

The Wood User's Guide to Green Building





Introduction	
Wood for a Cooler Planet	5
Wood and Greenhouse Gases	
What is Greener than Wood?	9
Green Building Standards	
What are Green Building Standards?	17
Materials Origin and Impact	
How Wood Rates	25
Conclusion	
Sustainability Reigns Supreme	33

Front and inside covers: Green-built homes in Castle & Cooke's Windermere community in Bakersfield, California offer energy efficient designs.



This spread and following page: Blakely Hall in Issaquah, Washington achieved a rating of Two Globes from the Green Building Initiative in recognition of the incorporation of energy and environmental considerations in the building's planning and construction.

Wood for a Cooler Planet



California is gaga over green buildings.

The concept, not the color.

Since the turn of the century, interest has exploded in creating more environmentally sound, energy efficient and water-saving structures. And the desire to build green is growing exponentially.

Some potential homebuyers are attracted to green because it's the right thing to do – and others are attracted to the savings they get on heating and water bills, among other things.

Much of the focus on building green today centers on commercial development and government buildings. These structures consume considerable resources and many governments have seized the opportunity to position themselves as environmental leaders. Residential construction appears to be the next frontier. Home builders are increasingly featuring green attributes and green labels in marketing efforts.

The United States Department of Energy says that America's 81 million buildings



gobble more energy than any other segment of the economy.

Building green can help save energy. Building green also reduces carbon dioxide (CO₂) emissions, which have been strongly linked to global warming.

While there are different green guidelines and different green rating systems, all share one central goal – sustainability.

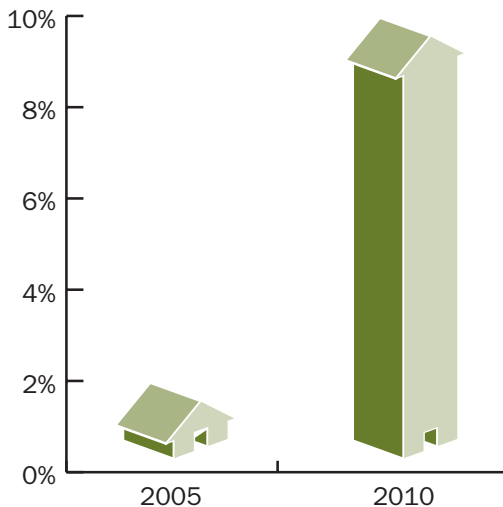
Sustainability means meeting today's needs while conserving the resources needed tomorrow.

And that means using wood.

In this booklet you'll find information about green building principles and rating systems and see how neatly California-grown wood dovetails with the world of green construction.

Expected Growth in Residential Green Building

Green building is on the rise, helping to reduce carbon emissions and conserve valuable energy and water resources.



What is Greener than Wood?



When you talk about construction materials, wood is about as green as it gets.

Wood is renewable. Steel, plastics and concrete aren't.

Wood is recyclable and biodegradable.

That's three reasons why nine out of 10 homes today are built with wood.

While lumber and plywood are used predominantly in residential construction, there is considerable potential for expanding wood use in commercial buildings.

The same considerations that make wood a green building material for homes make it a good choice for non-residential construction. Low-rise buildings three stories or less, in particular, are more amenable to wood construction now that building codes increasingly recognize creative ways to encourage using wood.

See www.woodworks.org for more information on using wood in commercial construction.



Photo courtesy of APA - The Engineered Wood Association.

Using more wood in non-residential structures like schools, stores and office buildings could save energy and reduce greenhouse gas emissions.



Managed forests remove carbon dioxide from the air. Wood stores the carbon, keeping it out of the atmosphere for the long haul.

Removing Carbon from the Air

Wood, by its nature, helps reduce greenhouse gas emissions.

The biggest contributors to global warming are three gases – carbon dioxide, methane and nitrous oxide.

Trees remove CO₂ from the atmosphere and replace it with oxygen. In fact, wood is about 50 percent carbon by weight.

Through photosynthesis, trees absorb the carbon and store it in their leaves, roots and wood fiber. Younger trees grab more CO₂ than mature trees. The older trees store carbon dioxide well, but the rate at which they absorb carbon has slowed significantly. Some old-growth forests may actually release more CO₂ into the air than they remove.

