Planning and Development Services

Green Building: Home Remodeling Guidelines

for Sustainable Building in the Sonoran Desert

CITY OF SCOTTSDALE

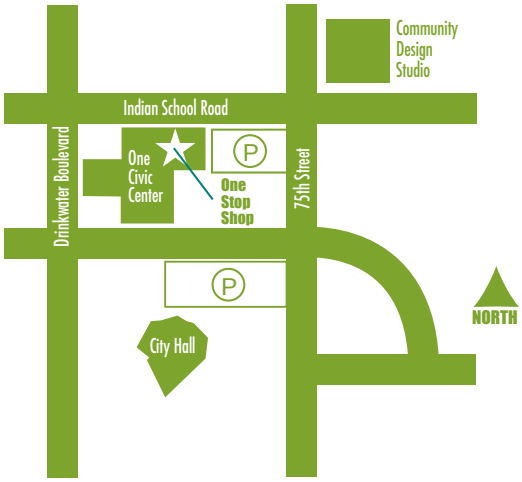
Green Building is a whole-systems approach through design and building techniques to minimize environmental impact and reduce the energy consumption of buildings while contributing to the health of its occupants.

These guidelines are offered for informational purposes only and are not intended to be used as a legally binding document for construction.

General Information

One Stop Shop Information

If at anytime during the process you have questions about this workbook, your specific remodel or would like to contact someone regarding your application requirements, please contact the City's One Stop Shop at (480) 312-2500.



One Stop Shop Main Number
480-312-2500

One Stop Shop Permit Counter
City of Scottsdale
First Floor, One Civic Center
7447 E. Indian School Rd.
www.ScottsdaleAZ.gov/onestopshop
(480) 312-2500
Office Hours: 8 a.m. - 5 p.m.

One Stop Shop Records Counter
City of Scottsdale
First Floor, One Civic Center
7447 E. Indian School Rd.
(480) 312-2356
Office Hours: 8 a.m. - 5 p.m.

Other Important Phone Numbers

Arizona Registrar of Contractors
(480) 542-1525

Building Code Hotline
(480) 312-2633

Building Official (Building Variances)
(480) 312-7080

Green Building Program
(480) 312-7080

Housing Resources Program
(480) 312-4304

Inspections and Land Survey
(general inspection questions and permit extensions)
(480) 312-5750

Permit Inspections
(automated scheduling of inspections)
(480) 312-5796

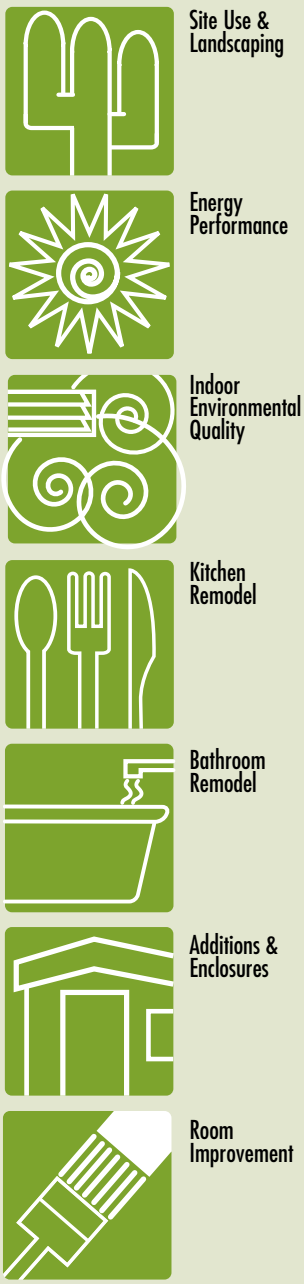
Plan Review
(480) 312-7080

Records
(480) 312-2356

Code Enforcement
(480) 312-2546

Arizona Blue Stake Center
(locating Utility lines)
(602) 263-1100

Graphics Legend



Office of the Mayor

3939 N. Drinkwater Boulevard
Scottsdale, AZ 85251

I hope you enjoy using this remodeling guide, which is based on Green Building principles. It is one of many projects aimed at making the protection of the environment part of our everyday lives in Scottsdale. I noted in my 2005 State of the City address that being "green" today doesn't mean living on the fringe. It means using common sense to save money, stay healthy and live more comfortably, while also preserving our unique environment.

Builders of new homes are adopting Green Building standards in greater numbers, and Scottsdale has won national respect for being a pioneer in this area. In 2004, one in five residential building permits issued in Scottsdale was for homes rated under the City Green Building Program. The City also is using Green Building principles in its own construction. Scottsdale this year became the first city in the United States to adopt the "gold" level LEED (Leadership in Energy and Environmental Design) standards set by the U.S. Green Building Council as the benchmark for all new City buildings. The new Senior Center opening in 2005 at McDowell Village will be the first LEED certified City building, and many more will follow.

It is also important for homeowners, contractors, architects and designers to incorporate Green Building techniques in remodeling homes, offices, shops and other structures. Scottsdale is rapidly reaching build-out, and the City is turning more of its attention to the revitalization of mature areas. It makes good sense, environmentally and economically, to invest in healthy, sustainable, energy-saving remodeling technologies.

Congratulations and thanks to the Environmental Quality Advisory Board's Green Building Advisory Subcommittee and the City staff for their work on this informative remodeling guide. And of course, their efforts would not be successful without the strong support of Scottsdale citizens like you. Our residents have consistently shown a commitment to the preservation and protection of our environment.

On behalf of the Scottsdale City Council, thank you for your interest in building "green" and for doing your part in protecting our environment for future generations.

Sincerely,

Mary Manross

Mary Manross
Mayor

NARI®
NATIONAL ASSOCIATION OF
THE REMODELING INDUSTRY

February 7, 2005

Anthony Floyd
Sustainable Building Manager
City of Scottsdale
7447 E. Indian School Road, Suite 125
Scottsdale, AZ 85251

Subject: Recognition of Scottsdale's Green Remodeling Guidelines

Mr. Floyd:

The National Association of the Remodeling Industry (NARI) Green Remodeling Program Development Sub-Committee conducted a technical review of the document titled "Green Building Remodeling Guidelines draft 11-23-04". The committee felt that the guidelines presented, adhered to the best practices industry standards in Green Remodeling. As such, NARI would be pleased to recognize your Green Remodeling program as meeting the industries standards of Green Remodeling.

If I can provide any additional assistance, please call at 847-298-9200.

Dan Taddei
Director of Education

Acknowledgements

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Additional Thanks:
We are grateful for the support of the Mayor & City Council, the Environmental Quality Advisory Board and its Green Building Advisory Committee.

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Contents

Introduction to Remodeling

Introduction

The City of Scottsdale's nationally recognized Green Building Program has encouraged energy efficient, healthy, and environmentally responsible building in the Sonoran desert region since 1998. This document provides green building information for citizens, architects, and builders. These Guidelines are organized into the following categories: site use and landscaping, energy performance, indoor environmental quality, kitchen remodel, bathroom remodel, additions and enclosures, room improvements, and supporting appendices.

The City of Scottsdale recognizes the importance of revitalization of existing neighborhoods and the value of home remodeling. The rising cost of new construction, coupled with a decline in available land, has placed increasing emphasis on remodeling existing housing. In addition to enhancing and preserving the City's existing housing, remodeling can be a more viable choice compared to selling and relocating. Established neighborhoods often offer amenities and proximity to services that may not exist in outlying developments.

Green remodeling contributes to environmental conservation, family health, improved energy and resource efficiency, reduced operating costs and improved home value. The neighborhood and surrounding community also benefits.

Housing in Scottsdale

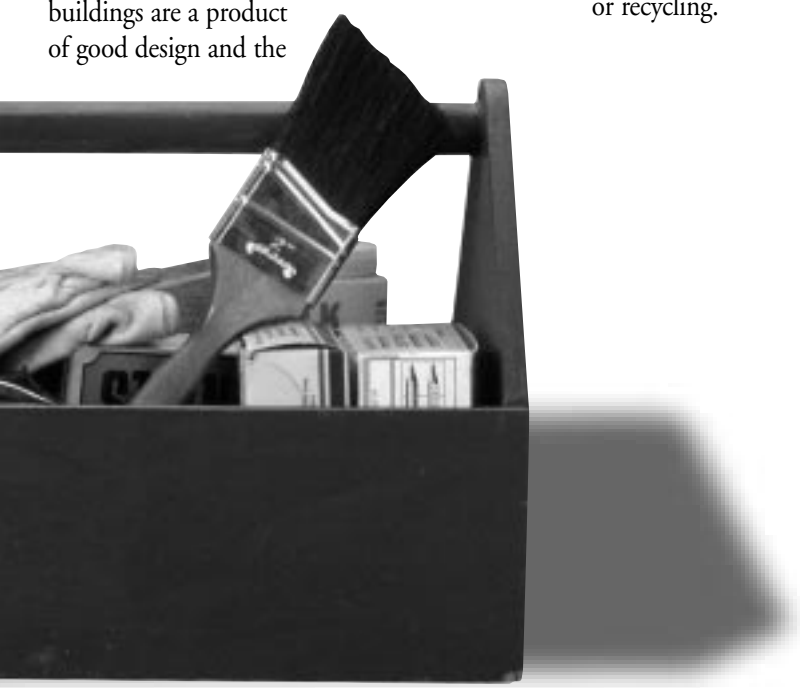
The majority of Scottsdale homes located south of Shea Boulevard consist of one story concrete block or brick construction, with roofing materials of asphalt or wood shingles. Construction and preservation of the mostly pre-1973 homes in this area are discussed in "Postwar Subdivisions in the West's Most Western Town: A Study of Ranch Home Development in Scottsdale, Arizona," an ASU Master's Thesis by Elizabeth Wilson. Some considerations for remodeling these homes includes landscaping and shading, building height, footprint, materials, structure, roofing, and design details. To determine if your house is in a historic preservation area, refer to the Historic Preservation Guide as part of the City of Scottsdale's Residential Revitalization Program.

Responsible Green Remodeling

Green building materials and techniques don't mean higher costs when addressing long-term issues for health, comfort, durability and efficient use of limited resources. It's about doing more with less in a healthy and responsible manner.

The environmental mantra of "Reduce, Reuse, and Recycle" encourages residents to consider alternatives to purchasing a new home when searching for more contemporary design, space, or amenities. Remodeling represents a form of "reuse" and a sustainable alternative to new construction. Remodeling reduces the consumption of resources, while encouraging a more responsible lifestyle and helping to "recycle" a portion of existing living space.

Increased square footage may not always be the answer. Alternative design strategies reveal new spatial and aesthetic potentials. The greenest buildings are a product of good design and the wise use and reuse of existing buildings and resources.



When remodeling, consider the concepts of embodied energy and life-cycle assessment [LCA]. Embodied energy is the energy required to extract, process, manufacture and transport materials. The use of low embodied energy materials can help to reduce the environmental impact of a remodeling project. Examples of low embodied energy materials include sand, gravel, adobe, poured earth, wood, agricultural fiber board, strawbales, and masonry, while materials such as plastics and most metals have high-embodied energy. Durability and recycled content are important considerations when selecting high-embodied energy materials such as metal framing or roofing. LCA provides a more comprehsnsive analysis by identifying the environmental impact of a building material over its entire life cycle, from extraction of raw materials, through use and subsequent disposal or recycling.

Life Cycle Assessment

Life-cycle assessment examines the total environmental impact of a product through every step of its life - from obtaining raw materials (for example, through mining or logging) to making it in a factory, selling it in a store, using it in the home and disposing of it.

Introduction to Remodeling (continued)

Deconstruction, Reuse and Construction Waste Management

Materials management and waste minimization represent a key element in any construction project.

Construction waste constitute a major portion of our nation's landfills. During the construction of a typical new home, 2.5 to 4 tons of material enters the waste stream, consisting of lumber and manufactured wood products (35%), drywall (15%), masonry (12%) and cardboard (10%). The remaining are a mix of roofing materials, metals, plaster, plastics, foam, insulation, textiles, glass, and packaging.

Deconstruction represents the first important element of green remodeling by reversing the building process through disassembly and salvaging material for reuse and recycling. Deconstruction is critical in the efficient use of resources.

Deconstruction regards older existing buildings and materials as valuable resources. Older buildings contain useful and unique construction materials. Deconstruction identifies and carefully removes reusable materials. It also reduces pollution and energy consumption associated with manufacturing and producing new materials. Another benefit is to salvage framing, beams, and specialty materials such as hard wood floors and architectural moldings, which reduces the use of new growth lumber. Finally, reuse of salvaged masonry and other durable materials provide for aesthetic character and design opportunities.

