GUIDE to the SINGLE-FAMILY HOME RATING

Version 2010.1
Austin Energy Green Building
Single-Family Program

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Disclaimer

The purpose of this Guide is to explain and clarify the Green Building Measures listed in the Austin Energy Green Building Single-Family Home Rating, Version 2010.1.

It reflects best practices known at this time by the Austin Energy Green Building staff for design and construction in the conditions of Central Texas. It is not intended to eliminate or substitute for the designer's and builder's own judgment or accepted engineering and construction practices.

Implementation of specific measures must be made in compliance with all current building codes and local, state, and federal regulations. Health and safety measures are not intended as medical advice.

Austin Energy Green Building relies on its participants to submit accurate rating information to the best of their ability.

Web sites and References

Please note that web sites and references may change and/or material may become outdated.
GUIDE to the
SINGLE-FAMILY HOME RATING
VERSION 2010.1

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INTRODUCTION: WHAT MAKES A HOME GREEN?

The Austin Energy Green Building (AEGB) Single-Family Home Rating assesses the design, construction, and performance of new homes according to a set of Basic Requirements for all Ratings and the extent to which they incorporate a set of recommended green building Measures For Points. The Rating also serves as an educational and marketing tool for AEGB participants and homebuyers and provides a handy means of comparison for both building professionals and homebuyers.

*It is crucial to recognize that a home could incorporate many of the measures listed below, achieving a high number of points, and still not be a high-quality green home. This could happen if the measures are not combined in a holistic way and in accordance with a clear understanding of building science. The home performance tests measure many aspects of building quality (mainly envelope and duct tightness and air pressure and movement) but cannot measure many others. AEGB encourages architects, designers and builders to improve their knowledge of building science in order to design and build homes that work as intended over a long lifetime.*

This Guide is intended for use as a handbook for building professionals that accompanies the Rating.

In order for the AEGB Rater to assess and rate a home, there must be some consensus regarding what a green home is. There is broad agreement nationally and across many disciplines and professions that in order for a home to be labeled “green,” it must address several concerns related to the environmental impacts of the building industry and the residential sector of the U.S. economy. These concerns can usually be divided into the five environmental impact topics listed below. Each topic can include several design, specification, construction, and performance steps and some are relevant to several different building professions and trades. In addition, the scope of each topic will vary significantly with geography, climate, demographics, and building practices.

- **ENERGY**
- **WATER**
- **MATERIALS AND PRODUCTS**
- **HEALTH AND SAFETY**
- **COMMUNITY**

**Energy**

Energy affects all facets of home design, construction, and operation, from drawing the initial plans to installing light bulbs and operating appliances. Energy use over the lifespan of a building may be the single most important environmental and economic issue to address in a home. Excessive fossil-fuel energy that is used to power our homes results in significant environmental impacts on a local as well as global scale, and unnecessarily increases the home’s annual operating and maintenance costs.

The green building measures listed in the Rating address the issue of energy-efficiency for the entire life of a home – starting with design, through the construction process, including operation and maintenance, and even considering repair and remodeling. Design techniques, such as placing the home on its site to best respond to climatic conditions and site characteristics, are strongly encouraged. In Central Texas, where hot, humid conditions prevail, mechanical cooling is typically the largest energy-user in homes. Many of the listed green building measures, therefore, address ways to keep a home cool by *design* measures, such as shading, proper sizing and placement of windows, and a “cool roof” assembly.
Proper construction of the thermal enclosure is critical in building an energy-efficient home, both in terms of products selected and quality of workmanship. There are several locations in a home’s exterior walls and roof, especially in wood frame construction, where air leakage is a particular problem. These include electrical boxes and services, framing around doors and windows, basement walls at sill plates and headers or band joists, the top of interior partitions and exterior walls, exhaust fans and dryer exhausts, plumbing vent pipes or stacks, supply and return pipes for air conditioning systems and heat pumps, and any other locations where exterior walls and ceilings are traversed by services, vents, and pipes. Openings such as these allow air to exfiltrate or infiltrate, and must be properly sealed to protect insulation, reduce drafts, reduce heating and cooling costs, and to avoid warranty repairs after construction has been completed.

Air barriers are systems of materials designed and constructed to control airflow between a conditioned space and an unconditioned space. The air barrier system is the primary air-enclosure boundary that separates indoor (conditioned) air and outdoor (unconditioned) air. To function properly in the long term, an air barrier must be durable, strong, and continuous. A house wrap or gypsum-board product facing the interior side of an exterior wall and partially supported on the other side by insulation can act as an air barrier. Homes that have a properly installed air barrier system can operate properly with a smaller cooling system since the cooling load does not have to compensate for a leaky building. To be contiguous, interior air barriers must not be missed in such locations as the attic-side of knee wall insulation and interior side of tubs, showers, and fireplaces on exterior walls.

A house cannot be too air-tight (but it can have too little controlled ventilation). When people speak about walls needing to breathe, they mean that water vapor (not air) should be able to pass through walls and dry to either side. The Central Texas climate includes quite a few cold days, as well as many hot, humid days, so sometimes walls need to dry to the outside and sometimes to the inside.

The quality of workmanship of the cooling system, especially the duct and air-supply components, is especially critical to efficient cooling of homes. High-efficiency heating and cooling systems, well-sealed ductwork, sufficient and controlled ventilation, and proper controls are all key components of an efficient HVAC system. Consequently, many of the green building measures focus not just on the equipment and materials selected, but also on the proper installation and quality of construction of cooling system components.

Using products such as high-efficacy lighting and ENERGY STAR appliances can significantly reduce operating energy use. Implementation of these green building measures results in a home that is both energy-efficient and less costly to operate and maintain.

In addition to energy conservation and efficiency measures, points are also awarded for the use of renewable energy sources, including both “passive” and “active” techniques. Passive techniques such as natural ventilation, shading and daylighting must be considered during the design phases of the project. Active systems appropriate for residential applications include solar water heating and solar photovoltaic power systems. With a substantial amount of average annual sunshine, solar water heating devices for domestic water and swimming pool heating and photovoltaic systems that provide electric power for homes can perform well year-round in Central Texas.

To assess the quality of workmanship of a home’s thermal-envelope/enclosure and the HVAC-system installation, various tests must be conducted by a qualified 3rd-parter tester (not the same person or company that installed the system), as required by City of Austin code amendments. These tests include a duct-leakage test, envelope/enclosure air leakage, static pressure test, supply airflow, return-air sizing and combustion-gas back-drafting. In most cases, one person can perform all the tests in one visit at a modest cost that will be quickly recouped by the homeowner by reduced utility bills.

**Water**

Water use in Central Texas has dramatically increased with the rapid growth of the area’s population. Water use has reached near capacity levels during several summers over the past decade. In addition, water quality issues have entered the limelight as development moves to the outskirts of towns into environmentally sensitive areas. Competing uses for water – domestic, industrial, agricultural, and recreational – will further aggravate the situation in the near future.
Green building measures under this topic include indoor and outdoor uses. With the recent inauguration of the federal WaterSense program, high-performing, low-flow plumbing fixtures are now readily identifiable and available. In summertime our outdoor water-use is the bigger challenge—more than double wintertime use in Central Texas, mainly due to landscape watering, particularly turfgrass. Hence, climate-appropriate landscaping, organic mulch and soil amendments, and rainwater catchment are top concerns.

**Materials and Products**

Green building measures address four issues associated with the use of building materials and products: resource depletion, environmental burdens of manufacturing, product durability, and construction waste management. In addition to using environmentally preferred materials and products, measures that can reduce the amount of materials and products that go into a home are also listed. Low-maintenance and durable materials and products reduce replacement and repair. Planning ahead for change can facilitate future remodeling.

Green materials and products are ones that have a high measure of the following attributes:

- Reused or salvaged
- Recycled-content and recyclable
- Resource-efficient during production and/or installation
- Rapidly renewable
- Low embodied-energy
- Locally produced
- Durable, low-maintenance
- Low in toxins
- Recyclable
- Biodegradable

It is extremely difficult to accurately assess the environmental performance of a building material or product over its entire life cycle. In many cases, AEGB relies on third-party certification organizations to help with this task. For example, the Forest Stewardship Council (FSC) certifies wood products that come from sources that follow a set of FSC sustainable-forest-management practices. Thus, several of the green building measures mention FSC-certified wood. Other recognized third-party certification organizations include Green Seal, GreenGuard, and ENERGY STAR.

In Central Texas, there is an abundant supply of locally produced building materials and products. Stone such as granite and limestone are durable, no-maintenance building materials. Local wood such as cedar/juniper, often cleared from property prior to development, is a good choice for casing, trim, and cabinetry. Local hardwoods, locally milled, like pecan and mesquite, make easily maintained, durable flooring materials. In addition, composite recycled wood/plastic decking and trim products are manufactured in the region.

**Health and Safety**

Health concerns have increased in prominence as homes have become tighter and more energy-efficient. In addition, modern building materials and products are typically highly processed and may contain chemical compounds that are irritants to some people when used under indoor conditions.

The three ways to improve indoor conditions are a) eliminate or reduce the source, b) adequately ventilate the space, and c) provide filtration of the indoor air. Green building measures include all three of these. Eliminating or reducing the source of indoor pollutants and contaminants is the best strategy. Examples are low-VOC and no-added-VOC paints, no-added-formaldehyde cabinets and insulation, and having the garage detached from the house. The second group of options includes installation of exhaust fans and outside air intake. Installing pleated-media or electronic filters are examples of implementing the third strategy.
Humidity control is extremely important in Central Texas homes. High humidity conditions that foster mold and mildew growth consistently occur year-round. Poor construction methods and over-sized cooling systems exacerbate this problem. The source cannot be easily eliminated—mold is everywhere—so mechanical ventilation and dehumidification are often the best solutions for discouraging growth. In addition, installing a hygrometer to measure humidity levels in a home is strongly recommended to help occupants become aware of how they operate their home.

For outside the home, good pest-management practices are probably the most critical health and safety issue. Many steps can be taken to avoid the use of chemical pest treatments. Keeping wood away from the soil, installing physical termite barriers, treatment with non-toxic materials, and proper landscaping—these are all important considerations.

Community

Green building measures under this topic improve the quality of “community” in Central Texas. They include location of a home near “life-support systems” of jobs, shopping and recreation. They include design features, such as front porches to encourage neighborhood interaction and safety.

Visitability, accessibility and universal design measures can potentially extend the useful life of a home for its occupants as they grow older or become infirm, or simply make a home more livable for anyone who may experience temporary mobility problems from a sports injury or accident. Homes built under the City of Austin’s S.M.A.R.T. Housing Program must comply with Austin’s Visitability requirements.

Small lots and lots with garage apartments and “granny flats” improve affordability and neighborhood diversity.
HOW THE SINGLE-FAMILY HOME RATING WORKS

Star Ratings
The Rating has five levels indicated by stars: One Star is the entry level, Five Stars the highest or “greenest” level.

Basic Requirements
All of the Basic Requirements must be fulfilled for a home to qualify for a Rating. (See page 2 of the Rating.) Compliance with all of these measures satisfies the requirement for a 1-Star Rating (without any additional points needed from Section B, the a la carte “Measures for Points” available for 2-Star through 5-Star Ratings).

Measures for Points and Special Requirements
Once the Basic Requirements have been fulfilled, points can be earned for green measures implemented. No negative points are assigned for failing to implement a given measure. It is not possible for all of the recommended green building measures to be implemented in a given house; in fact, many are mutually exclusive.

A minimum number of points is required for each star level beyond 1-Star and specific measures, called Special Requirements, are required for each star level, as well. These are indicated below and on the Rating document next to the point totals. (See “Star Levels” at the top of page 1 of the Rating.)

The following are the point requirements and Special Requirements for each Star Rating:

- **1 STAR** Basic Requirements only (no Measures for Points required)
- **2 STAR** 50–74 points plus Special Requirements--5.04 or 5.05, and 9.03
- **3 STAR** 75–99 points including all 2-Star requirements, plus Special Requirements 3.03 or 3.04 3.05 or 3.06
- **4 STAR** 100-149 points including all 3-Star requirements, plus Special Requirements 3.07, 3.08, 6.05 and 7.05 or 7.06 or 7.07 or 7.08 or 7.09 and 8.12 or 8.13 or 8.14 and 10.2 or 10.3
- **5 STAR** 150 *or more* points, including all 4-Star requirements, plus Special Requirements 3.21 or 3.22 or 3.23 and 7.03 and 10.06 and 11.07 and 11.09

Point Values
Points for each green building measure range in value from 1 to 5 and are assigned according to a measure’s environmental impact. For example, under SECTION 3: DESIGN, achieving measure 3.05 - “Energy-efficient design allows for a minimum of 800 sq. ft. of living space per ton of cooling” - receives 3 points, whereas implementing measure 3.31 - “Dedicated kitchen recycling center” - receives 1 point. The former measure will have a major impact on the energy consumption of the home whereas the latter measure will have a small impact. Difficulty of implementation and cost of installation are *not* factors used to determine points.

Additions and Innovations
Although the Rating is fairly comprehensive, it obviously does not include all possible green building measures.

You, the green building professional, may have your own suggestions you’d like to propose for consideration. AEGP welcomes ideas for further measures that may qualify for bonus points. List them in SECTION 12: ADDITIONS AND INNOVATIONS and discuss their potential point value with your AEGB Representative/Rater.
Compliance Verification and Documentation

The following verification and documentation is required:

**Completed Preliminary Single-Family Rating**
Must be submitted to Rater at commencement of rating process, once applicant has final design documents

Must be submitted to Rater at commencement of rating process, once applicant has final design documents
See Manual J Inputs for required Reports.  
*Manual J accuracy and equipment specifications must be approved by the Rater*

**Conditional Approval**
Must be obtained by Applicant from Rater before rating process can proceed

**Rough Inspection**
Must be made by Rater post rough-in mechanical, insulation and pre-drywall by Rater

**Final Inspection**
Must be made by Rater upon substantial completion

**Home Performance Testing**
Documentation must be submitted to Rater upon substantial completion by approved 3rd party inspector

**Other Documentation**
The AHRI certificate must be submitted to Rater. Other documentation may be required for items that cannot be sufficiently verified by inspection (e.g. toilet model, shower-head flow rate, construction-waste recycling) before Rating can be finalized

**Final Approval**
Will be granted by Rater if all Requirements for a Rating are met
RESOURCES

eeba.org
Indispensable handbook of building science and construction details for architects, designers and builders; other excellent books available from EEBA (Environmental and Energy Building Association)

Be sure information applies to your conditions. Central Texas is generally in the hot, humid climate zone (Zone 2) but some parts are drier and cooler (Zone 3). Much of the published information available to us applies to a northern climate and is incorrect for most of Texas.

Environmental Building News
http://www.buildinggreen.com/
Monthly online magazine; takes no advertising; very strong on material evaluation

Home Energy
www.homeenergy.org
https://www.homeenergy.org/member_register.php
Highly readable, monthly magazine, covering energy-efficiency, comfort, home performance and affordability.

Green Builder
http://www.greenbuildermag.com/
http://www.greenbuildermag.com/Magazine/Subscribe.aspx
Highly readable, monthly magazine from the “green branch” of the National Association of Homebuilders, covering a broad range of green building topics

Federal Government
www.energystarhomes.com
http://www.pathnet.org : Partnership for Advancing Technology in Housing; resource for homeowners and homebuyers, the homebuilding industry and federal agencies; PATH catalogs the best resources on advanced building technologies and practices to emerge from the decade-long public-private partnership, which ended in 2008

Building Science
www.fsec.ucf.edu : Florida Solar Energy Center—research institute of the State of Florida (hot, humid climate)
www.buildingscience.com : Private consulting company located in Massachusetts; top building scientists
www.buildingbetterhomes.com : Private consulting company based in Minnesota; top building scientists
www.eeba.org : education resource for building science

Other helpful websites
www.globalgreen.org : National environmental non-profit organization
www.sbicouncil.org : Sustainable Buildings Industry Council; Green Building Guidelines
BASIC REQUIREMENTS

Rated homes must meet all of the following Basic Requirements to qualify.

1. **Project team information** (architect/designer, builder, mechanical contractor, owner)

2. **TCV Score** (applies to new-construction detached homes)
   Minimum score required in 2010 is 0.0

TCV (Texas Climate Vision) is a collaborative effort of Energy Systems Laboratory (ESL) and Austin Energy, funded by the US Department of Energy (DOE) and the Texas State Energy Conservation Office (SECO). The mission of this endeavor is to realize 20%-40% increases in residential building energy-efficiency through a combination of better building codes, improved processes, inspection and testing verifications, and the use of computer modeling to provide analysis of energy use when compared to the 2009 International Energy Conservation Code (2009 IECC). The TCV Project is intended to serve as a pilot program by providing technical assistance, advanced modeling, training and support. One of the key benefits from the resulting energy savings will be a reduction in the NOx (nitrous oxide) emissions from energy generation, which can reduce dangerous ozone concentrations and improve air quality in the Central Texas area.

The goals behind development of TCV include:
- Increasing the number of homes built in Texas that are at least 20% better than the 2006 IECC baseline
- Increasing the number of builders and building officials familiar with high-performance homes
- Increasing the number of high-performance homes being built
- Aid in the marketing of high-performance homes
- Increasing the number of homes built with properly sized HVAC systems and performance-tested
- Quantifying emissions-reductions resulting from these efforts

To accomplish this, web-based software has been developed to model building plans and specifications, as well as to verify compliance with and performance above the IECC and City of Austin amendments. The software uses the DOE-2 simulation program to provide predictable energy performance based on local climate considerations and design factors.

**Note that in the year 2010, no percentage of energy efficiency above code will be required for a Rating for new-construction, detached homes. In the future, a higher minimum score will be established after more data has been collected.**

3. **Cooling and heating equipment and duct sizing determined by correct Manual J and D calculation, based on orientation, plans and specifications**
   a. Use “ACCA Manual J Inputs for Mechanical Equipment Sizing” for homes in the AE service area and appropriate ACCA inputs for other climate areas. **Equipment capacity must closely match the calculated loads as approved by the Rater.**

   b. If correct Manual J calculation results in fewer than 550 square feet of living space per ton of cooling, the design is **inappropriate** for Central Texas and the home will not be rated.

   c. Homes for which split systems are too large (approximately under 800 sqft conditioned space) must be equipped with a mini-split, inverter, or other equipment with capacity appropriate for the heating/cooling loads.

   d. Home design and construction must accommodate the selected equipment and the correctly sized and insulated ductwork.
e. Submit full Manual J and D Report with equipment specified; split-system equipment must be matched per AHRI to assure correct efficiency.

f. Submit AHRI certificate for split systems. For mini-split or alternative system, submit website printout.

One year in Central Texas is enough to convince anyone that heat is the main climate problem we have to deal with. If a home is appropriately designed for comfort in a hot climate, the mechanical cooling system won’t have to work so hard to meet modern comfort expectations and occupants won’t be bankrupted by their electric bills. Appropriate design for a hot climate is the responsibility of the architect or designer. Whether the design and specifications actually are appropriate is ascertained by an accurate Manual J calculation.

The Manual J calculation was developed by the Air Conditioning Contractors of America (ACCA) to determine the heating and cooling loads on a home (either an existing home or as designed to-be-built.) The loads determine the correct size of the heating and cooling equipment. The calculation must be based on actual design, specifications, and orientation of a project, applicable climate data, and other correct inputs. **It is a code requirement in the State of Texas that heating and cooling equipment be sized in accordance with Manual J.**

NOTE: Austin Energy Green Building requires that a copy of the full and detailed Manual J report be submitted with the Rating.

In order for a home to be energy-efficient in the Central Texas climate, it is critical that the cooling system be “right-sized.” The obvious problem with under-sizing cooling equipment is that the system will not maintain the desired temperature in hot weather. Oversized cooling equipment, on the other hand, will short-cycle, resulting in increased energy use and uncomfortably high humidity. Moreover, both the installed cost and operating cost are unnecessarily increased with oversized cooling systems.

A number of studies show that residential cooling systems are consistently and drastically oversized, especially when simple "rules of thumb" are used to select equipment. Yet complaints about uncomfortable rooms and high energy costs are common, regardless of climate or the size of the air conditioning equipment. For example, a room that is too hot in summer or too cold in the winter may not be receiving sufficient airflow - even if the system is over-sized - because of poor duct design and construction. However, high humidity in a home can indicate that the cooling equipment is too large.

Another important point to make about oversized cooling units is that they may never reach their predicted operating efficiency, expressed as a SEER number (seasonal energy-efficiency ratio), before shutting off. For example, an oversized 14.0 SEER unit might never run at more than an 8.0 or 9.0 SEER. As an analogy, think of city driving versus highway driving. A system that is cycling on and off will have a shorter life, as well. A smaller unit running continuously will operate at a higher efficiency and cost less to run than a larger unit running less often, and will keep the occupants more comfortable because it will dehumidify the air better.

When a home’s cooling load is calculated correctly, the Manual J calculation will determine both the sensible load (temperature) and the latent load (humidity) for the home. When the capacity of the cooling equipment matches the sensible and latent loads from this calculation (describing how much a unit dehumidifies in relation to how much it cools), then the proper equipment can be installed to adequately perform both tasks in the most cost-effective manner and provide year-round occupant comfort. Careless selection of equipment can result in a system that is too large or not matched for the load.

Manual J calculations must be performed for each individual home, taking into account the specifics of the building’s location, orientation, design, window sizes and placement, exact solar heat gain coefficient and U-value, shading elements, roofing type and color, duct type, and roof/wall/duct insulation, etc. Load calculations must be performed for the entire structure so that the capacity of heating and cooling equipment can be properly specified. In addition, a load calculation needs to be performed for each room in the home so that airflow requirements for each room can be determined.

Several software programs are available that perform residential Manual J calculations. The following software packages are recommended:

**RHVAC by Elite Software (www.elitesoft.com)**

**Right-J by Wrightsoft Corporation (www.wrightsoft.com)**
Manual J Version 8 cautions against oversizing by more than 15%, but the ½ ton increments in equipment capacity (1 ton increments in most dual capacity equipment) can make matching difficult, especially for smaller structures. Careful selection of the condenser and evaporator coil is required to achieve the closest match possible. Lack of availability at present of half-ton increments for variable-speed equipment also presents a sizing challenge. Inverter controlled systems, like some mini-splits, can be of a larger capacity due to their ability to operate at part capacity. This may be necessary for smaller structures.

Discuss sizing challenges with your Rater before equipment is purchased. Do not get into the position of installing equipment that may make the house unratable.

If a home cannot be comfortably cooled with a maximum of one ton of cooling per 550 square feet of net living space (floor area derived from the Manual J), based on an accurate Manual J calculation, Austin Energy Green Building does not consider it to be an appropriate design for Central Texas and it will not be rated.

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) is the trade association representing manufacturers of air conditioning, heating and commercial refrigeration equipment. AHRI administers the heating, ventilation, air conditioning and commercial refrigeration (HVACR) industry's performance certification programs for heating and cooling equipment and components.

Split air conditioning and heat pump systems (with indoor and outdoor units) need to be properly matched to achieve desired SEER and EER ratings and longevity from a system. When improperly matched, the efficiency and longevity of these systems are significantly compromised. AHRI tests thousands of indoor and outdoor units each year to verify that they will work together as a system to achieve a given energy efficiency rating.

The applicant should obtain the AHRI Certificate of Certified Product Performance from the mechanical contractor who installed the mechanical equipment. The reference number and certificate verify that the outdoor unit (condenser) and indoor unit (evaporator) combination has been certified as a matched system by the Air Conditioning, Heating and Refrigeration Institute (AHRI). The reference number can be entered into the AHRI Directory of Certified Product Performance to obtain a Certificate of Certified Performance. This certificate must be submitted to the Rater upon completion of the project.

4. Cooling and heating equipment minimum efficiency for split systems

Cooling equipment minimum efficiency: 14.5 SEER for split systems/12.0 EER
Gas furnace rated at >80 AFUE or Heat Pump rated at >8.2 HSPF
Air handlers must meet the Florida building code, Section 13-610.2.A.2.1 standard; see manufacturer’s specification.
Split-system heat pumps: an outdoor thermostat set at 40° must be installed to prevent heat strip from activating if outdoor temperature is above 40°

Every cooling unit is assigned an efficiency rating known as its “seasonal energy-efficiency ratio” (SEER). The SEER is defined as the total cooling output (in British thermal units or Btus) provided by the unit during its normal annual usage period divided by its total energy input (in watt-hours) during the same period. The higher the SEER rating, the more energy efficient the cooling unit is. The current Federal minimum for split residential cooling systems is 13.0 SEER.

NOTE: Selecting equipment with a higher SEER rating can save energy and money, but only if the equipment is properly sized and installed so as to deliver the actual SEER. Both efficiency and comfort are more dependent on quality of the installation than on the SEER rating of the equipment.

