VENTURA COUNTY REGIONAL ENERGY ALLIANCE OPPORTUNITIES FOR ENHANCING ENERGY EFFICIENCIES THROUGH GREENBUILDING

A California Local Energy Efficiency Program (CALeep)
Innovative "Best Practices "Pilot Initiative

Funded by
California ratepayers under the auspices of the
California Public Utilities Commission

Report Prepared by
Ventura County Regional Energy Alliance

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Report In Brief

This document has been prepared to report the general process and outcomes of the VCREA pilot project to enhance energy efficiencies through the application of greenbuilding practices in Ventura County.

The materials presented will be incorporated in the CALeep effort and have been in concert with the CALeep Workbook produced through this project.

This pilot project allowed VCREA to expand its role as a regional leader in reducing barriers to participation in energy efficiency and as local clearinghouse for energy services.

The outcomes as described in the materials and appendix will help align new construction projects with energy efficiency programs and mandates.

Acknowledgements

This project was developed through a project team of individuals who are listed below and acknowledged for making this pilot project possible, sustainable and durable:

John Deakin, John Deakin Associates, San Francisco, California
Ann Hewitt, Anacapa Consulting Services, Inc., Ventura, California
Kurt Kammerer, K.J. Kammerer & Associates, San Diego, California
Green Building Council of Ventura County
Ron Stassi, Principal, Navigant Consulting
David Inger, VCREA Energy Projects Manager
Cheryl Collart, VCREA Executive Director

Introduction to Ventura County Regional Energy Alliance

Formed in July 2003, the Ventura County Regional Energy Alliance (VCREA) is a Joint Powers Authority (JPA) composed of public agencies working in collaboration to approach the availability, reliability, conservation and innovative use of energy resources in the Ventura County region. The current JPA consists of Ventura County and the cities of San Buenaventura, Oxnard, Santa Paula and Thousand Oaks, as well as three special districts that include Ventura County Community College District, Ventura Regional Sanitation District and Casitas Municipal Water District.

The VCREA's Strategic Business Plan has identified enhanced energy efficiency as a strong and critical component to energy demand issues for the region. Implementation of green and sustainable building practices that use energy efficiency as their cornerstone will significantly increase the potential for future energy savings in both new and existing residential and commercial construction.

VCREA *Mission*

"Establish Ventura County, its communities and neighboring regions as the leader in developing and implementing durable, sustainable energy initiatives that support sensible growth, healthy environment and economy, enhanced quality of life and greater self-reliance for the region by: (1) Reducing energy demand and increasing energy efficiency and, (2) Advancing the use of clean, efficient and renewable local resources."

VCREA Goals:

1. Lead and coordinate regional integrated energy resource planning.
2. Develop a long-term, sustainable energy strategy and implementation plan.
3. Develop regional capability to respond to energy emergencies and short-term disruptions.
4. Increase awareness of and access to conservation, efficiency, and renewable opportunities.
5. Add value to, but not duplicate, services offered by public utilities and other regional providers.
6. Inform decision makers and stakeholders of energy policy, regulatory, and market changes.
7. Empower Ventura to lead RD&D, innovation and commercialization of sustainable energy

Project Background Information

The **Green Building and Energy Efficiency Project** is an initiative led by the Ventura County Regional Energy Alliance as part of the California Local Energy Efficiency Program (CALEEP), which seeks to identify innovative local government approaches to achieving higher levels of energy efficiency. The project is sponsored by Navigant Consulting, Inc. and funded by utility consumers under the auspices of the California Public Utilities Commission (CPUC).

The **Primary Objectives** of the project are to quantify, demonstrate and expand the economic value of combining energy efficiency practices with green building policies and practices and to identify opportunities in Ventura County for combining green building and energy efficiency in the design and construction of new residential and/or commercial buildings. The project has four major elements:

(1) Information and Education

From knowledge comes power, the power to make better choices. The project will build on this premise to support and strengthen local efforts to provide information and education on Green Building policies and practices. The project will leverage the current capabilities of the Ventura County Energy Resource Center (VCERC) and other local organizations. The VCERC is hosted by the VCREA, in partnership with Southern California Edison and the Southern California Gas Company. The VCERC is a central clearinghouse for energy information, education and resources and includes training facilities, a network of industry contractors and vendors, and a tool and resource lending library.

(2) Local Capacity Building

One of the objectives of the VCERC is to support and build the capacity for local contractors, vendors and other stakeholders to provide energy efficiency services. The project will leverage and expand this capability to the Green Building industry, including local architects, engineers, building officials and organizations that support the objectives of green building and sustainability.

(3) Assessing Potential Energy Impacts and Value of Green Building

The project will seek to quantify the potential electricity and natural gas energy and costs savings that can be achieved by implementing various green building strategies new and existing buildings, then comparing this scenario to a business-as-usual approach. This element will be important to educate stakeholders on the true costs and future benefits of building higher performance projects.

(4) Demonstrating Success

The project will seek to identify potential demonstration/model projects that are representative of the most pressing needs of the region. These projects will serve as "Case Studies" and will be targeted for future program support and funding.

Project Description Summary

The County of Ventura is considered a "green county" because of its commitment to the economic vitality of the agricultural industry and its desire to curtail urban sprawl in support of "smart growth" principles. The over-arching objective for this pilot project is to demonstrate the economic value of combining energy efficiency practices with greenbuilding policies. Building development and energy consumption will be the focus of the pilot. The VCREA Strategic Plan has identified these as critical energy related issues for the County. Implementation of green and sustainable approaches will significantly increase the potential for future energy savings in both new and existing residential and commercial construction.

Task 1 Develop Pilot Project Goals, Work Plan and Schedule

- Develop project goals and specific tasks for the Work Plan.
- Solicit stakeholder input from VCREA Advisory Committee and other stakeholders (e.g., design community, utilities, building owners and local governments).

Task 2 Identify Existing Conditions and Develop Best Practices

- Develop a focused list of technical measures associated with construction and water use that may be applied to new and existing buildings or operations for the purpose of achieving energy efficiency and sustainable buildings practices.
- Identify and evaluate existing green building policies/programs throughout the region for challenges and best practices; identify administrative and institutional opportunities (include industry organization and their capacity for development); evaluate technical resources and government policies, codes and ordinances to promote greenbuilding and energy efficiency in new and existing construction.
- Identify administrative and institutional opportunities available to local management and policy makers that encourage use of best technology for building construction and operations to reduce energy use.
- Prepare best practices report/document and recommend opportunities for development of new capabilities to deliver higher levels of energy efficiency through specific measures associated with residential construction and water use or operations.

Task 3 Establish Business-As-Usual Baseline and Identify Candidate Projects to Establish High-Performance Greenbuilding Scenario

- Conduct a literature search of case studies that compare existing construction practices and corresponding baseline energy use to projected new construction that meets LEEDS or other new and high performance standards to reduce baseline energy use.
- Develop specific case studies from the region that evaluate the costs versus benefits for business-as-usual versus building to a higher level of energy performance using greenbuilding design principles. The analysis will include an assessment of the costs versus benefits of typical measures, and project an estimate of cost and payback for each. The goal of this process is to develop policies, procedures and/or recommendations for offsetting the expected increase in energy consumption if higher performance standards are not implemented.
- For projects identified, create an action plan that includes energy efficiency as a first step to implementing changes, and leads to more significant changes in project designs that would quantifiably improve their energy performance.

Task 4 Community Outreach and Technology Transfer

- Conduct stakeholder meetings to solicit input on project progress and to adjust project approach to meet the needs of local constituents.
- Conduct a Greenbuilding Workshop that updates industry stakeholders on project results and how to best incorporate findings into future energy efficiency programs that approach LEED standards to harness the highest level of energy savings in the 2006 through 2012 timeframe.

Task 5 Develop Report

- Compile a preliminary report that describes the results of work completed.
- Develop a report of tiered- policies (policy menus) for public agencies and private sector stakeholders that represent greenbuilding projects from baseline through "best practices" and present to VCREA Advisory Committee, VCREA Board of Directors and other project stakeholders for review and comment.

Project Template Applying CALEEP Workbook Principles

As one of six pilots contributing to a larger workbook process, the VCREA pilot found the following steps most apropos to the success of the project.

Identify Issue/Need

- Greenbuilding and energy efficiency issues were coupled for the proposal
- Proposal matched to a grant funding resource

Gather the Champions and Stakeholders

- Developed the consultant working "green team"
- Connected the green team to board members, advisory committee, local professionals and community leadership
- Held initial meetings to educate, engage and create core stakeholders

Refine the Tasks and Issues for Research

- Developed the tasks suitable to a menus and matrix approach
- Assembled the data for usefulness
- Responded to the stakeholders need for education and engagement
- Identified and executed both a public planning process

Public Process

- Held stakeholders meetings and green workshops
- Conducted two case studies
- Reported findings in varied and useful formats

Identified Projects Transformed to Deliverables

- Practical policy and research identified for the regional needs
- Case studies and supporting data developed for immediate application
- Identified funding sources matched to projects
- Community leadership identified and activated
- Expanded awareness of the opportunities/desirability of green building

Project Deliverables
Findings/Appendix Materials

The deliverables were assembled in a manner most requested among stakeholders: straightforward menus and matrices for principal applications, supported by research and website support through VCREA offices.

The total number of documents, research sites and related materials will be available to architects, designers, builder and contractors as a new element of the Ventura County Energy Resource Center. These documents have been assembled in several formats to support the transfer of knowledge. The key pieces are attached with this report as examples of the work that was undertaken in this pilot and may be transferable to other community efforts.

