Designing and building a more sustainable home

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PORTLAND'S GREEN BUILDING RESOURCE

Green Home Remodeling Guide

From the City of Portland Office of Sustainable Development

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September 2005

Designing and building a more sustainable home: G/Rated Green Home Remodeling Guide

The Portland Office of Sustainable Development's G/Rated program encourages the sustainable building efforts of Portland-area homeowners and the remodeling industry with technical support, education, information resources, events and financial incentives.

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Disclaimer

The information provided in these guidelines is intended to assist homeowners, contractors, architects and other professionals in the course of designing and constructing modified structures. They are offered as a public service by the Portland Office of Sustainable Development to provide community and environmental benefits and reduce costs. The guidelines are not a substitute for the exercise of sound judgment in particular circumstances. Mention of products or services is not an endorsement, nor is absence of a product or service intended as a criticism.

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CITY OF PORTLAND
OFFICE OF SUSTAINABLE DEVELOPMENT
A BETTER FUTURE. A BETTER NOW.

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Thanks to these partners for supporting the Green Home Remodeling Guide.

EnergyTrust of Oregon, Inc.

The Energy Trust of Oregon, Inc., is a nonprofit organization dedicated to changing how Oregonians use energy by promoting energy efficiency and clean renewable energy for Oregon customers of Pacific Power, Portland General Electric and NW Natural. Energy Trust offers Oregonians cash incentives for energy-efficient improvements to their homes and businesses. www.energytrust.org.

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Green remodeling priorities

What choices and actions will have the greatest impact? Here's how the staff at the Portland Office of Sustainable Development prioritizes actions:

- **Small is beautiful.** The size of your remodel will determine the resources to build it and the energy to maintain comfort for many years in the future. Plan multi-use spaces to maximize efficiency and functionality.
- **Focus on energy.** Energy generation pollutes and contributes to global warming. Additionally, inefficient homes are costly.
- **Use the sun.** The sun provides free and plentiful energy in the form of daylight and heat. Use windows well, use direct solar for energy or heating water, and buy renewable power.
- **Reduce waste.** Implement a plan to eliminate construction waste, and recycle any waste you create. Re
- **Buy local.** Support businesses and jobs, keep dollars in the community, and help create a market for sustainable building. Use the NW Green Directory: www.nwgreendirectory.org.
- **Durability rules.** Select products and materials that are durable and low maintenance. You will save in the long run.
- **Reuse.** Whenever you reuse building materials, you eliminate the need to extract and process more stuff.
- **Get the whole story.** A product's lifecycle tells the whole story from extraction to end of life. Ask.
- **Avoid toxics.** Using safe, healthy materials helps protect your family and your community.
- **Gather rain.** Install rain barrels or a cistern for irrigation water.
- **Go organic.** Buy locally grown food from local vendors.
- **Walk and bike.** Getting out of your car can improve your health and reduce pollution.
- **Make it beautiful.** We take care of the things we love.

CHAPTER 1:
Welcome to green remodeling

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PORTLAND'S GREEN BUILDING RESOURCE

Salvage Douglas fir cabinets look great, and avoid the cutting of more trees

Your decisions are important to the future health and prosperity of your family and your community.

CHAPTER 1:

Welcome to green remodeling

Your home remodel is an exciting opportunity to adapt your house to fit your goals for livability, style and budget. By making informed choices, you can also lower your energy bills, reduce future maintenance, make your home healthier, and reduce waste and pollution.

Your remodel is an opportunity to make choices that reflect your values. Your decisions are important to the future health and prosperity of your family and your community.

1.1 What is "green remodeling"?

Green or sustainable remodeling pays attention to:

- Saving energy
- Using renewable energy such as sun or wind power
- Saving water
- Protecting rainwater and streams from pollution
- Recycling construction materials
- Reusing materials
- Using materials with recycled content
- Reducing indoor pollutants, including mold and toxic chemicals
- Durability and long life
- Reducing maintenance
- Using local products and services

This G/Rated guide includes many ways to integrate these ideas into your remodel. Whatever your budget or preferences, you can meet your goals while minimizing your impact on the environment.

1.2 Your remodel makes a difference

The Portland Office of Sustainable Development supports green remodeling as an important part of creating a sustainable city. Primary community goals are to:

- Promote salvage, reuse and recycling to minimize construction-related waste
- Create healthier and more durable homes
- Save energy, water and other resources
- Reduce the greenhouse gas emissions that cause global warming
- Make housing more affordable by reducing operating costs
- Support our local economy, such as manufacturers and suppliers of resource-efficient building materials.

The products and practices contained in this guide were selected for their availability, performance, cost and practicality for Portland homeowners and remodelers.

Remodeling contractors can use this guide to differentiate themselves in the marketplace, while protecting our environment.

The guide was developed through a partnership among local developers, architects, contractors, green building experts and staff of the Portland Office of Sustainable Development.

Your remodel and global warming

The scientific evidence for global warming is clear. The Earth has warmed by around 1 degree in the past century. Most of the 10 hottest years on record took place in the past decade. Weather anomalies have increased in the U.S. along with drought and flooding. Spring is coming around a week earlier to the Pacific Northwest. Cascade mountain glaciers are melting.

Global warming poses two challenges—or opportunities—as we consider remodeling. The first is to do the best we can to reduce our personal greenhouse gas emissions. That means reducing energy use. Fortunately, there are many smart, cost-effective alternatives for our homes. By reducing energy use, we also save money on the costs of power and fuels, so cutting greenhouse gases can be a good investment.

Second, we can plan and design a house adapted to a different climate. Over the next 50 years, climate scientists tell us Portland will become more like the Mediterranean, with warmer summers and longer dry periods.[1] We can take this change into account when remodeling—for example, by designing our houses to maintain comfort during warm weather, without the need for air conditioning.

[1] For a Northwest climate summary, see www.cses.washington.edu/cig/pnwc/cc.shtml.

House before remodeling

After remodeling, the house is ready for another century of living

The 1909 House: A showcase of green remodeling

Richard and Anne DeWolf of Arciform LLC restored and remodeled a home originally built in 1909 in the Alameda Ridge/Hollywood District of Portland. The project showcases current ideas, practices, materials and products for green remodeling. Arciform made the home available to the public as a green remodeling resource throughout the process of the remodel/restoration.

Arciform has joined with the Earth Advantage program and several local building professionals to include as many green features as possible in design and construction, including energy efficiency, healthier indoor air, resource efficiency and environmental responsibility. The 1909 House is a model of energy efficiency, yet retains the home's original period features.

For more details, including a list of team members and a complete project diary, go to www.1909House.com.

1.3 Making choices and setting goals

You already have your own ideas about living more lightly on the earth. Your own home can be an expression of those values and ideas. There's satisfaction in knowing that your flooring not only looks great, the forest it came from is still healthy and the people who made it received a living wage.

Green remodeling is about making informed choices. Your choices will be easier if you set goals and prioritize them.

For every decision along the way, you'll be asking questions like: What's it made of? Where did it come from? Will it save energy?

Most of us will also ask: How much will it cost?

Some choices may cost more; others might even cost less. For example, the price of safer paints, carpet, adhesives and other finishes is competitive with conventional products. And re-used or salvage materials often cost less than new. Many choices that do cost more now may save you money in the long term with products that reduce energy costs and last longer.

As you read through this guide, think about what you can easily do, and what you might be able to do if you stretch. Trust your instincts, and do the things that are important to you. By learning

about building products and making informed choices, homeowners and remodelers can use their purchasing power to transform the market toward more sustainable products and practices.

This section covers the major areas to think about while planning your remodel.

You and your contractor are welcome to contact the G/rated staff with questions about green remodeling: 503-823-7222.

1.4 How to use this guide

Topic areas

The guide is organized into sections that follow the design and construction process. Topic areas are separated with section dividers. Please use the table of contents to locate the sections that are most relevant to your project.

Checklists

The guide includes checklists of green features to consider when doing typical remodels like a kitchen or addition. You can look over the lists to spot ideas that appeal to you.

Photos and tips

The Guide includes photos of remodeled Portland homes that have been on the Build It Green tours. Held every September, the tour is a great way to see houses and meet their owners, designers and builders to ask about their experiences. Check the G/Rated web site, www.green-rated.org, for tour information.

Photos and examples from the 1909 House—as well as insider tips from Richard, the builder; Anne, the designer, and other members of the team—are used throughout this remodeling guide to illustrate sustainable design and construction ideas that are practical and affordable. Look for the "1909 House" logo.

CHAPTER 2:

Things to think about before you start

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PORTLAND'S GREEN BUILDING RESOURCE

Salvaged cabinets and wood from 1909 House ready to go to The ReBuilding Center

Conventional remodeling depletes natural resources. You can change that.

CHAPTER 2: Things to think about before you start

2.1 Reducing construction waste

Although Portland's overall recycling rate of 53% is one of the nation's highest, debris from construction and demolition accounts for about 25% of all material disposed of in our landfills.

The City of Portland and Metro are working with homeowners and the construction and building industry to keep these materials out of the landfill, by:

- Building "right-sized" houses that function well while reducing energy and materials.

Stair treads made from recycled polyethylene and wood fiber

Embodied energy

"Embodied energy" refers to the energy consumed over the life cycle of a product—the total energy used for resource extraction, processing, manufacturing, transportation and eventually disposal. Some building products have very high embodied energy because raw materials have to be processed at high temperatures to make them: examples include steel, aluminum, cement and glass. Thinking about embodied energy can help with decisions of whether to buy used or new materials.

- Deconstructing instead of demolishing older buildings.
- Salvage and reuse of materials.
- Job site recycling of waste materials.
- Efficient use of materials, such as advanced framing.
- Use of recycled-content building materials, like wheatboard made from waste straw.
- Use of durable materials that will need to be replaced less frequently.
- Use of materials that don't pollute the waste stream.

2.2 Conserving natural resources

Conventional remodeling consumes large quantities of wood, plastic, cardboard, paper, water and other natural resources, and leads—unnecessarily—to their depletion. You can change that. The key to conserving resources is to ask. As a consumer, you have a big influence on suppliers and contractors when you tell them you want products that are socially and environmentally responsible.

Remodelers have a rapidly expanding range of green building materials from which to choose, including decking, insulation, concrete, drywall, fiberboard, tile, flooring and paint. Much green

Reused cedar cabinet facings

building is just applied common sense. Reclaimed lumber and other products divert waste from landfills, while providing quality and durability that often exceed conventional materials. Many green products are also easier to maintain.

Wood

Wood, for example, is one of the most common remodeling materials. Wood from sustainably managed forests can be easily renewable, traded fairly, require minimal processing, have low embodied energy, cause relatively little pollution and support local economies. Independent certification helps you tell the difference. A Forest Stewardship Council (FSC) label is your assurance that your wood is from a healthy forest.

Salvage or reused wood can be better quality than new wood, and is well worth investigating. You can also ask your contractor to use wood efficiently so your remodel doesn't create a lot of scrap.

2.3 Healthier homes: indoor air quality

Some building materials can look attractive but may introduce harmful chemicals into the home. The United States Environmental Protection Agency (EPA) reports that the air in new homes can be ten times more polluted than outdoor air.

Certified maple flooring from sustainably managed forest

FSC certification

The Forest Stewardship Council (FSC) is a non-profit organization with world-wide membership. FSC has established guidelines for managing forests so that they remain healthy while producing wood products and supporting local economies. A forest is certified by a third-party company that applies FSC standards objectively. FSC certification is your assurance that wood you buy is genuine and you are not harming the forest it came from.

Other certification systems found in the marketplace may offer less protection for the forest, but they are evolving quickly in response to consumer demand.

For details, go to www.certifiedwood.org.

Locally made, Green Seal-certified paint reduces pollution and is cost-competitive. Miller Paint and Metro also offer non-toxic paints.

Look for labeling that says the product exceeds safety standards and is non-toxic.

According to research published in the New England Journal of Medicine, 40% of children will develop respiratory disease, in part due to the chemicals in their homes. Fortunately, a little forethought can eliminate most indoor pollutants for a safer home.

Causes of poor indoor air quality:

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

Formaldehyde in particleboard

One of the most common indoor pollutants is formaldehyde, which irritates the respiratory system and may cause other illnesses. Kitchen cabinets, countertops, shelving, underlayment and furniture are typically made from particleboard. The wood particles are held together by urea-formaldehyde adhesive. Formaldehyde may be released into the home for years after these products have been installed.

Volatile Organic Compounds

Many primers, paints, floor finishes, adhesives and caulks also contain unhealthy volatile organic compounds (VOCs). That "new house smell" is actually the odor of VOCs offgassing and is a telltale sign that there are harmful chemicals in the indoor environment. The building products industry has responded to these indoor pollution problems by developing alternative paint, finish, adhesive and caulking products. For example, solvent-free adhesives used in flooring and countertops can eliminate many suspected and known human carcinogens. Paints, varnishes and cleaners that don't utilize volatile compounds are now commonly available from most major manufacturers at costs comparable to conventional products.

Fair trade

"Fair trade" refers to workers receiving fair compensation for making a product. You can ask your supplier to tell you where a product is made and how the manufacturer supports its workers. The question is especially important with regard to materials.

Old garage becomes cob sauna in Southeast Portland

Safer alternatives

Products are readily available which perform well and are safer and less toxic. This G/Rated guide includes effective ways of preventing and removing pollutants, based on current best practices as recommended by the EPA and health advocates like the American Lung Association.

The State of Oregon currently has no building code that regulates indoor air quality, so this guide draws on the Washington building code in its recommendations for fresh air ventilation.

We focus on two practical strategies:

- Avoid introducing hazardous pollutants into the home, and
- Provide adequate fresh air ventilation.

2.4 Saving energy and water

Saving energy is one of the smartest investments you can make. Most energy-saving measures will pay back in just a few years. And if the prices of oil, natural gas and electricity rise in the future, the steps you take now will help buffer your family budget from those added costs.

Saving energy also reduces emissions of the gases that cause global warming. In Oregon, coal and natural gas produce about 40% of our electricity. Burning these fossil fuels creates greenhouse gases. For more detail on our Northwest power mix, visit www.nwppc.org and search for "power supply."

It's easy to save energy and water when selecting new appliances like dishwashers or clothes washers—just look for the Energy Star® label.

Building with clay is fun for everyone

Natural building

In addition to the growing number of readily available and cost-effective green materials, an increasing number of builders and remodelers are also using natural building materials such as straw-bale, clay plasters, light-clay and cob. While less common in their use, natural building products have a positive impact on the environment as they are renewable and abundant; energy efficient in production, transport and use; non-polluting; durable and long lasting as well as satisfying and fun to use.

Energy Star appliances save energy and are eligible for Oregon tax credits

Solar electric panels make clean power for this remodeled home

Saving energy with heating, cooling and weatherization measures like insulation and window selection is a bit more complex. We suggest some proven technologies and practices and point you to financial incentives available.

Energy efficiency

Energy efficiency is a cornerstone of any green building project. Improving energy efficiency and using renewable energy sources are effective ways to improve air quality and slow global warming. Improving energy efficiency also makes economic sense for consumers. Lowering utility expenses allows you to enjoy financial benefits year after year.

The Energy Trust of Oregon and Oregon Department of Energy offer financial incentives and tax credits for saving energy while remodeling and for renewable energy systems.

Step one:

The first step to increase energy efficiency while remodeling is to add insulation and seal air leaks wherever possible, install double-glazed/low-E windows and upgrade to high-efficiency appliances.

Step two:

If the heating system needs to be upgraded, energy-efficient equipment and duct sealing can save dollars and improve comfort.

Cost comparison: 75w incandescent vs. 23w compact fluorescent (CFL) light bulb

Energy	Cost	Life/Hrs	Wattage	$/kWh	On-time	Annual
INCANDESCENT	$0.50	750	75	$0.06	1000 hrs/yr	$4.50
CFL	$5.00	10,000	23	$0.06	1000 hrs/yr	$1.38
YEARLY SAVINGS:						$3.12

LIFETIME SAVINGS: One CFL will last as long as 13 incandescent bulbs, making the overall product cost of the incandescent $6.50 compared to $5 for the CFL. **Over its life the CFL will save about $33 – more if electric rates go up.**

Reused barrels are a popular way to store rainwater for the garden

Step three:

Renewable energy options include installing solar water heaters or photovoltaic panels. These are good long-term investments, and incentives will help pay for them. Even if the budget is tight, you can still purchase renewable power generated from sources like the sun, wind and biomass. Both PGE and Pacific Power offer renewable power.

