

E-House Summary and Technical Information

SMUD's Energy & Technology Center is an educational tool for promoting market acceptance and transformation of energy efficiency, renewable energy, and safe energy usage, products and processes. With workshops, exhibits, and consultations, the E&TC educates many residential customers, critical decision makers, and change agents in the greater Sacramento area.

The Energy & Technology Center exhibit, E-House, is a full-scale walk-through model of an energy-efficient home. It showcases techniques and materials in home framing, roofing, and insulation; energy-efficient windows and new daylighting products; a ground-source heat pump; whole-house fan; solar orientation; photovoltaic tiles that turn roof shingles into power plants; radiant barriers; advanced lighting technologies; and sustainable finishes. Residential customers and commercial contractors/building designers utilize E-House for energy education purposes and a hands-on tool to understand specific energy products and applications. E-House additions on the horizon: smart home building automation technology, smart home appliances, AMI meter, energy generating and consumption interactive software, and electric vehicle integrated into home energy infrastructure.

E-House Components

Framing

Traditional house framing uses significant amounts of lumber, yet wood is a poor thermal insulator and easily conducts heat, its usage escalates deforestation, and wood in framing restricts the insulation capacity. Advanced Framing, however, is a collection of techniques to reduce lumber and construction waste, while increasing energy efficiency and simplifying framing layout. Using Advanced Framing techniques (see below) can reduce annual heating and cooling costs by 5 percent (source: DOE).

Conventional Framing (versus Advanced Framing)

2" x 4" studs installed 16" on center

Double to triple top plate

Solid wood window header

Batt insulation

3-4 studs per corner

Cold/hot spots

Advanced Framing

2" x 6" studs installed 24" on center

Insulated window header with rigid insulation

Blown-in or foam insulation

2-stud corners

Single top plate

Vertically aligned stacked framing of roof trusses, wall studs, and floor framing

Header hanger instead of jack or trimmer stud

Structural Insulated Panels (SIPs)

- High performance building panels used in floors, walls, and roofs for residential and light commercial buildings
- Core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB)
- Structurally strong
- 50% more energy efficient than standard lumber construction
- Six-inch wall equivalent to R-24
- Prefabricated at a factory
- Custom designed for each home

FSC (Forest Stewardship Council) Certified Products

Logging can contribute to habitat destruction, water pollution, deforestation, aridity, and climate changes. A sustainably managed forest can conserve biological diversity and its associated water resources, soils, unique ecosystems, and ecological functions.

Insulation

Insulation is any material that restricts heat flow, which can help insulate a home from temperature and sound. Insulation helps to create an energy efficient house and comfortable living environment. The higher the R-value, the greater the insulating effectiveness and energy efficiency.

Infiltration Demonstration

Infiltration, or air leakage, is an important reason why most conventional houses waste energy. Leaks throughout the building can be greatly eliminated by sealing them. Using insulation, caulk and weather-stripping can greatly reduce leaks throughout a house.

E-House Demonstration Insulation:

- Formaldehyde-Free Fiberglass Batt (R-19)
Johns Manville Formaldehyde Free Fiberglass Batt, R-19, R-value of 3.1 per inch (Lowe's)
- Cotton Batt (R-19)
Bonded Logic UltraTouch Natural Cotton Fiber Insulation Batt, R-19, R-value of 3.4 per inch (Viktor Insulation, Service Partners, Son's Green Building Supply)
- Cellulose (R-21)
US GreenFiber Cocoon 2 Stabilized All Borate, R-21, R-value of 3.8 per inch (Lowe's, Homes Depot)
- Open Cell Foam (R-22)
BioBased 501 1/2lb Low Density Soy Based Polyurethane Foam, R-22, R-value of 4 per inch (Five Star Insulation)
- Closed Cell Foam (R-27)
NCFI InsulStar 2 lb Medium Density Agri Based Polyurethane Foam, R-27, R-value of 6.8 per inch (Five Star Insulation)

