**PDHonline Course G193 (4 PDH)**

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# Introduction to Green Buildings

*Instructor: Helen Chen, Ph.D., PE*

**2020**

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5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

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SAN MATEO COUNTYWIDE GUIDE

# SUSTAINABLE BUILDINGS

# SUSTAINABILITY:

*"The ability to meet the needs of the present without compromising the ability of future generations to meet their own needs."*

*– United Nations World Commission on Environment and Development*

Sustainable design and construction can preserve the unique environment and enhance the communities and built areas of San Mateo County.

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## More Information

More information on the checklist and the booklet, as well as electronic versions are available at www.RecycleWorks.org or by calling the RecycleWorks hotline at 1-888-442-2666. RecycleWorks is a program of the County of San Mateo. The checklists should also be available at your local permitting counter.

## Credits & Acknowledgements

The sustainable buildings checklist, booklet, and program were developed by a countywide committee consisting of city planning and permitting staff, city recycling staff, local architects, nonprofit representatives, and builders. While many people have reviewed and offered help and comments during the process, the following individuals were key to having this project come to fruition and deserve special recognition:

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## In addition we'd like to thank:

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David Johnston, our first consultant, who offered us both knowledge and encouragement and assisted us through the early planning stages.

450 Architects, and especially Raphael Sperry. 450 Architects is a San Francisco architecture firm specializing in sustainable building and community-based design and they brought new life to our project, finalized our draft checklist, offered practical wisdom and creative input, and produced this booklet on a tight deadline. Raphael Sperry, who authored this booklet, and the two principal architects, Richard L. Parker, AIA, and David Bushnell, AIA, took this project on with a commitment to both excellence and usefulness that has made the final stages of development a joy.

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C/CAG and the County of San Mateo for recognizing the importance of the emerging green building issues, providing the forum for these ideas to be addressed and the staff and financial support to coordinate the development of a countywide program and materials.

And finally, Supervisor Rose Jacobs Gibson, Supervisor Jerry Hill and the Board of Supervisors of the County of San Mateo for having the foresight to adopt the first Sustainable Buildings Policy in the county on December 11, 2001, which has helped all of us to recognize the importance of making decisions based on long term effects rather than short term gain.

## Cover photo credits:

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Back cover: Richard Parker, 450 Architects (left); Philippe Cohen (right)

# San Mateo Countywide Sustainable Buildings Guidelines

## Introduction

Welcome to the San Mateo Countywide Sustainable Buildings Guidelines and Checklist. These are provided to encourage you to explore what you can save – for yourself and for the environment – by building green.

This booklet aims to explain all the checklist items, some of which may be unfamiliar to some users, and to describe the major benefits and approaches to green. Many items on the checklist and in these guidelines are fairly simple, inexpensive, and easy to accomplish. Almost every project should try to do these practices. Others are more expensive or require a larger departure from some conventional building systems, but offer correspondingly large rewards. We hope that more and more San Mateo County building owners will explore and develop these strategies.

You can find additional information on the guidelines, and any requirements that are unique to your city in the Green Building section of the County of San Mateo RecycleWorks website: www.RecycleWorks.org.

## Who is this booklet for?

These guidelines are intended for people planning new construction and renovation projects. The environmental impacts of construction – and the opportunities to benefit from handling them well – are proportional to every project, from a small addition to your house to a large new office building. Every project is unique, so if some checklist items do not fit with the specifics of your site or program, focus on accomplishing ones that are appropriate for your project. The right-hand columns on the checklist identify items that are appropriate to each building type.

This booklet is also for members of the building industry: architects, engineers, building contractors, and others. Green building is a relatively new part of what clients are asking for, and professionals are at different levels of skill in providing green buildings. This booklet may introduce new ideas or serve as a jumping-off point for discussions with clients, colleagues, and consultants. We have solicited the input of many building industry members from San Mateo County and beyond in compiling this information, and we hope that their experience will be helpful to you.

## What is green building, and why do it?

Green building means taking the environment into account during design and construction. Green buildings aim for harmony with the local environment: they benefit from it, and protect and respect it. In general, green buildings are energy efficient, water conserving, durable and nontoxic, with high-quality spaces and high recycled-content materials.

Building impacts on the environment are substantial. Construction in the United States consumes 25% of all wood that is harvested, 40% of all raw stone, gravel and sand, pro-

duces 25% of the carbon dioxide added to the atmosphere, and generates 2 to 2.5 pounds of waste per square foot. Better building practices and materials can significantly reduce these impacts and, at the same time, reduce construction costs and lifetime operating costs, saving you money and reducing burdens on local infrastructure.

In addition, green buildings generally have more comfortable indoor conditions, natural lighting, connections, views to the outside, and healthier indoor air. Because green buildings are healthier and more pleasant to be in, their occupants consistently show lower absenteeism, higher productivity, and, in schools, higher testing scores. For homeowners, the increase in quality of life is always worth this investment, as documented in better resale values and satisfaction among green homeowners. For commercial building owners, increases in productivity can easily total more than a project's entire construction cost over the life of the building.

## Green building in San Mateo County

San Mateo County is a great place to build green! We are home to many green building experts and materials suppliers, and with our neighboring counties we constitute the largest concentration of green building expertise and availability in the country. If you're looking for an experienced architect, designer or builder, or a place to purchase green materials, you'll be able to find the resources in and around San Mateo County, and without the cost premiums that might apply elsewhere.

In addition, San Mateo County's natural resources make green building easy. Our outdoor climate is comfortable through much of the year, meaning that you can make equally comfortable indoor spaces with little or no extra energy for heating and cooling. We have many diverse microclimates, ranging from cool coastal bays to windy mountaintops – offering each project a unique situation to respond to. Our public open spaces support rich biodiversity, allowing projects to tap into living ecosystems in their landscaping and site plans. Our 20 cities and towns, all vibrant and distinctive communities, offer the opportunities for new projects to benefit from public transit systems, walkable town centers, and rich concentrations of services and customers. Just by opening up to what our county has to offer, your project can easily go green and benefit as a result!

## Planning Ahead

The most important part of the building process happens before ground is broken – the design stage. The decisions made in design have impacts for the life of the project (or even beyond) and on every building user. Studying alternatives is easy to do during design and is a good way to find cost-effective solutions to the needs of your particular project; by contrast, making changes during construction is the most common reason for projects to exceed their budgets.

In a green design process, you will still meet conventional design needs: providing useful space, fire exits, disability access, structural support, and the like. Considering environmental issues – site orientation, energy efficiency, indoor air quality, etc. – may seem an added complication, but it actually offers a larger and richer area in which to view your project. Enlarging the scope of your design offers more ways to understand your goals, and can help you find more efficient alternatives.

Photo: Philippe Cohen

*The Leslie Shao-ming Sun Field Station was designed with a goal of net zero carbon emissions on an annual basis, a goal which they are monitoring and reaching. To accomplish this, the lower set of solar collectors on the building have a dual role: heating the building in the winter and shading the windows in the summer. The roof mounted photovoltaic panels turn sunlight into electricity for the building. The integrated design of both passive and renewable sources of heat and energy resulted in a building where only the herbarium requires air conditioning.*

The Leslie Shao-ming Sun Field Station at Jasper Ridge Biological Preserve, winner of Sustainable San Mateo County's Green Building Award for 2002, makes an excellent example of the benefits of planning ahead. For instance, although initial estimates for the building project called for building 12,000 square feet, by careful analysis of the actual space needed to house all the researchers and functions, the design team fit all "the building's planned uses into 9,800 square feet. This reduced the construction cost by 18%, as well as reducing the consumption of energy and building materials by an equal amount.

Conventional stud construction can also become less costly and more efficient by planning ahead. Laying out a standard wood-framed house around the conventional 2-foot dimensions of milled lumber allows for a savings of $1.20 per square foot, which amounts to almost $3,000 for a typical home. In many of the strategies suggested in the checklist, alternatives to conventional heating and cooling systems or other building parts are suggested, which can save substantial amounts of energy and money for your building in construction and operation. These decisions cannot be made once ground is broken, when a project is already committed to its overall size, materials, and systems. Planning ahead is the only way to realize these efficiency benefits.

## Integrated Design

Integrated design, or "whole building design," means thinking about how all aspects of a building are interrelated – the structural components, heating and cooling systems, lighting, windows, walls, interior finishes, etc. By recognizing the connections between these systems, integrated design offers many benefits. For example, when operable windows (instead of sealed windows) are considered as part of a building's ventilation system, expensive ductwork and air handlers can be made smaller and less expensive. Planning on the "thermal mass" of concrete structural members to slow down indoor temperature changes can also reduce the need for conventional air conditioning. These kinds of "passive" or low-energy design strategies can only be effective if the whole building's energy performance is studied together, as is explained for many of the checklist descriptions below.

The Leslie Shao-ming Sun Field Station is an excellent example of integrated design right here in San Mateo County. The building's sloping roof allows in daylight, and also funnels rainwater to a storage tank for irrigation. Solar thermal panels provide three-quarters of the building's heating needs in winter and function as sun shades to keep the building cool in summer. Through a variety of passive cooling techniques, no air conditioning is necessary (except in the climate-controlled herbarium), and the scientists who use it say it exceeds their expectations for indoor comfort.

Building integration requires close collaboration between various members of the design team. For example, if daylighting is being used to reduce electricity consumption in lighting, the architect (who will specify the windows) would have to coordinate with the lighting designer and the electrical engineer (who determine the power and controls for the lighting), and all of them would coordinate with the mechanical engineer (who designs the ventilation and air conditioning system). Coordination of this kind is necessary to produce integrated lighting and ventilation systems that are less expensive both to build and to operate. This is another way that planning ahead, as stressed above, is central to achieving both the cost benefits and reduced environmental impacts of green building.

## How to use the rest of the booklet

These guidelines and the associated checklist are organized into thirteen areas, which roughly follow the course of a typical construction project – starting with site work, and moving through foundation work to interior finishing. This is intended to allow you to understand what you can do to be green at various points in your project, even though many of these strategies must be planned for in advance. Most construction contracts also include written specifications (details about specific materials and methods to be used), which are also usually arranged in this sequence. As noted throughout these guidelines, specifications present many opportunities to bring green materials and systems into your project through writing them down as project requirements in advance.

Within each area, we suggest one or more green goals that can benefit you and the environment. Some goals are relevant to more than one area – for instance, saving wood is relevant to both framing and interior wood use. Some projects will lend themselves more to some goals than others, although we hope that you will find all the goals worthy of serious consideration.

Within each goal, we describe one or more individual green strategies– these make up the items on the checklist. The following chapters should help you know what to ask of the building industry and design professionals so that your projects can be part of building a better, greener world here in San Mateo County.

checklist

These checklists are offered at the Planning and Permitting Departments of the cities, towns and county in San Mateo County to encourage the use of sustainable building practices in new construction and remodels or renovations. More information on individual checklist items is found in this guide.

For assistance in using the checklist, please consult with your jurisdiction's Planning or Permitting Department or call the RecycleWorks hotline at 1-888-442-2666.

| | ✓ | No. | Item | Applicable Building Types |
|---|---|---|---|---|
| Community Planning | | | **Goal: Create a more sustainable community** | |
| | | 1 | Build mixed-use developments and provide public amenities such as open space | c m |
| | | 2 | Cluster development to minimize paving and utilities, and to preserve open space | c m |
| | | 3 | Reuse a brownfield or previously occupied site | c m |
| | | 4 | Design for easy pedestrian, bicycle, and transit access | c t m |
| Site & Landscape | | | **Goal: Respect your site** | |
| | | 5 | Design and landscape to create comfortable micro-climates and reduce heat island effects | c m s |
| | | 6 | Optimize building orientation for heat gain, shading, daylighting, and natural ventilation | c m s |
| | | 7 | Reduce building footprint - smaller is better | c m s |
| | | 8 | Limit site impacts, balance cut and fill, preserve existing vegetation and protect soil during construction | c m s |
| | | 9 | Use native plants that are drought-resistant, create habitat for indigenous species, and do not require pesticides for maintenance | c m s |
| | | 10 | Use recycled rubble for backfill drain rock | c m s |
| | | | **Goal: Save water and reduce local water impacts** | |
| | | 11 | Maximize onsite stormwater management through landscaping and permeable pavement | c m s |
| | | 12 | Use rainwater harvesting | c m s |
| | | 13 | Use water-conserving landscape technologies such as drip irrigation, moisture sensors, and watering zones | c m s |
| Waste Reduction & Management | | | **Goal: Reduce, reuse, recycle** | |
| | | 14 | Reuse a building (renovate) instead of tearing down and rebuilding | c t m s |
| | | 15 | Deconstruct old buildings for materials reuse (salvage) | c t m s |
| | | 16 | Recycle construction & demolition waste | c t m s |
| | | 17 | Design for durability and eventual reuse | c t m s |
| | | 18 | Provide adequate space for storing and handling recyclables | c t m s |
| Concrete | | | **Goal: Make concrete with sustainable materials** | |
| | | 19 | Use flyash in concrete | c t m s |
| | | 20 | Use recycled aggregate in non-structural concrete | c t m s |
| | | 21 | Use prefabricated forms or save and reuse wood form boards | c t m s |
| Wood Framing | | | **Goal: Design to save wood and labor** | |
| | | 22 | Use spacings, sizes, and modular dimensions that minimize lumber use and optimize performance | c t m s |
| | | 23 | Use engineered lumber or metal stud framing to replace solid-sawn lumber | c t m s |
| | | | **Goal: Support sustainable forests** | |
| | | 24 | Use sustainably harvested lumber (FSC certified) for wood framing | c t m s |
| | | 25 | Use reclaimed or salvaged lumber | c t m s |
| Exterior Treatments, Siding & Roofing | | | **Goal: Make a sustainable roof** | |
| | | 26 | Use durable roofing materials | c m s |
| | | 27 | Use a cool roof | c m |
| | | 28 | Use a green or living roof | c m s |
| | | | **Goal: Support healthy environments and sustainable forests** | |
| | | 29 | Use sustainable siding materials | c m s |
| | | 30 | Use sustainable decking materials | c m s |

**KEY**

- c Commercial/ Industrial
- t Tenant Improvement
- m Multi-family housing
- s Single-family home

These checklists are offered at the Planning and Permitting Departments of the cities, towns and county in San Mateo County to encourage the use of sustainable building practices in new construction and remodels or renovations. More information on individual checklist items is found in this guide.

