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# sustainable solutions for historic houses in northern california

a voluntary green code & green rehabilitation manual



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# introduction

## **INTRODUCTION**

Statement of purpose

Background

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What is a Voluntary Green Code?

What makes a green product?

How to use this manual

### **Statement of purpose**

This manual was created to help homeowners choose sustainable strategies for restoring and rehabilitating many of the smaller, Victorian-style, wood-framed houses built in Northern California during the late 1800s and early 1900s.

### **Background**

This publication was created with support from the U.S. Environmental Protection Agency (EPA) under the Brownfields Sustainability Pilots program. Research for the Voluntary Green Code and Green Remodeling Manual included a site visit to Humboldt County, CA and assistance from local contacts and green building experts. The Samoa area has received EPA Brownfields support, including assistance with environmental site assessments.

A good deal of the research done for this manual focuses on Samoa, CA, a “company town” of historic, Victorian-style houses built during the redwood lumber boom in the early 1900s. The information also applies to many wood-framed houses built throughout the region around the same time period.

### Acknowledgements

By providing historical background, recommendations, cost information, and details on local conditions and best practices, the individuals mentioned below have contributed significantly to the success of this project. Diane Strassmaier deserves credit for getting this project started, moving it forward, and contributing her own expertise on restoring historic houses. Special thanks also to Sean Armstrong and Andrew Whitney, who recruited the “green team” listed below, orchestrated the kickoff roundtable discussion at the Samoa Women’s Center, and provided the Samoa houses as a model for this manual.

### Thanks to these local experts for contributing valuable information to this manual

- **Grant Lay** / owner, Trinidad Electric
- **Bill Hole** / professor of Construction Technology, College of the Redwoods
- **Heidi Benzonelli** / environmental resources specialist, RealSolutions
- **Sunny Simmons** / contractor & owner, New Dimensions
- **Dave Grow** / owner, Grow Insulation
- **Chuck Hubler** / owner, Maples Plumbing & Heating
- **Eric & Viviana Hollenbeck** / Blue Ox Millworks
- **Andrew Whitney** / Humboldt County Economic Development Division Specialist
- **Sean Armstrong** / Development Project Manager, The Danco Group



**What is a voluntary green code and how can it guide the rehabilitation of historic houses?**

Today the term “green” turns up everywhere, describing products, technologies, companies, strategies, and even individuals. What then, is a “voluntary green code,” and why is a green code important if you own an old house?

The first premise in this manual’s green code is simple: It’s greener to rehabilitate an old house than to destroy it in order to make way for new development. The second premise confirms that rehabilitation is the principal objective—preserving historical details while making repairs and improvements to ensure that an older house can continue to provide safe, affordable shelter and meet current building performance standards without adversely compromising the integrity of the structure.

The term “voluntary” is also important. The techniques and products mentioned in this manual are recommended as smart, sustainable choices, but they are not mandatory. Use this basic information as background for further research into options that may apply specifically to your situation.

### RECYCLED BUILDING MATERIALS HAVE THE GREATEST GREEN VALUE

When repairs, upgrades and alterations need to be done on houses, it's much more sustainable to use recycled materials instead of newly manufactured products. Recycled products are sometimes referred to as salvaged or reclaimed; these terms have the same basic meaning. Using a recycled material or product often has an additional green value: It costs less than a new version. The construction materials that offer the greatest potential for recycling include the following:

- Framing lumber
- Dimension lumber (such as 1x boards)
- Molding
- Doors
- Cabinets
- Hardware
- Wood flooring
- Plumbing fixtures
- Kitchen appliances
- Brick and concrete
- Lighting

### What makes a green product?

Many companies promote their products as green. This makes good sense from a marketing point of view. But "green" and "sustainable" are labels that can be broadly and creatively defined. That's why it's a good idea to double-check a manufacturer's claims. The questions below represent a good starting point.

- Is the product produced in the immediate area or region?
- How far does the product have to travel from manufacturing site to end user?
- Do activities associated with the product benefit the local economy (marketing, selling, installing, etc.)?
- Is the product made from renewable resources?
- Can the product be easily recycled?
- Are recycled materials used to produce the product?
- How much energy is required to manufacture the product? Less energy-intensive manufacturing processes help to improve green value.
- How long will the product last, and what kind of maintenance will it require?
- Does the manufacturing process have harmful environmental effects?
- Does the product emit any harmful gasses after installation or if it burns?

When evaluating a product's green value, keep in mind that few products score highly in all areas. For example, a countertop made from recycled glass and concrete offers the benefits of utilizing recycled material, but also the negatives associated with Portland cement's energy-intensive, greenhouse gas-producing manufacturing process. Are the countertops produced in the area or will they be shipped across the country? Does the manufacturer use flyash (a recycled material) to reduce the amount of Portland cement required? Is there a comparable, locally produced choice for countertops? If you're serious about sustainable building and remodeling, it's essential to educate yourself, ask plenty of questions, and weigh the positives against the negatives.

## WORK IN THE RIGHT SEQUENCE.

“What do I do first?” That’s the question that most people ask when they buy an old house. Remodel the bathroom or repair the siding? Install new light fixtures or add new insulation in the attic? There’s always work to be done in multiple areas, and the projects you WANT to do aren’t always the projects you NEED to do. Doing things in the right order will help to avoid cost overruns, while ensuring optimum results. Here are some guidelines that will help you prioritize what needs to get done.

- Identify and correct structural problems first.
- Make the building weathertight as soon as possible.
- Get an electrical upgrade done early, and make sure to account for future remodeling, heating and lighting system upgrades.
- If possible, hold off on insulating and air-sealing upgrades until after electrical, plumbing and heating system work has been completed. This will enable you to air-seal and insulate holes in walls and ceilings.
- Do the decorative work last – painting, plaster repair, refinishing wood floors, etc.

## How to use this manual

**Be safe and smart.** Some repairs and upgrades covered in this manual can be done effectively by homeowners. Other work is best done by experienced contractors. While it’s satisfying and economical to complete home-improvement projects yourself, it’s risky to go beyond your comfort zone, using unfamiliar tools, techniques and materials. Remember: If it feels unsafe, it probably is. Weigh the pros and cons carefully when deciding what you can do yourself and what should be done by building professionals.

**Avoid lead paint problems.** Lead paint, which is likely to be found on any house built before 1978, is associated with lead poisoning that can cause nerve and kidney damage, hearing loss, and developmental problems. Infants and young children are especially prone to lead poisoning. The older the house, the more layers of lead paint it probably has. This has important consequences for any work done in, on and around an old house. Whether this work is done by a homeowner or by contractors, it’s critical to make sure that established safety procedures are followed to prevent the health hazards associated with lead exposure. Safety regulations are clearly identified under Title 8, Section 1532.1 of the California Code of Regulations.

**Check with the building department.** If the work you’re planning to do or have done requires a building permit, it’s illegal to proceed without one. A phone call can usually establish whether or not a building permit is required.

## Combine preservation with modernization.

An old house is a piece of history. While it’s important to preserve the character and appearance of an historic property, a house also needs to meet current standards of comfort, convenience, safety and energy efficiency. Many upgrades (insulation and improved electrical service, for example) can be made without altering the exterior appearance of a house. Other work may involve deciding between an authentic restoration and one that uses alternative materials that can closely approximate an authentic appearance. The information in this manual will help you to make these decisions.

NOTE: This document is prepared for informational purposes only. Although best efforts were used to collect information from expert sources, no representation or warranties are made as to the timeliness, accuracy or completeness of the information.

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# 1

## CHAPTER OUTLINE

Four treatments provide  
a range of preservation options

# treatment standards for historic properties

For many homeowners and building contractors, preservation standards can seem arbitrary. How do I know what is “historic” and what is a later replacement? Is an alternative material acceptable if it looks the same as the original material? If an old window does not perform adequately it would seem logical to replace it, but what would be an appropriate replacement?

In order to remove some of the ambiguity of these choices, the Department of the Interior’s Standards for Treatment of Historic Properties were developed to help protect irreplaceable cultural resources. The DOI standards do this by promoting consistent preservation practices. The standards have long been used by many preservation organizations, including state and local historic preservation offices. The standards are broadly based, applying to all historic building types and materials, to interior and exterior elements, as well as to building sites and settings.

**The standards focus on four treatments: preservation, rehabilitation, restoration and reconstruction.**

Rehabilitation will be the most favored treatment for homeowners who are interested in retaining important historical details while also improving safety, energy efficiency and overall green value. However, the most sustainable strategies for preserving historic houses demand an awareness of all four areas of treatment.





### BASIC PRESERVATION GOALS

The full text of the Secretary of the Interior's Standards for Treatment of Historic Properties is available from the U.S. Dept. of the Interior ([www.nps.gov](http://www.nps.gov)). Briefly, the Secretary's Standards give these suggestions:

- Make every effort to use the building for its original purpose.
- Do not destroy distinctive original features.
- Recognize all buildings as products of their own time.
- Recognize and respect changes that have taken place over time.
- Treat sensitively distinctive stylistic features or examples of skilled craftwork.
- Repair rather than replace worn architectural features when possible. When replacement is necessary, new material should match the old in design, composition, and color.
- Clean facades using the gentlest methods possible. Avoid sandblasting and other damaging methods.
- Protect and preserve affected archeological resources.
- Compatible contemporary alterations are acceptable if they do not destroy significant historical or architectural fabric.
- Build new additions so they can be removed without impairing the underlying structure.

## Four treatments provide a range of preservation options

**Preservation.** This treatment places a high premium on the retention of all historic fabric through conservation, maintenance and repair. It reflects a property's continuum over time, and the respectful changes and alterations that are made through successive occupancies. Owners would use this approach if they wanted to stabilize and preserve an historic building to keep it the way it looks now.

**Rehabilitation.** This treatment also reflects a property's continuum over time. While emphasizing the retention and repair of historic materials, more latitude is provided for their replacement because the property is more deteriorated prior to the work. Alterations and additions for an updated use are acceptable. An owner would use this approach to update a building for a continuing or new use through repair, alterations, and additions.

**Restoration.** This treatment focuses on the retention of materials from the most significant time in a property's history. It permits the removal of materials from all other periods. This treatment is generally selected for interpretive purposes, by museums for example. An owner would use this approach if they wanted to backdate the building to an earlier period by removing later features.

**Reconstruction.** This treatment establishes limited opportunities to re-create a non-surviving site, landscape, building, structure, or object in all new material for interpretive purposes. Property owners would use this approach if they were to reconstruct a building that has vanished.

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# 2

## CHAPTER OUTLINE

Foundations

Floor systems

Walls

Roof systems

# structural details

Despite variations in size and style, many of the modestly sized, wood-frame houses built in Northern California between 1880 and 1920 share common structural details. Enough of these houses have been repaired, remodeled and upgraded to provide good information on common structural problems and solutions. As with all historic properties, the most difficult decisions usually revolve around what can effectively and affordably be restored versus what needs replacement and upgrading to improve longevity, structural integrity and building code compliance.

Exposure to storms and rainy weather can diminish the durability of any home located along the California's northern coast. Some of the weather-induced conditions that may cause structural problems in old houses include the following:

- wood that rots due to prolonged exposure to moisture.
- erosion from rain and storm water runoff that undermines foundations
- general building settling due to unstable soil conditions
- structural settling due to inadequate sheer bracing for lateral loads.

Fortunately, these conditions can be corrected if they are addressed early enough. Smart rehabilitation strategies for old house structural systems include replacing damaged material, improving structural integrity and managing moisture and drainage.



**Concrete solution.** *Over time, moisture that makes its way behind exterior siding will damage wall framing. Original framing that rests on or near the ground is also prone to moisture damage. In both cases, a reinforced concrete wall and new framing can solve the problem. The restoration work should include flashing and a moisture barrier to keep the framing dry in the future. If necessary, improved shear bracing can also be incorporated.*  
Bill Hole photo.

## Foundations

Many small historic houses in Northern California were built on foundations constructed from redwood posts nailed to redwood plates or grade beams resting directly on the ground. After leveling and grading the site, workers set the plates, pads and posts and then framed the first floor. The resulting crawlspace areas were typically left unfinished. Some houses have doors that provide access to the crawlspace area. With other houses, skirtboards must be removed for crawlspace access.

There are two major issues with this construction technique. First the post-and-grade beam system is probably not adequately anchored to a stable soil datum. This can mean that the building's structural load is not adequately distributed to the soil by spread footings or foundation walls.

Lateral loading is a related problem. Many buildings of this era weren't built to withstand loading from heavy winds or earthquakes. Without adequate shear bracing, the walls of a building are likely to wrack when a force (wind or a tremor) is applied to one side. Despite these foundation details, many historic houses continue to stand straight and true. The Samoa mill worker houses, for example, are remarkably intact and stable given their oceanfront location. Where settling has occurred it is generally due to individual posts shifting or deteriorating. This damage may have been caused locally by improper management of rain and storm water runoff. Instead of directing water away from foundation areas, improperly installed or poorly functioning gutters and downspouts force water back toward the house, where it erodes soil around perimeter posts and causes wood to rot and deteriorate.

### ► Common repairs and upgrades for foundations

Whether there are visible signs of damage or not, it's a good idea to have an experienced building contractor evaluate the general design and condition of an old foundation if this hasn't been done before. Depending on what is discovered,

the contractor may recommend that a local building inspector and/or structural engineer evaluate the foundation and determine what repairs and upgrades are required to ensure safety and code compliance.

### **CORROSION-RESISTANT FASTENERS AND HARDWARE**

The structural repairs and upgrades discussed in this chapter almost always involve fasteners and hardware to make and reinforce structural connections. It's important to select fasteners and hardware designed to resist corrosion in this extremely moist environment. Stainless steel, hot-dipped galvanized, and ceramic-coated products are recommended. Consult with the building department or with a structural engineer to ensure that correctly designed corrosion-resistant fasteners are selected.

## Floor systems

A typical floor framing system for a Samoa house (and similar historic houses) consists of full-dimension 2x8 joists spaced on 16-in. centers. Joists are typically supported by a central carrying beam and perimeter beams or girders. Floor sheathing is full-dimension 1x redwood boards, nailed either diagonally or perpendicular to joists. Often a second layer of sheathing was installed in opposite directions, with a finished floor on top.

### ► **Common repairs and upgrades for floor systems.**

#### **Perimeter beam and/or rim joist replacement.**

In cases where moisture damage has compromised the structural value of perimeter beams or rim joists, the damaged sections of these members should be replaced. Salvaged redwood framing lumber can be used, but other species of preservative-treated framing lumber are also acceptable choices. It's also important to determine the cause of the moisture damage and correct the problem when the repair is made. When the lower part of the wall is damaged, it can mean that there was a shift in the foundation that caused exterior materials to move apart, or that improved flashing and moisture protection are needed.