The efficiency of gas furnaces is measured by the annual fuel utilization efficiency (AFUE), a measure of performance over an entire season of use. Specifically, AFUE is the ratio of heat output of the furnace compared to the total energy input. Furnaces today are manufactured in an efficiency range between 78% AFUE and 96% AFUE. Traditional "power combustion" furnaces are 80-82% AFUE. Above 90%
AFUE, a furnace is "condensing," which means it recaptures some of the heat lost in conventional furnaces by condensing water vapor from the combustion gases. A sealed-combustion furnace brings outside air directly into the burner and exhausts flue gases (combustion products) directly to the outside, so they pose no risk of introducing dangerous combustion gases into the house. In furnaces that are not sealed-combustion units, back-drafting of combustion gases can be a big problem.

In warm climates, heat pumps may be preferable to condensing gas furnaces due to modest heating requirements. Central heat pumps operate much like a central air conditioner except that they can reverse the cycle in the winter to deliver heat to the house. Because heat pumps provide both heating and cooling, they have two efficiency ratings: seasonal energy-efficiency ratio (SEER) for cooling and heating system performance factor (HSPF) for heating. HSPF is calculated by dividing the total annual heating requirements, including all energy inputs, by the total electric power used. New hybrid gas-furnace heat pumps combine the comfort of gas heat with the efficiency of a heat pump. Either type will operate very energy-efficiently in mild or warm climates.

Most heat pumps installed in homes are air-to-air: in the winter, they extract heat from the outside air and transfer it to the interior of the home. Ground-source heat pumps draw heat from the earth and transfer it to the conditioned space; in the summer, they extract heat from inside the house and reject it to the earth. Because temperatures underground are nearly constant year-round (e.g. warmer than the outside air during the winter and cooler than the outside air during the summer), a ground-source heat pump can be much more efficient than an air-source heat pump. If not designed properly, with adequate ground space, there could be problems with such a system in the relatively warm climate of Central Texas. Water is an even better thermal reservoir for a heat pump if allowed by regulations protecting ground or surface water quality. Ground and water-source heat pump systems are much more expensive than air-source, so payback savings must be analyzed carefully. These systems have no outdoor equipment (thus, no outdoor condenser-unit noise) and typically have a longer service life than air-source systems.

**Air handler selection**

Since all rated homes must meet a specified maximum duct leakage standard, selection of a reasonably air-tight air-handler is critical. Some air-handlers currently on the market are so leaky that a home may have trouble passing the duct-leakage test even if the ducts are extremely well sealed. For this reason, AEGB requires that the air-handler meet the Florida code standard, which requires factory-sealed air handlers.

**Heat pump outdoor thermostat**

Heat pumps are equipped with electric heat strips to provide heat when the outdoor temperature is too low for the unit to deliver adequate heating capacity. Heating by this method is extremely inefficient and costly (like heating your home with your toaster). For this reason, heat pumps should be sized to provide adequate heating capacity, with the electric strips being used only at colder temperatures. The heat strips should be controlled by a second thermostat that prevents them from being activated when outdoor temperatures are above 40°F.

Many people inquire about installing a **hydronic or radiant floor heating system**. Such systems are efficient, especially when solar energy or a heat pump is used as a primary means to heat the water, but because Central Texas often experiences warm days in the middle of the winter, a radiant floor system could cause a floor to be too hot. For this reason, the heated area of the floor needs to be thermally isolated (insulated) from the rest of the floor, especially in slab-on-grade construction.

Although radiant floor heating is very pleasant and effective, it is seldom used in Central Texas because most people want a cooling system as well. That requires a dual system, however, since cold air distributed by a duct system or mini/multi-split system is the main cooling method available at present. A dual system (radiant floor heat + forced air cooling) would substantially raise the cost of conditioning a home.

5. **Ceiling registers: curved-blade type—fixed or adjustable; wall registers may be flat-blade, installed/adjusted to direct airflow across ceiling**

Supply registers have a substantial impact on the amount of air delivered to a room and how that air is distributed. Ceiling registers with curved blades reduce noise, increase air flow, and direct air across the ceiling for a better throw and better mix with the air in the room. This is especially important in newer tight homes, where rooms require less airflow but higher air velocity for good distribution. (Ceiling registers...
with flat, in-turned, blades deflect the air, reducing flow and cause it to go directly downward on occupants, making them uncomfortable.) It is important that the size, location and type of the register are matched to the air flow requirements for each room. For wall registers, the blades may be flat-type, but it is still important that the air flow across the ceiling, for the same reasons.

6. **Insulation installation meets ENERGY STAR Grade I; sealing of thermal enclosure/envelope meets current IECC standard for limiting air infiltration**

Proper installation of insulation and air barriers reduces energy costs and improves occupant comfort over the life of the home.

Insulation provides a thermal blanket for the home, which acts to limit the transfer of heat through the building enclosure. In order for insulation products to do their job effectively and perform even close to their rated R-value (the measure of the insulation products’ thermal resistance), they must be installed properly and be encased by an air barrier. *An insulation system works effectively only when it is uncompromised by air leaks or air movement and only when it touches the enclosure of the space it is meant to protect from heat gain or loss.*

Proper installation requires that the building enclosure be insulated and air-sealed at walls and ceiling (and floors other than slab foundations in most cases) with continuous and contiguous application. One should be able to visually follow around and up and down the exterior walls, ceiling (or roof line, as may be the case) and most non-slab floor and see uninterrupted coverage.

This includes kneewalls in attics, all of the wall area underneath staircases and tubs and showers on outside walls, and the outside walls of exterior chases for fireplace flues or duct chases (not at the interior walls). Special care must be taken in regard to the floors of living spaces above garages (notorious for being neglected and therefore uncomfortable). Even though the joist/truss may be much larger/wider than the insulation installed, the insulation must touch the under-surface of the sub-floor above for it to be effective. Another frequently ignored area that must be insulated is the space between joist ends at the rim joist of a two-story home.

The definition of ENERGY STAR “Grade I” must be met, which limits gaps, voids, and compressions to less than 2% overall. This is especially difficult when there are plumbing pipes, electrical wire, switch and outlet boxes, blocking and other obstacles within the building cavities of the enclosure plane, that need to be insulated. It is extremely difficult to install batt insulation without compressing it or to make the cuts around those obstacles while trying to keep the insulation in contact with the air barriers and fill the cavities to provide a good thermal blanket.

Insulation installed on the attic floor (blown, loose-filled) is not encased on its top side, so the depth of application must meet the required installation depth for the type of product being used to achieve the desired R-value. Air movement through loose-fill insulation is a problem in very cold climates (especially with fiberglass, which is lighter than cellulose), causing some loss of R-value, but is not considered a serious problem in Central Texas.

Spray or “total fill” insulation systems automatically comply with the Grade I requirement if they fill the cavity of a 2x4-depth wall. These include systems such as damp-blown cellulose and fiberglass blown-in blanket, as well as all spray foam applications. Damp-applied cellulose installations must be allowed to dry completely prior to encasing them with air barriers.

Of the two types of polyurethane foam, “open-cell” is most common in residential construction. This type of foam allows water to pass through it, so that roof leaks can be easily identified if they occur. “Closed-cell” foam is more common in commercial construction, but is also used in homes. This type of foam does not allow water to pass through it. Polyurethane spray-foam insulation installed at the walls and/or the roof acts as its own air barrier, so no supplemental materials are required to encase it. If foam is left exposed in an attic, it may require an ignition barrier or special coating, especially if an air handler and/or water heater is present or if the space is to be used for storage. Check the installation requirements for the foam that you anticipate using.

Rigid foam-board sheathing, with an R-value of at least R-2, may be added to the exterior of the wall to reduce thermal bridging. This is required if metal framing is used.

Air barriers must be stapled to the framing members at the outside perimeter and taped at all seams.
7. **Water heater meets the following minimum efficiency criteria:**

- ENERGY STAR efficiency for gas units,
- OR if no gas is available in right-of-way: >40 gallon electric WH with >0.94 EF;
- OR meets a Section 7. Four-Star requirement (See Measures for Points: 7.05, .06, .07, .08 or .09)

Water heating is the second largest energy expense in the average home, typically accounting for between 15 and 20% of the total energy used. In 2004, the U.S. Department of Energy adopted minimum efficiency standards for residential gas water heaters, with energy factors ranging from 0.61 for smaller storage heaters and 0.58 for larger ones.

The energy factor represents the amount of energy that goes to actually heating the water. For example, 40% of the gas consumed by a water heater with an EF of 0.60 is wasted. The most efficient conventional gas-fired storage water heaters have EFs ranging from 0.60 to 0.65, depending on their capacity, with condensing storage water heaters having EFs above 0.90. Many on-demand (tankless) water heaters have an EF of 0.80 or higher. Note that large water heaters (boilers) usually have large stand-by losses and are rated differently. For energy factors for both gas and electric water heaters, see the GAMA (Gas Appliance Manufacturers Association) Directory: www.gamanet.org.

When calculating the capacity needed to serve new construction or a remodel, do not rely on the gallon capacity of the storage tank. Instead, select capacity based on the first-hour rating, which is a factor of storage volume and burner output and the hour of the day when hot water use will be the highest. Many 40-gallon gas heaters have a first-hour rating of 75 to 80 gallons. These often have the highest EF as well. Most homes with low-flow plumbing fixtures and water-efficient appliances are easily served with a 40 gallon – or smaller - heater.

8. **Any wood/gas-burning fireplace/stove in conditioned space is vented and sealed; meets specifications outlined below**

While we traditionally think of a fireplace as a means of heating a home, we now know that the typical modern fireplace is an energy-loser and even potentially dangerous, due to the possibility of back-drafting in today’s tight homes with numerous vent fans operating. In any case, most people nowadays have a fireplace mainly for aesthetic reasons.

The recent popularity of unvented gas logs in fireplaces has been a particularly bad development. Field experience has indicated that a lack of venting introduces carbon monoxide, carbon dioxide, nitrous oxides, sulfur dioxide, water vapor and other undesirable combustion products, while reducing oxygen in the home— all a recipe for illness and even death. Although such fireplaces are still legal, they should not be and are not allowed in rated homes.

While a traditional fireplace provides an open burning-chamber that vents through a chimney—safe enough when drafting properly—it’s likely that a great deal of conditioned air will be lost up the chimney when the fireplace is in use, and even when not in use, due to the damper not making a complete seal.

All types of fireplaces within the conditioned space must have adequate combustion and ventilation air provided. Without a dedicated source for combustion air, a typical fireplace can create negative pressure in the home. In the event that other exhaust appliances are operated at the same time as the fireplace, this negative pressure can cause an unsafe spillage or back-drafting of fumes, contaminating indoor air with combustion gases.

All masonry fireplaces, masonry heaters, fireplace inserts, wood and pellet stoves, and other combustion furnaces must be equipped with permanently fixed glass fronts or gasketed doors. Wood- or gas-burning fireplaces must be designed to operate with the gasketed doors closed, so that all combustion air is supplied by a dedicated outside supply vent. If this cannot be met in a masonry fireplace in a custom house, the Rater shall decide whether to make an exception and what compensation to require.

**Direct-vent fireplaces**

A direct-vent fireplace does not require a chimney, and can vent horizontally out a sidewall or vertically to the roof. The direct-vent fireplace also has a completely enclosed chamber that is highly efficient, drawing in air for combustion from the outside and expelling gasses to the outside. It provides heat by radiation
through a well-sealed glass door. It heats a room without robbing it of oxygen or heated air, while also keeping it free of fumes and combustible materials such as embers or ash.

Besides providing clean warmth and the cheery glow of “real” fire, a direct-vent fireplace saves space by allowing furniture to be positioned directly on either side with “zero clearance.” This simply means that while heat is radiated out the front glass, the sides are safe for combustibles to butt up against the firebox. Though a direct vent fireplace does not require electricity, it does require propane or natural gas for fuel and burns logs specifically made for direct vent models.

The venting system of a direct-vent fireplace consists of a double-walled pipe – a pipe-within-a-pipe. The inner pipe provides venting to the outside, while the outer pipe carries outside air into the fireplace to enable combustion. As the outside air is sucked into the venting system, it is heated by the hot central-venting pipe, thus improving efficiency.

Safety testing

Each type of fireplace installed should comply with appropriate safety testing as follows:

- Natural gas and propane fireplaces that are power vented or direct vented should comply with ANSI Z21.88/CSA 2.33a or ANSI Z21.50/CSA 2.22.
- Factory-built, wood-burning fireplaces are in accordance with the certification requirements of UL 127 and are EPA certified.
- Wood stove and fireplace inserts, as defined in UL 1482, Section 3.8 are in accordance with the certification requirements of UL 1482 and are in accordance with the emission requirements of the EPA Certification and the State of Washington WAC 173-433-100(3).
- Pellet (biomass) stoves and furnaces are in accordance with the requirements of ASTM E1509 or are EPA certified.
- Masonry heaters are in accordance with the definitions in ASTM E1602 and ICC IBC, Section 2112.1.

9. Exhaust fans venting to outside for cooktops and baths with a tub or shower

Kitchen exhaust that equals or exceeds 400 cubic feet per minute must have make-up air provided.

In Central Texas, indoor relative humidity levels often rise above 60%. At that point, mold and mildew grow, severely impairing indoor environmental quality (IEQ). Odors and unhealthy fumes from cooking also reduce IEQ. Point-source removal of fumes and humidity by exhaust fans vented to the outside (not just to the attic space) reduces these potential contaminants.

The recommended ventilation rate for a bathroom is in the range of 8.0–12.0 ACH (air changes per hour). The exhaust of air should continue for at least 20 minutes after use. To calculate the cubic feet of air per minute required to provide this, divide the cubic feet total of the room by five (LxWxH/5=CFM). For example, if the bath is 8’x11’ with a ceiling height of 9’, 159 CFM is needed. Note: this is a minimum CFM.

Fans for ranges or cooktops should be appropriately sized. Fans with a capacity exceeding 200 CFM can depressurize a home, leading to uncontrolled infiltration of outside air and potential backdrafting of fireplaces and combustion appliances. Larger capacity fans should absolutely be avoided unless makeup air is provided, as stipulated. (They are often installed only for aesthetic reasons to match the look of giant commercial-type stoves currently fashionable.)

It is important that the occupants be educated about the use of these systems to achieve adequate ventilation safely and effectively.

See also 9.03.
10. **Low-VOC (volatile organic compound) interior wall and ceiling paint.**
VOC level of 100 grams per liter or less, or is CoA recycled paint; VOC documentation required

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids.
Most household paints contain VOCs that easily evaporate when exposed to air. This evaporation continues for a long time, even after the paint is dry. This process is known as *out-gassing* and may cause a variety of health problems, including irritation of the eyes, nose, throat and upper respiratory system, and a weakened immune system. Many of these chemicals also contribute to problems of regional low-level smog and to the global greenhouse effect. The lower a paint’s VOC level, the less threatening it is to people’s health.

Be aware that paint labels do not always give you the information you need. Some may say “Low-VOC”, but have higher levels than this standard. Some labels state only a maximum. In that case, the actual amount is typically much lower. An inquiry with the manufacturer for accurate information may be required.

For more information see the EPA’s webpage about indoor air quality and organic chemical gases: [www.epa.gov/iaq/voc.html](http://www.epa.gov/iaq/voc.html)

11. **Blocking for grab bar installed in all showers and tubs**
At any time in life, a home occupant may need the added safety of grab bars in showers and tubs. It's just common sense to install blocking for grab bars during the framing stage, so sturdy bars can easily be added to a home when the need arises. The following describes blocking requirements:

   a. Lateral two-inch by 6-inch or larger nominal wood blocking must be installed flush with stud edges of bathroom walls within the tub +/-or shower space.

   b. The centerline of the blocking must be 34 inches from and parallel to the interior floor level.

For an AEGB Rating, it is required that blocking be installed in showers and tubs *as feasible and reasonable*. Blocking is not likely to be required around a large garden-type tub, for example, since any grab bar would probably be too far away from the user to be functional. Blocking is not required behind a seat in a shower. *The plumber should be advised that blocking is required to reduce the likelihood that pipes will be installed where blocking is needed.* The Rater will check to see that blocking is installed where a person would actually need it.

*NOTE: If you are building in the City of Austin S.M.A.R.T. Housing Program, a blocking requirement applies to the entire bathroom, except behind the lavatory. (See 3.21 for City of Austin Visitability Ordinance.)*

The AEGB blocking requirement is also distinct from the City of Austin blocking requirement for first-floor powder rooms.

12. **All toilets are EPA WaterSense models**
(if tank and bowl are separate combination must be WaterSense)

As a result of toilet research over the last few years, new, more effective toilet designs have been developed.

The toilets on the EPA WaterSense list were selected because they meet two criteria. First, they have excellent flushing performance. Second, they do not use more than 1.28 gallons per flush or if dual-flush average 1.30 gallons. Only the styles listed for each toilet (round, elongated, ADA) meet this requirement. Other styles may be available for the same model of toilet, but do not meet the eligibility requirements for performance and water-savings.

[http://www.epa.gov/watersense/](http://www.epa.gov/watersense/)
13. ENERGY STAR-qualified appliances/fixtures

4 from following list: appliances, ventilation fans, light fixtures, ceiling fans

ENERGY STAR-qualified appliances incorporate advanced technologies that use 10–50% less energy and water than standard models. The money saved on utility bills can more than make up for the cost of a more expensive but more efficient ENERGY STAR model. Check out www.energystar.gov and http://www.epa.gov/watersense/

A helpful website for identifying the very most efficient appliances is www.aceee.org.

The average dishwasher uses 8 -12 gallons of water when set on its normal cycle. Though energy is used to run the machine, about 80% of it is used to heat the water. Decreased water usage can save hundreds of dollars over the lifetime of a machine. Some dishwashers have options to allow the adjustment of the machine’s settings to reflect the size of the load and how dirty the dishes are. This can also lower the water use and therefore the energy bills. An efficient dishwasher consumes less water and energy than washing dishes by hand under a running faucet.

ENERGY STAR-labeled dishwashers are at least 41% better than the federal water and energy requirements set for dishwashers. ENERGY STAR-labeled dishwashers typically use 4 - 6 gallons of water per cycle. Although ENERGY STAR does not measure water efficiency, Energy-Star-rated dishwashers typically use 30-50% less water.

ENERGY STAR qualified kitchen range hoods, bathroom and utility-room fans, and in-line fans provide energy savings and are significantly quieter than standard models. Qualified ventilation fans that include lighting use 70% less energy, on average, than standard models, saving $120 in electricity costs over the life of the fan. These fans have other benefits as well: due to their high performance motors and improved blade design, they provide better performance and longer life and are more than fifty percent quieter than standard models.

14. Ceiling fans: minimum of 2 installed within heated and cooled space

Ceiling fans provide an easy, inexpensive mechanism for achieving comfort in a home. Use of a ceiling fan allows occupants to set their thermostats four or five degrees higher, yet still be comfortable.

A ceiling fan doesn’t change the air temperature—it simply makes occupants feel cooler by moving air over the skin—but that’s what matters for comfort. Consequently, ceiling fans should only be used when the room is occupied.

They can also be used to facilitate the movement of warm air in the home during the heating season by inhibiting air-stratification. In winter, fans should be set at very low speed to avoid creating draft, but still push warm air down from the ceiling to occupant level.

Reversible, variable-speed ceiling fans provide the best option for use during both the cooling and heating seasons. Most residential ceiling fans (and all ENERGY STAR-qualified fans) feature the ability to reverse the motor and airflow direction, allowing one to operate the fan year-round. In addition, look for fans (such as the Hampton Bay “Windward” fan) with advanced blade design and fluorescent lights for more air movement and cooler light to reduce unwanted heat gain.

15. Planting beds have at least 6” of soil containing 25% compost

(e.g. Dillo Dirt™) and minimum depth of 2” organic mulch

Deep, nutrient-rich soil is the key to healthy plants and reduced need for watering. Such soil acts like a bucket holding water—the deeper the bucket, the more water is stored. Plant roots are able to reach down into the soil depths and use the water stored there. Shallow soil results in plants with shallow root structures. That results in less healthy, less drought-tolerant plants, especially as the soil surface heats up in summer.

Besides adding nutrients, the compost breaks up clay particles and makes the soil friable or crumbly, so plants can develop more easily. Compost and composted-sludge products, such as Austin’s own Dillo Dirt™ (see below), are excellent nutrient-rich soil additives. Such products release nutrients slowly, reducing the need for fertilizing and minimizing the risk of fertilizer washing out and becoming a source of pollution.
“Dillo Dirt™” is a compost made by the City of Austin since 1989. If you know Austin, you will not be surprised to learn that it was the first program of its kind in the state and one of the oldest in the nation. All yard trimmings collected curbside across the City as well as some of our treated sewage sludge are combined and composted to create Dillo Dirt™. The heat generated in composting (130 to 170 degrees Fahrenheit) is sufficient to eliminate human and plant pathogens. After active composting for over a month, this compost is "cured" for several months, then screened to produce finished Dillo Dirt™.

Dillo Dirt™ easily meets all Texas and EPA requirements for "unrestricted" use, which even includes vegetable gardens. Like many other composts, Dillo Dirt™ has many benefits to the soil and plants. Composts add to the organic matter in the soil, reducing the need for watering. Organic matter feeds the microbes in the soil as well as plants, fostering a healthier environment. Dillo Dirt™ is made from totally recycled materials, and this recycling is less expensive to citizens than landfilling these materials. For more information and a list of current suppliers of Dillo Dirt visit [www.ci.austin.tx.us/water/dillo.htm](http://www.ci.austin.tx.us/water/dillo.htm). Note that treated sludge in some other parts of the country may not meet the same safety standards.

Saving soil moisture is an important use of mulch in Central Texas. A mulch layer on the soil surface allows the soil to soak up more water and protects the soil from the sun’s heat.

Mulches help plants by gradually increasing soil fertility. Organic mulches enrich the soil as they decay and provide a better environment for plant growth. Organic mulch such as straw or leaves can be turned under the soil at the end of the season. This helps build the soil's nutrient content. Mulch should be turned under as soon as the gardening season is over so it breaks down before the garden is replanted. Soils high in organic matter are easier to till and better suited to vegetable gardening.

Most mulches also provide excellent weed control. Mulches do not prevent weed seeds from sprouting. However, weed seedling emergence is blocked by a mulch layer thick enough to exclude light. A 3-inch layer of mulch on the soil surface keeps most annual weed seedlings from coming through. Weeds that do manage to break through are removed more easily from mulched soil. Hard-to-control weeds such as nutgrass and johnsongrass may come through the mulch layer but can be pulled more easily or covered by fluffing the mulch with a fork.

Non-plant-based mulches, such as gravel, are not recommended for this area because they retain and reflect a lot of heat.

In summary, mulching helps retain moisture in the soil, keep roots cool, slows weed growth, and reduces erosion. The result is a reduced need for watering, weeding and replacement planting. For sloped areas, mulching (especially shredded types) helps prevent runoff.

Mulch needs to be reapplied as it decomposes and is best obtained from regionally derived materials, such as cedar, pecan hulls, pine needles, straw, wood chips, etc.

16. **A minimum of 90% of new plants from current Grow Green plant list**

Plants appropriate for Austin’s climate conditions are now readily available at most Central Texas nurseries.

Some people move to this area and try to surround themselves with plants they are familiar with from their past homes. These plants are often poorly suited to this climate and soils. By choosing native and adapted plants, a person becomes more knowledgeable about, more aware of, and more connected to the land of Central Texas.

The plants on the City of Austin GrowGreen plant list do well in Central Texas conditions. Once established, they can save time and money, since they require very little care, water, fertilizer and pest control. Our native landscape is the inspiration for this guide to earthwise plant choices for Austin-area gardens. The Grow Green plant list was created to help people select beautiful native and adapted plants which are naturally drought tolerant and resistant to pests and diseases. The less watering, fertilizing, and chemical control required in a yard, the more the home occupant contributes to the conservation and preservation of our precious water resources - our streams, lakes, and aquifers.

For more information:

Grow Green Plant List: [www.ci.austin.tx.us/growgreen](http://www.ci.austin.tx.us/growgreen)
17. **Current City of Austin IRC, IECC Codes, and Amendments must be met regardless of project location (including complete air barrier and restrictions on electric water heaters). Some elements of code may not apply to renovations but duct testing is required for all Ratings.**

As of October 1, 2010 the City of Austin is under the 2009 IECC with local amendments. These standards apply to all Austin Energy Green Building-rated homes, regardless of whether they are located within the City of Austin.


For City of Austin Amendmentments, see:
http://www.austinenergy.com/about%20us/environmental%20initiatives/ordinance/ordinance.pdf

18. **Home Performance Testing**

   New construction: all home performance testing as per code

   OR Renovated home: meets Star level requirement

**New construction:** must meet City of Austin energy code requirements

**Renovated Home:**

a. If ductwork is replaced or changed, it must meet requirements for new construction, including testing

b. If changes to the ductwork are not included in the scope of the project, all code-required testing must be performed for a Rating to be granted but the standards to be met for ACH and duct leakage are the following (which are less stringent than new construction):

<table>
<thead>
<tr>
<th>Thermal Enclosure</th>
<th>Natural Air Changes per Hour</th>
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<tr>
<td>Slab</td>
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<tr>
<td>1—3 Stars</td>
<td>≤0.65</td>
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<tr>
<td>4 and 5 Stars</td>
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<th>Duct Leakage</th>
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<td>1—3 Stars</td>
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<td>4 and 5 Stars</td>
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If existing ducts in a vented attic have insulation no greater than R-4, it is strongly recommended that the R-value be improved. Ducts lying on the attic floor can be buried in loose-fill insulation after the ducts have been sealed to the above maximum leakage.
MEASURES FOR POINTS

SECTION 1: PLANNING PROCESS

1. **AEGB Green by Design workshop attended by homeowner before home plans are finalized**

   When people have a good understanding of what green building is all about before purchasing a lot or planning a new home or remodeling an existing one, they make smarter choices and get better results—greater comfort and convenience, lower utility bills, better durability and less maintenance, better health, higher resale value, and reduced environmental impact.

