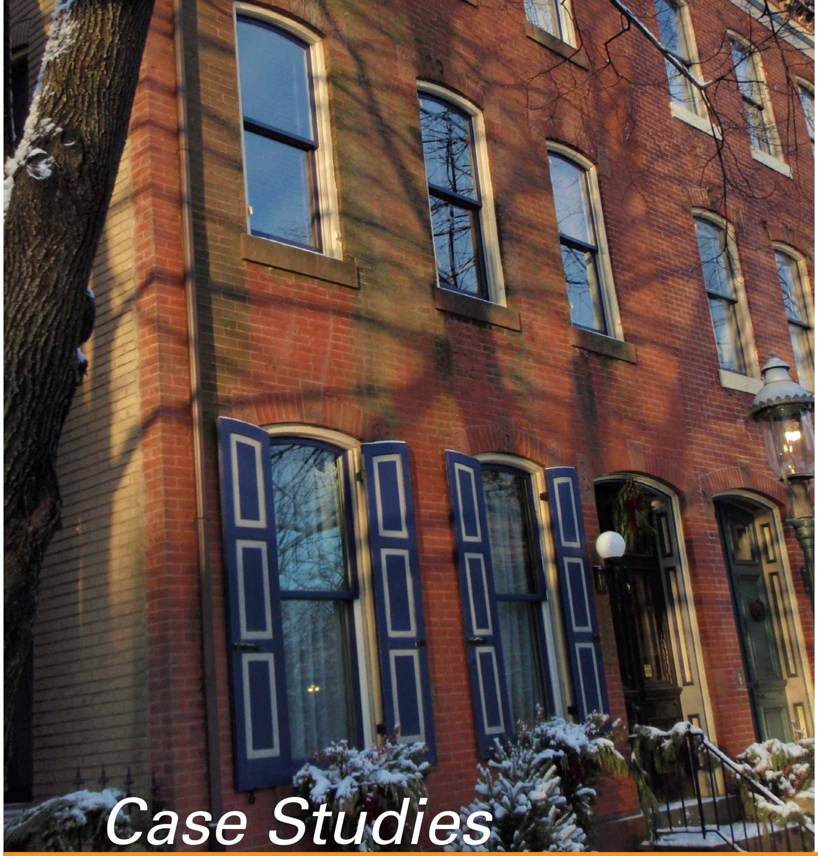

Case Studies

NJ GREEN HOME
REMODELING GUIDELINES

Use of the Guidelines

What are the guidelines and what are they not?

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

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

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

New Jersey Green Home Remodeling Guidelines Version 1.0

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

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The development of *NJGHRG Version 1.0* has been managed by the Rutgers Center for Green Building and has included review and suggestions by an Expert Advisory Group comprised of residential building and remodeling professionals, interior designers, landscape architects, and experts in the field of green building and energy-efficient design.

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Richard and Barbara Geller
James and Barbara Hanson
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Deborah Monroe
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Mr. and Mrs. Ryan Quinn
Ed Schwarts and Julie Tung
Randall Solomon and Rebecca Hersh

REGREEN
ASID & USGBC

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RUTGERS
Center for
GREENBUILDING

Jennifer Senick
Executive Director
Rutgers Center for Green Building

Weatherization and Energy

New Jersey's climate requires homes to perform efficiently in both hot and cold temperatures. Homeowners can use high-efficiency appliances and HVAC equipment, passive solar techniques, proper ventilation, air sealing, and durable roofs to ensure high performance and diminish the home's total energy consumption. The result will be a reduction in space heating, cooling and water heating requirements. These strategies promote overall building energy efficiency and durability throughout the year.