Saving water

Even though Portland's winters are rainy, our typical summer is very dry. Meanwhile, irrigation use increases the demand for water in the summer. Water conservation helps homeowners save money and ensures that our community will have enough water to meet everyone's needs—without adding expensive additional infrastructure. Today, remodelers can take advantage of a new generation of high-efficiency washers, dishwashers and landscape water-management systems.

2.5 Reducing monthly costs

Green building can help you save money.

When considering the cost of your remodel, be sure to think about energy savings and durability. An investment now may pay off in less time than you might expect.

EnergyTrust of Oregon, Inc.

The Energy Trust of Oregon offers home energy reviews and financial incentives.
1-866-ENTRUST

The Oregon Department of Energy offers tax credits.
1-800-221-8035
egove.oregon.gov/ENERGY

Locally grown and milled Oregon white oak flooring from a certified forest (What is FSC Certification? See Page 13)

A remodel that includes energy-efficient lights and appliances, weatherization, and efficient space and water heating can cut energy use in half compared to a conventional house. The Energy Trust of Oregon offers home energy reviews that can help you spot ways to target your investment in energy-saving upgrades.

Many green materials are more durable than their conventional counterparts and cost less to maintain.

2.6 Supporting local companies

One way to be green is to select products and materials that are produced and sold by local companies. Buying local products:

- Saves fuel and pollution caused by transporting goods from far-away places
- Keeps your dollars at work in our community, creating employment opportunities and strengthening local economies.

Just ask, "Where is that made?" when you shop.

CHAPTER 3:

Green building methods and materials

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PORTLAND'S GREEN BUILDING RESOURCE

Existing flooring in 1909 House was restored.

CHAPTER 3:

Green building methods and materials

The following sections provide more detailed descriptions of green building practices, material applications and associated environmental benefits. The items are listed in the order in which they would normally arise during design and construction.

Incentives and tax credits make renewable energy more affordable

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.1 Financial incentives and applications

In addition to whatever loan documents you may need to prepare for funding your remodel, make sure to check the websites of the Oregon Department of Energy and the Energy Trust of Oregon for procedures regarding state tax credits and cash incentives for improving efficiency and installing renewable energy equipment.

A tax credit reduces your tax obligation by the amount of the credit (as compared to a tax deduction). Oregon offers tax credits for energy-saving dishwashers, refrigerators, clothes washers, heating equipment and water heaters as well as for solar equipment. If you are considering a tankless water heater, check out the tax credit!

Oregon Department of Energy

Residential Energy Tax Credits:
egov.oregon.gov/ENERGY

The Energy Trust of Oregon

The Energy Trust offers cash incentives for remodeling features like insulation, windows, water heaters and clothes washers as well as major incentives for solar hot water and solar electric systems.

Energy Trust of Oregon Residential Incentives:
www.energytrust.org

These web sites explain how to document your purchases and fill out forms to get your tax credit and/or incentive payment.

Get a free energy review

Call the Energy Trust of Oregon, 1-866-ENTRUST, to see if you qualify for a home energy review. The review will provide an assessment of insulation, windows and HVAC equipment along with valuable information on cash incentives and potential Oregon energy tax credits.

Mortgage and insurance

If you plan to buy a fixer-upper and remodel, some local lenders such as Homestreet have low interest loans to roll into the mortgage for installing energy-efficiency measures. Make sure you have all the details while you are planning the project.

Ask your homeowners insurance agent if there are any measures for health and safety that might lower your monthly premium, such as fire-resistant exterior materials.

South light provides daylighting without discomfort

Design windows for comfort

When planning the size and location of new windows, keep these questions in mind:

- Will west-facing windows be difficult to shade in summer and cause overheating?
- Can south-facing windows have overhangs or shading to reduce summer heat gain?
- Can windows be placed on two sides of a room to balance light and cut glare?
- Will large window areas cause glare and excess brightness?
- Are the windows available with glass that keeps out excess solar heat?

A salvaged entry door

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.2 Salvage reusable building materials

DESCRIPTION ◆ Many building materials can be salvaged and reused, such as flooring, doors and windows, tubs and sinks, cabinets, electrical and plumbing fixtures and lumber. The remodeling contractor or a local deconstruction contractor can identify and properly remove reusable materials so they can be reused.

If the owners donate the materials to a non-profit for resale, they may be able to take a tax deduction for the value of the donated materials.

APPLICATION ◆ Before preparing construction plans, walk through the project with the designer/architect and general contractor and identify items to be salvaged. The contractor may selectively remove materials for reuse; or there are a number of licensed contractors that offer dismantling services to salvage materials for reuse. Many firms are non-profits and will provide itemized donation receipts. Usable items can also be dropped off at used building material stores. Salvaged items should be stored under cover to protect from weather. Call the Metro Recycling Hotline 503-234-3000 for a list of local deconstruction and salvage businesses. Visit www.metro-region.org/toolkit to learn more about salvage and recycling opportunities.

BENEFIT ◆ Salvage saves! Salvaging reusable building materials decreases disposal costs, saves natural resources and reduces landfill disposal. Salvaged materials are often of high quality, provide unique historic character, are stronger and more durable— yet are much less expensive than new materials. Donations can be tax deductible.

As the world's resources are increasingly overconsumed, "mining the city" for building materials helps reduce resource extraction.

DeConstruction services of The ReBuilding Center reclaiming material.

What is deconstruction?

Often, buildings are simply demolished and all the fragments either "downcycled" or sent to the landfill. An example of downcycling is sending wood to be chipped up for boiler fuel. Such wasteful demolition is appropriately described as "crunch and dump."

Deconstruction is the process of carefully disassembling a building so that its components can be saved and reused. Deconstruction may initially cost more than demolition, but the owner can get a tax deduction for donating materials to a non-profit like The ReBuilding Center or Habitat for Humanity ReStore. The value of the tax benefit can make deconstruction competitive with demolition.

"Our research shows that more than 25 percent of the waste going to landfills in our region comes from construction and demolition activities. Fifty percent of that waste could be recycled, salvaged, reused or otherwise kept out of the landfills."

—Bryce Jacobson, Metro

Salvaged sinks

"Deconstruction is where you go in and consciously remove items from the home to ensure that our landfills are not full up on materials that can be reused. Another alternative to deconstruction is cherry picking… that's a process where all the easily removable items of a house (doors, windows, cabinets, appliances, etc.) are removed before demolition of a house commences. We always encourage full deconstruction whenever possible to salvage as much as possible from going into the landfill.

"Deconstruction Services at the ReBuilding Center here in Portland does this. You or your general contractor hire them to deconstruct your residential structure. Their licensed and bonded crews are capable of both small and large jobs including kitchen tear-outs, garages, roof-to-foundation deconstruction, partial salvage, and more. When they complete a job, you receive a detailed portfolio including an itemized written and photographic documentation of the salvaged materials that you can use for tax purposes or for historic record. They are happy to give you a free estimate and to discuss all your removal options with you.

"Vinyl siding, old deteriorated fiberglass insulation, and old carpet padding from the 1909 house will be going to the landfill, but since doing this we have found another resource for the vinyl siding. Quantum Resource Recovery in Beaverton will take the siding and chip it for reuse in different products—unfortunately this information came to us AFTER we'd tried to find some place for it.

"Metro has a GREAT SITE with tons of information on what to do with building waste."

—Richard DeWolf, Arciform

Deconstuction Services: 503-331-9875
rebuildingcenter.org/deconstruct

Metro Recycling Hotline: 503-234-3000
www.metro-region.org

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.3 Recycle Job Site Construction and Demolition Waste

DESCRIPTION ◆ Construction waste generally consists of roofing, wood, drywall, metals, concrete, soil, plastic and cardboard. Most materials can be reused or recycled, if they are kept free of garbage.

APPLICATION ◆ Owner and contractor jointly set a recycling goal. In Portland, recycling at least 50% by weight is a practical goal and many contractors recycle 90%. The City of Portland requires recycling on jobs of $50,000 or more in value.

The general contractor can set up storage for recyclables to keep them separated. The general contractor will tell specialty trades about recycling, and keep records of amounts recycled for the owner.

If separation is not practical, recyclables can be mixed in a single dumpster or container. It is critical that trash be kept out, including food waste and containers. A mixed load can be recycled at a materials recycling facility (MRF).

Call the Metro Recycling Hotline, 503-234-3000 for information. Visit www.metro-region.org/toolkit for a free contractor's recycling guide.

BENEFIT ◆ Recycling reduces pressure on landfills, saves money by reducing disposal fees, and provides raw materials for local companies to recycle into new products.

Salvaged cabinets showcased on the Build It Green home tour

3.1 DESIGN AND CONSTRUCTION PLANNING

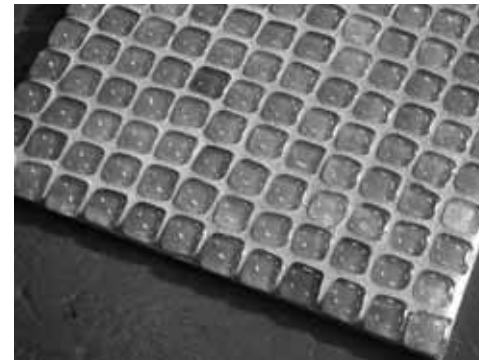
3.1.4 Use salvaged materials

DESCRIPTION ◆ Salvaged building materials, like old tubs, sinks, doors, light fixtures, marble and stone, flooring and wood trim can add character and history to a remodeling project. They often cost less than new products.

APPLICATION ◆ Local businesses like The ReBuilding Center, Habitat for Humanity ReStore, Rejuvenation, Endura Wood Products, Hippo Hardware, Environmental Building Supplies, Craftmark and many others sell salvaged materials. Homeowners will need to purchase salvaged items in advance and work out their use with designer and builder.

BENEFIT ◆ Reusing materials extends their service life and avoids having to manufacture new ones. Salvage wood is often better quality than new wood. Homes with character usually last longer because their owners enjoy and care for them.

The Rebuilding Ceter offers a wide variety of salvaged materials



These tiles are made from recycled glass

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.5 Use recycled-content materials

DESCRIPTION ◆ "Recycled content" means a building material or product made from something that used to be thrown away. Examples include Metro recycled paint, UltraTouch insulation made from waste denim cotton, Wheatboard made from waste straw, Trex deck boards from scrap wood and plastic waste, Shaw carpet from pop bottles, Traffic ceramic tiles from recycled auto windshields, and Hi-Tek roofing from recycled rubber tires. These products may outperform new materials. For example, strawboard does not emit harmful formaldehyde like the particleboard it replaces. And they may cost less—Metro recycled paint sells for less than half the price of new paint.

APPLICATION ◆ When shopping and selecting materials, ask about recycled content. Today many stores stock Recycled-Content products. A comprehensive product list is available on-line at www.ciwmb.ca.gov/RCP.

BENEFIT ◆ Recycled-content "closes the loop," turning wastes into usable products, saving the energy and resources used to make the original materials, and reducing landfills.

Bamboo flooring performs well and is competitive with wood flooring

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.6 Use rapidly renewable resources

DESCRIPTION ◆ "Rapidly renewable" means products made from resources that regenerate quickly—in less than ten years—such as bamboo, straw, poplar wood or cork. Most wood is not rapidly renewable because it takes longer to regrow. And petroleum-based or mineral resources are not renewable at all.

APPLICATION ◆ Cork flooring, bamboo flooring, bamboo plywood (cabinet facing), wool carpet, strawboard (for cabinets or shelves), linoleum (made with cork, jute and linseed oil), form-release agents made from plant oils, natural paints, erosion-control fabrics from coir and jute, and such textiles as organic cotton and sisal.

BENEFITS ◆ These resources provide jobs and are easier on the environment. Cork bark, for example, must be harvested by hand, so thousands of people in Mediterranean countries have raised and harvested cork trees for centuries.

Recycled glass door pulls

3.1 DESIGN AND CONSTRUCTION PLANNING

3.1.7 Use locally harvested or manufactured products

DESCRIPTION ◆ Building materials that are manufactured locally support jobs in our local economy. Since they don't travel as far, they reduce fuel use and pollution caused by transportation. Local companies in Oregon generally do a good job of protecting the environment and worker safety and health.

APPLICATION

Examples:

- Certified wood from Oregon forests including Warm Springs and Collins Pine
- Medite II and Medex medium-density fiberboard made in Medford
- Aurora Glass from Eugene
- Willamette Graystone pavers from Portland
- Greenline Cabinets in Vancouver, Neil Kelly Naturals in Portland

BENEFITS ◆ Reduces transportation, supports the economy and follows local environmental protection laws.

A bioswale for rainwater highlights the front yard of the 1909 House

1909 House
A Study in Respectful Remodel

"Amy Whitworth and Kathleen Leech of The Garden Design Studio put together a BEAUTIFUL landscape design that incorporates elements that are respectful to the environment. Included are native plantings, bioswales, composting area and the reuse of some of the hardscape elements already found in the yard. I cannot wait to see how everything will fall into place."

–Anne DeWolf, Arciform LLC

Go to www.1909house.com for a description and drawings from Amy and Kathleen's presentation.

3.2 SITE WORK

3.2.1 Control erosion

DESCRIPTION ◆ When soil is disturbed and exposed by excavations or grading, it can easily be washed into streets or storm drains and into local streams. Eroded soil damages streams and aquatic animals like fish.

APPLICATION ◆ City code requires erosion control. The minimum measures are shown on p. 17 of the Erosion Control Manual, which can obtained from the City of Portland Bureau of Development Services (see www.portlandonline.com/auditor, and look for Title 10 of the City Code & Charter).

Generally, minimize soil disturbance, cover exposed soil, install barriers and replace topsoil.

BENEFIT ◆ Keeping soil out of streams benefits aquatic organisms like fish, frogs and insects that depend on clean water.

3.2 SITE WORK

3.2.2 Protect existing trees and landscaping

DESCRIPTION ◆ A remodel may involve digging, such as for new foundations or to remove an old oil tank. Digging can damage the roots of trees that are valued for landscaping, shade, stormwater management and cooling by evaporation. Mechanical excavation can easily cause unintended damage to trees.

APPLICATION ◆ Before remodeling, evaluate the trees and large landscape features like rhododendrons or hedges to be protected. Best practice is to fence around the trees at the drip line to prevent digging or construction work that could damage roots or bark. it is also good practice not to remove soil in root zones or add more soil over established roots.

Smaller trees and shrubs can be temporarily relocated in a berm and replanted after construction. Landscape professionals can help with this process.

BENEFIT ◆ Landscape trees add to the value of property, help manage stormwater and improve air quality. Damaged trees may be costly to restore or remove.

Pavers with open corners provide more formal appearance and rainwater drainage

3.2 SITE WORK

3.2.3 Install permeable paving

DESCRIPTION ◆ Permeable paving allows water to percolate into the soil. For driveways, walkways and paths, utilize gap-spaced unit pavers, decomposed granite, gravel or grass-stabilization systems.

APPLICATION ◆ Use permeable paving for walkways, patios and driveways. Install like conventional pavers.

For driveways or aprons, combine hard surface with porous, as in a carriageway where concrete lanes are separated by pavers or gravel. Porous concrete or asphalt is available but may be hard to install in a home project.

BENEFIT ◆ Allowing stormwater percolation into soil reduces the volume of polluted water that flows into streams and the Willamette River, while replenishing soil moisture and local aquifers. Additional benefits include reduction in irrigation requirements as well as lower risk of flooding.

Stormwater management

Any remodel that adds over 500 square feet of impervious area—either in rooftops or paving—will require installation of stormwater management measures, such as a bioswale, planter or drywell. These measures divert rainfall from storm drains into the ground.

Native plants and water provide a home for tree frogs in this North Portland yard

3.2 SITE WORK

3.2.4 Design native and hardy plant landscapes and gardens

DESCRIPTION ◆ Conventional landscapes may require lots of water and chemical fertilizer, pesticides and herbicides. They are sometimes planted without regard for climate and soil conditions. This can result in excess water use, water pollution and waste generation.

APPLICATION ◆ Specify plants that are appropriate for the climate and soil of the area; select slow-growing, drought-tolerant plants; design with perennials instead of annuals; and site plants appropriately, giving them plenty of room to mature and reducing the need for pruning. Recycle yard trimmings by grasscycling, mulching and composting.

BENEFIT ◆ Sustainable landscape techniques help conserve water, reduce use of chemicals, create healthier soil and plants and increase biodiversity in landscape areas.

To learn more...

Enroll in a Naturescaping for Clean Rivers workshop sponsored by Metro and local soil and water conservation groups. Contact 503-797-1842 for a schedule. For free advice and consultation on naturescaping contact local volunteer Master Gardeners through Oregon State University Extension (extension.oregonstate.edu/mg).

