MUELLER GREEN RESOURCES GUIDE





Center for Maximum Potential Building Systems

Version 3 • October 2012



Contents

Chapter 1: Introduction 3

Chapter 2: USGBC's LEED[®] & Austin Energy Green Building Rating Systems 10

Chapter 3: Green Urbanism Signature Themes 23

Protecting Air Quality 24 Urban Heat Island Effect 36 Protecting the Night Sky 43 Creating Green Buildings 50

Chapter 4: Green Building Case Studies 74

Taylor-Robertson Residence75David Weekley Homes – Yard, Garden and Attached Homes78Wildflower Terrace80Home Depot82Dell Children's Medical Center of
Central Texas94

Chapter 5: Rebates and Incentives 87

Chapter 6: Resources 114





Acknowledgements

The Mueller Green Resources Guide version 3 was prepared by the Center for Maximum Potential Building Systems under contract with Catellus Development Corporation. The authors are solely responsible for the content.

Contributing to the Guide's third edition's research and writing are CMPBS staff Cassidy Ellis, Mary Petrovich and Gail Vittori. Harrison Saunders of Eco-Logic Design provided graphic design. We also benefited from the contributions of City of Austin staff, including Liana Kallivoka, Maureen Scanlon and Sophie Roark of Austin Energy and Dylan Siegler of the Office of Sustainability. Additional contributions were received from Adele Houghton and Scott Johnson. Images were provided with permission by Andy Karvonen; Andy Mattern, Artimbo.com; Austin Energy; Catellus Development Corporation; the City of Austin; Dan Overbey; David Weekley Homes; Eco-Logic Design; Jim Robertson; Mark Swendner, Seton Healthcare Family; McCann Adams Studio; Pliny Fisk III; Ronald McDonald House Charities; SustainableSources.com.

We extend our appreciation to Greg Weaver, Carl Paulson, Leo Lopez, Fei Dai, Tommy Tucker, Dee Desjardin, Jessica Reynolds and the entire Catellus team for their vision and leadership in establishing green urbanism and sustainable development and design as central tenets of Mueller.

Disclaimer

The information contained within this publication is for general information purposes only, and does not imply an endorsement or guarantee by Catellus Development Corporation or Center for Maximum Potential Building Systems as to performance or reliability.



2012 Mueller illustrative plan.

CHAPTER I

Introduction









The *Mueller Green Resources Guide* is a reference document to support green building practices at Mueller. Green building incorporates healthy, environmentally sensitive, socially responsible, and cost-effective strategies into building design, construction and operations. Today, green buildings are recognized as beneficial for the environment, for people, and for the bottom line.

GUIDING PRINCIPLES FOR GREEN BUILDING

- 1) **Design with Nature:** Specify climate- and site-responsive design and green infrastructure features to achieve building resilience and sustain ecosystems at local, regional and global scales.
- **2) Design for Flexibility:** Anticipate change in user needs by designing open, flexible building systems.
- **3) Design for Water and Energy:** Use green infrastructure to maximize stormwater retention and infiltration on site, minimize potable water use and take advantage of rainwater harvesting and reclaimed water sources, and take advantage of climatic design principles and on-site renewable energy systems to complement high-efficiency mechanical and electrical systems.
- **4) Design for Healthy Environments:** Specify and use non-toxic and low-emitting materials and maximize daylight and views for building occupants to protect air quality and enhance human health and well-being.
- 5) **Design for Zero Waste:** Manage construction sites and design buildings to promote reduction and reuse, divert recyclable and compostable debris from landfills, and specify and use high recycled-content materials.



Why Green Building?

Over the last three decades public awareness has heightened over the effects of buildings on the environment and human health. In the U.S., buildings are responsible for:

- 40% of energy use
- 13% of water use
- 40% of raw stone, gravel, sand and steel use
- 25% of virgin wood use

In addition, buildings generate about 39% of carbon dioxide emissions-a greenhouse gas associated with global warming-and 35% of municipal solid waste. Extracting, processing, and transporting building materials can disrupt sensitive ecological systems, and result in particulate and chemical emissions that can pollute the air, land and water. Furthermore, because people in the U.S. spend about 90% of every day indoors, it is essential that buildings have healthy indoor environments.

By integrating climatic design principles with environmentally-sensitive construction practices, healthy building materials, native plant landscaping, green infrastructure, and energy- and water-efficient mechanical and plumbing equipment, green buildings have lower operating costs, higher return on investment and appreciation, and enhanced occupant health and productivity. Based on recent studies, green buildings on average have a first cost premium of about two percent; these are commonly recouped from lower operating costs. Moreover, with the prospect of escalating energy costs, green building is a smart business decision and a demonstration of community and environmental stewardship.



Focus on Climate Change

In February 2005, 141 countries adopted the Kyoto Protocol as a response to climate change resulting from greenhouse gas emissions. While the U.S. has not ratified the Protocol, local governments, cities and organizations around the country have united to address the challenge.

The U.S. Mayor's Climate Protection Agreement,

launched in 2005, calls for the nation's mayors to take leadership in creating policies and programs to reduce greenhouse gas emissions within their communities. As of April 2012, over 1,000 mayors have signed the agreement, including Austin's former Mayor Will Wynn. The Agreement focuses on three strategic actions:

1. Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land use policies to urban forest restoration projects to public information campaigns;

2. Urge state governments and the federal government to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol – 7% reduction from 1990 levels by 2012; and,

3. Urge the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emissions trading system.

Austin Climate Protection Program

In February 2007, Austin City Council resolved to make Austin the leading city in the U.S. in the effort to reduce and reverse the negative impacts of climate change.

Included in the resolution that created the Austin Climate Protection Plan:

- Implement building codes that require all new single-family homes to be *net zero-energy capable* by 2015.
- Increase energy efficiency in all other new construction by 75% through building codes by 2015.
- Require disclosure of historic energy use, facilitate and require energy efficiency improvements in existing homes and buildings at point of sale.
- Develop enhanced incentives and standards for Austin Energy Green Building; develop a *"carbon neutral" certification.*

A Net Zero-Energy Capable Home achieves an efficiency level approximately 65% higher than homes built to the City of Austin Energy Code in effect in November 2006. This enables these homes to achieve annual net zero-energy with the provision of on-site energy generation.

Because all homes in Austin will have to be built to this standard at point of sale beginning in 2015, homes at Mueller can take the opportunity to build as close to net zero-energy capable as possible *now* to avoid upgrades/retrofits that may be required in the future. Homes can benefit from guidance in the *Mueller Green Resources Guide* to put them on track to become net zero-energy capable.

Architecture 2030 Challenge

Architecture 2030 is a non-profit organization established in 2002 by architect Edward Mazria. The 2030 Challenge goal is "to achieve a dramatic reduction in the climate change-causing greenhouse gas (GHG) emissions of the building sector by changing the way buildings and developments are planned, designed and constructed." (from www.architecture2030.org).

Architecture 2030 Targets:

■ All new buildings, developments and major renovations shall be designed to meet a fossil fuel, greenhouse gas emitting, energy consumption performance standard of 60% below the regional (or country) average for that building type.

At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, greenhouse gas emitting, energy consumption performance standard of 60% below the regional (or country) average for that building type.

The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:

- 70% in 2015
- 80% in 2020
- 90% in 2025
- Carbon neutral by 2030 (using no greenhouse gas-emitting fossil fuel energy to operate)

Achieving the targets may be accomplished through innovative design strategies, generating on-site renewable power and/or the purchase (maximum 20%) of renewable energy.* More information, energy charts, an incentive database, resources, and links are available at <u>www.architecture2030.org</u>.

In November 2006, Austin Mayor Will Wynn joined with his peers to support the 2030 Challenge with the unanimous passage of Resolution #50 by the U.S. Conference of Mayors. The 2030 Challenge is also supported by the American Institute of Architects, the U.S. Green Building Council, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the U.S. Environmental Protection Agency, the American Solar Energy Society and many other endorsing organizations and firms.

* Austin Energy's GreenChoice is a Green-E certified renewable energy based electricity provider. See Chapter 3 for more information about GreenChoice.



7

Green Building Rating Systems

Chapter Two provides an overview of green building rating systems relevant to new construction projects at Mueller.

Projects at Mueller may pursue a green building rating from two established programs:

- U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED[®]) Green Building Rating System
- Austin Energy Green Building (AEGB)
 Rating System

These rating systems provide strategies and best practices for creating green buildings and assessing building performance using their respective criteria and measurement.

Green Urbanism

Mueller's master plan is based on sound, pragmatic urban planning principles that emphasize a pedestrian-friendly streetscape and mixed-use development pattern; transportation options including auto, transit, bicycle and pedestrian connectivity; clustering of development to provide abundant parks and open space; and a system of wet ponds that remove pollutants from stormwater. These integrated planning principles, site design and development strategies reinforce Mueller's sustainability and green building goals and provide visible examples of "green urbanism." Chapter Three describes the four Green Urbanism Signature Themes that underlie design and construction at Mueller.

Protecting Air Quality addresses indoor and outdoor air quality considerations.

Mitigating Urban Heat Island Effects provides strategies to lessen a site's contribution to elevated air temperatures in urban areas.

Protecting the Night Sky responds to light pollution's adverse effect on nocturnal habitat.

Creating Green Buildings, the broadest Signature Theme, offers strategies to support the design, construction, and operation of healthy, green buildings.

Each Signature Theme is divided into the following sections:

Overview

Punch List – summarizes key strategiesStrategies – provides guidance for implementation

Together, the Signature Themes guide the development of a large, mixed-use project with an aim to measurably benefit current and future generations.



Case Studies

Chapter Four features five projects located at Mueller that demonstrate successful green building measures implemented at several building scales including single- and multi-family residential, large retail, and healthcare (institutional) sector.

Rebates, Incentives & Resources

Chapter Five summarizes incentive and rebate programs from the City of Austin, local utilities, the State of Texas, and the Federal Government that support green building strategies.

Chapter Six provides a list of print and online resources to aid in implementing a project's green building goals. Resources include green building professionals, public sector programs, incentives, and rebates.



CHAPTER 2

USGBC'S LEED[®] & Austin Energy Green Building Rating Systems





Introduction

All projects at Mueller greater than 25,000 square feet are required to achieve either the U.S. Green Building Council's LEED certification or Austin Energy Green Building rating. To date, most projects constructed at Mueller – even those less than 25,000 square feet – meet that requirement. In general, the two rating systems share similar frameworks: both identify multiple green building strategies, some of which are mandatory for certification and others that can be pursued at the discretion of the project delivery team. Both also require achieving a minimum number of points based on the varying certification levels.

Table 2.1 summarizes the green building certification level required for each building type at Mueller. Both rating systems can be used for specified building types; projects can choose to pursue both. The identified certification levels are minimum standards. Building teams are encouraged to achieve higher levels.

Mueller and LEED for Neighborhood Development.

In 2007, Mueller was selected as one of 238 development projects around the world to participate in the LEED for Neighborhood Development Pilot Program. The entire 711-acre Mueller development is pursuing certification under this pilot rating system. In 2009, Mueller earned a Stage 2 Silver certification for its approved master plan. Mueller is targeting final LEED for Neighborhood Development Pilot Stage 3

Table 2.1: Mueller Green Building Minimum Certification Requirements

Building Type	USGBC LEED		Austin Energy Green Building
Commercial Office	LEED for New Construction: Certified	and/or	AEGB Commercial: Two-Star Rating
Retail New Construction; Tenant Space	LEED for Retail: Certified	and/or	AEGB Commercial: Two-Star Rating
Multi-Family Residential	< 4 Stories: LEED for Homes	and/or	< 4 Stories - AEGB Multi-Family Residential: Two-Star Rating
	4 - 6 Stories: LEED for New Construction or LEED for Homes*		4 - 6 Stories: AEGB Commercials or Multi-Family: Two-Star Rating
	> 6 Stories: LEED for New Construction		> 6 Stories: AEGB Commercial: Two-Star Rating
Single-Family Residential Detached Single-Family Home: Duplexes; Townhomes	LEED for Homes s;	and/or	AEGB Single-Family Residential: Three-Star Rating

Note: Builders and developers are encouraged to exceed these certification levels.

* Multi-Family Residential Projects between 4 and 6 stories must use the "LEED for Homes Multifamily Midrise Rating System."

certification by the pilot period's conclusion in 2016 when the development is anticipated to achieve 75 percent substantial completion.

The LEED for Neighborhood Development Pilot rating system includes prerequisites and voluntary credits in four categories: Smart Location & Linkage, Neighborhood Pattern & Design, Green Construction & Technology,¹ Innovation & Design Process.

Mueller's engagement in the LEED for Neighborhood Development pilot supports the four Mueller Green Urbanism Signature Themes at the development scale. Chapter Three includes descriptions of specific goals and strategies as they align with the Green Urbanism Signature Themes.

Deciding Between LEED and Austin Energy Green Building Certifications, or Choosing Both.

Commercial, multi- and single-family residential projects at Mueller have the option to achieve either LEED or Austin Energy Green Building (AEGB) certification. Projects that choose to pursue both certifications may streamline documentation to avoid duplication of effort, in coordination with Austin Energy Green Building staff.



Solar panels on the roof of a home at Mueller.

Project teams that pursue LEED benefit from a balloted rating system developed by national and international subject matter experts who serve on volunteer committees, and from national exposure and recognition. LEED is an attractive option for national firms familiar with the LEED process

Project teams that pursue an AEGB rating benefit from a tool that reflects Austin's environmental priorities, local recognition and exposure of project

¹ Modified to Green Infrastructure & Buildings in the balloted LEED 2009 for Neighborhood Development.

achievements, and availability of AEGB staff to provide technical assistance. AEGB staff is available to identify relevant strategies that have been successfully implemented at Mueller as well as development-wide features that may contribute to credit achievement.

Pursuing both LEED and AEGB certifications may be desirable, with many shared credits and strategies across the two rating systems. This approach offers two distinct advantages: provides local and national recognition and exposure and establishes benchmarked leadership at both scales. To facilitate this, Austin Energy Green Building staff can identify strategies that fulfill requirements of both rating systems, and on a project-by-project basis can accept similar documentation. Because the requirements are not always identical, it is essential for project teams that opt to pursue both rating systems to have a thorough understanding of their similarities and differences and to consult with Austin Energy Green Building staff for their concurrence. When strategies are similar but requirements different, project teams are encouraged to pursue the more stringent reference standard.

Several projects at Mueller have pursued both LEED and AEGB certification. See Table 2.2.

Table 2.2: Projects at Mueller that have achieved LEED and **AEGB** certification.

Project	LEED Certification	GBP Commercial Rating
Seton Family of Hospitals Administrative Offices	Gold	4-Star
Dell Children's Medical Center of Central Texas	Platinum	5-Star
Mueller Central	Gold	4-Star
Mueller South Regional Retail - Starbucks	Silver (LEED for Commercial Interiors	s) 3-Star



Photovoltaic shading on public parking garage.

LEED and AEGB Certification Processes

For LEED for New Construction & LEED for Retail

Project teams pursuing LEED for New Construction and LEED for Retail must first register their project with the Green Building Certification Institute (<u>www.gbci.org</u>) and with the related LEED Online, the web-based resource for managing the LEED documentation process. As part of the registration process, project teams must choose one of two submittal options:

- A two-phase design + construction review: design documentation is submitted to GBCI for review; a final design + construction submittal is submitted after the end of construction.
- A combined review: design and construction documents are submitted after the end of construction.

Following any preliminary LEED review (design + construction, or combined), project teams have an opportunity to respond to GBCI's review comments. GBCI then conducts a final review, during which they award or deny credits. Project LEED certification is awarded following the project team's response to the final review.

For LEED for Homes

Project teams pursuing LEED for Homes begin the registration process by contacting a LEED for Homes Green Rater to confirm project eligibility. The Green Rater's project involvement begins during design and continues throughout the construction process. After a Green Rater is identified and the project is determined to be eligible for LEED for Homes, the projects must register through the USGBC website (www.usgbc.org). The Green Rater works with the LEED for Homes Green Provider and is responsible for on-site verification, assembling the project certification package and submitting it for certification review.

AEGB Commercial, Multi- and Single-Family Ratings

Teams pursuing AEGB Commercial, Multi- and Single-Family Ratings must register their project on the AEGB Online Rating System, the primary resource for managing electronic documentation during the AEGB review process. The most significant difference between the AEGB and LEED review processes are AEGB's interaction with projects through in-person consulting and site visits. AEGB representatives are assigned to a project at registration. Throughout project design and construction phases, AEGB staff consult with the project team, provide guidance towards meeting rating system requirements and conduct project site visits to confirm appropriate construction practices.

AEGB site visit and submittal phase requirements vary across the three rating systems. Teams pursuing an AEGB Single-Family Rating are required to attend a Single-Family Orientation prior to registering their project. The Commercial and Multi-Family Ratings make use of four submittal phases; planning, design, construction, and closeout.

- Planning and design phases: project teams submit preliminary project information, establish green building goals, and submit design documents.
- Construction phase: AEGB conducts occasional site visits, while the project team compiles construction documentation and provides monthly updates using the online rating system.
- Closeout phase, the project team responds with any remaining final documentation, and AEGB generates a final rating.

AEGB staff review updates and documentation and communicate with team members as necessary. Upon completion of documentation and site visits, AEGB provides approval for documented credits.

USGBC'S LEED[®] Green Building Rating System

The U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a voluntary, consensus-based, internationally-recognized certification system to support the design, construction and operations of high-performance, sustainable buildings. The non-profit USGBC, established in 1993, has rapidly become the most widely recognized green building organization in the U.S. and globally. Nine LEED rating systems are currently in use in the marketplace. Each corresponds to a distinct market sector (see Table 2.3). New projects pursuing LEED certification must select the appropriate rating system during the registration process; some building types are required to use a specific rating system.

New construction projects at Mueller will generally use one of three rating systems:

- Commercial office and multi-family projects use LEED for New Construction;
- Retail establishments use **LEED for Retail**;
- Single-family residential, duplexes, and multi-family projects up to 6 stories use **LEED for Homes**.

Version 3, LEED 2009, is the current issue of all LEED rating systems except for LEED for Homes,

most recently issued in 2008. LEED rating systems are updated regularly, with LEED V4 anticipated to be released in 2013.

Green Building Certification Institute

The Green Building Certification Institute (GBCI) was established in 2008 as an independent third party organization to administer and provide oversight for green building-related professional credentialing and project certification programs, including LEED accredited professionals and LEED certified projects, respectively. Project teams pursuing LEED certification, with the exception of LEED for Homes, must register the project with GBCI (www.gbci.org).

Projects pursuing LEED certification must meet Minimum Program Requirements (MPRs). The MPRs identify the appropriate building types to pursue LEED certification and together fulfill three goals: provide clear guidance to LEED customers; protect the integrity of the LEED program; and reduce complications that occur during the LEED certification process. The seven MPRs, below, apply to all LEED Rating Systems except LEED

Table 2.3 - LEED Rating Systems

New Construction	Healthcare
Core & Shell	Homes
Schools	Neighborhood Development
■ Retail*	Existing Buildings Operations
Commercial Interiors	and Maintenance

* LEED for Retail includes two distinct rating systems: LEED for Retail - New Construction and Major Renovations and LEED for Retail - Commercial Interiors



for Neighborhood Development which has no Minimum Program Requirements:

- 1. Must comply with environmental laws
- 2. Must be a complete, permanent building or space
- 3. Must use a reasonable site boundary
- 4. Must comply with minimum floor area requirements
- 5. Must comply with minimum occupancy rates
- 6. Must commit to sharing whole-building energy and water usage data
- 7. Must comply with a minimum building area-to-site area ratio

For more information, see www.usgbc.org/ DisplayPageaspx?CMSPageID=2102.

LEED Pilot Credits are innovative green building strategies available for market testing prior to the LEED public comment and balloting processes. Project teams may attempt Pilot Credits and provide feedback to facilitate the introduction of new credits into LEED through an open and transparent process. Projects registered for all LEED Rating Systems may earn up to the number of innovation points available with a specific rating system with pilot credits. The LEED Pilot Credit Library can be accessed through the USGBC website.

Regional Priority Credits, developed by each of eight regions as having region-specific significance, were debuted in LEED 2009. They offer project teams up to four additional points for earning LEED credits associated with each of the Regional Priority Credits.

LEED 2009 for New Construction Regional Priority Credits applicable to Mueller projects (subject to change in future versions of LEED; refer to www.usgbc.org for current information):

- SSc5.1: Site Development Protect or **Restore Habitat**
- SSc6.1: Stormwater Design Quantity Control
- SSc6.2: Stormwater Design Quality Control
- WEc2: Innovative Wastewater Technologies
- EAc2: On-Site Renewable Energy (1% of total energy load)
- MRc2: Construction Waste Management (diversion of 75% construction waste)



Development Scale Credit Achievement

For master planned developments like Mueller, the Green Building Certification Institute (GBCI) allows individual buildings pursuing LEED certification to achieve pre-selected credits by claiming strategies implemented on the development scale, such as infrastructure for stormwater quantity and quality control and brownfield remediation. Several LEED certified projects at Mueller have successfully used this approach to achieve specific credits.

LEED 2009 for New Construction credits for which the Mueller development-wide strategy may fulfill individual project credit requirements include:

- SSc1 Site Selection This credit rewards projects that select sites with minimal impact on environmentally sensitive areas. The entire Mueller development is located on the former Robert Mueller Municipal Airport (RMMA) and is considered previously developed. The site is not considered prime farmland, habitat for threatened or endangered species, within a development setback from a wetland, or previously set aside for public parkland.
- SSc3 Brownfield Development The entire Mueller property was identified as meeting the EPA's definition of a "brownfield" by the Project hydrogeologist who oversaw the RMMA environmental assessment and remediation. In response to the brownfield determination, data encompassing the entire 711-acre site was submitted to the Texas Commission on Environmental Quality (TCEQ) Voluntary Cleanup Program (VCP) to achieve regulatory closure with regard to environmental issues associated with former aviation operations. For several projects at Mueller pursuing LEED certification including Dell Children's Medical Center of Central Texas and Dell Pediatric Research Institute, the Green Building Certification Institute recognized the assessment and remediation work done to the site as a whole as sufficient to achieve SSc3.

- SSc5.2 Site Development, Maximize Open Space The Master Development Agreement between Catellus Austin LLC and the City of Austin requires a minimum of 140 acres (20% of the total Mueller redevelopment land area) of publicly accessible open space in the final development. A number of projects including Frost Bank and the Seton Administrative Offices have claimed this open space requirement to fulfill requirements of SSc5.2. The City of Austin Economic Growth and Redevelopment Services Office can support project documentation with a letter acknowledging this arrangement.
- SSc6.1 Stormwater Design, Quantity Control A series of stormwater detention ponds integrated into Mueller's landscaped greenbelts and parks were sized to manage stormwater runoff from the entire Mueller site. A number of projects have successfully documented qualifying post-development discharge rates based on development scale stormwater management strategies.
- SSc6.2 Stormwater Design, Quality Control Similar to SSc6.1, Mueller's stormwater detention ponds have allowed projects to document LEED-compliant stormwater quality. The ponds are designed to remove 80% of average annual post-development total suspended solids (TSS) from project runoff.

