

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]
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- 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]
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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

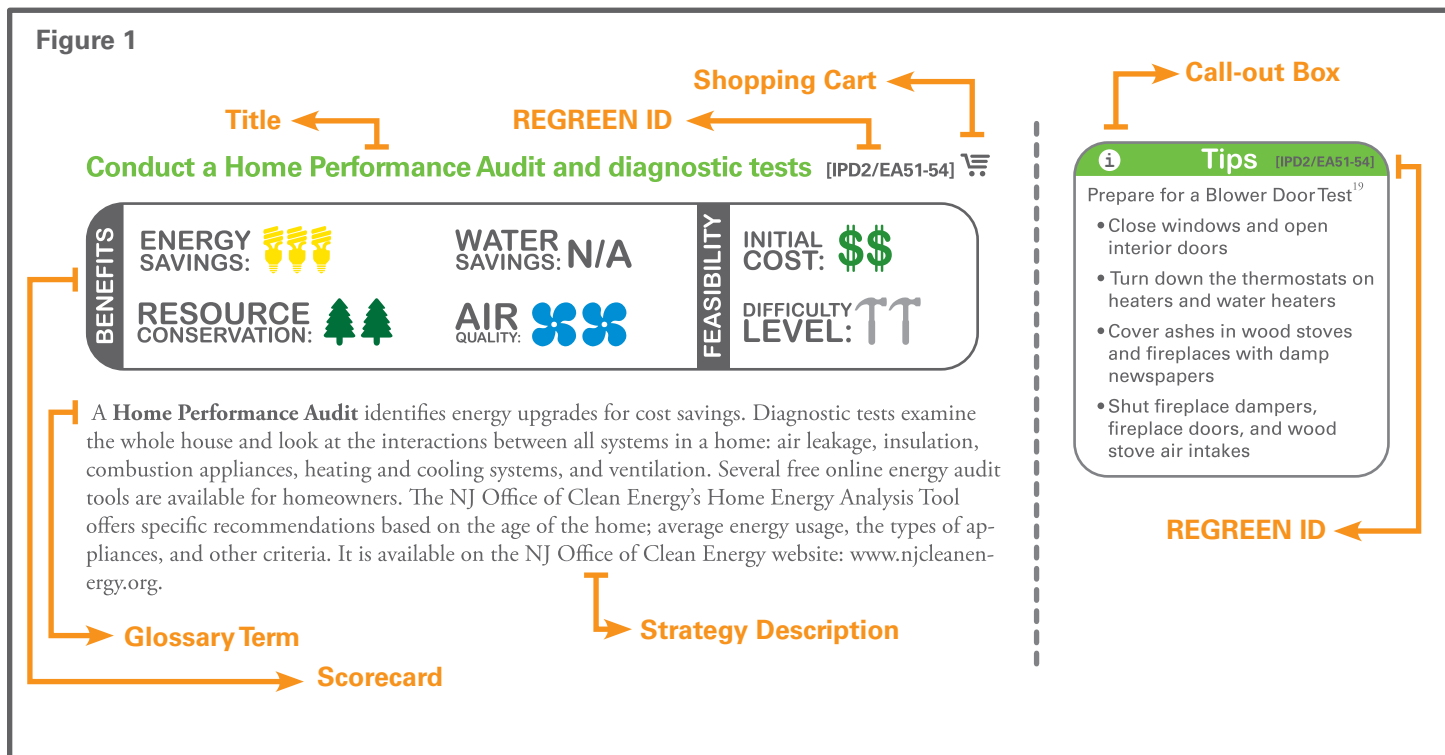
The Guidelines are organized into chapters by major project type: Kitchen, Bath and Living Spaces, Finished Basement and Major Addition, Weatherization and Energy, and Outdoor Living and Landscaping.

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.



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 
- HS2 – Hazardous Materials - Asbestos & Lead 
- HS3 – Mold 
- HS4 – Radon 

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.



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

 low difficulty level,  medium difficulty level,  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 (CO₂)** 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 CO₂ footprint.

Figure 2

i 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 straightforward to 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.

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

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

 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/rtrtp/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. If 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	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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.

Consider on-site renewable energy [EA102]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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 [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.

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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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.]

Minimize impervious surfaces [SS32]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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 [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

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**.

Tips [SS39]

Municipal Department of Public Works (DPW) often offer free chipped wood materials.

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.

Landscape to minimize heat island effects [IDP17]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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**.

Plan for erosion control [SS39]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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.

