Breaking through the Barriers to Sustainable Building:

Insights from Building Professionals on Government Initiatives to Promote Environmentally Sound Practices

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ABSTRACT

"Sustainable building" is the design and construction of buildings using methods and materials that are resource efficient and that will not compromise the health of the environment or the associated health and well-being of the building's occupants, construction workers, the general public, or future generations. Sustainable building involves the consideration of many issues, including land use, site impacts, indoor environment, energy and water use, lifecycle impacts of building materials, and solid waste.

In this thesis, the concept, benefits, and history of sustainable building are discussed. Empirical data, along with information from secondary sources, are then presented regarding: (a) the barriers to more widespread sustainable building practice; and (b) non-regulatory government programs with educational and economic strategies, as well as public-private collaborative efforts, that have been or might be effective in lowering the primary barriers.

The data presented in this thesis are mainly derived from interviews and from responses to a questionnaire that was developed for this research project. The questionnaire was completed by architects, engineers, contractors and builders, developers, and consultants who have a strong interest or involvement in the field of sustainable building.

The primary barriers to more widespread sustainable building practice, as identified by questionnaire respondents, are: (1) a lack of interest in or demand for sustainable building from clients (owners/developers), (2) a lack of training and education in sustainable design/construction, (3) the failure of service fee structures to account for the recovery of long-term savings, and (4) the higher costs (both real and perceived) of sustainable building options.

The work concludes with recommendations for government action.

ACKNOWLEDGMENTS

I could not have completed this project alone. First and foremost, I would like to thank my thesis committee members, Ann Rappaport and Christine Cousineau. Their feedback on earlier drafts made for a much improved final product. Of course, I am solely responsible for any word or idea problems that remain.

I am also very grateful to architects Peter R. Nobile, III, Andrew St. John, and Jim Batchelor for speaking with me and helping me to improve the questionnaire before I distributed it. Peter was also kind enough to alert me to a similar questionnaire that was being circulated by e-mail at the same time that mine was. That questionnaire was developed by Annie Pearce, a research engineer at the Georgia Institute of Technology. Annie openly shared her research with me, even in its early stages, which was very helpful. I also benefitted from seeing the results of another questionnaire, developed by Joseph Hittinger, an interior designer working towards his M.Arch. at The Catholic University of America.

I would also like to thank Sarah Hammond-Creighton, Angela Vitulli, and Janet Landman for reviewing and commenting on drafts of my questionnaire.

Credit for getting the questionnaire up on a website goes to Stephen Landman, www.egret.net webmaster, who patiently worked through tedious formatting incompatibilities and my seemingly endless text changes. His work gave countless people convenient access to the questionnaire form and later to a questionnaire response report.

I also owe thanks to the twenty-five building professionals who took the time to fill out my rather lengthy questionnaire. I received many thoughtful, substantive responses. Respondents' comments gave life and direction to this thesis.

To all of my friends off of whom I bounced ideas or to whom I may have whined now and then, and to everyone else who helped me along the way, thank you for your support!

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I. INTRODUCTION

Project Background

My interest in sustainable building issues was sparked when I took a job at an architecture firm in July of 1995. Through my academic and professional background in environmental policy, I had developed a general interest in the built environment and how it relates to our natural environment. Then, through my work at the firm, though it was administrative, I was exposed to the world of building design. I began to scan all of the architectural magazines that came to the office for articles with environmental themes; I started attending related conferences and workshops; and I eventually gave a presentation on the basics of sustainable building to my co-workers.

Then in early 1998, during my first year of graduate school in Urban and Environmental Policy at Tufts University, I had the opportunity to do a "field project" on sustainable building with other students in the department. Our clients worked for the Commonwealth of Massachusetts' Division of Capital Planning and Operations (now Capital Asset Management), and Operational Services Division. We produced two booklets for them: (1) a Resource Guide that included annotated listings of government programs, organizations, associations, consultants, firms, design specification manuals, product suppliers and certifiers, Internet resources, periodicals, books, and guides related to sustainable building; and (2) Case Studies of two government programs focused on sustainable building: the Green Builder Program in Austin, Texas, and the Sustainable Building Task Force in Los Angeles, California.

After completing that project, I decided that I wanted to enter the field of sustainable building in a more formal capacity. The field has been growing rapidly, with new technical knowledge, literature, and products coming out every day. But while sustainable building practices are certainly catching on, they are by no means standard practice. Having taken a good inventory of what has been going on the field and what sort of information is available, I felt that what was missing was a big picture analysis of what the major sources of resistance to sustainable building are and what methods have been and could be used to lower those resistances. So I decided that, for my thesis project, I would do an assessment of the major barriers to more widespread sustainable building

practice, and then use that information to determine what sorts of policies and programs could most effectively lower those barriers.

I felt that the best way for me to get a better understanding of barriers was to hear from the actual practitioners—to let building professionals speak for themselves. Practitioners determine whether sustainable building practices are carried out, and many have taken a leadership role in this field. They hold much of the control as well as the responsibility for how buildings effect the environment and how building environments effect people. Their perceptions of barriers should be heeded by government policy makers and program administrators whose work influences the building industry.

Thus, my research became focused on finding answers to two related questions: (1) What do building professionals see as the primary barriers to the increased use of sustainable building practices in their professions?; and (2) What types of policies and programs have been or would be the most effective in lowering those barriers in order to encourage building professionals to adopt more environmentally responsible practices?

Because these questions were too broad to address within the time, space, and resource constraints of this project, I narrowed the focus of my second question down to *government* policies and programs aimed at spurring *private sector* involvement in sustainable building. Though many sustainable building initiatives have come out of the non-governmental sector, I was particularly interested in the government's role—as policy setter, regulator, incentive provider, and educator. By "government," I am referring in this report only to governments within the United States (as other countries' building standards are quite different), but I have examined sustainable building initiatives from all *levels* of government within this country: local, state, regional, and federal.

Clearly, government-driven sustainable building initiatives aimed at *government-owned and -operated* building projects are also extremely valuable. Such projects help establish the cost effectiveness and performance of alternative methods and materials, and they help boost markets not only for green building products but also for services. For example, Hillary Brown, Assistant Commissioner in New York City's Office of Sustainable Design and Construction, says that the city's new High Performance Buildings Guidelines have created a demand for engineering firms with experience in DOE-2 computer energy modeling.[1] However, while the government's role as an example-setter and market-booster is important, it is not the focus of this report. Many existing government programs for sustainable building (including the City of Austin's Green Builder Program) cover both public and private building projects, but the distinction between the two is important because of their vast differences in funding and management.

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[1] Hillary Brown, Assistant Commissioner, Office of Sustainable Design and Construction, New York City Department of Design and Construction; Loeb Fellow, Harvard Graduate School of Design. Presentation, hosted by the Sustainability Roundtable and the Massachusetts Division of Capital Asset Management, Boston, MA, February 24, 1999.

While this report will focus on government initiatives to promote sustainable building in the private sector, it will mention a few non-governmental sustainable building initiatives, as well as governmental initiatives that focus on publicly-owned buildings, where they are relevant.

Research Methods

I used a variety of methods to find answers to my thesis questions. To get a firm footing, I did a review of the literature that speaks to these issues (including relevant surveys) and I conducted in-person interviews with three Boston-area architects with sustainable building experience: Peter R. Nobile, III; Andrew St. John; and James Batchelor. With input from these interviewees and my advisors, I developed a questionnaire to be completed by architects, engineers, builders and contractors, and developers. I wanted to get the perspectives of professionals involved in various aspects of the building process: business, design, *and* technical implementation.

Because I knew that it would be almost impossible to get responses from people who had never even considered "sustainable building," I decided to distribute the questionnaire to a sort of "focus group" of building professionals whom I knew to have at least *some* involvement or interest in sustainable building. Since people who fall into this category work closely with more mainstream building professionals every day, and have probably given some thought to the issue of sustainable practice barriers, I felt that this group could provide informed speculation about why their peers have not become as involved or interested in sustainable building issues.

I sent out a mass e-mail request for questionnaire responses—with a website address link and an e-mail version of the questionnaire—to approximately seventy-five e-mail addresses: some were individuals' work addresses and some were general firm/organization addresses. My e-mail message was then circulated by some of these recipients to an unknown number of other people within and outside of their workplaces. I collected responses over the course of a three-week period. Twenty-five individuals completed and returned the questionnaire.[2] Of the twenty-five, eleven (44%) of the respondents are architects, four (16%) are contractors or builders, four (16%) are engineers, four (16%) are sustainable building consultants (one of which is also a property manager and another is a materials specifier), and two (8%) are developers. Several respondents are quite well known as leaders in the field of sustainable building. Respondents' names are not used in this paper, except in a few cases, where I was granted permission to use the names of people whose comments I have quoted at length.

[2] Six of these respondents were *not* individuals to whom I had distributed my e-mail message, and do not work for firms or organizations to whom I had distributed the message; the message had been forwarded to them.

Limitations of the Study

The questionnaire was not intended to serve as an opinion poll for determining the extent of sustainable practice in the building professions. Furthermore, the distribution method was not designed to achieve a random or representative sample, and the data were not meant to be subjected to tests of statistical significance. Rather, both the quantitative and qualitative data provide an exploratory look at the views of a group of building professionals who are interested in or are actively practicing sustainable design or construction.

II. AN OVERVIEW OF SUSTAINABLE BUILDING

Elements of Sustainable Building

To some people in the building professions, the word "environmental" has negative connotations, because they associate it with issues like asbestos and lead abatement regulation. These remediation requirements are often seen as costly, laborious, not always necessary, or even, in some cases, more harmful than leaving the materials where they are. It is unfortunate that we have to spend time and money on removing toxic building materials and finishes that were commonly used in the past. But these sorts of mistakes are exactly what environmentally sustainable building aims to *prevent*. Sustainable building is about doing it right the first time, by keeping an eye to short and long-term consequences. Of course, back when asbestos and lead materials were being installed, we did not know that they were harmful. Though we have ceased to use those materials, we are now aware of many other building practices, with adverse short- and long-term consequences for us and our environment, that are still in common use.

Sustainable building is often referred to as "green" or "environmentally sound" building. Some also see it as "timeless." Others refer to some of the high-tech aspects of it as "high performance" or "smart" building. Architect William Bobenhausen thinks that it should just be called "good" building design.[3] However, I will refer to it throughout as "sustainable," mainly because that has become the most widely accepted, catch-all term: the one you can use when doing a keyword search at the library. "Sustainable"—as used in "sustainable development"—has come to connote a balancing of the relationships between environmental, social, and economic health. (The origins of this term and concept are discussed further in the section on Sustainable Building History & Practice.) While my focus in this paper may seem to be on the *environmental* impacts of building, I and many others do strongly believe that social and economic benefits can, should, and do come from environmental protection. The vitality of individuals, communities, and businesses is closely related to environmental conditions–indoors and outdoors. Sustainable building is based on an integrative perspective of the relationship between our natural and built environments.

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[3] William Bobenhausen, Director of Sustainable Design, Steven Winter Associates, Inc., Norwalk, CT. Presentation at an Urban Land Institute workshop on "Sustainable Design in Commercial Development," at AEW Capital Management, Boston, MA, November 10, 1998.

I like to define SUSTAINABLE BUILDING broadly as:

> **building design and construction using methods and materials that are resource efficient and that will not compromise the health of the environment or the associated health and well-being of the building's occupants, construction workers, the general public, or future generations.**

This is clearly an *ideal* state to work towards. Building has and will always have some impacts on the land and its resources, but these impacts should be minimized as much as possible. And, at a minimum, we should demand that our shelter not be harmful to us. With a little more thought, we can create indoor environments that are not just benign, but that enhance our lives: places in which we can be comfortable and healthy and of which we can be proud. After all, "productive living space is a resource for humanity, just as are energy, air, and water."[4]

Building designers have always been involved in assessing how the elements—like wind, water, and soil—will affect the integrity of building structures, and in mitigating those effects. However, they have *not* traditionally assessed or mitigated the flip side of that equation: how the buildings will affect the elements. Likewise, while most designers think about how the configuration of a built space will affect its users, aesthetically, they do not adequately consider how the materials that go into making a space will affect the users' health.

Whether we are at home or work or school or a store, most of us spend the vast majority of our time within enclosed structures. Buildings create indoor sub-environments within our larger natural environment, with their own climate, light levels, and air and water flow systems. As Anne Whiston Spirn says, "Buildings are mini ecosystems."[5] It is no wonder that the quality of those conditions has a serious effect on occupant health and well-being.

Furthermore, building construction and use account for a significant portion of public health problems, and of the energy, water, mineral, and wood resources consumed in our society. (Estimates of these impacts are given later in this section, within the seven categories of sustainable building elements.) A recent study by the Union of Concerned Scientists found that home-related resource uses made up four of the seven most environmentally harmful consumer activities, contributing greatly to air pollution, water pollution, global warming, and habitat alteration. The four they identified were: (1) energy use for household appliances and lighting, (2) energy use for household heating, hot

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[4] Kevin Lynch and Gary Hack, *Site Planning* (Cambridge: MIT Press, 1984), 12.

[5] Anne Whiston Spirn, *The Granite Garden: Urban Nature and Human Design* (Basic Books, 1984), 246.

water, and air conditioning, (3) land and materials impacts from home construction, and (4) household water use and sewage generation.[6]

Clearly, sustainable building includes not only interior, exterior/envelope, and site considerations, but also off-site considerations—local, regional, and global. Locally and regionally, for example, unsustainable building practices can put stresses on communities and government services, by filling up landfills, exacerbating flooding, spreading the demand for road building and utility infrastructure, etc. On a global level, building practices are affecting our climate, primarily because of our use of greenhouse gas-producing energy sources for heating, cooling, ventilation, and lighting, and our use of building materials and equipment that contain ozone layer-depleting chemicals.

Sustainable building can include a wide range of methods, materials, and systems. They could be traditional and low-tech (like adobe walls, rainwater collectors, or window shutters) or modern and high-tech (like occupancy detectors for lighting or greywater recycling systems). But, as architect William Bobenhausen has said: "It's not the gadgets; it's the process. It's a way of thinking."[7] Architect Andrew St. John also says sustainable building is not about technology or materials, as much as it is about "attitudes and approaches."[8] Technology can get us part of the way towards sustainability, but because in some instances it can end up doing more harm than good, it must be applied cautiously. A decision *not* to use certain high-tech gadgets can be as important as the decision to use others.