California's laws governing forest management are centered on the idea of sustainability – just as green building standards are – especially on privately-owned timberland.

When trees are harvested on private forestland in California and the atmospheric carbon they absorbed is safely secured in wood products, new seedlings typically are replanted to replace them. Young trees remove carbon from the air faster and more efficiently than the mature trees they replaced, and foresters continue a perpetual cycle of removing and storing carbon.

At the same time, the carbon absorbed by the harvested trees gets stored for the long-term in lumber, furniture and other products.

According to the U.S. Environmental Protection Agency, it is estimated that each year, forests in the United States remove the greenhouse gases emitted by 139 million cars.

In addition to pulling carbon out of the air while they grow, managed forests also help reduce the amount of carbon released into the atmosphere by controlling fuel loads. That lowers the threat of catastrophic wildfires that spew millions of tons of greenhouse gases into the air every year.



Renewable, recyclable wood is a green building material excellent for residential and commercial construction.

Some consumers fear that using more wood will lead to deforestation. While tropical deforestation is a significant contributor to greenhouse gas emissions, deforestation is not an issue in California or elsewhere in the United States.

“The arguments to promote “local food” are no more or less valid when considering one’s consumption of wood products. Forestry removes carbon and conserves resources more efficiently in California than in most corners of the globe.”

— *Dr. Keith Gilles, University of California - Berkeley*



California grows far more wood than it harvests every year and has about the same amount of forestland as it did a hundred years ago. The vast majority of California's wood is harvested from private forestland, and therefore in accordance with long-term sustainability plans and regulations.

But rather than harvest trees grown right here at home, California imports about 80 percent of the wood it uses from

places where Californians have no say in environmental standards or regulations.



Despite upholding some of the highest environmental standards in the world, California imports nearly 80 percent of the wood it uses.



Overcrowded forests are prone to burning in catastrophic wildfires. Managing forests can reduce fuel loads and emissions from wildfires while safely storing carbon in wood.

Global Focus on CO₂

CO₂ gets so much of the greenhouse gas story spotlight because it is closely linked to energy, and because atmospheric carbon levels are on the rise. When used in construction, wood retains its stored carbon. It stays safely out of the atmosphere for the life of the wood structure, and even then wood can often be recycled.

Using wood keeps CO₂ out of the atmosphere for a very long time.

It's not just wood framing that is beneficial. All wood doors, cabinets, flooring, molding and furniture store carbon dioxide.

While wood represents 47 percent of all raw materials used in the United States, the energy used to produce it is just 4 percent of the energy used to make all manufactured materials. That's because wood is energy-efficient. Not only is wood grown by harnessing solar power, but more than 60 percent of wood processing is powered by biofuels, a far cleaner source of energy than fossil fuels.

Energy to Burn

Biofuel energy means burning wood and other organic materials – chips, agricultural waste, bark, sawdust – to produce steam. The steam drives a turbine, which turns a generator to create electricity. Biofuel



Managing forests can conserve critical resources for generations.



A Northern California biofuel plant turns wood chips and agricultural waste into clean energy.

“One of the best ways to address climate change is to use more wood, not less. Every wood substitute – including steel, plastic and cement – requires far more energy to produce than lumber.”

— Dr. Patrick Moore, co-founder of Greenpeace

energy results in relatively low emissions, whereas burning fossil fuels results in significant carbon emissions. The U.S. Environmental Protection Agency considers biofuel emissions to



Biofuels can help California meet its growing demand for energy.

be “impact-neutral” on global warming because burning bark and agricultural waste for energy creates no net emission increase.

Although the production of biofuel energy has fallen in California since 1992, increased recognition of the importance of thinning overgrown public forestlands to reduce the threat of catastrophic wildfires may help revive the industry and, in turn, reduce reliance on imported wood and environmentally harmful fossil fuels.

More Good News about Energy

There’s more to wood’s energy story than the clean energy that can come from it.

The energy to grow wood comes from the sun. Other materials like steel and concrete require a great deal of energy to produce.

Studies have shown that from their creation to their scrapping, non-renewable products like concrete, steel and aluminum consume up to 250 percent more fossil fuel energy than wood products. Using concrete and

steel therefore results in greater greenhouse gas emissions than using wood.