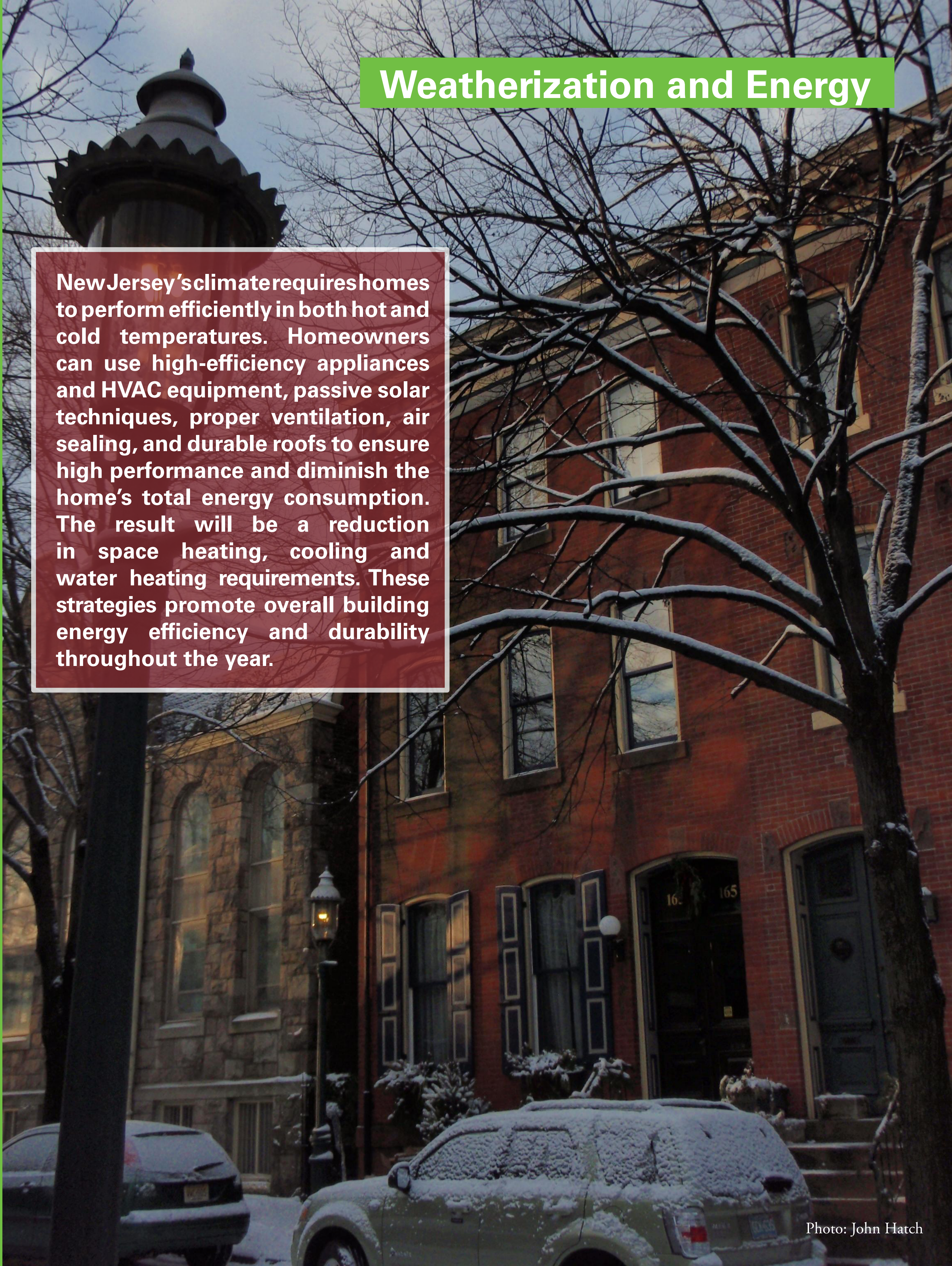


Photo: John Hatch

Case Study

Homeowners: Parkland Properties, LP, Thomas G Wells, Member
Interior Designer: Emily **K**. Buehrle, EKB Designs
General Contractor: Thomas G Wells Construction, L.L.C.
Area Affected: 3200 sq feet

Overview and Scope

This two-stage home renovation increases energy efficiency, improves indoor air quality, and utilizes sustainable building products. The first stage was a remodel of the kitchen, increasing its size from 123 square feet to 180 square feet. The second stage began with a comprehensive Energy Audit of the **building envelope** followed by remediation of air **infiltration** and insulation deficiencies, replacement of the existing oil furnace with a **heat pump**, and a post-remediation Energy Audit. The overall goal of the contractor was to make the interior space comfortable and visually appealing while ensuring easy maintenance and energy efficiency.