In other words, sustainable building has active and passive components. It involves maximizing the efficiency, health, and comfort of our indoor environments, while simultaneously minimizing the environmental and public health impacts and resource use associated with building. I think that sustainable building decisions usually fall into one of these three basic categories:

1. Materials & Equipment	(specifications and application methods)
2. Active/Systems Design	(mechanical, electrical, plumbing systems)
3. Passive/General Design	(placement/orientation of building and rooms)

The third category relates to how the designer spatially fits the building and its design "program" into the natural environment so as to take advantage of existing, free benefits—such as light and heat from the sun, shading from trees,

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[6] Warren Leon, "Better Homes and Planet," *Nucleus*, The Magazine of the Union of Concerned Scientists, Spring 1999, 3.

[7] Bobenhausen, presentation comments.

[8] Andrew St. John, Architect, Fidelity Corporate Real Estate, Boston, MA. Conversation with author, Boston, MA, December 29, 1998.

or insulation from hillside topography, to reduce land impacts and the need for non-renewable or wasteful resource use.

The following are some of the elements of sustainable building. This list includes the types of questions a developer, architect, engineer, or contractor/builder should ask when beginning a project. In a nutshell, sustainable building considerations range from general questions like whether to build new or to renovate and how big of a footprint a new structure will have, to the questions of where to build, how to build so as to minimize land impacts, how to protect occupants' health and well-being, how to reduce energy and water use, how to reduce solid waste, and how to select materials that have the lowest impact on the environment and public health over their entire lifecycles (from raw materials to post-use). Clearly, not all of the issues outlined below can be addressed in every project, and some apply to new construction while others apply to renovation work. (Note: Some elements of sustainable building fit into more than one of the following seven categories; however, for simplicity's sake, I have assigned each to the *most* applicable category below.)

1. General, Preliminary Considerations

- *Could the project be done by renovating an old building rather than building a new one?* This should help reduce the use of land, building materials, and energy resources, and would likely save money. (Of course, old buildings may not have the most efficient fixtures and systems and so might benefit from retrofitting.)
- *What will the square footage of the structure be? What will its footprint be?* In the last fifty years, while family sizes have become smaller, the average house size has more than doubled from about 1,000 to over 2,000 square feet.[9] The larger the building, the more material and energy resources it uses; and in general, the larger its footprint area, the greater its impact will be on the land.
- *How easy will it be to renovate the building or adapt it for reuse in the future?* If the structure can be adapted easily, fewer resources will be wasted in the process and the likelihood of premature demolition is lessened. Too often, buildings are treated as disposable items. The Center for Maximum Potential Building Systems and Carnegie Mellon's Center for Building Performance and Diagnostics have experimented with highly-adaptable "open building systems."

[9] "Small is Beautiful," *Environmental Building News* 8, no. 1 (January 1999), referencing the National Association of Home Builders publication: "House Size and Family Size 1940-1997."

2. Site Selection/Land Use Context

- *What were the previous uses of the land? Is there any soil or water contamination on or around the site?* If so, this could mean that remediation would be required to make the site safe for children to play on, for growing vegetables on, keeping pets on, putting a well on, or building on, in general. But remediating such a site would be better for the environment and the community than building on "virgin" land, away from existing infrastructure. (See the next bulleted item.) Government assistance and liability relief is often made available to ease the process of cleaning up contaminated "brownfields."
- *How close is the site to other development and existing infrastructure, like utility services, roads, and public transportation?* Reducing sprawl reduces people's need to drive and thereby reduces air pollution, preserves open space and habitat, and reduces the need for government to spend taxpayers' money on infrastructure expansion. Suburban sprawl also saps the economic vitality of urban centers. "Smart growth" management plans, such as Portland (Oregon) Metro's "urban growth boundary" strategy, are increasingly being developed by cities and regions, as they attempt to curtail sprawl.
- *Does the site provide needed habitat for rare or endangered animal or plant species?* The Union of Concerned Scientists say that "35 percent of land-based endangered species are threatened by expanding residential housing and the associated commercial development and roads."[10]
- *Does any part of the site include wetlands or a floodplain?* Wetlands and floodplains serve vital ecological functions as water treatment and water overflow zones. Building in these zones can endanger not only people and property on-site but also those downstream. Flooding can not only lead to a loss of life, but can impose a massive economic cost on government (and indirectly, to the public at large) for disaster relief.
- *Has a comprehensive site assessment been conducted?* This should help identify all of the sensitive resources mentioned in this section.

3. Site Planning/Land Impacts

- *How might the development degrade the soil and water quality or supply? How much impervious surface will cover the site? What types of landscaping will be included? How many trees will be removed from the site?* Minimizing paving or using permeable paving, and preserving existing mature trees and groundcover will prevent soil erosion and runoff, which

[10] Michael Brower and Warren Leon, *The Consumer's Guide to Effective Environmental Choices: Practical Advice from the Union of Concerned Scientists* (New York: Three Rivers Press, 1999), 101.

will prevent flooding and help conserve and protect groundwater. (Minimizing paving has the added benefit of reducing the "heat island" effect around buildings and cities.) Using climate-appropriate landscaping and irrigation methods will also help conserve water.

- *Where on the site will the building be placed?* Ideally, its location will be based on the site information listed under #2. For example, if the site is a large enough parcel that there are multiple areas one could choose to build on, the building should be sited away from any potentially contaminated areas, away from sensitive habitat areas, away from floodplains and wetlands on the site, and close to infrastructure and transit stops.

4. Occupant Health & Well-Being

- *What measures have been taken to protect indoor air quality?* Most of us spend at least 80% of our time indoors.[11] So it is especially concerning that approximately 30% of new and renovated buildings in the U.S. have poor indoor air quality.[12] Symptoms of "sick building syndrome" include headaches, sore throat, eye irritation, and respiratory problems.[13] Sick buildings have been ranked as one of the top five environmental threats to human health by the U.S. Environmental Protection Agency (EPA); EPA studies have found that indoor air quality is often five times, and can be up to one hundred times, worse than outdoor air.[14] Building design and materials, not just second-hand cigarette smoke, are major causes of indoor air pollution. Sick building symptoms are generally caused by fungi and bacteria that build up because of inadequate fresh air ventilation in structures that are tightly sealed or by formaldehyde or volatile organic compounds that are off-gassed from building materials; some of these air-borne particles can cause or exacerbate asthma and allergies. Also, when fresh air intakes are too close to the cooling tower drift of the building next door, microorganisms can migrate to people's lungs, causing Legionnaire's disease.[15] Providing adequate and proper outside air ventilation, venting fumes from copiers and other office equipment, and using materials and finishes (e.g., carpeting, upholstery,

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[11] Alex Wilson, Jenifer Uncapher, Lisa McManigal, L. Hunter Lovins, Maureen Cureton, and William Browning, *Green Development: Integrating Ecology and Real Estate.* Rocky Mountain Institute (New York: John Wiley & Sons, Inc., 1998).

[12] David Malin Roodman and Nicholas Lenssen, "A Building Revolution: How Ecology and Health Concerns are Transforming Construction," Worldwatch Paper #124 (Washington, D.C.: Worldwatch Institute, March 1995).

[13] Tony Hiss, *The Experience of Place* (New York: Alfred Knopf, 1990), 12-13.

[14] Wilson, et al., *Green Development.*

[15] Hiss, *The Experience of Place,* 13.

paint) and adhesives with no or low toxicity are the main ways to ensure indoor air quality. Certain indoor plants can also help absorb noxious gases.[16] It is important to remember that toxic materials can harm the tradespeople who must install or apply them, as well as building occupants. And the harm can be physical or mental.

- *If the project involves the renovation of an existing building, have lead and asbestos been tested for and abated, if necessary?* Lead paint abatement is especially important (and required) in buildings where children spend a lot of time, as numerous studies have established that children are especially susceptible to neurological damage leading to IQ deficiencies and learning and behavioral problems due to lead exposure.[17] Unfortunately, low-income families are generally more exposed to toxins like this, while they are also the least able to pay for health care.
- *To what extent has natural daylighting been incorporated into the design?* The line between health and well-being is somewhat fuzzy. Daylit interiors are not only more aesthetically pleasing, but they are healthier than spaces with only artificial light. In a speech, Vivian Loftness, Dean of Carnegie Mellon's Department of Architecture, cited a study that shows that workers report 20% fewer sick building symptoms when they work near windows; and having a desk near natural light was the #1 option requested by workers in a poll.[18] A research psychiatrist has found that exposure to sunlight affects "the production of a hormone called melatonin, which may affect mood and also fertility and many other body functions."[19] This may explain Seasonal Affective Disorder symptoms. The Rocky Mountain Institute and U.S. Department of Energy documented a sustained 6% rise in productivity (speed and accuracy of mail sorting) among workers at the Reno, Nevada Post Office after an energy-efficient daylighting retrofit was done; this performance increase turned the facility into the most efficient in the Western region, when it had been the least efficient before the retrofit.[20]

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[16] Connie Koenenn, "Pollution Fighters: Those houseplants that grace your living room work nonstop to clean the air you breathe," *The Ann Arbor News*, July 7, 1991, D6.

[17] "Indoor Pollutants: Household Hazards," *Environmental Issues Bulletin* 1, no. 3, produced by the National Safety Council's Environmental Health Center, for the Radio and Television News Directors Foundatio (September 1998).

[18] Vivian Loftness, Dean, Department of Architecture, Carnegie Mellon University, Pittsburgh, PA. Presentation at the Dimensions of Sustainability International Design Symposium, hosted by the MIT Department of Architecture, Cambridge, MA, November 15-16, 1996.

[19] Hiss, *The Experience of Place,* 10.

[20] Joseph Romm and William Browning, "Greening the Building and the Bottom Line: Increasing Productivity through Energy Efficiency," Rocky Mountain Institute paper, (Snowmass, CO: Rocky Mountain Institute, 1993).

- *What other well-being enhancements could be made to the indoor environment?* Where daylighting is not possible or appropriate, high-quality, full-spectrum artificial lighting is a reasonable substitute. Enhancing occupants' control over their thermal comfort is also beneficial; this can be achieved by providing operable windows and multiple thermostats for different areas of large buildings.

5. Energy and Water Use

- *What types of energy efficiency measures could be taken?* Building-related energy use represents more than 30% of the energy consumed in the U.S., including 60% of our electricity consumption.[21] Energy efficiency measures could include providing plenty of insulation; "right-sizing" the mechanical system (reducing load sizes); using energy-efficient HVAC equipment, lighting, appliances, office equipment, and glazing; and practicing "integrated building design" to optimize systems interactions by converting losses or wastes into gains or assets—through heat recovery systems and the like. Specifying materials that are produced locally can also save on energy use by eliminating the need for long-distance transportation.
- *What types of renewable/clean energy sources could be incorporated given the particular site and climate?* Buildings account for at least 35% of U.S. CO_2 emissions; and the manufacture of Portland cement alone accounts for up to 10% of those emissions.[22] Buildings also account for almost 50% of sulfur dioxide emissions, which cause acid rain, as well as some nitrogen oxide and carbon monoxide emissions.[23] Passive solar design could involve orienting the building, providing shading, and selecting light-colored roof surfaces so as to maximize or minimize solar gain. For example, planting trees near buildings can cut cooling needs up to 30%.[24] Solar photovoltaics, solar water heaters, biomass, and wind power are some other clean energy options, which go beyond conservation to active energy production.

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[21] Wilson, et al., *Green Development*.

[22] Pliny Fisk, Founder of the Center for Maximum Potential Building Systems. Presentation at the Harvard Graduate School of Design, April 5, 1999.

[23] Donald Aitken, "Putting It Together: Whole Buildings and Whole Buildings Policy," *Renewable Energy Policy Project (REPP) Research Report*, no. 5 (September 1998); referencing the *Core Data Book*, U.S. Department of Energy, Office of Building Technology, State and Community Programs, April 30, 1997.

[24] Roodman and Lenssen, "A Building Revolution."

- *What types of water conservation measures could be taken?* Buildings account for one-sixth of the world's freshwater withdrawals.[25] Water conservation measures could include the use of water-saving appliances, toilets, and faucet fixtures, as well as greywater recycling and rainwater catchment systems. The cost to expand water supply infrastructure is becoming prohibitive, especially in arid regions, where cities are having to take the politically unpopular route of diverting water from other areas of the country in order to meet their water supply demands.

6. Solid Waste

- *How could the amount of materials used be minimized?* A typical 1,700 SF wood-frame building requires the equivalent amount of wood as would be obtained by clearcutting one acre of forest.[26] Better ("optimum-value") engineering can achieve equivalent structural soundness with fewer structural members; for example "advanced framing" techniques often can reduce the amount of wood needed in stick framing by 25%.[27]
- *Has a program been set up for the recycling and/or reuse of construction and demolition debris?* In some regions of the U.S., 40% of landfill space is taken up by such debris; at least half of this waste could have been recycled.[28] With tipping fees rising exponentially in recent years because of landfill shortages, the social costs of waste are becoming more internalized, making waste reduction economically sensible.
- *Has a recycling system been incorporated into the design?* This could be as simple as a space for recycling bins in a kitchen or pantry, or as elaborate as a chute system for a multiple-floor building.
- *Have materials been selected based on their recycled content, recyclability, maintainability, and durability?* Maintainability and durability are not considered as much as recycled content issues. But low-maintenance materials do not have to be cleaned, painted, or otherwise treated as often, which can reduce the use of toxic products. And durable materials do not have to be replaced as often. For example, wood, linoleum, vinyl, or tile floors generally last far longer than carpet. (Incidentally, carpet is also worse

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[25] Ibid.

[26] Green Builder Program, City of Austin, *Sustainable Building Guidelines, Volume I.* Prepared by the Department of Public Works and Transportation and Environmental and Conservation Services Department, December 2, 1994.

[27] Center for Economic Conversion (CEC) Technical Brief #2: "Sustainable Buildings: Designing for Environmental and Economic Efficiency," August 1997, referencing "Cost-Effective Home Building," National Association of Home Builders Research Center paper, 1994.