Test and install a radon mitigation system [IEQ163]

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

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 [EA47]

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

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**

i **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.

i **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 [IDP19]

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  [IDP19]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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 [MR114]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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 Test¹⁹
- 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]

 **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.

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	INITIAL COST: \$\$\$
	RESOURCE CONSERVATION: 	AIR QUALITY: 		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.

Install or upgrade insulation [EA49]

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

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 (CFCs)** or **hydrochlorofluorocarbons (HCFCs)**, 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/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

 **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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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 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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	INITIAL COST: \$
	RESOURCE CONSERVATION: 	AIR QUALITY: 		DIFFICULTY LEVEL: TT

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   [IDP22]

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

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

[IDP24]

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

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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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 (HVACs) 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

[EA64]

BENEFITS

ENERGY SAVINGS:

WATER SAVINGS:

FEASIBILITY

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

ENERGY SAVINGS:

WATER SAVINGS:

FEASIBILITY

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 contaminants.

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	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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.

Conduct duct tightness test [EA68]

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

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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	INITIAL COST: \$
	RESOURCE CONSERVATION: 	AIR QUALITY: 		DIFFICULTY LEVEL: TT

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

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 [EA65]

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

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


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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	INITIAL COST: \$
	RESOURCE CONSERVATION: 	AIR QUALITY: 		DIFFICULTY LEVEL: T

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.

Tips [MR121]

Wiring raceways can simplify the task of wiring and reduce wall penetrations that can compromise a building's thermal performance.

Utilize solar water heating [EA101]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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 CO₂ annually and gas water heaters about two tons of CO₂ 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.

Plan for future wiring and cabling needs [MR121]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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  [EA83]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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 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	ENERGY SAVINGS: 	WATER SAVINGS: N/A	FEASIBILITY	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.

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

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



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

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 [MR126]

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

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

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.

Select eco-friendly wall coverings [MR129/IEQ186]

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

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.

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

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

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.

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.

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.

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 [IEQ188]

BENEFITS	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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	ENERGY SAVINGS: 	WATER SAVINGS: 	FEASIBILITY	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.sustainableites.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., PE.**

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.eere.gov/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_heating.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.

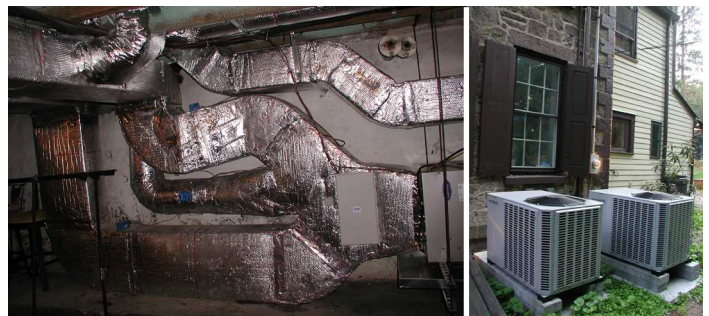
So far, the owners have reported reduced energy use from the previous owners by roughly 70 percent. When all aspects of the project are complete, they expect to be at 80 percent - 90 percent lower than the energy used by the previous owners despite the fact that the house will be nearly 40 percent larger!

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



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



Salvaged front doors

Expandable spray foam insulation*

*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, WESKerch 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 BASE, 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

Integrated 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 managers 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

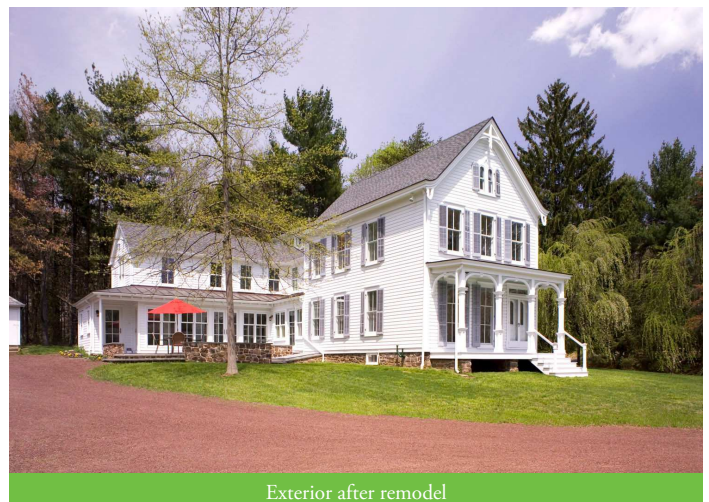
In order for a project to be truly sustainable and repeatable, it needs to be financially feasible. In this project, the research involved in determining which products to use, evaluating their impact and locating those products in a timely fashion was the greatest contributor to the increased budget 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 opposed 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)