A 2005 study compared a wood-frame house to a steel-frame house and a wood-frame house to a concrete-frame house. Wood outperformed steel and concrete across a range of environmental performance criteria. Steel and concrete required far more energy to create and caused more air pollution. Using steel generated 26 percent more greenhouse gas emissions than wood. Using concrete generated 31 percent more.

Energy Efficiency Comparison – Wood to Steel and Concrete

Minneapolis House	Wood Frame	Steel Frame	Difference	Steel environmental impact vs. wood
Embodied energy (GJ)	651	764	113	+17%
Global warming potential (CO ₂ kg)	37,047	46,826	9,779	+26%
Air emission index (index scale)	8,566	9,729	1,163	+14%
Water emission index (index scale)	17	70	53	+312%
Solid waste (total kg)	13,766	13,641	-125	-0.9%

Atlanta House	Wood Frame	Concrete Frame	Difference	Concrete environmental impact vs. wood
Embodied energy (GJ)	398	461	63	+16%
Global warming potential (CO ₂ kg)	21,367	28,004	6,637	+31%
Air emission index (index scale)	4,893	6,007	1,114	+23%
Water emission index (index scale)	7	7	0	0%
Solid waste (total kg)	7,442	11,269	3,827	+51%

Source: Consortium for Research on Renewable Industrial Materials (CORRIM)

What are Green Building Standards?



Green building standards are meant to be tools to help builders and architects design, construct and promote environmentally sustainable structures — and for consumers to understand how they can reduce their carbon footprint.

These systems encompass site planning, structural design and materials analysis. They aim to promote construction and land use practices that conserve environmental resources and improve energy efficiency.

At the center of green building science are four Rs:

Reduce.
Recycle.
Reuse.
Renew.

Green building relies on complex science, innovation and common sense. Green buildings use less construction materials because of better planning such as designing rooms in four foot multiples to accommodate standard-sized wallboard or plywood sheets. Green buildings use less energy and water by design.



Previous page: Castle & Cooke's Windermere community in Bakersfield, California embraces green building principles.

Right: Wood is featured prominently inside Blakely Hall, Washington, which earned a rating of Two Globes from the Green Building Initiative.

In general, recycled products are favored when feasible. Even the structure itself can be designed to be recycle-friendly at the end of its life.

Old construction materials are reused if structurally sound. Naturally generated energy, such as passive solar design, is encouraged.

Green building encompasses many things, including selecting plants with less pesticide and water needs, using low flush toilets and tighter heating and ventilation ducts; and keeping more onsite construction waste out of landfills.

At first, some builders avoided building green because of the cost it added to construction. But as more green building products come to market, the prices keep falling.

Estimates vary as to how much going green might add to the initial cost of construction. Green building supporters expect that the savings on energy and water use offset higher initial costs over the building's life.

Are the Standards Standard?

Evaluating green building programs can be confusing because there are a lot of standards and/or guidelines being proposed by a lot of organizations. Good news: there are more similarities than differences among them.

There are the Minnesota Design Guidelines, Built Green Colorado



The U.S. Green Building Council's Leadership in Energy and Environmental Design, or LEED, is a leading-edge system for designing, constructing, operating and certifying green buildings. The Green Building Initiative's Green Globes is an Internet-based alternative.

and Wisconsin Greenbuilt. The National Association of Home Builders has its own green construction guidelines. The California Building Industry Association has a Green Builder Initiative. There's also a California non-profit called Build It Green, which has a set of guidelines.

In 1993, the United States Green Building Council created perhaps the best-known rating system, LEED® – Leadership in Energy and Environmental Design. LEED has programs specific to new construction, existing buildings, commercial interiors, homes, and more.

Newer to the U.S., but also well known, is Green Globes™, a Web-based tool that includes an assessment protocol, rating system and guide for integrating environmentally friendly design into commercial buildings. It features modules for "New Construction" and the "Continual Improvement of Existing Buildings" and facilitates recognition of completed projects through third-party assessment.

Buildings that complete an independent, two-stage assessment process receive a final rating of one, two, three or four Green Globes, which are roughly equivalent to the certified, silver, gold and platinum levels that are offered under LEED. In fact, a report prepared for The Carpenters Industrial Council by the University of Minnesota estimates that nearly 80 percent of the available points in the Green Globes systems are addressed in LEED 2.2 and that more than 85 percent of the points specified in LEED 2.2 are addressed in the Green Globes system.