HOMEOWNER TIP: Compost fruit, vegetable and yard trimmings

Compost is nature's way of recycling. Turn fruit, vegetable and yard trimmings into a first-rate soil conditioner. Use compost to replace store-bought soil conditioners. Compost adds nutrients and beneficial microbes to soil, improves soil fertility and reduces watering needs. Composting saves money by lowering garbage bills, increases the ability of soil to hold water, improves soil health and helps extend the life of our landfills. Contact Metro at 503-234-3000 for more information and discounts on compost bins. Design and build locations in the kitchen for temporary storage and an outside area for composting.

3.2 SITE WORK

3.2.5 Install drip irrigation

DESCRIPTION ◆ Drip irrigation systems provide a small but constant water supply to landscape, thus preserving soil moisture and significantly reducing water waste from overspray.

APPLICATION ◆ Replace standard sprinkler systems with drip irrigation systems for all landscape applications except turf.

BENEFIT ◆ Drip irrigation systems can dramatically reduce landscape water use and water costs.

3.2 SITE WORK

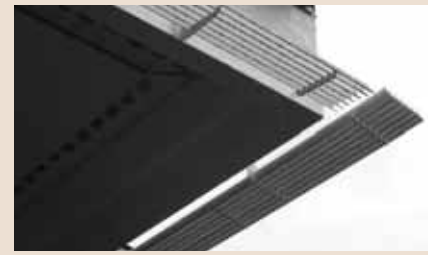
3.2.6 Install rainwater harvesting systems

DESCRIPTION ◆ Rainwater is channeled from rooftops through gutters and downspouts to a storage container, such as barrels or a cistern. Stored water may be used for landscape irrigation. Rainwater may be used inside the house for flushing toilet if plumbing is installed per City code. The rainwater harvesting code guide ensures safety and health by separating plumbing for rainwater from plumbing for City water. The guide can be found at City of Portland Bureau of Development Services website (www.portlandonline.com/bds; search under code guides for One & Two Family Dwellings).

APPLICATION ◆ Install wherever there is guttered roof runoff and room for storage barrels or a cistern.

BENEFIT ◆ Rainwater harvesting reduces the need to use treated, drinkable water for watering of lawns and gardens.

- The Portland Airport receives an average of 37" of rain annually.
- A typical roof (1,500 SF) collects about 35,000 gallons of rainfall each year.
- That much rain is about 25% of average annual family usage.
- Portlanders use 68 gallons per person per day on average.
- Some highly water-efficient families have been able to meet most of their use with rainwater, except during the dry summer period.



Alternative rainwater devices can replace downspouts

Disconnect your downspouts!

Portland Bureau of Environmental Services offers cash incentives for disconnecting downspouts from storm drains. Contact 502-823-5858.

3.3 FOUNDATIONS

3.3.1 Incorporate recycled fly ash in concrete

DESCRIPTION ◆ Fly ash is a waste product of coal-burning power plants. It can be an inexpensive substitute for a portion of Portland cement used in concrete.

APPLICATION ◆ Typically, 15-50% of cement can be replaced with fly ash in residential concrete mixes. Be sure to let the ready-mix supplier know you want to replace cement with fly-ash.

Fly ash improves strength of concrete, although it changes the curing time. Normally this should not be an issue in residential construction unless the schedule is very tight.

BENEFIT ◆ Fly ash increases the strength and durability of the concrete. Using fly ash also reduces the amount of cement needed, thereby decreasing the overall environmental impacts of cement production. Worldwide, cement production is a major generator of carbon dioxide, the primary cause of global warming.

Form boards to be reused for floor structure

3.3 FOUNDATIONS

3.3.2 Reuse form boards or use alternative form boards

Re-use form boards

DESCRIPTION ◆ Concrete form boards are often 2x10 or larger solid sawn lumber, typically cut from old-growth trees.

APPLICATION ◆ Forms are used whenever concrete is poured. By carefully removing and separating the forms, they can be reused several times.

BENEFIT ◆ Reuse of forms saves money and conserves resources. Solid sawn lumber is becoming increasingly expensive and scarce.

Use aluminum forms

DESCRIPTION ◆ Aluminum forms come in all sizes and shapes and produce a smooth finished surface on the concrete. They can be used repeatedly.

Rastra-insulated concrete form walls

APPLICATION ◆ Aluminum forms can be used in most applications to replace wood forms.

BENEFIT ◆ Because they can be reused many times, aluminum forms reduce wood use and, despite higher initial cost, pay for themselves quickly.

Install rigid foam, insulated concrete forms (ICFs)

DESCRIPTION ◆ Rigid foam forming systems hold concrete in place during curing and remain in place afterwards to serve as thermal insulation.

APPLICATION ◆ Use rigid foam forming systems wherever an insulated foundation is required.

BENEFIT ◆ ICFs are not subject to rot and result in a better-insulated foundation.

Use non-toxic form release

Wood forms are pre-coated with form release so they will separate easily from the cured concrete. Non-toxic and soy-based form release agents are available.

ICFs used for room additions

This Portland resident deconstructed her driveway and reused the gravel for permeable paving

3.3 FOUNDATIONS

3.3.3 Use recycled-content rubble for backfill drainage

DESCRIPTION ◆ Concrete and rubble can be crushed and used for backfill and drainage purposes at the base of foundations.

APPLICATION ◆ Use recycled materials for backfill.

BENEFIT ◆ Using recycled instead of virgin materials saves money and natural resources.

Rubble reused as base for permeable paving

3.4 STRUCTURE

3.4.1 Replace solid sawn lumber with engineered lumber

DESCRIPTION ◆ Solid sawn lumber in sizes of 2x10 or greater typically comes from old-growth forests. Engineered lumber products, on the other hand, usually come from small-diameter and fast-growing plantation trees. These products include glulams, laminated veneer lumber, wood I-joists, oriented strand board, parallel strand lumber, and other manufactured wood-fiber structural materials.

APPLICATION

A. Floor joists

2x10 and larger lumber is typically used for floor and ceiling joists and some seismic applications. Large-size lumber can be replaced with engineered lumber in most applications, unless required by seismic codes.

B. Non-load-bearing headers

Solid sawn 4x6 beams are often used for headers when smaller dimension lumber would suffice, such as doubled 2x6, unless solid 4x6s are required by seismic codes.

C. Structural headers and beams

Engineered lumber should be used whenever structural members are replaced. They substitute for 2x10 and 2x12 in most interior applications such as the structural framing of floors and roofs.

BENEFIT ◆ Reducing demand for large dimensional lumber decreases pressure to cut down old-growth forests. Engineered lumber uses wood fiber more efficiently than conventional lumber, resulting in stronger and higher-quality homes.

Efficient framing reduces non-structural wood

3.4 STRUCTURE

3.4.2 Use Forest Stewardship Council (FSC) certified wood for framing

DESCRIPTION ◆ FSC certification assures that the forest from which the wood is produced is managed in an environmentally and socially responsible manner.

APPLICATION ◆ Use FSC wood whenever new wood framing is required. Certified framing materials and plywood are available from local suppliers, such as Lumbermens and Disdero Lumber.

BENEFIT ◆ FSC certification guarantees that forests are managed in a way that will assure the long-term availability of precious woods while protecting old-growth forest health.

I-joists replace solid lumber joists

Open-web trusses also reduce wood use

3.4 STRUCTURE

3.4.3 Use wood I-joists for floors and ceilings

DESCRIPTION ◆ Wood I-joists are engineered to use only the wood fiber necessary for the structural function required. They typically use oriented strand board (OSB) for the web and either laminated veneer lumber or solid sawn lumber for the chords (top and bottom pieces).

APPLICATION ◆ Replace solid sawn lumber with wood I-joists for floor and ceiling joists. Consider using at 19.2" centers to save material.

BENEFIT ◆ Wood I-joists use 50% less wood fiber to perform the same structural function as similarly sized solid sawn lumber and will not twist, warp or split. They are stronger and lighter than 2x10 or 2x12 solid lumber and can span greater distances.

3.4 STRUCTURE

3.4.4 Use structural insulated panels (SIPs) for walls and roof

DESCRIPTION ◆ SIPs are a sandwich of rigid foam with OSB on either side. They come in nominal 4"-12" thickness and are about R-4 per inch.

APPLICATION ◆ Use SIPs for structural exterior walls and roofs in place of framing with lumber. SIPs can be designed to meet Seismic Zone 3 requirements.

BENEFIT ◆ SIPs are more energy-efficient, provide excellent soundproofing and reduce air infiltration compared to frame construction. They can be erected quickly, allowing for faster construction. They save wood by eliminating much of the conventional framing lumber. And they can form a strong, lightweight structure that is earthquake resistant.

Salvage lumber from The ReBuilding Center

3.4 STRUCTURE

3.4.5 Use salvage lumber

DESCRIPTION ◆ High-quality dimensional lumber in long lengths can often be salvaged from old buildings that are being deconstructed.

APPLICATION ◆ Use salvage lumber for non-structural applications, in place of new material. For structural applications, look for reclaimed lumber that has been regraded.

BENEFIT ◆ Salvage lumber from deconstructed buildings reduces resource consumption and landfill deposits. And salvage lumber is often of higher quality than new lumber.

This garden shed is built from salvage materials

Recycled-content decking

3.5 EXTERIOR FINISH

3.5.1 Use sustainable decking materials

A. Recycled composite and recycled-content decking

DESCRIPTION ◆ Composite decking lumber is made by combining recycled wood fiber and recycled plastic resins that are then formed into deck boards.

APPLICATION ◆ Recycled-content decking can be used in place of old-growth wood like redwood, cedar and pressure-treated pine. These products accept screws and nails and cut like wood.

BENEFIT ◆ The durability of these materials is greater than wood, providing cost savings to the homeowner over the life of the products. They will not rot, crack or splinter, do not require staining and are not treated with potentially toxic chemicals. Using recycled-content decking also reduces pressure on old-growth forests.

B. Forest Stewardship Council (FSC) certified wood decking

DESCRIPTION ◆ Certified, sustainably harvested lumber comes from forests managed in an environmentally and socially responsible manner.

APPLICATION ◆ Use FSC-certified lumber for all exterior decking applications or as structural deck members in conjunction with recycled-content decking.

BENEFIT ◆ FSC certification guarantees that forests are managed in a way that will assure the long-term availability of precious woods while preserving old-growth forests.

3.5 EXTERIOR FINISH

3.5.2 Use treated wood that does not contain chromium or arsenic for decking and sill plates

DESCRIPTION ◆ Alkaline Copper Quartenary (ACQ) and Wolman Natural Select are alternative treated woods that do not contain chromium – a heavy metal – and arsenic, which are detrimental to human health. ACQ and Wolman Natural Select eliminate both of these components yet provide long-term protection.

Wood can be treated with borates and used for indoor applications like bottom plates set on concrete.

A new material, TimberSIL, uses sodium silicate technology, a safe, non-toxic treatment.

APPLICATION ◆ Use non-chromium/arsenic-treated wood for any application that specifies treated lumber including decking, fencing and site furnishings.

BENEFIT ◆ ACQ and Wolman Natural Select use copper as their main component and are healthier alternatives to lumber treated with chromium and arsenic, particularly for children who play on or near decks. Note that only stainless-steel fasteners should be used to avoid corrosion. TimberSIL also inhibits mold growth.

Vented rain screen

Experience shows that water can get through any type of siding. A vented rain screen provides an air space behind the siding that allows water that does get through to drain or dry harmlessly. Products like Enkabarrier or Home Slicker can be used, or siding can be installed on furring strips to create an air space between the siding and moisture barrier.

For more details on moisture control in building envelopes see: www.buildingscience.com/resources/mold/Read_This_Before_You_Design_Build_or_Renovate.pdf

Fiber-cement composite siding is durable and low-maintenance

3.5 EXTERIOR FINISH

3.5.3 Use fiber-cement exterior siding

DESCRIPTION ◆ Fiber-cement siding is composed of cement, sand and cellulose fibers. It is available in shingles, planks or 4x8, 4x9, or 4x10 sheets. It is textured to look like wood siding or stucco finish.

APPLICATION ◆ Replace conventional wood siding with fiber-cement siding. This product can be cut with a carbide-tipped saw blade, snapper shears or with a guillotine cutter. Dust protection and control are required when cutting with a circular saw.

BENEFIT ◆ Fiber-cement siding is more durable than wood, termite resistant, non-combustible and warranteed to last 50 years. Using fiber-cement siding reduces the demand for old-growth wood siding. It may also reduce homeowner's insurance rates due to fire resistance. One drawback is that fiber-cement can't be recycled.

Exterior plaster finish has color built in and requires little maintenance

3.5 EXTERIOR FINISH

3.5.4 Use exterior plaster

DESCRIPTION ◆ Traditional cement and lime-based plasters offer outstanding esthetics and durability, although they are more costly than siding. Because the color is integral to the plaster, they never need painting, so the initial cost can be recovered in reduced maintenance.

Note that acrylic or synthetic stucco has been in the news related to moisture problems, but that is a very different material.

APPLICATION ◆ Plaster can be applied over typical framed wall construction.

BENEFITS ◆ Plasters last for decades or even longer, reducing maintenance and upkeep.

3.6 PLUMBING

3.6.1 Install hot water jacket insulation

DESCRIPTION ◆ Water-heater jacket insulation is an insulated wrapper that goes around the hot water tank and is secured in place.

APPLICATION ◆ Install on existing water heaters. New water heaters have adequate insulation.

BENEFIT ◆ Jacket insulation can reduce heat loss by about 10% or more on older water heaters.

When installing a new tank-type water heater

The Energy Trust of Oregon offers cash incentives. Oregon Department of Energy offers a tax credit for premium efficiency water heaters. Visit the Oregon Department of Energy website for a list of qualifying models.

A tankless water heater eliminates stand-by heat loss of conventional tank-type heater

3.6 PLUMBING

3.6.2 Convert gas to tankless water heaters

DESCRIPTION ◆ Tankless water heaters (flash or on-demand heaters) heat water as needed rather than having a tank in which hot water is stored. Their capacity to provide hot water is virtually unlimited.

APPLICATION ◆ Install tankless water heater as close to the point of use as possible. The device should have a variable-set thermostat and be appropriately sized. Gas tankless water heaters typically have more capacity than electric tankless heaters.

BENEFIT ◆ Typical water heaters lose 15% of their energy through standing tank losses, whereas tankless heaters use energy only for immediate hot water needs. Tankless water heaters often are quicker and more reliable.

A potential safety benefit: when you are away from home, a tankless heater does not operate.

The Oregon Department of Energy website has a listing of tankless water heaters that qualify for tax credits. The Energy Trust of Oregon has a list of tank/tankless models that qualify for cash incentives.

3.6 PLUMBING

3.6.3 Insulate hot and cold water pipes

DESCRIPTION ◆ Insulating water pipes reduces heat loss or gain in the pipes while the water is standing.

APPLICATION ◆ Insulate hot water pipes in all runs through unconditioned spaces: basements, crawl spaces, attics, etc. At a minimum, insulate both hot and cold pipes at least 6 feet from the water heater to prevent convective circulation from the water heater through the pipes.

BENEFIT ◆ Insulated pipes save energy and water.

3.6 PLUMBING

3.6.4 Retrofit all faucets and showers

DESCRIPTION ◆ Most faucets can be fitted with an aerator that reduces water flow. Low-flow showerheads can replace standard showerheads. Oregon energy code requires a showerhead of 2.5 gallons per minute flow (gpm), and 2.0 gpm models are available.

Another option is a showerhead with a button valve that allows water to be shut off while soaping up and turned back on to rinse.

APPLICATION ◆ Use flow reducers on all faucets and showers that accept reducers. Old fixtures may not accept reducers if they do not have screw threads.

When purchasing new faucets and showerheads, ask about the flow ratings. Faucets that are designed for lower flows often deliver a better stream than when retrofitted.

BENEFIT ◆ Aerators and showerheads can cut hot water usage with little noticeable effect.

3.6 PLUMBING

3.6.5 Replace toilets with low-flow models

DESCRIPTION ◆ New toilets use 1.6 gallons per flush compared with old toilets that require 5 to 7 gallons per flush. Dual-flush toilets are available that can flush with either 0.7 gallons or 1.6 gallons, depending on need.

APPLICATION ◆ Whenever possible, replace existing toilets with new 1.6-gallon models. Koehler and Caroma make dual-flush toilets available at local suppliers.

BENEFIT ◆ Low-flow toilets alone can save up to 22,000 gallons of water per year for a family of four.

Buttons control type of flush.