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| | ✓ | No. | Item | Applicable Building Types |
|---|---|---|---|---|
| Windows & Doors | | | **Goal: Save energy through passive design** | |
| | | 31 | Provide shading on east, west and south windows with overhangs, awnings, or deciduous trees | c m s |
| | | 32 | Plan windows and skylights, light shelves, and window treatments to provide daylight that improves indoor environments | c t m s |
| | | 33 | Choose window sizes, frame materials, and glass coatings to optimize energy performance | c m s |
| | | 34 | Stop air leakage at doors and windows | c m s |
| Plumbing | | | **Goal: Save water and energy in plumbing systems** | |
| | | 35 | Use water-conserving plumbing fixtures | c t m s |
| | | 36 | Use water-saving appliances and equipment | c t m s |
| | | 37 | Insulate hot and cold water pipes | c t m s |
| | | 38 | Use heat recovery equipment, tankless water heaters and/or on-demand hot water circulation pumps | c t m s |
| | | 39 | Pre-plumb for future graywater use for toilet flushing and landscape irrigation | c m s |
| | | | **Goal: Reduce environmental impacts from materials production** | |
| | | 40 | Use sustainable materials for pipes | c t m s |
| Electrical | | | **Goal: Save energy in lighting** | |
| | | 41 | Design lighting levels for actual use, and use task lighting to reduce general lighting levels | c t m s |
| | | 42 | Use energy-efficient lamps and lighting fixtures | c t m s |
| | | 43 | Use lighting controls that save energy such as occupancy sensors | c t m s |
| | | | **Goal: Save energy in equipment use** | |
| | | 44 | Use ENERGY STAR® appliances | c t m s |
| | | 45 | Use a building energy management system | c t m |
| Heating & Cooling | | | **Goal: Save energy through passive design** | |
| | | 46 | Use passive solar design, thermal mass, and insulation to reduce space heating needs | c m s |
| | | 47 | Replace air conditioning with natural ventilation and passive cooling | c m s |
| | | 48 | Use ceiling fans for comfort cooling, and use a whole-building fan for night-time cooling | c t m s |
| | | 49 | Upgrade wall, floor, and ceiling insulation to exceed minimum State requirements | c m s |
| | | | **Goal: Save energy in equipment use** | |
| | | 50 | Use high-efficiency equipment including furnaces, boilers, fans, and pumps | c m s |
| | | 51 | Use heat recovery equipment | c m s |
| | | 52 | Use geothermal systems, cogeneration, or other alternatives for heating and cooling | c m |
| | | 53 | Place ductwork within conditioned space, seal joints properly, and clean before occupancy | c t m s |
| | | 54 | Zone mechanical systems for more efficient heating and cooling | c t |
| | | 55 | Use radiant and hydronic systems for increased efficiency, health, and comfort | c t m s |
| | | 56 | Use equipment without ozone-depleting refrigerants | t m |
| | | | **Goal: Create healthy indoor environments** | |
| | | 57 | Use recycled-content, formaldehyde-free fiberglass insulation, cellulose insulation, or other green insulation products | c t m s |
| | | 58 | Separate ventilation for indoor pollutant sources and provide advanced filtration to improve indoor air quality | c t m s |
| | | 59 | Use clean and efficient alternatives to wood-burning fireplaces | m s |

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checklist

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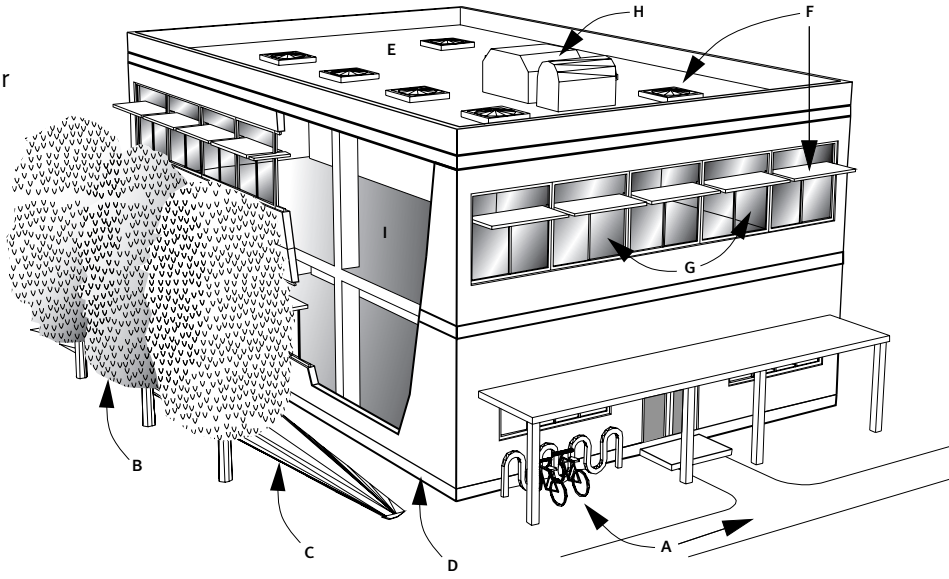
| | ✓ | No. | Item | Applicable Building Types |
|---|---|---|---|---|
| Renewable Power & Solar Energy | **Goal: Replace fossil fuel use with alternatives** | | | |
| | | 60 | Generate clean electricity onsite using solar photovoltaics | c m s |
| | | 61 | Generate clean electricity onsite using wind turbines | c m s |
| | | 62 | Use solar hot-water systems for domestic use and swimming pools | c m s |
| | | 63 | Use solar hot-water systems for space heating | c m s |
| | | 64 | Pre-plumb for a solar hot-water system | c m s |
| Interior Materials | **Goal: Create healthy indoor environments** | | | |
| | | 65 | Use low- or no-VOC, formaldehyde-free paints, stains, and adhesives | c t m s |
| | | 66 | Use low- or no-VOC carpets, furniture, particleboard, and cabinetry | c t m s |
| | | 67 | Use exposed concrete as a finished floor | c t m s |
| | | 68 | Use natural materials such as wool and sisal for carpets and wallcoverings | c t m s |
| | | 69 | Use sustainable materials for flooring, trim, and interior surfaces | c t m s |
| | **Goal: Support the market for recycled materials** | | | |
| | | 70 | Use recycled-content floor tile, carpets and pads, cabinets, and countertops | c t m s |
| | **Goal: Support sustainable forests** | | | |
| | | 71 | Use reclaimed / salvaged, sustainably harvested (FSC certified), or engineered wood for flooring and trim, or use wood alternatives such as bamboo and cork | c t m s |
| Other Green Alternatives | **Goal: Use creativity and innovation to build more sustainable environments** | | | |
| | | 72 | Use insulated concrete forms | c m s |
| | | 73 | Use structural insulated panels to replace wood-framed walls | c t m s |
| | | 74 | Use natural building materials and techniques | c m s |
| | | 75 | Other sustainable methods or materials used. *Please describe:* | c t m s |

**KEY**

- **c** Commercial/ Industrial
- **t** Tenant Improvement
- **m** Multi-family housing
- **s** Single-family home

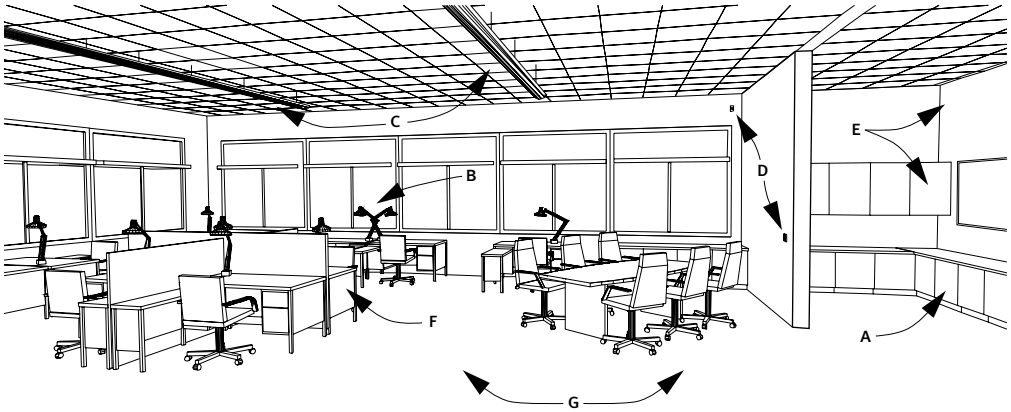
## Commercial / Industrial

A. Design for easy pedestrian, bicycle, and transit access
B. Use native plants that are drought-resistant, create habitat for indigenous species, and do not require pesticides for maintenance
C. Maximize onsite storm-water management through landscaping and permeable pavement
D. Use fly ash in concrete
E. Use a cool roof
F. Plan windows and skylights, light shelves, and window treatments to provide daylight that improves indoor environments
G. Replace air conditioning with natural ventilation and passive cooling
H. Use high-efficiency equipment including furnaces, boilers, fans, and pumps
I. Use recycled-content floor tile, carpets and pads, cabinets, and countertops




Not shown:

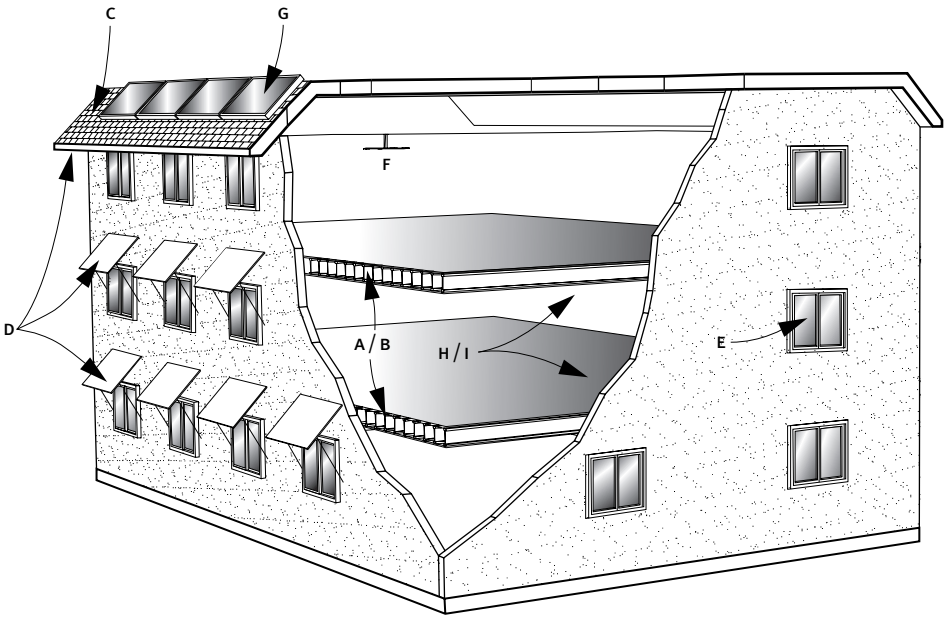
- Use water-conserving plumbing fixtures



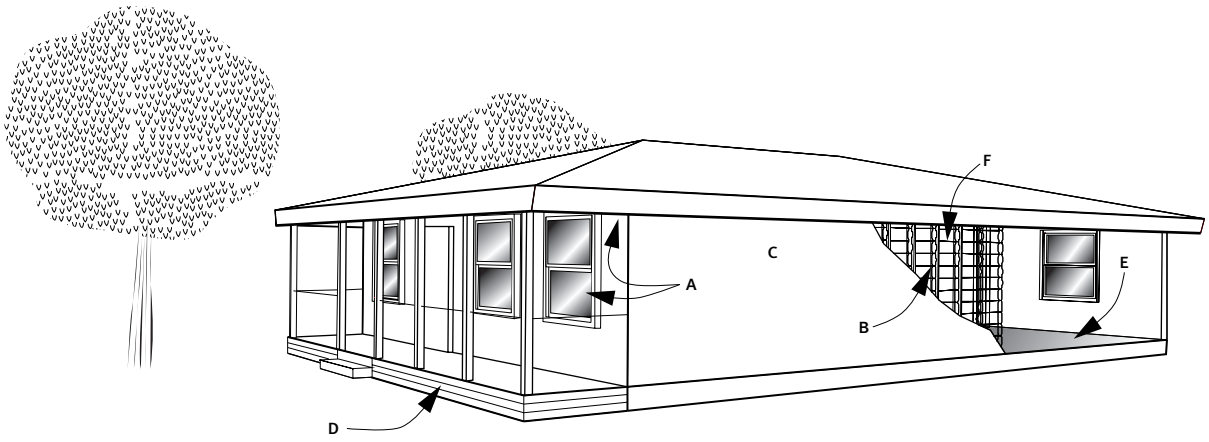

## Tenant Improvement

A. Provide adequate space for storing and handling recyclables
B. Design lighting levels for actual use and use task lighting to reduce general lighting levels
C. Use energy-efficient lamps and lighting fixtures
D. Use lighting controls that save energy such as occupancy sensors
E. Use low- or no-VOC, formaldehyde-free paints, stains, and adhesives
F. Use low- or no-VOC carpets, furniture, particleboard, and cabinetry
G. Use reclaimed or salvaged, sustainably harvested (FSC certified), or engineered wood for flooring and trim, or use wood alternatives such as bamboo and cork

## Multifamily Residential




A. Use spacings, sizes, and modular dimensions that minimize lumber use and optimize performance
B. Use engineered lumber or metal stud framing to replace solid-sawn lumber
C. Use durable roofing materials
D. Provide shading on east, west and south windows with overhangs, awnings, or deciduous trees
E. Choose window sizes, frame materials, and glass coatings to optimize energy performance
F. Use ceiling fans for comfort cooling, and use a whole-building fan for night-time cooling
G. Use solar hot-water systems for domestic use and swimming pools
H. Use natural materials such as wool and sisal for carpets and wallcoverings
I. Use sustainable materials for flooring, trim and interior surfaces




## Single Family Home

A. Optimize building orientation for heat gain, shading, daylighting, and natural ventilation
B. Use sustainably harvested lumber (FSC certified) for wood framing
C. Use sustainable siding materials
D. Use sustainable decking materials
E. Use radiant and hydronic systems for increased efficiency, health, and comfort
F. Use recycled-content, formaldehyde-free fiberglass insulation, cellulose insulation or other green insulation products

Not shown:

- Use heat recovery equipment, tankless water heaters and/or on-demand hot water circulation pump
- Use passive solar design, thermal mass, and insulation to reduce space-heating needs

## Will a project contribute to sprawl or build a more equitable and efficient pattern of land uses?

Will it fill in valuable open space or seek ways to tread lightly and even restore the land around it? Planning also sets the relationships of the project to its neighbors and its neighborhood. Good planning improves the environment and, often, local property values. Sustainable planning looks at the long term effects and seeks to ensure that improvements will serve future generations as well as the present.