Design Approach

The house is a rental property that the owners intend to rent well into the foreseeable future. This will enable monitoring of energy consumption and equipment durability over an extended period. The contractor saw this as an opportunity to try out various sustainable building products and energy efficiency strategies. He looked at the products needed for the project (i.e., new counter tops) and evaluated various sustainable options that fit the criteria. He also used this opportunity to evaluate the feasibility of various energy upgrades, such as air sealing and insulating knee walls in crawl spaces. The interior designer, Emily Buehrle, has a strong background in space planning and sustainable building products. She assisted the homeowners to meet their goals of interior features, colors, and textures that would resonate with the home's future occupants.

Team and Process

Tom Wells and his crew did the majority of the framing, finishing, window installation, cabinetry installation, and painting, while various other parts of the project were subcontracted. Tom was the leader in designing the green aspects of this project, relying on input from Wes Carver Electrical Contractors and Rob Taurino of JA Smith Heating and Air Conditioning. Ted Inoue was invaluable as the energy auditor and system evaluator.

Finance

The total cost of the renovations without the standard contractor mark-up was approximately $81,000. This overall cost did not seem out of proportion to other traditional kitchen remodeling projects done by the contractor. For this project, budgeting generally came secondary to the project goals; more importantly, the team wanted to demonstrate the value of techniques and products of which the average contractor and homeowner may not be aware. These included bamboo cabinetry, recycled glass countertops, **low-VOC** paints, spray foam insulation, and a **heat pump** to replace the oil furnace. The roof needed to be replaced unexpectedly due to leaky skylights; an asphalt roof was chosen instead of a metal roof for budget reasons. After the work was performed, the entire interior of the house was repainted.

First cost savings were not achieved by utilizing the green products, but are realized when factoring in the reduced energy consumption costs, increased comfort level, and otential increase in resale value of the house. The contractor also benefited from increased focus on his company by potential clients interested in green remodeling.

Lessons and Trade-offs

The major surprise came during the Energy Audit, which highlighted the many parts of the house that had air **infiltration** and insulation issues. The contractor believes that making the house as "tight" as possible is the most important aspect of the green remodel. The biggest trade-offs came from the unexpected roof replacement.

"The kitchen remodel is the most appealing and dramatic change to the house, but I am personally most excited about the energy efficiency package we installed. We are looking forward to monitoring the energy usage per square foot to see how it compares to homes of similar size."

- Tom Wells

List of Green Strategies

Energy Conservation

- Replaced old windows with **low-E** windows
- Removed trim from the windows and installed minimal expanding foam in the gap around the windows
- Replaced oil furnace with high-efficiency **heat pump**
- Installed spray foam insulation in open walls and ceilings in the kitchen, crawl space, the basement band joist, and part of the roof **sheathing**
- Installed dense pack **cellulose** in the exterior walls and attic
- Installed **fiberglass batts** covered with rigid foam board in second floor knee walls
- Caulked the baseboards to the hard wood floor
- Replaced the light bulbs with **CFLs** in the bedrooms
- Installed **CFL** recessed lights and high-efficiency light fixtures with insulated boxes in the kitchen, dining room, and family room
- Installed **LED** under-cabinet lighting
- Put mastic on the **HVAC** ductwork seams

Water Conservation

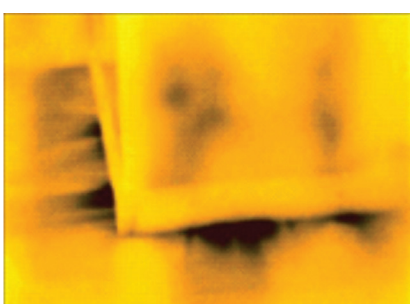
- Installed low-flow showerheads
- Utilized a kitchen faucet with a filtered water option

