

Why Build Green?

As our area landfills approach capacity, solid waste disposal becomes ever more challenging in Santa Cruz County. Minimizing the flow of waste to the landfill is critical to extending its useful life. This booklet highlights materials and techniques which help reduce Construction and Demolition waste, which accounts for over 20% of total waste volume.

In addition to environmental benefits, waste reduction directly contributes to our financial well-being. When we extend the life of the landfill and delay the expense of a replacement solution, taxpayers save money. Designing to use less material and minimizing construction waste reduces the material cost of a project, saving money for homeowners, contractors, and developers. Using salvaged, recycled, and remanufactured products helps the environment, and local manufacturing

supports our regional economy. The innovative practice of deconstruction diverts waste from the landfill, and surprisingly can reduce costs to building owners through available tax incentives and by reducing material requirements.

Eliminating or minimizing waste is one important element of "green building," a broad set of design and construction practices that provide healthy places to live and work while reducing negative impacts to the environment. Keep in mind that this booklet highlights only a small sample of greener materials. Every option has strengths and weaknesses to consider, and no single material is ideal for all applications. But do not let the pursuit of perfection stand in the way of doing something positive for occupants, the environment, the community, and our economy.

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KEY TO ENVIRONMENTAL BENEFITS



Minimizes waste through reuse, recycling, and/or material reduction



Promotes healthy indoor air quality



Conserves natural resources and ecosystems



Reduces air or water pollution



Increases efficiency or conserves energy

Deconstruction/Construction & Demolition Recycling



Deconstruction is the dismantling of a building to preserve the useful value of its component materials. Consider requesting bids to deconstruct rather than demolishing; the combination of tax breaks, new tools, and increasing local expertise are making it easier to keep materials out of the landfill, and money in owner's wallets.



PROS:

- Reduces or eliminates unnecessary waste – extends the life of our landfill and reduces the need for new materials as well as material costs.
- Older structures may contain hardwoods and dimensional lumber that are superior in size or quality to virgin materials.
- The tax deduction from donating deconstructed materials to a non-profit organization can be more valuable than the additional labor cost.

CONS:

- Deconstruction takes longer and initially cost more than demolition, but can reduce the overall project cost.
- Not all contractors are familiar with the techniques, tools, and tax breaks.

Passive Solar Design



Passive solar design is an effective method of heating and cooling through utilization of sunlight. Proper building orientation, thermal mass, and insulation are specified in conjunction with careful placement of windows and shading. Thermal mass absorbs heat during the day and radiates it back into the room at night. The effect is a quiet, comfortable, energy efficient space with stable year-round temperatures.

PROS:

- At little or no cost, passive solar design can easily be designed into new construction, and can be retrofitted into existing buildings in some cases.
- It pays dividends over the life of the building through substantially reduced or eliminated heating and cooling costs.
- Indoor air quality improved through elimination of forced air systems.

CONS:

- Not all building professionals are experienced with passive solar design.
- Retrofitting is rarely as effective as initially designing for this method.
- Sites with limited southern exposure may be less suitable.

Xeriscape



Xeriscape is landscaping designed to reduce the resources needed for maintenance (most notably water,) and the waste the landscape produces. Successful xeriscapes match local resources, soil, and climate with the aesthetic goals of the owner, and incorporate native California plant species as well as exotic plants suited to our climate.

PROS:

- Reduces irrigation, saving money for the owner and conserving for our common water needs.
- Reduces maintenance and green waste, saving time and money.
- Eliminates or reduces the expense of piping and trenching for irrigation.
- Requires less fertilizer, reducing pollution of air and water.
- May allow collected rainwater to be concentrated on edible plants.

CONS:

- Requires research (or at least asking questions at the garden store).
- Existing landscapes usually require some plant replacement to maximize water savings.

