Green Housing Development Guide

About this Tool

Description:

The Green Housing Development Guide is intended for use by Neighborhood Stabilization Program (NSP) grantees, sub grantees, and contractors wishing to incorporate green building into single-family housing development or rehabilitation programs. NSP grantees and subrecipients who are new to green building are urged to view the issue holistically, including site location, materials use, interior air quality, and long term maintenance. Green building standards offer myriad benefits to occupants, the community, and the environment as a whole.

The guide outlines eight green building categories that have been shown to be cost-effective in affordable housing in reducing energy and maintenance costs, improving the health and safety of the building for residents, and reducing environmental impacts. These eight categories include: 1. Integrated Design; 2. Location and Neighborhood Fabric; 3. Site Improvements; 4. Water Conservation; 5. Energy Efficiency; 6. Materials Beneficial to the Environment; 7. Healthy Living Environment; and 8. Operations and Maintenance. The green building measures described in this guide apply to new construction, substantial rehabilitation, and moderate rehabilitation.

Source of Document:

Primary source documents for this guide are the Enterprise Green Communities Criteria and “Incremental Cost, Measurable Savings: Enterprise Green Communities Criteria”, an evaluation of green-built affordable housing projects by Enterprise Community Partners. Both documents can be found at www.greencommunitiesonline.org.

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This resource is part of the NSP Toolkits. Additional toolkit resources may be found at www.hud.gov/nspta

Green Housing Development Guide

A. Overview of Green Building Standards

Introduction

The Neighborhood Stabilization Program is an unprecedented opportunity to use HUD funds for incorporating a green building standard into a public or non-profit housing program. Comprehensive green building standards improve the lives of residents, support community revitalization, and protect the environment as a whole. There are significant social, environmental, financial and health benefits to incorporating a comprehensive set of green building standards. While some housing programs may start off with a partial approach to "going green," the greatest benefits accrue from adopting a holistic green building standard that results in resource conservation, healthier living environments, and restored neighborhoods.

NSP grantees who are unfamiliar with green building may feel a bit overwhelmed at the prospect of identifying and adopting new standards. Yet because the NSP clearly encourages use of green building strategies, and does not require the subsidy layering such public funding often requires, it offers an extraordinary opportunity to integrate these approaches into public housing programs. Grantees should consider using NSP funds to adopt green building principles, develop a pilot project or demonstration program, increase local capacity to develop green buildings, and spur local demand for such housing.

Efforts to provide comprehensive green building standards began in the 1990s with LEED (Leadership in Energy and Environmental Design), which was developed by the U.S. Green Building Council (USGBC) and initially focused on commercial buildings. In the early 2000s, a few affordable housing developers began to apply green building standards to their projects and a few cities begin to promote their own standards for affordable housing and other residential development. Seattle's SeaGreen standard was an early and effective example.

Examples of National Green Building Standards

Enterprise Green Communities
www.greencommunitiesonline.org

LEED for Homes www.usgbc.org

NAHB National Green Building Standard www.nahbgreen.org

In 2004, the Green Communities Criteria were created as a green standard specially designed for use with affordable housing development. The Criteria were developed by Enterprise Community Partners, with input from USGBC, Southface Energy Institute, the Natural Resource Defense Council and other industry advisors. The Criteria apply to new construction, substantial rehabilitation, and—uniquely—moderate rehabilitation.

In 2004, the National Association of Home Builders (NAHB) published a set of green building guidelines, which by 2008 had evolved to a "National Green Building Standard" focused primarily on market-rate residential new construction and related land development.

Also in 2008, the U.S. Green Building Council released its "LEED for Homes" rating system. This standard applies to new and substantially rehabilitated housing, both single-family and multifamily—including mid-rise but not high-rise buildings. USGBC has made special efforts to encourage adoption by affordable housing developers.

Energy Star is an energy-conservation standard that was developed as a joint effort of the U.S. Environmental Protection Agency and the U.S. Department of Energy. It is designed to help consumers save money and protect the environment through improved building and energy performance and the selection of energy efficient products and practices. Appliances that reach a certain level of energy efficiency can earn an Energy Star label, as can homes. Several national and regional green building programs use this program as the basis for their residential energy criteria.