Indoor Air Quality

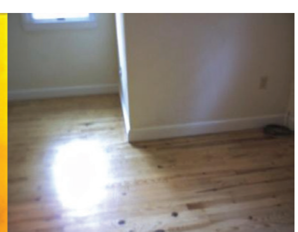
- Used **low-VOC** interior wall paints
- Used waterborne hardwood floor finishes

Sustainable Materials

- Installed recycled glass countertops and bamboo cabinetry with no added **formaldehyde** in the kitchen
- Installed a natural linoleum kitchen floor
- Used natural earth plaster and cork sustainable flooring in the mudroom
- Installed 50-year fiberglass architectural roof shingles



Infrared Image



Visible Light

The bright yellow shows the hotter warm floor and insulation. The darker spots reveal the leaks from under the baseboard and the loss of heat through the studs.

Rear of home

Remodeled Kitchen

Case Study

Location of Project: Mill Hill Historic District, Trenton, New Jersey

Homeowners: John Hatch, David Henderson

Architect: W. David Henderson, R.A., HHG Development, LLC; John D. S. Hatch, AIA; Clarke Caton Hintz

General Contractor: Atlantis Historic Properties

Area Affected: 3,000 sq. ft.

Overview and Scope

The project is the major renovation of an 1887 row house in Trenton's Mill Hill Historic District. When purchased, the house had been vacant for a number of years and was in need of major rehabilitation, including structural repairs, window replacement, all new systems (electrical, plumbing, and **HVAC**), repairs to damaged walls, replacement of roof, and installation of insulation.

Design Approach

In keeping with their commitment to green practices the design team decided to implement as many sustainable strategies as possible while still preserving and restoring the historic character of the house. Since the house is located in a designated local, state, and national historic district, the local historic preservation commission reviewed certain work. This included the exterior windows and the installation of the solar panels. The new windows have insulated glass and are very efficient, but match the original arched windows quite closely. The Landmarks Commission approved them. Since the solar panels are located on a roof not visible from the street, the installation was also not an issue.

Team and Process

The homeowners and the designers are one and the same, so that relationship was easy to manage. Making this project as green as possible meant reaching out to various contractors and suppliers to get ideas and products for how to improve the efficiency and sustainability of the house.

Finance

Based on prior utility bills and estimated usage, the house is at least 25 percent more efficient so energy costs are significantly lower. In addition, the solar panels provide 75 percent of the electricity that is typically used. When more power is produced than used, it is sold back to PSE&G. Most of the electrical bills are only $5! In addition, the homeowner received various green power incentives through the state and federal governments, which also helped to reduce up-front costs. This has made the payback for the solar panels very quick.

Since the house needed such major renovations, it was a question of choosing the most energy- and water-efficient items throughout the remodeling process. These may have cost slightly more than the alternatives, but were considered in the financing for the overall project.

Lessons and Trade-offs

The project team and homeowner were surprised at the affordability of the green strategies. If they had to do it all over again, they would go even further with the sustainable and energy-efficient strategies, even if they cost more. In the future, the payback will only get shorter!

"Making projects energy and water efficient while using sustainably produced products is only getting easier with time. In addition, it's getting more and more cost effective. While people don't normally associate historic preservation with sustainable design, reusing existing structures is actually one of the most sustainable actions that anyone can take. There is a tremendous amount of energy and carbon stored in the historic building's structure, energy that would be wasted if the building were demolished and rebuilt. The greenest home is the one that's already built!"

- John D. S. Hatch

Before remodel

After remodel

List of Green Strategies

Energy Conservation

- Installed photovoltaics provide more than 75 percent of the electrical requirements
- Installed high-efficiency **heat pump**: 17 **SEER**
- Purchased new combination washer and condensing dryer that utilizes a closed system to remove moisture from clothes, saving energy and eliminating the need for outside venting
- Utilized **Energy Star**® appliances
- Installed R15 insulation added to most walls, R30 to roof; as the original walls and roof had no insulation
- Replaced all light bulbs, inside and out, with color corrected **compact fluorescent**
- Installed solar powered attic fan keeps air flowing in the attic to reduce condensation, heat build-up and energy costs
- Replaced or restored most of the original windows with historically accurate windows with insulated glass and low-air **infiltration**