The California Integrated Waste Management Board has a wealth of information on green building with links to most of the standards or guidelines in use around the state

and throughout the country. See: www.ciwmb.ca.gov/GreenBuilding/Design/Guidelines.htm

Just complying with the requirements of California's existing building codes compares favorably with most commercial green building programs and those of other states. And California still wants to be greener.

California's Building Standards Commission is developing statewide green building standards that take a different approach from many existing standards.

Rather than offering architects and builders only an extensive laundry list of voluntary green options as most existing guidelines do, the state is also creating a list of mandatory requirements, such as low-flush



The Gulf Islands Operations Centre designed by Larry McFarland Architects, Ltd is the first building in Canada to achieve a LEED Platinum rating.



Reducing greenhouse gas emissions and California's increasing demands for energy have helped fuel an interest in green building.

toilets and a 50 percent reduction in construction waste.

California's emerging green standards also encourage the use of wood by allowing builders to use responsibly grown and harvested timber certified by any of four national marketing groups. LEED and Build It Green, in contrast, reward only wood certified by one group.

California's energy efficiency standards are already much tougher than those of the federal

government. In the wake of one of its recent energy crises, California updated its energy efficiency rules in October 2005 to call for more efficient lighting, the use of radiant barrier panels and improved window glazing, among other things.

More information on those standards can be found at the California Energy Commission website. www.energy.ca.gov/title24/2005standards/index.html

California's Higher Standards

California is developing even stronger efficiency standards, and will likely remain a world leader in advancing green building practices.

The executive order signed by Governor Schwarzenegger in December 2004 mandated that new and existing state office buildings sharply increase their energy and water efficiency in keeping with the principles of green building.

Some local governments have adopted green building ordinances or issued voluntary guidelines. San Diego County has had voluntary guidelines since 1997. Santa Monica's energy efficiency and run-off guidelines have also been

in place more than a decade. San Mateo County and San Francisco have green requirements for government buildings. Marin County demands that new homes be more energy efficient. And other cities and counties continue to follow suit.

Like California, the federal General Services Administration requires new U.S. government buildings to increase energy and water efficiency.

Other groups, like the American Society for Testing and Materials and the American Society of Heating, Refrigerating and Air-Conditioning Engineers, are creating minimum high performance standards.

Materials and Resource Considerations within LEED and Green Globes.

Issue	LEED® for New Construction	GREEN GLOBES™ for New Construction
Life Cycle Assessment (LCA)	Not currently included; the USGBC is considering how to incorporate LCA into future LEED products	10 points each for using LCA tools to choose building systems or assemblies
Renewability	1 point if 5% of the total value of building materials comes from rapidly renewable sources, defined as 10-year rotation or less	5 points for proportion of materials that are bio-based, such as green insulation, natural fibers and natural structural materials
Forest Certification	1 point if 50% or more of the wood-based material and products are FSC certified	5 points for lumber and timber panel products that originate from sustainable sources and are certified through SFI, CSA, FSC or ATFS
Locally Produced Materials	1 point if minimum 10% of total building materials were extracted, processed and manufactured within a 500 mile radius; a second point for 20% minimum	Potential advantages of locally manufactured materials are captured in preference for materials that have undergone LCA
Other Possible Points	1 point for low-emitting materials if composite wood and agrifiber products contain no added ureaformaldehyde resins	5 points for environmentally preferable products and equipment that are third-party certified 0.5 points for raised floors 0.5 points for partition walls that are easily removed and recyclable

The goal for all these programs is to raise the efficiency bar to levels higher than currently set in state law or regulations.

How Do the Rating Systems Rate?

How the rating systems rate depends on who you talk to.

First of all, it's important to understand that with the exception of some state and local government projects, there is no requirement

Different rating programs have different costs. The University of Minnesota found that certifying a commercial building through LEED could cost \$20,000 for non-members (\$17,500 for members), plus a fixed registration fee of \$600 (\$450 for members), compared to a flat registration fee of \$500 for Green Globes with certification costs ranging between \$4,000 and \$6,000. The October 2007 edition of *BUILDERnews* says LEED-

“Many green building programs determine environmentally preferable products based on intuition, bias, and internal politics.”