Fly Ash Concrete



Strong, inexpensive, durable, and adaptable, concrete is the most widely used construction material in the U.S. Its environmental impacts include habitat disturbance from extraction, and heavy energy use/pollution from the manufacture and shipping of cement. Manufacture of portland cement accounts for 90% of the embodied energy of concrete, but fly ash, a waste product diverted from coal power plants, can replace more than 50% of the cement and actually improve performance.

PROS:

- Reduces waste, pollution, and greenhouse gas emissions.
- Performs as well as or better than standard concrete, often at no addi-



Reusable materials are sorted as they are removed from this Santa Cruz deconstruction site.
Photo courtesy of Deconstruction Industries, Inc.

tional material cost.

- Increasing popularity has made it readily available.

CONS:

- Curing time may be extended.
- Determining the best mix for an application requires some research.
- Not all building professionals are familiar with fly ash concrete mixes.

Pervious Concrete



Up to 75% of urban surface area is covered by impermeable pavement, which inhibits groundwater recharge, contributes to erosion and flooding, conveys pollution to local waters, and increases the complexity and expense of storm water treatment. Pervious paving contains voids that allow water to percolate through to the base materials below.

PROS:

- Reduces peak storm water flow and water pollution and promotes groundwater recharge.
- May incorporate recycled aggregate and fly ash, reducing waste and embodied energy.
- Compressive strength (4000 psi) is suitable for parking and access.
- Reduces problems with tree roots; encourages roots to grow deeper.
- Enhanced heat exchange with the underlying soil can decrease summer ambient air temperature by 2-4°F.

CONS:

- May require vacuuming every few years to keep the voids open.

Insulated Structural Systems



Insulated structural systems integrate a building's structure and insulation into a single component. *Rastra* and *Insulated Concrete Forms* (ICFs) consist of a hollow shell that acts both

as insulation and a permanent form for concrete. *Structural Insulated Panels* (SIPs) are factory-built walls/roof panels consisting of rigid foam insulation sandwiched between two layers of structural facing (typically OSB).

PROS:

- Reduced construction waste – panels are pre-cut at the factory.
- Reduced or eliminated structural wood use.
- Superior structural, thermal, and acoustic performance.
- Excellent fire resistance (particularly in the case of Rastra).
- Rapid construction, some are suitable for do-it-yourself assembly.

CONS:

- Not all designers or builders are familiar with these systems.
- Higher material costs -though typically offset by reduced labor cost and accelerated construction schedules.

Earthen Building Materials



Beautiful, sculptural and durable, common earthen building materials include: *adobe* bricks - made from clay, sand, and straw; *rammed earth* - compressed with fly ash and/or fibers for stabilization; and *cob* - clay, sand and straw that is stacked and shaped while wet.

PROS:

- Plentiful materials, producing little or no waste, requiring minimal energy use (if materials are extracted locally), which can be pulverized back into soil at the end of its useful life.

Historically very durable. The adobe Santa Cruz Mission, for example, is over 200 years old.

- Provides excellent thermal mass for passive solar buildings, maintaining stable, comfortable indoor temperatures year round.

CONS:

- Thick walls may comprise a high percentage of floor area on small site.
- Construction is labor-intensive.
- Multi-story and cob structures require post-and-beam designs.

Most Structural Insulated Panels (SIPs) are produced with EPS foam core laminated between OSB sheathing. Factory built to custom specifications, they are quick to assemble and have excellent energy performance.

Straw Bale Construction



In straw bale construction, compressed bales of straw are stacked and covered by plaster, either as fill for a wall (non-load bearing) or as a structural component (load bearing). Both categories divert agricultural waste from burning or the landfill, and use much less wood and/or concrete than conventional construction.

PROS:

- Straw is a plentiful waste product and rapidly renewable.
- Provides excellent thermal and acoustical insulation.
- The small quantity of construction waste generated is compostable.
- Walls are more resistant to fire, mold, and vermin than conventional construction.

- Reduced material cost, and potential for lower labor cost.

CONS:

- Finished straw bale walls are 18" to 28" thick, potentially consuming significant space on a small lot.
- May require research or specialty contractor to construct.



