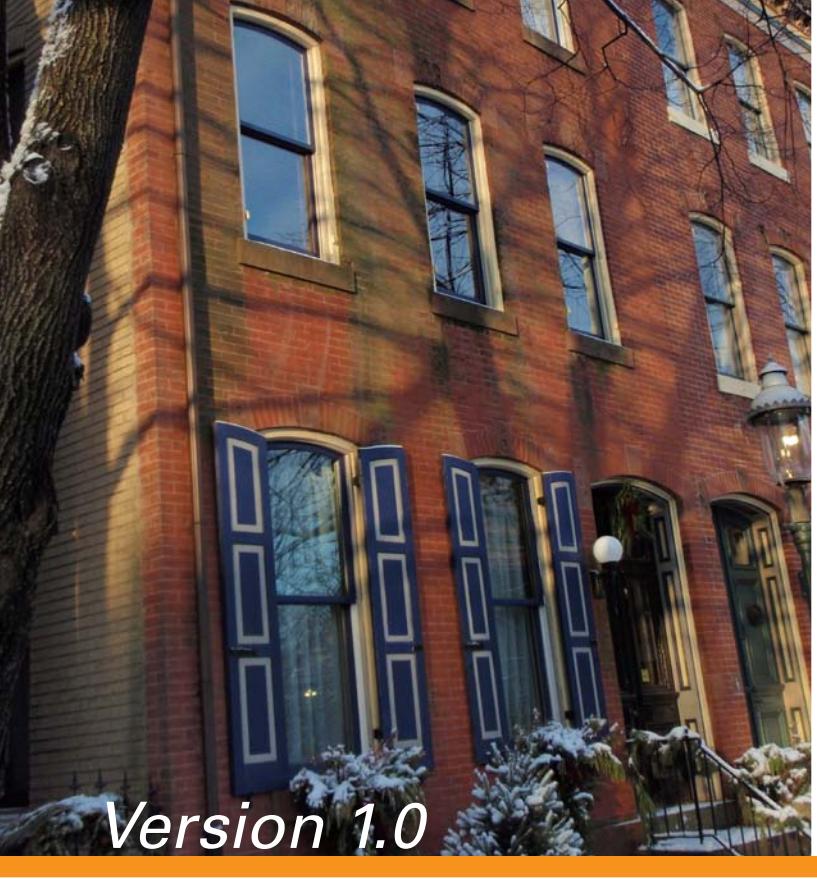

NJ GREEN HOME
REMODELING GUIDELINES

Use of the Guidelines

What are the guidelines and what are they not?

The information provided in these guidelines is intended to assist homeowners, contractors, architects, interior designers, landscape architects, and other professionals who design and remodel residential structures. They draw upon best practices and provide a general overview of green remodeling strategies customized for New Jersey, with links to additional information and resources. These guidelines introduce ways a homeowner or remodeling professional can incorporate green building practices into common home remodeling projects. These are not step-by-step technical guides but rather a menu of 'best practices' organized by major building systems. One should become familiar with local building code and zoning requirements before undertaking a green home remodeling project.

The guidelines do not list or endorse specific green products or services but rather identify 'greener' options to consider when selecting materials and services for the home.

These Guidelines do not constitute an endorsement, approval, or recommendation of any kind by any persons or organizations affiliated with developing these Guidelines. The NJDEP further disclaims any and all liability for any personal injury, property damage or any other damages that are caused by or that may result from the reliance on these NJ Green Home Remodeling Guidelines.

New Jersey Green Home Remodeling Guidelines Version 1.0

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Cover Images: Michael Fleischacker, Ford 3 Architects, Barbara Geller, Patricia Gaylor, John D. S. Hatch, Ed Schwartz

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The Rutgers Center for Green Building developed the guidelines with extensive input and review by an expert advisory group comprised of residential building and remodeling professionals, interior designers, landscape architects, and experts in the field of green building and energy-efficient design. The engagement of local expertise and real-life project examples were key to customizing the guidelines to New Jersey and providing insight into local opportunities, costs, and challenges.

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REGREEN
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RUTGERS
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Introduction

Green Home Remodeling and Sustainability

What is green home remodeling and why is it important?

Residential buildings account for 22 percent of total energy and 74 percent of water consumed in the United States. When they contribute to climate change, the electricity used is generated from non-renewable and carbon-based fuels. A typical home emits almost 9,000 pounds of **carbon dioxide*** per person per year; altogether, residences contribute 17 percent of the nation's **carbon dioxide** emissions. Moreover, Americans spend 90 percent of their time indoors, where concentrations of pollutants are often much higher than outside, making "green" in the residential sector important for both the environment and human health.

Within the menu of residential green practices, remodeling an existing home may be one of the most resource-efficient actions that a homeowner can take. Green home remodeling offers the opportunity to cost-effectively reduce home energy demand, reduce home maintenance costs, and increase occupant comfort and indoor air quality.

By taking advantage of pre-existing water, sewer, and road infrastructure, green home remodeling expands upon the inherent environmental benefits of remodeling with increased energy and water conservation, enhanced indoor air quality, reduced material waste and resource consumption, and the use of environmentally friendly products.

The basic principles of green remodeling are similar to those used in new green home construction. A major difference is that green home remodeling begins with an existing set of parameters that pose unique challenges and opportunities for employing green building strategies. Green construction of new homes can start with a blank slate of possibilities. However, it is the opportunity to green the nation's existing housing stock that offers the most promising opportunity to meet current greenhouse gas emission targets and environmental goals.

Green Home Remodeling in New Jersey

Why is green home remodeling important for New Jersey?

New Jersey is the most developed state in the nation—and not by a little bit. The Garden State leads its nearest competitor in this category, Rhode Island, by about 25 percent. Although opportunities for infill and brownfield redevelopment exist, New Jersey could be the first state to reach full build-out of its remaining developable lands in just 20 to 40 years at the current pace of development and preservation. While this development trend leaves a shrinking window of opportunity to construct new green homes, it offers a growing opportunity to employ green remodeling strategies in existing homes.

An analysis done by the Rutgers Center for Green Building shows that the majority of the state's housing stock is single-family detached housing built between 1940 and 1979. Houses need to be updated and remodeled 20 to 30 years after they are built, when major systems start to require upgrading or replacement. Therefore, the average age of the housing stock in New Jersey makes it an ideal candidate for green home remodeling. As fuel prices rise, homeowners in the state will greatly benefit from renovations that include the installation of energy-efficient appliances, efficient heating and cooling systems, and a better insulated **building envelope**.

At the national level, replacement projects that boost curb appeal – siding, windows, and decks – and kitchen remodels have been found to offer the best payback for homeowners (see Top 10 Project Paybacks for 2008, to the right). Given the recent real estate market, rather than buying a new house, many New Jersey homeowners may choose to stay put and remodel their homes.

The state's environmental goals and recent commitments to cut greenhouse gas emissions, to invest in renewable energy, and to create green jobs further advances green home remodeling in the state.[1]

Top 10 Project Paybacks for 2008

1. Upscale fiber cement siding **(86.7%)**
2. Midrange wood deck **(81.8%)**
3. Midrange vinyl siding **(80.7%)**
4. Upscale foam-backed vinyl **(80.4%)**
5. Midrange minor kitchen remodel **(79.5%)**
6. Upscale vinyl window replacement **(79.2%)**
7. Midrange wood window replacement **(77.7%)**
8. Midrange vinyl window replacement **(77.2%)**
9. Upscale wood window replacement **(76.5%)**
10. Midrange major kitchen remodel **(76.0%)**

Source: National Association of Realtors. 2008. Cost vs. Value Report.

***Green building terms are highlighted in bold and defined in a glossary at the back of each chapter.**

- A main goal of green remodeling is to reuse existing assets and limit the impact of the built environment on the natural environment. In this way, green remodeling helps to meet New Jersey's planning goal to prevent urban sprawl and preserve natural resources and open space.[2]
- The use of energy-efficient and renewable technologies can lower energy consumption by 30-50 percent annually, reduce utility bills and decrease demand on electrical power plants. This green strategy advances the state's goals of preserving energy resources and encouraging the development of different housing types within the limits of available infrastructure.
- Green homes consume less water than conventional homes through water-efficient appliances and by recycling water for irrigation and other uses. This helps to lower water bills and reduces costs associated with the adverse effects of stormwater runoff such as flooding and water pollution. This green strategy furthers the state's goals to preserve wetlands and prevent degradation of the environment.
- Green home construction calls for high-quality and durable materials, which reduces consumption of resources, maintenance costs, and adds value to a home. Reusing materials reduces the burden on the state's landfills, helps preserve the architectural features of historic homes, and maintains and improves the character of established neighborhoods in the state. This green strategy supports the state's goal to preserve the historical heritage of the region.[3]
- Green home building and remodeling reduces greenhouse gas emissions and curbs climate change. Almost all residential greenhouse gas emissions are related to energy consumption. Green home remodeling strategies that focus on energy efficiency help to reduce a home's carbon footprint. In turn, green home remodeling supports New Jersey's goal to reduce greenhouse gas emissions by 20 percent to 1990 levels by 2020, followed by further reductions of emissions to 80 percent below 2006 levels by 2050.

Development of the Guidelines

Why do we need the New Jersey Green Home Remodeling Guidelines?

Nationally, many states and local governments have recognized the need for green building and created programs and guidelines focused primarily on new green building, while offering some tips and techniques for green home remodeling. Specific green remodeling guidelines and certification programs are only now emerging, and several states have programs or are developing them. With no centralized national programs to certify green home remodeling projects, the United States Green Building Council (USGBC) partnered with the American Society of Interior Designers (ASID) to develop the REGREEN Residential Remodeling Guidelines 2008. Even though there are a growing number of green remodeling guidelines, books, websites, and magazines, many builders and homeowners are overwhelmed by the amount of information available and have no idea where to start. The *New Jersey Green Home Remodeling Guidelines* simplifies the process by highlighting strategies for remodeling homes of different ages and styles located in unique bio-regions of New Jersey. They draw on local expertise and examples and take into account the availability of materials, products, and services. The Guidelines recognize the local factors that influence the cost and feasibility of recommended green strategies and technologies, providing a customized roadmap with tips and knowledge not available in other state or national guidelines.

Role of the Expert Advisory Group

What was the process and who was involved in the development of the guidelines?

To gain a better understanding of the challenges and opportunities for green home remodeling in New Jersey, the RCGB conducted an analysis of the state's existing housing stock. Data gathered from the U.S. Census on housing unit type and age of structure showed the majority of the housing stock in rural and suburban counties of the State to be of single-family detached units built between 1940 and 1979. The Center also conducted a literature review to examine similarities and differences as well as applicability to New Jersey of several nationally recognized green home remodeling guidelines and programs.

The RCGB created an Expert Advisory Group in the spring of 2008 to inform the development of the guidelines. Meetings held during the course of the 16-month project and ongoing e-mail communication gathered the group's feedback and advice. Working groups matched expertise with the development of specific areas of the guidelines. Many of the case studies featured in the guidelines were either projects or

recommendations from members of the Expert Advisory Group. The engagement of local expertise and real-life project examples were key to customizing the guidelines to New Jersey and providing insight into local opportunities, costs, and challenges.

Relation to the REGREEN Residential Remodeling Guidelines 2008

REGREEN
ASID & USGBC

How have the REGREEN guidelines inspired and informed the New Jersey Green Home Remodeling Guidelines?

Concurrent with our launch of this project, the U.S. Green Building Council (USGBC) and the American Society of Interior Designers (ASID) unveiled the first draft of the REGREEN Residential Guidelines 2008 (www.regreenprogram.org). This opened an opportunity for the Rutgers Center for Green Building to benefit from national-level research on green home remodeling and customize recommendations for New Jersey.

The USGBC and ASID granted the RCGB the right to use the REGREEN strategy titles and strategy identification system (ID's) to establish a formal link to the REGREEN guidelines. The *New Jersey Green Home Remodeling Guidelines (NJGHRG) Version 1.0* encompasses the REGREEN strategies deemed significant for New Jersey as well as strategies not covered by the REGREEN Guidelines. In most cases the REGREEN strategy titles were revised or combined to better reflect the purposes of the *NJGHRG*. In all cases, the strategy descriptions reflect original research conducted by the RCGB and the Expert Advisory Group. Furthermore, the *NJGHRG* draw on some of the design and organizational features of REGREEN but incorporate original photos and illustrations, use regional case study examples and present local resources and references where possible.

This collaborative partnership between the USGBC and ASID and the RCGB provides a model for how to adapt REGREEN to a regional (state) scale.

Notes

[1] The Global Warming Response Act (GWRA) (P.L. 2007, c. 112) calls for reducing GHG emissions to 1990 levels by 2020, approximately a 25 percent reduction below estimated 2020 businesss-as-usual (BAU) emissions, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050.

[2] New Jersey State Planning Commission 2001. New Jersey State Development and Redevelopment Plan. Adopted March 1, 2009. (Accessed August 11, 2009): www.state.nj.us/dca/divisions/osg/plan

[3] Ibid.

How to Use the Guidelines

Organization of the Guidelines

The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

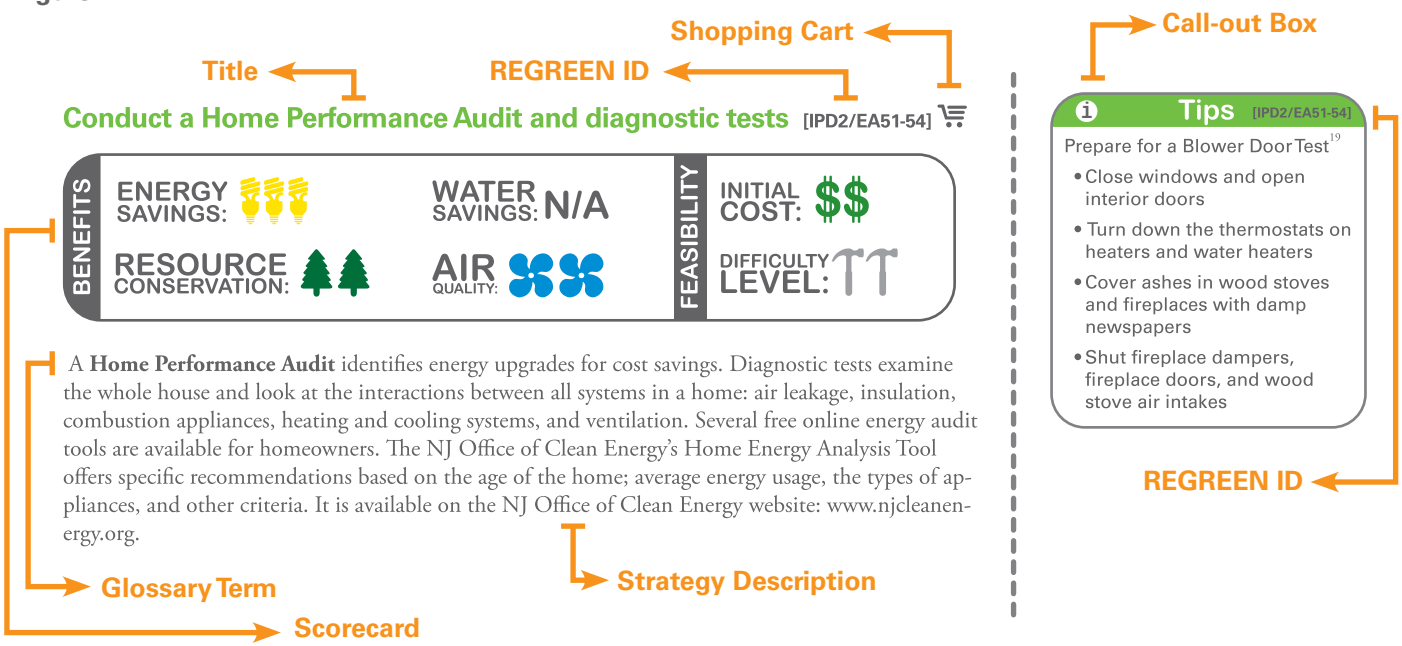
Each chapter includes the following:

- How to Use the Guidelines
- Health and Safety
- Green Home Maintenance and Housekeeping
- Best Practice Strategies
- Resources and References
- Case Studies
- Green Products and Services
- Glossary of Terms

Getting the Most from the Strategy Write-ups

The Guidelines provide information on best practice strategies for each project type. These strategy write-ups are organized by building system and follow the order of the 2008 REGREEN Residential Remodeling Guidelines (i.e., IDP2), which are incorporated with permission. **Figure 1** describes the information available.

Figure 1



Title and REGREEN Strategy ID – The strategies in the REGREEN Residential Remodeling Guidelines 2008 inspired most of the strategies in these Guidelines. Where appropriate, the strategy references the related REGREEN strategy ID.

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Shopping Cart – The cart denotes entries in the Green Product and Service Guide located in the back of each project chapter.

Strategy Description – This write-up provides an overview of each strategy and its environmental benefits.

Glossary Term – Acronyms and green building terms are highlighted in bold and defined in a glossary at the back of each chapter.

Call-out Boxes - The call–out boxes in **Figure 2** highlight information of special importance. These include the following types of information:

- Tips - useful hints or practical facts for accomplishing a strategy
- Incentive - sources of financial assistance
- New Jersey Bio-Region - New Jersey has 5 bio-regions, each with unique elements and environmental features to consider when remodeling
- Building Age - a home's age can inform needed repairs and call out special circumstances
- Caution - on occasion, there are hazards associated, so items are called out for safety reasons

Hazard Symbol - Symbols were developed to advise users of certain health and safety threats related to specific strategies. The symbols, which appear below, reference the guidance on Health and Safety located at the beginning of each section.

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

Web Link - When viewing this document electronically, the websites will hyperlink, however, occasionally website links change. In most cases, the site provides a seamless link to the new address. If this is not the case, users may need to copy and paste the link into the browser address bar. At the time of publication the hyperlinks in this report were all functional.

Scorecard - The scorecard, **Figure 3**, provides a snapshot of the environmental benefits, initial costs, and difficulty levels associated with a particular strategy. Both qualitative and quantitative information was used to assign scores to each strategy.

Figure 3

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

It is divided into two parts: 1) Benefits and 2) Feasibility.

Graphic icons were developed for each impact category.

BENEFIT Key

1 icon = low benefit, 2 icons = medium benefit, 3 icons = high benefit

FEASIBILITY Key

$ low initial cost, $$ medium initial cost, $$$ high initial cost

T low difficulty level, TT medium difficulty level, TTT high difficulty

The icons above have been developed to graphically describe the ratings that follow.

BENEFITS

Energy Savings

To help meet its greenhouse gas reduction responsibility, in 2007 New Jersey passed **carbon dioxide** (CO_2) reduction goals, i.e., achieve 1990 emission levels by 2020, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. The state has also established renewable energy and energy efficiency targets. Green remodeling strategies utilize renewable energy sources such as solar, geothermal, and wind to net a lower CO_2 footprint.

Figure 2

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

Water Savings

Water conservation reduces water use both inside and outside the home. Within the home this may include low-flow fixtures. Outside the home this may refer to using **native plants** that have lower watering requirements or rain barrels to collect rainwater for reuse on the lawn and garden. Water management includes providing proper moisture control at footings, slab perimeter, and foundation walls as well as using porous paving materials to encourage stormwater recharge for reduced runoff.

Air Quality

Americans spend up to 90 percent of their time indoors where air quality can be more polluted than outdoors. Pollutants range from allergens such as mold, mildew, fungus, and dust mites to toxins, such as asbestos, and volatile organic compounds like formaldehyde and benzene found in building materials and a number of household items including pressed-wood furniture, computer ink, carpeting, and conventional household cleaners and cosmetics.

Resource Conservation

Resource conservation means using materials that are durable and easy to maintain with low embodied energy (the energy used in resource extraction, manufacturing, shipping). These come from renewable sources or are produced from waste, recycled materials, or salvaged from other uses. Avoiding building materials that deplete natural resources, such as old-growth timber, and materials made from toxic or hazardous substances improves nature's ability to provide goods and services.

FEASIBILITY

$ Initial Cost

Cost is always a consideration for remodeling projects. Evaluating the cost of a recommended green remodeling strategy provides homeowners with a better sense of the relative costs and benefits of each recommended measure.

Costs come in two forms, so it is important to consider both in assessing feasibility. The first reflects initial costs of the strategy compared to conventional practices. A second consideration to make is the pay-back period or life-cycle cost. The pay-back costs are less obvious and are often project specific, but they can have significant environmental and economic value that factor into the overall cost. For more information on average costs, savings, and payback periods of typical energy efficiency improvements, see the Energy Efficient Rehab Advisor at (www.rehabadvisor.pathnet.org/). For customized results, have an energy professional conduct a thorough energy audit of your home.

$ Less than $500

$$ $500-$5,000

$$$ Greater than $5,000

Difficulty Level

Time is money and expertise is gained over time. Some people may consider a Home Performance Audit strategy in the 'medium' category because although relatively straightforwardto act on, it requires experts with custom equipment to prepare an accurate assessment. Implementing the findings from a Home Performance Audit becomes a 'high' difficulty category as space heating and cooling systems, ventilation, water heating, appliances, climate and even site factors need to be integrated to assure desired energy improvements across 'ALL loads' and to avoid negative unintended consequences. It is expected that 'high' difficulty strategies may also be dangerous for the basic homeowner to undertake.

T Easy to Do It Yourself (DIY) - little previous knowledge necessary

TT Task for an Experienced DIYer or Professional - may require additional effort and higher learning curve than conventional strategy it replaces

TTT Task for an Expert/Certified Professional - high learning curve; new technique; requires specific green knowledge

Notes: [1] U.S. Environmental Protection Agency 2008. Healthy Buildings, Healthy People: A Vision for the 21st Century

10 Green Rules of Thumb

1 Start from where you are

Every home has a unique story and different starting point for going green. Greening an existing home is about more than just introducing a single green product or a collection of green technologies; it's about how systems of the whole building work together to reduce environmental impacts. First, determine what makes sense for your home and your budget. Many of the most significant opportunities for reducing the environmental impact of a residential remodeling project lie in the decisions made at the very start of the project. Start with diagnostic tests such as a **Home Performance Audit** (**Blower Door Test**, **infrared imaging**, etc.) to uncover problem areas and discover opportunities for improvements and savings.

For more information on free and reduced-rate home performance energy audits, visit the New Jersey Clean Energy Office's website, www.njcleanenergy.com/

2 Expand your definition of cost

When undertaking a green remodeling project, it is important to focus on long-term savings, ease of maintenance and resource conservation. The initial cost only provides one of the true cost of a product or design; a higher price can mean a better deal in the long run. For example, resource-efficient fixtures may cost more up front but save money over time by lowering monthly utility bills. Durable materials save money by requiring less frequent replacement. A low purchase price may simply mean a good deal–or it may signify a lack of quality or durability. It may also mean that some environmental, health or social costs are not reflected on the price tag.

The cost and design of construction services might seem expensive if only the up-front costs are considered. The actual cost comes when the benefits are included, which reflects savings in operation and maintenance. The collaborative nature of the green design approach requires more up-front time (which usually translates into billable hours), but this early planning stage means tremendous benefits later: design solutions that better meet a homeowner's needs or reduce the project scope, fewer construction materials and expenses, or features that save energy, water, or maintenance.

For items that may increase your initial costs during construction, be sure to calculate the return on investment – the period of time it takes to realize the savings for items such as solar panels or added insulation. For information on Return on Investment for common green home remodeling strategies, see www.GreenandSave.com/master_roi_table.html

3 Reuse materials, reduce waste, and rethink space

Consider the 3-Rs: reduce, reuse, recycle. In green remodeling, the 3-Rs start at the earliest stages of design. By thinking creatively about how to reduce waste. Try to reuse as much as possible of the structure, finishes and furnishings. Keep in mind, though, that sometimes it makes sense to replace items, such as old, inefficient refrigerators with new energy-saving models. The size of your remodel will determine the resources to build it and maintain it. Before tearing down walls, think about how to reutilize existing rooms or consider opportunities to relocate space-constrained activities to outdoor spaces. If demolition is unavoidable, plan for deconstruction – or manually unbuilding and salvaging building materials – to help keep useable materials out of landfills.

Materials salvaged from deconstruction can be used on the current project, sold or donated. Develop a plan for recycling construction and demolition waste. Close the loop by choosing new materials that have a **High-Recycled Content**.

Look for salvaged materials at demolition sales and local salvage stores such as Habitat for Humanity ReStores (www.habitat.org/env/restores.aspx) and Goodwill Retail Stores (www.locator.goodwill.org/), or through websites like www.Craigslist.org and www.Freecycle.org.

4 Conserve energy and use the sun

The energy used to heat, cool and power homes pollutes the atmosphere and contributes to global climate change. Additionally, inefficient homes are costly to maintain. A first step in any green remodeling project involves making homes as energy-efficient as possible and then relying on sources of clean and renewable energy for any remaining energy demands.

The sun provides free and plentiful energy in the form of daylight and heat. Although it is easier to incorporate passive solar techniques when building a brand-new home, every remodeling project should also be evaluated to identify passive solar opportunities.

- Insulate the building to a very high level and reduce **infiltration** to prevent heat loss.
- Consider the orientation of the home or addition at the start of any project. South-facing walls and windows will receive the most sunlight. Design roof overhangs for south-facing windows to let sun in during the winter and keep sun out in the summer.
- Use wall and floor materials with thermal mass to absorb heat and cold.
- Incorporate **awnings**, **trellises** and deciduous shade trees to limit summertime solar heat gain through south-, east- and west-facing windows.
- Design windows and operable skylights to catch prevailing breezes and provide **natural ventilation**.
- Reduce solar heat gain by using light exterior colors or paints with reflective pigments, **ENERGY STAR®** roofing materials, and/or radiant barrier roof sheathing.

For more information about passive solar design for homes, visit the U.S. Department of Energy's website, www.eere.energy.gov/buildings/residential/solar.html.

5 Conserve water and gather rain

New Jersey has abundant water resources—so why worry about saving water? Aside from periodic droughts, the simplest answer is that conserving water saves money. If household water is supplied by a well and septic system, conserving water can extend the life of the system and delay the need for repair.

If a home is serviced by a municipal water system, the less water that it uses, the smaller the bill. Conserving water can also reduce energy bills lowering water heating costs. Most people use approximately 50–75 gallons of water indoors every day, with up to 75 percent of that used in the bathroom.[1]

According to the **EPA**, a typical single-family suburban household uses at least 30 percent of their water outdoors for irrigation. Some experts estimate that more than 50 percent of landscape water use goes to waste from evaporation or runoff caused by overwatering. Install faucet aerators and low-flow fixtures to reduce water use indoors and consider using a rain barrel or **rain garden** to water **native plants** in the garden.

For more information on how to save water in the home, visit the U.S. **EPA** WaterSense website, www.epa.gov/watersense/.

For up-to-date information on low-flow toilet performance tests, visit the California Urban Water Conservation Council website, www.cuwcc.org/maptesting.aspx.

6 Consider the life-cycle of products and materials

"The greenest home is the one that is already built"

– National Trust for Historic Preservation

Everything – every material, every product – has a life cycle. A life cycle is the journey a material goes through from its raw form through processing to a finished product. All the energy to extract, process, manufacture, transport, and install a product is called its 'embodied energy'. When a home is demolished and landfilled, the energy locked up in it is totally wasted. Demolition itself uses energy and, of course, the construction of a new home in place of the demolished one uses more energy and resources yet.

Embodied Energy of Materials and Construction per square foot of Construction[2]	
Residential – Single Family	700 MBTU/sq. ft.
Residential – 2 to 4 Family	630 MBTU/sq. ft.
Residential – Garden Apartment	650 MBTU/sq. ft.

To calculate the embodied energy of your home, take the Embodied Energy Survey developed by The Greenest Building Organization at www.thegreenestbuilding.org/survey.html.

Try to follow these guidelines:

- Design for long life and adaptability, using durable low maintenance materials.
- Ensure materials from construction and demolition wastes are reused or recycled.
- Use locally sourced materials (including materials salvaged on-site) to reduce transport.
- Select low-embodied energy materials (which may include materials with a **high-recycled content**).
- Select materials that can be reused or recycled easily at the end of their lives using existing recycling systems.
- Give preference to materials manufactured using renewable energy sources.
- Use efficient **building envelope** design and fittings to minimize materials (e.g., an energy-efficient **building envelope** can downsize or eliminate the need for a large **HVAC** system).

For more information on preserving a home's embodied energy as well as its historic features, visit the National Trust for Historic Preservation's website on sustainability: www.preservationnation.org/issues/sustainability/

7 Avoid Toxins

The **United States Environmental Protection Agency** (**USEPA**) reports that the air in homes can be 5-10 times more polluted than outdoor air. According to research published in the *New England Journal of Medicine*, 40 percent of children will develop respiratory disease in part due to the chemicals in their homes. To minimize exposure, select products and furnishings for the home that do not contain **volatile organic compounds** (**VOCs**), **flame retardants**, and **formaldehyde**. The Washington Toxics Coalition (WTC) reports that using entryway mats can reduce the amount of dust on carpets by 33 percent. And homes where shoes are removed at the door, according to the WTC, have 10 times less dust than homes where shoes are worn.

Leading causes of poor indoor air quality include:

- Off-gassing of chemicals from building products and materials
- **Combustion** by-products from open-flame appliances
- Lead dust from old paint
- **Asbestos** from old insulation, floor tiles, siding or fireproofing
- Dust mites and other biological pollutants like dander and pollens
- Mold caused by excess moisture and/or poor ventilation
- **Radon** that migrates from soil into the house

For more information on ways to reduce exposure to toxics in the home, see the Health and Safety section in this guideline or visit the American Lung Association's Health House website: www.healthhouse.org/

8 Connect to Nature

Disturbing or removing vegetation causes a site to lose valuable ecosystem services such as climate regulation, protection of soil health, provision of habitat for wildlife and pollinators, and filtration of pollutants from water and air. This also can restrict the capacity of

the landscape to intercept and infiltrate water which in turn manages stormwater, recharges groundwater and filters water. Furthermore, studies show that the visual effects of flowers and plants are good for people. A Chicago study links tree and grass cover to fewer property crimes, fewer violent crimes, stronger ties between neighbors, more frequent use of common neighborhood spaces and a greater sense of safety.[2] During construction, avoid cutting down existing trees and disturbing vegetation. Keep in mind that well-designed landscapes promote biodiversity with a mix of **native species** and ecologically appropriate non-native species.

For more information on creating sustainable sites, see the Sustainable Sites Initiative website (www.sustainablesites.org) or check out the National Wildlife Foundation's Garden for Wildlife website (www.nwf.org/gardenforwildlife).

9 Communicate Green Remodeling Priorities

A successful green remodeling project requires homeowners, interior designers, architects, engineers, builders, and trade contractors to coordinate their efforts as early as possible. To make sure that everyone understands and to hold them accountable for the green features of the project the following two steps are essential:

1. Incorporate green items directly into the specifications for the projects.
2. Attach a green remodeling checklist to the blueprints to make it easier for everyone involved—including the building professionals, homeowner and municipality—to see which green features are included in the remodeling project.

For tips on hiring and working with design professionals and contractors when working on green remodel projects, check out Seattle's Green Home Remodeling "Hiring a Pro" guide book: www.seattle.gov/dpd/cms/groups/pan/@pan/@sustainableblding/documents/web_informational/dpds_007579.pdf

10 Get Paid to Green Your Home

Homeowners can receive federal and state tax credits for installing energy-efficient windows, doors, roofing and insulation as well as furnaces, air conditioners and heat pumps. Details on qualifying improvements are updated regularly on the Database of State Incentives for Renewables and Efficiency (DSIRE) website, www.dsireusa.org/.

New Jersey electric and gas utilities also offer rebates for **Energy Star®** appliances and energy efficiency upgrades, as well as free online energy efficiency surveys for the home. Water utilities may offer free leak-detection services, free shower and faucet aerators, landscaping and water audits, and free or rebated toilets, dishwashers and clothes washers.

For more information, check with your local utility or the New Jersey Office of Clean Energy website, www.njcleanenergy.com/residential/home/home.

Notes:

[1]Sue Scibilia. (2003) "Hints for Household Water Conservation." Rutgers NJAES Cooperative Extension. Available at: www.njaes.rutgers.edu/pubs/publication.asp?pid=fs862

[2]Kuo, Frances E. The role of arboriculture in a healthy social ecology. Journal of Arboriculture 29 no.3 (May 2003): 149-155.

NJ DEP Clean Water NJ

www.cleanwaternj.org/index.htm

Kitchen, Bath, and Living Spaces

The contemporary home serves many different functions for both living and working. Today, best practice for remodeling these areas includes options that not only meet functional needs but are also highly effective in mitigating environmental impact. Kitchens and bathrooms are active spaces and significant consumers of water and energy; choosing environmentally friendly appliances, fixtures, and finishes helps to reduce energy and water consumption and protect non-renewable resources. In kitchens and especially bathrooms, it is advised to invest in durable, high performance features. Whether it's through an energy-saving dishwasher, living room flooring made from renewable materials, bed linens made from bamboo, or a high-efficiency exhaust system, greening living spaces is a fundamental part of the overall green home remodel.

Photo: Patricia Gaylor

Kitchen, Bath, and Living Spaces

How to Use the Guidelines

Health and Safety

HS1 - Nuisance and Toxic Dust Control
HS2 - Hazardous Materials - Asbestos & Lead
HS3 - Mold
HS4 - Radon

Green Home Maintenance and Housekeeping

Building Envelope

Detail window sills in wet areas **[IDP26]**
Seal and flash windows/skylights **[IDP27]**
Upgrade or replace existing windows **[EA56/59]**
Upgrade existing exterior door **[EA57]**
Provide shading of skylights as needed **[EA61]**
Isolate attached garages **[IEQ165]**

HVAC

Use ceiling fans for natural ventilation **[EA65]**
Install programmable thermostats **[EA67]**
Make sure ductwork is clean **[EA71]**
Install effective ventilation **[IEQ166-167/172]**
Provide fresh air in ventilation system **[IEQ171]**
Vent all combustion-based equipment **[IEQ168]**
Install automatic shut-off on bathroom fans **[IEQ167]**

Lighting and Electrical

Provide daylighting **[EA83]**
Provide appropriate lighting **[EA84]**
Install energy-efficient lighting **[EA85]**
Provide controllable interior shading **[IEQ178]**

Wall and Ceiling

Install eco-friendly interior sheathing **[MR126]**
Select eco-friendly interior doors **[MR127]**
Choose eco-friendly paints, sheens, and finishes **[IEQ185/MR130-131]**
Consider tile with recycled content **[MR132]**
Select eco-friendly wall coverings **[MR129/IEQ186]**
Use non-paper-faced gypsum board in moist areas **[IEQ183]**
Use low-VOC construction products **[IEQ187]**
Avoid carpeting in moist areas **[IEQ179]**

Floors and Flooring Products

Reuse existing flooring and subflooring **[MR133]**
Choose hard, low-formaldehyde floors **[IEQ180/MR134]**
Use reclaimed or renewable materials **[MR135-136]**
Refinish floors with eco-friendly products **[MR137]**
Select eco-friendly carpeting **[IEQ182/MR139]**

Plumbing

Install water-saving fixtures **[WE42-44]**
Install water filtration system **[IEQ175-176]**
Include a plumbing access panel **[MR123]**
Choose a high-efficiency water heater **[EA79]**
Consider eco-friendly piping material **[MR122]**
Reconfigure plumbing for efficiency **[EA77]**
Install instantaneous hot water heater

Equipment

Select high-efficiency clothes washer **[EA92]**
Select an energy-efficient refrigerator **[EA93]**
Choose an energy-efficient dishwasher **[EA94]**
Install energy-efficient cooking appliances **[EA95]**
Select energy-efficient office equipment **[EA99]**

Laundry

Install single-throw shut-off valve **[MR124]**
Install drain pan for clothes washer **[MR125]**
Provide air-lock dryer vent **[EA72]**
Minimize dryer duct lengths and turns **[EA73]**

Furniture and Fittings

Select eco-friendly furniture **[MR141-143/146-148/150]**
Select eco-friendly cabinetry and countertops **[MR140/145/148-149]**
Support local craftsmen **[MR153]**
Select furniture that is easy to clean **[IEQ192]**
Select healthier window treatments **[IEQ193]**

Uses

Use green cleaning materials/strategies **[IEQ196]**
Regularly maintain equipment **[EA91]**
Designate a built-in recycling center

Case Studies

Green Products and Services

Glossary of Terms

How to Use the Guidelines

Organization of the Guidelines

The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

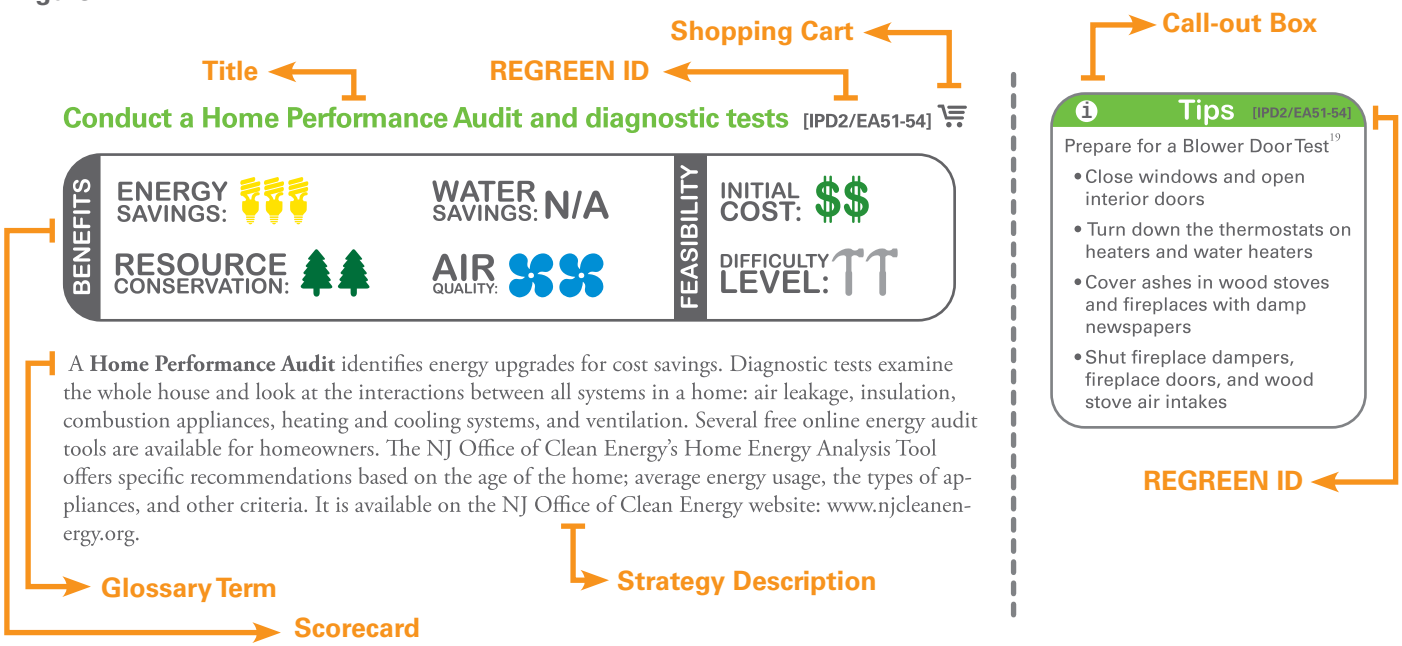
Each chapter includes the following:

- How to Use the Guidelines
- Health and Safety
- Green Home Maintenance and Housekeeping
- Best Practice Strategies
- Resources and References
- Case Studies
- Green Products and Services
- Glossary of Terms

Getting the Most from the Strategy Write-ups

The Guidelines provide information on best practice strategies for each project type. These strategy write-ups are organized by building system and follow the order of the 2008 REGREEN Residential Remodeling Guidelines (i.e., IDP2), which are incorporated with permission. **Figure 1** describes the information available.

Figure 1



Title and REGREEN Strategy ID – The strategies in the REGREEN Residential Remodeling Guidelines 2008 inspired most of the strategies in these Guidelines. Where appropriate, the strategy references the related REGREEN strategy ID.

Shopping Cart – The cart denotes entries in the Green Product and Service Guide located in the back of each project chapter.

Strategy Description – This write-up provides an overview of each strategy and its environmental benefits.

Glossary Term – Acronyms and green building terms are highlighted in bold and defined in a glossary at the back of each chapter.

Call-out Boxes - The call–out boxes in **Figure 2** highlight information of special importance. These include the following types of information:

- Tips - useful hints or practical facts for accomplishing a strategy
- Incentive - sources of financial assistance
- New Jersey Bio-Region - New Jersey has 5 bio-regions, each with unique elements and environmental features to consider when remodeling
- Building Age - a home's age can inform needed repairs and call out special circumstances
- Caution - on occasion, there are hazards associated, so items are called out for safety reasons

Hazard Symbol - Symbols were developed to advise users of certain health and safety threats related to specific strategies. The symbols, which appear below, reference the guidance on Health and Safety located at the beginning of each section.

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

Web Link - When viewing this document electronically, the websites will hyperlink, however, occasionally website links change. In most cases, the site provides a seamless link to the new address. If this is not the case, users may need to copy and paste the link into the browser address bar. At the time of publication the hyperlinks in this report were all functional.

Scorecard - The scorecard, **Figure 3**, provides a snapshot of the environmental benefits, initial costs, and difficulty levels associated with a particular strategy. Both qualitative and quantitative information was used to assign scores to each strategy.

Figure 3

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL: TT	

It is divided into two parts: 1) Benefits and 2) Feasibility.

Graphic icons were developed for each impact category.

BENEFIT Key

1 icon = low benefit, 2 icons = medium benefit, 3 icons = high benefit

FEASIBILITY Key

$ low initial cost, $$ medium initial cost, $$$ high initial cost

T low difficulty level, TT medium difficulty level, TTT high difficulty

The icons above have been developed to graphically describe the ratings that follow.

BENEFITS

Energy Savings

Energy efficiency reduces energy use in the home, reduces **carbon dioxide** (CO_2) emissions, and helps stem climate change. New Jersey passed aggressive CO_2 reduction goals to lower greenhouse gas emissions to 1990 levels by 2020. The 20 percent reduction is followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. The state has also established renewable energy targets. Green remodeling strategies utilizing renewable energy sources such as solar, geothermal, and wind will net a lower CO_2 footprint.

Figure 2

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

Water Savings

Water conservation reduces water use both inside and outside the home. Within the home this may include low-flow fixtures. Outside the home this may refer to using **native plants** that have lower watering requirements or rain barrels to collect rainwater for reuse on the lawn and garden. Water management includes providing proper moisture control at footings, slab perimeter, and foundation walls as well as using porous paving materials to encourage stormwater recharge for reduced runoff.

Air Quality

Americans spend up to 90 percent of their time indoors where air quality can be more polluted than outdoors. Pollutants range from allergens such as mold, mildew, fungus, and dust mites to toxins, such as asbestos, and volatile organic compounds like formaldehyde and benzene found in building materials and a number of household items including pressed-wood furniture, computer ink, carpeting, and conventional household cleaners and cosmetics.

Resource Conservation

Resource conservation means using materials that are durable and easy to maintain with low embodied energy (the energy used in resource extraction, manufacturing, shipping). These come from renewable sources or are produced from waste, recycled materials, or salvaged from other uses. Avoiding building materials that deplete natural resources, such as old-growth timber, and materials made from toxic or hazardous substances improves nature's ability to provide goods and services.

FEASIBILITY

$ Initial Cost

Cost is always a consideration for remodeling projects. Evaluating the cost of a recommended green remodeling strategy provides homeowners with a better sense of the relative costs and benefits of each recommended measure.

Costs come in two forms, so it is important to consider both in assessing feasibility. The first reflects initial costs of the strategy compared to conventional practices. A second consideration to make is the pay-back period or life-cycle cost. The pay-back costs are less obvious and are often project specific, but they can have significant environmental and economic value that factor into the overall cost. For more information on average costs, savings, and payback periods of typical energy efficiency improvements, see the Energy Efficient Rehab Advisor at (www.rehabadvisor.pathnet.org/). For customized results, have an energy professional conduct a thorough energy audit of your home.

$ Less than $500

$$ $500-$5,000

$$$ Greater than $5,000

Difficulty Level

Time is money and expertise is gained over time. Some people may consider a Home Performance Audit strategy in the 'medium' category because although relatively straightforwardto act on, it requires experts with custom equipment to prepare an accurate assessment. Implementing the findings from a Home Performance Audit becomes a 'high' difficulty category as space heating and cooling systems, ventilation, water heating, appliances, climate and even site factors need to be integrated to assure desired energy improvements across 'ALL loads' and to avoid negative unintended consequences. It is expected that 'high' difficulty strategies may also be dangerous for the basic homeowner to undertake.

T Easy to Do It Yourself (DIY) - little previous knowledge necessary

TT Task for an Experienced DIYer or Professional - may require additional effort and higher learning curve than conventional strategy it replaces

TTT Task for an Expert/Certified Professional - high learning curve; new technique; requires specific green knowledge

Notes: [1] U.S. Environmental Protection Agency 2008. Healthy Buildings, Healthy People: A Vision for the 21st Century

Health and Safety

Green remodeling poses hazards typical of many other home renovation or remodeling projects because of the age of the homes (given that they are more likely to contain older and use more hazardous materials) and the incentive for green remodeling to replace older or damaged building systems.

New Jersey homeowners considering green remodeling should anticipate potential emissions of hazardous air contaminants during removal of old building materials. The risks associated with improper removal of materials containing **asbestos**, lead, mold or even fiberglass insulation are minimized by understanding and following the steps listed here prior to initiating work. For complex situations, consider hiring professionals.

General hazard recognition and risk reduction information for the following potential renovation-related risks are contained in this section:

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

HS1 – Nuisance and Toxic Dust Control

Construction projects involving demolition of existing sheetrock, plaster, wood, brick or concrete products in ceilings, walls or floors of a home will release dust as these materials are ripped, sanded, ground, pulverized or crushed. Control of dust emissions during the pouring of solids or from transferring of small particles is controlled in industrial facilities. Homeowners planning renovation projects should also consider steps to minimize the release and maximize control of dust in the environment. These nuisance dusts, when released from the point of origin into the air of the home, tend to remain suspended in the air for very long periods of time, and as such, will be transported with air currents caused by open doors, cracks around and beneath doorways, forced air heating and cooling ductwork, and even by the air currents caused by persons walking in and out of dusty areas, to other areas of the home. At a minimum, allowing the uncontrolled release of nuisance dusts from any demolition project, as well as those created from sawing, sanding, or grinding of newly constructed materials (e.g., sheetrock, spackling, wood dust etc.) presents unnecessary and difficult dust cleanup demands for affected living spaces. At their worst, susceptible occupants of homes where uncontrolled nuisance dusts are allowed to escape into adjacent living spaces may temporarily experience eye, nose, or throat irritation. Asthmatics may experience adverse respiratory distress when exposed to high levels of nuisance dust particles.

There are several simple steps to minimize potential hazards of nuisance dust during remodeling.

1. Remove unnecessary porous and non-porous materials (e.g., draperies, bedding, upholstered furniture, children's toys, clothing, etc.) from the project area.
2. Seal the project area from the remainder of the home using polyethylene sheeting at doorways and at inlets to any forced air supply or **return registers** within the project space.
3. Consider installing **HEPA filtered air scrubbers** in the project area and discharging the exhaust air through an adjacent window using a tight fitting flexible duct through a sealed window opening (consider surrounding security requirements). Use a lightweight section of facial tissue at the doorways to confirm that air pressure is moving from the clean adjacent living space and into the project area (not the other direction) so that air leaks from the clean home into the dirty renovation area. This will reduce any potential for dusts from the renovation area to enter the adjacent areas of the home.
4. Periodically during the work session and after every work session, **HEPA vacuum** the renovation area following renovations to remove accumulated surface dust, without re-suspending it into the air.

HS2 – Hazardous Materials - Asbestos & Lead

When removing old building materials, know that they contain hazardous materials, which while intact present little to zero risk to occupants, but when removing can create airborne emissions and increase health and safety risks. This is especially true of **asbestos** and lead, and, possibly to a lesser extent, fiberglass. Removal of **asbestos**, lead or fiberglass needs to be planned and conducted with care to minimize exposures to airborne dust from these materials.

Asbestos

Asbestos is a mineral that has been mined in the U.S. since the early 1900's. Its superior heat resistance properties, combined with its lightweight, high-tensile strength, and non-corrosive qualities, made it an ideal building material for buildings constructed between 1940 and the late 1980's. **Asbestos** was banned as a building material in the U.S. after scientists concluded studies linking long-term occupational exposures to damaging respiratory health including asbestosis (scarring of the lung), lung cancer, and mesothelioma (cancer of the lining of the lung). Because intact **asbestos** presents no increased health risk, there is no requirement for removing it from existing homes. However, when it is disrupted, pulverized or suspended in air, the potential for inhalation of **asbestos** fibers increases risks of exposure. While health effects develop only after decades of long-term occupational or environmental exposure, homeowners should take particular care to prevent unintentional release of **asbestos** into the air of their homes during green remodeling efforts so that children and others are not exposed.

Asbestos is commonly found in older homes (constructed between 1940 and the late 1980's) in the following building materials:

- Pipe and boiler insulation
- Sprayed on fireproofing insulation
- Acoustical tiles and wall coverings
- Floor tiles
- Roof shingles
- Siding shingles

There is no requirement that homeowners remove **asbestos**-containing materials from homes. However, if removal is part of a green building remodeling project, material should be tested by a New Jersey licensed **asbestos** control monitor, and if determined to contain **asbestos**, be removed by a New Jersey licensed **asbestos** contractor. The number of the state program to contact for assistance in identifying qualified personnel to assist homeowners to safely address any possible **asbestos** concerns is (609) 292-7837.[5] General information about asbestos and its proper management and disposal can be found at the Department of Health website: www.state.nj.us/health/iep/asbestos.shtml and the Department of Environmental website: www.nj.gov/dep/dshw/rrtp/asbestos.htm.

Lead

Lead was in residential paints prior to 1978. It was banned after that time due to the significant health affects to children inhaling or consuming dusts from lead-based paints. Because of the hazards posed by dusts and chips of lead-painted surfaces, any remodeling or renovation which impacts painted surfaces of homes constructed prior to 1978 needs to be inspected by a New Jersey licensed lead inspector. If lead paint is identified, it should be safely removed by a state of New Jersey licensed contractor. They can safely remove lead-based paint and conduct follow-up surface lead testing to confirm that the removal was successful. Information on lead-based paint and qualifications for lead inspectors and contractors can be found at: www.state.NJ.us/health/iep/documents/pb_advisory_bulletin.pdf.

Contact the New Jersey Department of Health and Senior Services at (609) 292-7837 with any questions.

Fiberglass

Fiberglass insulation is a manufactured glass-wool-like material used as an insulation and sound absorption material in homes, schools, automobiles and consumer products since the 1970's. Fiberglass insulation can be safely installed if handled properly; any prolonged skin, eye or respiratory contact with fiberglass can cause temporary irritation. During renovation, wear loose fitting clothing and gloves to reduce skin contact, eye glasses or goggles to reduce eye exposure, and N95 disposable respirators (available from any home improvement store) if high levels of fiberglass dust are expected during removal or installation. More information on fiberglass safety precautions and handling recommendations can be found at the American Lung Association website at: www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=35439
or call the American Lung Association in New Jersey at (908) 687-9340.

HS3 – Mold

Mold contamination of building materials is not limited to older homes. Homes of any age can develop mold if moisture from leaky pipes, roofs, foundations, accumulates in the presence of dust, wood, paper or other **cellulose**-containing materials at normal room temperatures or high relative humidity (76 percent) for as little as 48 hours. Standing moisture around building materials such as wallboard, carpets, insulation, wood or other **cellulose** containing materials can cause mold. Many mold spores are known human allergens and produce toxins which may cause irritation or central nervous system effects. Because of vast differences in susceptibility, or if individual health impacts related to elevated mold spore exposure are of concern, consult a trained and experienced occupational/environmental health physician.

In addition to the above, mold damage can occur if flooding from faucets, showers, toilets (above the trap), is not completely dried within 48 hours of the incident. Floods from dirty water sources such as washing machines, dishwashers or sewers may contain high levels of bacteria, viruses, and protozoa which, along with potential mold growth, present additional risks.

If **mold amplification sites** occur, remove the affected material using methods that prevents unintentional dispersal of mold spores and the source of moisture intrusion. The U.S. **Environmental Protection Agency** indicates that small areas of mold growth (less than 10 square feet) can be cleaned or removed by homeowners themselves using precautions to prevent exposure and reduce spread of spores to adjacent areas. When mold contaminated areas exceed 10 square feet, special precautions including erecting containment barriers and the use of specialized **HEPA vacuum** devices should be used by trained professionals. When mold contamination occurs in excess of 100 square feet, professionals need to clean using full containment of the area (see www.epa.gov/mold/moldguide.html).

If mold growth from dirty water floods occurs, take special precautions to prevent skin, eye, oral and inhalation contact, and hire trained professionals to clean up in accordance with U.S. **EPA**: www.epa.gov/iaq/flood/index.html and IICRC S500 guidelines

Homeowners should anticipate that the amount of mold contamination shown on the outside of a piece of drywall or paneling may be less than the amount that will be exposed when wall cavities are opened up. If there is any doubt, consider hiring a professional Certified Industrial Hygienist (CIH) to evaluate the extent of damage before attempting to remove contaminated building materials yourself.

HS4 – Radon

Radon is a radioactive gas that comes from the natural decay of uranium in the ground. It is odorless, tasteless and invisible, and can only be detected through specialized tests. **Radon** enters homes through openings such as cracks and joints in the foundation, sump pits and openings around pipes. The home traps radon inside and it can build up to high levels.

Radon is the second leading cause of lung cancer in the United States, resulting in 15,000 to 22,000 deaths annually. It is the leading cause of lung cancer for non-smokers.

Radon concentrations can vary from house to house. The radon concentration in a home depends on a number of factors, including the amount of uranium present in the soil, the permeability of the soil, the number of openings in the foundation and air pressure differentials. Any home can have a **radon** problem, regardless of whether it is old or new, well sealed or drafty, or with or without a basement.

The New Jersey Department of Environmental Protection recommends radon testing for all homes in New Jersey. If the **radon** concentration is 4 pCi/L or higher, a **radon** mitigation system is recommended. There is no safe level of **radon** since lung cancer can result from very low exposures to **radon**, however, the risk decreases as the **radon** concentration decreases. f the **radon** concentration is less than 4 pCi/L, a mitigation company can be consulted to determine whether the **radon** level can be brought down still further. **Radon** levels have been brought to less than 1 pCi/L in sixty percent of the homes mitigated in New Jersey. Mitigation systems can also help reduce the potential for accumulation of volatile organic compounds that may be released from soil water vapor in areas where ground water contamination is an issue.

Radon test kits are commercially available at most home improvement stores, however, test conditions and locations may make data interpretation difficult or inaccurate. Carefully follow the kit directions to ensure proper use and confidence in the results. The New Jersey Department of Environmental Protection has issued licensing requirements for **radon** testing firms, and has a list of qualified professionals to perform **radon** testing and mitigation, see www.njradon.org.

Appendix

HS1= NUISANCE AND TOXIC DUST CONTROL

Fly ash Properties

www.austinenergy.com/energypercent20Efficiency/Programs/Greenpercent20Building/Sourcebook/flyashConcrete.htm

www.oikos.com/library/betterconcrete/index.html

HS2= HAZARDOUS MATERIALS - LEAD AND ASBESTOS

N.J. Department of Health Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

Agency for Toxic Substances and Disease Registry, New Jersey

www.atsdr.cdc.gov/Asbestos/sites/national_map/fact_sheets/trentonnj.html

N.J. Department of Environmental Protection, Guidelines for Disposal of Asbestos Containing Materials

www.state.NJ.us/dep/dshw/rrtp/Asbestos.htm

U.S. EPA Asbestos Caution Regulations adopted in New Jersey

www.EPA.gov/r02earth/ahera/ahera.htm

N.J. Department of Community Affairs Lead Testing and Abatement

www.state.NJ.us/dca/codes/code_services/xls/clc.shtml

New Jersey (NJ) Department of Health and Senior Services

http://www.state.nj.us/health/

Lead in Paint, Dust, and Soil (USEPA)

http://www.epa.gov/lead/

The Leadsafe NJ Program (NJDCA)

http://www.state.nj.us/dca/dcr/leadsafe/

HS3 = MOLD

USEPA Guide to Mold in Your Home

www.EPA.gov/mold/moldguide.html

USEPA Flood Clean-up Guidelines

www.EPA.gov/iaq/flood/index.html

N.J. Department of Health and Senior Services Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

HS4 = RADON

N.J. Radon Soil Gas Map

www.EPA.gov/radon/zonemap/newjersey.htm

N.J. Department of Environmental Protection Radon tiers by County

www.state.NJ.us/dep//rpp/radon/radonin.htm

N.J. Radon Levels

www.NJradon.info/NJ_counties.html

N.J. Radon Testing Guidelines

www.NJ.gov/dep/rpp/radon/radontes.htm

Green Home Maintenance and Housekeeping

Introduction

Your home is one of the biggest investments of your life. Can 'going green' protect your investment and make it safer, more enjoyable and save you money? Yes.

This guide to Green Home Maintenance and Housekeeping practices will improve the health, comfort and environment for your family, and save you money, most directly by reducing your utility bills. The guide's focus on 'Energy' savings, improvements to 'Indoor Air Quality', effective and efficient 'Household Waste Management' and conserving 'Water' all add measurable benefits to you and high return on your investment. Routine checks and repairs will ensure your home's appearance and proper function. By following these recommendations, you will also prevent more expensive damage from occurring.

Kitchen, Bath & Living Spaces

Kitchen, bath and living spaces comprise the prime areas of your home - with maximum utility, and hence require regular upkeep.

1. Maximize **natural ventilation** and daylight
   - Keep windows (especially kitchen window) open for **natural ventilation** whenever possible
   - Take full advantage of natural daylight
   - Clean and maintain windows and doors to keep them weatherproof and in good working order
   - Use the exhaust fan (vented to the outside) when cooking

2. Use appliances efficiently and effectively
   - If your refrigerator is more than 10 years old, consider replacing it as new technology has dramatically improved its energy efficiency
   - Clean the refrigerator's condenser coils twice a year
   - Clean the cooking range hood filter
   - Unplug appliances (like toaster, coffeemakers, etc..) when not in use.
   - Use microwave for quick food warming
   - Wash only full loads of dishes to save energy and water
   - Avoid the need for pre-rinse cycles by carefully scraping dishes before adding them to the load
   - Wash only full loads of laundry to save energy and water
   - Use cold water detergents to reduce the need for hot water laundry
   - Use a compost container instead of the garbage disposal to save energy and improve your garden soil

3. Minimize and dispose of waste appropriately - Reduce, Reuse, and Recycle
   - Provide easy access to and sufficient room for recyclables storage in the kitchen
   - Switch from disposable products to reusable products: food and beverage containers, cups, plates, writing pens, razors, towels, shopping bags, batteries, etc.
   - Instead of products that are packaged for single use, buy items in bulk and transfer to your own reusable containers
   - Buy recycled: resale shops offer good kitchen equipment at a fraction of retail costs
   - Sell or donate used goods instead of throwing them out
   - Recycle paper, yard trimmings, glass, aluminum, other metals, batteries, used motor oil, and plastics
   - Use canvas shopping bags
   - Use tap water in a reusable container instead of bottled water

4. Prevent Water-related Problems
   - Use bathroom fans while showering and allow them to run for 20 to 30 minutes after showering (installing a timer will make this easier)
   - Fix leaky toilets and repair dripping faucets
   - Check traps and drains under sinks, tubs, showers for leaks
   - Keep a check on bathtub surrounds to avoid mold problems

5. Use water wisely
   - Shut off water when brushing or shaving
   - Take short showers instead of baths
   - Dispose of tissues and other similar waste in the trash rather than flushing unnecessarily
   - Use a broom instead of a hose to clean your driveway or sidewalk

6. Keep your family and your home free from pollutants and pests
   - Organic fertilizers and pest control will cut down on the pollutants tracked into your home
   - Keep an entry mat and encourage everyone to remove their shoes at the doorway
   - Mount **carbon monoxide** monitors in living spaces
   - Do not allow smoking in homes as it can be harmful for the children and other occupants
   - Use non-toxic, biodegradable cleaners; vinegar and baking soda are among the most common (and cheapest!) recommended substitutes – and plain soap is still the cheapest effective disinfectant
   - Minimize the use of chemical formulations by cleaning surfaces and floors with soap and water along with additives such as lemons, vinegar and baking soda
   - Do not pour toxic cleaning products down the drain
   - Clean clogged drains with boiling water followed by baking soda and vinegar
   - Use a snake or a plunger for difficult clogs instead of toxic drain cleaners
   - Keep the kitchen counters, floor surfaces and stovetops clean to control pests (rodents, termites, roaches, etc.)
   - Keep exterior garbage (and kitchen compost) in tightly sealed containers
   - Handle pesticides and other products containing chemicals outside the house and apply only in recommended quantities
   - When using any strong cleaning products, or painting, keep windows open or a fan going to minimize inhaling unhealthy fumes
   - Never idle the car inside the garage
   - Use plants to improve indoor air quality

Detail window sills in wet areas HS3 [IDP26]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Windows near wet areas (such as in showers or near bathtubs) need to be properly detailed to avoid rot, mold, and mildew, and prevent air leakage. When installing a window in a wet area, select a window frame that is tolerant to high levels of moisture. Use a sill that is impermeable to water and seal as if it were an outdoor sill. Use moisture-resistant or impermeable materials such as marble or other durable material. This helps conserve resources by improving the durability of window frames, sill, and sheetrock and saving long-term costs for replacements.

Seal and flash windows/skylights HS1 HS3 [IDP27]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Air and water leakage problems commonly found around windows and skylights can cause structural damage and indoor air quality problems. According to the Partnership for Advancing Housing Technology (PATH), most leakage problems stem from improper or insufficient **flashing** details or the absence of **flashing**. By properly sealing and **flashing** around windows, doors and skylights one can reduce heat loss resulting in lower energy bills and prevent water damage which could lead to costly replacement of drywall and framing.

Upgrade or replace existing windows HS2 [EA56/59]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Determining whether the home's windows need to be updated or replaced starts with a **Home Performance Audit** (see strategy IDP2/EA51-54), which will reveal window leaks. Visual inspection may also reveal window problems. Are any of the windows cracked? Do they open to allow fresh air to enter? Are there any windows without **storm windows**?

Upgrade or replace **single-pane** with **double-pane windows** with low-E or spectrally-selective glass to save 10 to 25 percent per year on heating.[1] To help offset the up-front cost, check for incentives from federal tax credits and through state and local utilities. If window replacement is not in the budget and old **single-pane windows** are in good condition, install **storm windows** in the winter months. Upgrading the sash alone can also save money. **Storm windows** can reduce heat loss through the windows by 25 percent to 50 percent.[2] **Storm windows** also protect against impacts from rain, ice and snow. Bear in mind that good windows installed badly will not achieve expected savings, so see the link in the resources section for tips on "How to Hire an Expert Installer." Finally, windows that are properly sealed and caulked prevent leakage of air in and out of the house and provide a protective barrier from water and noise. [For more information, see Weatherization and Energy: Weatherstrip doors and windows EA58.]

Tips [EA56/59]

1) Add shrink-wrap plastic sheeting on windows that are rarely opened in the winter.

2) Install tight-fitting, insulating window shades on windows that feel drafty after **weatherizing**.

3) In the winter, close curtains and shades at night; open them during the day. In the summer, close curtains on south- and west-facing windows during the day.

Incentive [EA56/59

By installing eligible windows and skylights, homeowners can receive a tax credit of 10 percent of the cost up to $200. Installation costs are not included. The maximum amount of homeowner credit for all improvements combined is $500 during the three-year period (2006, 2007, and 2009) of the tax credit.

Building Age [EA56/59]

A historic wood window, properly maintained and fitted with a storm window, can be just as energy-efficient as a new window.

For more tips on green historic windows, see www.preservationnation.org/issues/sustainability/additional-resources/July2008WindowsTipSheet.pdf

Caution [EA56/59]

Be careful of lead-based paints and enamels on older windows, trims, and **sashes**.

Incentive [EA57]

Rebates and Tax Credits for Windows, Doors, and Skylights: www.energystar.gov/index.cfm?c=windows_doors.pr_tax-credits

Upgrade existing exterior door [EA57]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

An exterior door that is old, improperly installed, or not well sealed can contribute significantly to energy losses in a home. If the home has older doors or if installing a new door can be included as part of a larger home improvement project, replacing them will result in lower heating and cooling costs. Adding a storm door can be a good investment if a home's existing door is old but still in good condition, however, adding a storm door to a newer, insulated door is not generally worth the expense since it won't save much more energy.[3] When selecting a door for energy efficiency, consider its **energy performance rating** and look for the **Energy Star®** and **National Fenestration Rating Council** Label. Check for federal tax credits and state and local incentives for qualifying doors.

Provide shading of skylights as needed [EA61]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

Rooftop skylights, especially when facing south or west, cause significant household heat gain. Some skylights have built-in blinds mounted between the panes of glass that open and close to control heat gain. Skylights with **electrochromic glazing** to allow users to tint the glass with a push of a button. These are expensive, however, and while some exterior shading options are effective, they are not readily available. Translucent panel skylight systems are an alternative that provides optimal daylighting without glare that minimizes heat transfer. The best option is to install skylights only on north or east facing roofs.

Tips [EA65]

Turn ceiling fans off when rooms are unoccupied.

Open both sections of double-hung windows to allow cool air in the lower window and warmer air to escape upper windows.

Consider a solar powered attic or **whole house fan** for additional energy savings.

Isolate attached garages HS1 [IEQ165]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

Rooms attached to a garage often suffer from poor indoor air quality and air leakage. For health, safety and energy efficiency reasons, it is important that air and thermal barriers be complete and continuous between these two spaces. Installing an exhaust fan or vent in the garage can also help in removing fumes from cars and chemicals stored in the garage.

NJ Bio-Region [EA65]

Shore locations can save cooling costs by capturing natural shore breezes from ocean-facing windows.

Use ceiling fans for natural ventilation [EA65]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Use ceiling fans in conjunction with an air conditioning system in occupied rooms; people can tolerate higher temperatures when air is in motion. This reduces air conditioning use, saving money

Building Age [EA65]

Older homes pose challenges to designing optimal mechanical cooling, so consider ventilation options before installing air conditioning. Many older homes have cross ventilation systems built into their original design, as they were built before air conditioning became commonplace.

and electricity. In the summer, run ceiling fans in a counterclockwise motion. Ceiling fans can be used in the winter in a clockwise motion at low speeds to bring warm air back down into the occupied space.

Also consider a whole house fan to avoid air conditioner usage and expense. Generally a whole house fan is used at night and turned off during the day. It moves cooler nighttime air into the house through open windows and exhausts warm air through the attic.

Another way to cool the home is with **transoms** in window and door designs. Designing for convection directs cool air to enter the home on the lower floors (such as through the basement) and expels warm air through upstairs windows.

Strategic location of plants and landscaping can cool (and clean) the air before it enters the home. Finally, **awnings** and blinds provide additional passive cooling options.

Install a programmable thermostat [EA67]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A		DIFFICULTY LEVEL: T	

Programmable thermostats save energy and money by allowing homeowners to set temperatures based on occupancy and to schedule setting changes. This uses heating and cooling only when needed. **Programmable thermostats** are especially useful if the house is empty during the work week and only fully occupied on weekends. Pre-programming and proper use of a programmable thermostat saves energy costs by minimizing heating or cooling of an empty house. Save up to 2 percent on one's energy bill per 8-hour period by lowering the temperature in the winter from 2-5 degrees while no one is home or when occupants are asleep.[4]

Make sure ductwork is clean HS1 HS3 [EA71]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST: $$$	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL: TTT	

Duct cleaning refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, **diffusers**, **heat exchangers**, **heating and cooling coils**, **drain pans**, fan motor, fan housing, and the air handling unit. While clean ducts help maintain healthy indoor air quality, unless done properly, cleaning ducts can cause more indoor air problems.

If a visual inspect reveals infestation, mold or extreme debris problems, duct cleaning may be necessary. If so, be sure the service provider cleans all components of the system to avoid any recontamination that may require more serious cleaning needs. Be sure the service provider is qualified by the **National Air Duct Cleaners Association (NADCA)**. A certified service provider uses specialized tools to dislodge dirt and other debris in ducts and vacuums them out with a high-powered vacuum cleaner. Different types of ducts require different cleaning methods; sheet metal ducts with external insulation are the easiest to clean. A **Duct Blaster Test** should also be performed when cleaning ducts to gauge the tightness of the ductwork. Finally, be sure to cover duct registers and openings during renovation or remodeling.

Caution [EA65]

Fresh air is essential for indoor air quality and combustion safety, but energy-efficient homes may minimize air flows including fresh air. **Energy Star®** homes require a controlled mechanical vent to assure air exchanges such as a programmable bathroom fan.

Avoiding mold build-up in high humidity areas of the house may require mechanical cooling with dehumidifying capabilities.

Tips [EA67]

Before purchasing, check the compatibility of the thermostat with the respective **HVAC** system.

Make sure the thermostat selected operates via battery versus obtaining some power from the 24V AC **HVAC** lines.

Tips [EA71]

Cover air ducts and vents during any renovation. This can be done easily with duct tape and plastic and helps to avoid having to clean the ducts prematurely.

Caution [EA71]

Cleaning ducts is best done by a trained professional because if done improperly it can lead to the release of harmful contaminants and particles into the air.

Install effective ventilation HS1 [IEQ166-167/172]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$$$
RESOURCE CONSERVATION: N/A		AIR QUALITY:	DIFFICULTY LEVEL:	TTT

To maintain healthy indoor air quality requires proper ventilation in bathrooms, kitchens, garages and utility rooms. Kitchen exhaust hoods are an important fire safety requirement and generally aid in improving ventilation. In bathrooms and other moist areas ventilation is key to preventing mold and mildew. Installing a fan appropriate to the size of the bathroom can help keep moisture levels down. Increase efficiency by reducing the number of sharp turns in the ductwork. For quiet bathroom and kitchen fans, look for units that produce less than 1.5 **sones** while in use.

Offices and hobby rooms with large amounts of electronics also need extra air conditioning to handle extra heat created. Garages and storage rooms where hazardous materials are stored will require a higher rate of ventilation than other rooms in the house. If the entire house has a ventilation system, increase the rate in these specific rooms. If no complete ventilation system is installed, provide an exhaust fan in each room where necessary. Installing ductwork and exhaust fans can be complicated; using a licensed contractor is recommended.

Provide fresh air in ventilation system HS4 [IEQ171]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TTT

When closing leaks and tightening a building's envelope, mechanical ventilation becomes extremely important. Bringing fresh air into the spaces where people spend the most time in the home is important to maintain healthy indoor air quality. Relying on open windows for ventilation may not be enough during fall and spring, when pressure differences cannot properly ventilate the home. Also for those with allergy problems, open windows can cause respiratory problems and possibly complicate current health problems. Include a fresh intake on **HVAC** systems or install a dedicated ventilation system if necessary. Use a **heat- recovery ventilator (HRV)** that uses excess heat from the home to efficiently heat incoming fresh air. Installing **HVAC** and ventilation systems requires a licensed professional.

Vent all combustion-based equipment HS1 [IEQ168]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$
RESOURCE CONSERVATION: N/A		AIR QUALITY:	DIFFICULTY LEVEL:	TT

Anytime **combustion equipment** is introduced into the home, it must be properly ventilated. Failing to properly vent **combustion equipment**, can introduce toxic gases into the house. This is most often caused by **backdrafting**, where unstable pressure in the equipment that relies on a natural draft to invert, instead forces the gases back into the building. To avoid **backdrafting**, choose equipment with **sealed combustion** or **power-vented combustion**. Most of the newer high-efficiency models already incorporate these features into their design. Wherever this equipment is installed, be sure to install a **carbon monoxide** detector to warn occupants if gas leaks into the building. Avoid unvented **combustion equipment** in the home because they release **carbon monoxide** and other toxic gases and add water vapor into the air, leading to potential mold and mildew problems.

NJ Bio-Region [IEQ171]

Urban areas of New Jersey may need to have better air ventilation and filtration.

Caution [IEQ171]

Improper pressure balancing can cause **radon** from the soil to leak into the house. Follow the new **ANSI/ASHRAE** Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Building.

Building Age [IEQ168]

In older homes, existing boilers and furnaces may not have a built-in power ventilation or **sealed combustion**. In these cases consider installing a fresh air intake or exhaust fan near the equipment.

Caution [IEQ168]

Improper venting of **combustion equipment** can lead to poor indoor air quality, releasing **carbon monoxide** and other contaminants into the air. Install a **carbon monoxide** detector where necessary.

Install automatic shut-off bathroom fans HS3 [IEQ167]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

When installing a bathroom fan, find one that is quiet and of the appropriate size for the space. Installing a timer on a bathroom fan helps reduce energy consumption and improves indoor air quality. After showering, moist warm air in the bathroom contributes to mold and mildew growth. Installing an automatic timer vents the room and saves energy. Some bathroom fans come with a moisture sensor and turn off automatically once the room has been properly vented. Look for **Energy Star**® certified fans.

In general, exhaust fans should stay on for one hour after a bath or shower to effectively remove excess moisture from the room. A fan equipped with a timer ensures the fan remains on long enough to exhaust moisture completely. An electronic timer is quieter than a mechanical timer and offers a wide range of settings. Choose a timer setting with easy-to-understand instructions and be certain the timer itself is easy to operate. A delayed fan shut-off will keep the fan running for at least one hour after the homeowner leaves the room. Another option includes a motion sensor that activates the fan when anyone enters the bathroom.

Tips [IEQ167]

Fan loudness is measured in **sones.** The best fans have sound ratings of 0.5 **sones** or less. Avoid units that produce 4 **sones** or more.

Caution [IEQ167]

While most molds do not harm healthy people, people with allergies or asthma may be more sensitive.

Provide daylighting [EA83]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A		DIFFICULTY LEVEL:	

Sunlight is a natural way to reduce energy use during the daytime hours. Homes that only require artificial lighting at night and on darker days save more electricity and are more aesthetically pleasing than ones that do not.

Windows and skylights are obvious sources of daylight, but balance daylight access with appropriate **glazing** and shading techniques. Poorly designed window or skylight layouts can increase summer **cooling loads** significantly. **Awnings**, **louvers**, and shutters can block direct sunlight and allow indirect sunlight into the building. Conversely, a well-designed scheme reduces **heating loads** significantly in the colder months. In the northern hemisphere, south-facing windows receive the most sunlight over the course of the day. For these windows, properly sized overhangs will shade the window from direct summer heat but will allow the lower winter sunlight to filter through.

An alternative to window skylights is **solar tubes**. The flexible cylinders of the **solar tubes** draw sunlight from the roof into a ceiling fixture resembling a standard lighting fixture. They are useful in smaller interior rooms without space for a traditional skylight, such as a bathroom. Translucent panel skylight systems are another means of allowing in sunlight without producing glare and minimizing heat transfer.

Provide appropriate lighting [EA84]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A		DIFFICULTY LEVEL:	

Lighting consumes almost 15 percent of a household's electricity use.[5] Provide an appropriate mix of color-correct **ambient** and task lighting to improve both the quality and quantity of lighting used in the home.

Tips [EA84]

The U.S. Department of Energy offers the following energy-efficient lighting design tips:

- Remember that more light is not necessarily better. Human visual performance depends on light quality as well as quantity.
- Match the amount and quality of light to the performed function.
- Install **task lights**, such as desk lamps, where needed and reduce **ambient light** elsewhere.
- Use energy-efficient lighting components (i.e., **CFLs**, **LEDs**), controls, and systems.
- Maximize the use of daylighting.

Caution [EA84]

Fluorescent bulbs and lamps are considered hazardous waste and should be disposed of properly. If a bulb breaks, avoid direct contact with skin. Burned out or broken **fluorescent lamps** should be brought to a facility that recycles them. Check with your County's Solid Waste and Recycling Department or enter your zip code at www.Earth911.com to find out where you can recycle these materials.

Tips [EA85]

Not all **CFLs** are dimmable, so be sure to check before purchasing for a dimmable fixture.

Unplug **LED** lit appliances when not in use to further reduce energy costs.

Caution [EA85]

The **CFLs** contain traces of mercury; cleaning up a broken **CFL** must be done carefully, and check with your municipality for recycling instructions when bulbs wear out.

Tips [MR126]

Recycling opportunities for dry-wall cut-off waste are generally quite limited; on-site recycling of ground, unpainted **gypsum board** as a soil amendment is permissible in many locations.

Two ways of determining which lighting is appropriate for a particular use are its **color temperature** and its **Color Rendering Index (CRI)**.

Color temperature defines the color and warmness or coolness of a light source. **Color temperature** is measured in degrees **Kelvin (K)**. High **Kelvin** temperatures (3600–5500 **K**) are considered "cool" and low color temperatures (2700–3000 **K**) are considered "warm." Task lighting calls for cool light that produces a higher contrast than warm light and is better for visual tasks. Warm light is recommended for living spaces. A **color temperature** of 2700–3600 **K** is generally recommended for most indoor general and task lighting applications.

The **Color Rendering Index (CRI)** is a 1-100 scale that measures how colors appear under different light sources. A light source with a **CRI** of 80 or higher is considered acceptable for most indoor residential applications.

Install energy-efficient lighting [EA85]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Traditional incandescent bulbs will be phased out by 2012. The technological improvements in **compact fluorescent lighting (CFLs)** over the past decade have made for a smooth transition. **CFLs** are inexpensive, last ten times as long as traditional bulbs, and use a fraction of the electricity. They also fit into standard light fixtures, allowing for their widespread use with minimal up-front cost.

Light-emitting diodes (LEDs), currently used in a variety of applications, potentially could find their way into more traditional lighting applications. Highly efficient, durable, and non-toxic, **LEDs** currently cost too much to warrant their widespread use. However, rapid advances in **LED** technology continue to push **LED** lighting to more practical uses.

Wherever possible, replace incandescent bulbs with greener alternatives. It is a simple and affordable way to significantly reduce home energy use.

Provide controllable interior shading [IEQ187]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Rooms used frequently should have shades to reduce heat gain and minimize glare from natural light. Venetian or vertical blinds are effective, easy to install, and efficient means to control light entering the building. Manual and motorized screen shades are another means of interior shading. Accordion-shaped blinds effectively create an added layer of air preventing further heat loss Window quilts can be used at night to prevent warm air from escaping.

Install eco-friendly interior sheathing HS3 [MR126]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Paper-faced drywall is the most common and least expensive finishing for interior walls. It is easy to work with and its paper composition is typically recycled from 100 percent **post-consumer** waste. However, paper-faced drywall is highly susceptible to moisture damage and mold growth; do not use it in moist areas of the home.

Fiberglass-faced drywall is a paperless **gypsum** panel often used for exterior **sheathing** and interior walls in mold-prone areas. It contains no **cellulose**, which supports mold growth. Fiberglass-faced drywall, however, cannot be recycled and because of the fiberglass it cannot be ground for use as a soil amendment.