[28] Wilson, et al., *Green Development,* referencing a Worldwatch Institute paper.

for indoor air quality, because it provides a good environment for bacteria and mold build-up.)

7. Materials' Lifecycle Impacts

- *Have materials been selected based on analyses of their lifecycle impacts on environmental/public health?* Over the course of a product's life, cradle to grave (or, better, "cradle to cradle")[29]—from raw materials extraction to the manufacturing process, packaging, transportation, use and post-use (or re-use)—it will have water, embodied energy, waste, and pollution impacts. Inputs and by-products should be considered, as should the type of production methods (e.g., selective timber harvesting). For example, materials and equipment that contain polyvinyl chloride (PVC) should be avoided, because their manufacturing, use, and disposal are particularly harmful to public health. Of course, labels on building materials do not usually tell us much about the ins and outs of the manufacturing process. Some of the information is made available, by law, on the products' Materials Safety Data Sheets, which can be requested from the manufacturer. And more and more information on lifecycle impacts is being compiled and entered into databases every day. The Green Seal certification group, for example, regularly publishes reports that compare the lifecycle impacts of different products. Of course, once you become aware of the issues, you realize how much more there is to know. For example, it is generally believed that linoleum tile is environmentally preferable to vinyl flooring, because linoleum is made from natural materials, including linseed oil and pine resins. In a life-cycle analysis comparing the environmental impacts (use of fossil fuels, depletion of non-renewable materials, air pollution and waste generation) of linoleum, vinyl flooring, woolen and synthetic carpeting, researchers at Utrecht University found that linoleum had the fewest impacts.[30] However, as architect Peter Nobile points out, it is almost impossible to get complete information about a product's implications; for example, a wary specifier still might wonder about other impacts of linoleum, such as possible *water pollution* from pesticides that were used to grow the linseed, and what the downstream effects of that might be, and how *those* compare to the impacts of other flooring materials.[31]

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[29] This is an "industrial ecology" concept that expresses that a truly "closed loop" system is a zero waste system, in which "waste equals food."
William McDonough and Michael Braungart, "The Next Industrial Revolution," *The Atlantic Monthly*, October 1998, 82-92.

[30] J. Potting and Dr. K. Blok, "The Environmental Life Cycle Analysis of Some Floor Coverings," Department of Science, Technology, and Society, Utrecht University, The Netherlands. Report to the First CTAC World Congress, Lisbon, March 1993, referenced in Center for Economic Conversion Technical Brief #2.

[31] Peter R. Nobile III, Architect, Shepley Bulfinch Richardson and Abbott, Boston, MA. Conversation with author, Boston, MA, December 23, 1998.

Benefits of Sustainable Building

There are a number of environmental, social, and economic benefits to be reaped from building more sustainably. Benefits to our shared environment include:

- air and water quality protection
- soil protection and flood prevention
- solid waste reduction
- energy and water conservation
- climate stabilization
- ozone layer protection
- natural resource conservation
- open space, habitat, and species/biodiversity protection

People benefit from environmental improvements not only for health and aesthetic reasons, but also as tax payers. For example, reducing water, energy, and materials use and siting buildings close to public transportation reduces the demand for costly expansions of infrastructure—like water treatment plants, utilities, landfills, and roads. On an even broader societal level, sustainable building can enhance our national security—by reducing our country's dependence on fossil fuel imports, for example. Beyond these important benefits to society at large, sustainable building can offer benefits for designers, contractors, occupants, construction workers, developers, and owners. These benefits include:

- **Improved health, comfort, and productivity/performance** of occupants and construction workers; and related savings for their employers. As discussed in the previous section, improvements in a building's air quality and daylighting can make for healthier and happier occupants. In a workplace context, this means reduced labor costs and liability risk for employers, because of less absenteeism (fewer sick days) and lower health care costs, for example. A 1990 study by the American Medical Association and the U.S. Army found that indoor air quality problems cost U.S. businesses 150 million workdays and about $15 billion in productivity losses each year.[32] The World Health Organization puts the losses at more like $60 billion.[33] Studies have shown a "sustained three to fifteen percent increase in productivity" from

[32] Wilson, et al., *Green Development*.

[33] G.L. M. Augenbroe and A.R. Pearce, "Sustainable Construction in the USA: A perspective to the year 2010," in L. Bourdeau, P. Houvila, R. Lanting, and A. Gilham, eds., *Sustainable Development and the Future of Construction: A comparison of visions from various countries*, Rotterdam: CIB Publications, June 1998. <http://maven.gtri.gatech.edu/sfi/> (March 17, 1999).

indoor environment improvements.[34] The Verifone corporation's daylighting, air filtration, and low-toxicity materials specification contributed to a 45% decrease in absenteeism at their Costa Mesa plant.[35] About 75% of a business's total expenses goes towards salaries for its workers: exponentially more than it spends on construction or utility costs, so even small investments in worker health and productivity have enormous pay-offs.[36] The Reno Post Office retrofit's productivity increase (discussed in the Occupant Health and Well-Being part of the previous section) led to savings of $400,000 per year in labor costs, in addition to $50,000 per year in energy and maintenance savings, leading to a payback in less than 8 months of the $300,000 spent on the retrofit.[37] In addition, a study found that a newly daylit section of a Bullocks department store enjoyed a 15% increase in sales, regardless of what merchandise was displayed in that section.[38] Indoor environment improvements in schools have also been shown to improve the performance of students;[39] and abatement of toxins like lead can further increase the educational capacity of children in our society.

- **Market differentiation**: Developers and design or construction firms have the opportunity to broaden their market niche by attracting new clients who want to hire firms with demonstrated experience in sustainable building. Sustainable building projects tend to generate very positive publicity.
- **Regulatory advantages:** By being early adopters, building professionals can stay ahead of the game; by making gradual, voluntary changes, they will be prepared for some new regulations, so will not suffer the burden of having to adapt suddenly. Their leadership may also serve to prevent some new regulations. Proactive professionals commonly point out that meeting current codes simply means that if the building were built any worse, it would be illegal.
- **Lower construction costs**, mainly through materials use reduction and savings on disposal costs because of recycling, as well by downsizing mechanical equipment and avoiding certain infrastructure extension fees. Of course, the initial expense of other sustainable building measures may outweigh these savings, if measures are not selected and balanced carefully.

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[34] Center for Economic Conversion Technical Brief #2, 5.

[35] Wilson, et al., *Green Development*.

[36] National Resources Defense Council, "NRDC's Washington, D.C. Eco-Office: Tomorrow's Workplace, Today" Report, Executive Summary, 1996.

[37] Romm and Browning, "Greening the Building and the Bottom Line."

[38] Donald Aitken, "Putting It Together: Whole Buildings and Whole Buildings Policy," *Renewable Energy Policy Project (REPP) Research Report*, no. 5 (September 1998).

[39] Ibid.

One respondent attributed higher costs to some designers' attempt to make every single aspect of a project "green." On the whole, sustainable building practitioners tend to agree that project teams should select a package of strategies that make the most sense for that project's site and climate conditions, client priorities and budget, and design programming, rather than try to do a little of everything. (Cost issues are discussed further in Part III.)

- **Lower operating costs**, from energy and water savings. Energy efficiency investments, for example, almost always deliver a payback within one to five years: a very quick return on investment. Energy savings of up to 50% are not uncommon, according to Norman Willard of the U.S. Environmental Protection Agency;[40] in some cases, energy consumption can be cut by as much as 80%.[41] These savings can make a real difference, particularly for low-income residents, who spend a greater share of their earnings on home utility costs than do people with higher incomes.
- **Increased building value.** It is important for owners and developers to remember that the cheapest development is not necessarily the most profitable. Putting environmentally-sensitive features into a building enhances its quality and adds value, just as putting in typical amenities does. Lower operating costs and environmental features make buildings more attractive to potential buyers. The Condé Nast Publications company says that the sustainable design of the 4 Times Square building was a major factor in its decision to make that its new headquarters. Overall, building rental rates and tenant retention have been shown to be higher in sustainable projects.[42]

Daylighting is a great example of a sustainable building element that delivers environmental, social, and economic benefits. Not only can natural daylighting decrease the building's demand for fossil fuel-derived energy for lighting and heating, but it can simultaneously lower energy costs, improve the health and well-being of occupants (thereby lowering labor costs), and, in a retail environment, can even result in higher sales[43] (see the Occupant Health and Well-Being section of this chapter).

While sustainable building practices often have multiple benefits, some have conflicting effects that require a balancing of the trade-offs. For example,

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[40] Norman Willard, Climate Change Specialist, U.S. Environmental Protection Agency—New England. Presentation at the Commonwealth of Massachusetts' 4th Annual Buy Recycled and Environmentally Preferable Product Vendor Fair and Conference, Boxborough, MA, October 30, 1998.

[41] David Gottfried, "The Economics of Green Buildings," *Sustainable Building Technical Manual: Green Building Design, Construction and Operation.* (Annapolis Junction, MD: Public Technology, Inc., 1996).

[42] Wilson, et al., *Green Development.*

[43] Aitken, "Putting it Together."

creating a tightly-sealed structure that circulates the same air around all day (a common practice in the 1970s and ‘80s) may improve the energy efficiency of a building , but is also likely to lead to indoor air quality problems. Likewise, it is important to design daylighting carefully so that it does not create a much greater need for air conditioning, in the process of saving on heating. And a questionnaire respondent pointed out a classic, big picture dilemma: “The benefits of ‘green’ materials can be counterbalanced by the need to transport them long distances (such as bamboo flooring from China).”

Sustainable Building History & Practice

No modern-day building project can be said to be completely sustainable, but in recent years, more and more projects have been getting closer and closer to that goal. There are certainly more government agencies that require or encourage sustainable building practices in government projects; one notable example is the Naval Facilities Engineering Command, which recently became the first Federal agency to require *all* of its building and infrastructure projects to incorporate sustainable principles.[44] But private owners and developers are also getting on board, often but not always assisted by government. The 48-story skyscraper being built at 4 Times Square in Manhattan is a high-profile, large-scale example of a private sustainable building project, initiated by The Durst Organization developer. Companies like The Gap, Duracell, and the United Parcel Service have also commissioned the sustainable design of their facilities. Several environmental non-profits, including the NRDC, Audubon Society, and World Resources Institute, have also completed sustainable renovations of their offices. There are many more case studies than could be mentioned here.

The sustainable building concept has been recognized in institutional and professional circles, such as the American Institute of Architects. Not only does the AIA have a Committee on the Environment, but in 1993, the institute's president, along with the president of the Union Internationale des Architects, signed a Declaration of Interdependence for a Sustainable Future. Three thousand other participants in that year's World Congress of Architects (held in Chicago) also signed the declaration, boldly committing themselves to, among other things, "bring all existing and future elements of the built environment...up to sustainable design standards." The number of groups involved in sustainable building advocacy in the U.S. has become large enough that a coordinating body has emerged; the U.S. Green Building Council (GBC) formed in 1993. The GBC's membership is comprised of more than 150 groups, representing all segments of the building industry; member groups include professional societies, design firms, universities and research institutes, building owners and managers, product manufacturers, utilities, financial firms, environmental groups, as well as city, state, and at least twelve federal government agencies.

Further evidence that sustainable building has gone from being a movement to a bona fide field is that there are a growing number of sustainable building consultants who market their services as such, and firms, like Steven Winter Associates, who specialize in sustainable building. In fact, one of the world's largest design firms—Hellmuth, Obata + Kassabaum (HOK), Inc.—has

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[44] "Navy at the Leading Edge of Green Design," *Environmental Building News* 7, no. 10 (November 1998).

committed all of its many offices around the world to the goal of incorporating sustainable design guidelines into all of their projects. And the media has been covering the advancement of the sustainable building movement, with particular attention paid in the 1980s and early '90s to occupant health concerns in cases of Sick Building Syndrome. Other types of sustainable building stories are now being covered by mainstream media—in trade magazines, including *Architectural Record* and *Metropolis*, and in newspapers, including the *New York Times*.

So, what brought about this level of interest in sustainable building? I have gathered many different answers to this question from readings, interviewees, and questionnaire respondents. Respondents cited a number of people, organizations, publications, events, and experiences that were influential in developing their interest in sustainable building. The Rocky Mountain Institute was the organization cited by the greatest number of respondents; the lectures and writings of the institute's Amory Lovins and William Browning were specifically mentioned. William McDonough, Dean of Architecture at the University of Virginia and a modern-day visionary in the sustainable design world, was the individual cited most. The Environmental Building News monthly bulletin was the most cited publication. Other influences that were credited by respondents included: the U.S. Green Building Council, the American Institute of Architects (AIA), Pliny Fisk of the Center for Maximum Potential Building Systems, author and environmental educator David Orr of Oberlin College, and author and architect David Pearson.

Respondents also mentioned a couple of conferences that made a significant impression on them: an AIA Green Building Conference in Denver in 1992, and a Sustainable Construction Conference sponsored by the French Center for Building Research (CIB) and held at the University of Florida in Tampa in 1994, about which respondent Annie Pearce wrote:

> Paul Hawken's keynote speech at the 1994 Sustainable Construction Conference in Tampa was what really lit my fire. He referenced the 1986 study by Vitousek et al.[45] that talks about how humans are currently appropriating 40% of the products of biosynthesis, and showed how with population and consumption projections, we will very soon be living beyond the capacity of the environment to sustain us.[46]

The energy crisis of the 1970s is also seen as a catalyzing event for sustainable building by several building professionals I have heard from. The oil embargo certainly made it economically sensible to move towards energy

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[45] P.M. Vitousek, P.R. Ehrlich, A.H. Ehrlich, and P.A. Matson, "Human Appropriation of the Products of Photosynthesis," *BioScience*, 36, no. 6 (1986): 368-373.

[46] Annie R. Pearce, Research Engineer and Program Director, Sustainable Facilities and Infrastructure Program, Georgia Tech Research Institute, Atlanta, GA. Questionnaire respondent.

efficiency and increased use of solar power, and Presidents Nixon and Carter helped push through programs to support those goals.

With the exception of Frank Lloyd Wright, Buckminster Fuller, and E.F. Schumacher, most of the influences mentioned by respondents hail from the 1970s, '80s, and '90s. But the seeds of the American sustainable building movement sprouted much further back than that, as I will discuss in a moment.

