RESEARCH COMMITTEE POSITION STATEMENT

Funding for Research Advancing High-Performance Green Building

March 2007

Green Building Research Funding: An Assessment of Current Activity in the United States, a report published by the U.S. Green Building Council (USGBC) in March, 2007, found that research related to high-performance green building practices and technologies amounts to only 0.2% of all Federally funded research – an average of $193 million per year (2002-2005) and only 0.02% of the estimated value of annual U.S. buildings construction. In response to these findings, the USGBC Research Committee has prepared this position statement calling for a significantly higher level of funding for research that will advance building technology and techniques that minimize environmental and human health impacts.[1]

Rationale

The built environment plays a substantial role in the environmental health, human welfare and economic stability of the United States. Building operation consumes 40% of U.S. energy and 71% of the electricity[2], 12% of the water,[3] and rapidly increasing quantities of land. Building demolition, construction and renovation generate over 35% of non-industrial waste[4]. Buildings can also create health problems; indoor air pollutants are at concentrations typically between two and five—and occasionally more than 100—times greater than those of outdoor air[5]. Building operation accounts for 38% of the country's carbon dioxide emissions.[6]

The building industry represents the largest economic sector in the U.S. and the second largest manufacturing sector. In commercial buildings, the high costs associated with salaries, healthcare, recruitment and retention of employees point to the economic benefits of improved indoor environmental conditions.

Given the impacts that buildings have on our health, economy and natural environment, the USGBC Research Committee asks the following questions:

- Given that buildings operations account for almost 40% of U.S. energy use, why is the DOE budget for building-related research only 2.5% of their R&D program?
- Given that building operations contribute 38% of the nation's carbon dioxide emissions, why do EPA grants for direct green building research represent only 3.2% of their grant funding?
- Given that indoor air is significantly more polluted than outdoor air in many buildings, and poor indoor air quality in buildings has been linked to significant health problems, why is research specific to buildings not included in the National Institute of Health (NIH) budget?
- Given that building construction and renovation is 9% of the GDP, or $1 trillion, why is the National Science Foundation (NSF) budget for research needed for building innovation less than 1% of the total?

The funding assessment's findings clearly show that funding levels are not commensurate with the level of impact that the built environment has on our nation's economy, environment and quality of life. In some sectors of the economy much of the needed research is undertaken directly by industry, which invests in R&D to make a profit on new products and services. In the building sector, that direct R&D investment is much smaller, in part because of the diverse and highly fragmented nature of the industry and in part because improving the environmental and health performance of a product is a public benefit and not directly and reliably recaptured as profits[7] (a conclusion supported by a report published by the National Academy of Sciences on the worth of DOE's research[8]). Some research is also undertaken by industry trade associations but the overall level of private investment by industry falls far below the level needed. Public support of R&D can be used to leverage and extend private investments, and has had documented success.[9] Ideally, that public support can not only be planned, funded and coordinated at a national level but also implemented at a regional and state level.

Recommendations

Significant and immediate improvements to health and environmental quality can be made with a modest increase in investment of short term research and technology transfer work. The Federal government and other relevant funding sources should invest not only in these, but also in long term research programs to prompt the major shift in design, construction and operation practices necessary to support requisite large scale improvements to health and environmental conditions. While many parties have contributions to make to increase green building research funding, the Federal government plays a uniquely important role due to the coordination, resources and attention it can apply to these issues.

The USGBC Research Committee initially recommends that the two federal agencies with the primary function of funding academic research—the National Science Foundation and the National Institute of Health—direct at least 2% of their research budgets toward issues related to green building R&D and technology transfer in the near term. A similar initiative was instituted by Congressional leadership in the past decade to focus the NSF on advancing information technology for national competitiveness. It is imperative that Congress again take the lead to enhance the quality of our built environment for the health of U.S. citizens and the long term sustainability of our resources and society.

In addition, other federal agencies that address issues with relevance to the built environment should significantly increase their funding levels to be commensurate with buildings' impacts on society. Relevant organizations include those discussed in the funding assessment report as well as others that do not yet fund green building research at high levels (such as the U.S. Department of Education and Department of Transportation). Of the federal agencies, DOE has an especially important role. The Research Committee acknowledges DOE and other agencies for their demonstrated leadership in making important advances despite the constraint of limited resources, and encourages them to expand their efforts. To implement this expansion, agencies must attain levels of funding that are effective for fulfilling needs expressed by goal statements, research agendas and other strategic documents. For a list of various organizations' research agendas, see the funding assessment report.

For the purpose of having a simple benchmark, the Research Committee proposes that total federal funding equates to 0.10% of annual construction value ($1 trillion), or $1 billion (based on 2004 data). This investment is considered conservative.