   At the *Green by Design* workshop, attendees learn that a good home is the result of teamwork among all the people responsible for designing, building and operating it. They learn that a good home must be designed for the conditions it will "live" in, both the macro-conditions of its region and the micro-conditions of its site. They learn that a house is a system - its site, materials and products, methods of construction, mechanical systems, and occupant behavior all interact together for success or failure. The goal of the workshop is to show people how better design, construction, and operation of homes will provide the most long-term benefits to the occupants, their neighborhood, their community and their planet.

2. **Applicant is a certified graduate of Green Boots and/or Green Reboots**

   "Green Boots" is an education series developed by Austin Energy and sponsored by the Home Builder Association of Greater Austin and the National Association of the Remodeling Industry (NARI). It is aimed at educating homebuilders, remodeling contractors, architects and trade contractors on green strategies, products, and practices. Sessions are grouped in modules specific to each type of trade. Graduates of the series experience an overview of all aspects of green design and construction and gain a better understanding of how the building trades and their green knowledge and responsibilities relate to each other. Graduates receive Green Boots certification. New sessions serve as continuing education for earlier graduates. Remodeling contractors can achieve a "Green Reboot" certificate for attending all the field trips that address issues specific to remodeling projects, in addition to the main Green Boots course.

   For more information, visit [www.austinhomebuilders.com](http://www.austinhomebuilders.com) (under “Members” link and Event Calendar information) or call 512.454.5588.

3. **AEGB Green by Design workshop attended by member of current design +/or builder staff**

   See 1.01 for information about "Green by Design." Although not meant to be an in-depth technical seminar, *Green by Design* nevertheless offers building professionals a helpful overview of green building, and lets them know what homeowners are learning about green building. After attending Green by Design, Rating Applicants may claim the points for this measure on all their subsequent Ratings.

4. **Documented design team meetings held in design/planning stage of project; team includes (but is not limited to) the owner, designer, builder, and mechanical contractor**

   The importance of a team approach to the design and construction of a green home cannot be over-emphasized. It is the basis of green building. Through the sharing of expertise, better decisions are made, costs are reduced, the design and building process goes more smoothly and the result is more successful.

   The designer, builder, engineers, mechanical contractor, and other relevant building professionals (as well as the homeowner if the home is custom-designed and built), all need to be working together to ensure that sustainability will be the guiding principle of the design, construction, and operation of the home. Having both a designer/architect and builder/contractor who have experience in constructing green-rated homes will greatly facilitate the implementation of the green building measures described in this Guide.

   Green building begins with design. The designer/architect needs to understand and develop green building goals before starting the design process, so they are an integral part of decisions about aesthetics and function. The most important elements of green building are design issues and cannot be
simply tacked on later in the construction process. The designer/architect needs to work in conjunction with other participants of the design and construction team to ensure that all parts and systems will work together to fulfill the green goals.

*Green designs must be properly implemented during the construction process. If the builder/contractor understands the green goals of the project, then the reasons for related design and construction choices will be clear and the every-day decisions that the builder must make on the job site will be compatible.*

5. **Homeowner training; assessed and approved by Rater**

Homeowner choices and behaviors can significantly affect the overall life expectancy and efficient operation and cost of maintaining the home, and have a major impact on its systems and components. To assure that the rated home meets its intended durability and efficiency, it is necessary to provide homeowner education and training on operations and maintenance. The extent of training needed is dependent upon the complexity and diversity of the types of building material and systems installed, and therefore may vary from project to project, or be different for large and small building companies.

Minimum homeowner education should include simple operations and maintenance information specific to the site and products and systems installed in each home. Homeowners vary in their experience of ownership responsibilities or may have come from a different climate or culture or may have moved from homes that had fewer or older models of products or controls. Training should include review and conveyance to homeowner of all product information and owner manuals, as well as use and care instructions.

Education should be provided that at a minimum covers:

- Recommended types of air system filters, their location and how and when to change them
- Operation of exhaust fans to remove moisture introduced by cooking or bathing
- Programming the thermostat for occupant schedules and seasonal variations
- Review of the operation of other building components
- Review of the maintenance recommendations for protecting the home’s durability and ability to withstand damage from stormwater, weather and pests.

It is also important to help the homeowner understand how *moisture management and ventilation* play an important role in removing contaminants that affect indoor air quality, as well as discussing the use of *low-or no-VOC interior paints and other products when repainting is necessary*. If homeowners understand these matters, they are better able to maintain their investment as well as protect the health of their families, and they are less likely to replace those products and systems with less green alternatives.

Additionally, if the home has *advanced systems*, it may be wise to *have the installing contractor or a manufacturer’s representative meet with the homeowner to provide education and training on specific systems*. Some builders may have *training provided by independent third-party consultants who are qualified to explain operations, maintenance, and benefits of installed systems*.

Verification that all systems are operating according to their design capabilities is recommended for all rated homes. This is known as *commissioning* - the process that verifies and documents that selected building systems have been designed, installed, and function according to the owner’s project requirements and construction documents. Commissioning is required by code for new buildings of 5,000 gross square feet or larger.

*Austin Energy provides Applicants of all rated projects with a Rating Certificate and a Homeowner Manual, which the Applicant agrees to convey to the owner (the Applicant agrees to convey a copy of the final Rating, as well).*

The Homeowner Manual contains the following:

- Information on the importance of proper operations and maintenance of the "green" home, including maintaining the home’s exterior, including weatherization upkeep, cleaning gutters, drainage strategies and storm water management, humidity control, and using natural and organic cleaning products
- Home Maintenance Checklist for important components of the home
- Education on cooling system performance, operations, and recommended maintenance
Information on efficient operation and choices in appliances, light fixtures, and bulbs
Strategies to improve energy and water efficiency in homes
Information on “Grow Green” (native and adapted) landscaping that is less water dependent and less maintenance, as well as organic choices for caring for the landscape
Strategies and organic methods for pest management, including basic termite inspections
Considerations for moisture management and control of indoor pollutants to improve indoor air quality

SECTION 2: SITE SELECTION

1. Lot size is less than 5,750 square feet
A small lot may appear to pose design problems and constraints but it can encourage (if not force) one to design and construct a space-efficient, or not-so-big, home. (See 4.02 below.) Building on a small lot also increases density, thereby decreasing the need for sprawling new development and supporting infrastructure. Increased density typically reduces automobile use and resulting pollution, since small-lot sub-divisions are usually located within city limits where jobs, mass-transit, “life-support” businesses, and recreational facilities are also more likely to be located. Moreover, the cost of development infrastructure increases as lot size increases. (See 2.02 below.) Depending on zoning ordinances, there are several neighborhoods in the City of Austin that allow lot sizes between 3,600 and 5,750 sq. ft.

2. Street, electricity, water, wastewater have been in place for a minimum of 25 years
As developable land in central urban areas becomes more scarce and costly and may require clean-up, developers usually purchase land surrounding existing development. Consequently, infrastructure is being extended to support development that is further and further from existing sewer facilities, water supplies, roads, and electricity. In situations where state and local governments provide these services, this growth can ultimately cost taxpayers more money than the residential development provided to the city or town in return for its investment.

Several factors regarding a development's form are relevant. When other variables are held constant, the cost of extending infrastructure increases as:

- The distance to established service centers increases,
- Lots become more widely dispersed,
- Lot size typically increases.

Building in areas where the infrastructure for development—streets, electricity, water and wastewater—have been in place for at least 25 years reduces environmental damage caused by urban sprawl. Homes using existing infrastructure place less demand on city services, which are paid for by all taxpayers and utility ratepayers. Because existing developments are usually closer to shopping and job centers, building in these neighborhoods also minimizes impacts by reducing automobile miles traveled each day.

3. Public transit stop is within a ¼ mile walk

4. Food store is within a ½ mile walk

5. Four or more community resources are within a 1/2 mile walk (e.g. public park/trail, school, post office, community center/daycare/garden)
Building homes within close proximity to public transit stops, business and service establishments and other community resources gives homeowners an easy opportunity to travel short distances without needing to drive their personal car. Using public transit eliminates pollution caused by automobiles and eliminates the stress of driving. In some cases, it may eliminate the need for a family to have a second automobile. After a day of working or commuting in rush-hour traffic, many people would consider it a
great convenience to be able to walk to their destination instead of getting back into their automobiles and driving more miles. Building homes in areas convenient to business and service establishments, including retail, restaurants, banks, post office, medical and dental clinics, schools, daycare, laundromat, dry cleaner, or community center nearby also supports the local economy, reducing sprawl and the need to build additional infrastructure. This helps keep taxes lower.

In addition, homebuyers today are looking for neighborhood amenities, such as a recreation facilities, walking or biking trail, green belt, or park. Such an amenity raises the quality of the life and can increase the value of the home significantly. A recreational area provides a place for people to get out in the fresh air, exercise, walk the dog, and meet neighbors. This can help create a neighborly community and a safe place for children to live.

6. **Trees are protected with fencing at the drip line; and/or a tree protection plan prepared by professional arborist is followed**

Trees add value to our entire community because of their beauty, their cooling effect, and contribution to health. Each large shade tree cleans the air by absorbing carbon dioxide. It cleans up the amount of pollution created by a typical car that drives 11,000 miles per year. It reduces the temperature around it through shade and transpiration by about 10°F. In addition, trees help reduce the “heat-island effect” in cities. Heat islands develop as vegetation and its cooling effects are lost and replaced by heat-absorbing materials, such as asphalt and concrete. These higher temperatures result in increased demand for air-conditioning, which requires increased energy production, which increases greenhouse gasses (which increase global warming), and ground-level ozone, which increases threats to human health. For the individual homeowner, trees increase property value, as well.

Placing protective fencing *at the drip line* – the outer edge of the canopy of the tree - will greatly improve the chances that a mature tree will survive the construction process. In Central Texas, where there is often very little soil, the feeder roots of trees may spread out horizontally from the trunk as much as 2.5 times more than the height of the tree. When protective fences are placed too close to the trunk, trucks, equipment and even foot traffic can compact the soil above the root system. That prevents the tree from getting enough water and oxygen to thrive and can permanently damage the roots. It may take several years for this damage to become apparent, but by that time it may be too late to save the tree. A fence at the drip line is not ideal protection, but provides a simple rule-of-thumb.

It is far better to engage the services of a professional arborist. An arborist can prepare a detailed tree protection plan, which includes correct tree protection measures for a given site and tree, dedicated construction-traffic access, mulching, pruning, a replanting plan, etc. Following these practices will greatly increase the chances of maintaining healthy trees, thus increasing the value of the property.

7. **Permanent erosion and storm-water control measures (e.g. retaining walls, piped drainage system, berms and swales, French drain, rain garden)**

New developments are required to construct stormwater detention, retention and/or water quality ponds to reduce flow and clean the water from rain events. Individual homesites can be designed to do the same thing and capture rainwater in needed areas without the use of cisterns. Swales and berms, piped drainage systems, and French drains can direct the sheet-flow of rainwater to depressed areas where it can slowly percolate back into the soil. Another way to use stormwater on the landscape is to create a rain garden with native plants ([http://www.ci.austin.tx.us/growgreen/raingardenplants.htm](http://www.ci.austin.tx.us/growgreen/raingardenplants.htm)) that can live through droughts, then grow and bloom after rain events.
1. **TCV Score is greater than or equal to 15% above IECC 2009 and C.O.A. amendments**

2. **TCV Score is greater than or equal to 20% above IECC 2009 and C.O.A. amendments**
   
   See Basic Requirement #1 for an explanation of the TCV score. These scores may be adjusted after 2010 as more data is available.

3. **Energy-efficient design allows 600 or more square feet of living space per ton of cooling capacity if home is 1500 square feet or larger (as determined by Manual J calculation); if less than 600 sq. ft of living space per ton for smaller home, tonnage must be approved by Rater**
   
   For smaller homes: square footage per ton must be approved by AEGB for these points if 600 sq. ft. is not met (as determined by Manual J)

4. **OR Home design allows for a minimum of 700 sq. ft. of living space per ton of cooling capacity (as determined by Manual J)**

5. **OR Home design allows for a minimum of 800 sq. ft. of living space per ton of cooling capacity (as determined by Manual J)**

6. **OR Home design allows for a minimum of 900 sq. ft. of living space per ton of cooling capacity (as determined by Manual J)**
   
   The amount of square feet of living space that can be properly cooled per ton of cooling is a good indicator of a home's energy-efficiency. If a home cannot be adequately cooled with one ton of cooling for every 600 square feet or more of living space, then the home is not appropriately designed for the central Texas climate (or the Manual J calculation was incorrect).
   
   Reaching this standard does not require unusual design or specifications, since current building and energy codes, and home-performance testing result in quite energy-efficient homes. Builders and mechanical contractors cannot continue to make the same assumptions about a home's need for cooling tonnage that they made five or ten years ago, or even in 2009, since the adoption of the 2009 International Energy Code and Austin Amendments in 2010. The increase in window efficiency alone has reduced the home's cooling needs substantially.

7. **Indoor heating and cooling equipment is located within the thermal enclosure/envelope (i.e. insulated space)**
   
   All too often in southern climates, the indoor components of heating and cooling systems (air handler and ducts) are placed in an unconditioned, vented attic. If insulation is installed at the floor of the attic, then these components are located outside the home's thermal envelope/enclosure or insulation barrier. One reason for locating equipment in an attic is to retain every square foot of floor area for living space. Another reason is for easy access to the equipment. However, locating mechanical equipment outside of the thermal envelope/enclosure is extremely detrimental to energy-efficiency.
   
   Placing indoor heating and cooling equipment within the thermal envelope/enclosure of the home substantially increases the energy-efficiency of the system. In summer, unsealed attics in southern climates regularly reach temperatures of over 140 degrees, so obviously that's a poor environment for ducts filled with cold air. Equally, it makes no sense in winter, either.

8. **All ductwork is located within the thermal enclosure/envelope OR home has no ductwork**
   
   Although ductwork installed in unconditioned spaces in all new homes must be insulated to R-8, this amount of insulation is not sufficient to totally protect the cold air in the ducts from considerable heat gain.
in hot attics that regularly reach temperatures of over 140 degrees in summer (the reverse situation occurs in winter). Moreover, ducts leak conditioned air, leading to problems with air distribution and operating cost. 

For optimum performance, air distribution components of a cooling system should be located within the conditioned space. Placing the HVAC ductwork within the thermal envelope/enclosure of the home substantially increases the efficiency of the system. Here are some ways to get ductwork within the thermal enclosure:

- Insulate the attic at the roof deck/rafters with polyurethane spray foam or construct and insulate a section of the attic that houses the duct work (and equipment if that is also located in the attic);
- Drop ceiling areas (e.g. hallways) to provide a duct chase;
- Construct furred-downs/outs/ups for chases in locations where they will not be odd or unattractive;
- Provide roof-trusses with insulated chases;
- Run ducts between the floor joists of multi-story homes;
- Install exposed ducts in the living space (more aesthetically acceptable in some designs than others).

The measures listed above must be considered during the design phase. Interior duct chases, ceiling furr-downs, and openings in floor and roof trusses must be indicated in construction drawings and specifications.

Ductwork is inherently problematic. Heating and cooling systems that do not require ductwork (such as mini-splits—see 8.04) avoid these problems.

9. **All water heaters in 1-story home are located within 20 piped feet of appliances and/or fixtures they serve; within 30 piped feet for 2-story**

Limiting hot-water supply runs can reduce both energy and water use by reducing the time that it takes for hot water to reach points of use. The length of plumbing runs is generally determined by the design of a residence, both in its shape and size, as well as the location of appliances and bathroom/kitchen fixtures. When hot water is drawn into the plumbing pipes, then not used, it cools. The loss of this energy that was used to heat the water is called “standby loss.” (Storage tank water heaters also incur standby losses, especially when storage capacity exceeds household needs.) The longer the length of pipe to reach a faucet, the greater the standby losses will be and the more water will be wasted while the user waits for hot water to arrive.

Short runs for hot-water supply reduce the amount of pipe or tubing to connect appliances and fixtures to the water heater and can also reduce labor. In larger or spread-out houses, it may be necessary to have two water heaters to reduce standby losses. Another solution (where appropriate) is to use smaller diameter pipe, which further reduces standby losses. See also 7.02.

10. **Covered, usable front porch (minimum: depth 6’, minimum area 100 sf)**

11. **Covered, usable porch other than front porch (minimum: side 6’, minimum area 100 sq. ft.)**

A usable, covered front porch helps anchor a home to its site and makes a transition from public space to private space. It promotes interaction with neighbors and increases neighborhood security and sense of community. It provides weather protection at the entry door and a comfortable extension of living space, usable most of the year in the Central Texas climate.

We take it for granted that our homes are divided into rooms, but the concept of having similar "outdoor living spaces" doesn't as easily occur to us. Yet the more conscious we become of outdoor living spaces, the more we can tailor them to suit various seasonal activities. For example, outdoor cooking during the summer eliminates heat gain and moisture generation from inside the home.

In addition to creating more living space, covered outdoor spaces provide cooling shade and weather protection to the walls and windows of a home. Shading the walls, especially the east or west walls, will
reduce heat build-up in the home, making it more comfortable to live in and reducing energy costs. Covered east and west outdoor areas can also allow more windows to be placed on those walls without the heat gain that would normally result from such window placement. This can be especially important if there is a desirable view to the east or west.

12. Screened porch (minimum side dimension: 6'; minimum area 100 sf)
A screened porch extends the potential for outdoor living even more than an unscreened porch, since many people avoid using their porches during “bug season.”

13. Roof area of >400 sf is "solar-ready": oriented within 75 degrees of due south with < 9:12 roof pitch, unshaded and no penetrations
Builders or homeowners may be unable or unwilling to install photovoltaic systems at the time of construction, but owners may want to do so at a later time, especially with the rising cost of energy. It doesn’t make sense, therefore, to design homes with roofs that will not accommodate such systems – roofs with sufficiently large planes facing the sun. Obviously these planes must be shade-free, but the builder must also take care that they have no obstructions. That may mean consolidating vent pipes and having them penetrate the roof in a “non-solar-ready” plane. Builders need to write this in their agreements with relevant sub-contractors (especially plumbers) and discuss with them how venting can be placed elsewhere.

14. All roof overhangs project a minimum of 24” horizontally
Appropriately sized roof overhangs have two major functions: they block unwanted, hot summer sun from heating up a home and they help protect the home from moisture damage caused by precipitation. Due to the seasonal changes in the sun’s path, properly sized overhangs can block direct summer sunlight from entering windows and allow heat gain through windows from winter sunlight. The benefits are greater comfort, lower energy bills, and reduced maintenance problems and costs. Overhangs can also enhance a home’s visual appeal by emphasizing the sheltering roof.

Ideally, roof overhangs should be sized according to the direction they face, since each direction gets a different amount of sun. Since that is not always practical, however, at Austin’s latitude (and that of nearby counties), a 24” wide overhang will shade most south-facing glazing (typically a one-story or top story of a multi-story home) during the midday hours of summer. It will provide reasonable rain protection as well. While gable roofs provide full shading of windows on just two exposures, hip roofs provide shading and weather protection on all four exposures.

15. Windows are designed for daylighting: placed high on walls; not requiring privacy treatment
While design of electric lighting and efficient fixtures and lamps help reduce energy consumption in a home, good daylighting can sharply reduce consumption during daylight hours. Furthermore, natural daylight creates healthier environments by improving occupant mental well-being. When properly designed, transom windows, clerestories, and dormers can provide a large portion of lighting needs without undesirable heat gain or glare. To be counted for these points, windows must be located high on exterior walls so window treatments are not required for privacy.

A home designed with adequate overhang projections and the use of awnings or other shading devices can significantly reduce or negate heat gains while allowing natural light to penetrate a room. Indirect light itself actually carries less heat than that produced by incandescent lamps. This can result in smaller sensible-cooling loads and may allow the downsizing of cooling systems, reducing the initial cost of equipment.
16. **Spaces lacking natural lighting (e.g. internal stairwells or powder rooms) have an ENERGY STAR tubular daylighting device** (otherwise known as a solar tube or sun tunnel)

Since internal spaces cannot benefit from well-placed and sized windows for natural lighting, a tubular daylighting device can provide it in many cases. This is a reasonably energy-efficient compromise between a skylight, which would be much larger in area, and artificial lighting turned on during daylight hours. Seen from the inside space, these devices actually look like a light fixture. Selecting an ENERGY STAR model assures that the device will be energy-efficient.

17. **No skylights into conditioned space**

In Central Texas, due to the high summer sun-path, having a skylight in a house is much like punching a hole in the roof and letting the sun's heat pour in. Although skylights add light to dark interiors, that light comes at the cost of increased cooling bills and lowered comfort. They also are potential leak points in the roof, particularly during our torrential rains. In winter, they contribute to heat loss.

There are better ways to get light into the interior of a home without a lot of heat gain - for example, light tubes or windows placed high on vertical walls, well protected by overhangs (see 3.15 and 3.16).

18. **Designed, effective cross-ventilation in main living areas**

19. **Designed, effective stack ventilation (e.g. operable windows in cupola, clerestory, or at top of stairwell)**

In Central Texas, natural ventilation plays an important role in maintaining comfort, providing fresh air, and reducing the need for mechanical cooling, especially on days when the relative humidity is low.

Natural ventilation relies on air pressure differences to move fresh air through buildings. Air pressure differences can be caused by wind or the buoyancy-effect created by differences in temperature or humidity. Both cross-ventilation (air flow horizontally through the home) and stack-effect ventilation (buoyant, upward movement of air) should be considered while designing the home, taking into consideration that in most parts of Central Texas the prevailing breezes come from the south or southeast off the Gulf of Mexico for most of the year.

**Cross ventilation**

Cross ventilation is induced by wind pressure. Wind causes a positive pressure on the windward side and a negative pressure on the leeward side of a home. To equalize pressure, fresh air will enter any windward opening and be exhausted from any leeward opening. An open floor plan facilitates air movement. Major living spaces and rooms should be designed with openings in opposite and/or adjacent walls. Corner rooms should have windows on both exterior walls whenever possible. In addition, installing operable transoms above interior doors is a good way to facilitate air movement through rooms that frequently have closed doors.

Window styles play a role in enhancing cross ventilation. Casement windows provide the largest opening area and a right or left opening can be selected for a given room to best direct air into or out of a room. Furthermore, casements seal more tightly than other window styles. Awning windows can be left open during light rain if the wind is low. Double-hung windows, which open at both the bottom and the top, increase ventilation as well.

Sometimes wind flows at an acute angle or parallel to a wall rather than perpendicular to it. In this case, it is still possible to induce wind ventilation by architectural features or by the direction a casement window opens. For example, if the wind blows from southeast to northwest along an east-facing wall, the first window (closer to the south) would have hinges on the right-hand side opening toward the wind to the south acting as a scoop and directing air under positive pressure into the room. The second window (closer to the north) would hinge on the left-hand side opening down-wind to the north, allowing air under negative pressure to draw air out of the room.

**Stack-effect ventilation** can occur when no breeze is available, since it relies on convection--the fact that hot air rises. It requires the design of a high vertical architectural component such as a stairwell, cupola, monitor, or clerestory, with high operable windows or other exhaust vents. Outside air enters through lower windows, heats up inside the house, rises to the top and exits out operable windows or
vents at the top. The greater the distance between the intake and the exhaust, the greater the temperature differential that can be created, the faster the air will move (like a fireplace chimney), and the greater the cooling effect. This will be especially useful in the spring and fall of the year, when mechanical cooling may not be required.

In summary, a home can be designed to take advantage of either cross ventilation, stack ventilation, or both. Orientation of the home toward prevailing breezes, layout of interior spaces, and window style, size and placement and/or a thermal-chimney should be carefully designed and constructed to maximize passive cooling by ventilation. For ventilation to work, windows and vents need to be operated properly both seasonally and daily. In Central Texas, spring and fall are the best times of year to utilize natural ventilation, unless the relative humidity of outdoor air is unpleasantly high.

20. Shading or buffer spaces on west/southwest walls of living space for at least 50% of wall area (e.g. covered porch, pergola, trees, garage, closets)

Shading the east and west walls of a house is an effective way to lower cooling costs and increase comfort, since one or the other of these walls is always in the sun’s path. The solar heat gain is transmitted rapidly through unprotected windows and slowly through the exterior walls, gradually passing through even well insulated structures into the living space. Heat transfer through the walls continues well into the night.

Architectural features such as a pergola or trellis can shade the east and west walls of a home and significantly reduce cooling loads. Buffer spaces, such as the garage, closets, utility room, on the hot sides help as well.