#### **Selective floor joist and floor sheathing**

**replacement.** Original floor joists and floor sheathing boards that have been damaged because of moisture or other reasons should be replaced to restore the structural integrity of the floor system. While redwood material of identical dimension is the most historically accurate replacement strategy, more commonly available framing and sheathing materials are also acceptable. NOTE: It's incorrect to assume that new joists can be selected in the same dimension as original joists. Check with the building department or with a structural engineer to make sure new joists are adequately sized.

### SUBSTITUTES FOR REDWOOD FRAMING MATERIAL

Many historic houses in California have redwood framing. While it's historically accurate to replace damaged redwood framing with another redwood member, this approach isn't essential when rehabilitating an historic house. When the replacement member will not be seen after the repair or upgrade is complete (new studs or foundation posts, for example) and reclaimed redwood members are problematic to locate, it's appropriate to use other framing material that is sustainably produced.

Similarly, redwood sheathing can be replaced by modern structural sheathing like plywood or oriented strand board (OSB). This replacement strategy allows redwood to be used first and foremost where it is most visible and can contribute more significantly to the authentic appearance of the building.

## Walls

Balloon framing established standard spacing for studs and joists (typically on 16-in. or 24-in. centers) and standard dimensions for commonly used framing lumber. However, variations are often found. Although the walls of the Samoa houses are typically framed with nominal 2x4 studs (actual dimensions: 1 3/4 in. x 3 3/4 in.) spaced on 16-in. centers, other stud dimensions are also in evidence. Exterior wall sheathing is typically absent in houses finished with clapboards or other horizontal siding. However, diagonal braces were sometimes installed at building corners to improve a wall's shear strength. Also, redwood sheathing was used as underlayment beneath sidewall shingles.

### ► Common repairs And upgrades for wall systems.

**Stud and plate replacement.** Primarily because of moisture damage, some wall sections may require studs and plates to be replaced. When only part of a wall is damaged, the replacement framing can match the dimensions of the original framing, providing that the building inspector agrees with these specifications. The framing can be redwood or more commonly used species such as Douglas fir.

**Structural sheathing.** If the siding needs to be replaced, this is a good opportunity to insulate between studs and install structural sheathing, if it is not already present. Instead of sheathing with redwood boards, plywood or oriented strand board (OSB) sheathing is recommended.

**Skirtboard upgrades.** The tongue-and-groove or spaced redwood skirtboards provide very little structural value. If this lowermost part of the wall (typically extending from below the water table molding to grade level) needs to be repaired or replaced, this is an opportunity to improve the shear strength of the foundation and wall so that the house can better withstand high winds and earthquakes. The State of California has helpful advice on this kind of retrofit work (see Sources). If the skirtboard is replaced, check with the building department to make sure the crawlspace has adequate ventilation. This can usually be done by installing vents at regular intervals.



*A small patch makes a big difference. Exposed rafter tails are prone to moisture damage at their ends. A “Dutchman” repair restores the original appearance. An angled scarf joint like the one shown maximizes the glue area that connects the parts, ensuring a strong bond.*

## Roof systems

The roof on a typical 1900-vintage Victorian-style house was framed rather than trussed, which means that rafters were cut and installed individually. Redwood 2x rafters and ridgeboards were commonly used. Redwood 1x skip sheathing was nailed on top of rafters as an underlayment for the finished roof of wood shingles or sheetmetal. Today, many original roofs have been replaced with asphalt-fiberglass roof shingles. On some houses, asphalt shingles are nailed in place directly over the original wood shingles. On other houses, the original roofing material has been removed, and ½-in. plywood sheathing has been installed over the skip sheathing as underlayment for the asphalt shingles. to strengthen the roof and provide a solid base for asphalt shingles.

### ► Common repairs and upgrades for roof systems.

**Rafter tail replacement.** Projecting rafter tails are common on many houses built in Craftsman and Victorian folk styles. This highly visible architectural detail is worth preserving. Where damage has occurred, it is usually restricted to the end of the rafter, so the entire rafter does not need to be replaced. Instead, a “Dutchman” repair can be installed using epoxy adhesive and suitable fasteners (see photo). The repair material should be redwood to match the original rafter.

**Redwood sheathing replacement.** The underside of the roof sheathing is visible where roof eaves and gable ends extend beyond sidewalls. When this material needs to be replaced (to repair damage or during a reroof), redwood boards should be used as opposed to plywood or OSB sheathing.

**Reinforced roof framing.** In some cases, one or more original rafters may show signs of diminished structural value because of moisture damage, bowing or cracking. In these situations, it’s possible to sister new 2x material alongside of an original rafter to restore structural integrity. Alternatively, the old rafter can be removed and replaced. The new framing material does not need to be redwood. If old roofing material is to be removed in preparation for new roofing, this is a good opportunity to check existing roof sheathing and make repairs as necessary. If the original skip sheathing is still in place, a layer of ½-in. plywood sheathing can be added.

## Sources

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### Corrosion-resistant fasteners & framing connectors

Simpson Strong-Tie / [www.strongtie.com](http://www.strongtie.com)

USP Structural Connectors / [www.uspconnectors.com](http://www.uspconnectors.com)

Phoenix Metal Products / [www.framingconnectors.com](http://www.framingconnectors.com)

Manasquan Premium Fasteners / [www.manasquanfasteners.com](http://www.manasquanfasteners.com)

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### Earthquake safety

Homeowner's Guide to Earthquake Safety, available at

<http://www.seismic.ca.gov/hog.html>

# 3

## preserving exterior details

### CHAPTER OUTLINE

Dealing safely with lead paint

Rust-damaged exterior details

Entryway and porch details

Windows

Exterior doors

Siding and trim

Gutters

Paints and finishes

Sources

Even modestly sized Victorian-style homes (Samoa's mill worker houses are good examples) display a rich variety of exterior finish treatments. Siding treatments alone can include clapboards, tongue-and-groove boards and shingles that are installed in straight and decorative courses. Other exterior details include:

- Broad roof overhangs
- Exposed rafter tails
- Porches (larger houses) and covered entries (small houses)
- Turned wood columns (on larger porches)
- Traditional double-hung windows
- Flat exterior casing for windows and doors
- Triangular brackets used to support roof overhangs
- Steeply pitched roofs (Victorian style)
- Shallow roof pitch (on Craftsman-style bungalows)



***Curb appeal.** Restoring exterior details will be the most costly and time-intensive aspect of redevelopment, but this investment will also bring the highest return in terms of market appeal and long-term value.*





*Details worth saving. Even the smallest houses on Samoa have porches that convey craftsmanship, security and style—valuable qualities that need to be preserved.*

**Managing the preservation of exterior details is often the most visible and most challenging aspect of owning an historic house.** When weathering forces are significant (as they are in Northern California’s moist coastal environment), painted finishes on exterior details can crack or peel prematurely, and even old-growth redwood can succumb to moisture damage. In-kind replacement of damaged material is not a given because the current supply of sustainably sourced redwood is expensive and not as resistant to moisture and insect damage as old-growth redwood.

These challenges can be met successfully if smart, safe, skillful strategies for restoration, rehabilitation and replacement are followed. In many cases, the work that needs to be done is labor-intensive rather than material-intensive. While homeowners can tackle some restoration and repair work on exterior details, it’s also necessary to make use of local contractors experienced in working on historic properties. **A realistic approach to maintaining historic exterior details typically involves a blend of historic preservation techniques and alternative strategies that provide acceptable levels of historical accuracy with improved longevity and/or economy.**



*Electric heating element*



*Power plane*



*Shrouded disc sander*

## Dealing safely with lead paint

Whenever repairs, alterations and even cleaning work are performed on an old house, concerns about potentially harmful exposure to lead paint must be addressed. Lead exposure can come from airborne dust, fumes, and small particles and flakes that are accidentally ingested after being deposited on hands, clothes, food, plates and utensils.

The State of California describes health and safety precautions relating to lead paint exposure in their Code of Regulations, Title 8, Section 1532.1. Guidelines are also available from the U.S. Dept. of Housing and Urban Development (see Sources). It's critical to follow these safety guidelines, which include details on approved respirators, protective clothing, and effective cleanup procedures.

Removing lead paint is especially challenging on historic houses, when it's a priority to preserve original siding and other elements that contain lead paint. Contractors who specialize in this work rely on a number of techniques, including the following:

**Heat.** Heat guns and similar equipment can be used to soften paint so that it can be scraped free of the surface. Heat treatment and paint strippers are popular techniques for removing paint from doors, brackets and other architectural elements that include contours or recessed areas. Care must be taken to avoid charring the wood or causing combustible material to catch fire. Heat guns have also been known to cause panes of glass to crack when used on windows and doors. Although heat treatment makes it easier to collect removed paint, lead fumes are a potential hazard.

**Paint strippers.** Like heat treatment, chemically softening old paint limits the amount of airborne debris, but meticulous collection of waste material is still essential. Also, this technique still typically requires some sanding after stripping is completed.

**Power sanders and power planes.** Specialized paint-removal power tools are available to remove paint from siding and other surfaces (see Sources). As shown in the photos, these tools are shrouded to prevent debris from escaping. A dust port on the tool's housing makes it possible to attach the hose of a HEPA-rated dust collector. It takes a skilled operator to use these tools effectively—capturing paint dust while also minimizing damage to the wood surface. But this approach will remove paint quickly and thoroughly from clapboard siding and other flat surfaces, with the most effective capture of chips and dust.

**Scraping and sanding by hand.** This low-tech approach is also potentially the most hazardous, since there's no effective way to capture paint flakes and particles as they are created. Airborne debris can easily spread over a broad area, primarily impacting the soil surrounding the work zone.



*Coastal corrosion. Steel nails are certain to corrode, deteriorating finishes as well as structural connections. To eliminate rust stains, modern corrosion-resistant fasteners should be used for all exterior repairs and upgrade*

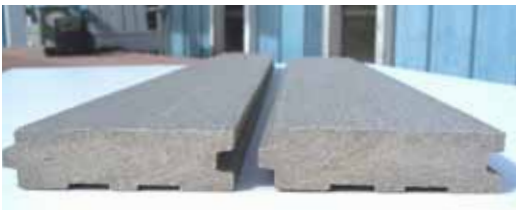
## Rust-damaged exterior details

In any moist climate and especially in coastal areas, fasteners, hardware and other elements made from steel are likely to show signs of rust damage. While naturally occurring tannins in redwood and cedar siding can also have a corrosive effect on steel, moisture in various forms has the most corrosive effect. Sometimes this damage shows up as rust stains that bleed through layers of paint (see photo). Other times, the fastener corrodes and breaks between the back edge of a board and the framing or sheathing, causing the exterior siding or trim to pull away from the substrate where it was attached.

Much of this damage can be addressed with spot repairs, without removing the siding or trim boards. When the surrounding wood is in good condition, the old steel fasteners should be removed; then the resulting holes can be consolidated and filled with epoxy. Refastening should be done using corrosion-resistant fasteners. Stainless steel, ceramic-coated and hot-dipped galvanized fasteners are recommended for all exterior repair and replacement work.



**Sound roof, shaky floors.** *A porch roof often remains sound even though flooring and stair treads succumb to weathering and foot traffic. When this happens, the roof can be supported by temporary posts while the floor is rebuilt.*



**Durable decking.** *Composite tongue-and-groove porch decking will not warp, crack or rot like solid wood, and this material contains up to 95% recycled content (See Sources).*

## Porch and entryway details

Larger historic houses typically have porches that incorporate a main entry. On these houses, the porch typically extends the full width of the street façade. Columns, railings and (in some cases) half-walls are noteworthy details. Smaller houses have covered main entries on the street façade. Despite the modest size of these entryways, the proportions and detailing are pleasing and consistent with the overall style of the house. Most often, a gabled entry roof is used, supported by an exposed post-and-beam framework.

### ► Common repairs and upgrades for entryways and porches

**Flooring replacement.** Damaged porch and entryway flooring can be expected on an old house, given the age of the flooring and the fairly constant exposure to moisture and foot traffic. However, some damage may also be attributable to problems with the foundation and framing. Because of this possibility, it's important to inspect the porch foundation and framing when damaged flooring is removed.

When choosing new flooring for entryways and porches, a composite tongue-and-groove flooring material called CorrectPorch is worth considering (see Sources). Made from waste wood and recycled plastic, CorrectPorch will not rot, crack, warp or succumb to insect attack. However, there are certain installation requirements that may make it difficult to duplicate historic porch floor details. Other recommendations for porch flooring include indigenous wood species like fir, redwood and red cedar. These flooring choices should be sustainably harvested and treated with an exterior wood preservative to help improve moisture repellency, rot resistance and resistance to ultraviolet (UV) damage.

**Foundation and floor framing repairs.** Damaged posts and floor framing can be replaced with redwood or with other framing lumber that has been treated to resist rot and insect attack. Make sure that new or rebuilt foundations comply with current building code requirements. With any porch or entry reconstruction, it's important to flash the ledger board's connection to the house to prevent moisture damage along this connection. Joist hangers and other framing connectors are recommended to enhance strength and simplify new framing work.

**Column repairs.** Columns typically deteriorate in top and bottom areas where moisture damage is more likely to occur. While rotted sections can often be repaired in place using a combination of wood patches and structural epoxies, a more durable repair can often be made by shoring up the porch with temporary braces and removing the column (see photo). This way, damaged interior areas can be treated and the column can be reinstalled with flashing and base support hardware that can help prevent future moisture damage.

**FAST FACTS**

Many green building experts don't consider the vinyl used to make windows and vinyl siding a green material. That's primarily because polyvinyl chloride (PVC) is a petroleum product that is not easily recycled into other products. PVC tends to persist in landfills rather than degrading naturally like wood products do. Research has also shown that vinyl can produce toxic gasses when burned.

## Windows

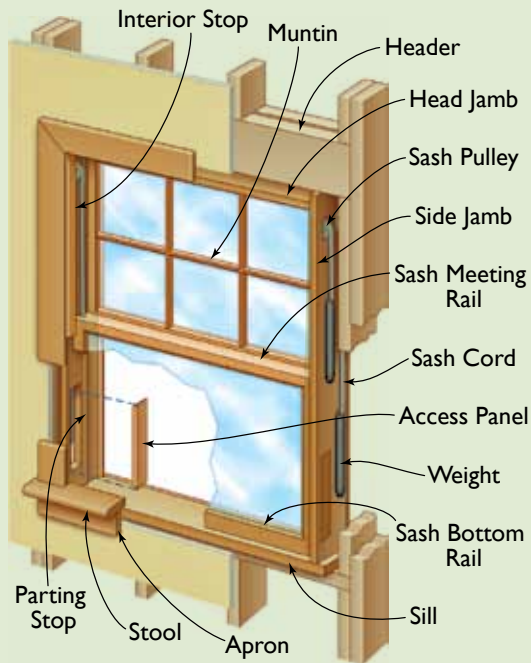
Windows have significant functional and aesthetic value in any house. They impact the homeowner's comfort level and heating bill while also playing a major role in the building's appearance. Old, single-glazed windows can account for 20%-50% of a building's heat loss. But studies have shown that single-glazed, double-hung windows that are otherwise in good condition can be upgraded to meet and even exceed the energy performance of modern replacement windows.