NOTE: Strategies described above are relative to LEED 2009 requirements. Projects pursuing certification using future versions of LEED should assess credit requirements of the specific rating system in use at that time.

Individual projects attempting to claim development scale strategies to achieve LEED credits should contact Carl Paulson at Catellus Development Corporation for more information. **Mueller Requirement - LEED for New Construction Eligibility:** Commercial and office projects; multifamily residential projects four stories or greater.²

Mueller Requirement: Certified-level certification. Higher certification levels are encouraged.

Fees: Registration and Certification fees apply. Fee structure based on USGBC membership status and project square footage. Refer to <u>GBCI website</u> for specific fee information.

Overview

The LEED for New Construction rating system is organized into five major categories:

- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials and Resources
- Indoor Environmental Quality

A sixth category, Innovation and Design Process, addresses exemplary performance and strategies not covered under credits in other categories, including LEED Pilot Credits. This sixth category is important because it promotes novel approaches to green building and site-specific elements; it also recognizes the participation of a LEED Accredited Professional on the design team. Each of the LEED categories is divided into prerequisites and credits. **Prerequisites** are required of all projects seeking LEED certification. Each project delivery team has the option to choose which **Credits** to pursue based on the particular goals and opportunities provided by their project, with a minimum number of points required to achieve each LEED certification level. See Table 2.4

Mueller Requirement - LEED for Retail

Eligibility: LEED For Retail - New Construction and Major Renovations: All new construction or major renovation of a retail project as defined by code. LEED for Retail - Commercial Interiors: Retail fit-outs of tenant spaces, Retail projects certified under LEED for Core and Shell.

Mueller Requirement: Certified-level Certification. Higher certification levels are encouraged.

Fees: Registration and Certification fees apply. Fee structure based on USGBC membership status and project square footage. Refer to <u>GBCI website</u> for specific fee information.

Overview

LEED for Retail includes two distinct rating systems oriented to the specific needs and goals of retail projects including big box stores, restaurants, banks, and smaller establishments. **LEED 2009 for Retail: New Construction and Major Renovations** (LEED Retail - NC) provides guidance for new retail projects

Table 2.4 - LEED Certification Levels*

Certification Level	Points Required**
Certified	40 to 49
Silver	50 to 59
Gold	60 to 79
Platinum	80 to 110

*The listed points requirements apply to all LEED rating systems except LEED for Homes. See Table 2.5 for the LEED for Homes point distribution.

**All point and certification requirements current as of this writing. Refer to the <u>USGBC website</u> for current information.

² Multi-family residential projects with 4 - 6 stories may pursue either LEED for New Construction or LEED for Homes certification. Multi-family projects greater than 6 stories must pursue LEED for New Construction.

or major renovations of existing buildings. LEED 2009 for Retail: Commercial Interiors Rating System (LEED Retail - CI) is appropriate for interior finishout of retail tenant spaces or projects pre-certified under LEED for Core and Shell. New projects will be directed to the appropriate rating system during the registration process.

Both rating systems include prerequisites and credits organized in the same six categories as LEED for New Construction and Regional Priority Credits. Although some prerequisites and credits are shared across rating systems, the LEED for Retail rating systems include credits specifically developed for retail projects. A minimum number of points are required to achieve each LEED certification level. See Table 2.4.

Mueller Requirement - LEED for Homes

Eligibility: Residential units less than 4 stories (mid-rise multi-family projects up to 6 stories may qualify using special guidance).

Mueller Requirement: LEED for Homes certification is encouraged though not required.

Fees: Registration and Certification fees apply. Fees based on USGBC membership status. Refer to **<u>GBCI website</u>** for specific fee information.

Overview

The LEED for Homes rating system was launched in 2008, specifically developed to support single-

and multi-family residential projects with fewer than 4 stories. Structured differently from other LEED rating systems, LEED for Homes requires the homeowner, developer, or builder to engage a LEED for Homes Provider as early in the process as possible. As of this writing there are 38 LEED for Homes Provider organizations located in most major housing markets in the U.S. Currently, six Providers service the Texas market; they are selected by the USGBC for their established expertise to support builders in the construction of high-performance, sustainable homes. The associated LEED for Homes Green Raters provide onsite verification of compliance with the LEED for Homes prerequisites and credits. In addition, all certified LEED for Homes projects must complete the Home Energy Rating System (HERS) Rating; many Green Raters are also HERS raters, streamlining this phase of the certification process.

LEED for Homes incorporates prerequisites and credits in eight categories:

- Innovation and Design Process
- Location & Linkages
- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials & Resources
- Indoor Environmental Quality
- Awareness & Education

Table 2.5 - LEED for Homes Certification Levels*

Certification Level	Points Required*
Certified	45 to 59
Silver	60 to 74
Gold	75 to 89
Platinum	90 to 136

*All point and certification requirements current as of this writing. Refer to the USGBC website for current information.



A LEED for Homes Gold-certified residence at Mueller built for the 2009 Parade of Homes sponsored by the Home Builders Association of Greater Austin.

Similar to other LEED rating systems, LEED for Homes is based on a set of prerequisites and optional credits. Currently, LEED for Homes has a unique point distribution required to achieve each level of certification different than other LEED rating systems. See Table 2.5.

With Mueller's LEED for Neighborhood Development Pilot Stage 2 Silver plan certification in place, homes at Mueller pursuing LEED for Homes certification can earn the maximum 10 points available in the Locations & Linkages LLc1.

Further Information

For information on LEED project registration and certification and LEED professional credentialing, visit <u>www.gbci.org</u>. For information about LEED educational and technical resources and USGBC membership, visit <u>www.usgbc.org</u>.

The LEED Green Building Design & Construction Reference Guide, 2009 edition, contains in-depth information regarding design strategies, requirements and calculations associated with each LEED prerequisite and credit applicable to LEED for New Construction, Core & Shell, and K-12 school projects and is available for purchase through the USGBC website www. usgbc.org. The reference guide for the LEED for Homes rating system and supplements for LEED for

Table 2.6 - Selected USGBC Resources

Description	Cost	Website
LEED Rating Systems Overview: Includes links to information about all LEED Rating Systems	Free Online Information	www.usgbc.org/DisplayPage. aspx?CMSPageID=222
LEED 2009 New Construction and Major Renovations Rating System (PDF)	Free Download	www.usgbc.org/ShowFile. aspx?DocumentID=8868
LEED 2009 Sample Credit Templates	Free Download	www.usgbc.org/DisplayPage. aspx?CMSPageID=1447
LEED 2009 Green Building Design and Construction Reference Guide (Includes LEED for New Construction, LEED for Core & Shell, LEED for Schools)	See USGBC website for current pricing	www.usgbc.org/Store/ PublicationsList_New.aspx? CMSPageID=1518
LEED for Homes Reference Guide, 2009 Edition		
LEED 2009 for Retail and Healthcare Supplements		

Retail and LEED for Healthcare are also available for purchase through the USGBC website. Table 2.6 summarizes some of the USGBC resources applicable to projects at Mueller. (Updated reference guides will be issued with the release of future versions of LEED rating systems.)

AUSTIN ENERGY Green Building

Austin Energy Green Building (AEGB) is the first green building program in the nation. The initial program development began in 1989 through a public-private partnership between the City of Austin and the Center for Maximum Potential Building Systems funded by The Urban Consortium. The program launched in 1991 supported by a Department of Energy grant. The City of Austinoperated program assists building design and construction teams to create sustainable and healthy buildings. The program offers an array of educational and technical resources to address the unique facets of commercial, single- and multi-family residential buildings.

Mueller Requirement – Austin Energy Green Building Commercial Rating

Eligibility: All commercial, office, institutional, and retail projects, or multi-family buildings greater than 6 stories. Multi-family buildings from 4 to 6 stories have the option to use AEGB's Commercial or Multi-Family Rating.³

Mueller Requirement: Two-Star Rating. Higher certification levels are encouraged.

³ The AEGB Online Rating System orients projects to the appropriate rating system during project registration.

Fees: Registration and Services Fees apply and vary by project square footage. Refer to the Austin Energy Green Building <u>Fee Schedule</u> for current fees.

Overview

Austin Energy Green Building Commercial Rating is organized around a system of green building measures associated with the projects' design and construction phases. The system includes eight *Basic Requirements* that must be fulfilled, in addition to Voluntary Measures that earn points towards star ratings ranging from One- to Five-Stars.

Commercial Rating Voluntary Measures are

organized into eight categories:

- Team Indoor Environmental Quality
- Site Materials & Resources
- Energy Education
- Water Innovation

Rating levels for the AEGB Commercial Rating are summarized in Table 2.7. Access the current *AEGB Commercial Rating Guidebook* here.



Table 2.7 - AEGB Commercial Rating Levels.*

Star Rating	Points Required
One-Star	Basic Requirements
Two-Star	30 to 36
Three-Star	37 to 43
Four-Star	44 to 58

*All point and certification requirements current as of this writing.

Mueller Requirement – Austin Energy Green Building Multi-Family Rating

Eligibility: All multi-family residential projects of 6 stories or less.

Mueller Requirement: Two-Star Rating. Higher certification levels are encouraged.

Fees: Registration and Certification Fees apply and vary by project square footage. Refer to the Austin Energy Green Building <u>Fee Schedule</u> for current fees.

Overview

Multi-family residential projects at Mueller of 6 stories or less have the option to use the AEGB Multi-Family Residential Rating. This rating is similar in structure to the AEGB Commercial Rating but includes 14 Basic Requirements and Voluntary Measures specific to multi-family projects. **Multi-Family Voluntary Measures** are organized into six categories:

- Site
- Energy Materials & Resources

Indoor Environmental Quality

■ Water ■ Innovation

The rating levels for the AEGB Multi-Family Residential Rating are summarized in Table 2.8. Access the current <u>AEGB Multi-Family Rating</u> *Guidebook here*.

Mueller Requirement – Austin Energy Green Building Single-Family Home Rating

Eligibility: Single-family homes, duplexes, and townhomes.

Mueller Requirement: Three-Star Rating. Higher certification levels are encouraged.

Fees: Registration and certification fees apply. Refer to the Austin Energy Green Building <u>Fee Schedule</u> for current fees.

Overview

Single-family, duplex and townhouse residences at Mueller are required to follow the AEGB Single-Family Home Rating. This rating includes 18 Basic Requirements and Voluntary Measures specific to single-family projects. Projects pursuing two or more Stars must also achieve specific points in addition to Basic Requirements. Rating levels for the AEGB Single-Family Rating are summarized in Table 2.9. Homebuilders are required to attend an AEGB Single-Family Orientation before registering new single-family projects. Access the current <u>AEGB Single-Family Rating Guidebook here</u>.

Further Information

For additional or more current information regarding AEGB Rating Systems and certification, refer to the <u>AEGB website</u>, or call 512-482-5300.

Table 2.8 - AEGB Multi-Family Rating Levels.*

Star Rating	Points Required
One-Star	Basic Requirements
Two-Star	29 to 35
Three-Star	36 to 42
Four-Star	43 to 56
Five-Star	57 or more

*All point and certification requirements current as of this writing.

Table 2.9 - AEGB Single-Family Rating Levels.*

Star Rating	Points Required
One-Star	Basic Requirements
Two-Star	50 to 74 including specific measures
Three-Star	75 to 99 including specific measures
Four-Star	100 to 149 including specific measures
Five-Star	150 or more including specific measures

*All point and certification requirements current as of this writing.

CHAPTER 3

Green Urbanism Signature Themes









options reduces dependence on automobile travel and associated NOx emissions. Mueller's Green

Image courtesy of Andy Mattern, Artimbo.co

MUELLER

Protecting Air Quality

Air quality is an economic, public health and social concern with direct effect on human health and comfort. It also is a measure of the broader environmental health. According to the U.S. Environmental Protection Agency, Americans spend about 90% of each day indoors. Recent studies indicate that health problems associated with compromised indoor air quality account for direct and indirect medical costs estimated as high as \$168 billion per year.

Over the past few decades, significant advances in public policy have benefited air quality, including regulations that prohibit tobacco smoking in or near buildings and outlaw harmful products such as lead-based paint. Limits on airborne particulates and volatile organic compounds (VOCs) have been established, acknowledging their adverse effects on human health. The general recognition that chemicals used in common building materials such as paints, sealants, adhesives, carpet and composite wood products—adversely affect human health and environmental quality has prompted focused research on the relationship of buildings, air quality and human health.

Austin's air quality is currently categorized as in a "near non-attainment area" relative to compliance with federal ground-level ozone standards. Engagement in specific voluntary initiatives to improve the current condition can prevent classification as a non-attainment area. Ground-level ozone is formed when nitrogen oxide (NOx) and volatile organic compounds react in the presence of sunlight. Emissions from fossil fuel combustion, industrial facilities, and unburned gasoline vapors are common sources of NOx, while chemical solvents used in paints, adhesives, and other products are common sources of VOCs.

Voluntary efforts to improve Austin's air quality over the last ten years have been effective. More stringent federal standards are anticipated for implementation in 2013. Without continued improvement, the new ground-level ozone standards may place Austin in non-attainment prompting a mandatory air quality improvement plan.

Buildings at Mueller can protect outdoor air quality through energy efficient design and use of low-emitting materials and products. At the development scale, diversifying transportation options reduces dependence on automobile travel and associated NOx emissions. Mueller's Green Urbanism design promotes multiple opportunities to reduce reliance on single-occupant vehicles by integrating street connectivity, transit corridors and hubs, sidewalks, and bike lanes and promoting walking, bicycling, and public transit.

Punch List

Design

- Breathable building skin to prevent moisture build-up
- High performance HVAC system filtration
- Natural ventilation/operable windows
- Occupant control of airflow, temperature, and lighting
- Entryway pollutant control system
- Separate ventilation for equipment and chemical mixing rooms
- Low-emitting materials: paint, sealants, adhesives, carpet, furniture, composite wood and agrifiber
- Low-maintenance products and materials
- Vegetation and open space
- Pedestrian, bicycle and transit-oriented location

Construction

- Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Construction Indoor Air Quality Guidelines
- Construction site air pollution reduction measures
- Construction air quality manager
- Building flush-out/indoor air quality testing prior to move-in

Operations

- Facilities manager responsible for monitoring and promoting healthy indoor air quality
- Low- and no-VOC materials for building interior and exterior maintenance
- Low-emitting lawn care and construction equipment
- Integrated pest management
- Green housekeeping



Strategies: Design and Location

Effective building design, construction and location strategies can benefit building occupant health during and after project completion. These include complying with or exceeding standards for low-emitting materials and responsible construction practices, and locating the building in an area that offers transportation options to decrease single-occupant vehicle travel. Together, these reduce contributions to air pollution and climate change.

Mildew and Mold

Eliminate sources of persistent moisture.

Mildew, mold and other fungi grow on moist surfaces and can contribute to health problems. Buildings in Central Texas are particularly prone to mildew and mold growth due to humid conditions. Mildew and mold are some of the most difficult air contaminants to manage because their moist growing conditions are often challenging to avoid. Inadequate drainage of exterior building surfaces and poorly designed and installed vapor barriers are two common factors contributing to mold and fungi growth.

Action Items

- Control moisture.
- Choose inherently mildew resistant building materials.
- Avoid materials that trap moisture, contributing to mildew growth: ceiling tiles made from synthetic mineral fiber, vinyl wall covering, kraft paper backed gypsum wallboard.

Ensure that the building skin (roofs, walls, joints) sheds precipitation and does not trap moisture.

Thermal Control Systems

Design HVAC System to provide appropriate filtration, ventilation, and occupant comfort. Air conditioning systems with improperly sealed ducts have the potential to distribute contaminants throughout the building.

Filtration Techniques

- Mechanical filters Remove particulates from the air.
- Electrostatic precipitation devices Remove fine particulates.
- Absorptive materials Remove gaseous contaminants such as VOCs, methane, formaldehyde and carbon monoxide.

Filtration of HVAC systems improves air quality and protects human health. It can be an effective method of keeping air handlers and ducts clean, prolonging the life of mechanical equipment, and preventing



Natural Ventilation – Convective Cooling. Image courtesy of Dan Overbey

fires and mold growth. Mechanical filters' effectiveness in removing dust particles is reflected by the MERV (minimum efficiency reporting value) rating. The higher the MERV rating, the more effective the filter is in removing dust from the air. See Table 3.3 on page 31 for more information about ventilation system protection and filters. Installing a higher MERV rated filter than is prescribed by the manufacturer may increase energy use due to additional strain on the air handling unit. Filters should be selected to balance air quality and energy efficiency needs.

Natural Ventilation

Natural ventilation is a fundamental green building strategy. It is common in residential buildings where operable windows are customary. Natural ventilation or hybrid natural/mechanical ventilation design strategies are also increasingly common for commercial buildings. Given appropriate climatic conditions, operable windows can benefit human health and productivity and improve building energy performance. Recognizing that outside conditions may not always be favorable for opening windows, some buildings employ a "green light-red light" signal switch to alert building occupants to when it is appropriate to open and close windows.

Occupant Control

Occupant control of airflow, temperature, and lighting helps to avoid complaints of discomfort and irritation associated with indoor conditions. Providing occupant control in the form of individual thermal and lighting controls, or operable windows can lead to higher productivity, lower absenteeism, and a more desirable workplace.

Action Items

- Use mechanical filters with a high MERV rating.
- Change filters regularly.
- Ensure HVAC ducts are properly sealed.
- Provide operable windows.
- Provide individual thermal and lighting controls.



Windows that open allow for natural ventilation, improve indoor air quality and eliminate the need for mechanical air conditioning.

Indoor Air Quality (IAQ)

Pollutant levels inside a building that affect occupant health and comfort.

Studies conducted by the U.S. EPA concluded that air pollution levels inside buildings may be two to five times higher than outdoor levels. These findings are of particular concern because Americans on average spend 90% of their time indoors.

Proper indoor air quality may be maintained by:

- Controlling the level of airborne contaminants circulating in the building
- Regulating the introduction and distribution of an adequate amount of outdoor air
- Maintaining thermal comfort levels
- Maintaining proper relative humidity levels

Typical symptoms of poor indoor air quality include:

- Headaches
- Persistent fatigue
- Itching or burning eyes
- Skin irritation
- Nasal congestion
- Dry or irritated throats
- Other respiratory irritations

Prolonged exposure to compromised indoor air quality can lead to health problems such as asthma and allergies. Healthy indoor air quality has been shown to improve productivity and occupant well-being and reduce absenteeism in workplaces and schools.

Physical Separation

Use an entryway system to trap contaminants before they enter the building.

Many contaminants are tracked into buildings on the bottom of shoes. Physical barriers such as grilles and grates in entryways and high traffic areas are an easy way to reduce contaminants from entering the building.

Mechanical Systems and Building Equipment

Provide separate ventilation for equipment with open combustion systems.

Combustion creates carbon monoxide and other gases detrimental to human health. Ensure that areas with combustion activities are separately ventilated to avoid contaminating interior spaces. This is a particular problem in residential buildings where gas ranges and fireplaces are common. If gas ranges are used, install kitchen range fans that exhaust contaminants to the outside.

Open Combustion Sources

- Gas water heater
- Gas range
- Gas furnace
- Wood or gas fireplace
- Woodstove

Chemical Storage

Provide separation and sufficient ventilation for chemical storage and use areas.

Design ventilation systems to protect air quality by creating negative pressure and sufficiently exhausting spaces intended for storage and use of hazardous chemicals, such as janitors closets, shops and maintenance areas.

Areas used for mixing chemicals may also be designed with separate exhaust systems to minimize impaired air quality in occupied areas.

Provide physical separation for occupied spaces adjacent to chemical storage and use areas by using barriers such as self-closing doors and deckto-deck partitions.

Low-Emitting Materials

Specify low- and no-VOC options for all paints, adhesives, sealants, carpet, upholstery, furnishings, and engineered wood.

Volatile organic compounds originate from both natural sources and manufactured products. They are of particular concern in building interiors because of their adverse effect on indoor air quality and occupant health. High-emitting exterior materials should also be avoided due to their contribution to pollution and ground level ozone formation.

Volatile Organic Compounds

Molecules containing carbon that are generally in a gaseous state at room temperature.

Many synthetic materials such as paint, carpet, engineered wood products, adhesives and sealants emit VOCs, compromising air quality and human health.

VOCs are linked to a range of health problems including short-term nose and throat discomfort and longer-term respiratory ailments. Some VOCs contain known or suspected carcinogens.

Volatile organic compounds are present in many commonly used materials and products, including:

- Solvents
- Pesticides
- Cleaning supplies
- Office equipment
- Paints and coatings
- Adhesives and sealants
- Carpet

In the building industry, VOCs are generally measured in grams per liter (g/L). Low concentration, long-term exposure and high concentration, short-term exposure to VOCs can cause skin or lung irritation, asthma, and other respiratory reactions; some VOCs are carcinogenic.

Low- and No-Emitting Materials

- Water-based products
- Low- and no-VOC paints and coatings (see Table 3.1)
- Carpet and Rug Institute Green Label Plus Certified carpet and Green Label Certified carpet pad
- Low- or no-VOC adhesives and sealants (See Table 3.2)
- Engineered composite wood, agrifiber, and batt insulation with no added formaldehyde
- Low- and no-VOC furniture, cubicle walls, and other upholstered items

Floor Coverings

Carpet is a popular flooring material due to its comfort, low cost and desirable sound-attenuation properties. However, carpet can be a significant source of VOCs in buildings. Carpet also serves as a sink for airborne contaminants and can encourage mold and fungi growth when exposed to moisture. Many new building projects opt for flooring materials other than carpet, including hardwood, tile, slate, linoleum, cork, bamboo, and concrete. All flooring options should be assessed for their VOC content, including the adhesives, sealants, and coatings used to install and finish them, and the cleaning agents used to maintain them during occupancy. When carpet is the preferred option, carpet and carpet pad are available with no- or very low-VOC content. It is also important to use low- and no-VOC carpet adhesives or opt for adhesive-free carpet installation. The Carpet and Rug Institute's Green Label Plus program certifies low-emitting carpet through testing of 13 chemical compounds considered hazardous to human or environmental health. For more information about low-emitting carpet, carpet pad and adhesive products and testing standards, refer to the Carpet and Rug Institute Green Label Plus Program website.