Dual-flush toilet, lit by solar tube in ceiling

3.6 PLUMBING

3.6.6 Install water filtration units at faucets

DESCRIPTION ◆ Water filtration units can be installed at individual faucets or for the whole-house. They reduce chlorine and many other chemicals, particulates and microorganisms.

APPLICATION ◆ Whole house filters are for drinking water and plumbing (not for hosebibs or toilets). Install filtration system between the cold water line and the main drinking water faucets in the house.

BENEFIT ◆ House filtration systems reduce the health threat of water contaminants.

1909 House purchases green power

"It was easy for us to make the commitment to using renewable energy! According to Pacific Power, the house is now supporting a mix of 100% renewable energy: 61% new wind, 38% biomass and 1% solar. Almost all of this energy is from sources in Oregon and Washington—of the three wind farms, two are located in Oregon and one on the Oregon/Washington border. The biomass is coming from a landfill gas facility in Washington and the solar is from the Eugene area primarily.

"For every 1,000 kilowatt hours of electricity that the 1909 House uses, our commitment to renewable energy will prevent 2,000 pounds of CO2 from entering the atmosphere—the equivalent of not driving the average car 2,143 miles."

—Melissa Fryback, for Arciform LLC

3.7 ELECTRICAL

3.7.1 Install compact fluorescent light bulbs (CFLs)

DESCRIPTION ◆ CFLs screw in like conventional bulbs but consume about one-fourth of the electricity used by incandescent bulbs to produce an equivalent amount of light.

APPLICATION ◆ Install CFLs in place of standard incandescent bulbs. Choose a CFL based on its lumen, or light output rating, to get the amount of light equal to the incandescent bulb it replaces.

BENEFIT ◆ CFLs use about one-quarter of the energy of incandescent bulbs of similar brightness and last up to ten times longer.

Recessed ceiling light fixtures:

Conventional recessed light fixtures cause air to leak into the attic or into floor cavities, because they have lots of vent holes to keep the bulb cool.

Specify "ICT" models that are designed to reduce air leakage. These fixtures usually have a double shell that allows air to circulate around the bulb, but keep the air inside the heated space.

3.7 ELECTRICAL

3.7.2 Install lighting controls

DESCRIPTION ◆ Lighting controls use sensors and timers to turn lights off in unused areas or during times when lighting is not needed.

APPLICATION ◆ Install lighting controls either at specific locations or as a whole-house system.

Dimmers will work on incandescent fixtures and help you to save energy.

Motion sensors can control room lights to turn off after you leave, or turn outdoor lights on and off.

Most CFLs do not work with a dimmer, although there are some on the market that have special dimming ballasts. Make sure to ask about this when purchasing CFL fixtures. (You can install CFLs in any medium-base light fixture, or there are now dedicated fixtures that have built-in ballasts, so only the bulb would have to be replaced.)

BENEFIT ◆ Lighting controls reduce energy use by having the lights on for shorter periods of time.

Recycled tire roofing goes on 1909 House

"On the final day, a beautiful full rainbow appeared 'on cue' arched over the house signaling the project's completion. Of course, the Hi-Tek Rubber roof is beautiful. It's unique because it's made of recycled tire rubber and looks so much like slate. Under the slate-style tiles, Grace Ice & Water Shield was applied. This adhesive-backed material acts as a membrane and when punctured (with a roofing nail, for example) the material tightly seals around the nail, not letting any moisture underneath it. I was told that the use of this material two feet from the eaves on roofs will soon be code up in Washington and Oregon is soon to follow. Well, we're very pleased that it's ALL over our roof!"

—Melissa Fryback, for Arciform LLC

3.8 ROOFING

3.8.1 Select light-colored roofing

DESCRIPTION ◆ Dark roofing materials absorb heat making the house warmer in summer months, whereas light-colored roofing reflects heat away from the building.

APPLICATION ◆ For pitched-roof buildings, use light-colored roofing.

BENEFIT ◆ Light-colored roofing reduces heat build up through the roof, increasing occupancy comfort in hot weather and decreasing air conditioning bills.

Recycled tire roofing on completed 1909 House

3.8 ROOFING

3.8.2 Select safe and durable roofing materials

DESCRIPTION ◆ Forty-year asphalt composition, cement tile, fiber-cement and metal are examples of safe and durable roofing materials. New composition roofing materials have recently been introduced, such as recycled-rubber roofing. Traditional copper, slate and tile are historic roofing materials with lifespans that can be over 100 years. They are fire resistant and less toxic than petroleum-based products.

APPLICATION ◆ Applicable anytime roofing material is specified.

BENEFIT ◆ A durable and safe roof is cost effective and reduces landfill deposits.

3.9 APPLIANCES

3.9.1 Install energy-efficient refrigerator

DESCRIPTION ◆ Older model refrigerators and freezers may be large users of electricity in older homes. New appliances are much more energy efficient.

APPLICATION ◆ Select Energy Star®-rated refrigerators when replacing old units.

BENEFIT ◆ New, efficient refrigerators can save money on electric bills. The Oregon Department of Energy offers a $50-70 tax credit on qualifying refrigerators (see http://egov.oregon.gov/ENERGY).

The Energy Trust of Oregon has a list of Energy Star® refrigerators at www.energytrust.org/residential.

Dishwashers can save water *and* energy

3.9 APPLIANCES

3.9.2 Replace dishwasher

DESCRIPTION ◆ New model dishwashers use both water and energy more efficiently.

APPLICATION ◆ Select Energy Star® dishwashers when replacing older models.

BENEFIT ◆ Water- efficient dishwashers are also energy-efficient because most energy consumed by dishwashers is used to heat water. Oregon Department of Energy offers a $50 tax credit on qualifying models (see http://egov.oregon.gov/ENERGY).

Energy Star® dishwashers: www.energytrust.org/residential.

This clothes washer saves water and energy

3.9 APPLIANCES

3.9.3 Install horizontal-axis ("front loading") washing machine

DESCRIPTION ◆ Horizontal-axis machines load from the front, spinning clothes in and out of the water to tumble them clean.

APPLICATION ◆ Install Energy Star® horizontal-axis washing machines when replacing older models.

BENEFIT ◆ Horizontal-axis machines save resources by using less water and energy. They use up to 40% less water and 50% less energy than conventional top-loading washers, translating into lower energy and water bills for the resident. Manufacturers claim that there is less wear and tear on clothes compared to the traditional agitator (top-loading) machines.

Oregon Department of Energy offers a $115-180 tax credit on qualifying models (see http://egov.oregon.gov/ENERGY).

Through December 31, 2005, the Energy Trust of Oregon offers a $100 incentive on qualified clothes washers. The list of eligible washers is at www.energytrust.org/cw.

3.9 APPLIANCES

3.9.4 Install an energy-efficient water heater

DESCRIPTION ◆ Energy-efficient tank-type water heaters are readily available in Portland.

Interest in tankless water heaters is growing.

APPLICATION ◆ When purchasing a gas water heater: specify an Energy Factor of 0.60 or higher.

For an electric water heater look for an Energy Factor of 0.93 or higher.

Set the thermostat on the water heater at 120º F, hot enough for bathing and clothes washing. Today's dishwashers usually have a built-in water heater to boost temperature.

BENEFIT ◆ Water heating is usually the second biggest energy user after space heating, so a new water heater can save money.

Tankless or on-demand water heaters

These water heaters save energy by eliminating the storage tank and its stand-by heat loss. They are widely used in Europe and Asia to save space and energy. They cost more than tank-type heaters, but the Oregon Department of Energy offers a tax credit of up to $340 on qualified models. See http://egov.oregon.gov/ENERGY under "For Residents."

More details on tankless water heaters are available from the US Department of Energy at http://www.eere.energy.gov (search under "tankless").

Spray-in Icynene provides complete cavity fill and is non-toxic

3.10 INSULATION

3.10.1 Upgrade wall and ceiling insulation

DESCRIPTION ◆ Insulation in exterior walls and ceilings can reduce the demand for heating and make homes more comfortable.

APPLICATION

A. Wall insulation

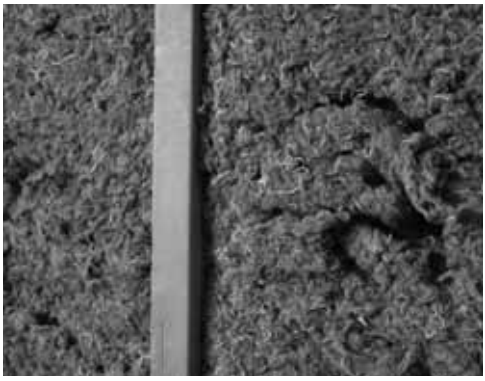
Insulate walls of existing wood-frame houses to the capacity of the wall cavity, R-11 to R-21. Wall cavities can be blown full of cellulose or fiberglass insulation, or filled with expanding foam insulation. Exterior walls can be clad with 1" (R-5) rigid foam to increase R-value, if the exterior refinish is being renovated.

B. Ceiling insulation

Increase attic ceiling insulation in an existing structure to R-38, and in vaulted or cathedral ceilings to R-30. Blown-in cellulose or fiberglass insulation is usually less costly to install than batts, but batts may make future access easier because they can be temporarily moved and replaced.

BENEFITS ◆ Increased wall and ceiling insulation improves comfort, decreases heating and cooling requirements, saves money and makes the home quieter.

The Energy Trust of Oregon offers cash incentives for insulation and window upgrades. See www.energytrust.org/hes.



Recycled cotton insulation batts are non-toxic, pleasant to handle

3.10 INSULATION

3.10.2 Install recycled-content, formaldehyde-free fiberglass insulation

DESCRIPTION ◆ Many fiberglass insulation products include recycled glass and formaldehyde-free binders and have no asphalt adhesives or colored dyes.

APPLICATION ◆ When using fiberglass insulation, specify recycled content and no formaldehyde. Fiberglass insulation can be used for any typical insulation installation.

BENEFIT ◆ Formaldehyde-free binders reduce indoor air quality problems, and insulation contains up to 30% recycled glass.

When insulating ceilings, it makes sense to add structural ventilation in the form of ridge vents and eave or soffit vents. Power vents are also an option. Extra venting protects the attic from moisture accumulation and may reduce summer overheating of rooms below the attic ceiling.

3.10 INSULATION

3.10.4 Use cellulose insulation

A. Walls: spray-in cellulose

DESCRIPTION ◆ Cellulose is a highly effective insulation made out of recycled newspaper. Cellulose wall insulation is mixed with water or low-toxic binders to adhere to stud and joist cavity surfaces.

APPLICATION ◆ This installation is intended for new construction or total "gut" renovation, where existing wall surfaces have been removed to the studs. It is not cost effective in other applications.

BENEFIT ◆ Spray insulation completely fills cavities and penetrations, thus reducing air infiltration. Using cellulose insulation makes the home quieter, more comfortable and energy-efficient.

B. Ceilings: blown-in cellulose

DESCRIPTION ◆ Dry-blown or loose-fill cellulose is treated with borates for fire and insect resistance. Cellulose does not contain formaldehyde, which is common in many fiberglass insulations.

APPLICATION ◆ Spread cellulose over ceiling joists or blow into tight cavities to increase ceiling R-value. It is important to maintain attic or ceiling ventilation pathways, especially in cathedral ceilings.

BENEFIT ◆ Cellulose insulation is formaldehyde-free, fire-resistant, manufactured with recycled materials, reduces air leakage and contributes to a more comfortable and energy-efficient home.

Cellulose vs. fiberglass...

Each of these insulations has advantages and disadvantages, and each one has its advocates. Bottom line: both work. Choose the insulation that fits your preferences and budget.

...Or recycled cotton insulation?

"UltraTouch" insulation is made from recycled cotton denim fabric scraps. It is available in standard-size batts from local building materials suppliers. Cotton insulation is pleasant to handle and install.

Spray-in cellulose insulates and stops air leaks

3.10 INSULATION

3.10.3 Reduce air infiltration

DESCRIPTION ◆ Expandable foam and caulk may be used to stop air infiltration at openings or penetrations, such as where pipes and wires pass through framing. Replace worn weatherstripping on entry doors.

Sealing air leaks is especially important on the ceiling to stop warm room air from leaking out and cold attic air from falling into interior walls. It's also a good idea to seal air leaks along the top of basement walls (where the floor framing sits on the concrete walls).

APPLICATION ◆ Seal before insulation is installed. Seal wires, pipes, plumbing vents, ducts, and around exhaust fans and ceiling light fixtures. Where a masonry chimney enters the attic, install 26 gauge sheet metal between framing and chimney to stop air flow. Gasket edges of an attic hatch with foam tape. If interior walls are accessible from the attic, seal along the top of framing between wood and drywall.

When framing new walls, run a bead of caulk under the bottom plate before tipping up the wall, or seal along joint where the bottom plate meets the subfloor.

BENEFIT ◆ Reducing unintended air infiltration increases comfort and reduces energy bills.

What are my window options?

"Option 'A' is replacing the sash only. This is good if the frame is still in good shape, and you are looking forward to stopping the breeze even when the window is closed. This option has easy installation, an energy-efficient upgrade, maintains the window's original glass area, avoids disturbing the existing casings and is the least expensive option.

"Option 'B' is insert a frame into the sash. It has more dependable energy ratings than option A, is less expensive than option C and won't disturb the existing casings, siding or wall coverings. However, it does reduce the glass area and have a bulkier look. For a do-it-yourselfer, it is the most expensive in materials alone, and the window's smaller opening might violate some fire code egress requirements.

"Option 'C' is replacing the entire window. This is what we are doing at the 1909 House. The interior and exterior finishes are being redone in most areas, so disturbing them does not make a difference. It is the most versatile because you can change the window's size. It is the most energy efficient, and it is the most durable, because you can upgrade the entire system down to the flashing. This method is invasive and most difficult, but due to the siding and interior finish replacements of the 1909 House, the least expensive in labor. We will also restore the original leaded windows in the 1909 House."

—Richard DeWolf, Arciform LLC

3.11 WINDOWS

3.11.1 Install energy-efficient windows

Windows play a big role in the energy efficiency and comfort of homes. In the summer they can allow unwanted heat into the house, and in the winter windows can account for as much as 25% of the heat loss. When replacing windows, look for models with the following energy-saving features:

A. Double-paned windows

DESCRIPTION ◆ Double glazing insulates almost twice as well as single glazing.

APPLICATION ◆ Replace older single-paned windows with double-paned windows whenever possible.

BENEFIT ◆ High-quality double-paned windows make the whole house quieter and more comfortable during all seasons, while saving energy and money.

B . Low-emissivity (low-E) windows

DESCRIPTION ◆ A low-E coating, virtually unnoticeable to the eye, is installed inside the air space of a double-paned window. The low-E coating helps prevent heat from escaping through the glass in winter and blocks heat from entering the home during summer.

APPLICATION ◆ Select low-E, double-paned windows whenever windows are replaced.

BENEFIT ◆ Low–E windows reflect heat, making the home more comfortable in cold weather and on hot summer days. The cost premium of 10-15% for low-E glass typically pays for itself in a few years. Low-E, double-paned glass coating increases glass R-value to 3 compared to R-1 for single-glazed windows.

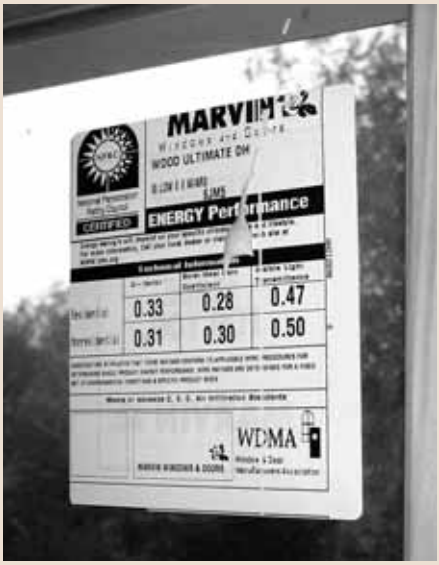
Check with the Energy Trust of Oregon for financial incentives, 1-866-ENTRUST (for homes served by PGE, Pacific Power or NW Natural).

C. Low-conductivity frames

DESCRIPTION ◆ Most window frames and sashes are made of wood, vinyl, fiberglass or a combination. Wood, vinyl and fiberglass insulate better than aluminum frames found in older homes.

APPLICATION ◆ Consider fiberglass or wood windows for any window that is being replaced.

BENEFIT ◆ Fiberglass- and wood-frame windows create greater comfort and better energy efficiency and are environmentally preferable materials.