Green Building Menu Template (Attachment A)

Useful menu approach suitable for variety of audiences; reproduced in printed brochure, electronic PDF, and wall posters.

Case Study Reports (Attachment B)

Residential – Cabrillo Economic Development Corporation, multifamily housing complex suitable for farmworkers and other low income families.

Commercial – Ventura County Museum of History and Art, facility expansion located in urban downtown redevelopment neighborhood.

Green Building Workshop (Attachment C)

Co-sponsored with Ventura County Green Building Council

Sampling of Reference Reports (Attachment D)

Energy Efficiency Measures Suggested for Residential New Construction projects is one sample document available to local professionals, builders and those associated with new construction.

Project Identification

Projects briefly described represent those that have been part of the initial case study selection or came directly as a result of the green workshop process. The participating organizations are committed to the inclusion of energy efficient measures in their new construction. These projects will be matched to available utility programs to further leverage available resources.

Cabrillo Economic Development Corporation Hermosa Housing Project

This project is residential multi-family project of 24 units to primarily serve low income families in a manner that encourages energy efficiency and creates an environment that support improved lifestyles.

Ventura County Museum of History and Art Expansion

This project is expected to break ground in late 2006, and will include plans for energy efficiency standards that exceed California title 24 standards, as well as develop a marketing program in support of costs associated with energy efficient upgrades which lead to long-term lowered energy operational costs.

Santa Paula Museum of Art

This is a downtown Santa Paula commercial redevelopment project that has been designated by the city to blend history and art with public education and wise use of resources. The venue will be a local "showcase" of best practices for sustainable energy practices and operational resources.

Ventura Artspace

This is a downtown Ventura live/work commercial redevelopment project in the early design phase. The project is adjacent to the Ventura County Museum of History and Art, and will expand on the concepts/process undertaken at the Museum. The leadership has already contacted VCREA for assistance in developing the case study and will seek funding through various energy efficiency programs offered by the utilities.

Implementation Plans

Based on this pilot, the VCREA is expected to link energy efficiency to green building new construction and is positioned to:

- Encourage the application of energy efficiency and greenbuilding principles to new construction projects and support such efforts with utility sponsored programs.
- Establish greater connection with Ventura County Green Building Council to support energy efficiency in all new building undertaken by its members and use the VCGBC as a point of connection for distribution of the greenbuilding menu and poster.
- Expand on the cooperative efforts between VCREA and VCGBC to jointly host a Greens Case Study Workshop in 2006.
- Expand on the link between energy efficiency and multi-family housing units by working more closely with public housing authorities to utilize utility allowance programs that have been underutilized in the past.
- Coordinate with regional public agencies who have expressed interest in developing and/or expanding protocols and policies for greenbuilding.

Ventura County Regional Energy Alliance—CaLeep Project
Green Building Measures for Ventura County

"A Green Building is sited, designed, constructed and operated to enhance the well-being of its occupants, and to minimize negative impacts on the community and on the natural environment."

Green building design concepts and practices can be integrated into just about every aspect of the urban environment in the Ventura region. Recommended concepts and practices fall into five major categories: site, energy, materials, water and indoor environmental quality.

Site

"Buildings too, are children of Earth and Sun" – *Frank Lloyd Wright*

A building that is well integrated with its site uses less energy and supports a more comfortable interior environment. Similarly, an integrated landscape design and maintenance plan conserves water and enhances the local ecology. We can also reduce a building's transportation related impacts by locating it near public transit, bicycle and pedestrian routes.

Green site practices for urban redevelopment and downtown areas include:

- Develop urban in-fill and mixed-use projects on "brown-field" sites, and avoid remote low-density "green-field" locations. Where possible, reuse existing buildings and infrastructure.
- Avoid unnecessary disturbance to existing trees, creeks, barrancas and wetlands. Control storm water run-off during site preparation and construction.
- Design landscaping, building exterior and outdoor paving areas to reduce unnecessary heat gain and the demand for air-conditioning.
- Orient buildings to maximize interior daylighting and solar access.
- Eliminate light pollution from exterior light fixtures into the night sky.
- Encourage resource-efficient transportation such as walking, bicycling, transit, carpooling, and other less-polluting means of transportation. Provide secure bicycle parking.
- Reduce storm water run off and where possible manage storm water on site. Use permeable paving materials wherever appropriate.
- Minimize bird / building collision problems; for example, by avoiding highly reflective surfaces and glazing that wraps around building corners, and by using mullions, patterned glass, window shading devices and screens, to create visual 'noise.'

Energy

"The cheapest watt of electricity is the one you don't use."

Reduce building energy demands by maximizing the use of natural light, natural ventilation, and renewable energy systems – especially solar hot water systems. Specify energy efficient lighting and heating, ventilating, and air-conditioning (HVAC) equipment.

- Reduce energy use through passive solar and integrated building systems design.
- Optimize beneficial building orientation, and maximize natural daylighting.
- Maximize the thermal efficiency of the building envelope (windows, walls, roof).
- Install high-efficiency motors and heating and cooling equipment – boilers, furnaces, air conditioners, on-demand "tankless" water heaters.
- Install high-efficiency lights, refrigerators and other appliances.
- Optimize the interaction of daylighting, HVAC, lighting, and system controls.
- Use renewable energy sources such as solar photovoltaics and solar hot water systems.

Materials

"Pollution is nothing but the resources we are not harvesting. We allow them to disperse because we have been ignorant of their value." *R. Buckminster Fuller*

Use building materials containing recycled content, such as recycled flyash in concrete, recycled-content thermal insulation, recycled steel and aluminum, recycled decking and carpet. Choose materials that can be recovered for reuse or recycling at the end of their service life. Choose materials manufactured in a sustainable manner and from renewable sources, such as certified sustainably harvested wood. Use engineered lumber and 'I' joists, and reduce and recycle construction and demolition waste.

- Conserve, renovate, and re-use existing buildings, infrastructure and construction materials.
- Use building materials and products that are made from renewable or recycled resources, and that are themselves also recyclable.
- Where possible, use locally produced materials to minimize unnecessary transportation.
- Use durable materials that will last and require minimum maintenance.
- Use materials and products manufactured in a manner that minimizes damage to the environment, and that emit little or no environmental toxins or volatile organic compounds (VOCs).
- Help building users to reduce and recycle waste materials by allocating adequate space for recycling facilities. Locate kitchens and copy rooms near exits, and provide waste-staging areas at loading docks to optimize sorting of recyclables and efficient waste collection.

Water

"We forget that the water cycle and the life cycle are one." *Jacques Yves Cousteau*

Integrate water conservation into the landscape design and irrigation system, and into the building's plumbing, heating, ventilating and air-conditioning (HVAC) systems. Specify water efficient appliances and fixtures, and consider the use of recycled water systems.

- Manage storm water on site, and collect rainwater to irrigate landscaping.
- Use permeable paving to aid the recharging of local groundwater basins.
- Minimize the use of conventional lawns and instead use water efficient landscaping, especially native and drought tolerant plants, and use water-efficient delivery technologies such as weather-based irrigation controllers.
- Specify low-water use toilets, urinals, faucets and showerheads.
- Use gray water from clothes washers, showers, and some sinks for flushing toilets and irrigating plants and landscaping.

- Choose water and energy efficient air conditioning systems.

Indoor Environmental Quality
"Build it tight and build it right."

Maximize natural ventilation, and optimize indoor air quality by reducing toxics in interior materials, such as paints, carpets, plastics and wood products. Provide thermal and visual comfort through optimized daylighting, HVAC, and lighting designs.

- Improve indoor air quality (IAQ) by maximizing natural ventilation.
- Avoid building materials that may "off-gas" over time, or encourage the growth of mold and mildew.
- Avoid compromising indoor air quality during construction through careful duct installation, avoiding dirt and dust trapped inside enclosed plenums and minimizing the use of toxic solvents.
- Locate outside ventilation air intakes away from sources of pollution such as roads, bus stops, laundry and kitchen vents, parking areas, etc.
- Locate and ventilate photocopying and cooking areas, and other sources of indoor pollution, to avoid contaminating indoor air.
- Provide "walk-off mats" at primary building entrances. Minimize the use of carpeting.
- Maximize natural lighting and acoustical privacy, to enhance comfort and reduce fatigue.
- Provide occupants with control over the lighting, heating and cooling in their own workspace.

Green Building Information Resources

Alameda County Waste Management Authority
San Leandro, CA
510.614.1699
www.stopwaste.org

California Integrated Waste Management Board
916.341.6474
www.ciwmb.ca.gov

Environmental Building News
Brattleboro, VT
802.257.7300
www.BuildingGreen.com

Global Green USA
Santa Monica, CA
310.851.2700
www.globalgreen.org

Green Building Council of Ventura County
805.--------------
www.------------

US Department of Energy, High Performance Building Database
www.highperformancebuildings.gov

US Green Building Council
www.usgbc.org

Ventura County Regional Energy Alliance
805.289.3335
www.vcenergy.org

Ventura County Regional Energy Alliance (VCREA) Green Building and Energy Efficiency

Cabrillo Economic Development Corporation
Vista Hermosa Project Review
September 27, 2005 9:00 – 12:00

Background and Record of Discussions

Background

The Ventura County Regional Energy Alliance (VCREA) is working to identify innovative approaches to achieving higher levels of performance of new and existing buildings, including energy efficiency and green building, through funds made available under the California Local Energy Efficiency Program (LEEP), sponsored by Navigant Consulting Inc. and funded by utility consumers under the auspices of the California Public Utilities Commission (CPUC).