Table 3.1 - Low-Emitting Materials - Interior Paints and Coatings - Green Seal Standard 11, Effective January 1, 2010

Product Type	VOC Limit (g/L)
Flat Topcoat	50
Non-Flat Topcoat	100
Primer or Undercoat	100
Floor Paint	100
Anti-Corrosive Coating	250

Table 3.2 - Low-Emitting Materials - Adhesives and Sealants, South Coast Air Quality Management District (SCAQMD) Rule #1168, Effective January 1, 2007*

Product Category	VOC Limit (g/L)
Sealant Primer	050
Architectural (non-porous)	250
Alchilectural (porous)	775
	130
Sealant	250
Alchillectural Non Membrane Roof	200
Roadway	250
Single-Ply Boof Membrane	450
Other	420
Substrate Specific Adhesives	
Metal to Metal	30
Plastic Forms	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80
Architectural and Specialty Ac	lhesives
Indoor Carpet Adhesives	50
Carpet Pad Adhesives	50
Wood Flooring Adhesives	100
Rubber Floor Adhesives	60
Subfloor Adhesives	50
Ceramic Tile Adhesive	65
VCI & Asphalt Adhesives	50
Drywall & Panel Adhesives	50
Cove Base Adnesives	50 20
Multipurpose Construction Adne	2SIVES 70 100
DVC Wolding	510
	400
ABS Welding	325
Plastic Cement Welding	250
Adhesive Primer for Plastic	550
Contact Adhesive	80
Special Purpose Contact Adhesi	ve 250
Structural Wood Member Adhes	ive 140
Sheet Applied Rubber Lining Op	erations 850
Top & Trim Adhesive	250

*Refer to current LEED and AEGB Ratings for specific requirements.

Vegetation and Open Space

Planting trees and other vegetation filters the air. Planting vegetation and providing ample open space contribute to multiple benefits including improving outdoor air quality by absorbing carbon dioxide and producing oxygen. Appropriately placed trees and vegetation can also serve as buffers, protecting residential and pedestrian areas by intercepting airborne particulates generated by traffic or industrial activities. Native plants are adapted to local climate and soils, and generally require less fertilizer and pesticide, lessening two major contributors to air and water pollution.

Action items

- Minimize disturbance of existing plant life on site, especially existing trees.
- Incorporate native landscaping into site plan.
- Plant species that are naturally resistant to pests.

Encourage Alternative Transportation Use

Provide Access to a Variety of Options to Avoid Single Passenger Vehicle Trips.

Transportation accounts for 29% of energy consumption in the United States. Alternatives to single passenger automobiles, such as bicycles and public transportation, lessen this carbon footprint.

Action Items

- Provide secure bicycle storage and shower facilities for building occupants.
- Encourage the use of public transportation options.
- Provide preferential parking for low-emitting and fuel efficient vehicles and charging stations for electric vehicles.
- Provide sidewalks, trails and other pedestrian- and bicycle-safe access to surrounding communities.



Strategies: Construction

Construction practices can impair outdoor and indoor air quality, resulting in adverse health consequences for construction workers, future building occupants, and the broader community.

Construction Air Quality

Reduce pollution on-site during construction.

Construction activities can contribute to outdoor air pollution. Diesel exhaust from construction equipment releases VOCs and particulate matter into the atmosphere, creating an unhealthy environment for construction workers, nearby residents and the broader community.

Action Items

- Adopt a construction environmental management plan.
- Prohibit equipment idling on the job site.
- Require low-emitting, new construction equipment that uses cleaner-burning fuels, such as biodiesel, propane, or electricity.
- Arrange for on-site fuel tanks to be filled with biodiesel in lieu of petroleum-based diesel fuel.
- Adopt low-noise standards for construction equipment to reduce noise pollution.

Construction Indoor Air Quality

Follow SMACNA Guidelines for Construction Indoor Air Quality and properly sequence material installation.

Broadly recognized and comprehensive constructionrelated indoor air quality (IAQ) standards come from the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). See Table 3.3 for an outline of the SMACNA Guidelines for Construction Indoor Air Quality.

Moisture and Job Site Contaminants

During construction, protect building materials from moisture and job site contaminants to avoid potential for mildew and mold and compromised indoor air quality. Building envelope and HVAC systems are priority areas.

- Store building materials in dry locations prior to installation.
- Seal HVAC ducts during construction to keep dust from entering mechanical systems.
- When HVAC must be turned on during construction, use temporary return air filters rated MERV 8 or higher.

Table 3.3 - Construction Indoor Air Quality (IAQ) Management Plan

Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) IAQ Management Plan

HVAC Protection

Shut down the return side of the HVAC system whenever possible during heavy construction or demolition. If the ventilation system must be operated during construction, it should be fitted with temporary filters that can be replaced with clean filtration media (recommended MERV 13) prior to completion and occupancy.

Source Control

Specify non-toxic and low- or non-emitting finish materials (e.g., paints, carpet, composite wood, adhesives, sealants) that are non-toxic and low- or non-emitting.

Pathway Interruption

During construction, isolate work areas to prevent contamination of clean or occupied spaces.

Housekeeping

Establish cleaning protocols that concentrate on HVAC and building spaces to remove contaminants from the building prior to occupancy. Protect building materials from exposure to weather and store in a clean area prior to unpacking for installation. All coils, air filters, and fans should be cleaned before performing testing and balancing procedures and especially before conducting baseline air quality tests.

Scheduling

Sequence construction activities to reduce potential for porous materials to absorb VOCs. Complete applications of wet and odorous materials such as paints, sealants, and coatings BEFORE installing absorbent "sink" materials such as ceiling tiles, carpets, insulation, gypsum products, and fabric-covered furnishings.

- Seal the building from precipitation and other moisture sources.
- Erect temporary moisture barriers until the permanent building shell is complete.
- Do not start construction on the interior until the shell is watertight.

Recommended construction sequencing following completion of the building shell:

- 1. Allow high-emitting materials such as furniture, composite woods, and carpet to off-gas outside the building before installing.
- 2. Allow high-emitting finish materials (such as paints) to off-gas before installing absorptive materials (such as furniture and carpet).

Volatile Organic Compound "Sinks"

"Sink" materials absorb volatile organic compounds and re-emit them over time. Install the following porous, absorptive materials after high-emitting materials have been installed and had time to off-gas VOCs:

- Ceiling Tile
- Insulation
- Carpet
- Drywall
- Upholstered furniture

Building Flush Out and Air Testing

Flush out building after all finishes are installed.

A building flush out involves introducing outside air at a higher than normal pressure to dilute concentrations of air pollutants, accelerating the off-gassing of high-emitting materials. A building flush out is most effective if completed prior to occupancy. Ambient air conditions and construction schedules can pose challenges to undertaking a conventional 14-day 100% outside air building flush out. In these cases, alternate flush out protocols can be pursued, including strategies outlined in LEED for New Construction EQc3.2.

Air testing for specific building contaminants prior to occupancy verifies indoor air quality with or without a building flush out.



Residential sources of indoor air pollution.

Particulate Matter (PM)

Airborne solid particles that irritate the eyes and respiratory system.

Particulate Matter is a category of criteria air pollutants that includes dust, soot, and other fine bits of solid material that are released into and move around in the air. Exposure to particulates can result in eye, nose and throat irritation and other health problems.

Particulates are produced by many sources, including:

- Diesel fuel combustion
- Incineration
- Road construction
- Industrial and mining operations
- Wood burning

Biodiesel

Biodiesel is a renewable fuel made from vegetable oils or animal fat. Often blended with petroleum diesel fuel, the percentage of biodiesel is indicated in the blend's name. For example, the most common blend, B20, is composed of 20% biodiesel and 80% petroleum diesel. The displacement of the petroleum diesel can reduce emissions, lessen dependence on foreign oil sources and provide an economic stimulus to farmers.

As of 2011, the City of Austin uses B20 biodiesel fuel in the majority (some 1,800) of their diesel-powered engines. This follows a successful City of Austin pilot project that used B20 in a contractor's construction equipment as part of a voluntary emissions toolkit. The City of Austin Public Works Department recommends the use of biodiesel to reduce equipment emissions. For more information, download the City of Austin Construction Emissions Toolkit: www.austintexas.gov/site/default/files/files/public-works/anti-idling_toolkit.zip.

Additionally, manufacturers of heavy industrial equipment have indicated that B20 is compatible with their diesel construction engines and will not void the engine warranty. Potential users should check with manufacturers regarding the highest allowed blend for their equipment and warranty-related information including intervals for changing oil filters.

When used as a fuel, B100, or 100% biodiesel, substantially reduces hydrocarbon emissions, particulate matter, greenhouse gases and air toxics compared to petroleum diesel. Although combustion of B100 may increase by up to 10% emission of nitrogen oxides (NOx), a precursor emission of ground-level ozone, B20 used in certain engines may result in no net increase in NOx. Third-party certifications verify NOx emission levels ranging from +2% to -2% for B20 compared to using petroleum diesel.

On December 21, 2008 the Texas Council on Environmental Quality (TCEQ) approved B5 (5% biodiesel) to be compatible with their Texas Low Emission Diesel formulation requirements. Currently in Central Texas, biodiesel made from animal fat is cost competitive with petroleum diesel, while soy-based B20 biodiesel generally costs more.

Eco-Wise, located at 110 Elizabeth Street in south Austin, is the only bio-diesel retailer within the Austin city limits as of this writing.

For further information, see National Biodiesel Board: www.biodiesel.org/resources/fuelfactsheets/default.shtm. Source: Scott Johnson





Strategies: Operations and Maintenance

Enhance indoor and outdoor air quality throughout a building's life cycle. Outdoor air quality is a health concern in Austin due to high levels of ground-level ozone and particulate matter.

O&M Air Quality

Establish operations and maintenance regimen that maintains healthy air quality.

- Establish a regular cleaning schedule to remove contaminants tracked in by occupants.
- Install an air monitoring system to test for contaminants (e.g., carbon monoxide, carbon dioxide) in the ventilation system and occupied areas.
- Specify low- and no-VOC paints, adhesives, and sealants for interior and exterior use.

Facilities Manager

Assign a specific staff member or team to monitor and maintain indoor air quality.

A facilities manager monitoring air quality helps maintain a healthy indoor environment.

- Maintain an up-to-date manual of building maintenance, housekeeping and pest management protocol.
- Include air quality management in staff training; provide regular training refreshers.
- Establish a standard protocol for reporting and resolving air quality concerns.
- Survey building occupants about building health and comfort.

Green Housekeeping

Avoid cleaning chemicals and practices that compromise air quality and human health.

Implementing a green housekeeping protocol can help eliminate sources of indoor air pollution associated with maintenance activities. Cleaning products often contain chemicals that may cause headache, discomfort, and eye, nose and throat irritation in maintenance staff and other building occupants. Building equipment such as floor sanders and buffers can create dust and particulate matter that contribute to respiratory discomfort.

- Adopt a green housekeeping protocol that specifies non-toxic cleaning agents and avoids toxic cleaners and surface treatments.
- Use vacuum cleaners and deep cleaning carpet extraction equipment certified by the Carpet and Rug Institute.
- Include green housekeeping procedures as part of standard initial and ongoing maintenance staff training.
- Specify materials and products that do not require toxic cleaners and surface treatments.



MUELLEF

Integrated Pest Management

Integrate a pest management plan that encourages use of non-toxic chemicals and pesticides.

Insect and other pest infestations can lead to expensive structural damage and unsanitary living conditions. Many commonly used pesticides contain toxic chemicals linked to human health and air quality concerns. An integrated pest management plan relies on physical barriers, routine monitoring and non-toxic prevention as the primary defense against pest infestation. Incidental pest outbreaks are treated with natural insect deterrents and chemicals to minimize deleterious human health effects.

- Incorporate physical barriers to pest infestation into building design such as Termimesh, a woven stainless steel mesh installed during building construction to block potential points where termites might enter.
- Monitor buildings on a regular basis for signs of pests to ensure timely and appropriates responses to pest infestations.
- Use plant-based insect deterrents or other non-toxic options such as diatomaceous earth to protect against pest outbreaks.

Landscaping Equipment

Reduce air pollution by purchasing low-emission lawn equipment.

Gas-powered lawn mowers, leaf blowers, and line trimmers are significant sources of air pollution and can pose health risks to landscape workers and the broader community. In recent years, emission standards for lawn equipment have become more stringent; electric powered alternatives are increasingly available.

Action Items

- Write low-emission equipment standards into landscape contracts to require equipment to exceed current air quality standards.
- Provide electric outlets in convenient outdoor locations to encourage the use of electric landscaping equipment.
- Avoid landscape features that require intensive maintenance.

Sick Building Syndrome (SBS)

Adverse health impacts on building occupants stemming from synthetic chemicals and mildew. The term "sick building syndrome" addresses a wide range of occupant health problems related to compromised indoor environments, including headaches, eye and throat irritation, nausea, fatigue, and dizziness. The World Health Organization estimates that up to 30% of the world's buildings suffer from sick building syndrome.

Occupants react differently to varying concentrations and combinations of chemicals, mildew and mold. As a result, sick building syndrome can be difficult to diagnose. Chemical contaminants of concern for indoor air quality include:

- Volatile organic compounds (VOCs) including formaldehyde
- Chlorinated compounds
- Biological agents
- Radon
- Second-hand tobacco smoke

Image courtesy of U.S. Consumer Product Safety Commission
Urban Heat Island Effect

The urban heat island effect occurs when expansive, dark colored impervious surfaces absorb and re-release the sun's radiant energy. The absorbed heat increases surface and air temperatures leaving the urban environment warmer than its surroundings. A study by NASA researchers concluded that the urban heat island effect is a complex phenomenon influenced by a number of factors including city size, density, building materials, urban vegetation, and the surrounding regional ecosystem.

In warm climates like Austin's, the urban heat island effect is of particular concern because higher temperatures lead to greater heat absorption by buildings, increasing energy use for cooling. Studies by Lawrence Berkeley National Laboratory's Heat Island Group found that elevated air temperature in urban areas resulting from the heat island effect is responsible for 5 -10% of urban peak electric demand for air conditioning use. By increasing energy demand, urban heat islands contribute to global warming emissions. In addition, the same study found the urban heat island effect to be responsible for increased smog formation by intensifying heat-driven photochemical reactions of key airborne pollutants.

Urban heat islands also compromise human health and alter regional microclimates, creating adverse conditions for native wildlife and plant habitat. Heated pavement and roof surfaces can raise the temperature of stormwater runoff, which in turn elevates temperatures in receiving bodies of water, affecting aquatic life. For people, consequences of heat islands such as higher temperatures and air pollution can cause heat cramps, respiratory ailments, exhaustion and heat-related mortality.

Austin Energy and Austin Water Utility provide educational resources, rebates and incentives promoting reflective roofing and sustainable landscaping. Information on Austin Energy rebates and incentives for reflective roofing materials can be found in Chapter 5: *Rebates and Incentives*.





MUELLER

Urban heat island profile showing higher temperatures in proximity to dense urban areas.

Punch List

Open Space and Vegetation

- Plant vegetation to shade structures and pavement
- Install vegetated roofs and walls
- Reduce building footprint and hardscape
- Do not exceed the minimum parking area required by code
- Stack building over parking elements or utilize underground parking

Materials

- Specify high SRI (Solar Reflectance Index) roofing materials
- Specify high albedo paving materials
- Specify porous and pervious paving materials







Strategies: Planning and Design

Maximize Open Space and Vegetation, Reduce Building Footprint and Hardscape

Projects can mitigate their contribution to the urban heat island effect by reducing the footprint of buildings and hardscape surfaces on a site, using less heat-absorbing materials and vegetating a greater percentage of the site.

Action Items

- Reduce building footprint and hardscape such as sidewalks, parking areas and driveways.
- Do not exceed minimum parking spaces required by local building codes.
- Stack the building and parking elements.
- Establish formal construction area boundaries to minimize disturbance of the existing ground surface and vegetation.

Shade Plants

Use vegetation to shade buildings.

Shading from trees and other vegetation blocks the sun's energy from striking and being absorbed by dark colored (low-albedo) surfaces. Proper placement of vegetation on the building site can cool the air through evapotranspiration. Vegetation also provides site and regional benefits by absorbing CO_2 , filtering air quality, enhancing aesthetic value and providing wildlife habitat.

Action Items

- Plant shade trees and other vegetation to shield roof surfaces, sidewalks, driveways, parking lots and exterior walls from direct solar heat gain.
- Plant deciduous trees on the building's south and west sides to protect from heat gain. In the winter months, deciduous trees lose their leaves and allow sunlight to heat and light building spaces.

Green Roofs

Reduce stormwater runoff and building heat gain by installing a green roof.

Green roofs can reduce the urban heat island effect by providing cooling from evapotranspiration and increased reflectivity, and by regulating heat transfer through a building's envelope. They can also reduce stormwater runoff volume, improve the building's energy performance and sound attenuation, provide wildlife habitat and extend the life of roof materials.

Intensive vs. Extensive

Green roofs are generally composed of a waterproof membrane covered by a drainage layer, growing medium, and vegetation. Some green roofs employ modular units that can facilitate maintenance and promote flexibility over time.



The Home Depot at Mueller uses numerous vine-coverd trellises to shade the building.

Green roofs have been used in Northern Europe for centuries. Their growing medium, and that of the "intensive" modern green roofs they have inspired, is generally 8 inches to several feet deep. The added weight of growing medium, drainage materials and plants can require structural reinforcement. Over the past two decades, thinner "extensive" green roofs have become more common. These roofs typically have a 4" to 6" depth of growing medium, reducing the need for added structural reinforcement compared to intensive green roofs.

A 2008 report on green roofs, written by the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, summarizes research comparing thermal performance and water retention of both conventional and green roof materials. These preliminary studies showed that although green roofs performed significantly better in terms of thermal performance and water retention, performance varied depending on product manufacturer. The report recommends that green roof design be tailored to fit local ecosystem requirements, and that green roof testing continue to evaluate factors contributing to performance. Continued testing is in progress at the Wildflower Center, with live comparison data on roof performance posted hourly on the Wildflower Center Green Roof Page.

The Wildflower Center recommends planting green roofs in Austin with native plants including:

- Crossvine
- Sideoats grama (the State Grass of Texas)
- Buffalograss
- Blue grama
- Texas sedge
- Mealy blue sage
- Mexican feathergrass
- Salvia greggii

Additional Native Green Roof species are available on the <u>Wildflower Center's website</u>.

Pricing: Costs and Benefits

Green roof pricing varies depending on design, manufacturer, climate, and plant selection. Since intensive green roof systems are often designed to create recreational space, they typically carry a higher cost than extensive systems due to additional structural and maintenance requirements. While the upfront cost of green roofs is often higher than conventional or cool roofing products, green roofs have demonstrated improved long-term energy savings and maintenance benefits compared to conventional roofing materials. The Wildflower Center's 2008 report estimates that green roofs have the potential to reduce a building's cooling costs by up to 21% in comparison to conventional black tar roofing materials.



Ronald McDonald House Charities of Austin and Central Texas located at Mueller includes a 926 sq. ft. roof garden.



For commercial and residential projects seeking regional- and building-specific energy savings information, Green Roofs for Healthy Cities, in collaboration with Portland State University and University of Toronto, offers a Green Roof Energy Calculator that compares annual energy performance of a building with a green roof to the energy performance of a building with conventional dark or light roofing materials. For example, the calculator estimates that a 5,000 square foot new office building located in Austin using an extensive green roof system that covers 100% of roof area, has 6 inches of growing medium and uses an irrigation system, can save \$228.59 in annual energy bills in comparison to a conventional dark roof. In addition, for the same building the Green Roof Energy Calculator estimates that the green roof will create a 65%reduction in net stormwater runoff.

Resource:

Green Roofs for Healthy Cities, Green Roof Energy Calculator.

West Lake Hills Poolhouse Green Roof Design: LZT Architects

This 650 sq. ft. extensive green roof is located at a private residence in West Lake Hills, Texas. The project was required to obtain a variance with the City of West Lake Hills allowing the green roof to count as permeable cover. The construction of the curved green roof includes a root barrier installed over the roof membrane, followed by a water-retaining polypropylene mat that slowly releases water back to vegetation, and above that an expandable soil retention mesh that holds lightweight growing media between 8 - 10 inches in depth. The roof uses a drip irrigation system. The design team worked to eliminate roof penetrations by routing mechanical and plumbing vents through the walls of the building. Native meadow plants were selected for specific characteristics including growth habits that allow the roofline to remain visible in every season, the ability to withstand full sun and sloped terrain, and a ratio of foliage to flowers that reduces maintenance by eliminating the need

to prune or mow. Species chosen for planting were purple coneflower, wine cup, blackfoot daisy, four nerve daisy, rain lily, blue sedge, and fall aster.





Images Courtesy of Whit Preston



Light Colored and Reflective Roofing and Paving Materials

Specify pavement and roof surfaces with high albedo, emittance, and solar reflectance index (SRI) values. In general, white or light colored surfaces are more effective at reflecting the sun's energy than darker materials.

Albedo

The higher the albedo value, the better.

Albedo (or reflectance) describes a material's ability to reflect solar energy measured on a scale from 0 to 1. Light colored surfaces tend to have high albedo values, meaning that they reflect most of the sun's energy. For example, fresh snow has one of the highest albedo values (0.90 or greater) because it reflects the majority of the sun's light back into the atmosphere. Conversely, dark colored surfaces such as rooftops and paved surfaces usually have low albedo values and consequently absorb solar energy instead of reflecting it.

Thermal Emittance

The higher the emittance value, the better.

Thermal emittance is the ability of a surface to re-radiate solar energy back into the atmosphere on a scale of 0 to 1. Most building materials have emittance values close to 0.90, varying slightly depending on material composition, thickness and temperature change. Metal building materials are the exception because they quickly absorb, but do not rapidly re-radiate, solar energy. As a result, they generally have low emittance values.

Solar Reflectance Index

The higher the SRI value, the better.

The solar reflectance index (SRI), calculated based on solar reflectance and thermal emittance values, measures a roof's ability to reject solar heat. Most roofing materials have an SRI between 0 (Standard Black) and 100 (Standard White).

A high SRI value means that a roofing material has a high degree of both solar reflectance and emittance and a corresponding lower contribution to the urban heat island effect.

Action Items

- Specify an ENERGY STAR[®] qualified or high SRI roof (<u>www.energystar.gov</u>).
- Specify a light colored, high albedo pavement (standard concrete complies with the LEED for New Construction Sustainable Sites Credit 7.1 requiring high albedo paving).
- Specify light-colored exterior walls for non-shaded areas.



Light colored concrete generally has a high albedo rating.

Table 3.4 - Examples of SRI Values for Typical Roofing Materials

Type of Material	SRI Value	
Gray EPDM	21	
Gray Asphalt Shingle	22	
Unpainted Cement Tile	25	
White Granular Surface Bitumen	28	
Red Clay Tile	36	
Light Gravel on Built-up Roof	37	
White Coating on Metal Roof	82	
White EPDM	84	
White Cement Tile	90	
White Coating, I coat, 8 mils	100	
PVC White	104	
White Coating, 2 coats, 20 mils	107	

Source: LEED 2009 Building Design & Construction Reference Guide - for reference only.

Pervious & Porous Pavement

Minimize paved surfaces. Install pervious pavement for drives, walkways, parking.