Select eco-friendly interior doors [MR127]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Look for recycled interior doors from salvage yards or reuse vendors or choose new doors that are **formaldehyde**-free or have **urea-formaldehyde-free** wood components. Doors that are **FSC-certified** ensure the wood was **sustainably harvested**. Using recycled products or **sustainably harvested** wood saves **virgin materials** from extraction and helps the environment.

Choose eco-friendly paints, sheens, and finishes [IEQ185/MR130/131]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

Traditional paints, finishes and coatings contain a variety of hazardous chemicals including **volatile organic compounds** (**VOC**s) which can be harmful to human health. Choosing zero- or low-**VOC** paints significantly improves indoor air quality. These products are readily available and come in a wide variety of colors and finishes. Also, choosing appropriate sheens can improve the durability of wall and other finished surfaces. For places that will be washed frequently use sheens with a high "scrubbability" rating.

To further reduce chemicals used in paints, manufacturers have recently introduced products made almost exclusively from plant oils and minerals. When possible, consider using natural paints, varnishes, finishes, and plasters instead of conventional petroleum-based products to help improve indoor air quality. The increasing availability of natural products has helped make them more competitively priced.

Consider tile with recycled content [MR132]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

When choosing tile and trim pieces, look for products that contain **recycled content** to help conserve natural resources. Utilizing waste from other products reduces the need for **virgin materials**. Recycled products can be made from glass and **pre-consumer** industrial waste.

NJ Bio-Region [MR126]

In high humidity areas request products that are resistant to moisture.

Caution [MR126]

Do not recycle or use fiberglass drywall for soil amendment.

Caution [MR127]

Salvaged or reused doors may have lead-based paint or traces of **formaldehyde** (used for drying).

Caution [IEQ185]

People with sensitivities to **terpenes** and other chemicals may still be affected by natural finishes. Follow the manufacturer's instructions to properly apply any paint products.

Tips [MR129/IEQ186]

An easy and inexpensive way to avoid mold and mildew growth in walls, moist areas and basements is to use **porous** paints or clay treatments. Preventing moisture build up improves the overall health of the home.

Select eco-friendly wall coverings HS1 [MR129/IEQ186]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A		INITIAL COST: $$	
RESOURCE CONSERVATION: N/A	AIR QUALITY:		DIFFICULTY LEVEL:	

When it is time to update wall covers, look for low-**VOC**-emitting products. Traditional wallpaper is coated with **PVC** and **plasticizers** that over time release chemicals found to interrupt the **endocrine system**. These impermeable plastic coatings also keep moisture in the walls which can lead to mildew and mold. Research linking the production and **off-gassing** to potential health effects spurred the introduction of many new low-**VOC** and natural fiber products. These products help reduce airborne chemicals and protect indoor air quality. They also prevent moisture retention behind walls. Natural and low-**VOC** products are slightly more expensive than traditional products and may need special care when installing. Follow any manufacturing guidelines that may come with the product.

Caution [MR183]

Moisture resistant "green board" that is coated with wax and still uses paper is not recommended.

Use non-paper-faced gypsum board in moist areas HS3 [IEQ183]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A		INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Minimize mold growth and maintain high indoor air quality and durability by using better wall and ceiling finishes. **Gypsum board (drywall)** is a universally used building product in the U.S. available in several varieties that resist mold growth. The most reliable is non-paper-faced **gypsum board**. Paper components absorb moisture because paper is a food source for mold. Non-paper-faced **gypsum**, originally developed for exterior **sheathing**, is useful in moist areas such as basements and bathrooms.

In damp areas, **cement board**, **mortar**, or non-paper faced **gypsum** can be used safely. Paper-faced **gypsum board** should never be used as backer for tub or shower surrounds where ceramic tile, marble, or any material with joints or grout lines is used as the finish. While more expensive to purchase than conventional paper-faced products, there are long-term savings in preventing damage from mold growth. Mold resistant paper faced board should not be used in damp areas. It is important to seek comparable data to assess performance of other mold resistant claims by manufacturers, as little independent analysis is available.

Use low-VOC construction products [IEQ187]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A		INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY:		DIFFICULTY LEVEL:	

Like paints and coating products, construction adhesives, grout, caulking, and sealants can have high VOC content. Low-**VOC** products are becoming readily available and are just as durable as conventional products. Avoiding products with **VOCs** improves indoor air quality.

Avoid carpeting in moist areas HS3 [IEQ179]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Carpeting may provide comfort, but it produces airborne dust and releases particulates from both the carpet and the padding. Avoid carpet in moist rooms or "high-spill areas" to maintain healthy indoor air quality. Carpets are difficult to clean, take time to dry properly, and can retain dust and dirt tracked in from the outdoors. Older carpet padding can deteriorate over time and may release **flame retardant** chemicals into the air.

Reuse existing flooring and subflooring HS3 [MR133]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

A great way to reduce the use of natural resources is to reuse old flooring. Often homes are made with structurally sound hardwoods or concrete. Refinishing these existing floors reduces the need to harvest new materials and reduces exposure to chemical **off-gassing** from new products. There are many new low- or no-**VOC** products for refinishing flooring.

Choose hard, low-formaldehyde floors [IEQ180/MR134]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Hard surface and low-**formaldehyde** flooring improves indoor air quality significantly. Hard surface floors do not hold dust and particles making them easier to keep clean. Also, by using materials such as concrete, a homeowner reduces the amount of natural resources used for flooring. If choosing to use new wood, look for **FSC-certified wood** to ensure sustainable harvesting practices. Many floor tile now use recycled materials. Always use low- or no-**VOC** adhesives, grout, and sealants when installing flooring.

Use reclaimed or renewable materials [MR135-136]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Choose wood flooring responsibly to preserve natural resources. **Reclaimed** or **rapidly renewable materials** (like bamboo, cork or linoleum) significantly reduce the pressure on natural forests. If a homeowner decides to buy new wood flooring, choose **FSC-certified wood** to ensure the manufacturers followed sustainable harvesting practices. Other products made from cork, wheat, and recycled waste paper offer environmentally benign options. As with other finishing products, always look for low-**formaldehyde** and low-**VOC** floor finishing products to maintain a healthy indoor environment.

Tips [IEQ179]

Using area rugs instead of wall-to-wall carpeting can help to create comfort in the home while also being easier to remove and clean to prevent the build-up of pollutants in the air.

Caution [IEQ179]

Older carpet cushions deteriorate over time and release harmful chemicals into the air.

Building Age [MR133]

Make sure flooring is structurally sound before reusing it in older homes.

Caution [MR133]

Beware of the possibility of lead based paints and **asbestos** in existing wood floors. Look at **HUD** and **EPA** guidelines for dealing with **asbestos** and lead-based products.

Refinish floors with eco-friendly products HS1 [MR137]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

When remodeling, reusing old wood flooring both conserves resources and preserves the character that older hardwoods gather over time. However, when looking to refinish these floors, be advised that older floors may have lead-based paint on them and should be tested. When selecting finishes, look for zero- or low-**VOC** finishes or a finish derived from a natural product like plant oils (i.e. , linseed) or beeswax. This helps maintain the home's indoor air quality. Some products may be hard to find so leave time to special order. Whenever possible, avoid products with **heavy metals** or harsh **solvents**. If a container has any "danger" or "warning" symbols, try and choose a different less toxic alternative. Beware of "organic" labels with finishes. Organic food is a good thing, but in terms of finishes, 'organic' could mean they are created from petrochemicals and probably contain **solvents**. Always have a constant flow of fresh air in areas when applying a finish and wear a mask for added protection. Overall, zero- or low-**VOC** products may cost more initially, but they pay off through reduced health concerns.

Select eco-friendly carpeting HS3 [IEQ182/MR129]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Wall-to-wall carpeting and large-area carpets can affect air quality in the home. The carpets and pads are difficult to clean and dry properly (creating an environment for mold and mildew) and hold on to dust and other particles. Small area rugs that accent hard floors are easier to remove and clean. Furthermore, new carpets and rugs may contain **VOCs** that **off-gas** and are unhealthy to breathe.

To reduce environmental and health impacts, look for carpets made from natural fibers with little or no chemical treatment. Also, purchase carpets with natural-fiber backing attached with less-toxic adhesives. Recommendations include organic cotton, hemp, **sisal**, seagrass, **jute**, or wool. Buying carpet "tiles" instead of a broadloom piece, as individual tiles can be replaced easily. Finding carpet made with low-**VOC** adhesives that meets Carpet and Rug Institute indoor-air quality standards. Use tacks instead of adhesive and look for **recycled content** or **reclaimed** carpet.

Install water-saving fixtures [WE42-44]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Kitchens and bathrooms continue to be a source of significant daily water waste. Replacing existing toilets, faucets, and showerheads can reduce home water and save money. It takes energy to deliver, heat and treat water, so by using less water a homeowner decreases energy use in the home. By installing a **WaterSense Labeled** High Efficiency Toilet that uses 1.28 gallons or less per flush, a homeowner can save a large amount of water and significantly reduce a home's water utility bill. Dual flush toilets have two buttons, a light flush that uses 0.9 gallons of water and a heavy flush that uses 1.6 gallons of water. When looking to replace faucets, look for fixtures that have a flow rate of 2.0 to 1.5. For replacing showerheads look for showerheads that uses less than 2.5 gpm.

Tips [WE42-44]

Leaks are one of the biggest causes of water waste in a home. When looking to reduce water usage, first check and repair any leaks. To check for a leak, turn off all water using appliances off in your home. Then go to the water meter and observe the location of the dial and see if it is moving. If it is moving then there is a leak. Also check the position of the dial and return in 10 minutes; if it has moved, then there is a slow leak.

Caution [WE42-44]

When older shower heads are replaced with low flow models, the valves must also be changed in accordance with the model. This will ensure that the shower head functions properly and avoids scalding.

Install water filtration system [IEQ175-176]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Home water filtration systems can remove some contaminants from water and improve taste. This is an inexpensive alternative to bottled water. There are several different systems available for under the sink filtration, which include **reverse osmosis**, **ultraviolet treatment**, and (most common and least expensive) are the **carbon or specialized media** filters. Also it is recommended to install filters on showerheads to remove chlorine from the water for bathing.

Include a plumbing access panel HS1 [MR123]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

When putting in new piping, install an access panel for easy access to make repairs or upgrades. This allows for easy inspection and reduces the amount of materials to be removed and discarded in order to make an otherwise simple repair. Install the access panel at a location that is most convenient to areas that could need maintenance, like pipes going toward a shower or bath. Proper sealing of the panel avoids spaces where air and moisture can leak into the house.

Choose a high-efficiency water heater [EA79]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Hot water heaters are one of the biggest energy consumers in the house (between 14-25 percent of total energy usage).[6] By replacing or upgrading an existing hot water heater, a homeowner can reduce significantly the amount of energy consumed on a yearly basis. Electric hot water heaters are not recommended for home use because of high energy demand. Gas-fired heaters with an electric ignition are more efficient than those that use a pilot light. The efficiency of a hot water heater is also determined by the efficiency of the **heat exchangers**, the insulation value of the tank, and the configuration of the burner. Tankless water heaters are becoming increasingly popular. These systems heat water when it is needed and eliminate the wasted energy during the storage of the hot water. However, tankless systems are not for every household. If the house uses hot water frequently in short amounts (like washing hands a dozen times a day) than the system will never reach its peak efficiency and could be wasting energy. Evaluate the home's needs and speak to a professional before buying one of these systems. When looking at gas-fired systems, be sure to choose a closed **combustion** system to avoid releasing toxic fumes into the house. Also, always be sure that the area around is properly ventilated.

Tips [EA79]

For a small investment of around $20 you can buy an insulating kit for your hot water heater that pays for itself in only a few months. Insulating your water heater you increase its efficiency and decreases heat loss.

Incentive [EA79]

For efficient water heaters New Jersey BPU offers a $25 rebate:

www.njcleanenergy.com/residential/programs/warmadvantage/warmadvantage

For tankless water heaters homeowners can receive up to a $300 tax credit:

www.pseg.com/customer/home/install/waterheaters.jsp

Tips [MR122]

Insulating piping can help reduce heat losses, make a system more efficient and limit wasted water while waiting for hot water to reach the faucet.

Consider eco-friendly piping material [MR122]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

There are several common household piping options: cast iron, copper, **chlorinated polyvinyl chloride (CPVC)**, **PEX (cross-linked polyethylene)**, **vitrified clay**, and **HDPE (High Density Polyethylene)**. Heavy cast iron pipes are energy intensive to mine and manufacture, and can corrode over time. They are, however, good in situations with large temperature fluctuations. Mining ore for copper pipes damages the environment and the manufacture of the pipes are energy intensive. There is some **recycled content** in newer copper piping, but most is still **virgin material**. Copper piping has high heat conductivity, so they need insulation to be efficient. **PEX** pipes are composed of a plastic made from carbon and hydrogen so environmentally-speaking it is relatively clean. **Vitrified clay pipes** have the lowest thermal expansion and therefore are good in places with high temperature fluctuations. They are very durable and resist corrosion from chemical reactions, however, like iron, they are very heavy. Variety in the sizes for new piping systems maximize efficiency by better matching the size to the use. Copper pipes may need insulation, but **PEX**, since it can be matched to specific use, is more efficient and may not need any insulation. **CPVC** pipe is not recommended, for although it does not need much insulation and is very inexpensive, the environmental costs of production are very high.

Reconfigure plumbing for efficiency HS2 [EA77]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Advancements in piping materials and plumbing systems cut installation and material costs, conserve water, and save energy. **Cross-linked polyethylene (PEX)** piping material has quickly earned a reputation as a durable replacement for copper because it is: [7]

- Flexible – allowing for fewer joints and an easier (and quicker) installation
- Durable - capable of withstanding extreme temperatures and highly resistant to chemicals
- Consumer friendly – quieter than traditional piping materials and offered in color-coded **PEX** tubing for simple identification of cold and hot water lines
- Energy-efficient – reduces heat loss from water in the pipe because it is a better thermal insulator than copper
- Water efficient – right-sizing capability allows for quicker hot water delivery

PEX also lends itself to **home run** or parallel pipe configurations in which hot and cold pipes originate at a manifold and service individual fixtures with dedicated supply lines. **Home-Run** systems can be installed more quickly (because of flexible piping) than more rigid and conventional "tree" type plumbing systems. The dedicated supply lines from the manifold to the fixture – particularly in the hot water supply lines – are often smaller in diameter for a **home-run** system, so less water goes down the drain while waiting for hot water at the fixture. Finally, **home-run** systems operate much like an electrical system breaker box, allowing homeowners to easily turn off the water for repairs or maintenance.

Install instantaneous hot water heater

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	N/A	AIR QUALITY:	N/A	DIFFICULTY LEVEL:

Installing an instantaneous or on-demand hot water heater greatly increases efficiency by eliminating the wasted heat during the storage of hot water. These devices save 8-14 percent compared to a conventional heater with a tank. When looking to install one of these hot water heaters, evaluate the home's water use first. If hot water use in the home is high, then this will not be the right system. If hot water use is relatively centralized, these systems can save on energy, materials for piping, and water wasted in the heating process. For these systems to run properly, they should be used with highly efficient fixtures. They do not provide the high flow rate of tank systems and provide lower water pressure than traditional tank systems. Use a professional to install these systems as they require specialized knowledge and some homes may not be equipped to meet the high voltage demanded by the electric version of these systems.

Select a high-efficiency clothes washer [EA92]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	N/A	DIFFICULTY LEVEL:

Clothes washers are responsible for about 22 percent of household water consumption or about 13,000 gallons of water each year.[8] Today's energy-efficient washers reduce water use and energy bills.

Replace a clothes washer when 1) a repair will cost more than half the price of a comparably equipped new appliance, and 2) a washer is more than seven years old. If you are in the market for a new clothes washer consider the following:[9]

- In selecting a washer load capacity, consider the household's largest routine load – larger capacity means fewer loads, saving time and energy
- Front-loaders use less energy and water, are usually gentler on clothes, and have faster spin speeds that drain more water out of laundry than regular top-loaders do
- Look for washers with the **Energy Star® label**

Front-loading washers are more expensive than top-loading washers, but in New Jersey, rebates are available for units that meet Tier 3 **Energy Star®** standards which require a **Modified Energy Factor (MEF)** of 2.2 or higher and a maximum **Water Factor (WF)** of 4.4. There is no certification for dryers, but a unit with a moisture sensor turns off automatically when clothes are dry saves money and energy.

Select an energy-efficient refrigerator [EA93]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	N/A	INITIAL COST: $$
RESOURCE CONSERVATION:		AIR QUALITY:	N/A	DIFFICULTY LEVEL:

Refrigerators consume more electricity than any major kitchen appliance. Energy efficient refrigerators like **Energy Star®** models are about 40 percent more efficient than refrigerators built before 2001, and 50 percent more efficient than those built before 1993. If an existing refrigerator is more than 10 years old, consider upgrading to a refrigerator that meets or exceed **Energy Star®** standards as a new refrigerator with an **Energy Star®** label uses at least 20 percent less energy than one required by current federal standards.

Tips [EA92]

By using the cold-water option on a washer, one can save on energy bills by eliminating the energy needed to heat the water. Season and weather permitting, hang clothes to dry; most of the energy consumed by a single load of laundry is from drying, so by using the sun and fresh air one can reduce their energy consumption.

Incentive [EA92]

Check the New Jersey's Clean Energy Program for rebates on teligible **Energy Star®** qualified clothes washers.

www.njcleanenergy.com/misc/residential/clothes-washers-rebates

Tips [EA93]

Cleaning the refrigerator coils once or twice a year can help to improve an existing refrigerator's efficiency. Keep some distance around the refrigerator to allow for proper air flow around the coils.

Size, options and freezer compartment configurations affect energy use. A larger unit may be **Energy Star**®certified, but a smaller unit may still use less energy, so choose the smallest refrigerator that appropriately meets household needs. Features (such as water dispensers) use energy, so fewer features mean both greater energy efficiency and a lower likelihood of repairs. Top freezer models are generally more energy efficient than side-by-side models. Leave room around the unit for proper air flow around the cooling coils to ensure peak efficiency. Maintaining the unit is also important.

Choose an energy-efficient dishwasher [EA94]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Most dishwasher energy use goes toward heating water, however, today's high-efficiency dishwashers use as little as three gallons of water thanks to sensors, high-efficiency pumps, and improved filtration. The expected life of a dishwasher is 9-12 years, and the payback period for a new dishwasher is long, but studies suggest it is more sensible to replace a dishwasher that is more than six years old rather than pay for repairs. Look for dishwashers the carry the **Energy Star**® label, which are over 40 percent more energy-efficient than the minimum government standards.

Caution [EA95]

When installing a gas range or oven, make sure to properly vent the area since you are introducing **combustible gas** into your home.

Install energy-efficient cooking appliances [EA95]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Cooking itself does not contribute significantly to overall home energy use, but preheating does, making it sensible to invest in an energy-efficient model. When shopping for new cooking appliances or remodeling the kitchen, consider making a fuel switch since running gas pipes, vents, and electrical connections will influence the layout of the kitchen. Consider cooking preferences and local gas and electric rates. If another appliance such as a furnace, clothes dryer, or water heater is also on a switch list, take this into consideration when you look at placement and installation costs.

In general, electric ranges and ovens are more efficient than gas units. The most efficient ovens are convection ovens that cook by circulating hot air around the food, using only one-third as much energy to operate as conventional ovens. They produce further savings through reduced cooking times because the food is more evenly exposed to heat. Among electric ranges, induction models may cost more but they are also the most efficient.

In terms of gas units, look for electronic or thermal igniters instead of standing pilot lights. For smaller meals, consider using a microwave oven or a toaster oven that require less energy than a large oven. Self-cleaning gas or electric ovens are more efficient because they have more insulation than non-self cleaning models.

Tips [EA99]

Energy-saving features, such as sleep mode, can be deactivated by users; homeowners should not disable energy conservation features.

Select energy-efficient office equipment [EA99]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Today there are about 18 million home-based business owners and 24 million telecommuters.[10] Working from home eliminates commute times and transportation related emissions, but it contributes to higher electricity bills to power office equipment and lighting. In fact, small electronic

devices alone account for 16 percent of an average home's energy bill. Office equipment that has earned the **Energy Star®** label uses less energy to perform regular tasks and automatically enter a low-power mode when not in use, thereby reducing **phantom loads**. Up to 75 percent of the electricity these units consume occurs while these devices are turned off.[11] When buying new office equipment, consider both the standby and the operating power consumption.

Energy Star® ratings are available for computers, monitors, printers, scanners, copiers, fax machines, multi-function devices (machines that combine printing, scanning, and faxing), lighting, cordless phones, answering machines, audio equipment, and room air conditioners.

Install single-throw shut-off valve [MR124]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

A **single throw shut-off valve** is a quick inexpensive device to help prevent leakage problems. Installing this simple valve on the supply line for the hot and cold water efficiently allows the user to shut off a malfunctioning system before it leaks substantial amounts of water.[12]

Install drain pan for clothes washer [MR125]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

More and more homeowners today install laundry rooms over finished spaces instead of in basements and utility rooms. Because of this trend, it is important to install a drain and **drain pan** below the clothes washer to avoid the damage that could be caused by a burst or a leak in the equipment. This will conserve resources and avoid potentially costly repairs.

Provide air-lock dryer vent [EA72]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Vents for the dryer that expel hot moist air to the exterior can be a significant source of leakage. Install a vent cap to help reduce both air leakage to the exterior and the overall **heating load** in the home.

Minimize dryer duct length and turns [EA73]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

A dryer vents properly when it has the right resistance to air flow in the ductwork. Minimizing the length and number of turns in the duct improves the capacity of the dryer to run efficiently. If needed, install a booster exhaust fan, following the manufacturer's guidelines for the maximum turns and length to retain efficiencies from the improvement.

Tips [MR124]

Washer hoses are notoriously weak, so always close the valves when leaving home for an extended period.[13]

Caution [MR142-150]

Materials made outside the United States could exceed federal standards for formaldehyde, so look out for imported products with formaldehyde.

Select eco-friendly furniture HS2 [MR142/147-148/150]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Before purchasing new furniture, consider refurbishing or using existing furniture in new ways, or buying salvaged items. When purchasing new furniture, select products from companies with responsible business practices that use recycled materials, **FSC-certified wood**, **formaldehyde-free**, and **low-VOC** finishes. Also, spending a little more up front to purchase high quality, solid furniture and cabinetry will help prevent the premature replacement and maintenance of the home and will use fewer resources in the long run.

Look for furnishings made locally. Products produced outside the United States and Canada use more transportation resources traveling to New Jersey. These imports also tend to have fewer controls on **formaldehyde** and **VOC** content.

Choose moisture-resistant furniture for longer life to save money and preserve natural resources. Select products made from **certified sustainable wood**, **reclaimed** materials, bamboo, recycled or recyclable metal or plastic, fixable materials, and durable materials for further value.

Tips [MR149]

When installing new countertops, specify that they are installed in one piece and in a way that they eventually can be removed and reused easily.[14]

Caution [MR140]

Avoid salvaging cabinets that contain lead paint.

Select eco-friendly cabinetry and countertops [MR140/145/148-149]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

When choosing materials for cabinets and countertops, consider salvaged items first. Refinishing old cabinets or furnishing countertops from salvaged stone or recycled material greatly reduces the energy intensity needed to process **virgin materials**.

If purchasing new cabinets, look for retailers that utilize recycled materials, **FSC-certified wood**, **formaldehyde**-free materials, and low-**VOC** finishes. In 2006, the Kitchen Cabinet Manufacturer's Association created a voluntary rating program called the Environmental Stewardship Program (ESP). ESP-certified cabinets are a good sustainable option. Conventional cabinetry contains urea **formaldehyde** that **off-gasses** at room temperature and can pose long-term health risks. Also consider wood veneer cabinets which give the look and feel of solid wood but use a fraction of the resources.

For countertops, there are several alternative materials that are more environmentally-friendly than conventional laminate or granite countertops. These include recycled concrete, glass tiles, plastic, paper composite, terrazzo, and wood.[13] Locally recycled or produced items are preferable, especially to imported furnishings from countries where standards on **VOCs**, **formaldehyde** and other toxic content may be more relaxed.

An investment in more durable high-quality materials, while more expensive initially, serves a dual purpose; not only will it benefit the environment and enhance the quality of the indoor environment, it will also save money and future resources by reducing the need for replacement of these items.

Support local craftsmen [MR153]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A		DIFFICULTY LEVEL:	

An easy way to promote sustainability is to buy art, furniture, and other home accessories from local artists and artisans. Usually local artists and **indigenous** peoples are more protective over the ecosystem. It is also possible to converse about the materials used in the production of their art if there are any particular concerns about their sources. Though almost any green product is available on the internet, a superior choice is to buy green products and services made and sold as close to home as possible. By doing so one uses products more appropriate to the local region and helps build a strong local economy.

Select furniture that is easy to clean [IEQ192]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

When looking for furniture and other items for the home, consider how easy they will be to clean and maintain. Items with reduced maintenance and cleaning needs are replaced less often, mitigating any higher up-front expenses by reducing future costs. Replacing furniture and household items less often conserves resources, reduces the need for new production, and eases the burden on landfills.

Materials that are easier to clean require fewer chemical products to be used within the home as well. Products that can be cleaned with natural "green" cleaning agents will also help maintain healthy indoor air quality.

Select healthier window treatments [IEQ193]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Most people do not think about window treatments as a way to go green, but consciously selecting these elements can have positive impacts. Good window treatments reduce harmful **UV** radiation and increases passive heating in the winter while keeping out excess heat in the summer and generally reducing heat loss. However, some drapes are very **porous**, thus absorbing dust and airborne particles. The difficulty in removing dust or cleaning the drapes can degrade air quality inside the home. Also, avoid curtains treated with toxic flame-retardants which are unhealthy to inhale. If possible, choose **non-porous** treatments like blinds and shutters and be careful to look for products with zero- or low-**VOC** finishes.

Caution [IEQ193]

Look out for products with toxic **fire retardants**. The may volatize and contribute to poor indoor air quality.

Use green cleaning products/strategies [IEQ196]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Using environmentally conscious cleaning products is healthier for indoor air quality and for occupants. Given the frequent use and close exposure to the user, toxic **VOC**-releasing cleaning products are dangerous to be around and inhale. Using less toxic cleaning products also keeps rivers cleaner because when products do end up down the drain, they do less damage to the ecosystem. This is especially true for laundry and dishwashing detergent and bathroom cleaning products, which flow directly down the drain.

Regularly maintain equipment [EA91]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Regular maintenance of appliances and mechanical equipment in the home greatly reduces home energy demand and the amount of repairs and replacements that will need to be made on the equipment. Simple things, like vacuuming refrigerator coils, emptying the lint trap before every load in the dryer, cleaning oven trays, and emptying the dishwasher food scrap bin can help to keep equipment running efficiently and save money. Follow manufacturers' guidelines for maintaining various appliances.

Designate a built-in recycling center

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Recycling at home reduces household garbage and landfilling of useful materials by up to 75 percent. By recycling, one can also decrease the amount of **virgin materials** extracted from the environment and reduce the overall strain on natural ecosystems. Many products containing toxic **heavy metals** and **solvents** require special arrangements for disposal. Proper disposal or recycling of these products prevents the contamination of local waterways and soils.

When buying for the home, look for products that contain the most **post-consumer recycled content** to ensure the least impact on the environment (i.e. toilet paper made from recycled paper). Many home products, especially paper products, are becoming available with **recycled content**. As part of your kitchen design, include waste disposal compartments that allow easy sorting of recyclables into the relevant types, including paper, mixed glass metal and plastics, an aluminum can crusher, and even compost and hazardous waste. By incorporating recycling into a kitchen design, it's easy for homeowners to properly recycle waste.

Building Envelope

Properly detail window sills in wet areas [IDP26]

Resources:

Toolbase Services: Tech Set 2 Durable Building Envelope

www.toolbase.org

Properly seal and flash windows/skylights [IPD27]

Resources:

U.S. Department of Energy: Weather Resistant Barriers

www.eere.energy.gov/buildings/publications/pdfs/building_america/28600.pdf

Durability by Design: A guide for residential builders and designers

www.pathnet.org/sp.asp?id=984

Moisture Resistant Homes

www.pathnet.org/sp.asp?id=18574

Upgrade or replace existing windows [EA56/59]

Resources:

USEPA Energy Star®. Rebates and Tax Credits for Windows, Doors, and Skylights.

www.EnergyStar.gov/index.cfm?c=windows_doors.pr_taxcredits

U.S. Department of Energy: Windows

www.eere.energy.gov/consumer/tips/windows.html

Consumer Reports: Windows.

www.consumerreports.org/cro/home-garden/home-improvement/hardware-building-supplies/windows/windows-10-07/overview/wind-ov.htm

Efficient Windows Collaborative

www.efficientwindows.org/index.cfm

National Fenestration Rating Council

www.NFRC.org/

References:

[1] **Consumer Reports: Windows**

www.consumerreports.org/cro/home-garden/home-improvement/hardware-building-supplies/windows/windows-10-07/overview/wind-ov.htm

[2] **U.S. Department of Energy: Windows**

www.eere.energy.gov/consumer/tips/windows.html

Upgrade existing exterior door [EA57]

Resources:

U.S. Department of Energy: Exterior Doors

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13610

USEPA Energy Star® Rebates and Tax Credits for Doors

www.EnergyStar.gov/index.cfm?c=windows_doors.pr_taxcredits

References:

[3] **U.S. Department of Energy: Exterior Doors**

www.energysavers.gov/your_home/windows_doors_skylights/index.cfm/mytopic=13620

Provide shading of skylights as needed [EA561]

Resources:

Efficient Windows Collaborative

www.efficientwindows.org/

The National Fenestration Research Council

www.NFRC.org/

SkyVision free software

www.irc.nrc-cnrc.gc.ca/ie/lighting/daylight/skyvision_e.html

Isolate attached garages [IEQ165]

Resources:

USEPA Energy Star® Thermal Bypass Checklist

www.EnergyStar.gov/

Five Steps to a Healthier Garage

www.web.extension.uiuc.edu/will/factsheets/family116.html

USEPA: Indoor Air Quality

www.EPA.gov/iaq/pubs/insidest.html

HVAC

Use ceiling fans for natural ventilation [EA65]

Resources:

U.S. Department of Energy: Ventilation

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12351

Forget AC! Cool Your Home Naturally by Carol Venolia and Kelly Lerner, Mother Earth News Homes: Guide to Affordable and Sustainable Building, Spring 2008.

www.MotherEarthNews.com

U.S. Department of Energy: Summer Energy Savers

www.energy.gov/4242.htm

Rocky Mountain Institute - Home Cooling

www.rmi.org/sitepages/pid208.php

USEPA Energy Star®

www.EnergyStar.gov/index.cfm?c=ceiling_fans.pr_ceiling_fans

Install programmable thermostats [EA67]

Resources:

American Council for an Energy Efficient Economy (ACEEE)

www.aceee.org/consumerguide/heating.htm

USEPA Energy Star® - Thermostats

www.EnergyStar.gov/index.cfm?c=thermostats.pr_thermostats

References:

[4] **American Council for and Energy-Efficient Economy**

www.aceee.org

Make sure ductwork is clean [EA71]

Resources:

Should You Have the Air Ducts in Your Home Cleaned?

www.EPA.gov/iaq/pubs/airduct.html

National Air Duct Cleaners Association

www.nadca.com/

Install effective ventilation [IEQ166-167/172]

Resources:

Home Ventilating Institute

www.hvi.org/

Oversized Kitchen Fans—An Exhausting Problem

www.homeenergy.org/archive/hem.dis.anl.gov/eehem/99/990113.html

Read This Before You Ventilate

www.buildingscience.com/documents/primers/bsp-042-read-this-before-you-ventilate-1

ASHRAE Standard 62.2: Ventilation and Acceptable Indoor

ASHRAE, Air Quality in Low-Rise Residential Buildings

www.bookmarki.com/ANSI-ASHRAE-62-2-2007-p/86158.htm

Provide fresh air in ventilation system [IEQ171]

Resources:

Home Ventilating Institute Library,

www.hvi.org/

ASHRAE Standard 62.2: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, ASHRAE

www.bookmarki.com/ANSI-ASHRAE-62-2-2007p/86158.htm

Read This Before You Ventilate

www.buildingscienceconsulting.com/resources/mold/

USEPA: Ventilation for Homes

www.epa.gov/iaq/homes/

Vent all combustion-based equipment [IEQ168]

Resources:

Backdrafting: Causes and Cures

www.homeenergy.org/archive/hem.dis.anl.gov/

Building Performance Institute: Combustion Safety Test Procedure for Vented Appliances

www.bpi.org/documents/gold_sheet.pdf

Lighting and Electrical

Provide daylighting [EA83]

Resources:

Understanding High Performance Lighting: Room-by-Room Designs

www.ibacos.com/hpl5.html

U.S. Department of Energy: Consumer's Guide: Window Overhangs

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13570

Southface: Passive Solar Design

www.southface.org/web/resources&services/publications/technical_bulletins/PSD-Passivesolarpercent2000-790.pdff

Low Impact Living: Install Solar Tube Lighting

www.lowimpactliving.com/blog/2008/01/14/how-to-install-solar-tube-light/

Provide appropriate lighting [EA84]

Resources:

New Jersey Clean Energy Program - Energy Efficiency Store for New Jersey Residents

www.energyfederation.org/njcleanenergy/default.php

Rensselaer Polytechnic Institute- Lighting Research Center

www.lrc.rpi.edu/

U.S. Department of Energy: Lighting Principles and Terms

www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11990

References.

[5] **U.S. Department of Energy, EERE. 2008. AConsumer's Guide: Lighting**

www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11980

Install energy-efficient lighting [EA85]

Resources:

Consumer Guide to Home Energy Savings, Lighting,ACEE 2009

www.aceee.org/consumerguide/lighting.htm

Energy Star® - Light Bulbs and Fixtures

www.energystar.gov/index.cfm?c=lighting.pr_lighting

EPA, Mercury – Spills, Disposal and Site Cleanup

www.epa.gov/mercury/spills/index.htm

Toolbase Services: LED Lighting

www.toolbase.org/Technology-Inventory/Electrical-Electronics/white-LED-lighting

Provide controllable interior shading [IEQ178]

Resources:

Window Orientation and Shading

www.fsec.ucf.edu/en/consumer/buildings/homes/windows/

Green Building Advisor - Do window shades save energy?

www,greenbuildingadvisor.com

Wall and Ceiling

Install eco-friendly interior sheathing [MR126]

Resources:

Green Building Advisor: Sheathing

www.greenbuildingadvisor.com

Select eco-friendly interior doors [MR127]

Resources:

REGREEN Reference Guide to Product Considerations

www.regreenprogram.org

Green Building Advisor: Interior Doors

www.greenbuildingadvisor.com

Choose eco-friendly paints, sheens, and finishes [IEQ185/MR130-131]

Resources:

REGREEN Reference Guide to Product Considerations

www.regreenprogram.org

Green Seal

www.greenseal.org/index.cfm

National Geographic Green Guide: Paint Buying Guide

www.thegreenguide.com/

Consider tile with recycled content [MR132]

Resources:

Green Buyer's Guide To Stone & Tile

www.bayarea.greenhomeguide.com/index.php/knowhow/entry/642/C225/

National Geographic Green Guide: Floor Buying Guide

www.thegreenguide.com/

Select eco-friendly wall coverings [MR129/IEQ186]

Resources:

Live Earth – Paint and Wallpaper

www.liveearth.org/2008/02/paint-or-wallpaper/

Green Seal

www.greenseal.org/

Green from Wall to Wall

www.edcmag.com/CDA/Archives8f8837e14c697010VgnVCM100000f932a8c0

Use non-paper-faced gypsum board in moist areas [IEQ183]

Resources:

Read This before You Design, Build or Renovate

www.buildingscienceconsulting.com/resources/foundations/

Use low-VOC construction products [IEQ187]

Resources:

U.S. Green Building Council

www.usgbc.org/ShowFile.aspx?DocumentID=2267

REGREEN Product Selection Resources

www.regreenprogram.org

Avoid carpeting in moist areas [IEQ179]

Resources:

House Dust Mites–OSU Extension Fact Sheet

www.ohioline.osu.edu/hyg-fact/2000/2157.html

Floors and Flooring Products

Reuse existing flooring and subflooring [MR133]

Resources:

National Wood Flooring Association

www.woodfloors.org/consumer/maintRenewal.aspx

National Geographic Green Guide: Floor Buying Guide

www.thegreenguide.com/

Choose hard, low-formaldehyde floors [IEQ180, MR134]

Resources:

Concrete Floor Finishes

www.toolbase.org

Floor Score: What and Why

www.rfci.com/int_FloorScore.htmorganic

Formaldehyde in the Home

www.arb.ca.gov/research/indoor/formaldgl08-04.pdf

Forest Stewardship Council

www.FSC.org

APA Wood – Formaldehyde Regulations

www.apawood.org/level_b.cfm?content=srv_env_form

Use reclaimed or renewable materials [MR135-136]

Resources:

Navigating the Flooring Ticket

www.bayarea.greenhomeguide.com/index.php/knowhow/entry/802/C22ether

REGREEN Product Selection Resources

www.regreenprogram.org

Refinish floors with eco-friendly products [MR137]

Resources:

Buyer's Guide to Clear Finishes

www.greenhomeguide.com/index.php/knowhow/

National Geographic Green Guide: Wood Finishes Information

www.thegreenguide.com/reports/product.mhtml?id=24&sec=2

Select eco-friendly carpeting [IEQ/182/MR139]

Resources:

National Geographic Green Guide – Finding a Healthy Carpet

www.thegreenguide.com/doc/BGG2/letters

Carpet and Rug Institute

www.carpet-rug.org

Carpet Cushion Council

www.carpetcushion.org

Greenguard Environmental Institute

www.greenguard.org

Plumbing

Install water saving fixtures [WE42-44]

Resources:

USEPA: Water Sense

www.EPA.gov/watersense/pp/het.htm

H2ouse.org – Top 5 ways to save water at home

www.h2ouse.org/

Water Use It Wisely

wwww.wateruseitwisely.com

Install water filtration system [IEQ175-176]

Resources:

REGREEN Program

www.regreenprogram.org/

Consumer Guide to Water Filters

www.nrdc.org/water/drinking/gfilters.asp

NSF: Home Water Treatment Devices

www.nsf.org/consumer/drinking_water/dw_treatment.asp

American Water Works Asscociation - WaterWiser

www.awwa.org/resources/waterwiser

Include a plumbing access panel [MR123]

Resources:

REGREEN Program

www.regreenprogram.org/

Do-It-Yourself Life.com – Installing a plumbing access panel instructions

www.diylife.com/2008/06/23/plumbing-access-panel-installation/

Choose a high-efficiency water heater [EA79]

Resources:

U.S. Department of Energy: Water Heating

www.eere.energy.gov/consumer/your_home/

Consumer Guide to Home Energy Savings: Water Heating

www.aceee.org/consumerguide/waterheating.htm

References:

[6] **U.S. Department of Energy, EERE. Water Heating**

www.energy.gov/waterheating.htm

Consider eco-friendly piping material [MR122]

Resources:

Copper Development Association

www.copper.org/environment/homepage.html

Plastic Pipe Institute, Information on Plastic Piping Systems
www.plasticpipe.org

Piping in Perspective: Selecting Pipe for Plumbing in Buildings

www.buildinggreen.com/auth/article.cfm?fileName=160401a.xml

Reconfigure piping for efficiency [EA77]

Resources:

American Water Works Association: Hot Water Delivery – Systems and Construction Practices

www.awwa.org/waterwiser/references/pdfs/RES_HW_Klein_G_Hot_Water_Delivery_Systems_and_Constructi.pdf

Tech Set 1: Resource Efficient Plumbing

www.toolbase.org

References:

[7] **James Lyons. 2009. Promising Plumbing. BUILDER. January 2009.** www.builderonline.com

Install an instantaneous water heater

Resources:

American Council for an Energy Efficient Economy

www.aceee.org/consumerguide/waterheating.htm#new

U.S. Department of Energy: Water Heating

www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12820

Equipment

Select high-efficiency clothes washer [EA92]

Resources:

Consortium for Energy Efficiency

www.cee1.org

USEPA Energy Star®

www.EnergyStar.gov

References:

[8] **American Water Works Association Research Foundation**

www.awwa.org/

[9] **Consumer Reports, Greener Choices**

www.greenerchoices.org/

Select an energy-efficient refrigerator [EA93]

Resources:

Consortium for Energy Efficiency: Refrigerators

www.cee1.org/resid/seha/refrig/refrig-main.php3

USEPA Energy Star® - Refrigerators

www.EnergyStar.gov/index.cfm?c=refrig.pr_refrigerators

New Jersey State Website – Information on Energy Star® Appliances

www.state.New Jersey.us/globalwarming/help/

Choose an energy-efficient dishwasher [EA94]

Resources:

USEPA Energy Star® - Dishwashers

www.EnergyStar.gov/

Consortium for Energy Efficiency : Home Appliances

www.cee1.org/resid/seha/seha-main.php3

Install energy-efficient cooking appliances [EA95]

Resources:

Consumer Guide to Home Energy Savings: Cooking

www.aceee.org/consumerguide/cooking.htm

Select energy-efficient office equipment [EA99]

Resources:

American County for an Energy Efficient Economy: Consumer Guide to Home Energy Savings

www.aceee.org/consumerguide/electronics.htm

USEPA Energy Star®: Home Electronics

www.energystar.gov

References:

[10] **Alliance to Save Energy**

www.ase.org/

[11] **U.S. Department of Energy: Home Office and Home Electronics**

www.eere.energy.gov/consumer/tips/home_office.html

Laundry

Install single-throw shut-off valve [MR124]

Resources:

Read This before You Design, Build, or Renovate

www.buildingscienceconsulting.com/resources/mold/

Do It Yourself – How to Install Shut Off Valves

www.doityourself.com/stry/installshutoffvalve

References:

[12] **This Old House. 2007: How to Stop a Flood in its Tracks**

www.thisoldhouse.com/toh/article/0,,193969,00.html.

Install drain pan for clothes washer [MR125]

Resources:

Checklist for Decay Resistance

www.lsuagcenter.com/en/family_home/home/la_house/my_house/Durable/

Clotheswasher Drain Pan Specifications

www.floodsaver.com/24_Specs.htm

Provide air-lock dryer vent [EA72]

Resources:

Heartland Dryer Vent Closure

www.energyfederation.org/consumer/default.php/cPath/86_742_110

American County for an Energy Efficient Economy: Consumer Guide to Home Energy Savings

www.aceee.org

Minimize dryer duct length and turns [EA73]

Resources:

Toolbase Services: In-line Fans

www.toolbase.org

Furniture and Fittings

Select eco-friendly furniture [MR141-143/146-147/150]

Resources:

Sustainable Furniture Council

www.sustainablefurniturecouncil.org

Habitat for Humanity Restores

www.habitat.org/env/restores.aspx

Craigslist

www.craigslist.org

Freecycle

www.freecycle.org

National Geographic Green Guide: Green Starter Furniture Finds

www.thegreenguide.com

Select eco-friendly cabinetry and countertops [MR140/145/148-149]

Resources:

Green Home Guide, Choosing Kitchen Countertops: Our Top Picks

www.greenhomeguide.com/index.php/knowhow/entry/931/C222/

Greenbuilding.com, Green Cabinets

www.greenbuilding.com/green-home-improvement/green-cabinets

Greencabinetsource.org

www.greencabinetsource.org/index.cfm?fuseaction=Defining.welcome

Habitat for Humanity, Habitat ReStores

www.habitat.org/env/restores.aspx

Sierra Club Green Home, Eco Cabinets

www.sierraclubgreenhome.com/educate/cabinets/eco-friendly-cabinets/

Natural Home Magazine, Cradle to Cradle Countertops

www.naturalhomemagazine.com/Tools-and-Tricks/Cradle-to-Cradle-Countertops.aspx

References:

[13] **Green Home Guide, Choosing Kitchen Countertops: Our Top Picks**

www.greenhomeguide.com/index.php/knowhow/entry/931/C222/

Support local craftsmen [MR153]

Resources:

Ten Thousand Villages.com – Fair Trade Retailer

www.tenthousandvillages.com

Select furniture that is easy to clean [IEQ192]

Resources:

Destination Green

www.destinationgreen.com

National Geographic Green Guide

www.thegreenguide.com/

Select healthier window treatments [IEQ193]

Resources:

How Do I Select Safe Natural Fiber Products for My Home?

www.greenhomeguide.com/index.php/knowhow/

Natural Home Magazine

www.naturalhomemagazine.com/

Sierra Club Green Guide: Window Coverings

www.sierraclubgreenhome.com

Uses

Use green cleaning products/strategies [IEQ196]

Resources:

U.S. Department of Health and Human Services: Household Product database

www.householdproducts.nlm.nih.gov

Properly maintain equipment [EA91]

Resources:

American Council for an Energy-Efficient Economy Consumer Guide to Home Energy Savings

www.aceee.org

HARDI Architect, Builder & Remodeler Good Practice Guide

www.hardinet.org/pdf/GdPractGuide2.pdf

Designate a built-in recycling center

Resources:

Climate Crisis – Things you can do at home

www.climatecrisis.net/takeaction/whatyoucando/index3.html

Earth 911 Recycling

earth911.com/recycling/

Earth Easy.com – Home Recycling Info

www.eartheasy.com/live_recycling.htm

NJ DEP Household Recycling & Recycled Product Directory

www.nj.gov/dep/dshw/recycling/

Case Study

Location of Project: Montclair, New Jersey

Interior Designer: Jacqueline Germany, President-Owner, and Principal Designer, Nina's Nuances Interior Design, Inc.

General Contractor: Jacqueline Germany

Overview and Scope

This project incorporated a total kitchen remodel with upgrades to the **HVAC** and water resource systems. The impetus for this green design and renovation project was twofold. The primary reason was that the kitchen did not meet the client's needs: it was outdated, aesthetically unappealing, inflexible, and functionally inefficient. This client was very conscious of his personal use of everyday household items and overall energy and resource consumption. Therefore, when deciding to remodel and renovate, the client chose to employ energy and environmental conservation strategies.

Design Approach

The environmentally-conscious client provided the principal inspiration for the project, however, being the designer's first truly "green" project opportunity, the designer was equally as excited about completing the remodel. The team undertook the project in 2004 at a time when resources for green design in the residential arena were more limited and the public's knowledge of the benefits and rewards of "green design" was not as sophisticated as it is in 2009. This provided some challenges but also gave the project a more innovative feel.

Team and Process

The respective backgrounds of the homeowner and designer complemented each other well. The homeowner possessed significant experiential insight as to what green products were available at the time, while the designer, by virtue of training in the environmental sciences and interior design, brought a professional awareness and knowledge of the synthesis and composition of the products. Facilitating the implementation of the green design aspects was the eagerness of suppliers to promote their green products and services.

Finance

At the time of the project, the cost of utilizing green design techniques was roughly 27 percent higher than conventional design; however, the rapid increase in availability of green design choices and products over the past several years has diminished this premium. For the designer, this project served as a "barometer" for project- related costs. Relative to today, the remodel came well within budget, even with the extra costs for the green features. The client reported energy savings of approximately 20 percent over the first full year following the renovation, and when he decided to sell the home in 2007, the green kitchen turned out to be the most compelling factor in the new owner's decision to purchase.

Lessons and Trade-offs

Through this project, both the client and designer learned a lot about the varying levels of "greenness" in products marketed as such. When researching green products, they found that one needs to examine carefully the product information and Material Safety Data Sheets (MSDS) to verify the accuracy of the claim. The homeowner and designer were surprised by the lack of quality in some green-labeled products. Therefore, they felt that research into product choices was critical. Luckily, there are several reliable resources available today as well as many more practicing green design and remodeling professionals.

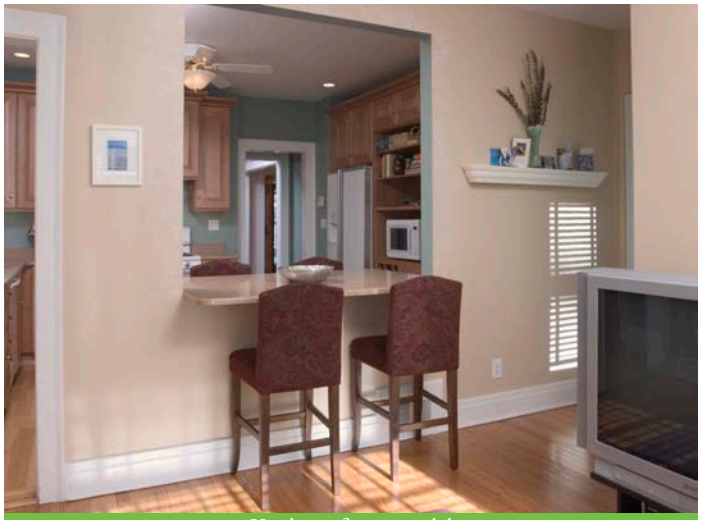
"In our efforts to help the environment by adhering to green principles of living, we often times forget to factor in how we dispose of our waste products…An important part of our efforts to do green building, design, or remodeling should be how we deconstruct that environment and what we do with its components and waste."

- Jacqueline Germany

Before

After

List of Green Strategies


Kitchen after remodel

Energy Conservation

- Replaced original appliances with energy-efficient ones
- Replaced original lighting fixtures with energy-efficient fixtures and lamps
- Utilized dimmer switches and more effective lighting controls
- Upgraded windows to improve insulation

Water Conservation

- Replaced original water heater with a tank-less model that heats water on demand
- Incorporated a **reverse osmosis** water filter with an instant hot water faucet
- Installed a whole-house water filter with water softener

Indoor Air Quality

- Used **low-VOC** paint and non-toxic interior finishing products on cabinets, walls, and flooring
- Replaced **HVAC** system and added new vents and filters
- Added a cooking hood with pollution controls to aid clean exhausting of odors and fumes
- Replaced old plaster and lath with paperless sheetrock

Sustainable Materials

- Installed countertops made from Azrock, a granite alternative made from 70 percent consumer recyclable materials
- Installed cabinets made from river-recovered wood
- Installed bamboo flooring
- Reused door hinges and some antique hardware from original kitchen

Before

After

Case Study

Location of Project: Elkins Park, PA
Homeowners: Mr. and Mrs. Ryan Quinn
Interior Designer: Lori Jacobsen, Lori Jacobsen Design, LLC.
Area Affected: 190 sq. ft.

Overview and Scope

The primary objective of the design firm was to create a safe and healthy nursery for an expanding family. Working within the framework of a nearly seventy-year-old home, the team made minimally invasive architectural changes to maintain the integrity of the home. Without changing the layout of the existing space, they focused on "choosing materials and products that are healthier for people, conserve resources and energy, and are resource efficient (as defined by ASID, June 2007)." Subscribing to the parameters of sustainable design, the constraints of the existing space, a fixed budget, and consideration of time, they created an eco-friendly or "green" baby's nursery.

Design Approach

The homeowners wanted to create the safest and healthiest environment for their baby. The firm helped to educate the couple on everyday products that can have an adverse effect on their health and helped the homeowners both select safe, environmentally-friendly products and make changes to improve indoor air quality.

Team and Process

Lori Jacobsen Design worked together with the homeowners throughout the design process. The project began with an in-home consultation with the clients. After defining the design needs of the client and considering the budget, they worked together to create a plan that met those needs. The homeowners were then asked to approve the final design plan.

Finance

Working with a budget of $10,000 the team was pleased to find out that their green choices and strategies came in under budget. Generally the design firm does not work with clients on a strict budget. Therefore, this project offered the opportunity to create a baseline for other projects of this kind.

The homeowners expect cost savings from their investments by lowering heating and cooling costs through yearly maintenance of the **HVAC** system, upgraded air filters, and installation of natural window shades with insulators.

Lessons and Trade-offs

Because of their extensive knowledge and continuing research in the area of green design, the design firm was not surprised by the project cost. To create a non-toxic nursery, the firm made suggestions to the homeowner about removing materials that could degrade indoor air quality. In general, the firm advises homeowners to participate in the design process, which helps create a transparent plan with few or no surprises in the end.

"This particular project was a dream. The client's and our firm's green objectives were completely aligned. Therefore, we all were on the same page from the beginning to the end."

- Lori Jacobsen

List of Green Strategies

Energy Conservation

- Checked heating and cooling systems to ensure optimal efficiency
- Upgraded air filters
- Installed energy-saving window shades and insulators

Resource Conservation

- Installed area rug made from 100 **post-consumer recycled content** (polyethylene terephthalate (PET) from recycled plastic bottles)
- Repurposed a salvaged chair using remnant fabric from a furniture manufacturer

Indoor Air Quality

- Removed all existing materials with high-**VOC** contents
- Used low-**VOC** paint
- Refinished hardwood floors with a no-sanding and non-toxic finishing product
- Cleaned floors with a neutral product that contains no harmful **solvents**
- Used environmentally-friendly, low-**VOC** carpeting and furnishings
- Chose a natural organic wool fiber and cotton mattress and bumpers for the crib

Repurposed chair from remnant fabric

Case Study

Location of Project: Highland Park, New Jersey
Homeowners: Randall Solomon and Rebecca Hersh
General Contractor: Richard Stryker Contracting
Area Affected: approx. 1350 sq. ft.

Overview and Scope

This green remodel of a 90-year-old craftsman bungalow included an upgrade to a high-efficiency natural gas furnace, replacement of **single-pane windows**, installation of spray denim insulation, and the addition of a dual-layer high-venting roofing system. Green interior renovations included upgrades to the kitchen with **Energy Star®** appliances and installation of water saving fixtures and dual flush toilets in the bathroom. Existing materials were preserved whenever possible, such as exterior cedar siding, wooden porch floor boards, antique doors and fixtures, and subway-style bathroom tiles. Care was also taken to properly remove lead paint and to use only non-toxic paints and finishes.

Design Approach

Randy and Rebecca wanted to design a home that embraced their sustainable values and lifestyles, and that would save them money through reduced utility bills, and provided a healthy environment for their growing family.

Team and Process

The homeowners were the driving force behind the green aspects of this project. They researched and proposed almost all of the green techniques and materials that went into the remodel, working step-by-step with the contractor to decide on the best options. By communicating the commitment to green design from the start, the homeowners made sure that the contractor also understood the importance of reducing construction waste materials and using non-toxic finishes whenever possible.

Finance

The homeowners looked to reduce costs and conserve resources by preserving and reusing existing features of the home. For example, instead of replacing bathroom tile with all new **recycled content** tiles, they only replaced the most worn out sections with new tiles. When it made sense to replace older systems (such as pre-1994 water guzzling toilets) the homeowner chose to invest in greener alternatives, such as low-flow dual flush toilets, that cost more up-front but that will pay for themselves in reduced water bills over time.

Lessons and Trade-offs

Do your homework. The homeowners didn't have to hire a "green" contractor but they did have to put in the extra time and effort to research green features and materials and to communicate these choices to the contractor.

"The good news is that the dual-flush toilets are a big hit with our friends…the bad news is that anytime we have a guests over we end up using more water because everyone wants to check them out!"

- Randy Solomon

Upstairs bathroom before

List of Green Strategies

Energy Conservation

- Replaced old single-pane windows with energy-efficient double-pane, **low-E**, argon filled windows with fiberglass composite frames
- Upgraded existing oil/steam heating system with highly-efficient (87 percent efficient) natural gas/hot water furnace
- Installed zone heating and **programmable thermostats**
- Upgraded kitchen appliances with **Energy Star®** dishwasher and refrigerator
- Added spray denim insulation (recycled blue jeans) to attic, basement, and exterior walls where no or little insulation existed
- Sealed cracks and leaks to reduce air **infiltration**
- Installed a dual layer, high-venting roofing system to reduce temperature build-up inside the attic during the summer months

Water Conservation

- Installed low-flow faucets and shower heads and added faucet aerators to existing fixtures
- Installed dual flush (0.8 and 1.6 gallon per flush) toilets

Resource Conservation

- Preserved 90 year old existing cedar siding
- Refurbished antique bathtub with a new coat of paint
- Preserved black and white subway tiles in upstairs bathroom by replacing only broken tiles
- Refinished and reused antique doors and fixtures
- Replaced rotten floor boards on the front porch with antique floor boards in the attic where they could be appreciated

Indoor Air Quality

- Professionally stripped lead paint from windows and doors
- Vacated the house during the renovation to avoid construction-related dust and air pollution
- Used low-**VOC** water-based finishes on all trim work

Downstairs bathroom after remodel

Case Study

Location of Project: Chatham Township, New Jersey
Homeowners: Ken and Kathy Abbott
Architect: Brian and Janet Siegel, Siegel Architects
Interior Designer: Eco-Interiors by Patricia Gaylor
General Contractor: John Marinaccio Construction
Green Building Consultant: Anna Hackman
Landscape Architect: Back to Nature
Organic landscaper: Greenpath Organic Landcare

Overview and Scope

Located in Chatham Township, New Jersey, this project entailed significant changes to a home previously renovated in 1988. It included changes to the kitchen, dining room, and family room as well as the addition of new living space over the garage. The dining room was relocated to its original location in the front of the house while the kitchen was shifted over to the dining room's position. This allowed the kitchen to become the "heart" of the home, providing a connection to the deck, family room, mudroom, and dining room. The wall between the new kitchen and existing family room was opened up completely, letting light flow from front to back of the house and giving a view of the family room and backyard from the kitchen. The mudroom, removed during the previous renovation, was restored. All of this reconstruction was done within the existing footprint of the house, except for a 72 square foot extension in the rear corner to make enough room for an office off the mudroom.

The 366.5 square foot addition above the garage contains a fifth bedroom, bath and laundry room. To make this section over the garage blend in with the rest of the house, the architect designed a hip roof for the entire house.

Design Approach

The homeowners, Ken and Kathy Abbott, were very focused on a green renovation. Their major goals included improving traffic flow and daylight downstairs, getting more counter space and cooking space in the kitchen, and providing an extra room for a new baby and an office upstairs.

Team and Process

Ken and Kathy Abbott provided the initial impetus for the green remodel. Working with the architect, the green building consultant, and the designer, she was very mindful of trying to save energy, re-purpose items she already had, use local materials, and keep the indoor air quality as clean as possible.

Finance

The Abbotts wanted to make the renovations as "green" as possible without incurring much additional expense. To that end, the only thing that cost more up front was the solar water heater, for which the estimated payback period was eight years.

Lessons and Trade-offs

If able to do it all over again, the Abbotts would choose an architect that was **LEED** certified, as they felt that they needed to educate the architect and builder on the green aspects of the project. One major lesson would be to perform air sealing before laying the sheetrock; they performed the air sealing after the building was done and afterwards an energy audit showed lots of air leaks from the attic and basement. One major design change would be to avoid putting recessed "can" lights (also called high-hats or recessed downlights) in ceilings that open to unconditioned spaces, such as the cathedral ceiling in the family room or upstairs rooms, because they allow unwanted heat flow between conditioned and unconditioned spaces.

"I love my bioswale, stream and organic gardens. I also like that we didn't put as much construction waste in the landfill as we would have with a conventional demolition or carpenter. I think about what my children and their children will do as landfill space becomes scarcer and scarcer. Sustainability is important to me. I felt a responsibility not to add to my family's carbon footprint."

- Kathy Abbott

Solar hot water heating

List of Green Strategies

Energy Conservation

- Replaced 30-year-old windows with new **low-E** windows throughout the house
- Installed triple cellular blinds in master bedroom
- Installed new **Energy Star**® appliances
- Added two solar panels used for hot water

Water Conservation (Outdoors)

- Ensured that there would be no net increase in stormwater **runoff** from the slight increase in our house footprint
- Contoured the garden on both sides of the house to absorb rain water
- Built a **bio-swale** containing attractive **native plants** on the uphill side of the yard that historically collected too much rain water and caused basement flooding
- Used sump pump water to make a landscaped stream that provides a frog habitat

Indoor Air Quality

- Used zero-**VOC** paints
- Installed **formaldehyde-free, sustainably-harvested wood** kitchen cabinets
- Purchased natural jute fabric for window treatments
- Used water-based wood floor finishes

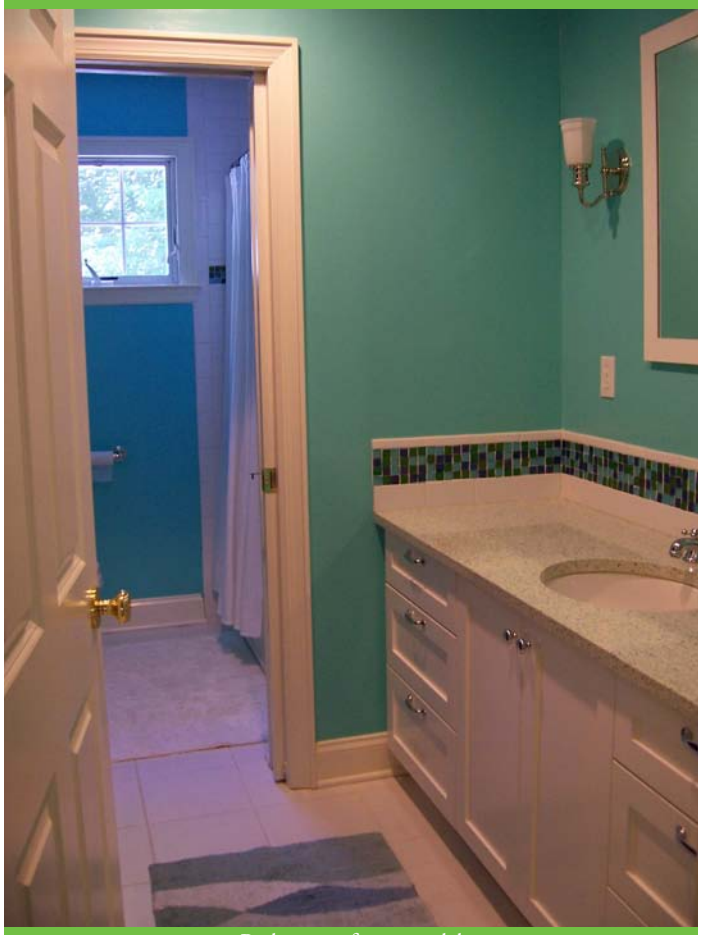
Resource Conservation

- Repurposed existing kitchen cabinets into two armoires and one laundry cabinet
- Altered existing wall unit in the family room to fit a new flat-screen TV
- Repurposed old kitchen sink into a laundry sink
- Installed recycled glass bathroom countertops and border tiles
- Installed an acrylic laundry countertop made from **recycled content**
- Purchased handmade kitchen tiles from New Hampshire, meeting criteria for locally-based products
- Requested a separate dumpster for concrete for the demolition of the old front porch and sidewalk

Sustainable Sites

- All the plantings, grass, etc., were planted with no pesticides
- Chose an organic landscaper to take care of the lawn and garden

Kitchen after remodel



Bathroom after remodel

Case Study

Location of Project: Montclair, New Jersey
Homeowners: Jeff and Amy Plaut
Architect: John Thomas Collins
Interior Designer: Eco-Interiors by Patricia Gaylor
General Contractor: Woodhaus Construction
Area affected: 1000 square feet

Overview and Scope

This house is an 1801 Federal-style farmhouse, one of the oldest continually-occupied homes in Montclair, and is on both the New Jersey and the National Registers of Historic Places. The current owners worked to achieve a balance between preservation of the historic character and fabric with green environmental standards and the everyday needs of an active family lifestyle. The renovation focused on opening up rooms and repurposing space. This included updates to the existing kitchen, family room, laundry room, and the addition of a breakfast room.

Design Approach

Designer Patricia Gaylor and the homeowners, Jeff and Amy Plaut, both desired to do as green a renovation as possible. The designer worked with the Plauts to develop an environmentally-conscious, practical design that also preserves the historic quality.

Team and Process

Patricia worked with the Plauts on the general look and plan for the renovation, and Patricia specified all the products being used to be as green as possible. All plywood used on the renovation by the contractor contained no added **formaldehyde**, energy-efficient lighting and appliances were specified, and the cabinets used were no added **formaldehyde** plywood boxes with a low-**VOC** paint finish.

Finance

The cost of the renovation was considerably high to begin with due to the age of the home. Special consideration had to be taken at every turn to keep costs to a minimum. But for the most part, selections were made on the basis of their sustainability and green quality, not over high price. The construction and materials costs were fair. There will be a huge return on investment in energy savings. Before the renovation, the house was leaky, and the homeowner's heating bills were very high. Good insulation, the addition of radiant heat flooring in the kitchen, and energy-efficient windows contribute to the new tighter building envelope.

Lessons and Trade-offs

The major surprise was how much work was required to fix old renovations and get the home up to current code. While this was expected for such an old house, the costs were higher than anticipated. Although the project was completed on time, the team ended up substantially over budget due to the poor condition of the home's infrastructure. However, both Patricia and the Plauts were very satisfied with the results.

"I thoroughly enjoyed working on a period renovation, and melding new technologies with the old house…Green remodeling is the only way to go, as far as I'm concerned. As a designer, it's my job to show the homeowner that a remodel of her home should be as healthy to the family as possible, leave as low a carbon footprint as possible, and make it as energy-efficient as possible. I think these things can be accomplished in a 'green' fashion with very little in the way of extra cash output…What surprised me the most? Nothing! Being in the remodeling business for so many years, green or not, it's always a challenge."

- Patricia Gaylor

Breakfast room

List of Green Strategies

Energy Conservation

- Selected **Energy Star®** appliances, including the refrigerator, dishwasher, television, and clothes washer and dryer
- Purchased a stove and refrigerator made domestically
- Installed hydronic radiant heat under the kitchen floor
- Installed highly efficient **low-E** glass and argon filled windows
- Chose borate-treated blown-in **cellulose insulation** for the space between the interior and exterior walls for significantly increased energy efficiency
- Used **CFLs** in the majority of light fixtures, including the outside fixtures

Water Conservation

- Installed water filtration systems at sinks to eliminate use of bottled water
- Installed low flow faucets and faucet aerators

Indoor Air Quality

- Built cabinets from wood with no added **formaldehyde**, and painted them with **low-VOC** paint
- Painted interior walls with environmentally-friendly **low-VO**C paint
- Purchased laundry room cabinets made of medium-density fiberboard (MDF) with no added urea **formaldehyde**
- Coated soapstone countertops are coated with food-grade mineral oil once a month

Sustainable Materials

- Stripped and repaired the original brick hearth to restore it as the focus of the kitchen
- Constructed porches using local bluestone and flooring made from **recycled content**
- Installed eastern white pine floors, harvested from family-owned, responsibly-managed New Hampshire forests
- Used domestic clay for the butler's pantry wall tile made by an environmentally responsible New Hampshire firm that reuses clay waste, water for processing, and shipping boxes
- Installed white Danby marble countertop from Vermont in baking area
- Installed Marmoleum linoleum flooring, made from **jute**, flax, and linseed oil

Gas range and oven

Mud room

Case Study

Location of Project: Galloway, New Jersey
Homeowners: Stephen and Barbara Fiedler
Interior Designer: Fiedler Designs, LLC
General Contractor: Fiedler Designs, LLC
Area affected: 350 sq. ft.

Overview and Scope

This project involved a total renovation of an existing kitchen and dining room into a combined kitchen with two sit-down eating spaces. The "great room" effect of this gathering space was the goal of the design, and the materials used helped meet the design goal of a total "green" or sustainable kitchen.

Design Approach

The Stephen and Barbara Fiedler looked to the **U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED)** for general green building guidance. They were inspired initially by the Jackie O'Neil LEED home in Perkiomenville, Pa.

Team and Process

The project involved numerous phone calls to green product suppliers and requests for product samples. The Fiedlers visited green product installation showrooms, read blogs on green products and attended seminars and conventions to educate themselves on green kitchen remodeling strategies and materials.

Finance

The Fiedlers put aside some cost considerations for this project in order to test the viability of several green products, many of which were new to the marketplace. In order to cut costs, the entire project's labor was performed by Fiedler Designs LLC. The cost savings of **Energy Star®** appliances, the tankless water heater, a smaller lighting load, and greater long-term material durability may pay for themselves, but not for some time. It will benefit future customers to choose sustainable products and techniques as they become more mainstream.

Lessons and Trade-offs

The biggest surprises of this project were the durability and stability of No-Added Urea Formaldehyde (NAUF) composite casework products and the bamboo cabinets. The Fiedlers would urge others to consider rapidly renewable woods, fibers, and composites as opposed to traditional woods with long growing times, and also to avoid products with high-**VOC** and urea **formaldehyde** content. Seeking out higher production capacity fabricators to use similar green materials would cut some costs. One of the biggest trade-offs was the lack of **LED** lighting choices for different applications. The designer looks forward to when **LED** lighting is available at a reasonable cost for task lighting and overhead lighting.

"The entire project was a valuable learning experience, particularly in researching and working with new green materials; understanding which green materials to recommend for future clients."

- Stephen Fiedler

Energy Star® refrigerator

List of Green Strategies

Energy Conservation

- Installed 14" round **solar light tubes** to bring in natural light
- Purchased **Energy Star**®-rated dishwasher, gas stove, refrigerator, and microwave
- Installed recessed hi-hat ceiling light fixtures with sealed, close contact insulation capability
- Used **LED** bulbs in high hat recessed fixtures
- Chose low-voltage lighting fixtures

Water Conservation

- Chose a two-handle kitchen faucet to minimize hot water demand
- Installed a tankless gas water heater
- Installed a reverse osmosis water purification system with a separate dispenser tap at sink
- Installed an under-mount stainless steel single bowl sink with a built-in drain board

Indoor Air Quality

- Used NAUF plywood for sub=flooring and cabinet case construction; NAUF bamboo materials
- Chose no-**VOC** paints for the walls, ceiling and trim
- Hazardous Air Pollutant (HAP) -free, no-VOC, water based finish on all cabinetry components

Sustainable Materials

- Chose bamboo products for cabinet doors, drawer fronts, side veneers, panels and case edging
- Installed recycled glass/concrete countertops
- Purchased engineered quartz secondary table tops
- Installed low-**VOC** natural linoleum flooring
- Installed insulation made from **borate**-treated shredded cotton blue jeans
- Tiled walls with 100 percent **pre-consumer recycled content** wall tiles
- Used 100 percent recycled wall board from power plant scrubber lime and recycled paper

Energy Star® gas range, oven, microwave, and dishwasher

Recycled glass countertop

Dining area

Case Study

Location of Project: Summit, New Jersey at the 100 year-old Twin Maples Estate

Homeowners: The Fortnightly Club of Summit (501c3 charity organization)

Architect: Hiland Hall Turner, Hiland Hall Turner Architects

General Contractor: Roger Polo, Polo Master Builders

Interior Designers: Peter Salerno of Peter Salerno Inc.; Kim Nadel of Niche Interior Design; Joan Picone of Joan Picone, Inc.; Jerri Eskow of Iron Gate Interiors; Sherrie Legro Round of Enchantment Lives; Kristen Bouterse of Paints Plus; Danielle Ann Millican of Danielle Ann Millican, Inc

Photographer: Marisa Pellegrini

Area Affected: Approximately 2200 square feet.

Overview and Scope

This project involved the preservation and complete green renovation of a century-old historic carriage house at the Twin Maples Estate in Summit, New Jersey. The work was completed for the recent Twin Maples Centennial Show. The second floor apartment was fully renovated, as was the lower level foyer and all of the heating, cooling and water systems for the structure. The lower level bays were left intact to preserve their historic terra-cotta tile floors and mahogany bead board walls and ceilings. Wood insulated garage doors were added to improve energy efficiency in the lower level.

Design Approach

One of the most important aspects of sustainable building practice and design is the reuse of existing structures and materials; the renewal of this 100 year-old carriage house represents a prime example of how new life can be brought to a historic building. The designers wanted to demonstrate that green design could be practical and aesthetically pleasing. They aimed to create beautiful interior spaces using environmentally-friendly furnishings, reclaimed and renewable flooring, and energy-efficient appliances throughout the house.

Team and Process

Seven interior designers teamed up with architect Hiland Hall Turner and builder Roger Polo. The designers incorporated several themes, including natural colors and materials, circular patterns representing the natural cycle, and a juxtaposition of contemporary and rustic details. The concept was to reuse, recycle and use renewable and energy-efficient resources.

Finance

Polo Master Builders and their subcontractors donated the materials and labor necessary to renovate the carriage house. Hiland Hall Turner donated his architectural services. The designers and their suppliers donated the interior finishes. Perfection Contracting donated the installation of the new high-efficiency hybrid heating and cooling system.

Lessons and Trade-offs

The design team found that while many green products, such as energy and water-efficient features, are readily available, other environmentally friendly products may be more expensive and require more careful research. Product availability for certain spaces may be trickier than others due to lack of knowledge on the part of suppliers as well.

"We hope to inspire architects, builders and homeowners to take action to make historic buildings more sustainable by installing history-friendly and eco-friendly building materials, as well as state-of-the-art efficient energy systems."

- Heidi Evenson, Co-Chairman, Twin Maples Centennial Show House

Remodeled Kitchen

List of Green Strategies

Energy Conservation

- Installed **Energy Star**® appliances in the kitchen
- Installed a high-efficiency hybrid heating and cooling systems to heat and cool the apartment and lower level foyer
- Added blown-in insulation to the walls and attic space
- Added a new insulated hay loft door and two insulated garage doors to improve energy efficiency and add natural light to the interior

Water Conservation

- Installed low-flow fixtures in the kitchen and bathroom
- Installed a dual-flush toilet in the bathroom

Indoor Air Quality

- Installed **formaldehyde-free** cherry cabinets in the kitchen
- Used low-**VOC** paints throughout the structure
- Used a green product to finish the recycled barn wood floor

Resource Conservation

- Incorporated fixtures comprised of existing materials such as **reclaimed** wood and recycled aluminum
- Refurbished new items from recycled materials such as a stairway runner from an old conveyor belt, a lamp from a wrought-iron gate, a nightstand from a sewing machine table, and a writing desk from an old barn door
- The flooring throughout was reclaimed from a barn in West Virginia

Sustainable Materials

- Utilized renewable and recycled materials throughout the house, including recycled leather tiles, bamboo flooring, reclaimed barn wood flooring, recycled glass, natural carpeting and wall-covering materials (including hemp, straw, and sea grass)

Remodeled Bedroom

Remodeled Foyer

Remodeled foyer

Remodeled bathroom

Remodeled and restored exterior

Green Products and Services

Introduction

The purpose of the Green Products and Services is to help homeowners navigate the market with some helpful tips on what to look for when shopping for a particular green home remodeling project. The Guide is organized by building system and lists the general products and services that pertain to remodeling tasks within that system. It includes features and applicable certifications to look for, as well as web links to more information on that product or service. Each item in the Guide also refers to the related REGREEN strategy IDs.

Please note that the New Jersey Green Home Remodeling Guidelines Version 1.0 do not endorse any particular brand or company. It is not the function of the Green Product and Service Guide to direct the consumer to a specific product, but rather to provide a resource to seek out an appropriate manufacturer or service provider to handle remodeling needs.

With the ever-increasing number of green products and services coming into the home remodeling market, finding the appropriate ones can be a challenge. Some manufacturers market products as "green" when in reality they are only marginally better for the environment or whose green features are neutralized by other aspects of their manufacturing or composition. This phenomenon is referred to as "greenwashing" and calls on consumers to seek out references and ensure the true extent of green value.