Reusing materials on-site and/or donating/selling salvaged items reduces waste, virgin material use and disposal cost. Typical salvage materials include appliances, blocks, bricks, carpeting, doors, flooring, lighting fixtures, framing, pipes, shelving, tile, windows, bathroom fixtures, cabinets, lumber, ductwork, insulation, paneling, oriented strand board (OSB), plywood, trim, and wood beams. Be aware that some materials and equipment are not reusable based on current standards, codes and laws. Other materials are toxic or hazardous and should be handled, used or disposed of carefully.

It is critical to create a deconstruction plan suitable to the time frame and materials required for the remodeling process. Deconstruction positively impacts building costs, land use, material reuse and reduces the amount of construction debris transported to landfill as waste.

Integrated Design

Scottsdale, has defined green building as "A whole systems approach utilizing design and building techniques to minimize environmental impact and reduce the energy consumption of a building while contributing to the health of the building's occupants." In other words, building a healthy, resource and energy efficient building. It's a matter of making the right design choices by choosing the right materials, resources, and methods of construction.

The fundamental goals of green design and remodeling requires an integrated design process. Buildings and their sites have to be evaluated as a unified system of interrelated parts.

"Integrated design" or "whole system" design analyzes a building and site as one, so that the whole is greater than the sum of the parts. The most effective results are obtained by considering the various building systems and their components (i.e. site, building form, envelope, cooling/heating systems, lighting, and contents) as interdependent parts, simultaneously interacting together and enhancing the environment. Integrated design is the cornerstone of sustainable building.

The Remodeling Guidelines utilize the category "icons" to emphasize the interrelationship of various building components and systems. The categories and associated icons are illustrated on this page. The icons will serve as a visual tool located at the top of each page to identify related information in other sections of this document. The intent of the icons is to emphasize the necessity for integrated design mentality: realizing the interrelation of our decisions.

For more information on green building, call 480-312-7080 or go to the Green Building website at www.ScottsdaleAZ.gov/greenbuilding

Permit Requirements

For more information about permits needed to complete your remodeling project, please visit or call the One Stop Shop at 480-312-2500 or go to the One Stop Shop's website at www.scottsdaleaz.gov/bldgresources/CounterResources/default.asp.

Universal Design

"Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." Ron Mace.

The intent of universal design is to simplify life for everyone by making products, communications and the built environment more usable by as many people as possible at little or no extra cost. Universal design benefits people of all ages and abilities.

For more information, please reference www.design.ncsu.edu/cud/univ_design/ud.htm

Graphics Legend


Site Use & Landscaping


Energy Performance


Indoor Environmental Quality


Kitchen Remodel


Bathroom Remodel


Additions & Enclosures


Room Improvement

Introduction to Remodeling (continued)

How to Use These Guidelines

The Green Home Remodeling Guidelines that follow are organized into seven major remodeling categories as listed in the Table of Contents. Each category is organized with a general information overview, followed by general design considerations, and subheadings containing specific guidelines and strategies. The guidelines are provided in bold text. Explanations and/or descriptive discussions follow the design considerations and guidelines where appropriate. Remember, the icons located at the upper right hand corner of each category page indicate the other categories that directly affect and require integration with the guidelines under immediate consideration. The guidelines are structured as follows:

Category
General information narrative discussing principles, environmental issues and concerns for each category or area of remodel.

Design Considerations
Overall considerations for establishing goals and beginning the remodel project.

- **Design considerations are in bold text.** Explanation and descriptive discussion of design considerations are in regular text.

Guidelines
The guidelines are listed and grouped under subheadings defining specific areas, systems or logical groupings.

Sub-headings

- **Guidelines are in bold text.** Explanation and descriptive discussions of guidelines are in regular text.

Each remodel project is unique in scope and size. These guidelines are divided in remodel project type or work area to assist in the design and construction of your specific remodeling endeavor. If you have any questions or would like to make an appointment to discuss your project, please call our Green Building Staff. We trust these guidelines will assist in creating a healthier, resource efficient and environmentally responsible home.

Site Use and Landscaping Overview

Renovating a home's landscape is an easy and enjoyable way to generate aesthetic, functional, and efficient improvements with minimal disturbance to a family's daily lifestyle. When changing landscape, be sure to consider microclimate, water and resource consumption, and energy efficiency.

A site and landscape plan should include an assessment for outdoor living and shading to reduce both indoor and outdoor summer heat gain. Good site design requires effective integration of existing site conditions with new landscape elements involving: topography, vegetation, drainage, and the changing seasons (sun, wind, temperature and humidity conditions). Incorporating the site's intertwined elements and conditions to function as a system results in a naturally efficient landscape. Restoration of the natural attributes of the site in the context of our desert region positively impacts the surroundings.

In the unique Sonoran desert ecosystem, water is extremely precious. Xeriscape techniques conserve water, protect the site and help to mitigate extreme seasonal conditions. Drought tolerant plants compliment our existing ecosystem. Careful planning includes soil improvement, minimal use of turf (high water consumption), efficient irrigation, mulches, and

appropriate maintenance. Scottsdale offers a landscape rebate to homeowners who install Xeriscape landscaping and/or electronically activated automatic irrigation controller. (See Resources section for further information.)

Plan outdoor areas to augment indoor living spaces as well as temper intense climate conditions by strategically locating shade and permeable paving materials. Effective shading can be achieved through a combination of extended roof overhangs, trellises, and/or trees and vines. An open trellis increases ventilation for better outdoor comfort. Trees improve air circulation and also provide cooling through the process of evapotranspiration.

Water features, including ponds and fountains, promote useful evaporative cooling when used in semi-enclosed spaces, such as courtyards, patios with low-walled perimeters or in a landscape niche. Remember to maximize shading to minimize evaporation of water.

Protected outdoor spaces serve as a buffer between indoor and outdoor conditions. They temper the surrounding environment of the home by reducing the extreme temperature range between the exterior and interior of the house, thus reducing energy use and costs. Trees and trellises with vines serve the same purpose. Protect the east and west sides of the house with

Outdoor cooking minimizes heat gain in air conditioned spaces during hot summer months.

vertical plantings and structures to prevent unwanted early morning and later afternoon summer sun exposure on the building. Cool the south and north side with overhead shading, overhangs, shade trees, and trellises with vines, etc.

Consider outdoor cooking opportunities when renovating. Use a portable or built-in grill or solar cooker as an alternative to indoor cooking, thereby reducing indoor heat during the summer months. To increase outdoor convenience, build a sink and counter near the grill.

Swimming pools and/or spas demand high water use in a dry climate, Use of these should be in a careful and sustainable manner. For example, use a pool's backwash system as a source for landscape irrigation. Use solar energy to heat the pool/spa water and to power the pumps and motors, and power outdoor lighting. Provide a pool and spa cover to reduce evaporation of water.

Don't overlook solid waste disposal during renovation. Whether recycling or composting, designate specific areas in the remodeling plan to encourage these sustainable options.

Heat Island Effect
On hot summer days, the air in urban areas can be 6-8ºF hotter than its surrounding areas. Scientists call these cities "urban heat islands." The higher temperatures in urban heat isalnds increase the need for air conditioning, thus raising pollution levels. Primary causes of the "heat island effect" includes concrete, dark surfaces and less vegetation that would otherwise provide shade and cool the air.

For more information, please reference www.eetd.lbl.gov/heatisland/

Graywater Irrigation
Graywater recycling systems irrigates landscape plants using household wastewater from showers, baths, bathroom sinks and washing machines. Using this recycled waer, which is safe for plants, reduces water consumption, thus conserving a valuable resource. It is important to note that sub-surface irrigation is the most appropriate distribution of graywater to avoid the negative health impacts of standing water.

Resource Organizations Involved:
Water Conservation Alliance of Southern Arizona

Building Code References:
Uniform Plumbing Code Appendix G

For more information, www.watercasq.org

Permaculture
Permaculture is a sustainable design approach that uses ecology as the basis for designing integrated systems, stressing the harmonious interrelationship of humans, plants, animals and the earth. Permaculture incorporates housing with food gardens, appropriate technologies and community development.

Site Use and Landscaping Guidelines

Planning protected outdoor living spaces allows you to enjoy the outdoors no matter what season it is. It also protects the house from summer heat gain.

Design Considerations

- **Consider the entire site as a usable area for living and working.** This includes expanding interior spaces with outdoor living and work areas, incorporating energy efficient strategies, developing the site elements as components for energy efficiency, and maximizing usable space.

- **Consider seasonal changes, adaptations, and energy impacts.** Plan landscape elements (natural and built) that aid in tempering exterior temperatures adjacent to the building. Modify the temperature of the areas immediately adjacent to the building to be as close as reasonable to the interior temperatures of the building. The greater the temperature difference between the exterior surface and the interior face of the building, the more heat will move and at a faster rate. In the summer, this means more heat getting into the building and in winter, more heat lost.

- **Orient the building and site components to take advantage of natural breezes for cooling; to provide access to solar energy, both passive and active systems; and to mitigate undesirable climatic conditions.** The building should orient itself to take advantage of shade and airflow for cooling in summer. This also takes advantage of passive solar energy for interior space heating and wind protection in the winter, and passive cooling in the summer.

- **Minimize earthwork and clearing.** Align building elements (long building dimensions) and site related development (parking areas, etc.) with natural landscape site contours. Designing with the natural topography will minimize site disturbance, maximize environmental features and reduce potential construction costs.

- **Take care in locating built and landscape elements.** Improper placement can create problems or negative energy conditions elsewhere. For example, improper placement of a pool or pond could reflect the summer sun's rays onto the building and increase the building's cooling load.

- **Create well-vented and open courts and outdoor use areas.** Avoid high, solid walls and solid covered structures that impede air movement and trap heat.

Xeriscaping your yard allows you to enjoy natural vegetation while conserving waer.

- **Use existing vegetation to moderate weather conditions and provide protection for native wildlife.** Use vegetation to provide shade and evapotranspiration in the summer and wind protection in the winter.

- **Modify the microclimate to maximize human comfort in the use of outdoor amenities such as arcades, patios, and sitting areas.** This includes the provision of north side cool courts for summertime outdoor use, and south side warm courts for winter use.

Site Use/Landscaping

- **Optimize use of xeriscape in landscaped areas.** Conserve water and protect the environment. Create a xeriscape landscape that includes soil types, appropriate plant selection, efficient irrigation, use of mulches, and timely maintenance.

- **Use vegetation to direct air for seasonal advantage.**

- **Maximize use of native desert and desert adapted plants and vegetation.** Avoid non-native species and vegetation not suited for desert conditions. This assures low water use and highest survival rate.

- **Use low water zoned irrigation systems (non-sprinkler) with separate valves to address different plant watering and maintenance needs.** A zoned irrigation system delivers the appropriate amount of water to the landscape by type. Group plants of similar water needs for a more efficient water distribution system.

- **Control irrigation with a rain sensor shut off to conserve water.**

- **Install a rainwater collection and storage system with on-site distribution to vegetation.** Naturally direct rainfall to landscape plants via swells, contoured slopes and berms. Strategically place plants needing relatively more water to collect more runoff. Build basins around particular plants to collect water and allow it to percolate slowly through the soil.

- **Avoid the use of chemical herbicides and fertalizers on site that can contaminate groundwater or runoff and provide potential indoor and outdoor air toxicity.**

- **North side of the house:** Incorporate an outdoor summer cool-side area. Natural shade of the building protects outdoor structures, vegetation, and water features. Outdoor spaces serve as buffer zones creating climatic stability for the building structure.

Site Use and Landscaping Guidelines (continued)

- **East and/or South side:** Design protected outdoor living areas. Shade to reduce heat gain and lower the temperature around the house, while promoting outdoor living.

- **Use outdoor structures, decking, and landscaping materials made from recycled content materials or non-toxic lumber.** Select composite wood products or lumber from sustainable managed forests.

- **Use permeable materials in walk ways, uncovered patios, and drive ways to reduce the amount of heat absorbed and radiated from the surface, and to allow for water percolation into the site.**

- **Use solar electric (photovoltaic) site lighting.** Reduce energy costs and use available natural resources.

- **Incorporate concepts of thermal decompression.** Sudden temperature changes negatively affect the human body. Thermal Decompression is simply developing the building site through layers of landscaping, materials choices, and built features so the temperature gradually decreases as a person approaches and enters the building.

Pools and Spas

- **Consider not installing a swimming pool or spa to reduce water and energy use for heating and filtering.** In the desert climate, the typical pool can evaporate its equivalent water volume in one year (13,000-25,000 gallons).

- **Consider installing only a spa to reduce energy and water demands.**

- **Plan to physically separate the pool and spa to conserve energy and extend seasonal use.**

- **Use a solar pool heating system to economically heat water.**

- **Use a solar electric (photovoltaic system) to run the pool equipment.**

- **If using a standard pool heating system, consider a gas spa heater with EPA Energy Star Rating.** A gas heater will use less energy than an electric heater to raise the water temperature quickly.