### Goal: Create a sustainable community

A sustainable community has a lot to do with diversity. A community must have a wide variety of options in building types, public spaces, routes and paths so that members can satisfy the variety of their needs and preferences locally. This means having a variety of uses in the same area, open spaces and built-up areas of various densities in reasonable proximity, and a real variety of options for how to get around. Sustainable communities also rebuild and restore empty or damaged spaces in their midst, rather than letting vacant or contaminated sites detract from larger community goals. Most older cities and towns in San Mateo have mixed-use downtowns, and while this good habit was lost in the middle of last century, it is making a resurgence in planning all across California and the rest of the country.

#### 1 Build mixed-use development and provide public amenities such as open space

**What is this?**

Mixed-use development means buildings that include more than one use – such as apartments or offices over ground floor retail space, or a hotel integrated with a shopping complex. It is also important to add to a public realm that supports the integrated living and pedestrian-friendliness of mixed-use areas, by providing open spaces, attractive street furnishings, or other benefits.

**Why do it?**

Mixed-use is a major characteristic of most vibrant neighborhoods. It allows for people to mix who do different things, and puts a variety of opportunities within walking distance of each other. Saving car trips and reducing traffic congestion makes building spaces more attractive to potential tenants; additionally, much of the most valuable real estate in the country is in mixed-use areas. The added value of mixed-use projects can typically support public amenities, which in turn often add to the long-term value of real estate adjacent to those amenities.

**How to do this?**

Plan mixed-use projects in the context of other projects within walking distance and with the public realm in mind.

**Who does this?**

Building owners, planners, architects.


Photo: RecycleWorks Green Building Program

*City Center Plaza is a model mixed-use development that contains affordable housing, commercial, educational and child care uses within walking distance of downtown Redwood City's shopping center, civic functions, and multiple public transit opportunities.*

## 2 Cluster development to minimize paving and utilities, and to preserve open space

**What is this?**

Typical subdivision plans have a single building in the center of open space on each lot. Clustered developments have larger open spaces and restricted building footprint areas. Easements or joint ownership arrangements such as homeowners associations, coop corporations, or cohousing are often used to manage shared open spaces.

**Why do it?**

When designing subdivisions or multi-building projects, placing buildings near each other will create a more varied site plan and can significantly reduce site development costs. Access roads can be shorter and shared, as well as water, sewer, power, and gas lines and other utilities.

**How to do this?**

Plan for shared open spaces and clustered developments. Portola Valley requires dedicated open space or conservation easements.

**Who does this?**

Building owners, planners, architects.

## 3 Reuse a brownfield or previously occupied site

**What is this?**

Brownfields are former industrial sites that have not been redeveloped but are often available close to desirable areas. Other former building sites are vacant for other reasons and can be good spots to build.

**Why do it?**

Rehabilitating brownfields, or finding other previously occupied areas to build on, reduces the loss of open space and preserves habitat for local plant and animal communities. Filling in the gaps left by vacated properties creates denser, more vibrant areas of activity in our already built-up cities and towns and raises local property values.

**How to do this?**

Brownfield remediation is a complex process, sometimes requiring environmental clean-up, for which state and federal assistance may be available. Brownfield redevelopment is a long-term commitment to a site, from which long-term benefits can be expected.

**Who does this?**

Building owners, government agencies, environmental engineers and consultants, planners.

## 4 Design for easy pedestrian, bicycle, and transit access

**What is this?**

People have many options for getting around. It is important for site selection and site designs to maintain and extend the viability of walking, bicycling, and transit use.

**Why do it?**

Moving away from single passenger automobile trips reduces traffic congestion, and can alleviate air pollution, concern over oil supplies, and global warming. A well planned site can assist the development of alternative transportation options and becomes more attractive to a wider range of potential users, tenants, and visitors.

**How to do this?**

Study and prioritize the availability of transit options – train stations, bus stops, bikeways, or walkable neighborhoods – when selecting sites for a proposed new project. Provide sidewalks, bike lanes, bike parking, trees or covered walkways, a bus shelter, or other amenities for pedestrians, bicyclists, or transit riders on your site.

**Who does this?**

Building owners, planners, architects.

*i*

Congress for the New Urbanism: www.cnu.org
EPA Brownfields Program: www.epa.gov/brownfields
CalEPA Brownfields: www.calepa.ca.gov/brownfields

## Whether your land is on the ocean side, in the mountains, or by the bay, it will have special characteristics that make it distinctive.

Understanding your site – what it offers, what lives there, how sun, wind, and water flow across the area – is central to using it in a meaningful way. Your site has a unique collection of San Mateo County plants, insects, and animals. The more your project recognizes the benefits they have to offer, and avoids the problems that arise when we neglect them, the better its indoor and outdoor spaces will be. The opportunity exists on every site to discover or restore natural communities and help people on the site connect with the environment. This is at the heart of "sustainability" – providing places that benefit current users without compromising the needs of other users and future generations.

## Goal: Respect your site

Designing your project to work harmoniously with the site is essential to achieving substantial energy and water efficiencies, and their associated cost savings. The most important thing to do is to think through your project first in the context of your particular needs and the site's particular opportunities and features. Design so that indoor and outdoor spaces are as comfortable as possible without the need for extra heating and cooling. Save space on your site for outdoor space and natural features, and save resources and money while doing it. Recognize the value of the existing soil and plants on your site and work with them, enhancing these living systems through thoughtful additions and transformations.

### 5 Design and landscape to create comfortable micro-climates and reduce heat island effects

**What is this?**

A "micro-climate" is the sum of the outdoor conditions in a specific place – a backyard, a parking lot, or a lawn all have micro-climates. Outdoor comfort depends on air temperature, humidity, sun, shade, and wind; but different conditions will be comfortable depending on your activities, clothing, and personal preferences.

When a city has a higher temperature than surrounding rural areas, it's called the "heat island effect." This is caused by the greater generation of heat by urban activities (factories, cars, air conditioners, equipment in buildings, etc.) and the greater absorption of solar heat by pavement and roofs as compared to forested or planted areas.

**Why do it?**

Your landscape design can create comfortable conditions and outdoor spaces that you can use and enjoy in all seasons. Furthermore, thoughtful design can reduce the contribution your project makes to unwanted regional heat gains, helping to reduce everyone's air-conditioning bills, including your own.

**How to do this?**

Reduce the amount of paved area on your site – it collects heat in summer and does not cool itself through evaporation like planted areas do. Add trees strategically to create shaded outdoor areas that might get too hot in summer, and also provide south-facing sunny outdoor areas for winter use.

**Who does this?**

Building owners, landscape architects, architects.

## 6 Optimize building orientation for heat gain, shading, daylighting, and natural ventilation

**What is this?**

Solar orientation describes the way that your building receives sunshine: south-facing walls receive strong midday sun, east and west faces get intense low-angled rays in the morning and afternoon, and the north face is shaded. Sunlight entering your building brings heat and light – which can be advantageous or, if not planned for, can cause problems. The shape and position of the building on your site also influences whether and how prevailing breezes can provide cross-ventilation.

**Why do it?**

Good solar orientation is an excellent opportunity to make a better indoor environment and reduce energy use substantially without any increase in project cost.

**How to do this?**

Consider the availability of sunshine, shade, and wind on your site before you plan the building, parking, and other areas of use. Also consider whether your building wants to gain free solar heat (as is typical for houses), or stay cool in the face of high internal heat gains (as in office spaces). A little study in advance can result in big energy savings and vastly more pleasant spaces.

**Who does this?**

Building owners, planners, architects, energy consultants.

## 7 Reduce building footprint – smaller is better

**What is this?**

Your building footprint is literally the amount of land area your project covers.

**Why do it?**

If you can achieve the same project goals – be that a comfortable home for your family, space for a certain number of workers, or some level of return on investment – with fewer square feet, you will provide the same level of benefit with a smaller financial investment. Smaller buildings require less of everything that makes projects expensive and increases their environmental impacts- building materials, labor, energy, waste generation, etc.

**How to do this?**

Consider the reasons for your building project, and how those needs can be met with the least space. Review the per-square-foot rules of thumb many projects use to see if they fit your project specifically. Look for innovative ways of housing people and activities that are equally or more satisfying and take up less space.

**Who does this?**

Building owners, planners, architects.

## 8 Limit site impacts, balance cut and fill, preserve existing vegetation and protect soil during construction

**What is this?**

The construction process has many short- and long-term impacts on your site that arise from land clearing, excavation, and earth moving. Best management practices prevent extensive loss of mature plants, groundcover, and soil during construction.

**Why do it?**

Preserving your site's integrity during construction is an important way to maintain the quality of the land resources you already own, while also preventing environmental degradation that might impact your neighbors or local water supplies.

**How to do this?**

Fence off sensitive areas of the site from construction workers and staging areas, including mature trees, established plant communities, and important landforms. Use erosion control materials such as straw bales and geotextiles on exposed cut slopes. Design your excavations and final grades so that a large quantity of earth is neither imported nor exported from your site. Include limits on site damage in your construction contract so that the value of soil and plants is apparent to your contractor.

**Who does this?**

Architects, landscape architects, civil engineers, specification writers, general contractors, excavation subcontractors.

Photo: Philippe Cohen

*Construction at the Leslie Shao-ming Sun Field Station protected the surrounding natural environment by fencing off the work area, not allowing heavy equipment or work within the drip line of mature trees and using straw bales and other techniques to prevent soil loss and erosion.*

## Use native plants that are drought-resistant, create habitat for indigenous species, and do not require pesticides for maintenance

9

**What is this?**

Proper selection of plants on your property can save the need for irrigation, fertilizers, and pesticides and also provide numerous environmental benefits. Native plants of San Mateo County are adapted to the long, dry summers, local soils and pests, and also provide the best habitat, food and shelter for local butterflies and other animals.

**Why do it?**

Reliance on irrigation and pesticides is not only expensive, but also environmentally poisonous. Urban runoff is the largest source of pollution for San Francisco Bay and many local water sources, and pesticides and fertilizers are a major component of that pollution. This not only harms bay life, but also poses a significant public health hazard.

**How to do this?**

Some strategies include: Group plants with similar water needs together. Select native plants that attract beneficial insects. Use perennial instead of annual plants. Replace lawn areas, which require intensive chemical maintenance, with native fescues or a "wild lawn" of groundcovers and wildflowers. Use mulch to prevent water loss and protect plant roots.

**Who does this?**

Landscape architect, landscape contractor, horticulturist, or gardener.

Photo: Middlebrook Gardens

*This example of native landscaping is planted alongside a commercial building.*

## 10 Use recycled rubble for backfill drain rock

**What is this?**

Drain rock is crushed stone placed against foundations so that water moving through the soil will not wick into the concrete, eventually getting inside the building.

**Why do it?**

Using recycled material reduces virgin material environmental impacts and waste disposal fees.

**How to do this?**

Demolished concrete from your jobsite or other sites is often available – small amounts of concrete can be broken into suitable pieces with hand labor, larger amounts can be machine-pulverized. Clean drain rock and use filter fabric to exclude all sand-sized and smaller particles that can block drainage.

**Who does this?**

General contractors, demolition and excavation subcontractors

# Goal: Save water and reduce local water impacts

In San Mateo County, most water arrives in winter storms. The water picks up all the accumulated waste, dirt, grit, and pollutants on the ground, so stormwater management is very important to maintaining good water quality. Furthermore, stormwater peak flows are often too large for local sewers and can cause sewer overflows. On the other hand, stormwater can be saved and stored for irrigation. Many other techniques in irrigation can save water, maximizing the benefits we get from this precious resource.

## 11 Maximize onsite stormwater management through landscaping and permeable pavement

**What is this?**

In typical construction, roofs and large paved areas – especially parking lots – send rain directly to catch basins and storm drains and eventually into sewers. Managing stormwater onsite involves alternative treatments for pavement and water channels, slowing down water so it can be filtered and absorbed by plants and will percolate back into groundwater.

**Why do it?**

Conventional engineered drainage systems can be very expensive – not only can alternatives be less costly, but they can also retain water for landscaping. Sending stormwater to drains can flood storm sewers, causing sewage backups, and delivers untreated pollutants such as motor oil or fertilizers from hard surfaces into San Francisco Bay and our other water bodies.

**How to do this?**

Permeable pavement (concrete that allows water to percolate through by leaving out fine particles), pavers set in sand with gaps, and grass- or gravel- stabilization mats and rings allow stormwater into soil, reducing peak stormwater flows. Vegetated swales (shallow trenches) can slow and absorb some stormwater from the edges of parking lots. They can lead to drains or to vegetated percolation basins. On small parcels, a "rain garden" can transform roof runoff into a valuable irrigation source and a playground of sound.

**Who does this?**

Landscape architects, civil engineers, architects.

## 12 Use rainwater harvesting

**What is this?**

Instead of directing roof runoff into drains, gutters, downspouts, and into the sewer system, rainwater can be stored in barrels, tanks, or cisterns to be used for future irrigation.

**Why do it?**

Farmers in dry climates have always stored rainwater. This not only lessens the amount of water you must purchase for landscape irrigation, but also reduces the burden on storm sewers as mentioned above.

**How to do this?**

The simplest system is probably a 50-gallon barrel under a roof downspout. Larger, more thoroughly planned systems can include an underground cistern or gravel-filled dry well connected to irrigation pipes. In San Mateo, large cisterns are better because almost all our rain comes in the winter and there is a long dry summer when it will be needed

**Who does this?**

Landscape architects, architects.

## 13 Use water-conserving landscape technologies such as drip irrigation, moisture sensors, and watering zones

**What is this?**

A lot of water used for landscaping is wasted, failing to reach the plants it is sprayed towards. Drip irrigation supplies water through small, perforated underground pipes that get water near plant roots – rather than on the surface where it can evaporate. Moisture sensors detect when irrigation is necessary, shutting it off when plants won't need water. Zoning your irrigation system allows plants of different kinds or in varying amounts of sun to get an appropriate amount of water, instead of applying equal water to all areas.

**Why do it?**

Saving water is always important, especially as San Mateo County is growing, but water supplies are not. While water prices may not reflect the full cost of delivering each gallon of water to your tap, saving water still saves money.

**How to do this?**

Design an efficient irrigation system – one that keeps plants healthy and doesn't use more water than necessary. Make sure that the amount of water and timing of delivery are appropriate to the types of plants you plan to use in different areas.

**Who does this?**

Landscape architects, landscape contractor, irrigation specialists.

**RecycleWorks Sustainable Sitework Page: www.recycleworks.org/greenbuilding/sus_sitework.html**

**San Mateo County Watershed Protection Standards www.co.sanmateo.ca.us (search for watershed)**

## In a sustainable economy, there is no such thing as waste.

In nature, decomposition and decay constantly recycle organic matter through a whole chain of organisms. In the construction industry, similar processes are possible. Choosing an alternative to sending construction debris to a landfill can recover the value of the solid components of old buildings, actually increasing the economic viability of many projects.