Product Certification Programs

That being said, there are several leading green product standards and certification programs that can help consumers identify products that meet predefined green criteria. The leading green product standards and programs include:

- Energy Star® - identifies efficient products that reliably deliver energy savings and environmental benefits
- WaterSense – identifies high performing, water efficient products and practices
- Cradle to Cradle - certifies products based on lifecycle of materials used to construct a product and the overall lifecycle of the product
- GreenGuard® Certification Program - certifies products and processes for their low chemical emissions and low toxicity
- Green Seal® - certifies products and practices for their low toxicity and overall environmental impact
- GreenSpec Directory - a published resource on environmentally preferable products
- Forest Stewardship Council (FSC)- certifies wood products coming from forests managed to meet social economic and ecological needs
- Sustainable Forestry Initiative (SFI) - certifies wood products coming from well-managed forests and responsible procurement practices
- National Fenestration Rating Council® (NFRC) - a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products

For more information on various certification programs currently in use by architects and designers see:

- the ecolibrary™matrix - www.thegreenstandard.org/documents/GGNC09_EcoLibCert.pdf
- Gaia Product Profile developed by The Green Standard™ - www.thegreenstandard.org/gaia.html

Two other reputable sources for green products and services are:

- Green Building Advisor that lists products from the GreenSpec Guide to Residential Building Materials www.greenbuildingadvisor.com/
- National Association of Home Builders (NAHB) Research Center - www.nahbrc.org/manufacturer/greenapproved/index.aspx

Product Standards for GreenSpec[1]

1. Products Made with Salvaged, Recycled, or Agricultural Waste Content
   a. Salvaged products
   b. Products with **post-consumer recycled content**
   c. Products with **pre-consumer recycled content**
   d. Products made with agricultural crop waste material

2. Products That Conserve Natural Resources
   a. Products that reduce material use
   b. Products with exceptional durability or low maintenance requirements
   c. Certified wood products
   d. Rapidly renewable products

3. Products That Avoid Toxic or Other Emissions
   a. Natural or minimally processed products
   b. Alternatives to ozone-depleting substances
   c Alternatives to hazardous products
   d. Products that reduce or eliminate pesticide treatments
   e. Products that reduce stormwater pollution
   f. Products that reduce impacts from construction or demolition activities
   g. Products that reduce pollution or waste from operations

4. Products That Save Energy or Water
   a. Building components that reduce heating and cooling loads
   b. Equipment that conserves energy and manages loads
   c. Renewable energy and fuel cell equipment
   d. Fixtures and equipment that conserve water

5. Products That Contribute to a Safe, Healthy Built Environment
   a. Products that do not release significant pollutants into the building
   b. Products that block the introduction, development, or spread of indoor contaminants
   c. Products that remove indoor pollutants
   d. Products that warn occupants of health hazards in the building
   e. Products that improve light quality
   f. Products that help noise control
   g. Products that enhance community well-being

Sources

[1] The online GreenSpec® Directory lists product descriptions for over 2,000 environmentally preferable products at www.buildinggreen.com

Alex Wilson."Building Materials: What Makes a Product Green?" EBN Volume 9, Issue 1 (revised January, 2006) www.buildinggreen.com/auth/article.cfm?fileName=090101a.xml

Kitchen Bath and Living Spaces

Building Envelope

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Windows	Look for windows with a high R-Value or low U-factor, and a low air leakage value.	ENERGY STAR NFRC National Fenestration Rating Council	National Fenestration Rating Council - Product Directory cpd.nfrc.org/search/searchdefault.aspx Energy Star® - Windows, Doors, Skylights www.energystar.gov/index.cfm?c=windows_doors.pr_windows Creating Windows of Energy-Saving-Opportunity www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970908.html Efficient Windows Collaborative www.efficientwindows.org/	EA56-59
Doors	Look for doors with a high R-Value or low U-factor, and Low Air Leakage Value.	ENERGY STAR NFRC National Fenestration Rating Council	National Fenestration Rating Council - Product Directory cpd.nfrc.org/search/searchdefault.aspx Energy Star® - Windows, Doors, Skylights www.energystar.gov/index.cfm?c=windows_doors.pr_windows Creating Windows of Energy-Saving-Opportunity www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970908.html Efficient Windows Collaborative www.efficientwindows.org/	EA56-59
Skylights	Look for skylights with a high R-Value or low U-factor, and Low Air Leakage Value.	ENERGY STAR NFRC National Fenestration Rating Council	National Fenestration Rating Council - Product Directory cpd.nfrc.org/search/searchdefault.aspx Energy Star® - Windows, Doors, Skylights www.energystar.gov/index.cfm?c=windows_doors.pr_windows Creating Windows of Energy-Saving-Opportunity www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970908.html Efficient Windows Collaborative www.efficientwindows.org/	EA56-59
Weatherstrip-ping	Weather resistant and durable will last longer and save resources because they are replaced less often.		U.S. Department of Energy - Energy Efficiency and Renewable Energy www..eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11280 Caulking and Weatherstripping www.eere.energy.gov/consumer/your_home/ How Stuff Works - Installing Weatherstripping home.howstuffworks.com/how-to-apply-weatherstripping.htm California Energy Commission - Consumer Energy Center www.consumerenergycenter.org/home/tightenup/weatherstrip.html	EA56-59

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Insulation	Reflective or radiant barrier insulation with a High R-Value will decrease heat loss.	ENERGY STAR	Energy Star® - Do It Yourself Guide to Sealing and Insulation www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing U.S. Department of Energy - Energy Efficiency and Renewable Energy www.eere.energy.gov/consumer/tips/insulation_sealing.html	EA56-59
Caulk and sealants	Always look for low- or no-VOC products.	GREEN SEAL, GREENGUARD	GreenGuard - Product Search www.greenguard.org/Default.aspx?tabid=12 Green Seal - Product Search www.greenseal.org/findaproduct/paints_coatings.cfm Green Builder Magazine - Adhesives and Caulk www.greenbuildermag.com/content/blogcategory/31/124/ Green Builder Magazine - Adhesives and Caulk www.greenbuildermag.com/content/blogcategory/31/124/	IEQ165/MR132
HVAC				
Dryer vent	Install an air-lock dryer vent to release hot moist air produced by the dryer. Installing a vent cap can reduce the heating load home by reducing air leakage.		Energy Federation Incorporated: "Heartland Dryer Vent Closure" www.energyfederation.org/consumer/default.php/cPath/86_742_110	EA72
Range hood/ kitchen ventilation	Units that produce 1.5 sones or less (measure of how loud fan is) are best for home use.	ENERGY STAR	American Council for an Energy-efficient Economy www.aceee.org/consumerguide/ventilation.htm EPA Energy Star® Ventilating Fans www.energystar.gov Home Ventilating Institute www.hvi.org	IEQ166/167/ IEQ172
Thermostat	Install a programmable thermostat that will save energy and money. The thermostat will reduce wasted cooling or heating by turning lower when no one is home.	ENERGY STAR	Climatecrisis.net: Take Action – What You Can Do www.climatecrisis.net/takeaction/whatyoucando/ American Council for an Energy-efficient Economy www.aceee.org/consumerguide/heating.htm Energy Star®: Thermostats www.energystar.gov/index.cfm?c=thermostats.pr_thermostats	EA67

Kitchen Bath and Living Spaces

Wall and Ceiling

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Fan shut-off	Automatic shut-off on bathroom fans can save money, energy and improve indoor air quality. Fans should be on for an hour after a shower or bath to remove moisture preventing mold growth.	ENERGY STAR	HGTV.com: Bathroom Fan Timers www.hgtv.com/home-improvement/bathroom-fan-timers/index.html HGTVpro.com –Bathroom Exhaust Fans www.hgtvpro.com/hpro/bp_mechanical/article/0,,HPRO_20151_4433444,00.html	IEQ167
Paint	Paints with natural pigments and oils and with low or no VOCs.	GREEN SEAL, GREENGUARD	GreenGuard - Product Search www.greenguard.org/Default.aspx?tabid=12 Green Seal - Product Search www.greenseal.org/findaproduct/paints_coatings.cfm Selecting Healthy and Environmentally Sound Finishes www.bayarea.greenhomeguide.com/index.php/knowhow/entry/760/C224	IEQ185/IDP5/MR130
Gypsum board	Products that are moisture resistant, non-paper faced, and mold resistant will improve indoor air quality and prevent premature replacement and repair.		Architech Magazine - Gypsum Board for the 21st Century www.architechmag.com/articles/detail.aspx?contentID=5938 ToolBase.org - Moisture Resistant Gypsum Panel Products www.toolbase.org/Technology-Inventory/Interior-Partitions-Ceilings/mold-resistant-gypsum-panel	IEQ183/IDP1/24 MR126
Tiles	Look for products with recycled content and that are durable.		GreenSupply.com - Recycled Tile Products www.greenbuildingsupply.com/Public/NaturalFlooring/RecycledTile/index.cfm National Parks Service - Toolkit www.nps.gov/sustain/spop/tile.html Green Buyer's Guide To Stone & Tile www.bayarea.greenhomeguide.com/index.php/knowhow/entry/642/C225/	MR132/156
Construction adhesives, grouts, caulking, and sealants	Products with low- or no-VOCs.	GREEN SEAL, GREENGUARD	GreenGuard - Product Search www.greenguard.org/Default.aspx?tabid=12 Green Seal - Product Search www.greenseal.org/findaproduct/paints_coatings.cfm Green Builder Magazine - Adhesives and Caulk www.greenbuildermag.com/content/blogcategory/31/124/	IEQ187/MR132

Kitchen Bath and Living Spaces

Floors and Flooring Products

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Hard surface flooring	Products with low -or no-formaldehyde, recycled content, low-or no-VOC finish, and hard durable surfaces.		FSC - Product Search www.fscus.org/faqs/fsc_products.php Green Seal - Product Search www.greenseal.org/findaproduct/index.cfm Green Guard - Product Search www.greenguard.org/?tabId=12 Formaldehyde in the Home www.arb.ca.gov/research/indoor/formaldgl08-04.pdf	IEQ180/159-160/191 MR134/114/IDP5
Certified, reclaimed or rapidly renewable flooring products	FSC-certified, recycled content, bamboo or other renewable material reduces strain on the environment. Always try to use low or no VOC finishes.		FSC - Product Search www.fscus.org/faqs/fsc_products.php Green Floors www.greenfloors.com/ ToolBase.org - Recycled Wood Floors www.toolbase.org/Technology- SmartWood Program of the Rainforest Alliance www.rainforest-lliance.org/forestry.cfm?id=certification Sustainable Forestry Initiative www.sfiprogram.org/	MR118/135-137
Finishes	Finishes derived from natural products like plant oils or beeswax are healthier for indoor air quality.		Building Supply- Non-Toxic Finishes www.greenbuildingsupply.com/Public/Non-ToxicFinishes/index.cfm Greener Building - Product List www.greenerbuilding.org/product_list.php?cid=45 Buyer's Guide To Clear Finishes www.greenhomeguide.com/index.php/knowhow/	MR137/IEQ159
Carpet	Brominated flame retardants (PBDE) are hazardous for indoor air quality.		Canada - Health Department www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/pbde-eng.php National Geographic -The Green Guide www.thegreenguide.com/doc/106/pbde	MR139/IEQ182
Grout, caulk, sealants	Look for low- or no-VOC products.		GreenSeal - Product Search www.greenseal.org/findaproduct/index.cfm GreenGuard - Product Search www.greenguard.org/?tabId=12	IEQ180/MR134

Kitchen Bath and Living Spaces

Plumbing

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Faucet fixtures and aerators	Low-flow faucets or aerators with a flow rate between 1.5 to 2.0 gallons per minute. Water Sense®-labeled faucets require a maximum flow rate of 1.5 gpm and a minimum flow rate of .8 gpm.	WaterSense Meets EPA Criteria	EPA Water Sense Program epa.gov/watersense/ Consumer Reports -Low Flow Faucets blogs.consumerreports.org/home/2008/05/epa-watersense.html H20use – Water Saver Home www.h2ouse.org/	WE41-44
Water filter	The most commonly used filter is a Granulated Activated Carbon (GAC,home carbon filter). More expensive options are Ultra-Violet (UV) filter, reverse osmosis.	NSF	NSF Water Treatment Product Search www.nsf.org/Certified/dwtu/ Minnesota Dept. of Health- Water Treatment Carbon Filters www.health.state.mn.us/divs/eh/hazardous/topics/gac.html Consumer Guide to Water Filters www.nrdc.org/water/drinking/gfilters.asp	IEQ175-176
Piping	Cross-linked polyethylene (PEX), or copper piping. PVC pipes are made from toxic chemicals that pollute the environment.	NSF	Hot Water Delivery – Systems and Construction Practices www.awwa.org/waterwiser/references/pdfs/RES_HW_Klein_G_Hot_Water_Delivery_Systems_and_Constructi.pdf Toolbase: Resource Efficient Plumbing www.toolbase.org Hot Water Delivery – Systems and Construction Practices www.awwa.org/waterwiser/references/pdfs/RES_HW_Klein_G_Hot_Water_Delivery_Systems_and_Constructi.pdf	MR122
Water heater	Units with closed combustion or electric ignition. Tankless water heaters may also work depending on the user.	GREEN SEAL, GREENGUARD	PSEG - Tankless Water Heaters www.pseg.com/customer/home/install/waterheaters.jsp American Council for an Energy Efficienct Economy www.aceee.org/consumerguide/waterheating.htm Insulate Your Water Heater Tank for Energy Savings http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13070	EA79
Equipment				
Refrigerator	The most efficient units are ones with the freezer on the top. Bottom freezer units are also very efficient, but avoid side-by-side units.	ENERGY STAR	American Council for an Energy-efficient Economy www.aceee.org/consumerguide/refrigeration.htm Energy Star® - Purchasing Tips www.energystar.gov/index.cfm?c=refrig.pr_tips_refrigerators Consortium For Energy Efficiency – Refrigerators www.cee1.org/resid/seha/refrig/refrig-main.php3	EA93

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Dishwasher	Units with an air-dry option and Energy Factor (EF) of at least 0.65		American Council for an Energy-efficient Economy www.aceee.org/consumerguide/dishwashing.htm Energy Star® - Purchasing Tips www.energystar.gov/index.cfm?c=dishwash.pr_tips_dishwashers	EA94
Cooking appliances (ovens, ranges)	Electric ignition ranges are more efficient than those with pilot lights. Self-cleaning ovens are more insulated and more efficient. Induction ovens are the most efficient but expensive; convection ovens are also efficient and more affordable.		American Council for an Energy-efficient Economy www.aceee.org/consumerguide/cooking.htm	EA95
Uses				
Cleaning products	Products derived from natural ingredients, plant-based oils,and disinfectants are healthier for home use. Always look for low- or no-VOC products.		Low Impact Living www.lowimpactliving.com/ Grist.org – A Test of 8 Green Bathroom Cleaning Products www.grist.org/advice/products/2008/03/25/	IEQ196
Laundry				
Shut-off valve	Install a single-throw shut-off valve on the supply line the for hot and cold water. This is a quick and inexpensive way to prevent potential leakage problems.		Do It Yourself – How to Install Shut Off Valves www.doityourself.com/stry/installshutoffvalve	MR124
Drain/drain pan	Install a drain and drain pan under the clothes washer that will prevent water damage should a break or a leak occur.		Checklist for Decay Resistance www.lsuagcenter.com/en/family_home/home/la_house/my_ house/Durable/ Clotheswasher Drain Pan Specifications www.floodsaver.com/24_Specs.htm ReGreen Reference Guide to Product Considerations, www.regreenprogram.org	MR125

ambient lighting Ambient lighting uses warm lighting sources with a color temperature between 2700 - 3000K that is more flattering to skin tones and clothing. Recommended for living spaces.

ANSI/ASHRAE

ANSI The American National Standards Institute oversees the activities of many industries in the United States to ensure competitiveness in the global marketplace, the health of consumers, and environmental protection.

ASHRAE The American Society of Heating, Refrigerating and Air-Conditioning Engineers is an international organization whose mission is to advance the arts and sciences of heating, ventilating, air conditioning, and refrigerating to serve humanity and promote a sustainable world.

asbestos Asbestos is the name given to a number of naturally-occurring, fibrous silicate minerals mined for their useful properties such as thermal insulation, chemical and thermal stability, and high tensile strength. Asbestos is commonly used as an acoustic insulator, and in thermal insulation, fire proofing and other building materials. Many products in use today contain asbestos.

awning An awning is a constructed frame covered in a material that extends from an existing structure (usually the side of a house) to provide protection from the sun and rain.

backdrafting Backdrafting occurs when a home becomes depressurized from air escaping to the outside and is replaced with air entering from the exterior. This air may contain combustion products including carbon monoxide.

Blower Door Test The Blower Door Test measures the leakiness of the house or its air infiltration and helps a homeowner prioritize problem areas. This test uses pressure differences created by air flow via a calibrated fan that mounts on the frame of an existing door and pulls air out of the house, lowering the inside air pressure. As higher pressure outside air travels in through unsealed cracks and openings, tools like a smoke pencil can detect these air leaks as part of a visual inspection process.

brominated Brominated materials are combined with Bromine, a heavy, volatile, corrosive, reddish-brown, nonmetallic liquid element, having a highly irritating vapor. Some of the materials include flame retardants, photographic chemicals, and dyes among others.

building envelope The building envelope of a structure is descriptive term that separates its interior from the exterior.

carbon dioxide (CO_2) Carbon Dioxide is a gas byproduct of the burning of fossil fuels and other forms of combustion.

carbon monoxide (CO) Carbon Monoxide is a toxic gas byproduct of combustion that is both odorless and colorless. Sources of its production include wood stoves, fireplaces, gas stoves, and furnaces among others.

carbon/specialized media Carbon or specialized media refers to the presence of bacteria that can be applied to a filtration system to remove certain pollutants.

cellulose Cellulose fibers from recycled newsprint can be applied as a form of insulation resistant to flame, mold, and pests; provides thermal and sound insulation, and resists settling.

cellulose fiber Cellulose fibers from recycled newsprint can be applied as a form of insulation that resists flame, mold, and pests, provides thermal and sound insulation, and resists settling.

cement board Cement board is a non-combustible, water-durable, and mold-resistant panel that is typically used under tile and other finishes, for interior and exterior use.

certified sustainable wood Certified sustainable wood meets specific criteria developed by organizations such as the Forest Stewardship Council to promote responsible wood harvesting and condemn the exploitation of local peoples.

Chlorinated Polyvinyl Chloride (CPVC) Chlorinated Polyvinyl Chloride (CPVC) are thermoplastic piping materials used for such applications as water distribution, industrial fluid handling, and fire suppression systems.

Color Rendering Index (CRI) The Color Rendering Index (CRI) is a 1-100 scale that measures how colors appear under different light sources. A light source with a CRI of 80 or higher is considered acceptable for most indoor residential applications.

combustion Combustion is the chemical process of the release of gasses in the process of burning of a fuel.

combustion appliances Combustion appliances burn fuels including stoves, water heaters, and clothes dryers. It is important to make sure that these appliances work correctly and are properly ventilated to prevent carbon monoxide, a byproduct of combustion, from entering the home.

combustion equipment Combustion equipment refers to appliances that burn fuels including stoves, water heaters, and clothes dryers. It is important to make sure that these appliances work correctly and are properly ventilated to prevent carbon monoxide, a byproduct of combustion, from entering the home.

Compact Fluorescent Lights (CFLs) Compact fluorescent lights are the miniature fluorescent lights that can screw into light fixtures that conventionally use incandescent bulbs. CFLs are more energy-efficient and durable than incandescent bulbs.

cross-linked polyethylene (PEX) Cross-linked polyethylene is a plastic often used for water supply piping that is flexible, resistant to scale and chlorine, doesn't corrode, is faster to install, and has fewer connections and fittings than does metal piping or rigid plastic piping such as PVC, CPVC, and ABS.

diffuser Diffusers are circular, square or rectangular air distribution outlets which are usually located in the ceiling. They are comprised of deflecting blades which discharge supply air in various directions. Diffusers are designed to mix the conditioned air entering the space with the air already contained in the space.

disposable respirators Disposable respirators or filtering facepieces can be made of cloth or paper and are designed to clean the air as you breathe it to prevent you from inhaling irritating substances.

double-hung window(s) Double-hung windows have two vertically sliding sashes, each closing a different part of the window.

double-pane window(s) Double-Pane Windows consist of two pieces of glass separated by an air space. The air space allows for less heat transfer between the interior and the exterior of the home reducing heating and cooling loads.

drain pan Drain pans are installed to catch any fluids leaking from a piece of equipment such as a clothes washer.

Duct Blaster Test A duct blaster utilizes a fan and a pressure gauge to measure the amount of air escaping from the ductwork of a home by pressurizing the system.

duct cleaning Duct cleaning refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, diffusers, heat exchangers, heating and cooling coils, drain pans, fan motor, fan housing, and the air handling unit.

electrochromic Electrochromic windows can convert from being transparent to tinted via an electrical switch, or a sunlight or temperature sensing detector that applies an electrical charge to the window. These window systems can control the amount of light and solar energy that pass through providing control over daylighting, glare, solar heat, and protection from harmful ultraviolet (UV) rays.

endocrine system The endocrine system regulates the release of hormones throughout the body. They control metabolism, growth and development, mood, and tissue function.

energy performance rating Energy performance ratings indicate the potential for heat transfer and sunlight transmittance of windows, doors, and skylights.

Energy Star® Label The Energy Star label appears on appliances that meet the standards developed by the United States Environmental Protection Agency of energy, water and other resource conservation.

Environmental Protection Agency (EPA) The United States Environmental Protection Agency conducts research, educates, and assesses issues in environmental science to promote human health and a healthy environment.

fire retardants Fire retardants are chemicals used to prevent or resist the spread of fire.

flame retardants Flame retardants are non-combustible materials that resist the spread of fire.

flashing Any piece of material, usually metal or plastic, installed to prevent water from penetrating the structure.

formaldehyde Formaldehyde is a chemical compound used in products including paper towels, photographic film, glues, and inks among others. It is important to avoid products containing formaldehyde whenever possible as they off-gas potentially hazardous pollutants.

Forest Stewardship Council (FSC) The Forest Stewardship Council (FSC) is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests.

Forest Stewardship Council (FSC)-Certified Wood The Forest Stewardship Council certifies wood that complies with its standards, disapproving of illegally harvested wood, wood harvested in violation of traditional and civil rights, in forests in which High Conservation Values (areas particularly worthy of protection) are threatened through management activities, from conversion of natural forests, and from areas where genetically modified trees are planted.

glazing Window glazings are compounds applied to glass to reduce the amount of heat transfer between the interior and the exterior of a building and/or the ultra-violet (UV) light passing that passes through it.

grille Grilles are vent covers that are normally used on air return ducts. Grilles do not have a pre-attached damper. Louver assemblies can be used with grilles so that the grilles can be used on forced air ducts and still provide airflow control.

gypsum Gypsum is a mineral found in sedimentary rock formations in a crystalline form known as calcium sulfate dihydrate. It is typically used in wall board to create of a non-combustible core.

gypsum board Gypsum board or drywall is used in various paneling applications that consist of a paper-faced non-combustible gypsum core.

H-axis machines Horizontal-axis (H-axis) or front loading washing machines use less water by dipping clothes into the water at the bottom of their basins as they rotate.

heat exchanger(s) Commonly used in space heating, refrigeration, air conditioning, and other applications, heat exchangers are devices built for efficient heat transfer from one medium to another.

Heat-Recovery Ventilator (HRV) Heat-recovery ventilators are air circulation systems that minimize the amount of heat that gets lost as air is transferred between the interior and exterior of a home, saving energy.

heating and cooling coils The heating and cooling coils of an appliance or piece of machinery converts electricity into heat energy.

heating load Heating load refers to the amount of heat it takes to maintain the temperature of an indoor space.

Heating, Ventilation, and Air Conditioning (HVAC) Systems Heating, Ventilating, and Air Conditioning systems process and supply air through ductwork helping to regulate humidity and temperature in buildings to provide safe, healthy, and comfortable conditions.

heavy metals Heavy metals including copper, selenium, and zinc are elements found in the earth's crust that can't be degraded or destroyed. Some in small doses are vital to bodily functions while high concentrations can be lethal.

HEPA filtered air scrubbers High efficiency particulate air or HEPA air filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles down to a size of 0.3 micrometers (μm) in diameter.

HEPA vacuum High efficiency particulate air or HEPA filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles 0.3 micrometers (μm) in diameter. HEPA filter

used in vacuum cleaners trap the fine particles (such as pollen and dust mite feces) which trigger allergy and asthma symptoms.

High-Density Polyethylene (HDPE) High-density polyethylene (HDPE) is a thermoplastic used to make milk bottles, packaging containers, toys and other products because of its resistance to most chemicals, high impact tensile strength, and insolubility in organic solvents.

Home Performance Audit Home Performance Audits are conducted to assess the energy efficiency of a home and evaluate possible energy saving measures.

home-run piping system Home-run or manifold plumbing systems utilize both PEX piping and a manifold. The system is characterized by direct lines from the manifold to any fixtures thus reducing the amount of water needed and provides hot water faster.

HUD The United States Department of Housing and Urban Development is a cabinet-level department that was created in 1965 to increase home ownership, support community development, and increase access to affordable housing free from discrimination.

IICRC S500 Guidelines The Institute of Inspection, Cleaning and Restoration is an independent, non-profit certification body that sets and promotes standards for the inspection, cleaning and restoration service industry. These guidelines provide specific practical standards for water damage restoration.

indigenous Indigenous peoples are descendents of the earliest known inhabitants of a particular geographic region.

infrared camera technology Infrared camera technology is used to detect thermal variations and may be used in conducting energy efficiency analyses.

jute Jute is a glossy plant fiber used to make sacks, rope, twine, and other materials.

Kelvin (K) Kelvin is a universally accepted base unit used to measure temperature. One degree in Celsius is equivalent to one degree in Kelvin. Water freezes at zero degrees Celsius, which is approximately 273.16 Kelvin.

Light-Emitting Diode (LED) Light Emitting Diodes are electronic light sources that use less energy than incandescent bulbs or compact fluorescent lamps.

louver(s) Louvers are vertical slats on a window, blind, or shutter that are angled in such away to allow in light and air while providing a shield from rain, direct sunlight, and noise.

low-E Low-E or Low-Emissivity glazings are metal or metal oxide coatings applied to windows to reduce heat flow.

low-VOC These products contain smaller amounts than standard materials of volatile organic compounds (VOCs) that can off-gas chemicals and cause air pollution.

Modified Energy Factor (MEF) is a combination of Energy Factor and Remaining Moisture Content (RMC). MEF measures energy consumption of the total laundry cycle (washing and drying). It indicates how many cubic feet of laundry can be washed and dried with one kWh of electricity; the higher the number, the greater the efficiency.

moisture meter Moisture meters are devices used to measure the amount of water in a given substance that help determine if it is ready to use.

mold amplification sites Mold amplification sites are locations where mold has built up over time. Typical sites of indoor mold buildup are damp cellulosic materials (e.g. wallboard paper, wallpaper, carpet backing, damp papers); debris in ventilation ducts, in carpets, or in mattresses or upholstered furniture; poorly maintained humidifiers; insulation on which organic film has accumulated; constantly humid painted, caulked or plastic surfaces (e.g., windowsills, shower stalls, cold air return vents); and potted plant soils.

mortar Mortar is a sandy material that combines with cement and water to bond tile, stone, brick, or concrete blocks.

National Air Duct Cleaning Association (NADCA) The National Air Duct Cleaners Association (NADCA) was formed in 1989 as a non-profit association of companies engaged in the cleaning of HVAC systems. Its mission was to promote source removal as the only acceptable method of cleaning and to establish industry standards for the association.

National Fenestration Rating Council (NFRC) The National Fenestration Rating Council (NFRC) is a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products.

off-gassing Off-gassing is a release of chemical materials due to evaporation and may release potentially hazardous gases.

passive heating Passive solar heating systems transfer sunlight into heat energy that can be used to warm building interiors.

petroleum-based Petroleum-based products are made from the raw natural resource petroleum, such as oil and natural gas.

phantom load The phantom load refers to the electricity being used by an appliance when it is turned off but still plugged into an outlet.

plasticizers Plasticizers are additives that increase a materials workability, flexibility, or pliability.

Polyvinyl Chloride (PVC) Polyvinyl chloride is a plastic commonly used as piping that is capable of off-gassing harmful chemicals.

porous Porous materials have spaces through which gases and/or liquids can pass.

post-consumer recycled content Post-consumer recycled products consist of materials that were previously used by consumers.

power-vented combustion Power-vented combustion appliances have fans that draw combusted air outside.

pre-consumer recycled content Pre-consumer recycled materials consist of industry scraps.

radon Radon is a carcinogenic (cancer-causing) radioactive gas produced from the decay of uranium in rock, soil, and water.

reclaimed materials Reclaimed materials are salvaged architectural components that save money, are better for the environment, and are aesthetically pleasing.

reclaimed wood Reclaimed wood is salvaged lumber that can save money, is better for the environment, and is aesthetically pleasing.

recycled content Products with recycled content are made from materials that have already been used in another product.

registers Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

return air duct Return ducts prevent the pressurization of closed rooms from supply air by allowing air to flow black to the central return grille.

reverse osmosis Reverse osmosis is a filtration process that forces a liquid through a membrane allowing only the pure solvent to pass.

R-Value The R-value of a material indicates its resistance to heat transfer. A high R-value is better than a low R-value.

sash Window sashes consist of the moving section(s) of a window.

s**ealed combustion** Sealed combustion appliances only use air from the outside and directly vent the combustion air back outdoors.

sheathing Sheathing refers to a building material that is used to cover exterior wall framing or roof trusses.

single-pane windows Single-paned windows have only one piece of glass separating the interior and exterior of a home. Double-pane windows are considered to be much more energy-efficient.

single throw shut-off valve Single throw shut-off valves can prevent flooding by turning off the supply of water should a clothes washer hose malfunction.

sisal Sisal is a plant that produces stiff fibers for applications such as rug or twine making.

Solar Heat Gain Coefficient (SHGC) The Solar Heat Gain Coefficient is the fraction of incidental solar radiation admitted through a window.

solar tube(s) Solar tubes consist of a clear dome that collects sunlight into a highly polished and reflective tube that reflects the light down to a diffuser on the ceiling. They are sufficient enough to light a small room, hallway, or staircase.

solvent A solvent is a liquid substance capable of dissolving other substances.

sones Sones are a measure of loudness.

storm door Storm doors consisting of a combination of glass and screens can be used to increase the energy efficiency of an exterior doorway.

storm window Storm windows are pieces of glass or plastic mounted to the interior or exterior of an existing window that serve to reduce the amount of airflow in and out of a home, reducing heating and cooling loads.

supply duct(s) Supply ducts made of formed sheet metal deliver air to interior spaces from an HVAC system.

task lighting Task lighting, often described as "cool" lighting, produces higher contrasts that are better for seeing. Task lighting sources emit temperatures between 3600-5500K.

terpenes Terpenes are found in nature usually as the essential oils of certain plants that are used in fragrances, food additives, and other products.

transom Transoms are the windows above doors that serve to allow in sunlight and release warm air.

U-Value The U-value or U-factor of a window assembly indicates its rate of heat loss. The lower the U-value the better.

Ultraviolet (UV) radiation Ultra-violet Light (UV) is defined as electromagnetic radiation in the spectral region between 180 and 400 nanometers. Prolonged exposure to UV light can result in sunburns, skin cancer, and the fading of certain materials.

ultraviolet treatment Ultraviolet water treatment systems utilize a mercury lamp that exposes water to UV rays to through a chamber that kills any bacteria. The system doesn't add any taste or odor to the water and should only be used with clear water.

urea-formaldehyde-free Urea-formaldehyde-free products lack any urea formaldehyde content known to off-gas harmful pollutants.

virgin materials Virgin material is made exclusively with raw materials and contains no recycled content.

vitrified clay Vitrified clay pipe (VCP) is a sustainable sewer piping material.

Volatile Organic Compound(s) (VOC) Volatile Organic Compounds (VOCs) are off gassed from certain solid or liquid products that when exposed to them may cause negative health effects.

Water Factor (WF) Water factor is the number of gallons needed for each cubic foot of laundry. A lower number indicates lower consumption and more efficient use of water.

Water Sense® labeled Water Sense labeled equipment meets specific water efficiency and performance criteria established by the U. S. Environmental Protection Agency.

weatherstripping Weatherstripping is the sealing of cracks or holes around windows, doors and other openings exposed to the exterior of a building with caulk, foam, rubber strips, or other materials that can be used to reduce airflow between the interior and the exterior.

whole house fan Whole house fans located on attic floors ventilate warm air from interior spaces to the outside while depressurizing the home to draw in cool air from open windows.

zero-VOC Zero-VOC products contain no volatile organic compounds and thus do not negatively impact air quality from off-gassing chemicals.

Increasing the livable space in the home through finishing the basement or adding a new addition provides an excellent opportunity to incorporate green home remodeling. In basement remodeling and additions, ensuring indoor environmental quality through radon reduction and moisture control is paramount. Before embarking on a do-it-yourself remodel, consider consulting with a professional who can help ensure implementation of proper green design techniques. Selecting green options for basements and major additions requires a bit of research, but the overall benefits of better insulation, ventilation, and finishes cannot be understated.

Finished Basement and Major Addition

Photo: Lise Thompson

Finished Basement and Major Addition

How to Use the Guidelines

Health and Safety

HS1 - Nuisance and Toxic Dust Control
HS2 - Cautious Materials - Asbestos & Lead
HS3 - Mold
HS4- Radon

Green Home Maintenance and Housekeeping

Site

Configure for solar access **[EA100]**
Consider on-site renewable energy **[EA102]**
Minimize site disturbance **[SS29]**
Landscape for passive heating and cooling **[SS30-31/36]**
Maintain slope to drain away from building **[IDP13]**
Minimize impervious surfaces **[SS32]**
Landscape to minimize heat island effects **[IDP17]**
Plan for erosion control **[SS39]**

Foundation

Test and install a radon mitigation system **[IEQ163]**
Insulate floor slab and foundation walls **[EA47]**
Provide moisture control at foundation **[IDP19]**
Utilize Integrated Pest Management **[IDP23]**
Use biobased form-release agents **[MR115]**
Use fly ash in concrete **[MR114]**

Building Envelope

Conduct a Home Performance Audit and diagnostic tests **[IDP2/EA51-54]**
Minimize wood use with advanced framing **[MR116]**
Install or upgrade insulation **[EA49]**
Install a durable wall cladding **[MR119]**
Air seal to reduce infiltration **[IDP55]**
Include capillary break **[IDP22]**
Provide moisture management strategies **[IDP24]**

HVAC

Follow standards for mechanical design **[EA63]**
Provide controls and zoning for HVAC **[EA64]**
Select high-efficiency HVAC equipment **[EA66]**
Install programmable thermostats **[EA67]**
Conduct duct tightness test **[EA68]**
Maintain HVAC systems **[EA69]**
Seal and insulate HVAC system **[EA70]**
Make sure ductwork is clean **[EA71]**
Use ceiling fans for natural ventilation **[EA65]**

Plumbing

Insulate water heater **[EA80]**
Insulate hot water pipes **[EA81]**
Utilize solar water heating **[EA101]**

Lighting and Electrical

Plan for future wiring and cabling needs **[MR121]**
Provide daylighting **[EA83]**
Provide appropriate lighting **[EA84]**
Install energy-efficient lighting **[EA85]**
Provide appropriate indoor lighting controls **[EA90]**

Wall and Ceiling

Use non-paper-faced gypsum board in moist areas **[IEQ183]**
Install eco-friendly interior sheathing **[MR126]**
Choose eco-friendly paints, sheens, and finishes **[IEQ185/MR130-131]**
Select eco-friendly wall coverings **[MR129/IEQ186]**

Furniture and Fittings

Select eco-friendly furniture **[MR141-143/146-147/150]**
Choose furniture/fittings that resist moisture **[IEQ188]**

Use

Select materials that are easy to clean **[MR156]**

Case Studies

Green Products and Services

Glossary of Terms

How to Use the Guidelines

Organization of the Guidelines

The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

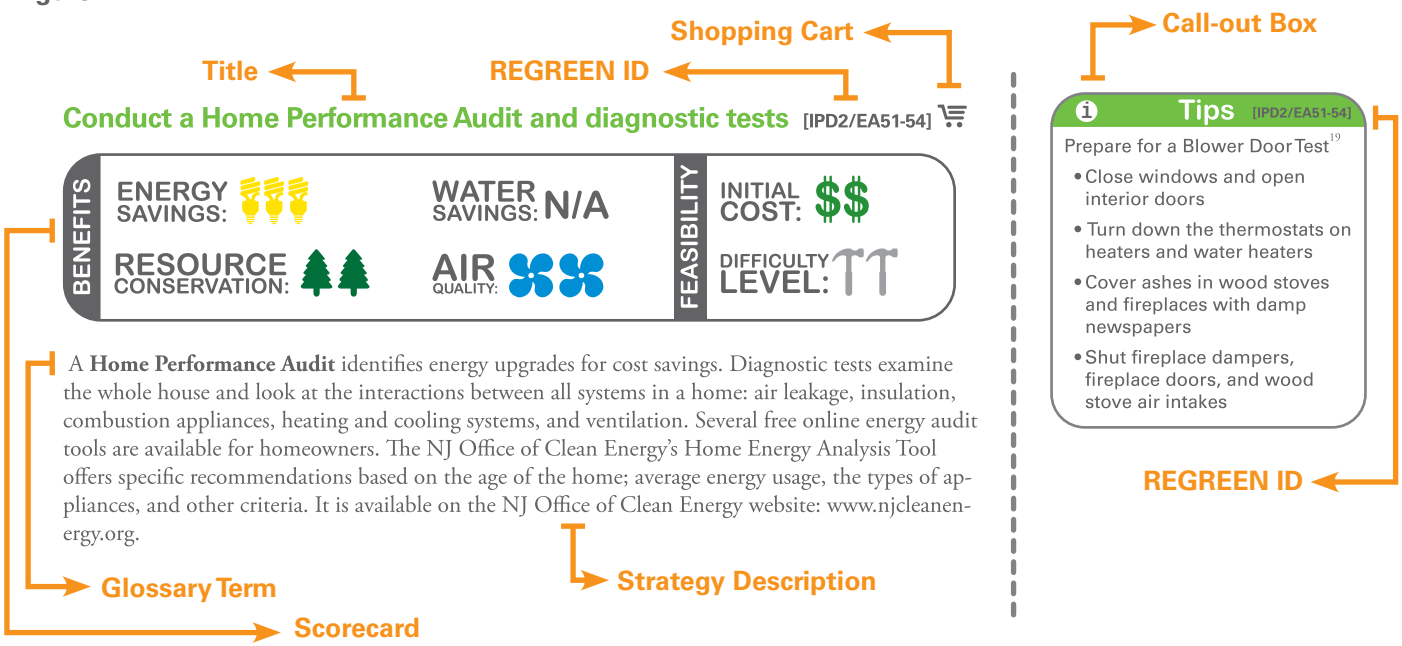
Each chapter includes the following:

- How to Use the Guidelines
- Health and Safety
- Green Home Maintenance and Housekeeping
- Best Practice Strategies
- Resources and References
- Case Studies
- Green Products and Services
- Glossary of Terms

Getting the Most from the Strategy Write-ups

The Guidelines provide information on best practice strategies for each project type. These strategy write-ups are organized by building system and follow the order of the 2008 REGREEN Residential Remodeling Guidelines (i.e., IDP2), which are incorporated with permission. **Figure 1** describes the information available.

Figure 1



Title and REGREEN Strategy ID – The strategies in the REGREEN Residential Remodeling Guidelines 2008 inspired most of the strategies in these Guidelines. Where appropriate, the strategy references the related REGREEN strategy ID.

Shopping Cart – The cart denotes entries in the Green Product and Service Guide located in the back of each project chapter.

Strategy Description – This write-up provides an overview of each strategy and its environmental benefits.

Glossary Term – Acronyms and green building terms are highlighted in bold and defined in a glossary at the back of each chapter.

Call-out Boxes - The call–out boxes in **Figure 2** highlight information of special importance. These include the following types of information:

- Tips - useful hints or practical facts for accomplishing a strategy
- Incentive - sources of financial assistance
- New Jersey Bio-Region - New Jersey has 5 bio-regions, each with unique elements and environmental features to consider when remodeling
- Building Age - a home's age can inform needed repairs and call out special circumstances
- Caution - on occasion, there are hazards associated, so items are called out for safety reasons

Hazard Symbol - Symbols were developed to advise users of certain health and safety threats related to specific strategies. The symbols, which appear below, reference the guidance on Health and Safety located at the beginning of each section.

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

Web Link - When viewing this document electronically, the websites will hyperlink, however, occasionally website links change. In most cases, the site provides a seamless link to the new address. If this is not the case, users may need to copy and paste the link into the browser address bar. At the time of publication the hyperlinks in this report were all functional.

Scorecard - The scorecard, **Figure 3**, provides a snapshot of the environmental benefits, initial costs, and difficulty levels associated with a particular strategy. Both qualitative and quantitative information was used to assign scores to each strategy.

Figure 3

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

It is divided into two parts: 1) Benefits and 2) Feasibility.

Graphic icons were developed for each impact category.

BENEFIT Key

1 icon = low benefit, 2 icons = medium benefit, 3 icons = high benefit

FEASIBILITY Key

$ low initial cost, $$ medium initial cost, $$$ high initial cost

T low difficulty level, TT medium difficulty level, TTT high difficulty

The icons above have been developed to graphically describe the ratings that follow.

BENEFITS

Energy Savings

To help meet its greenhouse gas reduction responsibility, in 2007 New Jersey passed **carbon dioxide** (CO_2) reduction goals, i.e., achieve 1990 emission levels by 2020, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. The state has also established renewable energy and energy efficiency targets. Green remodeling strategies utilize renewable energy sources such as solar, geothermal, and wind to net a lower CO_2 footprint.

Figure 2

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

Water Savings

Water conservation reduces water use both inside and outside the home. Within the home this may include low-flow fixtures. Outside the home this may refer to using **native plants** that have lower watering requirements or rain barrels to collect rainwater for reuse on the lawn and garden. Water management includes providing proper moisture control at footings, slab perimeter, and foundation walls as well as using porous paving materials to encourage stormwater recharge for reduced runoff.

Air Quality

Americans spend up to 90 percent of their time indoors where air quality can be more polluted than outdoors. Pollutants range from allergens such as mold, mildew, fungus, and dust mites to toxins, such as asbestos, and volatile organic compounds like formaldehyde and benzene found in building materials and a number of household items including pressed-wood furniture, computer ink, carpeting, and conventional household cleaners and cosmetics.

Resource Conservation

Resource conservation means using materials that are durable and easy to maintain with low embodied energy (the energy used in resource extraction, manufacturing, shipping). These come from renewable sources or are produced from waste, recycled materials, or salvaged from other uses. Avoiding building materials that deplete natural resources, such as old-growth timber, and materials made from toxic or hazardous substances improves nature's ability to provide goods and services.

FEASIBILITY

$ Initial Cost

Cost is always a consideration for remodeling projects. Evaluating the cost of a recommended green remodeling strategy provides homeowners with a better sense of the relative costs and benefits of each recommended measure.

Costs come in two forms, so it is important to consider both in assessing feasibility. The first reflects initial costs of the strategy compared to conventional practices. A second consideration to make is the pay-back period or life-cycle cost. The pay-back costs are less obvious and are often project specific, but they can have significant environmental and economic value that factor into the overall cost. For more information on average costs, savings, and payback periods of typical energy efficiency improvements, see the Energy Efficient Rehab Advisor at (www.rehabadvisor.pathnet.org/). For customized results, have an energy professional conduct a thorough energy audit of your home.

$ Less than $500

$$ $500-$5,000

$$$ Greater than $5,000

Difficulty Level

Time is money and expertise is gained over time. Some people may consider a Home Performance Audit strategy in the 'medium' category because although relatively straightforwardto act on, it requires experts with custom equipment to prepare an accurate assessment. Implementing the findings from a Home Performance Audit becomes a 'high' difficulty category as space heating and cooling systems, ventilation, water heating, appliances, climate and even site factors need to be integrated to assure desired energy improvements across 'ALL loads' and to avoid negative unintended consequences. It is expected that 'high' difficulty strategies may also be dangerous for the basic homeowner to undertake.

T Easy to Do It Yourself (DIY) - little previous knowledge necessary

TT Task for an Experienced DIYer or Professional - may require additional effort and higher learning curve than conventional strategy it replaces

TTT Task for an Expert/Certified Professional - high learning curve; new technique; requires specific green knowledge

Notes: [1] U.S. Environmental Protection Agency 2008. Healthy Buildings, Healthy People: A Vision for the 21st Century

Health and Safety

Green remodeling poses hazards typical of many other home renovation or remodeling projects because of the age of the homes (given that they are more likely to contain older and use more hazardous materials) and the incentive for green remodeling to replace older or damaged building systems.

New Jersey homeowners considering green remodeling should anticipate potential emissions of hazardous air contaminants during removal of old building materials. The risks associated with improper removal of materials containing **asbestos**, lead, mold or even fiberglass insulation are minimized by understanding and following the steps listed here prior to initiating work. For complex situations, consider hiring professionals.

General hazard recognition and risk reduction information for the following potential renovation-related risks are contained in this section:

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

HS1 – Nuisance and Toxic Dust Control

Construction projects involving demolition of existing sheetrock, plaster, wood, brick or concrete products in ceilings, walls or floors of a home will release dust as these materials are ripped, sanded, ground, pulverized or crushed. Control of dust emissions during the pouring of solids or from transferring of small particles is controlled in industrial facilities. Homeowners planning renovation projects should also consider steps to minimize the release and maximize control of dust in the environment. These nuisance dusts, when released from the point of origin into the air of the home, tend to remain suspended in the air for very long periods of time, and as such, will be transported with air currents caused by open doors, cracks around and beneath doorways, forced air heating and cooling ductwork, and even by the air currents caused by persons walking in and out of dusty areas, to other areas of the home. At a minimum, allowing the uncontrolled release of nuisance dusts from any demolition project, as well as those created from sawing, sanding, or grinding of newly constructed materials (e.g., sheetrock, spackling, wood dust etc.) presents unnecessary and difficult dust cleanup demands for affected living spaces. At their worst, susceptible occupants of homes where uncontrolled nuisance dusts are allowed to escape into adjacent living spaces may temporarily experience eye, nose, or throat irritation. Asthmatics may experience adverse respiratory distress when exposed to high levels of nuisance dust particles.

There are several simple steps to minimize potential hazards of nuisance dust during remodeling.

1. Remove unnecessary porous and non-porous materials (e.g., draperies, bedding, upholstered furniture, children's toys, clothing, etc.) from the project area.
2. Seal the project area from the remainder of the home using polyethylene sheeting at doorways and at inlets to any forced air supply or **return registers** within the project space.
3. Consider installing **HEPA filtered air scrubbers** in the project area and discharging the exhaust air through an adjacent window using a tight fitting flexible duct through a sealed window opening (consider surrounding security requirements). Use a lightweight section of facial tissue at the doorways to confirm that air pressure is moving from the clean adjacent living space and into the project area (not the other direction) so that air leaks from the clean home into the dirty renovation area. This will reduce any potential for dusts from the renovation area to enter the adjacent areas of the home.
4. Periodically during the work session and after every work session, **HEPA vacuum** the renovation area following renovations to remove accumulated surface dust, without re-suspending it into the air.

HS2 – Hazardous Materials - Asbestos & Lead

When removing old building materials, know that they contain hazardous materials, which while intact present little to zero risk to occupants, but when removing can create airborne emissions and increase health and safety risks. This is especially true of **asbestos** and lead, and, possibly to a lesser extent, fiberglass. Removal of **asbestos**, lead or fiberglass needs to be planned and conducted with care to minimize exposures to airborne dust from these materials.

Asbestos

Asbestos is a mineral that has been mined in the U.S. since the early 1900's. Its superior heat resistance properties, combined with its lightweight, high-tensile strength, and non-corrosive qualities, made it an ideal building material for buildings constructed between 1940 and the late 1980's. **Asbestos** was banned as a building material in the U.S. after scientists concluded studies linking long-term occupational exposures to damaging respiratory health including asbestosis (scarring of the lung), lung cancer, and mesothelioma (cancer of the lining of the lung). Because intact **asbestos** presents no increased health risk, there is no requirement for removing it from existing homes. However, when it is disrupted, pulverized or suspended in air, the potential for inhalation of **asbestos** fibers increases risks of exposure. While health effects develop only after decades of long-term occupational or environmental exposure, homeowners should take particular care to prevent unintentional release of **asbestos** into the air of their homes during green remodeling efforts so that children and others are not exposed.

Asbestos is commonly found in older homes (constructed between 1940 and the late 1980's) in the following building materials:

- Pipe and boiler insulation
- Sprayed on fireproofing insulation
- Acoustical tiles and wall coverings
- Floor tiles
- Roof shingles
- Siding shingles

There is no requirement that homeowners remove **asbestos**-containing materials from homes. However, if removal is part of a green building remodeling project, material should be tested by a New Jersey licensed **asbestos** control monitor, and if determined to contain **asbestos**, be removed by a New Jersey licensed **asbestos** contractor. The number of the state program to contact for assistance in identifying qualified personnel to assist homeowners to safely address any possible **asbestos** concerns is (609) 292-7837.[5] General information about asbestos and its proper management and disposal can be found at the Department of Health website: www.state.nj.us/health/iep/asbestos.shtml and the Department of Environmental website: www.nj.gov/dep/dshw/rrtp/asbestos.htm.

Lead

Lead was in residential paints prior to 1978. It was banned after that time due to the significant health affects to children inhaling or consuming dusts from lead-based paints. Because of the hazards posed by dusts and chips of lead-painted surfaces, any remodeling or renovation which impacts painted surfaces of homes constructed prior to 1978 needs to be inspected by a New Jersey licensed lead inspector. If lead paint is identified, it should be safely removed by a state of New Jersey licensed contractor. They can safely remove lead-based paint and conduct follow-up surface lead testing to confirm that the removal was successful. Information on lead-based paint and qualifications for lead inspectors and contractors can be found at: www.state.NJ.us/health/iep/documents/pb_advisory_bulletin.pdf.

Contact the New Jersey Department of Health and Senior Services at (609) 292-7837 with any questions.

Fiberglass

Fiberglass insulation is a manufactured glass-wool-like material used as an insulation and sound absorption material in homes, schools, automobiles and consumer products since the 1970's. Fiberglass insulation can be safely installed if handled properly; any prolonged skin, eye or respiratory contact with fiberglass can cause temporary irritation. During renovation, wear loose fitting clothing and gloves to reduce skin contact, eye glasses or goggles to reduce eye exposure, and N95 disposable respirators (available from any home improvement store) if high levels of fiberglass dust are expected during removal or installation. More information on fiberglass safety precautions and handling recommendations can be found at the American Lung Association website at: www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=35439
or call the American Lung Association in New Jersey at (908) 687-9340.

HS3 – Mold

Mold contamination of building materials is not limited to older homes. Homes of any age can develop mold if moisture from leaky pipes, roofs, foundations, accumulates in the presence of dust, wood, paper or other **cellulose**-containing materials at normal room temperatures or high relative humidity (76 percent) for as little as 48 hours. Standing moisture around building materials such as wallboard, carpets, insulation, wood or other **cellulose** containing materials can cause mold. Many mold spores are known human allergens and produce toxins which may cause irritation or central nervous system effects. Because of vast differences in susceptibility, or if individual health impacts related to elevated mold spore exposure are of concern, consult a trained and experienced occupational/environmental health physician.

In addition to the above, mold damage can occur if flooding from faucets, showers, toilets (above the trap), is not completely dried within 48 hours of the incident. Floods from dirty water sources such as washing machines, dishwashers or sewers may contain high levels of bacteria, viruses, and protozoa which, along with potential mold growth, present additional risks.

If **mold amplification sites** occur, remove the affected material using methods that prevents unintentional dispersal of mold spores and the source of moisture intrusion. The U.S. **Environmental Protection Agency** indicates that small areas of mold growth (less than 10 square feet) can be cleaned or removed by homeowners themselves using precautions to prevent exposure and reduce spread of spores to adjacent areas. When mold contaminated areas exceed 10 square feet, special precautions including erecting containment barriers and the use of specialized **HEPA vacuum** devices should be used by trained professionals. When mold contamination occurs in excess of 100 square feet, professionals need to clean using full containment of the area (see www.epa.gov/mold/moldguide.html).

If mold growth from dirty water floods occurs, take special precautions to prevent skin, eye, oral and inhalation contact, and hire trained professionals to clean up in accordance with U.S. **EPA**: www.epa.gov/iaq/flood/index.html and IICRC S500 guidelines

Homeowners should anticipate that the amount of mold contamination shown on the outside of a piece of drywall or paneling may be less than the amount that will be exposed when wall cavities are opened up. If there is any doubt, consider hiring a professional Certified Industrial Hygienist (CIH) to evaluate the extent of damage before attempting to remove contaminated building materials yourself.

HS4 – Radon

Radon is a radioactive gas that comes from the natural decay of uranium in the ground. It is odorless, tasteless and invisible, and can only be detected through specialized tests. **Radon** enters homes through openings such as cracks and joints in the foundation, sump pits and openings around pipes. The home traps radon inside and it can build up to high levels.

Radon is the second leading cause of lung cancer in the United States, resulting in 15,000 to 22,000 deaths annually. It is the leading cause of lung cancer for non-smokers.

Radon concentrations can vary from house to house. The radon concentration in a home depends on a number of factors, including the amount of uranium present in the soil, the permeability of the soil, the number of openings in the foundation and air pressure differentials. Any home can have a **radon** problem, regardless of whether it is old or new, well sealed or drafty, or with or without a basement.

The New Jersey Department of Environmental Protection recommends radon testing for all homes in New Jersey. If the **radon** concentration is 4 pCi/L or higher, a **radon** mitigation system is recommended. There is no safe level of **radon** since lung cancer can result from very low exposures to **radon**, however, the risk decreases as the **radon** concentration decreases. f the **radon** concentration is less than 4 pCi/L, a mitigation company can be consulted to determine whether the **radon** level can be brought down still further. **Radon** levels have been brought to less than 1 pCi/L in sixty percent of the homes mitigated in New Jersey. Mitigation systems can also help reduce the potential for accumulation of volatile organic compounds that may be released from soil water vapor in areas where ground water contamination is an issue.

Radon test kits are commercially available at most home improvement stores, however, test conditions and locations may make data interpretation difficult or inaccurate. Carefully follow the kit directions to ensure proper use and confidence in the results. The New Jersey Department of Environmental Protection has issued licensing requirements for **radon** testing firms, and has a list of qualified professionals to perform **radon** testing and mitigation, see www.njradon.org.

Appendix

HS1= NUISANCE AND TOXIC DUST CONTROL

Fly ash Properties

www.austinenergy.com/energypercent20Efficiency/Programs/Greenpercent20Building/Sourcebook/flyashConcrete.htm

www.oikos.com/library/betterconcrete/index.html

HS2= HAZARDOUS MATERIALS - LEAD AND ASBESTOS

N.J. Department of Health Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

Agency for Toxic Substances and Disease Registry, New Jersey

www.atsdr.cdc.gov/Asbestos/sites/national_map/fact_sheets/trentonnj.html

N.J. Department of Environmental Protection, Guidelines for Disposal of Asbestos Containing Materials

www.state.NJ.us/dep/dshw/rrtp/Asbestos.htm

U.S. EPA Asbestos Caution Regulations adopted in New Jersey

www.EPA.gov/r02earth/ahera/ahera.htm

N.J. Department of Community Affairs Lead Testing and Abatement

www.state.NJ.us/dca/codes/code_services/xls/clc.shtml

New Jersey (NJ) Department of Health and Senior Services

http://www.state.nj.us/health/

Lead in Paint, Dust, and Soil (USEPA)

http://www.epa.gov/lead/

The Leadsafe NJ Program (NJDCA)

http://www.state.nj.us/dca/dcr/leadsafe/

HS3 = MOLD

USEPA Guide to Mold in Your Home

www.EPA.gov/mold/moldguide.html

USEPA Flood Clean-up Guidelines

www.EPA.gov/iaq/flood/index.html

N.J. Department of Health and Senior Services Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

HS4 = RADON

N.J. Radon Soil Gas Map

www.EPA.gov/radon/zonemap/newjersey.htm

N.J. Department of Environmental Protection Radon tiers by County

www.state.NJ.us/dep//rpp/radon/radonin.htm

N.J. Radon Levels

www.NJradon.info/NJ_counties.html

N.J. Radon Testing Guidelines

www.NJ.gov/dep/rpp/radon/radontes.htm

Green Home Maintenance and Housekeeping

Introduction

Your home is one of the biggest investments of your life. Can 'going green' protect your investment and make it safer, more enjoyable and save you money? Yes.

This guide to Green Home Maintenance and Housekeeping practices will improve the health, comfort and environment for your family, and save you money, most directly by reducing your utility bills. The guide's focus on 'Energy' savings, improvements to 'Indoor Air Quality', effective and efficient 'Household Waste Management' and conserving 'Water' all add measurable benefits to you and high return on your investment. Routine checks and repairs will ensure your home's appearance and proper function. By following these recommendations, you will also prevent more expensive damage from occurring.

Finished Basement and Major Addition

The biggest challenge in basement maintenance is to prevent or resolve moisture problems. Any major addition or renovation work requires good selection of materials and use of sound construction techniques.

1. Preventing and solving basement water problems:
   - Use basements as living spaces only if they are leakproof and well ventilated
   - Use a dehumidifier in the basement to maintain humidity between 30 to 50 percent
   - Improve the ventilation in the basement.
   - Install a sump pump and check on the valve working
   - Keep a check on the roof gutters and downspouts and extend the downspout extension away from your home
   - Maintain the slope of your yard so that it causes rainwater to flow away from your home.
2. Use environment friendly materials for all improvements:
   - Use low-emitting and **VOC** free materials (interior sealers, adhesives, paints and insulation) for any repair work
   - Ask about **formaldehyde** content of pressed wood products, including building materials, cabinetry, and furniture before you purchase them
   - Do not remove lead paint yourself. Do not dry scrap, sand or burn off paint that may contain lead
   - Reduce exposure to **asbestos**; when you need to remove or clean up **asbestos**, use a professionally trained contractor. Do not cut, rip or sand **asbestos**-containing materials

Configure for solar access [EA100]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Orientation dramatically affects the energy efficiency of the **building envelope**. While existing structures cannot be reoriented, new additions can consider orientation and the potential for solar energy features, including **passive-solar heating**, daylighting, **solar water heating**, and **photovoltaic (PV)** power production. **Passive solar design** provides an integrated approach to addressing a building's heating, cooling, ventilating, day lighting, and electric needs.

The **passive solar** house is an energy-conserving house. Address energy leakages during a remodeling effort by conducting an **Home Performance Audit** before considering solar options as conserving energy is always the most cost-effective strategy.

Tips [EA100]

Check your local conditions in planning for renovations. The amount of solar radiation varies according to geographic location, time of day, season, local landscape and local weather.[1]

Consider on-site renewable energy [EA102]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Ongoing advances in solar and geothermal technologies coupled with broader government financial incentives have made on-site renewable energy increasingly more feasible for the homeowner. Providing some or all of the home's energy from on-site renewable sources is an excellent way to not only significantly reduce utility bills, but also decrease one's reliance on and consumption of traditional fossil fuel energy sources.

Due to the increasing number of incentives for solar equipment, a homeowner can install a **photovoltaic** array with smaller up-front costs and a quicker payback period. New Jersey maintains a **Solar Renewable Energy Certificate (SREC)** program that allows participants to receive sellable credits for the energy that they produce; each time a system generates 1000 kWh of electricity, a **SREC** credit is issued to the program participant.[2] Also, all equipment related to solar energy—including **passive solar** equipment—is eligible for sales tax exemption in the state.[3]

Another option for on-site energy production is the implementation of a solar water heating system. Solar water heaters can be either passive or active; passive systems are generally less expensive but not as efficient as active ones.[4] In New Jersey, a solar water heater would need to be used in conjunction with a traditional water heating system for cloudy days and winter months.

Geothermal technologies take advantage of relatively constant underground temperatures by pumping cooler air to the surface in the summer and warmer air in the winter. One of the more common applications of geothermal technology for homeowners is ground source **heat pumps** (**GSHPs**). Properly designed and installed **GSHPs** can provide efficient, clean, and renewable heating and cooling for homes. The U.S. Department of Energy calculates a payback period for individual geothermal systems of five to ten years from decreased energy costs.[5] The Resources section contains a link to the International Ground Source Heat Pump Association's website, which maintains a database of accredited geothermal heat pump installers.

Tips [EA102]

Before moving ahead with plans to install a **PV** array, hire a professional to assess your home's solar gain potential.

Incentive [EA102]

Many of the federal incentives have been expanded through the February 2009 American Recovery and Reinvestment Act (the "stimulus package"). This includes a rebate for 30 percent of the cost of qualifying photovoltaic arrays, solar water heaters, and **GSHPs**.

Minimize site disturbance [SS29]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

For any home remodeling work, minimizing site disturbance is essential to protect the existing natural environment and prevent soil **erosion**, particularly in New Jersey's suburban, rural, and shore communities. Before beginning a project, consult with the contractor to develop a comprehensive plan for site protection. The NJDEP has established **Erosion** Control Standards for the state. Check with your New Jersey local conservation district office or the Natural Resource Conservation Service for information about strategies for soil **erosion** prevention (such as silt fencing, mulching, etc..) as well as any applicable laws pertaining to your project. Designate off-site parking and a controlled location for building materials when possible. Smaller sites, such as those found in urban areas, may require additional planning for proper movement of materials on and off of the site.

Carefully provide for protection of trees and vegetation. The **drip line**, a vertical plane going from the perimeter of the crown to the ground, contains the minimum area around a tree that should be undisturbed. However, the shallow root system found in the **topsoil** extends further out from the **drip line**, so preserving extra area beyond the **drip line** minimum is critical. If work requires use of heavy equipment, ask for adequate layers of straw or other material to absorb and distribute the weight to prevent soil compaction. Create **tree wells** for changes in grading around trunks and root systems. Consider establishing a system of incentives and penalties with the contractor for protection of existing trees and shrubs.

Planning for minimizing site disturbance conserves resources by reducing the need for new soil and plantings as well as reducing use of excavation equipment. Protecting and/or transplanting existing vegetation avoids the costs of additional future landscaping. Reducing disturbance and stress on trees and plants will reduce additional watering needs. A pre-construction low impact checklist is provided in the Resource section.

Landscape for passive heating and cooling [SS30-31/36]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Proper placement of trees and landscaping beautifies outdoor space and reduces heating and cooling costs. Taller **deciduous trees** on the southeast, south and southwest side of a house provide shading from the high summer sun and allow low winter sun to filter into the home. Hardy **evergreen trees** and shrubs placed at the northeast and northwest corners of the landscape can reduce heating costs by blocking or redirecting cold winter winds over or around the home. On west walls, incorporate **trellises**, **arbors**, and **planting beds** for tall **annuals**, which provides shading of west-facing windows where summertime heat gain is the biggest problem.

Select site-appropriate plants including **native trees** that may reduce watering needs once they are established. Any newly planted tree will require watering, but smaller trees will adapt much faster to site conditions. Larger trees will cost more and take longer to establish in the landscape. **Evergreens** (trees or large shrubs) provide greater protection from wind and noise.

It is always important to consider **genetic diversity** in the design to minimize potential disease and insect problems. Also see The Tree Guide at www.Arborday.org, listed in the Resources section, for growth rate and **crown size** information for specific tree species. Check with New Jersey arborists or your county Master Gardeners' office to choose the right plant for the particular home and lot size. It is important to balance shading with solar access, especially for systems (like solar panels) that require the sun's energy.

Tips [SS30]

Keeping foundation plants a few feet away from the home improves air flow. Select low-growing shrubs or flowers to avoid blocking your windows. This allows for a clear line of vision into the landscape and adequate air circulation when windows are open.

Distance from homes and structures are important considerations. In general, medium to large trees should be placed at least 20 feet away from the house. Trees that will be smaller at maturity can be placed closer to the house, but be mindful of the breadth of the full-grown crown of the tree to maintain both energy and aesthetic value.

Make protection of existing trees and shrubs a priority. When possible, consider transplanting rather than complete removal. If trees or large limbs require pruning, use the tree materials for firewood, mulch, or **trellis** construction. When transplanting, remember, that they, too, require plenty of water until they are established (generally through at least one season, depending on size).

Maintain slope to drain away from building [IDP13]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

The soil next to the house frequently settles creating problems when water to runs toward the house rather than away from it. This creates moisture problems when you have rain or snow, and over time it will affect the durability of the foundation. Provide a minimum 6 inches of fall in finish grade over a distance of 10 feet from the building (minimum 5 percent slope) and exceed or extend this if possible. This is particularly important if there is any backfill that may induce settlement.[6] Be sure the ground slopes away from the downspout or gutter discharge. Surface soils with low **permeability** next to the house (e.g., with some clay content) can help reduce direct **infiltration** of rainwater adjacent to the foundation. [See related strategies here and in the Outdoor Living and Landscaping section.]

Tips [IDP13]

Obtain a straight 2x4 that is 10 feet long and use a carpenter's level to ensure the ground slopes away from the house at least 6 inches over 10 feet.

NJ Bio-Region [IDP13]

Different soils have different absorption properties. Where only pervious soils are available for backfill, the slope of grade away from the perimeter of the foundation should be increased or an impervious "skirt" of 6 mil **polyethylene** may be placed about 12" below grade.[7]

Minimize impervious surfaces [SS32]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

Stormwater **runoff** from **impervious surfaces** can cause flooding, **erosion**, and surface water contamination. Limiting paved surfaces and providing permeable drainage areas aids natural groundwater **infiltration**. **Porous** paving materials, **vegetative swales**, **rain gardens**, and other landscape features will improve **infiltration**.

An overall reduction in paved surfaces prevents **runoff**, allows for stormwater recharge, and mitigates the **heat island effect**, reducing home **cooling loads**. Aiding **infiltration** of groundwater alleviates possible moisture and mold problems that can impact indoor air quality as well.

Problems associated with water **runoff** are most prevalent in areas where there is a large percentage of **impervious** surfaces or in flood prone areas where **runoff** quickly collects, causing flood hazards. In those areas, or for homes with flat roofs, consider **creating a roof garden** to absorb stormwater on site. If a home relies on downspouts, direct them away from nonporous surfaces to allow water to infiltrate into the ground without creating **runoff**.

Rain gardens are depressed areas of the landscape containing various native plant species and are an effective way to reduce **runoff** and promote **infiltration**. Directing stormwater to these areas allows the plants and soil to naturally absorb and filter excess water.

The cost to replace, remove or modify existing paved areas can be significant, but it will mitigate hazards and provide various environmental benefits. See the Resources section for information regarding New Jersey's stormwater regulations, and check with municipal offices for any specific policies.

Tips [SS32]

Some **porous** paving systems may not be appropriate for New Jersey's climate. See: "Standard for Pervious Paving Systems" from the NJDEP Best Practices Manual in the Resources section, and check with an expert if you are unsure about the compatibility of a particular product.

Caution [IDP17]

It is important to consider roof design and structure to be sure it can withstand the load of a **green roof**.

Landscape to minimize heat island effects [IDP17]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

The **heat island effect** occurs in densely developed areas. It happens where high areas of built surfaces like brick, concrete, asphalt and stone, absorb **short-wave solar radiation** during the day. These surfaces store heat which is emitted later as **long-wave radiation**, resulting in increased temperatures.[8] Areas with less vegetation will also have less of the cooling effect created by evaporation of water from soil and leaves, exacerbating this localized warming.

The higher temperature in heat islands leads to greater air conditioning use, which increases overall energy use. As power plants burn more fossil fuel to meet the increased demand, pollution levels also rise. The rising pollution levels, exacerbated by high temperature, create **smog** which can create respiratory health problems and additional greenhouse gases are also emitted.[9]

Minimize heat islands by planting **native trees** and shrubs to provide shade and reduce paved surfaces. Properly placed trees and vegetation can reduce energy used for heating and cooling by up to 25 percent.[10] During remodeling, minimize damage to existing vegetation and transplant any trees or shrubs that must be removed. Use water as a landscape element to reduce the effects of heat islands. On flat roof homes, garages, and sheds, consider installing a vegetated or "**green roof**" to replace heat-absorbing surfaces with plants, shrubs, and small trees that cool the air through evapotranspiration.

If an existing roof is steeper than 12 degrees or the supporting structure is not strong enough to support a **green roof**, consider providing a **reflective roof** [MR120] to minimize the **heat island effect**.

Tips [SS39]

Municipal Department of Public Works (DPW) often offer free chipped wood materials.

Plan for erosion control [SS39]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	TT

During construction, take steps necessary to prevent soil **erosion**. Up to 1.7 tons of wood waste is generated during the construction of a 2,000 sq. ft. home.[11] Scrap lumber, pallets, sawdust, tree stumps, branches, and twigs that cannot be used for firewood or other use can be chipped or ground on-site and used as mulch to protect against soil **erosion**. Pack ground wood chips into **woven 'socks'** and place them on the edges of the construction site or around sewer drains to control **runoff** and prevent soil loss from a site.

After the site has been rough graded to control **erosion**, wood chip mulch may also be spread uniformly on the site as a temporary cover to reduce soil loss and allow vehicular and foot traffic over the area. When used in this way, the wood chips form a blanket over the soil to moderate its temperature, conserve moisture and provide an environment conducive to seed germination.

Untreated/unpainted dimensional lumber and engineered lumber such as **Oriented Strand Board (OSB)**, plywood and particleboard can all be mulched. Apply mulch uniformly at a rate of 6 to 9 tons per acre to achieve a minimum of 80 percent ground cover. This level of application creates a layer of wood chips or wood bark to approximately one inch thick.

NJ Bio-Region [SS39]

Check local regulations and permitting requirements related to the use of wood waste for mulching or soil **erosion** control

Use wood chip mulching on sites where slopes do not exceed 3:1. In steeper slope situations, **erosion** blankets or mats are more effective and may have a longer life span.

Building Age [SS39]

Deconstructing older homes provides material recycling opportunities. Contact companies specializing in reuse of architectural and other building materials.

Caution [SS39]

Composite, **pressure treated** or laminated wood materials (**CCA**, **green treated**, **creosote**, **Copper Quat**) should not be utilized for **erosion** control as they may contain toxic chemicals and non wood materials.

Dust emissions must also be attended to in the preparation of mulched materials.

Test and install a radon mitigation system HS4 [IEQ163]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

To save money, test for radon before beginning to remodel or convert an unfinished basement area into living space as it is more cost effective to do the mitigation as part of the renovation. A homeowner can conduct a radon test or hire a New Jersey certified radon measurement company to perform the testing. Some certified radon measurement companies sell test kits through mail order and test kits are often available in hardware stores or from local health departments. A single short-term test of 2-7 days in length can be used to indicate the radon level in your home. A long-term test of 3-12 months will provide your best estimate of average exposure over time, since radon levels fluctuate daily and by season. If mitigation is required, a certified mitigation company should be consulted.

The most common type of radon mitigation system is the sub-slab depressurization system. It is comprised of a vent pipe system and fan that pulls radon from beneath the house and vents it to the outside. The exhaust system runs 24/7 and does not require major changes to the home. The piping can be run either in the house with the fan generally located in the attic or outside with the fan on the side of the house. The radon is vented through the pipe to the outside, where it is quickly diluted. Cracks and openings in the foundation are sealed.

Homes undergoing green remodeling, in which new additions are part of the project, can include Radon Resistant New Construction techniques. These techniques include a gas permeable layer (e.g., 4-inch layer of gravel) beneath the slab to allow the soil gas to move freely underneath the house, plastic sheeting on top of the gravel to prevent the soil gas from entering the house, and a PVC pipe that runs through the house and roof to vent radon above the house. After testing, if the home has elevated radon levels, an electrical venting fan can easily be installed to activate the system at a reduced cost compared to a complete mitigation system.

The Department of Community Affairs requires all new construction of Groups E and R buildings in tier one areas (as defined by the New Jersey radon potential map) to meet the Radon Hazard Subcode of the Uniform Construction Code. This section further states that full compliance with the construction techniques is not required for additions in tier one areas; however, those construction techniques that are feasible are to be incorporated. These features can be incorporated voluntarily in tier two and tier three areas.

For more information and assistance in finding a certified radon professional, homeowners can contact the New Jersey Department of Environmental Protection's Radon Program at (800 648-0394 or visit www.njradon.org.

Insulate floor slab and foundation walls HS2 [EA47]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Often basements are cold and damp, but properly insulated foundation walls and floor slabs can reduce heating and cooling costs and result in more comfortable below-grade rooms. It can also help to prevent problems with moisture, insects, and **radon** in the home.

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency. See: www.ornl.gov/~roofs/Zip/ZipHome.html

If the exterior surface of the existing foundation walls can be accessed, that generally is the best location for added insulation. When possible, insulate exterior foundation walls with **rigid**

Tips [IEQ163]

Major renovations can change the level of **radon** in any home; the **EPA** recommends **radon** testing be performed after remodeling work is completed to ensure that any mitigation work during the remodeling is still effective, and that the renovations have not created additional **radon** burdens. Check with your contractor if there was a prior mitigation to ensure that those warranties are still valid.[14]

Radon levels vary from season to season and even from day to day, such that long-term tests must be utilized if a year-round average **radon** level is required.

When installing an exterior system, make sure the piping is set up so any condensation in the piping drains back past the fan and does not affect its performance.

NJ Bio-Region [IEQ163]

Highest Radon Potential: Morris, Sussex, Warren, Hunterdon, Somerset, Mercer, and Monmouth counties

Moderate Radon Potential: Bergen, Passaic, Essex, Union, Middlesex, Burlington, Camden, Gloucester, Salem, and Cumberland counties

Low Radon Potential: Ocean, Atlantic, and Cape May counties

Regardless of an area's potential for **radon** exposure, every home should be tested for **radon**.

See NJDEP **Radon** Potential Map:

www.njradon.org/radonmap.htm

Caution [IEQ163]

Radon is of special concern in indoor environments since it can concentrate indoors, seeping into buildings through foundation cracks or openings.

If the home uses well water and **radon** occurs in the area, test the well water for **radon** as well.

Tips [EA47]

When conducting a **home Energy Audit**, use **Thermographic (infrared) imaging** to assess the location and **R-value** of existing insulation and identify opportunities for added insulation.

Caution [EA47]

Vermiculite Insulation was used as **loose-fill insulation** in walls until it was discovered that it could contain naturally occurring **asbestos**. If this type of insulation is discovered, it is best not to disturb it. If necessary to remove, hire a certified professional.

Tips [IDP19]

Make sure the contractor or architect checks the soil before proceeding with a foundation related project; get a test kit from your county extension office to confirm your soil make-up; you may have filler dirt on your site.

NJ Bio-Region [IIDP19]

If the home has clay soils, prevent structural damage by removing these soils from around the foundation as they expand when wet. Replace it with gravel to improve durability of the foundation. Similarly, sandy soil, as found in locations with higher ground water, may require a larger perforated drainage pipe (6 inches) as these soils drain water more rapidly.

insulation board and water-proof coating. In most cases, it is not possible to access the outside of the walls, so insulation must be added to the interior walls.

When adding insulation to existing foundation walls consider using **loose-fill** or **sprayed foam insulation**. These insulation materials can be added to interior walls without disturbing finished areas of the home, and then can be covered with non-paper-faced **gypsum board**. A finished basement space may also incorporate a wall system built in layers, insulated, and finished with non toxic materials. Wall panel units incorporating **Oriented Strand Board (OSB)** can be applied using non-toxic glues. Another approach uses ceramic-based thermal paints that adhere to stucco and concrete and provide moisture, vapor and heat-loss controls without additional insulation layers.

Creating an insulation layer and a **vapor barrier** between the concrete slab and the ground beneath is the best approach for basement insulation. It's important to insulate under the slab (which may not be feasible for existing basements), but insulating around the sides of the slab is equally important. Slabs may be insulated at the perimeter on the exterior side with **borate-treated foam board** or **rigid glass fiber insulation**. Slab perimeters may be insulated on the interior side as well. This approach requires rigid insulation placed between the slab and the foundation wall, and under the slab, as required by local code.

For new additions, consider materials such as **insulated concrete forms (ICFs)**, **insulated pre-cast concrete wall systems** and **structural insulated panels (SIPs)** to provide structural support with built-in insulation. **SIPs** are made from a thick layer of foam (**polystyrene** or polyurethane) sandwiched between two layers of **Oriented Strand Board (OSB),** plywood, or fiber-cement.

Provide moisture control at foundation HS3 [IDP19]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TTT

Basements present extra moisture management challenges because of their proximity to the water table; foundations are one of the leading sources for moisture in the home. Moisture can enter the foundation through concrete slab floors and foundation walls. The best way to deal with moisture at the foundation is through proper foundation design, quality construction, and proper exterior drainage. Best practices in foundation design for moisture control include tamped, crushed stone under a foundation slab, a layer of durable polyethylene (protected from abrasion with insulation or sand), a capillary break between the footing and foundation walls, a damp proofing layer on the foundation exterior, and a drainage layer on the outside of the foundation wall, including geofabric to keep silt out of the drainage layer and drainage pipe.[15]

Utilize Integrated Pest Management [IDP23]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	T

The foundation is the primary entry point for insects, so follow **Integrated Pest Management (IPM)** best practices and keep untreated wood and vegetation at least a foot away from the soil line and foundation walls.

IPM best practices minimize environmental impacts by using eco-friendly methods to control pests. **IPM**'s prevention, monitoring, and control techniques offer an alternative to chemical pesticides. **IPM** techniques enhance sustainability of vital natural systems, promote insect and disease resistant lawns, trees and shrubs, and protect beneficial insects. **IPM** reduces threats to wildlife and water quality from chemicals that would otherwise reach our drinking and recreational water resources.[16]

Use biobased form-release agents [MR115]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

Standard **form-release agents** protect concrete surfaces from stains and help with mold control; green versions are made with biodegradable vegetable oils. Form-releasers help remove **concrete formwork** from hardened concrete footings and walls after concrete has set. Wood or metal foundation forms often are coated with **petroleum-based** oil so they won't stick to the concrete. However, the oil from these conventional **petroleum-based** products remains on the concrete even after the forms are removed – where it can seep into the ground around the foundation and contribute to indoor air quality problems. In general, products such as water-based form-release compounds using soy or other biologically-derived oils are biodegradable and are less harmful to indoor air quality.

Another option to removable concrete forms is permanent **Insulating Concrete Forms (ICF's)** that add both thermal and waste reduction benefits to the project when used as walls for a foundation or addition.

Use fly ash in concrete HS1 [MR114]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

Before there was **portland cement**, the Romans created concrete structures using lime and a volcanic ash that reacted with the lime and hardened the concrete.[17] Coal **fly ash** – the particulate matter collected by pollution-control equipment from the smokestacks of coal-burning power plants – has a similar strengthening effect because of its silica and alumina content.

Fly ash increases the durability of concrete and can also be used to shrink its environmental footprint by requiring less **portland cement** in the mix as producing 1 ton of **portland cement** emits 1 ton of **carbon dioxide**. Replacing 25 percent of cement with **fly ash** is a common practice, and up to a 50 percent substitution is acceptable for certain applications. However, concrete with high concentrations of **fly ash** must be tested before each application because the chemistry of the material varies more than that of **portland cement**; if too much **fly ash** is used, the concrete's freeze-thaw resistance is reduced. Mixes with higher levels of **fly ash** must also be cured differently, as they tend to cure more slowly. Specify the use of **fly ash** in concrete in the construction contract.

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

A **Home Performance Audit** identifies energy upgrades for cost savings. Diagnostic tests examine the whole house and look at the interactions between all systems in a home: air leakage, insulation, combustion appliances, heating and cooling systems, and ventilation. Several free online energy audit tools are available for homeowners. The NJ Office of Clean Energy's Home Energy Analysis Tool offers specific recommendations based on the age of the home; average energy usage,

Caution [MR114]

Fly ash can contain potentially hazardous heavy metals. There is little evidence that these metals (mercury, lead, selenium, arsenic, and cadmium) leach into the environment in **fly ash** concrete, but there is still some question as to how the metals might complicate its reuse or disposal.[18]

Tips [IPD2/EA51-54]

Prepare for a Blower Door Test[19]

- Close windows and open interior doors
- Turn down the thermostats on heaters and water heaters
- Cover ashes in wood stoves and fireplaces with damp newspapers
- Shut fireplace dampers, fireplace doors, and wood stove air intakes

Incentive [IPD2]

New Jersey's Clean Energy Program (NJCEP) offers low price Home Performance Audits and other incentives.

www.njcleanenergy.com/residential/home/home.

The Database of States Incentives for Renewables and Efficiency (DSIRE)

www.dsireusa.org/

the types of appliances, and other criteria. It is available on the NJ Office of Clean Energy website: www.njcleanenergy.org.

Certified professionals can conduct a more comprehensive **Home Performance Audit**. This often includes a combination of visual inspections and diagnostics tests to identify opportunities to repair or upgrade aspects of the building envelope or mechanical systems. The following strategies are common elements of a more comprehensive **Home Performance Audit**:

- **Blower Door Test – Blower door tests** help determine a home's airtightness. Proper airtightness is important for reducing energy use and drafts due to air leaks, avoiding moisture problems, and regulating indoor air quality. It is important that auditors use a calibrated blower door, which allows them to test airtightness before and after recommended changes have been implemented, and to verify that the work completed solved the problems.
- **Thermographic inspections** - **Thermographic inspections** or **infrared scanning** uses specially designed infrared video or still cameras to make images (called thermograms) that show surface heat variations. **Thermograms** help determine whether and where a home needs insulation. Because wet insulation conducts heat faster than dry insulation, **thermographic** scans can also detect roof leaks and other moisture problems.
- **Thermal Bypass Inspection (TBI)** – The **Energy Star® Thermal Bypass Inspection (TBI)**, and a corresponding checklist, is designed to check for missing or incorrectly installed insulation and sealing of penetrations and air gaps. It is most commonly performed for new construction and major renovations. Reducing thermal bypass, or the movement of heat around or through insulation, is important as they can lead to comfort issues as well as higher utility bills. For more information, see the **Energy Star® Thermal Bypass Checklist**: www.energystar.gov/index.cfm?c=bldrs_lenders_raters.thermal_bypass_checklist

The NJ Office of Clean Energy Home Performance with Energy Star Program provides reduced fee home energy audits and a listing of certified energy auditors on its website.

Minimize wood use with advanced framing [MR116]

BENEFITS

ENERGY SAVINGS:

WATER SAVINGS:

RESOURCE CONSERVATION:

AIR QUALITY:

FEASIBILITY

INITIAL COST: $$

DIFFICULTY LEVEL: TTT

Use advanced framing techniques to reduce the amount of unnecessary wood material used in a major addition project and therefore lower costs. Switch to 24-inch studs and roof trusses or rafters, switch from a double to a single top plate (and align roof trusses or rafters with wall studs), eliminate unnecessary studs, and replace solid-wood headers above windows and doors with engineered (and insulated) headers.[20] Advanced framing also improves energy efficiency by replacing lumber with insulation material.[21]

The type of wood used in advanced framing contributes to resource conservation. Insulated wood products such as **Oriented Strand Board (OSB)**, is typically made from secondary lumber and scrap wood, so it relies less on ecologically valued **old growth timber**. Another material, **Structural Insulated Panels** (**SIPs**), made with a rigid insulated foam sandwiched between layers of **OSB,** replaces structural framing altogether. Its built-in insulation provides a tight **building envelope**. Consider **SIPs** constructed with low- or no-**formaldehyde** glue for further reduction of air impacts.