First, however, it is important to note that buildings have not always been built *unsustainably*. Many of our most destructive building practices have actually evolved during this century. For example, while we have managed to make improvements in operational energy efficiency in recent decades, we have simultaneously seen an increase in the embodied energy of building materials.[47] We now use concrete and steel much more, which require much more energy to manufacture than does traditional timber production.[48] And, as I mentioned earlier, the average house size has more than doubled over the last fifty years, meaning that we are just using more resources in general. Also, in the days before air conditioning and fluorescent lighting, buildings were generally designed with better ventilation and daylighting than they are now.[49]

Then, with the industrial revolution came urban worker tenement buildings that were *not* designed with adequate air and light. In the late 19th and early 20th centuries, a movement arose to improve the living conditions of tenement dwellers, with the leadership of reformers like Chicago's Jane Addams and Alice Hamilton.[50] At that time, public health problems were first being linked with environmental risks, and "sun and ventilation were thought to be the cure for many of the industrial urban ailments—consumption, tuberculosis, etc."[51]

At about the same point in time (in the early 1900s), the "garden cities" movement began in Europe. It created an ecological urban planning ethic that is reflected in today's sustainable building movement. In Toni Garnier's planning model, for example:

> The whole city is laid out in relation to sun, wind, topography, transportation....the houses cannot shade one another: "the minimum distance between two dwellings in the north-south direction is equal to at least the height of the building situated on the other side"....[and] in the

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[47] St. John, conversation with author.

[48] James Steele, *Sustainable Architecture: Principles, Paradigms, and Case Studies* (New York: McGraw-Hill, 1997).

[49] Jane Hughes, BBC World radio report on 4 Times Square (January 21, 1999).

[50] Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington, D.C.: Island Press, 1993).

[51] Sim Van der Ryn and Peter Calthorpe, *Sustainable Communities: A New Design Synthesis for Cities, Suburbs, and Towns* (San Francisco: Sierra Club Books, 1986), 203.

> residential area, orientation and spacing of the dwellings probably constitute the first solar access code. Every room is to have at least one window....[52]

It is interesting to note how, at that time, solar orientation was encouraged for health reasons—not for energy efficiency, as it was later, in the 1970s. Garnier also called for the use of local construction materials, now a common tenet of the sustainable building philosophy. Ebenezer Howard designed (and coined the term) "garden cities" with similar principles in England around the turn of the century, and Lewis Mumford continued the tradition in the United States in the decades that followed.

Ian McHarg took ecological land use planning to a whole new, holistic level in the 1950s and '60s, directly inspired by Lewis Mumford. In his classic book, *Design with Nature,* he wrote that: "...architecture, landscape architecture, engineering, and construction are adaptive processes engaged in fitting of organisms and environment."[53] McHarg taught at the University of Pennsylvania, where he brought ecologists onto the faculty of the landscape architecture program. Pliny Fisk, also one of today's leaders in sustainable design, worked with McHarg there. McHarg is the father of the "environmental impact statement" and his ideas led to the development of Geographic Information Systems (GIS).[54] He is now in his late 70s.

In addition to this legacy of increasing awareness about the environmental impacts of site considerations, there is a legacy of awareness about environmental considerations in building design. Frank Lloyd Wright is a part of the latter legacy. His contribution to sustainable building came in the early 20th century, with his focus on "organic architecture": buildings that blended in well with the natural surroundings, used local materials, and employed direct-gain passive solar design and daylighting through building orientation. He was also responsible for developing some of the first radiant floor slabs for innovative heating.[55] Despite these contributions, Wright's work has been roundly criticized by environmentalists and ecologically-minded urban planners, because of the sprawling, automobile-centered nature of the communities that he advocated.

Buckminster Fuller was another architect and visionary whose ideas still resonate with sustainable building practitioners. From the late 1920s until his death in the '80s, he came up with cutting-edge designs, with the goal of energy and resource efficiency. He is best known for inventing the Geodesic Dome.

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[52] Ibid., 201-202.

[53] Ian McHarg, *Design with Nature* (Garden City, NY: Natural History Press, 1969), 197.

[54] David R. Butler, review of *A Quest for Life: An Autobiography,* by Ian McHarg, *American Scientist* 86, no. 1 (January 11, 1998).

[55] Van der Run and Calthorpe, *Sustainable Communities,* 218.

The sustainable building movement has developed not only from the visions of these leaders in the urban planning and architecture professions, but also out of a parallel, bigger-picture paradigm shift. Architect Peter Nobile put it this way:

> Our species is slowly developing, in fits and starts, a common vision so that all life on earth might survive and thrive, and a big initial part of that vision is a deep awareness of our effects on the ecosystems which we depend on for life. The goal of the sustainable or ecological design movement is on the surface to make "green" buildings, but the ultimate purpose is to utterly change the way we think about the planet and ourselves.[56]

And, as developer Eric Pravitz put it:

> Sustainable design is part of a larger movement to change the way we live, to reduce our ever consumptive lifestyle to one that focuses more on the quality of life...[57]

This "larger movement" is based on the concept of "sustainable development," which essentially represents an internationally-promoted philosophy that is challenging the conventional embrace of unbridled economic growth, by calling attention to the interdependency of economic, environmental, and social conditions. For example, there is a growing realization that "economic activity [not only] threatens the environment," but that "environmental degradation threatens economic activity"—and therefore, development.[58]

E.F. Schumacher espoused such ideas in his landmark book, *Small is Beautiful: Economics As If People Mattered,* published in 1973. He also advocated communities based on renewable energy and "intermediate" (or "appropriate") technology. A year before that book came out, the concept of "sustainable development" gained international legitimacy in the Club of Rome's *Limits to Growth* report.[59] Over a decade later, in the UN's 1987 World Commission on Environment and Development (or the "Brundtland Commission") report, the term was defined as "progress that meet[s] the needs of

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[56] Peter R. Nobile, Architect, Shepley Bulfinch Richardson and Abbott, Boston, MA. Questionnaire respondent.

[57] Eric Pravitz, Project Manager, Corcoran Jennison Co., Inc., Boston, MA. Questionnaire respondent.

[58] Mark Dowie, *Losing Ground: American Environmentalism at the Close of the Twentieth Century* (Cambridge: MIT Press, 1995).

[59] Steele, *Sustainable Architecture,* 1.

the present without compromising the ability of future generations to meet their own needs"—a definition that is now used by many.[60] This goal set the tone for the 1992 Earth Summit in Rio and later for the President's Council on Sustainable Development, which still meets.

Sustainable building is just one of the many ways that this overall goal of sustainable development, or sustainability, is being applied in practice. It is related to simultaneous initiatives for "smart growth" and "livable communities," which address land use and development patterns. With the Worldwatch Institute estimating that the construction, operation, and equipping of buildings accounts for 40% of the world's material and energy flows,[61] it is evident that buildings are an important part of the sustainability equation. Whether the issue is national economic development or real estate development (often seen as an indicator of economic development), the same general principles of sustainability apply.

Over the past two decades, the sustainable building movement has evolved tremendously. Sustainable building, as a concept, has become much more broad and inclusive, as more people recognize the connections between the natural and built environments, and between the economic, environmental, and social effects of standard building practices. William Bobenhausen has referred to the changes in sustainable building perspectives since the 1970s as the "Lean to Clean to Green" evolution.[62] "Lean" is best represented by resource and energy efficiency concerns, "clean" speaks to health issues, and "green" means all of the above, plus the bigger picture context, including land use considerations. "Green" is "sustainable."

Responses to my questionnaire indicate that the "lean" and "clean" types of sustainable strategies are still more widely practiced than the broader "green" strategies. (See Table 1.) Respondents reported that Energy and Water Conservation strategies are by far the most prevalent and most advanced of the sustainable measures that they have incorporated into their projects; all respondents but one said that they had incorporated energy and water conservation strategies that went beyond code compliance requirements, and the majority reported that they had used "best practices" in these areas. In fact, this category of strategies was the only one for which more respondents claimed to have used "best practices" rather than simply "improved practices." (Note: The terms "best" or "improved" are entirely subjective in this survey; their interpretation was left up to each respondent.) While an equal number of respondents reported taking measures to protect Occupant Health and Well-Being, fewer than half feel that those measures have risen to the level of "best practices."

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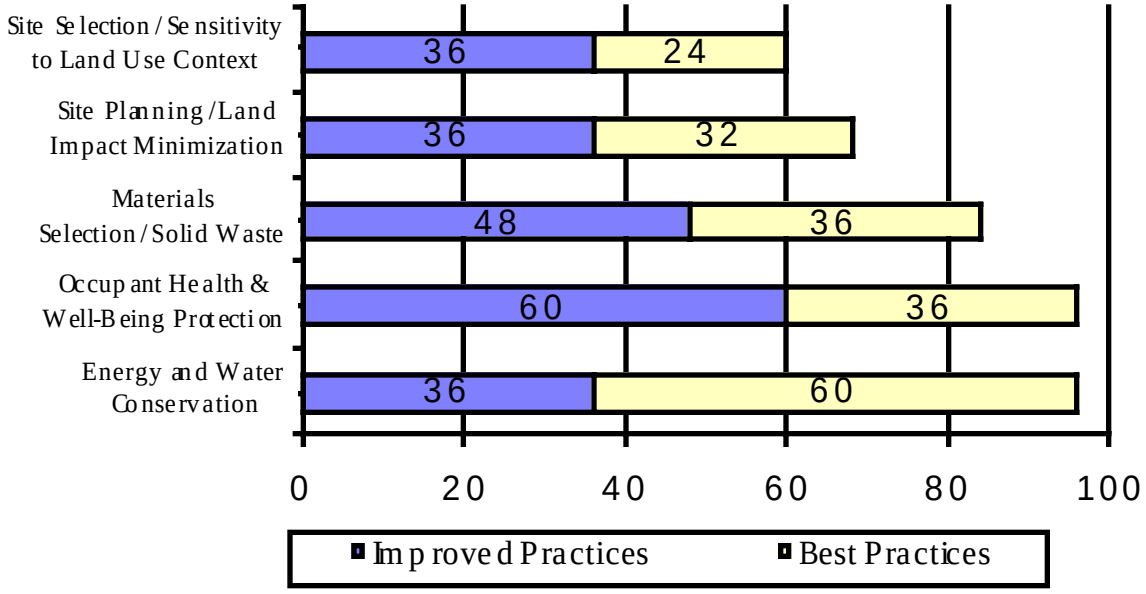
[60] Ibid., 5.

[61] Roodman and Lenssen, "A Building Revolution."

[62] Bobenhausen, presentation comments.

Materials selection/solid waste minimization strategies were the third most commonly incorporated practices reported by respondents. Site planning for land impact minimization ranked as the fourth most common strategy area; and site selection with sensitivity to the land use context came in fifth, as the least incorporated strategy type. (Note: The list of five strategy categories respondents were presented with did not include the first or seventh categories—General, Preliminary Consideration; and Materials' Lifecycle Impacts—that I listed earlier, in the Definition of Sustainable Building section. However, those general and lifecycle-related considerations were encompassed within respondents' comments regarding these five basic issues.)

Table 1. Types and Degrees of Sustainable Building Strategies (Beyond Code) Practiced by the 25 Questionnaire Respondents



The fact that sustainable site selection and site planning measures are reported to be the least practiced measures may partly be due to the fact that they cannot be factored into renovation project decisions like they can in new construction and that they are not within the scope of work for those building professionals who are not involved in the early stages of a project.

Eventually, all projects that claim to be "sustainable" should include a sensitivity to site selection and site planning concerns. But sustainability considerations should even go beyond those issues. Architect Peter Nobile commented that:

> The paradigm shift to true sustainability will have architects asking their clients: Do you really need to be doing this project, or can you use existing facilities or do without? This kind of thinking is...far afield at the moment, [but] it is simply a matter of time before the old ways of doing things become so undesirable as to render them obsolete.[63]

What is preventing the building industry from acting now? And, how can we accelerate the process of change, so as to protect our health and resources sooner rather than later? These questions are addressed in the following sections.

[63] Nobile, questionnaire comments.

III. BARRIERS TO WIDESPREAD SUSTAINABLE BUILDING PRACTICE

As Gail Vittori of the Center for Maximum Potential Building Systems has said, sustainable building is no longer "on the fringe."[64] But while many people may have heard of the idea now, it is by no means a pervasive practice. Of the 19 questionnaire respondents who were able to estimate what percentage of people in their building professions routinely incorporate sustainable elements into their projects, twelve (more than 60%) estimated that only 5-10% of their peers are routinely using sustainable building practices.

Presumably more than 5-10% of building professionals care somewhat about environmental issues, since polls show that about three-quarters of Americans claim to be concerned about environmental issues.[65] So what accounts for the gap between personal concern and professional application? In the questionnaire, I listed twelve different reasons that I had formulated through my research and my discussions with building professionals. Some of the twelve factors are clearly similar and almost all are probably related. While ten of the twelve are considered by the majority of respondents to be barriers to the increased adoption of sustainable building practices, the group certainly indicated that some of these factors are bigger barriers than others. (See Table 2.)

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[64] Gail Vittori, Co-director, Center for Maximum Potential Building Systems; Founder, Austin Green Building Program; Loeb Fellow, Harvard Graduate School of Design. Presentation, hosted by the Sustainability Roundtable and the Citizens' Housing and Planning Association, Boston, MA, January 13, 1999.

[65] Wilson, et al., *Green Development*, referencing a Roper Starch Worldwide "Green Gauge" poll done for the Times Mirror, 1995.

Table 2. Questionnaire Respondents' Ranking of 12 Barriers to More Widespread Sustainable Building Practice

BARRIERS	**% of respondents who consider it a "major" barrier**	**% of respondents who consider it a barrier** ("major" *or* "minor")
1. lack of expressed interest from clients (owners/developers)	**84**	**100**
2. lack of training/education in sustainable design/construction	**64**	**100**
3. recovery of long-term savings not reflected in service fee structure	**52**	76
4. sustainable building options too expensive	**48**	96
5. lack of technical understanding on the part of subcontractors	36	80
6. lack of technical understanding on the part of project team members	32	84
7. lack of interest from project team members	32	76
8. "green" products not available in my area	32	68
9. insurance/liability problems with offering warranty on non-standard materials or methods	24	60
10. lack of technical understanding on the part of the Clerk of the Works	24	44
11. difficult to obtain financing from banks for sustainable projects	16	68
12. not sure where to find information on sustainable building methods	12	44

Primary Barriers

According to the questionnaire respondents, the top four "major" barriers are: the lack of expressed interest from clients (owners/developers), the lack of training and education in sustainable design/construction, the failure of service fee structures to account for the recovery of long-term savings, and the higher cost of sustainable building options. Respondents indicated that the first two factors are particularly significant; *all* agreed that they are barriers, and the majority consider them to be major barriers. Approximately half of respondents feel that the other two are major barriers.