Energy label reports tested values for heat loss (U value), blocking solar heat gain (SHGC) and transmitting visible light (VT)

Reading labels on new windows

Look for this label as your assurance that this window has been independently rated using a procedure established by the NFRC (National Fenestration Rating Council). Use the following three values to find the best window for your home:

1. "U-factor" is a measure of heat transferred by the entire window (frame, sash and glass) either into or out of the building. A smaller U-factor will provide a window which is more comfortable on cold days. Oregon energy code requires a U-factor of 0.40 or lower. Most window companies offer models that are 0.35 or lower.

2. "Solar Heat Gain Coefficient" (SHGC) is a measure of the solar heat energy entering the building though the entire window. A lower SHGC will reduce air conditioning costs and provide more comfort on hot days. Look for a value of 0.50 or lower.

3. "Visible Transmittance" (VT) is a measure of the amount of visible light entering the window. Try to select a window with a high VT. It will bring more natural daylight into your home. Look for a value of 0.55 or higher.

Window installation

New windows are an investment that should last many years. Windows can be protected against future leaks or moisture damage by following a few simple guidelines.
The Building Science Corporation web site has an illustrated step-by-step guide to proper window installation: www.buildingscience.com/resources.

Marvin Tilt-Pac inserts upgrade older wood windows for efficiency and comfort

The house as a system:

Integrating heating, cooling, ventilation, insulation and air sealing

To get the best year-round comfort with low heating and cooling bills and have fresh healthy air without mold or other pollutants, a house must be designed and built as a system. The building envelope, heating system, and fresh-air ventilation should be designed to work together. A change in one part of the system will affect the other parts, so the goal is to keep everything in balance.

However, since different specialists install insulation, heating systems and ventilation equipment, they may not work together or may actually create conflicts.

For example, a new high-efficiency furnace alone can't keep a house comfortable if the walls and ceilings lack insulation and single-pane windows have not been replaced. Even if the heating contractor oversizes the furnace, it may not provide acceptable comfort.

When a house is insulated, new windows installed, and air leaks sealed, more moisture is kept inside and indoor humidity goes up. If ventilation fans are not installed, even new windows may "sweat" because of this increased humidity.

The designer or remodeling contractor should make sure that the thermal envelope, heating system and ventilation are designed to work together. For example, a new furnace must be properly sized in relation to the heating needs of the house after insulation and windows are installed.

See www.buildingscience.com/resources/mold/Design_Build.pdf.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Heating Systems

3.12.1 Use duct mastic on all duct joints

DESCRIPTION ◆ Heated air often leaks out through joints in ductwork. When ducts are in a crawl space or attic, the heated air is lost. It is not unusual for 20 to 30% of heated air to escape from ducts. Duct tape loses its effectiveness in 3 to 5 years. Mastic maintains its seal for decades.

APPLICATION ◆ Install mastic at every metal duct joint, around the bends in elbows and where ducts meet plenums. It is important for all ducts to be sealed.

BENEFIT ◆ Well-sealed ductwork saves energy, keeps the house more comfortable and can stop pollutants from garages and attics from entering the house. Oregon Department of Energy offers tax credits of $150-250 for duct sealing done by a qualified contractor (See http://egov.oregon.gov/ENERGY).

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Heating Systems

3.12.2 Install new ductwork within conditioned space

DESCRIPTION ◆ Ducts in exterior walls, attics and in crawl spaces lose a significant amount of heat.

APPLICATION ◆ All ductwork for heating (or cooling) should be run through conditioned space inside the insulated envelope. Interior duct runs require chases to be designed into the project from the beginning.

BENEFIT ◆ Locating ducts in the conditioned space significantly reduces energy loss and improves occupant comfort.

High-efficiency heat pumps

A heat pump can provide both heating and cooling. The energy efficiency of heat pumps is rated using two measurements: the Heating Season Performance Factor (HSPF) and the Seasonal Energy Efficiency Rating (SEER). HSPF estimates annual heating efficiency for the heat pump, allowing for weather factors. SEER rates cooling efficiency. A heat pump with an HSPF of 8.5 and SEER of 13 or higher is eligible for a $300-500 state tax credit (see egov.oregon.gov/ENERGY).

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Heating Systems

3.12.3 If forced-air furnace replaced, install 90% or greater efficiency model

DESCRIPTION ◆ High-efficiency furnaces convert natural gas to heat with greater efficiency. Some have variable speed blowers that use much less electricity to move air.

APPLICATION ◆ Replace conventional furnaces with high efficiency models. Installing the proper size of furnace for the home is just as important as its efficiency.

BENEFIT ◆ A properly sized, high-efficiency furnace costs less to operate. It saves natural resources, reduces air emissions and helps create a cleaner environment. Oregon Department of Energy has tax credits of $225-350 for qualifying models (see egov.oregon.gov/ENERGY).

Global warming and energy efficiency

If you are concerned about global warming, would like to reduce your reliance on fossil fuels, and reduce your personal greenhouse gas emissions, installing high-efficiency equipment is a sensible choice. A high-efficiency furnace with variable-speed blower, smart thermostat and tight ductwork (or ducts inside heated space) can cut energy use and greenhouse gas emissions by half or more compared to conventional systems.

Keep in mind, too, that electricity generated from renewable sources does not contribute to global warming.

You can calculate your personal greenhouse gas emissions at www.carboncounter.org. You can also elect to donate to carbon-offset programs that compensate for your contribution to global warming.

Zone thermostats control each room

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Heating Systems

3.12.4 Zone a forced-air system

DESCRIPTION ◆ Forced air systems are set up with a single thermostat that is intended to control temperature throughout the dwelling. Most homeowners would prefer to be able to zone the house, or set a different temperature in each room. Zoning would improve comfort and save on heating and cooling costs. Unfortunately, opening and closing the grilles in a forced air system isn't effective. Today, a forced air system can be retrofitted to allow zoning.

APPLICATION ◆ Ask your heating contractor for information on zoning your system. One locally available product for retrofitting a forced air heating system is from Home Comfort Zones, www.homecomfortzones.com.

BENEFIT ◆ Set comfortable temperature in individual rooms and shut off heat in unused rooms. Save heating and cooling energy and costs.

Radiant floor tubing ready for concrete pour

Hydronic boiler

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Heating Systems

3.12.5 Install hydronic radiant heating

DESCRIPTION ◆ Hydronic heating circulates hot water through radiators, wall-mounted fan-coil units or under floors. This heating system can be zoned to allow different temperatures in different rooms throughout the house. A hydronic system can be retrofitted by using flexible plastic tubing (cross-linked polyethylene).

In a well-insulated house, hydronic heating can be run under wood flooring without damaging it.

APPLICATION ◆ Use hydronic, radiant heating instead of forced air heating. The system must be designed before construction starts.

BENEFIT ◆ Hydronic heating is more comfortable and saves energy by heating only the zone that requires heat.

Hot water heat can be more efficient than forced air, because there are no ducts to leak and water can hold more heat than air.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Fireplaces and Wood Stoves

3.12.6 Retrofit older wood-burning fireplaces and stoves

DESCRIPTION ◆ The burning of wood in older wood stoves and fireplaces is a major source of air pollution during the winter months, generating significant airborne particulate matter on cold evenings.

APPLICATION ◆ One option is to replace a wood burning fireplace with an EPA-certified wood stove, fireplace insert or a pellet stove. These units should have direct outside combustion air vented into the insert.

A second option is replace a wood-burning unit with one that uses natural gas. Natural gas burns more cleanly and is convenient. Note: a natural gas fireplace or insert should vent its combustion byproducts to the outdoors, not inside the house.

BENEFIT ◆ The amount of pollutant particulate matter will be reduced by 75 to 90% compared to a standard fireplace.

Keeping the air clean in your neighborhood

Another way to reduce smoke and pollution is to burn short, hot fires using dry wood. Conversely, a dampered fire burning green wood produces the most smoke and pollution.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Fireplaces and Wood Stoves

3.12.7 Install/replace dampers on fireplaces

DESCRIPTION ◆ A damper in the fireplace flue reduces air infiltration and heat loss during cold weather.

APPLICATION ◆ Replace an old damper if it no longer seals the flue due to mechanical failure, rust or soot build up in the chimney.

BENEFIT ◆ A properly operating damper reduces cold drafts when the fireplace is not in use.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Fireplaces and Wood Stoves

3.12.8 Install airtight doors on fireplaces

DESCRIPTION ◆ Open fireplaces suck air out of the house and extract more heat than they provide. Airtight doors reduce the amount of air drawn from the house for combustion purposes.

APPLICATION ◆ Retrofit doors on fireplaces. Outside air, needed for combustion, should be brought in behind the doors. Some fireplaces provide for controlled air intake from inside the house that can be shut down when not in use.

BENEFIT ◆ When shut, airtight doors can reduce heat loss from the house. They also reduce drafts when the fireplace is not in use.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Fireplaces and Wood Stoves

3.12.9 Install a carbon monoxide alarm

DESCRIPTION ◆ In a house with gas-burning appliances, a carbon monoxide alarm can be installed to warn you in the unlikely event of a malfunction and build-up of this hazardous gas.

APPLICATION ◆ Carbon monoxide monitors are available at all hardware and home goods stores.

BENEFIT ◆ Carbon monoxide can build up in the bloodstream, causing on-going fatigue and malaise. An alarm is cheap insurance against injury or illness.

Radiant Cove heater located on wall warms this bedroom

Heating options for small houses or rooms

Small houses with good thermal envelopes or single rooms may not need a full-scale furnace and ductwork.

One option is a through-the-wall gas space heater. These heaters range in size from 10,000 to 40,000 Btu/hr, and do not require a flue. The combustion gases are exhausted to the outdoors through the wall. One example is the Rinnai series, sold by several Portland heating companies.

On the electric side, radiant cove heaters are an inexpensive option. These heaters provide radiant heat, which is very comfortable. They are placed high on the wall, where they are out of the way of doors and furniture. One example is the Radiant Systems Inc. Comfort Cove radiant heater.

Shading west-facing windows prevents overheated rooms

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cooling Systems

3.12.10 Incorporate natural cooling

DESCRIPTION ◆ Natural cooling systems incorporate passive features that do not use energy to cool, such as shading from deciduous trees, shrubs and vines; roof overhangs, trellises, window shades and screens; and operable windows and skylights.

APPLICATION ◆ Any combination of natural cooling techniques can be used to reduce overheating on homes.

Blocking direct summer sun is an effective way to keep a house cool. Shade is especially helpful on west-facing windows and walls and on rooftops.

Plants, especially trees and large shrubs, provide evaporative cooling. As they draw water up from the soil and it evaporates through the leaves, the air around the tree is cooled.

In the Portland climate, night air is usually cool so drawing it through the house can provide night cooling.

Houses with clean dry basements can take advantage of earth-coupling to draw air from the cooler basement up into the house. Sometimes this can be done just buy opening upstairs windows and the door to the basement; in other cases a fan may be required to move the air.

BENEFIT ◆ Natural cooling reduces the need for air conditioning, saves money on energy bills, and can make homes more comfortable without using air conditioning.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cooling Systems

3.12.11 Install whole-house cooling fan

DESCRIPTION ◆ A whole-house fan works by continuously replacing warm indoor air with cooler outdoor air. "Night flushing" is a way to cool the house off using cooler night air so it doesn't get as warm during the day.

APPLICATION ◆ The fan must be mounted in a hallway ceiling on the top floor of a house. An insulated, airtight seal is required to prevent air infiltration in winter. Fans should be sized to produce between 4-5 air changes per hour within the home and should have two speeds: low speed for continuous ventilation and high speed.

BENEFIT ◆ An average whole-house fan uses one-tenth the electricity of an air conditioning unit. In the Portland climate, moving large volumes of air can achieve indoor comfort at higher temperatures without air conditioning.

Cooling in the future?

If the costs of energy rise and Portland weather becomes warmer, natural cooling may become a valuable asset for a house.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cooling Systems

3.12.12 Install solar-powered attic fan

DESCRIPTION ◆ Solar attic fans exhaust heat from attic spaces in summer and clear condensation in the winter.

APPLICATION ◆ Solar attic fans are powered by the sun and are most effective when placed on the southern side of the roof and centered between roof rafters. Avoid installing under overhanging trees or other structures creating shade.

BENEFIT ◆ In the summer, attic air temperatures can reach 150º F. That heat radiates into the home through the ceiling and causes discomfort. A solar attic fan removes this hot air and helps cool the house. An attic fan may also increase the life of composition roofing.

Do your upstairs rooms overheat in summer?

Many Portland houses have upstairs rooms that are uncomfortably warm in summer. Even after sunset when the outdoors has cooled down, these rooms remain too warm. That's because the ceiling radiates heat from hot air trapped in the attic (or inside cavities in vaulted ceilings). The radiant heat from the ceiling feels uncomfortable, even if the room air temperature is normal. Venting out hot attic air will help cool upstairs rooms.

Room air conditioning

Before installing a room air conditioner, consider using shading devices or plants to block hot sun. Often a room overheats because it gets late-afternoon summer sun or is on the west side of the house. Shading will improve comfort, without using energy. For allergy sufferers, a room air conditioner can dry and filter air and may reduce symptoms.

If you do install a room air conditioner, select one with an Energy Star-efficiency rating (EER) of 9.4 or higher.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.13 Install a whole-house air filter

DESCRIPTION ◆ Either a forced-air furnace or a heat pump provides an opportunity to add effective air filtration. Standard air filters costing about $1 only protect the furnace blower, not human occupants. A good quality filter that can capture small particulates costs $10-12 at hardware and building supply stores.

APPLICATION ◆ Look for a filter with MERV test rating of 8 or higher (MERV = Minimum Efficiency Reporting Value). A MERV rating tells you the filter manufacturer is using up-to-date testing to accurately measure performance.

Another option is the electronic filter that is mounted next to the furnace or heat pump. These filters are efficient if they are washed regularly according to the manufacturer's recommendations.

An activated carbon filter can capture gases. Carbon filters are more expensive than particulate filters but may be helpful to people with chemical sensitivities.

Washable filters can be cleaned and reused. Non-washable filters must be replaced periodically. Wash/change filters at least twice a year (preferably more often) to ensure particulates are removed.

BENEFIT ◆ Better-quality furnace filters capture dust, pollen and other indoor pollutants. They also capture microscopic or "respirable" particulates under 0.3 microns in size (a human hair is about 100 microns thick). These particulates are suspected of causing respiratory injury and illness.

Good bathroom fans help prevent mold

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.14 Install effective bathroom fans

DESCRIPTION ◆ An effective exhaust fan helps eliminate excess moisture and mold in a bathroom. Many older fans are not effective. To test a fan, hold a square of bath tissue up to it. If the tissue snaps tight to the grill, the fan is moving air.

APPLICATION ◆ Select a good quality bath fan, rated at 80-100 cfm air flow with a noise rating of 1 sone or less. Install a timer switch to ensure that the fan runs long enough to remove excess moisture from bathing and showering.

Vent moisture-laden air out of the house (not into the attic).

BENEFIT ◆ An effective bath fan can eliminate or reduce excess moisture and mold.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.15 Install a kitchen range hood

DESCRIPTION ◆ A kitchen range hood picks up combustion byproducts, odors and excess moisture from the cooktop and oven and exhausts them out of the house.

APPLICATION ◆ Select a quiet model, preferably 2.5 sones or lower.

Note that some range hoods do not actually vent to the outdoors and will not remove combustion byproducts.

BENEFIT ◆ Children living in houses with combustion appliances have more respiratory illness. A range hood captures and removes combustion byproducts, especially nitrogen oxides, that may affect children's respiratory systems.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.16 Install heat recovery ventilation unit (HRV)

DESCRIPTION ◆ An HRV is a mechanical ventilation system that removes stale air, provides tempered fresh air and distributes air throughout the house. An HRV saves energy by recovering heat using an air-to-air exchanger in which outgoing exhaust air preheats or precools the incoming fresh air. Some HRVs can be fitted with high-efficiency air filters that may benefit allergy and asthma sufferers.

APPLICATION ◆ An HRV is particularly appropriate in a house with hydronic radiant heat, or where the house is exceptionally tightly sealed. One consideration is whether small-diameter ducts can be run from the HRV unit to individual rooms; this may be a challenge in an existing house.

BENEFIT ◆ Air-to-air heat exchangers provide for comfortable fresh air all year round while saving energy. The main reason for installing one is to ensure fresh air distribution.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.17 Install exhaust fan in attached garage

DESCRIPTION ◆ According to the EPA, an attached garage is the single most significant contributor to poor indoor air quality. Car exhaust contains many known carcinogens. It can migrate into living spaces through doors and cracks in walls adjacent to the garage or be picked up by a furnace located in the garage.

APPLICATION ◆ Install an exhaust fan on the opposite wall from the door to the house. It can be wired to an electric garage door or put on a timer to run for 15 minutes after door has been opened or closed.

