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Transforming the Market for Sustainable Design: Effective Public Policies and Strategies

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N. Carlisle
National Renewable Energy Laboratory

J. Glickman
U.S. Department of Energy Federal Energy Management Program

M. Brown
New York State Energy Research and Development Authority

M. Foster
City of San Jose, California

A.K. Bennett and K. Sandler
Environmental Protection Agency

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National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, Colorado 80401-3393
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Transforming the Market for Sustainable Design: Effective Public Policies and Strategies

Nancy Carlisle, National Renewable Energy Laboratory
Joan Glickman, U.S. Department of Energy Federal Energy Management Program
Matthew Brown, New York State Energy Research and Development Authority
Michael Foster, City of San Jose, California
Alison Kinn Bennett and Ken Sandler, Environmental Protection Agency

Abstract

The federal government strives to lead by example in energy and resource management and architectural design. This paper explores how public agencies are supporting that goal by using sustainable practices in the design and operation of their buildings. It presents some elements to consider in establishing a policy for sustainable design and a system for implementing that policy, including some of the most difficult implementation issues agencies have to face. The paper also highlights some of the strengths and weaknesses of federal, state, and local policies and practices governing the design of public buildings; two case studies provide examples. Different approaches are included to help agencies evaluate their effectiveness at various levels of government. And recommendations are made for agencies and others who are committed to sustainable design in both new construction and major renovations.

Introduction

This paper describes and evaluates policy options to encourage the design and construction of sustainable[1] buildings at federal, state, and local levels. Many sustainable, high-performance buildings have these characteristics: they feature measurable energy and water savings; they are functional, cost-effective, aesthetically pleasing, and contextually appropriate; they reflect an integrated, multidisciplinary design process; and they take into consideration all aspects of development (e.g., materials extraction, transportation, manufacture, building design, construction, and operations and maintenance) to minimize a building's resource consumption and environmental impact over its life cycle while improving the comfort, health, and productivity of its occupants.

Sustainable Design Policy Elements

The discussion that follows divides the elements of sustainable policy design and implementation into four categories: policy objectives, policy tools, implementation issues and lessons learned, and carrot/stick elements. Policy objectives are the overall drivers of a policy, such as cost savings over time, healthy building interiors, environmental protection, or a combination of these. Various tools to use in creating and implementing a policy are discussed, such as the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED™) rating system. The section on implementation issues and lessons learned identifies some challenging issues and effective ways to address them. Carrot/stick elements include some of the incentives and consequences that support the continued adoption of sustainable design and construction practices.

[1] Synonyms for sustainable buildings include "green buildings" and "high-performance buildings."

Policy Objectives

Often, an agency's overarching policy objective is to develop one single, comprehensive program or standard to promote sustainable building design. The policy should be easy to use and move the market in the right direction, though there may still be many unanswered research questions about the best choices (based on life-cycle assessments) for building components, materials, and systems. Since a sustainable building involves achieving a balance among various important elements—such as energy and water use over the building's life cycle, the creation of healthy indoor environments, and protection of the environment—an overarching policy requires an agency to evaluate the relative weighting of these elements in deciding how to define "green." Each element is discussed in more detail below.

Measurable Reductions in Carbon-Based Energy Use

At some agencies, this policy objective is the cornerstone of a sustainable buildings policy because of the need to reduce emissions, conserve resources, and enhance energy security. Energy use in the United States has risen 35% since 1975; 84% of the total is generated by burning fossil fuels. Rising oil imports, volatile energy prices, grid security and reliability, transmission capacity and access, and the direct correlation between increased energy use and the environment are some of the major reasons for supporting this policy objective.

One-third of all the energy we consume is used in our buildings. Thus, they represent a tremendous opportunity for energy savings and emissions reduction. LEED is sometimes used to formulate building policy objectives because it rates buildings at different certification levels (platinum, gold, silver, and certified) based on the total number of points or credits earned by their sustainable features. But the relative weighting of points or credits within LEED has been widely debated. An analysis of 50 public- and private-sector building projects that have received LEED certification shows that nine were certified without any energy credits at all; two were certified with only one energy credit (equivalent to 15% savings, compared with a reference building); two were rated silver with one energy credit; and one was rated gold with one energy credit (Dietsche 2003). Thus, if saving energy is a major objective in a sustainable buildings policy, using LEED alone might not be effective.