1. the lack of expressed interest from clients

This was cited as the most significant barrier to more widespread sustainable building practice. Eighty-four percent of (or 21 out of 25) respondents say that it is a major barrier. A questionnaire respondent commented that a building project cannot be done along sustainable lines without the owner or developer's "full support for sustainable concepts."

In another, similar survey conducted in 1999 by the Architectural Practice Research Project at the Catholic University of America, architects again cited client apathy as the main reason why most projects are not being designed sustainably.[66] Respondents in that survey indicated that fewer than 10% of their clients request sustainable design. (And, though those designers often presented their clients with sustainable designs for their projects anyway, fewer than 30% of those designs were selected by their clients and implemented. This indicates that, even where building professionals are taking the initiative in promoting sustainable building, public disinterest is getting in the way.) A 1996 survey that the Environmental Building News did of its subscribers turned up similar results; those respondents cited client resistance as one of the major impediments to sustainable practice.[67]

In my survey, the other major barriers that respondents cited suggest that the primary causes of clients' disinterest may well be: (1) a lack of education or "awareness" about sustainable building, and (2) economic/financial concerns.

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[66] Joseph Hittinger, Survey on "Implementing Environmentally Sustainable Design," Architectural Practice Research Project, The Catholic University of America, Washington, D.C., Winter 1999. April 15, 1999. <http://www.acad.cua.edu/aprp/olce/green/main-page.htm> (April 15, 1999).

[67] "Now We Know Who You Are," *Environmental Building News* 5, no. 5 (September/October 1996).

2. the lack of training/education in sustainable design/construction

Of the respondents, only two (8%) had been educated "frequently" about sustainable building issues through their degree or training programs, while over one-quarter of respondents had "never" been educated about sustainable building issues during their professional schooling. Both of the respondents who reported frequent sustainable building education were in their 20s, suggesting that some programs may have begun to incorporate more sustainable building issues into their curricula in recent years. While one of these respondents is an architect and the other an engineer, they both attended technical institutes. The similar survey done at the Catholic University of America found that 67% of educational institutions attended by respondents did not offer *any* courses focused on sustainability issues.[68]

In my survey, it is clear from respondents' rankings and comments that they feel that education about the principles and concepts of sustainable building is even more essential than, or at least must come before, technical training. Changing behavior requires changing attitudes. A number of respondents wrote about the need for more education (not only for building professionals, but for the public at large) about what sustainability is all about and *why* we should strive for it in buildings and in general. These types of comments were as follows:

- "Major barrier: Apathy about the condition of the planet by most people."
- "Many important stakeholders are not even aware of the concept [of sustainable building], and so are naturally resistant to change."
- "In my experience, the greatest barrier is the lack of understanding of the NEED for sustainable design."

3. the failure of service fee structures to reflect long-term savings; and
4. the higher cost of sustainable building options

I have lumped these two barriers together here because they are so closely related. These economic barriers are also inextricably tied to the educational barriers mentioned above, because markets are based on demand. This connection is plainly illustrated by some of the comments that respondents made, such as:

- "Cost is the primary issue and is related to availability. High cost is also due to the unfamiliarity of the design team and contractors with sustainable methods."

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[68] Hittinger, Survey on "Implementing Environmentally Sustainable Design."

- "By far, the #1 barrier that remains is lack of education about the economic benefits of this approach."
- "The problem as I see it is that 'green' materials and concepts need to be heavily marketed to the end user (home/property owners) who will in turn request or require the use of these products on their job. Leaving the choice up to contractors in most cases is clearly not the way.....the up-front cost difference is a clear disincentive."

All respondents but one said that they feel that the cost of sustainable building options is a barrier to the routine use of sustainable strategies in their professions. On respondent wrote: "The mainstream world won't do green unless it saves them money somehow." Another wrote: "Clients have not been interested in any sustainable features except for energy efficient heat, which could lead to an immediate payback." However, respondents are divided on just how *much* of a barrier this is; half feel that this is a major barrier and half feel that it is only a minor barrier. Some of this difference of opinion might be explained by a difference in interpretation. Based on what I have heard from many building professionals, I speculate that some respondents may have been providing an estimate of how much more expensive sustainable building options really are, while others may have been providing an estimate of how much the *perception* that they are more expensive serves as a barrier. One respondent summed up a common sentiment in stating that "the perception that good, sustainable practice is not good economic practice" is the primary barrier to more widespread sustainable building practice. While actual and perceived barriers are both significant, it is important to try to distinguish between the two, so that we know how best to address them. It may be just as important to educate professionals to correct common misperceptions about the cost of sustainable practices as it is to try to bring some of the *actual* costs down.

The actual costs of sustainable projects often are not as high as many people think they would be. For example, the HVAC modifications and green materials specification done to achieve good indoor air quality in the San Francisco Main Library added only 1.1% to the final construction costs.[69] Based on other estimates I have seen for other projects, this is fairly typical. Peter Yost, project manager of environmental systems at the National Association of Home Builders' Research Center, estimates that green homes end up costing "from zero to five percent" more than a conventional home.[70] The fact that Habitat for Humanity has been able to build sustainable and affordable housing, including the Jordan Commons project in Homestead, Florida, is testament to the

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[69] Anthony Bernheim, "San Francisco Main Library: A Healthy Building," Simon Martin-Vegue Winkelstein Morris Architects, San Francisco, referenced in the CEC Technical Brief #2.

[70] Janet Burkitt, "Environmentally Correct Homes on the Rise,"*Indianapolis Star*, July 19, 1998, H13.

possibility of not only keeping costs down, but even achieving lower costs for "green" projects.

When the City of New York's Office of Sustainable Design recently did a rough comparison of projected lifecycle costs for green versus conventional construction, it also found only a 1% increase in first cost. They also found more than 30% *savings* in operating costs for the use of green building practices. Overall, their estimate of average lifecycle savings came out to 11% for new green building projects and 5% for green renovations over conventional.[71]

It is clear that the determination of cost (and savings) depends on what is being included in the calculation. Some green building alternatives are undeniably more expensive than their conventional counterparts (e.g., solar hot water heaters instead of oil or gas hot water heaters), but that is looking only at their up-front costs. Of course, in traditional pro formas, "the prevailing concern among architects, clients, and contractors alike is initial cost, not extended cost," as noted by a respondent, and according to another, "most green designers don't understand...how to close the first-cost gap on green design." By not using a "lifecycle costing" or "full-cost accounting" approach, clients and building professionals are unable to appreciate the cost effectiveness of many sustainable strategies. Lifecycle, full-cost accounting takes into account the gradual savings in operating and maintenance costs, avoided first costs (such as not needing to install an air conditioning system because of shading and other natural cooling techniques), and avoided societal/economic costs (such as reduced labor or health care costs, or not needing to put tax money toward building a new waste incinerator). Nevertheless, a respondent noted that: "Many...projects are not able to justify increased first cost, despite demonstrable savings later."

One reason why not everyone has started taking advantage of such savings is that those who help fund an investment in sustainable materials or systems are often not in a position to benefit from the savings later. A respondent wrote: "The costs of improvements benefit the ultimate owner, not the developer." This problem applies particularly to private developments built "on spec." Slightly more than half of respondents feel that the way that their fee structures fail to account for long-term savings from sustainable building measures is a major barrier to the routine use of sustainable strategies in their professions. Many professionals are starting to advocate for performance-based fee structures, functioning sort of like a royalty system, that would help solve this compensation problem. A truly sustainable building process will eventually have building professionals advising their clients to build smaller structures or to use existing facilities whenever possible, but because there is currently a strong financial disincentive to do so, the entire fee system may need to be reinvented so as to find a way to reward moderation.

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[71] Hillary Brown, "Laying the Groundwork for High Performance Buildings: How NYC will capture real returns from more energy and resource efficient public facilities," Information Sheet, New York City Office of Sustainable Design, Department of Design and Construction, 1999.

Secondary Barriers

Four of the twelve factors listed in the questionnaire were each considered to be major barriers by approximately one-third of respondents. These factors are: the lack of technical understanding on the part of subcontractors, and on the part of other members of the project team, the lack of interest on the part of members of the project team, and the lack of "green" product suppliers in the area.

5. the lack of technical understanding on the part of subcontractors

Most respondents (20 out of 25, or 80%) feel that a lack of technical understanding on the part of subcontractors is at least a minor barrier to the routine use of sustainable strategies in their professions. One respondent wrote: "The greatest problem with subcontractors is their unwillingness to perform a familiar task differently." Still, these respondents were split on whether this is a minor or major barrier. According to one respondent, "A lack of technical understanding on the part of subcontractors...is not a problem if the principals of the design team are on board."

Nevertheless, another respondent commented that a major barrier is building professionals' "reluctance to engage in a truly collaborative approach to design: the Green Team vs. traditional linear processes." The Center for Economic Conversion, a group that was involved in the renovation of a former military building into the Thoreau Center for Sustainability project in San Francisco's Presidio, confirmed this point in a technical brief: "Green buildings are often the result of a more integrated planning, design, and construction process than the linear development process of conventional buildings."[72] For this reason, design/build firms tend to hold a process advantage in sustainable building. Interdisciplinary cooperation can lead to the discovery of solutions that single team members could not have figured out on their own. For example, an integrated or "whole systems" approach allows team members to see that the added expense of envelope upgrades can be more than made up for by the resulting ability to downsize the chiller.

Since sustainable building considerations should generally be incorporated early in the programming and design process, owners/developers and architects may have the most control over what sorts of sustainable elements end up in the plans and specifications; but these will not be carried out if communication, training, or the interest is not there on the part of the construction management and crew. The idea of a "green team" is typically that all "stakeholders," including tradespeople (subcontractors), maintenance/custodial staff, and

[72] Center for Economic Conversion Technical Brief #2.

prospective occupants be brought on board early on, so everyone understands, contributes to, and feels ownership over the process.

6. the lack of technical understanding on the part of project team members; and
7. the lack of interest on the part of project team members

In addition to the lack of technical understanding exhibited by many subcontractors, 84% (21 out of 25) of the building professionals surveyed indicated that members of their core project teams also often do not have adequate technical understanding of sustainable building methods and that this serves as at least a minor barrier. Respondents said that this is a problem among all parties on their project teams, including architects, mechanical/electrical and HVAC engineers, and contractors. One respondent, who is a sustainable building consultant, wrote: "We tend to spend a lot of extra time training project participants."

The majority (19 out of 25, or 76%) of respondents feel that a lack of *interest* in sustainable building on the part of other members of their project teams is a barrier to the routine use of sustainable strategies in their professions. The difference between the two barrier rankings suggests that some, but not all, of the lack of technical understanding can be explained by a lack of interest. This indicates that some building professionals are open to learning about sustainable building, but have not had adequate training in it.

Respondents reported that a lack of interest is a problem among members of all parties. One respondent offered this explanation for some team members' resistance: "Architects and designers (and property owners) are often far too willing to compromise on material choices and space configuration where traditional values are involved, i.e., architectural style, paint colors, perceived 'low-maintenance' surfaces, etc."

8. the lack of "green" products suppliers in the area

While the majority (17 out of 25, or 68%) of respondents feel that a lack of sustainable materials/products suppliers in their area is at least a minor barrier to the routine use of sustainable strategies in their professions, one-third of respondents (mainly architects and contractors) do *not* see this as a barrier. And those who *do* are split on just how much of a barrier it is. Of course, there are regional differences in the availability of certain green products, but some of the difference of opinion on this matter may also be due to varying degrees of awareness about what products are out there and where they can be found: an educational and marketing issue.

Also, it is clear from respondents' comments that product supply issues are inextricably tied to demand: both an economic and educational issue. One wrote: "Occasionally a supplier may stock a [green] item only to drop it later due to poor sales." And the availability of local suppliers has an impact on cost; a respondent

wrote that "having to get special materials shipped in" is responsible for much of the real increase in first cost.

The number of sustainable products that are available is growing rapidly. As of 1998, the Construction Specifications Institute database listed 1,800 such products[73]—and not all products that are "green" are even marketed as such, like linoleum. And according to sustainable design guru Pliny Fisk, "manufacturers are well ahead of the architectural profession in understanding the inherent efficiency of internalizing lifecycle and environmental considerations."[74]

Government procurement of environmentally preferable products for government-owned building projects is certainly helping to create viable markets for such products. But large-scale private projects can do this, as well. In fact, in the case of the Cambridge Co-Housing project, team members were even able to get *manufacturers* to make some product changes, because the project offered an economy of scale that made it cost-effective to do so.[75]

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[73] Sara Hart, "Guess Who's Going Green?: Innovation, integration, and especially imagination have moved 'green' building from the fringes to the boardroom," *Architecture* (August 1998).

[74] "Pliny the Greener," an interview with Pliny Fisk in *Architecture* (June 1998), 57.

[75] Vittori, presentation comments.

Questionable Barriers

Four of the twelve factors were each considered to be major barriers by *no more than* one-quarter of respondents. Therefore, it seems questionable whether these factors can be considered real or significant barriers. The four are: insurance/liability issues, lack of technical understanding on the part of the Clerk of the Works, the difficulty in obtaining financing from banks for sustainable projects, and uncertainty about where to find information on sustainable building.