- **Use retractable covers on pools and spas.** Covers reduce heat loss and evaporation to provide for safety and to keep pools cleaner.

- **Install a low-chlorine pool filtration system.** Chlorine filtration can be toxic to human health. A low-chlorine filtration system eliminates the harmful expo sure of chlorine and ameliorates sensitive eye, skin, and respiratory conditions.

- **Establish a zero water loss backwash system for the pool filtration system.** This conserves water by recycling filtered water back into the pool or into landscaped areas. The use of certain filtration technology, such as ozone, virtually eliminates the need to drain the pool.

Waste Reduction

- **Landscape for reuse and preservation.** Reuse existing site and landscaping components to conserve resources and divert demolition waste from the landfill.

- **Salvage reusable building materials.**

- **Allocate an area for City recycling containers directly accessible to the pick-up point.** Recycling con serves resources and diverts wastes from landfill.

Use permeable paving materials to help minimize heat gain and increase rainwater percolation.

Energy Performance Overview

Energy-efficiency represents a key concern for the overall performance of a home. Remodeling to update energy use reduces your heating and cooling bills and greatly enhances value. Improvements can range from minor changes, such as window shading to larger upgrades such as new windows and mechanical equipment.

Energy performance analysis provides a first step when considering changes to increase energy efficiency. Energy professionals can evaluate existing conditions to determine the current performance of the home. The performance analysis will identify upgrades and improvements.

Energy considerations always begin with the site. Mitigation of negative outdoor conditions and capitalization of the site's natural assets provides the best basis for a building's energy performance. Good insulation, properly installed at the wall and roof/ceiling areas improves the energy performance of the home. Properly sealed ductwork ensures energy efficient delivery of heated and cooled air traveling through the ducts.

After optimizing exterior conditions that affect the house, and improving the building envelope energy performance, consider the interior issues and opportunities. Buffer living spaces with secondary elements and rooms like closets, bathrooms, and storage areas. This buffering barrier provides for thermal stability of the living spaces. The incorporation of Energy Star appliances, an energy efficient heating, ventilating, and air conditioning [HVAC] system, lighting, and energy-efficient window system improvements can yield vast benefits in energy savings.

There are several elements for upgrading a building for comfort. A passive approach combines elements of site optimization, building orientation, spatial placement, appropriate materials selection and proper placement and sizing of windows and overhangs and orientation to minimize summer solar heat gain.

However, our hot desert climate requires supplementing passive strategies with active mechanical systems. Zoned HVAC systems and programmable setback thermostats provide for energy efficiency. Ceiling fans make a significant contribution to a comfortable indoor climate, without using much energy. Optimize the use of natural light (daylighting) by strategically locating windows to reduce the need for artificial lighting. Non-incandescent lighting reduces energy consumption. Overall, careful consideration of energy performance creates an effective balance between convenience and energy consumption. Behavior changes, often as simple as turning off the lights when leaving a room (or using automatic sensors to do the same), will positively impact a home's comfort and energy savings.

Energy Modeling
Energy modeling helps architects and building designers quickly identify the most cost-effective, energy-saving measures for commercial and residential buildings. Various software programs are designed to identify the best combination of energy-efficient strategies, including daylighting, solar and high-efficiency mechanical systems.

Resources Organization Involved
EPA Energy Star, U.S. Department of Energy (DOE), Sustainable Buildings Industry Council (SBIC)

Industry Standards
ENERGY-10 and REM/Design software

Building Code References
International Residential Code, 2003, Chapter 11; International Energy Conservation Code, 2003

For more information, please reference
www.nrel.gov/buildings/energy10/

Insulation
Heat flows naturally from a warmer to a cooler space, thus in Arizona, heat mostly flows from outdoors to the house interior. Insulation, used to resist heat flow, is rated in terms of thermal resistance, called R-value. Installing insulation in your home increases R-value and the resistance to heat flow. Several low or non-toxic materials are effective insulations.

Resource Organizations Involved
North American Insulation Manufacturers Association

Industry Standards
There are several recognized insulation standards. Please refer to the current energy codes to determine those most applicable to your project.

Building Code Reference
International Residential Code, 2003 - Chapter 11

For more information, please reference
www.ornl.gov/roofs+walls/insulation/

Energy Performance Guidelines

Creating shade outside of doorways creates an exterior tempered entry-way.

By incorporating recessed doors and windows into the design of your home, you can minimize solar heat gain.

Design Considerations

- **Use conservation and passive solar techniques for heating and cooling before thinking about mechanical equipment.** For every dollar spent on passive solar design and energy efficient upgrades, there is a reduction in mechanical equipment costs of $7 to 10 dollars. Utilize thermal mass (thermally dense materials like concrete, stone, tile) to assist in passive heating and cooling.

- **Minimize solar heat gain. Design remodels with attention to solar orientation.** Minimize direct solar heat gain in the summer months by using landscaping and site amenities as vertical barriers to the sun on the east and west sides. Use landscaping and building overhangs, trellises, etc. on the southern facade. During winter months, optimize solar gain into the building for natural heating and illumination.

- **Integrate passive solar heating and cooling strategies with natural daylighting design.** Utilize thermal mass concepts to achieve passive heating and cooling through proper materials selection. Passive design strategies reduce load requirements for building mechanical heating and cooling systems.

- **Build walls, roofs, and floors of adequate thermal resistance to provide human comfort and energy efficiency**. Thermal resistance (or "R" Value) measures the resistance to heat flow through a material or assembly. The higher the number, the better.

- **Design heating and cooling systems for variable load efficiency, optimized system efficiency and flexibility.** Buildings operate at part-load status most of the time. Select and size equipment that can accommodate demand and remain efficient over a wide range of load conditions.

- **Consider energy efficient appliances.** Use Energy Star labeled appliances.

- **Consider renewable energy sources such as solar, wind, biomass, and hydrogen power generating equipment.** Renewable energy sources are cleaner, less invasive to the environment, provide considerable energy benefits, and have added occupant comfort. Renewable energy reduces environmental impacts of fossil fuel based energy sources relative to extraction and pollution. Renewable sources also provide a significant life cycle return on investment.

- **Employ a method of evaluation for analyzing energy performance.** There are a number of programs and service providers that can assist in developing an energy efficient approach. A simple cost/potential savings guide to follow at home includes the following steps.
  1. Gather a year of most recent energy bills.
  2. Find the lowest month. This provides a base when heating and cooling was not used.
  3. Take each winter bill and subtract the base. This is the amount spent for heating.
  4. Take each summer bill and subtract the base. This is the amount spent for cooling.
  5. Use these heating and cooling costs as a guide for estimating projected savings, as well as for investment in energy reduction actions.

Building Envelope

- **Create landscape and site design that mitigates negative heat impact on the building in the summer, and allows for positive solar gain in the winter**. Use exteri or shading to reduce heat gain, glare, and localized overheating. A shaded window that allows air circulation between the shading device and the glass will greatly reduce solar heat gain.

- **Create exterior tempered entries (exterior air locks) at all points of building entry and egress.** The opening and closing of doors provide for major loss of interior cooled air in the summer and heated air in the winter. The greater the difference in temperature between the doorway interior and exterior, the greater the amount of heat flows.

- **Create exterior shading that protects all glass during the hottest months of the year.**

- **Construct or install vertical exterior shading to protect the west and east glass from the low summer sun.**

- **Consider texture as an energy strategy; a rough texture provides a cooler condition than a smooth texture.**

Energy Star
Energy Star labels are provided to homes and products that meet certain energy efficiency criteria. The rating is an objective, standardized evaluation of the home or product that compares it to a simulated reference home or product that meets minimum energy code requirements.

For more information
www.energystar.gov

Thermal Mass
Thermal mass refers to materials such as masonry that can store heat energy for an extended time, thus preventing rapid temperature fluctuations. For example, a basic passive cooling strategy is to permit cooler night air to ventilate a house and cool down the thermal mass (this can be brick, stone or concrete walls or floors) inside the house. The thermal mass will absorb unwanted heat during the day. Keeping it away from people disipates it during nightime cooling.

For more information
www.greenbuilder.com/sourcebook/PassiveSol.html

Energy Performance Guidelines

- **Consider exterior color as an energy strategy.** A light color is more reflective of sunlight and dark colors are more absorptive.

- **Install a radiant barrier at the roof or ceiling assembly.** Radiant barriers reduce heat flow. Maintain an air space on either side of the barrier.

- **Recess all doorway and window openings.** This creates exterior tempered pockets at all points of entry and egress.

- **Control the amount of glass in the building.** Windows represent the worst barrier to heat, even when shaded. Limit the amount of total glass, especially if unshaded.

- **Utilize wall assembly rated with a minimum R-19 or higher and ceiling insulation with a R-30 or higher.** This reduces the amount and rate of heat flow (inward during the summer, outward during the winter) through the building structure. The higher the resistance to heat flow (R-value) the less the amount and rate of heat flow.

- **Insulate all exterior doors to a minimum R-2 or higher.** Doors with higher insulation values reduce thermal migration, therefore saving energy.

- **Construct an air infiltration barrier.** A tightly sealed building envelope greatly reduces unwanted indoor/outdoor air migration and higher utility costs.

- **Use windows, skylights, or light tubes that have a low-e National Fenestration Rating Council (NFRC) recommended U-factor.** The lower the U-factor, the more efficient the window. Consider exterior shading or screening of sky lights to protect from summer sun.

- **Provide exterior screening, tinting and/or shading from the summer sun's rays.** This minimizes direct heat gain.

- **Integrate storm windows to existing windows.** This provides for an air space barrier to prevent heat gain.

- **Incorporate window illumination/heating combinations that allow for sunlight entry and the capture of the sun's energy for space heating.** Utilize light shelves and upper or clerestory windows to distribute sunlight for natural illumination.

- **Incorporate alternative window systems that provide for diffuse illumination, thermal protection and privacy.**

- **Select interior window treatments, such as insulating drapes or panels, with reflective properties and insulation value.** Although not as directly effective as exterior shading and high performance glass, adding light colored interior window treatment with reflective properties and insulation can decrease heating/cooling loads, energy use, and utility costs.

Heating, Cooling and Ventilation

- **Design the home for passive solar winter heating which takes advantage of direct and indirect solar heat gain.** This will reduce the use of mechanical heating systems and lower utility bills. Passive solar strategies also provide natural illumination and reduce artificial lighting use and cost.

- **Incorporate stack and/or cross ventilation for seasonal cooling.** This method uses natural breezes and air movement that help cool the house.

- **Vent attics with continuous ridge and eave vents.** Controlling thermal migration in roof cavities and attic spaces reduces heating/cooling loads, therefore reducing utility costs. In lieu of this method, apply insulation to the underside of roof deck.

- **Install a zoned HVAC system with individual room temperature control.** Efficiency can be significantly improved by heating or cooling to the desired temperature ONLY when occupants are present. Different desired temperatures can be set in each room. Using motion detectors can moderate the heating/cooling to each zone as people enter and leave.

- **Use HVAC units with a high Seasonal Energy Efficiency Ratio [SEER] rating.** The higher the SEER rating number, the more energy efficient the unit. Choose a unit with a minimum rating of 13 SEER.

- **If gas is desired, select a natural gas cooling unit with a min. 0.6 Coefficient of Performance [COP] rating.** Natural gas cooling is preferable to electric cooling since it decreases energy consumption. Also, natural gas cooling units do not use CFCs or HCFCs, therefore have less of a negative environmental impact.

- **Insulate ductwork to perform greater than R-4.2 in conditioned space and R-6 in unconditioned space.** Insulated ductwork in unconditioned spaces helps to maintain air temperature delivered to the conditioned space. Additional ductwork insulation in conditioned spaces further prevents air leakage and improve energy performance.

- **Prevent air duct leakage.** Leaking ductwork equals energy lost; therefore, designing the system for minimal leakage conserves energy.

- **Consider hiring a professional to evaluate ductwork for performance and efficiency.**

- **Consider an evaporative cooling system.** Design the system with an independent air distribution and consider indoor air quality implications. Recirculate water used into the system or recycle into the surrounding landscaping.

- **Consider a whole house fan.** When outside temperatures are cooler than inside temperatures, such as in early morning or late evening, the air conditioner can be turned off, and the whole house fan draws cool, fresh air into the house through the open windows or vents and expels the hot inside air out through attic vents.

National Fenestration Rating Council (NFRC)
The NFRC is a non-profit, public/private organization created by the window, door and skylight industry. It is comprised of manufacturers, suppliers, builders, architects and designers, specifiers, code officials, utilities and government agencies. NFRC provides consistent ratings on window, door and skylight products.

For more information,
www.nfrc.org

Low-E Windows
Low-emittance (Low-E) and spectrally-selective coatings are microscopically thin metal or metalic oxide layers deposited on glass. The coatings are transparent to visible light, but reflects short-wave and long-wave infrared radiation. Low-E windows significantly reduces solar heat gain and improves comfort while providing clear views and daylight. This results in lower summer cooling bills.