As an alternative, agencies could consider expressing required energy savings for new and renovated buildings in terms of source energy rather than site energy. Source energy takes into account energy generation, transmission, and distribution; site energy considers only the energy measured at the point of use. A goal expressed in source energy could encourage the use of on-site power production (e.g., in combined heat and power systems) as well as the use of renewable energy. Thus, it would be a strong statement in terms of environmental protection. As another alternative, the policy statement might simply stress the use of renewable energy and discourage the use of diesel engines, for example.

Measurable Water Savings

Two California studies show that commercial water use can be cost-effectively reduced up to 23% by using sustainable measures with only a 1.7-year payback (Kats 2003). However, an analysis of 50 LEED projects found that 18, or 36%, were certified with two or fewer points for water efficiency (Dietsche 2003). Expanding on the relationship between water and energy (e.g., it takes energy to pump, treat, and move water), Torcellini et al. documented the amount of fresh water that evaporates at a power plant in generating each kilowatt-hour of electricity (2003). A measurable water goal is especially recommended in drought-prone regions. Agencies must decide how important this is to include this in their policies.

Healthy Indoor Environments

Healthy indoor environments could be the most critically important sustainable goal for some agencies. A Sustainable Building Task Force in California found that adults spend about 90% of their time indoors and that indoor levels of contaminants can be 25 times higher than outdoor ones (2003). The State of California estimates an annual cost of $6 billion for the lower productivity caused by the environment of the workplace and the health impacts of indoor air pollutants (Kats 2003). Although it is difficult to quantify benefits, several studies are demonstrating the correlation between improved performance and a better indoor environment (Kats 2003). Goals and policies in this area tend to be prescriptive, and LEED includes various options for meeting indoor air quality requirements.

Environmental Performance

Policy objectives can strengthen the environmental performance of a sustainable building in several ways. For example, in Executive Order D-46-01, California stresses the importance of siting new public buildings to coincide with "sound and smart" growth patterns so these buildings will be close to public transportation, affordable and available housing, and pedestrian access to retail and commercial facilities. Linking policies for sustainable design to overall local and regional policies for smart development is an important consideration.

Policy Tools

As a consensus-based system that awards different levels of green building certification based on total credits or points earned, LEED can be an effective tool in sustainable building design. LEED credits, which are given for incorporating specific sustainable strategies into the design, are divided into six categories: (1) sustainable sites, (2) water efficiency, (3) energy and atmosphere, (4) materials and resources, (5) indoor environmental quality, and (6) innovation and design process. In addition to the credits, certain prerequisites must also be met.

LEED has been remarkably successful in the public sector. Of 948 LEED projects registered as of August 2003, 10% are federal projects, 13% are from state agencies, and 25% are from local governments (Cassidy 2003). LEED's success can be attributed to several factors: it is easy to understand; it gives credits for a wide range of sustainable features; it exemplifies the U.S. competitive spirit, with clearly established rules for success; and it provides a recognizable metric for making market comparisons (Eijadi et al. 2002). Registered LEED projects grew from 1.1 million ft^2 in 1999 to 139 million ft^2 in 2003 (Cassidy 2003). In 2003, registered projects totaled 51.5 million ft^2, or 6% of the U.S. commercial building market.[2]

With LEED's success has come greater scrutiny of actual resulting environmental performance, however. For example, although different points have different environmental impacts (and costs), all credits that score one point are considered equal. Although it is flexible, LEED's "all points are created equal" structure does not make it the best model for a policy objective. For example, the rating system defines a project as "greener" simply if it achieves more points. So, design teams might tend to aim for the least expensive points to maximize scores. Even with these limitations, though, LEED is an excellent sustainable design tool for use in government agencies at all levels.