As part of this effort, and with the advice of an advisory group, the VCREA project team selected two local projects as case studies and reviewed them to (a) assess what factors contributed to the incorporation of energy efficiency and green attributes and what factors and barriers prevented the adoption of other attributes and (b) provide recommendations on green building and/or energy efficiency measures that might be incorporated during the design, construction and/or occupancy phases of the buildings. The projects selected for review were Cabrillo Economic Development's Vista Hermosa, a 24 unit, multi-family housing project to be constructed in Santa Paula and the Ventura County Museum of History and Art's expansion project. The project also seeks to build local capacity in green building and energy efficiency; this objective is being addressed through collaboration with the newly-formed Green Building Council of Ventura County.

Vista Hermosa is a new 24 unit multi-family farm worker housing project for low and very low income workers. The development, one of five farm worker housing projects in CEDC's development pipeline, will be located near the corner of Palm and Harvard in Santa Paula and is scheduled to start construction in the fall of 2005.

Overview of Meeting

On September 27, 2005, CEDC's design and construction team, including the project manager and others, met with the VCREA Green Building project team and representatives of the GBCVC. The participants were:

CEDC and Design Team

- Dan Hardy, Project Manager for Vista Hermosa, CEDC
- Rodney Fernandez, Executive Director, CEDC
- Brady Roark, Fountainhead Architects, Architect
- Bob Blossom, Energy Consultant
- Bob Bailey, Construction Manager, CEDC
- Larry Pape, Construction Superintendent, CEDC
- Eduardo Hinojosa-Espinoza, Project Manager, CEDC
- Krystal Cook, Manager, CEDC

VCREA Green Building and Energy Efficiency Team

- Cheryl Collart, Executive Director, VCREA
- David Inger, Energy Program Manager, VCREA
- John Deakin, Energy Consulting Services
- Kurt Kammerer, Energy Consultant
- Ann Hewitt, Anacapa Consulting Services Inc.
- Chas Ehrlich, Heschong Mahone Group
- Heather Larson, Heschong Mahone Group

Green Building Council of Ventura County

- Tracey Reineke, President, Ventura County Green Building Council
- Tyson Cline, Vice-President, Ventura County Green Building Council
- David Intner, Ventura County Green Building Council and LEED-Certified Professional

Record of Discussions

The meeting was opened by Cheryl Collart, who outlined the expectations for the meeting and thanked the participants for their time and openness to a unique process. After a roundtable of introductions, John Deakin and Kurt Kammerer provided the participants with an overview of the VCREA approach to green building and energy efficiency.

Dan Hardy outlined the key elements of the project. Twenty-four units will be built on 1.39 acres. The project has taken five years to finance, with funding coming from the federal HOME program (via the County), USDA Rural Development, Proposition 46 Bond funds, Low-Income Housing Tax Credits, Bond financing, a construction bank loan, Affordable Housing Program dollars through the federal Home Loan Bank, and a predevelopment grant from the Ventura County Community Foundation. Design began in 2000. CEDC will be the developer and owner and the funding stipulates that they will own the units for a minimum of 55 years. Because of the nature of the funding sources (traditional and conservative), any green building or energy efficiency elements that add to the cost of the project cannot be introduced because there would be no funding to pay for them. The financing is based on ongoing costs of the project, including a utility allowance based on the Santa Paula Housing Authority. Dan Hardy reviewed the site and the orientation of units and improvements on it, the design of landscaping and water controls, indoor air quality and energy.

Issues

With respect to air quality, air exchange and ventilation is part of the design. Air conditioning is required because of the proximity of the project to the freeway, to reduce sound.

Energy efficiency was taken into account by rotating units on the site, without changing the basic architecture. The challenge was with west-facing three bedroom units.

Heschong Mahone has worked with CEDC to explore Energy Star incentives. CEDC has considered this program because of the incentives, the publicity, rebates, deferred costs and the fact that this is a better way to work. Under the old Title 24 standards, the project was somewhere between 15% and 30% above standards. Under 2004 standards, that percentage drops to 3%. Heschong Mahone worked with CEDC to explore an Energy Star incentive, but concluded that the incentive didn’t offset the cost of the recommendations. Nevertheless, changes to the water heater (including a tankless water heater) had a significant impact on the project’s energy efficiency. Nevertheless, the need to filter water is a maintenance issue for CEDC.

The site plan has been established and any changes to it would require new approvals, something that cannot be done at this point in the project. The challenge for this project was to maximize the number of units, while reducing the footprint; the solution was to place the garage under the living units. The group briefly discussed some of the changes that might be made to similar projects in the future, and agreed that changes that were possible were to the landscaping and to the exterior lighting.

Opportunities

Working with the housing authority to develop an energy efficient utility allowance might change the LIHTC pro forma, and allow costs for other green building and/or energy efficiency improvements.

Technologies like the “economizer” are available, that include sensors for doors and windows such that air conditioning is only operating when there are people in the home.

Since some of the technologies that will be used in the building are new, there is an opportunity to prepare a project-specific “tenants manual” that provides management guidelines.

There is a potential to install condensing tankless water heaters; this would allow for easier maintenance because they would be located in the garage using a marble neutralizer. Similarly hydronic fan coils could be used for heating.

Operable skylights can reduce the need for air cooling and do not impact the requirement to reduce sound in the units.

Not all units in the development are subject to the requirement to reduce sound, and CEDC could explore using whole house fans in those units rather than air conditioning.

VCREA and Heschong Mahone recommended that CEDC install lighting that is consistent with 2005 Title 24 standards, because it is so efficient and will reduce long-term and tenant costs.

Small changes to the way interior fixtures are installed can affect the interior air quality, including painting of bare surfaces on kitchen cabinets. CEDC was also encouraged to explore alternatives to concrete, if not for this project, then for future ones.

Closing and Follow-Up

At the close of the meeting, all participants indicated the value of the discussion. VCREA committed to assisting CEDC with their choices on condensing units. The Green Building Council agreed that over the long term they would work with local jurisdictions to reduce parking requirements for all projects, including low-income housing. VCREA agreed to work with housing authorities to develop energy efficiency utility allowances and to then educate developers on their use in increasing funding points under programs like the LIHTC.

Results of the meeting will be presented at the October 12, 2005 Green Building and Energy Efficiency Workshop to be held at the Ventura Museum of History and Art.

Ventura County Regional Energy Alliance (VCREA) Green Building and Energy Efficiency

Ventura County Museum of History and Art
Green Building and Energy Efficiency Review and Discussion
October 5, 2005 – 1:00 p.m. to 4:30 p.m.

Background and Record of Discussions

Background

The Ventura County Regional Energy Alliance (VCREA) is working to identify innovative approaches to achieving higher levels of performance of new and existing buildings, including energy efficiency and green building, through funds made available under the California Local Energy Efficiency Program (LEEP), sponsored by Navigant Consulting Inc. and funded by utility consumers under the auspices of the California Public Utilities Commission (CPUC).

As part of this effort, and with the advise of an advisory group, the VCREA project team selected two local projects as case studies and reviewed them to (a) assess what factors contributed to the incorporation of energy efficiency and green attributes and what factors and barriers prevented the adoption of other attributes and (b) provide recommendations on green building and/or energy efficiency measures that might be incorporated during the design, construction and/or occupancy phases of the buildings. The projects selected for review were Cabrillo Economic Development's Vista Hermosa, a 24 unit, multi-family housing project to be constructed in Santa Paula and the Ventura County Museum of History and Art's expansion project. The project also seeks to build local capacity in green building and energy efficiency; this objective is being addressed through collaboration with the newly-formed Green Building Council of Ventura County.

The Museum will be adding over 18,000 square feet of activity space to the existing building, located at 100 East Main Street in Ventura. The space will be used for additional galleries, an expanded library and archive, classrooms for the museum's educational programs and the Martin V. and Martha K. Smith Pavilion for cultural, recreational and educational activities. Fundraising is underway and on target and the City Planning Commission recently approved the expansion. The Museum's project team is now proceeding with design development and construction drawings, while fundraising continues.

Overview of Meeting

On October 5, 2005, the Museum's design team, including the Executive Director and the President of the Board met with the VCREA Green Building project team and representatives of the GBCVC. The participants were:

VCMHA and Design Team

- John R. McConica II, Board President
- Tim Schiffer, Executive Director
- David Dolan, Expansion Manager
- Kathy Henri, Collections Manager
- Architects: A C Martin Partners Inc., David Martin
- Electrical Engineers: G&W Consulting Electrical Engineers, Eric Percic
- Lighting Consultants: Ann Kale Associates, Jeffrey Boynton
- Mechanical Engineers: M.B.& A. Consulting, Mel Bilow
- The construction manager, Jim Azbell of HMH Construction was unable to attend due to prior commitments.

VCREA Green Building and Energy Efficiency Team

- Cheryl Collart, Executive Director, VCREA
- David Inger, Energy Program Manager, VCREA
- John Deakin, Energy Consulting Services
- Kurt Kammerer, Energy Consultant
- Ann Hewitt, Anacapa Consulting Services Inc.

Green Building Council of Ventura County

- Tracey Reineke, President, Ventura County Green Building Council
- Tyson Cline, Vice-President, Ventura County Green Building Council
- David Intner, Ventura County Green Building Council and LEED-Certified Professional

Two observers, Craig Fraki and Rick White were also present.