— *Dr. Jim L. Bowyer, Professor Emeritus of Bioproducts and Bioprocess Engineering, University of Minnesota*

that a builder or designer must get their project rated for greenness.

It's also important to understand that buildings can be built “green” without third-party certification.

Rating entities charge money for certification – sometimes so much money that developers believe going through the process needlessly inflates their bottom-line. Instead, they go ahead and build green and leave it at that.

Like so many other things, the beauty of a rating system is often in the eye of the beholder. Some people say a particular rating system demands too much of architects and builders. Others insist it doesn't demand enough.

certification of a commercial structure can cost in excess of \$50,000.

Rating systems also have different points of emphasis. For instance, Green Globes emphasizes “Energy Use” above all other categories.

In contrast, LEED allocates comparatively more points to “Materials.” Within its “Materials” category, LEED credits only materials that are renewable within 10 years. It credits bamboo as renewable but not wood. LEED also recognizes only one sustainable forestry certification program and requires certification for wood only, not other resources like bamboo, steel or concrete.

Green Globes is recognized as being user-friendly, practical and affordable, while also helping to achieve the desired end result.

The fact is that rating systems are evolving – and evolving quickly.

A key change appears to be a movement away from rating systems that dictate what practices can and cannot be used to systems that reward performance in improving sustainability.

Different rating systems are also geared toward different segments of the construction industry. The first word in LEED, its supporters like to say, is Leadership. So LEED says its standards should be higher than other rating systems. In fact, LEED targets just the top 25 percent of the market.

Although similar to LEED in what construction strategies it rewards, Green Globes is designed for more widespread appeal.

Projecting Market Demand

While green building is a popular idea, it's still unknown how commercial standard systems will fare when the rubber meets the road. In other words, how much of an impact will they really have on sales? How much market advantage will there be to getting an independent rating? How much will the consumer be willing to pay?

The argument goes that if an architect or builder demonstrates a home or some other structure is LEED certified or has a rating of three Green Globes that's akin to the "Good Housekeeping Seal of Approval" – an independent third-party has vouched that the building was designed to be energy and water efficient, that it used materials sustainably and has other green characteristics.

It's too soon to know if buyers will be content in the belief that a building is "green" because it complies to strict standards and is constructed by a builder who did the right thing – chose sustainable materials, attained energy savings, etc. – or whether buyers will demand and pay for a seal of approval.

Nor do we know how far green mandated programs will spread. While developed as voluntary guidelines for certain types of buildings, local governments increasingly are requiring designers or builders to certify projects much in the same way the state of California currently insists bidders for state office building projects earn at least a LEED Silver rating.

Click on LEED Credits at www.BuildingGreen.com for more information on specific credits or visit www.thegbi.org or www.usgbc.org.

How Wood Rates



Sustainable forest management conserves a host of forest resources like wood, soil and water.

Wood rates very well, if its prevalence as a construction material is any indicator. It rates well when you apply science, too.

Generally speaking, a relatively small amount of the points used in green rating systems are based on wood or other construction materials. Far more points come from energy efficiencies and the like.

But if from this point forward every new home built in the United States that would normally be framed in wood were instead framed in steel, the difference in energy consumption would be roughly equivalent to continuously operating a fleet of 950,000 SUVs, each driving 20,000 miles each year.

Using wood makes a difference.

But green building rating systems do not treat wood equally. LEED credits only wood certified by the Forest Stewardship Council. That represents less than one-

sixth of the certified forests in North America. In not recognizing other credible certification systems, LEED limits the supply of lumber that can be used in green building.

Green Globes recognizes wood certified not just by the Forest Stewardship Council but also by the Sustainable Forestry Initiative, the Canadian Standards Association and the American Tree Farm System – which are all valid certification systems aimed at promoting sustainable forestry.

Being rewarded for using wood approved by a broader range of certifying agencies gives builders more choice and encourages sustainable forestry on a broader scale – an approach California is supporting in the standards it is developing.

If from this point forward every new home built in the United States that would normally be framed in wood were instead framed in steel, the difference in energy consumption would be roughly equivalent to continuously operating a fleet of 950,000 SUVs, each driving 20,000 miles each year.