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[2] New construction for 2003 was 944 million ft^2, according to a February 2004 presentation by Cliff Brewis titled, "2004 McGraw-Hill Construction Forecast."

Some agencies have modified LEED to overcome these shortcomings in order to meet their specific policy objectives. For example, a Cook County, Ill., ordinance requires all newly constructed buildings to achieve a LEED silver rating, but it also requires that all new buildings earn at least eight credits in the area of energy and atmosphere (Templeton 2003).

However, LEED does not address ways to determine how well a building actually performs, or how to establish procedures to ensure that a building performs as designed over time. Other tools can help agencies meet these objectives, however, and many of them complement LEED in supporting sustainable policies. Table 1 on the following page lists some of these tools.

Implementation Process Issues and Lessons Learned

There are several important issues to consider in establishing and implementing a sustainable design policy. These include using an integrated design process; defining energy goals; requiring commissioning, along with measurement and verification; using a tiered approach to applying policies; addressing the added first cost and life-cycle costs; coordinating with other agencies; and providing education and training.

Integrated Design Process

An integrated, whole-building systems approach is key to achieving a sustainable building design, although LEED does not require it. An integrated, whole-building design often begins with a design charrette—an intensive workshop that brings together stakeholders and experts from many disciplines. Holding a design charrette results in a clear vision for the project, well-defined environmental performance goals, a strong multidisciplinary project team, and an overall strategy for achieving a sustainable building (Lindsay et al. 2003). Because architect-engineer-stakeholder interactions are key to achieving an integrated design, a design charrette is recommended for inclusion in a sustainable buildings policy.

The Oregon Department of Energy's (ODOE) State Energy Efficiency Design (SEED) program is a good example of the use of charrettes. The SEED program was established by state law (ORS 276.900.915) to ensure that cost-effective energy conservation measures are included in new and renovated public buildings. It requires a series of design process steps, including predesign discussions and meetings of the design team, an outside energy analyst, and the ODOE early in the design process to discuss the energy design goal, the approach to energy modeling, and the performance verification plan. Documentation is required at each step in the process.

Well-Defined Energy Goal

It is important for a policy to specify clear, measurable energy goals and for metrics to have distinct boundaries. For example, a baseline is necessary in specifying an energy savings of 30%; this could be a code-compliant building designed to a reference standard, such as the most current version of ASHRAE 90.1. Another less common method is to specify a source energy use target, such as 75 kBtu/ft^2, which would vary by region and building function. The goal could also require a minimum energy efficiency and a reduction in peak demand.

Table 1. U.S. Tools Available for Designing Sustainable Buildings

Tool	Used at what stage in the building's life cycle?	Applicable for multiple building types?	Scope of Tool	Market Share
LEED	Design and construction	Yes	Rating criteria for multiple dimensions of sustainable design. Uses results of simulated energy savings.	Over 4000 LEED accredited professionals (as of 2003). LEED registered projects are 6% of new construction in 2003.
ENERGY STAR® Building Ratings	Benchmarking actual operation	Yes	Portfolio manager uses measured energy data to characterize performance.	Over 20,000 buildings rated using portfolio manager; 1400 buildings (including 125 federal buildings) that have earned the ENERGY STAR® rating.
BEES[a]	Design	Yes	Provides life-cycle environmental and economic performance for competing building products.	Over 9000 copies of the software requested in 80 countries.
Whole Building Design Guide (WBDG) principles	Design	Yes	Web-based portal provides access to information from a whole-building design perspective. Information is organized by building type, design objectives, and products and systems.	As of April 2004, the Web site has had 22,000 unique visitors per month.
BLCC[b]	Design	Yes	For user-defined inputs, provides comprehensive economic life-cycle analysis of capital investments.	Several hundred users in the USA and abroad.
ASHRAE "Advanced Guidelines"[c]	All	Not yet	New guidelines will offer strategies to achieve savings of 30%-50% in small office buildings (less than 20,000 ft^2).	Under development.
E-benchmark[d]	All	Not yet	A process tool that defines required energy efficiency measures to achieve various performance levels (in 15 weather zones).	The target audience is utilities, organizations, architects, and engineers of mid-sized buildings.

a) Buildings for Environmental and Economic Sustainability (BEES) software was developed by the National Institute of Standards and Technology (NIST); it analyzes actual environmental and economic performance data for nearly 200 building products.
b) BLCC is a software tool for calculating building life-cycle costs. It is also available from NIST. All inputs are user-defined.
c) This is the product of ASHRAE special project 102.
d) E-benchmark is being developed by the New Buildings Institute.