Photo courtesy of Insulspan.

Advanced Framing Techniques



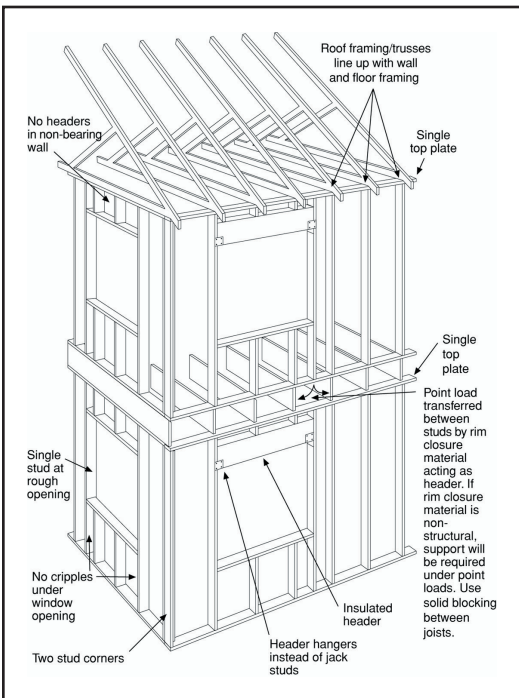
Advanced framing techniques reduce the quantity of wood required by up to 20% over conventional framing, and include such methods as: framing with 2x6 studs on 24" centers (in lieu of 2x4s on 16" centers); stacking roof rafters directly over studs; framed-in and insulated headers in lieu of solid dimensional lumber; use of prefabricated trusses or wall-units.

PROS:

- Widely accepted by building departments and code officials.
- Deeper wall cavity allows additional insulation. The use of fewer studs reduces thermal bridging, improving the efficacy of insulation.
- Reduces labor, waste and material costs while saving natural resources.

CONS:

- Buildings must be designed for 2x6 construction, requiring consideration early in the design process.
- Contractors may not be familiar with some techniques, requiring extra training or consultation with experienced installers.
- Installing drywall clips can be more labor-intensive than nailers.



FSC Certified Wood



Wood is a renewable resource that requires relatively little energy to process. However, logging, milling, transport, and disposal of wood have substantial environmental costs. These impacts can be reduced through minimizing wood use (substitution with alternate materials, reuse, design to reduce waste/redundancy), and by building with certified wood. Forest Stewardship Council (FSC) certification is a widely recognized and respected standard for responsible forest management.

PROS:

- Rough and finish materials are available.
- FSC lumber is available from several local suppliers (some harvest their wood locally, reducing the environmental effects of transportation).

CONS:

- Materials costs are up to 10% higher than non-certified lumber.
- Pre-ordering may be necessary; selection of dimensional lumber and quantities in stock are variable.

The FSC Logo identifies products which contain wood from well managed forests certified in accordance with the rules of the Forest Stewardship Council (FSC).



FSC-US-0050

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Advanced framing techniques reduce wood usage, minimize labor costs and increase the area available for insulation.

Illustration © Building Science Corporation. Used with permission.

Engineered Lumber



Engineered lumber consists of oriented strips of wood pressed together with a binding agent. The strength and durability of engineered lumber allows it to displace the use of large, mature timber. Using engineered lumber instead of large dimension rafters, joists, trusses and posts can save money and reduce total wood use in a construction project by as much as 35%.

PROS:

- Longer, stronger, straighter, more durable, and lighter than comparable solid lumber.
- Wider spacing of members increases the insulated portion of walls, reducing heat loss through the building frame.
- Widely available and cost-effective.

CONS:

- Uses petrochemical-based binders, generally phenolic formaldehyde (which is vastly preferable to urea formaldehyde, however).
- FSC certified options are very limited.