Record of Discussions

The meeting was opened by Cheryl Collart and John McConica, who outlined the expectations for the meeting and thanked the participants for their time and openness to a unique process. Mr. McConica outlined the importance and significance of the expansion for the Museum. It is a large undertaking, with a total budget of approximately $8 M, $6.5 of which will be used for construction. Fundraising is on target; $5 million have been pledged to date and it is anticipated that the full amount will be available as needed. The project will be built on 1.5 acres of land donated by the City of Ventura, and will include an area of open space that may be available for additional expansion at a later date. Construction is slated to begin in September 2006, pending the board meeting fundraising targets.

After roundtable introductions to familiarize participants with each others' roles in the project, Tim Schiffer outlined the history of the project and its main elements. The architectural competition took place in 2000, in response to needs identified by the Board, and A C Martin Partners Inc. were selected as the architects in 2001. (A C Martin was the architect for the original building.) The expansion takes into account the historical significance of the site, which was once the orchard for the San Buenaventura Mission, located nearby. Mr. Schiffer walked the group through the main features of the expansion; copies of drawings are attached to these notes as appendices. With respect to the site, Mission Park is to the east, a "grassy lawn" is to the south, with potential for additional expansion. The school district site behind the Museum and across Santa Clara Street has been sold and will be used for infill housing and two blocks away the City has planned a mixed use commercial/residential artspace.

Mr. Martin, the architect, discussed the design process, including the decision to use as a central theme the mission and orchard walls, constructed of river rock and wood. The front of the building incorporates these features and also accommodates an archaeological feature and creating a "pavilion in a park". Interior spaces are based on sequencing, moving from gallery to open space to gallery to open space, making the experience one of surprise and discovery.

The group then discussed the green features of the building using the LEED categories, the features of the building that relate to them and the challenges and opportunities for the project:

Building Site

- The green features of the building are drought-tolerant and native landscape, preservation of an archaeologically significant wall, heat-island issues, incorporation of bicycle racks.

- The museum will be used at night for showcase events and there is a desire to have it light the way, so that people are drawn from the central part of downtown to the museum. The challenge is to achieve this result without introducing light pollution.

- The design team has considered using a bio-swale to collect rainwater, but this may compete with future expansion plans.

- Currently the site includes a considerable amount of open space that can be used in ways that are consistent with green building. Trees on the site could also be used to shade the south side of the building.

- The aqueduct metaphor and the recycling of river rock from Thomas Aquinas College may provide an opportunity to educate the public about the value of recycling.

Energy and Atmosphere (including lighting and indoor air quality)

- Lighting in expansion will comply with Title 24 requirements, making energy efficiency good. New electrical service to the building is required.

- Use of natural ventilation is difficult to achieve due to stringent humidity control requirements for collections. This includes the requirement for 24-7 HVAC.

- Similarly, while daylighting reduces the need for energy-dependent lighting, collections are sensitive to sunlight and must be protected from it.

- For the expansion, there may be opportunities to make use of more daylighting and natural ventilation in the assembly room.

- Opportunities for improving the existing building could be explored further, e.g., replacing existing lighting to create a future positive cash flow. Similarly, although dimming and EE lighting (e.g., CFL, cold cathode) are not always appropriate in a museum setting, dimming could be used in conjunction with occupancy sensors to reduce energy use. The challenge will be to not create a situation where changes to the existing building must also meet Title 24 standards.

Materials

- The materials to be used in the building are stone, bamboo flooring, truss systems. The group also discussed the feasibility of using alternative materials in the building envelope, including alternatives to pressure-treated woods and the use of ICF.

Innovation

- This is one of the categories under LEED that can also include education. The Museum is interested in using some of the exhibit space to “tell the story” of green building and energy efficiency in the building.

- The group discussed the feasibility of LEED certification, noting that if the building were certified as silver, it would be the first LEED certified building in the City. The public value of LEED certification will be considered as the design team proceeds.

Financial Issues

- There was considerable discussion about decision-making based on “first-costs” (costs at construction) versus lifecycle costs and how long term benefits could be accrued by using LCA to determine cost savings and then using that analysis to identify funding sources like bonds, SCE on-bill financing, innovative benefactor contributions and financing. This would allow the design team to make different decisions about “high-ticket” items, including a high efficiency chill water system versus the currently planned package units. There is a need to maintain the Museum’s relationship with the SCE Savings By Design team, to update the assessment completed in 2004 and to seek additional rebates and incentives.

- Using a return on investment approach to fundraising (“your $5,000 donation now represents $50,000 in ten years) was seen as a promising approach to funding what are often seen as less visible parts of public spaces like museums and galleries.

Closing and Follow-Up

At the close of the meeting, all participants indicated the value of the discussion and the potentials it raised for fundraising and for improving the energy efficiency and sustainability of the building.

Results of the meeting will be presented at the October 12, 2005 Green Building and Energy Efficiency Workshop, to be hosted by the Museum.

Green Building and Energy Efficiency Workshop and Discussion

Ventura County Regional Energy Alliance and Ventura County Green Building Council[1]

Wednesday, October 12, 2005 – 3:00-7:00 p.m.
Ventura County Museum of History and Art
100 East Main Street, Ventura, California 93001

Summary of Discussion

Opening

Cheryl Collart, Director of the VCREA welcomed participants to the workshop, providing:

- an overview of the VCREA, its mission, goals, members and activities and the benefits it can offer to the community, and
- a brief description of the history and rationale for VCREA's green building and energy efficiency project, part of Navigant Consulting's CALeep program.

John R. McConica II, President of the Board of Directors for the Ventura County Museum of History and Art welcomed the group to the facility and expressed appreciation for the fact that the museum's expansion project had been considered as one of two case studies in the project.

Green Building and Energy Efficiency in Ventura County

John Deakin, energy consultant to the VCREA, provided an overview of VCREA's approach to green building, reviewing definitions used by other jurisdictions and proposing one for VCREA: A green building is sited, designed, constructed and operated to enhance the well-being of its occupants, and to minimize negative impacts on the community and on the natural environment. The current project sought to develop information on local priorities for green building, support local governments with their green building programs, and worked with local green building advocates, primarily the Green Building Council of Ventura County (gbcVC). VCREA's green building goals, that extend beyond the life of the current project, are to help remove barriers to green building and to make green building the "business as usual" choice in Ventura. The key elements of green building that have been addressed under the CALeep project are site, energy, materials, water and indoor air quality.

Kurt Kammerer, energy consultant to the VCREA, reviewed VCREA's approach to energy efficiency, noting that energy efficiency is a long term commitment and that will implementing energy efficiency is not difficult, it can challenge standard practices. As a result, excellence in energy efficiency requires good access to information and education, something that the VCREA's energy resource center provides. While public agencies can lead by example, success comes through strong partnerships that include utilities, local agencies,

[1] The project is part of the California Local Energy Efficiency Program (LEEP), which seeks to identify innovative local government approaches to achieving higher levels of energy efficiency. The project is sponsored by Navigant Consulting, Inc. and funded by California ratepayers under the auspices of the California Public Utilities Commission (CPUC).

stakeholders and the private sector. Green building is important because it addresses the energy challenges faced by the State: energy supply and reliability is still a challenge, continued high electricity and natural gas prices are expected. California policy has established energy efficiency as its number one resource priority. He then reviewed information related to California's energy supply, the efficiency of our energy distribution system, providing statistics on the value of implementing energy. Using current electricity rates and conservative estimates, savings would be in the range of $12.4M per year for Ventura County and, by 2013, the cumulative savings would be $115.2M. He then reported on the types of savings that are potential, based on end uses, and examined some of the new technologies that are being discussed, including solar power.

Tracey Miles Reineke gave an introduction to the Green Building Council of Ventura County, whose mission is to advise the community about Green Building technologies, development, resources, and materials while further establishing a forum for public interest in green building. The gbcVC was formed in October 2004, and is a coalition of professionals, businesses and concerned citizens. It is currently pursuing non-profit status as a professional association; gbcVC is not part of the U.S. Green Building Council, choosing to retain a more local presence. Its organizational goals are education, advocacy, resource compilation, capacity building and network partnerships. Long term goals are to become an integral component of the building community in Ventura County, to advocate for both the built and natural environments, to improve the methods of building in Ventura, to become a key local information resource and to encourage long-term, "life-cycle" thinking. He encouraged the group to view the organization's website at www.gbcvc.org.

Green Building and Energy Efficiency: Ventura Success Stories and Opportunities

David Inger, Energy Project Manager with the VCREA, reviewed the incentives that are available to VCREA member agencies through VCREA's partnership with Southern California Edison and the Southern California Gas Company. $579,833 in incentives have resulted in annual savings of $357,000 per year. One project that has been completed by the City of Ventura is the Public Works building. The project includes solar photovoltaics, lighting retrogrades and other energy efficiency improvements. It was financed through partnership funds, funds from the California Energy Commission and from the City and has resulted in what will be a "zero net energy" building, e.g., a building that produces as much energy as it needs to operate without relying on energy from utilities.

Tracey Miles Reineke, gbcVC discussed the history the City of Ventura's green building resolution, adopted in May 2005 and currently in the process of being implemented. The standards to be used are: for commercial buildings, United States Green Building Council's Leadership in Energy & Environmental Design for New Construction (LEED-NC); for residential developments with 4 or more dwellings, the Building Industry Institute's California Green Builder Program and for smaller residential projects, a local version of Seattle's Built Green program. The program is voluntary for private projects and mandatory for any city projects totaling 5,000 square feet or more. The benefits are "head of the line" service in permitting for developers, documented returns on investment, environmental benefits and positive publicity.