9. insurance/liability problems with offering a warranty on non-standard materials or methods

While more than half (15 out of 25, or 60%) of respondents—including all four sustainable building consultants and both developers—feel that insurance/liability problems associated with offering a warranty on non-standard materials or methods is a barrier to the routine use of sustainable strategies in their professions, most see it as a minor barrier. Furthermore, some professionals believe not only that sustainable building practices do not suffer from liability problems, but that such practices may *reduce* liability problems. One respondent noted that "Liability is actually greatly decreased due to due diligence related to Indoor Air Quality, etc." Indeed, according to the Rocky Mountain Institute, "an increasing number of building occupants are filing lawsuits claiming that they are suffering from 'sick building syndrome.'"[76] In a $1 million suit filed by employees who became sick from new carpeting put into—ironically—the EPA building in Washington, D.C., the employees won their case. In addition, "lower insurance and/or workers' compensation policy premiums could potentially result from better air quality in buildings."[77]

The insurance industry certainly seems to be taking note of the liability issues related to buildings and the environment, not only in the area of indoor air quality but also in energy conservation. After all, insurance companies have a great financial interest in combatting climate change, because the marked increase in the frequency and intensity of "natural" disasters is taking a bigger and bigger bite out of their profits.[78] This will increasingly compel these companies to promote energy efficiency and clean, renewable energy use.

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[76] Wilson, et al., *Green Development*, 16.

[77] Ibid., 17.

[78] Ibid., 254.

10. a lack of technical understanding on the part of the Clerk of the Works

Fewer than half of the respondents feel that a lack of technical understanding of sustainable building methods on the part of Clerks of the Works is a barrier to the routine use of sustainable strategies in their professions, and only about one half of those (one quarter of all respondents) see it as a major barrier.

Some respondents may be providing an estimate of the *degree* to which Clerks lack a technical understanding of sustainable building, while others are indicating whether they think that that lack of technical understanding actually serves as a barrier. Judging from comments like the following, some respondents seem to feel that Clerks' knowledge of sustainable building methods is not necessary for the implementation of sustainable strategies: "A lack of technical understanding on the part of...the Clerk is not a problem if the principals of the design team are on board." Nevertheless, some technical understanding of the issues by on-site supervisors—both the architect's representatives and the contractor's construction managers—can only help sustainable projects to succeed.

11. difficulty in obtaining financing from banks for sustainable projects

This was considered to be at *least* a minor barrier by the majority (17 out of 25, or 68%) of respondents—more than any of the other three "questionable" barriers. However, only 16% of respondents feel that it is a major barrier, and 32% of respondents (some architects and some contractors) do not see it as a barrier at all. One respondent wrote: "There is no difference in financing between sustainable and conventional practice." Though there is not consensus on this issue, both developer respondents (who are arguably the most familiar with financing) do see this factor as a barrier. One developer feels that "Financing partners/lending institutions (banks, insurance companies, conduit lenders) do not place a financial value on sustainable development. The developer/owner must finance such improvements themselves."

12. uncertainty about where to find information on sustainable building methods

This factor was seen as the least significant barrier of the twelve that were listed in the questionnaire. Fewer than one half of respondents feel that finding information on sustainable building methods is a problem, and only 12% see it as a major barrier.

More information is available on sustainable building concepts and techniques than most mainstream practitioners would imagine. In the last decade, a plethora of written materials have come out on all aspects of the

subject. According to one respondent, "Sources of information on sustainable building methods are well established." Several respondents mentioned Environmental Building News as an especially good source.

If anything, many practitioners active in sustainable building feel overwhelmed by the amount of information that is available. Annie Pearce, an engineer who does research on sustainable building at Georgia Tech, wrote: "There is an incredible amount of information out there, and we've found in surveys that information overload is more of a problem than too little information, at least for stakeholders interested in sustainability."[79]

Though there will always be room for more information (particularly lifecycle and performance assessments), lack of information is generally not a problem. However, the time it takes to sift through and distinguish among the many, and sometimes conflicting, sources of information is not budgeted into most professionals' busy workdays. One respondent wrote: "The major barrier appears to be the lack of a [consistent]...definition, approach, and means of evaluating sustainable/ecological design and construction." While there may never be, and maybe never should be, *one* universal definition, approach, and evaluation method for sustainable building (or for sustainable development, for that matter), there is certainly some need for comparison and consolidation.

Though I gave respondents the opportunity to list any barriers that were not included in my list of twelve, their responses all related in one way or another to those listed. As I see it, all barriers to more widespread sustainable building practice are of an educational or economic nature. And many barriers are a combination of both.

In addition to getting respondents' perspectives on barriers, I asked these building professionals to comment on how government programs and policies have helped or could better help to lower the barriers. Their responses to these questions are discussed in the following section.

[79] Pearce, questionnaire comments.

IV. NON-REGULATORY SUSTAINABLE BUILDING INITIATIVES—EXISTING & SUGGESTED

One purpose of government is to compel individual actors to make collectively wise decisions—in the interest of public health, safety, or welfare—through regulatory policy (requiring and prohibiting certain actions) or non-regulatory policy (creating incentives for or simply encouraging and facilitating certain actions). Public policies and programs serve to regularize good practices faster than they would spread without government intervention, when market forces are not sufficient to promote those practices or are creating obstacles to their adoption.

Government has a responsibility to intervene where private actions are threatening the greater good, as they are in the case of building practice. The building industry, the government, and the public at large *share* the responsibility for learning about, educating others about, demanding, and implementing more sustainable building practices. But the public sector is sometimes in a better position to effect change than the private sector is. For example, some jurisdictions have tried new practices internally, like mandating higher energy efficiency standards or recycled-content materials for public buildings. Their experiments and experience with "cleaning up their own house," so to speak, help helping to establish the credibility of such practices, thereby saving private entities from having the take on that risk. Also, government involvement can lend legitimacy to the environmental advocacy efforts of non-profits, since government is expected to have a more objective or conservative perspective than advocacy groups. Furthermore, because the building industry does not invest as much in research and development as most other industries do, the government must help spur innovation in this area.[80]

In my questionnaire, I asked respondents to list government programs and policies that have helped them practice sustainable building. More than half of the respondents listed *at least* one government initiative. Although they listed all types of programs and policies, most of the initiatives that they felt had contributed to their sustainable building work were those with primarily economic strategies—and to a lesser degree, educational strategies.[81] Many of the initiatives they listed are mentioned later in this section.[82]

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[80] Aitken, "Putting It Together."

[81] After all, most of these respondents are somewhat uniquely self-educated or were educated early on about issues of sustainable building, before their careers had even begun. Many of their comments indicate that their motivation to pursue sustainable building work mainly came out of a deep personal, and sometimes lifelong, interest in sustainability and environmentalism. For example, three respondents suggested that what they were taught by their parents made them predisposed to environmental awareness and gave them the values that they then applied to their work when

I also asked respondents whether they thought educational programs, economic incentives, regulatory requirements, and/or voluntary guidelines and standards would make it easier for them to incorporate sustainable strategies into their projects. Though more than half of the respondents felt that all four of these types of policies and programs would be helpful, almost *all* respondents selected economic incentives and educational programs.[83] Given the pattern that was established in their responses to the questions regarding barriers and existing initiatives, this is not surprising.

One respondent feels that: "By far, the #1 barrier that remains is the lack of education about the economic benefits of this approach." This was a common sentiment among respondents. (Before skeptics are convinced that there can be economic *benefits*, of course, the assumption that a sustainable approach necessarily means greater economic *costs* must be laid to rest; see Part III, barriers 3 and 4.) Another respondent wrote that "the most effective means for achieving environmental goals in the construction industry is clear demonstration of the economic benefits of Green Buildings. It's more effective than legislation; indeed, 'carrots' motivate better than 'sticks.'" Though both carrots and sticks are probably necessary, this preference for non-regulatory incentives was expressed by a number of respondents. For this reason, I have chosen to focus this part of the thesis on non-regulatory educational and economic actions that government could take to promote sustainable building practice.

Also, because so many of the existing and suggested initiatives that respondents listed were non-governmental, I have included a discussion of public-private collaboration later in this section.

Before I go into a discussion of non-regulatory approaches, however, I want to stress that, by doing so, I am not rejecting the effectiveness and need for regulatory approaches. As I said, the majority (17 out of 25: almost 70%) of respondents felt that these are also important. The government should certainly continue to use a diversity of strategies, which reinforce each other and make up for each other's shortcomings. Without the threat of new regulations ("sticks") hovering in the background, many voluntary efforts and innovations would not come about. One respondent called EPA regulations "absolutely necessary."

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they started careers in building. Others were influenced by specific professors, like Gil Masters of Stanford University's Civil Engineering department.

[82] Though I have attempted to categorize existing non-regulatory initiatives as "educational" or "economic," many of these programs have dual or even multiple mechanisms and purposes. I have incorporated respondents' comments about "voluntary guidelines and standards" into the Educational Programs and Economic Incentives sections, where appropriate.

[83] 92% of (23 out of 25) respondents selected "economic incentives," 88% (22) selected "educational programs," 68% (17) selected "regulatory requirements," and 64% (16) selected "voluntary design guidelines and construction standards."

In addition to federal regulations, regulatory strategies include state and local building codes and local zoning rules. Some building professionals, including architect Andrew St. John, feel that code changes will ultimately be needed to bring sustainable practices into the mainstream.[84] For now, however, as a respondent pointed out, codes are still primarily concerned with traditional "liability, life safety" issues, without including "environmental and human health...considerations," which may sometimes be harder to identify than emergency issues like fire hazards, but should also be recognized as liability concerns. Respondents suggested that many code requirements should be stricter, particularly in the areas of energy and indoor air quality, but also for solid waste, recycled-content material purchases, and site impact. Respondents also cited the need for more "case-by-case flexibility" in codes, since they are currently too rigid to allow for the use of new alternative technologies; "performance-based codes" would provide for more flexibility, by requiring outcomes instead of methods. But state building codes are not easy to change. The process of updating codes is a highly political one, involving much lobbying from numerous special interest groups within the building industry. Furthermore, some feel that codes are not adequately enforced as it is, so code changes may not even translate into changes in general practice.

Some people, including land use lawyer Jon Witten and architect James Batchelor, point out that local building authorities generally have more leeway (than state code officials) to raise code and permitting requirements to higher standards.[85] Several cities have worked out agreements whereby they agree to lower certain building permit requirements for developers (e.g., offering lower fees or speedier approval) in return for various sustainable building measures. Santa Barbara County's Green Building Permit Streamlining program is one such example.[86] Also, localities (not states or the federal government) have the authority to control land use through zoning regulations. In recent years, many cities and metropolitan regions have begun to hammer out zoning changes and growth management plans (often modeled after Portland Metro's plan) to encourage sustainable building patterns, in order to prevent endless sprawl. Some of the negative social and environmental effects of sprawl were mentioned in Part I.

For the purposes of this thesis, suffice it to say that a variety of regulatory tools have been used to change building practices for the greater good. Regulatory strategies should be used more extensively, but without the

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[84] St. John, conversation with author.

[85] James Batchelor, Principal and Chairman, Arrowstreet, Inc., Somerville, MA; conversation with author, Somerville, MA, December 22, 1998.

Jon Witten, Lecturer, Department of Urban and Environmental Policy, Tufts University; President (and land use lawyer), Horsley & Witten, Inc. environmental engineering firm, Sandwich, MA; personal communications with author, Spring 1999.

[86] Center for Economic Conversion Technical Brief #2.

simultaneous use of educational and economic strategies, they would likely be resented by many building professionals and would not enjoy as high a rate of compliance. The following sections explore existing as well as potential educational and economic strategies.

Educational Programs

When asked about existing governmental initiatives that have helped to encourage sustainable building practices, respondents mentioned Department of Energy (DOE) programs more than any others. Environmental Protection Agency (EPA) programs came in second. These two agencies have disseminated information, conducted and supported research, and orchestrated partnerships for sustainable building projects.

Some programs, including Energy Star (Buildings, Homes, Appliances, etc.) and Green Lights, are administered by both agencies. Among the specific DOE initiatives that were mentioned, those with strong educational components include Rebuild America and the National Solar Data Program. The agency's DOE-2 energy modeling software was also cited several times as a very valuable tool; it simulates a building's expected energy use through an integrated or "whole" building analysis. While I do not provide detailed information on each of these programs, I highlight the basic elements of some of them later in this chapter.

When asked to list the types of educational initiatives that are most *needed* to promote sustainable practices, respondents offered quite a variety of suggestions. Continuing education activities—including seminars, workshops, and conferences—were suggested the most. The next most common suggestions were demonstration projects, and case study analyses that document performance and costs. Sustainable building curricula were also mentioned.

Demonstration projects not only serve a positive economic purpose by helping boost markets for new products and services, thereby bringing costs down and enhancing availability, but they can have great *educational* value. But this value is only realized if they are seen and studied. A respondent wrote: "People will only believe by seeing what is possible." Assistant Commissioner of New York City's Office of Sustainable Design and Construction, Hillary Brown, has made good use of the "seeing is believing" strategy. She invited the Commissioner, who was not yet convinced of the benefits of sustainable building, to take a tour of the newly renovated Audubon House offices in New York City; when he saw the difference that daylighting and air quality made in that indoor environment, he immediately became supportive of her sustainable design initiatives.[87]

In addition to site visits, there is a need for assessments, documentation, and media coverage of demonstration projects' performance (e.g., lower energy and water usage, occupant satisfaction, longevity of alternative materials, etc.) and cost savings over time. The Environmental Building News subscriber survey found that the unproven track record of new materials is one of the

[87] Brown, presentation comments.

major impediments to the mainstreaming of sustainable building practices.[88] In my survey, a respondent echoed this sentiment, saying that because of the "fear of the unknown,...people would be much more interested in sustainable devices/materials if they saw them in common use." Demonstration projects can serve as testing grounds for experimental or unconventional technologies.

According to questionnaire respondent Annie Pearce of the Georgia Tech Research Institute, a recent survey that they conducted found that "the most effective means of learning about new technologies or alternative approaches is via demonstration projects or documentation of new technologies in credible publications."[89] Respondents suggested that having a more comprehensive "database" or "a repository of independently checked case studies with uniform performance and cost data...on the Internet" would be helpful.

Developing and distributing curricula that include sustainable building concepts is yet another effective way of spreading the message. One respondent called for "more information in standard high school and college curricula about the effects and solutions of the building industry." This respondent felt that technical design schools have been offering sustainable design courses or incorporating such issues into their curricula more than the "high design" architecture schools have been. From my observations of activities in Boston-area architecture programs in the past year or so, the "high design" schools seem to be starting to catch up (particularly in the area of land use impacts and ecological urban planning). However, the change still seems to come from the efforts of one or two individuals within these programs; very few programs have made sustainable design courses a part of their *core* curricula.

