | \$64,693 | \$47,333 |
| Present value over 250 year lifetime of the building (at 4% discount rate) | \$5,930,000 | \$4,340,000 |
| Total present value | \$10,270,000 | |

****NOTE:** In the first 12 months of operations, the Bullitt Center had an EUI of 9.4.

SOLAR ENERGY GENERATION

This valuation examines the benefits associated with clean, renewable energy production by the solar photovoltaic array on the roof of the Bullitt Center. The valuation includes both the energy provided and the carbon emissions avoided.

| | Avoided carbon emissions | Energy provided |
|--|------------------------------------|-----------------|
| Electricity produced per year | | 230,000 kWh*** |
| Annual baseline impact (based on US average) | 107.87 metric tons CO ₂ | |
| Annual feature impact (based on life-cycle assessment of solar panels) | 6.27 metric tons CO ₂ | |
| Annual avoided impact per unit | 101.60 metric tons CO ₂ | |
| Annual dollar value of avoided impact per unit (at \$200 per metric ton of CO ₂) | \$20,320 | |
| Annual dollar value of direct benefit (at utility power rates) | | \$15,456 |
| Present value over 250 year lifetime of the building (at 4% discount rate) | \$1,863,000 | \$1,417,000 |
| Total present value | \$3,280,000 | |

***First year's production: 252,560 kWh

FOREST STEWARDSHIP COUNCIL WOOD

This valuation examines the benefits associated with managing forests to higher environmental standards than required by law and by building with wood, rather than steel or concrete.

| | | | |
|--|---|--|---|
| Avoided impact | 545 metric tons CO ₂ sequestered in the building for 250 years | 141 additional metric tons CO ₂ sequestered in FSC certified forest | 1,158 metric tons CO ₂ emission avoided by building with wood (vs steel or concrete) |
| Total dollar value (at \$200 per metric ton of CO ₂) as one-time initial benefit | \$109,000 | \$28,224 | \$231,600 |
| Total | \$370,000 | | |