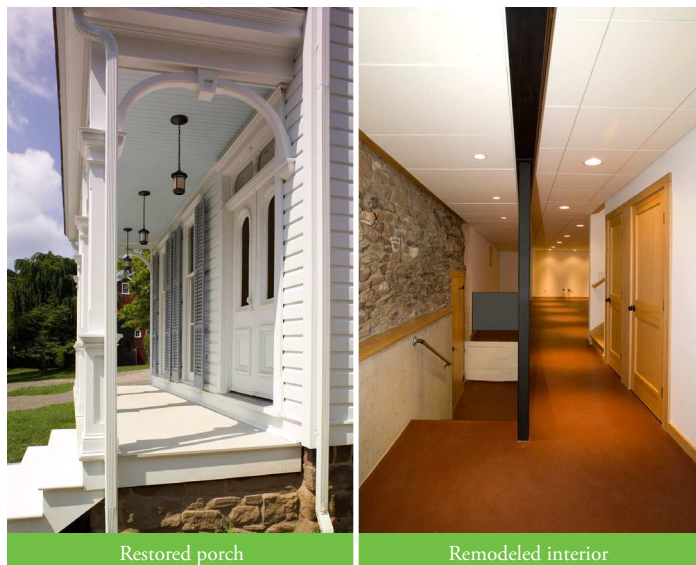
- Replaced existing built-in gutters and soffits with 16- ounce copper interior gutters and molding that match the original detailing
- Re-pointed and water proofed the original foundation
- Installed an underground drainage system that collects water from most of the downspouts and the foundation drain 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

- Guttered 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 GreenSpec¹


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







¹The 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.perviouspavement.org/ ToolBase Services. Permeable Pavement www.toolbase.org/Techinventory/TechDetails.aspx?ContentDetailID=604&BucketID=6&CategoryID=11 PerviousPavement.org: Pervious Concrete www.perviouspavement.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 .		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.		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, bamboo, 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.scs-certified.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.		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.		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.	 	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 .	 	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.		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.	 	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.		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).		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.		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 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.		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.eere.gov/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.		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 come with features such as dimming and motion sensors.		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 raceways	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.		<p>Taking a Green Approach to Furniture www.greenhomeguide.com/index.php/knowhow/entry/943/C221/</p> <p>Sustainable Furnishings Council www.sustainablefurnishings.org/</p> <p>Rapidly Renewable Revolution www.eco-structure.com/docs/archives%202006/eco_jan06/eco_jan06_eco-tech.pdf</p>	MR141-143/ 146-147/150
Used furniture	Reduces the need to produce new furniture and the pollution from the manufacturing and transportation processes.		<p>Craigslist www.craigslist.org</p> <p>Freecycle www.freecycle.org</p> <p>Habitat for Humanity ReStore Directory – New Jersey www.habitat.org/cd/env/restore_detail.aspx?place=67</p>	MR141-143/ 146-147/150
Cabinetry and furniture: certified sustainable wood	Responsibly harvested products promote resource stewardship.	<p>Rainforest Alliance-Smart Wood</p> 	<p>Forest Stewardship Council – FSC www.fsc.org</p> <p>Planet Green, a Discovery Company – How to Go Green: Furniture Planetgreen.discovery.com/go-green/green-furniture/</p> <p>Rainforest Alliance www.rainforest-alliance.org</p> <p>Taking a Green Approach to Furniture www.bayarea.greenhomeguide.com/index.php/knowhow/entry/943/C221</p>	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	<p>Scientific Certification Systems: Indoor Air Quality www.scs-certified.com/ecoproducts/indoorairquality/index.html</p> <p>Taking a Green Approach to Furniture www.greenhomeguide.com/index.php/knowhow/entry/943/C221/</p> <p>Sustainable Furnishings Council www.sustainablefurnishings.org/</p> <p>Rainforest Alliance – Rediscovered Wood www.rainforest-alliance.org/forestry.cfm?id=rediscovered-wood</p>	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.	<p>Scientific Certification Systems) -Indoor Advantage</p> 	<p>GreenGuard www.greenguard.org</p> <p>Scientific Certification Systems: Indoor Air Quality www.scs-certified.com/ecoproducts/indoorairquality/index.html</p>	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 (CO₂) 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 warmth 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 didcyldimethylammonium 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.

Glossary

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.

Glossary

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.