NJ Bio-Region [MR116]

Some advanced framing techniques may not be allowed in localities or circumstances such as those with high winds. Local building officials should be consulted in the design phase to obtain approvals for chosen techniques.

Caution [MR116]

Salvaged wood should not be used for structural purposes.

Install or upgrade insulation HS2 [EA49]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Insulation slows down the heat flow through a home's building envelope - the walls, attic, roof and basement. In the winter, insulation slows heat loss and helps prevent moisture buildup. During summer months, it reduces heat gain and helps keep a home cool.

Insulation is rated according to its **R-Value**, or its ability to resist heat flow, with a high **R-Value** being a greater resistance. Adding insulation with a higher **R-Value** can cut heating and cooling costs anywhere from 15 to 45 percent, depending on factors such as the original amount of insulation in the home, house size, air leaks and personal energy use and living habits.[22]

Certified energy auditors conduct an insulation check as part of a comprehensive home performance audit. They can determine the **R-Value** of the home's current insulation and measure air leakage. They then can recommend where air sealing and insulation should be added.

Thorough air sealing should be done before insulating. Insulation alone does not protect against air leakage; moist air can damage the insulation and reduce its effectiveness. Adding insulation before air sealing may make some air leaks difficult to access. Avoid **thermal bridging** by installing a layer of continuous insulating **sheathing** over frames or joists.

The general rule of thumb is to install insulation on any surface separating a heated space from an unheated space; walls, ceilings, attics, floors and ducts should be well-insulated. One of the best places to begin installing or upgrading insulation is in the attic as a significant amount of heat can be transferred through the roof. Installing attic insulation is also a relatively easy job for do-it-yourselfers.

There are four basic types of insulation:[23]

- **Batts** and blankets—**Batts** and blankets are made from mineral fibers, such as fiberglass and rock wool and typically have a value of R-3 per inch. They are available in widths suited to standard spacings of wall studs and attic or floor joists; 2x4 walls can hold R-13 or R-15 batts and 2x6 walls can have R-19 or R-21 products. Use this type of insulation below floors, above ceilings, and within walls. **Batts** and blankets can be installed by homeowners or professionals.
- **Loose-fill insulation**—**Loose-fill insulation** is often made from fiberglass, rock wool, or cellulose in the form of loose fibers or fiber pellets and typically has a value of R-3 to R-4 per inch. This type of insulation works best in places where it is difficult to install other types of insulation such as building cavities and attics. Loose-fill insulation is usually blown in by professional installers.
- **Rigid insulation board**— **Rigid insulation board** is often made from fiberglass, polystyrene, or polyurethane and typically has a value of R-4 to R-8 per inch. Use this type of insulation on basement walls and as perimeter insulation at concrete slab edges, and in cathedral ceilings. For interior applications it must be covered with 1/2-inch **gypsum board** or other building-code approved material for fire safety. For exterior applications, cover with weather-proof facing.
- **Spray foam**—**Spray foam insulation** comes in two forms: **open-cell** and **closed-cell**. The **closed-cell** foams typically have a higher **R-value** (R-7 to R-8 per inch) than **open-cell** foam (R-5.6 to R-8 per inch). Most foam insulation products have a higher **R-value** per inch than fiberglass **batt** insulation.[24] This type of insulation provides both insulation and an air barrier, and is suited well for filling small spaces —such as window jambs, small stud bays, **rim joist** areas, and for sealing around electrical boxes and other penetrations. **Spray foam insulation** should be applied by professional installers using special equipment to meter, mix, and spray the foam into place. Most foam materials can now be used with foaming agents that don't use **chlorofluorocarbons** (**CFC**s) or **hydrochlorofluorocarbons** (**HCFC**s), which are harmful to the earth's ozone layer.[25]

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/Zi-pHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

NJ Bio-Region [MR119]

Fiber siding can be cut and painted to match the original design such as a wavy effect typical of Victorian homes.

Building Age [MR119]

If upgrading the **cladding** of an older home, consider low-maintenance materials such as fiber siding that will need to be painted less often than wood.

Caution [MR119]

Older homes may have **cladding** in place that contains lead paint or **asbestos**.[27] **Asbestos** used in "cement form" releases particles if the siding is cut.

Tips [IDP55]

Use a re-useable dispenser gun to seal the harder to reach spots and increase your resource conservation!

Caution [IDP55]

To assure combustion safety, New Jersey building code requires foam insulation be covered by a non-combustible material such as **gypsum board**.

Air sealing should be performed in conjunction with an assessment of the home's ventilation system to protect indoor air quality and to prevent the build-up of **carbon monoxide (CO)** from improperly ventilated **combustion equipment**.

Building Age [IDP22]

In older homes the cost of properly insulating a basement while controlling moisture should be compared with the cost of constructing additional quality living space above grade.[30]

Install a durable wall cladding [MR119]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

A durable wall **cladding** should be part of the home's moisture management strategy. Proper installation of **cladding** requires a layered approach with an air space or **rainscreen** behind the siding so this area can dry out while also fully sealing the **building envelope**. Newer versions of **house-wrap** have textured surfaces that create a drainage plane to move water more readily behind the **cladding** and out to the wall assembly.

Siding properly installed over a **rainscreen** requires less frequent painting or staining than when installed directly over **sheathing**, reducing the need for refinishing. Factory pre-primed claddings are also highly efficient. Noncombustible siding, such as **fiber cement**, adds fire protection and is often required by building codes. This must be layered with fire-resistant screening in the air space behind the **cladding** to be effective.

Air seal to reduce infiltration [IDP55]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

Air infiltration or leakage may contribute to as much as 30 percent of a home's heating and cooling costs.[28] The most common sources of air infiltration are the attic, crawl space, or basement, and around windows, doors, and chimneys. Other sources include **plumbing chases**, electrical outlets, attic accesses, dropped ceilings and leaky ducts.

Reduce air leakage as much as possible before adding insulation and provide controlled ventilation as needed. First, identify air leaks in the home (see Conduct a Home Performance Audit and diagnostic tests [IDP2, EA51-EA54]). A good rule of thumb is to seal the high and low air leaks first. Start by plugging holes and leaks in the attic and basement, then move to the exterior wall, and look for smaller leaks around doors, windows and electrical switches and outlets. Use caulk to seal openings up to ¼ inch such as cracks and gaps between window frames and siding. For larger gaps, add a backing material before caulking or use a **spray foam** sealant. After all the larger air leaks have been sealed, **weather-strip** doors and windows.

Include capillary break HS3 HS4 [IDP22]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

Rain water **infiltration** is the largest source of material deterioration in buildings. **Capillary breaks** maximize protection using materials such as sill sealer or **gaskets**. **Capillary breaks** are placed at the critical junction between a **wet footing** and a dry wall for moisture control at the foundation.[29] They prevent capillary action of moisture through small interconnected spaces or **"wicking"** in the building. A sill sealer or **gasket** installed between all concrete and framing on exterior foundation walls serves as a **capillary break**. Airspace serves as a **capillary break** when it prevents water from saturating the drainage plane. To prevent moisture migration between the concrete foundation and the floor structure above, a **capillary break** should be installed between the top of the concrete and the sill plate to isolate the wood frame from any source of moisture and prevent rot. A **capillary break** installed between the footing and the concrete wall limits ground water absorption through the footing.

While the **capillary break** is important between all bottom plates, concrete foundation walls, or floors, under some conditions it can be expensive to implement. This is especially true in older homes, where interior and exterior wall heights may not line up. Weigh the full costs and benefits before deciding to implement this strategy.

Provide moisture management strategies HS3 [IDP24]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

A dry house is a more durable house. Not properly managing moisture effects both the durability of the structure of the building and indoor air quality, as mold can quickly reach toxic levels.

The **building envelope** plays a key role in the total performance of the building, so most moisture management strategies focus here. Several strategies keep the **building envelope** drier. Roof overhangs and overall sealing of any roof and wall penetrations are major examples. Incorporate a **house-wrap** or weather barrier when replacing the exterior **cladding**. Create a drainage plane, such as **house-wrap** with texture, placed under siding to allow hidden wet spaces to dry more quickly.

The integrity of the **building envelope** can be challenged by moisture in any state: 1) liquid, in the form of rainwater penetration, 2) solid, such as ice and snow, and 3) vapor, such as relative humidity. If these conditions are not managed properly, they can lead to premature decay of the home. [See additional window, wall and foundation strategies in this section to understand how to best manage moisture.]

Follow standards for mechanical design [EA63]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

The Air Conditioning Contractors of America (ACCA) developed standards to size heating, ventilating and air conditioning systems (**HVAC**s) to assure maximum comfort and energy efficiency. The ACCA also provides software that calculates **heating and cooling loads**. Use these calculations both before and after **HVAC** installation to assure effectiveness. Request **load calculations** from contractors to validate the overall size and design proposed. Addressing **building envelope** issues at the design phase can reduce the load and resulting size requirement of the home's **HVAC** systems.

The **ACCA Manual J - Residential Load Calculation** accurately estimates heating and air conditioning loads. **Manual S – Residential Heating and Cooling Equipment Selection** recommend optimal heating and cooling equipment to meet loads as identified from **Manual J** results. Use the **Manual S** calculation to assure proper sizing based on the square footage and the home's heat loss during cold weather and heat gains during warm weather. **Over-sizing** and improper design are major issues in **HVAC** installation and design. **Over-sizing** can compound the cause of indoor climate issues such as inconsistent temperatures from one room to another. Calibration of the **sensible (or dry) cooling load** and the **latent (or wet) cooling load** assures interactions with windows or people will be accounted for in the design.

Manual D – Residential Duct Systems provides tools for proper duct sizing and is used in conjunction with **Manual J** and **S** calculations. Correct sizing is essential to maximizing **HVAC** energy efficiency. A system that is too big used with a smaller duct system creates improper air flow and raises the utility bill. Proper duct design assures even air flow to each conditioned space within the home. Similar to the issues faced with an improperly or oversized **HVAC** unit, improper duct system design can lead to increased energy bills and a lack of comfort in the home due to an imbalance of heating or cooling in the conditioned spaces. Additional duct design attributes

NJ Bio-Region [IDP24]

While applicable to all areas, moisture management strategies are particularly crucial at shore locations to assure long-term durability.

Caution [IDP24]

Moisture leads to mold which can significantly degrade indoor air quality.

Tips [EA63]

It is more efficient for a smaller unit to run for longer time than a larger unit with shorter cycles. It can be likened to fuel usage differences between highway and local driving.

Incentive [EA63]

N.J. Clean Energy Program offers rebates for properly sized and installed high-efficiency systems: www.njcleanenergy.com

NJ Bio-Region [EA63]

Correct sizing matters, particularly in areas of high humidity such as shore locations where the air conditioning unit pulls substantial moisture out of the air.

Building Age [EA63]

Before installing an **HVAC** system in an older home, consider employing **natural ventilation** and **building envelope** upgrade strategies. A **whole house fan** in older homes may improve the overall ventilation and reduce the home's load demands.

Caution [EA63]

An improperly sized **HVAC** system can lead to indoor air quality issues, including mold. Combustion safety is a primary consideration requiring testing during **HVAC** design or modifications; a change in the home's air pressure can result in back drafting of combustion units, putting dangerous gases into the home. Testing before and after remodeling with a **Blower Door Test**.

Tips [EA64]

Almost 50 percent of a home's energy bill goes to heating and cooling; make sure the HVAC system is designed and implemented for maximum efficiency.[31]

Make sure the thermostat aligns with the **HVAC** system selected; for example, a **heat-pump system** needs a compatible heat-pump thermostat.

Incentive [EA64]

New Jersey Clean Energy Cool Advantage Program www.njcleanenergy.com/residential/programs/cooladvantage/cooladvantage-program

Building Age [EA64]

Retrofitting **zoning** into older homes or into any existing installation is a challenge and could prove to be very costly; consider options and benefits of doing so versus effort and costs before proceeding.

Tips [EA66]

Use the **Energy Star**® Yardstick www.energystar.gov/index.cfm?fuseaction=home_energy_yardstick.showStep2 to assess requirements for heating or cooling units updates; a score below 5 may mean that home has above average energy use and utility bills.

NJ Bio-Region [EA66]

Humid shore locations are sensitive to under performing cooling units that increase moisture inside the home during the summer season. Take advantage of natural breezes and save money by turning the **HVAC** system off.

Building Age [EA66]

Consider upgrading older less efficient heating and cooling equipment (over 25 years old) with **Energy Star**® equipment to reduce the home's annual energy bill, but only after big air leaks in the home have been repaired.

include well-insulated and sealed ducts, which are best placed within conditioned space and with a minimum number of turns. Placement of the duct system is also essential to assure energy efficiency, promote proper functioning of the entire unit, and reduce future maintenance requirements.

Provide controls and zoning for HVAC HS2 [EA64]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

The heating, ventilating and air conditioning (**HVAC**) system distributes air through the home via the **ducting system**. Assuring proper distribution across defined zones or areas of the home is another key design element and should be considered in conjunction with sizing to assure an efficient system. This is especially true in determining **optimal load calculations** and appropriate air flow for each room. **Zoning** more effectively directs heating and cooling from a single **HVAC** system to multiple areas of the home than multiple **HVAC** units and avoids the added expense that comes with them.

Proper **zoning** controls optimal comfort and efficiency. A **zone controller** connects multiple thermostats to the single **HVAC** system and allows for cooling customization, such as focusing the cooler air in occupied spaces at optimal times. **Zoning** increases overall thermal comfort of a home and is particularly useful in larger houses that are poorly conditioned, such as single-zone two-story houses with a generally warmer second floor.

Select high-efficiency HVAC equipment [EA66]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Heating is the largest energy expense in most homes, accounting for 35-50 percent of annual energy bills in northern New Jersey climates. Save money by reducing heating energy usage while also reducing the home's contribution to environmental problems by upgrading to **Energy Star**® rated heating equipment as determined by the **Annual Fuel Utilization Efficiency (AFUE)** rating for oil and gas furnaces and boilers (and other measures as applicable to heat pumps). **Energy Star**® rebates apply for **Energy Star**® rated equipment.

The American Council for an Energy-efficient Economy cites several considerations for assessing when it is time to replace the furnace.[32] In particular, gas furnaces or boilers or those that are older than 20 years are good candidates for replacement with a high-efficiency model with the guidance of an **Energy Star**® certified heating contractor and **heat-load calculations** that the contractor provides. If it is time to replace the furnace, installing a ground-source **heat pump** could be an option depending on the extent of the remodeling effort (see the Ridgewood historical remodel for a case study installation of a **heat pump**).

The efficiency of central air conditioning systems is rated by its **Seasonal Energy Efficiency Ratio (SEER)**. **SEER** ratings range from 14 to 23; a higher **SEER** rating means a more efficient unit. **Energy Star**® qualified central air conditioners have a **SEER** rating of greater than 14 and are significantly more efficient than standard models. Newer units in general contain significant technological advances to increase efficiency. The minimum **Energy Efficiency Ratio (EER)** for **Energy Star**® models is greater than 12 for **split systems**, and greater than 11.0 for **single-package models**. Higher efficiency units often cost more initially, but save on operating costs over their lifetime.[33] However, it should be noted that a high-energy-efficient unit must also be designed, installed and maintained properly to reap efficiency benefits [see EA63].

An effective pleated filter also contributes to savings on heating/cooling and helps prevent the introduction of pollutants into the living space. Radial pleated filter designs such as a 'MERV 8'

provide optimal dust holding capacity, especially as compared with standard rigid fiberglass filters that provide little resistance against dust or bio contaminates.

A highly-efficient unit must be designed, installed, and maintained properly to reap efficiency benefits. Keeping your efficient filter clean is an essential component of **HVAC** maintenance.

Install programmable thermostats [EA67]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A		DIFFICULTY LEVEL:	

Programmable thermostats save energy and money by allowing homeowners to set temperatures based on occupancy and to schedule setting changes. This uses heating and cooling only when needed. **Programmable thermostats** are especially useful if the house is empty during the work week and only fully occupied on weekends. Pre-programming and proper use of a programmable thermostat saves energy costs by minimizing heating or cooling of an empty house.

Conduct duct tightness test [EA68]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Similar to a pressure test of a plumbing system, a **Duct Blaster Test** gauges the tightness of the ductwork. It uses a fan combined with a pressure gauge to pressurize the duct system and measure air leakage of the ductwork. The test is often performed along with a **Blower Door Test** as part of a **Home Performance Audit** to find leaks. It should be performed before and after related work to properly identify and target areas for action and to assure resolution of desired upgrades to ensure energy and operating cost savings.

Maintain HVAC systems [EA69]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Heating, Ventilating, and Air Conditioning (**HVAC**) systems can be **commissioned** or tested to ensure **refrigerant** charge, airtight ducts, proper room-by-room pressure and proper airflow.

HVAC systems must be properly balanced to ensure even distribution of air and needs to be inspected, tested, and tuned up after installation. **Zoning** and other controls should also be tested to make sure they are functioning properly. To confirm functioning, have it **commissioned**. **Commissioning** provides documented confirmation that the **HVAC** systems are working as intended.

Commissioning systematically investigates, analyzes, and optimizes the performance of **HVAC** systems to improve their operation; maintenance ensures continued performance over time. Regular maintenance ensures that the energy efficiency upgrades remain at optimal levels as designed and are meets the homeowner's current needs.

To protect an investment in an **HVAC** upgrade and assure its efficiency over time, **HVAC** equipment should be tuned up annually and filters should be cleaned or be replaced on a regular basis. **Energy Star**® recommends tending to filters every 30 days during peak heating or cooling season. The wrong amount of **refrigerant** in air conditioners can also impact the functioning of the cooling unit. Proper maintenance extends the life of the **HVAC** system, extending the resource value of the system.

Caution [EA66]

If replacing heating or cooling units, assure proper disposal of the older units; make sure your contract defines the disposal process.

Tips [EA68]

A well-sealed **vapor barrier** may need to be installed on the outside of the insulation on cooling ducts to prevent moisture buildup.

Building Age [EA68]

Historically, only **supply ducts** were sealed, ignoring **return ducts** and **plenums**. Older homes will likely have leaks on the return side.

Caution [EA68]

If ducts don't work properly, they can cause build up of **carbon monoxide** (**CO**). If you have a fuel-burning furnace, stove or other appliance, or an attached garage, install a **CO** monitor to alert you if any of these situations create harmful **CO** levels. www.eere.energy.gov/consumer/tips/ducts.html

Tips [EA69]

Hire a technician trained to use advanced diagnostic tools and procedures to verify installation and operational requirements. For more information, see www.energystar.gov/ia/home_improvement/PHEE_InstallationAC_final.pdf

Building Age [EA69]

Commissioning is especially important in older homes to achieve optimal performance without having to replace equipment. Newer **HVAC** systems use high grade filters; these must be changed as scheduled to ensure the optimal functioning of the filter.

Caution [EA69]

Improperly balanced systems can depressurize the house, allowing **radon** and other hazardous **soil gases** to enter the home.

The **commissioning** process should check for **refrigerant** leaks that can emit **refrigerant** gasses into the air.

NJ Bio-Region [EA70]

A correctly sized and sealed **HVAC** system can be used to control mold related problems by removing humidity from the indoor air.

Building Age [EA70]

Sealing duct leaks is an essential aspect of an **HVAC** retrofit but is a challenge depending on accessibility of ductwork. Make sure the certified contractor addresses ductwork that is in unconditioned spaces, overall effectiveness, and costs before proceeding with work.

Caution [EA70]

Pressure imbalances due to duct leakage can force moisture laden air into **building envelopes** and lead to moisture problems.

Tips [EA71]

If you must clean the ductwork, check references and licenses and make sure the provider is a certified member of the **NADCA**. Air duct cleaning companies must meet requirements to become a **NADCA** Member including having certified Air System Cleaning Specialists (ASCS) on staff.

NJ Bio-Region [EA71]

Higher humidity can cause mold growth in the ducts, requiring more frequent maintenance and cleaning.

Building Age [EA71]

Inspect older **duct systems** before cleaning to be sure they do not have **asbestos**-containing materials.

To assure regular maintenance, homeowners should consider setting up an **HVAC** maintenance contract for "tune-up" of your **HVAC** system before heating and cooling seasons to protect performance. A maintenance contract can pay for itself in energy savings and ensures that your **HVAC** contractor will schedule tune-ups even if you forget.

Seal and insulate HVAC system [EA70]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	TT

A house can lose over 30 percent of its heating and cooling capacity from improperly sealed ducts, especially if the ducts are located in unconditioned spaces.[34] In the winter, hot air leaks into unconditioned spaces and causes the furnace to work harder. In the summer, hot attic air can leak in and increase the load on the air conditioner. A perfectly sealed operative duct system would have the same amount of air entering the return **grille** and leaving the supply registers, creating neutral air pressure. In contrast, leaky **supply ducts** create negative pressure that pulls outside air into the building. On the return side, leaks cause a suction that pulls air into the ducts, forcing more air into the home and creating a positive pressure that also overtaxes the **HVAC** system.

Seal all ducting with low-**VOC duct mastic**. The **Energy Star® Thermal By Pass Checklist** recommends the use of mastic, not tape, to seal ducts. Results have shown that using tape to seal ducts is ineffective as tape often frays and curls away degrading the seal. If any ductwork is in less desirable condition, or in uninsulated areas, additional insulation most likely will be required. A qualified professional can help insulate and repair ducts.

Make sure ductwork is clean [EA71]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	N/A	INITIAL COST:	$$$
RESOURCE CONSERVATION:		AIR QUALITY:		DIFFICULTY LEVEL:	TTT

Duct cleaning refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, **diffusers**, **heat exchangers**, **heating and cooling coils**, **drain pans**, fan motor, fan housing, and the air handling unit. While clean ducts help maintain healthy indoor air quality, unless done properly, cleaning ducts can cause more indoor air problems.

If a visual inspect reveals infestation, mold or extreme debris problems, duct cleaning may be necessary. If so, be sure the service provider cleans all components of the system to avoid any recontamination that may require more serious cleaning needs. Be sure the service provider is qualified by the **National Air Duct Cleaners Association (NADCA)**. A certified service provider uses specialized tools to dislodge dirt and other debris in ducts and vacuums them out with a high-powered vacuum cleaner. Different types of ducts require different cleaning methods; sheet metal ducts with external insulation are the easiest to clean. A **Duct Blaster Test** should also be performed when cleaning ducts to gauge the tightness of the ductwork. Finally, be sure to cover duct registers and openings during renovation or remodeling.

Use ceiling fans for natural ventilation HS3 [EA65]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Use ceiling fans in conjunction with an air conditioning system in occupied rooms; people can tolerate higher temperatures when air is in motion. This reduces air conditioning use, saving money and electricity. In the summer, run ceiling fans in a counterclockwise motion; ceiling fans also can be used in the winter in a clockwise motion at low speeds to bring warm air back down into the occupied space.

Also consider a **whole house fan** in the attic to avoid air conditioner usage and expense. Generally a whole house fan is used at night and turned off during the day. It moves cooler nighttime air into the house through open windows and exhausts warm air through the attic.

Another way to cool the home is with **transoms** in window and door designs. Designing for convection directs cool air to enter the home on the lower floors (such as through the basement) and expels warm air through upstairs windows.

Strategic location of plants and landscaping can cool the air before it enters the home. Finally, **awnings** and blinds provide additional passive cooling options.

Insulate water heater [EA80]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

New water heaters have added interior layers of insulation that improve their energy consumption. Older water heaters are the third largest energy expense in the home, accounting for about 13 percent of the utility bill.[35] Insulate free-standing water heater storage units for quick and inexpensive improvements in energy efficiency. Heat is lost because the temperature inside a water heater is significantly higher than the temperature of the room, especially when the water heater's location is unconditioned. **Water heater blankets** and kits are available from local hardware stores and **weatherization** supply companies.

Insulate hot water pipes [EA81]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Hot water pipes usually run through unheated areas of the home, so insulating them is important to prevent heat loss and help the water heater run efficiently. Insulated hot water pipes reduce water usage by increasing the amount of time that hot water stays hot thereby reducing the need to run tepid water through the faucet. Requiring less energy to heat water also reduces water heating bills.

Insulating hot water pipes on accessible pipes is an easy task. Pre-formed foam pipe insulation sleeves (available at local hardware stores) can be cut to fit snugly and snap in place on the pipes. Use a durable pipe insulation material that can withstand high temperatures over time. Cover slits and joints with vinyl duct tape to provide additional insulation.

Caution [EA71]

Existing ductwork should be covered during any construction or remodeling effort to prevent contamination from related dust and debris.

Tips [EA65]

Turn ceiling fans off when rooms are unoccupied. Consider a solar powered attic or **whole house fan** for additional energy savings.

Building Age [EA65]

Older homes pose challenges to designing optimal mechanical cooling, so consider ventilation options before installing air conditioning. Many older homes have cross ventilation systems built into their original design, as they were built before air conditioning became commonplace.

Caution [EA65]

To avoid mold build-up in high humidity areas of the house may require mechanical cooling with dehumidifying capabilities.

Tips [EA80]

Water heater blankets/wraps come in complete kits with tape and instructions. Turning down the thermostat on the water heater can also cut water heating bills. Be sure to also insulate hot water pipes leading from the water heater.

Tips [EA81]

The first six to eight feet of pipe from the water heater are the most important to insulate.

Assure a snug fit around the pipes, especially the elbows and angles; tight-fitting insulation is always more effective.

NJ Bio-Region [EA81]

Insulate cold-water pipes in areas with high summertime humidity to prevent condensation of moisture on the pipes which can degrade the durability of the piping.

Utilize solar water heating [EA101]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	
INITIAL COST:	$$$	RESOURCE CONSERVATION:	
AIR QUALITY:		DIFFICULTY LEVEL:	TTT

Solar water heating is cited as the most cost-effective renewable energy system for residential applications. Payback periods related to solar water heating differ depending on the cost of energy for heating water. In areas where electricity is used for water heating, the payback periods are shorter than for areas that use natural gas for water heating.[36] Installing a solar water heater is a proven solution to reducing the home's carbon footprint. Conventional electric water heaters produce about eight tons of CO_2 annually and gas water heaters about two tons of CO_2 annually.[37]

Solar water heating can be used for domestic hot water, pool heating, and space heating needs and is in use by over a million homes in the United States.[38] There are many types of solar water heaters. Evacuated tube solar hot water system can provide 90 percent–100 percent of domestic hot water needs.[39] Appropriate design and climate considerations are key in the consideration of any solar project. Care must be taken to guard against freezing of the collector and piping, and evacuated tubes for solar hot water can overheat and break if the power went out on a sunny day.

Tips [MR121]

Wiring raceways can simplify the task of wiring and reduce wall penetrations that can compromise a building's thermal performance.

Plan for future wiring and cabling needs [MR121]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	N/A
INITIAL COST:	$$	RESOURCE CONSERVATION:	
AIR QUALITY:	N/A	DIFFICULTY LEVEL:	TT

Cabling for electrical equipment is an important consideration in any 21st-century home, but especially in any space that could be used as a home office. Living rooms also have increased cabling needs if home has more sophisticated audio and visual systems. Recent changes from standard phone lines, to ethernet, to T-1 and fiber-optic created a need for enhanced electrical, communications and data cabling. It is possible that wireless technology will obviate the need for communications, and data cabling altogether, but to plan for the unknown and minimize the likelihood of expensive cabling upgrades in the future, provide either **wiring conduits** through which new cables can be run or surface-mounted **wiring raceways**. In addition to planning for adaptability, provide plenty of electrical receptacles and communications ports to give flexibility within the spaces.

Provide daylighting HS1 [EA83]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	N/A
INITIAL COST:	$	RESOURCE CONSERVATION:	
AIR QUALITY:	N/A	DIFFICULTY LEVEL:	TT

Sunlight is a natural way to reduce energy use during the daytime hours. Homes that only require artificial lighting at night and on darker days save more electricity and are more aesthetically pleasing than ones that do not.

Windows and skylights are obvious sources of daylight, but balance daylight access with appropriate **glazing** and shading techniques. Poorly designed window or skylight layouts can increase summer **cooling loads** significantly. **Awnings**, **louvers**, and shutters can block direct sunlight and allow indirect sunlight into the building. Conversely, a well-designed scheme reduces **heating loads** significantly in the colder months. In the northern hemisphere, south facing windows receive the most sunlight over the course of the day. For these windows, properly sized overhangs will shade the window from direct summer heat but will allow the lower winter sunlight to filter through.

An alternative to window skylights is **solar tubes**. The flexible cylinders of the **solar tubes** draw sunlight from the roof into a ceiling fixture resembling a standard lighting fixture. They are useful in smaller interior rooms without space for a traditional skylight, such as a bathroom. Translucent panel skylight systems are another means of allowing sunlight in without producing glare and minimizing heat transfer.

Provide appropriate lighting [EA84]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Lighting consumes almost 15 percent of a household's electricity use.[40] Provide an appropriate mix of color-correct **ambient** and task lighting to improve both the quality and quantity of lighting used in the home.

Two ways of determining which lighting is appropriate for a particular use are its **color temperature** and its **Color Rendering Index (CRI)**.

Color temperature defines the color and warmthor coolness of a light source. **Color temperature** is measured in degrees **Kelvin (K)**. High **Kelvin** temperatures (3600–5500 **K**) are considered "cool" and low color temperatures (2700–3000 **K**) are considered "warm." Task lighting calls for cool light that produces a higher contrast than warm light and is better for visual tasks. Warm light is recommended for living spaces. A **color temperature** of 2700–3600 **K** is generally recommended for most indoor general and task lighting applications.

The **Color Rendering Index (CRI)** is a 1-100 scale that measures how colors appear under different light sources. A light source with a **CRI** of 80 or higher is considered acceptable for most indoor residential applications.

Install energy-efficient lighting [EA85]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Traditional incandescent bulbs will be phased out by 2012. The technological improvements in **compact fluorescent lighting (CFLs)** over the past decade have made for a smooth transition. **CFLs** are inexpensive, last ten times as long as traditional bulbs, and use a fraction of the electricity. They also fit into standard light fixtures, allowing for their widespread use with minimal up-front cost.

Light-emitting diodes (LEDs), currently used in a variety of applications, potentially could find their way into more traditional lighting applications. Highly efficient, durable, and non-toxic, **LED**s currently cost too much to warrant their widespread use. However, rapid advances in **LED** technology continue to push **LED** lighting to more practical uses.

Wherever possible, replace incandescent bulbs with greener alternatives. It is a simple and affordable way to significantly reduce home energy use.

Tips [EA84]

Match the amount and quality of light to the function.

Install **task lights**, such as desk lamps, where needed and reduce **ambient light** elsewhere.

Use energy-efficient lighting components (i.e., **CFLs**, **LEDs**), controls, and systems.

Maximize the use of daylighting.

Caution [EA84]

Fluorescent bulbs and lamps are considered hazardous waste and should be disposed of properly. If a bulb breaks, avoid direct contact with skin. Burned out or broken **fluorescent lamps** and bulbs should be brought to a facility that recycles them. Check with your County's Solid Waste and Recycling Department or enter your zip code at www.Earth911.com to find out where you can recycle these materials.

Tips [EA85]

Not all **CFLs** are dimmable, so be sure to check before purchasing for a dimmable fixture.

Unplug **LED** lit appliances when not in use to further reduce energy costs.

Caution [EA85]

CFLs contain traces of mercury; cleaning up a broken **CFL** must be done carefully, and check with your municipality for recycling instructions for worn out bulbs.

Provide appropriate indoor lighting controls [EA90]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Lighting represents about 15 percent of household electricity usage and about 10 percent of household energy expenses. Newer lighting technologies, extensively used in commercial buildings, are now available for home use. These technologies can reduce lighting energy use in your home by over 50 percent.[41]

Lighting controls such as dimmers, timers, and motion detectors reduce light usage by synchronizing lighting directly with living patterns. Motion detectors switch the light on when someone walks into a room, while light sensitive detection adjusts indoor lighting based on the changing levels of outdoor light.

High tech lighting controls, including whole house systems that offer tie-ins to computer and security systems as well as outdoor lighting, are most effective in new construction that can be hardwired with low-voltage wiring.

Use non-paper-faced gypsum board in moist areas

HS3 [IEQ183]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Minimize mold growth, maintain high indoor air quality and improve durability by using better wall and ceiling finishes. **Gypsum board (drywall)** is a common building product in the United States and is available in several varieties that resist mold growth. The most reliable is non-paper-faced **gypsum board**. Paper components absorb moisture because paper is a food source for mold. Non-paper-faced **gypsum**, originally developed for exterior **sheathing**, is useful in moist areas such as basements and bathrooms.

In damp areas choose **cement board**, **mortar**, or non-paper faced **gypsum**. Paper-faced **gypsum board** should never be used as backer for tub or shower surrounds where ceramic tile, marble, or any material with joints or grout lines is used as the finish. While more expensive to purchase than conventional paper-faced products, there are long-term savings in preventing damage from mold growth. It is important to seek comparable data to assess performance of other mold resistant claims by manufacturers, as little independent analysis is available.

Install eco-friendly interior sheathing

HS2 HS3 [MR126]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Paper-faced drywall is the most common and least expensive finishing for interior walls. It is easy to work with and its paper composition is typically recycled from 100 percent **post-consumer** waste. However, paper-faced drywall is highly susceptible to moisture damage and mold growth; do not use it in moist areas of the home.

Fiberglass-faced drywall is a paperless **gypsum** panel often used for exterior **sheathing** and interior walls in mold-prone areas. It contains no **cellulose**, which supports mold growth. Fiberglass-faced drywall, however, cannot be recycled and because of the fiberglass it cannot be ground for use as a soil amendment.

Choose eco-friendly paints, sheens, and finishes

[IEQ185/MR130-131]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

Traditional paints, finishes and coatings contain a variety of hazardous chemicals and volatile organic compounds (**VOCs**) which can be harmful to human health. Choosing zero- or **low-VOC** paints significantly improves indoor air quality in the home. These products are readily available and come in a wide variety of colors and finishes. Also, choosing appropriate sheens can improve the durability of walls and other finished surfaces. For places that will be washed frequently use sheens with a high "scrubability" rating.

To further reduce chemicals used in paints, manufacturers recently have introduced products made almost exclusively from plant oils and minerals. When possible, use natural paints, varnishes, finishes and plasters instead of conventional **petroleum-based** products improve indoor air quality. The increasing availability of natural products has helped make them more competitively priced.

Caution [IEQ185]

People with sensitivities to **terpenes** and other chemicals may still be affected by natural finishes. Follow the manufacturer's instructions to properly apply all paint products.

Select eco-friendly wall coverings HS1 [MR129/IEQ186]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION: N/A	AIR QUALITY:	DIFFICULTY LEVEL:	

When it is time to update wall covers, look for low **VOC**-emitting products. Traditional wallpaper is coated with **PVC** and **plasticizers** that over time release chemicals found to interrupt the **endocrine system**. These impermeable plastic coatings also keep moisture in the walls which can lead to mildew and mold. The discovery of the effects of the production and **off-gassing** spurred the introduction of many new low-**VOC** and natural fiber products. These products help reduce airborne chemicals and protect indoor air quality. They also prevent moisture retention behind walls. Natural and low-**VOC** products are slightly more expensive than traditional products and may need special care when installing, so follow any manufacturing guidelines that come with the product.

Tips [MR129/IEQ186]

An easy and inexpensive way to avoid mold and mildew growth in walls, moist areas and basements is to use **porous** paints or clay treatments. Preventing moisture build up improves the overall health of the home.

Select eco-friendly furniture HS2 [MR141-143/146-147/150]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Before purchasing new furniture, consider refurbishing, creative reuse of existing furniture, or buying salvaged items. When purchasing new furniture, select products from companies with responsible business practices that use recycled materials, **FSC-certified wood**, **formaldehyde-free**, and **low-VOC** finishes. Also, spending a little more up front to purchase high-quality, solid furniture and cabinetry will increase the long-term viability of the products and reduce maintenance of the home and will use fewer resources in the long run.

Tips [MR145]

The Habitat for Humanity Re-Store program sells quality new and used tools and products donated to area Habitat affiliates. Proceeds benefit affordable housing projects. www.habitat.org/env/restores.aspx

Look for locally manufactured furnishings. Products produced outside the United States and Canada require more resources to transport to New Jersey and tend to have fewer protective controls on **formaldehyde** and **VOC** content.

Choose moisture-resistant furniture for longer life while saving money and preserving natural resources. Other ideas to save money and natural resources include selecting products made from **certified sustainable wood**, **reclaimed** materials, bamboo, recycled or recyclable metal or plastic, fixable materials, and durable materials.

Choose furniture/fittings that resist moisture HS3 [IEQ188]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	TT

Basements in New Jersey tend to be humid. To avoid problems with mold, do not use upholstered furniture or window treatments that absorb moisture easily. These products promote the growth of mold and mildew and degrade indoor air quality. Moldy furniture may be difficult or even impossible to clean, requiring replacement. Whenever possible, choose recycled or **sustainably harvested wood** furniture over upholstered furniture.

Also be careful of window finishes that may be susceptible to moisture. Finally, avoid carpets in basements. If necessary, use area rugs that can be easily cleaned.

Select materials that are easy to clean [MR156]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	T

When looking for furniture and other items for the home, consider how easy they will be to clean and maintain. Items with reduced maintenance and cleaning needs are replaced less often, mitigating any higher up-front expenses by reducing future costs. Replacing furniture and household items less often conserves resources, reduces the need for new production and eases the burden on landfills.

Materials that are easier to clean require fewer chemical products to be used within the home as well. Products that can be cleaned with natural "green" cleaning agents will also help maintain healthy indoor air quality.

Site

Configure for solar access [EA100]

Resources:

U.S. Department of Energy: Passive Solar Home Design

www.eere.energy.gov/consumer/your_home/designing_remodeling/index.cfm/mytopic=10250

Haggard, Ken - Basics of Passive Solar Design. Solar Today (May/June 2008) 6A-9A

Solar Site Assessment tool

www.howto.altenergystore.com/Articles-not-yet-activated/Tools-for-a-Successful-Solar-Electric-Install/a90/

Solar Site Assessment Tool
www.oregon.gov/ENERGY/RENEW/Solar/docs/SunChart.pdf

References:

[1] **U.S. Department of Energy. 2008. EERE. Solar Radiation Basics**
www.eere.energy.gov/consumer/renewable_energy/solar/index.cfm/mytopic=50012)

Consider on-site renewable energy [EA102]

Resources:

U.S. Department of Energy, Database of State Incentives for Renewables & Efficiency (DSIRE): New Jersey

www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=NJ

New Jersey Solar Renewable Energy Credit Program

www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-**srec**/new-jersey-solar-renewable-energy

USEPA Energy Star®, Federal Tax Credits for Energy Efficiency

www.energystar.gov/index.cfm?c=products.pr_tax_credits

U.S. Department of Energy, Energy Efficiency and Renewable Energy: "Solar Water Heaters."

www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850

U.S. Department of Energy: Geothermal Heat Pumps

www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

International Ground Source Heat Pump Association

www.igshpa.okstate.edu/

References:

[2] **New Jersey Solar Renewable Energy Certificate Program**

www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-srec/new-jersey-solar-renewable-energy

[3] **DSIRE: New Jersey Solar Energy Sales Tax Exemption**

www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ01F&re=1&ee=**1**

[4] **U.S. Department of Energy: Solar Water Heaters**

www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850

[5] **U.S. Department of Energy Energy Savers: Geothermal Heat Pumps**

www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

Minimize site disturbance [SS29]

Resources:

Sustainable Sites Initiative
www.oregon.gov/ENERGY/RENEW/Solar/docs/SunChart.pdf
www.sustainablesites.org/

Landscape for passive heating and cooling [SS30-S31/36]

Resources:

The Tree Guide

www.arborday.org/treeguide/growth.cfm

New Jersey Agriculture Extension Service

www.njaes.rutgers.edu

If Plants Could Talk

www.ifplantscouldtalk.rutgers.edu

NJDEP: A Quick Reference to New Jersey's Biotic Forest Health Threats

www.NJ.gov/dep/parksandforests/forest/forest_health_threats.pdf

Greenandsave: Trees

www.greenandsave.com/landscaping/gardens/trees.html

Conserving Energy with Landscaping

www.ext.vt.edu/pubs/envirohort/426-712/426-712.html

U.S. Department of Energy: Passive Solar Home Design

www.eere.energy.gov/consumer/your_home/

Maintain slope to drain away from building [IDP13]

Resources:

Do It Yourself, Home Drainage Systems

www.doityourself.com/stry/homedrainagesystems

Partnership for Advancing Technology in Housing (PATH). 2006. Moisture Resistant Homes

www.pathnet.org/sp.asp?id=18574

References:

[6] **U.S. Department of Housing and Urban Development. Moisture Resistant Homes – A Best Practice Guide and Plan Review Tool for Builders and Designers with a Supplement Guide for Homeowners. March 2006**

www.pathnet.org/sp.asp?id=18574 (accessed February 16, 2009)

[7] **Partnership for Advancing Technology in Housing (PATH) 2006. Moisture Resistant Homes**

www.pathnet.org/sp.asp?id=18574

Minimize impervious surfaces [SS32]

Resources:

Tool Base Services - Permeable Pavement

www.toolbase.org/Technology-Inventory/Sitework/permeable-pavement

NJDEP: New Jersey Stormwater Best Management Practices Manual, Standard for Pervious Paving Systems

www.state.NJ.us/dep/watershedmgt/DOCS/BMP_DOCS/bmpfeb2004pdfs/feb2004chap9_7.pdf

Polluted Runoff: Sewage: Your Environmental Impacts

www.lowimpactliving.com/pages/your-impacts/runoff

New Jersey Agriculture Extension Service: Rain Gardens

www.water.rutgers.edu/Fact_Sheets/fs513.pdf

New Jersey Agriculture Extension Service: New Jersey's Stormwater Regulations

www.water.rutgers.edu/Fact_Sheets/fs556.pdf

Landscape to minimize heat island effects [IDP17]

Resources:

NJDEP: Creating Sustainable Communities – A Guide for Developers and Communities

www.NJ.gov/dep/opsc/docs/Heat_Island.pdf

USEPA, Heat Island Effect

www.EPA.gov/heatisland/index.htm

Heat Island Group

www.eetd.lbl.gov/HeatIsland/

Minimizing the Urban Heat Island Effect through Landscaping

www.neduet.edu.pk/Arch_2Jne/Arch11/JRAP-2001/JRAPpercent201/Heatpercent20Island-New.pdf

References:

[8] **Solecki WD, Rosenzweig C, Parshall L, Pope G, Clark M, Cox J, Wiencke M. Mitigation of the heat island effect in urban New Jersey. Environmental Hazards 2005; 6:39.**

[9] **Heat Island Group [Internet]: Lawrence Berkeley National Laboratory; c2000 [cited 2008 2/27].**

eetd.lbl.gov/heatisland/

[10] **U.S. Department of Energy - Heat Island Effect**

www.energy.gov/energyefficiency/index.htm

Plan for erosion control [SS39]

Resources:

Toolbase Service: Construction Waste

www.toolbase.org

North Carolina Department of Environmental and Natural Resources Filter Berms and Filter Socks

www.dlr.enr.state.nc.us/TACpercent20website/2008_04_23/4.22percent20-percent20AAHTOpercent20Standardpercent20Specspercent20forpercent20Compostpercent20Filterpercent20Socks.pdf

High Beam, Erosion Control Using Wood Waste Materials

www.highbeam.com/doc/1P3-603533371.html

References:

[11] **The National Association of Home Builders:**

www.nahb.org/

Foundation

Test and install a radon mitigation system [IEQ163]

Resources:

NJDEP: Radon Section

www.njradon.org/index.htm

USEPA, Radon

www.EPA.gov/radon/index.html

References:

[12] **USEPA, A Citizen's Guide to Radon, Protecting Yourself and your family**

www.EPA.gov/radon/pubs/citguide.html

[13] **EPA Radon website**

www.EPA.gov/radon/healthrisks.html

[14] **See EPA Guidance**

www.EPA.gov/radon/pubs/consguid.html

Insulate floor slab and foundation walls [EA47]

Resources:

Building Science, Renovating Your Basement, 2007

www.buildingscienceconsulting.com/resources/foundations/renovating_your_basement.pdf

PATH, Quality and Durability Articles

www.pathnet.org/sp.asp?id=23716

Toolbase- Pre-case Concrete Panels

www.toolbase.org/Technology-Inventory/Foundations/precast-concrete-panels

Toolbase Service: Insulating Concrete Forms (ICFs)

www.toolbase.org/TechInventory/TechDetails.aspx?ContentDetailID=602&BucketID=6&CategoryID=54

Toolbase Service: Structural Insulated Panels (SIPs)

www.toolbase.org/TechInventory/TechDetails.aspx?ContentDetailID=975&BucketID=6&CategoryID=13

U.S. Department of Energy: Insulation and Air Sealing

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11220

Provide moisture control at foundation [IDP19]

Resources:

The Energy & Environmental Building Association (EEBA)™

www.eeba.org/index.html

Building Science.com

www.buildingscience.com/bsc/

HGTV Pro, French Drains (includes video link)

www.hgtvpro.com/hpro/bp_foundation/article/0hpro_20146_3463230,00.html

References:

[15] **USGBC and ASID. 2007. REGREEN Guidelines, pages 70-71**

Utilize Integrated Pest Management [IDP23]

Resources:

Integrated Pest Management (IPM) Practitioners Association

www.efn.org/~ipmpa/keydocs.html

Northeastern IPM Center

www.northeastipm.org/

Pest Management Office of Rutgers Cooperative Extension

www.pestmanagement.rutgers.edu/

If Plants Could Talk

www.ifplantscouldtalk.rutgers.edu/

Association of New Jersey Environmental Commissions: Integrated Pest Management

www.anjec.org/html/ipm.htm

New Jersey Agricultural Experiment Station- Cooperative Extension

www.njaes.rutgers.edu/extension/

Sustainable Site Initiative

www.sustainablesites.org/

References:

[16] **Association of New Jersey Environmental Commissions: Integrated Pest Management**

www.anjec.org/html/ipm.htm

Use biobased form-release agents [MR115]

Resources:

REGREEN Product Selection Resources

www.regreenprogram.org

Insulating Concrete Form Association

www.forms.org

Toolbase Service: Insulating Concrete Forms (ICF)

www.toolbase.org/Technology-Inventory/walls/Insulating-Concrete-Forms

Ecology Action, Concrete Framework

www.ecoact.org/Programs/Green_Building/green_Materials/concrete_formwork.htm

Use fly ash in concrete [MR114]

Resources:

Making Better Concrete, Bruce King, Chelsea Green Publishing, 2006

www.buildersbooksource.com/cgi-bin/booksite/21165.html

Toolbase Service: Fly Ash Concrete

www.toolbase.org

Ecology Action, Green Building Materials Guide

www.ecoact.org/Programs/Green_Building/green_Materials/concrete.htm

References:

[17] **BuildingGreen, LLC. 2008. "BackPage Primer – Using Fly Ash in Concrete." Environmental Building News. Volume 18, Number 2. February 2009.**

[18] **BuildingGreen, LLC. 2009. BackPage Primer – Using Fly Ash in Concrete. Environmental Building News. Volume 18, Number 2, February 2009.**

Building Envelope

Conduct a Home Performance Audit and diagnostic tests [IPD2, EA51-54]

Resources:

New Jersey Clean Energy Program – Home Performance with Energy Star®

www.njcleanenergy.com/residential/home/home

Home Energy Analysis – Free Online Tool

www.njcleanenergy.com/residential/tools-and-resources/home-energy-analysis/home-energy-analysis

U.S. Department of Energy: Do-It–Yourself Home Energy Audit

www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170

USEPA Energy Star® Home Energy Yardstick

www.EnergyStar.gov

Alliance to Save Energy Home Energy Checkup and Audit

www.ase.org

U.S. Department of Energy: Detecting Air Leaks

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11250

New Jersey Office of Clean Energy, Rebates and Promotions

www.njcleanenergy.com/main/rebates-and-promotions/rebates-and-promotions

Energy Star®, Thermal Bypass Inspection Checklist

www.EnergyStar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

Affordable Housing Design Advisor - Thermal Bypass Checklist (video tutorial)

www.designadvisor.org/

References:

[19] **U.S. Department of Energy: Blower Door Tests**

www.energysavers.gov

Minimize wood use with advanced framing [MR116]

Resources:

Toolbase Services: Advanced Framing Techniques: Optimum Value Engineering (OVE)

www.toolbase.org/Technology-Inventory/Whole-House-Systems/advance-framing-techniques

USEPA Energy Star®, 12 Roof Trusses

www.energystar2006.com/the-actual-construction/12-roof-truss-set/

Green Building Materials Guide, Advanced Framing

www.ecoact.org/Programs/Green_Building/green_Materials/advanced_framing.htm

References:

[20] **REGREEN Guidelines**

www.regreenprogram.org

[21] **U.S. Department Of Energy: Advanced Wall Framing**

www.eere.energy.gov/buildings/publications/pdfs/building_america/26449.pdf

Install or upgrade insulation [EA49]

Resources:

USEPA - Current Best Practices for Vermiculite Attic Insulation - May 2003

www.EPA.gov/Asbestos/pubs/insulation.html#What

U.S. Department of Energy: Insulation

www.eere.energy.gov/consumer/tips/insulation.html

USEPA Energy Star® Program

www.EnergyStar.gov

Energy Trust of Oregon, Home Energy Solutions, Weatherization Specification Manual Attic Insulation

www.energytrust.org/TA/hes/weatherization/attic.html#at37

U.S. Department of Energy: Seal Air Leaks and Save Money, Fact Sheet

www.eere.energy.gov/buildings/publications/pdfs/building_america/26446.pdf

U.S. Department of Energy: Radiant Barriers

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11680

USEPA Energy Star®, Guide to Do It Yourself Sealing and Insulating

www.EnergyStar.gov/ia/partners/publications/pubdocs/DIY_Guide_May_2008.pdf

References:

[22] **Iowa Energy Center. 2009. Home Tightening, Insulation and Ventilation. Home Series Booklets**

www.energy.iastate.edu/homeseries/downloads/HomeSeries1.pdf

[23] **U.S. Department of Energy. 2008. Insulation Fact Sheet**

www.ornl.gov/sci/roofs+walls/insulation/ins_02.html

[24] **Toolbase Services: Alternative Insulation Materials**

www.toolbase.org/Technology-Inventory/walls/sprayed-foam-insulation

[25] **U.S. Department of Energy: Sprayed-Foam and Foamed-In-Place Insulation**

www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11700

[26] **U.S. Department of Energy: Radiant Barriers**

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11680

Install a durable wall cladding [MR119]

Resources:

Wall cladding

www.buildinggreen.com

Toolbase Services: Tech Set 2 - Durable Building Envelope

www.toolbase.org

References:

[27] **Lead paint was banned in 1978, but houses painted prior to that date will have a paint with a high lead content.**

Air seal to reduce infiltration [IDP55]

Resources:

The Family Handyman: Insulate Basement Rim Joists

www.rd.com/familyhandyman/content/57548/

USEPA Energy Star® Methodology for Estimated Energy Savings from Cost-Effective Air Sealing and Insulating

www.EnergyStar.gov/index.cfm?c=home_sealing.hm_improvement_methodology

Oikos, Rim Joists

www.oikos.com/library/airsealing/rim_joists.html

The Best Way to Insulate a Rim Joist, Stop Energy Losses With A Spray-Foam Kit, Isaac Savage

www.taunton.com/finehomebuilding/PDF/Free/021189072.pdf

U.S. Department of Energy: Insulation and Air Sealing

www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11220

USEPA EnergyStar. 2008. A Do-It-Yourself Guide to Sealing and Insulating with Energy Star®

www.energystar.gov/index.cfm?c=diy.diy_index

Iowa Energy Center. 2009. Home Tightening, Insulation and Ventilation. Home Series Booklets

www.energy.iastate.edu/homeseries/downloads/HomeSeries1.pdf

References:

[28] **Partnership for Advancing Technology in Housing (PATH). 2008. Energy Efficient Rehab Advisor – Air Sealing**

www.rehabadvisor.pathnet.org/sp.asp?id=9715

Include capillary break [IDP22]

Resources:

Building Science Consulting, Designs That Work Cold Climate - The Basic House - Building Enclosure:

www.buildingscience.com/bsc/designsthatwork/cold/section2/enclosure.htm

USEPA Energy Star® Indoor Air Package Specifications

www.EnergyStar.gov/ia/partners/bldrs_lenders_raters/downloads/IAP_Specification_041907.pdf

References:

[29] **FabForm, Footings and Drainage, Jon Eakes, 2006**

www.fab-form.com/news/media/homebuilderpercent20magazine_mar_apr_2006.html

[30] **Basement Insulation Systems, Nathan Yost, M.D.Joseph Lstiburek, Ph.D., P.E.**

www.eere.energy.gov/buildings/building_america/pdfs/db/35017.pdf

Provide moisture management strategies [IDP24]

Resources:

Sustainability of the Building Envelope, Rob Bolin, PE

Syska Hennessy Group May 2008

www.wbdg.org/resources/env_sustainability.php

The Energy & Environmental Building Association

www.eeba.org/index.html

Building Science Consulting, Read This Before Your Design, Build or Renovate

www.buildingscienceconsulting.com/resources/mold/Read_This_Before_You_Design_Build_or_Renovate.pdf

Build Wisely, Moisture Proof Barrier

www.buildwisely.com/moisture-proof-barrier.html

HVAC

Follow standards for mechanical design [EA63]

Resources:

Air Conditioning Contractors of America (ACCA)

www.acca.org/

HVAC Calculations

www.hvacloadcalculations.com/

USEPA Energy Star®/ACCA Quality Installation Standards

www.acca.org/quality/

The Engineering Toolbox - Cooling Loads

www.engineeringtoolbox.com/latent-sensible-cooling-load-d_245.html

Provide controls and zoning for HVAC [EA64]

Resources:

U.S. Department of Energy: Thermostats and Control Systems

www.eere.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

California Energy Commission Consumer Energy Center, Central HVAC

www.consumerenergycenter.org/home/heating_cooling/heating_cooling.html

HVAC Control Tutorial by Jeff Fisher

www.hometech.com/learn/HVAC.html#zoned

U.S. Department of Energy, Best Practices Guide for residential HVAC retrofits

www.ducts.lbl.gov/HVACRetrofitguide.html

U.S. Department of Energy: Space Heating and Cooling

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12300

References:

[31] **U.S. Department of Energy. EERE. Space Heating and Cooling**

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12300

Select high-efficiency HVAC equipment [EA66]

Resources:

California Energy Commission Consumer Energy Center, Central HVAC

www.consumerenergycenter.org/home/heating_cooling/heating_cooling.html

USEPA Energy Star®: Heat & Cool Efficiently

www.EnergyStar.gov/index.cfm?c=heat_cool.pr_HVAC

USEPA Energy Star® Guide to Energy-efficient Heating and Cooling

www.EnergyStar.gov/ia/products/heat_cool/GUIDE_2COLOR.pdf

The Consortium for Energy Efficiency (CEE) and the Air-Conditioning and Refrigeration Institute (ARI) online database

www.ceedirectory.org/ceedirectory/pages/cee/ceeDirectoryMain.aspx

References:

[32] **American Council for an Energy-Efficient Economy**

www.aceee.org/consumerguide/heating.htm

[33] **Change for the Better with Energy Star®, Stewardship for the Earth**

www.EnergyStar.gov/ia/business/small_business/EnergyStarCongregationsHandout.pdf

Install programmable thermostats [EA67]

Resources:

Toolbase Services: Programmable Thermostats

www.toolbase.org/TechInventory/TechDetails.aspx?ContentDetailID=801&BucketID=6&CategoryID=6

USEPA Energy Star®: Programmable Thermostats

www.EnergyStar.gov/index.cfm?c=thermostats.pr_thermostats

U.S. Department of Energy: Thermostats and Control Systems

www.eeregov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

HVAC Control Tutorial by Jeff Fisher

www.hometech.com/learn/HVAC.html#zoned

Conduct duct tightness test [EA68]

Resources:

U.S. Department of Energy: Ducts

www.eere.energy.gov/consumer/tips/ducts.html

Southface Energy Institute - Blower Door and Duct Blaster Testing

www.southface.org/web/resources&services/publications/factsheets/22blowdoor.pdf

Why Test Ducts by Jim Fleming

www.energyrater.biz/Why_test.htm

U.S. Department of Energy - Best Practices Guide for residential HVAC retrofits

www.ducts.lbl.gov/HVACRetrofitguide.html

Maintain HVAC systems [EA69]

Resources:

Whole Building Design Guide: Plan the Commissioning Process

www.wbdg.org/project/plan_comm_process.php

USEPA Energy Star®, Quality Installation for HVAC

www.EnergyStar.gov/ia/home_improvement/PHEE_InstallationAC_final.pdf

Seal and insulate HVAC system [EA70]

Resources:

USEPA Energy Star® Thermal Bypass Inspection Checklist

www.EnergyStar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

U.S. Department of Energy: Best Practices Guide for residential HVAC retrofits

www.ducts.lbl.gov/HVACRetrofitguide.html

Why Test Ducts by Jim Fleming

www.energyrater.biz/Why_test.htm

U.S. Department of Energy: Insulation and Ducts

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11500

References:

[34] **U.S. Department of Energy: Insulation and Ducts**

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11500

Make sure ductwork is clean [EA71]

Resources:

USEPA: Should You Have Your Ducting Cleaned?

www.EPA.gov/iaq/pubs/airduct.html#whatpercent20ispercent20airpercent20ductpercent20cleaning

National Air Duct Cleaners Association

www.nadca.com/

Use ceiling fans for natural ventilation [EA65]

Resources:

U.S. Department of Energy: Ventilation

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12351

Forget AC! Cool Your Home Naturally by Carol Venolia and Kelly Lerner, Mother Earth News Homes: Guide to Affordable and Sustainable Building, Spring 2008.

www.MotherEarthNews.com

U.S. Department of Energy: Summer Energy Savers

www.energy.gov/4242.htm

Rocky Mountain Institute - Home Cooling

www.rmi.org/sitepages/pid208.php

USEPA Energy Star®

www.EnergyStar.gov/index.cfm?c=ceiling_fans.pr_ceiling_fans

Plumbing

Insulate water heater [EA80]

Resources:

Lowes - Making Your Home More Energy-efficient

www.lowes.com/lowes/lkn?action=howTo&p=Improve/HomeEnergyEfficient.html#1

Wrapping the water heater (video in English and Spanish)

www.pnm.com/customers/wx.htm

References:

[35] **U.S. Department of Energy: Water Heating**

www.eere.energy.gov/consumer/tips/water_heating.html

Insulate hot water pipes [EA81]

Resources:

Lowes - Making Your Home More Energy-efficient

www.lowes.com/lowes/lkn?action=howTo&p=Improve/HomeEnergyEfficient.html#1

U. S. Department of Energy: Water Heating

www.eere.energy.gov/consumer/tips/water_heating.html

Utilize solar water heating [EA101]

Resources:

Solar Site Assessment tool

www.howto.altenergystore.com/Articles-not-yet-activated/Tools-for-a-Successful-Solar-Electric-Install/a90/

Solar Site Assessment Tool

www.oregon.gov/ENERGY/RENEW/Solar/docs/SunChart.pdf

New Jersey Office of Clean Energy

www.njcleanenergy.com/renewable-energy

Southface Institute, Using the Sun to Heat Water

www.southface.org/web/resources&services/publications/factsheets/residential_solar_water111804.pdf

U.S. Department of Energy: Consumer's Guide to Renewable Energy and Energy Efficiency

www.eere.energy.gov/consumer/

Toolbase Services: Solar Water Heaters

www.toolbase.org/Technology-Inventory/Plumbing/solar-water-heaters

References:

[36] **Toolbase Services: Solar Water Heaters**

www.toolbase.org/Technology-Inventory/Plumbing/solar-water-heaters

[37] **West, Larry Benefits of Solar Water Heaters**

environment.about.com/od/renewableenergy/a/solar_water_hea.htm

[38] **Southface Institute, Using the Sun to Heat Water**

www.southface.org/web/resources&services/publications/factsheets/residential_solar_water111804.pdf

[39] **U.S. Department of Energy: Consumer's Guide to Renewable Energy and Energy Efficiency**

www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12870

Lighting and Electrical

Plan for future wiring and cabling needs [MR121]

Resources:

Toolbase Services: Electrical Raceways

www.toolbase.org

Provide daylighting [EA83]

Resources:

U.S. Department of Energy: Window Overhangs

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13570

Southface: Passive Solar Design

www.southface.org/web/resources&services/publications/technical_bulletins/PSD-Passivesolarpercent2000-790.pdf

Low Impact Living - Install Solar Tube Lighting

www.lowimpactliving.com/blog/2008/01/14/how-to-install-solar-tube-light/

Provide appropriate lighting [EA84]

Resources:

New Jersey Clean Energy Program - Energy Efficiency Store for New Jersey Residents

www.energyfederation.org/njcleanenergy/default.php

Rensselaer Polytechnic Institute- Lighting Research Center

www.lrc.rpi.edu/

References:

[40] **U.S. Department of Energy: A Consumer's Guide: Lighting**

www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11980

Install energy-efficient lighting [EA85]

Resources:

USEPA Energy Star® - Light Bulbs and Fixtures

www.EnergyStar.gov/index.cfm?c=lighting.pr_lighting

USEPA, Mercury – Spills, Disposal and Site Cleanup

www.EPA.gov/mercury/spills/index.htm

Toolbase Services: LED Lighting

www.toolbase.org/Technology-Inventory/Electrical-Electronics/white-LED-lighting

Provide appropriate indoor lighting controls [EA90]

Resources:

Whole Building Design Guide - Electric Lighting Controls by David Nelson, AIA, 05-14-2008

www.wbdg.org/resources/electriclighting.php

Green Living Ideas - Energy Saving Light Control Systems

www.greenlivingideas.com/lighting/energy-saving-light-control-systems.html

U.S.Department of Energy: Lighting

www.eere.energy.gov/consumer/tips/lighting.html

References:

[41] **U.S. Department of Energy: Lighting**

www.eere.energy.gov/consumer/tips/lighting.html

Wall and Ceiling

Use non-paper-faced gypsum board in moist areas [IEQ183]

Resources:

Read This before You Design, Build or Renovate

www.buildingscienceconsulting.com/resources/foundations/

Architect Magazine - Gypsum Board for the 21st Century

www.architechmag.com/articles/detail.aspx?contentID=5938

Building Science

www.buildingscience.com/documents/profiles/designs-that-work-mixed-humid-climate-charlotte-profile/

Gypsum Association

www.Gypsum.org

Install eco-friendly interior sheathing [MR126]

Resources:

Green Building Advisor: Sheathing

www.greenbuildingadvisor.com

Choose eco-friendly paints, sheens, and finishes [IEQ185/MR130-131]

Resources:

REGREEN Reference Guide to Product Considerations

www.regreenprogram.org

Green Seal

www.greenseal.org/index.cfm

Select eco-friendly wall coverings [MR129/IEQ186]

Resources:

Live Earth – Paint and Wallpaper

www.liveearth.org/2008/02/paint-or-wallpaper/

Green Seal

www.greenseal.org

Green from Wall to Wall

www.edcmag.com/CDA/Archives8f8837e14c697010VgnVCM100000f932a8c0

National Geographic Green Guide: Paint Buying Guide

www.thegreenguide.com

Furniture and Fittings

Select eco-friendly furnishings [MR145]

Resources:

Sustainable Furniture Council

www.sustainablefurniturecouncil.org

Rainforest Alliance

www.rainforest-alliance.org

Forest Stewardship Council – FSC

www.fsc.org

Planet Green, a Discovery Company – How to Go Green: Furniture

www.Planetgreen.discovery.com/go-green/green-furniture/

Rainforest Alliance – Rediscovered Wood

www.rainforest-alliance.org/forestry.cfm?id=rediscovered-wood

Green Guard

www.greenguard.org

Craigslist

www.craigslist.org

Freecycle

www.freecycle.org

Choose furniture/fittings that resist moisture [IEQ188]

Resources:

Planet Green, a Discovery Company – How to Go Green: Furniture

www.Planetgreen.discovery.com/go-green/green-furniture/

How Do I Select Safe Natural Fiber Products for My Home?

www.greenhomeguide.com/index.php/knowhow/

Use

Select materials that are easy to clean [MR156]

Resources:

Good, Clean Fun - How to Clean Your House without Hurting the Planet

www.grist.org/advice/possessions/2003/03/18/possessionscleaning/index.html

Unified Green Cleaning Alliance

www.zerowaste.org/ugca.htm

Destination Green

www.destinationgreen.com

Case Study

Location of Project: Ridgewood , New Jersey
Homeowners: Ed Schwartz, Julie Tung
Interior Designer: Lori Jacobsen, The Repurposed Home
Sustainability Consultant: Green Living Solutions
General Contractor: Norton Thompson, Tremor Contracting
Area Affected: ~5,000 square feet

Overview and Scope

This project involves the complete restoration of a historical home, originally built circa 1767. The new remodel has three major components. First, the existing part of the home was restored, all systems were updated and a thermal envelope was established. Next, an attached stucco garage built in the 1970's was removed, along with a damaged portion of the home, with plans for a new detached garage to be built later. Finally, a wing which was originally built in 1860 but removed at some point thereafter, is being partially rebuilt. This addition will include an expanded kitchen, family room, master suite, and finished basement.

Design Approach

The homeowners originally started this project with the challenge to show that a historical home could be remodeled sustainably while also adhering to the aesthetics and integrity of the building's past. To this end, the design team used **reclaimed**, salvaged, and recycled components wherever possible. The owners also desired to reduce their carbon footprint by increasing the energy and water efficiency of his home.

Team and Process

The homeowners planned this project before building green had started to become more common. Since at the time there were very limited resources to assist them, they were inspired to launch a green consulting firm, Green Living Solutions. Therefore they acted as the advisors, choosing all of the green products, features, and materials. The architect was chosen for his experience with older homes and not necessarily for his interest in sustainability, but working with the homeowners, the architect and contractor learned a great deal about green remodeling. The interior designer selected additional detail and materials to further a green result.

Finance

Restoring a historic house properly is inherently more expensive than a standard renovation. Materials used, as well as specialists with experience working on older homes, tend to be more expensive than average. Since the owners have a financial background, they considered the overall costs of operating a home and chose green features that had reasonable payback periods, including efficient lighting and **HVAC** equipment, better insulation, and a **photovoltaic** array. The payback periods for all of these features are estimated to be no longer than six years.

Other aspects of green construction were no more expensive than their conventional counterparts, since the homeowners had a good sense of what green products were available.

So far, the owners have reported reduced energy use from the previous owners by roughly 70 percent. When all aspects of the project are complete, they expect to be at 80 percent - 90 percent lower than the energy used by the previous owners despite the fact that the house will be nearly 40 percent larger!

Lessons and Trade-offs

The design team found that most contractors are not fluent in the latest green trends and sustainable practices. A green consultant can make one aware of those options and provide guidance on their viability in the real world; available locally, installed properly, performing up to expectations, etc. Green options tend not to be more expensive if one knows where to look. By becoming aware of green options, homeowners can make sustainable choices without sacrificing comfort, safety, or savings.

"People think of building green as being difficult, more expensive, etc.. It's at the point where all construction should be done with an eye for sustainability. Green building leads to more durable structures, better indoor air quality, greater comfort, and lower energy costs, not to mention doing our part to reduce green house gases and our reliance on foreign energy sources."

- Ed Schwartz

Ductwork sealed and insulated

All climate heat pumps

List of Green Strategies

Energy Conservation

- Improved the thermal envelope, allowing the system to perform much more efficiently
- Utilized a heat-pump-assisted water heating system that dehumidifies the basement, and captures energy to offset water heating needs
- Installed an ultra-insulated hot water tank
- Reduced air infiltration through caulking and air sealing
- Installed expandable spray foam insulation in parts of the attic, the basement ceiling, and the restored addition*
- Installed **cellulose insulation** in the attic
- Sealed and insulated ductwork
- Excavated dirt crawl spaces which will be replaced with poured concrete over 2" of rigid **extruded polystyrene** foam board
- Incorporated **fly ash** in the concrete of the new foundation to reduce the amount of cement needed
- Used **Energy Star®** rated appliances
- Used **CFLs** in most light fixtures
- Installed **solar tubes** for natural daylighting
- Proposed a solar array to offset a significant portion of electricity usage
- Retrofitted fireplaces with inserts that prevent conditioned air from being pulled from the home during use

Water Conservation

- Installed low-flow fixtures and toilets
- Utilized an outdoor rainwater harvesting system to reuse rainwater for gardens and landscaping
- Created **rain gardens** to keep storm water on site and facilitate **infiltration**
- Replaced part of the driveway with permeable surface

Salvaged front doors

Expandable spray foam insulation*

Deconstruction not Demolition

Indoor Air Quality

- Removed old **asbestos** and lead pipes
- Removed lead paint where necessary
- Replaced **carbon monoxide** producing appliances
- Used low- and no-**VOC** paints
- Used hardwood and cork flooring instead of carpeting
- Installed an all-climate **heat pump** with an air filtration system to constantly filter air, provide proper humidity levels, and produce indoor air quality that is better than outdoors

Resource Conservation

- Used **reclaimed** materials wherever possible
- Reused old floorboards for repairs in other parts of the home
- Salvaged front doors from a pre-demolition 1880's brownstone
- Reupholstered furniture with surplus scrap materials
- Collected stones to be used to build a retaining wall
- Sorted and recycled construction debris

Sustainable Materials

- Installed cork flooring in the foyer and kitchen
- Used countertops made from scrap pieces of granite and recycled glass
- Chose closets and cabinets from manufacturers with sustainable practices

*To avoid fire hazard when using spray foam materials installed in walls or ceilings, choose an approved, fire resistant thermal barrier with a finish rating of not less than 15 minutes as required by building codes. Rim joists/header areas in accordance with the IRC and IBC, may not require additional protection. Foam plastic must also be protected against ignition by code-approved materials in attics and crawl spaces. See relevant Building Codes and www.iccsafe.org for more information.

Case Study

Location of Project: Stormville, NY
Homeowners: Deborah Monroe
Architect: Jordan Valdina
Landscape Architect: Deborah Monroe
General Contractor: Deborah Monroe
Area Affected: 725 sq. ft.

Overview and Scope

The project transformed a 1960's studio apartment and garage into a 1-bedroom in-law apartment with a kitchen and bathroom, living room and laundry room. A new 3.5 bedroom/2.5 bath home, built to the **U.S. Green Building Council's LEED** Silver rating, was built and connected by a covered breezeway to the existing in-law apartment.

Design Approach

Surrounded by an organic beef farm and overlooking pastures and a pond, the homeowner wanted to respect the quiet and beautiful section of Stormville where she lived and aimed to have a lesser impact on the environment throughout the remodeling process. In turn, her desire was to make small changes to the house that would make a huge impact on energy savings and indoor health.

Team and Process

The homeowner was responsible for all changes and upgrades to the home. The renovation to the in-law apartment took place gradually over a period of six years.

Finance

The homeowner developed a marketing program to secure sustainable materials and sponsorships for the project. The program offered three levels of sponsorship (bronze, silver, gold) based on the percentage of discounted or donated materials and/or labor. In return, sponsors received varying levels of marketing and publicity, including recognition on the project's website. The highest level of sponsorship included participation in a series of open houses over the course of six months. For more information on the project and a full list of sponsors, see (www.monroegreenproject.com).

Lessons and Trade-offs

The homeowner was interested in installing **photovoltaic** panels but the existing site conditions that included a 200 year old maple tree on the south side of the home and the costly up-front investment did not create a good return on investment, even with New York State's solar rebates. Instead, the homeowner plumbed the home for future installation of geothermal and solar-thermal, to take advantage of these technologies as they become more cost-effective down the road through better incentives and/or and technological advancements.

"You can do things the easy way or do them the right way….only a valiant soul will endure the pressure to do anything the right way….be that valiant soul and change your world."

- Deborah Monroe

Before remodel

List of Green Strategies

Energy Conservation

- Removed vinyl siding, used **house-wrap** and added 2-3 inch insulation board to the exterior, and installed fiber-cement siding
- Installed **Energy Star®** lighting and appliances
- Removed saturated and non-functioning insulation with blown **cellulose** made from 100 percent recycled newspaper in the attic, bathroom, and under stairs to reduce drafts
- Added European flat panel radiant baseboard on the ground floor
- Installed double pane **low-E** windows; caulked and used foam insulation around windows to reduce air leakage
- Extended eaves for **passive solar heating** and cooling and took out roof **soffit** to eliminate drafts
- Installed chimney for pellet stove that currently uses 1/2 - 3/4 of the amount of pellets and propane used before the changes

Water Conservation

- Replaced a 3.5 gallon toilet from 1952 with a low flow toilet
- Installed low flow faucet in bathroom and water filter on kitchen sink (now uses tap water instead of bottled water)
- Replaced dirt driveway with semi-pervious stone that becomes more solid when wet but still allows for water **infiltration**
- Extended eaves to protect the home against rain and moisture

Indoor Air Quality

- Repainted entire house with no- or low-**VOC** paints
- Removed carpet and installed wood flooring upstairs to reduce allergens and eliminate **VOC off-gassing** from carpet
- Uses green cleaning products

Sustainable Materials

- Replaced trim with **FSC-certified wood**
- Replaced all sheetrock in bathroom with **recycled content** sheetrock

Blown cellulose insulation in attic

European flat panel radiant baseboard

Case Study

Location of Project: Tri-state area

Architect: Tom Vierschilling (Project Manager), **LEED** AP, WESKetch Architecture

Sustainability Consultants: Homeowners and project team members

Landscape Design: Gaia Gardens

General Contractor: Robert Nagy Building Company

Green Interior Design: Patricia Gaylor Interior Design

Energy Monitoring Services: Christine (Bruncati) Liaukus, R.A, New Jersey Institute of Technology

Area Affected: 3200 sq. ft.

Overview and Scope

A couple with young children purchased the house in which the wife grew up. The home is a 1930s colonial, 3-bedroom, 1.5 bath. Since they had to remodel, they decided to do a "green" remodel with improved energy efficiency, better indoor air quality, and sustainable materials and practices. Their goal was to create a safer, healthier, and more environmentally responsible home in which to raise their family. In addition, the move provided them with a "right-sized" home and a more sustainable location, with a greater number of amenities within walking distance to reduce the need to use a car for transportation. With some additional effort, they decided to pursue a **LEED** for Homes Platinum rating and use the project to help educate and inspire others about sustainable building and remodeling.

Design Approach

The design team initially struggled with trying to preserve as much as possible of the original home for conservation and sentimental reasons. But in the end it was agreed that the house's performance was best served by making it a true "gut-rehab." As a gut-rehab the house is eligible for seeking both the **Energy Star**® for Home rating and a **LEED** for Homes Platinum rating from the U.S. Green Building Council. (Only one home in New Jersey is currently rated Platinum, and that is new construction.) The residence is being remodeled using many of the latest environmentally responsible methods and materials. The benefits will include lower operating costs, a smaller carbon footprint, a healthier home, and better environmental stewardship. It will serve as a model of how to "green" an older traditional-style house at different ranges of budgetary investment and how traditional builders can adapt to green building techniques.

Team and Process

The homeowners met with the architect to scope the project and present the variety of initiatives they were interested in pursuing. The architect in turn made suggestions and initiated the design. The homeowners found an interior designer focused on green residential design. They interviewed several builders before deciding on a team that included a green building specialist and a builder who was interested in learning to adapt additional green building practices to his work. The homeowners brought an **HVAC** contractor on board to explore high-efficiency systems. As the team was assembled, they met and communicated frequently.

Finance

Many of the green methods and materials used can be implemented in any home, with a modest budget, and with a short payback to make it healthier and environmentally friendly. Others are appropriate in a remodel with a bit more investment and longer payback period. Some of the materials chosen, such as flooring, are less expensive than the traditional products. More expensive choices were evaluated using long-term cost savings as a basis, and some choices were pared back to reduce the budget. The homeowners anticipate tremendous savings in energy costs and maintenance. They are grateful to have had the assistance of the project team and partners in keeping costs reasonable, including BASF, Superior Walls, Huston Lumber, Serious Windows, Caroma, Smart Little House, and others.

Lessons and Trade-offs

The biggest challenges for the homeowners, though not really surprises, were the initial difficulties in finding a builder and subcontractors who were knowledgeable and interested in green building. It required research before deciding upon the products that met their needs, since many new options are just now becoming available. The final challenge was managing the budget. The best advice they have is to do a lot of research up front, assemble a capable and enthusiastic team in the design phase (including all of the major sub-contractors) and integrate them in the complete planning process. The team approach helps avoids delays and allows everyone to contribute ideas early in the process, where the costs are lower and benefits potentially higher.

Before remodel

"We're blending a variety of best practices in green home building while trying to preserve the character of a home that's been in the family for 50 years. It's a challenge, but we'll end up first of all with a very comfortable and healthy home for our family that will have low energy and maintenance costs, and is within easy walking distance of a variety of amenities. In the process of building a home, we're hoping to pass on the values and responsibility that will make the world a better place for our children and generations to come."

- Homeowners

List of Green Strategies

Energy Conservation

- Sealed all leaks in **building envelope** with **spray foam insulation** (seams, outlets, switches)
- Insulated exterior walls and attic roof with closed cell spray foam, which features twice the **R-Value** of typical batt insulation with no hydrochlorofluorocarbons (**HCFCs**) or **formaldehydes**
- Installed **low-E** glass windows with insulated frames and low **U-factors**
- Designed to maximize daylighting
- Replaced all lighting with efficient **CFL** and **LED** lighting
- Installed occupancy sensors and centrally/remotely controllable lighting
- Installed geothermal ground source **heat pump** for heating and cooling, expected to eliminate most fossil fuel usage
- Installed super-insulated, high-efficiency gas hot water heater, partially heated by geothermal system
- Installed efficient radiant floor heating
- Installed a whole-house energy recovery ventilation system to reduce need for air conditioning
- Designed for solar hot water heater
- Used advanced framing techniques: insulated headers, open insulated corners, 24" O.C. framing, hangers instead of jack studs, and no vents or piping in exterior walls
- Designed integrated shading system to block high angle summer sun and allow low angle winter sun for passive heating

Water Conservation (Indoors)

- Installed low-flow aerated faucets/showerheads
- Purchased touch-control kitchen sink faucet
- Installed dual-flush toilets (0.8 gpf and 1.26 gpf)

Water Conservation (Outdoors)

- Limited lawn area, reducing water, fertilizer, and pesticide usage and energy necessary to mow lawn
- Purchased **native, drought-resistant plants**
- Installed rain barrels and **rain gardens** to use rainwater for irrigation and reduce **runoff**
- Paved driveway and hardscapes with pervious paving materials

Indoor Air Quality

- Used low/no-**VOC** paints and sealants
- Purchased countertops and cabinets made with low-**VOC** finishes and other **formaldehyde-free** products
- Built detached garage to prevent auto fumes from infiltrating house
- Installed high-MERV air filter with ventilation systems
- Used no carpeting throughout the home

Resource Conservation

- Prefabricated foundation walls greatly reduce construction and demolition waste

Inegrated Pest Management

- Used organic fertilizers and pest control
- Used termite shields and simple screening

Superior building envelope

Advanced framing technology

Case Study

Location of Project: Rosemont, New Jersey

Design Team: Conservation Development, LLC and Entasis Architecture, LLC

Landscape Design: Paul W. Steinbeiser, Inc.