**Repairing and upgrading existing windows is greener than installing replacement windows.** It's also less expensive. When an historic house still has most or all of its original windows, the repair and weatherizing strategy should be considered first.



***Better than new.** To rescue this original window, both sash were removed, repaired, repainted and reglazed on the workbench. All parts, including jambs and exterior trim, were stripped and repainted. Then the sash and stops were reinstalled. A restoration like this costs between \$200-\$300 for labor and materials.*





**Traditional double-hung window anatomy.** Old double-hung windows can be restored and upgraded to operate easily and with higher levels of energy efficiency. The sash can be removed for repairs and weatherstripping. Weights, pulleys and other parts are available from numerous sources.

### ► Common repairs and upgrades for original double-hung windows

**Disassembly, sanding and smoothing.** Layers of paint can seal a window shut or build up thick deposits that prevent the sash from operating smoothly. In the disassembly process, stops and sash are removed so that these parts can be sanded, smoothed and (if necessary) repaired. Jambs are also smoothed. Weatherstripping can then be installed (see below) before the window is reassembled.

**Reglazing.** This is necessary when a glass pane breaks or old glazing compound is deteriorated or missing.

**Sill repair or replacement.** Solid wood sills will crack and rot if not properly protected from sun and moisture damage. Cracks and small sections of rot deterioration can be repaired with epoxy. In severe cases, the sill and lower side jambs may need to be replaced.

**Sash repair or replacement.** Loose or moisture-damaged joints between stiles, rails and muntins are common problems on old sash. Repairs can be made using a combination of liquid epoxy consolidant and solid epoxy patching material (see sidebar). If damage is too extensive, it's better to order and install replacement sash.

**Repair or replacement of stop moldings.** These can crack, splinter or break. If they can't be repaired to promote easy sash movement, they should be replaced.

**Insulation and weatherstripping.** These upgrades are essential to improve the energy performance of older windows. Low-expanding spray foam insulation can be used to fill the airspaces between the window frame and the surrounding framing. Weatherstripping can be applied to the jambs and to the sash.

**Storm windows.** Although factory-made, aluminum-frame storm window units are widely available, a wood-frame storm window is more historically appropriate. Such windows can be affordably fabricated by local millwork shops.

**Rope or chain replacement.** Rope can break or deteriorate over time. Chain doesn't normally wear out, but it can come loose from its sash attachment.

**Pulley replacement.** If a pulley wears out or stops turning smoothly, it can be replaced with a new one.

**Re-weighting.** Adding or subtracting sash weight is only necessary if the sash can't remain stationary after it's moved up or down.

NOTE: There are some excellent books available that offer detailed repair information on old windows (see Sources).

### RESCUING ROT-DAMAGED WINDOWS

Modern epoxies can truly work miracles on windows that have suffered rot and impact damage. This type of repair and restoration work is appropriate when historic preservation is the main priority. It can also be a cost-effective alternative to the installation of replacement windows, especially when undertaken by the homeowner. See Sources for suppliers of epoxy restoration materials. Epoxy restoration can be divided into 6 steps.

1. Remove sash from window, remove glass from sash.
2. Strip paint from sash.
3. Saturate damaged areas with liquid epoxy consolidant.
4. Apply solid epoxy to areas that need to be filled in with solid material. Reglue and clamp sash joints if necessary.
5. Shape, sand and smooth repaired areas.
6. Paint, reglaze and replace sash.

### ► Recommendations and considerations for replacement windows

**Cost and payback.** Replacement windows can cost from around \$250 to over \$500 apiece, depending on window type, size, features (cladding, low-e coating, etc.) and brand. In cold climates, the energy savings that accrue after installing replacement windows can repay the installation cost in five years. In milder climates such as the California coast, the payback time will be at least seven to 10 years.

**Historical integrity.** Installing replacement windows inside the original window jambs will diminish the available glass area and thus alter a home's appearance. The visual impact can be minimized by choosing replacement sash with narrow frames that are proportionately similar to the original sash frames.

**Replacement window recommendations.** If replacement windows must be installed, all-vinyl windows are the least-sustainable choice (see Fast facts). All-wood windows are a sustainable choice, but homeowners will be faced with the responsibility of applying and maintaining an exterior finish on the windows. The best combination of durability and sustainability is a solid wood window with fiberglass exterior cladding (see Sources). Fiberglass cladding has proven far more durable in harsh coastal environments than either vinyl or aluminum cladding. It's paintable and available in standard and custom colors.

**Low-e coatings.** Many new windows with (double-pane) insulated glass have "low-e" coatings to improve energy efficiency. In hot climates, this coating should be located on the inside face of the outer pane of glass to minimize solar gain. In colder climates (typical in Northern California), the coating should be applied to the outside face of the inner pane of glass. This will help to maximize solar gain.



*It takes more skill to use less material. Replacing only the damaged parts of an old window (sills and lower side jambs, in this case) preserves historic fabric and requires a minimal amount of new redwood. But this type of spliced-in repair also requires a skilled installer. Bill Hole photo*



*Traditional design.* A reproduction of an original five-panel door from the Hammond Lumber company is on display at Blue Ox Millworks in Eureka, CA

## Exterior doors

Providing that they aren't rotted or warped, the original exterior doors on an historic house are almost always worth preserving. Historic doors were typically made from premium-quality wood (redwood was often used on the West Coast). These doors usually feature frame-and-panel construction, with mortise-and-tenon joinery for extra strength.

### ► Common repairs and upgrades for exterior doors

**Refinishing.** If a door has peeling paint on its exterior face, the entire door should be stripped using approved techniques for handling lead paint. Stripping and refinishing only the exterior face of the door is not recommended because it is likely to cause the door to warp. With the door's bare wood exposed, spot repairs can be made effectively before the door is refinished (see Paint and stain, below).

**Weatherstripping.** This treatment is essential to improve energy performance. The easiest energy upgrade involves applying self-adhesive foam weatherstripping to the inside edges of door stop moldings and installing a surface-mount threshold seal along the bottom edge of the door. Homeowners can perform this upgrade with basic tools for under \$25.

**New threshold.** The solid wood threshold used on an exterior doorway is a wear item and should be replaced with a new wood threshold when it wears out.

**Replacement.** If a new exterior door is needed, a solid wood, frame-and-panel door is recommended. Depending on homeowner preferences relating to security or style issues, a glass top panel may be desirable. Local millwork shops are capable of duplicating original doors. Alternatively, it's also possible to closely approximate the style and proportions of these doors when ordering from major manufacturers.





*Well-crafted details. It's not unusual for a Samoa house to have several types of siding treatments. Fortunately, many of these decorative treatments can be reproduced using alternatives to redwood clapboards, shingles and boards.*

### ► Common repairs and upgrades for exterior siding and trim

Siding the exterior of a Victorian-style house gave designers the opportunity to work creatively with a range of different siding products, and challenged carpenters to achieve decorative details that still set a standard for craftsmanship today. But siding also has to function as the building's skin, shedding moisture and keeping cold winds outside.

With an old house, it's not unusual to find siding in excellent condition in one area, while the siding on another part of the house is too damaged to save. When repairs are made, the goal should be to preserve the original appearance as closely as possible, while upgrading durability through the use of modern materials and techniques. NOTE: Corrosion-resistant fasteners should be used for all of the repair and upgrade work covered in this section.

**Removal of peeling finish.** The safe removal and disposal of old finish on exterior siding and trim should be a top priority. Old finish that is left in place—especially when it's peeling away from the wood—poses a health hazard because of its lead content. Peeling paint is also aesthetically undesirable.

#### **Spot replacement of damaged siding and trim.**

On many houses, original siding and trim remain intact and in good condition near the top of walls, where weather exposure is not so severe. Lower wall sections have suffered more, and damaged siding in these areas should be replaced with new material that matches the wood species and dimensions of the original material.

**Complete residing.** Consider this option when more than a quarter of the existing siding on a wall needs replacement. With the siding fully removed, it's possible to inspect and repair framing. Insulation, wall sheathing and an air-moisture barrier membrane can then be installed prior to residing. The best practice standard for new wood siding installation

(especially in wet climates) is to use vertically installed furring strips (for horizontal siding) or a rainscreen material (beneath shingles and vertical board siding) so that an air space is created behind the siding. Called a "rainscreen wall," this technique effectively prolongs the life of siding and the paint that covers it. It is required by some building codes. In retrofit applications, installing a rainscreen wall will necessitate building out the exterior casing around windows and doors or extending door and window jambs to account for the added thickness of the rainscreen.

If redwood original siding was removed, it is desirable but not mandatory to install new redwood material. However, the new siding should be a sustainably produced equivalent that closely duplicates the original appearance. Acceptable substitutes include finger-jointed red cedar clapboards and composite lap siding such as the SmartSide product from Louisiana Pacific. New siding should either be back-primed at the jobsite prior to installation, or ordered with a factory-applied primer on all sides.

### RECONDITIONED SIDING

Remodeling contractors are accustomed to tearing off old wood siding and carting it to the landfill in preparation for residing with new materials. But on many historic houses along the California coast, siding was milled from premium-grade redwood with superior weather resistance and dimensional stability. Some of this material is worth saving—especially clapboards and tongue-and-groove boards. Sound redwood siding can be removed, reconditioned and then reinstalled. Removing lead paint in a workshop setting minimizes lead impact around the house perimeter, and can make it easier to remove paint safely and thoroughly. Following the steps outlined below will result in siding that's higher in quality and green value than any new wood siding you can buy today.

1. Use prybars to remove the siding. Work carefully to avoid splitting the material.
2. Remove any fasteners that remain in the material.
3. Discard boards and sections that have rotted, cracked, warped or bowed.
4. Remove peeling paint and loose finish, then sand the surface to feather the edges where intact paint meets bare wood. Safe practices for the handling and disposal of lead-based paint must be followed.
5. Fill any holes that will show after installation with epoxy filler.
6. Coat all sides of the material with stain-blocking primer.
7. Reinstall the siding and apply finish coats.

Fiber-cement siding is also a reasonable substitute for redwood siding, providing that its appearance (surface texture and overlap or exposure) can closely duplicate that of painted redwood siding. To make a greener choice, select fiber cement siding manufactured using flyash (an industrial byproduct) as a partial substitute for Portland cement (see Sources).

**Flashing.** When exterior trim and siding repairs are made, it's also an opportunity to upgrade the flashing details that help to protect wood from moisture damage. Flexible, rubber-based flashing material with self-adhesive backing is recommended for use around windows, doors, skylights and roof penetrations. Where flashing is visible (along the head casing of windows and doors, for example), copper flashing is recommended.

**Water table replacement.** When used to delineate the main level of the house, this trim element is prone to moisture and weathering damage because of its location and its projection beyond the exterior siding. Because many historic houses need water table replacement, a reliable supply of water table molding should be found among local millwork shops. Ideally, this molding can be produced from sustainably sourced material such as finger-jointed redwood or red cedar. Depending on cost and feasibility, composite material with a high recycled content could also be considered. Local experts in historic preservation should be consulted to make the water table less vulnerable to moisture damage by developing a better water-shedding profile and improved flashing details.



*Surface prep is the most important (and most troublesome) step. Once loose paint has been removed from exterior siding and trim, the wood must be sanded and primed before exposure to sunlight and weathering compromises its paint-holding ability.*

## Exterior finishes

Paint that is applied to exterior siding and trim will always need to be renewed. The good news is that the longevity of painted exterior finishes can be significantly extended (from 5-7 years to 15 or more years) by following proven techniques for surface preparation, application and finish selection. Research done by the Forest Products Laboratory (see Sources) has shown that the following steps will ensure optimum appearance, durability and resistance to cracking and chalking when exterior siding and trim are painted.

1. **Remove loose paint from wood surfaces.**  
CAUTION: Make sure to follow the health and safety precautions described by the California Code of Regulations, Title 8, Section 1532.1.
2. **Sand all surfaces to be repainted.** Use 120-grit sandpaper, and make sure to “feather” or smooth any transitions between bare wood and old paint that is solidly adhered to the wood.
3. **Wash and wipe down the siding.** For good paint adhesion, it’s critical to remove chalk, sawdust and other residue.
4. **Apply an “extractive-blocking” latex primer.** Use a high-quality primer that will prevent extractives from bleeding through the wood surface. Recommended primers include Sherman-Williams A-100 Latex Wood Primer; Pratt & Lambert Suprime Exterior Latex Wood Primer; Zinsser Cover Stain and Valspar Exterior Latex Primer. Old paint can be coated with primer, but it’s not necessary.
5. **Apply two finish coats of top-quality latex exterior house paint.** Avoid using low-quality latex paint. Premium-quality paint should say “100% acrylic” on the label.
6. **Make sure that siding and trim can dry.** Eliminate splashing and soaking caused by improperly functioning gutters and downspouts (see Gutters & downspouts, below).

### Stain

Stain is not historically accurate as an exterior finish on a Victorian-style house. However, a solid-color exterior stain is worth considering as a finish on newly installed siding for a couple of reasons:

A stain finish may prove to be less prone to cracking than a painted finish. Modern stain formulations—specifically “solid color latex stains”—come close to duplicating the appearance of a painted finish.

NOTE: Stain is not a suitable finish over paint; it’s only suitable for use on new siding. A solid color latex stain still requires a stain-blocking primer coat to be applied first.

### Unfinished siding

In cases where a house is resided with redwood or red cedar shingles, it’s acceptable to dispense with paint or stain and allow the wood to weather naturally. This avoids the possibility of peeling finish. A clear penetrating preservative formulated for exterior siding can enhance the natural rot-resistant qualities of redwood and cedar siding while also reducing damage from sun exposure.

**FAST FACTS**

All wood contains extractives that include tannins, oils, fats, resins, waxes, gums and other elements. Redwood and red cedar, two wood species used frequently to make exterior siding, have high extractive content, which is why special extractive-blocking primers are required to prevent these compounds from bleeding through the finish.

***Asphalt alternative.***

*While asphalt-fiberglass shingles are certain to remain the most cost-effective roofing material, other options are worth considering. Shown here, EnviroShake roofing shingles look like cedar but are made with 95% recycled rubber content.*

## Gutters and downspouts

Many historic houses acquire “modern” gutters and downspouts later in their lives, and for good reason. Without gutters, roof runoff can splash or blow against the siding and trim on lower sections of the house, eventually causing moisture damage.

**► Common repairs and upgrades for gutters and downspouts**

**New gutter and downspout installation.** Round-profile gutters and downspouts made from aluminum or galvanized steel are more historically appropriate than PVC gutters or aluminum “K”-profile gutters. Better-quality gutters will not crack like plastic or dent like lower-quality aluminum gutters. Local contractors should be selected who can correctly design, size and install gutters and downspouts.