Oriented Strand Board (OSB)



Oriented strand board (OSB), an alternative to plywood sheathing, consists of layers of wood bits oriented for strength and pressed together with a glue (or binder). In comparison

to plywood sheathing, OSB uses less wood and relies upon smaller, faster growing trees. OSB with an MDI binder (diphenyl methane diisocyanate) is preferable to the more common phenol formaldehyde glue, because MDI does not emit formaldehyde or VOCs. (Note that formaldehyde emissions from particleboard cabinets and furnishings are far more likely to be a concern because OSB is typically sealed in the wall or roof cavity.)

PROS:

- Made from more rapidly renewable resources than plywood.
- Typically less expensive than plywood.

CONS:

- Integrity can diminish with repeated and extended moisture exposure.
- As with any wood product, proper roof and wall assembly and finishing is essential for longevity.
- FSC certified options are very limited.

Recycled Plastic Lumber



Polyethylene grocery bags, soda bottles, and pallet wrap are remanufactured into dimensional “lumber” products. These may be pure plastic, or incorporate wood fibers to form a composite. Both are widely available alternatives to wood for outdoor projects, such as decks.

**PROS:**

- Very durable, immune to insects and rot, and UV resistant.
- High recycled content, reducing waste and embodied energy.
- Reduces logging of mature trees, particularly redwoods.
- Requires virtually no maintenance, eliminating the repeated use of solvent-based sealants commonly applied to wood.

CONS:

- Composites are not biodegradable or currently recyclable, though remanufacturing options may be developed.
- Structural options are limited.
- Higher first cost, but lower life-cycle cost.

Reclaimed Wood Siding



Wood siding can often be salvaged and refurbished. In the process, virgin wood use is reduced, a “waste” is kept in productive use and out of the landfill, and owners can save money.

**PROS:**

- Salvaged wood siding can offer unsurpassed beauty and quality that may no longer be available, frequently at a lower cost than new siding.
- Reduces waste sent to the landfill.
- Reduces virgin wood usage.

CONS:

- Finding salvaged siding in the desired style and quantity usually requires research, flexibility, and patience.
- Older painted wood should be tested for lead contamination. Lead contaminated wood should not be sanded, and should either be professionally treated or disposed of properly.

Fiber Cement Siding



Fiber cement siding and shingles consist of wood fibers blended with cement. The result can be smooth or embedded with a faux wood grain or texture. It is available pre-primed and/or pre-finished. Because its components are non-toxic, fiber-cement siding is a good alternative to vinyl siding.

**PROS:**

- Very durable with little maintenance (50+ year rating).
- Extremely resistant to pests and rot.
- Non-combustible.
- Can ultimately be crushed, recycled, and coked back into cement

CONS:

- Currently not manufactured from domestic wood sources. (Wood fibers must withstand the manufacturing process and the alkalinity of cement.)
- Cement has high embodied energy.
- Requires specialized cutting tools.



Metal Roofing



Metal roofing is typically extremely durable, and many materials may be refurbished on-site when needed, drastically reducing waste of roofing over the life of a building. Products with greater than 80% recycled content (largely post-consumer) are available.

PROS:

- Highly durable – some metal roofs installed in the 1800s are still in use.
- Recyclable, and available with high post-consumer recycled content.
- Low maintenance costs.
- Lightweight – useful for retrofits and seismic safety.
- Galvanized, painted, and coated options are appropriate for rainwater collection systems or growing edible plants near downspouts.
- Excellent fire resistance.

CONS:

- Higher initial cost – but typically offers favorable life cycle cost.
- Manufacture is energy intensive - partially offset by durability/recyclability.

Recycled Content Roofing



Highly durable roofing materials can be made from recycled rubber and/or plastics, providing the appearance of slate or wood shakes/shingles while keeping waste materials in productive use and out of the landfill.

PROS:

- Durable, available with a 50-year warranty.
- Contains recycled post-industrial rubber and plastics.
- Attractive, and with integral color, will retain its appearance over time.
- Lightweight, potentially reducing the necessary size of roof rafters.

Wood-plastic composite lumber may contain up to 35% recycled plastic, combined with 65% wood fiber—which may be post-industrial recycled content or virgin fiber.