## Goal: Reduce, reuse, recycle

Current best practices can keep over 90% of construction debris on most jobs from being treated as waste. The best way to avoid waste is to not generate it in the first place – why demolish a building if you can use it? Salvaging building parts uses the same principle on a piece-by-piece basis. Leftover materials and debris can often be recycled either by separating them onsite or taking them to a mixed construction and demolition sorting facility. As we become more familiar with these reuse and recycling operations, we can plan ahead for them, maintaining the future value of the pieces of a building for the long term.

### 14 Reuse a building (renovate) instead of tearing down and rebuilding

**What is this?**

Existing buildings have value that is preserved if the buildings are renovated or reused instead of demolished and rebuilt.

**Why do it?**

Renovating a building is so common that it is rarely recognized as a green building strategy, but it is a very important measure. Renovation extends the service life of many building components, whereas demolition would send them straight to a landfill.

**How to do this?**

Look for promising older buildings that might meet your program needs, or think creatively about older buildings already in your possession that are good candidates for "adaptive reuse."

**Who does this?**

Architects, contractors (for small projects).

Photo: RecycleWorks Green Building Program

*24% of what goes into Ox Mountain Landfill is from construction and demolition sites. Most of these materials are recyclable.*

## 15 Deconstruct old buildings for materials reuse (salvage)

**What is this?**

Most buildings are simply demolished when something new is planned on their site; deconstruction (or "soft demolition") is a more careful process that disassembles a building so that the vast majority of material in it can be reused in buildings or other applications.

**Why do it?**

Deconstruction produces salvage material for sale (wood, stone, brick, metals, used equipment) and preserves landfill space while conserving our natural resources.

**How to do this?**

Require deconstruction from your general contractor, include it in written specifications, and discuss it in advance so it is a clear requirement for the job. San Mateo County and surrounding areas have a number of specialized deconstruction companies.

**Who does this?**

Architects, specifications writers, general contractors, specialized subcontractors.

Photo: Whole House Building Supply and Deconstruction, East Palo Alto

*Deconstruction of this house in San Mateo County yielded great lengths of redwood siding and framing lumber, doors, windows, fixtures, hardwood flooring and cabinetry for resale.*

## 16 Recycle construction & demolition waste

**What is this?**

Construction and demolition waste (C&D) includes everything from concrete to carpet, and most of it can be recycled.

**Why do it?**

Waste from construction jobsites is the single largest component of material sent to our landfills. Reducing waste not only saves landfill space and creates recycled alternatives to virgin materials, but also saves money on the disposal "tipping" fees charged at the landfill. Many San Mateo County jurisdictions require C&D recycling – but going beyond the required minimum can save you more. Some local projects have achieved recycling rates of 90% or more.

**How to do this?**

Make sure your contractor plans ahead for C&D recycling and write it into your contract and specifications. Provide jobsite space for separating recyclables such as wood, metals, and sheetrock, or haul waste to materials sorting facility. Use industry take-back programs such as the one for carpet.

**Who does this?**

Contractors, specification writers.

## 17 Design for durability and eventual reuse

**What is this?**

Durable buildings contain materials that can withstand the wear and tear of time, and also have floor plans that allow for various uses over time. Planning for reuse allows building uses and building systems to be updated or changed without requiring full demolition of the building.

**Why do it?**

Durable buildings are inherently more valuable. A modest increase in a construction budget can often double the life span of a building, leading to vast cost savings. Additional future savings can be obtained if the design allows orderly reclamation of valuable building components such as structural steel or expensive finishes.

**How to do this?**

Choose long-lived building materials, such as brick and stone, over short-lived products, such as printed vinyl flooring. Design buildings so that systems such as the structural frame, mechanical system, electrical, plumbing, and finishes can be maintained and replaced independently of each other. Use mechanical fasteners, such as nuts, bolts and clips, instead of adhesives.

**Who does this?**

Architects, engineers.

## 18 Provide adequate space for storing and handling recyclables

**What is this?**

Individual bins for holding paper, bottles and cans, cardboard, food waste, and other recyclable materials take up space; make sure room is available so recycling can be done conveniently.

**Why do it?**

Recycling will save virgin natural resources, reduce environmental impacts from production processes, and reduce landfill volumes.

**How to do this?**

Estimate the amount of recyclables on a per-occupant basis – the more people, the more space you'll need. Put recycling space in convenient locations for occupants, custodial staff, and recycling haulers.

**Who does this?**

Architects, space planners.

**RecycleWorks has free Construction and Demolition Debris Recycling Guides and posters available to make it easier for contractors to salvage and recycle materials from their projects.**

**You can ask for a guide at your city's permitting counter or contact RecycleWorks at info@RecycleWorks.org or 1-888-442-2666. Local information on C&D recycling and locations is also found at www.RecycleWorks.org.**

## Reinforced concrete presents a great combination of strength, durability, and fire resistance, and can be green, too.

Because foundations carry the entire weight of the building and suffer wetness and microbial action from the ground, they are almost invariably made of reinforced concrete. Larger buildings also use concrete for floors, walls, and structural frames when loads and fire risks are high. The construction industry is working to lessen the environmental impacts of conventional concrete; every building project has the opportunity to support the use of better kinds of concrete and foundations.

## Goal: Make concrete with sustainable materials

Reinforced concrete is a blend of water, cement, sand, and gravel (or "aggregate") poured or sprayed into formwork around steel reinforcing bars, where it cures and hardens. Cement production involves mining of limestone and a very energy-intensive burning process that produces a substantial percentage (8% or more) of the world's $CO_2$ greenhouse gas emissions. Acquiring sand and gravel involves extraction and transportation of virgin materials. And concrete's wood formwork is often thrown away after a single use. Building sustainably with concrete means using alternatives to these conventional materials and techniques that perform as well but have lower impacts and lower costs. Reinforcing steel typically has a high percentage (60% or more) of recycled content; it is an important element of sustainable building as well.

### 19 Use flyash in concrete

**What is this?**

Flyash is a byproduct of coal-burning power plants that has binding properties similar to cement, and can be substituted for a large portion of the cement usually used to make concrete.

**Why do it?**

Substituting flyash, a waste material, for manufactured cement saves natural resources used in cement production and often saves money as well. Flyash also makes concrete stronger, more waterproof, and more durable, although it can slow curing time.

**How to do this?**

Many California concrete companies already provide some flyash in their standard concrete mix. Ask for the largest amount of flyash they are willing to provide and include this in written specifications. Structural engineers can specify even higher percentages of flyash if they are familiar with current research on its use.

**Who does this?**

Concrete companies and subcontractors, architects, structural engineers, specification writers.

## 20 Use recycled aggregate in non-structural concrete

**What is this?**

Crushed waste concrete from building and sidewalk demolition is often suitable for use as concrete aggregate – the gravel-sized particles that are held together by the cement and sand matrix of concrete in place of gravel or crushed rock from quarries.

**Why do it?**

Substituting a common waste material for virgin materials reduces the environmental impacts of materials mining, processing and transportation. It also saves landfill space and the fees charged to your project for dumping the rubble your project may generate in demolition.

**How to do this?**

Recycled aggregate is not appropriate for structural concrete, but can be used for sidewalks, low site walls, and topping slabs. In decorative applications, recycled materials can include native rocks, broken ceramic tiles, or glass. Also, consider simply using stacked stone or concrete rubble for site retaining walls – these could then include 100% recycled material.

**Who does this?**

Concrete companies and subcontractors, landscape contractors.

Photo: Richard Parker, 450 Architects

*Concrete can be ordered with high percentages of fly ash; many concrete companies already include some in their typical mix. Planning allows wood forms to be reused or salvaged.*

## 21 Use prefabricated forms or save and reuse wood form boards

**What is this?**

Wood form boards hold concrete while it cures from a semi-liquid to a hard finished material. By taking some care when removing wood form boards, they can be reused many times. Alternately, prefabricated forms, typically made of aluminum, can be substituted for wood forms.

**Why do it?**

Saving wood – especially the large-dimension boards often used for framework, reduces forest loss and especially harvesting of old-growth trees. Reusing forms also saves material costs, and prefabricated forms can be faster to install as well.

**How to do this?**

Plan out wood forms so that the boards can be removed in condition for reuse. Prefabricated or aluminum forms can be rented or purchased. Write specifications to prevent the construction of wasteful single-use formwork.

**Who does this?**

Concrete companies and subcontractors.

## Careful planning and thoughtful selections can improve the quality of wood framed buildings while reducing the impact on forests and saving money.

### Goal: Design to save wood & labor

Conventional wood framing is inherently wasteful, producing piles of useless wood scraps and using expensive full-size wood members for minor tasks such as supporting sheetrock in building corners. A good design will use wood efficiently and eliminate redundant members.

#### 22 Use spacings, sizes and modular dimensions that minimize lumber use and optimize performance

**What is this?**

Conventional wood construction uses many redundant members and can result in a substantial amount of waste. Planning carefully can allow the use of fewer or smaller structural members such as studs, joists, and window headers. "Optimum value engineering" is a term that refers to this kind of planning.

**Why do it?**

Reducing inefficiencies in wood design saves time, money, and trees – smaller members are cheaper and easier to install, and building with fewer members goes faster. Savings from this approach can amount to more than $3,000 per house or over $1 per square foot.

**How to do this?**

Lay out the building so that dimensions are multiples of two feet, – boards and plywood sheets typically come in multiples of two-foot lengths. Place joists and studs at 24 inches on center (thicker subfloors, wallboard, or sheathing may be necessary at this wider spacing). Design window headers to actual structural requirements, using double 2x lumber instead of 4x where possible. Use drywall clips instead of corner studs.

**Who does this?**

Architects, structural engineers, contractors, framing subcontractors and crew.

#### 23 Use engineered lumber or metal stud framing to replace solid-sawn lumber

**What is this?**

Engineered lumber is made from small pieces of wood glued together: common examples are glue-laminated beams, plywood, oriented strand board ("OSB"), finger-jointed studs, and wood truss joists ("TJI"s). Sheet metal studs are long folded sheet metal pieces that are arranged the same way as studs and joists and connected with self-tapping screws instead of nails.

**Why do it?**

Engineered lumber is made from wood from small trees, reducing the cutting of the larger trees that supply joists. Engineered

lumber is also straighter, less likely to shrink or warp, and often stronger than dimensional lumber. Steel studs replace wood framing entirely, and if they contain significant recycled content, can be an environmentally beneficial solution.

**How to do this?**

Most engineered wood products are made to directly replace solid wood pieces: joists, studs, and beams all have engineered counterparts. Steel studs can be substituted for solid-sawn lumber but cannot easily be combined with wood pieces. Your structural engineer should verify the appropriateness of engineered or sheet metal members and, where appropriate, account for their extra strength to reduce member sizes and save money.

**Who does this?**

Architects, structural engineers, contractors.

## Goal: Support sustainable forests

Wood stud framing – our most common building system – involves heavy and often destructive use of forest lands and ecosystems. Forests in the United States and all over the world continue to suffer from indiscriminate logging including frequent clear-cutting. The loss of forests impacts us in many ways, from species extinction to water pollution, reduced fisheries, and increased risk of global warming and climate change. While one approach is to use alternatives to stud framing (see Chapter 13), the versatility and ease of stud framing can still be employed in an environmentally sustainable manner by using various alternatives to lumber taken from clear-cuts.

### 24 Use sustainably harvested lumber (FSC certified) for wood framing

**What is this?**

The Forest Stewardship Council ("FSC") is a nonprofit organization that sets environmental standards for timber harvesting. Timber companies can certify their operations to its standards and then sell their wood as "sustainably harvested," or "FSC certified."

**Why do it?**

While the world's forest crisis is undeniable, it is also inconceivable to immediately stop using wood for construction. Ultimately, people must learn to provide for the ongoing life and health of forest ecosystems while continuing to take trees for our own use. The FSC system is a good step in this direction; purchasing FSC wood supplies crucial positive encouragement to timber companies to transform their management practices.

FSC

*The FSC logo identifies products which contain wood from well-managed forests that are certified in accordance with the rules of the Forest Stewardship Council.*

Photo: RecycleWorks Green Building Program

*San Mateo County's redwoods are beautiful and irreplaceable; finding and using alternatives to the products of destructive forestry practices is essential to the health of forests worldwide.*

**How to do this?**

Wood certified to FSC standards is marked with the logo of the FSC, as well as that of the third-party certifier. Many San Mateo County and Bay Area lumber yards now stock FSC certified wood. For larger projects, planning ahead with a lumber supplier is often necessary to ensure availability. Writing a requirement for FSC certified wood into project specifications is an important tool to educate contractors about this issue and ensure certified wood is actually purchased. While other claims are made for sustainable harvesting of lumber, the FSC system is the only one recognized by the US Green Building Council as meeting the standards of the green building community.

**Who does this?**

Owners, architects and specification writers, contractors, lumber yards.

## 25 Use reclaimed or salvaged lumber

**What is this?**

Reclaimed lumber is wood that was used in structures that have fallen out of use, such as old barns or railroad trestles. Salvaged wood also refers to previously cut and used wood, reclaimed by a salvage yard rather than a lumber company.

**Why do it?**

While old-growth trees have the highest-quality lumber, it is not only environmentally devastating to cut them down but increasingly hard to find available trees. Reclaimed lumber is often of high-quality old-growth stock, but can be reused without damaging living forests. The structural performance of reclaimed lumber can be greater than wood from harvested trees, and the aging process can produce distinctive and beautiful wood pieces.

**How to do this?**

Reclaimed lumber is mostly sourced by specialty lumber companies. Contact them early in your project about availability for the sizes of framing members you will need.

**Who does this?**

Owners, architects, contractors.

**i**

Natural Resources Defense Council publication "Efficient Wood Use in Residential Construction": www.nrdc.org/cities/building/rwoodus.asp

Forest Certification Resource Center: www.certifiedwood.org

## Show off your green building on the outside – by using green materials!

Because a building's exterior must endure rain, big swings in heating and cooling, and ultraviolet rays, durability is a central concern for exterior materials. So are moderating heat gain and stormwater runoff, and repelling microbial attack. Unfortunately, many durable, natural woods are endangered, and some durable synthetic materials are the products of toxic manufacturing processes. Green alternatives range from high-tech new "cool roofs" to time-tested standards such as stucco or stone.

## Goal: Make a sustainable roof

Typical roofing is a major non-recyclable component of our solid waste stream. More sustainable alternatives provide many benefits such as longer service life, lower maintenance costs, energy savings, and superior stormwater management, and can even be an environmental signature piece for a green project.

### 26 Use durable roofing materials

**What is this?**

Roofing can be considered durable if it has a life span of 40 years or more.

**Why do it?**

Re-roofing represents one of building owners' largest maintenance costs – buying two roofs in twenty years costs a lot more than buying one good roof that lasts for forty.