This guide is based primarily on the Enterprise Green Communities Criteria, a national green building program designed specifically for affordable housing. The Criteria ensure that homes are cost effective to build, and durable and practical to maintain. In addition, the principles work together to help produce green affordable housing that:

- Results in a high-quality, healthy living environment
- Lowers residents' utility costs
- Enhances residents' connection to nature
- Protects the environment by conserving energy, water, materials and other resources
- Advances the health of local and regional ecosystems

Like other comprehensive residential green building programs, the Criteria are divided into categories that address multiple aspects of housing development, including:

1. Integrated design
2. Site, location, and neighborhood fabric
3. Site improvements
4. Water conservation
5. Energy efficiency
6. Materials that benefit the environment
7. Healthy living environment and
8. Operations and maintenance of properties

Data in this guide on the performance and costs of green building measures came from *Incremental Cost, Measurable Savings: Enterprise Green Communities Criteria,* a study by Enterprise Community Partners of 27 affordable housing projects that incorporated the Green

Communities Criteria. It found that when the Criteria were adopted comprehensively, they offered measurable health, economic and environmental benefits.

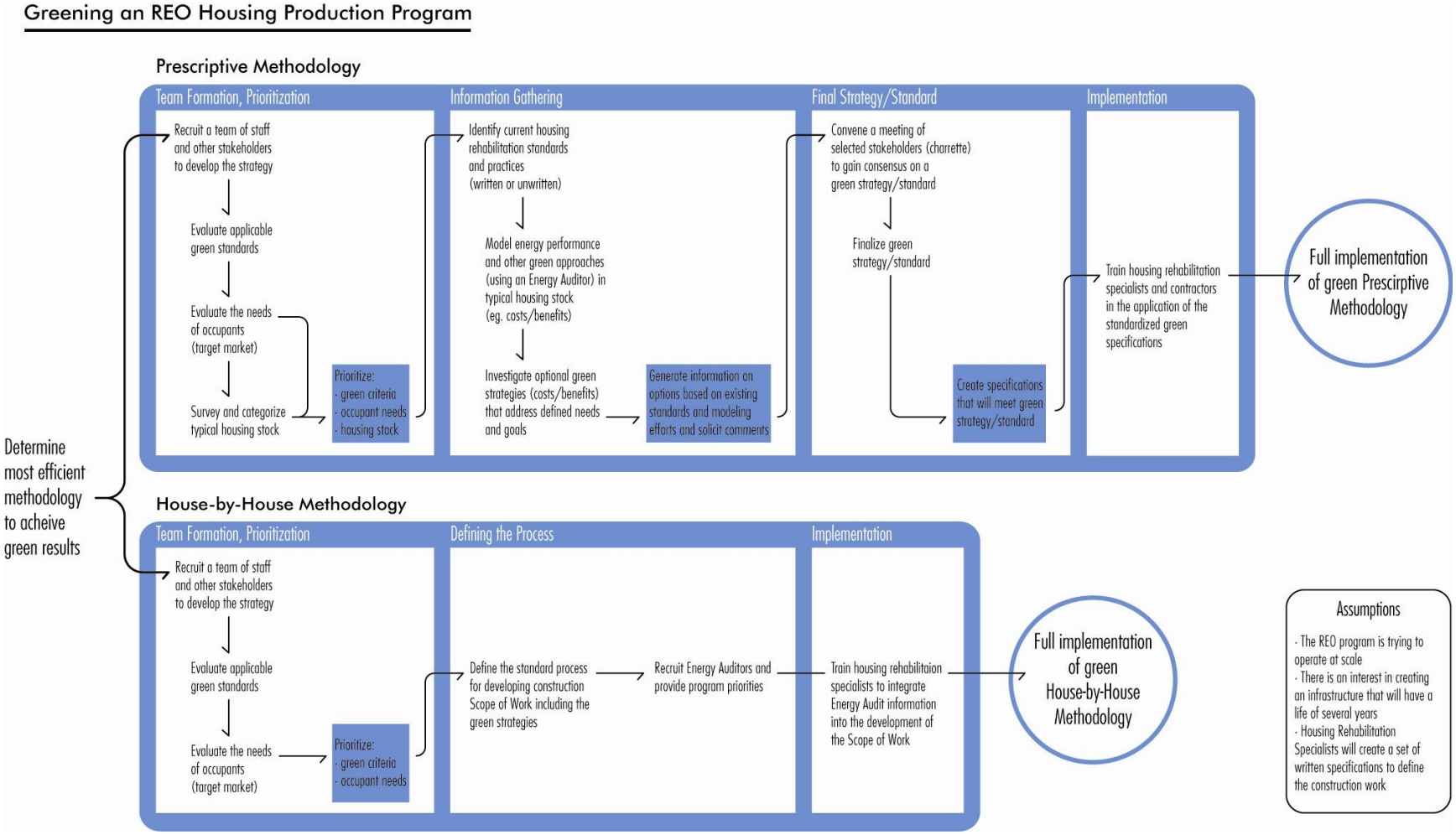
From a strictly financial standpoint, the Enterprise study found that the projected "lifetime" utility cost savings - averaging $4,851 per dwelling unit discounted to 2009 dollars - were sufficient to repay the average $4,524 per-unit cost of implementing the standards in all eight areas. These are described in more detail below, along with their key elements. To achieve the greatest benefit, and to ensure they are addressing all facets of green building, developers are urged to take an integrated design approach to green construction and rehab and use the Green Communities Criteria as a guide for establishing cost-effective green strategies early in the design and development process.