CONS:

- Products made from a mix of plastic and rubber (including this example) may reduce waste, but cannot be recycled again at end of use.
- Some recycled rubber products made from tires can leach small amounts of contaminants (such as metals) into rainwater, which is not desirable for rainwater collection or growing edible plants near a downspout.
- No post-consumer recycled content

"50-Year" Composition Roofing

Durable, 50-Year rated composition shingles are made primarily from asphalt and gravel. A light color reduces heat gain during summer months by reflecting more solar radiation than dark colors.

**PROS:**

- Reduces waste and saves money over the life of the roof by delaying or eliminating re-roofing.
- Saves resources - it takes about the same materials and labor to manufacture and install a 50-year rated shingle as a 30-year shingle.
- Readily available and familiar to any local roofing contractor.

CONS:

- Composition roofs are difficult to recycle and typically end up in the landfill.
- May leach minute quantities of noxious chemicals, which is not desirable for rainwater collection or growing edible plants near a downspout.
- Higher initial cost than 30-year shingles.

High efficiency windows may be constructed with wood, metal, fiberglass, or vinyl sash materials. They will have double or triple pane glazing with special coatings or gas fill for increased efficiency, which is especially important when glazing an entire wall, as shown in this photo. These windows also incorporate some FSC certified wood.

Photo courtesy of Loewen Windows

**Recycled Cotton Insulation**

Exposure to common fiberglass insulation can irritate skin and lungs.



Recycled cotton insulation, made primarily from post-industrial denim, is one benign alternative.

Cellulose is a common alternative insulation material made from recycled newspaper.

PROS:

- Thermal performance per inch is as good as fiberglass insulation.
- Better sound insulation per inch than fiberglass.
- Non-irritating to skin/respiratory system; cotton may be installed with bare hands.
- Higher recycled content than most fiberglass.
- Cotton and cellulose both have good resistance to fire, mold, insects, and rodents because of borate treatment.

CONS:

- Walls with poor moisture protection may result in a portion of the borate treatment leaching out. However, proper wall design and assembly is essential with any insulation.

Spray Foam Insulation

Sprayed Polyisocyanurate/Polyurethane Foam (SPF) is insulation that is sprayed directly into wall or roof cavities, expanding to fill cracks and voids. Sprayed cementitious foam (i.e. Air Krete) has many similar properties.

**PROS:**

- Thermal performance per inch is better than fiberglass insulation.
- Acts as both insulation and vapor barrier, making walls resistant to condensation and mold. Approved for insulating unvented roofs.
- Does not offgas once installed. Blowing agents do not damage ozone or contribute to greenhouse effect.
- Good fire resistance
- Durable, and can increase shear resistance values.

CONS:

- Hazardous during installation; requires trained professionals.
- Some SPF is partly made from renewable soybeans, but this example is derived from petroleum products.
- Not recyclable – but can be compacted.

High Efficiency Windows

Windows and skylights provide light, views, ventilation, and can help



capture solar heat. Look for Energy Star labeled windows and windows with an NFRC rated U-Factor of 0.4 or less for windows and 0.6 or less for skylights. Consider fiberglass window frames, which offer a good combination of low maintenance, durability, and insulation.

PROS:

- High quality windows last for decades, help maintain comfortable temperatures, and save energy.
- Superior acoustical insulation improves comfort.
- Wide variety of architectural styles.
- Single-pane windows being replaced may be reused for unheated spaces such as solarium or greenhouses.

CONS:

- Few new windows incorporate significant recycled content.
- Highly efficient options with the lowest life-cycle cost tend to have a higher purchase cost.

Recycled-Content Gypsum Wall Board



Gypsum board (commonly referred to by its proprietary names "drywall" or "sheetrock") is nearly pure gypsum covered by paper. It is the most common interior wall finish due to its price,



familiarity, and ease of installation. The paper facing is commonly made from recycled newsprint, and manufacturers are now offering products incorporating recycled gypsum (derived from coal ash.)