Define the reference case. A standard reference case, such as ASHRAE 90.1 for commercial buildings, is recommended. It is consistent with private practice and is the reference case in LEED. Each new release of the standard is more stringent; ASHRAE 90.1-2001 is the most current and a new one is expected this year. The designer should be required to calculate energy use or costs for a reference case using a whole-building energy simulation program early in the design process. Note, however, that ASHRAE 90.1-1999 specifies that the simulation of plug loads in the reference case should be the same as those in the "as designed" simulation. Thus, there is no incentive to specify high-efficiency equipment (e.g., with ENERGY STAR® labels). A requirement for ENERGY STAR®-rated equipment could solve this problem.

Require verifiable energy efficiency minimums. On average, green buildings consume 30% less energy than conventional buildings do (Kats 2003). However, a computer simulation tool should be used to ensure that the building design specifies a defined energy efficiency minimum relative to a reference case. The policy maker can decide how stringent the requirement should be. For example, pending federal legislation (H.R. 6, subtitle A; Federal Leadership in Energy Conservation) specifies that "if cost effective," all new federal buildings must be designed to save 30% more energy than that specified in the most recent version of ASHRAE 90.1. New York and Oregon specify 20% below their state codes, and California requires that new buildings meet the Title 24 standard, which is about 15% more stringent than ASHRAE 90.1-1999.

Reduce peak demand. Buildings meeting defined energy goals are more likely to also have a lower peak demand—for example, to improve energy reliability. A specific policy objective (e.g., 2 kW/ft^2) should be considered. For new construction, agencies can establish a peak demand goal along with a goal for reducing energy use.

Building Commissioning and Measurement and Verification

Commissioning and metering help to lower a building's operations and maintenance (O&M) costs and ensure that it meets and maintains performance targets. They also ensure that a building's systems and equipment are installed properly and will perform according to contract requirements throughout their life cycle. Because O&M costs in state buildings are nearly 10 times larger than energy costs (Kats 2003), reductions in O&M have significant financial benefits. One promising approach being piloted by the U.S. Army is "continuous commissioning" via design-build-commission contracting. By keeping the contractor on board for three to five years after construction is completed, the agency ensures that the building is performing at peak efficiency through continued adjustments.

Improved metering allows building managers to better manage upgrades and maintenance as well as anticipate and avoid equipment failure and other costly O&M problems. Metering also provides data that can be used to educate people about the value of sustainable building design. To date, the lack of data has been a barrier to making the business case for sustainable design. One helpful tool is the ENERGY STAR® buildings program portfolio manager. To ensure that policies lead to actual results, they can require agencies to implement both measurement and verification (M&V) and commissioning. If an agency is requiring or recommending the use of LEED, the credits dealing with these topics should be mandatory.

It is essential for buildings to demonstrate that energy savings estimated in the design process are actually achieved. For example, Oregon's SEED program requires performance data after 18 months of building operation to verify that it operates 20% better than it is required to by the state code. If that goal is not met, the agency must submit an energy conservation plan for reaching it. Any remedial action needed is then reported to the state legislature.

A Tiered Approach to Applying Policies

Approaches to using LEED can vary from mandating it for new construction to using it as a checklist. Agencies establishing a LEED-based requirement might want to consider a tiered implementation approach that could be more cost-effective than some others.