Water Conservation

- Used ultra low flow toilets: 1 gallon per flush

Sustainable Materials

- Utilized reuse of most interior materials. Wood floors and plaster walls were kept wherever possible. Reused two claw foot tubs; wood moldings were either kept in place, or, if reconfiguring the space, were removed and reused
- Use materials that are historically appropriate (wood windows and doors, for instance) and are also sustainable

Roof-top solar panels

Solar powered attic fan

Before remodel

After remodel

Case Study

Location of Project: Princeton, New Jersey
Homeowners: Janet Black
Energy Auditor: GreenStreet Energies
General Contractor: GreenStreet Construction
Area Affected: 2,000 sq. ft.

Overview and Scope

This **weatherization** and energy upgrade to a two-story, late 19th/early 20th century colonial-style home included a comprehensive **Home Performance Audit** and implementation of energy-efficient recommendations by GreenStreet Energies, a home performance consulting service of GreenStreet Construction. An audit checklist and thermal-imaging scans were used to reveal leaks and sources of air **infiltration** and energy loss in the home. The tests revealed opportunities to add insulation and to seal up drafty areas around the windows and doors with weather stripping. **Spray polyurethane** foam was added under the first floor in between the basement ceiling beams, where no insulation or subfloor existed. GreenStreet also installed **storm doors**, **storm windows**, and **door sweeps**.

Design Approach

The homeowner, Janet Black, was introduced to GreenStreet Construction while attending a presentation they made at Design Within Reach, an interior design store located in Princeton, New Jersey. She approached GreenStreet and expressed her interests in greening her home. Working with the homeowner, GreenStreet carried out the Energy Audit and upgrades.

Team and Process

GreenStreet Energies provided a detailed Energy Audit report and recommended upgrades to correct the deficiencies that the audit uncovered. They subsequently were hired to perform all the energy work except for the installation of the spray foam insulation, which was performed by an insulation company. The whole project was completed in less than two months.

Finance

The total cost for the **Home Performance Audit** including energy work was about $5000, with an estimated payback period of three to four years. The project was completed very recently so the homeowner currently is waiting to see how the energy bills will be affected. The homeowner plans to reinvest her energy savings into future energy upgrades such as installing **storm windows** on the remaining second floor windows.

Lessons and Trade-offs

The antique floor had gaps between the floorboards, without any subfloor underneath. This presented a problem as the **spray polyurethane** foam could possibly foam up out of the basement into the living area. GreenStreet fixed the problem by doing a little prep work from the basement side to seal up most of the larger gaps so that the expanding foam insulation didn't come up through the floor.

"Every home is different. This brings a need for a collaborative between GreenStreet and the client in order to take full advantage of all the tools and information available to produce exactly what the client is looking for.

In the case of Janet Black's home, we found a situation unfortunately common in older houses - a beautiful antique floor with small gaps in between the floorboards was the only thing separating her first floor living space from her 40-45 degree basement. We realized that assumptions cannot be made about previous construction, whether it is as obvious and visible as this situation or something hidden deep within the construction of the house."

- Rees Keck, GreenStreet Energies

Added insulation in basement (before barrier)*

List of Green Strategies

Energy Conservation

- Installed spray foam insulation in areas lacking insulation, such as the basement ceiling*
- Added **storm windows** and weather stripping to all doors and windows to reduce air leakage
- Added **storm doors** and **door sweeps** to reduce drafts around existing entrances

Indoor Air Quality

- Installed **formaldehyde-free spray foam insulation***
- Used only non-toxic caulking and weather stripping materials

Resource Conservation

- Added **storm windows** and doors instead of replacing existing windows and doors, increasing their durability by adding a layer of protection from the elements

*Spray foam materials installed in walls or ceilings may present a fire hazard unless protected by an approved, fire-resistant thermal barrier with a finish rating of not less than 15 minutes as required by building codes. Rim joists/header areas in accordance with the IRC and IBC may not require additional protection. Foam plastic must also be protected against ignition by code-approved materials in attics and crawl spaces. See relevant Building Codes and www.iccsafe.org for more information.

