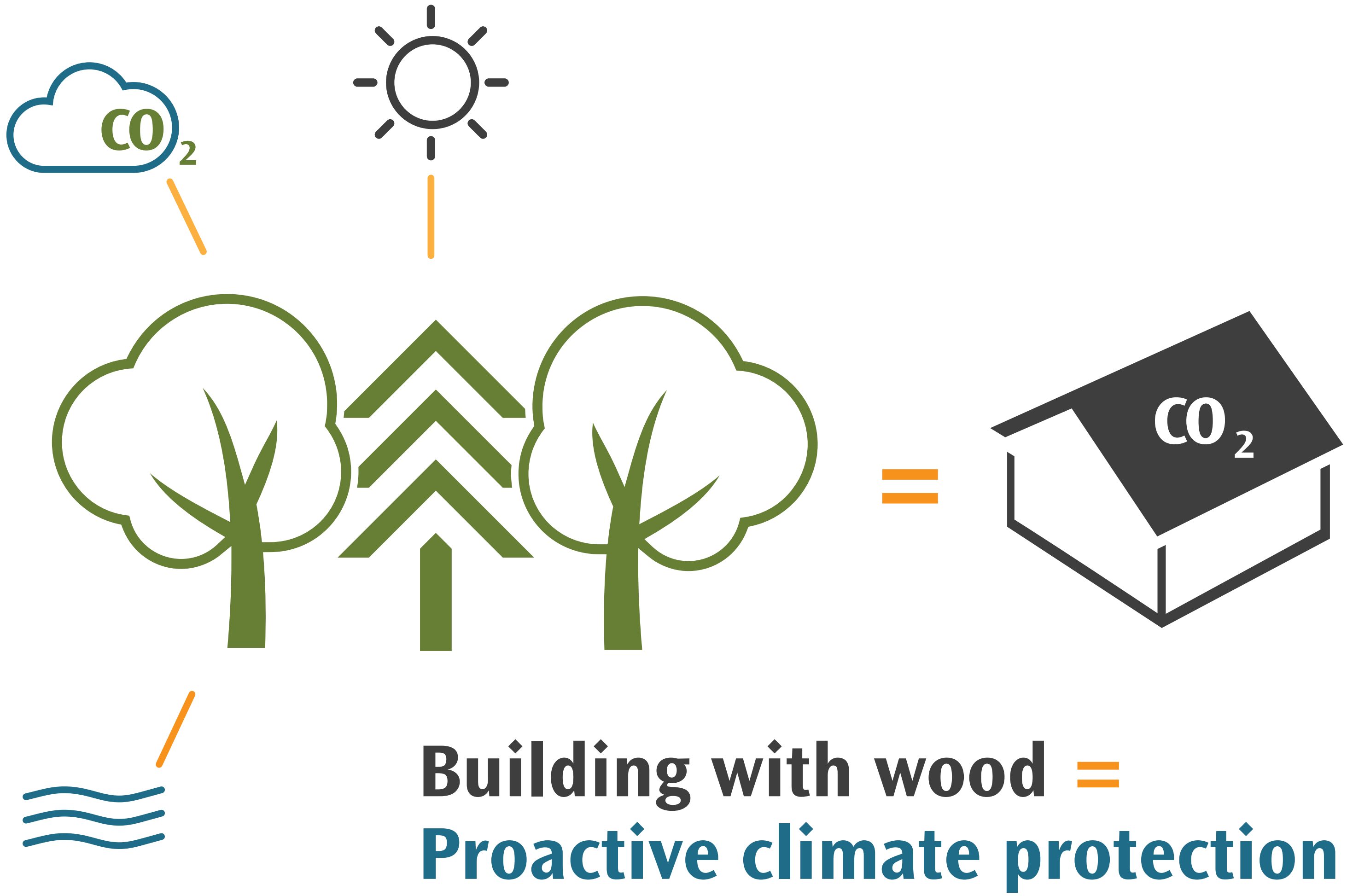


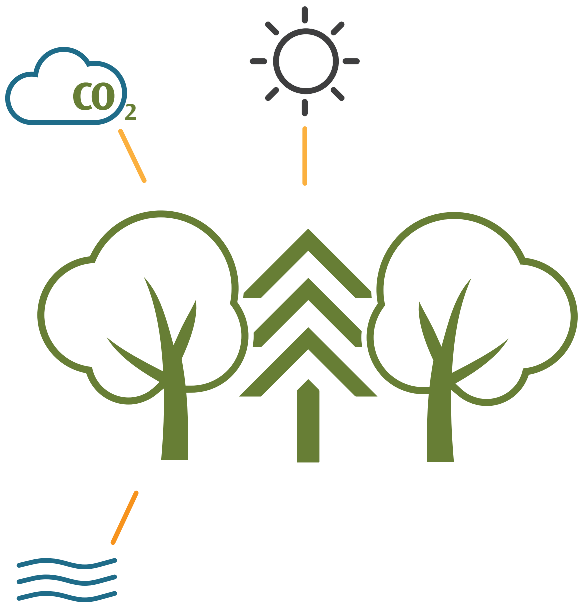
CO2
CO2
Building with wood =
Proactive climate protection

Forests = **Natural ecosystems, wildlife habitat, renewable products, carbon storage**
p. 3

Forests and Wood = **Carbon storage systems**
p. 5

Wood = **Stored Energy**
p. 7

Building with wood = **Proactive Climate Protection**
p. 9



Introduction

Forests play a critical role in filtering and renewing our air. Trees absorb carbon dioxide (CO_2) and water (H_2O), and release oxygen (O_2). The carbon absorbed is stored until the trees die and decay or are burned in a wildfire, at which point the carbon is released back into the atmosphere. Some of the carbon absorbed by trees is stored for a long period of time within the forest.