BENEFIT ◆ An exhaust fan creates a healthier indoor environment by preventing car exhaust from entering the house.

3.12 HEATING, VENTILATION AND AIR CONDITIONING (HVAC): Cleaning The Air

3.12.18 Clean forced-air ducts before occupancy

DESCRIPTION ◆ Debris and dust from construction may get into ducts and cause allergic reactions.

APPLICATION ◆ Clean or vacuum all ductwork before occupancy to eliminate dust. Clean ducts before carpet is laid and finishes are applied.

BENEFIT ◆ Children are especially sensitive to micro-sized particulates.

Passive solar glazing and thermal storage can reduce energy use and improve comfort

3.13 RENEWABLE AND SOLAR ENERGY

3.13.1 Incorporate passive solar heating

DESCRIPTION ◆ Passive solar systems provide heat to the structure through south-facing windows in conjunction with thermal mass.

APPLICATION ◆ A passive solar house incorporates windows that face within 30 degrees of due south and has the ability to store solar heat in massive elements such as a slab floor or stone fireplace. Passive solar can be built directly into a house or into an attached sunspace.

Passive solar design should be done by an experienced designer or builder who can integrate the windows and mass with the house.

BENEFIT ◆ Passive solar design can reduce heating requirements by 15 to 20%, saving energy and money.

Solar water heating works in Portland

3.13 RENEWABLE AND SOLAR ENERGY

3.13.2 Install solar water-heating system

DESCRIPTION ◆ Solar water-heating systems use solar panels to collect heat from the sun. The hot water is stored for use at a later time. Water pre-heated by a solar system can also supplement a standard water heater.

APPLICATION ◆ Provide sufficient south-facing roof area for collector panel(s) and space in a utility room or closet for an additional hot water storage tank.

BENEFIT ◆ In Portland, a solar hot water system can provide about half of the water heating for a family of four. The Energy Trust of Oregon offers a solar water heating incentive of up to $1,500 (see www.energytrust.org) and the Oregon Department of Energy offers a tax credit of up to $1,500 (see egov.oregon.gov/ENERGY). Solar systems are also exempt from property taxes.

3.13 RENEWABLE AND SOLAR ENERGY

3.13.3 Pre-plumb for solar water heating

DESCRIPTION ◆ Insulated water pipes are installed from the attic to a hot water closet or mechanical room for future solar installation. This option allows the homeowner to install an active solar system at a later date if they desire.

APPLICATION ◆ Provide south-facing roof area for collectors and access for piping to a mechanical room. This is primarily applicable to homes that are being extensively rehabilitated on the interior. The most cost-effective time to install this pre-plumbing is during construction.

BENEFIT ◆ Solar hot water pre-plumbing during the remodeling process can save money for the homeowners if, at some point in the future, they want to install a solar system.

Solar works in Oregon

EnergyTrust of Oregon, Inc.

In recent years hundreds of Oregonian homeowners and businesses have turned to a higher power: the sun. They are using a combination of Energy Trust cash incentives and Oregon energy tax credits to cut the costs of new solar systems, and trim 15% or more off their power bills.

Find out how well solar works everywhere in Oregon. Call 1-866-ENTRUST (368-8686) or log onto www.energytrust.org.

Photovoltaic panels on this Alameda home are barely visible from the street

3.13 RENEWABLE AND SOLAR ENERGY

3.13.4 Install solar photovoltaic (PV) panels

DESCRIPTION ◆ PV panels collect the sun's energy and convert it into electricity. Excess electricity can be sent back into the utility grid for a credit on electric bills.

APPLICATION ◆ A household PV system includes photovoltaic panels on the roof or on the ground at an appropriate angle (usually 40-60°), a power relay center and an inverter. The house can use electricity from the panels as well as from the utility grid.

BENEFIT ◆ PVs are a clean, renewable resource that do not contribute to global warming. If the price of electricity rises significantly PVs will buffer the added cost. The Energy Trust of Oregon offers an incentive of up to $10,000 for a PV system (see www.energytrust.org) while the state offers a tax credit of up to $1,500 (see http://egov.oregon.gov/ENERGY).

Financial incentives

Note that Oregon residents may receive the Energy Trust of Oregon incentives *and* the Oregon energy tax credits.

3.13 RENEWABLE AND SOLAR ENERGY

3.13.5 Buy renewable power

DESCRIPTION ◆ Both PGE and Pacific Power offer electricity from renewable sources for a small additional cost over electricity from conventional generation like coal- and gas-fired plants.

APPLICATION ◆ Sign up for one of PGE's renewable options, Green Source or Clean Wind, at www.portlandgeneral.com.

Sign up for Pacific Power's Blue Sky program at www.pacificpower.net.

BENEFIT ◆ These programs offer safe, clean renewable power at a modest cost.

Safe, non-toxic interior paint

3.14 INDOOR AIR QUALITY AND FINISHES

3.14.1 Use low/no-VOC and formaldehyde-free paint

DESCRIPTION ◆ Many interior paints release volatile organic compounds (VOCs), a major indoor air pollutant, into the home. Often low/no-VOC products are manufactured without mercury or mercury compounds, or pigments of lead, cadmium, chromium or their oxides.

APPLICATION ◆ Paint with low/no-VOCs is available from most major manufacturers and is applied like conventional paint products. Locally, both Miller Paint and Rodda Paint manufacture paints that have been certified to meet national standards for low VOCs and other components.

BENEFIT ◆ Low/No-VOC paint reduces the emissions of VOCs into the home, improving indoor air quality.

What are "VOCs"?

Volatile Organic Compounds evaporate quickly and are carbon-based. That means they pass through skin and cell walls readily. Many of the VOCs in building products are suspected of causing injury or illness. Where possible, select no- or low-VOC products.

3.14 INDOOR AIR QUALITY AND FINISHES

3.14.2 Use safer adhesives and caulks

DESCRIPTION ◆ Solvent-based adhesives and caulks may offgas toxic compounds. Low-VOC or solvent-free adhesives and caulks reduce toxic gases and solvents that contribute to air pollution.

APPLICATION ◆ Use low-VOC solvent-free products in place of standard adhesives and caulks for all interior applications such as installation of flooring, countertops, cove base, paneling and tub/shower enclosures and sealing around windows and trim.

For a list of safer paints, adhesives and sealants, see the Resource Center at green-rated.org.

BENEFIT ◆ Solvent-free adhesives and caulks are often stronger, emit fewer pollutants and reduce the potential harmful impacts on the health of the occupants and installers.

Properly dispose of household hazardous wastes

Portland residents can dispose of household hazardous wastes (paints, stains, adhesives, etc.) safely, conveniently—and for free! Call Metro at 503-234-3000 for drop-off locations and hours.

Low-VOC wood finish on oak flooring at 1909 House

3.14 INDOOR AIR QUALITY AND FINISHES

3.14.3 Use low-VOC, water-based wood finishes

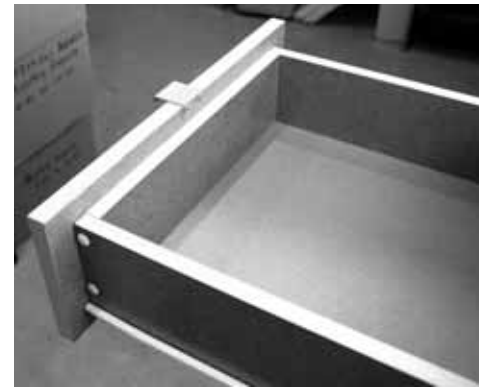
DESCRIPTION ◆ Conventional solvent-based wood finishes can offgas toxic chemicals and can be harmful to children. Low-VOC finishes, such as water-borne urethane and acrylic, are lower in toxic compounds compared to conventional solvent-based finishes while providing similar performance and durability.

APPLICATION ◆ Low-VOC wood finishes can be used in most applications where solvent-based finishes are typically used. If solvent-based wood finishes must be used, they should be allowed to offgas for three to four weeks prior to occupancy.

BENEFIT ◆ Using low-VOC wood finishes reduces offgassing into the home, improving indoor air quality and reducing the formation of urban smog.

Use low-toxic or citrus-based cleaning supplies

High-quality, non-toxic and environmentally responsible cleaning products are readily available. Choose products that are non-toxic, ammonia and chlorine-free, as well as biodegradable. These cleaning products are as effective as conventional cleaners, without harsh chemicals that can lead to health problems and atmospheric ozone loss. Download recipes and tips on how to make and use your own toxic-free household cleaners, at www.metro-region.org (search for "green cleaners").



Strawboard in this drawer does not emit formaldehyde

3.14 INDOOR AIR QUALITY AND FINISHES

3.14.4 Replace particleboard with formaldehyde-free materials

DESCRIPTION ◆ Particleboard is made from wood fibers and adhesive containing urea formaldehyde, a suspected human carcinogen. The formaldehyde is continuously released, or "offgassed," for years after installation. Formaldehyde offgassing contributes to poor indoor air quality. Particleboard is typically used for cabinets, counter tops, underlayment, stair treads and shelving.

APPLICATION ◆ Whenever possible, eliminate new particleboard inside houses by using solid wood, exterior-grade plywood, strawboard or formaldehyde-free medium density fiberboard (MDF) for shelving, cabinets and substrate for countertops. Fiber-cement and plywood sheets are options for underlayment.

BENEFIT ◆ Elimination of particleboard reduces formaldehyde exposure to residents, particularly children, who are most susceptible.

Read the MSDS

Material Safety Data Sheets are available from manufacturers of building products. They list the chemicals in the formulation and whether they may be hazardous.

Cabinets built with safe, non-toxic components

3.13 INDOOR AIR QUALITY AND FINISHES

3.13.5 Use exterior-grade plywood for interior uses

DESCRIPTION ◆ Exterior plywood uses phenolic resins that offgas much less formaldehyde than interior plywood. Interior plywood typically uses urea-formaldehyde glue which offgasses formaldehyde into the house.

APPLICATION ◆ Substitute interior plywood with exterior plywood for custom cabinets and shelving.

BENEFIT ◆ Formaldehyde is a suspected human carcinogen and should be avoided whenever possible.

3.14 INDOOR AIR QUALITY AND FINISHES

3.14.6 Select formaldehyde-free medium density fiberboard (MDF)

DESCRIPTION ◆ Most MDF is made from wood fiber and urea formaldehyde adhesive. MDF without formaldehyde binders is now available. Other alternatives include certified plywood and boards made from agricultural waste, such as wheatboard, a straw-based particleboard manufactured with non-formaldehyde and emission-free binder.

APPLICATION ◆ Whenever possible, eliminate formaldehyde-based MDF inside the home. MDF is typically used for cabinets, trim and shelving. Use alternatives such as certified plywood, formaldehyde-free MDF, wheatboard, tile and stone for shelving, cabinets and countertops. Made in Oregon, Medite II and Medex are examples of formaldehyde-free MDF.

BENEFIT ◆ Reduces formaldehyde exposure to residents, particularly children, who are more susceptible. Some boards made from agricultural waste are superior to wood-based particleboard in moisture resistance and structural properties, and they provide for the reuse of a former waste product.

Kitchen and bathroom cabinets

Green options for cabinets include:

- Casings: Replace particleboard and eliminate formaldehyde emissions with:
- Wheatboard, made from recycled straw
- Formaldehyde-free medium density fiberboard (MDF) such as Medite II or water-resistant Medex
- Plywood made with phenolic resin
- Adhesives: Specify safer, low-VOC adhesives
- Finishes: Specify low-VOC or water-based wood stains and finishes
- Wood doors and veneers: Specify FSC-certified hardwoods from sustainably harvested forests
- Countertops: Choose recycled-content ceramic tile, solid composites made with recycled-content inclusions, natural stone, paperstone composite, or butcher block made from certified wood.
- Pulls and handles: Choose recycled materials, such as Aurora Glass.
- Custom cabinets that combine the above features are available from Neil Kelly Co. in their Naturals collection.
- Salvage cabinets from The ReBuilding Center or Habitat for Humanity ReStore

Lower-grade certified maple flooring costs less because it has darker heartwood

3.15 FLOORING

3.15.1 Select Forest Stewardship Council (FSC) certified wood flooring

DESCRIPTION ◆ Certified wood flooring comes from forests that are managed so that harvesting trees for wood products does not damage long-term forest health. Certified wood flooring products are available in a wide variety of domestic and exotic species.

APPLICATION ◆ Use FSC-certified wood in place of conventional hardwood flooring.

BENEFIT ◆ Sustainable forest certification assures that the forest from which the flooring is produced is managed in a way that will assure the long-term availability of these precious woods while protecting ancient, old-growth forests.

Recycled Douglas fir flooring

3.15 FLOORING

3.15.2 Use rapidly renewable flooring materials

DESCRIPTION ◆ Bamboo and cork flooring are alternatives to hardwood flooring. Bamboo is a fast growing grass that can be harvested in three to five years. Cork is a natural flooring material that is obtained from the outer bark of the cork oak without harming the tree.

APPLICATION ◆ Use these alternative flooring materials in place of conventional hardwood.

BENEFIT ◆ Fast growing, rapidly renewable floor substitutes are attractive, perform well and reduce pressure on hardwood forests. Bamboo is as durable as wood; cork resists fire and moisture as well as absorbing sound.

Use salvage wood flooring

Reusing vintage wood flooring can save money while reducing pressure on forests. Salvage wood flooring is available through local companies like Craftmark, Endura Wood Products, Aurora Mills and Environmental Building Supplies. Vintage wood may be very high quality as it was usually cut from old-growth trees.

3.15 FLOORING

3.15.3 Use recycled-content ceramic tile

DESCRIPTION ◆ Recycled-content ceramic tile can contain up to 70% recycled glass. Originally developed for high-traffic commercial conditions, recycled-content tiles are very durable and wear well in residential applications.

APPLICATION ◆ Install recycled-content tiles wherever conventional tiles are specified.

BENEFIT ◆ Some recycled-content ceramic tile is very dense, which significantly reduces the amount of moisture and stains that are absorbed into the tile, making it more durable and easier to maintain.

Linoleum flooring

"The flooring is environmentally friendly sheet linoleum provided and installed by Lansing Linoleum. This long-wearing material has been around for the last 90+ years and has made several reappearances as kitchen flooring throughout the last century. Today it is very popular again mainly for its biodegradable content, durability and the range of beautiful colors it comes in. And for any you out there that HATE cleaning floors, the medium to dark colors seem to hide the dirt longer...."

—Anne DeWolf, Arciform LLC

3.15 FLOORING

3.15.4 Use exposed concrete as finish floor

DESCRIPTION ◆ For slab-on-grade additions, the concrete can be polished, finished with expansion joints in various patterns or stained with pigments to make an attractive finish floor. This approach is especially appropriate for radiant, in-floor heating systems.

APPLICATION ◆ Use this approach for finished basements or additions on slab construction. The finish must be designed and constructed when the slab is poured.

BENEFIT ◆ Using the slab as a floor finish eliminates the need to use other flooring materials. Additionally, it is durable and easy to clean.

3.15 FLOORING

3.15.5 Replace vinyl flooring with natural linoleum

DESCRIPTION ◆ Linoleum is manufactured from natural materials such as cork and linseed oil. Unlike sheet vinyl, linoleum does not contain petroleum-based products nor does it offgas chemical compounds which may cause injury or illness. Using linoleum eliminates concern about byproducts, such as cancer-causing dioxins, which may be produced during the manufacturing of vinyl.

APPLICATION ◆ Use natural linoleum in place of vinyl flooring.

BENEFIT ◆ Linoleum is low-toxic, durable and stain resistant. Linoleum can last up to 40 years.

Local stores offer recycled carpet, natural fiber carpet and carpet remnants

3.15 FLOORING

3.15.6 Install recycled-content carpet and cushion

DESCRIPTION ◆ Recycled-content carpet is made from recycled plastic bottles, recycled wool or recycled cotton. Recycled-content carpet does not differ in appearance or performance and the price is comparable to conventional carpet. Recycled-content carpet cushion is also available.

APPLICATION ◆ Use recycled-content carpet and cushion in all applications where conventional carpet is installed.

BENEFIT ◆ Recycled-content carpet saves resources and diverts waste from landfills. Approximately 40 two-liter soda bottles are recycled per square yard of carpeting. Recycled carpet is often more resilient and colorfast than carpet made from virgin fibers.