Spray foam insulation in basement (before thermal barrier is added)*

Storm door installed to provide added protection

Case Study

Location of Project: Trenton, New Jersey

Developer: Isles Inc. and Tara Construction Management Corp.

Architect: Frank Russo, Shapiro Petrauskas Gelber

Contractor: Omega Corporation

Green Design Consultants: Lyle Rawlings, Advanced Solar Products, Inc. and Andy Shapiro, Vermont Energy Investment Corporation

Area Affected: 2 semi-detached, 1700 sq. ft. units

Overview and Scope

In an area of Trenton, New Jersey where many of the dwellings are vacant or in disrepair, the 22 semi-detached units of the Bellevue Court project have newly renovated interiors restoring façades to their original grandeur. Part of the larger project, the dwellings at 233-235 Bellevue Court have green technologies behind their traditional brick façades.

Spearheaded by the City of Trenton and developed by Isles Inc. and Tara Construction Management Corp, these two "**microload**" homes are projected to use 60 percent less energy than a code compliant home and 30 percent less energy than their **Energy Star**® neighbors.

Design Approach

The two 1700 square foot units have three bedrooms and two and one half baths. Sustainable and recycled materials were incorporated throughout the homes. To help provide exceptional air quality in these airtight homes, mechanical ventilation is provided using a **heat recovery ventilator** (**HRV**). The exhaust vents from each bathroom and kitchen are ducted to the **HRV** while fresh air from the **HRV** feeds into the return **plenum** of the furnace.

The real benefit in these houses is the dramatic reduction of their heating and **cooling loads** and the ability of these homes to meet a substantial part of those loads with renewable energy. Heating and cooling losses were reduced through the **building envelope** with highly insulated walls and windows and air sealing. Custom designed overhangs on the south wall of the "microload" homes block the high summer sun and allow for **passive solar heating** during the winter. The window glass was selected to allow solar heat to enter in winter. As a passive cooling strategy, a skylight with a manually operated crank was placed over the central stair to allow for warm inside air to move up and out of the house in summer. This also provides daylight in the area.

A 2.5 kW **photovoltaic** array on the roof is projected to offset close to 70 percent of the electric loads in the house. The system will be net metered, allowing unneeded solar-produced electricity to be sold back to the utility.

Team and Process

Responding to a need for affordable housing and eager to save the architecturally unique homes on Bellevue Court, the City of Trenton committed to bringing back the block. Isles Inc, and Tara Construction Management Corp were selected as the nonprofit/for-profit partnership for the project.

Finance

For the entire 22-unit Bellevue project, the development costs (including property acquisition, construction, professional services, developer's fees, and other costs) totaled $4.2 million. The units were donated by the City of Trenton, along with a $1 million grant. Additional funding for the project was provided through state and federal grant money.

Lessons and Trade-offs

Looking strictly at the energy usage of the two solar homes, the buildings are performing less efficiently than modeled. A few observations reveal interesting lessons.

Homeowner consumption is a major factor in the energy efficiency equation. Both of the owners are using electric heaters on the first floor, both have 240 kWh/year freezers in the basement and both have multiple televisions and other electronics with significant plug loads. One homeowner is utilizing an electric fireplace for heat that is placed near the home's thermostat. In addition, one of the homeowners always has shades drawn on the south facade, which was designed for direct solar gain "sun tempering." According to the homeowner, this primarily is for security and privacy reasons.

Also, a number of systems and certain features where not properly installed or balanced. Finally, the **PV** system on one home is being shaded by an adjacent home, creating less than optimum conditions for electric generation. These situations confirm the need for residential **commissioning**, particularly for complex integrated technologies found in high performance homes.

"Cellulose insulation was a change from the construction contractor's normal practices, but they were sold on the acoustic performance of the product. "When you close the outside door in these houses, it's like being in a sound-proof room."