390 Million Acres of Certified Forest in North America



Certification:

- American Tree Farm System
- The Forest Stewardship Council
- Sustainable Forestry Initiative
- Canadian Standards Association

Of the more than 390 million acres of certified forest in North America, the Canadian Standards Association certifies nearly 180 million acres. The Sustainable Forestry Initiative covers 132 million acres. The Forest Stewardship Council certifies 57 million and the American Tree Farm System 24 million.

The websites for the Forest Stewardship Council and the Sustainable Forestry Initiative both detail their requirements for certification. See www.fscus.org and www.sfiprogram.org.

Generally, third-party certification is awarded to private timber owners who employ the best practices of sustainability. There are requirements relating to the licensing and training of forest managers, rules on harvesting practices, protections for soil, air and water quality, and more.

Interestingly, a 2003 study by California Polytechnic University in San Luis Obispo found that the rules California imposes on forestland owners are, in most cases, as strict or stricter than those set by the Forest



The O Bel Sole! development by Jennie Stabile & Al Stabile/K Street East LLC in Lancaster, California features 41 green homes.



Advanced science and technology have become key tools of sustainable forestry.

Stewardship Council and the Sustainable Forestry Initiative. For an overview of the comparison, visit: www.calforests.org/pdf/CalPoly_Explainer_Bro.pdf. For the complete text of the study see: www.ufe.calpoly.edu/files/ufeipubs/CAFPC.pdf. The study is the first item after clicking on the A-Z directory.



Sustainable Forestry Leadership

California is recognized as a world leader in sustainable forestry.

Before a tree can be turned into lumber in California there has to be a comprehensive harvesting plan developed by a licensed Registered Professional Forester and approved by state regulators with input from biologists, geologists, hydrologists, archeologists and fish and wildlife specialists, among others.

Every harvest and replanting operation on private forestlands in California includes provisions to conserve resources and maintain habitat for diverse wildlife. Even aesthetics must be considered, and all private forest management plans are open to public review.

California's tough forestry rules are one reason some builders – going for green certification or not – prefer to use California-grown wood.

Life Cycle Assessment Emerges

Another important distinction between LEED and Green Globes is that Green Globes uses a different methodology than LEED to calculate the ecological merits of construction materials.

This difference has a direct impact on how construction projects can earn points. As an example of how standards can be employed, LEED's rating system grants a builder one point if at least 50 percent of the wood-based materials and products used are certified by the stewardship council. Another point is earned if 10 percent of total construction materials are processed or manufactured within 500 miles of the building site. An additional point is awarded if 20 percent of the materials are from local sources.

While Green Globes doesn't reward materials manufactured near a construction site, it does reward design teams that incorporate Life Cycle Assessment as part of the decision-making process – and LCA takes into account the environmental impact of transporting the material.

LCA does just what the name says: it examines the impact of a material, assembly or even whole structure, from its creation to its disposal. It is the most rigorous scientific methodology that can

be applied to the selection of materials or assemblies.

For example, an assessment of a building material (like wood, steel or concrete) calculates a range of environmental impact indicators – such as the energy used to create and dispose of that material; the toxic releases generated; the pollution caused by transporting it; and other impacts on global warming – to form a detailed appraisal of that particular product's environmental impact.

The assessment offers architects and builders an impartial way to compare the environmental impact or value of various construction materials. Being able to do so gives them more flexibility in choosing the right mix of materials to meet their green objectives.

A helpful design tool for incorporating LCA is the ATHENA® *EcoCalculator for Assemblies*, offered free of charge from the Athena Institute. Originally developed for use with Green Globes, the *EcoCalculator* offers engineers and architects instant life cycle assessment results for a variety of building assemblies. It can be used for new construction projects, retrofits and major renovations.

The *EcoCalculator* offers results for hundreds of common assemblies grouped under six main categories: exterior walls, roofs, intermediate

floors, interior walls, windows, columns and beams. Find it at www.athenasmi.ca/tools/ecoCalculator/.

Why Wood?

It's easy to answer "why wood." Beyond the broad renewable vs. nonrenewable materials logic, in-depth science makes a compelling case.