Strategies for Adopting Green Building Standards

NSP grantees have multiple options for ensuring that green building standards are incorporated into housing programs. The first is to adopt a set of standards that is applied to all NSP-assisted housing (known as the "prescriptive method"). The second is to evaluate each house individually, the "house-by house" approach. The prescriptive method is useful when operating a high volume program, while the house-by-house approach is suitable when there are fewer properties addressed. The graphic on the following page illustrates the components of each method.

In the prescriptive approach, the grantee assembles a team of staff and other stakeholders to review potential green building standards and options, assess the local housing stock and the local availability of products, and develop the standards. Before final adoption, there should be a review process in which a broader array of partners and stakeholders can comment on the proposed standards. Once adopted, the grantee should create a corresponding set of specifications to be implemented by participating developers and their contractors. Providing training to housing rehab specialists, energy auditors, and other staff on how to work with the new standards and specifications is imperative, as well as training for local contractors on the proper implementation of these green strategies.

Greening an REO Housing Production Program



The house-by-house approach also begins with assembling the development or construction team to assess green standards, orient them to the target housing and occupant needs. The team agrees on the standards to be used, and provides training to housing rehab specialists, energy auditors, and other staff in how to apply them. Training for local contractors and developers will also be necessary.

For help in incorporating the recommendations of this Guide, NSP grantees are encouraged to look at the *"Sample Single-Family Housing Rehabilitation Standard";* the *"Sample Single-Family Housing Rehabilitation Specifications Including Green Specs"*, and the *"Sample Single-Family Housing Rehabilitation Checklist".* These can be found at www.hudnsphelp.info.

B. Specifics of Green Building Standards

1. Integrated Design

Integrated design addresses sustainability from the outset by connecting the design of the units or buildings to the local climate, and using a total-systems approach to the development process. The goal is to create a more efficient development process in consideration of a holistic green strategy and to place the responsibility of accomplishing each portion of the green standard on a specific professional team member. The promotion of good health and livability throughout the building's life cycle is also considered. An integrated design process can result in substantially lower development costs and greater health, economic and environmental benefits for residents, property owners and communities.