Windows

Window Glass

- Visible Transmittance (0 to 1): The higher the visible transmittance rating, the greater amount of visible light coming through a window. (high = good)
- U-Factor (0.20 to 1.20): The lower the U-factor, the greater the resistance to heat flow and more energy-efficient the window. (low = good)
- Solar Heat Gain Coefficient (0 to 1): The lower the SHGC, the less solar heat transmitted into a home. (low = good)
- Air Leakage (less than .30): Low air leakage rating means less air passing through the cracks of a window assembly and higher efficiency. (low = good)
- Condensation Resistance (0 to 100): The higher the rating, the better at resisting condensation formation. (high = good)

Window Frames

- Fiberglass Frame: High energy efficiency, low resource depletion, low manufacturing emissions
- Vinyl Frame: High energy efficiency, high resource depletion, high manufacturing emissions
- Wood Frame: Medium energy efficiency, medium resource depletion, medium manufacturing emissions
- Aluminum Frame: Low energy efficiency, medium resource depletion, medium manufacturing emissions

E-House Window Products

- Kitchen: Milgard casement window, fiberglass frame, SunCoatMax™ film with EdgeGardMAX™ window spacer (for local dealers, see www.milgard.com)
- Kitchen: Milgard casement window, vinyl frame, SunCoatMax™ film with 3D MAX™ package (for local dealers, see www.milgard.com)
- Hall: Milgard Single Hung, vinyl frame, SunCoatMax™ film, 3D MAX™ package (for local dealers, see www.milgard.com)
- Living Room: Milgard picture window, woodclad fiberglass frame, SunCoatMax™ film with EdgeGardMAX™ window spacer (for local dealers, see www.milgard.com)

Roofing

Increased air temperature at the core of a metropolitan area like Sacramento can be attributed to an “urban heat island” effect. Solar energy absorbed by the dark colors of paving surfaces and certain roofing materials is part of the problem and can actually raise the air temperature several degrees. As a result, efficiency of systems is reduced while air conditioning loads are increased, causing an increase in electrical demand, energy cost, and formation of smog. When choosing roofing products, high values for solar reflectance and emissivity increase the likelihood of a heat not entering a building.

- Solar Reflectance: The percentage of heat that reflected away from the building by the roofing material.

- Emissivity: Materials ability to radiate absorbed energy. The lower the emissivity, the more the material absorbs energy, whereas a higher value indicates the ability of a material to discharge energy.
- Relative Cooling Index: This value explains the ability of a rooftop material to keep a building cool. 100% being the most efficient and 0% being the least efficient.

E-House Roofing Products

- Cool Roof Clay Tile
MCA Superior Clay Roof Tile, Old Mission Blend B301 (MCA® Superior Clay Roof Tile), Reflectivity = 43%, Emissivity = 86%
- Cool Roof Coated Metal
ASC Building Products Skyline Roofing Standing Seem Metal, DuraTech XL Colors, Cool Canyon Red (ASC™ Building Products), Reflectivity = 43%, Emissivity = 85%
- Cool Roof Coated Metal
ASC Building Products Skyline Roofing Standing Seem Metal Roofing, DuraTech 5000 Colors, Cool Sierra Tan (ASC™ Building Products), Reflectivity = 49%, Emissivity = 86%
- Cool Roof Concrete
Eagle Roofing Concrete Tile, Bel Air Ridgecrest 4258 (Eagle Roofing), Reflectivity = 51%, Emissivity = 93%
- Building Integrated Photovoltaic Tiles
SOLAR SAVE® Roofing Tiles, Slate Gray (OPEN Energy Corporation)

Lighting

Lighting

Energy efficient lighting can be effective if skillfully incorporated into a home's design. While saving energy and reducing costs, it also provides comfortable illumination for tasks, sets the emotional tone for various rooms, and provides a safe environment. Lighting can be separated into three functional categories: ambient, task, and accent.

- Ambient Lighting: Provides a comfortable amount of light to enable people to move about and perform general tasks.
- Task Lighting: Used when working with small objects, reading, sewing, repairing, or similar activities.
- Accent Lighting: Used to draw attention to artwork, décor, and other architectural details.