Pervious Pavement – Also referred to as open grid pavement, pervious pavement is manufactured with voids that allow stormwater to filter into the subsurface while providing structural support for pedestrian and vehicle traffic.

Pervious pavement absorbs less solar heat than non-pervious pavement because the voids allow evaporation and, in some cases, support vegetation. These products are generally manufactured as modular units (e.g., blocks, grids or rolls), and can be used for low-traffic surfaces such as sidewalks, parking spaces, and driveways. Modular units are typically not specified for high-volume vehicle traffic areas because their modularity and honeycomb structure reduces structural performance.

Porous Pavement – Porous paving systems, first developed by the Franklin Institute in Philadelphia in the 1970's, include hard surface materials such as porous asphalt and concrete, and unstabilized systems such as decomposed granite.

While these materials are effective for stormwater infiltration, their ability to mitigate the urban heat island effect varies based on their albedo and emittance value. The City of Austin allows up to 20% of the area of interlocking and permeable pavers, and 100% of the area of unstabilized systems such as decomposed granite, to be excluded from a site's total impervious area calculations, provided the paving system is intended for pedestrian use only (i.e., sidewalks). The use of porous pavement can also reduce the site's overall water quality pond sizing. LEED and Austin Energy Green Building allow for both pervious and porous paving materials to contribute to their respective heat island-related credits.



Pervious pavement.



Protecting the Night Sky

Light pollution, a consequence of inefficient energy use, describes a condition of over-illumination or poorly controlled illumination of the built environment. This can result in unsafe conditions and undesirable brightening of the night sky. Each year in the U.S., an estimated \$2.2 billion is spent on ineffective lighting responsible for the release of an estimated 19 million tons of carbon dioxide and other air pollutants. The urgency for more efficient and effective exterior lighting increases in response to rising energy costs and greater recognition of environmental and health burdens associated with unnecessary reliance on fossil fuels.

Astronomers first raised concerns about light pollution finding the skyglow above towns and cities increasingly disruptive to their research. The characteristic nighttime glow of 'lit up' urban areas results from urban growth and the proliferation of exterior lighting. More recently, the general public has recognized light pollution as an aesthetic and wildlife habitat concern and an indicator of wasteful energy use.

Interest in the effects of light pollution has intensified in recent years as the importance of dark conditions for animals, plants, insects, and people has become better understood. Increased nocturnal light levels adversely impact foraging, breeding, and sleeping patterns of all living organisms, particularly those that function best in the dark. For example, Austin's beloved bat colonies, a significant tourist attraction and a natural form of insect control, depend on dark skies to forage. Higher ambient light levels disrupt their hunting and roosting behavior and alter biological rhythms.

Recognizing that nighttime lighting is required in urban areas for safety, navigation, advertising, and aesthetic applications, effective strategies to protect the night sky can be employed. Available with competitively priced off-the-shelf products, these night sky friendly fixtures prove to be more economical and environmentally friendly than conventional ones.

Common sources of light pollution include poorly designed and installed streetlights, outdoor security lights, and uplit signage. The intent behind controlling glare, light trespass, and uplighting, collectively referred to as "light pollution," is to provide effective and uniform exterior illumination, not to eliminate exterior lighting.



Aldrich Street will minimize light pollution.

Punch List

Design

- Design for uniform lighting more lights, lower overall illumination
- Create a lighting plan zone light levels based on an area's function
- Conform to neighborhood exterior lighting context
- Specify full cut-off fixtures
- Retrofit existing lighting to full cut-off
- Plant vegetative cover to minimize light trespass and reflective glare
- Provide downlighting for signs and buildings prohibit uplighting

Resource Efficiency

- Specify energy-efficient lamps
- Specify long-lasting, low-mercury fluorescent lamps or mercury-free lamps such as LEDs (light-emitting diodes)

Operations

- Adjust light fixture angle during scheduled maintenance
- Install a mechanical or astrological timer
- Install motion sensors where appropriate
- Provide safe collection areas for recycling used lamps, especially fluorescent and other mercury-containing lamps





Strategies: Planning and Design

Uniform Light

Install more lighting fixtures to provide more even coverage; specify lower overall light levels.

To minimize glare, lighting designers provide uniform light levels to reduce the difference between illuminated levels in adjacent areas. This strategy provides adequate illumination for safety and navigation while avoiding light pollution problems such as glare. Employ site-wide strategies to create uniform and reduced illumination levels.

Neighborhood Context

Vary lighting levels based on an area's function and location.

Design a property's lighting levels within the context of the surrounding neighborhood. For example, illumination levels at Mueller's commercial areas and the Town Center, which will host much of the development's nighttime activity, will require higher lighting levels than residential areas. See Table 3.5 for lighting levels identified in LEED 2009. Most of Mueller's commercial areas and the Town Center are in LZ3; residential areas are in LZ2.

Commercial Lighting Level Priorities – Safety and navigation lighting using full cut-off fixtures.

Residential Lighting Level Priorities – Targeted safety lighting using full cut-off fixtures.

Table 3.5 - Lighting for Exterior Environments

Lighting Zone Description	Recommended Max Initial Illuminance Levels (horizonal and vertical footcandles)	
	At Project Boundary	Beyond Project Boundary
LZ1: Dark (developed areas within national parks, state parks, forest land and rural areas)	0.01 fc	0.01 fc
LZ2: Low (primarily residential zones, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas)	0.10 fc	0.01 fc
LZ3: Medium (all other areas not included in LZ1, LZ2 or LZ4, such as commercial/industrial, and high-density industrial)	0.20 fc	0.01 fc
LZ4: High (high activity commercial districts in major metropolitan areas)	0.60 fc	0.01 fc

From LEED 2009 Building Design and Construction Reference Guide, adapted from IESNA RP-33.

Downlighting

Reduce skyglow and glare by angling light downwards. Illuminate buildings by installing full cut-off fixtures above and angle the light downwards focusing on the target of illumination. Similar strategies are effective for exterior signage, which also can be lit using backlighting or internal illumination.







Images courtesy of Rab Lighting, www.rabweb.com

Properly adjusted exterior lighting.

Light Trespass

Light that spills beyond the surface for which it is intended. Light trespass, also referred to as spill light, results from poorly designed or improperly directed lighting fixtures.

Examples of Light Trespass

- Streetlighting that illuminates rooftops and the night sky in addition to sidewalks and streets.
- Security lights that shine into buildings and on adjacent properties instead of illuminating exteriors or paved areas.

Uplight

Illuminates the night sky rather than a surface.

The most common form of uplight comes from light fixtures without full cut-off devices. For instance, globe and acorn lights illuminate in all directions, wasting the light they emit above the horizontal plane.

Common Targets of Uplighting

- Signage
- Building façades
- Advertising

Vegetative Cover

Mitigate unwanted light transfer from reflective surfaces.

Vegetation can reduce the reflective properties of paved surfaces.



Footcandles

The unit of measure of light falling on a given surface, equal to one lumen/sf. Footcandle levels can be dramatically reduced when careful attention is paid to control glare and provide uniform lighting levels. *Tips for Reducing Footcandle Levels*

- Install two light fixtures with lower footcandle levels and effective glare control instead of a single light fixture with higher footcandle levels.
- Design for the lowest lighting levels consistent with the project performance requirements.

Glare

Significant difference in light levels between light source and surroundings. Glare causes discomfort, annoyance, and loss of visibility for drivers, cyclists and pedestrians. The human eye experiences a period of adjustment called "transient adaptation" in response to extreme differences in light levels. During the period of adjustment, the eye temporarily experiences poor visibility until it acclimates to the new light conditions.

Everyone has experienced glare while driving a car or walking towards a light source when they are temporarily blinded. Glare is an annoyance – it creates unsafe conditions for people and makes buildings less secure. Uneven glare producing light sources also create shadows that can obscure undesirable activities.



Strategies: Energy-Efficient Lighting

Select energy-efficient, full cut-off lamps that provide appropriate levels of illumination.

Lamp types identified below can provide adequate and safe light levels while reducing energy use and addressing problems of over-illumination and glare.

Energy-Efficient Fixtures

- ENERGY STAR Qualified LED Lamps
- Low-pressure sodium lamps
- Supplement with metal halide or fluorescent lamps to improve color rendering characteristics

Mercury Vapor

The mercury vapor yard light is a common example of a poorly designed lighting fixture. These fixtures are generally multi-directional and illuminate both intended and unintended surfaces, resulting in wasted energy and light pollution. They are typically operated with a photocell sensor to turn them on at dusk and off at dawn. The long nightly operating period results in annual energy costs that on average are double the fixture's first cost.

LED Lamps and ENERGY STAR

LED lamps use multiple light-emitting diodes as their light source. These lamps produce very little

Full Cut-Off Fixtures

For full cut-off fixtures, zero candela intensity occurs at or above a 90° angle. Additionally, the candela per 1,000 lamp lumens does not numerically exceed 100 (10 percent) at or above a vertical angle of 80° above nadir. This applies to all lateral angles around the luminaires.

The Illuminating Engineering Society of North America (IESNA) recommends installing full cut-off fixtures to minimize light pollution. Manufacturers independently certify full cut-off fixtures through third-party certifiers. The International Dark-Sky Association (IDA) is a third-party certifier of fixtures. Their fixture seal of approval is awarded to fixtures with no light trespass above 90 degrees. By installing all full cut-off fixtures, projects can improve their ability to achieve credits associated with reducing light pollution under both LEED 2009 and AEGB 2010 rating systems.

Manufacturers and fixtures that have obtained the IDA fixture seal of approval can be found on the IDA fixture seal of approval site.



heat and are mercury-free. High performance LED lamps can last longer and use less energy than typical incandescent, fluorescent, and high intensity discharge lamps. ENERGY STAR-qualified LED lamps meet strict criteria for energy efficiency, lamp life, and manufacturer warranty.

Strategies: Operations

Timers & Motion Sensors

Timers and motion sensors conserve energy.

Exterior lighting can be managed by manual or automatic controls. Specify timers or infrared sensors to illuminate particular areas for specific time periods or when movement is detected.

Align Lighting Fixtures

Correctly align lighting fixtures during maintenance for proper illumination.

Re-align lighting fixtures during regular maintenance to accurately target the illumination and avoid glare and light trespass.

Action Items

- Adjust fixtures during installation and maintenance to direct light towards the intended target.
- Specify light fixtures with the highest level of energy efficiency and longest lamp life.
- Install low-mercury or mercury-free lamps. See *Creating Green Buildings* section for additional information.
- Install timers and motion sensors to limit lighting to specific times when needed.



Digital image modeling light pollution in the U.S., based on 1990 census data.

Creating Green Buildings

Green building is an integrated, systems design approach that has its roots in the energy crisis of the 1970s. Energy performance was a singular defining factor of environmentally responsive buildings during those years. By the late 1990s and early 2000s, the practice was expanded to include a broader range of design and operational considerations including location, water, materials, environmental quality, social equity and human health. The term 'green building' is used interchangeably with 'sustainable' and 'high performance' building. The approach integrates healthy, cost effective, environmentally and socially responsible strategies into building design, construction, and operations.

Green building professionals often combine highand low-tech strategies, such as coupling photovoltaic panels with natural ventilation, to create comfortable and energy efficient indoor environments. Similarly, a rainwater harvesting system combined with a lowwater landscape design creates opportunities to reduce or eliminate the use of potable water. In this way, 'green building' or 'high performance building' refers to thoughtful, innovative and integrated design strategies that work with nature's cycles to maximize building performance and enhance human health and well-being.

Austin has a long-standing commitment to green building, and is acknowledged as having the first green building program in the world. Mueller is similarly heralded for its green building leadership. From its inception, Mueller established green building certification as a requirement for residential and commercial buildings; at the development scale, it is one of a select group of participants in the U.S. Green Building Council's LEED for Neighborhood Development Pilot Program, and on track for final certification.

Mueller offers numerous opportunities to pursue green building. The previous three Green Urbanism signature themes – *Protecting Air Quality, Urban Heat Island Effect,* and *Protecting the Night Sky* – address issues that affect site and community.



Image courtesy of Austin Ei

MUELLER

The *Creating Green Buildings* signature theme covers five general strategies for designing, constructing, and operating green buildings:

- Climatic Design
- Materials Selection
- Energy & Atmosphere
- Water
- Construction & Operations

Punch List

Climatic Design

- Building orientation
- Appropriate shading and access to breeze
- Daylighting

Materials

- Low-emitting materials
- Rapidly renewable materials
- Low embodied energy/carbon neutral materials
- Recycled content and recyclable materials
- Sustainably harvested wood
- Salvaged/refurbished materials

Energy & Atmosphere

- Energy efficient design and high performance mechanical equipment, lighting and glazing
- Renewable energy systems
- Non-ozone depleting HVAC refrigerants and fire suppressants
- Combined heat and power plant

Water

- Low-flow toilets, urinals, faucets, showerheads
- Rainwater harvesting
- Reclaimed water
- Efficient irrigation equipment
- Native and non-invasive adapted plant species

Construction & Operations

- Construction waste management
- Tree preservation and protection
- Construction site boundaries
- Commissioning and continuous commissioning
- Operations/users manual
- Sustainable purchasing



Climate Change

Over the last 250 years, the burning of fossil fuels has altered the Earth's atmospheric composition by increasing the concentration of carbon dioxide and other greenhouse gases (GHGs). This has raised global temperatures, contributing to accelerated melting of polar ice caps and rising sea levels resulting in a global condition commonly referred to as climate change. Climate change is also associated with increasing intensity and frequency of calamitous weather events including hurricanes, tornadoes, extreme drought and excessive precipitation.

In 2011, Austin experienced the most severe oneyear drought on record, with more than 90 days of temperatures at or above 100°F and the hottest August in Texas' history. This global pattern of changing weather conditions puts ecosystems, wildlife and future generations at risk.







Climatic Design is the integrated optimization of building orientation, envelope, thermal and comfort strategies in response to local climatic and site conditions.

A building's heating, cooling and ventilation loads can be reduced by taking advantage of a site's climatic resources including solar energy, shade, and breeze. For example, daylighting can offset electrical lighting costs, and shade and natural ventilation can reduce a building's cooling load.

Building Orientation

Optimal orientation enables a building to take advantage of sun, breeze and shade.

Summer heat is the dominant climatic design consideration in Central Texas. Orienting buildings along an east-west axis takes advantage of climatic resources during both summer and winter months. To mitigate hot temperatures during summer months, designers should minimize solar gain and maximize natural ventilation, daylight and shade. During winter months when the sun is lower, southern exposures can benefit from passive solar heat gain. An east-west orientation can also benefit access to daylight.

Action Items

- Orient the building along an east-west axis to:
 Capture natural light and the sun's heat during winter months.
- Provide shade to prevent direct solar heat gain during summer months.
- Direct breezes to provide natural ventilation and moderate temperatures during summer months.



To maximize breeze, daylighting, and photovoltaic collection, and to minimize heat gain, a detached dwelling should be oriented within 30 degrees of true south.

Texas Dogtrot

Designed to take advantage of prevailing breezes, the classic Texas Dogtrot floorplan provides for an open breezeway or 'dogtrot' in the center of the building for the air to pass through, providing cooling breezes to the building's interior spaces.



The Dogtrot that separates the two wings of the Advanced Green Builder Demonstration building allows cool air to flow.

Shade

Use vegetation and architectural features to shade buildings' east, south and west façades.

Shade is one of the most effective strategies to temper heat gain from the hot summer sun.

Action Items

- Construct arcades, pergolas and trellises.
- Strategically locate vines, shrubs and trees.
- Install interior and exterior shade devices and properly sized and oriented building overhangs.

Daylighting

Daylighting takes advantage of sunlight to illuminate interior spaces.

Properly designed daylighting systems can reduce energy use and heat gain from electric lighting fixtures.

Action Items

- Maximize north-facing windows.
- Design rooms so daylight enters high and from at least two sides.
- Install vision glazing to complement the higher positioned daylight glazing.
- Install interior and exterior light shelves to bounce light deep into interior spaces.
- Have light-colored interior walls and ceilings to reflect light.



Properly designed daylighting reduces glare and heat gain while projecting diffuse daylight deep into a building's interior.

Materials

Building materials represent a significant financial investment and influence environmental quality and health. Look for a combination of the following attributes when specifying green building materials:

- Non-toxic, low-emitting
- Low embodied energy
- Renewable resources
- Sustainably harvested wood
- High recycled content
- Regionally sourced/manufactured
- Low-maintenance
- Recyclable, reusable, biodegradable
- Long-lasting, durable

Material Life Cycle

When choosing materials and products, consider life cycle factors such as maintenance, durability, and end-of-life recycling, reuse, biodegradability and safe disposal options.

Select durable, low-maintenance materials to create financial savings and reduce embodied energy over the life of a building. In addition, salvage, reuse, and recycling of building materials can be facilitated at the end of a building's life by specifying recyclable and reusable materials and designing for disassembly and reuse.

Low Embodied Energy

Avoid materials that require energy-intensive manufacturing practices and are transported long distances.

Embodied energy is the amount of energy used to extract, manufacture, and transport a building material. High embodied energy materials contribute proportionally higher CO_2 emissions than materials with low embodied energy. This reflects their dependence on energy intensive manufacturing processes and transportation (due to the mode of transport and distance traveled) that rely on burning fossil fuels. CO_2 releases resulting from manufacturing and transportation practices are significant contributors to global climate change.

Persistent Bioaccumulative Toxic Chemicals

Toxic chemicals that accumulate in organisms high in the food chain and do not break down.

The U.S. EPA defines persistent bioaccumulative toxic (PBT) chemicals as chemicals of concern because they are highly toxic, do not break down easily in the environment, and accumulate in living tissues. PBTs commonly linked to building materials include:

- Lead used as a stabilizer in roof flashing and in some PVC products and solders.
- Dioxin, released as a by-product of vinyl chloride monomer manufacture – a feedstock of PVC – and released as a consequence of accidental or intentional combustion of PVC and other halogenated organic compounds.
- Mercury, used in electrical switches, thermostats, relays and fluorescent lamps.

The U.S. Environmental Protection Agency's concern about PBTs is shared by the Stockholm Convention on Persistent Organic Pollutants (POPs), a global treaty signed by 151 nations, including the U.S., intended to protect human health and the environment related to exposure to persistent organic pollutants. Because of the significant and prolonged environmental and human health burdens, PBTs represent priority chemicals to avoid in building materials when more benign alternatives of equal or better performance are available and competitively priced.

Low-Emitting Materials

Specify low-emitting, non-toxic materials to improve air quality and human health.

Specifying materials with no- or low-volatile organic compounds and other toxic chemicals creates conditions for healthy indoor and outdoor air. Avoiding these chemicals can also reduce formation of ground level ozone (smog). See Low Emitting Materials tables on page 29 for further information.

Rapidly Renewable

Specify materials with a maximum 10-year growth-harvest cycle.

Rapidly renewable materials such as cork, bamboo, cotton, straw, and natural linoleum have short regeneration cycles that can limit some impacts associated with growth and harvesting practices. Rapidly renewable materials are biodegradable and often require less energy to manufacture than non-rapidly renewable materials.

Straw bale construction takes advantage of a rapidly renewable material readily available in Texas. Straw, a by-product of grain production, is insulative with varying R-values depending on the thickness of the bales or panels used. Straw is appropriate for both structural and non-structural applications. Straw and other agrifiber materials have also been used as replacements for engineered wood products such as medium-density fiberboard, particleboard and door cores. These are competitively priced and meet or exceed typical performance requirements for engineered wood products.

Table 3.6 - Examples of Rapidly Renewable Materials

	Building Product	Rapidly Renewable Material(s)
	Flooring	Bamboo Natural Linoleum Cork Wool Carpeting Natural fiber rugs
	Panels and Partitions	Sunflower seed Bamboo Straw
	Cabinetry and Casework	Wheatboard Strawboard Soybean Composite Bamboo
	Insulation	Strawbale Cotton Soy-based foam

FSC Certified Wood

Support sustainably managed forests by specifying FSC certified wood.

Forest Stewardship Council (FSC) is an international network that promotes environmentally appropriate, socially beneficial, and economically viable management of the world's forests.

Both LEED and AEGB recognize FSC as the reference standard for wood-related credits. While FSC does not certify forest operations or manufacturers, it accredits certification organizations aligned with FSC policies and standards.

An FSC Chain of Custody certificate ensures compliance with FSC standards, from extraction of raw materials from the forest through to final product manufacture.

Table 3.7 - Central Texas FSC Certified Wood Suppliers

Company	City/Phone/Website	Products	Required Notification	Other Information
Austin Lumber Company	Austin 512.476.5534 www.austinlumber.com	Lumber, MDF/HDF/LDF, panel products, plywood.	4 – 6 weeks.	Deposit required: ½ down at time of order.
Brazos Forest Products	Austin 800.777.7712 www.brazosfp.com	Industrial hardwood lumber, plywood, mouldings, panels, hardwood & softwood.	Free next day delivery, orders must be in by 3pm.	\$300 minimum for delivery.
Dixie Plywood	San Antonio 800.284.0089 www.dixieply.com/sanantonio	Plywood, hardboard, lumber, fire retardant wood, mdf, particle board.	Variable (4-8 weeks).	Wholesale only, must have account with company.
Home Depot	Austin, various locations www.homedepot.com	Varies by store.	Next day delivery, orders must by in by 3 pm.	
Mason's Mill and Lumber	Austin 512.295.3000 http://www.masons millandlumber.com/	Lumber, plywood, custom millwork.	Next day delivery, orders must be in by 3:30 pm.	\$50 delivery fee for orders less than \$500.
Roddis Lumber and Veneer Co.	San Antonio 800.292.5672 roddislumber.com	Hardwood plywood, framing lumber, dimensional lumber, mdf, particle board, laminates.	Delivers to Austin area. Lead time between 6 – 8 weeks, varies depending on products ordered.	\$500 minimum for delivery. 50% deposit required with no account.
Treehouse	Austin 512.867.0712 www.treehouseonline.com	Flooring, MDF and plywood. Some flooring in stock, all oth products require special order	Varies by manufacturer. er	Order minimum and freight shipping cost vary by manufacturer.

Recycled Content

Conserve natural resources and specify materials with high recycled content.

A spectrum of commonly available building materials such as glass, drywall, plastics, metals, composite wood, and many others are manufactured with recycled content. Products with high post-consumer recycled content take advantage of materials that have been reclaimed from the consumer waste stream rather than from the factory floor (referred to as pre-consumer recycled content). See Table 3.8 for examples of recycled content building products.

Recycled Content

Post-Consumer - Content that was recycled after passing through the consumer waste stream, such as: aluminum cans converted into aluminum siding; old newsprint converted into cellulose insulation.

Pre-Consumer - Content that was recycled after passing through the manufacturing process, such as: wood chips converted into medium density fiberboard and plywood.