To be effective, however, integrated design principles need to be part of the project planning from the outset. When developing or renovating rental housing, property management and maintenance staff should be consulted about issues such as tenant preferences, the durability of materials, and design features that improve the way buildings operate and the quality of life for residents. The integrated design process should result in a written plan that guides the development process and the long-term management of the property. Key elements of the plan include:

a) The name and role of each member of the professional design and development team;

b) A statement of the project's overall green development goals, and the expected intended outcomes of addressing those goals;

c) A description of the process used to select the green building strategies, systems and materials to be incorporated into the project;

d) A description of the rationale for choosing each of the green features;

e) Identification of which design and development team members are responsible for implementing the green features;

f) A description of follow-up measures to be taken throughout the design, permitting, construction and operation phases to ensure that the green features are included and

correctly installed, and that the owners or tenants receive information about the function and operation of these features.

On average, Enterprise's study of the application of Green Communities' Criteria found that the integrated design process added an average of $94/dwelling unit, or a weighted average cost per square foot of $.09. It is difficult to quantify exactly the actual cost savings and other benefits from following an integrated design process. Clearly, improving communication and planning efforts among the different designers—site planner, architect, civil and mechanical engineers—is fundamental to achieving the comprehensive results that green standards are intended to achieve. It can also avoid costly design mistakes or over-specifying. For example, focusing on design elements such as orientation of the housing, location of the windows and optimization of daylight into the housing, can lead to less expensive mechanical and electrical system purchases, allowing room in the budget for other measures such as healthier building materials.

2. Location and Neighborhood Fabric

Choosing smart sites for housing is a key principle of green housing design. Smart sites are adjacent to existing development, jobs and services. They maximize use of existing infrastructure, encourage walkable neighborhoods, and minimize sprawl. Careful site selection can help clean up and redevelop brownfields and to fill in gaps in the built environment. By avoiding damage to or loss of fragile eco-systems they protect natural resources. Finally, locating housing adjacent to development and services reduces residents' travel distances and costs, reducing strain on their budgets and increasing their opportunities for being involved in their communities. Key criteria of smart sites for housing include:

a) Locating the development on a site with access to existing roads, water, sewers and other infrastructure, and within a quarter mile walk to facilities such as libraries, supermarkets, schools, pharmacies, or places of worship. Developments should not be sited within 100 feet of wetlands, steep slopes, or 1,000 feet of a critical habitat.

b) Employing densities which are at minimum seven units/acre for detached or semi-detached houses, 12 for town homes and 20 for apartments.

c) Creating sidewalks or suitable pathways within a multifamily property or single-family subdivision to link the residential development to public spaces, open spaces and adjacent development. Walking and bike paths that connect the property to other neighborhoods offer even stronger benefits.

d) Using passive solar heating and cooling strategies such as increasing natural shading, or optimizing daylight through the design of the structure and how it is situated on the lot.

e) Building on grayfield, brownfield, or adaptive reuse sites.

f) Locating developments close to public transportation.

In the study Enterprise conducted, the cost of incorporating these measures ranged from a low of zero for locating a project next to other development, to a high of $109/unit (about $.11 a

square foot) for creating walkable neighborhoods. Some of the financial benefits of choosing a smart site include an increased marketability to residents, along with the potential for appreciation of market values, if homes are being sold. There are also social and financial benefits to residents of homes located within short distance to community amenities and mass transit.

3. Site Improvements

As noted in 2, above, green building includes utilizing infill sites or brownfields rather than raw land (also referred to as "greenfields"). Because brownfields have a history of prior use it is vital to conduct testing to determine whether these sites contain hazardous materials. Abating any hazards found will also be necessary before building can begin.

During the construction process the site must be managed to prevent erosion and limit sedimentation of nearby water bodies. Once construction of the buildings is completed, landscaping should be designed to help absorb rainfall and divert runoff into retention ponds. Long term energy use can also be reduced by planting trees that provide shade during summer months and allow for solar gain in the winter. Use of native species, for example xeroscaping in desert climates, reduces energy usage further. Strategies for the green handling of site improvements include:

a) Conducting an American Society for Testing and Material (STM) Transaction Screen or a Phase I Environmental Site Assessment, and (if required) a Phase II Abatement plan.

b) Implementing the U.S. Environmental Protection Agency's (EPA's) Best Management Practices (BMPs) for erosion and sedimentation control during construction.

c) Using local species in landscaping that will be less susceptible to disease, which reduces the burden of the occupant to replant at a later date. In dry climates, local species will also require less water.

d) Overall, landscaping with plants that are drought resistant will require less water, reducing energy and water costs.

e) Using tree plantings to promote shading and reduce heat island effect.

f) Installing site improvements to capture and, where possible, to re-use rainfall for irrigation. Such measures might include the use of rain barrels or rain gardens, incorporating permeable surfaces (such as gravel paths), and minimizing impervious surfaces (such as pavement) that do not allow stormwater infiltration.

g) Labeling storm drains to indicate where they lead, which reminds people not to dump garbage or pollutants into the drains.