PROS:

- Identical to standard gypsum board at no extra cost.
- Clean cutoffs can be pulverized and used as a soil amendment.
- Recyclable at the end of its useful life. (But, this is rare due to the low cost of virgin gypsum.)

CONS:

- West coast manufacturers tend to offer lower recycled-content products (<10%) because coal ash is less available in this region.
- Shipping recycled gypsum board from the Eastern U.S. is energy-intensive.

Homasote



Homasote panels consist of 100% recycled newspaper combined with a paraffin binder for water resistance.



The material is primarily used as an acoustical barrier behind gypsum board or under floor finishes, but can also be used for vertical sheathing. Other Homasote fiberboards are used as an insulating nail base for roofing, roof decking, sub flooring. Prefinished panels with decorative cork or fabric coverings is suitable interior wall paneling.

PROS:

- Effective acoustical barrier, and can add shear strength to a structure.
- 100% recycled, and recyclable (except when coated by paints or adhesives).
- Non-toxic; contains no asbestos,

formaldehyde, or fiberglass.

- Resists termites, rot, and fungi.
- Reduces solid waste, helps conserve trees.

CONS:

- Environmental impacts from transportation.

Recycled-Content Tile



Beautiful glass and ceramic tiles are made from waste materials such as glass from automobiles or bottles, reducing waste and requiring less energy to manufacture than standard ceramic tile. Like standard tiles, recycled glass and ceramic tiles last several times as long as laminate countertops or vinyl flooring, reducing waste through durability. For improved indoor air quality, install with low-VOC grout



and adhesive or thin-set.

PROS:

- Recycled glass tile is extremely durable. Its hardness and scratch resistance make most products suitable even for commercial high-traffic areas.

• Some regional manufacturers incorporate our waste glass into their products

- Cost and performance is comparable to standard ceramic tile.

CONS:

- Recycled-content tile is not yet carried by all retailers; research may be required.



Reclaimed Hardwood



Reclaimed wood may be used for flooring, trim, siding, furniture, or, in some cases, as structural members. Consider reusing wood from an existing building on site,



or look to salvage yards and on-site deconstruction sales for a portion of your materials.

PROS:

- Salvaging or reusing wood reduces solid waste, saves forest resources, and can save money.
- Reclaimed wood is frequently available in dimensions, species, and with old-growth-quality that is no longer obtainable from virgin forests at any price.

CONS:

- Planning and research are necessary as available species, dimensions, and lumber quality can vary considerably.
- For structural applications, inspection/approval or regrading by a certified professional is typically required.

Bamboo



Bamboo is a perennial grass, of which some species produces hard, strong, dimensionally stable wood which has been used as a building material for millennia. Bamboo grows much more rapidly than hardwood, maturing in as little as one year (compared with 80 to 100 or

Reclaimed Wood Flooring is made from timbers salvaged from old buildings, bridges, or other timber structures. It may also be manufactured from logs salvaged from river bottoms, or from trees being removed in urban and suburban areas. White pine, longleaf yellow pine, cypress, oak, walnut, and chestnut may be available from Eastern and Mid-western suppliers. Western suppliers commonly stock Douglas fir and redwood.

more). Vertically laminated plywood and flooring products consist of layers of bamboo compressed with a binder, creating a durable, resilient finish material.

PROS:

- Very rapidly renewable - conserves forest resources.
- Strong, hard, and dimensionally stable.
- Very durable - can last decades when well maintained.

CONS:

- Cost can be high (though comparable to hardwoods).
- Harvested/processed overseas; shipping increases embodied energy.
- Some products use urea formaldehyde binders, which release small quantities of formaldehyde.

Recycled-Content Carpet



2.5 million tons of carpet, typically manufactured from virgin petroleum, is discarded each year. By recycling polyethylene (PET) into polyester carpet fiber, common plastics are diverted from the landfill. Carpet with Nylon 6 fiber and backing is also repeatedly recyclable into new carpet. For a natural, biodegradable option, consider wool, jute, sisal, or coir.