**Splash plates.** Typically made from concrete or plastic, these products are affordable and easy to install. For maximum effectiveness, a downspout should terminate with an elbow that directs water away from house sidewalls, onto a splash plate that slopes away from the house.

## Roofing

Many historic houses that were originally built with cedar or redwood shingle roofs now have asphalt shingle roofs. While this change in material can’t be considered historically accurate, it is an acceptable substitute for several reasons. Modern asphalt-fiberglass roofing remains one of the most affordable roofing materials available. Asphalt-fiberglass shingles are extremely durable (some manufacturers offer 50-year warranties) and perform well under a wide range of weather conditions. Successful recycling programs are underway across the country, making asphalt roofing a more sustainable material (see Sources). And manufacturers have developed asphalt roof shingles that look remarkably like authentic wood roof shingles.

Other sustainable roofing materials that are appropriate for historic houses include metal roofing and a composite roof shingle called Enviroshake (see Sources).

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## Sources

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### Lead paint

*Lead Paint Safety Field Guide* / a field guide for painting, home maintenance, and renovation work; available for free from the U.S. Dept. of Housing and Urban Development  
Go to [www.hud.gov](http://www.hud.gov) or call 1-800-LEAD.

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### American International Tool Industries, Inc.

(power tools for paint removal) / [www.paintshaver.com](http://www.paintshaver.com)

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### Composite porch flooring

Correct Porch / [www.correctporch.com](http://www.correctporch.com)

Trex / [www.trex.com](http://www.trex.com)

TimberTech / [www.timbertech.com](http://www.timbertech.com)

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### Structural epoxy for repairing damaged windows, columns and other wood elements

Abatron / [www.abatron.com](http://www.abatron.com)

Resource Conservation Technology / [www.conservationtechnology.com](http://www.conservationtechnology.com)

ConServ Epoxy / [www.conservepoxy.com](http://www.conservepoxy.com)

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### Restoring old double-hung windows

*The Old House Journal Compendium* / Overlook (2007)  
available at amazon.com

*Working Windows, 3rd edition: A Guide to the Repair and Restoration of Wood Windows*, by Terry Meany / The Lyons Press / available at amazon.com

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### New windows

Bergerson Cedar Windows, Inc. / [www.bergersonwindow.com](http://www.bergersonwindow.com)

Milguard / [www.milguard.com](http://www.milguard.com)

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### Fiber-cement siding

Certainteed / [www.certainteed.com/products/fiber-cement-siding/siding](http://www.certainteed.com/products/fiber-cement-siding/siding)

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### Housewrap & rainscreen material

Barricade / [www.covalencecoatedproducts.com](http://www.covalencecoatedproducts.com)

Tyvek / [www.tyvek.com](http://www.tyvek.com)

Cedar breather / [www.benjaminobdyke.com](http://www.benjaminobdyke.com)

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### Paint & finish information

Forest Products Laboratory / [www.fpl.fs.fed.us/index.html](http://www.fpl.fs.fed.us/index.html)

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### Gutters & downspouts

Gutter Supply / [www.guttersupply.com](http://www.guttersupply.com)

Award Metals / [www.awardmetals.com](http://www.awardmetals.com)

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### Roofing

Recycling old asphalt shingles / [www.shinglerecycling.org](http://www.shinglerecycling.org)

Enviroshake roof shingles / [www.enviroshake.com](http://www.enviroshake.com)

Metal Roofing Alliance / [www.metalroofing.com](http://www.metalroofing.com)



# 4

## CHAPTER OUTLINE

Air-sealing, insulation and ventilation need to work together

Air-sealing to improve energy efficiency

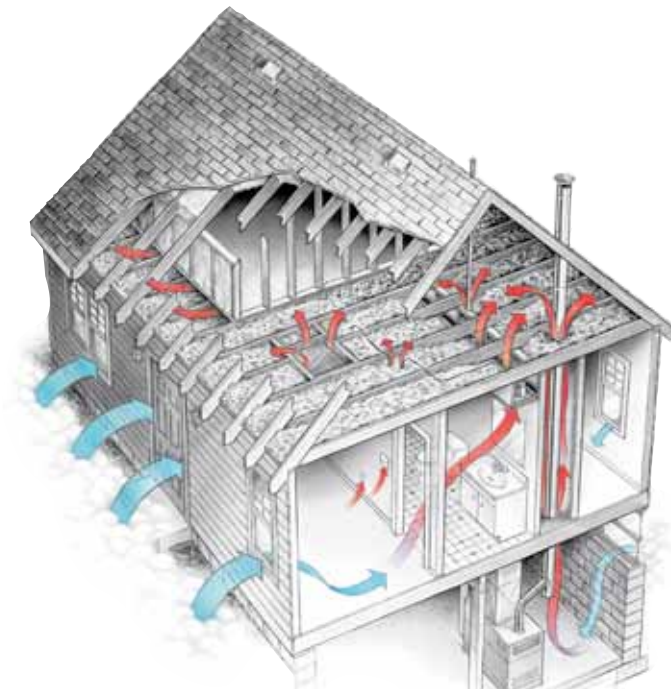
Avoiding moisture problems

Insulation recommendations

Choosing a whole-house insulating plan

Sources

# insulating for improved energy performance



### *Heat loss in a leaky house*

*During the heating season, warm interior air rises naturally by convection. Unless leaks in the attic ceiling are sealed, convective heat loss occurs through numerous cracks and openings. As hot air escapes, this creates a negative pressure inside the house that can draw cold air into the living space through leaky windows and doors and through other small cracks or openings.*

Old houses can benefit greatly from air-sealing and insulation upgrades. Air-sealing is done to plug leaks in the building shell or “envelope.” The goal when air-sealing is to make the building more airtight, which will minimize heat loss during cold weather and prevent cool air from leaking outside when air conditioning is being used. When air-sealing is combined with higher levels of insulation, even greater energy efficiency is achieved. Performing these two upgrades also improves the home’s green value, since using less energy helps reduce greenhouse gas emissions. It’s also important to note that unlike many other improvements and alterations that are performed on old houses, these upgrades can usually be completed without compromising a home’s historic value.

This chapter explains the materials, techniques and costs associated with different insulation and air-sealing options. When planning air-sealing and insulation upgrades to improve comfort and energy performance, make sure that ventilation improvements are also planned. See the next chapter for more detailed information on ventilation.



**Stop leaks around pipe penetrations.** High-expanding spray foam does a good job of sealing holes where vent pipes extend through framing.



**Fill gaps around wiring.** Exterior-grade acrylic caulk does a good job of stopping air leakage around ceiling-mounted electrical boxes. Use high-expanding spray foam to seal holes where wiring comes through wall framing. Photos this page courtesy of Family Handyman

## Air-sealing, insulation and ventilation need to work together

To achieve improved levels of energy efficiency and interior comfort, a house needs air-sealing, insulation, and ventilation. Insulation acts like the heavy sweater you put on before going outside on a cold day. Air sealing a house is akin to putting a windbreaker on over the sweater. And ventilation provides a controlled way for stale interior air to be moved out of the house so that it can be replaced with fresh air from outside, helping to maintain good indoor air quality and avoid moisture problems.

Because it's so inexpensive and yet so effective at improving a home's energy performance, air-sealing should be considered a "must-do" upgrade. Before insulation is installed, it's critical to use a combination of products—caulk, spray foam, gaskets and weatherstripping—to fill gaps and seal leakage points that allow air to move through the building envelope. When it may be too expensive or problematic to insulate walls, air-sealing is a logical fallback strategy that can be used in combination with insulation that is installed in more accessible areas (attic and crawlspace).

### ► Recommended air-sealing techniques / caulk

- Inside the house, use a paintable, exterior-grade acrylic (water-base) caulk to seal any openings or cracks where two walls meet and where the wall meets the ceiling. For best appearance where caulk will be visible, apply just enough to seal the crack, and smooth or "tool" the caulk so that it blends in seamlessly. It can then be painted to match trim or wall colors.
- Apply caulk where interior window and door trim meets interior wallboard. NOTE: Don't caulk interior trim to the wall if the trim first needs to be temporarily removed for spray foam insulation (see below).
- Seal exhaust fans and recessed lights to the ceiling or wall where they are mounted by pulling the fan or light housing away from the wall or ceiling and applying a bead of caulk beneath the mounting flange. Depending on the design of the housing, it may be more effective to use adhesive-backed foam weatherstripping instead of caulk.
- Caulk the joint where the baseboard molding meets the finished floor. If the house has a shoe molding installed between the baseboard and the finished floor, remove the shoe molding, caulk the gap, then reinstall the shoe molding.
- Use high-temperature caulk to seal sheet metal flashing against metal and masonry chimneys where they extend into an unheated attic. The sheet metal (commonly available aluminum flashing) can be cut and bent to fit around and against chimneys as shown in the photos on the next page.



### ► Recommended air-sealing techniques / spray foam

- Make sure to do any new wiring work before air-sealing with spray foam, to facilitate snaking wire and so that new holes can be foamed.
- Use high-expanding foam to fill gaps where pipes, wires, and ductwork go through the floor and into the attic or crawlspace. These gaps are most visible and accessible from the attic and from the crawlspace (see photos).
- Use high-expanding foam to seal and insulate around ceiling-mounted electrical outlet boxes that are accessible from above.
- Use high-expanding foam to fill gaps where pipes extend through masonry walls.
- If you suspect that the narrow “shim space” between the window frame and wall framing may not be properly insulated (typical in older houses), it’s worthwhile to remove interior window trim, then reinstall it after the gaps have been filled with spray foam. NOTE: Don’t fill the channels where the sash weights are if the weights, ropes and pulleys are still in use to operate the window.
- If replacement windows have been installed, remove interior window trim and make sure that the narrow sash weight channels on either side of the side jambs are filled with insulation. Fiberglass insulation will not perform as well here as spray foam or a combination of spray foam and rigid foam insulation.
- After removing interior door casings, fill gaps between exterior door frames and wall framing with low-expanding spray foam.

### ► Recommended air-sealing techniques / gaskets & weatherstripping

- Install a compressible foam gasket around the edge of any hinged or hatch-type door that provides access to the attic. Glue 2-in.-thick rigid foam insulation to the top surface of the hatch.
- Remove cover plates on the electric switches and receptacles located in exterior walls. Install specialized gaskets (see Sources) over the outlet box and reinstall the cover plates.
- Install weatherstripping around exterior doors and windows.

*Chimneys are challenging.* The air-sealing technique around a metal chimney is similar to the technique required where a masonry chimney extends through the ceiling. **First**, cut and caulk aluminum flashing to butt up against the chimney and seal to the ceiling wallboard. **Second**, use high-temperature silicone caulk to air-seal the flashing to the chimney. **Finish up** by forming a baffle from flashing to run around the chimney. This will prevent insulation from being in direct contact with the chimney.



**DON'T TRY THIS  
AT HOME:  
NEW INSULATION  
BEHIND OLD SIDING**

The sheathing panels and moisture barriers used today beneath exterior siding weren't around during the early 1900s. In the old days, clapboards were often nailed directly to studs. Shingles were often installed over skip sheathing—boards nailed horizontally to studs with spaces between them. These old-fashioned walls let in plenty of moisture behind the siding. That's why it's not a good idea to blow cellulose insulation into wall cavities that don't have some sort of moisture barrier. Wet insulation loses most of its R-value, while also inviting mold and other moisture damage. To avoid this problem, protect wall insulation by installing a breathable moisture barrier like Tyvek or builder's felt beneath exterior siding. This is also a good opportunity to improve moisture protection by installing self-adhesive flashing around window and door openings.

## Ventilate to avoid moisture problems

It's important to note that when insulation and air-sealing upgrades are made, steps must also be taken to avoid the moisture problems associated with tight, well-insulated houses. Make sure that the attic has sufficient ventilation. This can take the form of vents installed in gable ends, or a combination of soffit and ridge vents. Vent fans should be installed in kitchen, bathroom and laundry room areas as explained in Chapter 6. Vent fans must exhaust interior air directly outside, not into the crawlspace, attic, or soffit.

## Types of insulation

The type of insulation you choose depends on many factors, including R-value, availability, installation requirements and cost. The insulation types listed below are best-suited for use in most older houses.

### ► Loose-fill cellulose – R 3.8/in.

**Recommended uses:** Attics and walls. When blown into attics and wall cavities by a skilled installer, cellulose does a good job of filling voids.

**Total R-value:** R-38 for 10-in.-thick installation.

**Pros:** Cellulose is one of the greenest insulation materials, since it's made from old newspapers. It's widely available and has an installed price comparable to fiberglass, so it's one of the most affordable types of insulation. Cellulose does a better job of slowing air infiltration than fiberglass. It can absorb and release moisture in limited amounts, an advantage in older houses where moist interior air can sometimes make its way into attic and wall cavity areas. DIY attic installation is possible, if you rent equipment to blow cellulose.

**Cons:** When blowing cellulose into an attic, care must be taken not to block the soffit vents, if the house has this type of attic ventilation. Framing irregularities or blockages in stud bays can result in voids when blowing insulation into the wall of an existing house. Also, wall access holes must be drilled and plugged when blowing cellulose into finished walls. Plugs sometimes fall out or remain visible after installation.

**NOTE:** If you're having cellulose insulation installed or installing it yourself, make sure the insulation is treated to be noncombustible and to resist mold. The treatment process uses nontoxic natural materials and doesn't diminish insulation value.



*Expensive but comprehensive.* Spray foam is applied as a liquid, but quickly foams and expands to fill the insulating space. Photo courtesy of Spray Tech Foam



*User-friendly batts.* Insulation made from recycled cotton has comparable R-value to fiberglass batt insulation, but isn't irritating to handle. Photo courtesy of BondedLogic

#### ► **Fiberglass batts – R 3.2/in. for standard; R3.8/in. for high-performance**

**Recommended uses:** Attics. 10-in.-thick kraft-faced batts, designed for attics, are available to fit snugly between joists spaced on 16-in. or 24-in. centers. Install batts with the kraft paper facing up.

**Total R-value:** 38 for 10-in. high-performance batt.

**Pros:** The most affordable insulation is also universally available, and fairly easy to install. Fiberglass insulation is made from sustainable materials (sand and recycled glass). After installation, batts can be moved out of the way if necessary to access ceiling areas.

**Cons:** Installation is difficult with small attic hatchway and if attic space is cramped. Batt must be fit carefully to eliminate voids. Fiberglass is not as green as cellulose or recycled cotton batt insulation. Fiberglass insulation irritates the skin and airborne fibers pose a health hazard. It's essential to wear long-sleeve shirts, dust masks, safety glasses and gloves when handling the material. If attic floor framing isn't spaced on standard centers (16-in. or 24-in.), then cutting batt insulation to fit snugly between joists will be time-consuming and difficult.