General Contractor: Robert J. Brander, Inc. and Conservation Development, LLC

Homeowners: Lise Thompson and Robert Brander of Conservation Development, LLC

Area Affected: 5,646 sq. ft. home (including 2006 addition, finished basement and attic), 1,200 sq. ft. bank barn, 960 sq. ft. 3-bay garage barn, 384 sq. ft. barn, 195 sq. ft. barn , 70 sq. ft. well house, and metal corn crib, on 2.4 acre site

Overview and Scope

This project involved the preservation of and addition to a circa 1869 Victorian home and exterior buildings. Systems and landscape were modified where necessary. A barn of 1,200 sq. ft. was approved for conversion to apartment space.

Sustainable building practices were used where possible that included reused, recyclable, and renewable materials that promote healthy indoor living. Systems were designed to be energy-efficient and water saving

Design Approach

The goal of this project was to update and restore the historic home and its exterior buildings using methods that integrated sustainable building practices with historic detailing to highlight the existing original qualities of the home.

Team and Process

The owners acted as the general contractor and project mangers for this project. Their relationships of over 15 years with most of the contractors helped tremendously with communication throughout the project. They used a true integrated design process and made a commitment to spending scheduled time with all members of the project's team, allowing for the most efficient communication in order to integrate green design issues, materials and methods.

Finance

In order for a project to be truly sustainable and repeatable, it needs to be financially feasible. In this project, the research involved in determining which products to use, evaluating their impact and locating those products in a timely fashion was the greatest contributor to the increased budget of the project, which exceeded the installation cost of those products. Like many historic houses, the original house had a south-westerly orientation and the owners oriented the addition to take advantage of passive solar. However, while the quality of the workmanship was consistent with previous projects, the attention to details (e.g. increased insulation, choosing a lighter color for the roof as apposed to a black slate, added overhangs and increased attention to the window efficiency and mechanicals) will likely result in a significant reduction in the cost of heating and cooling the house.

Lessons and Trade-offs

The restoration process itself was a reminder of how many of the old world building practices are considered green today; siting a house in relationship to the land and weather, using local, reclaimed, or natural materials, natural day lighting and ventilation. Many of these simple time tested practices were applied to the new "green" addition. As part of the commitment to making this project a true restoration, one of the trade-offs was that the home did not qualify for Energy Star because they decided to restore all of the original windows, re-glaze them, add high performance storm windows and insulate around the windows thoroughly instead of replacing them.

"I believe that restoring an old building is inherently green; it sustains culture as well as resources. It was often a challenge deciding which products and techniques to utilize while trying to balance our commitment to an authentic restoration with our commitment to energy efficiency, a healthy environment and using natural, recycled or long life cycle materials. The green industry changes so rapidly, you have to keep the big picture in mind and make the best choices you can."

- Lise Thompson

Exterior after remodel

List of Green Strategies

Energy Conservation

- Installed **low-E** windows in the addition to prevent radiant heat from escaping and block ultraviolet rays that can fade many fabrics and materials
- Re-**glazed** existing windows to help control heat flow
- Replaced broken windows and added **storm windows** to reduce air leakage
- Installed rigid polyurethane foam insulation to cut air flow throughout the **building envelope** and reduce **heating and cooling loads**
- Installed a high-efficiency and high-velocity **HVAC** system and radiant hydronic heat
- Installed a high-efficiency oil-fired burner which doubles as the indirect hot water heater and can be converted to bio-diesel
- Insulated hot water lines with ½" walled rubber insulation
- Designed home to provide for excellent natural day lighting that reduces the demand for artificial lighting during the day
- Oriented renovations toward the southwest providing it **passive solar** advantages **reducing heating loads**
- Specified **Energy Star**® appliances where possible

Water Conservation (Indoors)

- Installed copper piping with minimal amounts of **PVC**
- Added new plumbing fixtures to comply with new energy codes
- Added ½ inch walled rubber insulation to domestic hot water lines allowing for constant hot water and reducing water wastage
- Installed a thermostatically activated recirculating line that heats water as needed saving energy
- Installed an indirect water heater

Water Conservation (Outdoors)

- Replaced existing built-in gutters and soffits with 16- ounce copper interior gutters and molding that match the original detailing
- Re-pointed and water proofed the original foundation
- Installed an underground drainage system that collects water from most of the downspouts and the foundation drain and redirects it to a **rain garden** located below the southern lawn
- Planted **rain garden** with **native plants** and with an emphasis on color, appeal to birds and butterflies, and water-absorbent properties
- Protected trees with rock-lined wells
- Used permeable Delaware red stone for driveway

Indoor Air Quality

- Gutted the original house allowing it to breathe and removing all the accumulated dust that usually remains inside the walls of old houses
- Used non-toxic, natural materials and no-**VOC** paint and water based finishes on the flooring and wood trim
- Utilized existing cross ventilation designed for the original house and added a fresh air exchange unit that brings **HEPA** filtered air into the house every 20 minutes
- Installed a high-efficiency, high-velocity **HVAC** system with multiple zones that aids in moisture control and the prevention of mold and mildew

Resource Conservation

- Preserved all components of the home and site where possible
- Restored moldings, doors, floors, siding, and masonry where possible with local materials
- Used reclaimed antique hemlock flooring to match the original flooring
- Re-**glazed** existing windows and replaced broken glass with reclaimed antique glass
- Restored barn foundations
- Preserved original roof rafters on the large bank barn while adding a new metal roof and purlins
- Repaired or replaced siding where needed with Pocono Eastern White Pine
- Relocated or replanted trees, shrubs, and other vegetation
- Installed copper gutters and piping that have a long service life and are recyclable
- Used steel beams instead of wood as girders where the original house attached to the new addition
- Installed a new metal roof on the bank barn that will be long lasting and is recyclable
- Utilized reused and local materials where possible

Restored porch

Remodeled interior

Green Products and Services

Introduction

The purpose of the Green Products and Services is to help homeowners navigate the market with some helpful tips on what to look for when shopping for a particular green home remodeling project. The Guide is organized by building system and lists the general products and services that pertain to remodeling tasks within that system. It includes features and applicable certifications to look for, as well as web links to more information on that product or service. Each item in the Guide also refers to the related REGREEN strategy IDs.

Please note that the New Jersey Green Home Remodeling Guidelines Version 1.0 do not endorse any particular brand or company. It is not the function of the Green Product and Service Guide to direct the consumer to a specific product, but rather to provide a resource to seek out an appropriate manufacturer or service provider to handle remodeling needs.

With the ever-increasing number of green products and services coming into the home remodeling market, finding the appropriate ones can be a challenge. Some manufacturers market products as "green" when in reality they are only marginally better for the environment or whose green features are neutralized by other aspects of their manufacturing or composition. This phenomenon is referred to as "greenwashing" and calls on consumers to seek out references and ensure the true extent of green value.

Product Certification Programs

That being said, there are several leading green product standards and certification programs that can help consumers identify products that meet predefined green criteria. The leading green product standards and programs include:

- Energy Star® - identifies efficient products that reliably deliver energy savings and environmental benefits
- WaterSense – identifies high performing, water efficient products and practices
- Cradle to Cradle - certifies products based on lifecycle of materials used to construct a product and the overall lifecycle of the product
- GreenGuard® Certification Program - certifies products and processes for their low chemical emissions and low toxicity
- Green Seal® - certifies products and practices for their low toxicity and overall environmental impact
- GreenSpec Directory - a published resource on environmentally preferable products
- Forest Stewardship Council (FSC)- certifies wood products coming from forests managed to meet social economic and ecological needs
- Sustainable Forestry Initiative (SFI) - certifies wood products coming from well-managed forests and responsible procurement practices
- National Fenestration Rating Council® (NFRC) - a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products.

For more information on various certification programs currently in use by architects and designers see:

- the ecolibrary™matrix - www.thegreenstandard.org/documents/GGNC09_EcoLibCert.pdf
- Gaia Product Profile developed by The Green Standard™ - www.thegreenstandard.org/gaia.html

Two other reputable sources for green products and services are:

- Green Building Advisor that lists products from the GreenSpec Guide to Residential Building Materials www.greenbuildingadvisor.com/
- National Association of Home Builders (NAHB) Research Center - www.nahbrc.org/manufacturer/greenapproved/index.aspx

Product Standards for GreenSpec[1]

1. Products Made with Salvaged, Recycled, or Agricultural Waste Content
   a. Salvaged products
   b. Products with **post-consumer recycled content**
   c. Products with **pre-consumer recycled content**
   d. Products made with agricultural crop waste material

2. Products That Conserve Natural Resources
   a. Products that reduce material use
   b. Products with exceptional durability or low maintenance requirements
   c. Certified wood products
   d. Rapidly renewable products

3. Products That Avoid Toxic or Other Emissions
   a. Natural or minimally processed products
   b. Alternatives to ozone-depleting substances
   c Alternatives to hazardous products
   d. Products that reduce or eliminate pesticide treatments
   e. Products that reduce stormwater pollution
   f. Products that reduce impacts from construction or demolition activities
   g. Products that reduce pollution or waste from operations

4. Products That Save Energy or Water
   a. Building components that reduce heating and cooling loads
   b. Equipment that conserves energy and manages loads
   c. Renewable energy and fuel cell equipment
   d. Fixtures and equipment that conserve water

5. Products That Contribute to a Safe, Healthy Built Environment
   a. Products that do not release significant pollutants into the building
   b. Products that block the introduction, development, or spread of indoor contaminants
   c. Products that remove indoor pollutants
   d. Products that warn occupants of health hazards in the building
   e. Products that improve light quality
   f. Products that help noise control
   g. Products that enhance community well-being

Sources

[1] The online GreenSpec® Directory lists product descriptions for over 2,000 environmentally preferable products at www.buildinggreen.com

Alex Wilson."Building Materials: What Makes a Product Green?" EBN Volume 9, Issue 1 (revised January, 2006) www.buildinggreen.com/auth/article.cfm?fileName=090101a.xml

Finished Basement and Major Addition

Site

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Block pavers	Allow water to infiltrate to subsoil for driveways, entryways, walkways, or terraces. Use block pavers that are made of recycled content, or salvaged from previous construction.		ToolBase Services. Permeable Pavement www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=604&BucketID=6&CategoryID=11	SS32
Native plants, species, and trees	Native plants and trees to provide shade and reduce watering needs.		N.J. Agricultural Experiment Station, Rutgers University www.njaes.rutgers.edu/ If Plants Could Talk – A Gardening Television Series, Rutgers University www.ifplantscouldtalk.rutgers.edu/Rain Garden Network www.raingardennetwork.com/ United States Department of Agriculture – Native Plant Database www.plants.usda.gov/checklist.html Native Plant Society of New Jersey www.npsnj.org/	SS32
Pavement	Porous pavement materials and/or materials that reflect sunlight to reduce heat gain.		Cool Pavements – U.S. EPA www.epa.gov/heatisland/mitigation/pavements.htm Cool Paving –The Encyclopedia of Earth www.eoearth.org/article/Cool_paving	IDP17
Porous paving materials	Porous asphalt or concrete can be used in pedestrian-only areas and areas with low traffic volumes with reduced speed including; overflow parking areas, residential driveways, alleys, and parking stalls.	ASTM 1319 (Standard specifications for Concrete Grid Paving Units) requires a minimum compressive strength of 5,000 psi.	Pavegreen.com: Asphalt www.pavegreen.com/water_quality.asp PerviousPavement.org: Pervious Concrete www.pervious pavement.org/ ToolBase Services. Permeable Pavement www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=604&BucketID=6&CategoryID=11 PerviousPavement.org: Pervious Concrete www.pervious pavement.org/	SS32
Storm water control – rain garden	Select appropriate rain garden plants to give rainwater runoff the opportunity to be absorbed into ground.		Rain Garden Network www.raingardennetwork.com/ New Jersey Agricultural Experiment Station, Rutgers University www.njaes.rutgers.edu/	SS32

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Roofing	Roof design minimizes heat island effects. Two types are cool roofs and green roofs. Cool roofs use reflective materials including metals and lightly colored shingles to decrease heat transfer into the indoor environment reducing need for cooling. Green roofs use plants, shrubs, and small trees to replace heat-absorbing surfaces. The plants cool the air through the process of evapotranspiration. Low slope roofs should have an initial solar reflectance of ≥0.65. After 3 years, the solar reflectance must be ≥0.50. Steep-slope roofs must have an initial solar reflectance of ≥0.25. After 3 years, the solar reflectance must be ≥0.15.	ENERGY STAR	New Jersey Department of Environmental Protection (NJDEP): Creating Sustainable Communities – A Guide for Developers and Communities www.nj.gov/dep/opsc/docs/Heat_Island.pdf Energy Star® Reflective Roofs www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products EPA – Heat Island Effect www.epa.gov/hiri/strategies/index.html Heat Island Group eetd.lbl.gov/HeatIsland/ Consumer Energy Center www.consumerenergycenter.org/coolroof/ Cool Roof Rating Council www.coolroofs.org	IDP17/SS32
Erosion control	Soil erosion is reduced and dirt is stabilized on construction site by using one or a combination of the following: socks filled with chipped or ground wood; silt fencing; or seeding		North Carolina Department of Environmental and Natural Resources: Filter Berms and Filter Socks www.dlr.enr.state.nc.us/TACpercent20website/2008_04_23/4.22percent20-percent20AAHTOpercent20Standardpercent20Specspercent20forpercent20Compostpercent20Filterpercent20Socks.pdf	SS39
Foundation				
Bio-based form-release agents	Bio-based form-release agents are made from vegetable oils, biodegrade naturally, and are less harmful in indoor air than traditional form-release agents .		MC Magazine - Form Release Agents www.precast.org/publications/mc/TechArticles/03_Winter_Form_Release_Agents.htm Green Building Advisor - Concrete Form-Release Agents www.greenbuildingadvisor.com/product-guide/cat/concrete-form-release-agents	MR115
Concrete	Fly ash concrete uses waste product of coal fired power plants to replace up to 50 percent of cement in concrete mixes, improving its strength.	ASTM	United States Department of Transportation: Fly Ash www.fhwa.dot.gov/infrastructure/materialsgrp/flyash.htm ToolBase Services. Fly Ash Concrete: www.toolbase.org/Technology-Inventory/Foundations/fly-ash-concrete	MR114

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Concrete footings	Use prefabricated flexible form footings that include a capillary break between the footing and the soil and provide a moisture barrier membrane.		Understanding Foundations www.buildingscienceconsulting.com/resources/foundations/Understanding_Foundations.pdf Fab-Form: Footings and Drainage www.fab-form.com/news/media/homebuilder%20magazine_mar_apr_2006.html The Engineered Wood Association: Foundations www.a-actionhomeinspection.com/library/Build%20A%20Better%20Home%20-%20Foundations.pdf	IDP19
Radon test kit	Some test kits include charcoal canisters, alpha-track detectors, and charcoal liquid scintillation devices. Depending on results, a second short-term test or a long-term test may be needed.		U.S Environmental Protection Agency: Radon www.epa.gov/radon/ State Radon Office (800) 648-0394 or call EPA's Drinking Water Hotline (800) 426-4791 for additional information on testing.	IEQ163
Flooring	Green flooring contains low to zero amounts of formaldehyde or VOCs. Look for durable and easy to clean materials. Green choices include hardwood flooring from certified well-managed forest, reclaimed and recycled wood flooring, bambook, and cork.		About.com-Home Renovations: The Basics of Engineered Wood Flooring homerenovations.about.com/od/floors/a/artengineerflr.htm Green Guard www.greenguard.org Green Seal www.greenseal.org/ Scientific Certification Systems: FloorScore www.scscertified.com/ecoproducts/indoorairquality/floorscore.html	EA47
Insulating Concrete Forms (ICFs)	Insulating concrete forms of plastic foam with an R Value of at least 38 hold the concrete while it is curing and remain in place afterwards, serving as a thermal insulator for the concrete.		Insulating Concrete Form Association: www.forms.org Toolbase.org: Insulating Concrete Forms (ICF) www.toolbase.org/Technology-Inventory/walls/Insulating-Concrete-Forms Energy Star® – Air Seal and Insulate: www.energystar.gov	EA47
Exterior paint	Thermal ceramic paint has little or no VOC content, certified for fire safety, environmental and related efficiency standards with high R-values.		Treehugger.com: Ceramic Paint-On Insulation: Does it Work? www.treehugger.com/files/2008/07/ceramic-insulating-paints.php ASTM – American Society for Testing and Materials www.astm.org Energy Star® www.energystar.gov	EA47

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Beneficial insects	Beneficial insects include predators, parasites, and pollinators. They control pests by feeding off other insects that harm plants. A variety of beneficial insects including praying mantises, certain species of beetles, ladybugs. Others can be used to target different species of insects harmful to plants.		Virginia Cooperative Extension – Beneficial Insects www.ext.vt.edu/departments/entomology/ornamentals/beneficials.html BeneficialInsects101.com – A Guide for Buying and Using Beneficial Insects www.beneficialinsects101.com/	IDP23
Building Envelope				
Home Performance Audit	Save up to 30 percent on energy costs and increase the comfort, safety, and durability of your home. Contact New Jersey Dept. of Energy to find certified contractors.		N.J. Department of Clean Energy - Call 1-866-NJSMART or visit www.njcleanenergy.com/residential/programs/home-performance-energy-star/home-performance-energy-star-r New Jersey Department of Energy List of Certified Contractors www.njcleanenergy.com/misc/residential/certified-contractors	IDP2
Concrete admixture	Water and corrosion-proofing admixture makes concrete hydrophobic; eliminating the need for an external waterproofing membrane. Select products with little or no VOC (volatile organic compound) content.		Toolbase.org: Concrete Admixtures www.toolbase.org/Technology-Inventory/Foundations/concrete-admixtures ConcreteNetwork.com: Concrete Admixtures www.concretenetwork.com/concrete/concrete_admixtures/ McDonough Braungart Design Chemistry (MBDC) Cradle to Cradle Certification www.c2ccertified.com/	IDP24
Foam sealers	Ozone-safe flame-retardant foam sealants come in a reusable dispenser.		The Family Handyman, Insulate Basement Rim Joists www.rd.com/familyhandyman/content/57548/ Oikos, Rim Joists oikos.com/library/airsealing/rim_joists.html Taunton - The Best Way to Insulate a Rim Joist www.taunton.com/finehomebuilding/PDF/Free/021189072.pdf	IDP55
House Wrap	Tear resistant house wraps; non-perforated to resist water with a surface texture that provides a drainage plane.		Making Sense of House Wraps by Fernando Pages Ruiz www.taunton.com/finehomebuilding/PDF/Free/021177066.pdf BuildingGreen www.buildinggreen.com	MR119

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Insulation	Formaldehyde-free, thermally efficient insulation with high R-values, noncorrosive, has sound control, and moisture control aids in resisting water vapor transmission preventing mildew.	GREENGUARD	Inhabitant, New Ideas for Green Insulation by Jill Fehrenbacher www.inhabitat.com/2006/08/10/lets-talk-about-insulation-baby/ U.S. Department of Energy, Energy Efficiency and Renewable Energy, Insulation www.eere.energy.gov/consumer/tips/insulation.html GreenGuard www.greenguard.org/	MR117
Structural Insulated Panels (SIPs)	Structural Insulated Panels (SIPS) use low/no-formaldehyde glue such as marine glue to hold the plywood together.	ENERGY STAR	USEPA Energy Star® www.energystar.gov BuildCentral – Green Building Talk www.greenbuildingtalk.com/ StyroHome News StyroHomeNews.blogspot.com Structural Insulated Panel Association www.sips.org	EA47/MR116
Window Glazings	Gas fills, heat-absorbing tint, insulated (double-glazed, triple-glazed), low emissivity (Low-E) coatings, reflective coatings, and spectrally selective coatings.	NFRC National Fenestration Rating Council; ENERGY STAR	National Fenestration Rating Council www.nfrc.org/ U.S. Department of Energy –A Consumer's Guide to Energy Efficiency and Renewable Energy: Types of Window Glazing or Glass www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13390 Efficient Windows Collaborative www.efficientwindows.org USEPA Energy Star® – High Performance Windows www.energystar.gov/ia/new_homes/features/HighPerformanceWindows1-17-01.pdf	EA60
Windows	Low-E (Low-Emittance), have U-factor (measure of the rate of heat loss) of ≥0.36, and a Solar Heat Gain Coefficient (SHGC) of ≥0.39.	NFRC National Fenestration Rating Council; ENERGY STAR	USEPA Energy Star® www.energystar.gov NFRC – National Fenestration Rating Council www.nfrc.org/	EA56/EA59/EA60

Finished Basement and Major Addition

HVAC

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Air conditioning system	Meets or exceeds Energy Star® standards. Choose a model with a Seasonal Energy Efficiency Ratio of at least 14 for ductless mini-split or central air conditioning.	ENERGY STAR	N.J. Department of Clean Energy www.njcleanenergy.com The Consortium for Energy Efficiency (CEE) and the Air-Conditioning and Refrigeration Institute (ARI) online database www.ceedirectory.org	EA66
Duct mastic/ sealant	Low- to zero-VOC content. Sealing ducts helps to prevent air from escaping the system and reduces its heating and cooling loads.	ENERGY STAR, GREENGUARD	USEPA Energy Star® www.energystar.gov/ GreenGuard www.greenguard.org/	EA68
Fan: attic	Meets or exceeds Energy Star® standards. Features include self flash, curb mount, and gable mount for pitched or flat roof applications. Installation flexibility allows for the retrofitting of the base assembly of any 12 inch turbine fan if needed.	ENERGY STAR	USEPA Energy Star® www.energystar.gov BuildingGreen www.Buildinggreen.com Home Venting Institute – Certified Products Directory www.hvi.org/resourcelibrary/proddirectory.html	EA65
Fan: bathroom	Reduces moisture in the bathroom that can cause mold. Select models with a built-in Energy Star® light fixture that are programmable, produce low noise (0.5 to 1.5 sones), and can have a high CFM (Cubic Feet per Minute).	ENERGY STAR	USEPA Energy Star®- www.energystar.gov/ Home Venting Institute – Certified Products Directory www.hvi.org/resourcelibrary/proddirectory.html	EA65/IEQ166/ IEQ167/IEQ172
Fan: Ceiling	Meet or exceed Energy Star® standards. Choose a model that has both clockwise and counter clockwise motion. Run fans using solar power.	ENERGY STAR	USEPA Energy Star® www.energystar.gov/ Home Venting Institute – Certified Products Directory www.hvi.org/resourcelibrary/proddirectory.html	EA65

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Programmable thermostat	Meets or exceeds Energ yStar® standards. The model should be compatible with your system and have features including battery operation and indicator, settings options that allow for vacation overrides and weekends, an energy monitor, and filter change indicator.	ENERGY STAR	USEPA Energy Star® on Programmable Thermostats www.EnergyStar.gov/index.cfm?c=thermostats.pr_thermostats ToolBase - Programmable Thermostats www.toolbase.org U.S. Department of Energy, Energy Efficiency and Renewable Energy Thermostats and Control Systems www.eeregov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720	EA67
Lighting and Electrical				
Fluorescent lamp	Compact Fluorescent Lamps (CFLs) use less energy, last longer, and contain less mercury than incandescent lamps. Choose lamps with a Color Rendering Index (CRI) of at least 80. For ambient lighting, select a lamp that produces 2700-3000K and a warm or yellowish hue. Task lighting requires lamps that produce 3600-5500K and a bluish or cool hue.	ENERGY STAR	USEPA Energy Star®: Compact Fluorescent Light Bulbs www.energystar.gov/index.cfm?c=cfls.pr_cfls United States Department of Energy – Energy Efficiency and Renewable Energy. 2008. "A Consumer's Guide to Energy Efficiency and Renewable Energy: Lighting Principles and Terms" www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11990	EA84
Recessed lighting	IC (Insulation Contact)-rated housing makes direct contact with the insulation. Light output for these models can reach up to 100 watts.		Recessed Lighting Tips www.ccl-light.com/docs/indoor/recessed/guide.html Do It Yourself - Installing Recessed Lighting www.doityourself.com/stry/installrecesslight High Performance Lighting Guide www.ibacos.com/hpl1.html	EA84
Light-Emitting Diode (LED) light fixture	Use less energy, produce less heat, and are more durable than incandescent and even fluorescent lamps. Some products com with features such as dimming and motion sensors.	ENERGY STAR	USEPA Energy Star®: Residential LED Lighting www.energystar.gov/index.cfm?c=ssl.pr_residential	EA84

Finished Basement and Major Addition

Wall and Ceiling

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Wiring race-ways	Use on the surface of interior walls to simplify wiring tasks and to prevent wall penetrations that can compromise a building's thermal performance.		Toolbase Services: Electrical Raceways www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=669&BucketID=6&CategoryID=4	MR121
Fiberglass-faced drywall	Fiberglass surfaces replace typical paper surfaces and are moisture resistant.		Toolbase Services: Mold Resistant Gypsum Panel Products www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=1013&BucketID=6&CategoryID=54	MR126
Monolithic Drywall	Has cellulose fibers dispersed through the board and is moisture resistant.		Toolbase Services: Mold Resistant Gypsum Panel Products www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=1013&BucketID=6&CategoryID=54	MR126
Paints and finishes	Use paints and finishes with low-or no-VOCs.	Master Painter Institute's Green Performance Standard	SpecifyGreen: Master Painter Institute's Green Performance Standard www.specifygreen.com/APL/ProductIdxByMPInum.asp NorthwestRenovation.com: What is Green Seal Certification? or The Many Shades of Green Paint Certification www.nwrenovation.com/33greenseal.html GreenGuard www.greenguard.org Green Seal www.greenseal.org	IEQ185
Paper-faced drywall containing gypsum	Uses recycled paper, gypsum and other materials. Produces a low off-gassing of pollutants.		Gypsum Association www.gypsum.org	MR126
Wall board	Non-paper faced gypsum wall board aid in moisture and mold resistance. Products should be monolithic (with cellulose fibers dispersed through the board) or fiberglass faced. Install with at least 3/16 inch of space from the concrete. Moisture-resistant "greenboard" that is paper-faced is not recommended.		Gypsum Association www.gypsum.org Archi-Tech Magazine: Gypsum Board for the 21st Century www.architechmag.com/articles/detail.aspx?contentID=5938	IEQ183

Finished Basement and Major Addition

Furniture and Fittings

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Cabinetry and furniture: rapidly renewable materials	Bamboo products as it is fast growing, highly renewable resource and can be used for many things in the home including furniture, flooring, and window blinds.		Taking a Green Approach to Furniture www.greenhomeguide.com/index.php/knowhow/entry/943/C221/ Sustainable Furnishings Council www.sustainablefurnishings.org/ Rapidly Renewable Revolution www.eco-structure.com/docs/archives%202006/eco_jan06/eco_jan06_eco-tech.pdf	MR141-143/ 146-147/150
Used furniture	Reduces the need to produce new furniture and the pollution from the manufacturing and transportation processes.		Craigslist www.craigslist.org Freecycle www.freecycle.org Habitat for Humanity ReStore Directory – New Jersey www.habitat.org/cd/env/restore_detail.aspx?place=67	MR141-143/ 146-147/150
Cabinetry and furniture: certified sustainable wood	Responsibly harvested products promote resource stewardship.	Rainforest Alliance-Smart Wood FSC	Forest Stewardship Council – FSC www.fsc.org Planet Green, a Discovery Company – How to Go Green: Furniture Planetgreen.discovery.com/go-green/green-furniture/ Rainforest Alliance www.rainforest-alliance.org Taking a Green Approach to Furniture www.bayarea.greenhomeguide.com/index.php/knowhow/entry/943/C221	MR141-143/ 146-147/150
Furniture: reclaimed, recycled, and durable materials	Furniture made with materials from old furniture, houses, factory scraps, and recycled products. Choose longer lasting products to avoid using resources.	Rainforest Alliance-Rediscovered Wood	Scientific Certification Systems: Indoor Air Quality www.scscertified.com/ecoproducts/indoorairquality/index.html Taking a Green Approach to Furniture www.greenhomeguide.com/index.php/knowhow/entry/943/C221/ Sustainable Furnishings Council www.sustainablefurnishings.org/ Rainforest Alliance – Rediscovered Wood www.rainforest-alliance.org/forestry.cfm?id=rediscovered-wood	MR141-143/ 146-147/150
Low-toxicity furniture	Avoid products that off-gas volatile organic compounds (VOCs) and that are made from synthetic materials including fire retardants and formaldehyde.	Scientific Certification Systems) -Indoor Advantage GREENGUARD	GreenGuard www.greenguard.org Scientific Certification Systems: Indoor Air Quality www.scscertified.com/ecoproducts/indoorairquality/index.html	MR141-143/ 146-147/150

ACCA Manual D The Air Conditioning Contractors of America's (ACCA) Manual D is a guide to designing residential duct systems.

ACCA Manual J The Air Conditioning Contractors of America's (ACCA) Manual J describes how to calculate the heating and cooling loads of a home or the residential load.

ACCA Manual S The Air Conditioning Contractors of America's (ACCA) Manual S provides information on selecting the appropriate heating and cooling equipment of a home based on the calculations derived from the formulas in Manual J.

ambient lighting Ambient lighting uses "warm" lighting sources with a color temperature between 2700-3000K that are more flattering to skin tones and clothing, recommended for living spaces.

annual Annual plants live for only one year at the end of which seeds are produced.

Annual Fuel Utilization Efficiency (AFUE) The Annual Fuel Utilization Efficiency of a furnace compares its total fuel consumption with the amount of fuel that is actually converted into heat.

arbor(s) Arbors or pergolas, as they are commonly known, typically consist of a combination of pillars, cross beams, and lattice work upon which vegetation such as vines can be trained and provide shade. Some varieties are attached to existing structures including houses or decks.

asbestos Asbestos describes a number of naturally occurring, fibrous silicate minerals mined for their utility for thermal insulation, chemical and thermal stability, and high tensile strength. Asbestos is commonly used as an acoustic insulator, and in thermal insulation, fire proofing and other building materials. Many products in use today contain fixed asbestos. It is only hazardous in air and does not pose a hazard if maintained in place.

awning An awning is a constructed frame covered in a fabric or other material extending from an existing structure (usually the side of a house) to provide protection from the sun and rain.

backdrafting Backdrafting refers to the process in which a home becomes depressurized from air escaping to the outside and is replaced with air entering from the exterior that may contain combustion products including carbon monoxide.

baffles Baffles are devices used to control movement of light, fluids, wind, and other forces.

biocide Biocides are chemicals used to destroy living organisms. They are typically selective and can be used agriculturally as pesticides or in other industries to control the infestation and growth of unwanted organisms.

Blower Door Test The Blower Door Test measures the leakiness of the house or its air infiltration and helps a homeowner prioritize problem areas. This test uses pressure differences created by air flow via a calibrated fan that mounts on the frame of an existing door and pulls air out of the house, lowering the inside air pressure. As higher pressure outside air travels in through unsealed cracks and openings, tools like a smoke pencil can detect these air leaks as part of a visual inspection process.

borate-treated foam board Borate-treated foam board is an insulation panel that is pest- and fire-resistant.

building envelope The building envelope of a structure is descriptive term that separates its interior from the exterior.

capillary breaks Capillary breaks, typically made of elastomeric asphalt coating or a polyethylene sheet, are installed between footings and the foundation wall to prevent water absorption.

carbon dioxide (CO_2) Carbon Dioxide is a gas byproduct of the burning of fossil fuels and other forms of combustion.

carbon monoxide (CO) Carbon Monoxide is a toxic gas byproduct of combustion that is both odorless and colorless. Sources of its production include wood stoves, fireplaces, gas stoves, and furnaces among others.

chromated copper arsenate (CCA) Chromated Copper Arsenate is a wood preservative used to prevent decay from insects and microbial agents. Its contents include chromium, copper, and arsenic and is limited to restricted use.

cellulose Cellulose fibers from recycled newsprint can be applied as a form of insulation that is flame, mold, and pest resistant, provides thermal and sound insulation, and resists settling.

cellulose insulation Cellulose fibers from recycled newsprint can be applied as a form of insulation that is flame, mold, and pest resistant, provides thermal and sound insulation, and resists settling.

cement board Cement board is a non-combustible, water-durable, and mold-resistant panel that is typically used under tile and other finishes for interior and exterior use.

certified sustainable wood Certified sustainable wood meets specific criteria developed by organizations such as the Forest Stewardship Council to promote responsible wood harvesting and condemn the exploitation of local peoples.

cladding Wall cladding is a nonstructural material used as the exterior covering for the walls of a building.

closed-cell Closed cell (spray polyurethane foam or SPF) is typically installed at a density between 2.0 to 3.0 lbs. per cubic foot, and is manufactured with non-ozone-depleting blowing agents.

Color Rendering Index (CRI) The Color Rendering Index (CRI) is a 1-100 scale that measures how colors appear under different light sources. A light source with a CRI of 80 or higher is considered acceptable for most indoor residential applications.

color temperature Color Temperature defines the color and warmness or coolness of a light source. Color temperature is measured in Kelvin (K) temperature. Contrary to what is expected, higher Kelvin temperatures (3600–5500 K) are considered cool and lower color temperatures (2700–3000 K) are considered warm.

- A color temperature of 2700–3600 K is generally recommended for indoor general and task lighting.
- Task lighting calls for cool light which produces a higher contrast and is better for visual tasks.
- Warm light is more flattering to skin tones and clothing and is recommended for living spaces.

combustion Combustion is the chemical process of the release of gasses in the process of burning of a fuel.

combustion appliances Combustion equipment refers to appliances such as stoves, water heaters, and clothes dryers that burn fuels. It is important to make sure that these appliances work correctly and are properly ventilated to prevent carbon monoxide, a byproduct of combustion, from entering the home.

commissioning Commissioning ensures that a home's mechanical systems have met their design intent, operate and interact optimally.

Compact Fluorescent Lights (CFLs) Compact fluorescent lights are the miniature fluorescent lights that can screw into standard light fixtures that conventionally use incandescent bulbs. CFLs are more energy-efficient and durable than incandescent bulbs.

concrete formwork Concrete formwork is a concrete walling system used for its insulating properties and durability.

cooling load Cooling load refers to the amount of heat that is to be removed from a space by a cooling system.

copper quat Copper quat is a wood treatment containing both copper oxide and quat as didecyldimethylammonium chloride (DDAC) to prevent decay and fungi and insects.

creosote Creosote is a wood preservative distilled from coal tar. Typically applied to utility poles and railroad ties, can only be used for commercial purposes.

crown size The crown size of a tree refers to the diameter of the portion of a tree that has foliage.

damper(s) Dampers are adjustable plates located in the flue of a fireplace that prevent heat from escaping when it isn't in use.

deciduous tree(s) Deciduous trees are species that shed their leaves for part of the year.

diffuser Diffusers are circular, square or rectangular air distribution outlets which are usually located in the ceiling. They are comprised of deflecting blades which discharge supply air in various directions. Diffusers are designed to mix the conditioned air entering the space with the air already contained in the space.

disposable respirators Disposable respirators or filtering facepieces can be made of cloth or paper and are designed to clean the air as you breathe it to prevent you from inhaling irritating substances.

double-hung window(s) Double-hung windows have two vertically sliding sashes, each closing a different part of the window.

drain pan Drain pans provide a basin to catch any fluids leaking from a piece of equipment such as a clothes washer.

dripline The dripline of a tree refers to the area of ground located directly under the circumference of its outermost branches. This area indicates where the tree should be watered as opposed to the base of its trunk where it can develop root rot.

Duct Blaster Test A Duct Blaster Test utilizes a fan and a pressure gauge to measure the amount of air escaping from the ductwork of a home by pressurizing the system.

duct cleaning Duct cleaning refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, diffusers, heat exchangers, heating and cooling coils, drain pans, fan motor, fan housing, and the air handling unit.

duct mastic Duct mastic is a sealant used to reduce air leakage in duct systems. Its flexibility enables it to contract and expand.

duct squeezing Duct squeezing refers to the use of under-sized ducts in an HVAC system in tight spaces that accelerates the air flow creating excessive noise and increases the system's operating costs.

ducting system Ducting systems are networks of ducts or formed sheet metal that direct the flow of air from central HVAC units.

Energy Star® for Homes Typically 20-30% more efficient than standard homes, Energy Star qualified homes must meet certain criterion including energy saving features.

Energy Star® Thermal Bypass Checklist (TBC) The Energy Star Thermal Bypass Checklist consists of guidelines for a home inspection that may reveal any opportunities for energy efficiency improvements.

erosion Erosion is the process by which soil and rock are worn away through water, wind, ice and wave transport.

evergreen trees Evergreen trees retain their needles or leaves through the winter and into the next growing season.

extruded polystyrene (XPS) Extruded polystyrene is a plastic foam insulating material that is resistant to moisture, rot, mold, and corrosion.

fiber cement Fiber cement siding is composed of sand, cement, and cellulose that make it more durable than wood, termite- and water-resistant, and non-combustible.

fiber cement siding Fiber cement siding is composed of sand, cement, and cellulose that make it more durable than wood, termite- and water-resistant, and non-combustible.

flame spread rating Flame spread ratings (FSRs) are used to evaluate "the surface burning characteristics of building materials including ignition temperature, smoke toxicity, and flame-spread." Building materials are compared to the FSR scale where inorganic reinforced cement board is 0 and red oak is 100.

fly ash Fly ash is a byproduct of coal-fired electric power generation that can be combined with cement in concrete to improve its strength.

form-release agents Form release agents assist in the removal of molds by producing a film that separates them from concrete.

formaldehyde Formaldehyde is a chemical compound used in products including paper towels, photographic film, glues, and inks among others. It is important to avoid products containing formaldehyde whenever possible as they off-gas potentially hazardous pollutants.

formaldehyde-free Formaldehyde-free products don't contain any formaldehyde. Formaldehyde is a chemical that off-gasses creating air pollution and should be avoided whenever possible.

Forest Stewardship Council (FSC) -Certified Wood The Forest Stewardship Council certifies wood that complies with its standards disapproving of illegally harvested wood, wood harvested in violation of traditional and civil rights, in forests in which High Conservation Values (areas particularly worthy of protection) are threatened through management activities, from conversion of natural forests, and from areas where genetically modified trees are planted.

gasket Gaskets are rings typically made of rubber or metal to create a liquid-tight seal between two joints.

geofabric Geofabric or landscape fabric is a synthetic material used to control erosion and prevent weed growth.

glazing Window glazings are compounds applied to glass to reduce the amount of heat transfer between the interior and the exterior of a building and/or the ultra-violet (UV) light passing that passes through it.

green roof Green roofs are contained vegetative roof coverings that provide a variety of economic, ecological, and aesthetic benefits including reducing the heating/cooling loads of the building, reducing runoff, and producing oxygen among others.

- **extensive** Extensive green roofs are 6 inches or shallower and are frequently designed to satisfy specific engineering and performance goals.
- **intensive** Intensive green roofs may become quite deep and merge into more familiar on-structure plaza landscapes with promenades, lawn, large perennial plants, and trees.

green treated "Green treated" wood refers to wood treated by chromated copper arsenate (CCA) to resist fungal decay and pests. CCA treated wood use is limited primarily to poles, pilings, and bridge timbers.

gypsum Gypsum is a mineral found in sedimentary rock formations in a crystalline form known as calcium sulfate dihydrate. It is typically used in wall board to create of a non-combustible core.

gypsum board Gypsum board or drywall is used in various paneling applications that consists of a paper-faced non-combustible gypsum core.

hardwiring Hardwiring refers to the use of cables or electric wire to connect electronic components.

heat exchanger(s) Commonly used in space heating, refrigeration, air conditioning, and other applications, heat exchangers are devices built for efficient heat transfer from one medium to another.

heat island effect The heat island effect occurs in densely urbanized areas where impermeable roof and pavement temperatures increase during the summer, elevating the air temperature. This in turn generates a greater demand in energy consumption for cooling systems which concentrates air pollutants and creates smog. Runoff from these heated surfaces reaches waterways where it can increase the water temperature and negatively affect ecosystems.

heating/cooling loads Heating and cooling loads refer to how much warm or cool air must be produced in order to maintain a building's temperature.

Heating, Ventilation, and Air Conditioning (HVAC) Systems Heating, Ventilating, and Air Conditioning systems process and supply air through ductwork helping to regulate humidity and temperature in buildings to provide safe, healthy, and comfortable conditions.

heavy metals Heavy metals including copper, selenium, and zinc are elements found in the earth's crust that can't be degraded or destroyed. Some in small doses are vital to bodily functions while high concentrations can be lethal.

HEPA filtered air scrubbers High efficiency particulate air or HEPA air filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles down to a size of 0.3 micrometers (µm) in diameter.

HEPA vacuum High efficiency particulate air or HEPA filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles 0.3 micrometers (µm) in diameter. HEPA filter used in vacuum cleaners trap the fine particles (such as pollen and dust mite feces) which trigger allergy and asthma symptoms.

high-recycled content Products of high-recycled content are made mostly with materials that have already been used.

Home Energy Analysis A Home Energy Analysis considers possible measures that can be taken to improve a home's energy efficiency based on certain criteria.

Home Performance Audit Home Performance Audits are conducted to assess the energy efficiency of a home and evaluate possible energy saving measures.

house wrap House wrap, typically made of polyethylene, is a breathable material used to prevent moisture and wind from entering the home.

IICRC S500 Guidelines The Institute of Inspection, Cleaning and Restoration is an independent, non-profit certification body that sets and promotes standards for the inspection, cleaning and restoration service industry. These guidelines provide specific practical standards for water damage restoration.

impervious surface Impervious surfaces such as concrete and conventional asphalt do not allow water penetration.

infiltration Infiltration is the process by which water seeps through the ground where it may reach a water body or an aquifer.

infrared camera Infrared cameras are used to detect thermal variations and may be used in conducting energy efficiency analyses.

infrared imaging Infrared imaging detects thermal variations and may be used in conducting energy efficiency analyses.

Insulated Concrete Forms (ICFs) Insulated concrete forms typically made of expanded polystyrene (EPS) or extruded polystyrene (XPS), are used to mold concrete. They remain in place permanently serving as a thermal barrier.

insulated pre-cast concrete wall systems Insulated pre-cast concrete wall systems consist of concrete panels that are cured off site. The installation of these panels to construct a foundation or a wall is much faster than the curing time of a formed concrete wall.

Integrated Pest Management (IPM) Integrated pest management is an effective and environmentally sensitive form of pest management that utilizes monitoring, prevention, and control techniques.

Kelvin (K) Kelvin is a universally accepted base unit used to measure temperature. One degree in Celsius is equivalent to one degree in Kelvin. Water freezes at zero degrees Celsius, which is approximately 273.16 Kelvin.

latent cooling load The latent cooling load of an HVAC system is the amount of heat energy produced by moisture from indoor and outdoor sources that needs to be removed from a home in order to maintain a constant temperature.

Light-Emitting Diodes (LEDs) Light-Emitting Diodes are electronic light sources that use less energy than incandescent bulbs or compact fluorescent lamps.

load calculations Load calculations are formulas used to derive the heating, cooling, or electrical loads of a system.

long-wave radiation Long-wave radiation is emitted from both the earth and the atmosphere influencing temperature.

loose-fill insulation Loose-fill insulation made of fiber, foam, or other recycled waste materials is able to be blown in places where the installation of other types of insulation is difficult.

louver(s) Louvers are vertical slats on a window, blind, or shutter that are angled in such away to allow in light and air while providing a shield from rain, direct sunlight, and noise.

low-E Low-E or Low-Emissivity glazings are metal or metal oxide coatings applied to windows to reduce heat flow.

low-VOC These products contain smaller amounts than standard materials of volatile organic compounds (VOCs) that can off-gas chemicals and cause air pollution.

low-VOC duct mastic Duct mastic is a sealant used to reduce air leakage in duct systems. Its flexibility enables it to contract and expand. Using low-VOC (volatile organic compounds) products reduces the off-gassing of harmful chemicals promoting a healthy indoor environment.

moisture meter Moisture meters are devices used to measure the amount of water in a given substance that help determine if it is ready to use.

mold amplification sites Mold amplification sites are locations where mold has built up over time. Typical sites of indoor mold buildup are damp cellulosic materials (e.g. wallboard paper, wallpaper, carpet backing, damp papers); debris in ventilation ducts, in carpets, or in mattresses or upholstered furniture; poorly maintained humidifiers; insulation on which organic film has accumulated; constantly humid painted, caulked or plastic surfaces (e.g., windowsills, shower stalls, cold air return vents); and potted plant soils.

mortar Mortar is a sandy material that combines with cement and water to bond tile, stone, brick, or concrete blocks.

National Air Duct Cleaners Association (NADCA) The National Air Duct Cleaners Association (NADCA) was formed in 1989 as a non-profit association of companies engaged in the cleaning of HVAC systems. Its mission is to promote source removal as the only acceptable method of cleaning and to establish industry standards for the association.

National Fenestration Rating Council (NFRC) The National Fenestration Rating Council (NFRC) is a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products.

native plants/species/trees Native plants are species of plants or trees that occur in the region in which they evolved.

natural ventilation Natural ventilation systems utilize pressure differences caused by wind or the buoyancy effect (created by differences in temperature or humidity) to circulate fresh air through buildings.

non-CFC sealant Non-CFC sealants don't contain the ozone depleting chemicals chlorofluorocarbons (CFCs).

non-combustible Non-combustible materials are incapable of burning.

non-porous Non-porous materials lack any spaces where gasses or liquids can pass through.

old growth timber Old growth timber comes from old growth forests where trees must compete for sunlight, growing slower, developing more dense rings increasing the strength of the wood.

open-cell Open cell, low-density polyurethane foam (typically 0.5 lbs. per cubic foot) is produced with a water or carbon dioxide blowing agent.

optimal load calculations The optimal load of an HVAC system can be calculated to determine the amount of energy required for it to operate most efficiently.

Oriented Strand Board (OSB) Oriented Strand Board is similar to plywood and consists of cross-layered rectangular wood strands fixed together with waterproof heat-cured adhesives.

over-sizing Over-sized ducting of HVAC systems may lead reduced indoor air quality and an imbalance of air flow distribution.

Pascal The Pascal is the standard unit of the measure of pressure equal to one Newton/square meter.

passive solar Passive solar home design considers the materials and arrangements of windows, walls, and floors to utilize solar energy for heating in the winter and reduce solar heat gain in the summer.

passive solar design Passive solar home design considers the materials and arrangements of windows, walls, and floors to utilize solar energy for heating in the winter and reduce solar heat gain in the summer.

passive solar heating Passive solar heating incorporates design and specific materials to heat a building directly using energy from the sun rather than a mechanical HVAC system.

permeability The permeability of a substance is a measure of how well liquids can pass through it.

petroleum-based Petroleum-based products are made from the raw natural resource petroleum, such as oil and natural gas.

phenol formaldehyde Phenol Formaldehyde (PF) is commonly used in polymer resins as a safer alternative in pressed-wood materials off-gassing less formaldehyde than products that use Urea Formaldehyde (UF).

photovoltaic (PV) power Photovoltaic power refers to the conversion of light into an electric current through a device such as a solar panel.

planting bed Planting beds are areas designated in a landscape for planting.

plenum(s) Plenums are boxes made of sheet metal that connect to the outlet of an air handler or furnace to which other ductwork can attach.

plumbing chase A hollow wall area accommodating piping used for drain waste or vent in plumbing systems.

polyisocyanurate Polyisocyanurate is a plastic consisting of closed-cell foam that contains a low-conductivity gas (usually hydrofluorocarbons or HCFC) in its cells. It has a high thermal resistance and is used as insulation that is available as a liquid, sprayed foam, or foam board.

polystyrene Polystyrene is a plastic foam that comes in extruded or expanded forms that are used in various building applications for their insulating properties.

porous Porous materials have spaces through which gases and/or liquids can pass.

portland cement Portland Cement consists of hydraulic calcium silicates that when combined with water harden to become water-resistant. It is one of the most widely used cements by concrete producers and are available in various levels of strength and durability.

post-consumer recycled content Post-consumer recycled products consist of materials that were previously used by consumers.

pressure treated Pressure treated wood undergoes a process in which a chemical preservative (usually chromate copper arsenate (CCA) or less toxic amine copper quat (ACQ)) is applied under high pressure and is intended primarily for exterior use.

programmable thermostat Programmable thermostats are devices used to control a home's heating/cooling system that can be set to turn off when no one is home and then back on when the home will be occupied to reduce the cooling load.

radiant barrier Radiant barriers are installed in homes to reduce summer heat gain and winter heat loss, and hence to reduce home heating and cooling energy usage. All radiant barriers have at least one reflective (or low emissivity) surface, usually a sheet or coating of aluminum.

radon Radon is a carcinogenic (cancer-causing) radioactive gas produced from the decay of uranium in rock, soil, and water.

rainscreen Rainscreens are used to reduce the exposure of exterior walls to precipitation, preventing moisture intrusion and the decay of materials. Every rainscreen consists of vented or porous cladding, an air cavity, a drainage layer on support wall, and a rigid, water-resistant, airtight support wall.

rain gardens Rainwater gardens are constructed landscape systems that utilize native plants to collect runoff.

reclaimed materials Reclaimed materials are salvaged architectural components that save money, are better for the environment and are aesthetically pleasing.

recycled content Products with recycled content are made from materials that have already been used in another product.

reflective roof Reflective roofs made of metal or that have reflective coatings reduce the cooling load of a building by decreasing the amount of heat that is absorbed through the roof.

refrigerant A refrigerant is a compound used in a heat cycle that undergoes a phase change from a gas to a liquid and back for use in refrigerators/freezers, air conditioners, and other appliances.

return duct Return ducts prevent the pressurization of closed rooms from supply air by allowing air to flow back to the central return grille.

return grille Return grilles are grates used to cover the ends of return ducts.

return register Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

rigid glass fiber insulation Rigid glass fiber insulation are sheets or molded-pipe coverings made of plastic foams or fibrous materials that provides thermal and acoustic insulation.

rigid insulation Rigid glass fiber insulation are sheets made of plastic foams or fibrous materials that provides thermal and acoustic insulation.

rigid insulation board Rigid glass fiber insulation boards are sheets made of plastic foams or fibrous materials that provide thermal and acoustic insulation.

rim joist Rim joists are the boards that cap the ends of the floor system.

roof garden Roof gardens are landscape systems constructed on a building's roof to reduce runoff, decrease heat island effect, remove air pollutants, and add aesthetic value among other purposes.

runoff Runoff is water that doesn't infiltrate the ground but instead flows above ground or through storm drains to a water body.

R-Value The R-value of a material indicates its resistance to heat transfer. A high R-value is better than a low R-value.

Seasonal Energy Efficiency Ratio (SEER) The seasonal energy efficiency ratio measures the efficiency of a central cooling system

over an entire season comparing the number of BTU's produced to watt-hours consumed.

sensible cooling load The sensible cooling load of a home refers to heat gain from the collective impact of conduction, convection, the exterior, people, and appliances.

sheathing Sheathing refers to a building material that is used to cover exterior wall framing or roof trusses.

shortwave solar radiation Shortwave solar radiation is direct energy from the sun.

single-package models Single-package model HVAC systems have all of their components, including evaporators, cooling coils, compressors, and condensers, contained within one unit.

single-pane window Single-paned windows have only one piece of glass separating the interior and exterior of a home. Double-pane windows are considered to be much more energy-efficient.

six-sided containment Six-Sided Containment refers to the insulating of all six sides of frame wall cavities in unconditioned, concealed spaces.

smog Smog is a combination of fog and smoke from combustion characterized by poor visibility and adverse health affects.

smoke pencil Smoke pencils detect air pressure differences between two spaces by emitting smoke that leaks through any cracks or openings.

soffit vent(s) Soffit vents are applied to the underside of a construction element and are perforated for intake ventilation.

soil gases Soil gases include radon and other gases that come from a ground source. Some of these gases such as radon are toxic and may require that a system be installed to prevent them from entering the home.

Solar Heat Gain Coefficient (SHGC) The Solar Heat Gain Coefficient is the fraction of incidental solar radiation admitted through a window.

Solar Renewable Energy Certificate (SREC) SREC stands for Solar Renewable Energy Certificate and is a tradable certificate that represents all the clean energy benefits of electricity generated from a solar electric system. Each time a solar electric system generates 1000 kWh (1 MWh) of electricity, an SREC is issued which can then be sold or traded separately from the power.

solar tubes Solar tubes consist of a clear dome that collects sunlight into a highly polished and reflective tube that reflects the light down to a diffuser on the ceiling. They are sufficient to light a small room, hallway, or staircase.

solar water heating Solar water heaters or domestic hot water systems utilize storage tanks and solar collectors to provide hot water for a home saving both energy and money.

split systems Split HVAC systems have their components including evaporators, cooling coils, compressors, and condensers located inside and outside of a building.

spray polyurethane Spray polyurethane foam (SPF) is a plastic insulation that expands and hardens after being installed as a liquid.

sprayed foam insulation Spray foam is a plastic insulation that expands and hardens after being installed as a liquid.

stormwater recharge Stormwater recharge is the active restoration of groundwater resources by way of stormwater drainage systems.

Structural Insulated Panels (SIPs) Structural Insulated Panels are made from a thick layer of foam (polystyrene or polyurethane) sandwiched between two layers of Oriented Strand Board (OSB), plywood or fiber-cement.

supply duct(s) Supply ducts made of formed sheet metal deliver air to interior spaces from an HVAC system.

supply register Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

sustainably harvested wood Sustainably harvested wood considers the social, economic, and ecological factors associated with logging to ensure long-term productivity while satisfying the desires of people.

task lighting Task lighting, often described as "cool" lighting, produces higher contrasts that are better for seeing. Task lighting sources emit temperatures between 3600-5500K.

thermal bridging Thermal bridging occurs when high thermal conductivity materials such as steel and concrete create pathways that bypass thermal insulation resulting in heat loss.

Thermal Bypass Checklist (TBC) The Thermal Bypass Checklist is a comprehensive list of building details where thermal bypass, or the movement of heat around or through insulation, frequently occurs due to missing air barriers or gaps between the air barrier and insulation.

Thermal Bypass Inspection The Energy Star® Thermal Bypass Checklist is a comprehensive visual inspection of building details where thermal bypass, or the movement of heat around or through insulation, frequently occurs due to missing air barriers or gaps between the air barriers and the insulation.

thermal paints Thermal paints are finishes with insulating properties that prevent heat transfer.

thermal scan A thermal scan of a home using infrared or heat sensing imaging detect where insulating improvements can be made.

thermographic (infrared) imaging Thermographic imaging is used to detect thermal variations and may be used in conducting energy efficiency analyses.

topsoil Topsoil is the outermost layer of soil primarily composed of organic matter.

transom Transoms are the windows above doors that serve to allow in sunlight and release warm air.

tree well Tree wells are the holes where trees are planted.

trellise(s) Trellises are structures that usually consist of latticework to support vegetation including vines and other creeping plants.

U-Factor The U-factor of a window assembly indicates its rate of heat loss.

U.S. Green Building Council's Leadership in Energy and Environmental Design for Homes (LEED-H) certification LEED for Homes is a rating system that encourages the building of green homes that use less energy, water and natural resources, create less waste, are healthier and more comfortable.

unconditioned spaces Unconditioned or unfinished spaces including attics and crawlspaces can provide a variety of energy saving opportunities.

vapor barrier Vapor barriers are materials that reduce the rate at which water vapor can move through a material.

vegetative swale Vegetative infiltration swales are planted areas intended to catch runoff where it can be filtered and enter the ground.

vermiculite insulation Vermiculite-insulation is a naturally occurring mineral, favored for its absorbent, lightweight, fire-resistant, odorless characteristics. Pre-1990 vermiculite insulation products are likely to contain some traces of asbestos associated with the mine where the vermiculite was collected.

Volatile Organic Compound(s) (VOC) Volatile Organic Compounds (VOCs) are off-gassed from certain solid or liquid products and may cause negative health effects when inhaled.

warm-edge spacer Warm-edge spacers are used to separate panes of glass in insulated windows and conduct less heat than standard aluminum spacers.

water heater blanket Water heater blankets are used to insulate water heaters with R-values less than 24.

water table The water table refers to the upper surface of ground water.

weatherization Weatherization involves procedures that protect a building from the elements.

weatherstrip Weatherstripping is the sealing of cracks or holes around windows, doors and other openings exposed to the exterior of a building with caulk, foam, rubber strips, or other materials that can be used to reduce airflow between the interior and the exterior.

wet footing Wet footings occur when there is groundwater in the footing trench.

whole house fan Whole house fans located on attic floors ventilate warm air from interior spaces to the outside while depressurizing the home to draw in cool air from open windows.

wicking Wicking is a term used to describe moisture that moves from the foundation up into walls by capillary action.

wind baffle Wind baffles are structures used to control the movement of wind.

windbreak Windbreaks are barriers typically consisting of trees, shrubs, crops, fences, and other materials to direct wind flow.

wiring conduits Wiring conduits are pipes or liners used as raceways to carry and protect conductors.

wiring raceways Wiring raceways are surface-mounted on interior walls to house wiring to maintain the integrity of a continuous wall system.

woven socks Woven socks filled with wood chips can be placed strategically at a site to control soil erosion and runoff.

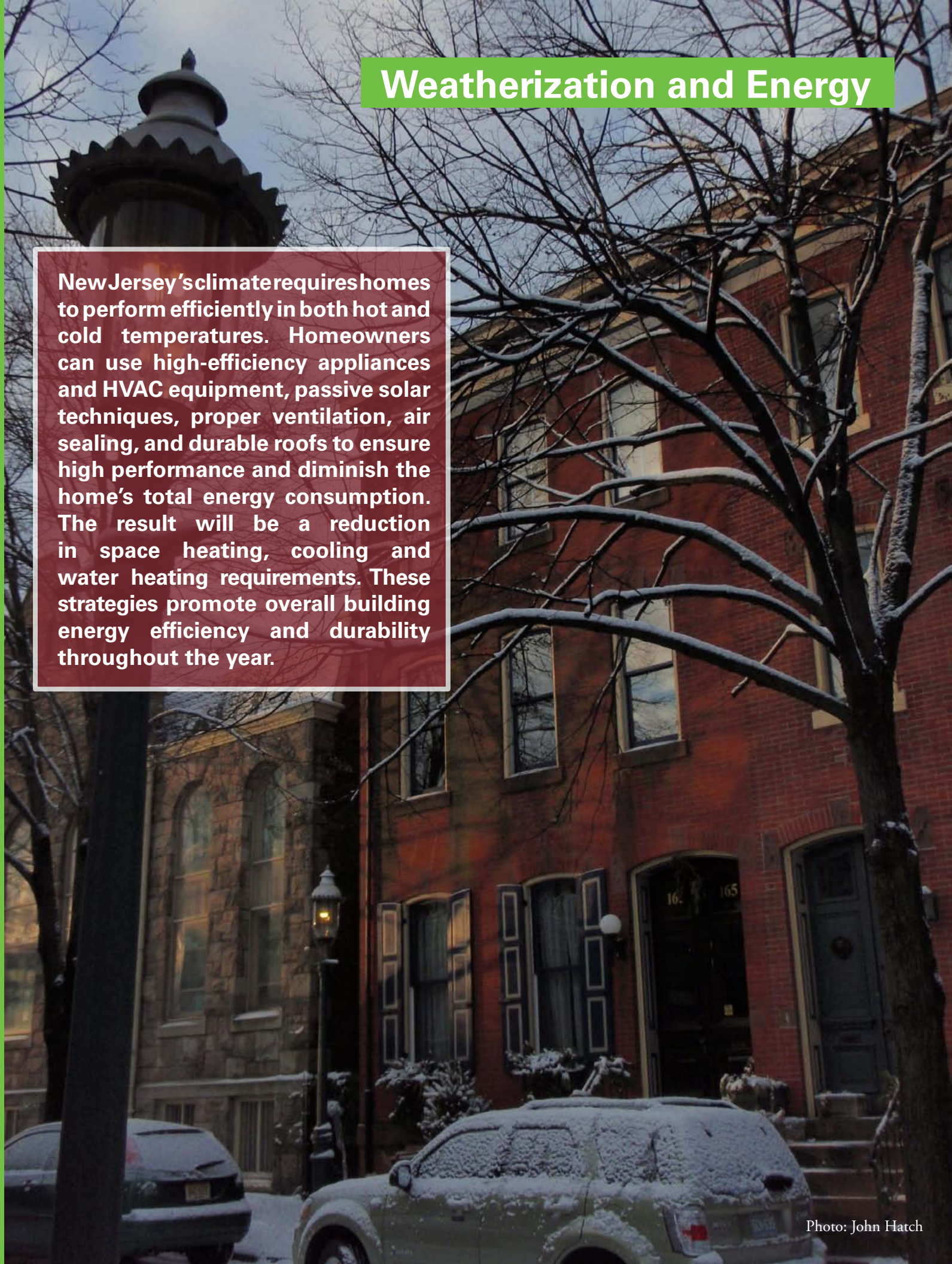
zero-VOC Zero-VOC products don't contain any volatile organic compounds that create air pollution by off-gassing chemicals

zero- or low-VOC Zero-VOC products contain no volatile organic compounds and thus do not negatively impact air quality from off-gassing chemicals.

zone controller A zone controller connects multiple thermostats to a single HVAC system.

zoning HVAC zoning strategically divides a building into zones where each has its own thermostat for independent temperature control.

Weatherization and Energy



New Jersey's climate requires homes to perform efficiently in both hot and cold temperatures. Homeowners can use high-efficiency appliances and HVAC equipment, passive solar techniques, proper ventilation, air sealing, and durable roofs to ensure high performance and diminish the home's total energy consumption. The result will be a reduction in space heating, cooling and water heating requirements. These strategies promote overall building energy efficiency and durability throughout the year.

Photo: John Hatch

Weatherization and Energy

How to Use the Guidelines

Health and Safety

HS1 - Nuisance and Toxic Dust Control
HS2 - Cautious Materials -Asbestos and Lead
HS3 - Mold
HS4- Radon

Green Home Maintenance and Housekeeping

Building Envelope

Conduct a Home Performance Audit and diagnostic tests **[IDP2/EA51-54]**
Install or upgrade insulation **[EA49]**
Air seal to reduce infiltration **[IDP55]**
Weatherstrip doors and windows **[EA58]**
Upgrade or replace existing windows **[EA56/59]**
Provide moisture management strategies **[IDP24]**
Use appropriate window glazing **[EA60]**
Upgrade existing exterior door **[EA57]**
Install window shading system **[EA62]**
Install a durable wall cladding **[MR119]**
Provide a durable and reflective roof **[MR120]**

HVAC

Follow standards for mechanical design **[EA63]**
Provide controls and zoning for HVAC **[EA64]**
Use ceiling fans for natural ventilation **[EA65]**
Install programmable thermostats **[EA67]**
Select high-efficiency HVAC equipment **[EA66]**
Conduct duct tightness test **[EA68]**
Maintain HVAC systems **[EA69]**
Seal and insulate HVAC system **[EA70]**
Make sure ductwork is clean **[EA71]**

Lighting and Electrical

Provide daylighting **[EA83]**
Provide appropriate lighting **[EA84]**
Install energy-efficient lighting **[EA85]**
Provide appropriate indoor lighting controls **[EA90]**

Plumbing

Insulate water heater **[EA80]**
Insulate hot water pipes **[EA81]**
Reconfigure plumbing for efficiency **[EA77]**
Utilize solar water heating **[EA101]**

Equipment

Select high-efficiency clothes washer **[EA92]**
Select an energy-efficient refrigerator **[EA93]**
Choose an energy-efficient dishwasher **[EA94]**
Install energy-efficient cooking appliances **[EA95]**
Select energy-efficient office equipment **[EA99]**
Consider on-site renewable energy **[EA102]**

Case Studies

Green Products and Services

Glossary of Terms

How to Use the Guidelines

Organization of the Guidelines

The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

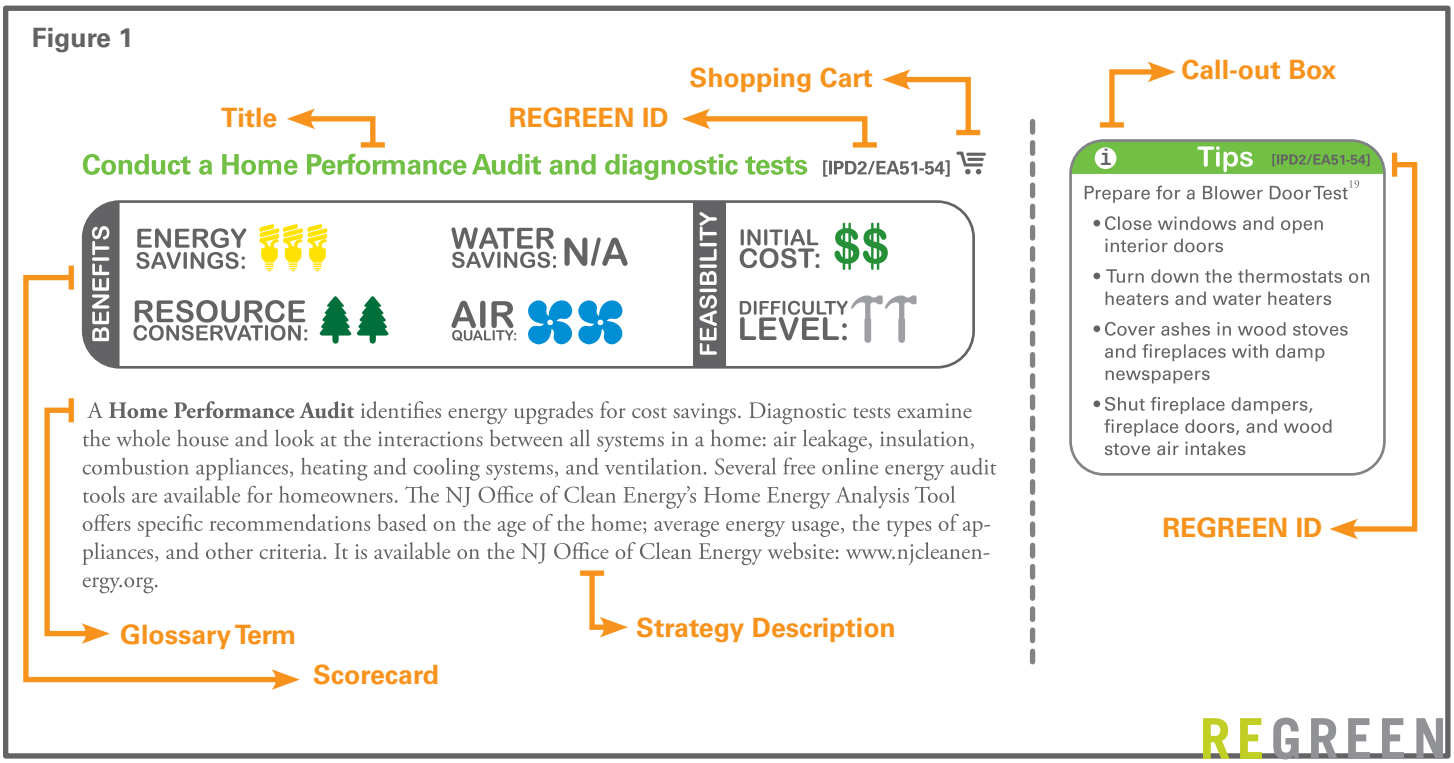
Each chapter includes the following:

- How to Use the Guidelines
- Health and Safety
- Green Home Maintenance and Housekeeping
- Best Practice Strategies
- Resources and References
- Case Studies
- Green Products and Services
- Glossary of Terms

Getting the Most from the Strategy Write-ups

The Guidelines provide information on best practice strategies for each project type. These strategy write-ups are organized by building system and follow the order of the 2008 REGREEN Residential Remodeling Guidelines (i.e., IDP2), which are incorporated with permission. **Figure 1** describes the information available.

Figure 1



Title and REGREEN Strategy ID – The strategies in the REGREEN Residential Remodeling Guidelines 2008 inspired most of the strategies in these Guidelines. Where appropriate, the strategy references the related REGREEN strategy ID.

Shopping Cart – The cart denotes entries in the Green Product and Service Guide located in the back of each project chapter.

Strategy Description – This write-up provides an overview of each strategy and its environmental benefits.

Glossary Term – Acronyms and green building terms are highlighted in bold and defined in a glossary at the back of each chapter.

Call-out Boxes - The call–out boxes in **Figure 2** highlight information of special importance. These include the following types of information:

- Tips - useful hints or practical facts for accomplishing a strategy
- Incentive - sources of financial assistance
- New Jersey Bio-Region - New Jersey has 5 bio-regions, each with unique elements and environmental features to consider when remodeling
- Building Age - a home's age can inform needed repairs and call out special circumstances
- Caution - on occasion, there are hazards associated, so items are called out for safety reasons

Hazard Symbol - Symbols were developed to advise users of certain health and safety threats related to specific strategies. The symbols, which appear below, reference the guidance on Health and Safety located at the beginning of each section.

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

Web Link - When viewing this document electronically, the websites will hyperlink, however, occasionally website links change. In most cases, the site provides a seamless link to the new address. If this is not the case, users may need to copy and paste the link into the browser address bar. At the time of publication the hyperlinks in this report were all functional.

Scorecard - The scorecard, **Figure 3**, provides a snapshot of the environmental benefits, initial costs, and difficulty levels associated with a particular strategy. Both qualitative and quantitative information was used to assign scores to each strategy.

Figure 3

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

It is divided into two parts: 1) Benefits and 2) Feasibility.

Graphic icons were developed for each impact category.

BENEFIT Key

1 icon = low benefit, 2 icons = medium benefit, 3 icons = high benefit

FEASIBILITY Key

$ low initial cost, $$ medium initial cost, $$$ high initial cost

T low difficulty level, TT medium difficulty level, TTT high difficulty

The icons above have been developed to graphically describe the ratings that follow.

BENEFITS

Energy Savings

To help meet its greenhouse gas reduction responsibility, in 2007 New Jersey passed **carbon dioxide** (CO_2) reduction goals, i.e., achieve 1990 emission levels by 2020, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. The state has also established renewable energy and energy efficiency targets. Green remodeling strategies utilize renewable energy sources such as solar, geothermal, and wind to net a lower CO_2 footprint.

Figure 2

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

Water Savings

Water conservation reduces water use both inside and outside the home. Within the home this may include low-flow fixtures. Outside the home this may refer to using **native plants** that have lower water requirements or rain barrels to collect rainwater for reuse on the lawn and garden. Water management includes providing proper moisture control at footings, slab perimeter, and foundation walls as well as using porous paving materials to encourage stormwater recharge for reduced runoff.

Air Quality

Americans spend up to 90 percent of their time indoors where air quality can be more polluted than outdoors. Pollutants range from allergens such as mold, mildew, fungus, and dust mites to toxins, such as asbestos, and volatile organic compounds like formaldehyde and benzene found in building materials and a number of household items including pressed-wood furniture, computer ink, carpeting, and conventional household cleaners and cosmetics.

Resource Conservation

Resource conservation means using materials that are durable and easy to maintain with low embodied energy (the energy used in resource extraction, manufacturing, shipping). These come from renewable sources or are produced from waste, recycled materials, or salvaged from other uses. Avoiding building materials that deplete natural resources, such as old-growth timber, and materials made from toxic or hazardous substances improves nature's ability to provide goods and services.

FEASIBILITY

$ Initial Cost

Cost is always a consideration for remodeling projects. Evaluating the cost of a recommended green remodeling strategy provides homeowners with a better sense of the relative costs and benefits of each recommended measure.

Costs come in two forms, so it is important to consider both in assessing feasibility. The first reflects initial costs of the strategy compared to conventional practices. A second consideration to make is the pay-back period or life-cycle cost. The pay-back costs are less obvious and are often project specific, but they can have significant environmental and economic value that factor into the overall cost. For more information on average costs, savings, and payback periods of typical energy efficiency improvements, see the Energy Efficient Rehab Advisor at (www.rehabadvisor.pathnet.org/). For customized results, have an energy professional conduct a thorough energy audit of your home.

$ Less than $500

$$ $500-$5,000

$$$ Greater than $5,000

Difficulty Level

Time is money and expertise is gained over time. Some people may consider a Home Performance Audit strategy in the 'medium' category because although relatively straightforwardto act on, it requires experts with custom equipment to prepare an accurate assessment. Implementing the findings from a Home Performance Audit becomes a 'high' difficulty category as space heating and cooling systems, ventilation, water heating, appliances, climate and even site factors need to be integrated to assure desired energy improvements across 'ALL loads' and to avoid negative unintended consequences. It is expected that 'high' difficulty strategies may also be dangerous for the basic homeowner to undertake.

T Easy to Do It Yourself (DIY) - little previous knowledge necessary

TT Task for an Experienced DIYer or Professional - may require additional effort and higher learning curve than conventional strategy it replaces

TTT Task for an Expert/Certified Professional - high learning curve; new technique; requires specific green knowledge

Notes: [1] U.S. Environmental Protection Agency 2008. Healthy Buildings, Healthy People: A Vision for the 21st Century

Health and Safety

Green remodeling poses hazards typical of many other home renovation or remodeling projects because of the age of the homes (given that they are more likely to contain older and use more hazardous materials) and the incentive for green remodeling to replace older or damaged building systems.

New Jersey homeowners considering green remodeling should anticipate potential emissions of hazardous air contaminants during removal of old building materials. The risks associated with improper removal of materials containing **asbestos**, lead, mold or even fiberglass insulation are minimized by understanding and following the steps listed here prior to initiating work. For complex situations, consider hiring professionals.

General hazard recognition and risk reduction information for the following potential renovation-related risks are contained in this section:

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

HS1 – Nuisance and Toxic Dust Control

Construction projects involving demolition of existing sheetrock, plaster, wood, brick or concrete products in ceilings, walls or floors of a home will release dust as these materials are ripped, sanded, ground, pulverized or crushed. Control of dust emissions during the pouring of solids or from transferring of small particles is controlled in industrial facilities. Homeowners planning renovation projects should also consider steps to minimize the release and maximize control of dust in the environment. These nuisance dusts, when released from the point of origin into the air of the home, tend to remain suspended in the air for very long periods of time, and as such, will be transported with air currents caused by open doors, cracks around and beneath doorways, forced air heating and cooling ductwork, and even by the air currents caused by persons walking in and out of dusty areas, to other areas of the home. At a minimum, allowing the uncontrolled release of nuisance dusts from any demolition project, as well as those created from sawing, sanding, or grinding of newly constructed materials (e.g., sheetrock, spackling, wood dust etc.) presents unnecessary and difficult dust cleanup demands for affected living spaces. At their worst, susceptible occupants of homes where uncontrolled nuisance dusts are allowed to escape into adjacent living spaces may temporarily experience eye, nose, or throat irritation. Asthmatics may experience adverse respiratory distress when exposed to high levels of nuisance dust particles.

There are several simple steps to minimize potential hazards of nuisance dust during remodeling.

1. Remove unnecessary porous and non-porous materials (e.g., draperies, bedding, upholstered furniture, children's toys, clothing, etc.) from the project area.
2. Seal the project area from the remainder of the home using polyethylene sheeting at doorways and at inlets to any forced air supply or **return registers** within the project space.
3. Consider installing **HEPA filtered air scrubbers** in the project area and discharging the exhaust air through an adjacent window using a tight fitting flexible duct through a sealed window opening (consider surrounding security requirements). Use a lightweight section of facial tissue at the doorways to confirm that air pressure is moving from the clean adjacent living space and into the project area (not the other direction) so that air leaks from the clean home into the dirty renovation area. This will reduce any potential for dusts from the renovation area to enter the adjacent areas of the home.
4. Periodically during the work session and after every work session, **HEPA vacuum** the renovation area following renovations to remove accumulated surface dust, without re-suspending it into the air.

HS2 – Hazardous Materials - Asbestos & Lead

When removing old building materials, know that they contain hazardous materials, which while intact present little to zero risk to occupants, but when removing can create airborne emissions and increase health and safety risks. This is especially true of **asbestos** and lead, and, possibly to a lesser extent, fiberglass. Removal of **asbestos**, lead or fiberglass needs to be planned and conducted with care to minimize exposures to airborne dust from these materials.

Asbestos

Asbestos is a mineral that has been mined in the U.S. since the early 1900's. Its superior heat resistance properties, combined with its lightweight, high-tensile strength, and non-corrosive qualities, made it an ideal building material for buildings constructed between 1940 and the late 1980's. **Asbestos** was banned as a building material in the U.S. after scientists concluded studies linking long-term occupational exposures to damaging respiratory health including asbestosis (scarring of the lung), lung cancer, and mesothelioma (cancer of the lining of the lung). Because intact **asbestos** presents no increased health risk, there is no requirement for removing it from existing homes. However, when it is disrupted, pulverized or suspended in air, the potential for inhalation of **asbestos** fibers increases risks of exposure. While health effects develop only after decades of long-term occupational or environmental exposure, homeowners should take particular care to prevent unintentional release of **asbestos** into the air of their homes during green remodeling efforts so that children and others are not exposed.

Asbestos is commonly found in older homes (constructed between 1940 and the late 1980's) in the following building materials:

- Pipe and boiler insulation
- Sprayed on fireproofing insulation
- Acoustical tiles and wall coverings
- Floor tiles
- Roof shingles
- Siding shingles

There is no requirement that homeowners remove **asbestos**-containing materials from homes. However, if removal is part of a green building remodeling project, material should be tested by a New Jersey licensed **asbestos** control monitor, and if determined to contain **asbestos**, be removed by a New Jersey licensed **asbestos** contractor. The number of the state program to contact for assistance in identifying qualified personnel to assist homeowners to safely address any possible **asbestos** concerns is (609) 292-7837.[5] General information about asbestos and its proper management and disposal can be found at the Department of Health website: www.state.nj.us/health/iep/asbestos.shtml and the Department of Environmental website: www.nj.gov/dep/dshw/rrtp/asbestos.htm.

Lead

Lead was in residential paints prior to 1978. It was banned after that time due to the significant health affects to children inhaling or consuming dusts from lead-based paints. Because of the hazards posed by dusts and chips of lead-painted surfaces, any remodeling or renovation which impacts painted surfaces of homes constructed prior to 1978 needs to be inspected by a New Jersey licensed lead inspector. If lead paint is identified, it should be safely removed by a state of New Jersey licensed contractor. They can safely remove lead-based paint and conduct follow-up surface lead testing to confirm that the removal was successful. Information on lead-based paint and qualifications for lead inspectors and contractors can be found at: www.state.NJ.us/health/iep/documents/pb_advisory_bulletin.pdf.

Contact the New Jersey Department of Health and Senior Services at (609) 292-7837 with any questions.

Fiberglass

Fiberglass insulation is a manufactured glass-wool-like material used as an insulation and sound absorption material in homes, schools, automobiles and consumer products since the 1970's. Fiberglass insulation can be safely installed if handled properly; any prolonged skin, eye or respiratory contact with fiberglass can cause temporary irritation. During renovation, wear loose fitting clothing and gloves to reduce skin contact, eye glasses or goggles to reduce eye exposure, and N95 disposable respirators (available from any home improvement store) if high levels of fiberglass dust are expected during removal or installation. More information on fiberglass safety precautions and handling recommendations can be found at the American Lung Association website at: www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=35439
or call the American Lung Association in New Jersey at (908) 687-9340.