**How to do this?**

Durable roofs include high-end single-ply membranes and composite shingles, stone or clay tile, and sheet metal. Roofs that wear out rapidly are often made of cheap asphalt shingles or built-up tar and gravel rolled layers. Get the longest possible warrantee from your roofing subcontractor, and write durability into your contract and specifications.

**Who does this?**

Architects, specification writers, contractors, roofing subcontractors.

### 27 Use a cool roof

**What is this?**

Cool roofs are designed to reflect the heat that comes with sunshine. They can be bright white membrane roofs, paint-on coatings (for retrofit applications), or light-colored or specially designed tiles and shingles. While metal roofs are reflective, they will only release heat gain if specifically coated to do so.

**Why do it?**

A cool roof alone can decrease the air conditioning costs of the space below by 20% or more and increase comfort dramatically. Cool roofs are also more durable than hotter roofs because there is less degradation from heating/cooling and UV exposure. Lastly, they reduce the heat island effect for the surrounding region (see Chapter 2).

**How to do this?**

Ask your architect or roofer for cool roof options. The ratings for the roof product should be 75% or greater reflectivity and 85% or greater emissivity. Cool roofs are especially appropriate for large flat roofs such as on industrial buildings, warehouses, and shopping malls but as new options become available, they will become more applicable for houses and small commercial buildings as well.

**Who does this?**

Owners, architects, specification writers, knowledgeable roofing contractors.

## 28 Use a green or living roof

**What is this?**

Green roofs have a layer of soil and living plants on top of root barriers, waterproofing layers, and a structural roof deck (usually made of concrete). They range from a thin soil layer that supports groundcover plants to gardens that include shrubs and even small trees.

**Why do it?**

Green roofs reduce heat gains inside (as with cool roofs), and protect your roof's waterproofing layers, adding great durability. They prevent stormwater runoff (see Chapter 2). They can even replace habitat for species that is lost under the footprint of new construction. Many can be used as beautiful outdoor garden spaces for building occupants.

**How to do this?**

Plan early for a green roof, because it has a significant impact on your building. It can change building height, and often requires a somewhat stronger structure to carry the soil weight (heavy trees can be located directly over columns). A number of manufacturers offer complete green roof systems including waterproofing, drainage layers, soil-holding layers, and even plantings.

**Who does this?**

Architects, structural engineers, green roof manufacturers and installers.

Photo: Mark Luthringer

*The green roof on these offices in San Bruno is intended to recall the form and floral variety of the hills in the center of San Mateo County.*

## Goal: Support healthy environments and sustainable forests

The health and environmental impacts of the production and extraction of building materials are substantial. Siding and exterior decking are two areas where these concerns are especially important because of the visibility of siding and the shortage of choices for exterior decks.

### 29 Use sustainable siding materials

**What is this?**

Wood siding, like structural framing, uses large boards that come from mature trees (see Chapter 5). Sustainable alternatives include fiber, cement and stucco.

**Why do it?**

FSC certified wood reduces loss of old-growth trees and keeps forest ecosystems healthy. Fiber-cement or stucco are lower-maintenance than wood siding, which requires frequent painting. However, vinyl siding, made from polyvinylchloride (PVC), and the dioxins that come from manufacturing it are among the worst and most common environmental toxins in the United States. Dioxins don't break down in the environment, and cause numerous health hazards. PVC also creates toxic fumes in building fires and becomes non-recyclable solid waste once its service life ends.

**How to do this?**

Green choices for siding include salvaged or FSC certified wood, brick and stone, stucco, fiber cement panels and boards, and non-PVC plastics such as polypropylene boards.

**Who does this?**

Owners, architects, specification writers, contractors.

### 30 Use sustainable decking materials

**What is this?**

Typical decking is made of durable woods that are endangered – particularly redwood – and that are generally not sustainably harvested. Plastic lumber (which contains recycled high density polyethylene, not PVC) and plastic-wood hybrid lumber are more sustainable substitutes for decking.

**Why do it?**

Outside of a few very small logging operations that are moving to sustainable harvesting, using redwood for decking contributes directly to the loss of California's last stands of coastal old-growth forest. Plastic lumber contains recycled materials, has lower maintenance than wood, and does not give splinters.

**How to do this?**

Check with local lumber yards for FSC certified redwood decking and plastic lumber or plastic-wood hybrid lumber. Also, consider using a brick or stone patio instead of a wood deck to create usable outdoor space.

**Who does this?**

Owners, architects, remodelers.

The Cool Roof Rating Council: www.coolroofs.org
Plastic Lumber Trade Association: www.plasticlumber.org
Healthy Building Network: www.healthybuilding.net
Green Roof Industry Resource Portal: www.greenroofs.com

# Windows and doors are the openings through which most energy flows in and out of your building. Use them to provide free heating, cooling, and lighting, and to make your building more pleasant and productive.

## Goal: Save energy through passive design

"Passive design" saves energy without expensive and high-maintenance mechanical systems by planning out the natural heat flow through your building openings in advance (also see Chapter 10). It starts with considering the exterior orientation and landscaping around each window and door, then the sizes and material choices for each opening, and works its way down to caulking gaps around the frames. It all adds up to big savings and a better indoor environment.

### 31 Provide shading on east, west and south windows with overhangs, awnings, or deciduous trees

**What is this?**

Shading windows with overhangs, awnings, or trees keeps heat from coming in through windows while still allowing diffuse daylight in and views out. Overhangs can be optimized to allow in warm direct sunshine during winter and provide shade in summer.

**Why do it?**

Direct sunshine coming in the window adds to air conditioning needs on hot days – shading windows is the simplest and most cost-effective way to reduce your air conditioning bills.

**How to do this?**

Size overhangs or awnings to cut off a 30-degree angle from the base of south-facing windows, and use overhangs with vertical fins on east and west facades. Awnings can be retrofitted to existing buildings with overheating problems. Deciduous trees in front of the building can block summer sun and allow in winter sun when they lose their leaves.

**Who does this?**

Architects.

## 32 Plan windows and skylights, light shelves, and window treatments to provide daylight that improves indoor environments

**What is this?**

Consideration of how daylight reaches indoor spaces and work surfaces is important to making daylighting work inside a building. Light shelves are horizontal dividers between lower "vision" windows and upper daylighting windows that reflect light deeper into indoor spaces; window treatments include louvers, interior and exterior blinds, shades, and tints.

**Why do it?**

Daylit spaces are naturally comfortable if appropriately designed, and can easily achieve enough light to remove the need for most daytime electric lighting. This can save a large amount of energy, and also make more pleasant spaces that help occupants be healthier and more productive.

**How to do this?**

Windows and skylights admit light, but controlling the light is very important – glare is a common problem in spaces with too many windows. Various rules of thumb used by architects apply to light shelves and daylighting penetration. For the biggest energy savings or for complex spaces, do daylight modeling in the design process, either with a large-size physical model or various software packages.

**Who does this?**

Architects, specialized daylighting consultants.

Photo: Cesar Rubio

*In the new San Mateo County Forensics Laboratory, windows are sloped and the interior is painted white to optimize daylight entry and distribution. Workers enjoy the views and natural daylight, increasing productivity.*

## 33 Choose window sizes, frame materials, and glass coatings to optimize energy performance

**What is this?**

Windows are less well insulated than solid walls, allowing more heat loss in winter and heat gain in summer. Bigger windows lose more heat, and let in more useful daylight and heat through sunlight. Window frames can be an area of high heat loss, and window coatings can help glass to retain heat inside or reflect heat outside as necessary.

**Why do it?**

Optimizing your windows to meet your expected heating, cooling, and lighting needs can reduce your energy bills substantially.

**How to do this?**

Building energy simulations – done on a computer – are the best way to realistically forecast the overall energy impact of windows on a design. Use information from National Fenestration Rating Council stickers to judge window insulation and performance levels.

**Who does this?**

Architects, energy consultants.

## 34 Stop air leakage at doors and windows

**What is this?**

Air leakage, or "infiltration" in building terms, is a major source of unwanted heat gain in summer and heat loss in winter. Window and door frames or openings are the most common major locations of air leakage.

**Why do it?**

Air infiltration control is one of the most cost-effective ways to improve any building and save money. An investment of less than $50 can save a 2,500 square-foot home around $25 per year; commercial and industrial spaces can also realize rapid returns on this investment.

**How to do this?**

Use foam or expandable caulk to seal cracks in framing around openings. Use weather-stripping and gaskets on the window and door openings themselves, especially in older buildings.

**Who does this?**

Building owners, architects, specification writers, contractors, tenants.

**For more information on upgrading windows in an existing home, ask for the RecycleWorks brochure on Energy Efficient Windows.**

## "Greening" your plumbing is an opportunity to realize important energy and water savings with efficiency investments that pay back rapidly.

Between well-known water conservation measures and new high-efficiency technologies there is a range of options from basic plumbing upgrades and renovations to new integrated systems that heavily reduce water consumption and recycle most or all water onsite. Integrated systems pay off not only in reduced water bills, but also in reduced installation costs as it can downsize boilers, pumps, and valves, and plumbing runs in a more efficient overall approach. Lastly, the health impacts of the materials commonly used in plumbing, and of water delivered to buildings, are areas where you can make contributions to your own health and the broader environment.

## Goal: Save water and energy in plumbing systems

Water heating can account for up to 15% of commercial building fuel use, or $300 per year for a single-family home. Heating water more efficiently, and preventing that heat from being lost, represent opportunities to claim often overlooked savings: techniques include both familiar approaches, such as insulation, and innovative new technologies such as heat recovery devices. San Mateo County's water systems are expensive to maintain and to enlarge, and this expense is reflected in your monthly water bill. Water conservation doesn't have to mean washing dishes by hand, however – lots of new technologies simply use less water to deliver the same level of service we get from older, less efficient equipment.

### 35 Use water-conserving plumbing fixtures

**What is this?**

Faucet and showerhead aerators, automated faucets and flush valves, waterless urinals, dual flush toilets, and pressure-assisted toilets are all available products that are reliable alternatives to older fixtures and use less water to perform the same functions.

**Why do it?**

The savings in water bills will often pay for water-conserving fixtures in short periods of time, and rebates are available for some conservation products. Also, plumbing fixtures that use less water often require smaller plumbing lines, or less plumbing, than conventional fixtures, making installation easier and less expensive.

**How to do this?**

System design in advance is always the best way to gain all the benefits of advanced performance. Ask about fixture water use and shop around for high-performance appliances if your supplier is not familiar with them or does not carry them.

**Who does this?**

Building owners, plumbing engineers, subcontractors.

## 36 Use water-saving appliances and equipment

**What is this?**

Major appliances use major volumes of water. Look for water-efficient dishwashers and washing machines for your home, and in commercial buildings, also consider chiller units and cooling towers. Newer appliances can cut water use – and associated costs – dramatically. The more you use, the more you will save.

**Why do it?**

Horizontal-axis washing machines and high-efficiency dishwashers use 40% less water than conventional models. Efficient cooling equipment can save millions of gallons per year for commercial projects.

**How to do this?**

Water-efficient appliances are energy-efficient too, so look for the ENERGY STAR® label. For engineered equipment and larger systems, be sure to evaluate projected water consumption of proposed units and factor it into your decision-making.

**Who does this?**

Homeowners, mechanical engineers, equipment subcontractors.

## 37 Insulate hot and cold water pipes

**What is this?**

A simple layer of pipe insulation prevents hot water from cooling off or cold water from heating up on its way to the tap.

**Why do it?**

This is one of the most cost-effective ways to save energy, where a very small investment can give back dollars every month. It will also keep hot water pipes hotter, shortening the waiting time for hot water to arrive at the tap.

**How to do this?**

Wrap pipes with wrap or tubular insulation, available at hardware stores for homeowners.

**Who does this?**

Homeowners, plumbers, facilities managers.

## 38 Use heat recovery equipment, tankless water heaters and/or on-demand hot water circulation pumps

**What is this?**

Heat recovery transfers heat from draining water to hot water supply lines without mixing the two streams. Tankless water heaters only heat water when needed, eliminating stand-by losses. On-demand pumps get hot water to taps faster, reducing time and water spent waiting for water to heat up.

**Why do it?**

Drainwater heat recovery can reduce hot water use 50% or more, which can allow for smaller water heaters if designed accordingly. Tankless heaters can reduce energy use by 15% compared to storage heaters, and take up a fraction of the space. On-demand pumps cut time waiting for hot water 75% or more.

**How to do this?**

Design an efficient plumbing system for a new building by thinking through water needs, mechanical space needs, and fuel costs first. More efficient systems can create additional savings in smaller return plumbing runs or reduced appliance sizes. When renovating or replacing equipment, upgrade components to more efficient varieties.

**Who does this?**

Homeowners, plumbing engineers or subcontractors.

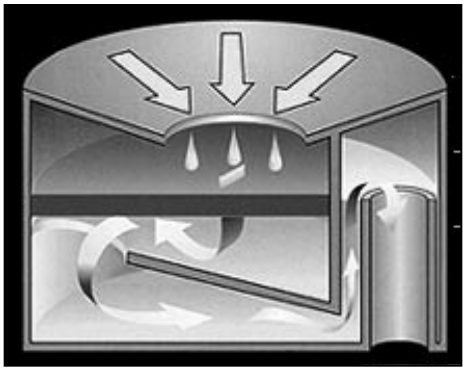


Illustration: Waterless Co., Vista, CA

*New waterless urinal technology: In the waterless urinal trap, lighter-than water fluid seals behind draining waste, reducing water consumption to zero. Waterless urinals represent a major opportunity for water savings in commercial buildings, and can be cheaper to install as well.*

## 39 Pre-plumb for future graywater use for toilet flushing and landscape irrigation

**What is this?**

"Graywater" refers to wastewater from sinks, showers, and laundry – in distinction to "blackwater" from toilets and urinals. Because graywater is not as dirty as blackwater, it can be used for non-potable uses, such as flushing toilets or watering lawns, with relatively minor treatment. Current plumbing codes do not recognize this distinction, so most large-scale graywater installations may not be possible; however, adding a little extra plumbing that will allow the eventual addition of a graywater system is a reasonable investment in a better future. These systems are in some ways similar to rainwater harvesting mentioned before (Chapter 2).

**Why do it?**

The water savings possible through graywater recovery are substantial. There's no need to use valuable treated water for toilet flushing when graywater will do the job just as well. Additionally, using graywater onsite keeps water out of the sewer system (or your septic system), reducing the burden on these facilities.

**How to do this?**

A graywater system consists of draining waste from sinks, showers, and laundry to a holding tank; a filtration or treatment system; and graywater supply plumbing to toilet tanks and irrigation runs. Pre-plumbing for graywater ranges from just adding a few extra plumbing Y's at these locations to placing additional supply lines or even mains, for very large installations. Also, be sure you have space available for a future storage tank and filter.