Tree shading will not be counted for this measure even though they are very helpful and are encouraged. They not only provide shade, but also create an area of cooler air around the house, due to transpiration of moisture from the foliage. Unfortunately, relying solely on trees is problematic, however, since trees may not survive construction or may be subject to pests and disease, such as oakwilt.

21. Overhang projection factor is >0.5 for all windows facing southwest to northwest (225o through 315o)

Shading windows in the summer to prevent excessive solar gain can greatly reduce overheating of a house and cut cooling bills. Overhangs are not sufficiently effective at all times, however, particularly at west- and southwest-facing windows because, when the sun is low in the west/southwest in the afternoon, shallow overhangs provide no protection. Making sure glazing is protected according to this standard will, however, substantially reduce direct sunlight.

The projection factor is calculated by dividing the depth of the overhang by the distance from the bottom of the window to the bottom of the overhang. For example, a 2 foot overhang above a 3’ wide x 5’ tall window, where the top of the window is 1’ below the bottom of the overhang, would be calculated as follows:

2’ overhang divided by (5’ high window + 1’ height from top of window to bottom of overhang) = 2/6 = 0.33

In this example, the project factor does not meet the requirement for points. If the overhang were increased to a 3’ depth, then 3/6 = 0.5, which would qualify for the points. Of course, a 6’ or deeper porch would provide the best shading for the window.

Since east/southeast-facing windows also allow a lot of solar heat-gain (which one is less aware of in the relatively cooler morning), these windows ought to be similarly protected from the sun. If provided, enter this information in Section 12 for potential extra points.

22. AND/OR Glazing on east and west walls combined does not exceed 25% of total glazing area; glazing on west wall does not exceed 10% of the west wall and glazing on east wall does not exceed 10% of the east wall

Window sizing and placement are usually the main determinant of a home’s cooling costs. It is extremely difficult to protect glazing on east and west walls from the sun’s heat, since it is always in the sun’s path for part of every day. Adding an unshaded 6’ sliding glass/patio door to the west side of a home can increase the cooling load by almost half a ton, for example.
Reducing the glazing area on east and west walls is one of the most effective ways to increase comfort and reduce utility bills. A good design guideline is to limit glass on these walls to no more than 25% of the total glazing area and to allow no more than 10% of an east and west wall area to be glazing.

Following this recommendation, most windows will be placed on the north and south sides of a home. Windows on the north provide very good light quality (the kind artists like) and will not contribute significantly to summer heat gain or glare. (Some heat gain due to diffuse or reflected solar input will occur.) North-facing windows are typically not a problem in Central Texas, except on very wind-swept sites. Windows on the south can reduce utility bills in winter without being a detriment in summer, due to the changing sun path: in winter the low sun helps heat the home and in summer the high sun is easily kept from shining on the windows with small overhangs and other shading devices.

**23. AND/OR Total glazing area is no greater than 18% of conditioned floor area**
A good thermal enclosure helps slow down heat transfer from outside to inside. Although window technology has improved substantially in recent years, the R-value of even code-minimum-insulated walls and ceilings still provides better thermal protection than windows commonly available on the market. Windows are in essence "holes" in the thermal enclosure. For that reason, it helps reduce energy costs to reduce window area.

Since many inefficiently designed homes have unnecessary wall projections and changes in walls that can adversely skew the window-to-wall ratio, a better gauge of an acceptable glazing area is the percentage of total window and skylight area to total conditioned floor area, not wall area.

**24. No fireplace is located within conditioned space**
Most modern fireplaces are not designed to provide heat: their main purpose is aesthetic value. In fact, most models tend to make a house less energy efficient. For this reason, a fireplace is discouraged unless it is outside of the conditioned living area.

**25. Attached garage has exhaust fan with timer; or passive vents installed at least 18” above finish floor**
A vehicle exhausts fumes that are dangerous and easily trapped in a garage. Even after it is turned off, fumes are emitted until the engine is cool. If the garage is attached to the house, fumes easily migrate into living space and ductwork, endangering the health and safety of occupants. An exhaust fan on an automatic timer exhausts these fumes to the outdoors. A minimum of two passive vents is acceptable.

*A carport is an acceptable substitute for this measure.*

**26. OR Attached garage is thermally broken and air-sealed from conditioned living space**
Although the common wall between the living space and an attached garage is considered an "exterior" wall as part of the overall thermal envelope/enclosure, studies have shown this can be the leakiest wall in the house. Many items are typically stored in garages that can contribute to indoor air pollution in our homes. These include auto exhaust fumes, engine oils and lubricants, gasoline-powered lawn equipment and fuels, paints, varnishes, adhesives, sealants, fertilizers, pest-control chemicals, cleaning materials and other chemicals that off-gas toxic fumes. When occupants turn on exhaust fans while cooking or bathing to remove moisture, negative pressure can be created in the home. This causes air to be sucked into the home, and it will choose the path of least resistance, i.e. that leaky garage wall. Thus, all the fumes from the automotive and stored chemical compounds are drawn into the home. This can happen through the wall itself, if insulation and air barriers are poorly installed, through a common doorway that is not properly weather-stripped and sealed, or through common attic space. If the air handler and duct work for the heating and cooling system are located in that common attic space, that is particularly dangerous, since they are never absolutely air-tight. Contaminants drawn into the air distribution system will be distributed throughout the home, not just into spaces adjacent to the garage.

It is important to make sure that a high-quality seal of insulation, air barriers, weather-stripping, and sealants are installed at all common walls and penetrations between the house and an attached garage space. Additional measures to separate the attic above the garage from the attic space of the main house are also required. This can be done by installing a fully insulated wall in the attic complete with air
barriers on both sides, making certain that all joints, seams, and penetration in that wall are completely sealed with tape and caulk.

27. OR Garage is detached from the house; or house has no garage
A detached garage or no garage solves all the problems of 3.26.

28. All doors are 2'-6" or greater (doors to non-walk-in closets excepted)
An important part of green building is to make homes that last a long time and make homes that people can last in a long time. Their health may change, their age obviously changes, children or other relatives may come or go from the household, so the best home can reasonably accommodate them over time. Although 2'-6" width doors are still narrower than the 2'-8" interior doors specified by Universal Design principles, they are nevertheless a move away from the extremely cramped 2'-0" doors found in many homes.

29. Basic access to house provided according to City of Austin Visitability Ordinance
Homes built to the City of Austin Visitability Ordinance make a home “visitible” to mobility-impaired guests. Moreover, if occupants become mobility-impaired, even temporarily, they will still have easy access to critical rooms of a home and easy use of the electrical controls. Building to this standard is a requirement for all City of Austin-financially-assisted housing projects.

The specific requirements are:

a. One ramp or no-step entrance on an accessible route with an entrance door that has a minimum net-clear-opening of 32 inches and a lever handle. It may be at the front, side, or back of the house. The ADA specified maximum height for thresholds is ¾ in. (19mm) for exterior sliding doors or ½ in. (13mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2.

b. Interior doorways on the first floor have a minimum net-free-opening of 30 inches and lever handles (not required for doors leading to closets less than 15sf).

c. A minimum 36-inch-wide level route through hallways and passageways throughout the first floor of the dwelling unit, with ramped or beveled changes at door thresholds.

d. Reinforcement in first floor bathroom walls (entire room), utilizing lateral two-inch by six-inch-or-larger wood blocking installed flush with stud edges of walls. The centerline of the blocking must be 34 inches from and parallel to the floor.

e. First floor light switches, thermostats, receptacles, and electrical panels must be within 18” and 42” above the floor, and outdoor electrical panels adjacent to an accessible route must be installed to the same height requirements.

30. OR Home incorporates barrier-free / universal design / ADA (American With Disabilities Act) elements
A barrier-free home or one with universal design features incorporates principles and features that allow more comfortable and independent living for more people of all ages. Here are possibilities--you may think of others (if you take credit for 3.29, you may not take credit for items a. or b.):

a. From an accessible route, a minimum of one ramp or no-step entrance on any side of the home with overhead protection (3.10 or 3.11: 3 or 2 points) that has a minimum net-clear opening of 32 inches. The ADA specified maximum height for thresholds is ¾ in. (19mm) for exterior sliding doors or ½ in. (13mm) for other types of doors. Raised thresholds and floor level changes at accessible doorways shall be beveled with a slope no greater than 1:2.

b. First floor light switches, thermostats, receptacles, and electrical panels must be within 18” and 42” above the floor, and outdoor electrical panels adjacent to an accessible route must be installed to the same height requirements
c. 42” minimum-clearance access corridors (hallways) throughout home with ramped or beveled changes at door thresholds
d. Full length sidelight at public entry
e. Adjustable-height closet rods and shelves
f. View-windows with a sill height of 36” or less
g. Knee space under the sink and cooktop
h. Lever-type water controls
i. Variable-height work surfaces
j. Contrasting border treatment on counter tops
k. Pull-out shelves in base cabinets
l. Knee space under bath lavatory
m. Roll-in shower and/or tub
n. Bath lavatory mirrors extending to backsplash behind sinks
o. Offset controls in tubs and showers
p. Adjustable-height showerheads
q. Elevator

31. Dedicated kitchen recycling center; approved by Rater
A dedicated kitchen recycling center encourages occupants to recycle. Recyclables can be neatly and immediately separated in this handy location. This needs to be more “formal” than simply a space to qualify for this point. Discuss with Rater.

SECTION 4: MATERIAL EFFICIENCY

1. Lot has more than one dwelling unit
More than one dwelling unit per lot increases density and decreases sprawl. This results in reduced need for utility and transportation infrastructure expansion. That, in turn, results in money saved on development costs. When a home site has more than one living unit, it also has the potential for rental income, which can be an excellent investment and hedge against property tax increases and other expenses.

2. Existing home removed from site is deconstructed and materials are >75% reclaimed/reused (not landfilled)

3. OR Existing home removed from site is relocated for use at another site
Redevelopment and/infill building in established neighborhoods often result in the demolition and disposal of older/smaller houses. From a resource-use perspective, this is extremely wasteful – the resources and energy that went into the demolished house are lost, while additional resources and energy are used to build the replacement.

Depending upon the condition and location of the existing house, it may be able to be moved to another location and this may preserve architecture that deserves to be saved. Depending upon lot size and zoning, a small house can sometimes be reused on site by moving it to another portion of the lot to make room for an additional residence.

Even if a house’s overall condition makes it a poor candidate for renovation, much of the structure is often salvageable. The type and quality of wood used in an older home is often unobtainable today – it could be used as attractive trim or architectural details in the house that replaces it. Solid wood siding on interior shiplap walls may be re-milled for cabinets or stair treads. Doors and other fixtures can often be reused, and are often more distinctive and affordable than contemporary replacements.
Affordable housing non-profits, like Habitat for Humanity, may be available to do deconstruction. These groups may use some materials in their own projects while offering remaining materials for sale, so as to fund their own homebuilding activities. A tax-deductible donation may be possible in some cases.

4. **Project is renovation of, and/or addition to, an existing home**

While the AEGB Single-Family Home Rating is primarily applicable to the design and construction of new residences, substantial improvements in energy-efficiency and water use, as well as resource efficiency, can be realized in the renovation of and additions to existing structures. Renovations are a resource-friendly means of increasing the volume of existing housing stock, since they extend the life of building materials already in use and avoid demolition/disposal of existing housing. If done carefully, an addition may substantially increase the square footage while having little impact on the overall energy use of the house.

The look and feel of a neighborhood or community is determined by the size and appearances of houses, as well as their setbacks from the street and adjacent houses. Renovations/additions can often be performed without altering the look and feel of the community. They can also renew older neighborhoods that have the advantage of a public transportation system and utility infrastructure already in place.

5. **Home is factory-built modular construction on permanent foundation**

Modular homes (not “manufactured” housing) can often outperform site-constructed homes from the standpoints of energy-efficiency, efficient use of building materials and waste reduction. When modules are assembled in a factory setting, greater quality control is often the result, and the process is inherently resource-efficient because there is very little material waste in a factory. Additionally, building materials are not lost to theft or damage from the elements.

Modular construction greatly reduces the influence played by the weather. Modules are constructed in factories, under conditions that are superior to those found on construction sites. Modules can usually be constructed in one week, and assembled on site in a single day, almost eliminating delays due to inclement weather.

Under Texas law, factory-built homes are required to meet the codes of localities where they are erected. Because modules have to withstand the stresses of transportation and handling, they are often more resistant to natural forces than are site-built homes.

6. **Conditioned space: maximum of 1,500 sq. ft.**

7. **OR Conditioned space: maximum of 1,200 sq. ft.**

8. **OR Conditioned space: maximum of 1,000 sq. ft.**

Common practice today is to build ever-larger homes with as much “cheap” space as possible. “Cheap” space includes living, dining, family rooms, and bedrooms, which are less expensive to build than kitchens and bathrooms, since there are no expensive fixtures and utilities to install in these rooms. While inexpensive to build, this space is just as expensive to heat, cool, illuminate, clean and furnish as any other space. The construction of excessively large homes consequently requires the homebuyer to spend more to purchase the home and more in operating costs, while not necessarily receiving more in function and beauty.

As the average American home size has steadily increased since 1940, the average family size has decreased.

Smart design results in a home with enough space for a convenient, comfortable lifestyle for its occupants without additional unneeded space. Square footage is not a component of beauty and elegance. Excessive size is frequently just an excuse for bad design. It results from not taking the time to solve design problems in more intelligent and aesthetically satisfying ways.

As Susan Susanka, author of “The Not So Big House” has stated, “the problem is that comfort has almost nothing to do with how big a space is. It is attained, rather, by tailoring our houses to fit the way we really live, and to the scale and proportions of our human form.” Designing and building a “not-so-big” house results in a home that offers greater comfort, pleasure and satisfaction with less consumption of energy,
water, and material resources and reduced impacts from both the construction and operation of the home than an unnecessarily large home. Many homeowners are now heeding Susanka's message.

9. Exterior rough-in dimensions are modules of 2’
Designing to a 2’ grid reduces waste, since most standard building products are sized in multiples of 2’ and many building components, such as floor and roof trusses, are typically laid out on 24” centers. Constructing on this grid saves time as well as materials, since fewer cuts may be required and less material is wasted. Using a 4’ module will be even more material- and labor-efficient, since many building materials come in 4- modules.

Wall framing is by the “Optimum Value Engineering” (OVE) or “advanced framing” method (as allowed by Code):

10. Exterior wall framing at 24” on center
11. Interior wall framing at 24” on center
12. Headers are sized for the loads they bear; no headers in load-bearing walls
13. No wood wall sheathing (structural sheathing for corner bracing excepted)
14. Other "Optimum Value Engineering" or "advanced framing" techniques (e.g. 2-stud corners and ladder blocking; drywall clips)
The extraction, manufacture, transport and disposal of lumber depletes resources, damages natural habitats, and pollutes air and water. Dimensional lumber depends upon larger trees that require decades to mature. Conventional framing can often be structurally redundant, using wood unnecessarily and reducing space for insulation.

Optimum Value Engineering (OVE), also known as advanced framing, provides a means to reduce environmental impacts in the construction of quality, structurally sound, code-approved wood-framed homes. According to the US Department of Energy’s Office of Building Technology, advanced framing techniques can save hundreds of dollars in material costs and shave 3 to 5 percent off labor costs. They reduce annual heating and cooling costs up to 5 percent by maximizing the exterior wall cavity available for insulation installation, creating a more energy-efficient building enclosure.

While the system can be applied as a whole package, many of its components can be used independently. Framers unfamiliar with these techniques may need training. In general more planning is needed when using these techniques, but once they are mastered, great savings can ensue. We suggest that builders try some of them and add more over time.

See the following websites for more information and details about OVE wood frame construction:
www.nrdc.org/cities/building/rwoodus.asp
www.pathnet.org

15. Exterior walls system is constructed off-site (e.g. panelized wood frame, SIPS)
Factory construction of entire wall assemblies leads to more efficient use of materials. Smaller cutoffs are used for blocking. The panels may also be built on waist-high assembly stations, reducing worker fatigue. In addition to reduced waste, the panels are true and square, since they are built with jigs to assist in assembly. The wall sections are numbered and loaded for delivery so the first wall section off the trailer is the first one needed on site.

Structural Insulated Panels (SIPS) are a “sandwich” panel product consisting of an insulated foam core, with an inner and outer layer of structural sheathing material – usually OSB (oriented strand board). They are available from various manufacturers and can be reliably used in place of conventional studs,
plywood, and insulation systems that use more natural resources and are more labor-intensive. SIPS provide greatly reduced air-infiltration, high R-values, rot/pest/fire resistance, and are easier and quicker to install.

16. OR Exterior wall system is ICF, ACC block, straw, rammed earth, compressed-soil block or other AEGB-approved system

There are many types of effective exterior-wall construction products and techniques other than conventional wood-framed walls. They may be known as “solid”, “advanced”, “alternative”, or “innovative” systems, and have a variety of advantages, depending on the system. They are typically very energy-efficient and quiet.

Here are some examples:

**Insulating Concrete Forms (ICFs)** are modular, panel or block-like, permanent, concrete forms with hollow-core interiors that are stacked or set in place and then filled with steel-reinforced concrete, creating a monolithic concrete structure. Foam types, assembly methods, and amount of concrete needed vary, depending on the manufacturer. Advantages are high insulation values, high strength, easy and rapid installation, rot/pest/fire resistance, and low maintenance.

**Aerated autoclaved concrete (ACC) blocks** are made of cement, sand, lime, and an aerating agent, and are baked in an autoclave. These lightweight and strong cement blocks are stacked together, much like bricks, and can be finished in a variety of methods, typically with stucco on the outside and plaster on the inside. Advantages are rot/pest/fire resistance, low maintenance, and ease of installation. The R-value is adequate for Central Texas.

**Straw bales** can be stacked like blocks and provide a highly insulative, natural wall system, usually given a stucco finish. The bales can be either the structural support for the roof or serve as an insulative infill in a post-and-beam type wall construction. Straw has low embodied-energy and is a waste product (do not confuse it with hay). It has no nutritive value and is largely composed of silica, which deters pests (they cannot penetrate it because it cuts them to pieces). This waste product has few traditional uses other than landscaping or animal bedding and unless prohibited, often burned, causing pollution.

**Earth** is a natural, beautiful, biodegradable, and abundantly available building material. It can be used for Rammed Earth, Compressed Soil Blocks, Cobb, Adobe, Superadobe, and other wall systems. Typically stabilized with a small amount of cement in the Central Texas climate, earth can provide both exterior and interior, structural and finish walls. It is pest resistant, long lasting and has high thermal mass (not a huge advantage in regard to temperature in Central Texas, with our low diurnal temperature swing, but probably a good means of regulating moisture). Like straw, it has the advantages of low embodied-energy, minimal impact on natural resources, and is biodegradable when the life of the building is over.

17. Engineered finger-jointed studs are used for a minimum of 80% of wall construction

The use of engineered, finger-jointed studs saves forests, material, time and money, without compromise of structural strength. Finger-jointed studs are comprised of short pieces of lumber glued together into stud lengths. These studs are straighter, more stable, and stronger than solid-sawn studs. This substantially reduces the need to cull bad studs, normally required with solid-sawn studs.

Structural finger-jointed lumber is manufactured to meet the requirements of two different types of end-use applications. The first category is basically an all-purpose product, indicated by CERT EXT JNTS on the grade stamp. The second category is appropriate for use where the primary loading will be in compression parallel-to-grain, indicated by VERTICAL USE ONLY on the grade stamp.

Finger-jointed products grade-stamped CERT EXT JNTS are intended for all structural applications. This lumber is assembled with a waterproof, exterior-type adhesive. Limitations on knot size and placement near joints are highly restrictive. CERT EXT JNTS-stamped products may be used interchangeably with any solid-sawn lumber product of the same species and grades. The lumber may be used as beams, joists, rafters, studs, plates, or in any other exterior or interior framing application.

Products that are grade-stamped VERTICAL USE ONLY (previously stamped and known as STUD USE ONLY) are appropriate for carrying loads in compression as vertical framing members. VERTICAL USE ONLY-stamped finger-jointed lumber is manufactured to meet the performance capabilities of solid sawn,
end-loaded bearing members where short-term bending or tension loads from lateral forces such as wind, seismic and impact may be present, but where forces from the conditions of long-term, sustained-bending or tension loading are not present.

18. Engineered floor trusses or materials such as webbed trusses, I joists, truss joists, or LVLs (no solid lumber 2x10 or larger)

19. Engineered roof trusses or materials such as I joists, truss joists, or LVLs, SIP Panels (no solid lumber 2x10 or larger)

Due to the dwindling supply of large timber, engineered wood products or non-wood substitutes should be used in place of large-dimension lumber. These products are more consistent in quality than solid lumber. They may be made up of smaller and/or shorter pieces of solid lumber, or from small, fast-growing tree species, or other materials, thus saving our old-growth forests.

Engineered wood products offer many advantages:

- Optimization of global wood resources by using only very small trees or fast-growing species
- Utilization of a very high percentage of the tree
- Consistency in quality and result in less waste
- Use of less material to provide greater strength
- Made-to-order for a given job, which reduces job site waste
- Less prone to expansion and contraction;
- Floor trusses less prone to squeaking
- Can be constructed to allow easy placement of ductwork, wiring and plumbing

All of the products described below fall into the general category of engineered lumber:

**Floor and Roof Trusses**

Wood trusses eliminate waste since they are made-to-order. They reduce the pressure on old growth forests by replacing 2x10s and 2x12s traditionally used for floor joists and roof rafters. Manufacturers have the ability to vary flange sizes, depth of webs, grades and types of timber to meet the desired load constraints and thereby maximize the use of raw material. The open web design also allows excellent access for plumbers, electricians and air-conditioning contractors to design and install services through the floor without cutting or notching.

**Glulams**

Glulams (glued laminated timber) are comprised of wood laminations, or "lams," that are bonded together with strong, waterproof adhesives. Glulam lumber can be milled from a variety of species. Individual "lams" are typically two inches or less in thickness and vary in width depending on the size of the beam. The final products are beams that range in size from 4x8 up to 6x20 and larger. Glulams can be used as beams and girders where standard construction practices would require large dimension timber.

**Laminated Veneer Lumber**

Laminated veneer lumber (LVL) is made from layers of dried and graded wood veneers bonded together with waterproof adhesive. The grain of each layer of veneer runs in the same direction, rather than cross-lamination which is typical of other engineered wood products such as plywood. The result is a solid and uniform engineered wood product that is sawn to consistent sizes and is virtually free from warping and splitting. LVL is available in various thicknesses and widths and is easily worked in the field using conventional construction tools. LVL typically out-performs conventional lumber and can be used as studs, headers, rim joists, beams, columns, and girders in floor framing and as rafters in roof framing. LVL is also known as structural composite lumber (SCL).

**Wood I-Joists and I-Beams**

Wood I-joists are comprised of top and bottom flanges of various widths combined with webs of various depths. The flanges resist common bending stresses, and the web provides outstanding shear performance. I-joists can be manufactured using solid sawn lumber or LVL for the flange components and plywood or oriented strand board (OSB) for the web. They can be manufactured to span longer
distances than solid lumber and can be purchased in lengths up to 40 feet. Moreover, they are dimensionally stable and do not crown or bow as does solid lumber.

**Oriented Strand Board**
Oriented strand board (OSB) is a solid panel product manufactured from water-resistant heat-cured adhesives and rectangularly shaped wood strands that are arranged in cross-oriented layers, similar to plywood. This results in a structural engineered wood panel that shares many of the strength and performance characteristics of plywood.

**Parallel Strand Lumber**
Parallel strand lumber (PSL) is manufactured from 2'-8' long, thin wood strands. The strands are generally taken from veneers peeled from the outermost section of the logs, where stronger grain is located. Veneers are dried to and graded for strength before chopping into strands. The strands are then aligned parallel to one another, coated with a waterproof adhesive, then pressed and cured to form a rectangular billet. The product is quite uniform throughout the cross section, and is re-sawn from the manufactured billet to a wide range of sizes. Large members, some approaching sizes common in glulams, are manufactured by assembling strands which have been chopped from sheets of veneer up to 8 feet long. The result is an engineered wood product with considerably higher strength than is available from solid timbers of the same cross section.

**Laminated Strand Lumber**
Laminated strand lumber (LSL) is manufactured from short (about 12") thin wood strands. The strands are aligned parallel to one another, coated with a waterproof adhesive, then pressed and cured to form a rectangular billet. Like PSL, the product is quite uniform throughout the cross section, and is re-sawn from the manufactured billet to a wide range of sizes.

20. Use of reclaimed materials, such as doors, hardware, flooring: provide list of all products used for this credit in Section 12
Reclaimed materials or products are ones that have previously had a life in one structure or location and are then removed and installed in a new or renovated one, thus reducing the need for virgin resources. These materials and products are often of higher quality than new ones and often are a better fit in a renovation project.

21. Use of recycled-content products
Recycled-content materials reduce depletion of natural resources, energy and water, reduce pollution and greenhouse gas emissions, reduce waste, and support a healthier economy by creating on average nine jobs for every one job in waste disposal. Recycled-content materials support companies that are making the effort to produce environmentally preferable products.