Light Emitting Diode (LED) lighting is becoming popular because it uses little energy and contains no mercury or lead. Colors vary greatly with LEDs, so look for color options when purchasing. The life of a LED is directly linked to heat; LEDs do not like the heat so they must be properly cooled through convection using metal. LEDs should also be recycled because they contain a lot of metal.

LED (Light Emitting Diode) Lighting

- Energy efficient

- Uses approximately 60% less energy than fluorescent and over 90% less energy than incandescent lighting

Dark Sky Lighting

- Light emitted from a light source within a fixture does not go higher than 90 degrees above the ground.
- Fixture blocks direct light from bulb
- Shines light only where needed
- Stops light trespass into neighboring properties, environment, and atmosphere
- Increases safety by eliminating glare
- Mitigates negative impact of lighting on nocturnal wild

Daylighting

Sometimes the best source of light comes from nature. Daylighting from window and skylight systems provides occupants with a link to the outside world and establishes the exterior and interior aesthetics of a home. Well-designed daylighting will increase the amount of natural light in a room without increasing heat gain or glare. Benefits of daylighting:

- Ability to ventilate rooms with operable windows
- Increase and control the sunlight into a room
- Helps to warm a room in the winter
- Electric lights can be dimmed or turned off
- Improved energy efficiency
- Improved psychological and physiological well-being and productivity.

E-House Lighting Products

LED Pathway Lights, 5 watts

LED Recessed Lights, 10-15 watts

LED Cabinet Lighting, 4-7 watts

LED Spot Lights, 6 watts

Exterior LED Lights, 5 watts

LED Ceiling Fan Light Kit, 35 watts

Fluorescent Recessed Lights, 26 watts

Fluorescent Cabinet Lighting, 18-32 watts

Fluorescent Wall Sconces, 18-42 watts

Fluorescent Ceiling Mount Fixture, 36 watts

Vacancy Sensors, three-way

Ventilation/HVAC

Whole House Fan

A whole house fan is an inexpensive and efficient alternative to using an air conditioner in the evening. Recessed in a ceiling, the fan works by replacing warm indoor air with cooler outdoor air through continuous circulation. This action keeps walls and other heat-absorbing surfaces

cool. Using the fan in the morning to pre-cool a house and using it again in the evening once the outdoor air temperature is 85 degrees or cooler can substantially reduce cooling costs.

E-House Demonstration: Whole House Fan: Delta Breeze®, 30-inch (FANMAN™)

Ceiling Fans

A ceiling fan is used to circulate the air in a room to increase occupant comfort and mitigate the need for added heat and air conditioning.

During summer, the leading edge of the fan blade should point up to direct air movement directly onto occupants, which can make a room temperature feel cooler as the blowing air over the skin increases evaporation and cools the body.

During winter, the leading edge of the fan blade should angle down to pull the cool air in the room upward which pushes the warm air hovering near the ceiling outward and down, forcing it to mix without creating much breeze.

Zoning

Zoning allows a building's heating, ventilation, and air conditioning system to maintain comfortable temperatures throughout the building. Thermostats and controllers open and close dampers in the ducts to allow cool or warm airflow into desired areas, allowing temperatures can be maintained in each room without having hot or cold spots in the building.

Geothermal Heat Pump

A geothermal heat pump is an electrically powered device that uses the natural energy storage ability of the earth to heat and cool buildings. To warm a home in the winter, heat is extracted from the earth using water flowing through a system of buried pipes, called a ground loop. After being warmed in the ground loop, the water flows through the geothermal heat pump and is extracted to warm a home. In summer, the process is reversed. Heat is removed from inside a house by the geothermal heat pump and transferred to the cooler earth through the ground loop.

The advantages of geothermal heat pumps:

- Very high efficiency for heating and cooling
- Long equipment life
- Low maintenance
- No outdoor unit
- Quiet operation, inside and outside the home
- No combustion of natural gas inside the house

Urban Heat Islands

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Vegetation

Planting a shade tree can reduce a home's cooling costs within a few years of planting. Upon maturity, it can cut cooling costs by up to 20-40%. Trees can also add value to property and beauty to a neighborhood. They help cool areas where buildings, traffic, and dark-paved surfaces create "heat islands." They produce the air we breathe and help cleanse air we pollute.