#### ► **Recycled cotton batts – R3.9/in.**

**Recommended uses:** Attics. Cotton batts can be installed just like fiberglass batts. Unfaced 8-in.-thick batts are sized to fit snugly between joists spaced on 16-in. or 24-in. centers.

**Total R-value:** R30 for an 8-in. batt.

**Pros:** This insulation has good green value, since it's made from recycled waste material. Cotton-based batts have good qualities for DIY installation. Handling the insulation won't irritate the skin, and it's

installed just like fiberglass insulation. After installation, batts can be moved out of the way if necessary to access ceiling areas. Cotton batt insulation costs slightly more than fiberglass batts.

**Cons:** It's bulkier than fiberglass. Cotton batts are also harder to cut and move around, and careful installation is essential to eliminate voids. Fewer thickness choices are available, and overall availability may be limited (see Sources).

#### ► **Polyurethane spray foam – approximately R4.5/in.**

**Recommended uses:** Spray-application between joists, studs, and rafters where these cavities are accessible. **Total R-value:** R-14 for a 3-in.-thick underfloor installation.

**Pros:** Expanding as it cures, spray foam air-seals and insulates in a single step, filling voids more effectively than any other type of insulation. Unlike fiberglass and cotton batt insulation, spray foam can't be turned into a habitat for raccoons or mice.

**Cons:** Spray foam is 2-3 times more expensive than

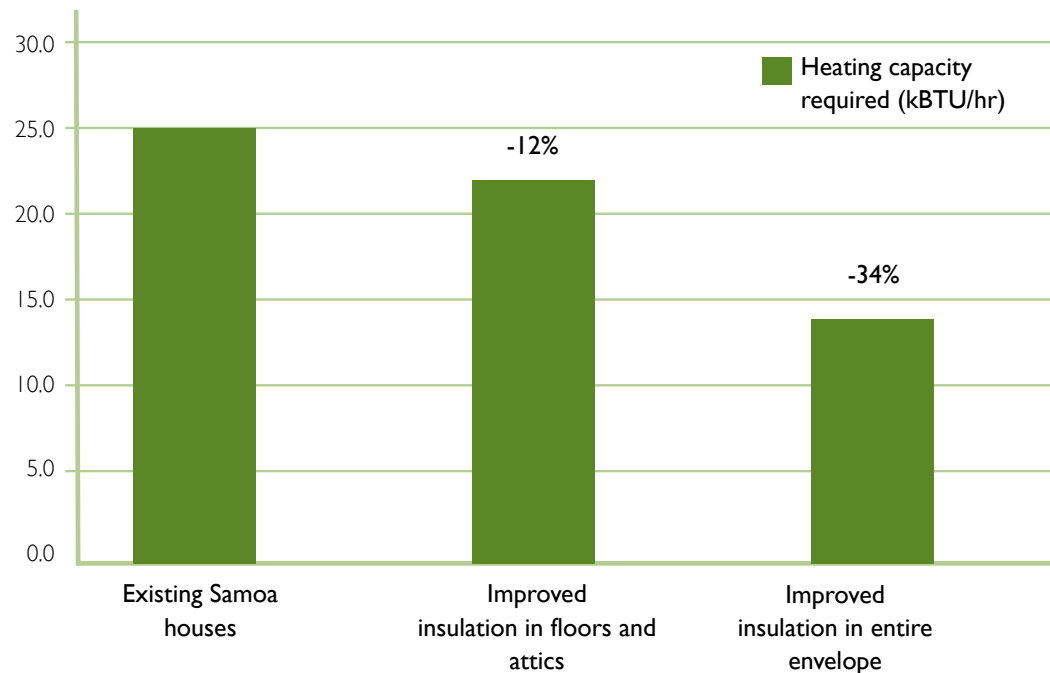
installing fiberglass batts. Large-scale installations should be done by a foam insulation contractor. Once applied, foam can't be easily removed. Spray foam formulations are made from petroleum products. Greener forms of spray foam utilize some resins derived from soybeans.

**NOTE:** Although DIY spray foam kits are available (see Sources), this approach is only recommended when a small area (between the joists under a laundry room addition, for example) needs insulating.

## Choosing a whole-house insulating plan

Assuming that the house has been made tighter with air-sealing techniques, the insulation strategy will depend on budget and the desired levels of comfort and green value. Here are two whole-house insulating options to consider. As shown in the graph below, upgrading attic and floor insulation results in a 12% reduction in heating requirements. The complete building envelope upgrade cuts heating requirements by 34%. Estimates are based on a 1000 sq. ft. Samoa house.

### ► Reducing heating requirements with insulation upgrades



**Existing home:** R18 fiberglass insulation in attic only.

**Improved insulation in floors and attics.** R14 spray foam insulation beneath the first floor; R-38 cellulose insulation in attic. Walls remain uninsulated.

**Improved insulation in entire envelope.** R14 spray foam insulation beneath the first floor; R38 cellulose insulation in attic; R14 cellulose insulation in walls.

### Sources

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#### Weatherstripping supplies

Resource Conservation Technology / [www.conservaiontechnology.com](http://www.conservaiontechnology.com)

Ultrafab / [www.ultrafab.com](http://www.ultrafab.com)

Weatherizationsource.com / [www.weatherizationsource.com](http://www.weatherizationsource.com)

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#### Cellulose insulation

Cellulose insulation trade association / [www.cellulose.org](http://www.cellulose.org)

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#### Cotton batt insulation

Bonded Logic / [www.bondedlogic.com](http://www.bondedlogic.com)

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#### Spray foam insulation

BioBased soy-based foam insulation / [www.biobased.net](http://www.biobased.net)

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#### DIY spray foam insulation kits

Foam it Green / [www.sprayfoamdirect.com](http://www.sprayfoamdirect.com)

Foam Power / [www.foampower.com](http://www.foampower.com)

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#### Avoiding crawlspace moisture problems

*New Light in Crawlspaces*, by Joseph W. Lstiburek, Ph.D., P.Eng.;

October 2008, [www.buildingscience.com](http://www.buildingscience.com)

# 5

## CHAPTER OUTLINE

Common upgrades for heating systems

Improving ventilation

# upgrading heating and ventilation

Due to mild summer temperatures, many homes along the Northern California coast don't need air conditioning systems. But heating systems are necessary, and keeping a house warm during winter months can account for 50% or more of a home's annual energy budget. That's why it's important to insulate well and have an efficient, right-sized heating system.

In this part of the country, houses built around 1900 typically relied on wood-burning stoves for heat. Today, it's not unusual to find historic houses that still use wood stoves, often in combination with electric resistance heaters. Unfortunately, this heating strategy isn't energy efficient, cost-effective or sustainable. To make old houses more comfortable and greener, modern heating systems are necessary.

*Fire is the focal point. Wood is a traditional fuel for keeping old houses warm, and it's still viable today, as long as an EPA-certified woodstove is being used. When equipped with a glass door, a woodstove can have the same visual appeal as a fireplace. A brick surround is a good idea because it minimizes clearance requirements while also storing and radiating heat. Photo courtesy of Lennox Hearth Products.*



**FAST FACTS**

How tight is my house? A sure way to find out is to have a “blower door test” done by a home energy analyst or by your utility company, if the utility offers this service. Basically, the test is done by shutting all windows, doors and vents so that the house can be pressurized by a huge “blower door” fan. This enables the energy technician to determine how many “air changes per hour” (ACH) the house allows. A tight house will have no more than 2-3 ACH.



**Compact and efficient.** A typical mini-split heat pump consists of a compressor/condenser unit that is mounted outdoors, one or more air-handler units that can be mounted on an interior wall or ceiling, and a handset that incorporates programmable controls. Photo courtesy of Mitsubishi Electric Co.

## Common upgrades for heating systems

Turning a leaky, poorly insulated house into a tight, well-insulated house causes dramatic changes in the way the building performs. If you’ve achieved this transformation, that’s great –you’re on your way to significant improvements in energy efficiency. But it’s a good idea to have an energy audit done on your “new” house before sizing and designing the HVAC system.

By measuring the tightness of the house (see Fast facts) and performing an energy modeling analysis based on insulation levels, house size, windows, local climate and other factors, your heating and ventilation system can be designed and sized for optimum performance and energy savings. The following upgrades are some, but not all, of the options available.

**EPA-certified woodstove.** Assuming that insulation and air-sealing upgrades have been done, heating with wood can be an attractive option. This is especially true if the house has an open plan and/or ceiling fans that can help distribute heat. The radiant heat from a woodstove offers homeowners an effective, low-tech means of keeping indoor humidity levels in check.

For wood heat to be considered green, it’s necessary to have an EPA-certified woodstove. Non-certified woodstoves should be replaced with certified models, which are available from numerous manufacturers (see Sources).

When an EPA-certified woodstove serves as the only heating appliance, an energy-modeling program shows that very little savings are achieved compared to the current or base case, electric baseboard heat. An energy modeling analysis based on a 1000 sq. ft. Samoa house shows a \$500 projected annual cost for electric baseboard vs. \$465 for wood heat. However, wood heat offers more benefits that these calculations indicate (see sidebar).

**Air-source heat pump.** A mini-split, air-source heat pump (also known as a ductless heat pump) can serve as a home’s primary heating system, or it can be used in combination with an EPA-certified woodstove. This type of heating system is appropriate for historic houses and for small houses in general. There’s no need to disrupt interior spaces in order to install ductwork. Depending on the system you choose, the compact air handler unit (which contains the fan, heating coil and control circuitry) can be mounted on the wall or ceiling. The compressor is located outdoors. These systems typically include programmable controls, which enable homeowners to optimize energy savings. In an energy-modeling analysis based on a 1000 sq. ft. Samoa house, an air-to-air heat pump cost under \$200 to operate for one year.



### FIVE REASONS WHY WOOD HEAT IS GOOD HEAT

1. Heating with wood is a sustainable choice in many areas where firewood can be harvested locally. Firewood is a renewable resource, and it contributes to the local economy.
2. EPA-certified woodstoves are about one-third more efficient than older non-certified stoves. The EPA's strict emissions standards mean that a certified stove produces about 90% fewer particulates than a non-certified stove. It also means that you'll use about one third less firewood to produce the same amount of heat.
3. The EPA rating system for woodstoves assumes the least-efficient mode of operation. If good-quality firewood is used and the woodstove is operated in its most-efficient mode, you can expect improved efficiency and greater savings.
4. Unlike other heating systems, a woodstove doesn't require electricity to operate. If there's a power outage, you can still keep the house warm as long as your firewood supply holds out.
5. If an outdated woodstove is being replaced, it's often possible to utilize the existing chimney or flue pipe as well as the surround where the old stove was located. This makes the installation easier and less expensive.

**Direct-vent gas heater.** Designed to be mounted indoors, against an exterior wall, this type of heater offers an affordable and economical way to heat a small house. Installation is easy: the heater requires a single hole in the wall to supply outside air for combustion and vent exhaust gasses. Once the gas line and wiring are hooked up and the system is checked, you're ready to go. Programmable controls enhance comfort and economy. As with mini-split heat pumps, there are no ducts to move heated air from one room to another. But in a well-insulated small house, one unit per floor may provide adequate heat. Many manufacturers who produce direct-vent gas heaters also make tankless water heaters (see Sources and Chapter 6), since the technology is similar.

**Radiant floor heating.** Electric radiant floors are popular in new bathrooms and in major bathroom remodel projects. The heating cable is embedded in mastic beneath a new tile floor, and its temperature is controlled by a wall-mounted switch. The finished flooring acts like a giant radiator. Radiant floor heat is comfortable, quiet and unobtrusive, since there are no ducts, vents or fans involved. But electric radiant floors aren't energy-efficient for whole-house heating. Hydronic radiant floors, on the other hand, are efficient, comfortable, healthful and very sustainable for whole-house heating. In a hydronic radiant floor, the tubing that carries the hot water is installed beneath the finished floor.

The main drawback with hydronic radiant floors is that they are expensive and complicated to install in an existing house. But there are circumstances that can make this heating option a first choice:

- If the house is being gutted down to its floor sheathing, this will facilitate the installation of hydronic tubing. The tubing can also be installed against the underside of the floor sheathing, but this can compromise efficiency.
- If you plan to live in the house for at least several years, your energy savings will start to offset the higher installation cost.
- Forced-air heating systems aren't recommended for some people who are prone to allergies or respiratory ailments, so radiant floor heating is sometimes chosen for health reasons.
- If it's possible to install an "open-direct" system, costs can be reduced significantly. This type of system uses a single water heater to supply domestic hot water and water for the radiant floor. No boiler is required. Open-direct radiant heating systems are not permitted in some areas, but they have proven to be as reliable as more-costly, boiler-based heating systems (see Sources).

## Improving ventilation

In the past, many builders assumed that uncontrolled air leakage through gaps and cracks in the building envelope would provide adequate ventilation for a home's occupants. But this approach to ventilation is no longer viable. Research has shown that without a way to exhaust stale, moist interior air and replace it with fresh air from outside, indoor air pollution can reach hazardous levels.

Poor ventilation can also increase the potential for mold and moisture damage caused by moist interior air that condenses against cold surfaces. As houses are built or upgraded to be more airtight and better insulated, it's critical to have a well-functioning ventilation system. **Given the importance and complexity of ventilation requirements in a tight, well-insulated house, it's wise to call on an HVAC contractor with expertise in energy-efficient construction to evaluate ventilation options.**

**Roof ventilation.** Vents that allow hot air to escape from the attic space and be replaced by a balanced amount of fresh air help to keep homeowners comfortable in hot weather while also prolonging the life of roof shingles. Roof ventilation is typically provided by a combination of ridge, soffit and gable-end vents. Ventilation requirements are measured in square feet or square inches of "net free vent area." NFVA isn't difficult to calculate. Divide the square footage of the attic by 300 to get the NFVA required for adequate roof ventilation. An 850sq. ft. attic area would require 2.8 sq.ft. (403 sq.in.) of NFVA. Soffit, ridge and gable-end vents carry specific NFVA ratings. If soffit and ridge vents are used, try to divide the NFVA requirements equally between soffits and ridge. NOTE: If insulation is installed between rafters to convert an unfinished attic into living space, make sure that inserts or baffles are placed between rafters prior to installing the insulation. This will maintain a ventilation space between the underside of the roof sheathing and the added insulation.

**Vent fans.** Permanently installed vent fans play an important role in removing odors, stale indoor air and excess humidity. A house should have a vent fan in the following locations:

- Bathrooms. A Title 24-compliant fan is required
- Kitchen range
- Laundry rooms and other high-humidity areas

For a bathroom or laundry room, it's advisable to buy a vent fan equipped with a time-delay switch, or a switch that turns the fan on when motion or a preset level of humidity is detected. This is the best way to ensure that a fan stays on long enough to fully exhaust all the excess humidity from a hot shower, and ensure a healthy amount of air exchange when the house is occupied. Panasonic, Broan and Aldes also make fans designed to run continuously at low speed, consuming a minimum amount of power while exhausting interior air. These fans are often combined with passive inlet vents (see next page), which bring in fresh air.