While non-profits, like Second Nature, and university research groups, like the University of Michigan's National Pollution Prevention Center, have played an important role in encouraging sustainability curricula in institutions of higher education, the government could do more to supplement this. The EPA has an environmental education program; perhaps it could extend its mission to include university-level design programs. One thing that education and training programs could do to help future building professionals become better versed in sustainability is to direct them to the best resources for information—not only through readings required in syllabi, but also by making publications like EBN available in school libraries.

Though the educational role of the media was mentioned briefly by respondents, in regard to publicizing demonstration projects and their demonstrated successes, I believe it needs more attention. When asked what their main sources of information on sustainable building practices have been, 68% (17 out of 25) of respondents cited "media/articles," compared to only 28% (7) who cited "continuing education workshops" and 24% (6) who cited

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[88] "Now We Know...," *Environmental Building News.*

[89] A.R. Pearce and V.T.C. Chen, "Sustainability and the A/E/C/ Industry: Results of a Series of Roundtable Discussions among Practitioners," Combined session transcripts and technical summary, Georgia Tech Research Institute, Atlanta, GA, 1998.

"courses." While professional and non-profit groups may contribute articles to magazines and other media outlets more often than government agency staff, the latter possibility should not be ruled out. Public service announcements (print or televised) and the support and distribution of documentaries on demonstration projects would be especially appropriate ways for governments to educate professionals as well as potential clients.

Finally, voluntary design guidelines and construction standards are worth mentioning here, as they serve an educational purpose—or at least they could. Respondent Annie Pearce wrote:

> There are already many of these guidelines out there, but they suffer from unclear scopes and a lack of common definitions of what sustainability is. Many are also too vague to provide concrete assistance regarding what to do, and all could [better assist] in prioritizing. After all, everyone is working under limited resource constraints.[90]

A number of guidelines have become accepted as standards of good practice and are commonly used in the professions, though they are not required. These are mainly engineering codes, like those distributed by ASHRAE or ASTM (American Society of Heating, Refrigerating, and Air Conditioning Engineers; and the American Society for Testing and Materials).[91] Because most professionals build according to these standards, most are going beyond the requirements of state building codes (particularly in the area of energy efficiency measures), but that does not mean that they are going as far as they should or could.

A variety of guidelines and specifications expressly for sustainable building also exist now. Respondents mentioned New York City's High Performance Buildings Guidelines, New Hampshire's Minimum Impact Development Guidelines, and Pennsylvania's proposed Green Spec. But a grievance expressed by several respondents was that guidelines criteria are not standardized enough. A recent study looked at twenty-six different sets of sustainable building guidelines, issued by various non-profits, government agencies, design firms, vendors, and consultants.[92] In my survey, a questionnaire respondent wrote: "We need consensus standards on what a green building really is and on what sustainable development should include, to make major reductions in

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[90] Pearce, questionnaire comments.

[91] ASTM has begun working on incorporating sustainable guidelines into their standards, through their U.S. Green Building Council sub-committee. A respondent suggested that ASHRAE do the same.

[92] Anna J. Jones-Crabtree, Annie R. Pearce, and Victoria C.P. Chen, "Implementing Sustainability Knowledge into the Built Environment: An Assessment of Current Approaches," IERC Conference Proceedings, Banff, BC, Canada, May 9-12, 1998.
<http://maven.gtri.gatech.edu/sfi/publications.html> (April 7, 1999).

greenwash...." The LEED (Leadership in Energy and Environmental Design) rating system for commercial buildings (developed by the U.S. Green Building Council) has probably come the closest to becoming an institutionalized standard; the DOE has provided the GBC with funding to further develop and implement the system. One reason that LEED is preferred is that it offers performance standards rather than rigid prescriptions of technologies or methods.

Another type of standard that has yet to be developed is some sort of green builder certification. Currently, eleven state architectural licensing boards require continuing education credits for registration renewal, like AIA membership, and more and more of the qualifying courses have sustainability themes; for example, the National Council of Architectural Registration Boards (NCARB) now offers Energy Conscious Architecture and Indoor Environment courses. Perhaps one day state licensing *exams* will include sustainability criteria.

Many of these educational efforts would indirectly provide economic incentives, as well. Strategies that provide more direct economic incentives are discussed in the following section.

Economic Incentives

Economic incentives will also be necessary, to boost the interest of those people who will never be compelled by the *environmental* reasoning behind sustainable building, and also to even the playing field for those who *are* compelled. Until better savings recovery arrangements are worked out, incentives can also serve to lower first costs in cases where the developer, or investor, is not able to recoup future savings. Economic incentives can be used to promote voluntary action (e.g., conservation) where it might not occur otherwise. Tools include tax credits and rebates, as well as financial assistance, such as loans with favorable terms or outright grants. According to a respondent, "These sorts of programs would help get owners interested in sustainability, which would in turn force the A/E/C [architecture/engineering/construction] industry to take notice."

Respondents listed a number of economic strategies that have helped them incorporate sustainable practices into their projects. The most commonly cited strategies were utility incentives, such as inspections/audits or rebates for installing new, efficient equipment, which a respondent described as being "enormously effective in reducing demand" for gas, electricity, and water. According to the Energy Manager's Multisite Assistant on-line service, more than 170 gas and/or electric utilities offer rebates or other types of incentive programs, and that is just to *commercial* customers.[93] Utilities have found that it is cheaper to invest in energy conservation than to create new capacity. But many of these demand-side management programs are being eliminated as these companies are becoming deregulated.[94] It remains to be seen exactly how the deregulation of utilities will shake out, and what the lasting effects will be on the utilities' conservation initiatives.[95] Increasingly, third-party Energy Service Companies (ESCOs) will probably take over much of the retrofit investment function that utilities have been providing; the DOE is exploring this "secondary market mechanism."[96]

DOE programs were often cited for providing economic incentives, as well as educational programs. For example, the agency has provided rebates on fuel cells, has offered "Energy Efficient Mortgages," and has helped fund some research projects—for organizations such as the Center for Maximum Potential Building Systems—as well as building projects—including the Cambridge Co-

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[93] Wilson, et al., *Green Development.*

[94] Ibid., 272.

[95] Some predict, however, that we will see increased use of renewable power, because of the greater consumer choice that deregulation is supposed to achieve.

[96] Wilson, et al.

Housing development. Other respondents mentioned getting grants through New York State's Energy Research and Development Authority (ERDA) for their sustainable building projects. The EPA also makes Sustainable Development Challenge grants available to non-profits (as well as to state and local governments) for such projects.

The DOE/EPA Energy Star and Green Lights programs I mentioned in the Educational Programs section are a good example of the combined use of educational and economic strategies. In addition to providing training sessions, references and guides, software, and analytical tools, the agencies make available to program participants a database full of information on financial assistance (mainly utility-sponsored). In this case, the agencies are acting as a sort of information broker. Big name members of the Energy Star Buildings program now include the owners of the Empire State Building, World Trade Center, and Sears Tower, who have committed to reducing their buildings' energy use by up to 30 percent.[97]

When asked to list the types of economic incentives that would be most helpful in promoting sustainable practices, respondents suggested tax credits more than anything else. These could take a variety of forms (e.g., property or sales tax exemptions, income tax credits, etc.) and could be applied for a number of different reasons (e.g., for using local materials, fuel cells, etc.); tax structuring is a complex issue that could fill an entire thesis on its own. But models do exist. For example, last year, the State of Vermont exempted used or scrap building materials from sales tax.[98] The Clinton Administration has instituted a "Million Solar Roofs" tax credit for homeowners who have solar panels installed on their homes. And several respondents noted that legislation for a green building tax credit is pending in New York State.

Favorable loans and mortgages for efficiency retrofits were also mentioned. These are usually based on the energy efficiency rating of the building. Rating systems typically assign a building up to four or five stars according to its expected performance. Several respondents mentioned the LEED rating system for commercial buildings. For residential ratings, the Home Energy Rating Systems Council has written "Guidelines for Uniformity." Austin's Green Builder Program created the first residential energy rating system.

Sustainable building rating systems not only educate owners about the environmental soundness of their homes or facilities, but they provide an indirect economic incentive by providing a marketing edge for building professionals who build structures that merit the higher ratings, because their buildings will sell for more (assuming that real estate brokers incorporate the rating system in their valuation of the sales price). Because of the higher

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[97] "Statement on the Energy Star Buildings Label Program: April 20, 1998," *Weekly Compilation of Presidential Documents* 34 , No. 17 (Transcript, President Bill Clinton), April 27, 1998: 678.

[98] "State of Vermont" Newsbrief, *Environmental Building News* 7, no. 5 (May 1998).

building value and the return on investment gained through the future savings in utility bills (reflected in the rating level), applicants can often get larger loans than they would otherwise. Colorado's E-Star program, designed with help from the federal Department of Housing and Urban Development and the Federal Housing Administration, is a model rating/mortgage program.

Despite the great interest in economic incentives, several respondents were "leery" of them, feeling that "green design should stand on its own." A few respondents were concerned about the use of incentives that "perpetuate a false economy." Instead, they would like to see "valuation...imposed...on externalities" and elimination of perverse disincentives. In other words, the view is that it would preferable to tax "bad" activities like nonrenewable fuel use (to internalize their costs) or at least to stop subsidizing them, rather than to start subsidizing good things. For example, one respondent wrote: "Remove subsidies for polluting industries and the energy supply system we have today, to level the playing field for safe energy and environmental building."

Collaborative Efforts

Though the focus of this paper is on government initiatives, many non-governmental groups have contributed to the spread of sustainable building practices: businesses related to the building industry, the investment and insurance communities, and foundations, as well as non-governmental organizations, including professional associations and non-profit groups. With more support from the public sector, these private sector groups could contribute even more.

Many of the changes that will need to be made to overcome current barriers—both educational and economic—will best be achieved through non-governmental action. For example, professional associations and environmental groups can offer workshops on sustainable building. The AIA does require its members to participate in some "Health, Safety, and Welfare"-related courses in order to meet their continuing education Learning Units requirement. Some of the courses they have identified have sustainable building themes, but the association could go further in seeking out sustainable building courses to qualify as AIA continuing education credits. Professional groups can also sponsor more sustainable building competitions and awards programs to encourage and publicly recognize model projects. They also are the logical locus for efforts to reform fee structures towards performance-based compensation, as well as to reform specifications that are accepted as the industry standard, and to make the team process a more integrated, less linear one. And, as mentioned before, non-governmental groups play an important role in bringing sustainable building stories to the attention of the media.

Government can tap into and support many of these activities. And government entities have, in fact, done a good job of collaborating with these groups, to augment expertise and share funding for research and implementation of sustainable practices. Again, the DOE and EPA have been the most visible leaders in sustainable building efforts within government. The DOE's Rebuild America program is a good example of the federal government's role as partnership organizer. Through this program, the DOE helps to set up and coordinate community-based partnerships between local organizations, state and local agencies, companies, lenders, and building professionals to enable energy and water conservation retrofits of commercial and multi-family residential buildings. The DOE provides technical assistance and helps owners and managers find funding sources. Partnering can provide new opportunities for leveraging funding, and can lead to bulk discounts on products. The DOE has a similar program, Building America, for home retrofits. Energy Star programs are also implemented through public-private partnerships.

The DOE and EPA also helped the AIA to coordinate the presentation of U.S. projects entered into the international Green Building Challenge competition and assessment program, held last year. And the agencies' funds helped the U.S. Green Building Council (GBC) and Public Technology, Inc. to

produce the Sustainable Building Technical Manual, which is considered by many in the field to be one of the more practical and comprehensive guidebooks on the topic.[99] The GBC's annual conference is also hosted by AIA, the DOE, and the National Institute of Standards and Technology (NIST). It is important that the government stay connected to the network established by the GBC.

In another important collaboration, the DOE and EPA joined with the Army's Construction Engineering Research Laboratories to provide funding for a Green Building Advisor CD-ROM tool that recommends appropriate design strategies tailored to specific projects. The tool itself was developed by a non-governmental partnership comprised of E-Build, Inc. (the group that produces the Environmental Building News), the non-profit Center for Renewable Energy and Sustainable Technology (CREST), and the Design Harmony architecture firm (headed by Gail Lindsey, Chair of the AIA's Committee on the Environment).

There are also a number of examples of public-private partnerships for sustainable building projects created without the participation of the DOE or EPA. One example is the vital role of the Center for Maximum Potential Building Systems non-profit in consulting for and running professional training seminars in support of the City of Austin's Green Builder Program and the State of Texas' Architecture and Engineering Guidelines.

In another local example, the City of Tucson went in as financial partner for the large-scale Civano sustainable village project. Through the sale of municipal bonds, the City has been able to offer low-interest rate, tax-exempt financing for the project. Its investment will not only be recouped within about eight years, because of avoided infrastructure costs (estimated to save about $500,000 a year), but the City expects an annual increase of $1 million in revenue because of the project.[100]

From reading case studies, I have observed that these sorts of collaborative sustainable building projects seem to be the most successful. Not only should there be more public-private partnerships, but the government itself must do a better job of collaborating internally. A research report for the Renewable Energy Policy Project (REPP) cited lack of coordination among various federal building programs as a major problem for getting truly sustainable, or "whole buildings," programs institutionalized.[101] The report recommends that an existing agency be given the authority to coordinate federal building programs under a sustainable umbrella framework, because in the attempt to make "federal programs recognize buildings as integrated systems, federal policy should also view [its building] programs as integrated systems."[102] This is the same logic that calls for

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[99] The manual can be downloaded from the DOE's website: http://www.eren.doe.gov/buildings

[100] Wilson, et al., *Green Development.*

[101] Aitken, "Putting It Together."

[102] Ibid., 12.

a more integrated, interdisciplinary process among project team members, discussed earlier.