**Who does this?**

Plumbing engineers, plumbers.

*Household appliances such as front-loading washing machines represent another large opportunity for water and cost savings.*

## Goal: Reduce environmental impacts from materials production

PVC, or polyvinyl chloride, is a common plastic material – ubiquitous as white plastic piping – with some serious environmental problems. PVC's manufacturing process is the leading source of toxic dioxin, a known carcinogen and one of the worst environmental pollutants in the United States. According to the Healthy Building Network, PVC is manufactured predominantly in low-income communities in Texas and Louisiana, which raises environmental justice concerns over the release of dioxins and resulting health issues. While other pipe materials have associated environmental problems, such as the destruction and pollution caused by most copper mining, PVC is not recyclable (unlike copper and many other materials) so its ongoing use means continued dioxin production.

### 40 Use sustainable materials for pipes

**What is this?**

While no material available today is endlessly recyclable with no production of unwanted byproducts or undue energy use, the various choices for piping have different levels of negative environmental impacts.

**Why do it?**

Choosing sustainable materials reduces pollution in water, groundwater, and air, protecting individuals from environmental health problems.

**How to do this?**

For water supply piping use cast iron, concrete, and plastics such as HDPE. For drain, waste and vent lines, use cast iron and ABS plastic. For either of these uses, copper and PEX plastic are suitable. Concrete, vitrified clay, and HDPE are appropriate for sewer pipes. With copper pipe, be sure to use best practices to avoid flow restrictions and environmental releases of copper due to poor soldering or rough pipe ends.

**Who does this?**

Architects, specification writers, plumbers.

**i**

California Urban Water Conservation Council, Home Conservation Tour: www.h2ouse.org.

Healthy Building Network: www.healthybuilding.net/

## Saving electricity saves money, decreases air pollution, and allows for more reliable energy delivery.

Because electricity generation is a leading source of the carbon dioxide emissions that cause global warming, using less electricity saves dollars and has a global impact. While many design features impact a building's electricity use, fixtures and equipment that use electricity directly are obvious targets for energy-saving measures.

## Goal: Save energy in lighting

When you design a lighting system, see if you can use windows or skylights to provide daylighting first (see Chapter 7), and then select efficient fixtures. New technologies can switch lights off or dim them when not in use to save more energy.

### 41 Design lighting levels for actual use, and use task lighting to reduce general lighting levels

**What is this?**

Different lighting levels are needed for different activities – for example, reading requires more light than walking down a hallway. A variety of lights are needed to match the variety of uses expected in every space.

**Why do it?**

Many buildings are vastly over-lit, which not only wastes money, but also reduces people's ability to use contrasts in lighting to identify important variations in space, making places bland and occasionally hard to use.

**How to do this?**

Recent standards from the Illuminating Engineer Society of North America have reduced recommended general ("ambient") light levels, recognizing that it is more important to light actual work areas ("tasks") than whole rooms. The ambient light level should be enough for general comfort, and need not be more than that. With computer screens, task areas may be effectively self-lighting.

**Who does this?**

Architects, electrical engineers, lighting designers.

### 42 Use energy-efficient lamps and lighting fixtures

**What is this?**

Use fluorescent lighting everywhere. Choosing the bulbs with the highest lumens per watt (at least 70 lumens/watt) and the highest color rendering index (CRI 80 or above) will give the greatest efficiencies and the best color. Replace incandescent bulbs, even in homes, with high-CRI compact fluorescent bulbs. For commercial fixtures, look for a high coefficient of utilization (CU 90 or above), which indicates how well the fixture distributes light.

**Why do it?**

Choosing fixtures that use all the light a bulb produces just makes sense – why absorb the light or point it where it's not needed? Fluorescent lights have made many recent improvements: new fluorescent lights don't flicker, have the same color light as incandescents, and produce 80% more lumens per watt. They also last up to eight times as long as incandescents, saving maintenance and replacement costs.

**How to do this?**

Use fluorescent lighting everywhere. Choosing the bulbs with the lowest lumens per watt and the highest color rendering index (CRI) will give the greatest efficiencies and the best color. Replace incandescent bulbs, even in homes, with high-CRI compact fluorescent bulbs. For commercial fixtures, look for a high coefficient of utilization (CU), which indicates how well the fixture distributes light.

**Who does this?**

Building owners, architects, electrical engineers, lighting designers, tenants.

## 43 Use lighting controls that save energy such as occupancy sensors

**What is this?**

Lighting controls are the switches that control lights, whether by manual operation or digital signals from light, motion and infrared sensors.

**Why do it?**

There's no point in providing electric light if no one's using it or free daylight is already arriving in the same place. Investments in lighting controls can pay for themselves rapidly by reducing energy waste. Some controls are already required by the State energy code (often referred to as "Title 24").

**How to do this?**

Use occupancy sensors to switch off lights in rooms that get occasional use such as garages, bathrooms, and conference rooms. Use light-level sensors to dim switch off lights in areas that have access to daylight such as open office areas, classrooms and workspaces.

**Who does this?**

Architects, electrical engineers, lighting designers.

## Goal: Save energy in equipment use

A lot of electricity used in buildings goes to appliances and equipment, and large cost savings are almost always possible by improving efficiency (see also Chapter 10). Efficiencies are available both when buying or replacing individual appliances, such as refrigerators, and in larger integrated systems that link many devices together.

*Using compact fluorescent bulbs is an easy way to save money and electricity.*

## 44 Use ENERGY STAR® appliances

**What is this?**

Energy Star is a U.S. Department of Energy program that sets standards for energy efficiency in a variety of appliances and other products and systems – both for household and business uses. Criteria to be an ENERGY STAR product vary by product type, and usually require products to exceed minimum efficiency standards by at least 10-25% and use low-power "sleep" modes.

**Why do it?**

The average household spends $1,400 on energy costs per year, and savings through appliances can approach $100 of this or more. For example, refrigerators can use 25% of all household electricity and using an ENERGY STAR refrigerator can save 40-60% of that; ENERGY STAR washing machines use 50% less energy than older models.

**How to do this?**

Look for ENERGY STAR labels and electricity usage information on appliances and purchase accordingly.

**Who does this?**

Building owners, tenants.


*Products that meet ENERGY STAR standards are easy to identify by checking for this logo.*

## 45 Use a building energy management system

**What is this?**

A building energy management system (BEMS) is a computer that controls all major building equipment such as heating, ventilation, and air conditioning units, elevators, lighting, etc.

**Why do it?**

BEMS's save on average 10% of total building energy use. They also collect information on building energy use, allowing for better maintenance, replacement, and adjustment over time.

**How to do this?**

Study your building's needs and clearly and accurately specify a BEMS that has appropriate computing power and control strategies. Make sure the system is fully inspected and tested during installation and after occupancy (called "commissioning") to ensure that it works as intended.

**Who does this?**

Building owners with large (over 100,000 square feet) or energy-intensive projects, architects, specification writers, electrical and mechanical engineers.

Illuminating Engineers Society of North America: www.iesna.org

Energy Design Resources design briefs, "Energy Management Systems": www.energydesignresources.com/resource/18/

ENERGY STAR Program: www.energystar.gov

Pacific Energy Center: www.pge.com/pec

RecycleWorks: www.RecycleWorks.org (see rebates and incentives)

## The greatest opportunities for energy savings come from heating and cooling your building more efficiently – and the investments pay back very fast.

Your project can be designed to use 30% less energy than typical buildings, and if you start this approach early in design, it can be built for the same initial cost. The key is integrated design – thinking about the whole building together and the way all the parts relate to each other, and how the outside environment affects mechanical systems inside. Ventilation is also an important way to provide a healthy building – and health is an investment that is always worthwhile.

## Goal: Save energy through passive design

Passive design means planning out the natural heat flows through your building in advance, so that the building will stay cool when it's hot outside, and warm when it's cold. Passive design is basically free, or "cost-neutral," because it uses essential building parts you have to buy anyway – mass and windows – and freely available sunshine and wind on your site (see Chapters 2 & 7). With the money saved by not buying expensive Heating Ventilating and Air Conditioning (HVAC ) equipment, you can afford items to fine-tune your passive design to achieve superior indoor comfort that reflects the best aspects of San Mateo County's mild climate.

### 46 Use passive solar design, thermal mass, and insulation to reduce space heating needs

**What is this?**

Passive solar design is the heating counterpart to passive cooling discussed above (see Chapters 2 & 7). South-facing windows will allow in warm winter sunshine. Thermal mass can absorb this free heat, instead of allowing it to overheat the room, and the right insulation level will prevent heat loss to the outdoors.

**Why do it?**

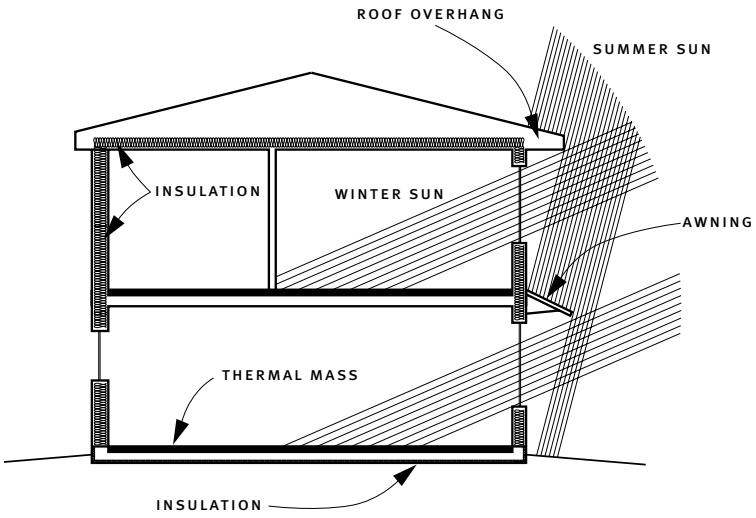
Sunshine is free but heating fuels cost money. A passive heating approach can easily replace 25% of heating fuel use; a thorough design can save 75% or more.

**How to do this?**

Computer building energy simulation is the best way to achieve a passive design that really works. Weather data for San Mateo County locations is combined with information about building size and orientation, windows, insulation in walls, and thermal mass to calculate what interior temperatures will be throughout the year. This approach also allows you to detect the potential for overheating in the summer and rectify it with additional shading or other techniques.

**Who does this?**

Architects, energy consultants, mechanical engineers.




*In simple passive solar design, roof overhangs, porches, trees, or awnings are arranged to allow sunshine in during winter and provide shade in summer. Building thermal mass and insulation keep the interior at a desirable temperature as outdoor conditions change.*

## 47 Replace air conditioning with natural ventilation and passive cooling

**What is this?**

Natural ventilation brings in outdoor air through windows instead of an air handling system. Passive cooling stores nighttime coolness in building "thermal mass" to offset the heat gained from building users, maintaining a comfortable temperature. In San Mateo County, air conditioning is not really necessary except in some commercial buildings. Less than 1% of the year has outdoor temperatures over 90°F in most places.

**Why do it?**

Comfort without air conditioning is cheaper and healthier. Heating and cooling often takes 40% of all energy used in a building, and passive design can reduce this to close to zero. Also, outdoor air from windows is free of the indoor pollutants that can accumulate in the recirculated air of conventional HVAC systems.

**How to do this?**

Design operable windows (ones you can open) to allow breezes in and out – and make sure they're shaded to prevent unwanted heat gains (see Chapters 2 & 7). Allow for night-ventilation of the building with windows, louvered vents, or fans, and provide adequate thermal mass (exposed concrete or extra gypsum wallboard) to hold the coolness. Balance these costs – plus operating energy savings – with the much smaller HVAC system you will need with this approach.

**Who does this?**

Architects, energy consultants, mechanical engineers.

## 48 Use ceiling fans for comfort cooling

**What is this?**

Ceiling fans don't make air colder, but when a fan blows air over your skin you feel cooler anyway. A whole-building fan enables passive cooling (see above) by replacing warm daytime air with cool night air.

**Why do it?**

An air conditioner uses a lot of energy and requires fans and ductwork to recirculate and cool air. Ceiling and whole-build-

ing fans are easier to install and use a lot less energy. They work with the San Mateo County climate, instead of ignoring it.

**How to do this?**

Whole-building fans should be located at the top of the building (for multistory buildings), and installed tightly sealed. Windows or louvered vents should be located far from the fan to take in air and be able to be left open while the fan runs. The fan should be sized to provide 4-5 air changes per hour. Ceiling fan installations are only limited by ceiling height; installation requires electrical wiring and a switch.

**Who does this?**

Building owners, architects, mechanical engineers, electricians.

### 49 Upgrade wall, floor, and ceiling insulation to exceed minimum State requirements

**What is this?**

Insulation prevents heat from moving through walls, ceilings and floors – it keeps warmth inside in winter and keeps heat outside in summer. California's Energy Code, often referred to as "Title 24," requires a minimum resistance rating ("R-value") of R-19 in San Mateo County (non-residential building walls can be R-11).

**Why do it?**

Title 24 is only a minimum standard, and an inch or two of additional insulation is often the most cost-effective way to reduce building energy use and save money.

**How to do this?**

Add rigid insulation board to exterior walls underneath sheathing, or use thicker insulation in cavities. In stud construction, sprayed-in insulation often has a higher R-value than conventional batt insulation, and also reduces air leakage (see Chapter 7). One inch of extruded polystyrene insulation board around foundations saves roughly three-quarters of the heat lost through the foundation in many buildings.

**Who does this?**

Building owners, architects, specification writers, energy consultants, contractors.

## Goal: Save energy in equipment use

Building equipment heats, cools, and moves air and water. It includes heating and cooling sources (such as furnaces, boilers, or chillers), and distribution equipment (such as fans, pumps, ducts, and pipes). High efficiency equipment and well laid-out distribution systems are a good investment, paying off in reliable energy savings.

### 50 Use high-efficiency equipment, including furnaces, boilers, fans, and pumps

**What is this?**

High-efficiency equipment does more heating, cooling, or pumping with less energy.