**Indoor air quality.** *In a tight, well-insulated house, the ventilation system needs to exhaust stale and humid air while also drawing in a balanced supply of fresh air from outside. A passive air inlet vent (above) is designed to provide makeup air from outside in response to the exhaust action of one or more vent fans. Another way to ensure healthful air exchange is to use a heat recovery ventilator (HRV), shown below. Photos courtesy of American Aldes*



**Passive inlet vents.** Passive inlet vents are designed to help tight houses breathe by admitting outside air in response to vent fans that exhaust stale interior air. Passive inlet vents can help prevent potentially dangerous backdrafting of combustion gasses (from a gas or wood-burning appliance) when a vent fan is operating. It's best to install passive inlet vents in a utility room rather than in living and dining areas, and the vent's inlet should be away from the exhaust vent of a heater or clothes drier.

**Heat recovery ventilators.** This ventilation appliance was developed specifically to provide balanced air changes in tight houses. An HRV exhausts interior air while simultaneously drawing in an identical volume of fresh exterior air. In the process, the interior air transfers some of its temperature to the outside air. Depending on its design, an HRV can include bathroom ventilation or work independently of bathroom vent fans.

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## Sources

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### EPA-certified wood stoves

NOTE: Companies listed below have manufacturing facilities in the Pacific Northwest.

Enviro wood stoves (manufactured in Saanichton, BC, Canada) / [www.enviro.com](http://www.enviro.com)

Quadra Fire stoves (manufactured in Colville, OR) / [www.quadrafire.com](http://www.quadrafire.com)

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### Mini-split heat pumps

GoDuctless.com / [www.goductless.com](http://www.goductless.com)

Ductless Depot / [www.ductlessdepot.com](http://www.ductlessdepot.com)

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### Direct-vent gas heaters

Monitor / [www.monitorproducts.com](http://www.monitorproducts.com)

Empire / [www.gas-space-heater.com](http://www.gas-space-heater.com)

Rinnai / [www.rinnai.us/](http://www.rinnai.us/)

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### Radiant floor heating

"Warm Floors on a Tight Budget" by Scott Gibson / Fine Homebuilding issue #201; pp. 42-47 / [www.finehomebuilding.com](http://www.finehomebuilding.com)

Hannel Radiant Direct / [www.radiantdirect.com](http://www.radiantdirect.com)

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### Vent fans, passive inlet vents & HRVs

Bathroom Fan Experts / [www.bathroomfanexperts.com](http://www.bathroomfanexperts.com)

Panasonic / [www.panasonic.com](http://www.panasonic.com)

Broan / [www.broan.com](http://www.broan.com)

American Aldes / [www.americanaldes.com](http://www.americanaldes.com)

IAQsource / [www.iaqsource.com](http://www.iaqsource.com)

Fantech / [www.fantech.net](http://www.fantech.net)

UltimateAir / [www.ultimateair.com](http://www.ultimateair.com)

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# 6

## CHAPTER OUTLINE

Common upgrades for plumbing systems

Tank-type water heaters vs. tankless water heaters

Solar hot water

Small-scale greywater systems

Sources

# plumbing improvements

The number and size of bathrooms that can be found in new homes today contrasts dramatically with the plumbing system that served a Victorian-style home built around 1900 or so. Some Samoa houses have small, shed-roofed additions built to house bathrooms and kitchens that weren't part of the original structure. In other historic houses, plumbing may have been incorporated into the original design, but in minimalist form.

Both cases usually call for plumbing improvements. Some of this work will be done to improve convenience and aesthetic appeal. But in this chapter, we'll focus on plumbing improvements that increase a home's green value by conserving energy, reducing water use, and minimizing a home's impact on a septic or municipal waste water treatment system.

*Solar heater in disguise.* Many collectors for solar hot water systems are designed to be mounted on top of the roof, but Velux has developed a system that installs and looks like a skylight. The plumbing components and connections are accessible from inside the house. Photo courtesy of Velux America.





***A blanket for the tank.*** Wrapping a tank-type water heater with specially made insulation will save money on water-heating costs. Tank insulating kits are available for water heaters of different sizes.

***Special insulation for hot water pipes.*** Sized to fit over different pipe diameters, rigid foam insulation is an energy-saving upgrade that's inexpensive and easy to perform. Where a pipe run turns a corner, use a sharp utility knife to make angled cuts as shown in the photo to keep insulation coverage continuous. Photos this page reprinted with permission from *Cut Your Energy Bills Now* by Bruce Harley, published by The Taunton Press. Photo ©Randy O'Rourke

## Common upgrades for plumbing systems

These upgrades are designed to improve energy efficiency and reduce water use. They'll also improve convenience and comfort by reducing the time it takes for hot water to reach the faucet or showerhead. Homeowners can complete these upgrades using basic tools. The products associated with these upgrades are available from hardware stores, home centers and online suppliers (see Sources).

### **Water-conserving showerheads and aerators.**

Designed to limit water flow without compromising cleaning and rinsing effectiveness, these devices are affordable and easy to install. A low-flow aerator should be rated to limit water flow to between .5 and 1.5 gallons per minute (gpm). Low-flow showerheads typically fall into the 1.3-2.5gpm range.

**Water heater insulation.** If the existing water heater is in good working order but lacks insulation, this upgrade can be done easily and affordably. The typical water heater insulation kit includes a fiberglass insulation blanket that can be cut to fit around the sides and top of the water heater; adhesive tape to hold the insulation in place, and installation instructions for gas and electric water heaters (see photo).

### **Pipe insulation for hot water supply lines.**

Insulating hot water supply lines saves water and energy while also reducing the time you have to wait for hot water to arrive. The hot water lines that benefit the most from insulation are those that run in unconditioned (unheated) space between the water heater and the inside of the house. If the water heater is located in a crawlspace or basement, hot water lines should be accessible. The best type of pipe insulation to use is the rigid foam type – a long foam cylinder with a hole down the middle and a slot for sliding the insulation over a length of pipe. Make sure to buy insulation that matches the diameter of the pipe you plan to insulate. Butt foam sections together when insulating straight sections of pipe. For elbows (90degree bends) in the pipe, make angled cuts in the foam to keep the insulation continuous.



**FAST FACTS**

Switching to an Energy Star washing machine can save a typical household 7000 gallons of water a year. Replacing a 12-year-old dishwasher with an Energy Star model can save 600 gallons of water a year and use 29% less energy.



***Tankless times two.** Mounted on an attic wall, a pair of tankless water heaters provide all the hot water for this house. Unlike tank-type water heaters, these heaters don't consume energy until the hot water is turned on. Photo courtesy of Noritz*

## Tank-type water heaters vs. tankless water heaters

Many old houses have tank-type water heaters that are worn-out and/or inefficient. Replacing an old tank-type heater with a new Energy Star model is a smart upgrade that can cut your energy bill by as much as 10%. Assuming that other water-conserving measures are taken, a 40-gallon model should be sufficient for a two-person household. A 50-gallon heater will work for four people.

Instead of installing tank-type heaters, some homeowners are choosing tankless models (also known as a "demand heaters"). While a tank-type water heater consumes energy to store water at a certain temperature, a tankless model only uses energy (electricity, propane or natural gas) when there's a demand for hot water. According to research done by PATH (see Sources) a tankless water heater can be 10%-20% less expensive to operate than a tank-type heater. But this savings needs to be balanced against higher initial cost and other considerations. To decide which water-heating option is best for your house, consider the following factors:

- A tankless heater typically costs 2-3 times as much as a tank-type heater.
- Warranties range from 10-20 years, depending on manufacturer and model. But tankless water heaters typically outlast tank-type heaters.
- Tankless water heaters can use electricity and propane to heat water, but the greatest energy savings typically come with natural gas units.
- Although larger units can provide hot water to multiple taps simultaneously, a tankless water heater works best when only one hot water tap is open at a time.
- A tankless system can work very well if the hot water taps in a house are relatively close together, with short hot water lines between them. If hot water taps are far apart, they are best served by separate tankless heaters or by a single tank-type water heater.
- A typical tankless heater is compact (about the size of a small suitcase), and can be mounted on an interior or exterior wall. Gas-fired models vent through the wall or through a vent pipe that extends through the roof.

### BEWARE OF LOW-PRICED LOW-FLUSH TOILETS

While all major plumbing fixture manufacturers have toilets that qualify as low-flush models (using 1.6 gallons of water or less), the performance and quality of these toilets vary greatly. Feedback from contractors and plumbers supports the contention that you get what you pay for. Better models that earn favorable ratings (like the Kohler Cimarron or the Ultramax from Toto) typically cost at least \$300.



*Greywater made simple. The Aquus greywater system comes in kit form, and is designed to recycle greywater from a bathroom sink for use in flushing the toilet. All the components can fit in the cabinet beneath the sink. Photo courtesy of WaterSaver Technologies*

## Solar hot water

Harnessing solar energy to heat water saves money and helps the planet by reducing demand for fossil fuel. Solar hot water systems have been in use for many years. Today it's not difficult to find experienced installers, and the current selection of components (flat plate collectors, pumps, valves, controllers, heat exchangers and water heaters) are more reliable than ever. Under ideal conditions, a solar hot water system can cut water heating costs by as much as 80%.

The most challenging aspects of a solar hot water installation are usually shouldering the up-front costs (which can range from \$6000-\$10,000 for a small house) and positioning the flat plate collectors for maximum sunlight exposure. Tax credits and other incentives can help offset installation costs (see Sources). To catch the sun, collectors can be mounted on the ground or on the roof, provided that the roof structure is sufficiently strong.

## Small-scale greywater systems

Greywater is defined as the household wastewater that results from bathing and washing clothes and dishes. Because it's more sustainable to recycle grey water than to let it pass into the septic system, greywater systems should be considered in any green community. Up until recently, any domestic greywater system had to be custom-built, typically at considerable expense.

Today, small-scale systems are being developed with an emphasis on affordability, safety and simplified installation. For example, the AQUUS system from WaterSaver Technologies is designed to recycle the greywater from a bathroom sink for use in flushing the toilet. A kit for a single bathroom installation, including all components and detailed installation instructions, is available for around \$400 (see Sources). As greywater technology becomes more accessible, the functionality of such systems can expand to watering lawns and plants. Greywater is purified naturally when used to water gardens and lawns, since phosphates and other chemical compounds leach into soil and can actually nourish plants.



### Sources

NOTE: All products mentioned below, except for greywater systems, can also be found at home centers, hardware stores, and building or plumbing supply outlets.

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#### Low-flow showerheads and faucet aerators

Eartheasy / [www.eartheasy.com](http://www.eartheasy.com)

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#### Water heater insulation kits

TierraPath / [www.tierrapath.com](http://www.tierrapath.com)

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#### Pipe insulation

AM Conservation Group / [www.amconservationgroup.com](http://www.amconservationgroup.com)

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#### Tankless water heaters

Monitor / [www.monitorproducts.com](http://www.monitorproducts.com)

Bosch / [www.boschhotwater.com](http://www.boschhotwater.com)

Rinnai / [www.rinnai.us](http://www.rinnai.us)

Takagi / [www.takagi.com](http://www.takagi.com)

PATH / [www.toolbase.org](http://www.toolbase.org)

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#### Solar energy

The California Solar Initiative  
(also the Million Solar Roofs Initiative) / [www.gosolarcalifornia.org](http://www.gosolarcalifornia.org)

Redwood Coast Energy Authority (Eureka, CA)  
[www.redwoodenergy.org](http://www.redwoodenergy.org) / 707-269-1700

Renewable Funding (innovative solutions for renewable energy  
and energy efficiency financing)

[www.renewfund.com](http://www.renewfund.com)

National Renewable Energy Laboratory / [www.nrel.gov](http://www.nrel.gov)

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#### Small-scale grey water systems

WaterSaver Technologies / [www.watersavertech.com](http://www.watersavertech.com)

Sloan Valve Company / [www.sloanvalve.com](http://www.sloanvalve.com)

# 7

## CHAPTER OUTLINE

Common upgrades for electrical systems

Super-efficient appliances exceed Energy Star requirements

Eliminating phantom loads

Energy-efficient upgrades for lighting

# electrical and lighting systems

Explore the attic of a house built in the early 1900s and you're likely to find old ceramic insulators, bare wires, and other evidence of knob-and-tube wiring systems –the earliest form of residential wiring. Despite subsequent electrical upgrades, an old house can still lag behind the latest standards for capacity, safety and energy efficiency. This chapter covers common upgrades that can improve electrical safety while also promoting efficient energy use. If you want to go beyond these basics, there are more ways to reduce electricity use and thus increase green value –with super-efficient appliances and photovoltaic panels. These options will be covered later in the chapter, along with lighting system upgrades.

Safety and code compliance. Working with electricity always poses potential safety hazards that range from mild shocks to fire and electrocution. Whether a homeowner or electrical contractor is doing electrical work, it's essential to check with the building department to see if a building permit is required, and to ensure that safe, code-compliant work is done.

*PV you can barely see. Building-integrated photovoltaic (BIPV) products make it possible to minimize the visual impact of PV installations. BIPV roof shingles offer a very unobtrusive way to generate electricity from sunlight –an attractive option for historic houses. Photo courtesy of the National Renewable Energy Laboratory*



### COMMON UPGRADES FOR ELECTRICAL SYSTEMS

An old house can get by for years with a marginal electrical system. To bring an historic home up to date, and make it compliant with current building codes, consider the following upgrades.

- Upgrade the service to 200 amps. This may not be necessary for a small house that utilizes energy-saving features, but it ensures adequate future capacity.
- Replace old fuse boxes with modern service panels equipped with circuit breakers.
- Install at least one outdoor receptacle.
- Install at least one outdoor light.
- Provide GFCI (ground fault circuit interruption) protection for kitchen, bath and outdoor circuits.
- Improve crawlspace, basement and attic lighting as necessary.
- Add interior receptacles as necessary for home office and home entertainment components.
- Install a Title 24-compliant bathroom fan in every bathroom.
- Install a vent fan in the laundry room.
- Install a vent fan for the kitchen range.

## Super-efficient appliances exceed Energy Star requirements

Established jointly by the U.S. Environmental Protection Agency and the Department of Energy (see Sources), the Energy Star program has been very successful in advancing energy-efficient technology in numerous areas. Energy Star-rated appliances typically exceed Federal standards for energy efficiency by 20% or more. But it's important to recognize that Energy Star standards represent minimum levels of energy-efficient performance.