- Omega Corporation

List of Green Strategies

Energy Conservation

- Installed highly efficient insulation in walls and ceilings
- Chose fiberglass frame double glazed **low-E** windows
- Carefully sealed all rough openings and basement ceilings
- Installed high-efficiency **HVAC** and water heating equipment
- Installed **Energy Star**® appliances throughout
- Installed a 2.5 kW rooftop **photovoltaic** array to provide a portion of the building's electricity needs

Water Conservation

- Installed dual-flush low water use toilets, low-flow showerheads, and low-flow faucets
- Created a **rainwater collection** system for gardening
- Planted drought-proof native plantings and grasses

Indoor Air Quality

- Used zero and **low-VOC** paints, caulks, finishes, and adhesives
- Purchased **formaldehyde-free** plywood kitchen cabinets
- Utilized a track-off mat system at the entryway
- Installed wood flooring and ceramic tile instead of carpeting
- Properly vented all occupied rooms
- Provided exhaust for all high-moisture areas

Sustainable Materials

- Reused and recycled many materials during construction
- Reused brick from the site for pervious paving
- Utilized **recycled content** plastic/wood lumber for porches and decks

Before After

Ducts sealed with mastic

Dining room hardwood floors

Photography Credits

Cover

Top left: John D.S. Hatch, Trenton Row House Case Study

Top right: Michael Fleischacker, Hanson Case Study

Below top right: Ed Schwartz, Schwartz Case Study

Bottom left (top): Patricia Gaylor, Abbott Case Study

Bottom left (bottom): Ford3 Architects and Barbara Geller, Geller Case Study

Bottom right: John D.S. Hatch, Trenton Row House Case Study

Kitchen, Bath and Living Spaces

Cover: Patricia Gaylor, Abbott Case Study

Case Study 1: Jacqueline Germany, Montclair Casew Study

Case Study 2: Lori Jacobsen, Quinn Case Study

Case Study 3: Randall Solomon, Solomon Case Study

Case Study 4: Patricia Gaylor, Abbott Case Study

Case Study 5: Patricia Gaylor, Collins Case Study

Case Study 6: Stephen Fiedler, Fiedler Case Study

Case Study 7: Photography by www.marisapellegrini, Twin Maples Case Study

Finished Basement and Major Addition

Cover: Lise Thompson, James Dean House Case Study

Case Study 1: Ed Schwartz, Ridgewood Case Study

Case Study 2: Deborah Monroe, Monroe Case Study

Case Study 3: Tom Verschilling, Greendale Case Study

Case Study 4: Lise Thompson, James Dean House Case Study

Weatherization and Energy

Cover: John D.S. Hatch, Trenton Row House Case Study

Case Study 1: Thomas G. Wells, Parkland Properties Case Study

Case Study 2: John D.S. Hatch, Trenton Row House Case Study

Case Study 3: GreenStreet Energies, Black Case Study

Case Study 4: Darren Port, Bellvue Court Case Study

Outdoor Living and Landscaping

Cover: Michael Fleischacker, Hanson Case Study

Case Study 1: Michael Fleischacker, Hanson Case Study

Case Study 2: Ford3 Architects and Barbara Geller, Geller Case Study

Back Cover

Left: Photography by www.marisapellegrini, Twin Maples Case Study

Middle: Lise Thompson, James Dean House Case Study

Right: Patricia Gaylor, Collins Case Study

Rutgers Center for Green Building [RCGB]

The Rutgers Center for Green Building is located at the Edward J. Bloustein School of Planning and Public Policy, Rutgers, The State University of New Jersey. The Center forms a common umbrella for existing and proposed initiatives being carried out through separate Centers at the Bloustein School, the School of Environmental and Biological Sciences (formerly Cook College), the School of Engineering and other Rutgers units that are integral to developing and implementing innovative green building strategies.

The Rutgers Center for Green Building has developed capabilities in applied green building research that entail modeling the life cycle cost and environmental impact of buildings, post occupancy study tools including survey research and building operating data analysis, and financial methodologies to better estimate green building value. The Center has produced a series of reports documenting best practices in green building and regularly provides green building training and education modules for a variety of audiences.

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The Rutgers Center for Green Building develope the guidelines with extensive input and review by an expert advisory group comprised of residential building and remodeling professionals, interior designers, landscape architects, and experts in the field of green building and energy-efficient design.

www.state.nj.us/dep/

www.epa.gov

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