David Intner, gbcVC described some of the green buildings that exist or are in design or construction in the County. They include: the U.S. Navy's Public Works Building (a LEED Gold facility), the Patagonia campus, the Ojai Foundation Gateway Building (the first legally-permitted straw bale building in Ventura County), the Burns residence, the Hernandez residence (a Habitat for Humanity house), the Bullard residence, and two residences that are under construction and/or in design phases: the Mint Lane residence and the Via Cielito residence.

Local Case Studies

The CALeep Green Building/Energy Efficiency project included more in-depth examination of two projects. Prior to the workshop, the VCREA and gbcVC team met with management and design representatives for each of the projects to explore ways in which green building and/or energy efficiency features could be enhanced.

- **Green Building and Energy Efficiency in Multi-Family Housing: Cabrillo Economic Development Corporation's Vista Hermosa**
  Kurt Kammerer (VCREA)
  Dan Hardy (CEDC)
  Karen Flock (CEDC)

Cabrillo Economic Development Corporation's (CEDC) Vista Hermosa is a new multi-family farm worker housing project for low and very low income workers. The development will be located near the corner of Palm and Harvard in Santa Paula and is scheduled to start construction in the fall of 2005. CEDC will develop the property and will also own it; funding conditions stipulate ownership for a minimum of 55 years. Twenty-four rental units will be located in six two-story buildings, with over-ground floor parking. The project team includes Brady Roark, architect, Hawks & Associates, Civil Engineers and Bob Blossom Architect, Energy Consultant. The site is centrally located, near parks, schools, grocery stores and public transportation. Because it is in the flood plain, the site required modification before building could occur. Financing for the building is complex, and includes a number of public and private sources, all of whom have unique grant and loan criteria, affecting the ability to introduce green building or energy efficiency improvements. When some contingency funds became available CEDC considered the Energy Star program, and worked with Heschong Mahone Group to consider what energy efficiency improvements above basic Title 24 requirements would be feasible. Heschong Mahone proposed the addition of R-30 attic insulation and a radiant barrier, R-13 insulation in the walls, a 12-13 SEER room heat pump and an instantaneous gas water heater. With an energy star rebate, the payback period on these investments would be 2.6 years. The case study meeting resulted in additional recommendations, including use of 2005 lighting standards and an Energy Star advanced lighting package, EnergyStar appliances, HERS inspections and tenant education about conserving energy, through the development of a "user's manual". Other options being considered by CEDC include rotating buildings and adding overhangs, and combining DHW and space heating for an 8% increase in performance.

- **Green Building and Energy Efficiency in a Commercial Application: Ventura County Museum of History and Art Expansion**
  John Deakin (VCREA)
  John R. McConica II (VCMHA)
  Tim Schiffer (VCMHA)

Tim Schiffer outlined the history of the project and its main elements. The architectural competition took place in 2000, in response to needs identified by the Board, and A C Martin Partners Inc. were selected as the architects in 2001. (A C Martin were the architects for the original building.) The expansion takes into account the historical significance of the site, which was once the orchard for the San Buenaventura Mission, located nearby. Mr. Schiffer walked the group through the main features of the expansion. Mr. McConica addressed the fundraising efforts related to the expansion and their relationship to green building and energy efficiency. John Deakin invited participants to provide comments on how to engage the local community and benefactors in funding items that are not as visible as other components of public projects, like assembly halls and galleries. The museum was encouraged to examine the implications of introducing energy efficiency for greenhouse gas emission reductions. The suggestion was made that a “tally” of energy savings could be located somewhere in the museum to demonstrate to visitors the effect of upfront costs in energy efficiency. The message to donors is that making a donation towards green building and/or energy efficiency is an investment and can influence the way people feel when coming through the door. The museum could be a showcase in Ventura – there is only one other LEED certified building in the County. Fundraising can take into account return on investment, so that people are aware that they are contributing beyond the “first costs” of a building.

Maintaining Momentum – How Do We Make Green Building Happen in the Ventura Region?

The first question raised by the facilitator, Ann Hewitt, was “what audiences/groups are and should be engaged in green building and energy efficiency?” Responses included (in no specific order): architects, engineers, owners, contractors, “old money”, building officials, children, homeowners, waste companies, health groups, gardening societies, service clubs, suppliers, historical groups, utilities, industry, politicians, art groups, “green” manufacturers, institutions, lending institutions, all level of government, spiritual leaders and churches and environmental stewards.

The group was then asked to explore the barriers to green building and energy efficiency, keeping in mind that barriers can be group-specific, and that one person’s barrier may not be another person’s. The following barriers (and their respective audiences) were identified:

- Lack of education/knowledge; a barrier for all of the groups identified above, but particularly for design professionals, clients, contractors and lending institutions.
- Access to products; a barrier for contractors and designers.
- Globalization of manufacturing; a barrier because it disconnects manufacturing from the local environment and introduces problems related to transportation, resulting in “embedded” energy in products. This is a particular barrier for designers.
- Building codes.
- Thinking of capital, short-term costs instead of operating, long-term costs.

Some recommendations made regarding these barriers included approaching banks with information on green building, documenting the benefits of green building and energy efficiency over the long term, connecting energy and other issues to questions of life quality and education, education, education.

The final question asked of the group was “how do we bring the groups we have identified together, in Ventura County, to solve barriers?” The suggestions that were discussed were:

- Be prepared for news coverage. Have “prepackaged” stories for newspapers that are available at any time, including photos. Use public radio.
- Consider a “barn raising” (like the one used to build the straw bale Ojai Foundation building) as an idea for demonstrating green building.
- Make city councils and design review committees aware that green buildings are what the community wants.

- Build green buildings and establish precedents so that groups (like developers, building officials, etc.) get over their hesitancy about something that is "new".
- Provide training for building officials on green building and energy efficiency.
- Learn from other communities that have managed to engage the public.
- Ask large public and private agencies (like city, counties, hospitals) to appoint an advocate for green building, someone that can champion the idea from within.
- Host media-only events to encourage green building and energy efficiency immediately.
- Host teacher-only events to encourage it in the long-term.
- Make presentations at farmers markets.
- Engage federal government agencies in green building when they develop properties in the county.
- Consider publishing a leaflet, to be included with utility bills, that outlines specific green building and energy efficiency practices.
- Ask for green building products in stores – they will respond to the demand.

Closing Remarks

Cheryl Collart thanked the group for attending, noting that many of the ideas were long term in nature and that the VCREA and the gbcVC are both committed to maintaining momentum on energy efficiency and green building. A report on the CALeep project will be made available via the VCREA website in the near future. She thanked the Museum for hosting the event and introduced Ron Stassi of Navigant Consulting. Mr. Stassi provided background information on the CALeep project and commended the group on the work that had taken place during the meeting.

Ventura County Regional Energy Alliance (VCREA)
CALeep Pilot Project

Building Energy Measures: Residential

1. Building Envelope (walls, windows, doors, roof)
    a. Title 24 building codes ensure that these elements measures are incorporated into all new homes. Windows and insulation are a very large opportunity for existing, older homes. In many cases, the need for heating and cooling can largely be eliminated, especially in coastal areas.
    b. Passive solar design (maximizing solar heating in winter and avoiding solar heating in summer).
        i. Building oriented east-west.
        ii. Strategic planting of deciduous trees south and west sides of the home).

2. Lighting
    a. High-efficiency, compact fluorescent lamps
    b.

3. Appliances
    a. Refrigerator
    b. Hot water Heater
        i. Add square footage to your home by installing a “tankless” water heater.
    c. Washer/ dryer
    d. Dishwasher
4. Active energy production (solar photovoltaics and solar domestic and pool hot water heating).
5. Pools
    a. High-efficiency motors and heating equipment
6. Plug Loads

Energy Efficiency Potential by Measure: Residential (Electric)