Thanks to competition among appliance manufacturers and even stricter performance standards for European and Japanese companies, it's possible to buy appliances that exceed Energy Star performance by significant margins. Don't just settle for an appliance with an Energy Star rating. Instead, compare the efficiency ratings, estimated annual operating costs and (on certain appliances) water consumption figures on appliance labels. Here are a few examples that illustrate the range in energy efficient performance for a few common appliances:

APPLIANCE	ENERGY STAR MIN. STANDARD (EFS=Exceeds Federal Standard)	BEYOND ENERGY STAR
Refrigerator	EFS by 20%	Frigidaire & Miele models EFS by up to 33%. SunFrost RF-12 (locally manufactured) EFS by 46%
Dishwasher	EFS by 41%	Bosch & Asko models EFS by over 141%
Clothes washer	EFS by 37%	Whirlpool, LG, Samsung models EFS by over 110%

**FAST FACTS**

Over the course of a year, a typical 3-in-1 fax/printer/copier can use over 800kWh or around \$100-worth of electricity. This is because it checks every 10 seconds to see if a fax has arrived.

## Eliminating phantom loads

Many electric devices consume power even when they're "off." Battery chargers for cell phones, cordless power tools and digital cameras are common examples. Then there are other appliances—like televisions, DVD players and computer monitors—that still use electricity in their standby state. Added together, these "phantom loads," can account for 5%-10% of a home's annual electric bill.

It may not be possible to eliminate all the phantom loads in the house—the digital display on a kitchen stove, for example. But you can eliminate quite a few by plugging appliances into a power strip that is controlled by a single switch. TVs, DVD players, computer monitors, printers, and battery rechargers fall into this category. Power strips are available at home centers and hardware stores. There are even "smart" power strips designed to turn off related devices all at once (see Sources). There's an added bonus in using power strips: Most include surge protection circuitry, which helps prevent damage from occasional surges in electrical current.

## Incentives make photovoltaic power more attractive

Installing photovoltaic (PV) panels to generate electricity is an energy-saving upgrade that will take longer to fully recover its initial installation cost. Northern California's rainy weather is another limitation. But there are still some powerful positives to consider:

- Using the sun's energy reduces our dependence on fossil fuels. Producing electricity with PV creates no green house gas emissions.
- Even a small PV installation can cut annual electricity use by 20%.
- Tax credits, California's Million Solar Roofs initiative and other incentives can reduce installation costs and help resolve funding barriers (see Sources).
- A house with PV may qualify for a more favorable mortgage. The house will also have improved resale value.
- Once the installation is complete, a typical grid-tied PV system requires little or no maintenance.
- "Building-Integrated" PV, such as PV roof shingles made using thin-film technology, are especially appropriate for historic houses because they don't alter existing rooflines. Some BIPV installations are nearly impossible to detect.



**Power strips can save power.** A good way to eliminate phantom loads is to use a power strip that can turn off related components (like a television, DVD player and cable box) all at once. The SmartStrip shown is designed so that when the component plugged into the blue receptacle is turned off, all other white receptacles automatically turn off as well.

**FAST FACTS**

When you switch from incandescent to fluorescent lights, the payoff begins immediately. Lighting costs, (which typically account for 10% of your electrical bill) can be cut by as much as 75%.



***Non-electric light fixture.** Installing a tubular skylight is a great way to bring light to interior spaces like this hallway, without turning on the power. The skylight's tube extends to a clear plastic dome on the roof, and has a mirror-like interior that brings sunlight inside. Photo courtesy of ODL.*

## Energy-efficient upgrades for lighting

### Switch from incandescent to fluorescent lighting.

The first part of this task couldn't be any easier: Simply replace incandescent lightbulbs with compact fluorescent lights (CFLs). The second part can take a little more work, if you decide to install new fluorescent fixtures or replace existing incandescent fixtures with fluorescent versions. Examples include ceiling-mounted fixtures in the kitchen, bathroom, laundry room, and closets. Fluorescent recessed lights are also available. NOTE: The development of LED (light-emitting diode) lights promises even greater energy savings than are possible with CFLs. However, at this time the limited availability and high cost of suitable LED lights make these products worth considering in the future.

### Replace Non-IC recessed lights with IC fixtures.

This is a smart upgrade to do along with air-sealing and insulating the attic (see Chapter 4). A substantial amount of heat loss can occur around recessed ceiling lights, especially "non-IC" fixtures that must not be in contact with insulation. To reduce heat loss, replace non-IC "cans" with IC-rated units. Caulk around the trim ring to air-seal the fixture to the ceiling. Then make sure to insulate around and over the light fixture from above.

### Use tubular skylights to put light in unexpected places.

A good way to save electricity during the day is to install one or more tubular skylights. Thanks to a reflective tube that can extend through unfinished attic space, a tubular skylight can bring sunlight to interior spaces like hallways, closets, and laundry rooms. These skylights are less-expensive than traditional skylights; some models cost less than \$300 (see Sources). Tubular skylights are easier to install than standard skylights.

### Add smarter switches to save power.

Dimmer switches allow you to adjust the light level coming from a light fixture. At lower light levels, you're saving electricity. Standard wall switches can be replaced with dimmer switches, as long as the dimmer is designed to be used with the light fixture. Some people install motion sensor switches in laundry or utility rooms because the light turns on automatically when you enter the room with your hands full. But these switches also save energy by turning off automatically after a preset interval when the room is empty. You can buy a motion-sensor switch that screws into a light socket, or install a motion-sensor switch in place of a standard, wall-mounted light switch. Exterior versions are also available to control outdoor lights.

### Sources

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#### Refrigerators

Sunfrost Refrigerators (Arcata, CA) / [www.sunfrost.com](http://www.sunfrost.com)

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#### Efficiency ratings on appliances

Energy Star / [www.energystar.gov](http://www.energystar.gov)

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#### Smart power strips

SmartHomeUSA: Surge protectors / [www.smarthomeusa.com](http://www.smarthomeusa.com)

Terrapass / [www.terrapass.com](http://www.terrapass.com)

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#### Solar & other renewable energy

The California Solar Initiative (also the Million Solar Roofs Initiative)

[www.gosolarcalifornia.org](http://www.gosolarcalifornia.org)

Redwood Coast Energy Authority (Eureka, CA)

[www.redwoodenergy.org](http://www.redwoodenergy.org) 707-269-1700

Renewable Funding (develops and delivers innovative solutions for renewable energy and energy efficiency financing) / [www.renewfund.com](http://www.renewfund.com)

National Renewable Energy Laboratory / [www.nrel.gov](http://www.nrel.gov)

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#### Lights

Elights.com / [www.elights.com](http://www.elights.com)

American Fluorescent / [www.americanfluorescent.com](http://www.americanfluorescent.com)

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#### Tubular skylights

Solatube (Eureka, CA) / [www.solatube.com](http://www.solatube.com) / 707-445-0786

Sun-Dome / [www.sun-dome.com](http://www.sun-dome.com)

Natural Light Energy Systems / [www.nltubular.com](http://www.nltubular.com)

Tubulardirect / [www.tubulardirect.com](http://www.tubulardirect.com)

TruLite / [www.tru-lite.com](http://www.tru-lite.com)

The Skylight Store / [www.theskylightstore.com](http://www.theskylightstore.com)

ODL / [www.odl.com](http://www.odl.com)



# 8

## CHAPTER OUTLINE

Wood & wallboard

Countertops

Sustainable flooring

Green paints & finishes

Sources

# sustainable materials for interior finish

The reward for resolving major issues like structural problems, heating systems, energy performance and damaged siding is in what comes next: improving and personalizing interior spaces. Much can be done in this area, and concerns for preserving historical authenticity are not as critical as they are with exterior details.

However, it's still important to choose green products over those that are not sustainably produced. Today manufacturers of building materials are paying attention to architects, contractors and homeowners who are looking for green products. The quantity and variety of green building materials continues to grow. In this chapter, we'll review a few of the green products that might be used to enhance the aesthetic and functional appeal of a home interior.



*New uses for old wood.* Wood countertops in this remodeled kitchen were made from antique elm boards salvaged from an old barn. Photo courtesy of Elmwood Reclaimed Timber



**Panel alternative.** Available in different thicknesses, Kirei board is made from waste material generated from processing various plants, such as coconut, sorghum and wheat. It can be used in place of plywood, particleboard and other panel products. Photo courtesy of Kirei USA

## Wood & wallboard

These two materials are primary ingredients in many home improvement projects. It's important to make sustainable choices here because you don't want to subsidize businesses that deplete natural resources or waste energy. In case the local suppliers that you normally use don't have access to the sustainable choices listed below, it's smart to plan projects well in advance, so that there's time to order the right materials and put off your start date until they arrive.

### ► Recommendations on wood and wallboard

**Certified wood.** Although there are quite a few certification programs designed to promote sustainable forestry practices, the Forest Stewardship Council (see Sources) has the most far-reaching influence. Established in 1995, the FSC sets forth principles and standards that address the economic, social, and environmental concerns associated with forest products. FSC standards for forest management have now been applied in over 57 countries around the world. If you are buying new lumber for a building or remodeling project, ask for FSC-certified material.

**Gypsum wallboard.** Drywall panels are used universally to form interior finished walls and ceilings. Unfortunately, the gypsum-based core of a standard drywall panel is a very energy-intensive material. Just one 4x8 sheet can require over 100,000 BTUs of energy and put 16lbs. of greenhouse gases into the atmosphere. For repairs, remodeling and new construction work in the Samoa community, a greener interior wallboard called EcoRock is recommended. The core material in EcoRock is made from 85% recycled content. EcoRock is also greener to manufacture because it doesn't require the energy-intensive heating and drying processes necessary for standard drywall. EcoRock costs slightly more than standard drywall.

**Bamboo.** A grass with tree-like qualities, bamboo is made into flooring, countertops, cutting boards, and composite panels that can be used in place of

cabinet-grade plywood. The widespread popularity of this sustainable material has actually led to some bad practices. These include the clearcutting of more diverse forests in China (where most bamboo products are manufactured), and the premature harvesting of bamboo, which yields inferior products. If you are considering bamboo products, it's best to look for FSC-certification and to ask for samples from the distributor before you place a big order. Also, make sure that the product is made using formaldehyde-free adhesives.

**Kirei board.** Consider this composite panel as an alternative to plywood or particleboard. Kirei board is made from reclaimed agricultural fiber (waste fiber from sorghum, coconut and wheat plants) and a nontoxic adhesive. It can be used for cabinetry, casework, furniture and other interior woodwork.



***New life for old bottles.** A number of companies are fabricating countertops made from recycled glass bottles. The broken bits of glass are blended with mortar, cast into flat panels, then polished to create the finished product. Photo courtesy of Enviroglass*

## Countertops

Replacing an old countertop with a new one makes a dramatic difference in any kitchen. There are quite a few green countertop choices available. When evaluating different options, keep in mind that it's possible to choose more than one type of countertop for a kitchen.

**Wood countertops.** Wood isn't a good idea around a sink, but it can be a great choice just about anywhere else. For maximum green value, a wood countertop should be made from reclaimed or sustainably sourced material. Endura Countertops, based in Portland, OR, are experienced fabricators who offer a wide range of choices in terms of wood species, design, edge profiles, and sizes (see Sources). It's also possible to have wood countertops made by a local cabinet shop.

**Paperstone.** Based in Hoquiam, WA, PaperStone has found a way to fabricate countertops by combining recycled cardboard and office paper with petroleum-free resins and organic pigments. Dense, durable and waterproof, Paperstone countertops come in 12 standard colors and different thicknesses. For countertop use, the 1-in. thickness is most popular. Prices for the material range from \$30-\$50 per sq. ft.

**Recycled glass.** Crushed glass bottles and a modified mortar mix are the main ingredients that a number of manufacturers are using to make countertops that literally sparkle with recycled content. Several companies are distributing these countertops nationally (see Sources), but it's also worth checking to see if local concrete countertop fabricators are offering this type of countertop.

**FAST FACTS**

The Forest Stewardship Council has certified 80 million acres of North American forestland. 260 million acres are certified globally. More than 2,600 U.S. companies are certified under FSC's chain-of-custody standards (11,100 globally).

**GOOD WOOD**

The logo of the Forest Stewardship Council is easy to spot, and indicates that the wood has passed stringent standards for sustainability.



## Sustainable flooring

If **wood flooring** is on your wish list, the greenest choice would be flooring that is milled locally or regionally from reclaimed wood. A good second choice would be flooring milled from FSC-certified wood.

**Cork flooring** is also a sustainable choice, and occupies its own unique category as a forest product. Available in tiles that are easy to install, cork provides a comfortable, resilient surface with good insulating qualities.

Affordable and available in many colors and patterns, **linoleum flooring** is the green alternative to vinyl flooring. It's an excellent material to use in laundry and utility rooms as well as in kitchens and kids' rooms.

For a longer-lasting floor, **tile** can't be beat. Many tile distributors now stock "green tile" that is manufactured with recycled content.

## Green paints and finishes

Because volatile organic compounds contribute to global warming, paints and other finishes that are formulated with VOCs should not be used. Fortunately, California has the strictest VOC regulations in the country. If you buy paint in California, it should comply with low-VOC content requirements.

However, it's possible to take an even greener approach, and aim for finishes that contain no VOCs. Be prepared to look beyond established names in paint, and discover no-VOC products produced by smaller companies like Freshaire Choice, YOLO Colorhouse, and AFM Safecoat. Also, it's worth considering milk paint, a traditional finish for wood furniture and other wood products. Milk paint formulations are also available for walls and ceilings (see Sources).