For more information,
www.efficientwindows.org/lowe.cfm

CFCs and HCFCs
Chloroflurocarbons (CFC) and Hydrochloroflurocarbons (HCFC) were commonly used in cooling systems and industrial applications prior to the discovery that their use causes a catalytic reaction that results in ozone depletion. Since the signing of the Montreal Protocol in 1987, the majority of CFC and HCFC use has been banned and substances that do not cause such a negative environmental impact are replacing these chemical compounds.

For more information,
www.cmdl.noaa.gov/

Energy Performance Guidelines

Task lighting saves energy by illuminating where needed.

Electrical Power, Lighting and Appliances

- **Incorporate daylighting.** Allowing natural light to enter the house reduces use of artificial light and energy bills.

- **Use light colored interiors.** Light colored surfaces optimize both artificial and free, natural daylighting.

- **Consider overall lighting wattage to reduce energy consumption.** The maximum interior lighting recommendations do not exceed 0.5 watts per sq. ft.

- **Eliminate poorly insulated recessed lights in insulated ceilings.** Recessed lights can affect a building's cooling load. Air sealed and insulation contact [IC] rated fixtures minimize penetration impact and reduce the chance of creating hot spots in the ceiling.

- **Use effective light fixture placement.** Locate lighting/lamps at room corners where light can reflect off of three surfaces (two walls and ceiling).

- **Emphasize task lighting.** Install individually switched task lighting to minimize the use of extra energy associated with traditional general illumination.

- **Install a lighting control system.** Control systems with variable settings lower overall lighting wattage and reduce energy consumption.

- **Install energy efficient lighting.** Non-incandescent light fixtures are more energy efficient than traditional incandescent fixtures.

- **Use power saving controllers for motor driven appliances.** Microcontrollers allow induction type appliances (refrigerators, freezers, etc.) to run cooler, quieter, and with less energy.

- **Locate the refrigerator in a cool area and maintain it frequently.** Refrigerators require ventilation and a cooler tempered location.

- **Consider alternative means to cooking in the summer.** A microwave cooks six times faster and uses 1/3 the energy. An outdoor kitchen barbeque or a solar cooker keeps heat out of the kitchen

- **Utilize gas appliances if service is available.** Natural gas is an efficient means of heating (dryer, water heater, range/oven, space heating, etc.)

Renewable Energy

- **Subscribe to the utility company solar power generation program.**

- **Provide unshaded south roof area and electrical pre-wire for future solar electric power system.** A pre-planned south roof area provides for easy installation of future solar panels (photovoltaic).

- **Solar electric power system installed.** Utilize a grid connected (utility shared) or off grid (with independent electrical storage) photovoltaic [PV] system for full or partial house load power generation. Check with government programs and your utility provider for incentive and buy-down programs.

- **Solar water heating system.** Integrate the system panels into the building form for compatibility and aesthetics. Locate the panels to minimize runs between the panels and the hot water storage system. Utilize, where reasonable, a solar photovoltaic system for powering pumps and sensors, and providing stability of operations during utility brownouts and blackouts. Check with government programs and your utility provider for incentive and buydown programs.

Plumbing System

- **Minimize distance between hot water storage and end fixture use.** Minimizing the distance between the heat storage and the fixture delivers hot water faster, decreasing the water wasted.

- **Insulate the hot water tank and water distribution lines.**

- **Consider a hot water recirculation system.** A looped hot water piping system can deliver hot water without waste. This uses a pump to circulate hot water in a pipe loop between the most remote plumbing fixture and the water heater. Water is saved by having hot water available when needed. Energy is saved when the recirculation is activated by a timer or on demand switch.

- **Electric heat pump water heater.** Electric heat pump water heaters save energy because they use surplus heat to heat water at little to no extra cost.

- **Tankless Water Heater.** Instead of wasting energy by storing hot water, as in a traditional hot water heater, a tankless water heater heats water as you use it, and therefore saves energy. Furthermore, if sized appropriately, the tankless water heater provides an endless supply of hot water.

Photovoltaics
Photovaltaic (or PV) systems convert light energy into electricity. Most commonly known as "solar cells," PV systems can run systems as simple as small calculators and wrist watches to more complicated systems such as providing electricity for pumping water, powering communications equipment and even lighting homes and running our appliances.

For more information,
www.azsolarcenter.com

Grid-tie solar electric (PV-photovoltaic) system augments energy to house, thereby reducing electric bills.

Indoor Environmental Quality Overview

Indoor Environmental Quality (IEQ) has many considerations including: illumination, acoustics, occupant control of building systems, daylighting, views, and Indoor Air Quality [IAQ]. The Environmental Protection Agency [EPA] has identified that IAQ has a significant influence on health, productivity, and quality of life. IEQ results from the interaction of many factors including: construction materials, furnishings and equipment, the building envelope, the ventilation system, building maintenance, occupants, and electric and magnetic fields. These factors each contribute different effects on IEQ.

Construction materials, furnishings, and equipment may emit odor, particles and volatile organic compounds [VOCs] as well as create an environment that support the growth of mold and bacteria. Exposure to these conditions can lead to health problems.

The building envelope controls the infiltration of outside air and moisture. Effective ventilation can be accomplished by proper placement of operable windows and vents. Acoustical materials used in heating, ventilating and air-conditioning [HVAC] systems may contribute to indoor air pollution.

Ventilation systems control the distribution, quantity, temperature, and humidity of the air. Lack of ventilation system maintenance allows dirt, dust, mold, odors, and particles to increase, resulting in poor IAQ. According to studies by the American Society of Heating, Refrigerating and Air-Conditioning Engineers [ASHRAE] pertaining to ventilation for acceptable indoor air quality, people and pets are major sources for microorganisms and airborne allergens in indoor environments. It is important to consider what cleaning agents are used within the home as products can contain high amounts of volatile organic compounds that pollute indoor air. Studies and research have indicated that electric and magnetic fields generated by power lines, internal wiring, and electric appliances may be potential sources of health problems.

Poor indoor air quality can cause health problems that may be short-term (sick building syndrome, building related illnesses) or long-term (multiple chemical sensitivities, environmental illnesses) ranging from minor irritations to life-threatening illnesses. It is important to employ strategies to achieve optimal IEQ in order to prevent the onset of such conditions.

Indoor Air Quality
Indoor air quality issues in homes are a result of indoor pollution sources that release gases or particles into the air. If too little outdoor air enters a home, pollutants can accumulate to levels that can cause health and comfort threats.

For more information,
www.iaqcouncil.org
www.epa.gov.iaq

Electromagnetic Fields
Power lines, electrical wiring and appliances all produce electric and magnetic fields. EMFs are invisible lines of force that surround only electrical devices. Electrical and magnetic fields have different properties and possibly different ways of cauisng biological effects. AC fields create weak electrical currents in the bodies of people and animals. This is one reason why there is a potential for EMFs to cause biological effects.

For more information,
www.who.int/peh-emf

Indoor Environmental Quality Guidelines

Design Considerations

- **Avoid materials, products, and furniture that have a high Volatile Organic Compound (VOC) content.** These items offgas and/or emit odors and particulates. See material options in Kitchen, Additions and Enclosures chapters.

- **Consider modifications and/or upgrades to existing heating, ventilating, and air conditioning system(s) for increased ventilation effectiveness.** Ventilation systems control the distribution, quantity, temperature, and humidity of the air.

- **Maintain a high standard for indoor air quality.** Particular occupant allergies and sensitivities must be taken into consideration regarding all design aspects of the indoor environment. EPA IAQ publications (www.epa.gov/iaq/pubs) and American Indoor Air Quality Council (www.iaqcouncil.org) are resources for addressing IAQ issues, information and education.

Heating, Cooling and Ventilation

- **Ventilation system installed per ASHRAE standards.**
  - ASHRAE Standard 62-1999: Ventilation For Acceptable Indoor Air Quality specifies minimum ventilation rates.

- **Use a sealed-combustion or power vented furnace.** A sealed combustion furnace uses outside air for combustion. A power vented furnace utilizes an integral motorized exhaust vent that monitors the airflow through the system, thereby reducing energy loss. Both of these furnace types improve IAQ because of outside air for combustion.

- **Consider an energy recovery ventilator or air-to-air heat exchanger.** These units exchange the inside air with outside air to remove indoor air pollutants and captures the low temperature of outgoing cool air to cool down incoming hot air. This improves IAQ and reduces energy needed for cooling.

- **Use a furnace and/or duct-mounted electronic air cleaner or HEPA filter.** Air cleaners or filtration systems effectively improve IAQ by filtering particles that are hazardous to occupant health. These particles can include toxic gases, molds, and particulate matter.

- **Install a range hood vented directly to the building exterior.** Venting the range hood directly outdoors improves a home's IAQ by pre venting lingering odors and particulate matter.

- **Install an exhaust fan in the garage on a timer or directly wired to door opener.** A garage door wired to an exhaust fan will remove toxic automobile emissions from the garage, preventing them from leaking into the home.

- **Design/build a detached garage.** A detached garage will separate and prevent toxic fumes from entering the home.

- **Install a central vacuum system with exhaust to the building exterior.** Venting the vacuum to the outside prevents the release of indoor pollutants back into the home.

- **Enclose, insulate and seal the mechanical rooms that have combustion appliances and equipment.** Creating a barrier between the mechanical room and the rest of the house prevents toxic gas leakage and air pressure imbalance. Provide proper venting of the room in accordance with the City Mechanical Code.

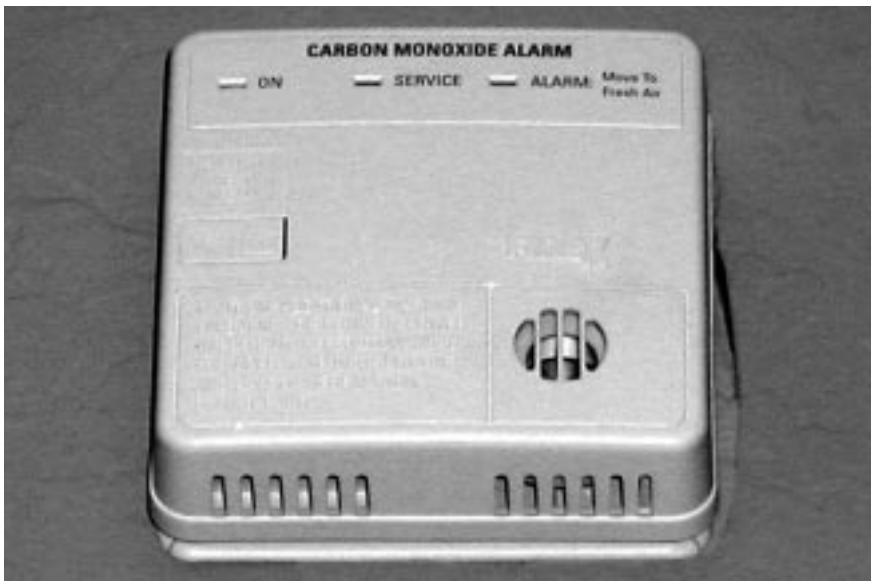
- **Install a sealed combustion or power-vented water heater.** Sealed combustion water heaters draw all their combustion air from the outdoors. This feature is especially helpful in airtight homes, where appliances compete for combustion air. In addition, sealed combustion water heaters can save energy because they do not use heated or cooled indoor air from the house. In a power vented water heater, excess heat is pushed outside through vents, thereby conserving energy. Both of these water heater types improve IAQ.

Consider a pleated return air filter with a min. MERV (minimum efficiency reporting value) rating of 8.

Occupant Activity Control

- **Use carbon monoxide [CO] sensors in occupied spaces, where combustion appliances are used.** Carbon monoxide detectors warn against high levels of toxic carbon monoxide.

- **Evaluate the daily activities of people and pets within the indoor home environment.** People and pets are major sources of microorganisms and airborne allergens in indoor environments. Modifying certain activities to isolated indoor areas or to the building exterior, contribute to better IAQ.



Install a carbon monoxide detector in habitable rooms that have combustion appliances (i.e. - a kitchen with a gas range).

Building Maintenance

- **Select easy to maintain building materials and systems.** Low maintenance building materials and systems are usually hard, smooth and non-absorbant. These materials limit the accumulation of indoor pollutants and reduce the need to use potentially toxic cleaning agents.

- **Select environmentally friendly cleaning agents.** Environmentally friendly cleaning agents reduce the negative impact on IAQ by reducing toxic substances into the home.

- **Implement an integrated pest management plan using only non-hazardous substances.**

Finished concrete floors create smooth surfaces that are easy to maintain and stay cooler in the summer months.