Recycled-content may come from post-consumer or post-industrial sources. Post-consumer waste relates to materials that have been used by consumers and are diverted from the landfill to be repurposed into some other product. Examples of post-consumer products are cellulose insulation made from old newspapers, carpet made from plastic bottles, or fiberglass made from recycled glass. Post-industrial are waste by-products typically generated from industrial activities that can be used as content for building materials. An example of post-industrial content is the use of fly-ash as a substitute for Portland cement in the making of concrete. Fly ash is a waste product of coal power plant production processes, whereas Portland cement is a natural resource that is being depleted.

Recycled-content materials are required to have a minimum recycled content of 25%, measured according to the Federal Trade Commission regulations for claiming recycled content in their products.

22. Use of local materials/products for major elements of the home; harvested or manufactured within 500 miles
Embodied energy refers to the energy required to transport raw materials to manufacturing facilities, finished products from manufacturing to the jobsite, and from the jobsite to the facility that will manage the disposition of the materials at the end of a product’s life. The environmental impact of long-distance transportation cannot be offset since it does nothing to improve the product, extend its’ life cycle, or otherwise add value to the product over products available locally. Products made from raw materials
that are extracted or harvested and/or manufactured within 500 miles of the jobsite have much lower embodied energy and therefore lower impact on the environment.

Many raw materials are available within 500 miles of the Central Texas market area, including southern pine lumber, stone products, and abundant supplies of sand and aggregate. Many national product manufacturers also have operations within this region, including gypsum drywall, cementitious siding, autoclaved aerated concrete, windows and doors, flooring, countertops, and others. Most of them are happy to accommodate order requests to ship from those local facilities.

23. **SFI-certified: a minimum of 50% of framing or sheathing or decking material is SFI-certified engineered product or lumber**

SFI—the Sustainable Forestry Initiative—is the certification program of the forestry industry. See: [http://www.sfiprogram.org](http://www.sfiprogram.org). This industry has made steady advances in recent years toward more sustainable forestry practices and 3rd-party certification. It differs substantially from the FSC in regard to its assessment of the amount of remaining old-growth forests. See the document “FSC and SFI Similarities and Differences” on the SFI website.

A number of local lumber suppliers carry SFI-certified lumber and products.

24. **FSC-certified: a minimum of 50% of framing or sheathing or decking material is FSC-certified engineered product or lumber**

FSC-certified wood products are verified by a third party as originating from sustainable, well-managed forests. The Forest Stewardship Council (FSC) is currently recognized as having the most rigorous standards and also the only certification system that provides for chain-of-custody supervision to ensure that products used were derived from certified forests. FSC has developed a set of Principles and Criteria for forest management that are applicable to all FSC-certified forests throughout the world. There are 10 Principles and 57 Criteria that address legal issues, indigenous rights, labor rights, multiple benefits, and environmental impacts surrounding forest management.

Sustainable forestry practices as established by the FSC minimize or eliminate the negative impacts on air, water and soil quality, wildlife, recreation, and forest longevity that are associated with conventional forestry. The use of FSC certified products reduces the negative impacts of conventional forestry practices—such as clear-cutting, monoculture, destruction of recreational areas and wildlife habitat.

For further information visit the U.S. FSC website: [www.fscus.org](http://www.fscus.org)

Some FSC-certified lumber and products are available in Austin.

**SECTION 5: CONSTRUCTION WASTE MANAGEMENT**

By reducing the amount of waste sent to the landfill we not only reduce the quantity of new materials that must be purchased, but also save transportation to the landfill, dump fees, and the resulting impact on the environment. It is, furthermore, the goal of the City of Austin, as set forth in its Zero Waste Plan, to reduce the amount of waste Austinites send to the landfill by 90% by the year 2040.

1. **On-site facilitation of sorting and reuse of scrap building material; appropriate for project; as approved by Rater**

Providing dedicated space on-site for the sorting of reusable and recyclable construction waste focuses attention on the generation of waste and teaches trade contractors that the builder and owner value waste reduction and reuse.

2. **On-site grinding of brush, lumber, cementitious material and/or gypsum waste; used on-site or off; not landfilled; documentation required**

Wood waste and brush can be mulched on-site to provide ground stabilization to protect tree root zones or as a finish for landscaping beds. Gypsum drywall scraps can be ground up and used as a soil amendment and concrete waste can be ground up and used in drainage features or underlayment for storage sheds and the like.
3. Excess material used in construction or other approved projects offsite, not landfilled; documentation required
There are many possibilities for reusing excess materials elsewhere if it is not possible to use them on-site. They may be used to construct a different house or for a different purpose, e.g. making furniture out of excess wood. They may be given to a school for art projects.

4. Minimum 50%-by-weight of waste is recycled/reused; not landfilled; documentation required
Most waste from construction sites can be recycled for new uses instead of being sent to a landfill. For example, wood may be find new life in engineered lumber. The gypsum in drywall can be used as a soil amendment, in the production of cement, and as an ingredient in the manufacture of many types of commercial products.

In Central Texas, a number of professional construction waste recycling companies are now available to manage waste and document what happens to it after removal from the construction site. See 5.05

5. OR 5 Construction waste management plan, approved by Rater at commencement of project; documentation required
The purpose of a construction waste plan, is to reduce the need for landfills, reduce hauling and its environmental impacts, reduce dumping and storage fees, provide materials for reuse and resources for the manufacture of new products, and save money for the builder and owner.

This plan is ideally included in the specifications, but if this has not been done, the builder can develop a plan and may want to do so with a construction waste management company. It may include 5.01, 2, 3 and 6.

Here are examples of matters a construction waste plan should address:

- Measures taken to reduce on-site waste (e.g. factory-construction of walls)
- Reuse of usable structures and materials, on-site if possible
- Recycling of waste materials for new uses, on-site if possible
- Proper and safe disposal of unusable or hazardous material

Best practice is to use construction waste on site as much as possible. This reduces the impacts related to transport and disposal—pollution from vehicle emissions and shortened life of disposal sites. It may also mean finding uses for deconstructed materials in a new structure that are often much higher quality than available new materials.

Trade contractors are available that bring a mulching machine to a site to pulverize materials, such as scrap lumber, gypsum board, stone, brick, concrete, cementitious exterior products and roof tiles for on-site or reuse. This material can be spread around the foundation to keep workers from tracking through mud and for erosion control. It can be used for landscaping, as well. Mulched gypsum provides a soil amendment which loosens the soil, increases water penetration, and reduces stormwater runoff.

To the extent that construction waste cannot be used on-site or on a neighboring site, a plan can be developed for uses off-site, always with the goal of sending as little waste as possible to the landfill. The easiest method is to contract with a construction-waste-management company. Some of these companies do not require any job-site sorting—they do it themselves at their own site. They have contacts for selling reusable and recyclable material. They are set up to keep track of what happens to the waste, by volume or by weight, obviating the need for the builder to do this.

6. Concrete truck wash-out managed by a professional company to recycle concrete residue and treat wash-out water; documented
It is important to contain and safely dispose of concrete waste water because it is highly polluting. It is alkaline and contains high levels of chromium, which can leach into the ground and contaminate groundwater. If wash-out allows runoff into storm drains, creeks, and streams, their pH is increased. This not only harms aquatic life but affects our drinking water supply. Managing concrete washout can prevent
this contamination, as well as reduce construction waste by diverting and recycling concrete waste from the landfills.

Due to the difficulty of accomplishing this job correctly, points for this measure will only be awarded if the work is done by a professional concrete wash-out company.

The wash-out container must be water-tight to prevent all water and fine concrete material from coming in contact with the ground. The wash-out water must be treated to remove contaminants before it is allowed to permeate into storm drains or ground soils. The treatments site must be located for convenient access for the concrete trucks near the area where concrete is being poured so that the maximum amount of residue can be treated. The system of treatment must be inspected and serviced frequently to assure components are functioning to completely remove contaminants. Aggregates must be salvaged for reuse.

**SECTION 6: THERMAL ENVELOPE, MOISTURE AND PEST CONTROL**

See “Builder’s Guide to Hot-Humid Climates” for design and construction guidelines. In Central Texas, make wall system as air-tight as possible but vapor permeable and able to dry to both inside and outside.

1. **Sand or mechanical-barrier termite control system is used (or structure is not termite-edible)**

   Physical barriers, made of materials such as aggregate, stainless-steel mesh or plastic, do the job of termite control without dangerous chemicals, which could harm occupants and ground water. Actually most of the chemicals that are still legal aren’t very effective after a short time anyway, so why risk using them?

   Stainless-steel-mesh barriers must have correctly sized openings that termites cannot pass through and they must be strong enough not to break. Plastic barriers have a termiticide sandwiched between layers of plastic, but this is not the kind of termiticide used in conventional chemical treatment. All of these methods rely on correct installation and must stay intact over time. A sand barrier requires the correct grain size—one that termites are unable to dig through or move.

   When slab foundations first became common, people assumed they would offer better protection against termites but that has not been the case. In fact, subterranean termites like the underside of slabs, are well-protected there, enter the home through tub traps openings, control joints, plumbing and other penetrations, and cannot be easily discovered until they have done their damage. (Termites are now being found farther north, as slabs have become a more accepted foundation type in moderate climate areas). Pier and beam foundations actually make termite detection easier.

2. **All wood framing is treated with a borate product to a minimum of 3 feet above the foundation (or structure is not termite-edible)**

   The old-fashioned “spray and kill” methods of termite control are dangerous, not only to termites, but also to workers, occupants, the soil, beneficial insects, pets, plants and groundwater.

   There are numerous advantages to using borate chemicals on lumber. Although they are highly toxic to wood boring insects and fungi, they exhibit low toxicity to humans and other mammals. Once the wood has been treated and kept dry, the borate protection is extremely long lasting. What's more, the borates do not affect the appearance or workability of the lumber. The borates are non-corrosive to metal fasteners used in lumber, they are odorless, and they are extremely cost-effective.

   Borate is usually sold in powder form that readily dissolves in water. It should be applied to framing lumber after the house is dried in. The borate solution should be sprayed or brushed on before the lumber is covered over with insulation or drywall. If possible, two applications on separate days are preferable to one. Dry, rough lumber absorbs borate chemicals readily. The depth and extent of penetration depends on several things: temperature of the lumber, lumber species and texture, the internal moisture content of the lumber, and the number of applications.
3. **All exterior wood-to-concrete connections are separated by metal or plastic fasteners/dividers (e.g., posts, deck supports, stair stringers)**

If exterior wood comes in direct contact with concrete (especially if it is sunk directly into it), the wood tends to rot quickly. That’s because the wood swells and shrinks from rain and humidity changes and can’t drain and dry out properly. By separating the wood and concrete with metal or plastic, a barrier is created and the wood has a better chance to dry out. Fasteners designed for this purpose, with air separation and drainage, do the best job. Be certain that wood-to-concrete connections are properly made with metal or plastic spacers. This will reduce chances of wood rot, structural damage, and termite infestation.

4. **Window and exterior door glass has U-Factor of 0.35 or lower**

Window products must be rated, certified, and labeled for thermal conductance (U-Factor) [as well as solar heat gain, SHGC] in accordance with the procedures of the National Fenestration Rating Council (NFRC) at levels which meet the qualification criteria for the Climate Zone in which the home is located. A product's energy-efficiency for a given climate is based on its impact on heat gain and loss in cold weather and heat gain in warm weather. Windows that are energy-efficient in Minnesota will not necessarily be energy-efficient in Texas and vice-versa.

The U-factor is a measure of the whole window unit—both the frame and glazing together. The lower the U-Factor, the more efficient the window. **The U-Factor affects cold-weather comfort much more than summer comfort.**

To be thermally efficient, a window must be double-paned and have a good frame. Wood makes the most effective frame (it can be metal clad on the exterior to reduce maintenance), vinyl and fiberglass are typically the second most effective. Metal with a thermal break is usually third. Metal with a thermal break is, however, a cost-effective option and high-quality units hold up well in the Central Texas climate. Modeling has shown that for a 2,000 square foot house with a typical and equal amount of window area on all sides, the savings of vinyl over thermally broken metal was only $15 at 2009 Austin Energy prices. The AEGB discourages the use of vinyl for environmental reasons. Fiberglass frames are recommended over vinyl and have the added advantage of the glass and frame responding similarly to temperature and humidity, since they are basically the same material.

5. **No skylights; or any skylights installed meet current ENERGY STAR criteria for SHGC and U-Factor**

In Central Texas, having a skylight in a house is much like punching a hole in the roof and letting the sun’s heat pour in. Although skylights add light to dark interiors, that light comes at the cost of increased cooling bills and lowered comfort. They also are potential leak points in the roof during our torrential rains. In winter, they contribute to heat loss.

There are better ways to get light into the interior of a home without a lot of heat gain - for example, light tubes or windows placed high on vertical walls, well protected by overhangs.

If the architect/designer or homeowner insist on having a skylight, however; the skylight must meet current ENERGY STAR criteria for a skylight in regard to U-Factor and solar heat gain coefficient. If possible, it should not be installed on a west-facing plane of a pitched roof.

6. **“Raised-heel” or “energy” roof trusses (vented attics only)**

Typical roof construction with standard trusses or cut-in rafters (rafter meets bottom chord at top of wall) does not allow sufficient space above the wall for ventilation-air intake and full depth of insulation where the rafter meets the wall if the attic is vented. If a larger overhang is desired for shading and protection from rain, the rafter tail obscures the view out the window, especially if the roof is steeply pitched.

With raised-heel trusses, the rafter and bottom chord of the truss meet at the outer end of the overhang or rake (not at the top of the wall), so all the above problems are solved. These trusses are cost-effective and installation is no different from conventional pre-fabricated trusses.
7. **Vented attic has continuous ridge and soffit vents; no other functioning vents installed**

Continuous ridge and soffit vents provide the best method of cooling a vented attic in hot weather. They allow the relatively cooler outside air to enter the attic in a continuous path under the entire length of the eave and exit along the entire length of the ridge. This means the whole underside of the roof will be bathed in cooler air. This attic ventilation system exhausts the largest possible volume of air continuously and evenly and is not affected by wind volume or direction. It works naturally, based on the physics of hot-air-rising, and needs no mechanical help. A cooler attic results in less heat flowing through the attic insulation into the living space on hot summer days and provides a more congenial space for the cooling equipment and ductwork, if they are located in the attic.

Ridge vents are inexpensive, easy to install, reduce the number of roof penetrations and are more aesthetically pleasing than gravity vents, since they can be roofed over and are virtually invisible. Some hip-style roofs may not have room for a sufficiently long continuous ridge vent. With such designs, hip vents or gravity-type exhaust vents placed as close to the peak as possible may be required to augment or replace the ridge vent.

Other types of vents, such as gable vents, gravity vents, and non-continuous soffit vents result in limited and uneven air paths and are more dependent on wind volume and direction.

Power attic vents are not recommended because their energy consumption exceeds their overall energy benefit and are seldom repaired if they stop working. Even the use of solar-powered vents is not recommended for the latter reason.

8. **AND/OR Closed/sealed attic system**

**unvented; polyurethane foam-insulation at roof rafters, minimum 5.5” depth**

(any gas-powered equipment located therein must be sealed-combustion)

The dominant heat-transfer mechanism in an attic is radiation. This heat slowly passes through insulation on the floor of the attic into the living space. When ductwork is installed in a vented attic, the problem is compounded, since heat passes into the conditioned air in the ducts as well, which passes directly into the living space.

To date, we have no evidence that sealed and insulated attics in hot, humid climates trap moisture. In fact, researchers have found that in this climate, buildings with unvented attics are actually less likely to have condensation and mold than those with vented attics. That's because in our climate most moisture comes from outside, and the foam keeps the attic dryer.

In Central Texas, it makes sense to insulate the attic at the roof plane/rafters (no ventilation provided), bringing the attic space and anything within it inside the thermal enclosure. In most localities, building codes will allow unvented roof assemblies if two conditions are met: there is no vapor barrier between the attic and the home's living space and the insulation installed between the rafters is an air-impermeable product—i.e. polyurethane spray foam.

An unvented, sealed attic may result in a slight increase in shingle temperature but this has not been proven to have an impact on shingle durability. (The same battle with shingle manufacturers was once fought over the use of radiant barrier.) The color of the shingle is more important than venting or non-venting. However, the biggest factor in long-term shingle durability is ultra-violet radiation, which is the same whether the attic is vented or not.

**NOTE:** For ease of installation, the attic can be foamed before any mechanical equipment and ductwork is installed in the attic. Check with your building official for approval of this process.

The International Residential Code requires that most spray-foam insulation products be covered with either a prescriptive ignition barrier or a coating that has been approved for that specific foam insulation product. Before selecting or installing foam insulation, determine what requirements, if any, apply. (In virtually all cases, the foam must be separated from occupied areas with a thermal barrier. That means that if the attic space is intended for storage, it must be dry-walled.)

For a case study of unvented attics in production-built homes see: [www.nrel.gov/docs/fy01osti/30909.pdf#search=%22unvented%20attic%22](http://www.nrel.gov/docs/fy01osti/30909.pdf#search=%22unvented%20attic%22)
9. **Attic insulation: >R-38**
Attic insulation of ≥R-38 will provide greater thermal protection for a home than code requires.

10. **“Total-fill” insulation in walls (e.g. blown cellulose, BIBS, spray foam) and > R-2 exterior sheathing (corner-brace sheathing excepted); or SIPS**
The aim of this measure is to improve the thermal enclosure above code requirements. Total-fill insulation refers to any type of insulation that is blown, packed or sprayed into the wall framing that fills all “nooks and crannies”, so there are no visible voids, gaps or compression. Various insulation materials may be applied or installed in this manner. Adding the insulative exterior sheathing reduces thermal bridging through the studs.

Infrared camera pictures show that a SIPS wall system (structural insulated panel system) is another method for improving the thermal enclosure (and a SIPS roof system would improve it further). The expanses of insulation are increased and the seams where bridging is likely are reduced.

11. **Insulation has no added urea-formaldehyde**
Formaldehyde glues have typically been a common component of fiberglass batt insulation. The glue is used to hold the short fibers together and help maintain batt shape. Since formaldehyde is a known health threat, the reduction of its use will contribute to improved indoor environmental quality and occupant health.

Formaldehyde-free fiberglass insulation is being produced by major manufacturers and is readily available. It is often distinguishable by its white color. Most other types of insulation, such as cellulose, rock wool, cotton, and foam, do not contain added urea-formaldehyde.

12. **Roofing solar reflectance + Solar Reflectance Index (SRI): slope >5/12= >0.20/16; >3/12--<5/12: >0.30/30; <3/12: >0.55/64**
Roof products that meet or exceed a specified solar reflectance, without compromising product quality, performance and longevity, qualify for the ENERGY STAR label.

ENERGY STAR roof standards are not restricted to any particular type of roofing product. However, ENERGY STAR assumes that, at least initially, metal, single-ply membrane, and roof coating products will be most widely represented.

For ENERGY STAR roof products see:
www.energystar.gov/index.cfm?c=roof_prod_pr_roof_products

For more energy information about roofing products, see
The Cool Roof Rating Council (CRRC) develops accurate and credible methods for evaluating and labeling the solar reflectance and thermal emittance (radiative properties) of roofing products. CRRC recognizes only roofing-product, radiative-property tests performed by properly trained and accredited independent laboratories. CRRC standardizes and assures the quality of the rating process - they don’t establish or enforce performance thresholds. EPA’s ENERGY STAR program is complementary in that it promotes only products meeting certain performance levels but it relies on manufacturer performance claims.

Other “cool” roofing materials may be found in the Lawrence Berkeley Labs (LBL) “Cool Roofing Materials Database”. These roofing materials have been selected for performance, durability, and availability. Some are appropriate only for low-slope and flat roofs. The LBL cool roof list can be found at the following website: http://eande.lbl.gov/coolroof

13. **Roofing is metal or tile or green (vegetative)**
Tile and metal roofing materials out-perform other kinds in regard to keeping a house cooler. Tile does not transfer heat well. Metal, though it can get very hot, cannot hold much heat, and cools quickly in the evening when the sun is no longer striking it. Because these materials are poor heat sinks, they will not be radiating heat to the interior all night long, as composition shingles do. If they are white in color, they offer reflectance as well, for the ideal cooling combination.
In addition, tile and metal roofing materials are typically life-time materials, so the homeowner may never have to replace them and the need for virgin materials is reduced. Lifetime labor costs are reduced by up to 60% compared to roofing materials that need replacing every 15 to 25 years and a huge amount of landfill space can be saved. Clay tiles are biodegradable. Metal roofing typically has a high percentage of recycled content and can be recycled over and over again.

A third benefit of tile and metal roofs is that they are well suited as a collecting surface for rainwater harvesting systems. Because of their longevity, they are also a better choice for installation of solar thermal collectors and photovoltaic panels, since the panels won’t have to be removed and replaced for a re-roofing job.

Another potentially energy-efficient roof is the “green” or vegetative type. Be advised, however, that this is a complicated matter to construct and maintain in Central Texas due to our frequent drought conditions and requires a major commitment from the homeowner. The Lady Bird Johnson Wildflower Center is researching appropriate plants for this type of roof in an attempt to identify those that can best survive drought and temperature conditions in this area.

14. **Roofing material installed with air-space offset between roofing and roof deck from eave to ridge**

An air space between the roof sheathing and the roofing surface decreases attic temperatures through thermally induced natural ventilation that is set in motion as the roof heats the air in the gap. This offset should be a minimum of ¾” of continuous air space. Be sure the manufacturer’s installation instructions allow this.

15. **Complete gutters and downspout system directs storm water away from foundation to landscaping or catchment system**

A rain gutter system is an effective way to help protect a home’s walls, windows, doors and foundations from damage due to stormwater run-off from the roof. Water and moisture at the foundation and wall system also attract termites. Directing this captured water away from the foundation to the landscaping or a catchment system will put this water to use, saving on water bills, as well.

16. **Blower door test performed results in envelope/enclosure leakage no greater than 0.25 ACH (air changes per hour) AND mechanical ventilation (must choose 8.13 or 8.14 or 8.15)**

For good energy-efficiency, the staff at Austin Energy Green Building believes that it is always best to build the tightest-possible structure and to control ventilation through mechanical means.

A blower-door test determines the amount of air infiltration through the thermal envelope/enclosure. A large fan is attached to the open front door, the home is de-pressurized, and the amount of outside air entering the home—through all the cracks in the envelope/enclosure—is measured.
SECTION 7: PLUMBING AND APPLIANCES

1. > R-4 insulation of all hot water lines located outside the thermal envelope/enclosure and in exterior walls
Insulating hot water pipes reduces heat loss and raises water temperature 2°F–4°F hotter than uninsulated pipes can deliver, allowing for a lower water temperature setting on the water heater. Occupants also won't have to wait as long for hot water when turning on a faucet or showerhead, which helps conserve water.

All accessible hot water pipes should be insulated, especially within 3 feet of the water heater. It's also a good idea to insulate the cold water inlet pipes for the first 3 feet.

NOTE: It is a good idea to minimize plumbing in exterior walls. Plumbing that is located there can compromise the integrity of insulation by causing it to be compressed or otherwise reduced in thickness. This is especially true of plumbing drains that have a diameter only slightly less than the depth of a 4" (nominally, 3½") stud wall. Installation of plumbing also requires boring or notching of the framing members through which they are installed.

Water supply pipes are also more prone to freezing when placed in exterior walls, especially cold water pipes which are often not insulated. (The City of Austin code requires that hot water pipes be covered with at least ½ inch of insulation when installed within walls.) Condensation can also form on cold water pipes if their temperature falls below the dew point, a situation more likely to occur in an exterior wall.

2. **Push-button on-demand hot-water recirculation system (not continuously operating pump system; not motion-activated)**
A huge amount of water gets wasted when we let water run down the drain while waiting for it to get hot. The typical home wastes between 7,000–14,000 gallons per year for this reason. This raises utility bills for both water and energy, not to mention wasting the money, time, equipment and materials used to clean and get that water to the home, heat it, and carry it away in the sewage system. This problem is growing, due to the increase in the size of homes, the increase in the size of water pipes, and the increase in the number of fixtures requiring hot water. Aside from the cost of this wasted water, it is annoying to wait for hot water.

An on-demand hot-water recirculation system can significantly reduce wasted water. By running a return line from the last tap on the hot water supply line back to the water heater and installing a small circulating pump, hot water is circulated in the supply line and is quickly available when the faucet is turned on. The direction of flow moves from the water heater through the hot water supply line, through the return line, through the recirculating pump, and then back to the water heater.

*This system is user-activated by a button or “momentum” switch, so hot water is only circulated when needed.* A thermo-sensor in the pipe deactivates circulation when hot water is no longer needed. It’s not necessary to have this device on every tap, but it’s a good idea for taps that are most remote from the water heater, especially showers.

Points are not awarded for motion activation since a person may frequently come within range of the motion-detector when they do not intend to turn on the hot water.