Measure	Levelized Energy Costs ($/kWh)	Statewide GWh Savings	Total Statewide Estimated Cost Savings	Ventura County Estimated Cost Savings ($ MM)
Water Heater Blanket	$ 0.008	126	$ 18.900	**$ 0.4**
Pipe Wrap	$ 0.016	24	$ 3.600	**$ 0.1**
High Efficiency Tube Fluorescent	$ 0.017	324	$ 48.600	**$ 1.0**
Double Pane Window	$ 0.023	976	$146.400	**$ 3.1**
Low Flow Showerhead	$ 0.026	45	$ 6.750	**$ 0.1**
High-Efficiency Pool Pump and Motor	$ 0.029	1,152	$172.800	**$ 3.6**
Faucet Aerators	$ 0.031	28	$ 4.200	**$ 0.1**
Compact Fluorescent Lamps	$ 0.036	6,523	$978.450	**$ 20.5**
High-Efficiency Clothes Washer	$ 0.043	654	$ 98.100	**$ 2.1**
High-Efficiency Water Heater	$ 0.057	97	$ 14.550	**$ 0.3**
High-Efficiency Freezer	$ 0.064	181	$ 27.150	**$ 0.6**
Refrigerator- Early Replacement	$ 0.065	4,313	$646.950	**$ 13.6**
Heat Pump Space Heater	$ 0.085	419	$ 62.850	**$ 1.3**
Energy Star Dishwasher	$ 0.086	199	$ 29.850	**$ 0.6**
Duct Insulation	$ 0.109	28	$ 4.200	**$ 0.1**
High-Efficiency Refrigerator	$ 0.120	1,077	$161.550	**$ 3.4**
Thermal Expansion Valve-A/C	$ 0.124	127	$ 19.050	**$ 0.4**
Heat Pump Water Heater	$ 0.143	622	$ 93.300	**$ 2.0**
High-Efficiency Clothes Dryer	$ 0.178	173	$ 25.950	**$ 0.5**
Wall Insulation	$ 0.205	214	$ 32.100	**$ 0.7**
Ceiling Insulation	$ 0.215	276	$ 41.400	**$ 0.9**
Programmable Thermostat	$ 0.240	50	$ 7.500	**$ 0.2**
HVAC Testing and Repair	$ 0.241	175	$ 26.250	**$ 0.6**
Duct Repair	$ 0.263	87	$ 13.050	**$ 0.3**
Floor Insulation	$ 0.477	23	$ 3.450	**$ 0.1**
High-Efficiency Room Air-Conditioner	$ 0.529	36	$ 5.400	**$ 0.1**
Window with Sunscreen	$ 0.600	420	$ 63.000	**$ 1.3**
Solar Water Heater	$ 0.647	261	$ 39.150	**$ 0.8**
Direct Evaporative Cooler	$ 0.652	197	$ 29.550	**$ 0.6**
Whole House Fans	$ 0.679	206	$ 30.900	**$ 0.6**
Attic Venting	$ 0.789	67	$ 10.050	**$ 0.2**
Central Air-Conditioner	$ 1.095	468	$ 70.200	**$ 1.5**
Infiltration Reduction	$ 2.049	16	$ 2.400	**$ 0.1**
Ceiling Fans	$ 2.454	18	$ 2.700	**$ 0.1**
Cool Roofs	$ 16.810	107	$ 16.050	**$ 0.3**

Energy Efficiency Potential by Measure: Residential (Gas)

Measure	Levelized Energy Cost $/Therm	Statewide Mth Savings	Total Statewide Estimated Cost Savings
Water Heater Blanket	$ 0.080	105	$ 116
Pipe Wrap	$ 0.170	20	$ 22
Low-Flow Showerhead	$ 0.290	39	$ 43
Faucet Aerators	$ 0.340	24	$ 26
Boiler Controls	$ 0.400	8	$ 9
Duct Insulation	$ 0.590	12	$ 13
Programmable Thermostat	$ 0.600	15	$ 17
HVAC Testing and Repair	$ 0.780	60	$ 66
High-Efficiency Boiler	$ 0.820	6	$ 7
High-Efficiency Water Heater	$ 0.930	76	$ 84
Horizontal Access Clothes Wash	$ 0.930	322	$ 354
Wall Insulation	$ 0.980	152	$ 167
Ceiling Insulation	$ 1.070	84	$ 92
Duct Repair	$ 1.700	40	$ 44
Energy Star Dishwasher	$ 1.990	79	$ 87
Condensing Furnace	$ 2.820	193	$ 212
Floor Insulation	$ 3.110	71	$ 78
Solar Water Heat	$ 3.520	831	$ 914
Infiltration Reduction	$ 5.060	6	$ 7
High-Efficiency Clothes Dryer	$ 6.430	5	$ 6

Need to Add
Tankless Water Heater
Solar Hot Water Heating

Residential Electricity Energy Efficiency Measures

HVAC

Central Air Conditioner Upgrade
Air conditioner equipment includes a compressor, an air-cooled or evaporative-cooled condenser (located outdoors), an expansion valve, and an evaporator coil (located in the supply air duct near the supply fan). Cooling efficiencies vary based on the quality of the materials used, the size of equipment, the condenser type and the configuration of the system. Central air conditioners may be of the unitary variety (all components housed in a factory-built assembly) or be a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor at either the outdoor or indoor location). Efficient air conditioner measures involve the upgrade of a standard efficiency unit (10 SEER) to a higher efficiency unit (12, 13, or 14 SEER).

TXV
Thermostatic expansion valves optimize refrigerant flow over a wide range of load conditions. The TXV helps regulate the refrigerant to match the load conditions inside the home, thereby reducing compressor use. The air conditioners then operate about 10-20 percent more efficiently.

High Efficiency Room Air Conditioner
Window (or wall) mounted room air conditioners are designed to cool individual rooms or spaces. This type of unit incorporates a complete air-cooled refrigeration and air-handling system in an individual package. Cooled air is discharged in response to thermostatic control to meet room requirements. Each unit has a self-contained, air-cooled direct expansion (DX) cooling system and associated controls. The efficient room air conditioner measure involves the upgrade of a standard efficiency unit (8.8 SEER) to a higher efficiency unit (10.3 SEER).

Heat Pump
Heat pumps consist of a refrigeration system using a direct expansion cycle. Equipment includes a compressor, an air-cooled or evaporative-cooled condenser (located outdoors), an expansion valve, an evaporator coil (located in the supply air duct near the supply fan) and a reversing valve to change the DX cycle from cooling to heating when required. The cooling and heating efficiencies vary based on the quality of the materials used, the size of equipment, the condenser type and the configuration of the system. Heat pumps may be of the unitary variety (all components housed in a factory-built assembly) or be a split system (an outdoor condenser section and an indoor evaporator section connected by refrigerant lines and with the compressor at either the outdoor or indoor location).

Condensing Furnace 92 AFUE
Condensing furnaces have annual fuel use efficiencies (AFUEs) of 90 percent or higher, compared to standard efficiency furnaces with AFUEs

of around 78. Efficiency is dependent on vent type, burner type and heat transfer surface. Condensing furnaces derive useful heat from condensing vaporized by-products of combustion by exchanging this heat with the circulating indoor air stream. Furnaces with intermediate efficiencies (82 percent to 90 percent) typically form condensate and have high flue gas temperatures that require costly, corrosion-resistant metals for the venting system. For this measure, it is assumed that a standard-efficiency central furnace is replaced with a condensing furnace.

Programmable Thermostat
A clock thermostat reduces the heating set point or increases the cooling set point during programmed periods during the day or week. This method of control is used, most often, to reduce heating and cooling energy use during unoccupied periods. Clock thermostats for heating and cooling units are available in one-day, seven-day, and 365-day programmable versions, with a battery backup in case of power failure. Clock thermostats are available in electronic and mechanical versions.

Ceiling Fans
The convective heat transfer from the body depends on the velocity of the air moving over it. Humans can remain comfortable in a warm humid environment if the air movement is high. For this measure, propeller style fans are hung from the ceiling to provide air motion directly to occupants. Energy savings are assumed to occur, because higher cooling temperature set points are facilitated by the rapid air motion provided by the fans.

Whole House Fans
Whole house fans keep a home cool during the cooling months instead of running the air conditioner. These fans typically consume 0.22kW (1/3 hp) about one-third the consumption of a central air conditioner. These fans pull cool air from the outside, move air through the house, and/or remove hot air through the attic.

Attic Venting
Attic venting reduces heat gain in the summer and prevents condensation (humidity) in the winter. This measure involves a motor-driven, thermostat controlled fan.

HVAC Diagnostic Testing and Repair
This measure involves diagnostic and repair services for existing central air conditioners to improve their efficiency. Inspection and services of AC systems involves checking the refrigerant level, cleaning the coils, cleaning the blower, and cleaning or replacing filters. Additionally, furnace adjustments increase efficiency by insuring that the furnace fan stays on as long as there is heat in the exchanger. Fan off control is adjusted to maximize efficiency. Additional adjustment of the thermostat anticipator, which controls gas burn time, can increase furnace cycling efficiency.

Duct Repair
An ideal duct system would be free of leaks, especially when the ducts are outside the conditioned space. Leakage in unsealed ducts varies considerably with the fabricating machinery used, the methods for assembly, installation workmanship, and age of the ductwork. To seal

ducts, a wide variety of sealing methods and products exist. Care should be taken to tape or otherwise seal all joints to minimize leakage in all duct systems and the sealing material should have a projected life of 20 to 30 years. Current duct sealing methods include use of computer-controlled aerosol and pre- and post-sealing duct pressurization testing.

Duct Insulation

Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated flexible duct, duct board, duct wrap, tacked or glued rigid insulation, and water proof hard shell materials for exterior ducts. Duct insulation for existing construction involves wrapping uninsulated ducts with an R-4 insulating material.

Building Envelope

Ceiling and Floor Insulation

Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. By inhibiting the flow of heat energy, thermal insulation can conserve energy by reducing heat loss or gain of a structure. An important characteristic of insulating materials is the thermal resistivity or R-value. The R-value of a material is the reciprocal of the time rate of heat flow through a unit of this material in a direction perpendicular to two areas of different temperatures. Insulation material inhibits the transfer of heat through the roof, wall or floor structure. The type of building construction helps define insulating possibilities. Because there are a variety of structure construction types, the choice of insulation materials will also vary. Typical insulating materials include: loose-fill (blown) cellulose; loose-fill (blown) fiberglass; batts of fiberglass; and rigid polystyrene. Two ceiling insulation measures are included in this study: (1) adding R-19 insulation to an un-insulated home, and (2) increasing insulation from R-19 to R-38 for homes with some existing insulation.

Floor Insulation

Floor insulation involves adding R-19 insulation to raised floors in existing homes. Most newer homes are constructed with cement slab foundations, in which case this measure does not apply.

Wall Insulation

For existing construction, this measure involves adding R-11 insulation to uninsulated walls. This is usually accomplished by drilling holes into the building's siding and blowing in insulation material.