Among those projects reporting additional costs for site improvements, the weighted average cost per square foot was $.52 or $227 per dwelling unit. Installing erosion and sedimentation controls added $.06 per square foot, or $11 per dwelling unit. Surface water management added $.30 per square foot, or $764 per dwelling unit. For larger projects, a Phase I, and potentially a Phase II site assessment is required for the use of any federal funds, so this should

be a part of standard policies and procedures for housing programs involving new construction or substantial rehabilitation of larger properties.

Single-family projects are not usually subject to Phase I or II environmental assessments if the NSP grantee has completed what is called a "Tier One" environmental assessment for a target area. In that case, a "Tier Two" review is usually limited to historic review, floodplain issues, and a limited number of other site-specific reviews.

4. Water Conservation

Showers and faucets account for about 25% of indoor water use, and toilets account for an additional 20%. Low flow faucets, shower heads, and toilets are widely available and easy to install. Due to increasing attention in the media they are also accepted and increasingly expected by consumers. To ensure that the right fixtures and appliances are utilized, developers should research these in advance and specifically list them in project plans and specifications so subcontractors know what to use. Water conserving strategies should include:

a) Toilets that use no more than 1.28 gallons per flush or better, and showerheads, kitchen and bathroom faucets that are at 2.0 gallons per minute or less.

b) Installing energy efficient landscape irrigation (if this is needed at all) by using graywater (from sinks, showers and tubs), roof water, or collected site runoff.

Water conservation also conserves energy use that may be associated with pumping, heating, flushing, and treating water, and has the added benefit of being relatively inexpensive to achieve.

Use of water conserving fixtures and appliances added $128 per unit on average in the Enterprise study, but the estimated lifetime water savings was $935 per unit.

5. Energy Efficiency

Energy efficiency measures have the combined benefit of increasing resident comfort while reducing utility bills and lowering carbon emissions. On a global scale, these criteria help to mitigate the cumulative burdens of energy production and delivery, extraction of non-renewable natural resources, air quality degradation, global warming, and increasing concentrations of pollutants. For maximum benefit, these measures should be included in the project planning and design from the outset, as it is less expensive to incorporate them into the early stages of construction than to add them later. As with water conservation, many energy efficiency measures, such as creating a tight building envelope or use of Energy Star appliances, have a payback of less than 10 years. Key energy efficiency measures include the following:

a) Meeting or exceeding nationally established standards such as Energy Star, or American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This can be achieved by using a Home Energy Rating System (HERS) or Building Performance Institute (BPI) certified rater.

b) Installing Energy Star clothes washers, dishwashers and refrigerators when providing new appliances.

c) Installing Energy Star–labeled lighting fixtures or the Energy Star Advanced Lighting Package in all interior units, using Energy Star or high-efficiency commercial-grade fixtures in all common areas as well as outdoors, and installing daylight sensors or timers on all outdoor lighting.

d) Tracking individual residents' energy consumption through the installation of individual or sub-metered electric meters. Raising their awareness of their usage may help them reduce it.

e) Installing renewable energy measures such as photo-voltaic panels, thermal hot water heaters, and wind turbines.

In Enterprise's study, the estimated incremental cost per unit of meeting Energy Star, HERS, or exceeding ASHRAE standards by 15% was $1,784 per unit. However, these measures produced an estimated lifetime energy savings of $3,916 per unit and had an estimated payback of nine years. Installing photovoltaic panels without public subsidies averaged $8,018 per unit and had a payback period of 40 years. When subsidies were available this option became far more attractive, reducing the added per unit cost to $108 and providing a one year payback. Subsidies may be available from city, state, or federal programs; NSP grantees are encouraged to research the incentives available in their own areas, including layering with federal weatherization subsidies.