The first tier of buildings could be those targeted to the highest LEED rating levels. In 2002 in California, before all major capital projects were required to be LEED-certified (where appropriate), each agency designated a certain number of projects as "leadership buildings" (SBTF 2003), or prototypes for high-performance state government buildings. Similarly, the U.S. Army set a goal of ten gold- and platinum-rated buildings, using its SpiRiT rating tool rather than LEED, in the first year of application, and two more gold or platinum buildings every year thereafter. All other projects must strive for at least a bronze SpiRiT rating (Cassidy 2003). This was done to elevate the program's visibility beyond the agency level, to demonstrate leadership, and to provide many agencies with new opportunities for collaboration.

Tier two could be a class of buildings for which LEED is mandated, for example, all new buildings larger than 50,000 ft^2 and major renovations costing more than $5 million. This might not have to require the achievement of a "silver" or "certified" LEED rating, however.

The third tier could require that all new buildings of more than 5,000 or 10,000 ft^2 be designed using the LEED checklist. Project members would have to document that the design meets the "silver" or "certified" level. The project manager could then decide whether to actually submit a formal application to LEED for certification.

To exempt a project from these requirements, the agency could be required to show that a "less green" design is more life-cycle cost-effective or is required for mission-specific reasons. In the federal sector, for example, a policy could require that a senior official submit an exemption request in writing, signed by an Office of Management and Budget (OMB) official.

Added First Cost and Life-Cycle Costing

Several important studies have identified the first-cost premiums associated with sustainable buildings. Kats (2003) found a green building premium of 0-2% in studying more than 40 California buildings. And Mathiessen et al. (2003) cite a cost premium of 1.9%-4.6% for buildings featuring energy savings of 42%-47%, and almost no premium for buildings meeting just the LEED certified level. The FEMP business case for sustainable design (Dyer & Crawley 2003) cites a green premium of less than 2%. New public buildings and major renovations can thus include green features at almost no added premium. But even minimal additional costs can be a roadblock. For example, on a 50,000 ft^2 building costing $150/ft^2$, a 0.5% premium amounts to $375,000—extra funds not readily found in agencies' budgets.

Kats (2003) maintains that investing less than 2% of construction costs up front yields life-cycle cost savings greater than 10 times the initial investment. However, many cost savings are difficult to quantify (e.g., higher productivity, better indoor air, greater energy reliability). Also, in both the public and private sectors, no dollar value is assigned to externalities like reductions in air or water pollution or in waste. To address this, lawmakers could mandate certain features for public buildings. For example, Oregon requires commissioning and building energy analysis, and California requires a list of energy efficiency measures. These requirements allow any added costs to be included in initial budget requests.

Federal agencies must use life-cycle decision-making tools in selecting energy efficiency measures and systems. This is a good first step, but how can life-cycle savings pay for added up-front costs? In the public sector, managers of new construction projects and operations managers are usually in different departments. Life-cycle cost savings thus accrue to a different department than the one needing the money for the construction. Therefore, public agencies often forgo capturing these cost savings.

For the federal government, capturing the quantifiable portion of life-cycle cost savings would require fundamental changes in the budgeting process, including merging O&M and capital budgets. OMB would need to work with agency budget offices to develop clear guidance that includes definitions and specific examples of life-cycle savings. For example, a capital project could be required to submit long-term projections for items such as energy, water, and O&M costs (OFEE 2003). This could provide additional dollars to cover the added first cost of construction for operational savings that can be quantified.

Requiring public buildings to have sustainable features and to capture life-cycle cost savings comes down to a question of values. Governments must decide how important sustainable buildings are to the public good and to the viability of the organization when compared with other funding priorities.

Agency Coordination

It is important for any agency to coordinate decisions about the long-term O&M cost of buildings with decisions about their initial design. Coordination among departments responsible for these areas is a good first step toward making long-term, cost-effective decisions. The next step is to create a link between construction and O&M budgets. A policy requiring an integrated design process for new buildings would increase this kind of coordination.