Infiltration Reduction

Infiltration reduction measures include weather-stripping and caulking. These measures reduce energy consumption by improving the tightness of the building shell and limiting heat gain and loss. Home installation of these measures is usually most effective at fixing easily found leaks. Professional installation of these measures sometimes includes use of blower doors and is usually much more effective than home installation methods. Measure costs for this study reflect professional weatherization.

Cool Roofs
The color and material of a building structure surface will determine the amount of solar radiation absorbed by that surface. By utilizing the appropriate, lighter-colored building materials (and lower solar absorption), the roof will absorb less solar radiation and consequently reduce the cooling load.

Double Pane Clear Windows to Double Pane, Med Low-E Coating
Windows affect building energy use through thermal heat transfer (U-value), solar heat gains (shading coefficient), daylighting (visible light transmittance), and air leakage. The performance of a window is determined by the type of glass, the number of panes, the solar transmittance, the thickness of, and the gas type used in the gap between panes (for multi-pane windows). The best spectral selectivity would have a high transmittance over the entire solar spectrum. This would include admitting the most solar radiant heat and a low emissivity (high reflectivity) over the long-wavelength infrared radiation spectrum, to reflect low-temperature radiant heat from the walls and room furnishings back into the building. Conventional low-emittance (low- E) windows approximate this ideal performance.

Window Film
This measure involves application of a dark-colored film to the existing windows of a home. The film lowers the shading coefficient of a window, reducing the amount of solar heat gain of a building, and thus decreasing the cooling load for the building.

Sunscreen
This measure is a dark colored screen that is attached to the outside of a window. Similar to window film, this measure lowers the shading coefficient of a window.

<u>Lighting</u>

Compact Fluorescent Lighting (CFLs)
Compact fluorescent lamps are designed to replace standard incandescent lamps. They are approximately four times more efficient than incandescent light sources. Screw-in modular lamps have reusable ballasts that typically last the life of four lamps.

T-8 Lamps with Electronic Ballast
T-8 lamps are a smaller diameter fluorescent lamp than T-12 lamps. When paired with specially designed electronic ballasts, T-8 lamps provide more lumens per watt resulting in energy savings. Electronic ballasts replace the standard core and coil technology in magnetic ballasts with solid-state components. This technology allows for more consistent control over ballast output and converts power to higher frequencies, causing the fluorescent lamps to operate more efficiently.

Halogen PAR Flood Lights
Halogen PAR (parabolic aluminized reflector) lamps use an enclosed tungsten filament within a halogen-filled glass tube. This design allows them to remain brighter for a longer time. A 90-watt halogen PAR lamp can replace a conventional 150-watt PAR lamp.

Metal Halide Lamps

Metal halide lamps are HID lamps, which are approximately four times more efficacious than incandescent lamps. Metal halide (MH) lamps are a form of high intensity discharge (HID) lighting with good lighting efficiency and excellent color rendition.

Appliances

Energy Star Efficiency Refrigerator
ENERGY STAR® refrigerators must exceed the stringent new July 1, 2001 minimum federal standards for refrigerator energy consumption by at least 10 percent. An energy efficient refrigerator/freezer is designed by improving the various components of the cabinet and refrigeration system. These component improvements include cabinet insulation, compressor efficiency, evaporator fan efficiency, defrost controls, mullion heaters, oversized condenser coils, and improved door seals.

Refrigerator Early Replacement
For this measure we assume replacement of an older refrigerator (10 years old or more) with a new standard-efficiency refrigerator. The early replacement assumes that the same new refrigerator would have been bought, only six years later. Savings for this measure result for six years because the newer refrigerators, given the stringent efficiency standards implemented in 2001, use much less energy than older units.

High Efficiency Freezer
Stand-alone freezers include either upright or chest models. Efficient freezers should exceed standard efficiencies by 10 percent or more.

Energy Star and High Efficiency Clothes Washer
A standard clothes washer uses various temperatures, water levels, and cycle durations to wash clothes depending on the clothing type and size of the laundry load. A high-efficiency vertical-axis clothes washer, which eliminates the warm rinse option and utilizes a spray technology to rinse clothes, can significantly reduce washer-related energy. Such machines also utilize a spin cycle that eliminates more water from the clothes than conventional clothes washers and are generally driven by more efficient motors. A horizontal axis clothes washer utilizes a cylinder that rotates horizontally to wash, rinse, and spin the clothes. These types of washing machines can be top loading or front loading, and utilize significantly less water (hot and cold) than the standard vertical axis machines. A vertical axis machine generally fills the tub until all of the clothes are immersed in water. In contrast, the horizontal axis machine only requires about one third of the tub to be full, since the rotation of the drum around its axis forces the clothes into the water and thus can drastically reduce the total energy use for washing. These machines are also easier on clothes and use less detergent.

Energy Star Dishwasher
ENERGY STAR labeled dishwashers save by using both improved technology for the primary wash cycle, and by using less hot water to clean. They include more effective washing action, energy efficient motors and other advanced technology such as sensors that determine the length of the wash cycle and the temperature of the water necessary to clean the dishes The ENERGY STAR qualified models with internal water heaters boost the water temperature inside the dishwasher to at least 140°F.

This allows one to turn down the thermostat on the household water heater to 120 degrees, reducing water heating costs by up to 10 percent.

High Efficiency Clothes Dryer (gas and electric)
A standard clothes dryer uses various temperatures and drying durations to dry clothes depending on the clothing type and size of the laundry load. In general, the dryer cylinder is spun to rotate the wet clothes, as hot air is injected into the drying cylinder. Wet moist air is then exhausted from the dryer. The cycle duration is manually set. An energy efficient clothes dryer uses a moisture-sensing device to terminate the drying cycle rather than using a timer. In addition, an energy efficient motor is used for spinning the dryer tub.

<u>Water Heating</u>

High Efficiency Water Heater (electric or gas)
The electric water heater measure involves substitution of a standard efficiency water heater (with an energy factor, EF, of 0.88) with a high efficiency water heater (EF of 0.93). For gas, a 0.60 EF water is replaced with a high efficiency, 0.63 EF, water heater. Energy factors are a measure of water heater efficiency that combines recovery efficiency with standby losses. While California Title 20 appliance standards require minimum EFs of 0.544 for 40 gallon gas water heaters, we have utilized a EF of 0.60 as our base because the majority of new water heaters being installed have EFs of 0.60 or more, and effective January 2004, the required minimum EF will be 0.594 (for 40 gallon units).

Heat Pump Water Heater
Air-to-water heat pump water heaters extract low-grade heat from the air then transfer this heat to the water by means of an immersion coil. This is the most commonly utilized residential heat pump water heater. The air-to-water heat pump unit includes a compressor, air-to-refrigerant evaporator coil, evaporator fan, water circulating pump, refrigerant-to-water condenser coil, expansion valve, and controls. Residential heat pump water heaters replace base electric units with the same tank capacities.

Solar Water Heater
Heat transfer technology that uses the sun’s energy to warm water. Solar water heaters preheat water supplied to a conventional domestic hot water heating system. The energy savings for the system depend on solar radiation, air temperatures, water temperatures at the site, and the hot water use pattern.

High Efficiency Boiler
Boilers provide hot water for some multifamily dwellings. This measure involves installation of a high efficiency gas boiler (95 percent efficiency) instead of a standard 82 percent efficient boiler.

Boiler Controls
Controllers optimize the performance of a boiler by learning the daily demand pattern of domestic hot water and adjusting the water supply accordingly. The controllers usually have the ability to automatically lower water temperatures during low use periods.

Low Flow Showerhead
Many households are still equipped with showerheads using 3+ gallons per minute. Low flow showerheads can significantly reduce water heating energy for a nominal cost. Typical low flow shower heads use 1.0-2.5 gallons per minute compared to conventional flow rate of 3.5-6.0 gallons per minute. The reduction in shower water use can substantially lower water heating energy use since showering accounts for about one-fourth of total domestic hot water energy use.

Pipe Wrap
Thermal insulation is material or combinations of materials that are used to inhibit the flow of heat energy by conductive, convective, and radiative transfer modes. By inhibiting the flow of heat energy, thermal insulation can conserve energy by reducing heat loss or gain. Insulation material inhibits the transfer of heat through the hot water tanks and hot water pipe. In residential applications, usually the first five feet of pipe closest to the domestic water heater are insulated. Small pipes are insulated with cylindrical half-sections of insulation with factory applied jackets that form a hinge-and-lap or with flexible closed cell material.

Faucet Aerators
Water faucet aerators are threaded screens that attach to existing faucets. They reduce the volume of water coming out of faucets while introducing air into the water stream. A standard non-conserving faucet aerator has a typical flow rate of 3-5 gallons per minute. A water-saving aerator can reduce the flow to 1-2 gallons per minute. The reduction in the flow rate will lower hot water use and save energy (kitchen and bathroom sinks utilize approximately 7 percent of total domestic hot water energy use). Under current Title 24 Standards, new faucets can have a maximum flow rate of 2.2 gallons per minute; thus, this measure applies only to retrofits.

Water Heater Blanket
Adding water heater blankets to the hot water storage tank can prevent standby heat loss. This measure is especially effective when installed on older, less-insulated tanks. Insulation levels on automatic storage heaters can be increased by installing a fiberglass blanket on the outside of the tank. This increase in insulation reduces standby losses and saves energy.

<u>Pools</u>

High Efficiency Pool Pump and Motor
This measure involves the replacement of a standard efficiency motor and low volume pump with a smaller high-efficiency motor and a new high volume pump.