Kitchen Remodel Overview

The kitchen can serve as the nucleus of a home. A remodeled kitchen can provide increased convenience, aesthetics, and energy and human efficiencies, as well as improved indoor environmental quality. Pollutants that impact indoor environmental quality can be reduced by choosing hard, smooth, and nonabsorbent surfaces, thus decreasing the opportunity for oils, dust and other allergens to accumulate. These finishes also allow for easier clean up and maintenance.

Also, choose durable finishes for floors, countertops, casework, and appliances that do not negatively contribute to indoor environmental quality by off-gassing. Better choices include finish materials specified as formaldehyde-free, natural, and durable.

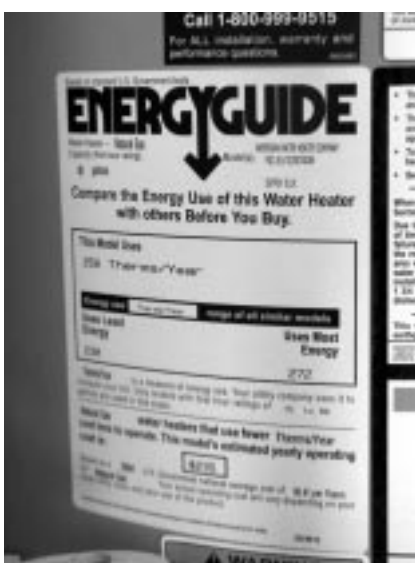
Energy is an important remodeling consideration. Reduce energy consumption by installing appliances that display the Energy Star label. Reducing electrical lighting needs by using natural daylight. Outdoor cooking saves energy and reduces summer air conditioning use and cost.

Water conservation is an important kitchen remodel consideration. Efficient use of water can be accomplished by using Energy Star labeled dishwashers, and low flow faucets.

Composting is another water saving practice. Composting minimizes using in-sink garbage disposal systems, thus reducing the amount of water used. The process of composting transforms food waste into a fertilizer which can then be used in the garden or yard..

Energy Star Appliances
Energy Star labeled appliances meet established energy efficiency criteria. The rating is an objective, standardized evaluation of the appliance that compares it to refrenced standards for minimum energy performance requirements.

For more information
www.energystar.gov



Use Energy Star appliances and energy efficient water heating equipment.

Kitchen Remodel Guidelines

Design Considerations

- **Assess kitchen for needs, uses, preferences, and functional relationships.** Start by noting any problem areas in the kitchen and decide how to correct them. Determine how to maximize functional efficiency of the room. Consider the main functions of preparing and cooking food, as well as other activities that take place in the kitchen.

- **Assess existing appliances and fixtures.** Consider replacing inefficient appliances and fixtures. Newer appliances can provide energy efficiency, material quality, and safety features that can save money in the long run. Make sure pipes are leak-free and select low-flow water fixtures.

- **Assess performance, durability, and maintenance in selection of materials, equipment/appliances, and fixtures.**

- **Maintain and clean the kitchen with low emitting, environmentally friendly cleaning agents and products.** Select durable, smooth surfaces that can be wiped clean easily and select eco-friendly cleaning agents. Look for finishes that will withstand constant use and washing, and will not require special cleaning to maintain their appearance.

Select cabinets of domestic hardwood and/or formaldehyde-free casework.

Concrete countertops have durable surfaces and are made from local resources.

Appliances/Equipment/Fixtures

- **Choose energy efficient appliances, such as those with an Energy Star label.** Energy Star labeled products reduce energy and water use, resulting in lower utility bills.
- **Replace existing faucets with low flow faucets.** The minimum flow rate is determined by the current industry standards. If reusing existing faucets, attach low flow reducers to the end of the faucets.
- **Install individually switched task lighting.** Specific use lighting is more effective than traditional general-purpose lighting.
- **Provide proper ventilation for adequate comfort and odor/moisture control.**
- **Vent range hood directly to the outside.** This provides adequate exhaust, which results in healthier indoor air.
- **Design for outdoor cooking capability.** An outdoor kitchen minimize the indoor cooling load during warm months and prevents the negative impact of inadequate ventilation year-round.

A built-in recycling center in the kitchen allows a family to sort their waste and recyclables for curbside pick-up.

Solar Cooking
Purchase or build a solar cooker. Solar energy creates a fun and adventurous way to cook food and pasturize water, while saving energy.

Resource Organizations Involved
Solar Cookers International, Solar Energy International

Industry Standards
Standards can be found on the Solar Cookers International website at www.solarcooking.org/

For more information,
www.solarcooking.org

Solar cooker

Kitchen Remodel Guidelines (continued)

Environmentally Responsible Materials

Flooring

- **Select hard/non-absorbent flooring materials.** These are easier to clean and maintain and can contribute to better air quality.
- **Install recyclable and/or recycled content flooring.** This reduces material consumption and minimizes waste.
- **Install rapidly renewable resource flooring.** Both bamboo and cork flooring are durable floor materials that are derived from fast-growing plants.
- **Use low toxic, solvent-free adhesives, mastics, and sealants**. Reduce toxic offgassing of Volatile Organic Compunds (VOCs) and other toxic substances.

Cabinetry and Trim

- **Select cabinet cases made from domestic hardwood or from certified sustainable sources.** This preserves endangered forests and supports managed forestry practices.
- **Insist on formaldehyde-free casework.** Cabinets made from formaldehyde-free particleboard or medium density fiberboard (MDF) eliminate Volatile Organic Compounds [VOCs].
- **Install pre-finished cabinets or use on-site applied finishes with low toxicity.** Pre-finishing cabinets off-site minimizes harmful VOC exposure to laborers and inhabitants. If finishing cabinets on-site, use a low toxic finish to avoid potential harm from VOC exposure.
- **Consider replacing cabinet facings only (i.e. doors, drawers, fronts and panels) for aesthetic improvement.** Using existing cabinet structure conserves natural resources and saves money.
- **Consider using recycled content countertops.** This reduces material consumption and minimizes waste. Recycled content materials can include glass, plastics, metals and paper.
- **Consider regionally quarried or processed countertops.** Local/regional materials such as concrete, stone and tile reduce costs and pollution related to transportation and supports the local economy.
- **Avoid using tropical woods.** This preserves endangered forests .
- **Minimize the use of wood crown molding.** The elimination of wood trim reduces the excessive use of wood.
- **Install finger-jointed/engineered wood for interior trim.** Finger jointed or engineered wood trim originates from small pieces glued together. This reduces waste by using more of the tree

Waste Reduction

- **Designate an area for recycling.** Provide an area or build a recycling center for two or more 5 gallon bins in or near kitchen to sort and store recyclable materials (i.e. paper, corrugated cardboard, glass, plastics and metals).

- **Donate excess building materials.** Non-profit building organizations can utilize the material and provide a tax incentive.

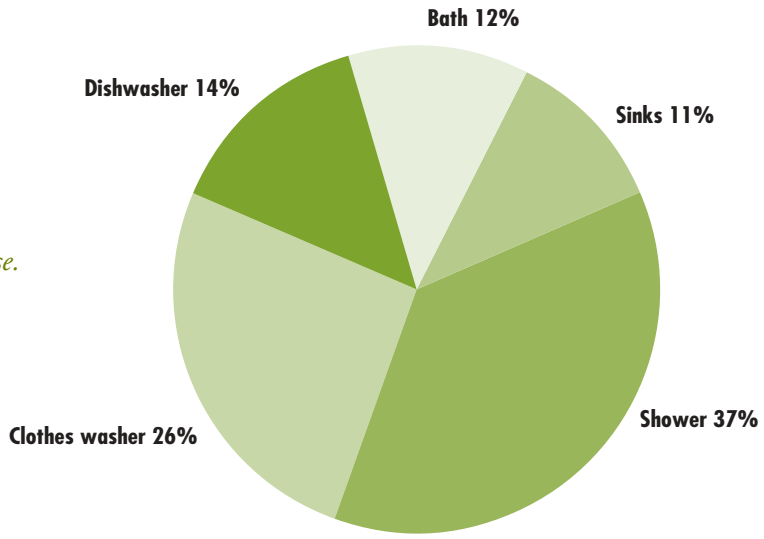
Bathroom Remodel Overview

A bathroom remodel can incorporate many green building strategies and practices. Hard, smooth and non-absorbent surfaces decrease the opportunity for mold and bacteria to grow, and limit the amount of moisture absorbed. Careful caulking and sealing of joints can help to combat dampness and excessive moisture buildup and absorption. Regular cleaning with low or non-toxic solutions will help reduce mold and mildew accumulation. Ventilation is critical in bathrooms, not only for mitigating moisture, but also for minimizing the negative impact of various chemicals used for cleaning, grooming and, deodorizing.

Water and energy conservation are important. Installing low flow toilets, fixtures, and showerheads decreases the amount of water consumed. The City of Scottsdale offers a plumbing rebate to water customers who install conservation devices for toilets and showers. Consider plumbing designed to use gray water from the shower or bathtub for landscape and garden irrigation. Tankless or recirculating hot water systems can decrease water consumption while meeting a family's water heating needs. Solar water heating systems use a free and abundant energy source to heat water.

A family should become more conscious of their water and energy use and make lifestyle changes to conserve resources.

A bathroom becomes one of the most important rooms to remodel with careful attention to planning, design, operation and maintenance. Minimal improvements can have a positive impact in a frequently used space.



Hot Water Usage
The average U.S. homeowner's water consumption by place of use.

Source: Energy Savers (6/03)

Bathroom Remodel Guidelines

The City of Scottsdale offers rebates for the installation of low-flow water fixtures.

Dual control flush toilet saves water (0.8 gallon per flush for liquid waste and 1.6 gallon per flush for solid waste).

Design Considerations

- **Assess bathroom for needs, uses, preferences, and functional relationships.** Some bathrooms are considered a utilitarian space for hygienic purposes only. Others are a sanctuary of relaxation and rejuvenation. Planning for current and future uses will result in a bath room that is flexible, efficient, and multi-functional.

- **Assess existing fixtures and related equipment for efficient use of water.** Check for leaking pipes and fixtures. If your house was built prior to 1992 and without later fixture replacement, the plumbing fixtures would most likely need to be replaced to current low-flow standards.

- **Assess performance, durability and maintenance in selection of materials, appliances/equipment and finishes.**

- **Maximize fresh air ventilation.** Use operable windows and/or exhaust fans.

- **Install built-in and individually switched task lighting.** Consider using task lighting at vanities, water closets, tubs or showers to provide specific use lighting in lieu of general-purpose lighting.

Plumbing Systems/Water Conservation

- **Install water efficient toilets:** 1.6 gallons/flush (or less) or dual control flush toilets conserve precious potable water. The City offers rebates for low-flow and dual flush toilets.

- **Install or retrofit low-flow (1.5 to 2.5 gallons/minute) showerheads and faucet aerators.** Showerheads and faucet aerators pressurize tap water flow and mix it with air to produce a stream that quickly wets and rinses but uses 70 percent less water.

- **Consider a graywater recovery system.** Graywater systems use wastewater from washing machines, showers, tubs, and bathroom sinks to irrigate the yard. Wastewater from kitchen sinks, toilets, and diaper laundry are excluded.

- **Place water heaters closer to bathroom fixtures to minimize source to fixture distance.** Warm water will be available immediately and heat is not lost along the way.

- **Consider a hot water recirculation system.** A hot water recirculation system delivers hot water without waste. A pump circulates hot water in a pipe loop between the most remote plumbing fixture and the

water heater. Water and time is saved by having hot water available when needed. Energy is saved when the recirculation pump is activated by a timer or on-demand switch.

- **Tankless Water heater.** A tankless water heater heats water only as you use it and therefore saves energy.

Environmentally Responsible Materials

- **Maximize use of smooth, hard, nonabsorbent surfaces.** Non-porous surfaces prevent the development of mold and mildew, thus providing for optimum health and indoor air quality.

- **Caulk and seal joints between different materials and surface plane changes.** The caulking and sealing of joints can help to combat the negative effects of dampness and excessive moisture.

- **Use salvaged materials, such as existing fixtures or vanities.** This minimizes waste in landfills, recycles materials, and reduces costs.

- **Use recycled content materials in flooring and countertops.** This reduces material consumption and minimizes waste. Recycled content materials can include glass, metals and plastics.

- **Use paints/finishes with minimum VOC content.** Volatile Organic Compounds [VOC] are a class of chemical compounds that can cause short or long-term health problems.

Non-porous countertops, such as concrete or stone, have durable surfaces, are made from local resources and prevent the development of mold and mildew.

Additions and Enclosures Overview

When designing an addition, many considerations contribute to an environmentally responsible solution. An addition parallels the construction of a new home; involving structural, plumbing, electrical, and ventilation systems; each presenting possibilities for implementing green building principles. Adding one or multiple rooms to a previously existing home, enclosing an exterior covered area, and/or converting a garage to living quarters all enhance and extend the usefullness of an existing home.