When using life cycle assessment, wood is superior to other construction materials in several key aspects – air and water quality and greenhouse gas emissions among them.

Very little energy at all is used in the life cycle of wood.

The energy to grow trees comes from the sun and much of the energy used to process lumber comes from wood itself. Producing steel and concrete requires lots of fossil fuels. The production of wood reduces carbon emissions while the production of steel and concrete increases carbon emissions.

A 2005 study examined the impacts of lumber, plywood, strand board and other wood-derived building products. It compared the impact of wood to two houses, one in a cold climate and the other in a warm climate, one using steel frame and the other concrete.

A wood frame house in the cold climate was compared to one in



The NewPage Corporate Headquarters building in Miamisburg, Ohio achieved a rating of Three Globes from the Green Building Initiative for combining innovative environmental design with the functionality of an office space.

which steel was substituted for wood studs in the walls and floors. In the warm climate, a wood frame house was compared to one in which concrete was substituted for wood in the exterior walls.

The truth is most buildings, particularly homes, use a variety of different materials, each with differing environmental footprints. A wood framed house sits on a concrete pad. Focusing on assemblies that feature direct product substitution – exterior walls, for instance – highlights the impact of using wood rather than steel or concrete.

Use of steel had 33 percent more global warming impact than wood. Steel generated 11 percent more air emissions and 867 percent more harmful water emissions. The solid waste impact was the only factor in which wood and steel were roughly equal.

Similarly, concrete had 80 percent more global warming impact than wood. Concrete had 46 percent more air emissions and

164 percent higher impact on solid waste. Concrete and wood generated the same amount of water emissions.

While wood conserves more energy and releases fewer greenhouse gas emissions, it will still be part of a mix of materials. Tools like the Athena Institute *EcoCalculator* can help strike the most environmentally sound balance.

Understanding the Value of Wood

Environmental performance indices for above-grade wall designs

Minneapolis House	Wood Frame	Steel Frame	Difference	Steel vs. wood (% change)
Embodied energy (GJ)	250	296	46	+18%
Global warming potential (CO ₂ kg)	13,009	17,262	4,253	+33%
Air emission index (index scale)	3,820	4,222	402	+11%
Water emission index (index scale)	3	29	26	+867%
Solid waste (total kg)	3,496	3181	-315	-0.9%

Atlanta House	Wood Frame	Concrete Frame	Difference	Concrete vs. wood (% change)
Embodied energy (GJ)	168	231	63	+38%
Global warming potential (CO ₂ kg)	8,345	14,982	6,637	+80%
Air emission index (index scale)	2,313	3,373	1,060	+46%
Water emission index (index scale)	2	2	0	0%
Solid waste (total kg)	2,325	6,152	3,827	+164%

A comparison of wood, steel and concrete shows wood to be an energy efficient building material. Focusing on exterior wall assemblies that directly substitute concrete or steel for wood highlights the environmental benefits of using wood.

Sustainability Reigns Supreme



Worldwide, there is a growing awareness that without careful stewardship, the natural resources we depend on may be squandered.

In California, sustainability is more than an abstract concept – it is an approach to conserving natural resources and beautiful landscapes for generations. Increasingly, private forestland owners are demonstrating how forest management can provide green building materials, clean water, abundant wildlife habitat and safer forests. Managed forestlands may be the most effective scrubbers of greenhouse gases on the planet and can be a critical tool in addressing global warming.

Unlike other building materials, wood is renewable. Growth exceeds harvest across California and there is roughly the same amount of forestland in the United States today as there was 100 years ago.



California forestry has been in the forefront of advancing technology and science to sustain forest resources while meeting the demands of a growing population. Wildlife biologists and hydrologists increasingly work with foresters and archeologists to ensure California's forestry practices are not only efficient and high tech but also ecologically responsible. Computer-based harvesting equipment and milling operations have helped raise California's high environmental standards.



World class research institutions, high-tech harvesting equipment and advanced science have helped establish California as a leader in sustainable forestry. California's well managed forestlands provide diverse wildlife habitat, conserve water resources and yield perhaps the greenest building material on earth.

Regardless of how green an architect, a builder or a homeowner wants to be, whether they want to pay for a green rating or go green on their own, the most sustainable choice is wood.

Wood looks great, too.





California Forest
Products Commission

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