Fly Ash Cement

The process of manufacturing Portland cement – a key ingredient in standard concrete mixes typically representing from 10% to 15% of raw materials – is energy intensive and responsible for about 6% of global carbon dioxide (CO_2) emissions, a precursor of global warming. Substituting fly ash (a by-product from coal-burning power plants) for a calculated percentage of Portland cement lowers concrete's embodied energy and carbon dioxide footprint while utilizing an abundant waste product. Many ready-mix concrete suppliers in Austin provide high volume fly ash concrete mixes in the range of 25% to 50% and even higher.

Table 3.8 – Examples of Recycled Content Building Products

Product	Recycled Content Materials
Road Base	Glass, Concrete, Asphalt
Cement	Fly Ash
Fiberglass Insulation	Glass
Cellulose Insulation	Newsprint
Steel Framing	Steel
Carpet	Nylon Fiber
Plastic Lumber	Plastic, Recycled Wood
Clay Brick	Bottom Ash, Fly Ash
Composite Panels	Wood Fiber, Straw
Gypsum Wallboard	Synthetic Gypsum, Kraft paper backing

Salvaged/Refurbished

Conserve natural resources and save money by using existing or salvaged building materials, fixtures and furniture.

Using salvaged or refurbished building products diverts these items from the waste stream and reduces adverse impacts associated with producing new materials from virgin resources. Material reuse can range from retaining a previously existing building shell to specifying salvaged finish materials, fixtures and furniture.

While it is tempting to outfit new buildings with brand new furniture and fixtures, an increasing number of suppliers offer lightly used products at substantially discounted prices. This is particularly true for office furniture such as chairs, desks, cubicles, tables, and shelving.

For more information:

The Design for Reuse Primer by Public Architecture: www.publicarchitecture.org/reuse/pdf/ Primer-Online.pdf.

Planet ReUse: www.planetreuse.com.

Table 3.9 – Salvaged Materials Resources

Resource	Materials
Austin Habitat for Humanity ReStore 310 Comal Street Austin, TX 78702 www.re-store.com 512.478.2165	Lumber, tiles, hardware, stoves, toilets, doors, windows, etc.
Backyard Salvage and Garden 111 E. Koenig Lane Austin, TX 78751 512.537.2974	Receives salvaged materials from DAR Demolition. Materials vary – includes flooring, doors, windows, lumber, siding, appliances, brick, etc.
TOPS Texas Office Products & Supply 2307 Kramer Lane Austin, Texas 78758 512.833.7777	Office Furniture
Planet Reuse Marketplace www.planetreuse.com/marketplace	Salvaged material consultancy and brokerage. Marketplace connects purchasers with regional reuse centers that sell used building products and materials.



Energy & Atmosphere

Mechanical equipment and systems can be complex, particularly in commercial buildings. Austin's challenging hot, humid climate can complicate system design. Designers are encouraged to combine climatic design principles with energy modeling software to estimate building cooling and heating loads to properly size mechanical equipment. In the U.S. buildings consume about 49% of energy produced and account for about 47% of CO₂ emissions. Concerns about climate change highlight the importance of ecoBalanced,¹ carbon neutral buildings.

Energy Efficiency

Comply with ASHRAE Standard 90.1-2007 as a first step to conserve energy.

LEED 2009 requires compliance with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Energy Standard 90.1-2007. For projects registered after June 26, 2007, LEED requires a minimum 10% energy reduction in new buildings. Austin Energy Green Building (AEGB) requires a 7.5% improvement over the same standard.²

Action Items

■ Minimize HVAC load with a high performance building envelope and "right size" based on appropriate ton per square foot ratio (for example, 1 ton AC/600 square feet).

- Use ASHRAE 90.1-2007 lighting tables to guide lamp purchasing.
- Incorporate daylighting and light sensor controls, complemented with task lighting, to offset lighting load.
- Apply for applicable local, state, and federal rebates and incentives (see Chapter 5) to assist with energy efficiency measures.

¹ EcoBalance[™] is a sustainable land use planning and design methodology that uses life cycles as the framework to sustain basic life support systems of air, water, food, energy, materials, and balance as the underlying performance metric.

² ASHRAE Standard 90.1 is regularly updated. Refer to LEED and AEGB reference documents for current requirements.

Carbon Neutral

Carbon neutral is defined as "pertaining to or having achieved a state in which the net amount of carbon dioxide or other carbon compounds emitted into the atmosphere is reduced to zero because it is balanced by actions to reduce or offset these emissions." Buildings can achieve carbon neutrality through their design and operations by relying on passive solar and climatic design strategies and renewable energy technologies to offset reliance on carbon dioxide emitting fossil fuels.



Table 3.10 - Energy Performance Modeling Tools

Tool	Website/Information
E-Quest	Free software available at www.doe2.com
Trace 700	www.trane.com/Commercial/Dna/View. aspx?i=1136
REM/Rate	Residential energy analysis: www.archenergy.com/products/remrate
Energy Plus	www.apps1.eere.energy.gov/buildings/ energyplus

Occupancy Sensors

Occupancy sensors turn lights off after a designated time interval when a space is unoccupied.

Occupancy or motion sensors are inexpensive devices that can easily be installed for indoor and outdoor applications and are especially appropriate for rooms that are intermittently occupied. A California Energy Commission study estimated that typical energy savings from installed occupancy sensors range from 35-45%.

Occupancy sensors can be calibrated with daylight sensors to dim and brighten lights in response to available daylight.

Recommended Rooms for Occupancy Sensor Installations:

- Conference rooms
- Bathrooms
- Closets/storage
- Private offices

Pecan Street, Inc.

Austin's Pecan Street Inc., established in 2008, is an innovative research and development organization with a mission to "...reimagine Austin's energy distribution system in a way that could support and accelerate the installation and management of smarter and cleaner electricity services." The organization supports the development of "Smart Grids," electrical grids that digitally monitor energy consumption, to better inform both consumers and producers and encourage more efficient energy use. Its premiere research effort, the Pecan Street Demonstration, focuses on a clean energy smart grid demonstration project at Mueller, supported by \$10.4 million in funding from the U.S. Department of Energy, in addition to more than \$14 million provided by project partners: The University of Texas, the National Renewable Energy Laboratory and Environmental Defense Fund.

Pecan Street Inc.'s smart grid demonstration will engage up to 1,000 homes and 75 businesses in and around Mueller in multiple ways including:

- Distributed clean energy
- Energy storage technologies
- Smart appliances
- Plug-in electric vehicles
- Advanced meters and home energy management systems
- Green building
- New electricity pricing models

In addition, Pecan Street Inc. is building the Pike Powers Commercialization Lab at Mueller. Designed to be the first nonprofit smart grid research lab, its mission is to promote research, commercialization and educational opportunities for students and faculty from the University of Texas and start-up companies from UT's Austin Technology Incubator. Opening is scheduled for late 2012.

For more information, contact Cate Smithson at csmithson@pecanstreet.org.

Information source: www.pecanstreet.org.



Installing photovoltaic panels.

61

Renewable Energy

Lower dependence on grid-supplied energy by installing renewable energy infrastructure.

Install renewable energy systems such as photovoltaics and solar water heaters on to residential, commercial and institutional buildings. Austin Energy offers rebates for incorporating these strategies into commercial and residential projects, and the federal government provides tax incentives. See Chapter 5 for available rebates and incentives.

Solar Water Heaters

With about 300 sunny days per year, Austin is well positioned to take advantage of solar water heating technology. Depending on the size and type of system installed, solar heated water can effectively and economically fulfill a high percentage of a building's hot water needs.

Solar hot water systems vary depending on the type of collector and storage tank. The three main types of collectors are batch, flat plate, and evacuated tube. Commercial and residential projects should consult the Mueller Design Guidelines prior to choosing a collector and system design to ensure compliance. Refer to Austin Energy's rebate program and federal incentive requirements for financial assistance. See Chapter 5 for additional rebate and incentive information.

ENERGY STAR

Space heating and cooling and water heating equipment comprise 60% of residential energy use. Appliances account for an additional 13% of energy consumption. The U.S. Environmental Protection Agency's ENERGY STAR program provides guidance for selecting appropriate, energy efficient equipment. ENERGY STAR rated products carry a yellow Energy Guide label that provides a comparison between similar products. Other ENERGY STAR labeled products include light bulbs, fans, office equipment and electronics. Selecting products with the ENERGY STAR label and choosing those with the best energy performance based on the ENERGY STAR label information is a simple way to save on utility costs and reduce CO_2 emissions.

www.energystar.gov

Renewable Energy

Sustainable energy sources such as solar, wind, and biomass that reduce dependence on fossil fuels and associated emissions.



Passive water heating systems such as this thermosiphon system use natural convection or household water pressure to circulate water. Image courtesy of SustainableSources.com

Renewable Energy Certificates

Offset CO_2 emissions by purchasing Renewable Energy Certificates (RECs).

Carbon emissions associated with car or air travel may be offset by purchasing Renewable Energy Certificates. Each credit purchased ensures 1,000 kWhs of green energy will be added to the electrical grid. The renewable energy credits offset CO_2 releases, increase consumer demand and encourage development of more renewable energy sources.



Austin Energy GreenChoice®

Austin Energy (AE) customers can choose electricity generated from clean, renewable sources. The green power that flows into the AE grid reduces pollution and curbs reliance on non-renewable fuels that can experience volatile price swings. GreenChoice is one of the most successful utility-sponsored green power programs in the nation with over 875 million kWh in subscriptions as of April 2012.

Program Details – Austin Energy receives green power from six wind turbines in west Texas as of this writing.

Subscription Information – GreenChoice is available for new subscribers as of this writing (Batch 6), and is available at a rate of 5.7 cents per kWh fixed until December 31, 2021. The fixed rate buffers consumers from price fluctuations associated with grid energy rates over the life of the contract. For the average residential customer consuming 1,000 kWhs per month, the GreenChoice rate would increase utility bills by about \$21/month relative to current conventional residential grid energy rates.

Contact Information

Austin Energy Green Choice Program: (512) 974-7827

green.choice@austinenergy.com

www.austinenergy.com/Energy Efficiency/Programs/ Green Choice/



Non-Ozone Depleting Refrigerants/Fire Suppressants

Mitigate ozone depletion by avoiding CFC/HCFC refrigerants and halons.

Some chemicals used for refrigerants and fire suppression such as CFCs, HCFCs, and halons contribute to stratospheric ozone depletion. The thinning of the ozone layer increases people's exposure to cancer-causing ultra-violet rays. CFCs are prohibited in aerosol cans and new equipment. Ozone-friendly options are available for most air conditioning, refrigerant and fire suppression applications. HFCs have lower ozone depletion potential but higher global warming potential than HCFCs.

Table 3.11 – Relative Atmospheric Impacts of Common Refrigerants and Fire Suppressing Chemicals

Chemical Type	Ozone Depletion Potential	Global Warming Potential
CFCs	Very High	Very High
HCFCs	Low	Low to Moderate
HFCs	Very Low	Moderate to High
Halons	Very High	Low

Source: US Green Building Council. LEED Reference Guide for Green Building Design and Construction, 2009 Edition, EAc4 - Enhanced Refrigerant Management.

Mueller Energy Center

Austin Energy constructed an on-site district Combined Heat and Power (CHP) plant located adjacent to the Dell Children's Medical Center of Central Texas. The plant produces electricity, steam and chilled water to meet the needs of the hospital, and provides extra chilled water capacity to meet the air conditioning and de-humidification needs of some commercial and multi-family developments in Mueller's Northwest Quadrant and the Town Center. Chilled water is distributed via underground pipes installed along Barbara Jordan Boulevard and Mueller Boulevard.

By operating at more than 60% efficiency, the Mueller Energy Center substantially reduces greenhouse gas (i.e., carbon dioxide) and other chemical and particulate emissions associated with fossil fuel combustion. It also provides price stability in a volatile energy market. For buildings connected to the CHP, this positive environmental impact contributes to achieving LEED and Austin Energy Green Building energy-related points. The CHP plant provides superior reliability when compared to conventional energy systems, is continuously monitored and enables new construction projects that tie-in to eliminate building-specific installed mechanical equipment.

Contact Information

Austin Energy District Energy Services: 512-322-6559



Water

Reducing potable water consumption relieves demand on water treatment plants saving money, energy and natural resources.

Low-Flow Plumbing Fixtures

Conserve water and save money by installing low-flow plumbing fixtures.

Amendments to City of Austin Plumbing Code effective October 1, 2010, mandate that all single- and multi-family residential, commercial and institutional building projects install plumbing fixtures that meet the current Uniform Plumbing Code with Austin Amendments, as displayed in Table 3.12

Rainwater Harvesting

Capture and store rainwater on-site to offset reliance on municipally-treated potable water.

The Austin area receives on average 32 inches of rain per year. The 2009 and 2011 historic droughts have stressed native plants and trees and highlighted the importance of taking full advantage of the rainfall for highest and best use. Capturing rainwater for irrigation and indoor uses is a historic practice in Central Texas that has gained popularity in recent years.

Rainwater may be captured in barrels or cisterns, underground storage tanks, or detention ponds. When used as 'graywater' for non-potable uses such as irrigation, clothes washing, and toilet flushing, the

Table 3.12 – Uniform Plumbing Code with Austin Amendments





Rainwater harvesting lifecycle. Image courtesy of Dan Overbey

captured rainwater passes through a particulate filter prior to use. Further filtration and purification, such as an ultraviolet (UV) lamp, is advised for rainwater used for drinking and cooking.

Action Items

- Determine the available collection area (typically a roof or parking surface).
- Multiply the collection area by Austin's average annual rainfall (32") to determine potential supply. It is recommended that projects adjust calculations to account for lower annual rainfall amounts.

- Determine annual water demand to right-size the storage containers.
- Install high-efficiency irrigation and other plumbing fixtures to reduce water consumption.

Rules of Thumb

- One hundred square feet of roof area results in 60 gallons of water collected per inch of rain.
- One gallon of storage costs about \$1-\$2 of system cost for residential systems.

Graywater Reuse

Reduce reliance on municipal potable water in certain applications by installing permitted graywater reuse system.

The City of Austin allows graywater reuse systems for commercial, multi- and single-family residential applications. The requirements are established in the 2009 Universal Plumbing Code (UPC) with Austin amendments adopted in October 2011.

The 2009 UPC differentiates between "domestic" systems installed in residential projects and "commercial, industrial and institutional" systems. All systems installed within the City of Austin must be designed by a licensed engineer and permitted by the City's Planning and Development Review Department. Any system larger than 400 gallon per day capacity is also required to obtain a water discharge permit from the Texas Commission on Environmental Quality.

Graywater Working Group

In January 2012, Austin City Council convened the Graywater Working Group charged with four tasks:

- The exploration of the feasibility of code amendments and make recommendations, inclusive of both retrofitting and new construction;
- 2. A permitting and approval process for graywater systems;
- 3. A technical guidance document, with recommendations for the *Environmental Criteria Manual*; and
- 4. A program for staff support of graywater systems, potentially housed in the Austin Green Building Program, including recommendations on trainings, resources, and incentives and/or rebates for participation.

The Graywater Working Group provided general recommendations for code amendments and permitting approval to City Council on June 30, 2012. These recommendations will be formalized into a technical and staff support guidance document by March 31, 2013.



Rainwater harvesting system at a Mueller home.

Residential systems are limited to the use of laundry, shower, and bathroom sink reuse for subsurface irrigation systems. Graywater may not collect, pool or come in contact with potable water systems. All other wastewater must be routed to the City wastewater system. Graywater from laundry must go to a holding tank prior to use. Other graywater may be used directly and immediately. All graywater not used within a 24-hour period must be drained directly to the City wastewater system. The use of hose bibs on reclaimed or other auxiliary water systems is prohibited with the exception of rainwater systems that are permanently labeled "Non-Potable Water."

• **Commercial systems** may use graywater for expanded uses including spray irrigation and interior toilet and urinal flush water. However, commercial systems are subject to stricter testing and treatment requirements than residential.

Projects considering installing graywater systems should contact the City of Austin Planning and Development Review Department for more information about the permitting process.

Contact Information:

City of Austin Planning and Development Review Department (512)974-7668 www.austintexas.gov/department/planning

Reclaimed Water (Purple Pipe)

To lessen dependence on municipally-treated potable water for non-potable uses, Austin Water Utility is constructing a "purple pipe" reclaimed water system with networks distributed throughout the City. Mueller is one of the first areas to have access to the reclaimed water service. Mains carrying the reclaimed 'purple pipe' water are installed along 51st Street, in the commercial and multifamily areas in Mueller's Northwest Quadrant, and through parts of the single-family development in Mueller's Southwest Quadrant. As construction continues at Mueller, mains will be installed in all of the development's major roads. The reclaimed water system serves as the primary source of irrigation water for Mueller's public open spaces and streetscapes and is available for residential and commercial uses throughout the development.

Contact Information Austin Water Utility: 512-972-0074 www.austintexas.gov/department/water



Map of the Reclaimed (Purple Pipe) System that runs through Mueller.

Efficient Irrigation

Conserve water and save money by installing efficient irrigation systems.

According to Austin Energy Green Building, outdoor watering represents about 38% of Austin's annual water use and more than 50% during summer months. Efficient and well-planned irrigation systems reduce run-off and erosion and prevent water contaminated by pollutants from entering streams and aquifer recharge zones.

During drought periods the City of Austin enacts water restrictions, placing increasing limitations on irrigation and watering based on the severity of the water shortage:

- Stage 1 Water Restrictions limit operation of irrigation systems to mornings and evenings and restrict irrigation to two days per week.
- Stage 2 Water Restrictions limit irrigation system operation to one day per week.
- Stage 3 Water Restrictions limit irrigation to hand watering one day per week.

Action Items

- Adhere to City of Austin water restrictions.
- Evaluate irrigation systems' efficiency and check for leaks and broken lines. (See Chapter 5 for information on City of Austin free irrigation audits.)
- Ensure irrigation systems are designed to only water landscape-not sidewalks or roads.

Austin Water Utility's Vegetable Garden Policy

Responding to Austin residents' interest in vegetable gardening and to support local food production, Austin Water developed alternative water use restrictions to support growing food producing plants in outdoor gardens. With a permit, residents have expanded days and hours when watering is allowed, providing flexibility to support healthy food producing gardens. For information and to request a permit, call 974-2199 or email watercon@austintexas.gov, or go to www.austintexas.gov/sites/default/files/files/ Water/Conservation/gardenpolicy.pdf.

Apply for Austin Water Alternative Compliance Application for Vegetable Gardening.

Contact Information

City of Austin Water Utility: 512-974-2199 http://www.austintexas.gov/department/ water-conservation Table 3.13 – Sample Approved Native and Adapted Plants*

Native	Non-Invasive Adapted
Red Buckeye	Crape Myrtle
Pecan	Drake Elm
Post Oak	Dwarf Yaupon
Texas Red Oak	Oleander
Texas Madrone	Rosemary
Texas Mountain Laurel	Butterfly Bush
Agave	Lantana
Agarita	Sedum
Prickly Pear Cactus	Pomegranate
Turks Cap	Mountain Sage

* For a more extensive list of native and non-invasive adapted plant species, refer to the Accepted Plant List in the Mueller Design Book.



Native and Adapted Landscaping

Reduce irrigation needs by planting native and adapted plants.

Native and adapted plant species, appropriate for Austin's climate and rainfall pattern, help reduce Mueller's landscape irrigation requirements. The *Mueller Design Book* describes minimum landscaping requirements for residential projects at Mueller³:

- Minimum 50% of the total plant material shall come from the suggested Native Plant List.
- 90% of the total plant material shall be native and adapted plants, from the *Mueller Design Book* Accepted Plant List. A sample of approved native and adapted plants from the Accepted Plant list can be found in Table 3.13 on page 68.
- Invasive plants listed in the Do Not Plant List are not allowed.

For irrigation related rebates available from the City of Austin, refer to Chapter 5.

Citizens Water Conservation Implementation Task Force

On August 5, 2009, the Austin City Council convened the Citizens Water Conservation Implementation Task Force (Citizens Task Force), with the goal of producing a policy document recommending water conservation measures to reduce water use within Austin. The Citizens Task Force's work enhanced on-going water conservation efforts established by the previous work of the Water Conservation Task Force created by City Council in 2006. The Citizens Task Force issued their final report, Water Conservation 2020: Strategic Recommendations, in March 2010. The Citizens Task Force recommended over 100 strategies with 25 strategies identified as "first tier" for further analysis. The recommendations include measures to be implemented in the near- and long-term.

City of Austin Citizens Task Force Recommendations:

- Limit outdoor irrigation system use to twice per week. Implement restriction year-round.
- Simplify and consolidate existing rebate programs to streamline and extend service.
- Amend Plumbing Code to facilitate air conditioner condensate use.

- Develop water efficiency criteria for new construction based on Austin Energy Green Building or similar standards.
- Provide and strategically market comprehensive retrofit packages to institutions such as universities with residential campuses, K-12 schools and hospitals.
- Provide and promote interior home water audits in conjunction with existing outdoor audits.
- Sub-meter and separately bill multi-family residences.
- Parks and Recreation Department should implement a robust conservation program for all water use.
- Retrofit all city facilities with efficient plumbing fixtures and appliances; install drought-tolerant landscapes and efficient irrigation systems.
- Support conservation programs with robust public education component.

For additional information, see the Citizens Task Force final report including the complete list of recommended strategies:

www.ci.austin.tx.us/water/conservation/downloads/ cwcitfpolicydocument_v10_march22_final.pdf.

³ Accepted native and adapted plant list available in the *Mueller Design Book*, <u>www.muelleraustin.com/the-plan/</u><u>design-guidelines</u>.

Construction & Operations

The long-term success and benefits of green buildings rely on diligent construction and operations procedures. A building designed with green features will realize long-term performance benefits only if it is properly built and operated. Particularly for commercial buildings, commissioning mechanical systems and envelope during construction and establishing a regimen of continuous commissioning during a building's operational phase is key to ensure long-term high performance.

During construction, implement strategies to maintain a safe and healthy building site:

- Construction indoor air quality management plan (see Protecting Air Quality section for more details).
- Construction waste recycling plan.
- Construction site boundary restrictions.
- Tree preservation and protection.

Construction Waste Management

Divert waste from landfills by recycling construction debris.

Diverting construction debris from landfills conserves natural resources, extends landfill life and can reduce project costs. Construction and demolition debris is estimated to comprise about 20% of Austin's municipal solid waste.

Recyclable Construction Debris:

- Concrete
- Cardboard
- Clean wood
- Gypsum drywall
- Steel
- Aluminum
- Paint

Construction Waste Management Plan

Austin Energy Green Building requires that Commercial, Multi- and Single-Family Residential projects recycle or salvage a minimum 50% (by weight) of construction debris. Projects in Austin have achieved construction waste diversion rates greater than 80%. Strategies that yield high diversion rates include:

- Establish clear waste reduction goals early in project.
- Establish a relationship with recycling service providers and/or markets for recyclables.
- Establish a clearly marked area for recycling containers.
- Train construction workers on which materials to recycle and how to sort them to avoid contamination of recyclables.