PROS:

- Costs and available colors of recycled and/or recyclable carpets are comparable to standard carpets.
- Low-emitting carpets and padding certified by GreenGuard and/or the Carpet and Rug Institute (CRI Green Label), and installed with tack-strip or low-emitting adhesives, can improve indoor air quality.
- Selection of environmentally preferable carpets is increasing.

CONS:

- Recycled content may be <20%.
- All carpet tends to harbor more dust, allergens and other contaminants than flooring such as natural linoleum, tile, or cork.

Recycled polyethelene from commonly land-filled materials like these beverage bottles, may be remanufactured into very durable and stain-resistant carpets available in a wide variety of colors.

Linoleum Flooring



Linoleum is a natural flooring material made from linseed oil, pine resin, and wood flour on a natural jute-fiber backing. It comes in a wide variety of colors and styles to suit

applications from home to heavy-traffic commercial uses. Linoleum has been used for decades and is regaining popularity in contemporary homes.

PROS:

- Very durable, often lasting for decades, which reduces waste associated with relatively frequent replacement of flexible vinyl flooring.
- Quiet, comfortable, and easy to maintain.
- Made from non-toxic components, and biodegradable at the end of its useful life.

• Low emissions of VOCs when installed with appropriate adhesives.

CONS:

- More expensive than vinyl, its typical alternative (vinyl lasts approx. ten years, generates toxic pollution in manufacturing, and is neither biodegradable nor recyclable).

Cork Flooring



Cork flooring is made from the bark of cork oak trees, which is harvested approximately every 9 years - without harm to the tree it is harvested from.

By comparison, hardwood timber requires decades or centuries to mature. For



improved air quality, install with low-VOC adhesives or as a floating floor. If properly maintained, cork flooring may be used in any room of a house. Beautiful cork wall coverings are also available.

PROS:

- Very durable - can last for decades.
- Highly renewable.
- Biodegradable at the end of its useful life.
- Thermal and acoustic insulator.
- Comfortable to walk on.
- Floating floors now available, eliminating the need for adhesives.

CONS:

- Less desirable in wet areas such as bathrooms.
- Imported from the Mediterranean region - currently no local producers.

Zero-VOC Paint



Volatile Organic Compounds (VOCs) in building materials are associated with headaches, nausea, respiratory problems, eye/skin irritation, and can even damage the liver and kidneys. These toxic compounds can be emitted at room temperature for days or months after painting. VOCs are not the only ingredients of concern; paints may also contain solvents, vinyl and other chlorinated organics, and heavy metals. Look for paint certified by Green Seal, an independent environmental standards organization.

PROS:

- Minimal odors, dries quickly, and washable once dried.
- Interior zero-VOC paints are widely available with a comparable cost and performance to standard products.

CONS:

- Limited options for zero-VOC exterior paints.
- *Though there are economical low- and zero-VOC options, high-end non-toxic paints, including silicate paint, can command premium prices.*

Natural Wallcovering



Common vinyl-based wall covering (e.g. "wallpaper") can be a significant source of Volatile Organic Compounds (VOCs), will produce both dioxin and hydrochloric acid in the event of a fire, and can leach phthalate plasticizers, which can disrupt hormonal functioning. Natural wall coverings, composed primarily of plant-derived fibers, are a beautiful alternative.

PROS:

- Durable and generally readily cleaned with non-toxic cleansers.
- Breathable and low or no emissions, reducing the likelihood of mold, and helping indoor air quality when applied with appropriate adhesives.
- Made from non-toxic components, and typically biodegradable at the end of their useful life.

CONS:

- More expensive than vinyl, but better indoor air quality can potentially yield a much lower life-cycle cost.

High-Efficiency Appliances



The cost of energy and water an appliance uses is typically many times its purchase cost. When buying new appliances, look for the EPA Energy Star seal, or refer to American Council for Energy Efficient Economy's free independent buyers guide (www.aceee.org).