3. **Any installed irrigation system must include water-efficiency features listed below**
   - Designed by a certified professional in accordance with EPA WaterSense criteria
   - High distribution-uniformity (DU) rotary spray heads, drip irrigation, bubblers, subsurface irrigation and/or soaker hoses. Plantings should be grouped for similar watering needs based on their species and microclimate location in the landscape and appropriate type of irrigation delivery used for each planting area and plant type
   - SMART controller
   - Soil moisture sensor
• Use of 6" heads in turf areas (Typical pop-up spray heads rise 4". After installation, heads tend to sink or get pushed down. In summer months when longer turf is encouraged, water distribution can be affected by the grass itself. Therefore, 6" heads provide plenty of clearance and are a better choice in the long run.)
• Use of pressure-compensating heads (Although code requires irrigation components to operate within the manufacturer’s specifications, including pressure ranges, pressure-compensating heads are a double-check on excessive pressure.)

For more information about irrigation systems contact the City of Austin Water Conservation Division: http://www.ci.austin.tx.us/watercon/contactus.htm

NOTE: As of January 1, 2010, the Texas Commission on Environmental Quality (TCEQ) requires that a licensed irrigator or licensed irrigation technician be on site at all times when an irrigation system is being installed.

Basic Requirement #16 requires that a minimum of 90% of new plants installed are from current Grow Green plant list. These species are native and adapted to our Central Texas climate and therefore should only require supplemental irrigation, once established, in periods of extended drought. In other words, they will survive on normal rainfall levels and patterns in Central Texas. The components specified above provide high-efficiency irrigation to insure that water is not wasted. However, it is important to remember that even this type of irrigation should only be used in order to get the plantings established for their first couple of years and to maintain them through exceptional drought conditions. Continued use of irrigation outside of these periods can turn these native and adapted species into water-dependent hybrids that will suffer in the event of extensive water restriction mandates.

4. Greywater for toilet flushing or landscape watering
The fulfillment of this measure is currently not allowed within the City of Austin due to concerns about cross-contamination in a densely populated area. For questions in this regard, contact Danny Lytle, danny.lytle@ci.austin.tx.us

5. Gas water heater is sealed-combustion/direct vent model; minimum Energy Factor (EF) of 0.80
Sealed-combustion gas water heaters draw combustion-air directly from outdoors through a pipe connected to the burner compartment. The air-intake pipe should be separate from the exhaust pipe. The entire combustion process is totally sealed from the interior of the house, avoiding the introduction of combustion by-products, such as carbon monoxide, into the living space. Consequently, sealed-combustion units are safer and typically more efficient than open-combustion units.

Compare this with the commonly installed open-combustion design: the combustion chamber and flue are open to the surrounding air and the flame takes combustion air from the space around it. The hot combustion by-products flow up through the appliance flue and out of the house because they are lighter than the surrounding air. It’s very important for this to occur properly, because combustion gases contain carbon monoxide and other noxious and dangerous gases, which can cause health problems (headache, fatigue, respiratory problems) and even death.

In very tight houses, drawing combustion air from the house and passively venting flue gases up the chimney can sometimes result in back-drafting of dangerous combustion gases into the house. This can occur if depressurization occurs inside the house. This could be caused by a gust of wind, poorly constructed flues, leaks in the HVAC duct system, too many exhaust fans running at the same time, or an over-sized range hood in the kitchen.
6. **OR Gas water heater is tankless/on-demand; minimum Energy Factor: 0.82**

As described by their name, on-demand/tankless water heaters have no storage tank for hot water. (An on-demand water heater is not the same as an instantaneous water heater.) A heating element heats water only when there is a demand for hot water—i.e. when someone turns on a hot water faucet. Since these water heaters have no stand-by losses (heat loss out the walls of the storage tank), they have higher efficiency—typically 10% to 20% higher than storage-tank water heaters. **However, whether or not these water heaters actually save water and energy may depend on hot-water use patterns within the home.**

Tankless models do have some clear advantages, however, even if the water and energy are not so clear. They can be installed outside in the Central Texas climate (solving the venting problem and keeping a gas-burning appliance outside). This can be a particular plus for remodeling older homes with a lack of storage space.

It is important to choose the right tankless water heater for occupant needs, since adequate water flow of a sufficiently high temperature is limited in many models. Large units intended for whole house water heating should be located as centrally as possible. If necessary, more than one unit can be installed, especially if baths, laundry, and kitchen are not well consolidated.

A hybrid model with a small storage tank may be used. It has the advantage of always having sufficient flow to properly activate the heating cycle.

Only gas models receive points on the Rating. Gas models have a higher hot water output than electric ones. Look for a model with electronic ignition to eliminate the energy consumed by a continuously burning pilot light.

**NOTE:** *The gas line must be the appropriate size.* In renovations, replacement of a tank gas water heater may require increasing the size of the gas line.

Federal tax credits may apply: [2009 federal tax credits](https://www.toolbase.org/TechInventory/techDetails.aspx?ContentDetailID=599).

For more information see the NAHB research center website: [www.toolbase.org/TechInventory/techDetails.aspx?ContentDetailID=599](https://www.toolbase.org/TechInventory/techDetails.aspx?ContentDetailID=599)

7. **OR Water heater is integral heat pump; minimum efficiency: 2.0 EF**

Heat-pump water heaters use one-third to one-half as much electricity as conventional electric-resistance models (and in a warm climate like Central Texas may do even better). This is because they use electricity to move heat from one place to another rather than to generate heat directly.

As of fall, 2009, they are available with built-in water tanks called integral units. This is an exciting new option for locations that have no natural gas available, for people who don’t want combustion appliances in their home, and as a very high-efficiency choice.

Note that a heat-pump water heater produces cold air, which may affect where you decide to locate it.

8. **OR Water heater is solar thermal; meets Austin Energy requirements**

According to the Department of Energy Efficiency and Renewable Energy division, solar water heaters can be a cost-effective way to supply hot water to a home. They can be used in any climate, and the energy they use to heat the water—sunshine—is free. In the Austin area, a solar thermal system can supply up to 70% of a household’s annual hot water needs, and 100% in the summer months.

Solar water heating systems include solar collectors, a storage tank, and (depending on the system) valves, pumps and controllers. There are two basic types of solar water heating systems: active, which have circulating pumps and controls, and passive, which don’t.

Most solar water heaters require a well-insulated storage tank. Solar storage tanks have an additional outlet and inlet connected to and from the collector. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is
combined with the solar storage in one tank. Electric resistance back-up is generally preferred, since stratification in the storage tank increases the overall efficiency of the system.

Three types of solar collectors are used for residential applications:

- **Flat-plate collector**
  Glazed flat-plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or plastic (polymer) covers. Unglazed flat-plate collectors (usually used for swimming pool water heating) have a dark absorber plate, made of metal or polymer, without a cover or enclosure.

- **Integral collector-storage systems**
  Also known as ICS or batch systems, they feature one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. They should be installed only in mild-freeze climates because the outdoor pipes could freeze in severe, cold weather.

- **Evacuated-tube solar collectors**
  They feature parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin’s coating absorbs solar energy but inhibits radiative heat loss. Because they can operate at very high temperatures, a special fluid is often substituted for water. These collectors are used more frequently for U.S. commercial applications or where high temperatures (250°F or higher) are required.

There are two types of active solar water heating systems:

- **Direct circulation systems**
  Pumps circulate household water through the collectors and into the home. They work well in climates where it rarely freezes.

- **Indirect circulation systems**
  Pumps circulate a non-freezing, heat-transfer fluid through the collectors and a heat exchanger. This heats the water that then flows into the home. They are popular in climates prone to freezing temperatures. Indirect systems can use water as the heat transfer fluid if they are a drain-back type.

Passive solar water heating systems are typically less expensive than active systems, but they’re usually not as efficient. However, passive systems can be more reliable and may last longer. There are two basic types of passive systems:

- **Integral collector-storage passive or “batch” systems**
  These work best in areas where temperatures rarely fall below freezing. They also work well in households with significant need for hot water both day and night.

- **Thermosyphon systems**
  Water flows through the system when warm water rises as cooler water sinks. The collector must be installed below the storage tank so that warm water will rise into the tank. These systems are reliable, but contractors must pay careful attention to the roof design because of the heavy storage tank. They are usually more expensive than integral collector-storage passive systems.

Solar hot water systems should be designed with a solar collection area of 10-15 square feet and 20-30 gallons of storage for each occupant. In central Texas, collectors should ideally be placed facing south and tilted at a 30-degree angle for optimal results.

*WaterSense toilets, faucets and showerheads are recommended to reduce hot-water needs.*

For more information see the WaterSense, DOE/EERE and NREL websites:

http://www.epa.gov/WaterSense/
www.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=1285
www.nrel.gov/learning/re_solar_hot_water.html
Austin Energy offers rebates for installation of solar thermal hot water systems for existing homes that use electric resistant water heaters, as well as for new homes, as funds are available. For information on the rebate, as well as advice on back-up hot water and other details, consult with program staff (512-482-5390) and see:


For information on potential federal tax credits for solar thermal hot water systems, see:

http://www.energystar.gov/index.cfm?c=tax_credits.tx_index

9. **AND/OR Water heater is integrated with space heating**

("combo" system); sized for space heating; minimum efficiency: 0.85 CAE

A gas-fueled, combination ("combo"), hydronic space-and-water-heating system uses a water heater as a heat source for a forced-air heating system. (In a cold climate, where space heating requirements are greater, a boiler would likely be used.) Typically, hot water from the water heater circulates through a coil in an air-handler, where a blower moves air across the coil. The air picks up heat from the coil and is distributed throughout the house.

**NOTE:** The water heater must be sized for the heating requirements of the dwelling unit and the hot water requirements of the occupants.

The improvement in energy efficiency of the water heater in a combo system results from the dual use, which minimizes standby heat loss. The efficiency of a combination water and space heating system is indicated by the combined appliance efficiency rating (CAE)—the higher the number, the more energy-efficient. Combination appliance efficiency ratings vary from 0.59 to 0.90. **Look for a CAE of 0.85 or higher.**

Check with your gas utility to see if a rebate is offered for this type of system (new construction or existing building). For Texas Gas Service see:

http://www.texasgasservice.com/SaveEnergyAndMoney/ConservationPrograms/AustinConservationProgram/Residential/~/media/TGS/Misc/ConservationPrograms/HydronicHeating.ashx

10. **Toilet is WaterSense dual flush model**

Dual-flush toilets offer two flush options: a standard flush for solid wastes and a lower-volume flush for liquid wastes and paper. Typical products average 1.24—1.3 gallons and meet the new requirements of 1.24 gallons per flush. One manufacturer estimates that a typical family of four will save approximately 7,000 gallons of water per year with this toilet, compared with a standard 1.6 gallon-per-flush toilet. In terms of flush performance, the toilet successfully removes 800 grams of test media at full flush, based on standardized tests.

11. **Toilet in at least one bath/powder room is WaterSense ADA model (located on entry-level floor; > 2’8” door)**

The two standards set forth by the Americans with Disabilities Act that apply to residential toilets are the height to the top of the seat and the location of the flush controls. The top of the seat must be at least 17” and no more than 19” above the floor. The flush controls cannot be mounted above 36” from the floor and must be mounted on the "wide," or unobstructed, side of the toilet. Toilets listed on the EPA WaterSense list that are available meeting the ADA compliance requirements will have a model number listed as “ADA (17”) Bowl: [model number].” The ADA toilet must be located on the entry level of the dwelling. The bathroom doorway must have a minimum clear opening of 32” with the door open 90 degrees, measured between the face of the door and the opposite stop.

12. **All bathroom sink faucets are WaterSense models**

Faucets account for more than 15% of indoor household water use—more than one trillion gallons of water each year in the United States. WaterSense-labeled bathroom sink faucets can reduce a sink’s water flow by 30% or more without sacrificing performance. This saves the average household about 500
gallons per year. Since these water savings will reduce demand on water heaters, households save energy at the same time.

All products bearing the WaterSense label complete a third-party certification process that includes independent laboratory testing to ensure they meet EPA criteria for water efficiency and adequate flow.

13. All shower heads have maximum flow of 2.0 gallons per minute; no more than one shower head per shower or tub

A great deal of water is wasted by shower heads with high flow rates. The average family could save about 23,000 gallons of water a year by installing 2.0/gallon shower heads as compared with higher-volume models. The challenge in the past was finding low-flow models that gave a satisfactory shower to the user. With new showerhead designs, however, this is no longer a problem.

There are two types of low-flow shower heads: aerating and non-aerating.

Aerating - mixes air into the water stream. This maintains steady pressure so the flow has an even, full shower spray. Because air is mixed in with the water, the water temperature can cool down a bit towards the floor of the shower. Aerating shower heads are the most popular type of low-flow shower head.

Non-aerating - air is not mixed into the water stream. This maintains temperature well and delivers a strong spray. The water flow pulses with non-aerating shower heads, giving more of a massaging-showerhead effect.

WaterSense shower heads are now available and recommended. For more information see http://www.epa.gov/WaterSense/products/showerheads.html and www.h2ouse.net.

14. Clothes washer from current WashWise list of the City of Austin Water Conservation WashWise list

The City of Austin Water Conservation Program maintains a list of high-efficiency clothes washers. Due to limited availability of water and the high cost to treat it, the City’s Water Conservation Program offers rebates on the listed models. Some manufacturers offer rebates, as well, as funds allow.

The list includes both top-loading and horizontal-loading models, but typically the horizontal-type (horizontal axis) has some added advantages: they rate very high in both water- and energy-savings (they use on average 40% less water and 50% less energy than typical top-loading washers); they clean by a rotating basket, not agitation, so they are gentler on clothes; they need very little detergent; and because the door is gasketed, they do not add humidity to the home’s interior.

City of Austin high efficiency clothes washer list: www.ci.austin.tx.us/watercon/sfwasher.htm

SECTION 8: MECHANICAL

1. Cooling tonnage does not exceed 4 tons

2. OR Cooling tonnage does not exceed 3 tons

3. OR Cooling tonnage does not exceed 2 tons

If tonnage is less than 2, write in amount in Section 12)

The square footage of living space per ton of cooling is an excellent indicator of climate-appropriate design. A well-designed 3,000-square-foot house may require no more cooling than an inappropriately designed 1,000-sq. ft. house. For example, the 3,000 house might have very little wall area and very little unprotected glass facing west, while the 1,000 house might have a lot.

Of course, cooling tonnage is not the only measure of “greenness”, since the larger house will require much more material. Even if the larger home has fewer occupants than the smaller home, studies show it will typically use more water and energy.
4. Whole house, ductless, mini-split or multi-split heating and cooling system

Very common in other parts of the world, ductless mini-split heat pumps are becoming a more popular choice for homes in the U.S., too, especially for smaller homes (for which the smallest split systems are too large) or those in which a ducted, forced-air system would be impractical. While cooling-only models are available, heat pump models, which both heat and cool, are more practical for Central Texas’ mild winters, where heating requirements are modest.

Like standard cooling systems, mini-splits have two main components: an outdoor compressor/condenser, and an indoor air-handling unit. But unlike standard systems, which distribute cooled or heated air throughout the house via ducts, mini-splits distribute refrigerant to air handlers that are located in each room or area to be cooled.

Mini-splits come in a wide range of sizes and capacities, with from one to eight air handlers operating off of a single compressor/condenser (more than one air handler is a multi-split system), making them suitable for a single room or an entire house. Depending upon the manufacturer, air handlers can be hung on a wall, recessed in or suspended from a ceiling, or concealed in a chase. Some units can accommodate short ducts to distribute air to adjacent rooms. Most use a remote control to facilitate programming of the air handler when it's positioned in an elevated location.

Several features of mini-splits make them more energy efficient than conventional ducted systems. Because each air handler can be controlled independently of the others, a house can be zoned room-by-room. Some mini-splits rely on variable-speed fans and compressors (inverter technology) to respond precisely to demands for heating and cooling. Energy losses through duct leakage, a major concern with ducted systems, are obviously not an issue. Mini-splits are available with seasonal energy efficiency ratings (SEER) up to 21.

For types of construction where there is no or limited space for ducts, a mini-split may be the only option. The lineset (refrigerant lines, condensate tube and power/controller wires) from the air handler to the compressor/condenser generally requires only a three-inch hole for installation.

While window units and PTACs (packaged terminal air conditioners) are also ductless, they are generally not recommended due to their lower efficiency (10 to 12 SEER) and higher noise levels. Most require installation in a window or through a substantial opening in an exterior wall.

5. Variable-speed air handler and minimum 600 sq. ft./ton of cooling

Variable-speed air handlers are desirable for their ability to meet both normal demand (most hours of the cooling season) and abnormal demand (during unusually hot periods or an above-average occupant load), as well as their superior ability to dehumidify immediately upon start-up due to lower fan speeds.

Electrically commutated motors (ECMs) for powering fans/blowers are becoming more common in residential air handlers. Electronic controllers automatically change the fan motor speed and the amount of air flow to match heating and cooling requirements. This unique feature of speed variability helps ensure compressor reliability, proper system capacity and airflow distribution through the duct system. Because the motor only runs at a speed that meets required air flow, it also reduces electric consumption.

ECMs are a necessity for zoned systems, in which dampers shut off airflow to one or more rooms in a house. The controller can sense the resulting increase in pressure within the system and lower the speed of the fan motor accordingly. They can also facilitate humidity removal by delivering less air flow across the evaporator coil.

When mechanical ventilation (a necessity in tightly-built houses) is incorporated into the heating and cooling system, ECMs can be used to move just enough air through the system to satisfy ventilation requirements.

NOTE: Some mechanical contractors use installation of ECMs as a rationale to oversize an HVAC system. ECMs allow a system to be sized more closely to heating and cooling requirements, so oversizing the system would be wasteful and inefficient and defeat the purpose of installing one in the first place. Points are awarded for installation of an ECM only for systems serving 600 square feet or more per ton of cooling capacity.
6. **Variable-capacity compressor and minimum 600 sq. ft./ton of cooling**

Variable capacity (also known as dual-stage or dual capacity) compressors achieve high efficiency by tailoring refrigerant delivery to meet partial cooling/heating requirements.

Variable capacity is usually accomplished via inductive control of the compressor motors. While this system is fairly common in ductless mini-split systems, it is only now being introduced in ducted split-systems common in North America.

More common are systems using either a two-stage compressor or two compressors—one smaller and the other larger. When the system starts up, it usually operates at the smaller capacity. If the thermostat setpoint cannot be reached at the smaller capacity, the second stage (or larger compressor) is brought into operation. In other words, only the capacity needed to satisfy the thermostat setpoint is utilized.

This type of system can also be used to reduce humidity levels when cooling is not needed. The smaller compressor capacity, coupled with a lower fan speed, dehumidifies with reduced power consumption. When properly sized to heating and cooling loads, dehumidification can be improved as part of the cooling cycle.

**NOTE:** Some contractors may want to oversize a dual stage system because of its ability to operate at reduced capacity. Superior dehumidification occurs only when the system is properly sized: an oversized dual stage system will have the same type of comfort problems as a single-speed system and will increase peak electricity demand. Points are awarded only for installation of multi-stage systems serving 600 square feet or more per ton of cooling capacity.

7. **Ground- or water-source heat pump**

Geothermal heat pumps (ground- or water-source) use earth or water as a heat source or sink but otherwise operate similarly to a traditional air-source heat pump. Instead of rejecting heat from the cooling cycle to the air, the heat is rejected to the earth or water through buried or submerged piping. The indoor unit is the same as an air-to-air unit but the geothermal has no outside condensing unit.

Ground-source heat pumps take advantage of the near-constant temperatures that exist underground or in the deeper waters of lakes. In the summer, heat is removed from the house and transferred to the earth or water, which is at a lower temperature. In the winter, the process is reversed, with the heat pump extracting heat and then transferring it into the conditioned space.

Different types of installations include:

- **Trench**—Trenches for the tubing, often hundreds of feet long, require a lot of surface area, but may be the only option in hard to drill areas. Refrigerant is sent through closed spirals of tubing and back to the indoor unit.

- **Deep Well**—Wells are drilled (usually one per ton of cooling) and refrigerant is sent through closed, deep pipes and back into the unit. Requires less land area than the trench installation, but drilling the wells may be more costly than trenching.

- **Water source**—An open system where water is pumped into a deep well and drawn out of an adjacent well. Prohibited in many areas due to concern over potential for groundwater contamination.

- **Lake Source**—If a large private body of water is nearby, it can be the most economical ways to reject heat. Closed tubes are extended to the bottom of the lake and back.

Ground-source heat pumps can achieve efficiency ratings as high as 28 SEER but homeowners probably will not see such advertised savings in the Central Texas climate—that is more likely in a climate with both extreme heat in summer and extreme cold in winter, such as the Dakotas. The initial cost is still very high, but the lifespan is typically longer than an air-to-air heat pump.

**Caution:** All of these systems require careful calculations to ensure the length of pipe run will reject enough heat to operate the unit efficiently. This is particularly important in Central Texas where the ground or bodies of water are relatively warm and could heat up too much to function effectively as a heat sink in summer.
8. **Gas furnace is sealed combustion/direct vent model**  
(CoA requirement if located in “sealed” attic)

A sealed-combustion furnace draws combustion-air directly from outdoors through pipes or tubes connected to a sealed-burner compartment. The best units have both an air intake pipe and an exhaust pipe. The entire combustion process is totally sealed from the interior of the house, avoiding the introduction of combustion by-products into the living space. Consequently, sealed-combustion units are safer and usually more efficient than open-combustion units. They get all the air they need for the flame to burn from outside the home, not from the air in the living space. They prevent dangerous and noxious gases, such as carbon monoxide, from entering the home, in case of a drop in air pressure.

(Compare this with most residential gas appliances installed in Central Texas, which are open-combustion designs: the combustion chamber and flue are open to the surrounding air and the flame takes combustion air from the space around it. The hot combustion by-products flow up through the appliance flue and out of the house because they are lighter than the surrounding air. It’s very important for this to occur properly, because combustion gases contain carbon monoxide and other noxious and dangerous gases, which can cause health problems (headache, fatigue, respiratory problems) and even death. Combustion gases may back-draft into the living space, however, if depressurization occurs inside the house. This could be caused by a gust of wind, poorly constructed flues, leaks in the HVAC duct system, too many exhaust fans running at the same time, etc.)

9. **Sheet metal plenum and main trunk lines; any flex-duct take-offs are no longer than 10 feet**

An air-delivery system of a sheet-metal plenum and main trunk lines with short flex-duct runs (no longer than 10’) will result in good air-flow, more even temperatures from room to room, and greater energy-efficiency. This will help improve total system efficiency.

As handy as flex-duct is to install, it was not designed for long duct runs, due to its corrugated, high-friction interior surface and consequent reduced airflow. It was designed for very short runs that would be difficult or not cost-effective to fabricate from metal.

Main trunk lines should be used to avoid the “octopus” effect. If too many sections of flex duct are run directly from a small plenum, airflow will not be equal among them. Some will receive more air than necessary and some less.

10. **Air-tight supply boots/buckets (ductboard or pre-fabricated)**

The 2009 IECC requires that HVAC duct-system joints and seams “shall be made substantially airtight by means of tapes, mastics, gasketing or other approved closure systems.” Air-tight supply buckets or supply boots are available ready-made that meet this requirement by using snap-rail flanges. This improved boot design is available either uninsulated or wrapped with an R-6 expanded polystyrene cover.

Supply buckets fabricated from ductboard can be made fairly leak-proof, since they have a minimum of seams that can be sealed with mastic or approved tape. Care should be exercised to avoid damaging the outer surface of unlined ductboard since small holes or scrapes can allow supply air to escape.

11. **Ductwork is masked/sealed at supplies and returns during construction**

In most residential construction, the ducts are installed after the structure is framed, but before drywall, paints, and other components are installed or applied. If the openings in the ductwork are not sealed, dust and other contaminants produced during the construction process can settle in them. These contaminants, if deposited on the blower and coil, reduce system efficiency. Dust in the ducts can also contribute to the growth of mold and dust mites.

All ducts should be sealed at the supplies and returns until the rest of the mechanical system is installed and work in the interior of the house is substantially complete.
12. Mechanical ventilation with automatic damper and timer brings fresh air into return-air plenum

13. OR Mechanical ventilation with automatic damper, timer, and humidity and temperature controls provides fresh air into return-air plenum

Improvement in building materials and construction techniques produces tighter houses, which means mechanical ventilation is needed to maintain indoor air quality. The amount of mechanical ventilation required depends on a number of factors: size of the house, number of occupants, rate of natural infiltration (tightness), amount/types of indoor pollutants, and climatic conditions.

The original standard for residential ventilation air called for a combined natural infiltration/mechanical ventilation rate of 0.35 ACH (air changes/hour). The current standard, ASHRAE 62.2-2007, sets a ventilation rate based on the square footage of the house and estimated number of occupants (number of bedrooms + 1), and includes a default infiltration rate of 2 cfm per 100 sqft of conditioned space. This results in a ventilation rate for smaller houses that is similar to the old standard, but generally lower for larger houses. It is up to the builder and mechanical contractor to determine the natural infiltration rate and what amount of mechanical ventilation is required using the following formula:

\[
\text{(total square footage of the home/100)} + ((\text{number of bedrooms+1}) \times 7.5 \text{ cfm})
\]

It is a fairly common practice to introduce ventilation air in a controlled manner by means of a fresh-air intake duct to the return side of the HVAC system. While not the optimum method of introducing ventilation air, it is fairly economical and produces two desired results: it allows the HVAC system to condition the air brought in from outside, and distributes this air throughout the house. If the ventilation air is supplied after the return air filter, it should be filtered with its own filter of MERV 6 or better. Keep in mind that with this type of installation the HVAC system is being used to condition the outside air and ventilation is only occurring when the air handler is operating.