Table 3.14 – Construction Waste Management Providers

Waste Hauler	Construction, Demolition and Landclearing Debris Collection
Recon Services 512.894.4441	Construction and demolition debris
River City Rolloffs 512.832.8300	Wood, brush, concrete, metals, cardboard/paper, plastics, clean drywall
Texas Disposal Systems 512.421.1300	Commingled construction and demolition debris, clean drywall, clean wood, land clearing debris
Triad Building Maintenance and C&D Recycling 512.385.1189	Construction and demolition waste diversion consulting only – no hauling services.
Waste Management 512.272.6214	Comingled construction and demolition debris: metal, clean wood, clean drywall (limited quantities), concrete, asphalt, shingles, cardboard, paper

Construction Site Boundary

Reduce site impact and preserve existing vegetation by limiting construction activities to a specified distance from buildings and hardscape.

Construction activities and equipment can damage a site's natural ecology. During design phase, buildings should be sited to increase open space and preserve unique species and natural features. Although biodiversity and ecological processes can be recovered through post-development restoration, project teams can save time and money and protect ecological function by installing physical barriers such as chain link fencing to preserve open space and existing natural vegetation from potential damage during construction.

Tree Preservation and Protection

Preserve existing trees on the construction site by installing appropriate protection measures.

Create a tree preservation plan prior to construction, highlighting trees to be removed or retained and describing measures to prevent trees from damage by construction activities and equipment. Tree protection measures recommended by the City of Austin include chain link or wood fencing placed to protect the tree's critical root zone from compaction. Additional tree preservation code requirements can be found on the City of Austin <u>Arborist</u>. <u>Program site</u>.

Zero Waste

On World Environment Day in 2005 in San Francisco, former Austin Mayor Will Wynn signed the Urban Environmental Accords committing Austin to take action towards becoming a sustainable city. The accords include a focus on a global zero waste initiative directing cities to promote waste reduction and achieve zero waste by 2040.

In 2008, as a result of this commitment, the City of Austin passed a resolution adopting a Zero Waste Strategic Plan developed by Gary Liss & Associates. The Zero Waste Strategic Plan commits to the following goals:

20% reduction in per capita solid waste to landfills and incinerators by 2012

- 75% reduction of waste to landfills and incinerators by 2020
- 90% reduction of waste to landfills and incinerators by 2040

On December 15, 2011, Austin City Council unanimously approved Austin Resource Recovery's proposed Master Plan, identified as "...the road map to get us to Zero Waste." It sets a target to achieve zero waste (defined as reducing the amount of waste sent to landfills by 90%) by 2030, ten years ahead of the previous plan.

Austin Resource Recovery's Master Plan is available at Austin Public Library locations and <u>online</u>.


Operations

By planning ahead for sustainable building operations after construction has been completed, project teams and building owners can ensure positive sustainability measures for the lifetime of the building.

Implement the following strategies to create positive, high performance building operations:

- Commission the building's energy- and water-using systems and envelope.
- Create an operations manual for building occupants.
- Use low-emitting operations practices such as green housekeeping and integrated pest management (see Protecting Air Quality Section for more details).
- Create a sustainable purchasing plan that includes low mercury bulbs and recycled content office and housekeeping supplies.

Commissioning

Engage a third party commissioning agent to ensure that the building envelope, energy and water systems are installed correctly and perform according to the owner's project requirements.

The commissioning process improves the building's performance by identifying and correcting errors in systems installation, function, and use. A 2009 study by Lawrence Berkeley National Laboratory found that building commissioning projects resulted in 13 - 16% energy savings, with commissioning costs being paid back between 1.1 to 4.2 years of completion. Commissioning begins early in the building design process when the owner, design team and commissioning agent work together to develop and record the owner's project requirements and the basis of design. These documents include the owner's goals and priorities, system descriptions, environmental, energy and water efficiency criteria, and references to applicable codes and standards. From these documents, the commissioning agent will develop a plan that outlines the commissioning process including criteria, schedule, and final documentation requirements. The commissioning agent tracks contractor submittals, and verifies the installation and performance of the commissioned systems.

Commissioning projects can vary widely depending on scale and scope of the project, with the greatest savings achieved by more comprehensive commissioning. For example, for tenant improvement projects, commissioning activities can be adapted as appropriate to project scale and scope. To be effective, the commissioning process must, at minimum, address specific energy-related systems: HVAC, lighting and daylighting controls, domestic hot water, and renewable energy systems. Additional savings and benefits are gained when commissioning includes water-using systems and materials and systems related to the building envelope. Building envelope commissioning



verifies that building orientation, massing, glazing, envelope materials, and indoor air quality measures are designed, specified, and installed to meet the owner's requirements.

Continuous Commissioning

Basic commissioning activities are pursued only through installation and initial startup of the commissioned systems. Continuous commissioning engages the commissioning agent to review systems' performance at designated dates following building occupancy and extended use of the commissioned systems. Continuous commissioning activities provide the opportunity to confirm post-occupancy systems' performance, operator training, and occupant thermal comfort needs.

Operations Manual

Provide a roadmap to operate a green building.

Often, the team that designs and constructs the building is not the owner or final building occupant. While the design team may understand best practices for operating the building, the owner and occupants may not. To assist in the handoff, it is essential for the project delivery team to create a manual that describes building features and provides instructions on how to operate and maintain the building over time. If a building team undertakes commissioning, the operations manual may be a deliverable resulting from the commissioning process.

Sustainable Purchasing

Create a purchasing plan for the building and site that promotes a sustainable supply chain.

By adopting a plan for sustainable purchases of ongoing consumable materials used throughout the life of a building (such as paper towels and tissue, plastic trash can liners and office paper products), building owners and occupants can extend sustainability goals beyond construction completion. LEED Existing Building Operations and Maintenance (EBOM) identifies environmentally preferable product criteria to guide purchasing policies.

- Recycled content
- Regional content
- Rapidly renewable material
- FSC certified
- Rechargeable batteries
- ENERGY STAR certified products
- Corded electric or battery-operated equipment to replace gas-powered equipment
- Low-mercury or mercury-free lamps

Refer to EBOM prerequisite MRp1 and credits MRc1 – 4 for additional thresholds and recommendations related to LEED-recommended environmental criteria.

Low Mercury Lamps

Exposure to mercury can adversely affect human and environmental health. Mercury is present in many building products including linear and compact fluorescent lamps. If improperly handled, discarded mercury-containing fluorescent lamps can result in mercury releases into the environment with potential harm to people and wildlife through contamination of air, land, and water. Many manufacturers of fluorescent lamps offer products with reduced mercury content, while another alternative, LED (light emitting diode) lamps, are mercury-free and generally more energy efficient than fluorescent lamps.

CHAPTER 4

Green Building Case Studies









SINGLE-FAMILY RESIDENTIAL Taylor-Robertson Residence

Rating:

5-Star Austin Energy Residential Green Building

Owner/Architect Jim Robertson designed this 2,700 square foot home located adjacent to Mueller Lake Park for his family of four, with an emphasis on energy and water efficiency, green, low-emitting materials, and planning for installation of a solar photovoltaic (PV) array following initial construction. The three-bedroom, three-bathroom home achieved a 5-Star Austin Energy Green Builder Rating reflecting careful planning during the design and construction phases.

Building Orientation

The 0.12-acre lot has an east-west orientation enabling the house to take advantage of several climatic design opportunities. The roof has a long east-west axis that provides ideal solar access for installing south-facing photovoltaic panels to generate electricity. This long east-west axis also reduced solar heat gain by reducing the east- and west-facing facades. Further, the unconditioned garage is attached at the east side, providing a buffer that protects first floor living spaces from direct solar heat gain. The west side of the home takes advantage of expansive views of Mueller Lake Park with generously sized windows, while protecting those windows from excessive solar heat gain by using a recessed, shaded porch on the ground floor and substantial windowspecific overhangs on the second floor.

Project Team

Owner/Architect: Jim Robertson General Contractor: The Muskin Company Solar Photovoltaic Installer: Lighthouse Solar Completion Date: September 2010



The Taylor-Robertson residence.

Solar Photovoltaics

South-facing solar access is an important consideration when planning to install photovoltaic (PV) panels. Although PV panels were not installed during the home's initial construction, Robertson's goal was to add PV at a later date. With financial support from Austin Energy's Solar Rebate program and additional financial incentives provided by the non-profit Pecan Street Project, Lighthouse Solar was contracted to install a 6.3 kW photovoltaic system, the maximum size allowed by the rebate program at the time. Many of the measures taken during the initial design and construction paved the way for the PV installation. In addition to a long expanse of south-facing roof, the roof pitch of 30% (7:12 pitch) was designed to maximize PV electrical generation. Robertson also worked with the contractor, The Muskin Company, to ensure that all roof penetrations - such as plumbing vents - were located on the north side of the roof. This created an opportunity for a simple PV system design, with no roof obstructions to break up the placement of the panels. The home's standing seam metal roof enabled solar technicians to reduce roof penetrations by using clips to attach the PV racks to the roof's ridges. Only one roof penetration was necessary to install the entire PV array.



Technicians install solar panels on the Taylor-Robertson home

Energy Efficiency

Energy efficiency measures in the Taylor-Robertson home span design and materials decisions. The home's long east-west axis and strategic window placement on the north and south walls allows ample daylight while minimizing direct sun intrusion, reducing energy use associated with electrical lighting during the day. Substantial overhangs (typically 36") along the roof's perimeter shield windows from direct solar heat gain during summer months, minimizing mechanical cooling and associated energy use and cost.

All appliances in the home are ENERGY STAR compliant, and compact fluorescent light bulbs are used in the majority of the home's light fixtures. Open cell sprayed foam insulates the home's walls (R-13) and roof (R-19) and seals the building envelope from unwanted air infiltration. Insulation installed at the attic rafters provides a semiconditioned space to house the HVAC ductwork, increasing system efficiency. Additional buffering of the attic space is provided by the solar panels, which shade a substantial portion of the roof.

An added bonus of the photovoltaic system was the ability to view home energy use and PV energy production in real time. This enables the Taylor-Robertson Family to make informed lifestyle adjustments – particularly in their use of electricity – to enhance energy efficiency and home performance. During the winter months, the PV array can generate more electricity than the family consumes. On an annual basis, the system is anticipated to produce about two-thirds of the electricity needed to power the home. By specifying electrical HVAC and appliances, the Taylor-Robertsons are able to take full advantage of the electricity produced by their PV array.

Water Efficiency

The landscaping was designed with water efficiency in mind, limiting the amount of turfgrass and selecting only native and drought tolerant plant species.

Green and Healthy Materials

With an interest to create an indoor environment with healthy air quality, low-emitting finish materials are installed throughout the home including:

- Flooring throughout the entire first floor is the exposed concrete slab, which was smooth-finished and stained.
- The limited amount of carpet installed on the second floor meets the Carpet and Rug Institute's Green Label certification standards.
- Kitchen cabinetry uses urea-formaldehyde free composite wood products.
- Low VOC paints and finishes were applied throughout.



Native species planted around the house help maximize water efficiency

Single-Family Residential David Weekley Homes – Yard, Garden, and Attached Homes

Ratings:

3-Star Austin Energy Residential Green Building Energy Star 3.0 qualified Environments for Living Platinum certification

David Weekley Homes is one of the production scale residential builders participating in single-family residential development at Mueller. During Mueller's first three residential construction phases, David Weekley Homes constructed approximately 350 homes, with an additional 73 homes planned for the fourth phase. David Weekley Homes' completed and planned construction at Mueller consists of three types of homes – Yard, Garden, and Attached – that vary in size and lay-out.

All David Weekley Homes at Mueller achieve a minimum 3-Star Austin Energy Green Builder Rating in addition to being ENERGY STAR qualified and Environments for Living certified. Design and construction are approached with a focus on energy and water efficiency, long-term performance, and homeowner education.

Energy Efficiency

All David Weekley Homes at Mueller are ENERGY STAR qualified. They are outfitted with high efficiency, 16 SEER air conditioning systems that exceed the air conditioning efficiency requirements of both ENERGY STAR and Austin Energy Green Builder. Programmable thermostats provided in each home

Project Team David Weekley Homes



David Weekley Homes

include an option to participate in the Austin Energy Power Saver program which allows Austin Energy to coordinate home air conditioning cycles to save power on days when electricity peak demand is highest. Appliances and ceiling fans are ENERGY STAR certified, and the majority of light fixtures are fitted with ENERGY STAR certified compact fluorescent lamps.

The homes are insulated with R-19 batts and R-2 sheathing in the walls, and R-22 or R-38 insulation in ceilings depending on the ceiling slope. Insulation is installed to ENERGY STAR Grade 1 requirements by fitting batts to fill cavities between wall studs snugly, without gaps or compression. Insulation undergoes multiple inspections to ensure that it meets ENERGY STAR and AEGB installation requirements. The homes' roof decking includes a radiant barrier to reduce heat transfer through the roof.

Water Efficiency

Water efficiency measures include native and drought tolerant species selected for landscaping, and irrigation system rain sensors to reduce unnecessary watering during rain. Homebuyers can also opt for a second water-saving irrigation measure: wireless moisture sensors that monitor soil moisture and turn on irrigation only when needed.

Long-Term Performance and Homeowner Education

David Weekley's construction practices focus on improved home performance in many ways, including:

- Moisture control is an important consideration, both to reduce home maintenance and to improve indoor air quality by limiting mold. Absorptive materials are protected from moisture and delivered to the job site only when needed. Interior moisture from bathrooms is controlled through use of durable materials and leak-resistant construction.
- Finish materials installed in the homes can influence indoor air quality. Low VOC paints are used as standard practice, and homeowners can select additional low-emitting materials options such as reduced carpeting and urea-formaldehyde free composite wood in cabinetry.
- Optimized function of the home is also a priority. Mechanical, electrical, and plumbing systems are tested and confirmed to be working prior to move-in. Homeowners are educated about green building and energy efficiency features throughout the purchasing and construction processes. At construction completion, David Weekley Homes educates homeowners on the function and maintenance of their home's systems to ensure appropriate expectations for home performance and to achieve optimal energy efficiency.



David Weekley Home

Multi-Family Residential Wildflower Terrace

Rating:

1-Star Austin Energy Multi-Family Green Building LEED certification pending

Completed in February 2012, the 352,000 square foot Wildflower Terrace provides a multi-family residential option at Mueller for seniors of varying incomes, with 171 of the 201 apartments "affordable to persons with incomes at or below 60 percent of area median income." The project offers a range of amenities, including basic features such as a fitness center and laundry center, and more unique ones such as a home theater, computer center, art studio, and even a library. It is conveniently located within a half mile of at least 10 community amenities, and within a quarter mile from a bus route, with another route in planning stages, lessening dependence on singleoccupant vehicles and promoting healthy lifestyles.

Site

Like other projects at Mueller, the site was a brownfield remediated to meet the 'unrestricted' standard to support construction of residential and commercial structures. Along with the amenities and social benefits, Wildflower Terrace also serves as a multi-family example of sustainable design and construction, with a 1-Star Austin Energy Green Building rating

Project Team

Owner/Developer: DMA Development Company, LLC Architect: Nelsen Partners, Inc. Mechanical Engineer: EN, Inc. Civil Engineer: Urban Design Group Structural Engineer: Strand Systems Engineering, Inc.

Landscape Architect: Carolyn Kelley General Contractor: Carlton Construction, Ltd. Commissioning Agent: Green Living, LLC Sustainable Design/LEED Consultant: Lee Gros Architect and Artisan, Inc. Completion Date: February 2012



MUELLER

Wildflower Terrace

and LEED certification pending. Integrated pest management is used throughout the project, creating a healthy environment for the residents and surrounding neighborhood.

Energy and Water Efficiency

Wildflower Terrace's energy savings result from installing 14 SEER HVAC systems and ENERGY STAR rated indoor lighting fixtures and appliances in each apartment, yielding 17.5% improved energy performance compared to code. Water savings reflect the installation of low flow toilets and bathroom faucets. In addition, outdoor potable water use was reduced as a result of tying in to the City of Austin's purple pipe system for irrigation, and directing the air conditioning condensate into the project's rain garden, providing ample irrigation for the native plant landscape.

Green Materials

The project team prioritized using regionally sourced and healthy materials, with a large percentage sourced and manufactured in Texas. In addition, exterior and outdoor-facing interior walls were constructed without vinyl wall coverings or vapor barriers to protect against the potential for mold and mildew growth. Low-emitting adhesives, sealants, paints, and floor coverings were used in the building interior. Provisions were also made to store and collect residents' recyclable materials to facilitate their diversion from the landfill once the building is occupied.



Wildflower Terrace

LARGE RETAIL Home Depot

Rating:

4-Star Austin Energy Commercial Green Building

Early in the planning and design of the Home Depot located at Mueller, the project team committed to create a store that exceeded Mueller's minimum green building requirements. Working closely with Austin Energy Green Building (AEGB) staff, the project team was able to substantially exceed the minimum number of points needed to earn a 4-Star AEGB Commercial Rating. Significant achievements include mitigating the urban heat island effect, diverting construction debris from landfills, reducing indoor and outdoor water use, and specifying and installing recycled-content, Texas manufactured, and low-emitting materials and products.

Urban Heat Island Effect

The Urban Heat Island Effect is one of Mueller's four Green Urbanism Signature Themes. A heat island results when dark-colored, impervious surfaces absorb and re-radiate the sun's radiant energy, increasing surface and air temperatures in urban areas. (See Chapter 3 for more information.) The Home Depot at Mueller opted to install concrete paving for its parking lot rather than asphalt. The lighter colored concrete has higher reflectance and lower heat absorption than darker colored asphalt, thus reducing the pavement's contribution to the heat island effect.

Another effective strategy to mitigate the urban heat island effect is shade. Home Depot implemented "orchard parking," a Mueller development-wide strategy that requires planting at least one tree for every four parking spaces, exceeding City of Austin requirements. Trees provide multiple benefits including shading pavement and parked cars, filtering air for improved air quality, and providing habitat for birds and other wildlife.

Project Team

Developer: Catellus Development Corporation Tenant: Home Depot Architect and MEP Engineer: WD Partners Landscape Architect: TBG Partners General Contractor: J.R. Heineman & Sons Commissioning Authority: Entek Completion Date: October 2008



Home Depot at Mueller

Materials and Construction Debris

The project team improved the project's environmental and occupant health performance through careful material selection and waste reduction. For example:

- 22% (by cost) of installed building materials had recycled content.
- 50% (by cost) of installed building materials were sourced in Texas, reducing transportation-related emissions and supporting the Texas economy.
- All new wood products were sourced from forests certified by the Forest Stewardship Council.
- Low VOC paints, coatings, adhesives and sealants were selected for all interior and exterior applications.
- All installed carpet met the Carpet & Rug Institute's (CRI) Green Label Plus standards; carpet pads met CRI's Green Label standards.
- Resilient flooring products were Floorscore certified; composite wood and laminate flooring contained no added urea-formaldehyde.
- Batt insulation was GREENGUARD-certified and formaldehyde free.
- 94% (by weight) of total construction debris, representing 331.7 tons, was diverted from landfills and redirected for reuse and recycling. This was accomplished through careful planning beginning

early in design, the development of a detailed Construction Waste Management Plan, and diligent on-site separation and segregation of construction debris. Off-site waste recycling strategies included chipping untreated wood cut-offs for use as mulch; grinding gypsum wallboard for use as a soil amendment; melting down steel for manufacture into new products; and crushing masonry and concrete rubble for use as aggregate.

Other Notable Accomplishments

- Bike racks accommodating up to 10 bicycles were provided to serve customers and employees who choose to bike to the store; showers are available for employees.
- Modeled indoor water use was reduced by 43% (calculated savings of 331,782 gallons of water annually) compared to a baseline building of equivalent occupancy by using 1.2 gpf water closets, 0.5 gpf urinals, and 0.5 gpm lavatory faucets.
- 100% of the building's irrigation needs are met by tying into the City of Austin's Purple Pipe reclaimed water system, offsetting reliance on treated potable water.
- Installed skylights daylight the sales floor. The building's lighting system was designed to dim the electrical lighting fixtures when adequate daylight is available.



Vegetative strategy employed at Mueller's Home Depot.

INSTITUTIONAL Dell Children's Medical Center of Central Texas

Ratings:

LEED Platinum Certified 5-Star Austin Energy Commercial Green Building

Dell Children's Medical Center of Central Texas (DCMCCT) set the standard for high performance sustainable design at Mueller and around the world. As the world's first LEED Platinum and Austin Energy 5-Star certified hospital, DCMCCT demonstrates leadership in all LEED and Austin Energy Green Building categories. Its high performance envelope, mechanical, and lighting systems are calculated to save enough energy to power approximately 300 average homes in Austin every day. The project installed recycled content, regionally sourced and low-emitting building materials to enhance environmental and human health attributes during the building's construction phase and throughout building operations. Abundant garden spaces inside and outside the building are landscaped with native and drought tolerant species, reducing water demand while providing peaceful places of respite for patients, staff and visitors. The Neurosurgical Suite Addition, completed in 2009, achieved LEED-NC for New Construction Gold certification. The Bed Tower 3 addition, scheduled to open in Spring 2013, is one of the first projects to pursue LEED 2009 for Healthcare

Project Team

Owner: Seton Family of Hospitals

Principal Architect: Karlsberger (base building), Polkinghorn Group Architects (neurosurgical suite addition and bed tower 3 addition) Mechanical Engineer: CCRD Partners Landscape Architect: TBG Partners Civil Engineer: Bury and Partners General Contractor: White Construction (base building), Burt Watts (neurological suite addition), Beck Group (bed tower 3 addition)

Sustainability/LEED Consultant: Center for Maximum Potential Building Systems

Completion Dates: June 2007 (base building), September 2009 (neurosurgical suite addition), anticipated March 2013 (bed tower 3 addition)



Dell Children's Medical Center of Central Texas

certification, with a target of Platinum certification. Recognizing its exemplary commitment to green and healthy building, the U.S. Green Building Council presented its Leadership Award for the Non-Profit sector to Dell Children's Medical Center of Central Texas in October 2011.

Commitment to Health

Dell Children's Medical Center of Central Texas has an overarching commitment to support the health of the environment, the community and the building's patients, staff and visitors. Designed as a healing environment, generous distribution of windows, courtyards and gardens connect patients and staff to natural day/night cycles and the calming properties of nature. Thermal and lighting controls enable building occupants to adjust their personal environment to respond to individual comfort needs. Careful material and product selections contribute to a healthy indoor environment. Low-emitting paints, coatings, adhesives, and sealants reduce off-gassing associated with the release of volatile organic compounds (VOCs). Carpet, carpet pad and adhesives meet the Carpet and Rug Institute's Green Label and Green Label Plus Indoor Air Quality Test programs' stringent standards. Composite wood and agrifiber products contain no added urea- formaldehyde. The building's air conditioning

and ventilation system ensures that ample fresh air circulates throughout.