A new addition presents opportunities for materials and systems that may differ from the existing structure. As long as the details are carefully considered, many materials can work together. Environmentally responsible options for consideration include salvaged materials and alternative wall systems such as metal stud framing, insulated concrete forms (ICF), autoclaved aerated concrete (AAC), structural insulated panels (SIP), integral insulated masonry, adobe, poured earth, and straw bale. The use of locally extracted and/or manufactured resources is an effective approach because of the reduced transportation costs, and support for the local economy. Information sources on the many material options suitable for an addition include City of Scottsdale Green Building Program, material manufacturers, publications and websites. See the resource list in the appendix.

Adding a second floor helps to conserve the site, maintaining naturally existing plant life and drainage ways. Additions create opportunities to utilize renewable energy such as a passive solar design, solar electric (photovoltaic) and solar hot water systems.

Roofing is an important element of environmentally responsible building. It protects the house from extreme climatic conditions such as the hot summer sun or monsoon storms. Roofing options include metal, rubber, or concrete, which are recyclable, reusable, and/or contain previously recycled material. In the Sonoran desert, light colored or reflective roof surfaces reduce heat impact. Durability is an important consideration in roofing material selection.

Once the addition and/or enclosure is completed, the owner can implement similar strategies through the remainder of the house and create a fully environmentally responsible building.

Light colored roofs reflect heat, therefore, keep interior spaces cooler during hot months.

Salvaged Lumber
Salvaged lumber can be the product of building deconstruction. The deconstruction process dismantles a building in order to salvage components for reuse or recycling. Salvaged materials conserve finite old growth resources.

Reused lumber can only be used for non-load bearing applications, unless determined otherwise by a structural analysis.

Engineered Lumber
Engineered lumber combines smaller pieces of wood into larger structural members. The benefits of engineered lumber are that it is stronger, straighter, easier to work with, uses more of the tree, reduces waste and therefore is more resource efficient than solid sawn lumber.

Resource Organizations Involved
The Engineered Wood Association, American Wood Council

For more information,
http://www.building-green.com/products/timberstandstuds.cfm

Additions and Enclosures Guidelines

Design Considerations

- **Consider the site microclimate impacts in the design to minimize or enhance conditions.**

- **Consider the new addition's relationship to the existing building and neighboring properties.** Think about how the new addition will impact the house, yard, and adjacent property.

- **Consider how rainwater runoff will impact the building and the site.** Capture, store and use rainwater for irrigation.

- **Evaluate the addition's solar orientation.** Orient the addition to minimize summer exposure.

- **Consider the impact of additional demands on the existing capacity of electrical, plumbing, heating, and cooling systems (HVAC).** Depending on the size of the addition, an upgraded electrical service may be needed, the plumbing supply line size may need to increase, and the air conditioning and heating system may need to be upgraded.

- **Consider existing room relationships and circulation patterns.**

- **Consider the use of windows for natural light and natural ventilation.** If designed carefully, an addition can improve both natural daylight and ventilation.

- **Consider use of salvaged building materials.** The use of savaged materials alleviates pressure on virgin resources and prevents usable materials from going to the landfill. Salvaged materials can also provide aesthetic character.

Structural Elements

- **Install non-asphalt based dampproofing at basement and/or retaining walls.** Asphalt below grade may contribute to ground water contamination from leaching petroleum and toxins.

- **Choose western coal fly ash to reduce use of Portland cement in concrete.** Fly ash is a waste product of coal power generating plants.

- **Select lumber from certified sustainable sources.** These materials use trees from sustainably managed forests. Look for FSC or FSI certified woods.

- **Use engineered lumber for floor and roof structures, beams and headers, and interior framing.** Engineered lumber is stronger and uses more of the tree, there by reducing waste.

- **Install low-toxic subfloor and/or sheathing.** Use exterior grade sheathing, which contains phenol formaldehyde because it is less toxic than urea formaldehyde, commonly used in interior grade sheathing.

- **Use an integral exterior wall system (multi functional system which combines structural, thermal properties and/or finish).** Consider integral insulated masonry, structural insulated panels [SIPs], insulated concrete forms [ICF], autoclaved aerated concrete [AAC], insulated sandwich panel [ISP], and solid foam wall panels as a wall system.

- **Use materials from local and regional resources and products.** Consider materials that are extracted and/or manufactured within 500 miles. Use of these materials (masonry, adobe, rammed earth, cast earth, straw bale) reduce transportation costs and support the local economy.

Roofing

- **Use recycled content roof material.** Consider metal, rubber and other alternatives.

- **Use high durability/low maintenance roof material.** Consider metal, fiber cement, concrete, slate, and clay. Consider a minimum 35-year manufacturer warranty for a shingle roof or use a bitumen underlayment for concrete/clay tile roof.

- **Use a reflective or light-colored roof surface to reduce heat gain.** Reflective and light colored roofs lower surface temperatures and reduce summer heat gain.

Exterior Finishes

- **Select regionally produced, manufactured and quarried materials.** Local material use minimizes energy and pollution associated with transportation, and supports the local economy.

- **Select reconstituted or recycled-content material for siding, fascia, soffit, or trim.** Reconstituted or recycled-content materials reduce the amount of new material used in production and reduces landfill waste.

- **Select engineered wood materials for sub-fascia, soffit, and trim.** Engineered lumber uses smaller strands of lumber that are laminated together. It uses more of the tree and reduces waste.

- **Use integrally colored stucco.** This provides a low maintenance, fade resistant, and durable finish.

- **Apply stucco directly to masonry or other cementitious wall systems.** The elimination of metal lath reduces the use of unnecessary resources.

- **Use fiber cement siding material.** Fiber cement siding is made with recycled content material from sawmill waste and Portland cement, and provides a strong, long lasting, and fireproof application.

- **Consider materials that can be used in their natural state.** The use of structurally sound, weather-resistant materials in their natural state for finished walls reduces costs associated with labor, materials and maintenance.

Waste Reduction

- **Plan for and implement a construction waste reduction and material reuse.** A construction waste reduction, recycle, and reuse plan reduces the amount of waste ending up in landfills. Construction debris now represents 50% of the volume of landfill waste.

- **Donate excess building materials**. Non-profit building organizations can utilize the material and/or resale as used materials. Donated materials are also tax deductible.

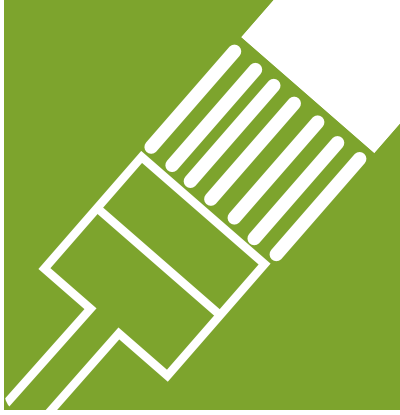
Certified Lumber
Certified lumber helps to ensure that logging and timber management activities protect the integrity of forests, both during and after harvest. This involves biodiversity, water quality, and economic and social responsibility criteria. Certified lumber results in better quality wood.

Resource Organizations Involved
Certified Forest Products Council, Forest Stewardship Council (FSC), Sustainable Forest Initiative (SFI)

Industry Standards
Certification standards vary slightly among organizations. However, the key principles are similar. In general, forest management practices must incorporate social and environmental criteria.

For more information,
www.certifiedwood.org

Room Improvements Overview



Remodeling can involve minor improvements to floor and wall finishes, doors, lighting, cabinetry and trim. Though these changes can be rather inexpensive, their overall impact on the home can be quite impressive. In addition to adding value and aesthetics to the home, remodeling a room can incorporate green aspects positively impacting health, efficiency, and sustainability.

Floors can include hard and carpeted surfaces. Though hard surfaces provide an easier method of achieving optimum indoor air quality and may help in passive heating and cooling applications, carpeted surfaces can also be an environmental consideration. Carpets can come from a recycled or natural fiber source; may be attached with tacks instead of adhesive; or be used sparingly, such as with area rugs. Other green flooring options range from finished concrete and tile to natural renewable materials.

Interior wall finishes typically include paint, plasters or wallpaper covering some form of wallboard. Conventional wallboard can be replaced in a green remodel using a wallboard made with agricultural material. Paints can be made with natural materials or be manufactured to have zero-VOC content. This eliminates offgassing that can negatively affect indoor air quality. Clay paints and plasters provide breathable, moisture regulating, and odor neutralizing surfaces. Adhesives, mastics, and sealants used in interior finish applications should be low, zero VOC, or water-based products.

Other interior components for consideration include doors, cabinetry, and trim. It is important to know that there are sustainable options. If wood is the preferred material, use domestic wood or wood selected from a certified sustainable source. In Arizona, common domestic woods include Ponderosa/Sugar Pine, Hem Fir, and Douglas Fir.

Lighting fixtures are a key element of a home and can often be updated at a lower long term cost. Incandescent bulbs can be replaced with non-incandescent lamps, creating substantial energy savings. Natural light is a resource that can be used to a homeowner's maximum benefit. Evaluate the balanced use of windows for natural light with respect to energy demand and ventilation benefits.

Daylighting strategies can be employed, and shading devices can be installed to minimize direct summer solar gain through windows. Light color wall and ceiling finishes improve daylighting distribution.

Room Improvements Guidelines

A cork floor is aesthetically pleasing, easy to maintain and is a rapidly renewable resource.

Finished concrete floors create smooth surfaces that are easy to maintain and stay cooler in the summer months.

Design Considerations

- **Incorporate opportunities to reduce, reuse and recycle.** Using this environmentally conscious attitude allows homeowners to optimize a number of existing materials in their home that can be incorporated into any remodeling project.

- **Organize rooms to make efficient use of space.** Improved use of space can reduce the need for room additions and/or enlargements.

Interior Finishes

Floors

- **Use water based finishes.** Avoid oil based finishes containing high VOC content.

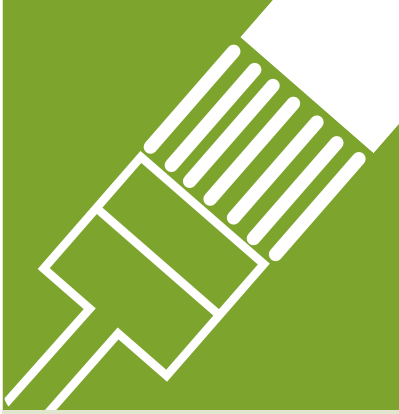
- **Install hard flooring for durability, maintenance and health effects.** Consider treating concrete as a durable floor surface to eliminate the cost of additional flooring materials.

- **Select regionally quarried stone.** Use of local materials minimizes energy and pollution associated with transportation, and supports the local economy.

- **Choose low-fired temperature tile.** This type of tile conserves energy in the manufacturing process (i.e. saltillo).

- **Install rapidly renewable resource flooring.** Bamboo and cork flooring, both durable and flexible materials, come from fast growing plants.

- **Install recycled content or reused flooring.** This reduces use of new materials and minimizes waste.



- **Install natural linoleum with low toxic adhesive or backing.** Natural linoleum is made from linseed oil, cork powders, tree resin, wood flour, clay pigments and a jute back. It is long lasting and is naturally anti-microbial.

- **Incorporate area rugs made of natural fibers or recycled materials.** Natural fiber carpets do not offgas like synthetic carpet.

- **Tack or tape carpeting and pad to avoid the use of toxic glues and adhesives.** This eliminates volatile organic compound [VOC] offgassing.

- **Minimize use of carpet.** Hard flooring can improve indoor air quality by: 1) eliminating the off-gassing that occurs from many synthetic carpets, and 2) eliminating the entrapment of organic and inorganic pollutants in carpets. (i.e. dust mites, pollen fungi)

Walls/Ceilings

- **Use wallboard made with recycled material.** Recycled content wall-board contains "synthetic" gypsum, a waste byproduct and reduces the demand of virgin gypsum mined from the ocean floor.

- **Use board materials made from agricultural based products (i.e., wheat, straw, rice).**

- **Apply zero VOC paint products.** Interior paints and finishes with no VOCs or ethylene glycol (EG) reduces negative effects on indoor air quality.

- **Select paints/finishes with minimum 20% recycled content.** Some local manufacturers provide standard colors and finishes with recycled content.

- **Use low toxic, solvent-free adhesives, mastics, and sealants.** This reduces toxic offgassing of VOCs and other toxic substances.

Interior Doors, Cabinetry and Trim

- **Select solid wood doors of domestic hardwoods or wood from certified sustainable sources.** A certified sustainably managed forest does not use clear cutting practices, and plants new trees for each cut in production.

- **Select composite doors made from non-toxic binders.** Toxic binders, such as urea-formaldehyde, off-gas chemicals such as VOCs, negatively impacting health and indoor air quality.

- **Select cabinet cases made from domestic hardwood or from certified sustainable sources.** This preserves endangered forests and supports managed forestry practices.