PROS:

- Energy efficiency not only saves money, it reduces pollution and greenhouse gas emissions.
- Efficient models perform as well or better than standard models.
- Reduced water consumption helps stretch supplies and saves additional energy by reducing the amount of pumping, treatment, and/or water heating per load of dishes, laundry, etc.
- Utilities frequently offer rebates for efficient products.

CONS:

- Sometimes costs a little more than comparable, less efficient appliances.
- Appliances that are "efficient" will still waste energy and water if they are oversized. Look for the right-sized option.

Solar Photovoltaics



Photovoltaic (PV) materials, such as the thin-film product laminated directly onto this metal roofing sample, convert sunlight into electricity. By adding photovoltaics to the roof of your home or office building, you can generate clean, renewable energy and enjoy protection from rising electricity costs.

PROS:

- Reduced use of electricity from the grid directly reduces greenhouse gas emissions.
- PV panels can provide most or all of the electricity needed for most homes, often even in fairly foggy microclimates.
- Durable – many panels installed in the 1970's are still operating today.
- State and federal incentives can offset the initial cost to install.
- Excess electricity produced by your PV system can be fed back into "the grid" – the utility company bills only for net amount of power used.

CONS:

- High initial cost – but prices are increasingly competitive.

Radiant Hydronic Heating



In radiant hydronic heating systems, hot water is piped through the floor, warming the room from below. They are particularly effective when combined with passive solar design, and help maintain steady, comfortable interior temperatures when installed in floors with high thermal mass.

PROS:

- Highly efficient, may reduce heating costs by more than 30%. Solar water heating can further reduce energy use.
- Improves indoor air quality by eliminating ducts and fans that accumulate and distribute dust and other allergens.
- Provides excellent comfort, and keeps concrete or tiled floors comfortably warm to the touch.

CONS:

- May be more expensive than forced air, depending on design.
- Durable piping is essential because repairing leaks can be difficult.
- Knowledgeable design is critical to performance.
- Electric radiant systems are typically less desirable than hydronic.

Radiant heating systems provide stable, comfortable temperatures, and will keep typically cold concrete or tiled floors warm to the touch. They can also help improve indoor air quality over forced air systems.

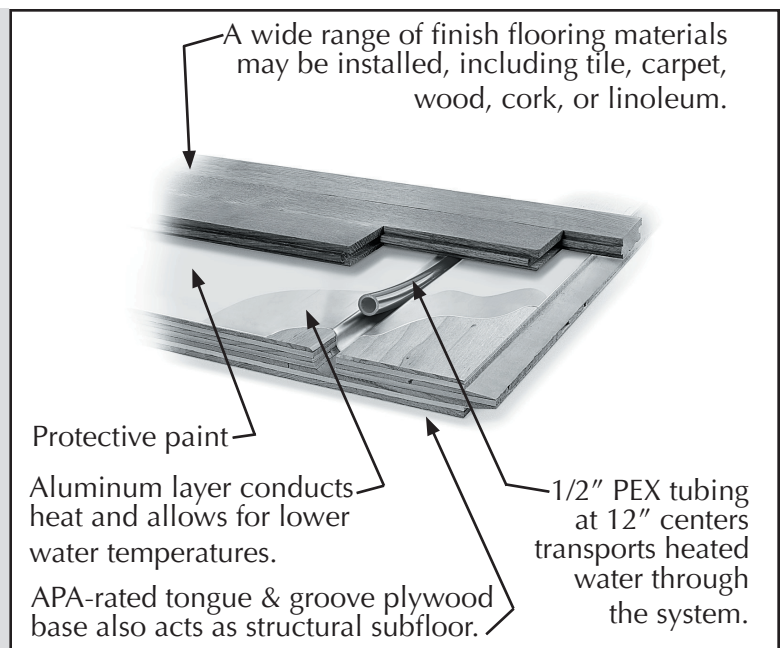


Photo courtesy of Warmboard, Inc.



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