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## Sources

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### Reclaimed & FSC-certified lumber

Forest Stewardship Council / [www.fscus.org](http://www.fscus.org)  
Old Growth Timbers, esp. redwood (Petrolia, CA)  
[www.oldgrowthtimbers.com](http://www.oldgrowthtimbers.com)  
TerraMai (Mt. Shasta, CA) / [www.terramai.com](http://www.terramai.com)  
EarthSource Forest Products (Oakland & San Jose, CA)  
[www.earthsourcewood.com](http://www.earthsourcewood.com)

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### Interior wallboard

EcoRock, made by Serious Materials / [www.seriousmaterials.com](http://www.seriousmaterials.com)

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### FSC-certified bamboo & Kirei board

Smith & Fong Plyboo (based in San Francisco) / [www.plyboo.com](http://www.plyboo.com)  
Kirei USA / [www.kireiusa.com](http://www.kireiusa.com)

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### Paperstone countertops

Manufacturer: Paneltech International / [www.paperstoneproducts.com](http://www.paperstoneproducts.com)

### Local distributors:

Alternative Building Center / [www.abcgreenbuilding.com](http://www.abcgreenbuilding.com)  
4 West Fourth Street / Eureka, CA 95501 / 707.445.4733  
Counter Creations / [www.countercreations@suddenlink.net](mailto:www.countercreations@suddenlink.net)  
4892 Walnut Dr. / Eureka, CA 95503 / 707.444.9193

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### Glass & concrete countertops

Icestone / [www.icestone.biz](http://www.icestone.biz)  
Enviroglass / [www.enviroglasproducts.com](http://www.enviroglasproducts.com)

To find a local concrete countertop fabricator,  
go to [www.theconcretenetwork.com](http://www.theconcretenetwork.com)

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### Linoleum

Armstrong / [www.armstrong.com](http://www.armstrong.com)  
Forbo / [www.forbolinoleumna.com](http://www.forbolinoleumna.com)  
Johnsonite / [www.johnsonite.com](http://www.johnsonite.com)

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### Tile

Terra Green Ceramics / [www.terragreenceramics.com](http://www.terragreenceramics.com)  
United Tile / [www.unitedtile.com](http://www.unitedtile.com)  
Nemo Tile / [www.nemotile.com](http://www.nemotile.com)

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### Green paints and finishes

Alternative Building Center (Eureka, CA) / [www.abcgreenbuilding.com](http://www.abcgreenbuilding.com)  
707-445-GREEN  
The Old-fashioned Milk Paint Company / [www.milkpaint.com](http://www.milkpaint.com)  
Freshaire choice / [www.freshairechoice.com](http://www.freshairechoice.com)  
YOLO ColorHouse / [www.yolocolorhouse.com](http://www.yolocolorhouse.com)  
AFM Safecoat / [www.afmsafecoat.com](http://www.afmsafecoat.com)

# 9

## CHAPTER OUTLINE

Rain and storm water management

Plants

Vegetable gardens

Fences

Sheds and outbuildings

# landscaping recommendations

Landscaping guidelines are especially important in communities like Samoa, where lots are small and houses are spaced closely together. Any planting and hardscaping work done in one yard is certain to have visual consequences for neighboring houses and yards. The small distance between houses also means that drainage problems originating on one property may have an impact on adjacent properties. The landscaping recommendations in this chapter are aimed at achieving the following goals:

- Manage rain and storm water runoff to avoid erosion and associated property damage.
- Promote the cultivation of plant species that will help stabilize soil, enhance property values and require little or no upkeep.
- Provide guidelines for successful small-scale vegetable gardens.
- Provide guidelines for fences, sheds and other hardscape elements
- Maintain the historical integrity of the community.







**Better drainage.** Sometimes downspouts alone don't do enough to keep water away from the house foundation. One way to improve water management is to attach flexible drain pipe to a downspout and run the pipe into sandy soil or a gravel bed, as shown here. Photo courtesy of FLEX-Drain.

## Rain and storm water management

Coastal storms and significant seasonal precipitation make rain and storm water management a priority in many communities along California's northern coast. A first step in handling the rain is to upgrade gutters and downspouts as recommended in Chapter 3. In addition, splash plates can help to move water from gutters away from the house. However, the following additional drainage work should also be considered.

### ► Common upgrades to improve rain and storm water management

**Permeable paving materials.** In selected areas, existing asphalt paving can be replaced with permeable paving. Permeable paving materials should be selected that can provide the functionality of asphalt paving without blocking the passage of water into the soil. In addition to being installed as a replacement for asphalt paving, permeable paving can be used as an alternative to lawns in some areas.

**Downspout extensions.** The layer of topsoil associated with the cultivation of lawns around many houses can also contribute to water problems by blocking the passage of water into sandy soil. It's possible to improve drainage by connecting downspouts into short (less than 10-ft.) sections of perforated drain pipe that extend into sandy soil or into a gravel bed beneath the grass layer (see photo). When done in combination with a gutter and downspout upgrade, this improvement will help prevent one home's roof runoff from creating problems for neighboring houses.

**Rain water harvesting.** With minor modifications, a home's gutter and downspout system can feed into rain barrels that store roof runoff, providing water for plants, washing the car, or other uses. Reducing demand on individual wells or the municipal water supply is a very green initiative that isn't expensive to implement. Special rain barrels are available for use with downspouts, along with fixtures that filter out leaves and other debris.



***The reel deal.** If you have a small lawn (or can make a big lawn smaller using alternative landscaping), a modern reel-type mower offers a great way to cut the grass. The shearing action of the blades provides a cleaner cut than you get with a rotary mower, and using a manual mower will help the planet and the operator live longer.*

## Plants

Like many areas along California's coast, the Samoa Peninsula was once much more lush than it is now. Indigenous plants were cut down or removed –trees to turn into lumber; shrubs and ground cover to make way for houses, commercial buildings and roadways. Wherever possible, at least some of this lushness should be restored. Ideally, the plants selected will survive well in the local coastal environment with little or no care, help stabilize the soil, and add beauty and diversity to the neighborhood.

### ► Plant recommendations

**Trees.** Monterey cypress (*cupressus macrocarpa*) does well in a coastal environment, and will develop a classic windswept look. Monterey pine (*pinus radiata*) grows quickly and will work best as a windbreak away from high-traffic areas. Catalina ironwood (*lyonothamnus floribundus*) is a medium-size broadleaf evergreen that copes well with wind and sandy soil. For use around buildings and walkways, shore pine (*pinus contorta*) is a good choice.

**Shrubs.** Coastal silk tassel (*ganya elliptica*) is a beautiful native shrub that is dense, hardy and wind tolerant. Rhododendron will do well when protected from high winds. Pacific wax myrtle (*myrica californica*) is hardy and fairly wind tolerant.

**Ground cover.** Different varieties of mansanita (*arctostaphylos uva-ursi*) are recommended as an alternative to grass cover.

**Non-polluting lawnmowers.** Gas-powered lawnmowers contribute to air and noise pollution, while also prolonging our dependence on foreign oil. If the lawn belonging to a house is small enough, it can be mowed the old-fashioned way –with a reel-type mower that only requires a push to power its cutting action. The hand-powered reel mowers available today are lighter, more mechanically efficient and easier to use than older machines. Using one is a very green way to cut grass while getting exercise at the same time (see Sources). In cases where a reel mower isn't an option, the next-best choice is an electric mower.



*Water supply from the sky. Available from different sources, rain barrels are designed to function like small cisterns, capturing rain water that's delivered by downspout. This rain barrel has several useful features, including an overflow pipe, a built-in spigot, and a protective top that includes a filter to capture leaves, twigs and other debris.*

## Vegetable gardens

Growing your own produce is a core principle of sustainable living. Green living advocates have demonstrated that vegetable gardening can be done successfully in small spaces and in spite of challenging conditions. There are certainly a few challenging conditions in the Samoa community. Yard sizes are typically small, and closely spaced houses can limit the amount of direct sunlight that reaches some areas of a yard. But in the spirit of sustainable living, every reasonable effort should be made to promote home-grown produce.

### ► Recommendations for vegetable gardening

**A community garden.** Many homeowners may find that their yards are not large enough or properly oriented for vegetable gardening. If property can be set aside to develop a community garden, then every household would have the opportunity to grow their own food regardless of lot size or orientation.

**Smart vegetable selection.** Cool season vegetables like lettuce, spinach, chard, cabbage and kale can be grown all year long. Green beans, peas, carrots, radishes, beets, potatoes and squash are also smart choices. Artichokes, asparagus and zucchini do well, and are likely to yield large crops.

**Raised bed and container gardening.** These two established techniques should help homeowners cope well with conditions on Samoa. Raised beds and containers will enable gardeners to improve upon the sandy soil by filling beds and containers with nutrient-rich soil. If containers are compact enough to be moved, they can follow the sun to ensure sufficient exposure.



*Fences by the yard. A well-maintained picket fence enhances the value of an historic house. Fences also temper the transition from public to private space, enabling small yards to be private yet welcoming.*

## Fences

In the Samoa community and elsewhere, fences have historically been used to delineate yard areas, corral children and pets, and express pride of place. These positive effects should continue in the future, which means that guidelines on fence design and location should be established. This is the best way to avoid disputes, while also preserving valuable historic character.

### ► Recommendations for fences

**Standards for style and height.** Picket fences are preferable because they're historically appropriate, and because they don't block a pedestrian's view of the house or yard. There are many attractive variations in picket fence design, so homeowners have plenty of design choices within this style. Fence height (from the ground to the top of the picket) should be 36 in. or less along the front of the house.

**Sustainable materials.** Many fencing companies are promoting the durability of vinyl fencing. But this material can't be considered green because it's made from petroleum products. It also produces toxic gas when burned, and typically has no recycled content. Until a vinyl fence manufacturer develops a program to keep the material out of landfills by

recycling old vinyl fencing, and until new fencing is manufactured with high recycled content, this fencing option can't be considered sustainable. For the time being, wood fencing is the greener choice.

**Location.** When lot sizes are small, it makes sense for homeowners to be able to install a fence on the property line. Setback requirements aren't practical.

**Negotiation.** Owners of adjacent houses should agree on the style, height, material and other details for any fence that runs along a property line.



*Small but significant. A shed provides sheltered, secure storage space for bicycles, garden tools and plenty of other items that would otherwise clutter up the yard. To improve appearance and longevity, anchor the shed to a sound, level foundation that keeps the floor framing several inches above the ground.*

## Sheds and outbuildings

A small house on a small lot is certain to be short on storage space. A shed can be a very useful addition under these circumstances. Existing sheds in the Samoa community fall into two categories: those that are adjacent to individual homes and those that are grouped separately, located some distance from houses. These recommendations focus primarily on the sheds that are adjacent to houses, but may also apply to separate sheds.

### ► Recommendations for sheds and outbuildings

**Deconstruction.** Outbuildings that are in poor repair or have been deemed unnecessary should be dismantled carefully so that sound building materials (primarily siding, framing, sheathing and doors) can be salvaged for reuse. Establishing a community “bank” of building materials salvaged from different deconstruction projects would create a valuable resource. It would also be an excellent example of sustainable redevelopment.

**Solar features.** Providing that the orientation allows for good solar exposure, a shed roof can be a very serviceable platform for photovoltaic or solar hot water panels. Mounting these components on the shed’s roof provides a good measure of security and protection, while also freeing up yard space that might otherwise be allocated for solar panels.

**Compatible style and proportion.** Sheds that are built on-site are preferable to factory-made versions because they can be sized to fit a particular space. A site-built shed can also be designed to look compatible with the house.

### Sources

FLEX-Drain flexible expanding

landscape drain pipe / [www.flex-drain.com](http://www.flex-drain.com)

FLEX-Drain is also available at Lowes, TrueValue and ACEhardware stores.

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### Reel-type lawnmowers

Eartheasy / [www.eartheasy.com](http://www.eartheasy.com)

People Powered Machines / [www.peoplepoweredmachines.com](http://www.peoplepoweredmachines.com)

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### Electric lawnmowers

Neuton / [www.neutonpower.com](http://www.neutonpower.com)

People Powered Machines / [www.peoplepoweredmachines.com](http://www.peoplepoweredmachines.com)

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### Plants, vegetables and garden supplies

Pierson's Garden shop & Nursery (Eureka, CA)

[www.thebighammer.com](http://www.thebighammer.com) / 707-441-2713



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## Additional resources

EPA Office of Brownfields and Land Revitalization (OBLR)  
[www.epa.gov/brownfields](http://www.epa.gov/brownfields)  
EPA Region 9 / [www.epa.gov/region09/waste/brown/index.html](http://www.epa.gov/region09/waste/brown/index.html)  
EPA Technical Assistance to Brownfields (TAB) Communities Program;  
Region 8-10 Grantee, Center for Creative Land Recycling (CCLR)  
[www.cclr.org](http://www.cclr.org)

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### Local resources

Redwood Coast Energy Authority / [www.redwoodenergy.org](http://www.redwoodenergy.org)  
Alternative Building Center / [www.abcgreenbuilding.com](http://www.abcgreenbuilding.com)  
4 West Fourth Street / Eureka, CA 95501 / 707.445.4733  
College of the Redwoods Construction Technology Department  
[www.redwoods.edu/eureka](http://www.redwoods.edu/eureka)  
735 I Tompkins Hill Rd. / Eureka, CA 95501 / 707-476-4100

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### Energy rating

CHEERS / California Home energy efficiency rating services [www.cheers.org](http://www.cheers.org)

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### Information on favorable mortgages and other financial incentives

CHEERS California Home energy efficiency rating services [www.cheers.org](http://www.cheers.org)  
Redwood Coast Energy Authority / [www.redwoodenergy.org](http://www.redwoodenergy.org)

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### Regional resources

California Center for Sustainable Energy (San Diego, CA) / [www.energycenter.org](http://www.energycenter.org)  
Build it Green (Berkeley, CA) / [www.builditgreen.org](http://www.builditgreen.org)  
EcoHomeImprovement (Berkeley, CA) / [www.ecohomeimprovement.com](http://www.ecohomeimprovement.com)  
EcoTimber flooring (Richmond, CA) / [www.ecotimber.com](http://www.ecotimber.com)  
Real Goods (Hopland, CA) / [www.realgoods.com](http://www.realgoods.com)  
Endurawood countertops (Portland, OR) / [www.endurawood.com](http://www.endurawood.com)  
Crossroads Recycled Lumber (North Fork, CA) [www.crossroadslumber.com](http://www.crossroadslumber.com)  
Black's Farmwood recycled lumber (San Rafael, CA) [www.blacksfarmwood.com](http://www.blacksfarmwood.com)

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### Regionally manufactured, EPA-certified woodstoves

Enviro wood stoves (manufactured in Saanichton, BC, Canada)  
[www.enviro.com](http://www.enviro.com)  
Quadra Fire stoves (manufactured in Colville, OR)  
[www.quadrafire.com](http://www.quadrafire.com)

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### Solar & renewable energy

Getsolar / [www.getsolar.com](http://www.getsolar.com)  
Earth 4 Energy / [www.earth4energy.com](http://www.earth4energy.com)  
Solarenergy.com / [www.solarenergy.com](http://www.solarenergy.com)  
Solar Energy Industries Association / [www.seia.org](http://www.seia.org)  
California Solar Initiative (also the Million Solar Roofs Initiative)  
[www.gosolarcalifornia.org](http://www.gosolarcalifornia.org)  
Renewable Funding (develops and delivers innovative solutions  
for renewable energy and energy efficiency financing)  
[www.renewfund.com](http://www.renewfund.com)  
National Renewable Energy Laboratory / [www.nrel.gov](http://www.nrel.gov)

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### National organizations

U.S. Green Building Council / [www.usgbc.org](http://www.usgbc.org)  
U.S. Dept. of Energy Building Technology Program  
<http://www1.eere.energy.gov/buildings/>  
Energy Star / [www.energystar.gov](http://www.energystar.gov)  
Partnership for Advancing Technology in Housing (PATH)  
[www.pathnet.org](http://www.pathnet.org)

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### Publications

Fine Homebuilding / [www.finehomebuilding.com](http://www.finehomebuilding.com)  
BuildingGreen / [www.buildinggreen.com](http://www.buildinggreen.com)