HS3 – Mold

Mold contamination of building materials is not limited to older homes. Homes of any age can develop mold if moisture from leaky pipes, roofs, foundations, accumulates in the presence of dust, wood, paper or other **cellulose**-containing materials at normal room temperatures or high relative humidity (76 percent) for as little as 48 hours. Standing moisture around building materials such as wallboard, carpets, insulation, wood or other **cellulose** containing materials can cause mold. Many mold spores are known human allergens and produce toxins which may cause irritation or central nervous system effects. Because of vast differences in susceptibility, or if individual health impacts related to elevated mold spore exposure are of concern, consult a trained and experienced occupational/environmental health physician.

In addition to the above, mold damage can occur if flooding from faucets, showers, toilets (above the trap), is not completely dried within 48 hours of the incident. Floods from dirty water sources such as washing machines, dishwashers or sewers may contain high levels of bacteria, viruses, and protozoa which, along with potential mold growth, present additional risks.

If **mold amplification sites** occur, remove the affected material using methods that prevents unintentional dispersal of mold spores and the source of moisture intrusion. The U.S. **Environmental Protection Agency** indicates that small areas of mold growth (less than 10 square feet) can be cleaned or removed by homeowners themselves using precautions to prevent exposure and reduce spread of spores to adjacent areas. When mold contaminated areas exceed 10 square feet, special precautions including erecting containment barriers and the use of specialized **HEPA vacuum** devices should be used by trained professionals. When mold contamination occurs in excess of 100 square feet, professionals need to clean using full containment of the area (see www.epa.gov/mold/moldguide.html).

If mold growth from dirty water floods occurs, take special precautions to prevent skin, eye, oral and inhalation contact, and hire trained professionals to clean up in accordance with U.S. **EPA**: www.epa.gov/iaq/flood/index.html and IICRC S500 guidelines

Homeowners should anticipate that the amount of mold contamination shown on the outside of a piece of drywall or paneling may be less than the amount that will be exposed when wall cavities are opened up. If there is any doubt, consider hiring a professional Certified Industrial Hygienist (CIH) to evaluate the extent of damage before attempting to remove contaminated building materials yourself.

HS4 – Radon

Radon is a radioactive gas that comes from the natural decay of uranium in the ground. It is odorless, tasteless and invisible, and can only be detected through specialized tests. **Radon** enters homes through openings such as cracks and joints in the foundation, sump pits and openings around pipes. The home traps radon inside and it can build up to high levels.

Radon is the second leading cause of lung cancer in the United States, resulting in 15,000 to 22,000 deaths annually. It is the leading cause of lung cancer for non-smokers.

Radon concentrations can vary from house to house. The radon concentration in a home depends on a number of factors, including the amount of uranium present in the soil, the permeability of the soil, the number of openings in the foundation and air pressure differentials. Any home can have a **radon** problem, regardless of whether it is old or new, well sealed or drafty, or with or without a basement.

The New Jersey Department of Environmental Protection recommends radon testing for all homes in New Jersey. If the **radon** concentration is 4 pCi/L or higher, a **radon** mitigation system is recommended. There is no safe level of **radon** since lung cancer can result from very low exposures to **radon**, however, the risk decreases as the **radon** concentration decreases. f the **radon** concentration is less than 4 pCi/L, a mitigation company can be consulted to determine whether the **radon** level can be brought down still further. **Radon** levels have been brought to less than 1 pCi/L in sixty percent of the homes mitigated in New Jersey. Mitigation systems can also help reduce the potential for accumulation of volatile organic compounds that may be released from soil water vapor in areas where ground water contamination is an issue.

Radon test kits are commercially available at most home improvement stores, however, test conditions and locations may make data interpretation difficult or inaccurate. Carefully follow the kit directions to ensure proper use and confidence in the results. The New Jersey Department of Environmental Protection has issued licensing requirements for **radon** testing firms, and has a list of qualified professionals to perform **radon** testing and mitigation, see www.njradon.org.

Appendix

HS1= NUISANCE AND TOXIC DUST CONTROL

Fly ash Properties

www.austinenergy.com/energypercent20Efficiency/Programs/Greenpercent20Building/Sourcebook/flyashConcrete.htm

www.oikos.com/library/betterconcrete/index.html

HS2= HAZARDOUS MATERIALS - LEAD AND ASBESTOS

N.J. Department of Health Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

Agency for Toxic Substances and Disease Registry, New Jersey

www.atsdr.cdc.gov/Asbestos/sites/national_map/fact_sheets/trentonnj.html

N.J. Department of Environmental Protection, Guidelines for Disposal of Asbestos Containing Materials

www.state.NJ.us/dep/dshw/rrtp/Asbestos.htm

U.S. EPA Asbestos Caution Regulations adopted in New Jersey

www.EPA.gov/r02earth/ahera/ahera.htm

N.J. Department of Community Affairs Lead Testing and Abatement

www.state.NJ.us/dca/codes/code_services/xls/clc.shtml

New Jersey (NJ) Department of Health and Senior Services

http://www.state.nj.us/health/

Lead in Paint, Dust, and Soil (USEPA)

http://www.epa.gov/lead/

The Leadsafe NJ Program (NJDCA)

http://www.state.nj.us/dca/dcr/leadsafe/

HS3 = MOLD

USEPA Guide to Mold in Your Home

www.EPA.gov/mold/moldguide.html

USEPA Flood Clean-up Guidelines

www.EPA.gov/iaq/flood/index.html

N.J. Department of Health and Senior Services Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

HS4 = RADON

N.J. Radon Soil Gas Map

www.EPA.gov/radon/zonemap/newjersey.htm

N.J. Department of Environmental Protection Radon tiers by County

www.state.NJ.us/dep//rpp/radon/radonin.htm

N.J. Radon Levels

www.NJradon.info/NJ_counties.html

N.J. Radon Testing Guidelines

www.NJ.gov/dep/rpp/radon/radontes.htm

Green Home Maintenance and Housekeeping

Introduction

Your home is one of the biggest investments of your life. Can 'going green' protect your investment and make it safer, more enjoyable and save you money? Yes.

This guide to Green Home Maintenance and Housekeeping practices will improve the health, comfort and environment for your family, and save you money, most directly by reducing your utility bills. The guide's focus on 'Energy' savings, improvements to 'Indoor Air Quality', effective and efficient 'Household Waste Management' and conserving 'Water' all add measurable benefits to you and high return on your investment. Routine checks and repairs will ensure your home's appearance and proper function. By following these recommendations, you will also prevent more expensive damage from occurring.

Weatherization and Energy

You can save energy and money at home by making small changes and following some easy, practical solutions/tips

1. Easy energy saving kitchen tips.
   - Air dry dishes instead of using the dishwasher's drying cycle.
   - Recommended temperatures for the refrigerator are 37°F to 40 °F for the fresh food compartment and 0° to 5°F. for the freezer compartment.
   - Cover liquids and wrap foods stored in the refrigerator. Uncovered food release moisture and make the compressor work harder.
   - Instead of preheating and using a stove's larger oven, consider using a pressure cooker, slow cooker or a microwave; for small meals use the toaster oven rather than your large stove/ oven.
   - Use a covered kettle or pan to boil water.
   - Match the size of the pan to the heating element.
   - Keep range-top burners and reflectors clean; they will reflect the heat better and save energy.
   - In natural gas appliances, look for blue flames; yellow flames indicate the gas is burning inefficiently and an adjustment may be needed. Consult the manufacturer or your local provider.

   Note: Homes with combustion appliances should install **carbon monoxid**e **(CO)** alarms to prevent accidental death by **carbon monoxide** poisoning. For more information, see the U.S. Environmental Protection Agency, "Indoor Air Quality Carbon Monoxide Fact Sheet" available at www.epa.gov/iaq/co.html

2. Laundry tips
   - The biggest energy and cost savings comes from alternatives to the dryer. Air dry your clothes on clothes lines or drying racks.
   - Wash your clothes in cold water using cold-water detergents whenever possible.
   - Wash and dry full loads. If you are washing a small load, use the appropriate water-level setting.
   - Wash and dry towels and heavier cottons in a separate load from lighter-weight clothes.
   - Don't over-dry your clothes. If your machine has a moisture sensor, use it.
   - Clean the lint filter in the dryer after every load to improve air circulation.
   - Use the cool-down cycle to allow the clothes to finish drying with the residual heat in the dryer.
   - Periodically inspect your dryer vent to ensure it is not blocked.

3. Optimize energy usage in your home
   - Lower the thermostat on your hot water heater to 120°F.
   - Drain a quart of water from your hot water tank every three months to remove sediment that impedes heat transfer and lowers the efficiency of your hot water heater. Follow the manufacturer's advice.
   - Plug home electronics into power strips; turn the powers strips off when the equipment is not in use.

- Turn off your computer and monitor when not in use.
- Replace all bulbs in your home with **Compact Fluorescent Lamps** (**CFLs**).

4. Check your home insulation and prevent air leaks.
   - Air seal the attic floor joists wherever wires, heating ducts, or plumbing pipes come through; caulk or foam the top plate of the partitions below the attic floor. Install gaskets and 4 inches of rigid foam insulation on top of the attic access panel or access door.
   - Air seal the band joists in the basement using 2 inch rigid foam and foam-in-a-can.
   - Add additional insulation if the home is built before 1980, or to achieve an insulation **R-value** of R-38 to R-50. (Air seal first.)
   - Prevent air leaks when the fireplace is not in use. Keep the fire **damper** tightly closed and use inflatable chimney balloons that fit beneath the fireplace flue.
   - Use kitchen exhaust fan covers that keep air from leaking in when the exhaust fan is not in use.

5. Maximize the efficiency of your **HVAC** system
   - Set the thermostat as low as is comfortable in the winter and as high as is comfortable in the summer. Typically, thermostats are set between 65°F and 70°F for heating and 72°F and 78°F for cooling.
   - Using a 2-inch paint brush, apply duct mastic to all accessible duct work joints or holes.
   - Clean or replace filters on furnaces once a month or as is needed.
   - Remove the register covers and caulk the duct work in the wall, floor and ceiling to prevent conditioned air from being lost in the wall or ceiling cavity. This is especially important in the ceilings directly below the attic.
   - Clean warm-air registers, baseboard heaters, and radiators as needed; make sure they are not blocked by furniture, carpeting or drapes.
   - Bleed trapped air from hot-water radiators once or twice a season; call a professional if required.
   - Place heat resistant radiator reflectors between exterior walls and the radiators.
   - Minor duct repairs are easy to make, but it is best to get a qualified professional for insulating, sealing or repairing any ducts.
   - For summer cooling, install a whole house fan to pull cool air through the house and exhaust warm air through the attic.
   - Avoid placing lamps or TV sets near your air-conditioning thermostat.
   - Keep the air conditioning unit in the shade and not in the sun.
   - Add plantings to shade air conditioning elements in sunny locations. Leave sufficient space so air flow is not obstructed and access is available in the event of a need for service.

6. Your home's energy performance can be improved by improving the performance of the windows.
   - Lower the amount of gas or electricity used to heat and cool your home. In summer, open windows at night to let in cool air and close both windows and shades during the day to keep out heat. During winter, do the opposite. Open shades in the morning to capture sunlight and close them at night to retain the heat.
   - Install exterior or interior **storm windows**.
   - Repair and **weatherize** windows.
   - When installing new windows, consider **double-glazed, low-E** windows with high performance glass.

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

A **Home Performance Audit** identifies energy upgrades for cost savings. Diagnostic tests examine the whole house and look at the interactions between all systems in a home: air leakage, insulation, combustion appliances, heating and cooling systems, and ventilation. Several free online energy audit tools are available for homeowners. The NJ Office of Clean Energy's Home Energy Analysis Tool offers specific recommendations based on the age of the home, average energy usage, the types of appliances, and other criteria. It is available on the NJ Office of Clean Energy website (www.njcleanenergy.org).

Certified professionals can conduct a more comprehensive **Home Performance Audit**. This often includes a combination of visual inspections and diagnostics tests to identify opportunities to repair or upgrade aspects of the building envelope or mechanical systems. The following strategies are common elements of a more comprehensive **Home Performance Audit**:

- **Blower Door Test – Blower door tests** help determine a home's airtightness. Proper airtightness is important for reducing energy use and drafts due to air leaks, avoiding moisture problems, and regulating indoor air quality. It is important that auditors use a calibrated blower door, which allows them to test airtightness before and after recommended changes have been implemented, and to verify that the work completed solved the problems.
- **Thermographic inspections - Thermographic inspections** or **infrared scanning** uses specially designed infrared video or still cameras to make images (called thermograms) that show surface heat variations. **Thermograms** help determine whether and where a home needs insulation. Because wet insulation conducts heat faster than dry insulation, **thermographic** scans can also detect roof leaks and other moisture problems.
- **Thermal Bypass Inspection (TBI)** – The **Energy Star® Thermal Bypass Inspection (TBI)**, and a corresponding checklist, is designed to check for missing or incorrectly installed insulation and sealing of penetrations and air gaps. It is most commonly performed for new construction and major renovations. Reducing thermal bypass, or the movement of heat around or through insulation, is important as they can lead to comfort issues as well as higher utility bills. For more information, see the **Energy Star® Thermal Bypass Checklist**: www.energystar.gov/index.cfm?c=bldrs_lenders_raters.thermal_bypass_checklist

The NJ Office of Clean Energy Home Performance with Energy Star Program (www.njcleanenergy.com/) provides reduced fee home energy audits and a listing of certified energy auditors on its website.

Tips [IPD2/EA51-54]

Prepare for a Blower Door Test[1]

- Close windows and open interior doors
- Turn down the thermostats on heaters and water heaters
- Cover ashes in wood stoves and fireplaces with damp newspapers
- Shut fireplace dampers, fireplace doors, and wood stove air intakes

Incentive [IPD2]

New Jersey's Clean Energy Program (NJCEP) offers low-price Home Performance Audits and other incentives.

www.njcleanenergy.com/residential/home/home

The Database of States Incentives for Renewables and Efficiency (DSIRE) provides information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency.

www.dsireusa.org/

Install or upgrade insulation HS2 [EA49]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:		WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:		AIR QUALITY:	DIFFICULTY LEVEL:	

Insulation slows down the heat flow through a home's building envelope - the walls, attic, roof and basement. In the winter, insulation slows heat loss and helps prevent moisture buildup. During summer months, it reduces heat gain and helps keep a home cool.

Insulation is rated according to its **R-Value**, or its ability to resist heat flow, with a high **R-Value** being a greater resistance. Adding insulation with a higher **R-Value** can cut heating and cooling costs anywhere from 15 to 45 percent, depending on factors such as the original amount of insulation in the home, house size, air leaks and personal energy use and living habits.[2]

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where.

http://www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost-effective than installing a radiant barrier.[6]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website www.EPA.gov/asbestos/pubs/verm.html

Certified energy auditors conduct an insulation check as part of a comprehensive home performance audit. They can determine the **R-Value** of the home's current insulation and measure air leakage. They then can recommend where air sealing and insulation should be added.

Thorough air sealing should be done before insulating. Insulation alone does not protect against air leakage; moist air can damage the insulation and reduce its effectiveness. Adding insulation before air sealing may make some air leaks difficult to access. Avoid **thermal bridging** by installing a layer of continuous insulating **sheathing** over frames or joists.

The general rule-of-thumb is to install insulation on any surface separating a heated space from an unheated space; walls, ceilings, attics, floors and ducts should be well-insulated. One of the best places to begin installing or upgrading insulation is in the attic as a significant amount of heat can be transferred through the roof. Installing attic insulation is also a relatively easy job for do-it-yourselfers.

There are four basic types of insulation:[3]

- **Batts** and blankets—**Batts** and blankets are made from mineral fibers, such as fiberglass and rock wool, and typically have a value of R-3 per inch. They are available in widths suited to standard spacings of wall studs and attic or floor joists; 2x4 walls can hold R-13 or R-15 batts and 2x6 walls can have R-19 or R-21 products. Use this type of insulation below floors, above ceilings, and within walls. **Batts** and blankets can be installed by homeowners or professionals.
- **Loose-fill insulation**—**Loose-fill insulation** is often made from fiberglass, rock wool, or cellulose in the form of loose fibers or fiber pellets and typically has a value of R-3 to R-4 per inch. This type of insulation works best in places where it is difficult to install other types of insulation such as building cavities and attics. Loose-fill insulation is usually blown in by professional installers.
- **Rigid insulation board**— **Rigid insulation board** is often made from fiberglass, polystyrene, or polyurethane and typically has a value of R-4 to R-8 per inch. Use this type of insulation on basement walls and as perimeter insulation at concrete slab edges, and in cathedral ceilings. For interior applications it must be covered with 1/2-inch **gypsum board** or other building-code approved material for fire safety. For exterior applications, cover with weather-proof facing.
- **Spray foam**—**Spray foam insulation** comes in two forms: **open-cell** and **closed-cell**. The **closed-cell** foams typically have a higher **R-value** (R-7 to R-8 per inch) than **open-cell** foam (R-5.6 to R-8 per inch). Most foam insulation products have a higher **R-value** per inch than fiberglass **batt** insulation.[4] This type of insulation provides both insulation and an air barrier, and is suited well for filling small spaces — such as window jambs, small stud bays, **rim joist** areas, and for sealing around electrical boxes and other penetrations. **Spray foam insulation** should be applied by professional installers using special equipment to meter, mix, and spray the foam into place. Most foam materials can now be used with foaming agents that don't use **chlorofluorocarbons** (**CFC**s) or **hydrochlorofluorocarbons** (**HCFC**s), which are harmful to the earth's ozone layer.[5]

Air seal to reduce infiltration [IDP55]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Tips [IDP55]

Use a re-useable dispenser gun to seal the harder to reach spots and increase your resource conservation.

Caution [IDP55]

To assure combustion safety, New Jersey building code requires that foam insulation be covered by a non-combustible material such as **gypsum board**.

It is advisable to test for **carbon monoxide** before air sealing efforts.

Air infiltration or leakage may contribute to as much as 30 percent of a home's heating and cooling costs.[7] The most common sources of air infiltration are the attic, crawl space, or basement, and around windows, doors, and chimneys. Other sources include **plumbing chases**, electrical outlets, attic accesses, dropped ceilings and leaky ducts.

Reduce air leakage as much as possible before adding insulation and provide controlled ventilation as needed. First, identify air leaks in the home (see Conduct a Home Performance Audit and diagnostic tests [IDP2, EA51-EA54] above). A good rule of thumb is to seal the high and low air leaks first. Start by plugging holes and leaks in the attic and basement, then move to the exterior wall, and look for smaller leaks around doors, windows and electrical switches and outlets. Use

caulk to seal openings up to ¼ inch such as cracks and gaps between window frames and siding. For larger gaps, add a backing material before caulking or use a **spray foam** sealant. After all the larger air leaks have been sealed, **weather-strip** doors and windows.

Weatherstrip doors and windows [EA58]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

When replacing doors or windows is not feasible, consider **weatherstripping. Weatherstripping** stops drafts coming into the home from under or around doors and windows; on newer windows and doors it is fairly easy. On average, doors have more gaps and larger cracks than even loose-fitting windows.

Weatherstripping kits for doors are readily available at local hardware stores, but finding replacement **weatherstripping** that matches the old can be a challenge. Steel or custom door kits may be harder to find. Check with the manufacturer in these cases. Typical **weatherstripping** kits include two side strips, a top strip, and fasteners. Consider a **door sweep** if the floor, carpet or rug is below the bottom of the door frame. The cost of materials will pay for themselves in energy savings within one year, saving about 10 percent on heating and **cooling loads.**

Proper sealing means **weatherstripping** the entire door jamb in one continuous strip on both sides. For air sealing windows, apply **weatherstripping** between the sash and the frame. In both cases make sure that the **weatherstripping** is the right thickness so as to not impair the ability of doors or windows to open and close.

Double-hung windows are trickier than **casement windows** to **weatherstrip**, requiring two types of **weatherstripping**. The type of **weatherstripping** needed depends on the type of window and the situation. Angled or V-shape spring-type **weatherstripping** is nailed to the frame and bottom sash to seal **double-hung windows**. Pliable **weatherstripping** is sponge-like and installed in the channels and sash of wood **casement windows**. Compressible felt strips are not as durable at these other options but good for use with warped windows or for windows that are not often opened.

Upgrade or replace existing windows HS2 [EA56/59]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Determining whether the home's windows need to be updated or replaced starts with a **Home Performance Audit** (see strategy IDP2/EA51-54), which will reveal if some or all of the windows leak. Visual inspection may also reveal window problems. Are any of the windows cracked? Do they open to allow fresh air to enter? Are there any windows without **storm windows**?

Upgrade or replace **single-pane** with **double-pane windows** with low-E or spectrally-selective glass to save 10 to 25 percent per year on heating.[8] To help offset the up-front cost, check for incentives from federal tax credits and through state and local utilities. If window replacement is not in the budget and old **single-pane windows** are in good condition, install **storm windows** in the winter months. Upgrading the sash alone can also save money. **Storm windows** can reduce heat loss through the windows by 25 percent to 50 percent. **Storm windows** also protect against impacts from rain, ice and snow. Bear in mind that good windows installed badly will not achieve expected savings, so see the link in the resources section for tips on "How to Hire an Expert Installer." Finally, windows that are properly sealed and caulked prevent leakage of air in and out of the house and provide a protective barrier from water and noise. (For more information, see Weatherization and Energy: **Weatherstrip** doors and windows [EA58]).

Tips [EA58]

Before purchasing **weatherstripping** materials, make sure the draft is not caused by loose hinge screws; if it is, glue wood plugs using **low-VOC** glue in the holes and re-drive the screws.

Ensure the door shuts and latches before completely nailing in the **weatherstripping**.

To prevent binding, plane the top with the door still in place and always move the plane toward the center of the door to avoid splintering off the edges.

Building Age [EA58]

Older windows, especially double-hung windows, are difficult to **weatherstrip**. If they're in bad shape, consider replacement windows; see related window strategies.

Caution [EA58]

Weatherstripping can dramatically change the pressure of the home and may cause **backdrafting** from an gas water heater that previously had no drafting issues. As part of a whole-house systems approach to home performance, make use of pre- and post-diagnostics to evaluate and confirm building performance changes.

Tips [EA56]

- Add shrink-wrap plastic sheeting over windows you rarely open in the winter.
- Install tight-fitting, insulating window shades on windows that feel drafty after **weatherizing**.
- In the winter, close curtains and shades at night and open them during the day. In the summer, close curtains on south and west windows during the day.

Incentive [EA56/59]

Fed Tax credit info:
www.aceee.org/energy/national/

NJ Bio-Region [EA56/59]

Energy Star®'s criteria for residential windows (as well as doors and skylights) are tailored to four Climate Zones nationally, two of which, 4 and 5, are defined by **Energy Star**® for New Jersey www.efficientwindows.org/factsheets/Newpercent20Jersey.pdf

To find the Climate Zone for a specific zip code, consult the **Energy Star**® Climate Zone Finder www.energystar.gov/index.cfm?fuseaction=windows_doors.search_climate

Building Age [EA56]

A historic wood window, properly maintained and fitted with a **storm window**, can be just as energy-efficient as a new window. For more tips on green historic windows, see www.preservationnation.org/issues/sustainability/additional-resources/July2008WindowsTipSheet.pdf

Caution [IPD24]

Moisture leads to mold and can significantly degrade indoor air quality.

NJ Bio-Region [EA60]

Salt air and moisture wear down window **glazing**.

Building Age [EA60]

Older homes with **single paned** glass may be able to be re-glazed.

Provide moisture management strategies HS1 [IDP24]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

A dry house is a more durable house and therefore extends the value of the home, a precious resource. The cost and complexity of moisture management strategies depends on what steps will be undertaken. Consider the costs of not properly managing moisture in terms of the durability of the structure of the building and to a home's indoor air quality, as mold can quickly reach toxic levels.

The **building envelope** plays a key role in the total performance of the building, so most moisture management strategies focus here. Several strategies keep the **building envelope** drier. Roof overhangs and overall sealing of any roof and wall penetrations are major examples. Incorporate a **house-wrap** or weather barrier when replacing the exterior **cladding** such as upgrading the house siding. Create a drainage plane, such as **house-wrap** with texture placed under siding, to allow hidden wet spaces to dry more quickly.

The integrity of the **building envelope** can be challenged by moisture in any state: 1) liquid in the form of rainwater penetration, 2) solid such as ice and snow, and 3) vapor, such as relative humidity. If these conditions are not managed properly, they can lead to decay of the home, creating permanently wet conditions that also affect indoor air quality. [See additional window, wall and foundation strategies in this section to understand how to best manage moisture.]

Use appropriate window glazing [EA60]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

Correctly designed **glazing** systems reduce energy usage and enhance natural daylighting in the home. Optimizing window **glazing** is a **passive solar design** that considers the orientation of the sun and adjusts window **glazing** accordingly. **Glazing** is measured by its **Solar Heat Gain Coefficient (SHGC)**. The **SHGC** gauges the amount of solar heat energy transmitted through the window **glazing**. Higher heat energy - indicated by a high **SHGC** - is desirable for south-facing windows in northern climates. Design east and west windows with a lower **SHGC** to keep the heat gain down in summer. To best balance the temperature of the **building envelope**, **glazing** as part of a whole window design assures that all issues are factored in for optimal comfort and energy savings. **SHGC** is considered with a window's **R-Value** rating to assure optimal window performance.

Window performance also depends on the connection to the adjacent envelope elements so these need to be properly water-managed. A **glazing** system has high resistance to water vapor transport but must be integrated with the **building envelope**'s rainwater management design as framing design and construction techniques also impact water intrusion.

When replacing windows, select units with features that improve energy performance. These features include double or triple **glazing**, warm-edge spacers, gas filling between the panes (argon, krypton or a mixture of both), and a variety of coatings on the glass including **low-emissivity** (**low-E**) coatings. All of these features improve the **U-factor** by reducing the heat loss through the window.

Upgrade existing exterior door [EA57]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

An exterior door that is old, improperly installed, or not well-sealed can contribute significantly to energy losses in a home. If the home has older doors or if installing a new door can be included as part of a larger home improvement project, replacing them will result in lower heating and cooling costs. Adding a storm door can be a good investment if a home's existing door is old but still in good condition, however, adding a storm door to a newer, insulated door is not generally worth the expense since it won't save much more energy. When selecting a door for energy efficiency, consider its **energy performance rating** and look for the **Energy Star®** and **National Fenestration Rating Council** labels. Check for federal tax credits and state and local incentives for qualifying doors.

Incentive [EA57]

Rebates and Tax Credits for Windows, Doors, and Skylights:

www.energystar.gov/index.cfm?c=windows_doors.pr_taxcredits

Building Age [EA57]

Older homes may require or desire custom doors to fit with the structure and original architecture. Consider a locally hand built door made from salvaged wood.

Install window shading system [EA62]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Roughly 40 percent of the unwanted heat build-up in the home comes in through windows. High performance windows can partly compensate for poor orientation and/or poorly placed windows (See Use appropriate window glazing EA60 above). However, shading devices can supplement the benefits of high-tech windows and add an extra layer of protection against the sun. Shading on south and west facing windows helps reduce heat gain in the summer. In the winter, when the sun is lower in the sky, windows permit sunlight to pass through the window to warm the interior. **Deciduous trees** on the southeast, south and southwest areas of the home can provide considerable shade and natural cooling during summer months. These same trees will lose their leaves during the winter months, allowing sunlight to heat homes during the day. Although both exterior and interior shades can control heat gain, exterior shading devices - such as roof overhangs, **awnings**, **louvers**, shutters, and **solar screens** - are most effective since they block sunlight before it enters the windows.

Roof overhangs can help keep unwanted summer midday sun from heating a home, and can protect the home from rain and potential moisture damage. The drawbacks of overhangs are that they are difficult to add unless the remodel includes plans for work on the roof, and there is no way to retract them. While there is not a universally accepted method for calculating sizes for overhangs, the U.S. Department of Energy offers the following general guidelines for moderate climates:

- Moderate climates: below 6,000 heating degree days (HDD) (at base 65°F [18°C]) and below 2,600 cooling degree days (CDD) (at base 75°F [22°C]) (HDD

  and CDD data is available from local weather services.)
- Locate shadow line at window sill using the June 21 (summer solstice) sun angle.
- Sustainable by Design offers the following shareware design tools for calculating solar angles and designing window overhangs: www.susdesign.com/tools

Awnings are often made of fabric or metal and can be stationary or retractable. A light-colored **awning** also reflects sunlight. To take advantage of the desirable winter heat gain, homeowners should remove **awnings** for winter storage or buy retractable ones.

Louvers operate like exterior mini-blinds. They can have vertical or horizontal slats to control the level of light entering a home and, depending on the design, can be adjusted from either inside or outside of the house.

Shutters are moveable wooden or metal coverings that, when closed, keep sunlight out. They can be either solid or slatted, with fixed or adjustable slats. Rolling shutters have a series of horizontal slats that run down along a track.

Solar screens look like standard window screens, except they block light and cut glare.

Tips [EA62]

If a home is oriented more than 30° off true south, the effectiveness of an overhang, as with any solar feature, begins to decrease significantly

NJ Bio-Region [EA62]

Sunny areas with less natural shade can benefit from **awnings** in the summer. In the cold winter months, however, **awnings** should be removed and stored.

Building Age [MR119]

If upgrading the **cladding** of an older home consider low-maintenance materials such as fiber siding that need to be painted 25 percent less often than wood.

Caution [MR119]

Older homes may have **cladding** in place that contains lead paint and **asbestos**.[9] **Asbestos** used in "cement form" releases particles if the siding is cut.

Tips [MR120]

According to studies by the Oak Ridge National Laboratory, lightly colored, more reflective roofing can save up to 40 percent in summer cooling energy costs while highly emissive roofs can reduce urban air temperatures by as much as 12 ° F.

NJ Bio-Region [MR120]

According to the Cool Metal Roof Coalition, a highly reflective and highly emissive painted or granular coated metal roof is optimal for reducing energy consumption where annual cooling loads dominate (Florida) while an unpainted metal roof is more desirable because of its low infrared emittance in colder climates where heating degree days dominate (New Jersey).

Building Age [MR120]

The normal life of a roof today is 35-50 years, depending upon the maintenance of the roof. Signs that it's time to replace the roof:

1) roof leaks 2) missing, torn or curled shingles 3) poor condition of interior walls touching the roof (moisture marks, loss of paint)

Install a durable wall cladding [MR119]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TTT

A durable wall **cladding** should be part of the home's moisture management strategy. Proper installation of **cladding** requires a layered approach with an air space or **rainscreen** behind the siding so this area can dry out while also fully sealing the **building envelope**. Newer versions of **house-wrap** have textured surfaces that create a drainage plane to move water more readily behind the **cladding** and out to the wall assembly.

Siding properly installed over a **rainscreen** requires less frequent painting or staining than when installed directly over **sheathing**, reducing the need for refinishing. Factory pre-primed claddings are also highly efficient. Noncombustible siding, such as **fiber cement**, adds fire protection and often is required by building codes. This must be layered with fire-resistant screening in the air space behind the **cladding** to be effective.

Provide a durable and reflective roof [MR120]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	TTT

Roofs are the home's first layer of defense against the elements: temperature fluctuations, **UV** light, rainstorms, snow and ice, and high winds. Roofing, especially dark colored roofing, can be a source of significant unwanted heat gain. Discarded roofing material, such as asphalt shingles, is also a major source of Construction and Demolition (C&D) waste.

If adding a new roof as part of an addition or replacing an existing roof, consider environmentally friendly alternatives to conventional asphalt roofing shingles such as clay, concrete, slate tile, **cool metal roofing**, fiber-cement composite roofing, **recycled content** plastic/rubber shingles, or a green or **vegetated roof** (made with living plants). In general, light colored roofs offer a greener alternative to dark roofing materials since they reflect rather than absorb heat. Consider a cool metal or reflective roof with material certified by USEPA **Energy Star**® Reflective Roof Program. Also, look to install a highly durable, **50-year roof**. Keep in mind that light colored shingles often make for a longer lasting roof since they experience less contraction and expansion than darker ones.

Cool metal roofing can achieve solar reflectance of over 70 percent, which means that less heat is transferred into the home. It also means a reduction in the **urban heat island effect** (the local warming due to dark-colored surfaces and buildings). Infrared emittance -- the amount of absorbed solar radiation that is re-emitted from the roof to the sky -- varies with the surface finish. For example, the emittance of painted or granular-coated metal roofing is higher than unpainted metal roofing and can be as high as 90 percent. Select cool metal roofs qualify as **USEPA Energy Star**® Roofing Products.

Follow standards for mechanical design [EA63]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

The Air Conditioning Contractors of America (ACCA) developed standards to size heating, ventilating and air conditioning systems (**HVAC**s) to assure maximum comfort and energy efficiency.

The ACCA also provides software that calculates **heating and cooling loads**. Use these calculations both before and after **HVAC** installation to assure effectiveness. Request **load calculations** from contractors to validate the overall size and design proposed. Addressing **building envelope** issues at the design phase can reduce the load and resulting size requirement of the home's **HVAC** systems.

The **ACCA Manual J - Residential Load Calculation** accurately estimates heating and air conditioning loads. **Manual S – Residential Heating and Cooling Equipment Selection** recommends optimal heating and cooling equipment to meet loads as identified from **Manual J** results. Use the **Manual S** calculation to assure proper sizing based on the square footage and the home's heat loss during cold weather and heat gains during warm weather. **Over-sizing** and improper design are major issues in **HVAC** installation and design. **Over-sizing** can compound the cause of indoor climate issues such as inconsistent temperatures from one room to another. Calibration of the **sensible (or dry) cooling load** and the **latent (or wet) cooling load** assures interactions with windows or people will be accounted for in the design.

Manual D – Residential Duct Systems provides tools for proper duct sizing and is used in conjunction with **Manual J** and **S** calculations. Correct sizing is essential to maximizing **HVAC** energy efficiency. A system that is too big used with a smaller duct system creates improper air flow and raises the utility bill. Proper duct design assures even air flow to each conditioned space within the home. Similar to the issues faced with an improperly or oversized **HVAC** unit, improper duct system design can lead to increased energy bills and a lack of comfort in the home due to an imbalance of heating or cooling in the conditioned spaces. Additional duct design attributes include well-insulated and sealed ducts that are best placed within conditioned space and with a minimum number of turns. Placement of the duct system is also essential to assure energy efficiency, promote proper functioning of the entire unit, and reduce future maintenance requirements.

Provide controls and zoning for HVAC [EA64]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

The heating, ventilating and air conditioning (**HVAC**) system distributes air through the home via the **ducting system**. Assuring proper distribution across defined zones or areas of the home is another key design element and should be considered with sizing to assure an efficient system. This is especially true in determining **optimal load calculations** and appropriate air flow for each room. **Zoning** more effectively directs heating and cooling from a single **HVAC** system to multiple areas of the home than multiple **HVAC** units and avoids the added expense that comes with them.

Proper **zoning** controls optimal comfort and efficiency. A **zone controller** connects multiple thermostats to the single **HVAC** system and allows for cooling customization, such as focusing the cooler air in occupied spaces at optimal times. **Zoning** increases overall thermal comfort of a home and is particularly useful in larger houses that are poorly conditioned, such as single-zone two-story houses with a generally warmer second floor.

Use ceiling fans for natural ventilation [EA65]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Since people can tolerate higher temperatures when air is in motion, use ceiling fans in conjunction with an air conditioning system in occupied rooms. This reduces air conditioning use,thus saving electricity and money. In the summer, run ceiling fans in a counterclockwise motion. Ceiling fans can be used in the winter in a clockwise motion at low speeds to bring warm air back down into the occupied space.

Caution [MR120]

If a roof is to be used to collect potable water, its material should not capture or hold contaminants (such as asphalt or fiberglass with a textured surface), and it should not leach contaminants into the water, as can be the case with copper and certain other materials.

Tips [EA63]

It is more efficient for a smaller unit to run for longer time than a larger unit to operate with shorter cycles. This can be likened to fuel usage differences between highway and local driving.

NJ Bio-Region [EA63]

Correct sizing matters, particularly in areas of high humidity such as shore locations where the air conditioning unit pulls substantial moisture out of the air.

Caution [EA63]

An improperly sized system can lead to indoor air quality issues, including mold. Combustion safety is a primary consideration requiring testing during **HVAC** design or modifications; a change in the home's air pressure can result in **backdrafting** of combustion units, putting dangerous gases into the home. Test before and after remodeling with the **Blower Door Test**.

Building Age [EA64]

This strategy does not apply to older homes with boilers and hot water steam heat. Retrofitting **zoning** into older homes or into any existing installation is a challenge and could prove to be very costly; consider options and benefits of doing so versus effort and costs before proceeding.

Tips [EA65]

Turn ceiling fans off when rooms are unoccupied.

Open both sections of **double-hung windows** to allow cool air in the lower window and warmer air to escape upper windows.

Consider a solar powered attic or **whole house fan** for additional energy savings.

NJ Bio-Region [EA65]

Shore locations can save cooling costs by leveraging natural shore breezes from ocean-facing windows.

Building Age [EA65]

Older homes pose challenges to designing optimal mechanical cooling, so consider ventilation options before installing air conditioning. Many older homes have cross ventilation systems built into their original design, as they were built before air conditioning became commonplace.

Caution [EA65]

Fresh air is essential for indoor air quality and combustion safety, but energy-efficient homes may minimize air flows including fresh air. **Energy Star®** homes require a controlled mechanical vent to assure air exchanges such as a programmable bathroom fan.

Tips [EA67]

Before purchasing, check the compatibility of the thermostat with the respective **HVAC** system. Make sure the thermostat selected operates via battery versus obtaining some power from the 24V AC **HVAC** lines.

Incentive [EA66]

N.J. Clean Energy Program offers rebates for properly sized and installed high-efficiency systems www.njcleanenergy.com

Also, consider a whole house fan to avoid air conditioner usage and expense. Generally a whole house fan is used at night and turned off during the day. It moves cooler nighttime air into the house through open windows and exhausts warm air through the attic.

Another way to cool the home is with **transoms** in window and door designs. Designing for convection directs cool air to enter the home on the lower floors (such as through the basement) and expels warm air through upstairs windows.

Strategic location of plants and landscaping can cool (and clean) the air before it enters the home. Finally, **awnings** and blinds provide additional passive cooling options.

Install programmable thermostats [EA67]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Programmable thermostats save energy and money by allowing homeowners to set temperatures based on occupancy and to schedule setting changes. This uses heating and cooling only when needed. **Programmable thermostats** are especially useful if the house is empty during the work week and only fully occupied on weekends. Pre-programming and proper use of a programmable thermostat saves energy costs by minimizing heating or cooling of an empty house.

Select high-efficiency HVAC equipment [EA66]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Heating is the largest energy expense in most homes, accounting for 35-50 percent of annual energy bills in northern climates. Save money by reducing heating energy usage while also reducing the home's contribution to environmental problems by upgrading to **Energy Star®** rated heating equipment as determined by the **Annual Fuel Utilization Efficiency** (**AFUE**) rating for oil and gas furnaces and boilers (and other measures as applicable to heat pumps). **Energy Star®** rebates apply for **Energy Star®** rated equipment.

The American Council for an Energy-Efficient Economy cites several considerations for assessing when it is time to replace the furnace.[10] In particular, gas furnaces or boilers that are older than 20 years are good candidates for replacement with a high-efficiency model with the guidance of an **Energy Star®** certified heating contractor and heat-**load calculations** that the contractor provides. If it is time to replace the furnace, installing a ground-source **heat pump** could be an option depending on the extent of the remodeling effort; see the Ridgewood historical remodel case study at the end of this chapter for a **heat pump** upgrade in practice.

The efficiency of central air conditioning systems is rated by a **Seasonal Energy Efficiency Ratio** (**SEER**). **SEER** ratings range from 14 to 23; a higher **SEER** rating means a more efficient unit. **Energy Star®**-qualified central air conditioners have a **SEER** rating of greater than or equal to 14 and are significantly more efficient than standard models; as such, **Energy Star®** models provide for more cost savings over the life of the unit. Newer units in general have incorporated significant advances to increase efficiency. **Energy Star®** models also require a minimum **Energy Efficiency Ratio (EER)** of greater than or equal to 12 for **split systems**, and of greater than or equal to 11 for single-package models. While higher efficiency units often cost more initially they save on operating costs over their lifetime.[11] A high-efficiency unit must also be designed, installed, and maintained properly to reap efficiency benefits (see [EA63]).

An effective pleated filter also contributes to savings on heating/cooling and helps prevent the introduction of pollutants into the living space. Radial pleated filter designs such as a 'MERV 8' provides optimal dust holding capacity, especially as compared with standard rigid fiberglass filters

that provide little resistance against dust or bio contaminates. Keeping the filter clean is an essential component of **HVAC** maintenance.

Conduct duct tightness test [EA68]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Similar to a pressure test of a plumbing system, a **Duct Blaster Test** gauges the tightness of the ductwork. It uses a fan combined with a pressure gauge to pressurize the duct system and measure air leakage of the ductwork. The test is often performed along with a **Blower Door Test** as part of a **Home Performance Audit** to find leaks. It should be performed before and after related work to properly identify and target areas for action and to assure resolution of desired upgrades and energy and operating cost savings.

Caution [EA68]

Ducts that don't work properly can create serious, life threatening **carbon monoxide** (**CO**) problems in the home. Install a **CO** monitor to alert you to harmful **CO** levels if you have a fuel-burning furnace, stove or other appliance, or an attached garage.

www.eere.energy.gov/consumer/tips/ducts.html

Maintain HVAC systems [EA69]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Heating, Ventilating, and Air Conditioning (**HVAC**) systems can be **commissioned** or tested to ensure systems are operating as the manufacturers intended, e.g., **refrigerant** adequately charged, airtight ducts, proper room-by-room pressure and proper airflow.

HVAC systems must be properly balanced to ensure even distribution of air and need to be inspected, tested, and tuned up after installation. **Zoning** and other controls should also be tested to make sure they are functioning properly. To confirm functioning, have all aspects of the **HVAC** system **commissioned**. **Commissioning** provides documented confirmation that the **HVAC** systems are working as intended.

Commissioning systematically investigates, analyzes, and optimizes the performance of **HVAC** systems to improve their operation; maintenance ensures continued performance over time. Regular maintenance ensures that the energy efficiency upgrades remain at optimal levels as designed and are meeting the homeowner's current needs.

To protect an investment in an **HVAC** upgrade and assure its efficiency over time, **HVAC** equipment should be tuned up annually and filters should be cleaned or be replaced on a regular basis. **Energy Star**® recommends tending to filters every 30 days during peak heating or cooling season. The wrong amount of **refrigerant** in air conditioners can also impact the functioning of the cooling unit. Proper maintenance extends the life of the **HVAC** system, extending the resource value of the system.

To assure regular maintenance, homeowners should consider setting up an **HVAC** maintenance contract for "tune-up" of your **HVAC** system before heating and cooling seasons to protect performance. A maintenance contract can pay for itself in energy savings and ensures that your **HVAC** contractor will schedule tune-ups even if you forget.

Tips [EA69]

Hire a trained technician to verify installation and operational requirements. **Energy Star**® has collaborated with the **EPA** to provide documented standards for assuring proper installation and verification of **HVAC** systems.

www.energystar.gov/ia/home_improvement/PHEE_InstallationAC_final.pdf

Caution [EA69]

Improperly balanced systems can depressurize the house, allowing **radon** and other hazardous **soil gases** to enter the home.

The **commissioning** process should check for **refrigerant** leaks that can emit **refrigerant** gasses into the air.

Seal and insulate HVAC system [EA70]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

A house can lose over 30 percent of its heating and cooling capacity from improperly sealed ducts, especially if the ducts are located in unconditioned spaces.[12] In the winter, hot air leaks into

Tips [EA70]

The contractor should be able to confirm the sealing work with a **Duct Blaster Test** performed before and after duct sealing.

Caution [EA70]

Pressure imbalances due to duct leakage can force moisture laden air into **building envelopes** and lead to moisture problems.

unconditioned spaces and causes the furnace to work harder. In the summer, hot attic air can leak in and increase the load on the air conditioner. A perfectly sealed operative duct system would have the same amount of air entering the return **grille** and leaving the supply registers, creating neutral air pressure. In contrast, leaky **supply ducts** create negative pressure that pulls outside air into the building. On the return side, leaks cause a suction that pulls air into the ducts, forcing more air into the home and creating a positive pressure that also overtaxes the **HVAC** system.

Seal all ducting with low-**VOC duct mastic**. The **Energy Star® Thermal By Pass Checklist** recommends the use of mastic, not tape, to seal ducts. Results have shown that using tape to seal ducts is ineffective as tape often frays and curls away degrading the seal. If any ductwork is in less desirable condition, or in uninsulated areas, additional insulation most likely will be required. A qualified professional can help insulate and repair ducts.

Tips [EA71]

Check references and licenses to locate a duct cleaning provider and make sure they are a certified member of the **NADCA**. Air duct cleaning companies must meet requirements to become a **NADCA** Member including having certified Air System Cleaning Specialists (ASCS) on staff.

Caution [EA71]

HVAC components can become contaminated with particles of dust, pollen or mold that can be released into the home's living space cause allergic reactions.

The homeowner should inquire about the use of **biocides** or chemical treatments in the duct cleaning process to make sure a service provider would not intend to use them.

Older **duct systems** should be inspected before cleaning to be sure that there are no **asbestos**-containing materials.

Make sure ductwork is clean [EA71]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	$$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TTT

Duct cleaning refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, **diffusers**, **heat exchangers**, **heating and cooling coils**, **drain pans**, fan motor, fan housing, and the air handling unit. While clean ducts help maintain healthy indoor air quality, unless done properly, cleaning ducts can cause more indoor air problems.

If a visual inspect reveals infestation, mold or extreme debris problems, duct cleaning may be necessary. If so, be sure the service provider cleans all components of the system to avoid any recontamination that may require more serious cleaning needs. Be sure the service provider is qualified by the **National Air Duct Cleaners Association (NADCA)**. A certified service provider uses specialized tools to dislodge dirt and other debris in ducts and vacuums them out with a high-powered vacuum cleaner. Different types of ducts require different cleaning methods; sheet metal ducts with external insulation are the easiest to clean. A **Duct Blaster Test** should also be performed when cleaning ducts to gauge the tightness of the ductwork. Finally, be sure to cover duct registers and openings during renovation or remodeling.

Provide daylighting HS1 [EA83]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	$
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	TT

Sunlight is a natural way to reduce energy use during the daytime hours. Homes that only require artificial lighting at night and on darker days save more electricity and are more aesthetically pleasing than ones that do not.

Windows and skylights are obvious sources of daylight, but balance daylight access with appropriate **glazing** and shading techniques. Poorly designed window or skylight layouts can increase summer **cooling loads** significantly. **Awnings**, **louvers**, and shutters can block direct sunlight and allow indirect sunlight into the building. Conversely, a well-designed scheme reduces **heating loads** significantly in the colder months. In the northern hemisphere, south facing windows receive the most sunlight over the course of the day. For these windows, properly sized overhangs will shade the window from direct summer heat but will allow the lower winter sunlight to filter through.

An alternative to window skylights is **solar tubes**. The flexible cylinders of the **solar tubes** draw sunlight from the roof into a ceiling fixture resembling a standard lighting fixture. They are useful in smaller interior rooms without space for a traditional skylight, such as a bathroom. Translucent panel skylight systems are another means of allowing sunlight in without producing glare and minimizing heat transfer.

Provide appropriate lighting [EA84]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Lighting consumes almost 15 percent of a household's electricity use.[13] Provide an appropriate mix of color-correct **ambient** and task lighting to improve both the quality and quantity of lighting used in the home.

Two ways of determining which lighting is appropriate for a particular use are its **color temperature** and its **Color Rendering Index (CRI)**.

Color temperature defines the color and warmth or coolness of a light source. **Color temperature** is measured in degrees **Kelvin (K)**. High **Kelvin** temperatures (3600–5500 **K**) are considered "cool" and low color temperatures (2700–3000 **K**) are considered "warm." Task lighting calls for cool light that produces a higher contrast than warm light and is better for visual tasks. Warm light is recommended for living spaces. A **color temperature** of 2700–3600 **K** is generally recommended for most indoor general and task lighting applications.

The **Color Rendering Index (CRI)** is a 1-100 scale that measures how colors appear under different light sources. A light source with a **CRI** of 80 or higher is considered acceptable for most indoor residential applications.

Install energy-efficient lighting [EA85]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Traditional incandescent bulbs will be phased out by 2012. The technological improvements in **compact fluorescent lighting (CFLs)** over the past decade have made for a smooth transition. **CFLs** are inexpensive, last ten times as long as traditional bulbs, and use a fraction of the electricity. They also fit into standard light fixtures, allowing for their widespread use with minimal up-front cost.

Light-emitting diodes (LEDs), currently used in a variety of applications, potentially could find their way into more traditional lighting applications. Highly efficient, durable, and non-toxic, **LED**s currently cost too much to warrant their widespread use. However, rapid advances in **LED** technology continue to push **LED** lighting to more practical uses.

Wherever possible, replace incandescent bulbs with greener alternatives. It is a simple and affordable way to significantly reduce home energy use.

Provide appropriate indoor lighting controls [EA90]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST: $$	
RESOURCE CONSERVATION: N/A	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Lighting represents about 15 percent of household electricity usage and about 10 percent of household energy expenses. Newer lighting technologies, extensively used in commercial buildings, are now available for home use. These technologies can reduce lighting energy use in your home by over 50 percent.[14]

Lighting controls such as dimmers, timers, and motion detectors reduce light usage by synchronizing lighting directly with living patterns. Motion detectors switch the light on when someone walks

Tips [EA84]

The U.S. Department of Energy offers the following energy-efficient lighting design tips:

- Remember that more light is not necessarily better. Human visual performance depends on light quality as well as quantity.
- Match the amount and quality of light to the performed function.
- Install **task lights**, such as desk lamps, where needed and reduce **ambient light** elsewhere.
- Use energy-efficient lighting components (i.e., **CFL**s, **LED**s), controls, and systems.
- Maximize the use of daylighting.

Caution [EA85]

Fluorescent bulbs and lamps are considered hazardous waste and should be disposed of properly. If a bulb breaks avoid direct contact with skin. Burned out or broken fluorescent lamps should be brought to a facility that recycles them. Check with the County's Solid Waste and Recycling Department or type in your zipcode at www.Earth911.com to find out where you can recycle miscellaneous items such as **CFL**s.

Tips [EA85]

Not all **CFL**s are dimmable, so be sure to check before purchasing for a dimmable fixture.

into a room, while light sensitive detection adjusts indoor lighting based on the changing levels of outdoor light.

High-tech lighting controls, including whole house systems that offer tie-ins to computer and security systems as well as outdoor lighting, are most effective in new construction that can be hardwired with low-voltage wiring.

Caution [EA80]

Do not block air flow beneath a gas-fired natural draft water heater. Do not cover the burner access or the flue collar. Leave about 2" of exposed area around the flue collar. Don't use a regular blanket or insulation not designed to be used specifically with a water heater. Follow manufacturer's instructions for insulation.

Insulate water heater [EA80]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

New water heaters have added interior layers of insulation that improve their energy consumption. Older water heaters are the third largest energy expense in the home, accounting for about 13 percent of the utility bill.[15] Insulate free-standing water heater storage units for quick and inexpensive improvements in energy efficiency. Heat is lost because the temperature inside a water heater is significantly higher than the temperature of the room, especially when the water heater's location is unconditioned. **Water heater blankets** and kits are available from local hardware stores and **weatherization** supply companies.

Tips [EA81]

The first six to eight feet of pipe from the water heater are the most important to insulate. Assure a snug fit around the pipes especially the elbows and angles; tight-fitting insulation is always more effective. Also Insulate cold-water pipes in areas with high summertime humidity to prevent condensation of moisture on the pipes and the associated sweating or dripping which degrades the durability of the piping.

Insulate hot water pipes [EA81]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Hot water pipes usually run through unheated areas of the home, so insulating them is important to prevent heat loss and help the water heater run efficiently. Insulated hot water pipes reduce water usage by increasing the amount of time that hot water stays hot thereby reducing the need to run tepid water through the faucet. Requiring less energy to heat water also reduces water heating bills.

Insulating hot water pipes on accessible pipes is an easy task. Pre-formed foam pipe insulation sleeves (available at local hardware stores) can be cut to fit snugly and snap in place on the pipes. Use a durable pipe insulation material that can withstand high temperatures over time. Cover slits and joints with vinyl duct tape to provide additional insulation.

Building Age [EA81]

Older homes should also consider covering cold water pipes especially those in unheated areas of the home to prevent freezing.

If the hot water pipes are buried into the slabs consider re-plumbing as part of a whole house performance plan.

Utilize solar water heating [EA101]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Solar water heating is cited as the most cost-effective renewable energy system for residential applications. Payback periods related to solar water heating differ depending on the cost of energy for heating water. In areas where electricity is used for water heating, the payback periods are shorter than for areas that use natural gas for water heating.[16] Installing a solar water heater is a proven solution to reducing the home's carbon footprint. Conventional electric water heaters produce about eight tons of CO_2 annually and gas water heaters about two tons of CO_2 annually.[17]

Solar water heating can be used for domestic hot water, pool heating, and space heating needs and is in use by over a million homes in the United States.[18] There are many types of solar water heaters. Evacuated tube solar hot water system can provide 90 percent–100 percent of domestic hot water needs.[19] Appropriate design and climate considerations are key in the consideration of any solar

project. Care must be taken to guard against freezing of the collector and piping, and evacuated tubes for solar hot water can overheat and break if the power went out on a sunny day.

Reconfigure plumbing for efficiency HS3 [EA77]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	N/A	DIFFICULTY LEVEL:	TTT

Heating the water in your house accounts for about 11 percent of your annual energy costs. One can save water and energy by redesigning plumbing efficiently. Advancements in piping materials and plumbing systems cut installation and material costs, conserve water, and save energy. **Cross-linked polyethylene (PEX)** piping materials have quickly earned a reputation as a durable replacement for copper because they are:[20]

- Flexible – allowing for fewer joints and an easier (and quicker) installation
- Durable - capable of withstanding extreme temperatures and highly resistant to chemicals
- Consumer friendly – quieter than traditional piping materials and offered in color-coded **PEX** tubing for simple identification of cold and hot water lines.
- Energy-efficient – reduces heat loss from water in the pipe because it is a better thermal insulator than copper
- Water efficient – right-sizing capability allows for quicker hot water delivery

PEX also lends itself to **home-run** or parallel pipe configurations in which hot and cold pipes originate at a manifold and service individual fixtures with dedicated supply lines. **Home-Run** systems can be installed more quickly (because of flexible piping) than more rigid and conventional "tree" type plumbing systems. The dedicated supply lines from the manifold to the fixture – particularly in the hot water supply lines – are often smaller in diameter for a **Home-Run** system, so less water goes down the drain while waiting for hot water at the fixture. Finally, **Home-Run** systems operate much like an electrical system breaker box, allowing homeowners to easily turn off the water for repairs or maintenance.

Select a high-efficiency clothes washer [EA92]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	N/A	DIFFICULTY LEVEL:	T

Clothes washers are responsible for about 22 percent of household water consumption or about 13,000 gallons of water each year.[21] Today's energy-efficient washers reduce water use and energy bills.

Replace a clothes washer when 1) a repair will cost more than half the price of a comparably equipped new appliance, and 2) a washer is more than seven years old. If you are in the market for a new clothes washer consider the following:[22]

- In selecting a washer load capacity, consider the household's largest routine load – larger capacity means fewer loads, saving time and energy
- Front-loaders use less energy and water, are usually gentler on clothes, and have faster spin speeds that drain more water out of laundry than regular top-loaders do thus shortening drying times and energy use
- Look for washers with the **Energy Star® label**

Front-loading washers are more expensive than top-loading washers, but in New Jersey rebates are available for units that meet Tier 3 **Energy Star®** standards which require a **Modified Energy Factor (MEF)** of 2.2 or higher and a maximum **Water Factor (WF)** of 4.4. There is no certification

Tips [EA92]

Consumer Report's Washer Tips:

1. Keep wash temperatures low. Reserve hot water for very special stains, like oil, that respond best to hot water, or for allergy-proofing bed linens. Also consider cold water detergents.
2. Wash full loads.
3. Use your washer's fastest spin speed. The more water your washer extracts from clothing at the end of the cycle, the less energy your dryer will need to dry the clothes

Incentive [EA92]

New Jersey **Energy Star®** Rebates

www.njcleanenergy.com/

Tips [EA93]

Find out how much your old refrigerator is costing you: www.energystar.gov/index.cfm?fuseaction=refrig.calculator

If you have an older unit with coils on its back side, vacuuming it once a year will help maintain optimal efficiency. Be sure to unplug the appliance before you do so.

Check the refrigerator door's **gasket** seal by closing the door on a dollar bill. Replace it if the bill falls out or can be easily removed without opening the door. Keep door gaskets clean of mold and mildew with mild detergent and water, not bleach.

Caution [EA93]

Household refrigerators and freezers manufactured before 1995 typically contain **chloro-fluorocarbon** (**CFC**) refrigerants - ozone-depleting substances (ODS) that are also potent greenhouse gases. The U.S. **EPA** provides guidance on the safe disposal of refrigerated house-hold appliances. www.EPA.gov/ozone/title6/608/disposal/household.html

Caution [EA94]

Most dishwasher detergents con-tain **phosphates** that may harm the environment by promoting algae growth. Consumer Reports has information on eco-friendly brands that clean well without using **phosphates**.

Caution [EA95]

When installing a gas range or oven, make sure to properly vent the area since you are introduc-ing combustible gas into your home.

for dryers, but a unit with a moisture sensor that turns off automatically when clothes are dry saves money and energy.

Select an energy-efficient refrigerator [EA93]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Refrigerators consume more electricity than any major kitchen appliance. Energy efficient refrigerators like **Energy Star**® models are about 40 percent more efficient than refrigerators built before 2001, and 50 percent more efficient than those built before 1993. If an existing refrigerator is more than 10 years old, consider upgrading to a refrigerator that meets or exceed **Energy Star**® standards as a new refrigerator with an **Energy Star**® label uses at least 20 percent less energy than one required by current federal standards.

Size, options and freezer compartment configurations affect energy use. A larger unit may be **Energy Star**®certified, but a smaller unit may still use less energy, so choose the smallest refrigerator that appropriately meets household needs. Features (such as water dispensers) use energy, so fewer features mean both greater energy efficiency and a lower likelihood of repairs. Top freezer models are generally more energy efficient than side-by-side models. Leave room around the unit for proper air flow around the cooling coils to ensure peak efficiency. Maintaining the unit is also important.

Choose an energy-efficient dishwasher [EA94]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Most dishwasher energy use goes toward heating water, however, today's high-efficiency dishwashers use as little as three gallons of water thanks to sensors, high-efficiency pumps, and improved filtration. The expected life of a dishwasher is 9-12 years, and the payback period for a new dishwasher is long, but studies suggest it is more sensible to replace a dishwasher that is more than six years old rather than pay for repairs. Look for dishwashers the carry the **Energy Star**® label, which are over 40 percent more energy-efficient than the minimum government standards.

Install energy-efficient cooking appliances [EA95]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Cooking itself does not contribute significantly to overall home energy use, but preheating does, making it sensible to invest in an energy-efficient model. When shopping for new cooking appliances or remodeling the kitchen, consider making a fuel switch since running gas pipes, vents, and electrical connections will influence the layout of the kitchen. Consider cooking preferences and local gas and electric rates. If another appliance such as a furnace, clothes dryer, or water heater is also on a switch list, take this into consideration when you look at placement and installation costs.

In general, electric ranges and ovens are more efficient than gas units. The most efficient ovens are convection ovens that cook by circulating hot air around the food, using only one-third as much energy to operate as conventional ovens. They produce further savings through reduced cooking times because the food is more evenly exposed to heat. Among electric ranges, induction models may cost more but they are also the most efficient.

In terms of gas units, look for electronic or thermal igniters instead of standing pilot lights. For smaller meals, consider using a microwave oven or a toaster oven that require less energy than a large oven. Self-cleaning gas or electric ovens are more efficient because they have more insulation than non-self cleaning models.

Select energy-efficient office equipment [EA99]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Today there are about 18 million home-based business owners and 24 million telecommuters.[23] Working from home eliminates commute times and transportation-related emissions, but it contributes to higher electricity bills to power office equipment and lighting. In fact, small electronic devices alone account for 16 percent of an average home's energy bill. Office equipment that has earned the **Energy Star®** label uses less energy to perform regular tasks and automatically enter a low-power mode when not in use, thereby reducing **phantom loads**. Up to 75 percent of the electricity these units consume occurs while these devices are turned off.[24] When buying new office equipment, consider both the standby and the operating power consumption.

Energy Star® ratings are available for computers, monitors, printers, scanners, copiers, fax machines, multi-function devices (machines that combine printing, scanning, and faxing), lighting, cordless phones, answering machines, audio equipment, and room air conditioners.

Tips [EA99]

Energy-saving features, such as sleep mode, can be deactivated by users; homeowners should not disable energy conservation features.

Consider on-site renewable energy [EA102]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A		INITIAL COST: $$$	
RESOURCE CONSERVATION:	AIR QUALITY: N/A		DIFFICULTY LEVEL:	

Ongoing advances in solar and geothermal technologies coupled with broader government financial incentives have made on-site renewable energy increasingly more feasible for the homeowner. Providing some or all of the home's energy from on-site renewable sources is an excellent way to not only significantly reduce utility bills, but also decrease one's reliance on and consumption of traditional fossil fuel energy sources.

Due to the increasing number of incentives for solar equipment, a homeowner can install a **photovoltaic** array with smaller up-front costs and a quicker payback period. New Jersey maintains a **Solar Renewable Energy Certificate** program that allows participants to receive sellable credits for the energy that they produce; each time a system generates 1000 kWh of electricity, a **SREC** credit is issued to the program participant.[25] Also, all equipment related to solar energy—including **passive solar** equipment—is eligible for sales tax exemption in the state.[26]

Another option for on-site energy production is the implementation of a solar water heating system. Solar water heaters can be either passive or active; passive systems are generally less expensive but not as efficient as active ones.[27] In New Jersey, a solar water heater would need to be used in conjunction with a traditional water heating system for cloudy days and winter months.

Geothermal technologies take advantage of relatively constant underground temperatures by pumping cooler air in the summer and warmer air in the winter to the surface. One of the more common applications of geothermal technology for homeowners is **ground source heat pumps** (**GSHPs**). Properly designed and installed **GSHPs** can provide efficient, clean, and renewable heating and cooling for homes. The U.S. Department of Energy calculates a payback period for individual geothermal systems of five to ten years from decreased energy costs.[28] The Resources section contains a link to the International Ground Source Heat Pump Association's website, which maintains a database of accredited geothermal heat pump installers.

Tips [EA102]

Use NREL's PVWatts™ calculator to determine the potential energy production and cost savings of installing a PV array.

www.nrel.gov/rredc/pvwatts/

Incentive [EA102]

Many of the federal incentives have been expanded through the February 2009 American Recovery and Reinvestment Act (the "stimulus package"). This includes a rebate for 30 percent of the cost of qualifying photovoltaic arrays, solar water heaters, and **GSHPs**.

Building Envelope

Conduct a Home Performance Audit and diagnostic tests [IPD2, EA51-54]

Resources:

New Jersey Clean Energy Program – Home Performance with Energy Star®

www.njcleanenergy.com/residential/home/home

Home Energy Analysis – Free Online Tool

www.njcleanenergy.com/residential/tools-and-resources/home-energy-analysis/home-energy-analysis

U.S. Department of Energy: Do-It–Yourself Home Energy Audit

www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170

USEPA Energy Star® Home Energy Yardstick

www.EnergyStar.gov

Alliance to Save Energy Home Energy Checkup and Audit

www.ase.org

U.S. Department of Energy: Detecting Air Leaks

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11250

New Jersey Office of Clean Energy, Rebates and Promotions

www.njcleanenergy.com/main/rebates-and-promotions/rebates-and-promotions

USEPA Energy Star®, Thermal Bypass Inspection Checklist

www.EnergyStar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

Affordable Housing Design Advisor - Thermal Bypass Checklist (video tutorial)

www.designadvisor.org/

References:

[1] **U.S. Department of Energy: Blower Door Tests**

www.energysavers.gov

Install or upgrade insulation [EA49]

Resources:

USEPA - Current Best Practices for Vermiculite Attic Insulation - May 2003

www.EPA.gov/Asbestos/pubs/insulation.html#What

U.S. Department of Energy: Insulation

www.eere.energy.gov/consumer/tips/insulation.html

USEPA Energy Star® Program

www.EnergyStar.gov

Energy Trust of Oregon, Home Energy Solutions, Weatherization Specification Manual Attic Insulation

www.energytrust.org/TA/hes/weatherization/attic.html#at37

U.S. Department of Energy: Seal Air Leaks and Save Money, Fact Sheet

www.eere.energy.gov/buildings/publications/pdfs/building_america/26446.pdf

U.S. Department of Energy: Radiant Barriers

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11680

USEPA Energy Star®, Guide to Do It Yourself Sealing and Insulating

www.EnergyStar.gov/ia/partners/publications/pubdocs/DIY_Guide_May_2008.pdf

References:

[2] **Iowa Energy Center. 2009. Home Tightening, Insulation and Ventilation. Home Series Booklets**

www.energy.iastate.edu/homeseries/downloads/HomeSeries1.pdf

[3] **U.S. Department of Energy. 2008. Insulation Fact Sheet**

www.ornl.gov/sci/roofs+walls/insulation/ins_02.html

[4] **Toolbase Services: Alternative Insulation Materials**

www.toolbase.org/Technology-Inventory/walls/sprayed-foam-insulation

[5] **U.S. Department of Energy: Sprayed-Foam and Foamed-In-Place Insulation**

www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11700

[6] **U.S. Department of Energy: Radiant Barriers**

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11680

Air seal to reduce infiltration [IDP55]

Resources:

The Family Handyman: Insulate Basement Rim Joists

www.rd.com/familyhandyman/content/57548/

USEPA Energy Star® Methodology for Estimated Energy Savings from Cost-Effective Air Sealing and Insulating

www.EnergyStar.gov/index.cfm?c=home_sealing.hm_improvement_methodology

Oikos, Rim Joists

www.oikos.com/library/airsealing/rim_joists.html

The Best Way to Insulate a Rim Joist, Stop Energy Losses With A Spray-Foam Kit, Isaac Savage

www.taunton.com/finehomebuilding/PDF/Free/021189072.pdf

U.S. Department of Energy: Insulation and Air Sealing

www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11220

USEPA EnergyStar. 2008. A Do-It-Yourself Guide to Sealing and Insulating with Energy Star®

www.energystar.gov/index.cfm?c=diy.diy_index

Iowa Energy Center. 2009. Home Tightening, Insulation and Ventilation. Home Series Booklets

www.energy.iastate.edu/homeseries/downloads/HomeSeries1.pdf

References:

[7] **Partnership for Advancing Technology in Housing (PATH). 2008. Energy Efficient Rehab Advisor – Air Sealing**

www.rehabadvisor.pathnet.org/sp.asp?id=9715

Weatherstrip doors and windows [EA58]

Resources:

Weatherstripping a wooden door

www.rd.com/18170/article18170.html

Lowe's How To: Weatherstripping Windows and Doors:

www.lowes.com/lowes/lkn?action=howTo&p=Improve/Weatherstripping.html

Home Tips: Options for Weatherstripping Windows

www.hometips.com/content/**weatherstrip**_intro.html

How to install Weatherstripping

home.howstuffworks.com/how-to-apply-weatherstripping2.htm

Applying permanent weatherstripping

www.easy2diy.com/cm/easy/diy_ht_3d_index.asp?page_id=35758373

U.S. Department of Energy: Weatherstripping

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11280

Upgrade or replace existing windows [EA56/59]

Resources:

Building Science.com

www.buildingscience.com/bsc

Efficient Windows Collaborative. Fact Sheet: Selecting Energy-efficient Windows in New Jersey

www.efficientwindows.org/factsheets/Newpercent20Jersey.pdf

American Council for an Energy-efficient Economy: ACEEE Consumer Resources

www.aceee.org/Consumer/index.htm

Build Wisely: Moisture Proof Barrier

www.buildwisely.com/moisture-proof-barrier.html

U.S. Department of Energy Energy Efficiency and Renewable Energy Windows

www.eere.energy.gov/consumer/tips/windows.html

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13310

GBlist: Environmental windows

www.ibiblio.org/london/renewable-energy/mailarchives/greenbuilding2/msg01067.html

Home Energy Magazine Online September/October 1997, Creating Windows of Energy-Saving Opportunity

www.homeenergy.org/archive/hem.dis.anl.gov/eehem/97/970908.html

The National Fenestration Rating Council (NFRC), Fenestration Facts

www.NFRC.org/fenestrationfacts.aspx

Lowe's, Curing Indoor Condensation Problems

www.lowes.com/lowes/lkn?action=howTo&p=Repair/IndrConden.html

References:

[8] **Journal of Light Construction June 2008, A Close Look at Common Energy Claims, Martin Holladay as seen on**

www.ecohomemagazine.com/energy-efficient-design/a-close-look-at-common-energy-claims.aspx

Provide moisture management strategies [IDP24]

Resources:

Sustainability of the Building Envelope, Rob Bolin, PE

Syska Hennessy Group May 2008

www.wbdg.org/resources/env_sustainability.php

The Energy & Environmental Building Association

www.eeba.org/index.html

Building Science Consulting, Read This Before Your Design, Build or Renovate

www.buildingscienceconsulting.com/resources/mold/Read_This_Before_You_Design_Build_or_Renovate.pdf

Build Wisely, Moisture Proof Barrier

www.buildwisely.com/moisture-proof-barrier.html

Use appropriate window glazing [EA60]

Resources:

Building Science

www.buildingscience.com/bsc/

Efficient Windows Collaborative

www.efficientwindows.org/index.cfm

American Council for an Energy-efficient Economy: ACEEE Consumer Resources

www.aceee.org/Consumer/index.htm

Build Wisely: Moisture Proof Barrier

www.buildwisely.com/moisture-proof-barrier.html

Architecture Week, Glazing for Daylight by Gregg D. Ander, FAIA

www.architectureweek.com/2004/0211/building_1-1.html

Whole Building Design Guide, Windows and Glazing by Gregg D. Ander, FAIA

www.wbdg.org/resources/windows.php

How to Glaze Old Windows - Step By Step Guide

www.diythisnthat.com/2008/08/05/glazing-old-windows-step-by-step-guide/

The Natural Handyman, Window Glazing and Glass Replacement

www.naturalhandyman.com/iip/infwindows/infgla.html

U.S. Department of Energy: Windows

www.eere.energy.gov/consumer/tips/windows.html

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13310

GBlist: Environmental windows

www.ibiblio.org/london/renewable-energy/mailarchives/greenbuilding2/msg01067.html

The National Fenestration Rating Council (NFRC), Fenestration Facts

www.NFRC.org/fenestrationfacts.aspx

Upgrade existing exterior door [EA57]

Resources:

The sustainable entrance

www.entrepreneur.com/tradejournals/article/181772176_2.html

Day Light and Natural Air Flow

www.smgreen.org/Content/envelope/envairflow.html

National Fenestration Rating Council

www.NFRC.org/

Better Homes, Installing Door Hinges and Locksets

www.bhg.com/home-improvement/exteriors/doors/installing-door-hinges-and-locksets/

Install window shading system [EA62]

Resources:

Lawrence Berkeley National Laboratory: Shading Strategy

www.windows.lbl.gov/daylighting/designguide/section5.pdf

PATH Tech Set 4: Energy-Efficient Lighting

www.pathnet.org/sp.asp?id=16574

Consumerenergycenter.org, Windows, Shades Awnings

www.consumerenergycenter.org/home/windows/shades_**awnings**.html

U.S. Department of Energy: Landscape Shading

www.eere.energy.gov/consumer/your_home/landscaping/index.cfm/mytopic=11940

Install a durable wall cladding [MR119]

Resources:

Wall cladding

www.buildinggreen.com

Toolbase Services: Tech Set 2 - Durable Building Envelope

www.toolbase.org

References:

[9] **Lead paint was banned in 1978, but houses painted prior to that date have paint with a high lead content.**

Provide a durable and reflective roof [MR120]

Resources:

USEPA – Cool Roofs

www.EPA.gov/heatisland/mitigation/coolroofs.htm

Heat Island Group: Lawrence Berkeley National Laboratory

www.eetd.lbl.gov/heatisland/

USEPA Energy Star®: Reflective Roof Products

www.EnergyStar.gov/index.cfm?c=roof_prods.pr_roof_products

The Cool Metal Roofing Coalition

www.coolmetalroofing.org/index.htm

HVAC

Follow standards for mechanical design [EA63]

Resources:

Air Conditioning Contractors of America (ACCA)

www.acca.org/

HVAC Calculations

www.hvacloadcalculations.com/

USEPA Energy Star®/ACCA Quality Installation Standards

www.acca.org/quality/

The Engineering Toolbox - Cooling Loads

www.engineeringtoolbox.com/latent-sensible-cooling-load-d_245.html

Provide controls and zoning for HVAC [EA64]

Resources:

U.S. Department of Energy: Thermostats and Control Systems

www.eere.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

California Energy Commission Consumer Energy Center, Central HVAC

www.consumerenergycenter.org/home/heating_cooling/heating_cooling.html

HVAC Control Tutorial by Jeff Fisher

www.hometech.com/learn/HVAC.html#zoned

U.S. Department of Energy, Best Practices Guide for Residential HVAC retrofits

http://ducts.lbl.gov/HVACRetrofitguide.html

U.S. Department of Energy: Space Heating and Cooling

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12300

Use ceiling fans for natural ventilation [EA65]

Resources:

U.S. Department of Energy: Ventilation

www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12351

Forget AC! Cool Your Home Naturally by Carol Venolia and Kelly Lerner, Mother Earth News Homes: Guide to Affordable and Sustainable Building, Spring 2008.

www.MotherEarthNews.com

U.S. Department of Energy: Summer Energy Savers

www.energy.gov/4242.htm

Rocky Mountain Institute - Home Cooling

www.rmi.org/sitepages/pid208.php

USEPA Energy Star®

www.EnergyStar.gov/index.cfm?c=ceiling_fans.pr_ceiling_fans

Select high-efficiency HVAC equipment [EA66]

Resources:

California Energy Commission Consumer Energy Center, Central HVAC

www.consumerenergycenter.org/home/heating_cooling/heating_cooling.html

USEPA Energy Star®: Heat & Cool Efficiently

www.EnergyStar.gov/index.cfm?c=heat_cool.pr_**HVAC**

USEPA Energy Star® Guide to Energy-efficient Heating and Cooling

www.EnergyStar.gov/ia/products/heat_cool/GUIDE_2COLOR.pdf

The Consortium for Energy Efficiency (CEE) and the Air-Conditioning and Refrigeration Institute (ARI) online database

www.ceedirectory.org/ceedirectory/pages/cee/ceeDirectoryMain.aspx

References:

[10] **American Council for an Energy-Efficient Economy**

www.aceee.org/consumerguide/heating.htm

[11] **Change for the Better with Energy Star®, Stewardship for the Earth**

www.EnergyStar.gov/ia/business/small_business/EnergyStarCongregationsHandout.pdf

Install programmable thermostats [EA67]

Resources:

Toolbase Services: Programmable Thermostats

www.toolbase.org/TechInventory/TechDetails.aspx?ContentDetailID=801&BucketID=6&CategoryID=6

USEPA Energy Star®: Programmable Thermostats

www.EnergyStar.gov/index.cfm?c=thermostats.pr_thermostats

U.S. Department of Energy: Thermostats and Control Systems

www.eeregov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12720

HVAC Control Tutorial by Jeff Fisher

www.hometech.com/learn/HVAC.html#zoned

Conduct duct tightness test [EA68]

Resources:

U.S. Department of Energy: Ducts

www.eere.energy.gov/consumer/tips/ducts.html

Southface Energy Institute - Blower Door and Duct Blaster Testing

www.southface.org/web/resources&services/publications/factsheets/22blowdoor.pdf

Why Test Ducts by Jim Fleming

www.energyrater.biz/Why_test.htm

U.S. Department of Energy - Best Practices Guide for Residential HVAC retrofits

http://ducts.lbl.gov/HVACRetrofitguide.html

Maintain HVAC systems [EA69]

Resources:

Whole Building Design Guide: Plan the Commissioning Process

www.wbdg.org/project/plan_comm_process.php

USEPA Energy Star®, Quality Installation for HVAC

www.EnergyStar.gov/ia/home_improvement/PHEE_InstallationAC_final.pdf

Seal and insulate HVAC system [EA70]

Resources:

USEPA Energy Star® Thermal Bypass Inspection Checklist

www.EnergyStar.gov/ia/partners/bldrs_lenders_raters/downloads/Thermal_Bypass_Inspection_Checklist.pdf

U.S. Department of Energy: Best Practices Guide for residential HVAC retrofits

www.ducts.lbl.gov/HVACRetrofitguide.html

Why Test Ducts by Jim Fleming

www.energyrater.biz/Why_test.htm

U.S. Department of Energy: Insulation and Ducts

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11500

References:

[12] **U.S. Department of Energy: Insulation and Ducts**

www.eere.energy.gov/consumer/your_home/insulation_airsealing/index.cfm/mytopic=11500

Make sure ductwork is clean [EA71]

Resources:

USEPA: Should You Have Your Ducting Cleaned?

www.EPA.gov/iaq/pubs/airduct.html#whatpercent20ispercent20airpercent20ductpercent20cleaning

National Air Duct Cleaners Association

www.nadca.com/

Make sure ductwork is clean [EA71]

Resources:

USEPA, Should You Have your Ducting Cleaned

www.EPA.gov/iaq/pubs/airduct.html#whatpercent20ispercent20airpercent20ductpercent20cleaning

NADCA Code of Ethics

www.nadca.com/consumerinformation/codeofethics.aspx

Lighting and Electrical

Provide daylighting [EA83]

Resources:

U.S. Department of Energy: Window Overhangs

www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13570

Southface: Passive Solar Design

www.southface.org/web/resources&services/publications/technical_bulletins/PSD-Passivesolarpercent2000-790.pdf

Low Impact Living - Install Solar Tube Lighting

www.lowimpactliving.com/blog/2008/01/14/how-to-install-solar-tube-light/

Provide appropriate lighting [EA84]

Resources:

New Jersey Clean Energy Program - Energy Efficiency Store for New Jersey Residents

www.energyfederation.org/njcleanenergy/default.php

Rensselaer Polytechnic Institute- Lighting Research Center

www.lrc.rpi.edu/

References:

[13] **U.S. Department of Energy: A Consumer's Guide: Lighting**

www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11980

Install energy-efficient lighting [EA85]

Resources:

USEPA Energy Star® - Light Bulbs and Fixtures

www.EnergyStar.gov/index.cfm?c=lighting.pr_lighting

USEPA, Mercury – Spills, Disposal and Site Cleanup

www.EPA.gov/mercury/spills/index.htm

Toolbase Services: LED Lighting

www.toolbase.org/Technology-Inventory/Electrical-Electronics/white-LED-lighting

Provide appropriate indoor lighting controls [EA90]

Resources:

Whole Building Design Guide - Electric Lighting Controls by David Nelson, AIA, 05-14-2008

www.wbdg.org/resources/electriclighting.php

Green Living Ideas - Energy Saving Light Control Systems

www.greenlivingideas.com/lighting/energy-saving-light-control-systems.html

U.S.Department of Energy: Lighting

www.eere.energy.gov/consumer/tips/lighting.html

References:

[14] **U.S. Department of Energy: Lighting**

www.eere.energy.gov/consumer/tips/lighting.html

Plumbing

Insulate water heater [EA80]

Resources:

Lowe's Making Your Home More Energy-Efficient

www.lowes.com/lowes/lkn?action=howTo&p=Improve/HomeEnergyEfficient.html#1

U.S. Department of Energy Energy Efficiency and Renewable Energy, Water Heating

www.eere.energy.gov/consumer/tips/water_heating.html

Wrapping the water heater video in English and Spanish

www.pnm.com/customers/wx.htm

Charles and Hudson, How to Insulate Your Hot Water Tank by Murray Anderson

www.charlesandhudson.com/article?PLUCKarticleId=732a4e15-27b1-39a3-dd03-02c458b44ae4&PLUCKtitle=How_to_Insulate_Your_Hot_Water_Tank&PLUCKmediaType=Text&PLUCKauthor=Murraypercent20Anderson&PLUCKwhichPage=articlePage

References:

[15] **U.S. Department of Energy Energy Efficiency and Renewable Energy, Water Heating**

www.eere.energy.gov/consumer/tips/water_heating.html

Insulate water hot water pipes [EA81]

Resources:

Lowe's Making Your Home More Energy-Efficient

www.lowes.com/lowes/lkn?action=howTo&p=Improve/HomeEnergyEfficient.html#1

U.S. Department of Energy: Water Heating

www.eere.energy.gov/consumer/tips/water_heating.html

Utilize Solar Water Heating [EA101]

Resources:

Solar Site Assessment tool

www.howto.altenergystore.com/Articles-not-yet-activated/Tools-for-a-Successful-Solar-Electric-Install/a90/

New Jersey Office of Clean Energy

www.njcleanenergy.com/renewable-energy

Southface Institute, Using the Sun to Heat Water

www.southface.org/web/resources&services/publications/factsheets/residential_solar_water111804.pdf

U.S. Department of Energy: Consumer's Guide to Renewable Energy and Energy Efficiency

www.eere.energy.gov/consumer/

Toolbase Services: Solar Water Heaters

www.toolbase.org/Technology-Inventory/Plumbing/solar-water-heaters

References:

[16] **Toolbase, Solar Water Heaters**

www.toolbase.org/Technology-Inventory/Plumbing/solar-water-heaters

[17] **West, Larry Benefits of Solar Water Heaters**

environment.about.com/od/renewableenergy/a/solar_water_hea.htm

[18] **Southface Institute, Using the Sun to Heat Water**

www.southface.org/web/resources&services/publications/factsheets/residential_solar_water111804.pdf

[19] **U.S. Department of Energy: Consumer's Guide to Renewable Energy and Energy Efficiency"**

www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12870

Reconfigure plumbing for efficiency [EA77]

Resources:

Toolbase Services: Resource Efficient Plumbing

www.toolbase.org

HGTVPRO- Home Run Plumbing - www.hgtvpro.com

PEX Information - www.pexinfo.com

References:

[20] **James Lyons. 2009. Promising Plumbing. BUILDER. January 2009**

www.builderonline.com

Equipment

Select high-efficiency clothes washer [EA92]

Resources:

Consortium for Energy Efficiency

www.cee1.org

USEPA Energy Star®

www.EnergyStar.gov

References:

[21] **American Water Works Association Research Foundation**

www.awwa.org/

[22] **Consumer Reports, Greener Choices**

www.greenerchoices.org/

Select an energy-efficient refrigerator [EA93]

Resources:

Consortium for Energy Efficiency: Refrigerators

www.cee1.org/resid/seha/refrig/refrig-main.php3

USEPA Energy Star® - Refrigerators

www.EnergyStar.gov/index.cfm?c=refrig.pr_refrigerators

N.J. State Website – Information on Energy Star® Appliances

www.state.New Jersey.us/globalwarming/help/

Choose an energy-efficient dishwasher [EA94]

Resources:

USEPA Energy Star® - Dishwashers

www.EnergyStar.gov/

Consortium for Energy Efficiency : Home Appliances

www.cee1.org/resid/seha/seha-main.php3

Install energy-efficient cooking appliances [EA95]

Resources:

Consumer Guide to Home Energy Savings: Cooking

www.aceee.org/consumerguide/cooking.htm

Select energy-efficient office equipment [EA99]

Resources:

American County for an Energy Efficient Economy: Consumer Guide to Home Energy Savings

www.aceee.org/consumerguide/electronics.htm

USEPA Energy Star®: Home Electronics

www.energystar.gov

References:

[23] **Alliance to Save Energy**

www.ase.org/

[24] **U.S. Department of Energy: Home Office and Home Electronics**

www.eere.energy.gov/consumer/tips/home_office.html

Consider on-site renewable energy

Resources:

National Renewable Energy Laboratory: PV Watts™

www.nrel.gov/rredc/pvwatts/

U.S Department of Energy., Database of State Incentives for Renewables & Efficiency (DSIRE): New Jersey

www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=New Jersey

N.J. Solar Renewable Energy Credit Program

www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-**srec**/new-jersey-solar-renewable-energy

USEPA Energy Star®: Federal Tax Credits for Energy Efficiency

www.energystar.gov/index.cfm?c=products.pr_tax_credits

U.S. Deparment of Energy: Solar Water Heaters."

www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850

U.S. Deparment of Energy: Geothermal Heat Pumps

www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

International Ground Source Heat Pump Association

www.igshpa.okstate.edu/

References:

[25] **New Jersey Solar Renewable Energy Certificate Program**

www.njcleanenergy.com/renewable-energy/programs/solar-renewable-energy-certificates-**srec**/new-jersey-solar-renewable-energy

[26] **DSIRE: New Jersey Solar Energy Sales Tax Exemption**

www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ01F&re=1&ee=**1**

[27] **U.S. Deparment of Energy: Solar Water Heaters**

www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12850

[28] **U.S. Department of Energy: Geothermal Heat Pumps**

www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

Case Study

Location of Project: Yardley, Pa
Homeowners: Parkland Properties, LP, Thomas G Wells, Member
Interior Designer: Emily K. Buehrle, EKB Designs
General Contractor: Thomas G Wells Construction, L.L.C.
Area Affected: 3200 sq feet

Overview and Scope

This two-stage home renovation increases energy efficiency, improves indoor air quality, and utilizes sustainable building products. The first stage was a remodel of the kitchen, increasing its size from 123 square feet to 180 square feet. The second stage began with a comprehensive Energy Audit of the **building envelope** followed by remediation of air **infiltration** and insulation deficiencies, replacement of the existing oil furnace with a **heat pump**, and a post-remediation Energy Audit. The overall goal of the contractor was to make the interior space comfortable and visually appealing while ensuring easy maintenance and energy efficiency.