States should follow the lead of New York and California which provide positive models for the distribution of state and utility "public goods" funds for research and deployment activities that increase the energy and resource efficiency of the built environment. Such an approach is especially effective in regards to regional and local contexts.

The USGBC Research Committee is currently working to identify and assess critical research needs for market transformation in greening the built environment; this information will be published in the forthcoming *National Green Building Research Agenda*.

Preliminary Thoughts for a National Green Building Research Agenda

Critical research is needed in most areas related to building performance for the sake of human and environmental health. Many of the examples below relate to major cross-cutting priorities for human and environmental health such as energy and water security, global climate change prevention, indoor environmental quality, and passive survivability (making buildings self-reliant in the face of natural and man-made disasters).

The following categories provide an organizational structure within which to identify broad research programs. While all are important, the forthcoming *National Green Building Research Agenda* report will attempt to prioritize these research needs. Regionally-specific aspects will be addressed whenever relevant (i.e. climates and stressed natural resources).

Environmental and human health categories, in alphabetical order:

- **Energy:** Develop high performance climate-responsive building envelopes and their integration with HVAC and lighting systems, examining features such as operable façades for natural ventilation, façade-integrated HVAC, lighting quality, daylighting, and shading performance. Further develop technologies for power demand management, on-site ("distributed") energy generation (especially renewable energy). Evaluate energy impacts of development patterns and transportation modes.
- **Indoor Environmental Quality:** Develop personal (workstation) climate control systems for improved energy and human performance with life cycle cost analysis. Develop mixed-mode building systems for new and existing buildings that support natural conditioning integrated with advanced mechanical and control systems. Examine health impacts of moisture and microorganisms. Quantify impacts of IEQ on performance, productivity, and health.
- **Land Use:** Quantify the impacts of land use and transit-oriented planning on energy, health and environmental quality. Develop model zoning in support of high-performance green building approaches.
- **Materials:** Develop and refine life cycle assessment (LCA), databases and tools to facilitate holistic evaluation of materials' environmental and health impacts. Fill data gaps (e.g. occupational health risks, manufacturing emissions' affect on surrounding

communities, installed product emissions). Develop product and building designs for deconstruction and reuse. Develop industry-specific materials flow analysis, accounting methods and tools. Develop and evaluate modular building system technologies and transfer into appropriate markets.

- **Water:** Develop building system approaches to net zero water consumption, combining rain capture with potable to grey to black water reuse incorporating water efficient technologies and operations both inside and outside buildings.

Cross-cutting categories:

- **Evaluation and metrics:** Develop and test effective building performance metrics and field evaluations for sustainability. This area would develop performance assessment protocols, databases, and benchmarks that would be used to compare predicted and measured performance (i.e., energy, water, indoor environmental quality) for a range of building types.
- **Tools:** Establish information technology and design process innovation for sustainability. This area would advance building information models (BIM), interoperable software tools and product data management to reduce costs and errors while improving all aspects of performance over the design-construct-operate lifecycle of a building.
- **Marketplace Transformation:** Develop real estate valuation and financial risk assessment methods/tools for high performance buildings. Evaluate environmental impact of regulations and incentives. Improve contracts and legal frameworks for sustainable buildings. Develop formal education programs (K-12, collegiate, continuing education).

ENDNOTES

[1] Research committee members and liaisons that are Federal employees abstained from conversations and decisions having to do with funding recommendations.

[2] Annual Energy Review 2005. DOE/EIA-0384 (2005). Energy Information Administration, U.S. Department of Energy. July 2006.

[3] Estimated Water Use in the United States in 1995. U.S. Geological Survey. http://water.usgs.gov/watuse/pdf1995/html/ 18 December 2006.

[4] Office of Solid Waste, U.S. Environmental Protection Agency: Characterization of Building-Related Construction and Demolition Debris in the United States. EPA 530-R-98-010; June 1998; http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf; and Municipal Solid Waste in the United States: 2001 Facts and Figures. October 2003. http://www.epa.gov/garbage/pubs/msw2001.pdf 18 December 2006

[5] The Total Exposure Assessment Methodology (TEAM) Study. EPA 600/S6-87/002. U.S. Environmental Protection Agency. 1987. http://www.epa.gov/ncepihom/

[6] 2006 U.S. DOE Buildings Energy Databook. U.S. Department of Energy. http://buildingsdatabook.eren.doe.gov/

[7] Building Technologies Program, Planned Program Activities for 2007-2012, pp 4-5. U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, February 2007.

[8] Energy Research at DOE: Was it Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000, page 6. National Research Council, Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy. National Academy of Sciences, 2001, http://www.nap.edu/catalog/10165.html.

[9] *Ibid*.