6. Use of Materials That Benefit the Environment

There are many techniques and building products on the market that conserve natural resources and reduce emissions associated with manufacturing and transporting raw materials. The three primary strategies for managing materials in a way that benefit the environment are to reduce, reuse and recycle waste. Reduction can be achieved by choosing products for the project that eliminate waste or energy costs, such as obtaining locally made building materials, or using engineered framing materials that avoid use of old growth trees for framing timbers. Reuse of wood and other materials salvaged from residential or commercial projects eliminates the costs of disposing of those products and manufacturing new ones. Finally, when options for reducing or reusing products are exhausted, purchasing products manufactured with recycled content, or incorporating recycling practices on site such as capturing rainwater or stormwater runoff for irrigation, can help shrink the environmental footprint of the project.

This area of green development is in its early stages, so access to information about costs and the availability of materials is limited. However, recommended components of green development include:

a) Ensuring that at least 5 percent of construction materials are re-used from other projects or contain recycled materials.

b) Using at least 50% (by cost) wood products and Forest Stewardship Council–certified materials, salvaged wood or engineered framing materials.

c) Using water-permeable materials, such as pervious interlocking concrete paving blocks, concrete grid pavers, perforated brick pavers, and compacted gravel in at least 50 percent of walkways and driveways to reduce run-off.

d) Use of Energy Star-compliant (i.e., reflectivity of greater than 6.5) and high-emissive roofing with an emissivity of at least 0.8 when tested in accordance with American Society of Testing and Materials 408 (ASTM 408), or to install a green (vegetated) roof on at least 50 percent of the roof area.

e) Installing light colored and/or open grid pavement with a minimum Solar Reflective Index of 0.6, over at least 30 percent of the site's hardscaped area to reduce heat island effects and resulting loads on the building's cooling system.

Additional costs from these components ranged from $.17/square foot for installing water permeable walkways to $.61/square foot for paving parking areas with water permeable material. As the industry gains experience in this area the ability to track costs and measure benefits will improve. While these cost figures can be used as a guide, actual costs are likely to vary according to the locale and the individual project.

7. Healthy Living Environments

The importance of a healthy living environment is a significant green building issue directly affecting residents. Creating a healthy environment involves using materials that do not cause negative health impacts for residents, especially for more sensitive groups such as children, seniors, and individuals with existing respiratory problems and compromised immune systems. Creating a healthy living environment requires minimizing residents' exposure to toxic materials by using safe, biodegradable materials. Proper home ventilation and minimal moisture buildups are crucial to maintaining healthy indoor air quality and reducing the potential for mold growth in living areas and basements. Development strategies that can promote healthy living environments include:

a) Ensuring that all interior paints and primers comply with current Green Seal standards for low volatile organic compound (VOC) limits.

b) Using low VOC adhesives that comply with Rule 1168 of the South Coast Air Quality Management District. All caulks and sealants must comply with regulation 8, rule 51, of the Bay Area Air Quality Management District.

c) Avoiding use of exposed particleboard (which contains added urea-formaldehyde, a toxin), unless the exposed area has been sealed. Formaldehyde exposure can cause watery eyes, nausea, coughing, chest tightness, wheezing, skin rashes, allergic reactions and burning sensations in the eyes, nose and throat.

d) Avoiding installation of carpet in basements, entryways, laundry rooms, bathrooms or kitchens because of potential problems with moisture retention and mold growth. If carpeting is installed in other parts of the home, use the Carpet and Rug Institute's (CRI's) Green Label-certified carpet and pad, which have low VOCs.

e) Installation of Energy Star-labeled bathroom fans that exhaust to the outdoors and are equipped with a humidistat sensor or timer, or operate continuously. Also required in kitchens — except in moderate rehabilitation projects — are Energy Star-labeled power vented fans or range hoods that exhaust to the exterior. Properly sized and controlled exhaust fans in bathrooms and kitchens reduce moisture condensation, lowering the potential for indoor mold growth that may yield odors and pose health hazards to residents.