Design Approach

The house is a rental property that the owners intend to rent well into the foreseeable future. This will enable monitoring of energy consumption and equipment durability over an extended period. The contractor saw this as an opportunity to try out various sustainable building products and energy efficiency strategies. He looked at the products needed for the project (i.e., new counter tops) and evaluated various sustainable options that fit the criteria. He also used this opportunity to evaluate the feasibility of various energy upgrades, such as air sealing and insulating knee walls in crawl spaces. The interior designer, Emily Buehrle, has a strong background in space planning and sustainable building products. She assisted the homeowners to meet their goals of interior features, colors, and textures that would resonate with the home's future occupants.

Team and Process

Tom Wells and his crew did the majority of the framing, finishing, window installation, cabinetry installation, and painting, while various other parts of the project were subcontracted. Tom was the leader in designing the green aspects of this project, relying on input from Wes Carver Electrical Contractors and Rob Taurino of JA Smith Heating and Air Conditioning. Ted Inoue was invaluable as the energy auditor and system evaluator.

Finance

The total cost of the renovations without the standard contractor mark-up was approximately $81,000. This overall cost did not seem out of proportion to other traditional kitchen remodeling projects done by the contractor. For this project, budgeting generally came secondary to the project goals; more importantly, the team wanted to demonstrate the value of techniques and products of which the average contractor and homeowner may not be aware. These included bamboo cabinetry, recycled glass countertops, **low-VOC** paints, spray foam insulation, and a **heat pump** to replace the oil furnace. The roof needed to be replaced unexpectedly due to leaky skylights; an asphalt roof was chosen instead of a metal roof for budget reasons. After the work was performed, the entire interior of the house was repainted.

First cost savings were not achieved by utilizing the green products, but are realized when factoring in the reduced energy consumption costs, increased comfort level, and otential increase in resale value of the house. The contractor also benefited from increased focus on his company by potential clients interested in green remodeling.

Lessons and Trade-offs

The major surprise came during the Energy Audit, which highlighted the many parts of the house that had air **infiltration** and insulation issues. The contractor believes that making the house as "tight" as possible is the most important aspect of the green remodel. The biggest trade-offs came from the unexpected roof replacement.

"The kitchen remodel is the most appealing and dramatic change to the house, but I am personally most excited about the energy efficiency package we installed. We are looking forward to monitoring the energy usage per square foot to see how it compares to homes of similar size."

- Tom Wells

List of Green Strategies

Energy Conservation

- Replaced old windows with **low-E** windows
- Removed trim from the windows and installed minimal expanding foam in the gap around the windows
- Replaced oil furnace with high-efficiency **heat pump**
- Installed spray foam insulation in open walls and ceilings in the kitchen, crawl space, the basement band joist, and part of the roof **sheathing**
- Installed dense pack **cellulose** in the exterior walls and attic
- Installed **fiberglass batts** covered with rigid foam board in second floor knee walls
- Caulked the baseboards to the hard wood floor
- Replaced the light bulbs with **CFLs** in the bedrooms
- Installed **CFL** recessed lights and high-efficiency light fixtures with insulated boxes in the kitchen, dining room, and family room
- Installed **LED** under-cabinet lighting
- Put mastic on the **HVAC** ductwork seams

Water Conservation

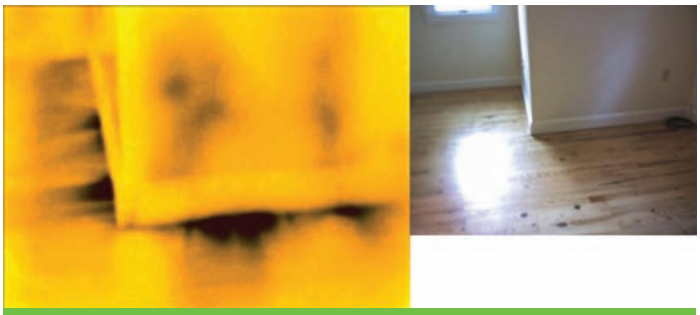
- Installed low-flow showerheads
- Utilized a kitchen faucet with a filtered water option

Indoor Air Quality

- Used **low-VOC** interior wall paints
- Used waterborne hardwood floor finishes

Sustainable Materials

- Installed recycled glass countertops and bamboo cabinetry with no added **formaldehyde** in the kitchen
- Installed a natural linoleum kitchen floor
- Used natural earth plaster and cork sustainable flooring in the mudroom
- Installed 50-year fiberglass architectural roof shingles



Infrared Image Visible Light

The bright yellow shows the hotter warm floor and insulation. The darker spots reveal the leaks from under the baseboard and the loss of heat through the studs.

Rear of home

Remodeled Kitchen

Case Study

Location of Project: Mill Hill Historic District, Trenton, New Jersey

Homeowners: John Hatch, David Henderson

Architect: W. David Henderson, R.A., HHG Development, LLC; John D. S. Hatch, AIA; Clarke Caton Hintz

General Contractor: Atlantis Historic Properties

Area Affected: 3,000 sq. ft.

Overview and Scope

The project is the major renovation of an 1887 row house in Trenton's Mill Hill Historic District. When purchased, the house had been vacant for a number of years and was in need of major rehabilitation, including structural repairs, window replacement, all new systems (electrical, plumbing, and **HVAC**), repairs to damaged walls, replacement of roof, and installation of insulation.

Design Approach

In keeping with their commitment to green practices the design team decided to implement as many sustainable strategies as possible while still preserving and restoring the historic character of the house. Since the house is located in a designated local, state, and national historic district, the local historic preservation commission reviewed certain work. This included the exterior windows and the installation of the solar panels. The new windows have insulated glass and are very efficient, but match the original arched windows quite closely. The Landmarks Commission approved them. Since the solar panels are located on a roof not visible from the street, the installation was also not an issue.

Team and Process

The homeowners and the designers are one and the same, so that relationship was easy to manage. Making this project as green as possible meant reaching out to various contractors and suppliers to get ideas and products for how to improve the efficiency and sustainability of the house.

Finance

Based on prior utility bills and estimated usage, the house is at least 25 percent more efficient so energy costs are significantly lower. In addition, the solar panels provide 75 percent of the electricity that is typically used. When more power is produced than used, it is sold back to PSE&G. Most of the electrical bills are only $5! In addition, the homeowner received various green power incentives through the state and federal governments, which also helped to reduce up-front costs. This has made the payback for the solar panels very quick.

Since the house needed such major renovations, it was a question of choosing the most energy- and water-efficient items throughout the remodeling process. These may have cost slightly more than the alternatives, but were considered in the financing for the overall project.

Lessons and Trade-offs

The project team and homeowner were surprised at the affordability of the green strategies. If they had to do it all over again, they would go even further with the sustainable and energy-efficient strategies, even if they cost more. In the future, the payback will only get shorter!

"Making projects energy and water efficient while using sustainably produced products is only getting easier with time. In addition, it's getting more and more cost effective. While people don't normally associate historic preservation with sustainable design, reusing existing structures is actually one of the most sustainable actions that anyone can take. There is a tremendous amount of energy and carbon stored in the historic building's structure, energy that would be wasted if the building were demolished and rebuilt. The greenest home is the one that's already built!"

- John D. S. Hatch

Before remodel

After remodel

List of Green Strategies

Energy Conservation

- Installed photovoltaics provide more than 75 percent of the electrical requirements
- Installed high-efficiency **heat pump**: 17 **SEER**
- Purchased new combination washer and condensing dryer that utilizes a closed system to remove moisture from clothes, saving energy and eliminating the need for outside venting
- Utilized **Energy Star®** appliances
- Installed R15 insulation added to most walls, R30 to roof; as the original walls and roof had no insulation
- Replaced all light bulbs, inside and out, with color corrected **compact fluorescent**
- Installed solar powered attic fan keeps air flowing in the attic to reduce condensation, heat build-up and energy costs
- Replaced or restored most of the original windows with historically accurate windows with insulated glass and low-air **infiltration**

Water Conservation

- Used ultra low flow toilets: 1 gallon per flush

Sustainable Materials

- Utilized reuse of most interior materials. Wood floors and plaster walls were kept wherever possible. Reused two claw foot tubs; wood moldings were either kept in place, or, if reconfiguring the space, were removed and reused
- Use materials that are historically appropriate (wood windows and doors, for instance) and are also sustainable

Roof-top solar panels

Solar powered attic fan

Before remodel

After remodel

Case Study

Location of Project: Princeton, New Jersey
Homeowners: Janet Black
Energy Auditor: GreenStreet Energies
General Contractor: GreenStreet Construction
Area Affected: 2,000 sq. ft.

Overview and Scope

This **weatherization** and energy upgrade to a two-story, late 19th/early 20th century colonial-style home included a comprehensive **Home Performance Audit** and implementation of energy-efficient recommendations by GreenStreet Energies, a home performance consulting service of GreenStreet Construction. An audit checklist and thermal-imaging scans were used to reveal leaks and sources of air **infiltration** and energy loss in the home. The tests revealed opportunities to add insulation and to seal up drafty areas around the windows and doors with weather stripping. **Spray polyurethane** foam was added under the first floor in between the basement ceiling beams, where no insulation or subfloor existed. GreenStreet also installed **storm doors**, **storm windows**, and **door sweeps**.

Design Approach

The homeowner, Janet Black, was introduced to GreenStreet Construction while attending a presentation they made at Design Within Reach, an interior design store located in Princeton, New Jersey. She approached GreenStreet and expressed her interests in greening her home. Working with the homeowner, GreenStreet carried out the Energy Audit and upgrades.

Team and Process

GreenStreet Energies provided a detailed Energy Audit report and recommended upgrades to correct the deficiencies that the audit uncovered. They subsequently were hired to perform all the energy work except for the installation of the spray foam insulation, which was performed by an insulation company. The whole project was completed in less than two months.

Finance

The total cost for the **Home Performance Audit** including energy work was about $5000, with an estimated payback period of three to four years. The project was completed very recently so the homeowner currently is waiting to see how the energy bills will be affected. The homeowner plans to reinvest her energy savings into future energy upgrades such as installing **storm windows** on the remaining second floor windows.

Lessons and Trade-offs

The antique floor had gaps between the floorboards, without any subfloor underneath. This presented a problem as the **spray polyurethane** foam could possibly foam up out of the basement into the living area. GreenStreet fixed the problem by doing a little prep work from the basement side to seal up most of the larger gaps so that the expanding foam insulation didn't come up through the floor.

"Every home is different. This brings a need for a collaborative between GreenStreet and the client in order to take full advantage of all the tools and information available to produce exactly what the client is looking for.

In the case of Janet Black's home, we found a situation unfortunately common in older houses - a beautiful antique floor with small gaps in between the floorboards was the only thing separating her first floor living space from her 40-45 degree basement. We realized that assumptions cannot be made about previous construction, whether it is as obvious and visible as this situation or something hidden deep within the construction of the house."

- Rees Keck, GreenStreet Energies

Added insulation in basement (before barrier)*

List of Green Strategies

Energy Conservation

- Installed spray foam insulation in areas lacking insulation, such as the basement ceiling*
- Added **storm windows** and weather stripping to all doors and windows to reduce air leakage
- Added **storm doors** and **door sweeps** to reduce drafts around existing entrances

Indoor Air Quality

- Installed **formaldehyde-free spray foam insulation***
- Used only non-toxic caulking and weather stripping materials

Resource Conservation

- Added **storm windows** and doors instead of replacing existing windows and doors, increasing their durability by adding a layer of protection from the elements

*Spray foam materials installed in walls or ceilings may present a fire hazard unless protected by an approved, fire-resistant thermal barrier with a finish rating of not less than 15 minutes as required by building codes. Rim joists/header areas in accordance with the IRC and IBC may not require additional protection. Foam plastic must also be protected against ignition by code-approved materials in attics and crawl spaces. See relevant Building Codes and www.iccsafe.org for more information.

Spray foam insulation in basement (before thermal barrier is added)*

Storm door installed to provide added protection

Case Study

Location of Project: Trenton, New Jersey

Developer: Isles Inc. and Tara Construction Management Corp.

Architect: Frank Russo, Shapiro Petrauskas Gelber

Contractor: Omega Corporation

Green Design Consultants: Lyle Rawlings, Advanced Solar Products, Inc. and Andy Shapiro, Vermont Energy Investment Corporation

Area Affected: 2 semi-detached, 1700 sq. ft. units

Overview and Scope

In an area of Trenton, New Jersey where many of the dwellings are vacant or in disrepair, the 22 semi-detached units of the Bellevue Court project have newly renovated interiors restoring façades to their original grandeur. Part of the larger project, the dwellings at 233-235 Bellevue Court have green technologies behind their traditional brick façades.

Spearheaded by the City of Trenton and developed by Isles Inc. and Tara Construction Management Corp, these two "**microload**" homes are projected to use 60 percent less energy than a code compliant home and 30 percent less energy than their **Energy Star**® neighbors.

Design Approach

The two 1700 square foot units have three bedrooms and two and one half baths. Sustainable and recycled materials were incorporated throughout the homes. To help provide exceptional air quality in these airtight homes, mechanical ventilation is provided using a **heat recovery ventilator** (**HRV**). The exhaust vents from each bathroom and kitchen are ducted to the **HRV** while fresh air from the **HRV** feeds into the return **plenum** of the furnace.

The real benefit in these houses is the dramatic reduction of their heating and **cooling loads** and the ability of these homes to meet a substantial part of those loads with renewable energy. Heating and cooling losses were reduced through the **building envelope** with highly insulated walls and windows and air sealing. Custom designed overhangs on the south wall of the "microload" homes block the high summer sun and allow for **passive solar heating** during the winter. The window glass was selected to allow solar heat to enter in winter. As a passive cooling strategy, a skylight with a manually operated crank was placed over the central stair to allow for warm inside air to move up and out of the house in summer. This also provides daylight in the area.

A 2.5 kW **photovoltaic** array on the roof is projected to offset close to 70 percent of the electric loads in the house. The system will be net metered, allowing unneeded solar-produced electricity to be sold back to the utility.

Team and Process

Responding to a need for affordable housing and eager to save the architecturally unique homes on Bellevue Court, the City of Trenton committed to bringing back the block. Isles Inc, and Tara Construction Management Corp were selected as the nonprofit/for-profit partnership for the project.

Finance

For the entire 22-unit Bellevue project, the development costs (including property acquisition, construction, professional services, developer's fees, and other costs) totaled $4.2 million. The units were donated by the City of Trenton, along with a $1 million grant. Additional funding for the project was provided through state and federal grant money.

Lessons and Trade-offs

Looking strictly at the energy usage of the two solar homes, the buildings are performing less efficiently than modeled. A few observations reveal interesting lessons.

Homeowner consumption is a major factor in the energy efficiency equation. Both of the owners are using electric heaters on the first floor, both have 240 kWh/year freezers in the basement and both have multiple televisions and other electronics with significant plug loads. One homeowner is utilizing an electric fireplace for heat that is placed near the home's thermostat. In addition, one of the homeowners always has shades drawn on the south facade, which was designed for direct solar gain "sun tempering." According to the homeowner, this primarily is for security and privacy reasons.

Also, a number of systems and certain features where not properly installed or balanced. Finally, the **PV** system on one home is being shaded by an adjacent home, creating less than optimum conditions for electric generation. These situations confirm the need for residential **commissioning**, particularly for complex integrated technologies found in high performance homes.

"Cellulose insulation was a change from the construction contractor's normal practices, but they were sold on the acoustic performance of the product. "When you close the outside door in these houses, it's like being in a sound-proof room."

- Omega Corporation

List of Green Strategies

Energy Conservation

- Installed highly efficient insulation in walls and ceilings
- Chose fiberglass frame double glazed **low-E** windows
- Carefully sealed all rough openings and basement ceilings
- Installed high-efficiency **HVAC** and water heating equipment
- Installed **Energy Star®** appliances throughout
- Installed a 2.5 kW rooftop **photovoltaic** array to provide a portion of the building's electricity needs

Water Conservation

- Installed dual-flush low water use toilets, low-flow showerheads, and low-flow faucets
- Created a **rainwater collection** system for gardening
- Planted drought-proof native plantings and grasses

Indoor Air Quality

- Used zero and **low-VOC** paints, caulks, finishes, and adhesives
- Purchased **formaldehyde-free** plywood kitchen cabinets
- Utilized a track-off mat system at the entryway
- Installed wood flooring and ceramic tile instead of carpeting
- Properly vented all occupied rooms
- Provided exhaust for all high-moisture areas

Sustainable Materials

- Reused and recycled many materials during construction
- Reused brick from the site for pervious paving
- Utilized **recycled content** plastic/wood lumber for porches and decks

Before After

Ducts sealed with mastic

Dining room hardwood floors

Green Products and Services

Introduction

The purpose of the Green Products and Services is to help homeowners navigate the market with some helpful tips on what to look for when shopping for a particular green home remodeling project. The Guide is organized by building system and lists the general products and services that pertain to remodeling tasks within that system. It includes features and applicable certifications to look for, as well as web links to more information on that product or service. Each item in the Guide also refers to the related REGREEN strategy IDs.

Please note that the New Jersey Green Home Remodeling Guidelines Version 1.0 do not endorse any particular brand or company. It is not the function of the Green Product and Service Guide to direct the consumer to a specific product, but rather to provide a resource to seek out an appropriate manufacturer or service provider to handle remodeling needs.

With the ever-increasing number of green products and services coming into the home remodeling market, finding the appropriate ones can be a challenge. Some manufacturers market products as "green" when in reality they are only marginally better for the environment or whose green features are neutralized by other aspects of their manufacturing or composition. This phenomenon is referred to as "greenwashing" and calls on consumers to seek out references and ensure the true extent of green value.

Product Certification Programs

That being said, there are several leading green product standards and certification programs that can help consumers identify products that meet predefined green criteria. The leading green product standards and programs include:

- Energy Star® - identifies efficient products that reliably deliver energy savings and environmental benefits
- WaterSense – identifies high performing, water efficient products and practices
- Cradle to Cradle - certifies products based on lifecycle of materials used to construct a product and the overall lifecycle of the product
- GreenGuard® Certification Program - certifies products and processes for their low chemical emissions and low toxicity
- Green Seal® - certifies products and practices for their low toxicity and overall environmental impact
- GreenSpec Directory - a published resource on environmentally preferable products
- Forest Stewardship Council (FSC)- certifies wood products coming from forests managed to meet social economic and ecological needs
- Sustainable Forestry Initiative (SFI) - certifies wood products coming from well-managed forests and responsible procurement practices
- National Fenestration Rating Council® (NFRC) - a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products

For more information on various certification programs currently in use by architects and designers see:

- the ecolibrary™matrix - www.thegreenstandard.org/documents/GGNC09_EcoLibCert.pdf
- Gaia Product Profile developed by The Green Standard™ - www.thegreenstandard.org/gaia.html

Two other reputable sources for green products and services are:

- Green Building Advisor that lists products from the GreenSpec Guide to Residential Building Materials www.greenbuildingadvisor.com/
- National Association of Home Builders (NAHB) Research Center - www.nahbrc.org/manufacturer/greenapproved/index.aspx

Product Standards for GreenSpec[1]

1. Products Made with Salvaged, Recycled, or Agricultural Waste Content
   a. Salvaged products
   b. Products with **post-consumer recycled content**
   c. Products with **pre-consumer recycled content**
   d. Products made with agricultural crop waste material

2. Products That Conserve Natural Resources
   a. Products that reduce material use
   b. Products with exceptional durability or low maintenance requirements
   c. Certified wood products
   d. Rapidly renewable products

3. Products That Avoid Toxic or Other Emissions
   a. Natural or minimally processed products
   b. Alternatives to ozone-depleting substances
   c Alternatives to hazardous products
   d. Products that reduce or eliminate pesticide treatments
   e. Products that reduce stormwater pollution
   f. Products that reduce impacts from construction or demolition activities
   g. Products that reduce pollution or waste from operations

4. Products That Save Energy or Water
   a. Building components that reduce heating and cooling loads
   b. Equipment that conserves energy and manages loads
   c. Renewable energy and fuel cell equipment
   d. Fixtures and equipment that conserve water

5. Products That Contribute to a Safe, Healthy Built Environment
   a. Products that do not release significant pollutants into the building
   b. Products that block the introduction, development, or spread of indoor contaminants
   c. Products that remove indoor pollutants
   d. Products that warn occupants of health hazards in the building
   e. Products that improve light quality
   f. Products that help noise control
   g. Products that enhance community well-being

Sources

[1] The online GreenSpec® Directory lists product descriptions for over 2,000 environmentally preferable products at www.buildinggreen.com

Alex Wilson."Building Materials: What Makes a Product Green?" EBN Volume 9, Issue 1 (revised January, 2006) www.buildinggreen.com/auth/article.cfm?fileName=090101a.xml

Weatherization and Energy

General

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Home Performance Audit	Save up to 30 percent on energy costs, increase the comfort, safety, and durability of your home. Contact N.J. Office of Clean Energy to find certified contractors.		N.J. Office of Clean Energy - Call 1-866-NJSMART or visit www.njcleanenergy.com/residential/programs/home-performance-energy-star/home-performance-energy-star-r N.J. Office of Clean Energy List of Certified Contractors www.njcleanenergy.com/misc/residential/certified-contractors	IDP2
Awnings	Purchase an awning or screen shade to install over your deck or patio to block direct sunlight and rain and save energy. Some units are retractable manually or mechanically.		Professional Awning Manufacturers Association www.awninginfo.com/ Awnings Today www.awningstoday.com/ LBL Shading Strategy www.windows.lbl.gov/daylighting/designguide/section5.pdf FSEC Window Orientation and Shading www.fsec.ucf.edu/en/consumer/buildings/homes/windows/ Awnings in Residential Buildings: The Impact on Energy Use and Peak Demand www.awninginfo.org/images/stories/documents/pdf/energystudy22007.pdf	EA62
Native plants, species, and trees	Plant native plants and trees to provide shade and reduce watering needs.		New Jersey Agricultural Experiment Station, Rutgers University www.njaes.rutgers.edu/ If Plants Could Talk – A Gardening Television Series, Rutgers University www.ifplantscouldtalk.rutgers.edu/ Conserving Energy with Landscaping www.ext.vt.edu/pubs/envirohort/426-712/426-712.html	EA62
Roofing	Install a "cool roof" with highly reflective material such as lightly colored shingles and/ or metal. Metal roofing materials are highly reflective, durable, recyclable, usually composed of recycled materials, and resist against harsh weather and fire.	ENERGY STAR	USEPA Energy Star®: Reflective Roof Products www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products Metal Roofing Alliance www.metalroofing.com/ USEPA – Heat Island Effect www.epa.gov/hiri/mitigation/coolroofs.htm	MR120

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Spray foam insulation	Consider spray foam insulation such as open-cell foam which allows vapor to pass through and is R-4 per inch, and closed-cell foam which slows the passing of vapor and is R-6 to R-7. Look for products that are flame retardant, formaldehyde-free, contain no VOCs, and use a non-ozone depleting blower agent.		Taunton - The Best Way to Insulate a Rim Joist" by Isaac Savage www.taunton.com/finehomebuilding/PDF/Free/021189072.pdf U.S. Department of Energy- Insulation Fact Sheet www.ornl.gov/sci/roofs+walls/insulation/ins_08.html Air Seal and Insulate with Energy Star® www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_sealing	IDP55
Windows	Several types of window glazing are gas filled, heat-absorbing tint, insulated (double-glazed, triple-glazed), low emissivity (low-E) coatings, reflective coatings, and spectrally selective coatings. Select Windows that are Low-E have U-factor of less than 0.36, and a Solar Heat Gain Coefficient (SHGC) of less than 0.39.	ENERGY STAR NFRC National Fenestration Rating Council	National Fenestration Rating Council www.nfrc.org/ U.S. Department of Energy –A Consumer's Guide to Energy Efficiency and Renewable Energy: Types of Window Glazing or Glass www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13390 Efficient Windows Collaborative www.efficientwindows.org USEPA Energy Star® – High Performance Windows www.energystar.gov/ia/new_homes/features/HighPerformanceWindows1-17-01.pdf	EA60/56/59
HVAC				
Air conditioning system	Select an Air Conditioning System that meets or exceeds Energy Star® standards. Choose a model with a Seasonal Energy Efficiency Ratio (SEER) of at least 14 for ductless mini-split or central air conditioning.	ENERGY STAR	New Jersey Clean Energy Program www.njcleanenergy.com The Consortium for Energy Efficiency (CEE) and the Air-Conditioning and Refrigeration Institute (ARI) online database www.ceedirectory.org American Council for an Energy-Efficient Economy - Consumer Resources www.aceee.org/Consumer/index.htm HARDI Architect, Builder & Remodeler Good Practice Guide www.hardinet.org/pdf/GdPractGuide2.pdf	EA66
Duct mastic/ sealant	Seal ducts with products that have low to zero VOCs. Choose products that are Energy Star® and GreenGuard certified.	ENERGY STAR GREENGUARD Indoor Air Quality Certified	USEPA Energy Star® www.energystar.gov/ GreenGuard www.greenguard.org/	EA68

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Fan: attic	Install an attic fan that meets or exceeds Energy Star® standards. Choose models with features including self flash, curb mount, and gable mount for pitched or flat roof applications. Installation flexibility allows for the retrofitting of the base assembly of any 12" turbine fan if need be.		Energy Star® www.energystar.gov BuildingGreen.com www.Buildinggreen.com Home Ventilating Institute - Home Ventilation & Indoor Air Quality Guide www.hvi.org/resourcelibrary/publications.html	EA65
Fan: bathroom	Install a bathroom fan to reduce moisture in the bathroom that can cause mold. Select models with a built-in Energy Star® light fixture that are programmable, produce low noise (0.5 to 1.5 sones), and can have a high CFM (Cubic Feet per Minute).		USEPA Energy Star® www.energystar.gov/ Home Ventilating Institute - Home Ventilation & Indoor Air Quality Guide www.hvi.org/resourcelibrary/publications.html	EA65/IEQ166/ IEQ167IEQ172
Fan: ceiling	Install ceiling fans that meet or exceed Energy Star® standards. Choose a model that has both clockwise and counter clockwise motion. Run fans using solar power.		USEPA Energy Star® www.energystar.gov/ Home Ventilating Institute - Home Ventilation & Indoor Air Quality Guide www.hvi.org/resourcelibrary/publications.html	EA65
Programmable thermostat	Install a programmable thermostat that meets or exceeds Energy Star® standards. The model should be compatible with your system and have features including battery operation and indicator, settings options that allow for vacation overrides and weekends, an energy monitor, and filter change indicator.		Energy Star® on Programmable Thermostats www.energystar.gov/index.cfm?c=thermostats.pr_thermostats ToolBase Service: Programmable Thermostats www.toolbase.org U.S. Department of Energy: Thermostats and Control Systems www.eeregov/consumer/your_home/space_heating_cooling/index.cfm/ mytopic=12720	EA67

Weatherization and Energy

Lighting and Electrical

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Compact Fluorescent Lamp (CFL)	Select compact fluorescent lamps (CFLs) that use less energy, last longer, and contain less mercury than incandescent lamps. Choose lamps with a Color Rendering Index (CRI) of at least 80. For ambient lighting, select a lamp that produces 2700-3000K and a warm or yellowish hue. Task lighting requires lamps that produce 3600-5500K and a bluish or cool hue.	ENERGY STAR	USEPA Energy Star® Compact Fluorescent Light Bulbs www.energystar.gov/index.cfm?c=cfls.pr_cfls United States Department of Energy – Lighting Principles and Terms www.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=11990 General Electric Lighting. 1997-2009. Color Rendering www.gelighting.com/na/business_lighting/education_resources/learn_about_light/color_rendering.htm Rensselaer Polytechnic Institute: Lighting Research Center www.lrc.rpi.edu/	EA84
Light-Emitting Diode (LED) light fixture	Select LED light fixtures that use less energy, produce less heat, and are more durable than incandescent and even fluorescent lamps. Some products come with features such as dimming and motion sensors.	ENERGY STAR	USEPA Energy Star®: Residential LED Lighting www.energystar.gov/index.cfm?c=ssl.pr_residential	EA84
Plumbing				
Piping	Use PEX (or cross-linked polyethylene) tubing as a plumbing substitute for copper or rigid plastic piping. Look for products made of non-halogenated plastics that contain no heavy metals or brominated flame retardants.		PEX Information www.pexinfo.com PEX Piping- PATH Case Study www.pathnet.org/si.asp?id=2584 Hot Water Delivery – Systems and Construction Practice www.awwa.org/waterwiser/references/pdfs/RES_HW_Klein_G_Hot_Water_Delivery_Systems_and_Constructi.pdf Toolbase Services: Resource Efficient Plumbing www.toolbase.org	EA77
Water Heater	Consider purchasing an On Demand Water Heating Systems or "flash" or "tankless" water heater.		GreenandSave: On Demand Water Heater www.greenandsave.com/utility_savings/gas/demand_water_heater.html Consumer Reports: Tankless Water Heaters www.consumerreports.org/cro/appliances/heating-cooling-and-air/water-heaters/tankless-water-heaters/overview/tankless-water-heaters-ov.htm	EA77

Weatherization and Energy

Equipment

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Cooking Appliances	Purchase Energy Star® – rated cooking appliances.	ENERGY STAR	American Council for an Energy-Efficient Economy: Cooking www.aceee.org/consumerguide/cooking.html USEPA Energy Star® www.energystar.gov	EA95
Dishwasher	Select a dishwasher that meets or exceeds Energy Star® standards	ENERGY STAR	USEPA Energy Star®: Dishwashers www.energystar.gov/ia/partners/manuf_res/downloads/Dishwasher_ConsumerBrochure.pdf GreenerChoices: Dishwashers www.greenerchoices.org/ratings.cfm?product=dishwasher Consortium for Energy Efficiency: Dishwashers www.cee1.org/resid/seha/dishw/dishw-main.php3 Consumer Reports: Dishwashers www.consumerreports.org/cro/appliances/kitchen-appliances/dishwashers/index.htm?resultPageIndex=1&resultIndex=1&searchTerm=dishwashers	EA94
Office equipment	Select office equipment that meets or exceeds Energy Star® standards. Look for products that can go into sleep mode when not in use to reduce phantom loads.	ENERGY STAR	USEPA Energy Star®: Office Equipment www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductCategory&pcw_code=OEF Consumer Reports-Greener Choices www.Greenerchoices.org Consumer Guide to Home Energy Savings, 9th Edition, American Council for an Energy-Efficient Economy, 2007 www.aceee.org Consumer Reports www.consumerreports.org	EA99
Range hood	Choose a range hood with an Energy Star® rated fan that uses less energy and is quiet. Kitchen ventilation systems remove moisture and VOCs that are produced from cooking.	ENERGY STAR	USEPA Energy Star®: Ventilating Fans www.energystar.gov/index.cfm?c=vent_fans.pr_vent_fans	EA95

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Refrigerator	Select an energy-efficient refrigerator that meets or exceeds Energy Star® standards. Top-freezer models are the most efficient followed by bottom-freezer models, while side-by-side models are the least efficient.	ENERGY STAR	USEPA Energy Star®: Refrigerators www.energystar.gov/index.cfm?c=refrig.pr_refrigerators Consumer Reports-Greener Choices: Refrigerators www.greenerchoices.org/ratings.cfm?product=fridge	EA93
Washing machine	Select a high-efficiency, front-loading washing machine that meets or exceeds Energy Star® standards. Rebates are available for selected models.	ENERGY STAR	GreenerChoices: Washers www.greenerchoices.org/ratings.cfm?product=washer USEPA Energy Star®: Clothes Washers www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers New Jersey Energy Star® Rebates www.njcleanenergy.com/residential/programs/energy-star-product-rebates/new-jersey-energy-star-product-rebates Consortium for Energy Efficiency: FAQs for Washing Machines www.cee1.org/resid/seha/prod-list-faq.php3	EA92

50-year roof 50 year roofs are built with durable materials such as fiber-cement that enable them to last up to 50 years.

The Air Conditioning Contractors of America's (ACCA) Manual S Manual S provides information on selecting the appropriate heating and cooling equipment of a home based on the calculations derived from the formulas in Manual J.

The Air Conditioning Contractors of America's (ACCA) Manual D Manual D is a guide to designing residential duct systems

The Air Conditioning Contractors of America's (ACCA) Manual J Manual J describes how to calculate the heating and cooling loads of a home.

ambient lighting Ambient lighting uses "warm" lighting sources with a color temperature between 2700-3000K that are more flattering to skin tones and clothing, recommended for living spaces.

asbestos Asbestos is the name given to a number of naturally occurring, fibrous silicate minerals mined for their useful properties such as thermal insulation, chemical and thermal stability, and high tensile strength. Asbestos is commonly used as an acoustic insulator, and in thermal insulation, fire proofing and other building materials. Many products in use today contain asbestos.

awning An awning is a constructed frame covered in a fabric that extends from an existing structure (usually the side of a house) to provide protection from the sun and rain.

backdrafting Backdrafting refers to the process in which a home becomes depressurized from air escaping to the outside and is replaced with air entering from the exterior that may contain combustion products including carbon monoxide.

baffles Baffles are devices used to control movement of light, fluids, wind, and other forces.

biocide Biocides are chemicals used to destroy living organisms. They are typically selective and can be used agriculturally as pesticides or in other industries to control the infestation and growth of unwanted organisms.

Blower Door Test The Blower Door Test measures the leakiness of the house or its air infiltration and helps a homeowner prioritize problem areas. This test uses pressure differences created by air flow via a calibrated fan that mounts on the frame of an existing door and pulls air out of the house, lowering the inside air pressure. As higher pressure outside air travels in through unsealed cracks and openings, tools like a smoke pencil can detect these air leaks as part of a visual inspection process.

borate Borates are boron-containing, naturally-occurring minerals. Common commercial applications of borates include wood treatment, detergent additive, and plant fertilizer.

building envelope The building envelope of a structure separates its interior from the exterior.

carbon dioxide (CO_2) Carbon Dioxide (CO_2) is a gas byproduct of the burning of fossil fuels and other forms of combustion.

carbon monoxide (CO) Carbon Monoxide is a toxic gas byproduct of combustion that is both odorless and colorless. Sources of its production include wood stoves, fireplaces, gas stoves, and furnaces among others.

casement windows Casement windows are hinged and open like doors with a crank.

cellulose Cellulose fibers from recycled newsprint can be applied as a form of insulation that is flame, mold, and pest resistant, provides thermal and sound insulation, and resists settling.

cellulose insulation Cellulose fibers from recycled newsprint can be applied as a form of insulation that is flame, mold, and pest resistant, provides thermal and sound insulation, and resists settling.

CFC sealant Chlorofluorocarbon (CFC) sealants and other CFC products cause ozone depletion.

chase Chases are grooves cut into walls to receive pipes, cables, or ducts.

cladding Wall cladding is a nonstructural material used as the exterior covering for the walls of a building.

Color Rendering Index (CRI) The Color Rendering Index (CRI) is a 1-100 scale that measures how colors appear under different light sources. A light source with a CRI of 80 or higher is considered acceptable for most indoor residential applications.

color temperature Color Temperature defines the color and warmness or coolness of a light source. Color temperature is measured in Kelvin (K) temperature. Contrary to what is expected, higher Kelvin temperatures (3600–5500 K) are considered cool and lower color temperatures (2700–3000 K) are considered warm.

- A color temperature of 2700–3600 K is generally recommended for indoor general and task lighting.
- Task lighting calls for cool light that produces a higher contrastand is better for visual tasks.
- Warm light is more flattering to skin tones and clothing and is recommended for living spaces.

combustion Combustion is the chemical process of the release of gasses in the process of burning a fuel.

combustion appliances Combustion appliances refers to appliances such as stoves, water heaters, and clothes dryers that burn fuels. It is important to make sure that these appliances work correctly and are properly ventilated to prevent carbon monoxide, a byproduct of combustion, from entering the home.

commissioning Commissioning ensures that a home's mechanical systems have met their design intent, operate and interact optimally.

Compact Fluorescent Lights (CFLs) Compact fluorescent lights are the miniature fluorescent lights that can screw into standard light fixtures that conventionally use incandescent bulbs. CFLs are more energy-efficient and durable than incandescent bulbs.

cool metal roofing Cool metal roofing is made from metals such as copper that is used to reflect sunlight and reduce the amount of heat that is transferred into a building.

cooling load Cooling load refers to the amount of heat that is to be removed from a space by a cooling system.

cross-linked polyethylene (PEX) Cross-linked polyethylene is a plastic often used for water supply piping that is flexible, resistant to scale and chlorine, doesn't corrode, is faster to install, and has fewer connections and fittings than does metal piping or rigid plastic piping such as PVC, CPVC, and ABS.

damper Dampers are adjustable plates located in the flue of a fireplace that prevent heat from escaping when it is not in use.

deciduous trees Deciduous trees are species that shed their leaves for part of the year.

diffuser Diffusers are circular, square or rectangular air distribution outlets which are usually located in the ceiling. They are comprised of deflecting blades which discharge supply air in various directions. Diffusers are designed to mix the conditioned air entering the space with the air already contained in the space.

disposable respirators Disposable respirators or filtering facepieces can be made of cloth or paper and are designed to clean the air as you breathe it to prevent you from inhaling irritating substances.

door sweep Door sweeps are hardware that attach to the bottom of a door to reduce draft.

double-hung window(s) Double-hung windows have two vertically sliding sashes, each closing a different part of the window.

double-pane window(s) Double-pane windows consist of two pieces of glass separated by an air space. The air space allows for less heat transfer between the interior and the exterior of the home reducing heating and cooling loads.

drain pans Drain pans provide a basin to catch any fluids leaking from a piece of equipment such as a clothes washer.

Duct Blaster Test A Duct Blaster Test utilizes a fan and a pressure gauge to measure the amount of air escaping from the ductwork of a home by pressurizing the system.

duct cleaning Refers to the cleaning of heating and cooling system components in forced air systems, including the supply and return-air ducts, registers, grilles, diffusers, heat exchangers, heating and cooling coils, drain pans, fan motor, fan housing, and the air handling unit.

duct mastic Duct mastic is a sealant used to reduce air leakage in duct systems. Its flexibility enables it to contract and expand.

duct squeezing Duct squeezing refers to the use of under-sized ducts in an HVAC system in tight spaces that accelerates the air flow creating excessive noise and increases the system's operating costs.

ducting system Ducting systems are networks of ducts or formed sheet metal that direct the flow of air from central HVAC units.

energy performance rating Energy performance ratings indicate the potential for heat transfer and sunlight transmittance of windows, doors, and skylights.

Energy Star® for Homes Typically 20-30 percent more efficient than standard homes, Energy Star qualified homes must meet certain criterion including energy saving features.

Energy Star® Thermal Bypass Checklist (TBC) The Energy Star® Thermal Bypass Checklist consists of guidelines for a home inspection that may reveal any opportunities for energy efficiency improvements.

Extruded Polystyrene (XPS) Extruded polystyrene is a plastic foam insulating material that is resistant to moisture, rot, mold, and corrosion.

fiber cement Fiber cement siding is composed of sand, cement, and cellulose that make it more durable than wood, is termite- and water-resistant, and non-combustible.

fiber-cement composite roofing Fiber-cement composite roofing is made of sand, cement, wood fiber and clay. It is recyclable, fire-proof, and durable, lasting up to 50 years.

flame spread rating Flame spread ratings (FSRs) are used to evaluate the surface burning characteristics of building materials including ignition temperature, smoke toxicity, and flame-spread. Building materials are compared to the FSR scale where inorganic reinforced cement board is 0 and red oak is 100.

flashing Any piece of material, usually metal or plastic, installed to prevent water from penetrating the structure.

foam sheathing Foam sheathing includes expanded polystyrene (EPS), Extruded Polystyrene (XPS), and Polyisocyanurate (PIR). These foam insulation materials are used for applications such as controlling heat flow, airflow, rain penetration, water vapor flow, and condensation.

formaldehyde Formaldehyde is a chemical compound used in products including paper towels, photographic film, glues, and inks among others. It is important to avoid products containing formaldehyde whenever possible as they off-gas potentially hazardous pollutants.

formaldehyde-free Formaldehyde-free products don't contain any formaldehyde. Formaldehyde is a chemical that off-gasses creating air pollution and should be avoided whenever possible.

glazing Window glazings are compounds applied to glass to reduce the amount of heat transfer between the interior and the exterior of a building and/or the ultra-violet (UV) light passing that passes through it.

grille Grilles are vent covers that are normally used on air return ducts. Grilles do not have a pre-attached damper. Louver assemblies can be used with grilles so that the grilles can be used on forced air ducts and still provide airflow control.

gypsum Gypsum is a mineral found in sedimentary rock formations in a crystalline form known as calcium sulfate dihydrate. It is typically used in gypsum board that consists of a non-combustible core.

gypsum board Gypsum board or drywall is used in various paneling applications that consists of a paper-faced non-combustible gypsum core.

hard wire Hard wiring refers to the use of cables or electric wire to connect electronic components.

heat exchanger(s) Commonly used in space heating, refrigeration, air conditioning, and other applications, heat exchangers are devices built for efficient heat transfer from one medium to another.

heat pump system Heat pumps use electricity to move heat from a cool space into a warm, making the cool space cooler and the warm space warmer. During the heating season, heat pumps move heat from the cool outdoors into your warm house; during the cooling season, heat pumps move heat from your cool house into the warm outdoors. Because they move heat rather than generate heat, heat pumps can provide up to 4 times the amount of energy they consume.

heating and cooling coils The heating and cooling coils of an appliance or piece of machinery converts electricity into heat energy.

heating load Heating load refers to the amount of heat it takes to maintain the temperature of an indoor space.

Heating, Ventilation, and Air Conditioning (HVAC) Systems Heating, Ventilating, and Air Conditioning systems process and supply air through ductwork helping to regulate humidity and temperature in buildings to provide safe and healthy conditions.

HEPA filtered air scrubbers High efficiency particulate air or HEPA air filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles down to a size of 0.3 micrometers (µm) in diameter.

HEPA vacuum High efficiency particulate air or HEPA filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles 0.3 micrometers (µm) in diameter. HEPA filter used in vacuum cleaners trap the fine particles (such as pollen and dust mite feces) which trigger allergy and asthma symptoms.

high-density fiberglass batts High-density fiberglass batts are insulation with higher R-values (a measure of resistance to heat flow) than other fiberglass batts. These materials are considered to be less irritating and don't require a chemical binder for securing.

high-recycled-content Products of high-recycled content are made mostly with materials that have already been used.

Home Energy Analysis A Home Energy Analysis considers possible measures that can be taken to improve a home's energy efficiency based on certain criteria.

Home Performance Audit Home Performance Audits are conducted to assess the energy efficiency of a home and evaluate possible energy saving measures.

home-run piping system Home-run or manifold plumbing systems utilize both PEX piping and a manifold. The system is characterized by direct lines from the manifold to any fixtures that reduce the amount of water needed and provides hot water faster.

house wrap House wrap, typically made of polyethylene, is a breathable material used to prevent moisture and wind from entering the home.

IICRC S500 Guidelines The Institute of Inspection, Cleaning and Restoration is an independent, non-profit certification body that sets and promotes standards for the inspection, cleaning and restoration service industry. These guidelines provide specific practical standards for water damage restoration.

infiltration Infiltration is the process by which water seeps through the ground where it may reach a water body or an aquifer.

infrared Infrared radiation is electromagnetic radiation of wavelengths approximately between 0.75 and 1000 mm.

infrared camera Infrared cameras are used to detect thermal variations and may be used in conducting energy efficiency analyses.

infrared imaging Infrared imaging detects thermal variations and may be used in conducting energy efficiency analyses.

Kelvin (K) Kelvin is a universally accepted base unit used to measure temperature. One degree in Celsius is equivalent to one degree in Kelvin. Water freezes at zero degrees Celsius, which is approximately 273.16 Kelvin.

latent cooling load The latent cooling load of an HVAC system is the amount of heat energy produced by moisture from indoor and outdoor sources that needs to be removed from a home in order to maintain a constant temperature.

Light-Emitting Diode (LED) Light-Emitting Diodes are electronic light sources that use less energy than incandescent bulbs or compact fluorescent lamps.

load calculations Load calculations are formulas used to derive the heating, cooling, or electrical loads of a system.

louver(s) Louvers are vertical slats on a window, blind, or shutter that are angled in such away to allow in light and air while providing a shield from rain, direct sunlight, and noise.

low-E Low-E or Low-Emissivity glazings are metal or metal oxide coatings applied to windows to reduce heat flow.

low-VOC Low-VOC products contain smaller amounts of volatile organic compounds (VOCs) that can offgas chemicals and cause air pollution.

manometer Manometers are instruments used to measure pressure.

Microload home The New Jersey Clean Energy Program defines "microload" as a "customized high performance level at or approaching Net-Zero Energy." While a regular home built to code would receive a Home Energy Rating System (HERS) score of 100; a Microload home would be built to use 50% less energy and would receive a HERS score of 45 or less. Microload homes are eligible for incentives under Tier 3 of the New Jersey Energy Star Home Program.

Modified Energy Factor (MEF) is a combination of Energy Factor and Remaining Moisture Content (RMC). MEF measures energy consumption of the total laundry cycle (washing and drying). It indicates how many cubic feet of laundry can be washed and dried with one kWh of electricity; the higher the number, the greater the efficiency.

moisture meter Moisture meters are devices used to measure the amount of water in a given substance that help determine if it is ready to use.

mold amplification sites Mold amplification sites are locations where mold has built up over time. Typical sites of indoor mold buildup are damp cellulosic materials (e.g., wallboard paper, wallpaper, carpet backing, damp papers); debris in ventilation ducts, in carpets, or in mattresses or upholstered furniture; poorly maintained humidifiers; insulation on which organic film has accumulated; constantly humid painted, caulked or plastic surfaces (e.g., windowsills, shower stalls, cold air return vents); and potted plant soils.

National Air Duct Cleaners Association (NADCA) The National Air Duct Cleaners Association (NADCA) was formed in 1989 as a non-profit association of companies engaged in the cleaning of HVAC systems. Its mission is to promote source removal as the only acceptable method of cleaning and to establish industry standards for the association.

National Fenestration Rating Council (NFRC) The National Fenestration Rating Council (NFRC) is a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products.

natural ventilation Natural ventilation systems utilize pressure differences caused by wind or the buoyancy effect (created by differences in temperature or humidity) to circulate fresh air through buildings.

non-CFC sealant Non-CFC sealants do not contain the ozone depleting chemicals chlorofluorocarbons (CFCs).

non-combustible Non-combustible materials are incapable of burning.

optimal load calculations The optimal load of an HVAC system can be calculated to determine the amount of energy required for it to operate the most efficiently.

out-gas/off-gas Out gassing or off-gassing is the evaporation of chemical materials that may be hazardous.

over-sizing Over-sized ducting of HVAC systems may lead reduced indoor air quality and an imbalance of air flow distribution.

Pascal The Pascal is the standard unit of the measure of pressure equal to one Newton/square meter.

passive solar Passive solar home design considers the materials and arrangements of windows, walls, and floors to utilize solar energy for heating in the winter and reduce solar heat gain in the summer.

passive solar design Passive solar home design considers the materials and arrangements of windows, walls, and floors to utilize solar energy for heating in the winter and reduce solar heat gain in the summer.

petroleum-based Petroleum-based products are made from the raw natural resource petroleum, such as oil and natural gas.

phantom load The phantom load refers to the electricity being used by an appliance when it is turned off but still plugged into an outlet.

phenol formaldehyde Phenol Formaldehyde (PF) is commonly used in polymer resins as a safer alternative in pressed-wood materials, off-gassing less formaldehyde than products that use Urea Formaldehyde (UF).

plenum Plenums are boxes made of sheet metal that connect to the outlet of an air handler or furnace where to which other ductwork can attach

plumbing chase A hollow wall area accommodating piping used for drain waste or vent in plumbing systems.

polyisocyanurate Polyisocyanurate is a plastic consisting of closed-cell foam that contains a low-conductivity gas (usually hydrofluorocarbons or HCFC) in its cells. It has a high thermal resistance and is used as insulation that is available as a liquid, sprayed foam, or foam board.

polystyrene Polystyrene is a plastic foam that comes in extruded or expanded forms that are used in various building applications for their insulating properties.

post-consumer recycled content Post-consumer recycled products consist of materials that were previously used by consumers.

pre-primed Pre-primed materials are already prepared with a primer allowing for the application of other products, oftentimes paint.

programmable thermostat Programmable thermostats are devices used to control a home's heating/cooling system that can be set to turn off when no one is home and then back on when the home will be occupied to reduce the cooling load.

R-Value The R-value of a material indicates its resistance to heat transfer.

radiant barrier Radiant barriers are installed in homes to reduce summer heat gain and winter heat loss, and hence to reduce home heating and cooling energy useage. All radiant barriers have at least one reflective (or low emissivity) surface, usually a sheet or coating of aluminum.

rainscreen Rainscreens are used to reduce the exposure of exterior walls to precipitation preventing moisture intrusion and the decay of materials. Every rainscreen consists of vented or porous cladding, an air cavity, a drainage layer on support wall, and a rigid, water-resistant, airtight support wall.

reconstituted wood fiber Reconstituted wood fiber materials use chipped or stranded small-diameter trees as their wood source. This material is then bound together into forms suitable for use in construction.

recycled content Products with recycled content are made from materials that have already been used in another product.

recycled paper cellulose Recycled paper cellulose is an environmentally-friendly insulation alternative made of waste paper.

refrigerant A refrigerant is a compound used in a heat cycle that undergoes a phase change from a gas to a liquid and back used in refrigerators/freezers, air conditioners, and other appliances.

refrigerant charge Refrigerant charge refers to the quantity of refrigerant in a refrigerant system.

return air duct registers Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

return duct Return ducts prevent the pressurization of closed rooms from supply air by allowing air to flow black to the central return grille.

return grille Return grilles are grates used to cover the ends of return ducts.

rim joist Rim joists are the boards that cap the ends of the floor system.

roof overhangs Roof overhangs are an element of passive solar home design used to shade buildings that may be adjustable, removable, or fixed.

R-Value The R-value of a material indicates its resistance to heat transfer. A higher R-value is better than a low R-value.

sash Window sashes consist of the moving section(s) of a window.

Seasonal Energy Efficiency Ratio (SEER) The seasonal energy efficiency ratio measures the efficiency of a central cooling system over an entire season by comparing the number of BTUs produced to watt-hours consumed.

sensible cooling load The sensible cooling load of a home refers to heat gain from the collective impact of conduction, convection, the exterior, people, and appliances.

sheathing Sheathing refers to a building material that is used to cover exterior wall framing or roof trusses.

shutters Shutters are moveable wooden or metal coverings that, when closed, keep sunlight out. They can be either solid or slatted, with fixed or adjustable slats. Rolling shutters have a series of horizontal slats that run down along a track.

single-package models Single-package model HVAC systems have all of their components, including evaporators, cooling coils, compressors, and condensers, contained within one unit.

single-pane window Single-paned windows have only one piece of glass separating the interior and exterior of a home. Double-pane windows are considered to be much more energy-efficient.

six-sided containment Six-Sided Containment refers to the insulating of all six sides of frame wall cavities in unconditioned, concealed spaces.

smoke pencil Smoke pencils detect air pressure differences between two spaces by emitting smoke that leaks through any cracks or openings.

soffit vent(s) Soffit vents are applied to the underside of a construction element and are perforated for intake ventilation.

Solar Heat Gain Coefficient (SHGC) The Solar Heat Gain Coefficient is the fraction of incidental solar radiation admitted through a window.

Solar Renewable Energy Certificate (SREC) SREC stands for Solar Renewable Energy Certificate and is a tradable certificate that represents all the clean energy benefits of electricity generated from a solar electric system. Each time a solar electric system generates 1000 kWh (1 MWh) of electricity, an SREC is issued which can then be sold or traded separately from the power.

solar screen(s) Solar screens are mounted to the exterior of windows to reduce sunlight transmittance and prevent heat transfer.

solar tube(s) Solar tubes consist of a clear dome that collects sunlight into a highly polished and reflective tube that reflects the light down to a diffuser on the ceiling. They are sufficient to light a small room, hallway, or staircase.

solar water heating Solar water heaters or domestic hot water systems utilize storage tanks and solar collectors to provide hot water for a home, saving both energy and money.

split systems Split HVAC systems have their components, including evaporators, cooling coils, compressors, and condensers, located inside and outside of a building.

spray polyurethane Spray polyurethane foam (SPF) is a plastic insulation that expands after being installed as a liquid.

stack ventilation Passive stack ventilation are devices known for extracting warm air from the upper regions of a room or building, with incoming air being admitted via inlets lower down in the room or building. In winter, such incoming air will need to be heated for the comfort of occupants and this is wasteful.

storm door Storm doors consisting of a combination of glass and screens can be used to increase the energy efficiency of an exterior doorway.

storm window Storm windows are pieces of glass or plastic mounted to the interior or exterior of an existing window that serve to reduce the amount of airflow in and out of a home, reducing heating and cooling loads.

supply air duct registers Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

supply duct(s) Supply ducts made of formed sheet metal deliver air to interior spaces from an HVAC system.

supply register Registers are vent covers that are typically used on forced air ducts. They have a pre-attached damper or set of louvers to help control airflow.

task lighting Task lighting, often described as "cool" lighting, produces higher contrasts that are better for seeing. Task lighting sources emit temperatures between 3600-5500K.

thermal bridging Thermal bridging occurs when high thermal conductivity materials such as steel and concrete create pathways that bypass thermal insulation resulting in heat loss.

Thermal Bypass Checklist (TBC) The Thermal Bypass Checklist is a comprehensive list of building details where thermal bypass, or the movement of heat around or through insulation, frequently

occurs due to missing air barriers or gaps between the air barrier and insulation.

thermal bypass inspection The Energy Star® Thermal Bypass Checklist is a comprehensive visual inspection of building details where thermal bypass, or the movement of heat around or through insulation, frequently occurs due to missing air barriers or gaps between the air barriers and the insulation.

transom Transoms are the windows above doors that serve to allow in sunlight and release warm air.

U-Factor The U-factor of a window assembly indicates its rate of heat loss.

Ultraviolet (UV) light Ultra-violet light (UV) is defined as electromagnetic radiation in the spectral region between 180 and 400 nanometers. Prolonged exposure to UV light can result in sunburns, skin cancer, and the fading of certain materials.

unconditioned spaces Unconditioned or unfinished spaces including attics and crawlspaces can provide a variety of energy saving opportunities.

urban heat island effect The heat island effect occurs in urban areas where impermeable roof and pavement temperatures increase during the summer, elevating the air temperature. The increase in air temperature generates a greater demand in energy consumption for cooling systems and promotes the development of smog due to the concentration of air pollutants in urbanized areas. Also, runoff from these heated surfaces reaches waterways where it can increase the water temperature affecting the ecosystem.

U.S. Green Building Council's Leadership in Energy and Environmental Design for Homes (LEED-H) certification LEED for Homes is a rating system that encourages the building of green homes that use less energy, water and natural resources, create less waste, are healthier and more comfortable.

vermiculite insulation Vermiculite is a naturally-occurring mineral, favored for its absorbant, lightweight, fire-resistant, odorless characteristics. Pre-1990 vermiculite insulation products are likely to contain some traces of asbestos associated with the mine where the vermiculite was collected.

Volatile Organic Compounds (VOCs) Volatile Organic Compounds are off-gassed from certain solid or liquid products and may cause negative health effects when inhaled

wall cladding A wall cladding is a nonstructural material used as the exterior covering for the walls of a building.

warm-edge spacer Warm-edge spacers are used to separate panes of glass in insulated windows and conduct less heat than standard aluminum spacers.

warp Warping is the distortion or bending of wood due to moisture.

Water Factor (WF) Water factor is the number of gallons needed for each cubic foot of laundry. A lower number indicates lower consumption and more efficient use of water.

water heater blanket Water heater blankets are used to insulate water heaters with R-values less than 24.

weatherization Weatherization involves procedures that protect a building from the elements.

weatherstripping Weatherstripping is the sealing of cracks or holes around windows, doors and other openings exposed to the exterior of a building with caulk, foam, rubber strips, or other materials that can be used to reduce airflow between the interior and the exterior.

whole house fan Whole house fans located on attic floors ventilate warm air from interior spaces to the outside while depressurizing the home to draw in cool air from open windows.

window glazing Window glazings are compounds applied to glass to reduce the amount of heat transfer between the interior and the exterior of a building and/or the ultra-violet (UV) light passing that passes through it.

wind-washing Wind-washing refers to the movement of air caused by wind entering through building enclosures, usually at the corners and roof eaves, that can have a major impact on its thermal efficiency and moisture control.

zone controller A zone controller connects multiple thermostats to a single HVAC system.

zoning HVAC zoning strategically divides a building into zones where each has its own thermostat for independent temperature control.

Transforming the conventional lawn into green outdoor living space complements the home and connects it with nature. New Jersey, with long summer days and cool autumn evenings, provides a perfect environment for outdoor living. As the primary connection to our natural surroundings, yards function as a beautiful, livable extension of the home. Whether planning your own outdoor project or hiring a professional, there are dozens of ways to implement renewable products, conserve resources, promote biodiversity and wildlife habitat, and reduce home heating, cooling, and water usage.

Outdoor Living and Landscaping

Photo: Michael Fleischacker

Outdoor Living and Landcaping

How to Use the Guidelines

Health and Safety

HS1 - Nuisance and Toxic Dust Control
HS2 - Cautious Materials -Asbestos & Lead
HS3 - Mold
HS4- Radon

Green Home Maintenance and Housekeeping

General Design and Construction

Design to support connection with nature **[SS15]**

Site

Minimize site disturbance **[SS29]**
Conduct a soil test
Start a compost pile
Landscape for passive heating and cooling **[SS30-31/36]**
Minimize impervious surfaces **[SS32]**
Replace lawn with turf grass or groundcover **[SS34]**
Provide wildlife habitat **[SS35]**
Provide for edible plants in the landscape design **[SS37]**
Utilize Integrated Pest Management **[SS38]**
Provide rainwater collection system **[WE40]**

Outdoor Structures

Use eco-friendly patio/decking materials **[MR111-113]**
Properly detail between deck and house **[IDP28]**
Plan projects for easy clean-up and disposal **[IEQ162]**
Create a roof garden
Choose eco-friendly pool/hot tub options **[EA97]**

Lighting and Electrical

Use efficient lighting/minimize light pollution **[EA88-89]**

Furniture and Fittings

Choose eco-friendly furniture/accessories **[MR154]**

Case Studies

Green Products and Services

Glossary of Terms

How to Use the Guidelines

Organization of the Guidelines

The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

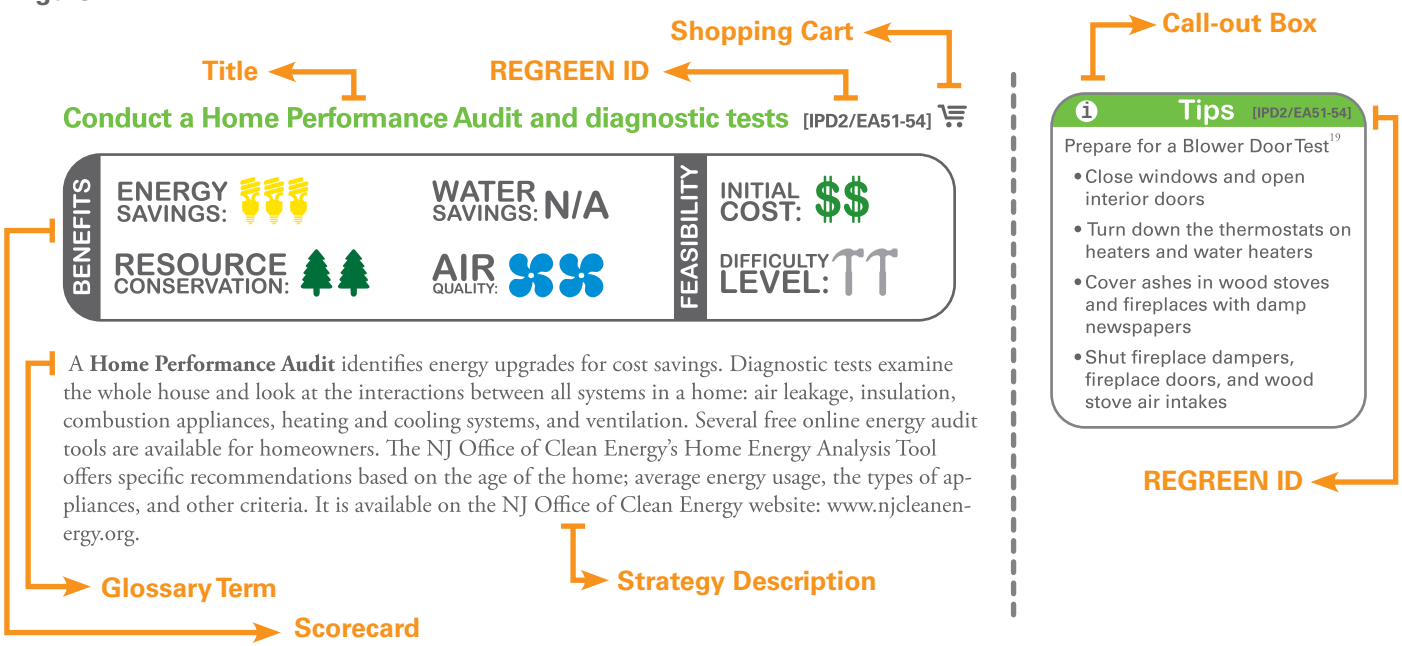
Each chapter includes the following:

- How to Use the Guidelines
- Health and Safety
- Green Home Maintenance and Housekeeping
- Best Practice Strategies
- Resources and References
- Case Studies
- Green Products and Services
- Glossary of Terms

Getting the Most from the Strategy Write-ups

The Guidelines provide information on best practice strategies for each project type. These strategy write-ups are organized by building system and follow the order of the 2008 REGREEN Residential Remodeling Guidelines (i.e., IDP2), which are incorporated with permission. **Figure 1** describes the information available.

Figure 1



Title and REGREEN Strategy ID – The strategies in the REGREEN Residential Remodeling Guidelines 2008 inspired most of the strategies in these Guidelines. Where appropriate, the strategy references the related REGREEN strategy ID.

Shopping Cart – The cart denotes entries in the Green Product and Service Guide located in the back of each project chapter.

Strategy Description – This write-up provides an overview of each strategy and its environmental benefits.

Glossary Term – Acronyms and green building terms are highlighted in bold and defined in a glossary at the back of each chapter.

Call-out Boxes - The call–out boxes in **Figure 2** highlight information of special importance. These include the following types of information:

- Tips - useful hints or practical facts for accomplishing a strategy
- Incentive - sources of financial assistance
- New Jersey Bio-Region - New Jersey has 5 bio-regions, each with unique elements and environmental features to consider when remodeling
- Building Age - a home's age can inform needed repairs and call out special circumstances
- Caution - on occasion, there are hazards associated, so items are called out for safety reasons

Hazard Symbol - Symbols were developed to advise users of certain health and safety threats related to specific strategies. The symbols, which appear below, reference the guidance on Health and Safety located at the beginning of each section.

HS1 – Nuisance and Toxic Dust Control HS1

HS2 – Hazardous Materials - Asbestos & Lead HS2

HS3 – Mold HS3

HS4 – Radon HS4

Web Link - When viewing this document electronically, the websites will hyperlink, however, occasionally website links change. In most cases, the site provides a seamless link to the new address. If this is not the case, users may need to copy and paste the link into the browser address bar. At the time of publication the hyperlinks in this report were all functional.

Scorecard - The scorecard, **Figure 3**, provides a snapshot of the environmental benefits, initial costs, and difficulty levels associated with a particular strategy. Both qualitative and quantitative information was used to assign scores to each strategy.

Figure 3

Conduct a Home Performance Audit and diagnostic tests [IPD2/EA51-54]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS: N/A	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	TT

It is divided into two parts: 1) Benefits and 2) Feasibility.

Graphic icons were developed for each impact category.

BENEFIT Key

1 icon = low benefit, 2 icons = medium benefit, 3 icons = high benefit

FEASIBILITY Key

$ low initial cost, $$ medium initial cost, $$$ high initial cost

T low difficulty level, TT medium difficulty level, TTT high difficulty

The icons above have been developed to graphically describe the ratings that follow.

BENEFITS

Energy Savings

To help meet its greenhouse gas reduction responsibility, in 2007 New Jersey passed **carbon dioxide** (CO_2) reduction goals, i.e., achieve 1990 emission levels by 2020, followed by a further reduction of emissions to 80 percent below 2006 levels by 2050. The state has also established renewable energy and energy efficiency targets. Green remodeling strategies utilize renewable energy sources such as solar, geothermal, and wind to net a lower CO_2 footprint.

Figure 2

Tips [EA49]

Use the U.S. Department of Energy's Zip-Code Insulation Program to determine how much insulation to add and where to achieve the recommended insulation levels for maximum energy efficiency www.ornl.gov/~roofs/Zip/ZipHome.html

Incentive [EA49]

Federal tax credits may be available for added insulation to walls, ceilings, or other part of the **building envelope**. See the Tax Incentive Assistance Project: www.energytaxincentives.org/general/legislative.php.

NJ Bio-Region [EA49]

In colder climates, adding extra insulation is more cost effective than installing a **radiant barrier.**[26]

Building Age [EA49]

Insulation in older homes will have settled and at best be dusty or dirty so new attic insulation is typically installed on top of old insulation.

Caution [EA49]

Vermiculite Insulation was used in attics until it was discovered that vermiculite ores from some sources have naturally occurring **asbestos** in trace amounts. This type of insulation is only a health concern when someone comes into contact with it; while it is contained, it is not determined to be a health risk. If a remodeling or renovation project involves removal of this type of insulation, certified professionals will be needed to safely remove or contain the material. For more information, see **EPA** website: www.EPA.gov/asbestos/pubs/verm.html

Water Savings

Water conservation reduces water use both inside and outside the home. Within the home this may include low-flow fixtures. Outside the home this may refer to using **native plants** that have lower watering requirements or rain barrels to collect rainwater for reuse on the lawn and garden. Water management includes providing proper moisture control at footings, slab perimeter, and foundation walls as well as using porous paving materials to encourage stormwater recharge for reduced runoff.

Air Quality

Americans spend up to 90 percent of their time indoors where air quality can be more polluted than outdoors. Pollutants range from allergens such as mold, mildew, fungus, and dust mites to toxins, such as asbestos, and volatile organic compounds like formaldehyde and benzene found in building materials and a number of household items including pressed-wood furniture, computer ink, carpeting, and conventional household cleaners and cosmetics.

Resource Conservation

Resource conservation means using materials that are durable and easy to maintain with low embodied energy (the energy used in resource extraction, manufacturing, shipping). These come from renewable sources or are produced from waste, recycled materials, or salvaged from other uses. Avoiding building materials that deplete natural resources, such as old-growth timber, and materials made from toxic or hazardous substances improves nature's ability to provide goods and services.

FEASIBILITY

$ Initial Cost

Cost is always a consideration for remodeling projects. Evaluating the cost of a recommended green remodeling strategy provides homeowners with a better sense of the relative costs and benefits of each recommended measure.

Costs come in two forms, so it is important to consider both in assessing feasibility. The first reflects initial costs of the strategy compared to conventional practices. A second consideration to make is the pay-back period or life-cycle cost. The pay-back costs are less obvious and are often project specific, but they can have significant environmental and economic value that factor into the overall cost. For more information on average costs, savings, and payback periods of typical energy efficiency improvements, see the Energy Efficient Rehab Advisor at (www.rehabadvisor.pathnet.org/). For customized results, have an energy professional conduct a thorough energy audit of your home.

$ Less than $500

$$ $500-$5,000

$$$ Greater than $5,000

Difficulty Level

Time is money and expertise is gained over time. Some people may consider a Home Performance Audit strategy in the 'medium' category because although relatively straightforwardto act on, it requires experts with custom equipment to prepare an accurate assessment. Implementing the findings from a Home Performance Audit becomes a 'high' difficulty category as space heating and cooling systems, ventilation, water heating, appliances, climate and even site factors need to be integrated to assure desired energy improvements across 'ALL loads' and to avoid negative unintended consequences. It is expected that 'high' difficulty strategies may also be dangerous for the basic homeowner to undertake.

T Easy to Do It Yourself (DIY) - little previous knowledge necessary

TT Task for an Experienced DIYer or Professional - may require additional effort and higher learning curve than conventional strategy it replaces

TTT Task for an Expert/Certified Professional - high learning curve; new technique; requires specific green knowledge

Notes: [1] U.S. Environmental Protection Agency 2008. Healthy Buildings, Healthy People: A Vision for the 21st Century

Health and Safety

Green remodeling poses hazards typical of many other home renovation or remodeling projects because of the age of the homes (given that they are more likely to contain older and use more hazardous materials) and the incentive for green remodeling to replace older or damaged building systems.

New Jersey homeowners considering green remodeling should anticipate potential emissions of hazardous air contaminants during removal of old building materials. The risks associated with improper removal of materials containing **asbestos**, lead, mold or even fiberglass insulation are minimized by understanding and following the steps listed here prior to initiating work. For complex situations, consider hiring professionals.

General hazard recognition and risk reduction information for the following potential renovation-related risks are contained in this section:

HS1 – Nuisance and Toxic Dust Control

HS2 – Hazardous Materials - Asbestos & Lead

HS3 – Mold

HS4 – Radon

HS1 – Nuisance and Toxic Dust Control

Construction projects involving demolition of existing sheetrock, plaster, wood, brick or concrete products in ceilings, walls or floors of a home will release dust as these materials are ripped, sanded, ground, pulverized or crushed. Control of dust emissions during the pouring of solids or from transferring of small particles is controlled in industrial facilities. Homeowners planning renovation projects should also consider steps to minimize the release and maximize control of dust in the environment. These nuisance dusts, when released from the point of origin into the air of the home, tend to remain suspended in the air for very long periods of time, and as such, will be transported with air currents caused by open doors, cracks around and beneath doorways, forced air heating and cooling ductwork, and even by the air currents caused by persons walking in and out of dusty areas, to other areas of the home. At a minimum, allowing the uncontrolled release of nuisance dusts from any demolition project, as well as those created from sawing, sanding, or grinding of newly constructed materials (e.g., sheetrock, spackling, wood dust etc.) presents unnecessary and difficult dust cleanup demands for affected living spaces. At their worst, susceptible occupants of homes where uncontrolled nuisance dusts are allowed to escape into adjacent living spaces may temporarily experience eye, nose, or throat irritation. Asthmatics may experience adverse respiratory distress when exposed to high levels of nuisance dust particles.

There are several simple steps to minimize potential hazards of nuisance dust during remodeling.

1. Remove unnecessary porous and non-porous materials (e.g., draperies, bedding, upholstered furniture, children's toys, clothing, etc.) from the project area.
2. Seal the project area from the remainder of the home using polyethylene sheeting at doorways and at inlets to any forced air supply or **return registers** within the project space.
3. Consider installing **HEPA filtered air scrubbers** in the project area and discharging the exhaust air through an adjacent window using a tight fitting flexible duct through a sealed window opening (consider surrounding security requirements). Use a lightweight section of facial tissue at the doorways to confirm that air pressure is moving from the clean adjacent living space and into the project area (not the other direction) so that air leaks from the clean home into the dirty renovation area. This will reduce any potential for dusts from the renovation area to enter the adjacent areas of the home.
4. Periodically during the work session and after every work session, **HEPA vacuum** the renovation area following renovations to remove accumulated surface dust, without re-suspending it into the air.

HS2 – Hazardous Materials - Asbestos & Lead

When removing old building materials, know that they contain hazardous materials, which while intact present little to zero risk to occupants, but when removing can create airborne emissions and increase health and safety risks. This is especially true of **asbestos** and lead, and, possibly to a lesser extent, fiberglass. Removal of **asbestos**, lead or fiberglass needs to be planned and conducted with care to minimize exposures to airborne dust from these materials.

Asbestos

Asbestos is a mineral that has been mined in the U.S. since the early 1900's. Its superior heat resistance properties, combined with its lightweight, high-tensile strength, and non-corrosive qualities, made it an ideal building material for buildings constructed between 1940 and the late 1980's. **Asbestos** was banned as a building material in the U.S. after scientists concluded studies linking long-term occupational exposures to damaging respiratory health including asbestosis (scarring of the lung), lung cancer, and mesothelioma (cancer of the lining of the lung). Because intact **asbestos** presents no increased health risk, there is no requirement for removing it from existing homes. However, when it is disrupted, pulverized or suspended in air, the potential for inhalation of **asbestos** fibers increases risks of exposure. While health effects develop only after decades of long-term occupational or environmental exposure, homeowners should take particular care to prevent unintentional release of **asbestos** into the air of their homes during green remodeling efforts so that children and others are not exposed.