The Bed Tower 3 addition design team is furthering Dell Children's commitment to safe and healthy building materials by limiting the use of materials that contain potentially harmful halogenated organic compounds, including flame retardants and phthalates. For example, non-halogenated HDPE 'purple pipe' is used in lieu of PVC piping. The project established rigorous limits on mercury content in lamps and specified lead-free domestic water supply piping, solder, wire and cable, roofing and flashing. In addition to requiring low VOC content, interior and exterior paints are leadand cadmium-free.

Dell's Children Medical Center Bed Tower 3

The Bed Tower 3 addition, scheduled for completion in Spring 2013, is one of the first projects to pursue certification using the LEED 2009 for Healthcare rating system. All projects pursuing LEED for Healthcare certification are required to develop a Health Mission Statement reflecting a commitment to economic, social and environmental values.

Dell's Children Medical Center Bed Tower 3: Health Mission Statement

Dell Children's Medical Center of Central Texas Bed Tower 3 will be a state-of-the-art healthcare facility dedicated to providing premium care to the children of Central Texas in an environment that promotes human and environmental health. The project will endeavor to exceed the pioneering efforts of the base building to create an environment that promotes health and well being for patients, staff, and the Earth.

Energy

The Mueller Energy Center is an energy efficient, natural gas-fueled combined heat and power (CHP) plant owned and operated by Austin Energy. (See Chapter 3 for more information.) Located across the street from Dell Children's, it supplies the hospital with electricity, chilled water and steam. The CHP has significantly lower emissions than large-scale centralized fossil fuel-based power plants. Emissions reductions from the CHP are calculated to be equivalent to removing over 2,000 automobiles from the road or planting over 2,400 acres of forest. The Bed Tower 3 addition added a 50KW solar photovoltaic system and 300 MMBtu solar hot water system, further offsetting the hospital's reliance on fossil fuel power. Combined with other energy conserving measures including high performance windows, insulation and efficient lighting, Dell Children's modeled energy cost savings is 60% below a baseline hospital of equivalent size.

Water

Water is a precious resource in Central Texas. To reduce potable water consumption, Dell Children's 27-acre site features native and adapted vegetation requiring substantially less water than conventional landscapes. The project benefits from connecting to the City of Austin's reclaimed purple pipe water system, offsetting reliance on municipally treated potable water for all but the landscaped interior courtyards that rely on treated potable water due to infection control considerations. Low-flow bathroom fixtures reduce indoor water use by 33% in the base building and 39% in the Bed Tower 3 addition, based on modeled water performance.



CHAPTER 5

Rebates and Incentives











Rebate offerings are subject to change. Rebate information published in the *Mueller Green Resources Guide* version 3 is current as of April 2012. Funding for all rebates is limited and available on a first come, first served basis. Contact the department referenced in each section to verify current information.

The rebates and incentives included in this chapter reinforce the Mueller Green Urbanism Signature Themes, particularly *Protecting Air Quality* and *Creating Green Buildings*. Chapter Three highlights each Green Urbanism theme and describes how they bring benefits to residents and the broader Austin community.





AUSTIN ENERGY Power Saver™ Programs

Austin Energy Power Saver[™] Programs provide rebates and incentives to eligible commercial, single- and multi-family Austin Energy customers to encourage energy efficient buildings and mechanical, solar photovoltaic and solar water heating systems.

Austin Energy Power SaverTM – Residential and Commercial Solar Water Heater Rebates and Solar Photovoltaic Loans



Commercial, single- and multi-family Austin Energy customers are eligible for rebates of \$1,500 - \$2,000 on purchase/installation of a new solar water heater. Solar water heaters must be SRCC (Solar Rating Certification Corporation) certified to qualify.

Contact

www.austinenergy.com/Energy%20Efficiency/Programs/Rebates/Solar%20Rebates/ Solar%20Water%20Heater/index.htm



Commercial, single- and multi-family Austin Energy customers may apply for loans to finance the purchase and installation of eligible solar PV electric systems. Austin Energy contracts with Velocity Credit Union to offer current market interest rate loans of up to \$20,000.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Loans/Residential/Solar/index.htm

General Contacts and Information

Power Saver[™] Commercial and Residential **Rebates and Incentives** (512) 974-7827 custinfo@austinenergy.com www.austinenergy.com/energy%20efficiency/ Programs/index.htm

Power Saver[™] Multi-Family Rebates and Incentives

(512) 482-5346

custinfo@austinenergy.com

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Commercial/Multi-Family%20 Properties/index.htm

Power Saver[™] Solar Photovoltaics Program (512) 482-5346 solarrebate@austinenergy.com www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Solar%20Rebates/index.htm

Austin Energy Power Saver[™] – Single-Family Residential Rebates and Incentives

Air Conditioning and Heat Pumps

Rebate amounts range from \$50 - \$600, depending on equipment type and level of efficiency. Rebates are available for the following equipment:

- Split System Air Conditioners and Heat Pumps (15 SEER/12.5 EER or greater)
- Packaged Air Conditioners and Heat Pumps (14 SEER/12 EER or greater)
- Mini-Split Air Conditioners and Heat Pumps (14 SEER/11.5 EER or greater)
- Window Units, Air Conditioners and Heat Pumps (< 19,999 BTUS: 10.7 EER or greater; > 20,000 BTUS: 9.4 EER and above
- Ground Source Heat Pumps (with and without Desuperheater), existing residential only,
 1.5 to 6 tons

🖗 💿 Water Heating

In addition to rebates offered for solar water heating systems, Austin Energy awards a \$500 rebate for purchase and installation of a heat pump water heater.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Residential/index.htm

Home Performance with Energy Star[™] Rebates

Homes more than 10 years old that engage in home energy analysis with a participating company can receive rebates on suggested improvements worth up to 20% of the cost of certain improvements, not to exceed \$1,575.

Suggested improvements include:

- Air conditioner or heat pump (14 SEER/12 EER or greater)
- Duct repair and sealing
- Additional attic insulation

- Solar screens, window film, and low-E glass
- Caulking and weatherstripping
- Attic radiant barrier/reflective material

Bonus rebates up to \$650 are available from Austin Energy if homeowners install a new air conditioner or heat pump sized to service at least 600 square feet per ton that meets or exceeds all SEER/EER requirements, and perform all recommended weatherization activities at the time of installation.

Texas Gas Service offers additional rebates and incentives to homeowners participating in the Home Performance with ENERGY STAR program. See the Texas Gas Service Conservation Programs section on page 101 for more details.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Residential/Home%20 Performance%20with%20Energy%20Star/ index.htm



Austin Energy customers not applying for a Home Performance with ENERGY STAR rebate may be eligible to apply for an energy improvement loan (minimum \$1,500) or a personal loan (minimum \$500) to cover the following improvements.

- Installation of a new energy-efficient air conditioner or heat pump (14 SEER or greater)
- Additional attic insulation
- Repair of leaking AC ducts
- Caulking around plumbing under sinks
- Weatherstripping around doors
- Installation of low-E glass, solar screens, or window film
- Installation of attic radiant barrier reflective material (optional)

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Loans/Residential/Home%20 Performance%20with%20Energy%20Star/ index.htm

Single-Family Residential Solar Photovoltaic Rebates

Rebates are available based on watts generated by eligible solar photovoltaic (PV) electric systems to offset cost to purchase and install the PV system. Eligibility is assessed based on home ownership, roof orientation and condition, shading, deed restrictions, and energy efficiency. Austin Energy must approve solar PV rebate applications prior to installation. The typical payback period for a solar photovoltaic system is 12 – 25 years, based on the cost of equipment and installation. Electric bill savings associated with one kilowatt photovoltaic systems typically range from \$85 to \$155 per year.

Customers may apply for solar PV rebates and loans.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Solar%20Rebates/ residential.htm



Austin Energy Power Saver[™]– Commercial, Multi-Family, and Small Business Rebates and Incentives

Commercial Business Rebates and Incentives

Austin Energy offers assistance to qualifying businesses wishing to identify and install energy conservation improvements that will reduce peak energy demand. Rebates and incentives are offered in the following technology categories:

- Air conditioning
- Chillers
- Custom technologies
- Energy recovery ventilator
- Lighting
- Motors
- New construction
- Reflective roof
- Solar photovoltaics
- Solar water heaters
- Variable frequency drives (VFD)
- Window treatments

Additional incentives include:

- Building commissioning
- Load co-op (customer agrees to curtail peak energy load at Austin Energy's request between 1pm and 8pm during summer months)
- Free thermostats
- Energy misers
- Thermal energy storage

Energy efficiency measures by businesses may also be eligible for the federal energy efficient commercial buildings tax deduction. See the Federal Tax Credits and Incentives section on page 110 for details.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Commercial/Commercial %20Energy/index.htm

Commercial and Multi-Family Solar Photovoltaic Performance-Based Incentive

Qualifying customers who install a solar photovoltaic system that meets Austin Energy guidelines are eligible to receive quarterly incentive payments based on the kilowatt-hour production of their system. Austin Energy currently pays \$0.14 per kilowatt hour for ten years. Customers can apply for both the performance-based incentives and solar photovoltaic loans to finance purchase and installation of solar PV systems.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Solar%20Rebates/ commercial.htm



Owners, developers and property managers of multi-family properties with two or more airconditioned residential units are eligible for rebates up to \$200,000 on the following types of energy efficiency improvements:

- Window treatments: Up to 80% of the cost of solar screens or film.
- Insulation: \$0.05 to \$0.23 per square foot, depending on placement and level of existing insulation.
- Roof Coatings with at least 75% reflectivity: \$0.15 per square foot.
- Air Conditioners and Heat Pumps (1.5 5 tons, 14 SEER, 11.3 EER and greater): Rebates from \$200 \$600 for replacement of old systems, rebate level depends on type of type of system installed.
- Lighting: Per fixture and per lamp rebates available for conversion from incandescent to fluorescent. Additional rebates available for hard wire retrofit, fixture replacement, high performance ballasts, and occupancy sensors.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Commercial/Multi-Family %20Properties/index.htm



In addition to being eligible for all commercial Power Saver[™] rebate programs, houses of worship, not-forprofit organizations and qualifying small businesses that do not exceed an average monthly electric demand of 100 kilowatts during any summer billing period are eligible for Austin Energy's small business rebates and incentives in the following categories:

- Air Conditioning: Extra rebates for units 5 tons or greater.
- Windows: Up to \$0.80 per square foot for window tinting.
- Roofing: Qualifying coatings (at least 75% reflectivity) receive a rebate of \$0.30 per square foot.
- Small Business Lighting Program: Austin Energy offers rebates up to 75% of the customer's cost to retrofit interior lighting systems with high-efficiency fixtures. Special incentives are available to retrofit T-12 lighting with T-8 lights of 32 watts or better.

Contact

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Commercial/Commercial %20Energy/smallBusiness.htm



CITY OF AUSTIN WATER UTILITY Water Conservation Rebates and Programs

Austin Water Utility offers rebates and incentives promoting water conservation through rainwater harvesting, efficient irrigation practices, efficient clotheswashers and other water-using equipment.

Residential and Commercial Rainwater Harvesting Rebate

Rebates are offered for installation of a rainwater harvesting system. Rebate amounts are \$0.50 per gallon storage for non-pressurized systems and \$1.00 per gallon storage for pressurized systems, up to \$5,000, not to exceed 50% of the project cost. Rebates are available for new systems and existing systems adding storage capacity.

System Requirements:

- Tanks 500 gallons and larger require the installation of a first-flush diversion system and a sturdy, level base constructed of gravel, sand, or concrete. Wooden, above ground platforms are not permitted for large cisterns.
- Unlined galvanized collection tanks are not eligible. However, metal tanks with liners may be approved by submitting tank specifications.
- Transparent or translucent collection tanks and piping must be painted or enclosed to prevent penetration from sunlight.

- Rainwater harvesting systems utilizing a pump require the installation of a reduced pressure zone backflow prevention assembly (RPZ) at City of Austin water meters to reduce the potential for cross contamination between the public water supply and private auxiliary water systems. Installation of the assembly requires a plumbing permit.
- Depending on the system, other permits may be required. It is the applicant's responsibility to ensure that the system does not violate City Code requirements (including setbacks, impervious cover, etc.) and homeowners association enforced restrictions.

Contact

www.austintexas.gov/department/ rainwater-harvesting-rebates

austintexas.gov/sites/default/files/files/ Water/RebateApplications/rainh2orebate.pdf

General Contacts and Information (512) 974-2199 watercon@ci.austin.tx.us www.austintexas.gov/department/ water-conservation-rebates



Rainwater collection tanks. Pedernales Lofts.

Austin Water Utility Single- and Multi-Family Residential Water Conservation Rebates and Incentives

Free Showerheads and Faucet Aerators

Austin Water Utility provides free, water efficient showerheads that use 1.5 gallons per minute, bathroom faucet aerators that use 1.0 gallons per minute, and kitchen faucet aerators that use 2.2 gallons per minute.

Faucet aerators and showerheads can be picked up in person between 8am and 4:30pm, Monday through Friday, at 625 E. 10th Street.

Contact

www.austintexas.gov/department/ free-showerheads-faucet-aerators

Pressure Regulating Valve Rebate

A rebate of \$100 is available for the purchase and installation of a pressure regulating valve (PRV) to customers with existing water pressure over 80 pounds per square inch, who do not have an existing installed PRV. Multi-family customers may receive \$100 per unit, for up to \$500 per property.

Contact

http://austintexas.gov/department/ pressure-regulating-valve-rebate

Drought Survival

In response to Central Texas drought conditions in 2011, Austin Water Utility provides hose meters and soil moisture meters to assist consumers in measuring and regulating irrigation water use.

Borrow a Hose Meter

Customers may sign out a digital meter attachment for garden hoses and hose-end sprinklers to measure water use for up to 2 weeks at a time.

Contact

www.austintexas.gov/department/borrowdigital-hose-water-meter-austin-water

Free Soil Moisture Meters

Free soil moisture meters are available to allow customers to monitor soil moisture and determine when and where to provide supplemental water.

Contact

www.austintexas.gov/department/droughtsurvival-tools

Meters can be picked up in person between 8am and 4:30pm, Monday through Friday, at 625 E. 10th Street.

Residential WashWise Rebate Program

Customers meeting the following requirements are eligible for rebates on the purchase of qualifying high efficiency clothes washers.

- Electric Water Heater: must be a customer with Austin Energy.
- Gas Water Heater: must be a customer with Texas Gas Service and live within Austin City limits (rate code Austin I/S Res).

The rebate is \$75 - \$100, and is made up of two parts: a \$50 water rebate and a \$25 (Texas Gas Service) or \$50 (Austin Energy) energy rebate.

Propane water heaters are not eligible for the energy rebate.

Contact

www.austintexas.gov/department/washwiserebate-program

www.austintexas.gov/sites/default/files/files/ Water/RebateApplications/sfwasherapp.pdf

Residential Irrigation System Evaluations and Rebates

Irrigation System Evaluation

City of Austin Water Utility or eligible water district customers who have an in-ground sprinkler system and use more than 15,000 gallons per month in the summer qualify for a free irrigation audit.

Irrigation Rebate

Following completion of an irrigation audit, customers who complete all recommended improvements are eligible for up to \$375 in rebates.

Contact

www.ci.austin.tx.us/watercon/ irrigation_audit.cfm

www.austintexas.gov/department/irrigationsystem-evaluations-and-rebates#overlaycontext=department/irrigation-systemevaluations-and-rebates&overlay=node/5349/ edit%3Fdestination%3Dadmin/workbench



Commercial Water Conservation Rebates and Incentives

Calculate, Conserve

Austin Water Utility provides business-specific water conservation recommendations to businesses that complete a 3C application form providing information about water use. The 3C Business Challenge also provides businesses with points towards the Austin Green Business Leaders program, a City of Austin Office of Sustainability initiative.

Contact

www.austintexas.gov/department/3c-businesschallenge-commit-calculate-conserve

Commercial WashWise Rebate Program

Rebates of up to \$250 per machine for water- and energy-saving coin-operated machines selected from list of approved models. Only coin-operated clothes washers listed on the Consortium for Energy Efficiency (CEE) website are eligible for rebates. The rebate is separated into water and energy components: the energy component of \$100 is available only to customers using gas supplied by Texas Gas Service for water heating and a qualifying rate code. Customers must receive water from Austin Water Utility or eligible MUD to receive an additional \$150 water-related rebate. No rebate will be given to replace existing front-loading machines or to new construction projects.

Contact

www.austintexas.gov/department/washwiserebate-program-0

Commercial Irrigation Evaluation and Rebate

Free irrigation evaluations are offered to assist commercial properties in identifying and correcting equipment problems and reducing overall landscape watering demands. Customers who participate in irrigation audits may be eligible for a rebate of up to \$1,000 per account for making recommended upgrades to existing systems.

Contact

www.austintexas.gov/department/commercialirrigation-evaluations-and-rebates

www.austintexas.gov/sites/default/files/ files/Water/Conservation/irrigation rebate_comm2.pdf





Austin Water Utility water conservation auditors are available to evaluate all aspects of a building's water consumption. Auditors will suggest opportunities for reducing water consumption and discuss eligibility for the following special rebates and incentives:

Laundry Water Reuse and Reduction Incentives

A rebate is available to assist with purchase of ozone and water reuse equipment. Rebate amounts are based on the amount of water saved, or half the cost of equipment, whichever is less. The State of Texas also offers tax incentives for installing this equipment.

Special Commercial Rebates

Rebates of up to \$100,000 are available to industrial, commercial and institutional customers for making upgrades to conserve water at existing facilities. Upgrades must reduce water consumption by at least 300 gallons per day. Examples of eligible upgrades include capturing on-site sources of water such as HVAC condensate, reuse of high quality rinse water, and installing water saving equipment in a commercial laundry or car wash. Rebates are only awarded for upgrades other than plumbing fixtures and irrigation system upgrades.

Contact

www.austintexas.gov/department/commercialprocess-water-evaluation

Sales Tax Exemption for Water Conservation

Water conservation strategies and associated equipment, supplies and services are exempt from sales tax if used solely for the purposes described below:

- Rainwater harvesting: rain barrels; gutters used solely to route the water into rain barrels or rainwater collection systems; tanks and cisterns; roof washers used in rain harvesting systems; screens and filters for the gutters, barrels, tanks, cisterns and roof washers; and a collection surface area not used as a roof of a structure or storage area.
- Water recycling and reuse: chemicals; tanks & cisterns; and water recycling systems for washing machines.
- Reduction or elimination of water use: water dams for toilets; timers attached to sprinkler systems;

water displacement devices for toilet tanks; and faucet sensors that shut off water flow.

- Desalination of surface water or groundwater: cleaning and pickling valves; filters; membranes; pre-filter pumps; product flow meters; salinity meters; and high-pressure control valves.
- Brush control designed to increase the availability of water: spray equipment & calibration of equipment, herbicides, tractors, bulldozers and chain saws.
- Precipitation enhancement: end-burning cloudbase flares; acetone solution wing-tip generators; pressure transducers; spectrometer probes; calibration equipment.
- Water or wastewater system: equipment, services, and supplies to construct or operate a system certified by the Texas Commission on Environmental Quality (TCEQ) as a regional system.

Source – Texas Water Development Board: www.twdb.state.tx.us/conservation/ municipal/commercial-institutional/doc/ SalesTaxExemption.pdf

VETERANS LAND BOARD Residential Assistance Programs

The Veterans Land Board (VLB) offers financial assistance in the form of loans to eligible veterans and their spouses for the purchase of land, housing, and home improvement projects. Eligibility requirements are available on the VLB website: www.glo.texas.gov/vlb/veterans-benefits/veteran-loans/eligibility.html

🛐 Land Loan Program

Financing is offered for up to \$80,000 for the purchase of one acre or more of land. A minimum 5% down payment, certified survey, and appraisal and contract service fee are required.

Contact

www.glo.texas.gov/vlb/veterans-benefits/ veteran-loans/land-loans/index.html

Berogram Housing Assistance

Financing is offered for up to \$325,000 with a fixed interest rate for 15-, 20-, 25-, or 30-year terms toward the purchase of a home. Homes must meet the following requirements:

- Serve as the veteran's primary residence.
- Be located in Texas.

- Be a single-family attached or detached home, town home, condominium or planned unit development.
- Duplexes or other multi-family units must have been constructed at least five years prior to the closing date of the loan.
- The VLB must be contacted to confirm eligibility for manufactured/modular homes.
- All new construction housing must meet the U.S. Environmental Protection Agency's guidelines for ENERGY STAR qualified homes and must be ENERGY STAR labeled and certified.

Contact

www.glo.texas.gov/vlb/veterans-benefits/ veteran-loans/home-loans/index.html

General Contacts and Information

Texas General Land Office (800) 998-4GL0 (4456) www.glo.texas.gov/

Veterans Land Board

(800) 252-VETS (8387) or (512) 463-5060 or www.glo.texas.gov/cf/vlb-contact-us-form/index.html

Brogram

Below-market interest rate loans are provided to qualified veterans for home repairs and improvements to existing homes. Repair work must be completed by a general contractor. Repairs must substantially protect or improve the basic livability or energy efficiency of the property, correct damage resulting from natural disaster, or correct conditions that are hazardous to health or safety.

A list of eligible and ineligible improvements is available at <u>www.glo.texas.gov/vlb/_documents/</u> <u>loans/vhip_improve_list.pdf</u>.

Contact

www.glo.texas.gov/vlb/veterans-benefits/ veteran-loans/home-improvement/index.html



TEXAS GAS SERVICE Conservation Programs

Texas Gas Service Conservation Programs provide rebates and incentives to residential and commercial customers and homebuilders building in eligible areas served by Texas Natural Gas. These programs encourage the purchase, installation, and maintenance of natural gas heating and water heating equipment, clothes washing machines, natural gas dryers, home energy efficiency improvements, natural gas vehicles and home fueling stations.

Residential Rebates Available to Homeowners

Residential Hydronic Heating Rebate

Texas Gas Service offers an incentive of \$125 per dwelling unit for purchase and installation of a new hydronic heating system.

To qualify for the rebate, customers must install a natural gas water heater as the primary heating source, and meet the US Department of Energy's minimum energy efficiency requirements for residential water heaters. The water heater must be listed in the Gas Appliance Manufacturer's Association's *Consumer Directory of Certified Energy Efficiency for Residential Heating and Water Heating Equipment.* Retrofitting an existing natural gas water heater will also qualify. Rebate is also available to homebuilders.