A number of thermostats or HVAC system controllers have the ability to control mechanical ventilation and can be adjusted to provide the correct amount of ventilation air for the size and tightness of the house, as well as factor in outside temperature and humidity.

NOTE: Some integrated ventilation systems take into account exhaust fan operation and can adjust the operation of ventilation fans accordingly so as to not exceed the maximum rate. Care should also be taken to temporarily suspend or reduce ventilation when the outdoor temperature/humidity is extremely high.

If it is desired to introduce ventilation air when the heating/cooling system is not operating, it is necessary to have a means of controlling the air handler and ventilation damper simultaneously. In other words, the air handler is operating at a reduced speed when the damper is open. It is off when the damper is closed. Operating an air handler continuously is a waste of energy and can hinder humidity removal in the cooling season.

14. OR ERV (enthalpy recovery ventilator) with dedicated duct system

It is not only desirable but necessary to have fresh air at all times. In the old days, if we weren’t heating or cooling, we opened the windows. We know that many people no longer do that and, frankly, we have some sympathy for them—in the spring and fall, the relative humidity is often sky-high, so mold spores multiply and there are many other allergens, as well. Then the only answer is more serious dehumidification.

There is always an energy penalty associated with ventilating with outside air, especially in the summer or winter, when the HVAC system must handle the heating/cooling load at the same time. In more moderate weather, air handler operation is required for ventilation to occur (if that’s how ventilation is being done). A variable-speed air handler can perform this task while requiring less energy.

An enthalpy-recovery ventilator, or ERV, is a stand-alone appliance that reduces the energy penalty that comes with mechanical ventilation. Unlike its close cousin, the heat recovery ventilator (HRV), used in cold climates, the ERV also reduces the amount of moisture or latent energy in the incoming ventilation air. This is important in humid areas, where the outdoor air can have a much higher latent load than the air inside the house.
For an ERV to operate at optimum efficiency, the intake and exhaust sides must have balanced flow. The best way to ensure this is to connect the ERV to a dedicated duct system. A common installation is to have the exhaust air taken from bathrooms while the fresh air is distributed to the living area and largest bedroom.

It is important to note that the ERV is not a substitute for dedicated bath and kitchen exhaust fans. Exhaust fans are intended for removal of moisture and odors, while the ERV is designed for ventilation and enthalpy recovery.

15. Stand-alone hygrometer; OR thermostat has integral hygrometer or humidistat

A hygrometer measures both temperature and relative humidity. Although it doesn’t “do” anything, it serves as a useful tool to help occupants better understand and operate their home. It should be placed where the occupants will see it frequently and they should be instructed about the relationship of temperature and humidity and a desirable range and balance between the two. Understanding this will help them operate their home more intelligently.

A thermostat with an integral humidistat can allow certain cooling equipment to maintain a desired relative humidity. This is especially valuable in the spring and autumn when humidity is high but the temperature moderate, causing the system to “short cycle” and turn off before moisture in the air has had a chance to condense on the evaporator coil located inside the house. Humidistats are usually combined with variable-speed air handlers (see 8.06). When set to dehumidify, the air handler operates at a lower airflow which allows the evaporator coil to reach a lower temperature more quickly.

Humidity control is important in Central Texas homes since high humidity conditions that foster mold and mildew growth consistently occur year-round. Poor construction methods (or methods that are inappropriate for a hot, humid climate) and over-sized cooling systems exacerbate this problem. Sources for mold growth cannot be easily eliminated, so mechanical ventilation and dehumidification are often the best solutions.

16. HVAC filter: > 4” pleated-media, or electronic (not electrostatic); easily accessed; HVAC system designed for filter type

The filter is an important part of the heating, ventilating, and air conditioning (HVAC) system. The purpose of the filter is to protect the evaporator coils and blower fan from dust, pollen and other particulates that can significantly decrease the HVAC unit efficiency and shorten its life. A filter may also have the purpose of improving the quality of conditioned indoor air for the occupants.

Filters are rated on a scale called the Minimum Efficiency Reporting Value, otherwise known as MERV. The MERV system rates filters on a scale of 1 to 20, 20 being the most effective at removing contaminants. Standard woven-fiberglass panel filters rate 1.0 or less on the MERV scale and provide no improvement in indoor air quality and virtually no protection for the HVAC equipment. These filters are not allowed by code in permitted systems in Austin.

Other filters described below are effective and may or may not be an appropriate choice for a given household. In any case, due to its impact on airflow, the filter must function properly with the mechanical system. In a new system, it should be possible to get good filtering and proper airflow at the same time because they are designed to go together. More efficient filters require a more powerful blower.

A one-inch, pleated-media filter with a MERV 6 rating is reasonably effective at doing both filter jobs for a modest price. A 4-inch pleated-media filter typically lasts six months or more in most households, especially one without pets. People who get twice-a-year HVAC maintenance (a good idea) can have the technician take care of the filter and they never have to bother with it themselves (also good for the people who are bad at home maintenance). This could be a selling point for this filter.

Electronic filters use high voltage to charge particles in the return-air stream. They are extremely efficient and restrict airflow only minimally. However, they are very expensive, use electricity, and must be well-maintained. They are the best filter for people with severe allergy problems but may not be practical for other people, especially for those who are maintenance-averse.

Another choice for people suffering from allergies is a HEPA (high-efficiency-particulate-arresting) filter. It is made of ultra-fine glass fibers pressed into a paper-like material, which is folded in pleats to maximize
surface area, thereby improving air flow and increasing the apparent thickness of the filter medium relative to the particle’s angle of attack. The principle means by which HEPA filters stop particles is simply through impact. As a particle tries to penetrate the filter it runs into a fiber and remains there because of the attraction between positively-charged and negatively-charged materials.

NOTE: We do not recommend electrostatic filters (even though they have the virtue of being reusable and of not restricting air flow) because they are not very efficient. Ozone generators are not recommended because ozone is a powerful oxidant and can damage lung tissue.

We reemphasize: The mechanical system must be designed for the filter because filters affect airflow and system static pressure. Also, location of filters is also an important part of design: they should be located for easy maintenance. It’s important that occupants be made aware of all filters in their system, so they can insure proper maintenance—whether they do it themselves or employ a technician.

17. Air distribution system leakage < 8% for <3 ton systems or <6% for >3 ton systems, as ascertained by duct-blaster testing method

18. OR Air distribution system leakage <4 cfm to outside per 100 square feet as ascertained by a duct-blaster test and blower door test together

Air-distribution system leakage no greater than 10% as verified by a direct duct-pressure test performed by approved 3rd party, is required by the City of Austin energy code for all homes permitted since January 1, 2008 and for homes in any location rated under the AEGB program.

Leakage of 8% or less represents a substantial improvement over that requirement for homes requiring smaller systems (typically smaller homes) and 6% or less represents a substantial improvement for larger systems (typically larger homes).

Air leakage is more difficult to identify than water leaking from pipes, but the problems created by it may be just as serious. These problems may include loss of conditioned air, infiltration of unconditioned outside air, unbalanced supply-air flow, backdrafting of combustion gases from gas appliances, and introduction of dust, pollen, and mold into living spaces.

HVAC system leakage testing and repair can improve cooling-equipment efficiency, operating conditions, and indoor air quality in a home in four ways:

1. The quality of workmanship can be evaluated. When leaking supply-air ducts are located in an attic, for example, the conditioned air leaks out into the attic and is eventually vented to the outside without ever reaching a living space. It is obviously inefficient and costly to condition air only to have it leak to places where it is not needed. Good test results can assure the homeowner that conditioned air is being delivered to actual living space and not unintentionally to locations outside the home’s thermal envelope/enclosure.

2. Air pressure imbalances in a home may be discovered. When the indoor air pressure is negative in the summer time the house will draw in hot, humid air from outdoors, from the attic, crawl space, basement and garage. In addition, toxic gases can be drawn into the living space from flues and chimneys. This backdrafting and can occur when fireplaces, gas furnaces and gas water heaters are being used or operated in cold weather.

3. Health and safety risks can be assessed. Sealing leaks in return-air ducts stops pollutants from being drawn into the home from the attic (insulation fibers, dust), crawl space (moisture, pesticides, mold and mildew spores, animal residue, insulation fibers, dust), and the garage (car exhaust, carbon monoxide, chemical fumes, dust).

4. A smaller capacity and less costly cooling unit may be installed. A person performing Manual J calculations (see above) can now rely on correct duct installation and therefore won’t be tempted to over-size the equipment.

The duct leakage test is performed by the 3rd party home performance testing company when construction is complete. It is good practice, however, for the mechanical contractor to test at the rough stage to be sure he is on track to pass the final 3rd party test. This is particularly critical if ductwork will not be accessible later on (e.g. it is located in a furred-down or the house is 2-story with ductwork in the floor
between). A final test at completion is always needed, however, since damage may occur at a later time during construction.

Builders should be sure that their agreement with the mechanical contractor states that testing will be done, and that the mechanical contractor is responsible for workmanship that meets the Rating standard.

SECTION 9: ELECTRICAL

1. Ceiling fans in all bedrooms

Air moving over the skin increases the evaporation rate of moisture on it, which has a cooling effect. A person exposed to moving air will be comfortable at a temperature four to five degrees higher in hot weather than if he is in still air. The thermostat can be raised several degrees, thus saving on expensive air-conditioning. A ceiling fan costs about the same to run as a 100-watt incandescent bulb, so they are a much cheaper way of providing comfort than lowering the thermostat.

Ceiling fan blade spans range from 29 to 54 inches. To determine which size you need, measure the room where the ceiling fan will be installed and follow these guidelines:

<table>
<thead>
<tr>
<th>Room Dimensions Suggested Fan Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 75 ft² 29 - 36&quot;</td>
</tr>
<tr>
<td>76 - 144 ft² 36 - 42&quot;</td>
</tr>
<tr>
<td>144 - 225 ft² 44&quot;</td>
</tr>
<tr>
<td>225 - 400 ft² 50 - 54&quot;</td>
</tr>
</tbody>
</table>

ENERGY STAR-qualified ceiling fans are recommended. They provide more energy savings with improved motors and blade designs and light kits. Ceiling fan/light combination units that have earned the ENERGY STAR designation are about 50% more efficient than conventional fan/light units. This can save $15-$20 per year on utility bills.

The Gossamer or Windward line of fans, designed by the Florida Solar Energy Center, has a particularly efficient blade design. The pitch and chord vary along the length of the blade, which maximizes air movement for the energy used. These fans are considerably more efficient than other ENERGY STAR-qualified fans.

2. Whole-house fan with factory-insulated cover (ventilated attic only)

A whole-house fan (also known as an attic fan) can reduce the need for mechanical cooling when properly used. Opening windows and running the whole-house fan whenever the outdoor temperature is lower than the indoor temperature and relative humidity is reasonable will help cool the house. This might be done only briefly before closing up the house again and turning on the cooling system—comparable to quickly flushing out a car that has been sitting in the hot sun and suffering from green-house effect with relatively cooler moving outside air.

Determining the amount of airflow in cubic feet per minute (cfm) that the whole house fan should provide involves a simple calculation. Multiply the total gross square footage of the house (include upstairs area) by the ceiling height (typically 8 feet). Select a fan that delivers between one half to one times that amount of cfm at 0.1" static pressure. For example, a 25'x40', one-story home is 1,000 square feet and would need an 8 x 1,000 x 0.5 = 4,000 cfm fan or better. One manufacturer offers a two-speed unit that delivers 4,500 cfm at the high setting (240 watts) and 3,200 cfm at low (120 watts); this unit should be adequate.

A removable, factory-insulated cover should be installed for use when the fan is not on. If an insulated cover is not used, conditioned air will escape from the living spaces through the fan opening.

Homeowners should be informed that the fan must be used in conjunction with open windows. They should also be told that during times of high humidity, it’s better to use the central cooling system, which dehumidifies the interior air, rather than the whole-house fan, which will draw in outside humid air.
3. **Bathroom exhaust-fans are connected to a timer or humidistat (not motion-sensor); recommended sone rating <1.0**

Whether a bathroom fan is connected to the light switch or is independently switched, the occupant typically turns off both at the same time before the fan has had time to exhaust excess humidity. Since good dehumidification typically requires a run-time of about 20 to 30 minutes, separating these functions and connecting the fan to a timer or humidistat will do a much better job.

People are reluctant to use a noisy fan, so it is important to pay attention to the sone (sound) rating. One sone is equivalent to the sound of a quiet refrigerator in a quiet kitchen and this is a noise level acceptable to most people. It’s obtained by combining a more powerful fan motor with a larger turbine (fan blade) than in noisy fans. Typically, the sone level is measured at maximum CFM (speed). However, some newer products are also being tested at normal CFM (speed) settings to provide consumers with typical sound level information. Installation quality is equally important to having a quiet fan, however. The duct should be right-sized for the fan, as short as possible, taut and well supported, and have no kinks or compression (just like HVAC ductwork).

4. **Recessed-can lighting fixtures do not penetrate the thermal enclosure; OR no recessed-can fixtures are installed**

Research shows that recessed-can lights (even air-sealed IC-AT type) in insulated ceilings are one of the largest sources of air loss in homes because they usually puncture and compromise the thermal envelope/enclosure.

If a home has a sealed attic (polyurethane foam at the rafters), can lights are acceptable. They are also acceptable in the first-floor ceiling of a 2-story home. Otherwise they must be omitted for these points to be awarded.

5. **ENERGY STAR Advanced Lighting Package (ALP) requirements met**

An ENERGY STAR Advanced Lighting Package includes only lighting fixtures and ceiling fan products that are rated for compliance according to EPA/DOE’s stringent requirements aimed at maximizing efficiency and energy bill savings. The ALP designation applies to lighting packages that consist of a minimum of 60% ENERGY STAR-qualified, hard-wired fixtures and 100% ENERGY STAR-qualified ceiling fans. ENERGY STAR-qualified recessed can-lights, ceiling-fans and ventilation fans may also be counted toward the fixture requirement. Certain fixtures are required to use non-screw-based technologies for sustained savings so that CFL or LED bulbs cannot be replaced by standard screw-in incandescent bulbs. (See ENERGY STAR website: [www.energystar.gov](http://www.energystar.gov))

Lighting fixtures that have earned the designation combine high performance, attractive design, and highest levels of energy-efficiency, so they conserve energy, save money on utility bills and help protect the environment. ENERGY STAR fixtures accommodate bulbs that have an average minimum life of 10,000 hours. This means that with regular use (i.e., four hours per day), occupants won't need to change the bulb for at least seven years in the typical case. All ENERGY STAR-qualified light fixtures carry a two year warranty - double the industry standard. They also have a color rendition index (CRI) of 82 or higher, so the colors they illuminate look true and natural. Qualified fixtures can now be found at most home centers, lighting showrooms, and specialty stores. Look for qualified fixtures for the following applications: torchieres, under- and over-cabinets lights, ceiling-mounted wall sconces, suspended fixtures and outdoor lighting, including motion sensor fixtures.

**NOTE:** The 2009 Austin Energy Code (2009 IECC with Austin amendments) requires that 90% of lamps (bulbs) be high efficacy. This requirement can be met with a mixture of ENERGY STAR qualified fixtures and regular fixtures that have high efficacy lamps installed in them.
6. ENERGY STAR-qualified appliances and or fixtures: ≥ 2 in addition to 4 of Basic Requirements

ENERGY STAR-qualified appliances incorporate advanced technologies that use 10–50% less energy and water than standard models. The money saved on utility bills can more than make up for the cost of an ENERGY STAR model.

The average dishwasher uses 8 -12 gallons of water when set on its normal cycle. Though electricity or gas is used to run the appliance, about 80% of the energy consumed by the dishwasher is used to heat the water. Therefore, decreased water usage can save hundreds of dollars over the lifetime of a machine. Some dishwashers have options to allow the adjustment of the machine’s settings to reflect the size of the load and how dirty the dishes are. This can also lower the water use and therefore the energy bills. An efficient dishwasher typically consumes less water and energy than washing by hand under a running faucet.

ENERGY STAR-labeled dishwashers are at least 41% better than the federal water and energy requirements set for dishwashers and require substantially less water per cycle (4 gallons for compact models and 5.8 for standard ones.) A list of these appliances and other information on efficient appliances can be found at the ENERGY STAR web site. Although ENERGY STAR does not measure water efficiency, Energy-Star-rated dishwashers typically use 30-50% less water.

Check out these websites:
www.epa.gov/WaterSense/
www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers

A helpful website for identifying the most efficient dishwashers and other appliances is www.aceee.org.

ENERGY STAR qualified ceiling fans use improved motors and blade designs. Ceiling fan/light combination units that have earned the ENERGY STAR are about 50% more efficient than conventional fan/light units and can save occupants more than $15 per year on utility bills.

ENERGY STAR qualified kitchen range hoods, bathroom and utility fans, and inline fans provide energy savings and are significantly quieter than standard models. Qualified ventilation fans that include lighting use 70% less energy on average than standard models, saving $120 in electricity costs over the life of the fan. These fans have high performance motors and improved blade design, providing better performance and longer life and are more than fifty percent quieter than standard models.

7. Occupancy sensors control ≥50% of interior lighting

Occupancy sensors are mechanisms that automatically turn off lighting and/or electricity once a room is vacant. The two most common technologies are infrared and ultrasonic. Infrared sensors detect temperature changes in a room, and work well if the entire room is within the sensor’s field of view. Ultrasonic sensors use high-frequency sound, much like bats do, to detect motion (even around corners). Dual-technology sensors are available, increasing accuracy and flexibility.

8. Energy-management monitoring and control system

Energy-monitoring systems provide valuable feedback to homeowners while identifying large energy-consuming devices within the home. There are several methods to monitor usage: outlet monitoring, whole-house power monitoring, and smart home/appliance systems. Outlet monitoring provides point-of-use data, which can be helpful for identifying phantom loads (power being drawn by plugged-in devices, whether or not they are turned on) or steady-state usage. Outlet monitors may or may not link to a “dashboard.”

For points on this Rating, only fixed-outlet monitor systems are accepted. Whole-house monitoring gives a big-picture view of energy usage. This can provide peak (time of day when the most electricity is required from the utility) and off-peak usage, as well as time-of-day usage. Whole-house monitoring often links to a computer “dashboard.” Smart home/appliance systems are more interactive by linking appliances, plugs, and mechanical systems together. A computer-controlled interface may allow the user to customize devices while providing real-time energy consumption of these devices. Please review your options with a Green Building representative to verify compliance.
9. **All exterior light fixtures are designed to reduce up-lighting / light pollution, or fixture locations are shielded from above**

Exterior light fixtures, which allow light to shine above the horizontal plane of the home, create light pollution and rob people of being able to see the night sky. Furthermore, they frequently cause annoying “light trespass” on to neighboring property, and are often a safety hazard because they produce a blinding glare.

An obvious result of all this wasted light is the huge waste of the energy required to produce it. The International Dark-Sky Association estimated in 1996 that the cost of energy spilled upward into the night sky was nearly 1.5 billion dollars per year in the U.S. alone. The cost of energy wasted in light trespass was not calculated. The costs of power production and the resulting pollution are borne by the whole community.

Attractive, appropriate light fixtures that prevent up-lighting are readily available. Fixtures that reduce light trespass as well are also available. Wattage of the lamps/bulbs should be as low as possible to reduce glare and prevent energy waste. The eye adapts very quickly to low light levels at night, so high wattage is in no way necessary for visibility and safety.

The International Dark-Sky Association (IDA) provides objective, third-party certification for luminaires that minimize glare, reduce light trespass, and don’t pollute the night sky. For a modest fee, IDA will evaluate the photometric data of any luminaire submitted by its manufacturer. When the fixture is approved, the manufacturer receives a certificate and the Fixture Seal of Approval. Manufacturers may use the FSA seal to promote and advertise their IDA-Approved™ Dark Sky Friendly products. For a directory of lighting fixtures approved by the International Dark Sky Association see: www.darksky.org/fixtures/.

**NOTE:** To earn the points of this measure, it is not necessary to install IDA-approved fixtures.

10. **All exterior lighting has motion detectors with photocell controllers or is solar-powered**

Outdoor lighting that is fluorescent, motion detector, or photocell-controlled will reduce energy costs to the homeowner and provide security or landscape lighting when it is needed.

Motion-detector lighting provides security lighting when someone enters the field of the motion detector. This type of security lighting is far more effective than security lighting that is always on, since people tend to ignore an unchanging environment. It also saves energy by having the light on only when it is needed. This is convenient for the occupant needing to find the keyhole at night, and makes him/her feel safer. Motion-detector lighting should be equipped with a photocell. Photocells sense ambient light and only turn on when ambient light falls below a certain level.

Solar-powered outdoor lighting fixtures use photovoltaic cells to produce electricity directly from sunlight.

11. **Central vacuum system; exhausts to the outside**

Central vacuum systems offer numerous advantages in terms of improved indoor air quality, reduced energy usage, and reduced landfill waste. When installed with exhaust air to the outside, many pollutants are removed from the indoor living space. Look for systems with the following environmentally friendly features:

- Can be made of recyclable steel, reducing the impact on landfills
- No paper bags or filters reducing the impact on forests and landfills
- Longer life than traditional vacuum cleaners - less impact on landfills than traditional vacuum cleaners
- Built-in dust pan to encourage sweeping dust to the pan, which means the central vacuum runs less, thus conserving energy
- Turbine powerheads run from the airflow of the central vacuum instead of from electricity, so they further reduce the amount of energy used
12. **Home is wired as solar-ready (Home must also qualify for measure 3.13: solar-ready roof.)**

In the future, homes with appropriate preparatory features already in place will have advantages in installing solar thermal and photovoltaic systems. To qualify for this credit, the following measures must be taken during construction:

**Solar Thermal Hot Water Heating Requirements:**

- Run dual ¾” Schedule L copper plumbing, wrapped with R-4 foam insulation from attic location (below roof panel mounting location) to mechanical room or area planned for future hot water storage tank
- Install plumbing valves for future water storage tank (if home currently has some other type of water heating appliance, i.e. tankless unit)
- Install an electrical outlet at location for future water storage tank
- Have design and location of all installed components approved by an Austin Energy-approved solar system installer
- Label the conduits and valves with “Solar Thermal Ready” identification tags

**Photovoltaic Requirements:**

- Home must qualify for measure 3.14 Roof area of >400 sf is “solar-ready”: oriented within 75° of due south with ≤ 8:12 roof pitch, unshaded and no penetrations
- Designate an acceptable location within 10’ of utility meter and electrical service panel, measuring at least 6’ x 6’, for future mounting of inverter, disconnects, metering equipment, and other wall mounted components
- Provide the following: 1” Electric Metallic Tubing (EMT) conduit, stubbed and capped on the roof, running from an aesthetically most appropriate corner of the intended array location, through wall assemblies, and terminated at an NEC-approved junction box within 10’ of utility meter and electrical service panel for future photovoltaic system
- Have design and location of all installed components examined by an Austin Energy-approved solar system installer
- Label the conduits and junction box with “Solar Ready” identification tags

13. **OR solar photovoltaic (PV) power system installed: 1.5 kW minimum**

Solar electric photovoltaic panels turn a home into its own power plant. Although it is not yet practical for a home connected to an electric grid to have a solar PV array large enough to meet its entire need for electricity, a small array provides an excellent supplement.

*It makes sense, however, to install PVs only after insuring that the home is built to a high standard of energy-efficiency. Otherwise the PVs would be like lipstick on a pig (or hog, for a more apt simile).*

A photovoltaic or solar cell is the basic building block of a photovoltaic / solar electric system. An individual PV cell is usually quite small, typically producing about 1 or 2 watts of power. To boost the power output of PV cells, we connect them together to form larger units called modules. Modules, in turn, can be connected to form even larger units called arrays, which can be interconnected to produce more power, and so on. In this way, we can build PV systems able to meet almost any electric power need, whether small or large.

The most common array design uses flat-plate PV modules / panels. These panels can either be fixed in place or allowed to track the movement of the sun. They respond to sunlight that is either direct or diffuse. Even in clear skies, the diffuse component of sunlight accounts for between 10% and 20% of the total solar radiation on a horizontal surface. On partly sunny days, up to 50% of that radiation is diffuse. On cloudy days, 100% of the radiation is diffuse.
It is the law in the State of Texas that an electric provider must buy back excess electricity produced by a home or building. Some electric service providers try to discourage the installation of grid-tied systems by making the process difficult and costly, some make it easy.

Austin Energy encourages customers to have PVs installed to supply energy to their home or to the centralized grid when the PV power exceeds the homeowner’s need for electricity. The interface between the home-produced power and the grid is metered so that when power produced by the PVs is sent into the grid, the meter will run backwards and the homeowner’s utility bill is credited. When power is needed from the grid, the meter runs forward and the utility bill is charged. The monthly utility bill will therefore be the cost for the home’s “net energy use” – total power provided by Austin Energy minus the unneeded power the home’s PV system sent back to the electric grid.