f) Installation of a ventilation system for the dwelling unit that provides 15 cubic feet per minute of fresh air, per occupant. Various means exist for achieving this standard, such as whole-house mechanical ventilation systems, constantly running low-speed exhaust fans, and “slit” ventilators in window frames.

g) Sizing heating and cooling equipment in accordance with the Air Conditioning Contractors of America, Manuals J and S, to prevent short cycling of heating or air conditioning, and ensure adequate dehumidification.

h) Installing tankless water heaters, or conventional water heaters in rooms with waterproof floor coverings, and drains or catch pans piped to the exterior of the dwellings. The use of heaters with drains and catch pans prevents moisture problems caused by leakage or overflow.

i) Insulating exposed cold water pipes in climates and building conditions susceptible to moisture condensation to prevent condensation that can lead to mold growth.

j) In wet areas of buildings, installation of materials with smooth, durable, cleanable surfaces, instead of mold-propagating materials, such as vinyl wallpaper and unsealed grout. Shower areas must have a one-piece fiberglass or similar enclosure. Alternatively, when using any form of grouted material, use backing materials, including cement board, fiber cement board, fiberglass-reinforced board or cement plaster.

k) Installing vapor barriers under all slabs in basements or under living areas, since water can migrate through concrete. Vapor barriers and waterproofing materials greatly reduce the migration of moisture that can occur even in non-saturated soils. Installation of radon-resistant features reduces concentrations of radon, a cancer-causing soil gas that leaks into homes through cracks in slab and foundation.

l) Installing foundation drainage systems to divert surface and underground water down to the lowest level of concrete, away from windows, walls and foundations. This also requires that foundation walls be carefully waterproofed on the exterior to avoid moisture migration, and that surface water be diverted away from the building by gutters, downspouts, drainage systems and proper grading of lawns, patios and walkways.

m) Installation of a continuous air barrier between the conditioned (living) space and any unconditioned garage space to prevent the migration of any contaminants into the living space. In single-family houses with attached garages, developers must install a carbon monoxide (CO) alarm inside the house on a wall attached to the garage or outside the sleeping area.

n) Exhausting clothes dryers directly to the outdoors, to reduce moisture buildup in living areas.

o) Sealing all wall, floor and joint penetrations to prevent pest entry, including providing rodent- and corrosion- proof screens (e.g., copper or stainless steel mesh) for large openings.

p) Renovating properties built before 1978 using lead-safe work practices during renovation, remodeling, painting and demolition. Any activity that disturbs painted surfaces or building components in pre-1978 dwellings that contain lead-based paint may generate and spread lead dust and debris, increasing the risk of lead poisoning for exposed children and families. Controlling lead dust and debris helps minimize lead in the environment.

q) Use of non-vinyl, non-carpet floor coverings, such as non-vinyl composite tile, colored concrete, ceramic tile, natural linoleum and wood, in all rooms. Carpeting can serve as a sink for dust, allergens and other substances that may pose health hazards to susceptible residents.

r) Installation of whole-house vacuum systems with high-efficiency particulate air filtration.

Costs for construction strategies that promote healthy living environments vary on average from a low of $.01/square foot for use of water and mold resistant materials in wet areas to a high of $.58/square foot for use of healthy flooring materials that minimize dust and mold growth. As to health benefits, Enterprise Community Partners commissioned a study of the Seattle Housing Authority's Breathe Easy Homes, part of the Seattle Highpoint HOPE VI redevelopment , to assess the costs and benefits of the original investment after one year of occupancy. The following health-related results were identified:

- Children with asthma experienced a 65% increase in symptom-free days
- For all 35 households, the number of emergency room or urgent doctor visits declined by two-thirds, from 61.8 to 20, in a three-month period
- The caretakers of asthma sufferers also reported an increase in their quality of life

The health benefits of these homes are impressive, but these results show that the health benefits from living in a green home can produce a financial reward, as well. For example, the second bullet highlights the significant decrease in the number of emergency room visits. If each emergency room visit were to cost $300, before living in green homes these 35 households would have spent $18,540 cumulative on emergency room visits over a three-month period. In comparison, for the three months of this study when these 35 households were living in green homes, they spent just $6,000, a 68% decrease.