Education and Training

Some public policies include education and training to help ensure that both agency representatives and external parties understand how to implement sustainable design policies and procedures effectively. And lack of education is often cited as a major barrier to implementing sustainable design. Thus, both the city of San Jose, Calif., and the State of New York view education as a key policy element. In Oregon, the ODOE assumes an educational role, serving as facilitator and technical consultant to all other state agencies. It provides design reviews, helps to define goals, and facilitates the design process, as required by state law. In addition, sustainable, high-performance federal, state, and local buildings themselves play a very important role in educating people about green design.

Carrot/Stick Elements: Rewards and Accountability

An agency's sustainable design policy should include a means of rewarding designers, builders, and agency representatives who meet sustainable design objectives.

Cash Incentives

Incentives for public agencies could include set-aside funds to help them with process requirements and up-front cost premiums. For example, agencies might want to consider setting up a budget of seed funds for 30 to 50 agency projects identified as "leadership buildings."

Awards

Agencies can also offer awards and recognition to encourage a culture shift in which sustainable building practices are the norm. Awards could be given to all types of individuals, including project managers, senior officials accountable for policy implementation, and representatives from the private sector who assist in design and construction.

Reporting and Accountability

The federal government holds senior agency officials accountable for progress in energy efficiency and other goals through an annual report to the President and agency scorecards. A reporting mechanism and an evaluation are key to ensuring the implementation of sustainable design requirements. Policies can specify accountability for senior agency officials down the reporting chain in performance appraisals. Accountability should involve a comparison of estimated energy performance with actual energy performance, based on measured performance data for one year. Remedial actions should be required when the measured performance is less than that predicted.

Case Studies

The following case studies illustrate many of the policy objectives and strategies discussed in this paper. The first case study is of a New York State policy established by an executive order; the second describes a policy being implemented in the city of San Jose, California.

New York State

On June 6, 2001, New York Governor George Pataki issued Executive Order No. 111, *"Green and Clean" State Buildings and Vehicles*. The order addresses green design, energy efficiency, peak load, renewable energy, alternative fuel vehicles, and purchasing standards. It directs all agencies, departments, authorities, and other entities over which the Governor has executive authority to immediately begin meeting the standards identified in the order.

Overall public policy goals include reducing operating costs; improving operations, management practices, and reliability; increasing knowledge; using green construction practices; increasing the availability of renewable energy sources and premium efficiency products; reducing summer peak demand; strengthening deregulated markets and the economy; and reducing the long-term tax burden and economic dependence on oil and other imported fuels.

Design standards require documentation for a minimum LEED certified rating. A formal rating is not required, though many project leaders apply for one. New construction must comply with the requirements of four sections of the New York State Green Building Tax Credit. These require indoor air quality (IAQ) testing, an IAQ management plan during construction, an O&M plan, and building commissioning. New construction must be 20% more energy efficient than the current state code based on ASHRAE 90.1–1999. There are also requirements for peak load planning and advanced metering.

New York's green design standards are also being used voluntarily in the private sector. Because Executive Order No. 111 has many goals, there are direct links from green design standards to continuous improvement and ongoing ratings. This is shown in the annual reporting required of each agency's energy usage index, a directive to use the ENERGY STAR® Portfolio Manager, and a focus on commissioning and O&M as implementation strategies.

The Order also created an Advisory Council on State Energy Efficiency composed of 14 agencies and chaired by the New York State Energy Research and Development Authority (NYSERDA). The Council meets twice a year, which provides ongoing opportunities to revise the guidelines and give feedback to agencies trying to comply and those providing services. Commissioning, metering, and education and training are key components of the implementation strategy. Training covers basic energy simulation tools, IAQ issues, distributed generation, metering, and other topics. New York's annual energy report highlights outstanding projects.

San Jose, California

In June 2001, San Jose approved a Green Building Policy that calls for all new public building projects and major retrofits larger than 10,000 ft^2 to be constructed to LEED certified standards. The policy directs staff to work with private developers to achieve LEED certification and to provide supportive incentives and helpful educational programs. San Jose has also adopted a Sustainable City Strategy as well as an energy policy.