VOCs
Volatile Organic Compounds (VOC) are used as ingredients in household products such as paints, varnishes, binders, adhesives, sealants, wax, cleaning and disinfecting supplies, cosmetics, degreasing agents, hobby products and fuels. The use of products containing VOCs result in the release of organic compounds that can be harmful to you and your family. Several low-toxic products are available as alternatives to the use of these harmful substances.

Resource Organizations Involved
EPA, American Lung Association

Industry Standards
Standards for low-VOC paints have been established by the non-profit organization, Green Seal, which has set the following VOC limits: for flat paints, 50 g/L (grams per liter); for non-flat paints, 150 g/L. For standards relating to other finish applications, visit Green Seal's website at www.greenseal.org

For more information,
www.epa.gov/voc.html

Room Improvements Guidelines (continued)

- **Improve indoor air quality by blocking toxics from outgassing.** Seal all exposed substrate materials containing formaldehyde with water-based formaldehyde blocking finishes.

- **Use a formaldehyde-free casework.** Cabinets made from formaldehyde-free particleboard or medium density fiberboard [MDF] improves indoor air quality.

- **Install pre-finished cabinets or use a on-site applied finishes with low toxicity.** Pre-finishing cabinets off-site minimizes harmful VOC exposure to laborers and inhabitants on-site. Use a low toxic finish to avoid potential harm from VOC exposure.

- **Consider using recycled content countertops.** This reduces material consumption and minimizes waste. Recycled content materials can include glass, plastics, metals, and paper.

- **Consider regionally quarried or processed countertops.** Local/ regional materials such as concrete, stone and tile reduce costs and pollution related to transportation and supports the local economy.

- **Install finger-jointed/engineered wood for interior trim.** Finger jointed or engineered wood trim originates from small pieces glued together. This reduces waste by using more of the tree.

- **Avoid using tropical woods.** This preserves endangered forests.

- **Minimize the use of wood-base, crown moulding, door and window trim.** The elimination of wood trim reduces the excessive use of wood.

Waste Reduction

- **Recycle waste materials and product packaging.**

Recycled Content
Recycled content refers to any of the following: post consumer waste (the garbage that individuals routinely discard), post-industrial waste (generated as a by-product of a given process) and/or recovered materials. There are building materials made from recycled content (insulation, plastic lumber, tiles) that are market ready, competitively priced and perform as well as virgin products. As a general rule, recycled content products contain a minimum threshold of 20% of the recycled material.

Resource Organizations Involved
For information on where or how to buy recycled building products, call the Recycling Hotline toll free at 1-877-STOPWASTE or visit www.stopwaste.com

For more information,
www.nol.org/home/NEO/home_const/recycled_content.htm

Resources

Sonoran Desert Ecosystem
Desert Naturalist
www.arizonensis.org/sonoran/index.html

Sonoran Desert
www.desertusa.com/du_sonoran.html

Energy
Alliance to Save Energy
www.ase.org

Arizona Energy Office
www.azcommerce.com/energy

Arizona Solar Center
www.azsolarcenter.com

Center for Renewable Energy and Sustainable Technology (CREST)
www.crest.org

Energy & Environmental Building Association
www.eeba.org

ENERGYguide
www.energyguide.com

Energy Star
www.energystar.gov

Home Energy Saver
http://hes.lbl.gov

Photovoltaics for Buildings
www.nrel.gov/buildings/pv

National Renewable Energy Laboratory (NREL)
www.nrel.gov

Southwest Energy Efficiency Project (SWEEP)
www.swenergy.org

State Incentives for Renewable Energy
www.dsireusa.org

Tucson/Pima County Metropolitan Energy Commission
www.tucsonmec.org

US Department of Energy, Renewable Energy
www.eere.energy.gov

Water Efficiency
Arizona Municipal Water Users Association
www.amwua.org

Desert Botanical Garden
www.dbg.org

Forgotten Rain
www.forgottenrain.com

Landscaping in Arizona
www.gardeninginnevada.com

Rainwater Harvesting for Drylands
www.harvestingrainwater.com

Water CASA, Graywater Guidelines
www.watercasa.org

Water: Use It Wisely
www.wateruseitwisely.com

Xeriscape
www.xeriscape.org/xeriscape.html

Indoor Environmental Quality
American Indoor Air Quality Council
www.iaq-council.org

American Lung Association Health House
www.healthhouse.org/index.asp

Environmental Protection Agency, Indoor Air Quality
www.epa.gov/iaq

The Healthy House Institute
www.hhinst.com

Materials and Reuse
a.k.a. Green
www.akagreen.com

Arizona Resource Exchange
www.azrex.org

Center for Resourceful Building Technology
www.crbt.org

Eco-Logic Foundation
www.eco-logicfoundation.org

Green Building Pages
www.greenbuildingpages.com

Green Building Resources Guide
www.greenguide.com

Green Spec
www.buildinggreen.com/menus

Greener Bulilding
www.greenerbuilding.org

Habitat for Humanity -
Discount Home Improvement Center
www.habitataz.org

Oikos: Green Building Source
www.oikos.com

Stardust Building Supplies
www.stardustbuilding.org

Remodeling Guides

Alameda County Green Guidelines
www.stopwaste.org/home/index.asp?page=488

Green Home Guide
www.greenhomeguide.com

Seattle Green Home Remodel Guides
www.seattle.gov/sustainablebuilding

Other Resources

Alamedea County Green Building
www.stopwaste.org/home/index.asp?page=469

Building Science Corporation
www.buildingscience.com

City of Austin
www.ci.austin.tx.us/greenbuilder

City of Santa Monica
www.greenbuildings.santa-monica.org

City of Scottsdale
www.scottsdaleaz.gov/greenbuilding

City of Seattle
www.seattle.gov/sustainablebuilding

City of Portland
www.green-rated.org

Colorado Built Green
www.builtgreen.org

Development Center for Appropriate Technology
www.dcat.net

Environmental Building News
www.buildinggreen.com

GreenBuilding.com
www.greenbuilding.com

Green Matrix
www.greenmatrix.com

Green Seal
www.greenseal.org

Healthy Home Plans
www.healthyhomeplans.com

National Association of Home Builders
www.nahbrc.org/greenguidelines

Natural Home and Garden
www.naturalhomemagazine.com

Oasis Design
www.oasisdesign.net

Permaculture
www.attra.ncat.org/attra-pub/perma.html

Public Technology: Green Buildings Technologies
www.pti.org/greenbuildings

Rocky Mountain Institute
www.rmi.org

Smart Communities Network
www.sustainable.doe.gov

Southface Energy Institute
www.southface.org

Sustainable Architecture, Building and Culture
www.sustainableabc.com

Sustainable Building Industry Council
www.SBICouncil.org

Sustainable Sources
www.greenbuilder.org

The Urban Forum
www.urbanforum.org

US Green Building Council
ww.usgbc.org

For more information on the City of Scottsdale Green Building Program, visit
www.ScottsdaleAZ.gov/greenbuilding

Glossary

A

Active Solar Heating - A space heating approach using mechanical and electrical systems to move air or liquid through a sun-exposed collector, and to transfer the captured heat or energy to storage for direct or later use.

Active Solar Water Heater - A solar water heating approach using mechanical and electrical systems to circulate liquid through a sun-exposed collector and move the heated liquid to storage. Variations include using water directly in the system, or using a high thermal capacity liquid to capture solar heat and a heat exchanger to transfer the captured heat to house water.

Agricultural By-Products - Products developed in agriculture that are not the primary goal of the agricultural activity. Some by-products are used as building materials, i.e. wheat board.

Agricultural Fiber - Agricultural fibers such as cotton as insulation materials or straw used in fiber board.

Air Infiltration Barrier - "Housewraps", reduce air infiltration and improve energy performance while releasing trapped moisture.

Asbestos - A mineral fiber commonly used in older building construction materials (older than 20 years). Asbestos fibers have been connected to lung disease and cancer.

B

Borate-Treated Products- Borate, a mineral product from borax, is commonly used to treat wood, insulation, and other materials for insect and moisture protection.

Buffer Zone - Temper the surrounding environment by reducing the extreme temperature range between the exterior and interior, thus reducing energy costs. Trees and trellises with vines protect outdoor spaces.

British Thermal Unit [BTU] - A measure of heat energy; the amount needed to raise the temperature of one pound of water by one degree Fahrenheit from 70 to 71 degrees.

Building Envelope - The total area of the floor, walls and roof separating the interior volume from the outside environment.

C

Carbon Dioxide [CO^2] - A colorless, odorless, incombustible gas considered to be a major contributor to global warming. It is a by-product of all combustion processes.

Carbon Monoxide [CO] - A colorless, odorless gas resulting from incomplete combustion. Sources include: gas stoves, fireplaces, kerosene appliances, tobacco smoke, and automobile exhaust. Carbon monoxide can cause sickness or death.

Casework - All components of cabinetry; excluding the doors. Casework includes the back, sides, and face frames.

Cellulose - Fibrous plant material used in making paper, textiles, and building products.

Cellulose Insulation - Cellulose insulation made from recycled newspaper.

Cementitious - Having properties of cement. Cement is the primary binding agent in concrete.

Cementitious Foam Insulation - A magnesium oxide-based material blown with air to create an inert, effective insulation. It may be especially helpful for people with chemical sensitivities.

Certified Products from a Sustainably Managed Forest - Certifying organizations oversee the harvesting of lumber. The underlying guideline of these organizations is a focus on preserving a diverse forest that exhibits the same ecological characteristics as a healthy natural forest.

CFC/HCFC - Chlorofluorocarbon [CFC] and hydrogen chlorofluorocarbon [HCFC] represent major contributors to the destruction of the earth's ozone layer.

Composite Wood Products - Building materials using wood fibers, flakes, chips or shavings, veneers or paper. During the manufacturing process, these materials combine with different glues, resins, water repellents and preservatives to produce sheet boards.

Compost-Connected Disposal - A disposal system that grinds food waste into a container and separates waste from water. The contained food waste then goes to a composting system.

Compost System - A compost system converts organic waste (food, plant material) into a rich fertilizer.

D

Daylighting - Use natural light to full advantage to minimize artificial light usage during the day. This reduces energy consumption and cooling costs.

Deciduous - Trees and plants that shed their leaves at the end of the growing season.

Domestic Wood - Wood grown in North America. Examples include Pine, Hem Fir, Douglas Fir, Maple and Oak.

Drip Irrigation - Low pressure watering system that releases small, steady amounts of water through emitters placed near individual plants.

E

Earth Sheltered Design - Houses designed partially or totally below ground, or with berming, or by filling over parts of the structure. Earth sheltered designs use the temperature of the soil to improve energy efficiency.

Embodied Energy - The total energy invested in bringing a product or material into use, including resource extraction, processing, manufacturing, transportation, and installation.

Energy Efficient Appliances - Energy Guide labels on appliances show energy efficiencies in dollar amounts on a comparative use basis. The American Council for an Energy Efficient Economy [ACEEE] publishes energy ratings of commonly used appliances.

Energy Efficient Lighting - Lighting systems, fixtures and bulbs that provide optimum illumination at minimum energy consumption and heat generation. This includes motion sensors and photoswitches.

Energy Recovery Ventilator [ERV] with Humidity Regulation - An ERV creates decreased or increased humidity as needed in incoming air for ventilation. During the summer, heat is removed from incoming outside air through an exchange with exhausted air.

Evapotranspiration - The process of water loss from plants and vegetation by both evaporation, and transpiration during the oxygen production process.

Exterior Grade Plywood - Uses phenol formaldehyde (a toxic adhesive substance) that offgasses in much smaller amounts compared to urea formaldehyde, often used in interior grade plywood and particleboard.

Exterior Tempered Pockets - Protected exterior areas surrounding windows and doors that create a temperate transition between outdoors and indoors. This strategy minimizes interior cooled air or heated air losses from opening and closing doors and windows.

Glossary

F

Fascia - An architectural feature consisting of a flat member of a building, roofline band or broad fillet. The flat board or element that occurs at the ends of a roof eave or overhang.

Fenestration - The arrangement of windows in a building.

Formaldehyde - A colorless, pungent smelling material used as an adhering component in many wood products and can cause respiratory problems, cancer and chemical sensitivity.

Fresh Air Ventilation - Ventilation that provides a fresh source of outdoor air that helps dilute indoor pollutants.

G

Global Warming - Global warming refers to an average increase in the Earth's temperature, which in turn causes worldwide climate changes such as rainfall patterns, as well as impacts on sea levels, plants, wildlife, humans and water temperature. Human activity and industrial development contribute to global warming.

Gray water - The wastewater produced from baths, showers, wash basins, and clothes washers, excluding kitchen sink and toilets. This water can be diverted and used for landscape irrigation.