**Why do it?**

More efficient equipment saves money through reduced energy bills. Be sure to account for the future energy savings over

| | |
|---|---|
| | 8-10 years when comparing a more efficient unit to a cheaper alternative. If the more efficient unit also has a longer life span (and many do), consider the replacement cost savings as well in this decision. |
| **How to do this?** | ENERGY STAR® (see Chapter 9) identifies efficient equipment such as boilers, furnaces, and central air conditioners. For larger buildings, write minimum efficiency levels into your contract and written specifications. Mechanical engineers should also consider the efficiency of larger equipment, including distribution piping or ductwork. |
| **Who does this?** | Architects, specification writers, mechanical engineers. |

## 51 Use heat recovery equipment

| | |
|---|---|
| **What is this?** | Heat recovery is a way of transferring heat energy from an exhaust stream of air or water to an intake stream (or vice versa) without contaminating the two streams. |
| **Why do it?** | Heat exchange saves energy by keeping heat where you want it (indoors in winter, outdoor in summer) while still allowing air or water to enter and leave the building. |
| **How to do this?** | Install air heat recovery devices such as "heat wheels" in duct work. Use a gravity flow exchanger (GFX) for recovering heat from drainwater. |
| **Who does this?** | Building owners, mechanical engineers, subcontractors, plumbers. |

## 52 Use geothermal systems, cogeneration, or other alternatives for heating and cooling

| | |
|---|---|
| **What is this?** | Many technologies can deliver heating and cooling more efficiently than just burning fossil fuels (for heating) or using electricity to run an air conditioner. Geothermal systems tap the earth's constant ground temperature as a source of heating and cooling for building use. Cogeneration burns gas to produce electricity and uses the waste heat locally, dramatically saving energy. |
| **Why do it?** | As energy prices climb and resources dwindle, conventional systems are becoming obsolete and incapable of delivering heating and cooling effectively. Alternatives are cost competitive and more efficient, and often can make your project an example of innovative thinking. |
| **How to do this?** | Exploring alternative technologies requires planning in advance to determine site feasibility and the availability of specialized systems and components. |
| **Who does this?** | Mechanical engineers, energy consultants, specialized manufacturers. |

## 53 Place ductwork within conditioned space, seal joints properly, and clean before occupancy

**What is this?**

Ductwork distributes air within a building, and is mainly made of large sheet metal and plastic tubes. It connects fans, furnaces, and air conditioners to air distribution and return vents.

**Why do it?**

Where and how ductwork is installed, and how it is maintained, have a big impact both on energy use and indoor air quality. Ductwork outside of conditioned spaces (on a rooftop, in an attic or crawlspace) loses heat to the outdoors. Leaky ductwork anywhere loses heat and lets in unfiltered and dirty air. Because construction produces dust and fumes, duct cleaning should be done at the end of construction to keep building air clean.

**How to do this?**

Work with your mechanical engineer or subcontractor to address concerns about leakage and cleanliness. Use duct mastic (glue), instead of duct tape (which wears out) on all joints.

**Who does this?**

Mechanical engineers, mechanical subcontractors.

## 54 Zone mechanical system for more efficient heating and cooling

**What is this?**

Different building areas often have different heating, cooling, and ventilation needs. Creating "zones" through more sophisticated control systems allows a mechanical system to deliver an appropriate amount of air at an appropriate temperature.

**Why do it?**

Zoning the mechanical system increases comfort and decreases energy use.

**How to do this?**

Variable air volume (VAV) systems offer the greatest flexibility for air distribution systems in large buildings. For smaller buildings, zoning can be achieved by using separate systems for separate areas; each system can then be optimized for its area's particular needs.

**Who does this?**

Mechanical engineers.

## 55 Use radiant and hydronic systems for increased efficiency, health and comfort

**What is this?**

Hydronic systems circulate hot and cold water, instead of air, to heat and cool buildings. Radiant systems transfer hydronic heat to occupants through the floor or with ceiling panels.

**Why do it?**

Hydronic heat delivery uses pipes instead of ducts, which are smaller and so save building space. Also, adding control zones (see above) is a minor expense for hydronic systems, but costly for air systems. Radiant systems can also be more comfortable and more efficient than air-based heating and cooling.

**How to do this?** Plan early for a hydronic system, since the savings on duct space (especially in dropped ceilings) can be substantial. A small air system may still be necessary to meet ventilation air requirements, although this can often be achieved with natural ventilation (see above). Radiant floors in particular require careful integration with building structural components.

**Who does this?** Architects, mechanical engineers, specialized consultants and subcontractors.

### 56 Use equipment without ozone-depleting refrigerants

**What is this?** Most refrigerants used in air conditioners are hydrochlorofluorocarbons (HCFCs) that destroy ozone in the atmosphere; some newer models use alternatives.

**Why do it?** International treaties have banned the worst ozone depleting chemicals. Most of their current replacements still deplete ozone, but at a slower rate, so using truly ozone-friendly alternatives is still important to protect the Earth from excessive UV radiation.

**How to do this?** Include this requirement in project specifications and consult with your mechanical engineer or subcontractor

**Who does this?** Mechanical engineers, mechanical subcontractors

## Goal: Create healthy indoor environments

Indoor air quality is affected by building materials and activities inside of buildings. Choosing materials that are non-toxic helps prevent indoor illnesses, especially among especially sensitive individuals, children, and the elderly.

### 57 Use recycled-content, formaldehyde-free fiberglass insulation, cellulose insulation, or other green insulation products

**What is this?** Green insulation products include fiberglass made in formaldehyde-free processes (in white batts); sprayed cellulose (shredded paper with non-toxic fire retardants); cotton batts; and hypo-allergenic foams (Icynene™, AirKrete™, and BioBase 501™ are leading examples).

**Why do it?** Conventional fiberglass insulation (in pink or yellow rolled batts) contains formaldehyde, which is a known carcinogen. Not only can you keep this dangerous substance out of your house, but many alternative products are easier to install (such as cotton batting) and/or tighter sealing (such as cellulose and hypo-allergenic foams), which saves energy.

**How to do this?** Alternative batt insulation products replace fiberglass directly and most contractors can handle the substitution themselves. Sprayed-in insulation usually requires a specialty subcontrac-

| | |
|---|---|
| | tor and additional jobsite preparations. Write these products into project specifications so general contractors can plan on including them. |
| **Who does this?** | Architects, specification writers, contractors, specialized subcontractors. |

## 58 Separate ventilation for indoor pollutant sources and provide advanced filtration to improve indoor air quality

| | |
|---|---|
| **What is this?** | Some indoor materials and activities generate toxic air pollutants, especially copiers and other office machines, storage of paints and chemicals, gas stoves, and parking garages. You can usually smell the contaminants from these sources. New buildings can be designed with separate ventilation for these areas. Advanced filtration – HEPA and electronic filters – can also improve air quality. |
| **Why do it?** | Garages and chemical workspaces are required to have separated ventilation; treating less intense pollutant sources similarly will improve health. Filters are important for sensitive individuals. |
| **How to do this?** | Plan your space layout and ventilation system with future uses in mind. Place filters in locations where they can easily be changed and maintained. |
| **Who does this?** | Architects, mechanical engineers. |

## 59 Use clean and efficient alternatives to wood-burning fireplaces

| | |
|---|---|
| **What is this?** | Wood-burning fireplaces have very low temperature fires, creating lots of pollutants in their smoke, which cause a significant health hazard both indoors and outdoors. |
| **Why do it?** | A number of jurisdictions in San Mateo County have already prohibited the installation of new wood burning fireplaces as a result of this hazard. Additionally, fireplaces are inefficient heating sources, providing relatively little heat and causing cold drafts, and wasting heating fuel, unlike alternatives. |
| **How to do this?** | Alternatives to wood-burning fireplaces include wood stoves and gas fireplaces. |
| **Who does this?** | Building owners, architects. |

**Radiant Panel Association: www.radiantpanelassociation.org**

**Bay Area Air Quality Management District, wood burning page: www.baaqmd.gov/pio/woodburning/woodburning.asp**

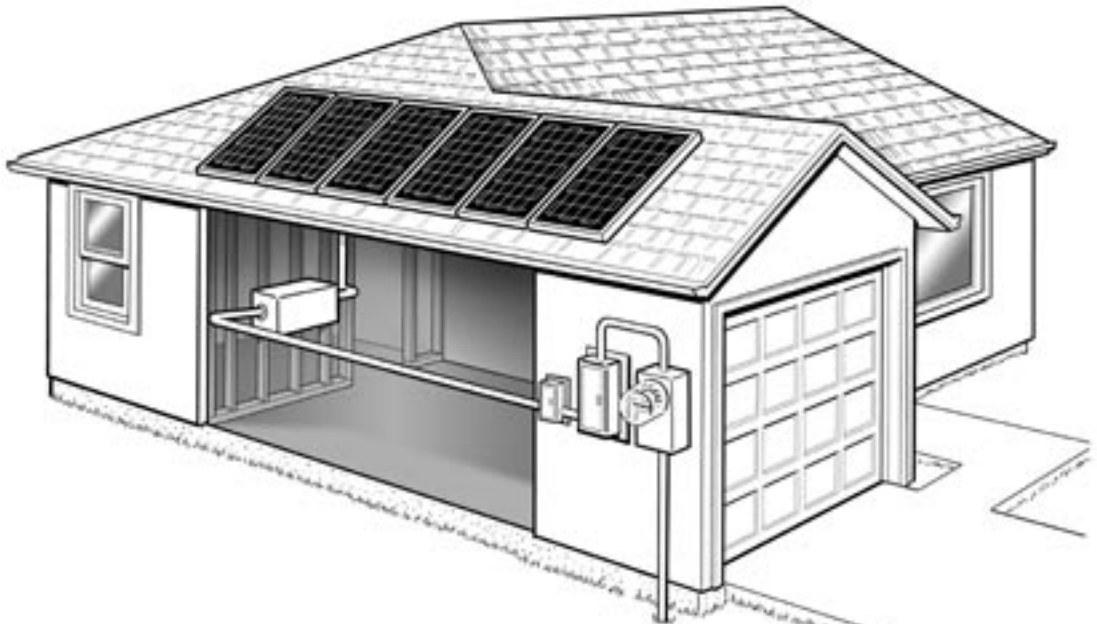
**Green Resource Center: www.greenresourcecenter.org**

## Renewable energy is the ultimate solution to many of today's biggest environmental problems, such as air pollution, natural resource depletion, and climate change.

Renewable power includes sources like sunshine and wind, but excludes oil, coal, natural gas, and nuclear power. Unlike nonrenewable power, which is sold by large corporations that control fuel and distribution networks, renewable power is generated locally and runs for free.

### Goal: Replace fossil fuel use with alternatives

The number of alternatives to nonrenewable, fossil-fuel powered electricity, heating, and cooling is increasing all the time. Solar panels that produce electricity (called "photovoltaic" or "PV" panels) are visible on more and more buildings in San Mateo County. Wind turbines are now popular for small and large applications. Solar hot water (also called "solar thermal") panels are a tried-and-true system that generates hot water for any number of uses from swimming pools to household hot water to space heating.



*Photovoltaic equipment can fit easily on many existing and new houses. Panels mount to the roof, run to an electrical inverter typically placed in a garage, and then are connected to the electric meter outside.*

## 60 Generate clean electricity onsite using solar photovoltaics

**What is this?**

Solar photovoltaic panels and small wind turbines are well-established technologies for generating electricity on your site that are easily available in San Mateo County. They produce no combustion waste, pollution, or greenhouse gases.

**Why do it?**

Solar electric systems offer strong returns on investment. It makes good sense to compare the costs of buying energy over many years to the one-time purchase of renewable equipment that provides free energy for its lifetime. These power systems can also serve as a visible hallmark of your project's commitment to the environment. Also, substantial rebates and tax credits from the State of California and the Federal government are available to customers who purchase renewable energy equipment.

**How to do this?**

Solar electric systems will produce the most total electricity over the course of the year if they are installed tilted up and facing South, but because electricity is most expensive on hot afternoons when the sun is right overhead, panels laid flat produce more power at those times and can be as cost-effective as angled panels. Solar panels can also be used as sunshades over windows, roof panels for covered walkways and carports, and mounted vertically on building walls. These "building-integrated" applications save you the cost of buying other materials for use as sunshades, covers, or facades.

**Who does this?**

Building owners, architects, electrical engineers, solar power companies.

Photo: PowerLight Corporation

*This installation of PV panels, equivalent to one-half of an acre, covers the roof of the new San Mateo County Forensics Laboratory.*

SAN MATEO COUNTY
**Solar Home Tour**

*RecycleWorks sponsors a Solar Home and Building Tour every October, which allows you to visit private homes, view their solar systems, and talk to homeowners and solar providers about solar installations. To keep informed of the tour and other green building events, join the RecycleWorks GreenBuilding e-list at www.RecycleWorks.org/greenbuilding.*

## 61 Generate clean electricity onsite using wind turbines

**What is this?**

Wind turbines are electrical generators turned by large fan blades facing into the wind.

**Why do it?**

Like solar power, wind power is a good return on investment. For large installations, installed costs can beat the cost of conventional fossil-fuel generated power, but without the uncertainties of future oil and gas price changes and without contributing to global warming.

**How to do this?**

Wind turbines are generally mounted on stand-alone towers in areas free of trees, buildings and other obstructions that block wind. Because of noise issues, they are most appropriate for rural areas.

**Who does this?**

Building owners, electrical engineers, wind power companies.

## 62 Use solar hot-water systems for domestic use and swimming pools

**What is this?**

Solar hot-water systems consist of collectors (usually roof-mounted flat black panels), a storage tank (similar to a familiar water heater), and a control system (valves, temperature sensors, a small pump). Solar hot-water systems have been in use for water heating for over 30 years and are popular in countries all over the world.

**Why do it?**

Solar hot-water systems are a reliable way to heat water, and a reliable way to reduce your fuel bills throughout the year. Typical systems pay for their installation cost in four to seven years, yet save you money over 25 years or more.

**How to do this?**

Standard packaged systems are available from many solar power companies, and are easy to integrate with conventional household plumbing. These systems can easily be added to existing buildings as well. With thoughtful design, panels can be sized and mounted to contribute to the overall building design. In order to maximize power production, panels are typically mounted within 10 degrees of due South and tipped up at an angle that averages the sun's height over the course of the year, around 38 degrees for San Mateo County.

**Who does this?**

Building owners, architects, mechanical engineers, solar power companies.

## 63 Use solar hot-water systems for space heating

**What is this?**

If you are using a hydronic system that uses hot water for space heating, you can heat that water with solar thermal panels instead of a gas or electric boiler. This is also called "active" solar space heating, and is a good addition to "passive" solar space heating discussed earlier.

**Why do it?**

Space heating is a major source of building energy use. Solar thermal systems heat water for free and remove your project from reliance of commercial fuel or energy deliveries. This is an essential part of off-grid projects.

**How to do this?**

Your first step should be to reduce your project's need for heating through strong passive design (see chapters 7 & 10). Then you can meet the remaining demand with solar thermal panels, a storage tank, and a small hydronic delivery system (see also chapter 10).

**Who does this?**

Building owners, architects, mechanical engineers, power companies.

## 64 Pre-plumb for a solar hot-water system

**What is this?**

Solar hot-water systems heat water with panels on the building roof or elsewhere outside, and bring the water inside for use. Installing plumbing connections at key points can make the later addition of a solar thermal system easy and inexpensive.