The study was titled "Green Housing Series: A New Prescription for Asthma Suffers: Healthier Homes" and can be found at www.seattlehousing.org.

8. Operations and Maintenance

The benefits of integrating green building features into a project are maximized only if building systems are well maintained and residents understand how the use of their homes and surrounding space can affect not just their utility bills, but also their own health and the environment.

Both residents and Operations and Maintenance staff are the essential links between the initial design and construction of a building that incorporates green features, and a building that will continue to be green and realize the planned benefits once it is occupied. Without guidance on specific measures —such as re-painting with low-VOC paints, using CRI Green Label carpets, changing air filters regularly, irrigating according to the landscape architect's water efficiency guidelines, continuing to use compact fluorescent lamps, etc. — green projects will likely perform beneath their potential over time. Strategies to ensure proper operations and maintenance include:

a) Creating operating manuals for homeowners or tenants describing the intent, benefits, use and maintenance of green building features, and encouraging additional green activities such as recycling, gardening and use of healthy cleaning materials. For rental property managers and maintenance staff, manuals should include routine maintenance plans, instructions for all appliances, HVAC operation, water-system turnoffs, lighting equipment and other systems that are part of each unit; information on how to maintain the site's green features, including paving materials and landscaping, and an occupancy turnover plan that describes in detail the process of educating tenants about proper use and maintenance of all building systems.

   Sample guides for both homeowners and renters can be found on Enterprise's website www.enterprisecommunity.org.

b) Conducting a walk-through and orientation to the homeowner or new resident that reviews the building's green features and operations, and maintenance processes.

Typical costs for implementing these strategies are about $.01/square foot, or from $6 - $15 per dwelling unit. The benefits are difficult to quantify in dollars. However, it is clear that building managers and residents should be educated in how to use and benefit from green building features. Otherwise, the financial savings (from energy conservation) and health benefits will be diminished. Rather than simply providing a manual, which may never get read, NSP grantees and developers are urged review the manual and its key points with prospective homeowners and tenants. This could be done in homebuyer education classes or as part of tenant orientation sessions.

Considerations for Housing Rehabilitation

In the Enterprise study, the incremental cost of incorporating the Enterprise Green Communities Criteria was lowest among moderate rehabilitation projects. The predicted lifetime savings for these projects was two times the reported incremental costs of complying with the Criteria, giving moderate-rehab projects the highest return on investment of any

subset of the 27 projects surveyed. Substantial rehabilitation projects had the highest cost premium for compliance. At the same time, these developments were projected to have remarkably high lifetime utility cost savings.

Conclusion

The Neighborhood Stabilization Program was established to help bring stability to neighborhoods across the country that have been crippled by abandonment and foreclosure. Green building helps stabilize communities by providing housing that offers lower utility bills, reduces maintenance, and creates healthier living environments. These increase the likelihood that tenants and homeowners will remain in their homes for the long term.

Enterprise's study, "Incremental Cost, Measurable Savings", demonstrates that, when green strategies are included in the planning and design from the outset, they can be implemented with reduced cost and yield substantial benefits in terms of reduced energy usage, lower environmental impact, and improved resident health and safety. The average cost per dwelling unit to incorporate the energy and water criteria was $1,917, returning $4,851 in predicted lifetime utility cost savings (discounted to 2009 dollars). In other words, the energy and water conservation measures not only paid for themselves but also produced another $2,900 in projected lifetime savings per unit.

Examples of measures that did not have easily identifiable direct financial savings, but that have clear indirect financial benefit, included the integrated design process, ensuring a healthy living environment, reducing construction waste, and providing operations and maintenance manuals. In fact, tradeoffs between cost expenditures and financial savings underscore the importance of executing an integrated design approach. Focusing from the start on design elements such as orientation of the housing on the site, location of the windows, and optimization of daylight into the units, can reduce the cost of mechanical and electrical system purchases, allowing room in the budget for other measures such as the use of healthier building materials.