Recycled-content products and materials available locally:

- Crushed concrete for backfill and base
- Plastic composite lumber for decking and outdoor structures
- Fly ash for concrete foundations and paving
- Insulation (fiberglass, cellulose and cotton)
- Carpet and cushion
- Medium density fiberboard (MDF)
- Strawboard
- Ceramic tiles
- Paint for interiors and exteriors
- Drywall
- Nails
- Cellulose wallboard and underlayment
- Countertops
- Furniture

CHAPTER 4:
Ideas, illustrations & checklists

rated
PORTLAND'S
GREEN BUILDING
RESOURCE

CHAPTER 4:

Ideas, illustrations & checklists

These checklists and illustrations are intended to serve as tools for project planning and design, materials selection and construction. When building or remodeling, it is important to look carefully at the type of project and incorporate as many green features as possible. The items listed on the checklist represent a variety of green building opportunities; however, not all of them may apply to your remodeling project. There is no standard definition for what constitutes a "green building," but in general a green project will incorporate as many items on this checklist as are practical and applicable to your project. The following sections provide more detailed descriptions of green building practices, material applications and associated environmental benefits. The items are listed in the order they would normally come up during design and construction.

Rainwater harvesting

Large gutters and downspouts collect rainwater

Metal roofing stays clean

Roof washers divert first flow

Roof washer (below)

Rainwater harvesting (CONT'D)

A Cistern located under driveway

Particle and UV filters purify rainwater

Plumbing meets standards of Portland Rainwater Harvesting Code Guide – including cautionary label

1909 House

PEX polyethylene plumbing is safe, easy to retrofit

Features like a handsome bay window are kept

Salvage materials include wood, cabinets, plumbing and light fixtures

1909 House (CONT'D)

Describing recycled rubber roofing at open house event

Dining room before (above): flooring was refinished

Dining room after (left): repainted, sideboard rebuilt, windows replaced

Kitchen before (above): short on storage, work surfaces, social space

Kitchen after (left): more usable, better lighting, convivial space

1909 House (CONT'D)

Bathroom before (above): small, lacks light and storage

Bathroom after (right): restores historic character of house

Living room before (above): entry opens into living room, traffic cuts through

Living room after (right): entry door moved, entry space created, more welcoming

Entry before (above): no access from front sidewalk

Entry after (right): opens out to front sidewalk

1909 House (CONT'D)

Features like linoleum carpet were saved wherever possible (above)

Linoleum carpet after cleaning and refinishing (left)

Celebrating the home's completion

Salvage and reuse

Refurbished gas and electric stoves at a Portland supplier

Metro recycled paint

Salvage pine countertop

Salvage and reuse (CONT'D)

Shoppers find marble tiles at The ReBuilding Center

Fence built with cedar offcuts from local mill

Tub surround made from salvage tile

Salvage and reuse (CONT'D)

Staircase from deconstructed hotel, stair treads from bleachers

A wide variety of certified and salvage wood products are available

Salvage Alaska yellow cedar siding

Salvage and reuse (CONT'D)

Reused solar water heater

Damaged flooring can be restored

4.1 Comprehensive remodel

Design and construction planning

- ☐ Salvage Reusable Building Materials
- ☐ Recycle Job Site Construction and Demolition Waste
- ☐ Use Salvage Materials
- ☐ Use Recycled-Content Materials

Site work

- ☐ Control Erosion
- ☐ Protect Existing Trees
- ☐ Install Permeable Paving
- ☐ Install Drip Irrigation
- ☐ Design Native and Hardy Plant Landscapes and Gardens
- ☐ Install Rainwater Harvesting

Foundations

- ☐ Incorporate Recycled Fly Ash in Concrete
- ☐ Reuse Form Boards
- ☐ Use Recycled-content Rubble for Backfill Drainage
- ☐ Use Aluminum Forms
- ☐ Install Rigid Foam Insulated Concrete Forms (ICFs)

Structure

- ☐ Substitute Engineered Lumber for Solid Sawn Lumber
- ☐ Use FSC-Certified Wood for Framing
- ☐ Use Wood I-Joists for Floors and Ceilings
- ☐ Use Structural Insulated Panels (SIPs) for Walls / Roof
- ☐ Use Salvage Lumber

Exterior finish

- ☐ Use Sustainable Decking Materials
- ☐ Use Treated Wood that Does Not Contain Chromium or Arsenic for Decking and Sill Plates
- ☐ Use Fiber-Cement Exterior Siding

Plumbing

- ☐ Install Water-Heater Jacket Insulation
- ☐ Install a Tankless Water Heater
- ☐ Insulate Hot and Cold Water Pipes
- ☐ Retrofit all Faucets and Showers
- ☐ Replace Toilets with Low Flow Models
- ☐ Install Chlorine Filter on Showerhead
- ☐ Install Water Filtration Unit at Faucet

Details like this recycled glass doorknob are the finishing touches on an Alameda craftsman home remodel.

Electrical

- ☐ Install Compact Fluorescent Light Bulbs
- ☐ Install Lighting Controls

Roofing

- ☐ Select Light-Colored Roofing
- ☐ Select Safe and Durable Roofing Materials

Appliances

- ☐ Install Energy-Efficient Refrigerator
- ☐ Install Water- and Energy-Efficient Dishwasher
- ☐ Install Horizontal Axis Washing Machine

Insulation

- ☐ Upgrade Wall and Ceiling Insulation
- ☐ Install Recycled-Content, Formaldehyde-Free Fiberglass Insulation
- ☐ Use Cellulose Insulation
- ☐ Reduce Air Infiltration

Windows

- ☐ Install Energy-Efficient Windows

Heating, ventilation and air conditioning (HVAC)

- ☐ Use Duct Mastic on All Duct Joints
- ☐ Install New Ductwork within Conditioned Space
- ☐ Install 90% or Greater Efficiency Gas Forced Air Furnace
- ☐ Install Zoned, Hydronic, Radiant Heating
- ☐ Vent Range Hood to the Outside
- ☐ Install Solar Attic Fan
- ☐ Clean All Ducts Before Occupancy
- ☐ Install Whole-House Cooling Fan
- ☐ Retrofit Wood-Burning Fireplaces
- ☐ Install/Replace Dampers on Fireplaces
- ☐ Install Airtight Doors on Fireplaces
- ☐ Install Heat Recovery Ventilation Unit (HRV)
- ☐ Install Separate Garage Exhaust Fan
- ☐ Install Effective Bathroom Fans

Renewable and solar energy

- ☐ Incorporate Natural Cooling
- ☐ Incorporate Passive Solar Heating
- ☐ Install Solar Water System
- ☐ Pre-Plumb for Solar Water Heating
- ☐ Install Photovoltaic (PV) Panels

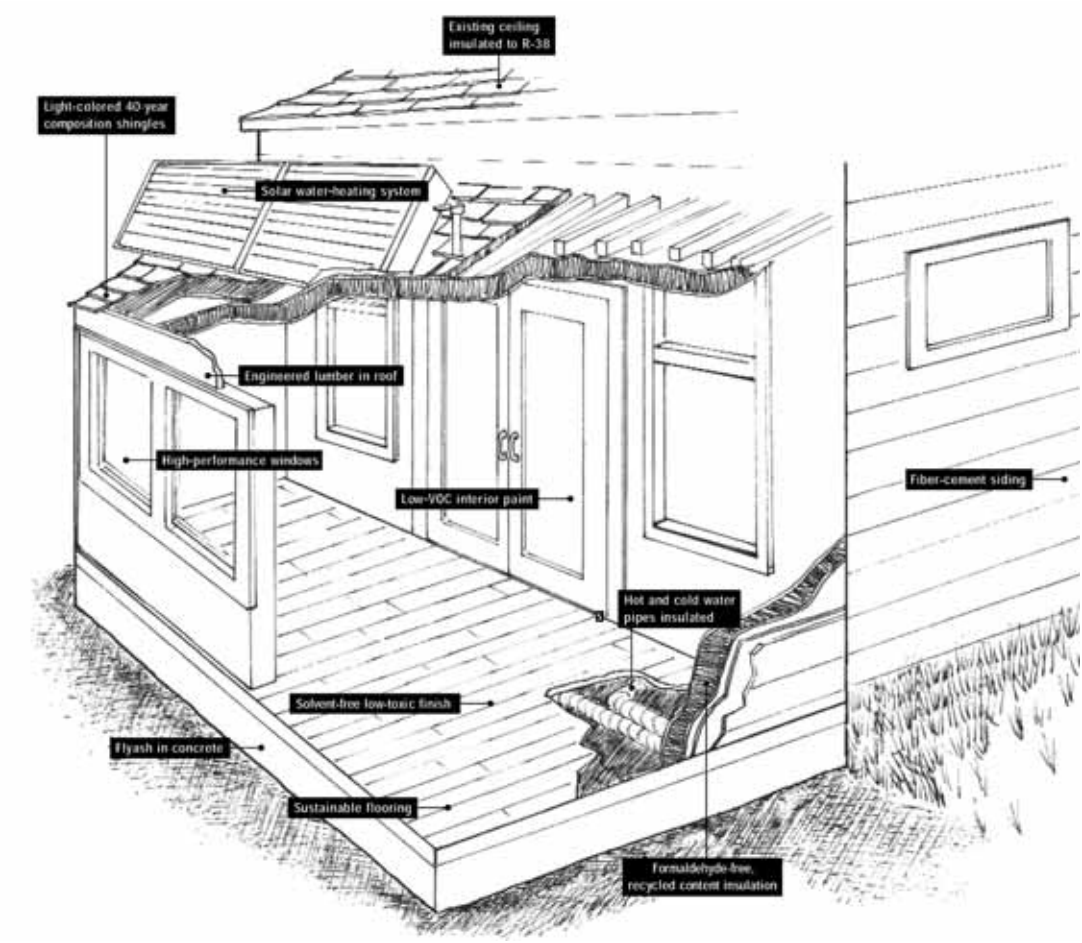
Indoor air quality/finishes

- ☐ Use Low/No-VOC and Formaldehyde-Free Paint
- ☐ Use Solvent-Free Adhesives
- ☐ Use Low-VOC, Water-Based Wood Finishes
- ☐ Substitute Particleboard with Formaldehyde-Free Materials
- ☐ Use Exterior-Grade Plywood for Interior Uses
- ☐ Select Formaldehyde-Free Medium Density Fiberboard (MDF)

Flooring

- ☐ Select FSC-Certified Wood Flooring
- ☐ Use Rapidly Renewable Flooring Materials
- ☐ Use Recycled-Content Ceramic Tile
- ☐ Use Exposed Concrete as Finish Floor
- ☐ Replace Vinyl Flooring with Natural Linoleum
- ☐ Install Recycled-Content Carpet and Cushion

See Resource List for local sources for the materials listed in these guidelines.



4.2 New addition

Consider the following green remodeling options in a new addition.

Design and construction planning

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Site

- ☐ Install Drip Irrigation
- ☐ Incorporate Permeable Paving
- ☐ Design Native and Hardy Plant Landscapes and Gardens
- ☐ Provide for Rainwater Harvesting

Foundation

- ☐ Incorporate Recycled Fly Ash in Concrete
- ☐ Use Aluminum Forms
- ☐ Reuse Form Boards
- ☐ Use Recycled-Content Rubble for Backfill Drainage
- ☐ Insulate Foundation before Backfill
- ☐ Use Rigid Foam Insulated Concrete Forms (ICFs)

Structure

- ☐ Substitute Engineered Lumber for Solid Sawn Lumber
- ☐ Use FSC-Certified Wood for Framing
- ☐ Use Wood I-Joists for Floors and Ceilings
- ☐ Use Finger-Jointed Studs
- ☐ Use Structural Insulated Panels (SIPs) for Walls/Roof
- ☐ Use Salvage Lumber

Exterior finish

- ☐ Use Sustainable Decking Materials
- ☐ Use Treated Wood that Does Not Contain Chromium or Arsenic for Decking and Sill Plates
- ☐ Use Fiber-Cement Siding Materials

Plumbing

- ☐ Install Water-Heater Jacket Insulation
- ☐ Install a Tankless Water Heater
- ☐ Insulate Hot and Cold Water Pipes
- ☐ Retrofit all Faucets and Showers
- ☐ Replace Toilets with Low-Flow Models
- ☐ Install Chlorine Filter on Showerhead
- ☐ Install Water-Filtration Units at Faucets

Electrical

- ☐ Install Compact Fluorescent Light Bulbs
- ☐ Install Lighting Controls
- ☐ Install Whole-House Cooling Fan

Roofing

- ☐ Select Light-Colored Roofing
- ☐ Install Minimum 40-Year Composition Roofing

Insulation

- ☐ Upgrade Wall and Ceiling Insulation
- ☐ Install Recycled Content, Formaldehyde-Free Fiberglass Insulation
- ☐ Use Advanced Infiltration Reduction Practices
- ☐ Use Cellulose Insulation

Windows

- ☐ Install Energy-Efficient Windows

Heating, ventilation and air conditioning (HVAC)

- ☐ Use Duct Mastic on All Duct Joints
- ☐ Install New Ductwork within Conditioned Space
- ☐ Install 90% or Greater Efficiency Gas Forced Air Furnace
- ☐ Install Zoned, Hydronic, Radiant Heating

A green addition added 1,500 sq ft to this historic Council Crest home.

- ☐ Vent Range Hood to the Outside
- ☐ Install Solar Attic Fan
- ☐ Clean All Ducts before Occupancy
- ☐ Install Whole-House Cooling Fan
- ☐ Retrofit Wood-Burning Fireplaces
- ☐ Install/Replace Dampers on Fireplaces
- ☐ Install Airtight Doors on Fireplaces
- ☐ Install Heat Recovery Ventilation Unit (HRV)

Renewable and solar energy

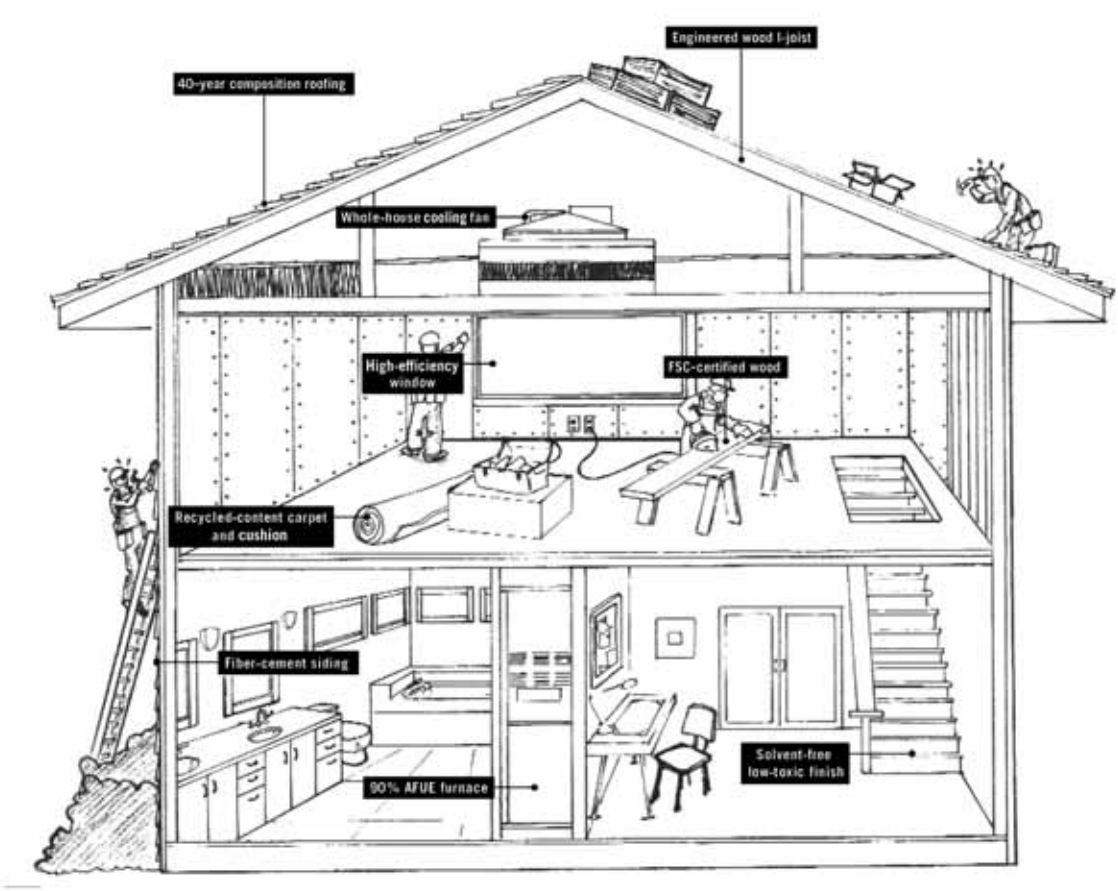
- ☐ Incorporate Natural Cooling
- ☐ Incorporate Passive Solar Heating
- ☐ Install Solar Water System
- ☐ Pre-Plumb for Solar Water Heating
- ☐ Install Photovoltaic (PV) Panels

Indoor air quality/finishes

- ☐ Use Low/No-VOC and Formaldehyde-Free Paint
- ☐ Use Low-VOC, Water-Based Wood Finishes
- ☐ Use Solvent-Free Adhesives and Caulks
- ☐ Substitute Particleboard with Formaldehyde-Free Materials
- ☐ Use Exterior-Grade Plywood for Interior Uses
- ☐ Select Formaldehyde-Free Medium Density Fiberboard (MDF)

Flooring

- ☐ Select FSC-Certified Wood Flooring
- ☐ Use Rapidly Renewable Flooring
- ☐ Use Recycled-Content Ceramic Tile
- ☐ Replace Vinyl Flooring with Natural Linoleum
- ☐ Use Exposed Concrete as Finish Floor
- ☐ Install Recycled-Content Carpet and Cushion



4.3 Second floor

Consider the following green remodeling options in a second floor.