Funding the added first cost of energy- and water-efficient equipment has been very challenging for San Jose because of coordination and budgeting issues. Two different departments manage capital and operational budgets. Capital budgets are usually controlled by the Public Works Department; operation and maintenance is controlled by the General Services Department. Furthermore, all budgeting is appropriated through the Budget Department and has to be approved by elected officials. Project managers have not tended to consider long-term savings in the face of higher first costs, which negatively impact a project's bottom line. A possible solution is to borrow against the operating budget for the capital budget, since efficient technologies reduce operating costs. However, O&M budgets are not usually appropriated until the fiscal year in which the building is ready for occupancy. This results in a 2- to 3-year gap between equipment purchases and building completions and makes borrowing more difficult.

Since the Green Buildings Policy began, however, record budget deficits in San Jose have prevented staff from developing strong incentives for private-sector involvement. These were slated to include fast-tracking permits, eliminating permit fees for photovoltaic systems, reducing inspection fees for projects receiving commissioning credits, and lowering permit fees for storm-water management and reduced water usage. In May 2001, the City Council was finally able to give the go-ahead to an ordinance to suspend the Buildings and Structures Tax for commercial, residential, and multifamily building owners who install solar energy equipment.

Conclusion and Recommendations

In this paper we have explored many elements to consider in developing a sustainable building design policy at any level of government. We assume that such a policy would require LEED certification or a checklist for all new public buildings or renovations. The policies and implementation strategies that appear most important for such a market transformation include (1) laws that define the policy and its objectives, (2) requirements for commissioning and measurable savings, (3) a well-defined implementation process, and (4) a mechanism that addresses the added first costs of sustainable design.

First, laws should include policy objectives. For example, to achieve greater energy efficiency, the law should include a defined energy goal for applicable buildings in addition to a requirement that buildings meet a certain minimum level of LEED certification.

Second, building commissioning and measurable savings should be required and verified after construction is completed to ensure that design goals are being met. This should be coupled with the remedial actions required if the goals are not met.

Third, the implementation process should be defined. In the SEED program, for example, the State of Oregon clearly states the steps to take in an integrated design process. The steps include checklists at each stage of the process, which allow the ODOE to assume a mentoring role and to track and facilitate the process for each state building.

Finally, a mechanism is needed to address the added first costs of a sustainable design. One way to achieve this is through legislation requiring sustainable design for all new buildings. Agencies would then need to plan for this in their budget requests. (Note that the phrase "when cost-effective" might weaken such a law.) Another way is for governments to restructure the budgeting process so that life-cycle cost savings are used to offset added first costs. A third way is to initially limit sustainability requirements to a small but visible subset of new public buildings. Project results could then be documented to demonstrate life-cycle savings in energy, water, and O&M as well as benefits that are hard to quantify, such as increases in occupants' health and productivity. The documentation could then be used as a basis and rationale for expanding the original policy so it covers all new construction.

A number of challenging issues remain if we are to achieve sustainable buildings at all levels of government, however. First, we must continue to work on aligning budget processes with the need for structures that are cost-effective both to build and to operate. Next, additional research is needed on the best sustainable materials and building systems. Finally, policies must include both incentives and requirements for the continuous environmental improvement of our public buildings.

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Nancy Carlisle, NREL; Joan Glickman, U.S. Department of Energy; Matthew Brown, New York State Energy Research and Development Authority; Michael Foster, City of San Jose, California; and Alison Kinn Bennett and Ken Sandler, U.S. Environmental Protection Agency

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The federal government strives to lead by example in energy and resource management and architectural design. This paper explores how public agencies are supporting that goal by using sustainable practices in the design and operation of their buildings. It presents some elements to consider in establishing a policy for sustainable design and a system for implementing that policy, including some of the most difficult implementation issues agencies have to face. The paper also highlights some of the strengths and weaknesses of federal, state, and local policies and practices governing the design of public buildings; two case studies provide examples. Different approaches are included to help agencies evaluate their effectiveness at various levels of government. Recommendations are made for agencies and others who are committed to sustainable design in both new construction and major renovations.

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