Asbestos is commonly found in older homes (constructed between 1940 and the late 1980's) in the following building materials:

- Pipe and boiler insulation
- Sprayed on fireproofing insulation
- Acoustical tiles and wall coverings
- Floor tiles
- Roof shingles
- Siding shingles

There is no requirement that homeowners remove **asbestos**-containing materials from homes. However, if removal is part of a green building remodeling project, material should be tested by a New Jersey licensed **asbestos** control monitor, and if determined to contain **asbestos**, be removed by a New Jersey licensed **asbestos** contractor. The number of the state program to contact for assistance in identifying qualified personnel to assist homeowners to safely address any possible **asbestos** concerns is (609) 292-7837.[5] General information about asbestos and its proper management and disposal can be found at the Department of Health website: www.state.nj.us/health/iep/asbestos.shtml and the Department of Environmental website: www.nj.gov/dep/dshw/rrtp/asbestos.htm.

Lead

Lead was in residential paints prior to 1978. It was banned after that time due to the significant health affects to children inhaling or consuming dusts from lead-based paints. Because of the hazards posed by dusts and chips of lead-painted surfaces, any remodeling or renovation which impacts painted surfaces of homes constructed prior to 1978 needs to be inspected by a New Jersey licensed lead inspector. If lead paint is identified, it should be safely removed by a state of New Jersey licensed contractor. They can safely remove lead-based paint and conduct follow-up surface lead testing to confirm that the removal was successful. Information on lead-based paint and qualifications for lead inspectors and contractors can be found at: www.state.NJ.us/health/iep/documents/pb_advisory_bulletin.pdf.

Contact the New Jersey Department of Health and Senior Services at (609) 292-7837 with any questions.

Fiberglass

Fiberglass insulation is a manufactured glass-wool-like material used as an insulation and sound absorption material in homes, schools, automobiles and consumer products since the 1970's. Fiberglass insulation can be safely installed if handled properly; any prolonged skin, eye or respiratory contact with fiberglass can cause temporary irritation. During renovation, wear loose fitting clothing and gloves to reduce skin contact, eye glasses or goggles to reduce eye exposure, and N95 disposable respirators (available from any home improvement store) if high levels of fiberglass dust are expected during removal or installation. More information on fiberglass safety precautions and handling recommendations can be found at the American Lung Association website at: www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=35439
or call the American Lung Association in New Jersey at (908) 687-9340.

HS3 – Mold

Mold contamination of building materials is not limited to older homes. Homes of any age can develop mold if moisture from leaky pipes, roofs, foundations, accumulates in the presence of dust, wood, paper or other **cellulose**-containing materials at normal room temperatures or high relative humidity (76 percent) for as little as 48 hours. Standing moisture around building materials such as wallboard, carpets, insulation, wood or other **cellulose** containing materials can cause mold. Many mold spores are known human allergens and produce toxins which may cause irritation or central nervous system effects. Because of vast differences in susceptibility, or if individual health impacts related to elevated mold spore exposure are of concern, consult a trained and experienced occupational/environmental health physician.

In addition to the above, mold damage can occur if flooding from faucets, showers, toilets (above the trap), is not completely dried within 48 hours of the incident. Floods from dirty water sources such as washing machines, dishwashers or sewers may contain high levels of bacteria, viruses, and protozoa which, along with potential mold growth, present additional risks.

If **mold amplification sites** occur, remove the affected material using methods that prevents unintentional dispersal of mold spores and the source of moisture intrusion. The U.S. **Environmental Protection Agency** indicates that small areas of mold growth (less than 10 square feet) can be cleaned or removed by homeowners themselves using precautions to prevent exposure and reduce spread of spores to adjacent areas. When mold contaminated areas exceed 10 square feet, special precautions including erecting containment barriers and the use of specialized **HEPA vacuum** devices should be used by trained professionals. When mold contamination occurs in excess of 100 square feet, professionals need to clean using full containment of the area (see www.epa.gov/mold/moldguide.html).

If mold growth from dirty water floods occurs, take special precautions to prevent skin, eye, oral and inhalation contact, and hire trained professionals to clean up in accordance with U.S. **EPA**: www.epa.gov/iaq/flood/index.html and IICRC S500 guidelines

Homeowners should anticipate that the amount of mold contamination shown on the outside of a piece of drywall or paneling may be less than the amount that will be exposed when wall cavities are opened up. If there is any doubt, consider hiring a professional Certified Industrial Hygienist (CIH) to evaluate the extent of damage before attempting to remove contaminated building materials yourself.

HS4 – Radon

Radon is a radioactive gas that comes from the natural decay of uranium in the ground. It is odorless, tasteless and invisible, and can only be detected through specialized tests. **Radon** enters homes through openings such as cracks and joints in the foundation, sump pits and openings around pipes. The home traps radon inside and it can build up to high levels.

Radon is the second leading cause of lung cancer in the United States, resulting in 15,000 to 22,000 deaths annually. It is the leading cause of lung cancer for non-smokers.

Radon concentrations can vary from house to house. The radon concentration in a home depends on a number of factors, including the amount of uranium present in the soil, the permeability of the soil, the number of openings in the foundation and air pressure differentials. Any home can have a **radon** problem, regardless of whether it is old or new, well sealed or drafty, or with or without a basement.

The New Jersey Department of Environmental Protection recommends radon testing for all homes in New Jersey. If the **radon** concentration is 4 pCi/L or higher, a **radon** mitigation system is recommended. There is no safe level of **radon** since lung cancer can result from very low exposures to **radon**, however, the risk decreases as the **radon** concentration decreases. f the **radon** concentration is less than 4 pCi/L, a mitigation company can be consulted to determine whether the **radon** level can be brought down still further. **Radon** levels have been brought to less than 1 pCi/L in sixty percent of the homes mitigated in New Jersey. Mitigation systems can also help reduce the potential for accumulation of volatile organic compounds that may be released from soil water vapor in areas where ground water contamination is an issue.

Radon test kits are commercially available at most home improvement stores, however, test conditions and locations may make data interpretation difficult or inaccurate. Carefully follow the kit directions to ensure proper use and confidence in the results. The New Jersey Department of Environmental Protection has issued licensing requirements for **radon** testing firms, and has a list of qualified professionals to perform **radon** testing and mitigation, see www.njradon.org.

Appendix

HS1= NUISANCE AND TOXIC DUST CONTROL

Fly ash Properties

www.austinenergy.com/energypercent20Efficiency/Programs/Greenpercent20Building/Sourcebook/flyashConcrete.htm

www.oikos.com/library/betterconcrete/index.html

HS2= HAZARDOUS MATERIALS - LEAD AND ASBESTOS

N.J. Department of Health Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

Agency for Toxic Substances and Disease Registry, New Jersey

www.atsdr.cdc.gov/Asbestos/sites/national_map/fact_sheets/trentonnj.html

N.J. Department of Environmental Protection, Guidelines for Disposal of Asbestos Containing Materials

www.state.NJ.us/dep/dshw/rrtp/Asbestos.htm

U.S. EPA Asbestos Caution Regulations adopted in New Jersey

www.EPA.gov/r02earth/ahera/ahera.htm

N.J. Department of Community Affairs Lead Testing and Abatement

www.state.NJ.us/dca/codes/code_services/xls/clc.shtml

New Jersey (NJ) Department of Health and Senior Services

http://www.state.nj.us/health/

Lead in Paint, Dust, and Soil (USEPA)

http://www.epa.gov/lead/

The Leadsafe NJ Program (NJDCA)

http://www.state.nj.us/dca/dcr/leadsafe/

HS3 = MOLD

USEPA Guide to Mold in Your Home

www.EPA.gov/mold/moldguide.html

USEPA Flood Clean-up Guidelines

www.EPA.gov/iaq/flood/index.html

N.J. Department of Health and Senior Services Indoor Environments Program

www.state.NJ.us/health/iep/index.shtml

HS4 = RADON

N.J. Radon Soil Gas Map

www.EPA.gov/radon/zonemap/newjersey.htm

N.J. Department of Environmental Protection Radon tiers by County

www.state.NJ.us/dep//rpp/radon/radonin.htm

N.J. Radon Levels

www.NJradon.info/NJ_counties.html

N.J. Radon Testing Guidelines

www.NJ.gov/dep/rpp/radon/radontes.htm

Green Home Maintenance and Housekeeping

Introduction

Your home is one of the biggest investments of your life. Can 'going green' protect your investment and make it safer, more enjoyable and save you money? Yes.

This guide to Green Home Maintenance and Housekeeping practices will improve the health, comfort and environment for your family, and save you money, most directly by reducing your utility bills. The guide's focus on 'Energy' savings, improvements to 'Indoor Air Quality', effective and efficient 'Household Waste Management' and conserving 'Water' all add measurable benefits to you and high return on your investment. Routine checks and repairs will ensure your home's appearance and proper function. By following these recommendations, you will also prevent more expensive damage from occurring.

Outdoor Living and Landscaping

Smart decisions about lawn maintenance and landscaping techniques improve water quality and local habitat. Environmentally-responsible landscaping increases native plant diversity, and reduces stormwater runoff that deposits sediment and pollutants into local rivers and streams.

1. Lawn and landscape care.
   - Perform a soil test to determine **pH** and nutrient availability (test for lead near highways and near old buildings).
   - Evaluate site conditions for sunlight, drainage and space requirements for plants.
   - Improve poor soil conditions with **organic amendments** or quality **topsoil**. Adjust **pH** and add nutrients or install soil drainage systems.
   - Select a diversity of plants adapted to site conditions (soil, light, drainage and space), adding native or pest resistant plants to your landscape design.
   - Select low maintenance cultivars and use proper maintenance to reduce unnecessary pesticide and fertilizer use.
   - For lawns, recycle clippings, keep mower at 2 ½ inches, water early morning and **de-thatch** if **thatch** reaches more than ½ inch in thickness.
   - Landscape to maximize energy efficiency for heating and cooling of home and surroundings.
2. Tips for yard irrigation.
   - Start a **compost pile** and use compost in the garden and landscape to improve soil and provide nutrients to plants.
   - Install a **rain garden** or water collection barrels to reduce the amount of potable water used in your garden and prevent **runoff**.
   - **Drip-irrigate** beds. Line gardens with soaker hoses – no sprinklers, no hassle.
   - Use the proper thickness (3 inches) of natural mulches or dark stone (with landscape fabric) around trees and shrubs to conserve moisture and protect roots from excessive hot or cold temperatures.
   - Chip woody waste and tree clippings into mulch for use on-site.

Design to support connection with nature [SS15]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Fostering **biophilia** through design beautifies space and promotes health and well-being. Inside the home, use indoor plants to provide visual connections to the outdoors through large well-placed windows. Use and enjoy outdoor spaces through the addition of porches, patios, and decks.[1]

A great way to better utilize and appreciate a backyard is to treat it as an extension of the home. By creating different spaces in a yard through the use of hedges, fences, or outdoor elements like gazebos or gliders, homeowners can create beautiful spaces that encourage outdoor living. When designing outdoor spaces, consider the intended functions: play areas, meditation areas, outdoor dining areas, etc. It is important to incorporate as many green strategies as possible.

Time spent outdoors can also help reduce energy consumption and household maintenance costs. There are many do-it-yourself guides to creating outdoor living spaces, or invest in a landscape architect or other professional who specializes in designing green outdoor space. Both will add value to the home landscape and add aesthetic benefits for the homeowner.

Tips [SS15]

Too few guides to creating and designing outdoor living spaces focus on green strategies. Be sure to incorporate strategies from these Guidelines into your plans to enjoy green outdoor living.

Minimize site disturbance [SS29]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

For any home remodeling work, minimizing site disturbance is essential to protect the existing natural environment and prevent soil **erosion**, particularly in New Jersey's suburban, rural, and shore communities. Before beginning a project, consult with the contractor to develop a comprehensive plan for site protection. The NJDEP has established **Erosion** Control Standards for the state. Check with your New Jersey local conservation district office or the Natural Resource Conservation Service for information about strategies for soil **erosion** prevention (such as silt fencing, mulching, etc.) as well as any applicable laws pertaining to your project. Designate off-site parking and a controlled location for building materials when possible. Smaller sites, such as those found in urban areas, may require additional planning for proper movement of materials on and off of the site.

Carefully provide for protection of trees and vegetation. The **drip line**, a vertical plane going from the perimeter of the crown to the ground, contains the minimum area around a tree that should be undisturbed. However, the shallow root system found in the **topsoil** extends further out from the **drip line**, so preserving extra area beyond the **drip line** minimum is critical. If work requires use of heavy equipment, ask for adequate layers of straw or other material to absorb and distribute the weight to prevent soil compaction. Create **tree wells** for changes in grading around trunks and root systems. Consider establishing a system of incentives and penalties with the contractor for protection of existing trees and shrubs.

Planning for minimizing site disturbance conserves resources by reducing the need for new soil and plantings as well as reducing use of excavation equipment. Protecting and/or transplanting existing vegetation avoids the costs of additional future landscaping. Reducing disturbance and stress on trees and plants will reduce additional watering needs. A pre-construction low impact checklist is provided in the Resource section.

Tips [SS29]

Mulch around the base of trees will suppress weeds and retain moisture.
However, "volcanoes" of mulch built-up around the trunk of a tree will weaken and eventually can kill a tree, so keep mulch to the minimal amount needed.

Tips

The best time to conduct a soil sample test is in the fall after harvest or in the spring before fertilization. Sampling should not be done shortly after fertilization or in wet conditions. For lawn care, summer sampling may be conducted to prepare for fertilization in the fall. It is recommended that soil testing be done every 2 to 3 years.

Caution

Gardens with edible components should be grown away from the home as it is less likely that lead and other contaminants may be present in the soil.

Tips

The Rutgers New Jersey Agricultural Experiment Station (NJAES), "Home Composting" article in the Resources section is an excellent guide for constructing, maintaining, and troubleshooting a **compost pile**.

Consult with your County Master Gardeners on good composting strategies and demonstration sites in your area.

Incentive

Check with County/Municipal Recycling Department for free or reduced cost compost bins.

Caution

Open compost piles may attract black bears in northern and central New Jersey. Be careful not to put too much fruit or vegetable waste in an open compost pile if you live in a black bear habitat region.

Tips [SS30]

Keeping foundation plants a few feet away from the home improves air flow. Select low-growing shrubs or flowers to avoid blocking your windows. This allows for a clear line of vision into the landscape and adequate air circulation when windows are open.

Conduct a soil test

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Soil testing determines the fertility and **pH** level, and detects levels of metals such as lead in the soil. To best facilitate new plant and garden growth, one should always first conduct a soil test to determine the optimum level of fertilization needed. Excessive fertilization of nutrients and/or lime can be detrimental to plant growth and may lead to contamination of water resources by nitrates, phosphorus, and other chemicals. In addition, understanding the composition of your soil can help to assess the need for any improvements to facilitate water infiltration of stormwater runoff.

Using a sampling probe, trowel, or spade, collect ten to fifteen cores or slices of soil six inches in length from the surface in the area that is being tested. Mix all of the soil samples in a bucket and put two cups into a plastic bag. This sample can then be sent to a soil sample laboratory for testing. Separate samples should also be gathered in areas where different species of plants are grown.

Soil sample kits may be purchased from your local Rutgers Cooperative Extension county office, garden center, or online. It is imperative to collect soils following the correct procedures to achieve accurate results.[2] Check the Resources section to find your local Rutgers Cooperative Extension county office. Further information on soil testing can be obtained from these offices.

Start a compost pile

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Start a **compost pile** and use compost in the garden and landscape to improve soil health and provide nutrients to plants. Compost piles contain materials like vegetable scraps, grass clippings, leaves, and sawdust that decompose into natural fertilizer. C**ompost** recycles nutrients back into the earth, eliminating the need for store-bought fertilizers and helping the natural environment. Compost also helps the soil retain moisture, aiding **infiltration** and protects roots from excessive hot or cold temperatures.

Homeowners can construct their own compost structures or purchase bins. A **compost pile** in an inconspicuous part of the yard will eventually decompose, but many prefer bins. Bins not only keep the pile neat and deter animals, they also facilitate the decomposition process. Several New Jersey counties offer tours of different types of compost bins and workshops for composting.

Landscape for passive heating and cooling [SS30-31/36]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Proper placement of trees and landscaping beautifies outdoor space and reduces heating and cooling costs. Taller **deciduous trees** on the southeast, south and southwest side of a house provide shading from the high summer sun and allow low winter sun to filter into the home. Hardy **evergreen trees** and shrubs placed at the northeast and northwest corners of the landscape can reduce heating costs by blocking or redirecting cold winter winds over or around the home. On west walls, incorporate **trellises**, **arbors**, and **planting beds** for tall **annuals**, which provides shading of west-facing windows where summertime heat gain is the biggest problem.

Select site-appropriate plants including **native trees** that may reduce watering needs once they are established. Any newly planted tree will require watering, but smaller trees will adapt much faster to site conditions. Larger trees will cost more and take longer to establish in the landscape. **Evergreens** (trees or large shrubs) provide greater protection from wind and noise.

It is always important to consider **genetic diversity** in the design to minimize potential disease and insect problems. Also see The Tree Guide at www.Arborday.org, listed in the Resources section, for growth rate and **crown size** information for specific tree species. Check with New Jersey arborists or your county Master Gardeners' office to choose the right plant for the particular home and lot size. It is important to balance shading with solar access, especially for systems (like solar panels) that require the sun's energy.

Distance from homes and structures are important considerations. In general, medium to large trees should be placed at least 20 feet away from the house. Trees that will be smaller at maturity can be placed closer to the house, but be mindful of the breadth of the full-grown crown of the tree to maintain both energy and aesthetic value.

Make protection of existing trees and shrubs a priority. When possible, consider transplanting rather than complete removal. If trees or large limbs require pruning, use the tree materials for firewood, mulch, or **trellis** construction. When transplanting, remember, that they, too, require plenty of water until they are established (generally through at least one season, depending on size).

NJ Bio-Region [SS30]

The Cape May Plant Materials Center (www.plant-materials.nrcs.usda.gov/njpmc/) provides specific planting ideas that control wind **erosion** using windbreaks and herbaceous wind barriers.

Caution [SS30]

Trees and large limbs can be unwieldy. Removal is best handled by a certified **arborist**.

Minimize impervious surfaces [SS32]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Stormwater **runoff** from **impervious surfaces** can cause flooding, **erosion**, and surface water contamination. Limiting paved surfaces and providing permeable drainage areas aids natural groundwater **infiltration**. **Porous** paving materials, **vegetative swales**, **rain gardens**, and other landscape features will improve **infiltration**.

An overall reduction in paved surfaces prevents **runoff**, allows for stormwater recharge, and mitigates the **heat island effect**, reducing home **cooling loads**. Aiding **infiltration** of groundwater alleviates possible moisture and mold problems that can impact indoor air quality as well.

Problems associated with water **runoff** are most prevalent in areas where there is a large percentage of **impervious** surfaces or in flood prone areas where **runoff** quickly collects, causing flood hazards. In those areas, or for homes with flat roofs, consider **creating a roof garden** to absorb stormwater on site. If a home relies on downspouts, direct them away from nonporous surfaces to allow water to infiltrate into the ground without creating **runoff**.

Rain gardens are depressed areas of the landscape containing various native plant species and are an effective way to reduce **runoff** and promote **infiltration**. Directing stormwater to these areas allows the plants and soil to naturally absorb and filter excess water.

The cost to replace, remove or modify existing paved areas can be significant, but it will mitigate hazards and provide various environmental benefits. See the Resources section for information regarding New Jersey's stormwater regulations, and check with municipal offices for any specific policies.

Tips [SS32]

Some **porous** paving systems may not be appropriate for New Jersey's climate. See the "Standard for Pervious Paving Systems" from the NJDEP Stormwater Best Practices Manual in the Resources section, and be sure to check with an expert if you are unsure about the compatibility of a particular product.

Replace lawn with turf grass or groundcover [SS34]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

The costs—financially and environmentally—of maintaining a conventional lawn are considerable. Irrigation of landscaped areas accounts for 30 percent of residential water or roughly 7 billion gallons every day.[3] Gas-powered lawnmowers create more air pollution per unit of gasoline than cars.

Tips [SS34]

For lawns, recycle clippings, keep mower at 2 ½ inches, water in the early morning and **de-thatch** if thatch reaches more than ½ inch in thickness.

Every county in New Jersey has a Master Gardener program. These trained volunteers provide guidance on lawn alternatives through the County Extension Office.

Tips [SS35]

See the National Wildlife Federation's "Create a Certified Wildlife Habitat" website for information on native plant species and a wealth of other tips.

Incentive [SS35]

The New Jersey Natural Resources Conservation Service runs a Wildlife Habitat Incentives Program (WHIP) that "provides technical and financial assistance for creating, enhancing, and maintaining wildlife habitat on non-federal lands."[4]

NJ Bio-Region [SS35]

Suburban and rural areas may allow for more elaborate habitats, but urban areas benefit too. Even small habitats within their cities add value for nature.

Caution [SS35]

Certain animals, especially bees and wasps, will defend their nests or dens but only if provoked. Protect your wildlife habitat from human or pet intrusion.

Tips [SS37]

Call your County Extension Office for free advice from the county Master Gardener Program.

www.njaes.rutgers.edu/county

NJ Bio-Region [SS37]

The northwestern and shoreline areas of New Jersey have slightly cooler and warmer year-round climates, respectively, than the rest of the state. Check with a local expert if you are unsure about growing specific plants in those bio-regions.

Caution [SS37]

Before deciding to grow your own produce, you may want to test your soil for possible contaminants, such as lead, which could be harmful. The NJAES's Soil Testing Laboratory provides information on contaminants and how you can test your soil for them.

Groundcovers and garden beds are but a few of the many alternatives to the conventional lawn. Naturalizing with **native plants** and creating wildlife habitats are gaining popularity in neighborhoods across the country. Where complete removal of lawn area is undesirable, consider replacing the current grass with low-maintenance **turf grass** varieties, such as **tall fescue** and **fine fescue** that require less water, chemical applications, and less frequent mowing.

Rather than a complete overhaul of the yard, consider creating a gradual plan to reduce lawn area, which will help keep cost to a minimum.

Provide wildlife habitat [SS35]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Creating a wildlife habitat can be a fun, rewarding, and educating experience. It allows for greater appreciation of nature, encourages outdoor living, offers a host of ecological benefits and contributes to natural water **infiltration** and a reduction in lawn area.

Providing a natural habitat for wildlife helps increase local biodiversity and ecosystem stability. It also can facilitate **natural pest management**, reducing the need for pesticides and other higher cost interventions. In New Jersey specifically, there is a need for providing habitats for honey bees, whose numbers have been in decline. Fostering natural habitats for bees could have a significant impact on local pollination and food production in the state.

In designing a natural wildlife habitat, select a diversity of plants from different families that are adapted to site conditions (soil, light, drainage and space). Select plants that are pest resistant and whenever possible use **native plants** in the design. Incorporate sources of food, water, and shelter: bird houses, feeders, and baths; logs and rocks for ground dwellers; and plenty of shaded areas. It is important to remember that creating a "natural" habitat may not be exactly like the original environment and will take some time for species to adapt to the site.

Incorporate edible plants into landscape design [SS37]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

The Garden State is ideal for growing edible plants at home. Growing even small amounts of fruits or vegetables encourages healthy eating and sustainable lifestyles, protects the environment, and gives gardeners a sense of personal satisfaction.

Food-producing plants require watering, but may require less than a conventional lawn. Incorporating edible plants such as blueberries or raspberries along with ornamentals contributes to overall lawn reduction and less mowing. Growing one's own food not only saves money at the grocery store, it helps protect the environment by reducing energy use and overall pollution associated with the transportation of food products. Consider using **indoor sunspaces** or insulated porches for winter growing as well.

There are a wide variety of vegetables, fruits, and herbs that grow well in New Jersey's climate. Best of all, the seeds and small plants needed to get started are very inexpensive and widely available. Keep in mind that some food-producing plants may need as much water, fertilizer and pesticides as a lawn. For example, vegetables like sweet corn, tomatoes, and melons and fruits such as peaches and apples can be higher maintenance crops. Information on species that grow well in New Jersey, as well as strategies for incorporating edible plants properly into your yard, is available in the Resources section. One may also want to consider protecting their fruits and vegetables from being eaten by animals (ie., deer, gophers, voles) with a fence. There are also some natural organic repellents that use various smells and tastes to keep pests out of the garden.

Practice Integrated Pest Management [SS38]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Chemicals from pesticide applications enter our **watersheds** as **runoff** and **infiltrate** underground **aquifers**. They are tracked into our homes by shoes and pets, compromising the safety of our indoor environment. Their toxicity is dangerous to people, children, and wildlife, and they contribute to an overall unhealthy natural world. Therefore, in landscaping, an essential strategy must be to require minimal, if any, chemicals, pesticides, or artificial fertilizers.

Integrated Pest Management includes best practices to minimize environmental impacts by using eco-friendly methods to control pests. **IPM**'s prevention, monitoring, and control techniques offer an alternative to chemical pesticides. **IPM** techniques enhance sustainability of vital natural systems, promote insect and disease resistant lawns, trees and shrubs, protecting beneficial insects and wildlife. **IPM** reduces threats to water quality from chemicals that would otherwise reach our drinking and recreational water resources.

Select low maintenance turf grasses and plant cultivars and use **IPM** approaches to reduce unnecessary pesticide and fertilizer use.

Provide rainwater collection system [WE40]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Utilizing a **rainwater collection system** can be a simple inexpensive way to control **runoff** and greatly reduce outdoor water use. Add a rain barrel under the roof's downspout to collect and store rainwater. In the case of significant rainfall events, connect another rain barrel to the system for overflow protection. With the addition of a hose or a spigot, the water is easily used in the yard or garden. Rain barrels can be either homemade or store-bought. See the Resources section for links to step-by-step instructions for constructing your own. More sophisticated systems can store collected rainwater in large underground or above ground tanks, where it is then recycled for irrigation.

This strategy is particularly cost-effective in suburban and rural parts of New Jersey where there is considerable outdoor watering. In all areas, however, **rainwater collection** is important since it helps alleviate **runoff** problems.

Check with your local municipality for any restrictions and regulations concerning **rainwater collection systems**.

Use eco-friendly patio/decking materials [MR111-113]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A	INITIAL COST:	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

A deck or patio is an important aspect of creating an outdoor living space. Fortunately, consumers have many alternatives for environmentally-responsible materials to create these central features. For wooden decks, consider choosing locally grown cedar or **pressure-treated lumber**, the best of which is treated with sodium silicate and heat. If this is unavailable, other treatments include copper, **borates**, and **Light Organic Solvent Preservatives** (**LOSPs**). Alternatives to wooden decks are plastic and wood-plastic composite decks. These products are often made from recycled material and generally last longer than wooden decks.

Tips [SS38]

The foundation is the primary entry point for insects so follow the **Integrated Pest Management (IPM)** best practice and keep untreated wood and vegetation at least a foot away from the soil line and foundation walls.

The County Extension Offices in New Jersey have gardener hotlines staffed all year long by trained Master Gardener Volunteers. They can answer all your questions about companion plantings, lawn alternatives and **Integrated Pest Management**.

Caution [WE40]

Rain barrels should be securely covered to protect children and animals from accidental drowning and to reduce egg-laying potential of mosquitoes. It only takes a few days for mosquitoes to go from egg to adult.

Caution [MR111-113]

Cooking on an outdoor grill over plastic deck materials can be a potential fire hazard, as hot coals may quickly ignite these kinds of decks.

Tips [IDP28]

Depending on the decking material, special fasteners may be necessary. For example, copper based preserved lumber is corrosive to steel.

Caution [IDP28]

The REGREEN Guidelines provide instruction on how to properly detail the connection, but if you are not comfortable, consider hiring a professional who can do the work properly.

Tips [IEQ162]

An overall reduction in waste materials requires less transport of waste from your home, saving energy and money.

Add sawdust from untreated lumber to your compost pile along with leaves and household vegetable waste.

Caution [IEQ162]

In older homes, concerns about **asbestos** and lead paint should be referred to a professional.

NJ Bio-Region

Urban areas in particular can benefit greatly from roof gardens, as they generally contain more flat roof area and less green space at the ground level.

Caution

Do not underestimate the combined weight of soil, plants, and even fruits or vegetables; all roofs, especially those of older structures, need to be examined carefully for structural soundness before attempting this strategy.

The greenest option is to choose a stone or brick patio over a deck when possible. Patios last longer and can reduce the potential for water damage to the house. Reuse salvaged stone or brick to conserve resources, especially when these materials are obtained locally. **Porous** pavement is another option. Instead of concrete, fill the space around the paving elements with sand to facilitate filtration and reduce **runoff**. Some local public works departments may have facilities where bricks are recycled, so check there if planning to build a brick patio. While the up-front costs for environmentally-friendly materials can be higher, the durability requires less maintenance and replacement.

Properly detail between deck and house [IDP28]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS:	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY: N/A	DIFFICULTY LEVEL:	

Fasten and seal decks properly to prevent structural damage from water flowing into the **ledger plate** and **rim joists** of the house. A poor connection will shorten the life of the deck and require replacement or repairs far sooner. Carefully detailed connections seal water away from the structure of the house, which also can help protect indoor air from the mold and mildew problems associated with moisture.

Correctly connected decks are especially important in wet and flood-prone and coastal regions of New Jersey, as well as on older homes where age could contribute to structural concerns. A well-constructed connection means a deck will last considerably longer, reducing the need for repair and replacement. This saves money and conserves natural resources.

Plan projects for easy clean-up and disposal [IEQ162]

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

When planning for any outdoor construction, it is important to anticipate sawdust and other waste products and have a strategy for controlling and disposing them properly. Sawdust in particular can be dangerous if it gets into the water system where it can affect water quality for aquatic animals.

Proper removal of sawdust prevents it from polluting the water system or from getting indoors and into the air you breathe. When possible, recycling of waste products will save future resources.

The extra planning necessary for proper waste material management is not difficult, but it does require careful consideration.

Create a roof garden

BENEFITS		FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	INITIAL COST: $$$	
RESOURCE CONSERVATION:	AIR QUALITY:	DIFFICULTY LEVEL:	

Any flat or gently sloping roof (including those on garages and sheds) can potentially accommodate a **green roof**. This centuries-old practice has received renewed interest due not only to its aesthetic quality but also the environmental benefits associated with **green roofs**. **Green roofs** greatly reduce stormwater **runoff**, reduce the **heating and cooling loads** of a building, and help to increase the life span of the roof itself. Moreover, they increase green space and provide a habitat for birds, small animals, and insects.

Green roofs are known by many names - eco-roofs, rooftop gardens, vegetated rooftops, sky gardens, etc. Most **green roof** systems fall into two categories, **extensive** and **intensive**. This

categorization is based on soil depth, but determines a variety of factors including weight, cost, maintenance, plant selection, and function. Not all residential buildings may be structurally designed to handle intensive **green roof** systems (those that contain several feet of soil and can grow large plants and trees). Extensive **green roofs**, therefore, may be a more viable option. These **roof gardens** can contain a wide variety of plants that require minimal care: mosses, lichens, sedums, wildflowers, meadow grasses, etc.. While more limited in the range and size of plant species as a more intensive roof garden, they are cheaper both to create and maintain and provide many of the same environmental benefits.

Another avenue to pursue is a **container garden** that will allow a homeowner to grow a variety of vegetables and fruits in raised **planting beds** and plant containers. Growing tomatoes, cucumbers, or peppers in a **roof garden** is an excellent way for a homeowner to enjoy greater use of the roof.

Choose eco-friendly pool/hot tub options [EA97]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:		INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	TT

Swimming pools and hot tubs make great recreational additions to any home, but consume high levels of water and energy. Fortunately there are ways to minimize the environmental damage of pools and hot tubs.

Use a swimming pool cover for a simple, affordable way to prevent evaporation, the biggest source of energy loss in the pool. Prices vary as do styles, so homeowners should expect to spend more on certain alternatives, like a **solar cover**. The return on investment for a solar pool cover, however, will defray the up-front cost in greatly reduced heating costs. Hot tubs should be well-insulated and have a tight cover to reduce heat loss and evaporation.

Another popular option is to install a **solar pool heating system**. Swimming pools require simpler solar heating systems than homes due to their design, seasonal use, and lower temperature requirements. The cost for purchasing and installing a solar heating system can be high, but since such a system significantly reduces energy use thus eliminating all future pool heating bills, the payback period improves dramatically.

When possible, consider alternatives to high chlorination for swimming pools and hot tubs. **Copper/silver electrolysis**, **ionization**, and **UV** technologies offer alternatives to chemically-treated water. Saltwater pools are also viable alternatives, but may be subject to local prohibitions.

Use efficient lighting/minimize light pollution [EA88-89]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS:	WATER SAVINGS:	N/A	INITIAL COST:	$$
RESOURCE CONSERVATION:	AIR QUALITY:	N/A	DIFFICULTY LEVEL:	TT

In recent decades, nighttime **light pollution** has become an increasing concern. While many cite safety as the main reason to keep areas lit at night, there are a host of problems associated with outdoor lighting. Not only does it block out the view of the night sky, it negatively impacts sleeping patterns and disturbs the natural cycles of plants and animals. In addition, too much nighttime lighting may actually reduce overall visibility. Excessive use of nighttime lighting puts additional energy cost burdens on both individual owners and to municipal and state governments. **Light pollution** is a major concern in densely-populated New Jersey, especially in its urban areas; our state's residents should seek opportunities to reduce their individual contributions to this problem.

Fortunately there are ways to reduce **light pollution**. Motion sensors provide light only when needed, which cuts overall lighting and saves electricity. Also, **full cut-off fixtures** limit light above or to the side of the fixture. These features are commonly available and, once installed, do not require daily maintenance. Consider replacing old light fixtures with **Energy Star**®-rated ones. Choose solar powered lamps as alternatives for lighting along driveways and walkways. These units store energy during the day, are easy to install and do not require any electricity or wiring.

Tips [EA88]

Since outdoor motion sensor lighting requires lamps that turn on instantaneously, incandescent bulbs are more appropriate than **CFLs** in those types of fixtures. Advances in **LED** lighting will make them more affordable than they currently are and a greener option for outdoor lighting. [4]

NJ Bio-Region [EA88]

In New Jersey, many municipalities and counties (including Eatontown, Hopewell Township, Moorestown, and Hunterdon County) have enacted outdoor lighting ordinances intended to control light pollution. More locations may follow suit as public awareness of the problems associated with light pollution increases. Be sure to check local ordinances for outdoor lighting requirements or restrictions.

Caution [EA88]

CFLs contain small amounts of mercury. Therefore, they need to be recycled properly. See the Resources section for information on how to clean up a broken **CFL**.

Choose eco-friendly furniture/accessories [MR154]

BENEFITS			FEASIBILITY	
ENERGY SAVINGS: N/A	WATER SAVINGS: N/A		INITIAL COST: $$	
RESOURCE CONSERVATION:	AIR QUALITY:		DIFFICULTY LEVEL:	

Choosing outdoor furniture is difficult since weather degrades many materials. Furniture made from **virgin plastic** and **PVC** (vinyl) is generally inexpensive but degrades in sunlight, requiring more frequent replacement and creates solid waste problems. Therefore, consider locally-grown cedar products, **FSC-certified wood** furniture or furniture made from **High-Density Polyethylene (HDPE)** composite material.

For other outdoor equipment, look for durable products designed to withstand the elements, including stainless steel grills and terra-cotta fire pots. Whenever possible, consider using salvaged wood and other products for furniture or accessories. With a little creativity, salvaged products can make attractive outdoor accessories.

Tips [MR154]

Cover your outdoor furniture or store it indoors when not in use to protect it from New Jersey's extreme winter and summer weather.

General Design and Construction

Design to support connection with nature [SS15]

Resources:

HGTV: Outdoor Rooms

www.hgtv.com/gl-design-small-space/outdoor-rooms/index.html

References:

[1]**REGREEN Residential Remodeling Guidelines 2008**

www.regreenprogram.org/documents/regreen_guidelines.pdf

Site

Minimize site disturbance [SS29]

Resources:

NJDEP (2004) New Jersey Stormwater Best Management Practices Manual: Low Impact Checklist

www.state.nj.us/dep/stormwater/tier_A/pdf/Nj_SWBMP_A.pdf

NJDEP, New Jersey Erosion Control Standards

www.nj.gov/agriculture/divisions/anr/nrc/njerosion.html

NJDEP, Conservation Districts in New Jersey

www.nj.gov/agriculture/divisions/anr/nrc/conservdistricts.html

Rutgers New Jersey Agricultural Experiment Station: Transplanting Trees and Shrubs

www.njaes.rutgers.edu/pubs/publication.asp?pid=fs376

Controlling Soil Erosion and Sediment During Construction, www.sanjuanislandscd.org/Information/Articles/assets/04-06percent20Erosionpercent20Controlpercent20Duringpercent20Construction.pdf

Conduct a soil test

Resources:

Rutgers: If Plants Could Talk

www.ifplantscouldtalk.rutgers.edu/

Rutgers New Jersey Agricultural Experiment Station: Soil Testing Laboratory

www.njaes.rutgers.edu/soiltestinglab/

Rutgers New Jersey Agricultural Experiment Station: Cooperative Extension County Offices

www.njaes.rutgers.edu/county/

References:

[2]**Rutgers Cooperative Research and Extension. Heckman, Joseph R., Lance-Scibilia, Susan and Murphy, Stephanie. 2004.**

Soil Testing for Home Lawns and Gardens

www.njaes.rutgers.edu/pubs/publication.asp?pid=fs797

Start a compost pile

Resources:

Rutgers New Jersey Agricultural Experiment Station (New Jersey Agricultural Experiment Station), Home Composting

www.njaes.rutgers.edu/pubs/publication.asp?pid=FS811

USEPA: Composting

www.EPA.gov/osw/conserve/rrr/composting/index.htm

New Jersey's Manual on Composting Leaves and Management of Other Yard Trimmings

www.nj.gov/dep/dshw/rrtp/compost/front.htm

New Jersey Agricultural Experiment Station: Backyard Leaf Composting

www.njaes.rutgers.edu/pubs/publication.asp?pid=fs074

New Jersey Agricultural Experiment Station: County Master Gardeners Office

www.njaes.rutgers.edu/county

Landscape for passive heating and cooling [SS30-31/36]

Resources:

The Tree Guide

www.arborday.org/treeguide/growth.cfm

N.J. Agricultural Experiment Station: Transplanting Trees and Shrubs

www.njaes.rutgers.edu/pubs/download-freeasp?strPubID=FS376

New Jersey Agricultural Experiment Station: How to Hire a Tree Care Professional

www.njaes.rutgers.edu/pubs/download-free.asp?strPubID=FS019

NJDEP: A Quick Reference to New Jersey's Biotic Forest Health Threats

www.nj.gov/dep/parksandforests/forest/forest_health_threats.pdf

New Jersey Agricultural Experiment Station: Plant and Pest Advisory

www.njaes.rutgers.edu/pubs/plantandpestadvisory/2001/ln0726.pdf

New Jersey Pest Management Association

www.njpma.com/consumers/index.html

Trees ROI Calculator

www.greenandsave.com/landscaping/gardens/trees.html

Minimize impervious surfaces [SS32]

Resources:

NJDEP: New Jersey Stormwater Best Management Practices Manual, Standard for Pervious Paving Systems

www.state.Nj.us/dep/**watershed**mgt/DOCS/BMP_DOCS/bmpfeb2004pdfs/feb2004chap9_7.pdf

Polluted Runoff: Sewage: Your Environmental Impacts

www.lowimpactliving.com/pages/your-impacts/**runoff**

New Jersey Agricultural Experiment Station : Rain Gardens

www.water.rutgers.edu/Fact_Sheets/fs513.pdf

New Jersey Agricultural Experiment Station : New Jersey's Stormwater Regulations

www.water.rutgers.edu/Fact_Sheets/fs556.pdf

Wisconsin Department of Natural Resources: Rain Gardens – A how-to manual for homeowners

www.dnr.state.wi.us/org/water/wm/dsfm/shore/documents/rgmanual.pdf

Replace lawn with turf grass or groundcover [SS34]

Resources:

Rubin, Carole et al. *How to Get Your Lawn Off Grass*. Harbour Publishing, 2002.

Rutgers New Jersey Agricultural Extension Service: Landscaping for Water Conservation

www.njaes.rutgers.edu/pubs/download-free.asp?strPubID=E080

Lawn Alternatives

www.eartheasy.com/grow_lawn_alternatives.htm

Reducing Lawn Area

www.recycleworks.org/greenbuilding/sus_lawnarea.html

References:

[3] USEPA WaterSense: Outdoor Water Use in the United States

www.epa.gov/watersense/pubs/outdoor.htm

Provide wildlife habitat [SS35]

Resources:

New Jersey Audubon Society: Backyard Habitat

www.njaudubon.org/Education/BackyardHabitat/

National Wildlife Federation: Create a Certified Wildlife Habitat

www.nwf.org/backyard/

USDA NCRS: Backyard Conservation – Wildlife Habitat

www.nrcs.usda.gov/feature/backyard/pdf/Wildlife.pdf

New Jersey Agricultural Experiment Station: Crop Profiles for Honey Bees in New Jersey

www.pestmanagement.rutgers.edu/njinpas/CropProfiles/NJHoneyBeeCP.pdf

New Jersey NCRS: Wildlife Habitat Incentives Program

www.nj.nrcs.usda.gov/programs/whip/

New Jersey Agricultural Experiment Station: County Extension

www.njaes.rutgers.edu/county

References:

[4] WHIP – New Jersey NCRS

www.nj.nrcs.usda.gov/programs/whip/

Provide for edible plants in landscape design [SS37]

Resources:

New Jersey Agricultural Experiment Station: Planning a Vegetable Garden

www.njaes.rutgers.edu/pubs/publication.asp?pid=FS129

New Jersey Agricultural Experiment Station: Varieties for New Jersey Vegetable Gardens

www.njaes.rutgers.edu/pubs/publication.asp?pid=FS681

N.J. Agricultural Experiment Station: Selecting Blueberry Varieties for the Home Garden

www.njaes.rutgers.edu/pubs/publication.asp?pid=FS419

New Jersey Agricultural Experiment Station, Lead Contaminated Soil: Minimizing Health Risks

www.njaes.rutgers.edu/pubs/publication.asp?pid=FS336

New Jersey Agricultural Experiment Station: Soil Testing Laboratory

www.njaes.rutgers.edu/soiltestinglab/

Virginia Cooperative Extension, Intensive Gardening Methods

www.ext.vt.edu/pubs/envirohort/426-335/426-335.html

Utilize Integrated Pest Management [SS38]

Resources:

National Sustainable Agriculture Information Service, Companion Planting: Basic Concepts and Resources

www.attra.ncat.org/attra-pub/complant.html

USEPA, Integrated Pest Management

www.EPA.gov/agriculture/tIpm.html

New Jersey Agricultural Experiment Station, Cooperative Extension Pest Management Office

www.pestmanagement.rutgers.edu/index.htm

Washington Toxics Coalition, Lawn and Garden Chemicals

www.watoxics.org/homes-and-gardens/lawn-and-garden

Association of New Jersey Environmental Commissions, Integrated Pest Management
www.anjec.org/html/ipm.htm.

Division of Parks & Forestry – Tree Care & Pests and Diseases
www.state.nj.us/dep/parksandforests/forest/community/Tree_care.htm

Provide rainwater collection system [WE40]

Resources:

Chesapeake Bay Foundation: Build Your Own Rain Barrel

www.cbf.org/site/DocServer/rain_barrel_guide-web.pdf?docID=2868

Mid-America Regional Council: Build Your Own Rain Barrel

www.marc.org/Environment/Water/buildrainbarrel.htm

Home & Garden Television: Rain Barrels

www.hgtv.com/landscaping/rain-barrels/index.html

Rainwater Collection

www.greenandsave.com/utility_savings/water/rain_water_collection.html

Green Values Stormwater Calculator

www.greenvalues.cnt.org/calculator

NJ Department of Agriculture – Jersey Grown

www.jerseygrown.nj.gov/

Outdoor Structures

Use eco-friendly patio/decking materials [MR111-113]

Resources:

REGREEN Product Checklist

www.regreenprogram.org/documents/product_checklist.pdf

Green Living Ideas – Sustainable Decking Solutions

www.greenlivingideas.com/decking/sustainable-decking-solutions.html

Decking

www.greenandsave.com/landscaping/patio_deck/decking.html

Properly detail between deck to house [IDP28]

Resources:

U.S. Forest Service, Details for a Lasting Deck

www.fpl.fs.fed.us/documnts/pdf1997/falk97d.pdf

This Old House, Building a Safe Deck

www.thisoldhouse.com/toh/article/0,,212625,00.html

REGREEN Guidelines, IDP 28 Deck Attachment at Band Joist, p.143

www.regreenprogram.org/

Plan projects for easy clean-up and disposal [IEQ162]

Resources:

Lumber Pressure Treated with CCA

www.dec.ny.gov/chemical/8790.html#epaalt

Create a roof garden

Resources:

The Environment Site Green Living Guides – Building a Roof Garden

www.theenvironmentsite.org/guides/eco-friendly-roof/building-a-roof-garden/

Green Roofs for Healthy Cities, greenroofs.org/

USEPA: Green Roofs

www.EPA.gov/hiri/strategies/greenroofs.html

Earth Pledge – About Green Roofs

www.earthpledge.org/gr/more-about-green-roofs

Michigan State University - Green Roof Research Program

www.hrt.msu.edu/greenroof/

Osmundson, Theodore H. *Roof Gardens: History, Design, and Construction.* New York: W.W. Norton and Co. 1999

National Renewable Energy Laboratory – Solar Hot Water

www.nrel.gov/learning/re_solar_hot_water.html

Choose eco-friendly pool/hot tub options [EA97]

Resources:

Energy Efficiency Fact Sheet: Hot Tub and Pool Conservation Tips

www.energy.wsu.edu/documents/building/res/spatips.pdf

National Renewable Energy Laboratory, "Conserving Energy and Heating Your Swimming Pool with Solar Energy"

www.nrel.gov/docs/fy00osti/28038.pdf

U.S. Department of Energy: A Consumer's Guide to Swimming Pool Heating

www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13130

Lighting and Electrical

Use efficient lighting/minimize light pollution [EA88-89]

Resources:

USEPA Energy Star® - Light Bulbs and Fixtures

www.EnergyStar.gov/index.cfm?c=lighting.pr_lighting

USEPA, Mercury – Spills, Disposal and Site Cleanup

www.EPA.gov/mercury/spills/index.htm

Greenandsave.com: Solar Path and Garden Lights

www.greenandsave.com/landscaping/lighting/solar_path_and_garden_lights.html

International Dark Sky Association, www.darksky.org

New Jersey Astronomical Association, Light Pollution

www.njaa.org/light.html

NJDEP, Outdoor Lighting Ordinance Guide

www.state.Nj.us/dep/opsc/docs/Sample_Lighting_Ordinance.PDF

Furniture and Fittings

Choose eco-friendly furniture/accessories [MR154]

Resources:

Five Eco-Friendly Outdoor Furniture Brands

www.associatedcontent.com/article/678943/five_ecofriendly_outdoor_furniture.html?cat=6

Greening Your Outdoor Furniture

www.hubpages.com/hub/Greening_Your_Outdoor_Furniture

Case Study

Location of Project: Bernardsville, New Jersey

Landscape Architect: Michael Fleischacker CLA, ASLA, **LEED** AP

General Contractor: Back to Nature

Overview and Scope

This project involved a home converted from stables located on a six-acre property. The homeowners approached Back to Nature in 2002 to help transform the outdoor spaces surrounding the home to be in tune with their organic, nature-loving, and family-oriented lifestyle. The project incorporated several environmentally-conscious strategies, and the outdoor spaces continue to develop as a reflection of the clients' green lifestyle.

Design Approach

The original goal of this project was to create a series of outdoor rooms that would "unfold" in a way similar to the indoor rooms of a home. The project started with a site master plan that evaluated the barriers between indoors and out. Over the next seven years, the landscape architect continued working with the client as the project evolved in the areas of growing organic food, restoring native habitats, integrating alternative energies and stormwater retention practices, promoting a healthy and inviting atmosphere for family and friends, and connecting the homeowners with their land.

Team and Process

An integrated design process has played a value-adding role in realizing the potential of this project. Over the course of this outdoor remodel, stakeholders have included the clients, the landscape architect, architects, contractors from all trades, engineers, arborists, organic consultants, apiary specialists, forest managers, municipal agents, and neighbors.

Finance

Costs are an important consideration for all projects. This venture was no different as costs were woven into the fabric of the project. The project team anticipated and realized both tangible and intangible returns on the investments into this project including a decreased reliance on purchased produce, transportation energy savings and a greatly expanded living space.

Lessons and Trade-offs

The landscape architect points out that there are always surprises in the construction industry; it is a matter of recognizing that fact and anticipating as many of the surprises as you can up front. Having said that, he did not think he would have done anything differently. One thing that this project taught him was that the entire process must be flexible and evolve the same way that the stakeholders and the site do. The world is constantly changing, and so all projects must evolve with it.

> *"The most rewarding aspect of this project is the relationships I have found myself in with the clients and the other professionals that have had a stake in this regenerative residence."*
>
> ***- Michael Fleischacker***

Streetside garden

Organic garden

Compost bins

List of Green Strategies

Native Restoration

- Converted lawn to birch grove garden, woodland gardens, and native stone terraces
- Removed invasive species and reintroduced **native species** to woodland ground covers and understory
- Removed stilt grass and lawn from septic field area and reseeded with native prairie mix

Growing organic food and flowers

- Planted peach, pear, and apple trees in orchard
- Created a part-shade herb and vegetable garden with plants selected for their historic medicinal and food value
- Incorporated raised garden beds and a kitchen/cutting garden that expanded significantly the farming capabilities of the property
- Incorporated cold frames to extend the growing seasons and provide a controlled environment for drying fruit, herbs, and vegetables
- Created compost bins from cedar logs, allowing for 100 percent of biodegradable waste to remain on-site and be reintroduced as compost soil in the garden beds
- Built a corn crib-inspired wood shed used to split and store wood harvested from dead or fallen trees, which then are used in wood burning stoves as alternative heating for the residence and ancillary structures
- Created an apiary garden with a beehive that produces fresh honey for a variety of family uses while adding value to the gardens through pollination
- Proposed future projects, including a "green" greenhouse and free range chicken

New pavillion

Other Green Strategies

- Installed low voltage landscape lighting
- Planted edible "living" holiday trees for wildlife habitat and food throughout the winter
- Utilized regional materials and contractors for all aspects of this project.
- Installed an outdoor kitchen
- Proposed **photovoltaic** array, salt water spa, and solar energy for water heating

Kitchen garden

Before

After

Case Study

Location of Project: Bucks County, PA

Homeowners: Richard and Barbara Geller

Architect: Moira McClintock, Jane Wilson, Ford3 Architects

General Contractor: Robert Mitchell

Landscape Architect: Barbara Geller, Landscape Designer, GardensByBarbara

Area Affected: Approximately 600 square feet

Overview and Scope

The project was a new 'garden room' addition to a historical 18th century bank barn that was converted into a home in the 1970's. The owners wanted to have the addition integrate with both the existing living space and the surrounding landscape, using similar materials and repeating design elements. The room was intended to expand the size of the indoor living area yet convey the feeling of being outdoors and close to nature.

Since the owner is a landscape designer and believes in advancing ecological goals, the possibility of incorporating a vegetative **green roof** was seriously considered during design discussions.

Design Approach

The architects are committed to green solutions and implement both active and passive sustainable technologies in their projects. They encouraged exploration and had access to knowledgeable local contacts.

The owner was particularly attracted to the aesthetics and ecological advantages of using a **green roof**. In addition, she was open to using other green technologies, if cost effective.

Team and Process

The homeowners and designers each had a general orientation to green solutions. The architects, in particular, had many successful green project implementations. The building contractor had many years of experience working in the Bucks County area and had previously done work for the owners. He, however, had no experience with green technologies. For the **green roof** installation, he worked closely with the **green roof** suppliers to make sure all components were correctly installed. Over time, he became very committed to the project and felt a genuine pride and enthusiasm in his contribution.

Finance

Since the actual size of the **green roof** was relatively small (approximately 250 square feet), the added cost of a **green roof** was not as much of an issue as it would have been for a larger area. The owner/landscape designer was committed to doing a **green roof**; the additional cost was not an issue.

The owner is a recent graduate of the NY Botanical Garden in Landscape Design and had many contacts at the school for suppliers of **green roof** materials. She acquired estimates for building the **green roof** from several of these established **green roof** supplier/builder teams prior to actually selecting the supplier and builder. When a builder the owner had previously used said he would come out of retirement and travel up from Florida to do the project, the owners decided it was an offer too good to refuse. The actual cost incurred by purchasing the supplies directly from a **green roof** supplier and using the owners' contractor was approximately 10 percent less than working with an established supplier/builder team. The cost of the **green roof** was approximately 15 percent more than a high quality copper standing seam roof which would have been the alternate choice.

The owner anticipates a lower cost for heating and air conditioning as a result of installing a **green roof** and having good cross ventilation compared to a more traditional roof. The savings, however, are difficult to quantify since the room has only existed with a **green roof** and there would be no other comparable experience.

Lessons and Trade-offs

There were no serious surprises with this project. The roof was designed and built in an arched form to match the surrounding landscape. The construction work involved in implementing the roof curve was more than anticipated and added to the complexity of installing the **green roof** components.

Serious planning was required to determine the plants for the **green roof**. The site is only sunny for about a third of the day, so sedum plants, which are traditionally used for **green roofs** and thrive in the hot, dry sun, were not an option. Instead, the landscape designer decided to use a palette of low-maintenance, drought-tolerant, ground cover plants with various leaf textures and flowering times. The plants were installed in late August 2008 and have thrived in the special **green roof** growing media. It is anticipated that some supplemental watering will be required for the first year or two until the plants are well established. This plant palette also required a media depth of 4 - 5 inches. The structural engineer needed to take into account this additional roof load when specifying the **glulam** support beams.

In the opinion of the landscape designer and owner, the combination of the aesthetics of a **green roof** and its ecological advantages make it an obvious solution for anyone who is interested in the environment and has an appreciation of nature.

"I felt the project was a great example of collaboration and synergy between the architects, builder and owner. Each provided their own particular expertise and worked collaboratively with the others, presenting ideas and brainstorming solutions. The final result is terrific ."

- Barbara Geller, owner/landscape designer

Green roof over new addition

List of Green Strategies

Energy Conservation

- Installed **green roof** to reduce **heating and cooling load**
- Incorporated cross ventilation into window design to reduce cooling load
- Installed **roof overhang** to reduce summer heat gain and increase winter **passive heat** gain from the sun
- Installed radiant floor heating
- Increased roof insulation **R-Value** by using foam insulation

Water Conservation

- Reduced stormwater **runoff** by installing **green roof**

Resource Conservation

- Reused Bucks County field stone from an abandoned stone wall found up the road from new structure

Outdoor Air Quality

- Increased carbon dioxide absorption and oxygen emission from the **green roof** plant photosynthesis

Before

After

Green Products and Services

Introduction

The purpose of the Green Products and Services is to help homeowners navigate the market with some helpful tips on what to look for when shopping for a particular green home remodeling project. The Guide is organized by building system and lists the general products and services that pertain to remodeling tasks within that system. It includes features and applicable certifications to look for, as well as web links to more information on that product or service. Each item in the Guide also refers to the related REGREEN strategy IDs.

Please note that the New Jersey Green Home Remodeling Guidelines Version 1.0 do not endorse any particular brand or company. It is not the function of the Green Product and Service Guide to direct the consumer to a specific product, but rather to provide a resource to seek out an appropriate manufacturer or service provider to handle remodeling needs.

With the ever-increasing number of green products and services coming into the home remodeling market, finding the appropriate ones can be a challenge. Some manufacturers market products as "green" when in reality they are only marginally better for the environment or whose green features are neutralized by other aspects of their manufacturing or composition. This phenomenon is referred to as "greenwashing" and calls on consumers to seek out references and ensure the true extent of green value.

Product Certification Programs

That being said, there are several leading green product standards and certification programs that can help consumers identify products that meet predefined green criteria. The leading green product standards and programs include:

- Energy Star® - identifies efficient products that reliably deliver energy savings and environmental benefits
- WaterSense – identifies high performing, water efficient products and practices
- Cradle to Cradle - certifies products based on lifecycle of materials used to construct a product and the overall lifecycle of the product
- GreenGuard® Certification Program - certifies products and processes for their low chemical emissions and low toxicity
- Green Seal® - certifies products and practices for their low toxicity and overall environmental impact
- GreenSpec Directory - a published resource on environmentally preferable products
- Forest Stewardship Council (FSC)- certifies wood products coming from forests managed to meet social economic and ecological needs
- Sustainable Forestry Initiative (SFI) - certifies wood products coming from well-managed forests and responsible procurement practices
- National Fenestration Rating Council® (NFRC) - a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products

For more information on various certification programs currently in use by architects and designers see:

- the ecolibrary™matrix - www.thegreenstandard.org/documents/GGNC09_EcoLibCert.pdf
- Gaia Product Profile developed by The Green Standard™ - www.thegreenstandard.org/gaia.html

Two other reputable sources for green products and services are:

- Green Building Advisor that lists products from the GreenSpec Guide to Residential Building Materials www.greenbuildingadvisor.com/
- National Association of Home Builders (NAHB) Research Center - www.nahbrc.org/manufacturer/greenapproved/index.aspx

Product Standards for GreenSpec[1]

1. Products Made with Salvaged, Recycled, or Agricultural Waste Content
   a. Salvaged products
   b. Products with **post-consumer recycled content**
   c. Products with **pre-consumer recycled content**
   d. Products made with agricultural crop waste material

2. Products That Conserve Natural Resources
   a. Products that reduce material use
   b. Products with exceptional durability or low maintenance requirements
   c. Certified wood products
   d. Rapidly renewable products

3. Products That Avoid Toxic or Other Emissions
   a. Natural or minimally processed products
   b. Alternatives to ozone-depleting substances
   c Alternatives to hazardous products
   d. Products that reduce or eliminate pesticide treatments
   e. Products that reduce stormwater pollution
   f. Products that reduce impacts from construction or demolition activities
   g. Products that reduce pollution or waste from operations

4. Products That Save Energy or Water
   a. Building components that reduce heating and cooling loads
   b. Equipment that conserves energy and manages loads
   c. Renewable energy and fuel cell equipment
   d. Fixtures and equipment that conserve water

5. Products That Contribute to a Safe, Healthy Built Environment
   a. Products that do not release significant pollutants into the building
   b. Products that block the introduction, development, or spread of indoor contaminants
   c. Products that remove indoor pollutants
   d. Products that warn occupants of health hazards in the building
   e. Products that improve light quality
   f. Products that help noise control
   g. Products that enhance community well-being

Sources

[1] The online GreenSpec® Directory lists product descriptions for over 2,000 environmentally preferable products at www.buildinggreen.com

Alex Wilson."Building Materials: What Makes a Product Green?" EBN Volume 9, Issue 1 (revised January, 2006) www.buildinggreen.com/auth/article.cfm?fileName=090101a.xml

Outdoor Living and Landscaping

Site

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
New Jersey native plants	Locally grown plants that will thrive in New Jersey's climate and advance local biodiversity. Shop at local nurseries, university agriculture sales, etc.		National Gardening Association www.garden.org/home Native Plant Society of New Jersey, List of New Jersey Native Plants: www.npsnj.org/lists_njplants.htm Conserving Energy with Landscaping www.ext.vt.edu/pubs/envirohort/426-712/426-712.html NJ Department of Agriculture – Jersey Grown www.jerseygrown.nj.gov/	SS34/35/37-38
Block pavers	Use block pavers for driveways, entryways, walkways, or terraces.		ToolBase Services. Permeable Pavement www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=6604&BucketID=6&ategoryID=11	SS32
Pavement	Use porous pavement materials and/or materials that reflect the sun.		Cool Pavements - USEPA www.epa.gov/heatisland/mitigation/pavements.htm Cool Paving -The Encyclopedia of Earth www.eoearth.org/article/Cool_paving	SS32
Porous concrete	Use porous concrete. It requires the same equipment as standard concrete. The mix is composed of gravel and a low water-to-concrete ratio.	American Society for Testing and Materials - ASTM 1319 (standard specifications for Concrete Grid Paving Units) requires a minimum compressive strength of 5000 psi.	PerviousPavement.org, "Pervious Concrete" www.pervious pavement.org	SS32
Rain garden plants	Select appropriate rain garden plants.		Rain Garden Network www.raingardennetwork.com NJAES, Rutgers University njaes.rutgers.edu	WE40

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Pesticide	For gardening, look for an insecticidal soap and a broad-spectrum natural pesticide containing neem oil, spinosad, or pyrethrum.		Natural Pesticides www.livingwithbugs.com/natural_pesticides.html Earth Easy - Natural Lawn Care www.eartheasy.com/grow_lawn_care.htm	SS38
Erosion control products	Silt fencing and mulching help control erosion, especially during construction. Use socks filled with chipped or ground wood to reduce soil erosion and manage runoff.		Controlling Soil Erosion and Sediment During Construction www.sanjuanislandscd.org/Information/Articles/assets/04-06percent20Erosionpercent20Controlpercent20Duringpercent20Construction.pdf	SS29
Fertilizer	For lawn care, use a fertilizer with time-released, water-insoluble nitrogen, or use composting for natural fertilizer. Control weeds with corn gluten (which kills weed seedlings) and spot-spray weeds with a solution of 5 parts white vinegar, 2 parts water, 1 part dish soap.		Earth Easy - Natural Lawn Care www.eartheasy.com/grow_lawn_care.htm	SS34
Outdoor Structures				
Sustainably harvested wood	Wood labeled FSC is certified by the Forest Stewardship Council (FSC) and meets high social and environmental harvesting criteria.	FSC	How To Find Sustainable Wood www.thedailygreen.com/environmental-news/community-news/sustainably-harvested-wood-66120201 Plastic Lumber Guide: Healthy Building Network healthybuilding.live.radicaldesigns.org/downloads/gtpl_condensed.pdf	MR111-113
Plastic lumber	HDPE wood plastic composites	FSC	Plastic Lumber Guide Healthy Building Network: healthybuilding.live.radicaldesigns.org/downloads/gtpl_condensed.pdf California Integrated Waste Management Board's Recycled Content Product Directory www.ciwmb.ca.gov/RCP/	MR111-113
Rain barrel	Rain barrels either can be purchased or homemade. Several online retailers and some hardware or garden stores sell rain barrels of varying size and complexity.		Chesapeake Bay Foundation: Build Your Own Rain Barrel www.cbf.org/site/DocServer/rain_barrel_guide-web.pdf?docID=2868 Mid-America Regional Council: Build Your Own Rain Barrel www.marc.org/Environment/Water/buildrainbarrel.htm Home & Garden Television: Rain Barrels www.hgtv.com/landscaping/rain-barrels/index.html	WE40

Outdoor Living and Landscaping

Site

Product	Features	Certifications	Product Directory/Service Resources	REGREEN ID
Pool chemicals	Copper/silver ionization and UV technologies are effective non-chemical strategies to keep pools clean and free from harmful pathogens.		Green Style Mag: Eco-friendly Pool Treatment www.greenstylemag.com/blog/?p=845 Associated Content "Eco Friendly Swimming Pool Supplies" www.associatedcontent.com/article/1837785/eco_friendly_swimming_pool_supplies.html?cat=6 Coolest Gadgets - Solar Powered Pool Purifier www.coolest-gadgets.com/20070629/solar-powered-pool-purifier-makes-swimming-nearly-chemical-free/	EA97
Compost bin	Protected area to collect yard and vegetable waste to make organic soil.		University of Missouri Extention: How to Build a Compost Bin www.extension.missouri.edu/publications/DisplayPub.aspx?P=G6957 Backyard Gardener: Garden Compost Site www.backyardgardener.com/compost/index.html	
Lighting and Electrical				
Energy efficient lighting	CFLs or LEDs; solar lighting fixtures	ENERGY STAR	USEPA Energy Star®, Light Bulbs and Fixtures www.energystar.gov/index.cfm?c=lighting.pr_lighting Lighting Research Center Outdoor Lighting Handbook www.lrc.rpi.edu/researchAreas/outdoor.asp International Dark Sky Association www.darksky.org	EA88-89
Furniture and Fittings				
Outdoor furniture	Look for products made with sustainably harvested wood or recycled content.	FSC	Eco-Friendly Outdoor Furnishings: The Home Know-It-All www.thehomeknowitall.com/the_home_knowitall/2008/05/eco-freindly-ou.html	MR154

aquifer An aquifer is an underground formation of permeable material that contains a substantial quantity of water.

arbor(s) Arbors or pergolas, as they are commonly known, typically consist of a combination of pillars, cross beams, and lattice work upon which vegetation such as vines can be trained and provide shade. Some varieties are attached to existing structures including houses or decks.

asbestos Asbestos is the name given to a number of naturally occurring, fibrous silicate minerals mined for their useful properties such as thermal insulation, chemical and thermal stability, and high tensile strength. Asbestos is commonly used as an acoustic insulator, and in thermal insulation, fire proofing and other building materials. Many products in use today contain asbestos.

biophilia The term biophilia literally means the "love of living things." It was coined by Edward O. Wilson, an entomologist at Harvard University, to describe his hypothesis that humans have an inherent connection to nature associated with our evolution.

borate(s) Borates are boron-containing, naturally-occurring minerals. Common commercial applications of borates include wood treatment, detergent additive, and plant fertilizer.

combustion appliances Combustion equipment refers to appliances that burn fuels including stoves, water heaters, and clothes dryers. It is important to make sure that these appliances work correctly and are properly ventilated to prevent carbon monoxide, a byproduct of combustion, from entering the home.

Compact Fluorescent Lights (CFLs) Compact fluorescent lights are the miniature fluorescent lights that can screw into standard light fixtures that conventionally use incandescent bulbs. CFLs are more energy-efficient and durable than incandescent bulbs.

companion planting Companion planting can be described as the establishment of two or more plant species in close proximity so that some natural benefit (pest control, higher yield, etc.) is derived.

compost pile A compost pile consists of organic matter including lawn clippings, leaves, and branches that is typically collected in a bin where it can decompose and be added to plant beds improving the soil quality with nutrients.

container garden Containers including planter boxes, wooden barrels, and large flower pots can be filled with soil, be planted, and arranged as an addition to an existing garden or to create a new one where plants wouldn't otherwise be able to grow in places such as rooftops or patios.

cooling load Cooling load refers to the amount of heat that gets removed by an HVAC system.

copper/silver electrolysis Electrolysis is the process by which an electric current is passed through a substance that causes it to gain or lose electrons.

deciduous tree(s) Deciduous trees are species that shed their leaves for part of the year.

dethatch Dethatching is the removal of dead grass from a lawn.

disposable respirators Disposable respirators or filtering facepieces can be made of cloth or paper and are designed to clean the air as you breathe it to prevent you from inhaling irritating substances.

drip-irrigation Drip, or micro-irrigation, technology uses a network of plastic pipes or soaker hoses to carry a low flow of water under low pressure to plants. Drip irrigation exceeds 90 percent efficiency whereas sprinkler systems are 50 to 70 percent efficient.

dripline The dripline of a tree refers to the area of ground located directly under the circumference of its outermost branches. This area indicates where the tree should be watered as opposed to the base of its trunk where it can develop root rot.

erosion Erosion is the process by which soil and rock are worn away through water, wind, ice and wave transport.

evergreen trees Evergreen trees retain their needles or leaves through the winter and into the next growing season.

fine fescue Fine fescues are grasses chosen for their advantageous IPM qualities such as drought tolerance, low maintenance, texture and color differences, and their performance as natural or unmowed areas.

Forest Stewardship Council (FSC) – Certified Wood The Forest Stewardship Council certifies wood that complies with its standards-disapproving of illegally harvested wood, wood harvested in violation of traditional and civil rights, in forests in which high conservation values (areas particularly worthy of protection) are threatened through management activities, from conversion of natural forests, and from areas where genetically modified trees are planted.

full cut-off fixture Full cut-off light fixtures direct light from outdoor light sources to where it is needed and block excess light that is emitted upwards or sideways reducing light pollution.

garden bed Garden beds are designated areas in a landscape for plants and other natural materials.

genetic diversity Genetic diversity refers to the variety in a gene pool of a species or population.

glazing Window glazings are compounds applied to glass to reduce the amount of heat transfer between the interior and the exterior of a building and/or the ultra-violet (UV) light passing that passes through it.

glulam Glulam is a structural timber product composed of laminated layers of wood. It is generally composed of woods that could otherwise be waste. The laminate strengthens the beams making them good elements for green roofs.

green roof Green roofs are contained vegetative roof coverings that provide a variety of economic, ecological, and aesthetic benefits including reducing the heating/cooling loads of the building, reducing runoff, and producing oxygen among others.

- **extensive** Extensive green roofs are 6 inches or shallower and are frequently designed to satisfy specific engineering and performance goals.
- **intensive** Intensive green roofs may become quite deep and merge into more familiar on-structure plaza landscapes with promenades, lawn, large perennial plants, and trees.

hardy turf grass Hardy turf grasses are able to grow in a variety of conditions and are low maintenance reducing the need for fertilizers and pesticides.

heat island effect The heat island effect occurs in densely urbanized areas where impermeable roof and pavement temperatures increase during the summer, elevating the air temperature. This in turn generates a greater demand in energy consumption for cooling systems which concentrates air pollutants and creates smog. Runoff from these heated surfaces reaches waterways where it can increase the water temperature and negatively affect ecosystems.

HEPA filtered air scrubbers High efficiency particulate air or HEPA air filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles down to a size of 0.3 micrometers (µm) in diameter.

HEPA vacuum High efficiency particulate air or HEPA filters are a type of high-efficiency air filter that remove at least 99.97% of airborne particles 0.3 micrometers (µm) in diameter. HEPA filter used in vacuum cleaners trap the fine particles (such as pollen and dust mite feces) which trigger allergy and asthma symptoms.

High-Density Polyethylene (HDPE) High-density polyethylene (HDPE) is a thermoplastic used to make milk bottles, packaging containers, toys and other products. It is known for its resistance to most chemicals, high impact tensile strength, and insolubility in organic solvents.

Home Performance Audit Home Performance Audits are conducted to assess the energy efficiency of a home and evaluate possible energy saving measures.

IICRC S500 Guidelines The Institute of Inspection, Cleaning and Restoration is an independent, non-profit certification body that sets and promotes standards for the inspection, cleaning and restoration service industry. These guidelines provide specific practical standards for water damage restoration.

impervious surface Impervious surfaces such as concrete and conventional asphalt that do not allow water penetration.

indoor sunspace Indoor sunspaces provide a buffer between a home's interior and exterior reducing the exposure of temperature fluctuation and direct sunlight. Made of glass, they may serve as an additional living space where the user can enjoy the natural warmth and light produced by the sun.

infiltration Infiltration is the process by which water seeps through the ground before reaching a nearby water body or an aquifer.

Integrated Pest Management (IPM) Integrated Pest Management is an effective and environmentally sensitive form of pest management that utilizes monitoring, prevention, and control techniques.

ionization Ionization is a treatment where water passes through a metal chamber (usually copper or silver) exposed to a low voltage causing the ions to penetrate the outer membrane of any pathogens in the water and thus kill or render them harmless.

ledger plate A ledger plate is a strip of wood laid flat across the tops of studding as a support for joists.

Light-Emitting Diode (LED) Light Emitting Diodes are electronic light sources that use less energy than incandescent bulbs or compact fluorescent lamps.

Light Organic Solvent Preservatives (LOSPs) Light organic solvent preservatives contain insecticides and sometimes water repellents to protect wood from pests and weather conditions.

light pollution Light pollution is excessive, unwanted light typically projected upward and/or outward from an artificial light source.

mold amplification sites Mold amplification sites are locations where mold has built up over time. Typical sites of indoor mold buildup are damp cellulosic materials (e.g., wallboard paper, wallpaper, carpet backing, damp papers); debris in ventilation ducts, in carpets, or in mattresses or upholstered furniture; poorly maintained humidifiers; insulation on which organic film has accumulated; constantly humid painted, caulked or plastic surfaces (e.g., windowsills, shower stalls, cold air return vents); and potted plant soils.

National Fenestration Rating Council (NFRC) The National Fenestration Rating Council (NFRC) is a non-profit organization that administers the only uniform, independent rating and labeling system for the energy performance of windows, doors, skylights, and attachment products.

native plants/species Native plants, species or trees that occur in the region in which they evolved.

natural pest management Natural pest management employs pest control techniques that are environmentally sensitive and effective based on prevention, monitoring, and using the least toxic chemicals possible.

non-porous Non-porous materials lack any spaces where gasses or liquids can pass through.

organic amendments An organic soil amendment improves soil's water retention, permeability, water infiltration, drainage, aeration and structure by adding materials such as wood chips, grass clippings, straw, compost, manure, sawdust and wood ash. Organic is a greener substitute for inorganic amendments that use non-living or synthetic materials.

pH pH is a measure of the acidity or basicity of a solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are said to be basic or alkaline.

planting bed Planting beds are areas designated in a landscape for planting.

porous Porous materials have spaces through which gases and/or liquids can pass.

pressure-treated lumber Pressure-treated lumber undergoes a process where chemical preservatives are infused deeply within. These products are insect and rot resistant and can be found in a variety of forms including boards, posts, and plywood primarily for exterior use.

PVC (vinyl) Polyvinyl chloride is a plastic commonly used as piping that is capable of off-gassing harmful chemicals.

rainwater collection system Rainwater collection systems, also known as rainwater catchment systems or rainwater harvesting, employ a system of gutters, pipes, and containers to collect and store rainwater from roofs. Depending on the amount of water collected, it can serve as a primary or supplementary water source for such uses as watering plants. Collecting rainwater reduces runoff and saves resources.

rainwater garden Rainwater gardens are constructed landscape systems that utilize native plants to collect runoff.

rim joist Rim joists are the boards that cap the ends of the floor system.

roof garden Roof gardens are landscape systems constructed on a building's roof to reduce runoff, decrease heat island effect as well as cooling load in the summer and heating load in the winter, remove air pollutants, and add aesthetic value among other purposes.

runoff Runoff is water that doesn't infiltrate the ground but instead flows above ground to a water body.

single-pane window Single-paned windows have only one piece of glass separating the interior and exterior of a home. Double-pane windows are considered to be much more energy-efficient.

solar cover Solar covers are used to retain the water temperature in pools and may also serve as a form of protection.

solar pool heating system In solar pool heating systems water circulates through a large heat exchange surface, usually located on your roof, and absorbs the sun's energy. Most solar 'collectors' are flat black panels manufactured from high technology plastics which have been designed to resist weather and ultraviolet radiation. These heating systems can also be used for hot tubs.

stormwater recharge Stormwater recharge is the active restoration of groundwater resources by way of stormwater drainage systems.

tall fescue Tall fescues are grasses that can grow in cool conditions as a lawn, for erosion control, athletic fields, and other uses.

thatch Thatch is a layer of grass stems, roots, clippings, and debris that settle on the ground and either slowly decompose and/or accumulate over time. Some thatch is healthy for a lawn, but excessive thatch (over 1/2 inch thick) creates a favorable environment for pests and disease, an unfavorable growing environment for grass roots, and can interfere with some lawn care practices.

topsoil Topsoil is the outermost layer of soil primarily composed of organic matter.

trellis Trellises are structures that usually consist of latticework to support vegetation including vines and other creeping plants.

Ultraviolet (UV) technologies Ultraviolet technologies include systems that utilize ultraviolet radiation for purposes such as water treatment.

vegetative infiltration swale Vegetative infiltration swales are planted areas intended to catch runoff where it can be filtered and enter the ground.

virgin material Virgin material is made exclusively with raw materials and contains no recycled content.

watershed Watersheds physically describe the drainage basins of a region including all lands and water bodies that flow into it main waterway.

windbreak Windbreaks are barriers typically consisting of trees, shrubs, crops, fences, and other materials to direct wind flow.

Photography Credits

Cover

Top left: John D.S. Hatch, Trenton Row House Case Study

Top right: Michael Fleischacker, Hanson Case Study

Below top right: Ed Schwartz, Schwartz Case Study

Bottom left (top): Patricia Gaylor, Abbott Case Study

Bottom left (bottom): Ford3 Architects and Barbara Geller, Geller Case Study

Bottom right: John D.S. Hatch, Trenton Row House Case Study

Kitchen, Bath and Living Spaces

Cover: Patricia Gaylor, Abbott Case Study

Case Study 1: Jacqueline Germany, Montclair Casew Study

Case Study 2: Lori Jacobsen, Quinn Case Study

Case Study 3: Randall Solomon, Solomon Case Study

Case Study 4: Patricia Gaylor, Abbott Case Study

Case Study 5: Patricia Gaylor, Collins Case Study

Case Study 6: Stephen Fiedler, Fiedler Case Study

Case Study 7: Photography by www.marisapellegrini, Twin Maples Case Study

Finished Basement and Major Addition

Cover: Lise Thompson, James Dean House Case Study

Case Study 1: Ed Schwartz, Ridgewood Case Study

Case Study 2: Deborah Monroe, Monroe Case Study

Case Study 3: Tom Verschilling, Greendale Case Study

Case Study 4: Lise Thompson, James Dean House Case Study

Weatherization and Energy

Cover: John D.S. Hatch, Trenton Row House Case Study

Case Study 1: Thomas G. Wells, Parkland Properties Case Study

Case Study 2: John D.S. Hatch, Trenton Row House Case Study

Case Study 3: GreenStreet Energies, Black Case Study

Case Study 4: Darren Port, Bellvue Court Case Study

Outdoor Living and Landscaping

Cover: Michael Fleischacker, Hanson Case Study

Case Study 1: Michael Fleischacker, Hanson Case Study

Case Study 2: Ford3 Architects and Barbara Geller, Geller Case Study

Back Cover

Left: Photography by www.marisapellegrini, Twin Maples Case Study

Middle: Lise Thompson, James Dean House Case Study

Right: Patricia Gaylor, Collins Case Study

Rutgers Center for Green Building [RCGB]

The Rutgers Center for Green Building is located at the Edward J. Bloustein School of Planning and Public Policy, Rutgers, The State University of New Jersey. The Center forms a common umbrella for existing and proposed initiatives being carried out through separate Centers at the Bloustein School, the School of Environmental and Biological Sciences (formerly Cook College), the School of Engineering and other Rutgers units that are integral to developing and implementing innovative green building strategies.

The Rutgers Center for Green Building has developed capabilities in applied green building research that entail modeling the life cycle cost and environmental impact of buildings, post occupancy study tools including survey research and building operating data analysis, and financial methodologies to better estimate green building value. The Center has produced a series of reports documenting best practices in green building and regularly provides green building training and education modules for a variety of audiences.

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The Rutgers Center for Green Building develope the guidelines with extensive input and review by an expert advisory group comprised of residential building and remodeling professionals, interior designers, landscape architects, and experts in the field of green building and energy-efficient design.

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