The fact that sustainable building programs can be found scattered across a number of agencies is not a problem in and of itself. In fact, such diversity is a good sign that various interests are seeing how sustainable building applies to their missions and are contributing to the spread of sustainable practices. However, these programs would enjoy more efficient and effective implementation if they were coordinated by some entity that could serve as a centralized clearinghouse of information on program strategies, case studies, and resources—in other words, to do in-house what the U.S. Green Building Council does outside of government to coordinate all sectors. This would reduce duplication of efforts and help achieve a "coherent federal policy" of complementary and comprehensive sustainable building initiatives.[103]

The REPP report identified the DOE's Buildings for the 21st Century and the Department of Housing and Urban Development's (HUD) Partnership for Advancing Technology in Housing (PATH) programs as some of the best models of interagency and public-private collaboration and integration of sustainable building efforts. However, the DOE program has been largely unfunded and, though it is broad, it is still focused, understandably, on building *energy* issues; truly sustainable building must address more than that. HUD's PATH program is not comprehensive either, since it only addresses residential buildings.

Rather than diminish the diversity of federal initiatives, an interagency coordination body could bring even more agencies on board. Sustainable building cuts across almost every issue addressed by government. In addition to the agencies that have already been mentioned, others like Transportation, Health and Human Services, the Occupational Health and Safety Administration, the National Science and Technology Council's Committee on Construction and Buildings, and congressional bodies like the Energy and Water Appropriations subcommittee should get more involved in developing sustainable building policy. And in order to make changes to establish economic incentives, the IRS and the congressional Finance and Ways and Means committees will need to be involved, as well.[104]

As for where the interagency coordinating body should be housed, it seems to me that the EPA would be the most logical home. Though the DOE has arguably done the most to promote sustainable building, its environmental mandate is more limiting than the EPA's. Of course, whichever agency would take on the coordination role would need to receive more funding to do so. According to a research report for the Renewable Energy Policy Project (REPP), relatively little of the $476 million that the federal government spent on buildings-related research and development last year went towards programs that use a sustainable, "whole buildings" approach. And because the large and

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[103] Ibid., 10.

[104] Ibid.

fragmented building industry spends very little (compared to other industries) on research and development, there is a need for government to exert leadership for innovation in this area.[105]

State and local governments should also be better able to take advantage of federal agencies' expertise, resources, and connections if they had an interagency clearinghouse to approach for information on existing initiatives. At least 25 municipal or regional sustainable building programs are now off the ground, including strong programs in Austin, Los Angeles, New York City, Denver, Santa Monica, and Metro Portland, Oregon. With better governmental coordination, these types of programs would more quickly become the rule rather than the exception.

[105] Ibid.

V. SUMMARY OF FINDINGS & RECOMMENDATIONS

All barriers identified in my questionnaire to the increased adoption of sustainable building practices in the building professions could be characterized as educational or economic factors. Similarly, the types of government programs and policies that questionnaire respondents reported as having contributed to their sustainable building work were mostly programs with economic or educational strategies. And, when asked whether they thought educational programs, economic incentives, government regulations, and/or voluntary guidelines would make it easier for them to incorporate sustainable strategies into their projects, educational and economic approaches were, again, the top choices.

According to my findings, educating all segments of society about the need for sustainable building and, secondarily, training building professionals in sustainable building concepts and methods, are the most essential ways of encouraging the more widespread adoption of sustainable building practices. Such education could create a greater demand for sustainable building products and services, which would boost these markets, thereby spurring more innovation and bringing prices down. Clearly, educational and economic approaches go hand in hand. Economic incentives will also be necessary, to boost the interest of those people who will not be compelled by the *environmental* reasoning behind sustainable building, and also to even the playing field for those who *are* compelled.

The problems with conventional building are known, the means and benefits of sustainable building have been identified, a vision and examples of better built environments exist, goals have been set, guidelines have been created. Finding information about sustainable building concepts and methods is *not* a significant barrier, according to my findings. And now, the remaining barriers are better understood. Governments and building professionals have all the ingredients they need to promote sustainable building practices. And some governmental and non-governmental groups *have* started promoting such practices. Yet respondents estimate that only 5-10% of building professionals routinely incorporate sustainable elements into their building projects. Clearly, existing programs should evaluated, and the most effective ones should be expanded and replicated. Taking advantage of the existing knowledge base requires more collaboration—between agencies, between levels of government, and between sectors.

While respondents most often cited federal programs as being helpful, the federal government could still do a better job of coordinating its agencies' scattered activities and of supporting new state and local sustainable building policy efforts. The state level is where code changes will need to take place, and the local level is where much-needed changes in land use development patterns can be effected.

Sustainable building programs should also more strategically address the key barriers to their goal. The following recommendations for government action are presented within the three categories of: Boosting Client Demand, Expanding Professional Training and Education Opportunities, and Reducing Costs and Cost Misperceptions, because these goals address the primary barriers that respondents identified. Non-regulatory government actions typically include providing technical assistance, research data, incentives, financing information, and funding. Some of the initiatives listed here have been or are still being carried out by government entities; the recommendation in such cases is that these initiatives be continued or expanded, because respondents feel that these have been effective.

Boosting Client Demand

Despite existing educational initiatives, respondents feel that significant educational barriers remain—particularly concerning the low levels of client demand for sustainable building. The fact that clients often reject sustainable designs even when architects take the initiative to present such designs to them (see Part III, barrier 1) indicates that demand is not necessarily being unmet by supply, but that more demand needs to be created.

Because private "clients" are not only developers, but can also be institutions, property owners, business owners, and home owners, the target group for sustainable building education is quite diffuse; it is essentially the general public. Expressing a common sentiment among respondents, one noted: "If the public is well informed, they will demand environmentally responsible buildings and spaces."

So, how could government agencies better address the need to educate not only building professionals (see next section) but also consumers about the need for and benefits of sustainable building? One thing that consumers could be better educated about is the advent of cleaner or more efficient building technologies; Donald Aitken writes:

> The federal government has historically emphasized strategies that attempt to "push" technologies out of the laboratories into the hands of industry who will commercialize and "sell" the new technologies. ...the federal government must also adopt a "pull strategy," whereby consumers are educated on the availability and desirability of [building] technologies so that they begin to demand them.[106]

[106] Ibid., 15.

As a questionnaire respondent wrote: "Education is the key; how is the problem." Some of the elements of a public education campaign for boosting consumer demand for sustainable buildings have been discussed in this thesis. They include the following:

- Inform the public about sustainable programs and incentives through public service announcements, informational videos, and other forms of media.
- Organize tours of and events at demonstration buildings for skeptics in influential positions and for the general public.
- Conduct performance and cost assessments of demonstration projects and distribute/publicize the documentation (issue press releases).
- Support more demonstration projects in areas that currently have none.
- Offer or support workshops for developers, institutions, property owners, business owners, and home owners on the benefits of sustainable building, through their respective networks of professional associations, conferences, etc.
- Promote sustainable building competitions and awards programs (and other forms of free/low-cost marketing for responsible owners and developers)—like the cities of Portland, Oregon and Austin, Texas do with their Businesses for an Environmentally Sustainable Tomorrow (BEST) awards programs.
- Organize creative partnerships that bring new non-governmental entities into collaborative sustainable building projects.

Expanding Professional Training and Education Opportunities

As the barrier rankings suggest, there is also still a need to educate and train building professionals in sustainable practices. In fact, according to one respondent: "There should be ongoing education and training for construction industry professionals at all levels, in all fields of the industry." In addition to those commonly thought of as building professionals—architects, engineers, and contractors—realtors, appraisers, developers, and lenders also need to be educated about sustainable building.

While building professionals are looking to their clients for the demand for sustainable buildings, many also accept the responsibility of educating themselves, their peers, *and* their clients about why and how to build sustainably. Building professionals have significant influence over the decisions their clients make, because they present clients with the options. For example, clients usually look to architects for advice on what materials to specify. Architects should be prepared to explain not only the cost but also the quality

(including environmental quality) advantages of different materials. Architecture deemed to be of high "quality" should not encompass architecture that compromises the health and well-being of current and future generations. To knowingly compromise these things is irresponsible. My assumption is that if more professionals *learn* just how severely conventional building harms people and the planet, they will want to be responsible and will change their practices.

How can government agencies help to better educate and train building professionals in sustainable practices? All of the general educational strategies listed in the previous section can also be applied to the building industry. The following are a few strategies that could be used to target the building industry, more specifically:

- Continue to support and participate in national conferences (like the U.S. Green Building Council's) that bring members of different professions together to share information on sustainable building.
- Fund professional education and research programs for sustainable building; help disseminate existing sustainable building curricula.
- Offer or support continuing education offerings with sustainable building themes.
- Provide additional support for sustainable building research and development.
- Review, compare, and evaluate existing guidelines (including voluntary standards, rating systems, performance evaluation criteria, software tools), and consolidate or endorse certain guidelines, so as to promote consensus on a comprehensive, clear, and flexible set for building professionals to refer to.
- Work with state licensing/registration boards to explore the development of a sustainable designer/builder certification procedure.

<u>Reducing Costs and Cost Misperceptions</u>

Despite some existing economic initiatives by government, respondents feel that significant economic barriers remain—particularly in terms of first cost problems and perceptions, as well as the lack of accounting for and recovery of long-term savings. It is important to keep in mind that any added costs for sustainable projects are primarily a concern for clients (rather than building professionals), since clients ultimately pay for the project. Therefore, as with educational programs, economic incentives must be aimed directly at potential clients: the general public. In addition to providing incentives and outright funding to lower project costs, the government should help counter commonly held misperceptions or exaggerations of the increased cost of sustainable practices, and should help institutionalize new accounting procedures that

properly measure *all* building costs and longer-term returns on investment. Government programs and policies that could address these needs include the following:

- Review and recommend the best methods of lifecycle (or full-cost) financial analysis for building projects.
- Conduct long-term, lifecycle analysis of the costs and benefits of demonstration projects, and publicize the benefits of this approach with case studies in professional and trade literature (as well as the public media).
- Publicize the long-term cost savings of building/property owners who incorporated sustainable practices into their projects, particularly those who have done so at a large scale (e.g., federal government, institutions, large corporations, eco-tourism industry).
- Write and adopt legislation for sustainable building tax credits or exemptions.
- Raise the rates on utility resources that the local or state government still controls (e.g., water), to provide an economic incentive to conserve.
- Work with newly deregulated utilities to determine whether demand management programs' incentives can be continued; continue to explore a "secondary market mechanism" as a substitute.
- Offer rebates for the use of new technologies.
- Remove subsidies for environmentally-damaging industries.
- Tax environmentally-harmful products (like fossil fuels) so that the price of such unsustainable options will fully reflect their social and environmental costs.
- Provide low-interest loans or loan guarantees for sustainable building projects or installations.

As I stated in Part II, sustainable building practices involve the use of design and construction methods and materials that are resource efficient and that will not compromise the health of the environment or the associated health and well-being of the building's occupants, construction workers, the general public, or future generations. To make such practices mainstream essentially means "fighting the inertia of the status quo with a new paradigm of design," as one questionnaire respondent put it. Lowering the major barriers of client disinterest, lack of education and training for building professionals, and cost concerns about sustainable building will take some time. Though the movement has come a long way in the last decade, major shifts in cultural attitudes happen very gradually. Sustainable business guru John Elkington suggests that it usually takes more than a generation for the ideas of revolutionary movements to take hold and really transform society; so, using the 1987 Brundtland Report as a baseline date, he speculates that the grand paradigm shift implied by the sustainability movement may not be achieved before the year 2020.[107] I believe that the government efforts discussed in this paper can help speed the process of mainstreaming sustainable practices.

Many building professionals recognize that the sustainability movement is more than a fad, and will even become more than a sub-field in the future. Douglas Durst of The Durst Organization, developer of the 4 Times Square skyscraper, believes that "environmental responsibility is the future of real estate—the choice is not whether, but when. As the public begins to understand that healthier and more productive buildings are possible, they will demand them!"[108] And architect Peter Nobile has said that one day it will be just as unthinkable to build *unsustainably* as it is now unthinkable to use lead piping for potable water.[109] The status quo does change, little by little.

Many people, myself included, believe that it is preferable to try to get the majority of people interested in some *part* of sustainable building (for now) than to succeed in getting only a handful to go all the way. People become interested in sustainable building for different reasons. The field can attract people who care about public health, occupational health, labor productivity, brownfields redevelopment, open space preservation, climate stabilization, biodiversity, or renewable energy, to name only a few of the issues it touches. The diversity of the movement could be its greatest strength. Perhaps, as different people with different agendas come to realize their stake in the use of sustainable practices, they will gradually realize what they have in common and how their goals are inextricably linked. I hope that occupant health and well-being, public health,

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[107] John Elkington, *Cannibals with Forks: The triple bottom line of 21st century business*. (Stony Creek, CT: New Society Publishers, 1998), 385.

[108] Wilson, et al. *Green Development*, testimonials page at the front of the book.

[109] Nobile, questionnaire comments.

land impact, and land use considerations will soon achieve the level of attention that energy efficiency has enjoyed in recent years.

We all have a stake in the sustainability of our built environments. When a critical mass of people in our society recognize this and mainstream building professionals feel the pressure of public demand, sustainable practices will become the industry standard.

Appendix A.

GROUPS TO CONTACT FOR FURTHER INFORMATION

American Institute of Architects' Committee on the Environment
Washington, D.C.; 800-242-3837
http://www.e-architect.com/pia/cote

Center for Maximum Potential Building Systems
Austin, TX; 512-928-4786; max_pot@greenbuilder.com
http://www2.cmpbs.org/cmpbs

Center for Renewable Energy and Sustainable Technology (CREST)
http://www.crest.org

Environmental Building News
E-Build, Inc., Brattleboro, VT; 802-257-7300; info@ebuild.com
http://www.ebuild.com

Oikos: Green Construction Source
Eugene, OR; 541-484-9353; iris@oikos.com
http://www.oikos.com

Rocky Mountain Institute
Snowmass, CO; 970-927-3420; info@rmi.org
http://www.rmi.org/gds

U.S. Department of Energy
Center of Excellence for Sustainable Development
sustainable.development@hq.doe.gov
http://www.sustainable.doe.gov/buildings/gbintro.htm
Energy Efficiency and Renewable Energy Program, Office of Building Technology
http://www.eren.doe.gov/buildings

U.S. Environmental Protection Agency
Green Buildings Program
http://www.epa.gov

U.S. Green Building Council
San Francisco, CA; 415-543-3001; info@usgbc.org
http://www.usgbc.org

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