Contact

www.texasgasservice.com/en/SaveEnergy AndMoney/ConservationPrograms/Austin Conservation/ResidentialPrograms/Heating-Programs/HydronicHeating.aspx

General Contacts and Information Contact: (800) 700-2443

www.texasgasservice.com/About/Contact.aspx

www.texasgasservice.com/SaveEnergyAndMoney/ ConservationPrograms.aspx



Natural Gas Furnace Rebate

Texas Gas Service offers an incentive of \$75 per dwelling unit for purchase and installation of a new natural gas furnace with a minimum annual fuel utilization efficiency of 80%.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ HeatingPrograms/Furnace.aspx

Natural Gas Furnace Tune-Up

Texas Gas Service offers an incentive to residential customers of \$25 per dwelling unit for completion of a natural gas furnace check-up and the 26-point Furnace Tune-up Checklist by a licensed contractor. Customers are eligible for this rebate every three years.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ HeatingPrograms/FurnaceTuneup.aspx



Texas Gas service offers a \$40 rebate for purchase and installation of a new high-efficiency natural gas water heater with an energy factor of 0.62 through 0.81.

Tankless or Super High-Efficiency Natural Gas Water Heater Rebate

Texas Gas Service offers a \$300 rebate for the purchase and installation of a new natural gas tankless or super high-efficiency water heater with an energy factor of 0.82 or higher.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/Water HeatingProgram/NGWaterHeaters.aspx

Solar Water Heater with Natural Gas Backup Rebate

Texas Gas Service offers a \$750 rebate for purchase and installation of a new solar water heater with natural gas backup. Only active systems with panels certified OG-100 by the Solar Rating Certification Corporation qualify. Solar-assisted natural gas water heaters must be installed to support a new or existing natural gas appliance such as a boiler, storage, tankless or pool heating system. Solar appliances that do not work in conjunction with a natural gas appliance do not qualify.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/Water HeatingProgram/SolarWaterHeater.aspx



Water Heater Conversion Bonus

Texas Gas Service offers a \$250 bonus to customers who replace their electric resistance water heater with a new natural gas high-efficiency, tankless or super high-efficiency natural gas water heater with a minimum energy factor of 0.62. Rebate only applies to customers who purchase and install new equipment for an existing residence.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ WaterHeatingProgram/BonusConversion Rebate.aspx

Washing Machines and Natural Gas Dryers

WashWise Program

Texas Gas Service partners with Austin Water Utility to provide rebates on purchase and installation of new washing machines for customers with gas water heaters. Additional information and qualifying washing machines are available on the Austin Water site: www.austintexas.gov/department/ washwise-rebate-program

Natural Gas Dryers

Texas Gas Service offers a \$75 rebate for the purchase and installation of a new natural gas clothes dryer with a moisture sensor. Contact Texas Gas Service for a list of eligible residential clothes dryers.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ AppliancePrograms.aspx



Home Improvements: Duct Sealing and Attic Insulation

Texas Gas Service partners with Austin Energy's Home Performance with ENERGY STAR Program. Customers participating in the Home Performance with ENERGY STAR program, and who have an existing natural gas furnace, are eligible for additional rebates for upgrading attic insulation and installing ducts.

For attic insulation in an existing residence, customers can receive a rebate equal to the amount of their Austin Energy rebate, up to \$300. For duct diagnostic and sealing activities, customers can receive an additional \$0.08 per square foot of duct.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/Home Improvement.aspx

Austin Energy's Home Performance with ENERGY STAR Program also provides more details:

www.austinenergy.com/Energy%20Efficiency/ Programs/Rebates/Residential/Home%20 Performance%20with%20Energy%20Star/ index.htm



Natural Gas Equipment and Weatherization

Texas Gas partners with Austin Energy's Free Weatherization Program to provide customers on fixed or moderate incomes, the elderly, and those with disabilities with free installation of new or replacement space heaters, wall furnaces or central furnaces; natural gas water heaters and ranges; free weatherization services; and installation of carbon monoxide and smoke detectors.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ OtherPrograms/Weatherization.aspx

Customers must apply to the program through Austin Energy:

www.austinenergy.com/Energy%20Efficiency/ Programs/Free%20Home%20Energy%20 Improvements/index.htm



Texas Gas Service offers a \$2 gas bill credit for a period of 24 months to qualifying customers who use natural gas for water heating and space heating. Customers must meet one of the following requirements to participate:

- Occupy an Austin Energy Green Buildingcertified home with a minimum 3-Star rating.
- Participated and received a certificate of compliance in Austin Energy's Home Performance with ENERGY STAR Program.
- Participated and received a certificate of compliance in Austin Energy or Travis County's low-income weatherization program.
- Participated and received a certificate of compliance in a comparable energy efficiency/ weatherization program.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ OtherPrograms/GreenSaver.aspx

Homebuilders Rebate Programs

Residential Hydronic Heating Rebate

Texas Gas Service offers an incentive of \$125 per dwelling unit for purchase and installation of a new hydronic heating system.

To qualify for the rebate, customers must install a natural gas water heater as the primary heating source and meet the US Department of Energy's minimum energy efficiency requirements for residential water heaters. The water heater must be listed in the Gas Appliance Manufacturer's Association's *Consumer Directory of Certified Energy Efficiency for Residential Heating and Water Heating Equipment.*

Retrofitting an existing natural gas water heater will also qualify.

Contact

www.texasgasservice.com/en/SaveEnergy AndMoney/ConservationPrograms/Austin Conservation/ResidentialPrograms/ HeatingPrograms/HydronicHeating.aspx

Natural Gas Furnace Rebate

Texas Gas Service offers an incentive of \$75 per dwelling unit for purchase and installation of a new natural gas furnace with a minimum annual fuel utilization efficiency of 80%.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/ HeatingPrograms/Furnace.aspx

High-Efficiency Natural Gas Water Heater Rebate

Texas Gas Service offers a \$40 rebate for purchase and installation of a new high-efficiency natural gas water heater with an energy factor of 0.62 through 0.81.

Tankless or Super High-Efficiency Natural Gas Water Heater Rebate

Texas Gas Service offers a \$300 rebate for the purchase and installation of a new natural gas tankless or super high-efficiency water heater with an energy factor of 0.82 or higher.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/Water HeatingProgram/NGWaterHeaters.aspx

Solar Water Heater with 🚽 Natural Gas Backup Rebate

Texas Gas Service offers a \$750 rebate for purchase and installation of a new solar water heater with natural gas backup. Only active systems with panels certified OG-100 by the Solar Rating Certification Corporation qualify. Solar-assisted natural gas water heaters must be installed to support a new or existing natural gas appliance such as a boiler, storage, tankless or pool heating system. Solar appliances that do not work in conjunction with a natural gas appliance do not qualify.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/ResidentialPrograms/Water HeatingProgram/SolarWaterHeater.aspx



In addition to heating and water heating rebates, homebuilders are offered the opportunity to participate in the Whole Home Program.

Homebuilders who achieve Austin Energy Green Building 3 – 5 Star ratings, pipe their home for natural gas, and include four or more natural gas stubs are eligible for rebates between \$325 and \$500.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/HomebuilderPrograms/ HBWholeHomeProgram.aspx



Commercial Rebate and Incentive Programs

Water Heating Systems

Texas Gas Service offers the following rebates for commercial water heating systems:

Up to 14% of the equipment cost for a new natural gas commercial water heating system with an energy factor of 0.62 through 0.86.

Up to 20% of the equipment cost for a new natural gas commercial water heating system with an energy factor of 0.87 or higher.

- Applicants for natural gas water heating system rebates must submit a letter of intent with equipment specifications.
- Water heating systems must be inspected and approved by a Texas Gas Service representative prior to payment.
- The rebate applies to tank-type water heaters only and cannot be combined with tankless water heater rebates. Water heating boilers qualify.

Up to 20% of the installed cost for purchase and installation of a new solar water heater with natural gas backup.

All applications must be pre-approved prior to installation.

- Solar assisted natural gas water heaters must be installed to support a new or existing natural gas appliance such as a boiler, storage, tankless or pool heating system. Solar appliances must work in conjunction with natural gas appliances to qualify.
- Only active systems with panels certified OG-100 by the Solar Rating Certification Corporation qualify for this rebate.

Contact

Natural Gas Water Heating:

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/ WaterHeatingPrograms/CommWater HeatingSystem.aspx

Solar Water Heating:

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/Water HeatingPrograms/CommSolarHeating.aspx

Hydronic Heating Rebate

A rebate of \$125 is available for the purchase and installation of a commercial hydronic heating unit.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/ CommHeatingPrograms/CommHydronic Heating.aspx



Evacuated tube collector solar water heaters work well in overcast conditions and operate in temperatures as low as -40°F. *Image courtesy of U.S. EPA*


Rebates ranging from \$200-\$500 are available for installation of qualifying new natural gas food service equipment, including:

- Infra-red fryer
- Infra-red griddle
- Convection oven
- Conveyor oven
- Gas booster heater, minimum efficiency of 80 percent TE

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/ FoodServiceEquipment.aspx

Washing Machines and Natural Gas Dryers

A rebate of \$75 is available for the purchase and installation of a new natural gas dryer with a moisture sensor. A list of eligible dryers is available on the Texas Gas website:

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/Comm AppliancePrograms/~/media/Energy Efficiency/TGSRebates/TGS-Comm_Eligible Dryers.ashx

In partnership with Austin Water Utility, Texas Gas Service provides a rebate of up to \$100 for the purchase of an energy efficient front-loading commercial clothes washing machine.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/Comm AppliancePrograms.aspx



Small commercial customers are offered a \$2 gas bill credit for a period of 24 months. The credit is available to eligible customers who use natural gas for water heating and space heating, and who occupy a building that currently holds a 3-Star rating by Austin Energy Green Building.

Contact

www.texasgasservice.com/SaveEnergyAnd Money/ConservationPrograms/Austin Conservation/CommercialPrograms/ GreenSaver.aspx



Residential Natural Gas Vehicle Rebate Programs

Natural Gas Vehicles and Conversions

A \$2,000 rebate is offered for the purchase of a new natural gas vehicle.

A \$3,000 rebate is offered for vehicles recently converted to natural gas by a certified technician.

Rebates are also available for used vehicles that were converted by a previous owner:

- Light duty vehicles (pick up trucks, vans, and automobiles) - \$2,000
- Medium duty vehicles (step vans, for transit, medium duty trucks, and airport shuttles) - \$2,000
- Heavy duty vehicles (garbage trucks and top kick trucks) - \$2,000
- Forklifts \$1,000

Conversions must be performed by a conversion center currently licensed by the Texas Railroad Commission. A pre- and post-conversion reading is required on each converted vehicle and must be submitted with the application.

Natural Gas Vehicle Home Refueling Unit

A \$2,000 rebate is available for the purchase and installation of a new natural gas vehicle home refueling unit. Installation must be completed by a certified dealer/installer.

Contact

www.texasgasservice.com/en/SaveEnergy AndMoney/ConservationPrograms/Austin Conservation/ResidentialPrograms/Vehicle Programs.aspx



FEDERAL Tax Credits and Incentives

Residential and Corporate Energy Conservation Subsidy Exclusion

Section 136 of the U.S. Internal Revenue Code states that energy conservation subsidies provided to customers by public utilities are non-taxable. If a taxpayer claims federal tax credits or deductions for the energy conservation property, the investment basis for the purpose of claiming the deduction or tax credit must be reduced by the value of the energy conservation subsidy (i.e., taxpayers may not claim a tax credit for an expense that they did not ultimately pay).

Sources

www.dsireusa.org/documents/Incentives/ US03F1.htm

www.dsireusa.org/incentives/incentive.cfm? Incentive_Code=US03F&re=1&ee=1

General Contacts and Information

State Database of Incentives for Renewables & Efficiency <u>www.dsireusa.org/incentives/index.cfm?state=us</u> <u>&re=1&EE=1</u>



Residential Tax Credits and Incentives

Residential Renewable Energy Tax Credits

A tax credit of 30% of cost with no upper limit is available for purchase and installation of the following renewable energy equipment types:

- Geothermal Heat Pumps that meet the following conditions:
- Closed Loop: EER greater/equal 14.1, COP greater/equal 3.3
- Open Loop: EER greater/equal 16.2, COP greater/equal 3.6
- Direct Expansion EER greater equal 15, COP greater/equal 3.5
- All ENERGY STAR geothermal heat pumps qualify for this credit.
- Water to water geothermal heat pumps can qualify for this credit.
- Small Wind Turbines with a nameplate capacity of no more than 100kw
- Solar Energy Systems
- Solar Water Heaters where at least half of the energy generated must come from the sun.
 Systems must be certified by the Solar Rating

and Certification Corporation or a comparable entity endorsed by the government of the state in which the property is installed.

Solar Panels (Photovoltaic Systems) must provide electricity for the residence and must meet applicable fire and electrical code requirements.

This credit expires December 31, 2016, and applies to existing homes and new construction. Both principal residences and second homes qualify. The credit is not available to rentals.

Residential Fuel Cell and Microturbine System

A tax credit is available for 30% of fuel cell purchase and installation costs, up to \$500 per 0.5 kw of power capacity. Existing homes and new construction are eligible to receive this credit. Homes must be a principal residence; rentals and second homes do not qualify. Fuel cells must have an efficiency of at least 30% and a capacity of 0.5 kw.

Energy-Efficient Mortgages

Homeowners can take advantage of energy efficient mortgages (EEM) to either finance energy efficiency improvements to existing homes, including renewable energy technologies, or to increase their home buying power with the purchase of a new energy efficient home. The U.S. federal government supports these loans by insuring them through Federal Housing Authority (FHA) or Veterans Affairs (VA) programs. This allows borrowers who might otherwise be denied loans to pursue energy efficiency, and it secures lenders against loan default.

The FHA allows lenders to add up to 100% of energy efficiency improvements to an existing mortgage loan with certain restrictions. Mortgage limits vary by county, state, and number of units in a dwelling. Loan amounts may not exceed the projected savings of the energy efficiency improvements. Of the entire mortgage, energy improvements may only account for the lesser 5% of:

- The value of the property
- 115% of the median area price of a single-family dwelling
- 150% of the Freddie Mac conforming loan limit Homeowners must submit a Home Energy Rating, contractor bids, and an FHA B Worksheet.

Commercial Tax Credits and Incentives

Energy-Efficient Commercial Buildings Tax Deduction

A tax deduction of \$0.30 - \$1.80 per square foot is available for commercial buildings in which any of the following efficiency measures have been installed:

- Equipment insulation
- Water heaters
- Lighting
- Lighting controls/sensors
- Chillers
- Furnaces
- Boilers
- Heat pumps
- Central air conditioners
- Caulking/weatherstripping
- Duct/air sealing
- Building insulation
- Windows
- Doors
- Siding
- Roofs
- Comprehensive measures/whole building

The deduction depends on the technology and amount of energy reduction achieved.

For buildings exceeding ASHRAE 90.1-2001 by 50%, a deduction of \$1.80 per square foot is available. Prorated deductions are available for individual systems. Partial deductions of up to \$0.60 per square foot can be taken for measures affecting any one of these three building systems: the building envelope, lighting, or heating/cooling systems.

For additional details related to this deduction, visit <u>www.efficientbuildings.org/</u>.



Business Energy Investment Tax Credit

Tax credits are available for purchase and installation of eligible systems including:*

Solar: Credit for 30% of expenditures, with no maximum.

Eligible solar energy property includes solar equipment that generates electricity, heats or cools a structure, or provides solar process heat; and hybrid solar lighting systems which use solar energy to illuminate the inside of structure using fiber-optic distributed sunlight.

Passive solar systems and solar pool heating systems are not eligible.

• Fuel cells: Credit for 30% of expenditures, with no maximum credit. Credit for fuel cells is capped at \$1,500 per 0.5 kilowatt of capacity. Fuel cells should have a minimum capacity of 0.5 kilowatts and an electricity-only generation efficiency of 30% or higher.

* The American Recovery and Reinvestment Act of 2009 allows taxpayers eligible for the federal renewable electricity production tax credit (PTC) to take the federal business energy investment tax credit (ITC). The Treasury Department issued Notice 2009-52 in June 2009 giving limited guidance on how to take the federal business ITC instead of the federal renewable electricity production tax credit. See <u>www.irs.gov/</u> <u>pub/irs-drop/n-09-52.pdf</u>.

- Small Wind Turbines: Credit for 30% of expenditures, with no maximum credit, for small wind turbines (up to 100 kW in capacity).
- Geothermal Systems: Credit for 10% of expenditures, with no maximum credit. Eligible systems include geothermal heat pumps and equipment used to produce, distribute or use energy derived from a geothermal deposit. For electricity production from geothermal power, equipment qualifies up to, but not including, the electric transmission stage.
- Microturbines: Credit for 10% of expenditures, with no maximum credit, capped at \$200 per kW of capacity. Microturbines up to 2 megawatts (MW) with electricity-only generation efficiency of 26% or higher are eligible.
- Combined Heat and Power (CHP): Credit for 10% of expenditures, with no maximum credit. Eligible systems include CHP systems up to 50 MW that exceed 60% energy efficiency. CHP systems that use biomass for at least 90% of the system's energy source are exempt from energy efficiency requirement.



A per kilowatt hour tax credit is available for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. This credit was enacted in 1992 and has been renewed and expanded numerous times. Credit amounts have been indexed for inflation since 1993 and are subject to change. The following credit amounts were available as of 2011:

- Wind: \$0.022 per kWh
- Closed-Loop Biomass: \$0.022 per kWh
- Open-Loop Biomass: \$0.011 per kWh
- Geothermal Energy: \$0.022 per kWh
- Landfill Gas: \$0.011 per kWh
- Municipal Solid Waste: \$0.011 per kWh
- Qualified Hydroelectric: \$0.011 per kWh
- Marine and Hydrokinetic (150 kW or larger):
 \$0.011 per kWh

The duration of the credit is generally 10 years after the date the facility is placed in service. This tax credit is also reduced for projects that receive other federal tax credits, grants, tax-exempt financing, or subsidized energy financing.



CHAPTER 6

Resources









Green Building Professionals

LEED Accredited Professionals, www.sslll.cyzap.net/gbcicertonline/onlinedirectory Austin Energy Green Building Professionals, <u>www.my.austinenergy.com/wps/portal/aegb</u> (follow links to Green Building Professionals for each rating system) American Institute of Architects Committee on the Environment, Austin Chapter, www.aiaaustin.org Sustainable Sources Directory, www.greenbuilder.com

Green Materials Retail Locations in Austin

EcoWise, 110 W. Elizabeth St., Austin, 512-326-4474, www.ecowise.com House+Earth, 1214 W. 6th St. #120, Austin, 512-300-0484, www.houseandearth.com TreeHouse, 4477 S. Lamar Blvd, Suite 600, Austin, 512-861-0712, www.treehouseonline.com



Related Information & Organizational Websites

Alpine, TX Outdoor Lighting Ordinance, www.iessanjacinto.org/Ordinances/Alpine_5-23-05.pdf American Water Works Association, 800-926-7337, www.awwa.org American Wind Energy Association, 202-383-2500, www.awea.org Austin EcoNetwork, www.austineconetwork.com Austin Energy Green Building, www.austinenergy.com BuildingGreen, Inc., 802-257-7300, www.buildinggreen.com Carpet and Rug Institute Green Label/Green Label Plus, www.carpet-rug.org Center for Maximum Potential Building Systems, 512-928-4786, www.cmpbs.org City of Austin Grow Green Plant List, www.austintexas.gov/department/plants City of Austin Office of Sustainability, www.austintexas.gov/department/sustainability City of Austin Water Utility, www.austintexas.gov/department/water City of Austin Xeriscape Plant List, www.ci.austin.tx.us/water/conservation/downloads/CommercialPlantList.pdf Colorado Ready Mixed Concrete Association, Specifier's Guide for Pervious Concrete Pavement Design, www.udfcd.org/downloads/pdf/tech_papers/Pervious_Concrete_Guide_2009_08-18.pdf Cool Roof Rating Council, <u>www.coolroofs.org</u> Database of State Incentives for Renewables and Efficiency, www.dsireusa.org Design~Build~Live, www.designbuildlive.org DOE Office of Energy Efficiency and Renewable Energy, www.eere.energy.gov Environmental Building News/GreenSpec (paid subscriptions required), www.buildinggreen.com Forest Stewardship Council, www.fsc.org GreenBlue, www.greenblue.org Green Building Certification Institute, www.gbci.org

GREENGUARD Environmental Institute, <u>www.greenguard.org</u> Green Roofs for Healthy Cities, www.greenroofs.org Green Seal, <u>www.greenseal.org</u> Healthy Building Network, www.healthybuilding.net Illuminating Engineering Society of North America, www.iesna.org International Dark Sky Association, Fixture Seal of Approval Program, www.darksky.org Lady Bird Johnson Wildflower Center at the University of Texas, 512-232-0100, www.wildflower.org Lawrence Berkeley National Laboratory Heat Island Group, heatisland.lbl.gov LEEDuser, www.leeduser.com Lighting Research Center, <u>www.lrc.rpi.edu</u> National Asphalt Pavement Association, www.asphaltpavement.org Native Plant Society of Texas, <u>www.npsot.org</u> Oikos Green Building Source, www.oikos.com Pecan Street Inc., www.pecanstreet.org Planet ReUse, 816-918-1120, www.planetreuse.com SMACNA 2007 IAQ Guidelines for Occupied Buildings Under Construction, www.smacna.org South Coast Air Quality Management District, Rule 1168, www.aqmd.gov Sustainable Sources, <u>www.sustainablesources.com</u> Texas Solar Energy Society, 800-465-5049, www.txses.org Texas Water Development Board, www.twdb.texas.gov U.S. EPA Heat Island Program, www.epa.gov/heatisland U.S. EPA Indoor Air Quality, www.epa.gov/iaq U.S. Green Building Council, <u>www.usgbc.org</u>

U.S. Green Building Council Central Texas - Balcones Chapter, www.usgbc-centraltexas.org



Image Acknowledgements

Front Cover: Mueller sketches – Roma Design Group

Table of Contents: Mueller elevation – Roma Design Group

Chapter 1 Title Page 3: residence at Mueller – Eco-Logic Design; transit section – Roma Design Group; stack effect diagram – Dan Overbey.

Chapter 2 Title Page 3: "Mueller Central – Eco-Logic Design; open grid pavement – Andy Karvonen; Wildflower Terrace entrance gate – Eco-Logic Design.

Chapter 3 Title Page 3: night sky – International Dark Sky Association; bicycling in the park – Andy Mattern, Artimbo.com; roof garden of Ronald McDonald House Charities of Austin and Central Texas – Tom McConnell; rainwater harvesting at Mueller – Eco-Logic Design).

Chapter 4 Title Page 3: David Weekley home at Mueller – David Weekley Homes; Wildflower Terrace – Eco-Logic Design; Taylor-Robertson residence – Jim Robertson; Home Depot at Mueller – Andy Mattern, Artimbo.com; Dell Children's Medical Center of Central Texas – Mark Swendner, Seton Healthcare Family.

Chapter 6 Title Page 3: construction workers – U.S. Bureau of Labor Statistics; Center for Maximum Potential Building Systems – Paul Bardagiy.