Finishes

Recycled and Sustainable Products

Using recycled, local and rapidly renewable products reduces the energy required to grow, extract and transport materials to manufacturing and/or construction sites. Additionally, using reclaimed and recycled products lessens the need for landfills (which can contaminate ground water), can reduce cost, and reduces land, water, and air pollution. The use of local materials also supports the local economy. Commons examples of these types of products in buildings include reclaimed wood and other reclaimed building materials, recycled glass products, bamboo flooring, linoleum flooring, cotton batt insulation, wool carpet, bamboo window blinds, and FSC (Forest Stewardship Council) certified wood products

Materials and Air Quality

People spend significant time indoors, upwards of 90% of their time. The quality of the indoor environment is critical to comfort, health, student and employee attendance, and productivity. Many building products and finishes, common office equipment, and appliances can cause high levels of indoor air pollutants and contaminants. To ensure high quality indoor environments, building materials should have low or no VOCs (volatile organic compounds). VOCs react with sun and nitrogen oxides to form ground level ozone, a cause of health problems and a major component of smog. Some preferred finishing products could include low or no-VOC paint, coatings, flooring systems, furnishings, cabinetry with non-toxic finishes, and ceiling/wall systems.

E-House Finish Products

Interior Paint

- Interior Wall: AFM Safecoat® (no VOC), Quilter's Thread 4031P (Green Sacramento)

- Interior Baseboards, Trim, Handrail: AFM Safecoat® (no VOC), White Lace OW21 1P (Green Sacramento)
- Interior Ceiling: AFM Safecoat® (no VOC), White Lace OW21 1P (Green Sacramento)

Exterior Paint

- Exterior Stucco: Yolo Colorhouse® (no VOC), Cloud .02 (Green Sacramento)
- Exterior Siding: Yolo Colorhouse® (no VOC), Cloud .02 (Green Sacramento)
- Exterior Window Trim: Yolo Colorhouse® (no VOC), Canyon .03 (Green Sacramento)
- Exterior Eaves and Door Trim: Yolo Colorhouse® (no VOC), Canyon .06 (Green Sacramento)
- Exterior Handrails: Visions Low VOC Desert Gray (Visions Paint Recycling, Inc.)

Flooring

- Porch: EcoTimber Woven Bamboo, Amber (Green Sacramento)
- Living Room: Earth Weave Rainier, Tussock, with Earth Weave Wool Underpad (Green Sacramento)
- Kitchen: EcoTimber Hickory Prefinished Engineered Single Strip, Natural (Green Sacramento)
- Ramp: Forbo Marmoleum, Barley (Green Sacramento)
- Baseboards: FSC Certified Lumber (Home Depot)

Cabinetry

- Cabinetry: FSC-certified solid wood exterior materials, formaldehyde-free plywood interiors, low VOC finishes & adhesives (Grass Cabinetry through Green Sacramento)
- Countertop: Vetrazzo-G3, Hollywood Sage (Green Sacramento)
- Backsplash Tile: Fireclay Debris Series, Sage Green (Green Sacramento)
- Grout: LATICRETE PermaColor Grout (Lowe's, Brickyard Building Material, Tom Duffy Company)

Water Efficiency

In the United States, billions of gallons of fresh water are withdrawn per day for both domestic and commercial use. Significant energy is used to extract, transport, heat, cool, and clean the water, and 65% of this water is then discharged into rivers and other water bodies. Conserving water helps to ensure fresh water availability and mitigate greenhouse gas emissions caused by its transport and usage.

E-House Water Efficiency Products

- Hot Water Pump: Metlund® Hot Water D'MAND® System S-50T (www.gothotwater.com)
- Water Pedal: PEDALWORKS™ Faucet Controller, PV1-21-BN (www.pedalvalve.com)