For more information about how PV systems work, visit the DOE Energy Efficiency and Renewable Energy website: www1.eere.energy.gov/solar/photovoltaics.html

To encourage the implementation of solar technology, Austin Energy offers rebates as funds allow to its qualifying electric customers to help offset the cost of a solar photovoltaic electric system or solar-thermal hot water system. The federal government offers tax incentives, as well.

For more information about the Austin Energy solar rebate program visit:
www.austinenergy.com/Energy%20Efficiency/Programs/Rebates/Solar%20Rebates/index.htm

For information on potential federal tax credits for photovoltaic systems, see:
http://www.energystar.gov/index.cfm?c=tax_credits.tx_index

**SECTION 10: INTERIORS**

See Section 4. **MATERIAL EFFICIENCY** for credit for interior materials that are recycled, reclaimed, or local, etc.

1. **Carbon monoxide detector installed (may be combined with smoke detector)**

Today’s houses are built very tight to be energy-efficient, so maintaining a healthy indoor environment is becoming an increasing concern, especially in homes with gas appliances (see H17). A carbon monoxide detector can be a helpful tool to alert occupants if there is any leaking or back-drafting from combustion appliances.

Only a few gas appliances are made with sealed-combustion chambers, and installation of available ones (some furnaces, water heaters and fireplaces) is not yet the norm in Central Texas, due to unfamiliarity and higher cost. For these reasons, it is wise to install a carbon monoxide detector. Two-story and spread-out one-story homes may need more than one.

2. **Finish flooring is durable material for minimum of 50% of all floor area (e.g. ceramic tile, concrete, wood)**

3. **OR Flooring is 100% durable material**

When floors are made of durable materials such as the ones listed above, they require less maintenance, less frequent replacement (in some cases, they never need replacing) and contribute to a healthier indoor environment, for both installers and occupants. They are easier to clean and do not harbor dust mites, as carpet does.

NOTE: Although soft vinyl flooring (sheet vinyl) has some of these same benefits, it is does not qualify for these points, due to our efforts to reduce the use of fossil-fuel and chlorine-based materials, with their associated health and environmental risks. Superior substitutes are readily available, such as true linoleum. Vinyl composition tile currently remains on the acceptable list because it does not contain plasticizers--chlorine-based compounds that increase health risks and environmental burdens.
4. Flooring is rapidly renewable or reused material for a minimum of 25% of all floor area (e.g. cork, wool)

Rapidly renewable materials can be replenished quickly and have minimal negative environmental impacts. Examples of such materials are cork, linoleum, bamboo, and carpeting of sisal, sea grass, jute, and wool.

- Cork can be safely harvested from cork trees every nine years. It provides acoustic and thermal insulation, is resilient (if dented, returns to its shape), is air and water-tight, termite and rot-resistant, and provides a pleasant cushion underfoot. It is no longer made with urea-formaldehyde binders.
- Linoleum (made from linseed oil, wood flour, cork flour and ground limestone) is extremely durable and resilient (good point load, so very resistant to high heels), naturally anti-static and anti-bacterial (therefore popular in hospitals), resistant to oil and many solvents, and has low flammability. Do not confuse it with vinyl.
- Bamboo is harvested about every six years and is as hard as maple, but is more stable in conditions of changing humidity (as is common in our climate) than hardwoods. Buyers should look for products which do not contain added formaldehyde in glues and finishes.
- Wool carpet naturally resists dirt and stains, reduces the problem of static electricity, is flame resistant, and will far outlast synthetic carpets because of its natural resilience (the fiber is shaped in a coil and can spring back many more times than synthetic fiber).

Bear in mind that many of these materials are sourced in far-away locations that substantially increase their embodied energy by the time they get to the job-site.

NOTE: In recent years, many flooring products have flooded the market under the banner of “green.” They should not be selected purely on the basis of the base material but on the quality of the overall product and the ability of the installer to install it properly.

5. Carpet, carpet padding or flooring adhesives have the CRI Green Label

Although carpet leaves a lot to be desired as a flooring material from a health and life-cycle point of view (it harbors dust, dust mites, mold and other allergens, requires frequent replacement and disposal) it will nevertheless be selected by many homeowners for cost and aesthetic reasons. The CRI Green Label helps one make the best possible choices among carpets and related materials.

The Carpet and Rug Institute has established a labeling program to identify carpet, carpet padding and flooring adhesives, which have been tested by an independent laboratory and met certain criteria for low emissions of harmful chemicals. (See [http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=4](http://www.carpet-rug.org/drill_down_2.cfm?page=8&sub=4)) Products are re-tested quarterly to monitor continued compliance. The current criteria, based on a maximum emission factor measured in mg/m² hr are as follows:

<table>
<thead>
<tr>
<th>Carpet</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total VOCs</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>4-PC</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Styrene</td>
<td>0.40</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Carpet padding/cushion</th>
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<th></th>
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</thead>
<tbody>
<tr>
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<td>1.00</td>
<td></td>
</tr>
<tr>
<td>BHT</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>4-PC</td>
<td>0.05</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Adhesives</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total VOCs</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>2-Ethyl-1-Hexanol</td>
<td>3.00</td>
<td></td>
</tr>
</tbody>
</table>
6. **Any non-durable flooring installed is rapidly renewable or CRI Green Label**
(This measure combines 10.04 and 10.05 as a 5-Star requirement.) Non-durable flooring refers to carpet, vinyl, or other “soft” goods permanently installed in the home. These materials should be made of rapidly renewable materials (see 10.04) or, in the case of carpet, carry the CRI Green Label (see 10.05).

7. **Cabinet materials + adhesives: a) meet E1 Standard; or b) CARB Phase I Standard; or c) have no added urea-formaldehyde**
Since formaldehyde is a known threat to health, reducing its use in building products is a prudent thing to do. Formaldehyde is a common component of typical cabinet materials, such as interior plywood, most medium-density fiberboards (MDF), and particleboard. Materials that meet the E1 standard (which is in effect in most European countries) have formaldehyde emissions no greater than 0.1 parts per million. Materials meeting this standard usually have this designated on their labeling. If there is any question as to whether a material meets the standard, contact the manufacturer.

CARB Phase 1: In April, 2007, California adopted limits on formaldehyde for panel materials that are similar to the E1 standard. (The California standard relies on the ASTM E-1333-1996 testing protocol, which differs from the European protocol.) The initial phase of the standard took effect in January, 2009.

See [http://www.arb.ca.gov/toxics/compwood/compwood.htm](http://www.arb.ca.gov/toxics/compwood/compwood.htm)

Examples of materials that do not have added formaldehyde are solid wood, metal, glass, and “formaldehyde-free” MDF panels. In regard to these MDF materials, that means that no formaldehydes have been added during manufacture. Very low levels of formaldehyde may occur naturally in the wood itself.

8. **Interior wall and ceiling paint has maximum VOC level of 10 grams per liter**
See Basic Requirements. The more we can reduce VOC levels in our indoor environment, the less health risk occupants will face. The lowest level paints are particularly recommended for remodeling work if occupants remain in the home while work is being done. Of course, workers’ health should always be considered.

9. **All doors have lever handles**
Lever door handles are much easier to turn than knobs. People with a hand impairment from illness or injury will have a much easier time using doors with lever handles. Since they can be operated with a push of the elbow, they are more convenient for someone with his hands full, as well.

10. **Grab bars installed in tub +/or shower of at least one bathroom**
Grab bars make tubs and showers safer for all users.

Many people associate grab bars with the elderly and, not wanting to put themselves in that category, don’t want to consider installing these bars. But even able-bodied people have accidents in slippery tubs and showers—e.g., they may be distracted by shaving or they may be stiff and sore from overdoing their exercise program. They may be temporarily disabled from an accident or operation.

Fortunately there are styles of bars to suit every décor now, so one doesn’t have to settle for “hospital” style.
SECTION 11: SITEWORK AND LANDSCAPEING

See Grow Green for information on appropriate, water-wise landscaping for Central Texas

1. Built-in outdoor fireplace (no indoor fireplace installed)

2. Built-in outdoor kitchen

3. Plumbed outdoor shower
   These three measures are aimed at reducing indoor heat and humidity. They are eminently feasible in the mild Central Texas climate, with a long season to enjoy outdoor living, encourage occupants to extend that season, and reduce the need for use of the mechanical system to cope with indoor heat and humidity.

4. Permeable materials are used for a minimum of 25% of driveways, parking areas, walkways, and patios; may not be installed over impermeable base
   Pervious pavements (also known as porous or open-graded pavement) are designed to allow slow percolation or infiltration of stormwater through the surface into the soil below where the water is naturally filtered and pollutants are removed. In traditional pavement techniques, rainfall will shed quickly across asphalt and concrete, picking up oil, detergents, solvents, pesticides, fertilizers, and bacteria from pet waste. These contaminants are then carried through the storm-drain system into waterways. Permeable pavements provide a reservoir and percolation-field for surface water to re-enter ground aquifers.

   Permeable paving is an excellent technique for dense urban areas because it does not require any additional land. It is not ideal for high traffic or high speed areas because it has lower load-bearing capacity than conventional pavement. Nor should it be used on stormwater "hotspots" with high pollutant loads because stormwater cannot be pre-treated prior to infiltration.

   There are many permeable pavement options:

   **Porous Asphalt:** A great advantage of porous asphalt is that the same mixing and application equipment is used as for impervious asphalt. Only the formula for the paving material mix changes. This form is appropriate for pedestrian areas and low-volume vehicle access, such as residential driveways, alleys and parking stalls.

   **Porous Concrete:** The same equipment may be used as for standard concrete. Larger pea gravel and a lower water-to-cement ratio are used to achieve a pebbled, open surface that is roller-compactd.

   **Plastic Grid Systems:** High-strength plastic grids (often made from recycled materials) that can support heavy vehicles are placed in roadway areas. They are designed in two ways—either to be filled with gravel on top of an engineered aggregate material or filled with a sand/soil mixture on top of an aggregate/topsoil mix that allow grass to be planted on the surface.

   **Block Pavers:** This material can be used to create a porous surface with the aesthetic appeal of brick, stone, or other interlocking paving materials. They are most often used for driveways, entryways, walkways, or terraces to achieve a more traditional, formal appearance.

5. Decking material of raised porch/deck is recycled-plastic/composite lumber
   Wood composite and plastic lumber are manufactured with up to 100% recycled materials, sometimes including a large percentage of post-consumer products. They are durable, waterproof, and pest resistant.

   They also tend to get much hotter than wood, however, so it may be undesirable to use such material in highly sun-exposed areas where people are likely to go barefoot.
6. **Turfgrass does not exceed 50% of pervious cover area or existing vegetation is retained on ≥50% of pervious cover area**

Turfgrass lawns are popular for their beauty and for being a pleasant surface for recreational activities. However, most varieties require huge amounts of water to thrive in the Central Texas climate. Reducing the amount of turfgrass planted (or eliminating it altogether), reduces or eliminate the need for water, fertilizer, pesticides, cutting time and their costs. Many other kinds of vegetation, with fewer negative environmental impacts, are available for attractive landscaping.

Existing natural vegetation has proven itself able to thrive on the site without added water or fertilizers. Keeping this vegetation intact, when possible, will eliminate the homeowner’s need for landscape maintenance, the use of pesticides and fertilizers, and will reduce water bills. It will also help preserve existing wildlife on the site. Taking the lessons that nature provides us about our soil, water, and sun will give us clues to the types of plants to put into re-planting areas.

Some of this vegetation may be native to our area and some of it may simply be well-adapted for our conditions, although many well-adapted plants are highly invasive and should be avoided.

For additional information on native vegetation go the Lady Bird Johnson Wildflower Center at http://www.wildflower.org/collections/collection.php?collection=TX_central or see Native and Adapted Landscape Plants http://www.ci.austin.tx.us/growgreen/pg_pdfs.htm from the City of Austin Grow Green Program.

7. **All new plants are from the Grow Green list AND turfgrass area installed or planned does not exceed 2,000 square feet**

See Basic Requirement 16 and 11.03.

“Planned” means that the entire site is landscaped/protected with something other than turf (for example, hardscape areas, mulched sections, or a groundcover named on 11.06 approved lists). This does not mean that the builder has provided nothing, leaving a bare site subject to erosion or leaving landscaping to an unknown homeowner, who will then likely install turfgrass.

8. **Turfgrass/lawn in full sun is AEGB-approved low-water variety**
   (e.g. common Bermuda, zoysia, buffalo)

The blazing sun in Central Texas takes a heavy toll on most varieties of turf grass. A number of low-water varieties are available, however, that thrive better in sunny areas. They typically have these advantages:

- Drought-tolerant
- Heat and cold-tolerant
- Establish quickly
- Need very little fertilizer
- Need very little watering
- Insect, disease, and fungus-resistant

Common Bermuda grass requires 1/5 of the water commonly required by St. Augustine grass. Buffalo grass is the most water-conserving type of grass for Central Texas. It grows slowly and seldom needs mowing (maybe only twice in a season). (609 Buffalo Grass will thrive in shadier areas as well: it needs only 5-6 hours of sun per day.)
Here is a list of acceptable grasses for Central Texas. Please note that this list may change as more research is done and new grasses are developed. For more information about grass choices, contact your Austin Energy Green Building Representative/Rater.

<table>
<thead>
<tr>
<th>Benefits of Suitable Grasses</th>
<th>Buffalograss</th>
<th>Bermudagrass</th>
<th>Zoysiagrass</th>
<th>St. Augustine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available as seed</td>
<td>Common, Top Gun</td>
<td>Common only</td>
<td>Limited, sources on the Web</td>
<td>No</td>
</tr>
<tr>
<td>Available as sod or plugs</td>
<td>Prairie, 609, Stampede (dwarf)</td>
<td>419 Tifway, Tifway, Tifway II, Tifdwarf, Tifgreen</td>
<td>Palisades, El Toro, JaMur, Cavalier, Crowne</td>
<td>Common, Floratam, Raleigh, Palmetto</td>
</tr>
<tr>
<td>Green Building allowable growing conditions</td>
<td>Minimum 6 hours of sun per day</td>
<td>Minimum 6 hours of sun per day</td>
<td>Full sun or part shade</td>
<td>NO FULL SUN Shady areas only</td>
</tr>
<tr>
<td>Drought tolerance</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Insect problems</td>
<td>Minimal</td>
<td>Chiggers, Bermuda mites</td>
<td>Grub worms</td>
<td>Chinch bugs Grub worms</td>
</tr>
<tr>
<td>Weed problems</td>
<td>Nutgrass, Bermudagrass invades easily if you mow &amp; watered! Will not discourage weeds until established.</td>
<td>Nutgrass, broad-leaved weeds, crabgrass, dallisgrass, others.</td>
<td>Some weeds possible, but good cultural practices discourage weeds.</td>
<td>Broad-leaved weeds, crabgrass, nutgrass (not noticeable), others.</td>
</tr>
<tr>
<td>Disease problems</td>
<td>Occasional fungal diseases</td>
<td>Occasional fungal diseases</td>
<td>Fungal diseases</td>
<td>Fungal, viral diseases</td>
</tr>
</tbody>
</table>

NOTE: water use is not the only criteria for turfgrass choice. Some grasses will take more wear and tear, some are more susceptible to weed invasion or disease, some are more invasive, etc. A custom client should decide what is most appropriate for his needs. In the case of a speculatively built home, the architect or builder should decide what is most appropriate for the site and target buyer.

See the Water Conservation Program website for more information: www.cityofaustin.org/watercon.

9. Newly installed turfgrass areas have at least 6” of soil containing >25% compost (e.g., Dillo Dirt, http://www.ci.austin.tx.us/water/dillo.htm); OR no turfgrass installed or planned

See Basic Requirements #15 and Measures for Points 11.04.

10. National Wildlife Federation "Certified Wildlife Habitat" or Texas Parks & Wildlife "Texas Wildscapes" certification

Providing a safe haven for local wildlife supports bio-diversity while reducing the ecological footprint caused by construction. By adopting essential components such as food and water sources and places of shelter for wildlife to raise young, a healthy sustainable habitat can be created. Use the following websites to apply for certification.

Texas Parks & Wildlife:
www.tpwd.state.tx.us/huntwild/wild/wildscapes/certification/tx_wildscapes/

National Wildlife Federation:
www.nwf.org/gardenforwildlife/certify.cfm
11. All new plants have trunk, base, or stem located at least 36” from foundation

Extra precaution should be taken to keep landscape plants a safe distance from the foundation and walls of a home. A clear space—devoid of plants, bushes, and trees—around the perimeter of a house allows easy access for homeowner inspection for termite tunnels and removes an easy pathway for termites and other pests to attack the house. Having this clear space is not a guarantee, but it is an aid in having a termite-free home. Occupants should be informed to maintain this clear zone around their home over time—to prune and remove plants as necessary. This will also make it easier to inspect for good drainage away from the home, as well. Keeping plants away also protects siding materials from deterioration.

12. Rainwater Harvesting: 110--600 gallons storage

13. OR Rainwater Harvesting: 601--3000 gallons storage

14. OR Rainwater Harvesting: 3001 or more gallons storage

Rainwater harvesting is an old idea that is popular again. The future of our region depends, in large part, on innovative approaches to our water supply. In Central Texas, as in many parts of the world, sources for potable water are diminishing. On building sites with no municipal water supply, rainwater harvesting may be an especially appealing option, since wells are expensive and the water quality is often very poor. Due to its high mineral content, well water often has an unpleasant taste, stains plumbing fixtures and teeth, degrades water lines and damages appliances.

Harvesting rainwater is a great way to get high-quality water with the following benefits:

- Excellent pH (“soft”—good for hair, skin and plants)
- Chlorine-free
- Tasty
- Won’t stain plumbing fixtures
- Good for plumbing system and appliance lifespan (no mineral scaling)
- Good for plant growth
- Reduces water bills
- Reduces the burden on municipal water system
- Reduces the need for a well when no municipal supply is available
- Provides better control of storm-water runoff

In Central Texas, with a yearly average rainfall of 32 inches, almost 45,000 gallons of water fall on a 2,500 square-foot roof. Obviously, rainwater harvesting is potentially a viable method to achieve sustainability with regard to water resources.

The basic concept of harvesting rainwater is simple. Rainwater is typically collected from the roofs of buildings. It flows by gravity through gutters and downspouts into a storage tank. From the tank it can be used in the landscape as is, or it can be filtered and treated to become a source of high-quality drinking water.

Since most of our rainfall occurs in large storm events, the ability to store collected rainwater is paramount. Farmers and ranchers know the value of stored water as evidenced by today’s major sources for large water tanks—fence, ranch, and feed stores. But, garden and nursery retailers sell smaller rain barrels and the City of Austin Water Conservation Program may offer barrels at a subsidized cost and provide rebates for larger storage systems, as funds allow.

All of the components for rainwater harvesting can be found in the plumbing section of area retailers. A typical system replaces metal downspouts with solvent-welded PVC piping. By making the downspouts watertight, water can be carried by gravity to a storage tank. Several downspouts can be joined together into one larger main pipe leading to the tank. An inlet to the tank is installed as high as possible to maximize storage capacity. The inlet can be on the side or the top of the tank. The solid PVC piping system (downspouts) at the building must be at least 6 inches (preferably 18 inches) above the highest piping at the tank. This will allow the tank to fill, as the pressure of the water will work like a “P” trap under
a sink. The water will equalize and flow into the tank. This "P" trap part of the system must also have an outlet installed to allow water to drain out for maintenance and to prevent freezing.

Numerous rainwater harvesting installation companies exist in Central Texas, as well as consultants who can advise what type of system is most appropriate for a given situation.

For more information visit the following websites:

City of Austin
www.ci.austin.tx.us/watercon/ Click on ‘Outdoor Uses’ and then on ‘Rainwater Harvesting’
State of Texas Water Development Board

15. Rainwater is the sole source of indoor water; 20,000 gallon minimum storage; back-up well allowed

Home sites for which a centralized potable water source is not available have traditionally depended on well water. When more development occurs in the area, wells may have to be deepened. In some areas, the well water is not suitable for drinking without considerable processing. Rainwater is an excellent alternative with costs similar to drilling and outfitting a well. It is acceptable, however, to have a back-up well in addition, due to the possibility of extended periods with insufficient rain in Central Texas for which 20,000 gallons of storage may not suffice for indoor use. When a dependable water provider services a site with piped water, rainwater harvesting for potable uses may not be an economical alternative.

SECTION 12: ADDITIONS AND INNOVATIONS

The advancement of building science and development of better practices and new materials is occurring at a rapid pace. Builders, architects and designers sometimes incorporate features, materials, or technology that is not covered by the items in the preceding sections. Please confer with your AEGB Representative/Rater to discuss what measures may be included and points earned in this Section.
Appendix

Standards for additions and innovations will be added to this Guide as the need arises.

Site-applied interior products meet GS-11 and GS-47 (Green Seal) VOC standards

The GS-11 and GS-47 (Green Seal Environmental Standard for Paints and Coatings) establishes environmental requirements for volatile organic compounds. The standard includes wall, anti-corrosive, and reflective coatings, floor paints, primers and undercoats. The GS-11 Standard does not include stains, clear finishes, recycled (consolidated or reprocessed) latex paint, specialty (industrial, marine or automotive) coatings, or paint sold in aerosol cans.

NOTE: The calculation of VOCs excludes water and tinting color added at the point of sale.

<table>
<thead>
<tr>
<th>Interior Coatings: Coating Type</th>
<th>VOC weight in grams/liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-flat</td>
<td>150</td>
</tr>
<tr>
<td>Flat</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exterior Coatings: Coating Type</th>
<th>VOC weight in grams/liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-flat</td>
<td>200</td>
</tr>
<tr>
<td>Flat</td>
<td>100</td>
</tr>
</tbody>
</table>

The Green Seal Environmental Standard for Stains and Finishes GS-47 establishes environmental requirements for stains and finishes. The standard is intended for products generally applied to metal and wood substrates and includes sealers but does not include paints, floor polishes, specialty (industrial, marine, or automotive) coatings, or products sold in aerosol cans.

<table>
<thead>
<tr>
<th>VOC Limits on Stains and Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating type</td>
</tr>
<tr>
<td>Finishes</td>
</tr>
<tr>
<td>Varnishes</td>
</tr>
<tr>
<td>Oil finishes</td>
</tr>
<tr>
<td>Lacquer</td>
</tr>
<tr>
<td>Clear lacquer brushing</td>
</tr>
<tr>
<td>Shellacs/pigmented</td>
</tr>
<tr>
<td>Stains</td>
</tr>
<tr>
<td>Shellacs/Clear</td>
</tr>
<tr>
<td>Water-borne stains</td>
</tr>
<tr>
<td>Solvent-borne stains</td>
</tr>
<tr>
<td>Semi-transparent stains</td>
</tr>
<tr>
<td>Opaque stains</td>
</tr>
</tbody>
</table>

Certified low-VOC products (caulks, sealants, adhesives and/or wood materials) or certified hard-surface flooring

Just about all traditional interior-finish products are made or installed with binders, adhesives, or finishes that off-gas volatile organic compounds, some for years after they are installed in the home. Many manufacturers now offer low-VOC alternatives, but there are too many products to list individually. In general, this credit is awarded if 85% of the products within each category comply with third-party certification / documentation for:

- Interior caulks
- Exterior sealants
- Flooring adhesives
- Pre-finished products used on wood, laminate, bamboo, or cork flooring
• Particle board, MDF, hardwood plywood, composite wood, or strawboard panels used for interior trim, doors, and closet shelving
• Countertop laminates, finishes and adhesives

In order to encourage and address the use of these alternatives, the following guidelines are offered for confirming compliance. The amount of credit will be based on the following criteria:

<table>
<thead>
<tr>
<th>Number of product types used:</th>
<th>Points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% of one product type</td>
<td>1 point</td>
</tr>
<tr>
<td>85% of two product types</td>
<td>2 points</td>
</tr>
<tr>
<td>85% of three product types</td>
<td>3 points</td>
</tr>
<tr>
<td>85% of four product types</td>
<td>4 points</td>
</tr>
<tr>
<td>85% of five product types</td>
<td>5 points</td>
</tr>
</tbody>
</table>

Acceptable third-party certification of products includes:

• Hard-surface flooring certified by RFCI's (Resilient Floor Covering Institute) FloorScore Indoor Air Certification Program or the GREENGUARD Environmental Institute's Children and Schools Certification Program.

• Site-applied interior products certified by Scientific Certification Systems (SCS) Indoor Advantage Gold Program or the GREENGUARD Environmental Institute's Children and Schools Certification Program.

• Exterior adhesives and sealants meet the criteria of CARB consumer products regulation as follows:
  a. Construction Adhesives: VOC content not to exceed 7% by weight or 75 grams/liter
  b. Exterior sealants (i.e., silicones, polyurethanes, and hybrids, VOC content not to exceed 4% by weight or 50 grams/liter
  c. All other caulks and sealants VOC content not to exceed 2% by weight or 30 grams/liter
  d. Contact adhesives VOC content not to exceed 55% by weight or 480 grams/liter

• Interior low-VOC adhesives and sealants meet the requirements of GS-36 (Green Seal Environmental Standards for Commercial Adhesives) or are certified by Scientific Certification Systems (SCS) Indoor Advantage Gold Program or the GREENGUARD Environmental Institute's Children and Schools Certification Program.