<u>Office Equipment</u>

Office Equipment Power Management Enabling
This measure can be applied to PCs, PC monitors, and copiers. For PCs and copiers, manual enabling of the power management features is the only viable solution. For monitors, manual enabling and group enabling via network software are options.

LCD Monitors

LCDs are becoming more attractive options in terms of quality. However, because they cost five times more than a comparable CRT, until prices drop, using them purely as an energy saving measure will not be an option for most desktop users.

Printer Night-time Shutdown

The simplest action to save printer energy is to shut the machine off at night. While this recommendation is particularly important for conventional printers without power management, it is important to turn off ENERGY STAR printers as well, as they can draw up to 30-45 watts when in low power mode.

Residential Natural Gas Energy Efficiency Measures

HVAC - Shell

Ceiling Insulation
Fiberglass or cellulose insulation material in floor, wall or roof cavities reduces heat transfer across these surfaces. The type of building construction limits insulation possibilities. Choice of insulation material will vary depending on the roof construction type. Nominal R-values are used as the performance factor for insulation levels. The overall R-values include the thermal resistances of construction layers (gypsum, air gaps, framing, sheathing, concrete, roofing, etc.). Insulation measure is assumed to be from R-5 to R-24.

Double Pane Low Emissivity Windows
The important energy performance parameters for windows are U-value, shading coefficient, visible light transmission and air leakage. The window U-value will vary as a function of the number of panes, gap thickness, gap fill (air or inert gas), presence of low-emissivity (low-e) coatings, and frame type. The shading coefficient and visible transmission will vary as a function of glass type and low-e coatings. Air leakage will depend on the type of frame and window design (casement vs. slider). Replacing single pane with double pane windows reduces the U-value and heat transfer considerably. Adding a low-e coating will improve the U-value by about 15%.

Duct Insulation
Insulation material inhibits the transfer of heat through the air-supply duct. Several types of ducts and duct insulation are available, including flexible duct, pre-insulated flexible duct, duct board, duct wrap, tacked or glued rigid insulation, and water proof hard shell materials for exterior ducts.

High-Efficiency Furnace/Boilers
High-efficiency condensing gas furnaces and boilers have AFUEs of greater than 90% compared to base efficiencies in the 80% range. For furnaces, efficiencies above 90% can be achieved with a number of technologies, pulse combustion being just one of many design approaches. High-efficiency gas furnaces can be installed in new construction or can be retrofitted to existing Residential structures which have other heating systems. In most cases, a condensate drain must be added and a new or modified venting system must be installed. Condensing boilers are available which operate with thermal efficiencies as high as 95% or more. These condensing units achieve their high efficiency by operating with stack gas temperatures around 100 F. At this low stack temperature the water vapor in the products of combustion is condensed. When the water vapor is condensed, its latent heat from the phase change is recovered, resulting in very high efficiencies.

Boiler Pipe Insulation
Insulating accessible steam or hot water supply pipes in the boiler room is a cost effective way to save energy. Savings will vary depending on the temperature of the hot water or steam and the ambient temperature. An estimate of 2% savings are utilized in this study.

Boiler Tune-Up

A high-efficiency boiler tune-up performed by a properly trained technician can improve average combustion efficiency by 2 to 10 percent. To ensure that the boiler tune-up is a success, the tune-up technician should use an electronic flue-gas analyzer that is capable of continuously monitoring stack temperature, oxygen (O2 in percent), and carbon monoxide (CO in ppm). In addition, the technician should determine the boiler's actual gas input rate (cubic feet per minute). Some boilers can't be tuned up because there is no way to control the excess air or gas flow. Before examining this measure the technician or auditor must determine if the boiler is tunable. For this study, a conservative savings estimate of 2% was utilized.

Water Heating

Gas Water Heater

Efficient Gas Water Heaters consist of a high efficiency natural gas, storage-type hot water heater and tank. According to the State of California Appliance Standards, the minimum efficiency level for gas water heaters is EF=0.62-0.0019*(storage volume in gallons). (CEC 1991B) Many small Residential buildings and even some large Residential buildings use residential-sized water heaters to meet their needs for hand washing in restrooms or janitorial purposes (i.e. small office, small retail, supermarket, and warehouse). There are four categories of residential-sized gas-fired, storage-type water heaters: condensing gas water heaters (0.86 EF), high efficiency gas water heaters (0.70 EF), efficient gas water heaters (0.62 EF), and standard water heaters (0.54). This study uses and upgrade from a 76% to a 95% system efficiency.

Instantaneous or Demand Hot Water Heater

Demand water heaters are available in propane (LP), natural gas, or electric models. Unlike "conventional" tank water heaters, tankless or instantaneous water heaters heat water only as it is used, or on demand. A tankless unit has a heating device that is activated by the flow of water when a hot water valve is opened. Once activated, the heater delivers a constant supply of hot water. The output of the heater, however, limits the rate of the heated water flow. They come in a variety of sizes for different applications, such as a whole-building water heater, a hot water source for a remote bathroom, or as a boiler to provide hot water for a heating system. They can also be used as a booster for dishwashers, washing machines, and a solar or wood-fired domestic hot water system. They are either installed centrally or at the point of use, depending on the amount of hot water required.

DHW Circulation Pump Time Clock Retrofit

Installing a time clock on the circulation pump for the domestic hot water system can reduce demand during periods when the building is unoccupied. Since, systems must be protected from damage from freeze in all California climates time clocks may include an override setting if the temperature reaches below a predetermined set point.

Tank Insulation

Residential water heater insulation is available either by the blanket or by square foot of fiberglass insulation with protective facing.

Insulation blankets range from 50 to 82 gallon tank sizes, with thicknesses of 2 to 4 inches, and R-values ranging from 5 to 14. Many retailers and wholesalers surveyed suggested using two or more blankets for larger tanks, and double-wrapping tanks for increased R-value. They also note that squeezing the blanket to fit into tight applications lowers the R-value.

DHW Pipe Insulation
The first five feet of pipe closest to the domestic water heater should be insulated. Small pipes are insulated with cylindrical half-sections of insulation with factory applied jackets that form a hinge-and-lap or with flexible closed cell material. Current Title 24 Energy Standards require insulation only on the portion of DHW piping through which water is recirculated. Some energy savings are possible by insulating non-recirculating branch piping, depending on the frequency of hot water use through this piping. If usage is infrequent, savings will be low.

Low Flow Shower Heads
Standard non conserving shower heads have a flow rate of 3.5 to 6 gallons per minute (gpm at 80 psi). Typical water saving shower heads use 1 to 2.4 gpm and are designed to provide a good quality shower with less water. Water saving shower heads are available in a variety of styles to produce vigorous or misty showers. Current California standards require measured flow rates of no greater than 2.45 gpm (at 80 psi) for all shower heads.

Faucet Aerators
Standard non conserving faucet aerators have a flow rate of 3-5 gpm (at 40 to 60 psi). Water saving faucet aerators for bathroom applications have flow rates of 0.5-1.0 gpm and water saving faucet aerators for kitchen applications have average flow rates of 1.5 2.0 gpm. The kitchen requires a slightly greater flow rate to wash dishes and food and also to fill pots when cooking. A lower flow rate in bathrooms is allowable for the tasks of washing hands and faces, brushing teeth or shaving. Water saving faucet aerators deliver water at a lower flow rate, but there is usually no perceptible reduction in service because the aerators are designed to entrain more air into the water, creating a foamier flow that tends to wet objects more thoroughly rather than water bouncing off objects.

Active Solar DHW Systems
Solar water heaters preheat water supplied to a conventional domestic hot water heating system. In addition to system design and component quality, solar water heater performance depends on solar radiation, outdoor temperature, and daily water use. There are active and passive solar DHW system. This study uses an active solar system. Active solar systems preheat the water that is fed to a conventional domestic water heater. The components of active systems are one or more flat plate collectors, a storage tank, a pump, piping, and controls. Systems must be protected from damage from freeze in all California climates. Active systems typically are less cost-effective than passive systems. The energy savings for these systems depend on solar radiation, air temperatures, and water temperature at the site and the hot water use pattern. Solar system savings per collector area decline as the fraction of total load met increases. The cost-effectiveness of the system is a linear function of the price of conventional fuel.

Cooking Appliances

EnergyStar Appliances

Pools

Pool Heater
High efficiency pool heaters are now available with efficiencies of over 90%. These heaters utilized technologies similar to those of high efficiency boilers.

Pool Cover
Installing a pool cover is one of the most cost-effective ways to reduce energy use with a heated swimming pool. Pool covers typically save about 50 to 65% of the energy used to heat the pool if the cover is on 12 hours per day. A pool cover entirely eliminates evaporative heat losses, and reduces convective and radiative heat losses. Pool covers are available in three basic styles; transparent bubble covers similar to very thick bubble wrap type packaging, thin transparent plastic covers, and insulating opaque foam covers. The plastic bubble cover is the most widely used type of cover. Covers can be installed with an automatic or manual roller to allow easier on-off operation. Security pool covers attach firmly to the edges of the pool, preventing small children from accidentally falling under the cover and into the pool.

Solar Pool Heater
One of the most common solar pool heaters used in California is a drain down system that uses a differential thermostat. The pool filter pump is used to pump pool water through the solar collector. When it's cloudy or when the sun goes down, a sensor tells the control unit to shut the system off and water is drained from the solar collector back into the pool. The modes are controlled by solenoid valves or other automatic valves in conjunction with a vacuum breaker relief valve, which allows drain down.