Gypsum/Cellulose - An interior wallboard product that uses cellulose from recycled newspapers for facing and gypsum and perlite on the interior.

H

Harvested Rainwater - The rain that falls on a roof or yard and channeled by gutters, drains, scuppers, swells, and/or berms with or without a storage tank for landscape irrigation.

Healthy Home - A 'healthy home' design ensures its inhabitants can breath clean air and drink clean water. It provides an environment safe from the hazards posed by air and water pollution from outside sources such as lead, radon, pesticides and carbon monoxide. A healthy home reduces the chances of allergic reactions and asthmatic attacks caused by pollens, dusts and other outdoor pollutants. A healthy home minimizes indoor pollutants, such as volatile organic compounds [VOCs], asbestos, combustion products and microbiological organisms that cause respiratory problems.

High Quality Duct System - Technical tools are used by professionals to optimize duct performance design. Seal all ducts (both inner and outer linings) by using a fibrated latex mastic and fiberglass tape, or metal tape meeting SMACNA Standard 181, not by duct tape. The air handler, support platform, and return plenum are sealed airtight at all joints. Duct tape is not used in any part of the system. The system is performance tested to ensure proper installation.

I

Indigenous Stone - Stone from the southwest region.

Indoor Environmental Quality - The quality of an indoor environment that affects the health and well-being of occupants.

Insulated Masonry - Reinforced (rebar and grout) cementitious blocks integrally insulated with Expanded Polystyrene [EPS], Polyurethane or other insulation material. Some systems utilize the thermal mass properties of the block as well.

Integrated Pest Management - Integrated pest management is a decision making process that uses a combination of techniques to reduce pests. Some techniques include planning and managing ecosystems to prevent organisms from becoming pests; identifying potential pest problems; and monitoring populations of pests and beneficial organisms, pest damage and environmental conditions.

G

K

Kilowatt-Hour (kWh) - A measure of electric usage equivalent to the use of 1,000 watts for one hour.

Kitchen Recycling Center - A built-in section of the kitchen cabinetry that allows convenient separation and storage of recyclable materials.

L

Lead - A harmful environmental pollutant that is typical in older homes with lead-based paints and in the lead solder used in plumbing. Lead is toxic to many organs and can damage the brain, kidneys, and nervous system.

Least-Toxic - This characterization of a building material for the Green Builder Program indicates that urea formaldehyde is not present and/or VOC contents are minimal and/or water-based constituents are used. Products that have been certified to be 'least toxic' by certification groups such as Green Cross, Green Shield, and Eco-Logo (Canada) qualify for the Green Builder Program.

Life Cycle - A life cycle assessment [LCA] is an objective process to evaluate all the environmental burdens of a product or process through its entire existence. This encompasses extracting and processing raw materials, manufacturing, transportation, distribution, use and maintenance, recycling and final disposal.

Linoleum - Natural linoleum is an enduring finish surface manufactured from a number of natural renewable ingredients, including linseed oil, cork powder, wood floor and limestone residue. It can be used on floors, countertops, desks and other surfaces without sacrificing indoor air quality.

M

Microclimate - The climatic conditions surrounding a building or home. This is affected by elements such as ground cover, tree canopy characteristics, solar access, presence of water, on-site raw materials, topographic rise, soil characteristics, wind patterns, etc.

Mold/Mildew - Mold is a fungi that grows with the presence of a food source, a certain temperature, and moisture. Mildew commonly refers to the discoloration caused by mold in buildings.

O

Old Growth - Wood from trees found in mature forests. In many cases, the trees have never been exposed to logging operations. In the northwest United States, only about 10% of these biologically rich areas are left. It is difficult to know which wood is from old-growth areas when buying wood locally.

Organic Waste - Natural materials, such as food and yard waste that decompose naturally.

Offgas - The emitting of fumes into the ambient air.

P

Passive Design - Building design that uses site, vegetation, natural processes, elements, and materials attributes coupled with building orientation, spatial placement, and materials selection to provide non-mechanical use of, and/or mitigation to, diurnal and seasonal conditions to achieve human comfort and minimize resource and energy consumption and costs.

Passive Cooling - Non-mechanical and electrical approaches to establishing a cool environment by using naturally existing amenities-site and vegetation, orientation, building form and shape, materials, spatial planning, natural ventilation and illumination-thus eliminating or reducing cooling equipment and energy bills.

Glossary

P (continued)

Passive Heating - Non-mechanical and electrical approaches to establish a warm environment through orientation, building form, shape and materials, and spatial planning. Capture solar heat within the interior surfaces (walls and floors) that store the warmth and release it as colder temperatures occur. These strategies lead to the elimination or reduction of heating equipment and energy bills.

Passive Solar Water Heater - A solar water heating panel and storage system that does not require mechanical pumps or controls or electricity to create hot water for domestic use. There are several types available commercially, as well as information resources for do-it-yourselfers.

Passive Solar Techniques - The natural use of solar radiation to heat or cool a building.

Perlite - A natural volcanic glass that expands with heat and transforms into a fluffy form that can be used for insulation purposes. Its drawback is that it will settle over time.

Permeable - Permeable refers to a material that allows water or air to pass through thus minimizing heat radiation or water runoff. Examples include spaced pavers or decomposed granite.

Pervious Paving - Paving material that allows water to penetrate to the soil below.

Photovoltaic - The process of converting sunlight directly into electricity. The electricity is either used immediately, stored in batteries or sold to a utility. Costs continue to drop and efficiency is improving for this technology. Scottsdale has excellent sun conditions for using photovoltaics.

Potable Water - Drinkable water.

Pressure-Treated Wood - As of January 1, 2004, wood-treating companies can no longer buy and use CCA (chromated copper arsenate) for treating wood products for most residential applications per the US Environmental Protection Agency (EPA). Alternatives to CCA treated wood include ACQ (ammoniacal copper quaternary), copper azole and borates. Borates are considered fine for applications where the wood is protected from moisture, but not for use outdoors or in-ground contact. Borates also provide non-toxic protection against insects and fungi, as well as increases the fire resistance of wood.

Programmable Thermostat - A mechanical or electronic device that regulates the temperature setting and time of day operation of heating and cooling systems. The user determines the temperature and time of day settings so that optimal efficiency is attained while maintaining comfort levels.

Proper Ventilation - Combustion gases are vented completely to the outdoors. Combustion gases that escape into a living space can pose a health hazard.

R

R-value - R-value rates insulation and building materials in terms of thermal resistance, which indicates the resistance to heat flow. The higher the R-value, the greater the insulating effectiveness. The R-value of thermal insulation depends on the type of material, its thickness and density.

Radiant Barrier - A layer of metallic foil that reflects thermal radiation without transferring heat to other materials.

Radon - A radioactive, colorless, odorless gas that occurs naturally in the earth. When trapped in buildings, concentrations build up, and can cause health hazards such as lung cancer.

Rain Sensor - A simple, inexpensive device that measures rainfall and prevents unnecessary irrigation when used with an automatic controller.

Rammed Earth - A building technique for exterior walls where earth is 'rammed' (or pressed down) between forms. Mixture of earth, water and stabilizer are used in this technique to harden under pressure and form a strong solid wall, which is then covered by a weatherproof sealer.

Reconstituted - The process of taking small pieces of material and binding them together to form a larger item. Examples include wood chips that are adhered together to form substrates and/or structural components in trim, doors, windows, structural material, and sheet materials. Finger jointed and laminated materials are other examples.

Recycled Content - Recycled content refers to building products that contain any of the following: post consumer waste, post industrial waste, industrial scrap, pre-consumer materials, and/or recovered materials.

Recycled Plastic Lumber - Recycled plastic made into lumber that is workable like traditional wood lumber. It is insect and water resistant.

Recycled Roofing - A roof system that reuses existing building materials.

Renewable Resource - Any natural resource, such as certain woods or solar energy, that is replenished naturally.

Run-off - Water from rainfall or irrigation that is allowed to flow off the property. Run-off is considered a lost resource and a contributor to non-point source pollution.

S

Soaker Hose - Low-flow watering device with small holes throughout the surface of the hose. Good for plant beds and gardens.

Soil Moisture Sensor - A device that can be attached to any automatic irrigation system that monitors the water available to plants and allows irrigation only when the soil moisture level drops below the desired level.

Soffit - The underside of a projection, sucah as a roof overhang.

Straw Bale Technique - A construction system that uses bales of straw as non-structural exterior walls within a structural frame. This provides a highly insulative barrier to undesirable heat flow.

Straw-Mud - This is an old building technique for exterior walls where earth material is mixed with straw, moistened and pressed between forms where it hardens into a strong wall. It is covered with a waterproofing plaster system.

Substrate - An underlying support or foundation, as for a building.

T

Thermal Chimney - An element or device of a building where solar heat or thermal currents are controlled in a manner that stimulates an updraft and exhaust of heated air. This can be used directly to heat space or can draw in fresh air to occupied areas of the building through open windows or vents for a passive cooling method.

Thermal Envelope - The shell of a building that essentially creates a barrier from the elements. A highly insulated thermal envelope allows maximum control of interior temperatures with minimal outdoor influence.

Thermal Mass - Materials that absorb heat or coolness and retain it for long periods of time. Water and masonry materials can provide thermal mass. Such materials respond slowly to rapid temperature change. Thermal mass is an important aspect of any passive heating or cooling system.

Glossary

T (continued)

Traffic Flow Pattern - Refers to the way a building's inhabitants travel through the interior space.

Tropical Hardwood - Wood products harvested from tropical rainforests. Tropical forests are not being harvested in a well-managed manner except in a few isolated cases. Certification efforts indicating sustainably harvested woods are just beginning.

U

U-factor - U-factor is a measurement of the heat transfer coefficient of a material or an assembly of materials. It is measured in terms of Btu per hour, per square foot of area, and/or per degree of temperature difference across the material. The lower the U-factor, the better the resistance to the heat flow.

V

Vapor Retarder - A continuous plastic membrane that surrounds the entire thermal envelope of a house and prevents moisture penetration into the wall cavity. This is generally not required in the Scottsdale climate for moisture control, but may serve as an effective air infiltration barrier.

Ventilation - A natural or mechanical system in a building that provides fresh air.

Volatile Organic Compounds [VOC] - A large family of chemicals including all organic compounds containing hydrogen and carbon that vaporize at room temperature and pressure. They are found in many indoor sources, including many common household products and building materials. Finishes that contain VOCs can function as sealants, preventing offgassing of other toxic substances. There are commercial brands of finishes available that minimize the VOC content. Only these brands should be used and care must be taken in their application. Once thoroughly dried, they do not pose a health hazard.

W

Waste Heat - Heat that escapes to the atmosphere during a mechanical or fuel combustion process. Minimizing and recapturing waste heat is a valuable energy conserving strategy. For example, in homes there may be flues from wood-burning stoves and/or heat pump fluids, where the waste heat can be captured for other uses such as preheating domestic hot water. Waste heat from electrical and mechanical equipment and devices, and from disposed bath and laundry water can also be captured and used.

Water Budget - This is the calculated amount of water a household should use based on the type and number of fixtures, landscape requirements, and size of the family. City of Scottsdale can assist in developing your budget.

Water Conserving Irrigation System - Drip irrigation, soaker hoses, bubblers and low-trajectory spray heads for water distribution, zoning irrigation for different water demand plant types, electronic timers with five-day programming and rain override devices, irrigation schedules for early morning watering every five to seven days, and soil moisture sensors are the possible components for a water conserving irrigation system.

Water Purification - The process of removing impurities to create potable water.

Watt - A unit of power indicating the rate at which work is done. The faster an agent can do work, the more powerful it is, and the higher its wattage.

Whole-house Fan - A fan that is typically centrally located in the ceiling of the house. It pulls house air up into the attic area where it vents to the outdoors. The house air is replaced by outdoor air through open windows and screen doors when outside temperatures have cooled down in the evening. This is a less costly way, financially and environmentally, to cool a house.

Work Triangle - An efficient organization of space connecting the three major work areas of a kitchen: the cleaning area (sink), the cooking area (range or cooktop) and the cold storage area (refrigerator). More trips are made within this triangle than to any other areas in the kitchen.

X

Xeriscape - The climate and special beauty of the desert southwest are valuable resources enjoyed by many. With limited rainfall and high temperatures, water is a vital resource. The valley of the sun receives annually about seven inches of rainfall per year and loses much more than that through evaporation and human usage. The seven xeriscape principles are: good planning and design, practical lawn areas, efficient irrigation, soil improvement, use of mulches, low water demand plants, and good maintenance.

Z

Zoned HVAC System - A single zoned Heating, Ventilaiton and Air Conditioning (HVAC) system is an area of a building that is supplied with conditioned air from one mechanical unit and controlled by one thermostat. A multi-zoned HVAC system can provide better efficiency and comfort because the temperature levels can be set independently for each zone based on use, site orientation, time of day and season.

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