**Why do it?**

A full solar thermal system can be expensive, but adding one later can cause problems of running plumbing through completed roofs and walls. A very minor investment during construction allows the installation of energy-savings solar thermal systems later.

**How to do this?**

Identify potential solar-thermal panel locations on South-facing roofs or walls, and a route for plumbing connections to your building's water heater. Put plumbing sleeves where this route crosses walls and, especially the roof, where water-proofing is necessary. Leave enough space in the mechanical room for a solar storage tank, valves, and a pump.

**Who does this?**

Architects, mechanical engineers, plumbers.

*Solar Electricity and Solar Hot Water for your Home*, published by RecycleWorks: info@RecycleWorks.org or 1-888-442-2666

RecycleWorks Solar Information and Guide to Solar Providers: www.RecycleWorks.org/greenbuilding/solar.html

Northern California Solar Energy Association: www.norcalsolar.org

California Solar Energy Industries Association: www.calseia.org

California Energy Commission: www.consumerenergycenter.org

## Most Americans spend 90% of their time indoors, and studies have shown that air quality is often worse indoors than outdoors at the same location.

The materials that make up a building have a big impact on indoor air quality especially finish materials, paints, coatings, and the like that are most exposed to indoor air. These impacts are especially critical to children, the elderly, and individuals with chemical sensitivities. You can also choose materials with high recycled content, and protect our forests by using sustainably harvested woods or wood substitutes. The interior materials you choose can be a statement of your commitment to the local and global environment as well as health.

## Goal: Create healthy indoor environments

Choose materials that don't off-gas, or release harmful gases into the air.

### 65 Use low- or no-VOC, formaldehyde-free paints, stains, and adhesives

**What is this?**

Volatile Organic Compounds (VOCs), are a wide variety of potentially harmful gases. The full health effects of long-term, low-level VOC exposure is hard to study but is of significant concern to many health professionals. The drying of conventional paints, stains, and adhesives all produce VOCs.

**Why do it?**

VOC exposure produces complicated health risks because of the large number of gases involved, their potential interactions, and their low concentrations over long periods of time. People can tell the difference when VOCs are avoided, and they appreciate it; buildings finished without VOCs lack the unpleasant smells of drying paint.

**How to do this?**

The best way to avoid any potentially dangerous exposure is to reduce use of VOC-containing products.Choose and specify low- or no-VOC paints, stains, and adhesives such as those that meet Green Seal standards. All major paint manufacturers now offer low-VOC lines, and they are applied like other paints. Specialty paints are also available for use around chemically sensitive individuals.

**Who does this?**

Building owners, architects, specification writers, painters.

Photo: Eco Design Resources

*The kitchen at the Eco Design Resources showroom in San Carlos has a Richlite® solid surface countertop (a paper-based product from managed forests), recycled hand-glazed clay tiles, 100% recycled glass tiles, a cork-tiled floor, and bamboo cabinets. The appliances are highly energy-efficient.*

## 66 Use low- or no-VOC carpets, furniture, particleboard and cabinetry

**What is this?**

Volatile Organic Compounds (VOCs), come not only from drying-out solvents (as discussed above), but also from the long-term off-gassing of glues and chemical coatings in solid materials ranging from carpets to plywood.

**Why do it?**

As discussed above, VOCs pose uncertain but significant long-term health risks that can best be mitigated by choosing not to introduce VOCs into your building in the first place.

**How to do this?**

Avoid wood particleboard in cabinetry, doors, and furniture, with urea formadehyde resin, choosing MDI or phenolic resins instead – substituting exterior plywood for interior grade plywood will achieve this. Look for carpets with the Carpet and Rug Institute's Indoor Air Quality label, or other interior products such as wallcoverings and furniture with GreenGuard certification.

**Who does this?**

Building owners, architects, specification writers.

## 67 Use exposed concrete as a finished floor

**What is this?**

Finished concrete is a durable and attractive material, common in retail as well as industrial uses.

**Why do it?**

Many buildings have a slab-on-grade first floor, so it can be practical and inexpensive to add a finished topping slab. Concrete poses no VOC risks, requires little finishing, and is easy to clean and maintain. It offsets the need for other flooring materials, and works well with radiant heating systems (see Chapter 10).

**How to do this?**

Either finish and protect your initial slab, or plan an additional 2-3-inch thick topping slab on top of a rough concrete pour for the finished slab. Investigate concrete colorings and surface finishes as a wide range of appearances are possible. Area rugs can be used on concrete floors to add softness while keeping the space clean and low-maintenance.

**Who does this?**

Architects, contractors, subcontractors.

## 68 Use natural materials such as wool and sisal for carpets and wallcoverings

**What is this?**

Natural materials are produced from biological fibers, oils, and inert minerals. Wool comes from sheep, and sisal comes from sea grass.

**Why do it?**

Natural materials add warmth and comfort to interior spaces, and tend to cause less damage to the environment than the processing of synthetic materials. They may also pose fewer health risks than synthetic materials, although some natural materials may not be suitable around sensitive individuals.

**How to do this?**

Choose and specify finishes that include natural materials. Many choices are available for carpets, mats, and wall coverings, as well as natural paints and sealants.

**Who does this?**

Building owners, architects, specification writers.


*Paints and finishes without VOCs (volatile organic compounds) are readily available in many brands and stores.*

Photo: RecycleWorks Green Building Program

## 69 Use sustainable materials for flooring, trim, and interior surfaces

**What is this?**

Many interior materials are produced from natural, renewable sources and contain no toxic components or byproducts. Some commonly used materials for rolled sheet flooring and flooring tiles, such as vinyl (technically known as polyvinyl chloride or PVC), do entail significant environmental problems and are not sustainable.

**Why do it?**

Vinyl production is not sustainable because it produces dioxins that pose major environmental and human health risks in the areas where manufacturing occurs. Also, additives that harden PVC can be hazardous, PVC releases dangerous gases during building fires, and it is not recyclable. By contrast, purchases of other materials support industries that produce less environmental pollution.

**How to do this?**

Sustainable options for typical interior uses include real linoleum (made of linseed oil, sawdust and rock flour), sheet rubber, cork and stone for flooring; and rubber, sustainably harvested wood or recyclable plastics for trim (see above and below).

**Who does this?**

Building owners, architects, specification writers.

## Goal: Support the market for recycled materials

"Buy recycled" is a good motto not only for paper products but also for building materials. More and more building products contain recycled content, helping to close the loop and keep solid waste from accumulating in our shrinking supply of landfill space.

## 70 Use recycled-content floor tile, carpets and pads, cabinets, and countertops

**What is this?**

Many interior materials are available with recycled content. Recycled carpets often are made from old carpet fiber, while ceramic tiles contain glass waste and cabinets are made from wood scrap.

**Why do it?**

As both environmental and monetary costs of waste disposal continue to increase, recycling is becoming more important. Using recycled-content products helps to accelerate the development of recycling technologies and support this transformation.

**How to do this?**

Choose and specify recycled content interior materials. Use a variety of green materials listings if your architect or contractor is not familiar with these products.

**Who does this?**

Building owners, architects, specification writers.

## Goal: Support sustainable forests

Wood is a great interior finish material, used for floors, trim, handrails, furniture, and many other applications. In order to ensure our supply of wood in the future – and especially beautiful tropical hardwoods – we must harvest wood at a sustainable rate and ensure that forests are healthy ecosystems.

### 71 Use reclaimed or salvaged, sustainably harvested (FSC certified), or engineered wood for flooring and trim, or use wood alternatives such as bamboo and cork

**What is this?**

Sustainably harvested wood is certified by the Forest Stewardship Council (FSC – see Chapter 5). Engineered wood is made from small trees and scraps (see Chapter 5) and is available for trim and flooring. Bamboo is a plant that grows much faster than trees, making it easier to harvest repeatedly, and cork is bark harvested from cork trees without killing the parent tree.

**Why do it?**

Current patterns of wood use are not sustainable; we must switch to sustainable harvesting and wood alternatives before exhausting the world's forests and causing irreversible environmental damage.

**How to do this?**

Specify and choose FSC-certified wood for all interior uses where wood is to be used, or use wood alternatives.

**Who does this?**

Building owners, architects, specification writers.

**i**

Eco Design Resources: www.ecodesignresources.com

RecycleWorks IAQ: www.RecycleWorks.org/greenbuilding/indoorairquality.html
Building materials: www.RecycleWorks.org/greenbuilding/gbdatabase.html

Green Seal: www.greenseal.org

GreenGuard: www.greenguard.org

Carpet and Rug Institute: www.carpet-rug.com (select indoor air quality)

## Technologies considered alternative today are the source of the innovations that will produce big economic and environmental benefits in the near future.

Sustainability is a growing part of the building industry, and an area where every project can make a contribution. Thirty years ago, passive solar design was considered "alternative"; now it is a basic assumption of high-performance buildings. Your opportunity to pursue alternatives can result in big rewards for your project and many projects that follow.

### Goal: Use creativity and innovation to build more sustainable environments

Take the opportunity to use your creativity – and the creativity of architects, engineers, and designers – to use new products and find new solutions to familiar problems. The outcome can save resources, save money, and add to your satisfaction in the building process.

### 72 Use insulated concrete forms

**What is this?**

Insulated concrete forms (ICFs) replace typical wooden concrete formwork with rigid insulating foam (typically expanded polystyrene) that is left in place after the pour. ICFs can be used for foundations and above-grade walls as well. The resulting walls are ready for a finished surface application such as stucco.

**Why do it?**

ICFs are an easy way to insulate concrete while also saving the wood used in conventional formwork. ICF walls give high levels of insulation without the thermal gaps and air leakage typical of stud construction. Additionally, some (although not all) varieties of ICF use a substantial amount of recycled material in their products.

**How to do this?**

Current ICF systems are proprietary, so work closely with each specific product's manufacturer to make sure that the system is specified and installed as recommended.

**Who does this?**

Architects, contractors, product manufacturers, local representatives and distributors.

## 73 Use structural insulated panels to replace wood-framed walls

**What is this?**

Structural Insulated Panels (SIPs) are a sandwich of plywood or oriented strand board (OSB) glued to a center slab of foam insulation. They come as panels 2 to 4 feet wide and 8 to 24 feet long, and can be used as walls, floors or roof planks. The use of OSB, made from wood particles from small trees or wood waste, also reduces the use of large trees needed to supply regular framing lumber.

**Why do it?**

SIPs create a super-insulated building exterior with few air gaps, are fast to install, very strong, and made with relatively low impact materials as compared to dimensional lumber.

**How to do this?**

SIP manufacturers provide engineering data and detailed support for using their products. Consultation with manufacturers is central to working with these systems, especially to make electrical and plumbing systems fit with SIP walls.

**Who does this?**

Architects, structural engineers, SIP manufacturers.

## 74 Use natural building materials and techniques

**What is this?**

"Natural building" refers to building with relatively unprocessed, locally available materials such as straw bales, rammed earth, adobe (earth bricks) and round wood, among others. Natural building also encompasses finishing techniques such as hand-applied plasters, earthen floors, and hand-built furniture.

**Why do it?**

Natural building makes direct connections between the earth, its living systems, and how we build. Natural building offers some of the lowest environmental impacts in building methods and often utilizes vernacular or indigenous building techniques. Natural buildings also often use low-cost or free materials and are labor intensive, making them suitable for owner-builders or group projects where labor is volunteered or otherwise low-cost.

**How to do this?**

Natural building is most suitable for small buildings, although some medium-sized examples exist. Learn about natural building from the numerous books, magazines, web resources, and videos on the subject, and through meeting local groups that practice various techniques. You may choose to build your project yourself, or hire a contractor familiar with natural building techniques. Additionally, some natural finishing techniques can be applied easily to portions of a conventional building.

**Who does this?**

Building owners, specialty contractors, natural building groups.

Photo: Outdoor Education

*San Mateo County Office of Education's Outdoor Education Program built the county's first permitted straw bale building using a local contractor and five weekend volunteer workshops. The straw is covered with earth plaster on both the inside and outside. The passive solar design includes correct site orientation, double-paned windows and overhangs. This allows the classroom's temperature to remain comfortable all year without additional heating or cooling.*

## Other sustainable materials and practices used. *Please describe.*

75

**What is this?**

Innovation is by definition an ongoing process – we'd like to know what new ideas you are bringing to your project.

**Why do it?**

You and your project team understand the needs and goals of your project best and may think of a way to achieve those that we have not listed. These new ideas are essential to the progress and improvement of green and sustainable building techniques.

**How to do this?**

While no one can teach creativity and innovation, we encourage you to "think outside the box," talk to other knowledgeable individuals in relevant fields, and continue to learn about sustainability and buildings. Then share your innovative ideas with San Mateo County's Green Building staff.

**Who does this?**

Building owners, architects, engineers, contractors, other project team members.

Ecological Building Network: www.ecobuildnetwork.org
Insulating Concrete Form Association: www.forms.org
California Straw Building Association: www.strawbuilding.org
Structural Insulated Panel Association: www.sips.org

## Sustainable Building Awards

Each year Sustainable San Mateo County, a local nonprofit, presents sustainable projects and businesses with awards, including one award specifically for green buildings. If your building is a good example of sustainable design and incorporates items from many sections of the checklist, please consider applying for an award. More information is available on the Sustainable San Mateo County website – www.sustainablesanmateo.org – and the RecycleWorks website – www.RecycleWorks.org – in the green building section. RecycleWorks also features local green buildings, including the award winners.

Sustainable San Mateo County
*Dedicated to the long-term health and vitality of our region*

***Featured Sustainable San Mateo County Award Winners***

City Center Plaza, Redwood City
Leslie Shao-ming Sun Field Station, Jasper Ridge Preserve
San Mateo County Forensics Laboratory

## RecycleWorks offers additional resources

RecycleWorks is a program of the County of San Mateo, which serves the residents and businesses of the cities, towns, and unincorporated areas of the County. The RecycleWorks website has a comprehensive section on green building practices and materials, including additional information on the countywide checklist items. RecycleWorks also covers construction and demolition debris recycling and provides a user-friendly Green and Recycled Products database that lists local sources for many of the products described in this booklet. Green building, construction and demolition recycling, and general recycling or waste reduction publications are available in print, on the website or by download.

COUNTY OF SAN MATEO
RECYCLEWORKS

www.RecycleWorks.org
RecycleWorks Hotline
1-888-442-2666
info@RecycleWorks.org

## INFORMATION on:

- Community planning
- Site & Landscape
- Waste Reduction & Management
- Concrete
- Wood Framing
- Exterior Treatments, Siding & Roofing
- Windows & Doors
- Plumbing
- Electrical
- Heating & Cooling
- Renewable Power & Solar Energy
- Interior Materials
- Other Green Alternatives