Design and construction planning

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Site

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Structural frame

- ☐ Substitute Engineered Lumber for Solid Sawn Lumber
- ☐ Use FSC-Certified Wood for Framing
- ☐ Use Wood I-Joists for Floors and Ceilings
- ☐ Use Structural Insulated Panels (SIPs) for Walls/Roof
- ☐ Use Salvage Lumber

Exterior finish

- ☐ Use Treated Wood that Does Not Contain Chromium or Arsenic for Decking and Sill Plates
- ☐ Use Fiber-Cement Siding Materials

For information on energy saving programs and incentives contact the Energy Trust of Oregon at 1-866-ENTRUST.

Plumbing

- ☐ Insulate Hot and Cold Water Pipes
- ☐ Install Chlorine Filter on Showerhead
- ☐ Install Water-Filtration Unit at Faucet

Electrical

- ☐ Install Compact Fluorescent Light Bulbs
- ☐ Install Lighting Controls
- ☐ Install Whole-House Cooling Fan

Roofing

- ☐ Select Light-Colored Roofing
- ☐ Install Minimum 40-Year Composition Roofing

Insulation

- ☐ Upgrade Wall and Ceiling Insulation
- ☐ Install Recycled-Content, Formaldehyde-Free Fiberglass Insulation
- ☐ Reduce Air Infiltration
- ☐ Use Cellulose Insulation

Windows

- ☐ Install Energy-Efficient Windows

Heating, ventilation and air conditioning (HVAC)

- ☐ Use Duct Mastic on All Duct Joints
- ☐ Install New Ductwork within Conditioned Space
- ☐ Install Solar Attic Fan
- ☐ Clean All Ducts before Occupancy
- ☐ Install Whole-House Cooling Fan
- ☐ Install 90% or Greater Efficiency Gas Forced Air Furnace
- ☐ Install Heat Recovery Ventilation Unit (HRV)

Renewable and solar energy

- ☐ Incorporate Natural Cooling
- ☐ Incorporate Passive Solar Heating
- ☐ Install Photovoltaic (PV) Panels

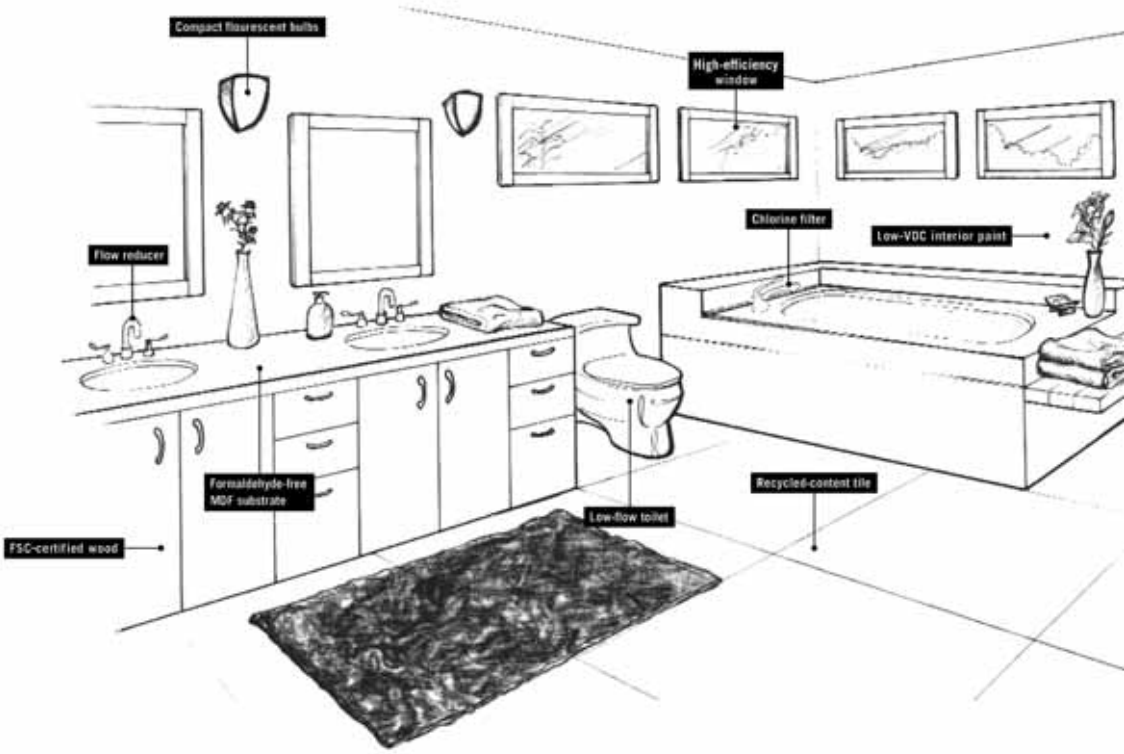
Indoor air quality/finishes

- ☐ Use Low/No-VOC and Formaldehyde-Free Paint
- ☐ Use Low-VOC, Water-Based Wood Finishes
- ☐ Use Solvent-Free Adhesives and Caulks
- ☐ Substitute Particleboard with Formaldehyde-Free Materials
- ☐ Use Exterior-Grade Plywood for Interior Uses
- ☐ Select Formaldehyde-Free Medium Density Fiberboard (MDF)

Flooring

- ☐ Select FSC-Certified Wood Flooring
- ☐ Use Rapidly Renewable Flooring Materials
- ☐ Use Recycled-Content Ceramic Tile
- ☐ Replace Vinyl Flooring with Natural Linoleum
- ☐ Install Recycled-Content Carpet and Underlayment

For information on saving water check out: www.portlandonline.com/water.



4.4 Bathroom

Consider the following green remodeling options in a bathroom.

Design and construction planning

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Site

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Structure

- ☐ Substitute Engineered Lumber for Solid Sawn Lumber
- ☐ Use FSC-Certified Wood for Framing
- ☐ Use Wood I-Joists for Floors and Ceilings
- ☐ Use Salvage Lumber

Plumbing

- ☐ Install Water-Heater Jacket Insulation
- ☐ Install a Tankless Hot Water Heater
- ☐ Insulate Hot and Cold Water Pipes
- ☐ Retrofit all Faucets and Showers

- ☐ Replace Toilets with Low-Flow Models
- ☐ Install Chlorine Filter on Showerhead
- ☐ Install Water-Filtration Unit at Faucet

Electrical

- ☐ Install Compact Fluorescent Light Bulbs
- ☐ Install Lighting Controls
- ☐ Install Ceiling Fans

Insulation

- ☐ Upgrade Wall and Ceiling Insulation
- ☐ Install Recycled-Content, Formaldehyde-Free Fiberglass Insulation
- ☐ Reduce Air Infiltration
- ☐ Use Cellulose Insulation

Windows

- ☐ Install Energy-Efficient Windows

Heating, ventilation and air conditioning (HVAC)

- ☐ Use Duct Mastic on All Duct Joints
- ☐ Install New Ductwork within Conditioned Space
- ☐ Clean All Ducts before Occupancy

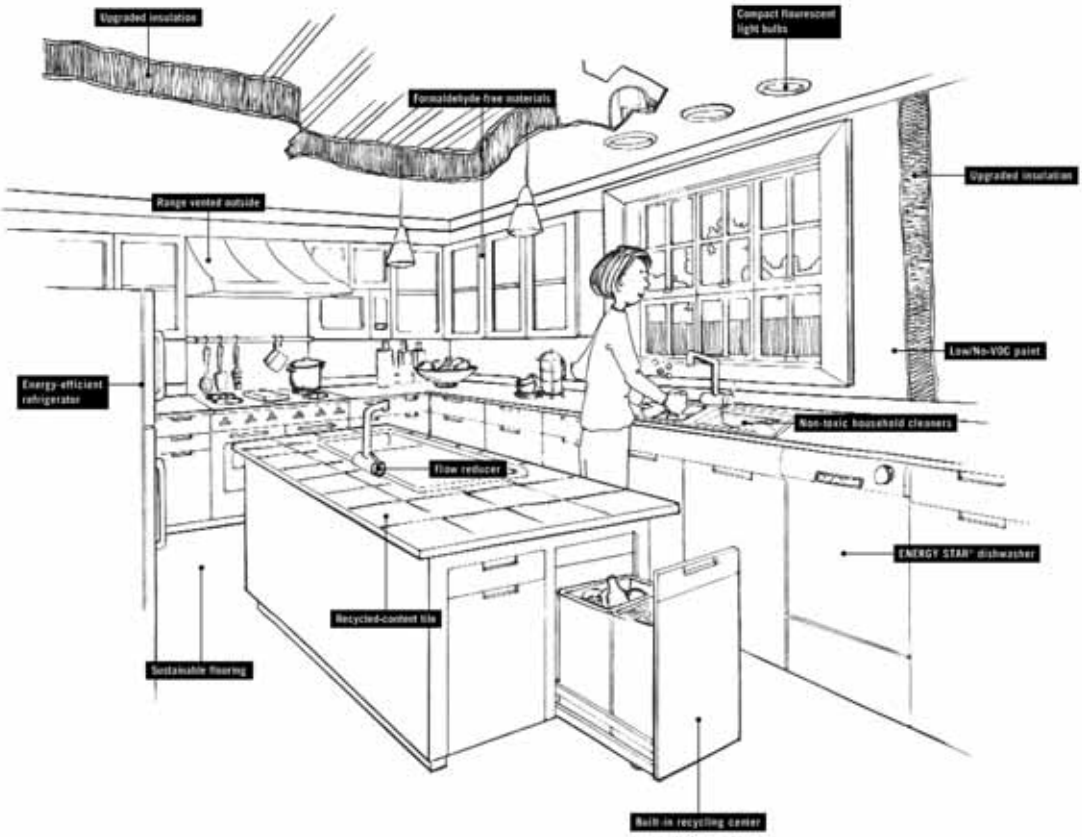
Indoor air quality/finishes

- ☐ Use Low/ No-VOC and Formaldehyde-Free Paint
- ☐ Use Low-VOC, Water-Based Wood Finishes
- ☐ Use Solvent-Free Adhesives
- ☐ Substitute Particleboard with Formaldehyde-Free Materials
- ☐ Use Exterior-Grade Plywood for Interior Uses
- ☐ Select Formaldehyde-Free Medium Density Fiberboard (MDF)

Flooring

- ☐ Select FSC-Certified Wood Flooring
- ☐ Use Rapidly Renewable Flooring Materials
- ☐ Use Recycled-Content Ceramic Tile
- ☐ Replace Vinyl Flooring with Natural Linoleum
- ☐ Use Exposed Concrete as Finish Floor
- ☐ Install Recycled-Content Carpet and Cushion

For information on construction and demolition, recycling and composting contact Metro at 503-234-3000.



4.5 Kitchen

Consider the following green remodeling options in a kitchen.

Design and construction planning

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Site

- ☐ Salvage Reusable Materials
- ☐ Recycle Job-Site Construction and Demolition Waste

Plumbing

- ☐ Insulate Hot and Cold Water Pipes
- ☐ Retrofit All Faucets with Flow Reducers
- ☐ Install Water-Filtration Unit at Faucet

Electrical

- ☐ Install Compact Fluorescent Light Bulbs
- ☐ Install Lighting Controls
- ☐ Install Ceiling Fans

Appliances

- ☐ Install Water- and Energy-Efficient Dishwasher
- ☐ Install Energy-Efficient Refrigerator

Insulation

- ☐ Upgrade Wall and Ceiling Insulation
- ☐ Install Recycled-Content, Formaldehyde-Free Fiberglass
- ☐ Reduce Air Infiltration
- ☐ Use Cellulose Insulation

Windows

- ☐ Install Energy-Efficient Windows

Heating, ventilation and air conditioning (HVAC)

- ☐ Use Duct Mastic on All Duct Joints
- ☐ Vent Range Hood to the Outside

Flooring

- ☐ Select FSC-Certified Wood Flooring
- ☐ Use Rapidly Renewable Flooring Materials
- ☐ Use Recycled-Content Ceramic Tile
- ☐ Replace Vinyl Flooring with Natural Linoleum
- ☐ Use Exposed Concrete as Finish Floor
- ☐ Install Recycled-Content Carpet and Cushion

Indoor air quality/finishes

- ☐ Use Low/No-VOC and Formaldehyde-Free Paint
- ☐ Use Low-VOC, Water-Based Wood Finishes
- ☐ Use Solvent-Free Adhesives
- ☐ Replace Particleboard with Formaldehyde-Free Materials
- ☐ Use Exterior-Grade Plywood for Interior Uses
- ☐ Select Formaldehyde-Free Medium Density Fiberboard (MDF)

rated
PORTLAND'S GREEN BUILDING RESOURCE

Local green building resources

The Portland Office of Sustainable Development's G/Rated Green Building Program provides:

- Technical support
- G/Rated green remodeling case studies and fact sheets
- Build It Green! annual tour of green homes and remodels
- ReThink annual residential class series
- Green Investment Fund grants

Check out www.green-rated.org or call 503-823-7222.

Remodeling resources

Green building web site

Portland Office of Sustainable Development offers green remodeling ideas, case studies and other resources at www.green-rated.org.

Look in the 'Resource Center' under 'Practices and Strategies'.

Annual green home tour

OSD sponsors the annual Build It Green Tour of Homes and Information Fair in September. The tour offers an opportunity to visit remodels and talk to the owner and contractor about green features. The fair brings together local businesses and organizations involved in green building.

Energy Trust of Oregon incentives

Energy Trust of Oregon offers financial incentives for energy efficient lighting, appliances, heating & cooling, solar and weatherization to residents of Portland metro area at www.energytrust.org.

Look in 'For Homes' at 'Home Energy Savings', 'Efficient Home Products', 'Solar Electric' and 'Solar Water Heating'.

Oregon income tax credits

Oregon Department of Energy offers tax credits for high-efficiency appliances, water heaters, heating and cooling equipment and solar electric and hot water systems at http://egov.oregon.gov/ENERGY.

Look in 'Residential Energy Tax Credits'.

Deconstruction

When planning your remodel, find out what materials can be salvaged for re-use. Your contractor can assist you, or call Deconstruction Services at 503-331-9875 for advice.

Salvage materials

Several Portland suppliers carry salvage materials such as flooring and fixtures, including:

Environmental Building Supplies, 503-222-3881

Endura Wood Products, 503-233-7090

Habitat for Humanity ReStore, 503-283-6247

The ReBuilding Center, 503-331-1877

Rejuvenation Inc., 503-238-1900

Hippo Hardware, 503-231-1444

CraftMark, 503-472-6929

Find contractors and vendors

Oregon Remodeling Association web site allows searching for members: www.oregonremodelers.com/FindAPro.aspx

Remodelers Council of the Home Builders Association of Metropolitan Portland directory: www.homebuildersportland.org/Remodelers.htm

Ecologically sustainable professional services

Northwest Ecobuilding Guild 'Green Pages', www.ecobuilding.org (OR, WA)

ReDirect Guide, www.redirectguide.com (Portland-Vancouver)

CITY OF PORTLAND
OFFICE OF SUSTAINABLE DEVELOPMENT
A BETTER FUTURE. A BETTER NOW.

The Portland Office of Sustainable Development (OSD) brings together community partners to promote a healthy and prosperous future for Portland. OSD advances improvements and innovation in energy use and technologies, waste disposal, recycling, sustainable purchasing, environmental education and high-performance green building practices. OSD programs, policies and partnerships promote community well-being, economic opportunity and environmental health for Portland, its businesses and residents.

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503-823-7222
www.sustainableportland.org

Suggested retail:
$10