Less known is the fact that trees use carbon (CO_2) to produce wood, and that products made from wood continue to store carbon for as long as they exist. In fact, one-half the weight of wood is carbon. *The ability of wood to store large quantities of carbon for long periods of time sets wood apart from, and provides a significant advantage over other building materials such as steel and concrete.*

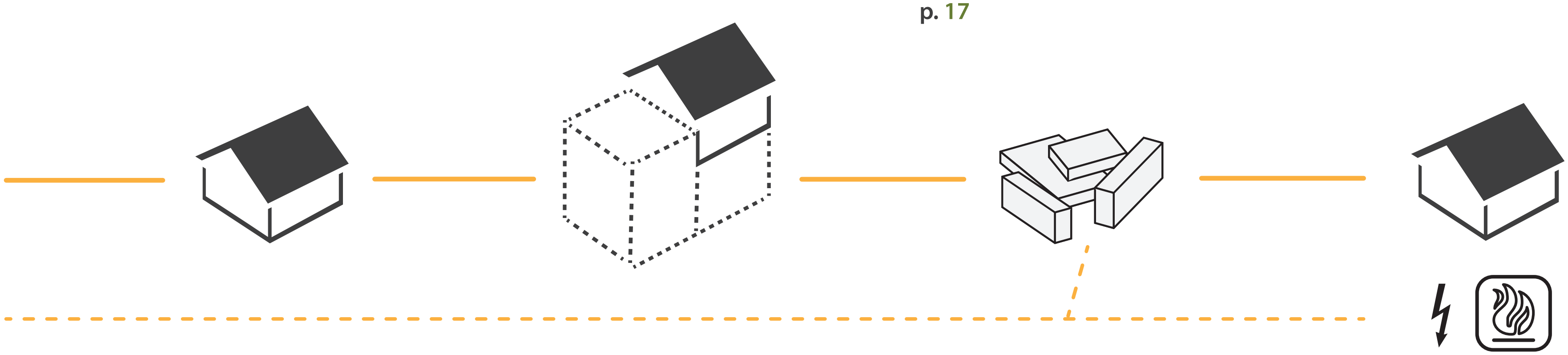
Wood not only stores large quantities of carbon, but its manufacture into useful products *results in significantly lower emissions of greenhouse and other gases* than does the production of other materials. This is because trees create wood using solar energy and, once formed, relatively little additional energy is needed to manufacture wood products. In addition, a large portion of the energy used in North American forest products manufacturing facilities is produced from biomass – bark, sawdust, and small wood scraps – meaning that *the amount of fossil fuel energy used to produce wood products is vastly lower than other materials*.

Wood in Commercial Buildings = Climate Protection Opportunity
p. 10

Wood Life Cycle = Conservation, Energy-Efficiency, Recycling
p. 12

Wood Construction = Climate Protection Projects
p. 13

Building with Wood = Long-Term Positive Effects
p. 17



The long-term positive change benefit of using wood can be summed up by the Nobel Prize-winning Intergovernmental Panel on Climate Change (IPCC) when it concluded that:

"A sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber fiber or energy from the forest, will generate the largest sustained (climate change) mitigation benefit."

Forests = Natural ecosystems, wildlife habitat, renewable products, carbon storage

Unlike mines and farms, U.S. forests are generally diverse ecosystems. As a result they provide many amenities. Forests provide a wide variety of habitats for wildlife species – from mammals and birds to reptiles and amphibians – and influence marine and fish habitats. They filter water for communities and local businesses. They offer areas for recreation, relaxation and enjoyment of nature – places for quality time with friends and families. And, they provide food, fiber and building products that support our quality of life.

Wood is also renewable. As long as forests are managed sustainably, trees can be grown, harvested, replenished, and then harvested again and again in an ongoing cycle of harvest, renewal, and growth. U.S. forests today add over twice as much wood through new growth annually than is removed or lost through natural mortality. Consequently, wood volumes contained within the nation's forests have been increasing.

The amount of forestland area in the U.S. has been essentially constant since 1900. This reality and a long history of positive net growth (growth in excess of mortality and removals), coupled with improvements in forest management and supported by strong markets for forest products, have resulted in U.S. forests storing more carbon than they release into the atmosphere (i.e. are net carbon sinks). In fact, scientists estimate that U.S. forests have been a net carbon sink since the early 1900s.

U.S. Forests Contain 1 trillion cubic feet of wood and add about **26.5 billion** cubic feet of new growth annually

Wood may be one of the world's oldest building materials, but it is now also one of the most advanced. Building stronger markets for innovative new wood products supports sustainable forestry, helps buffer and/or reduce greenhouse gas emissions, and puts rural America at the forefront of an emerging industry.

USDA Secretary Tom Vilsack

The U.S. consumes more wood than any nation on earth, and U.S. Forests are critically important to our economy. Wood from U.S. forests provides Americans with shelter, furniture, packaging, and is a major source of energy. As a result, the wood products sector:

- Is composed of thousands of companies across all 50 states
- Is a top 10 manufacturer in 47 states
- Represents 4.5% of US manufacturing GDP
- Employs about 900 thousand people
- Has a $50 billion payroll
- Generates virtually zero waste in manufacturing (less than 1%)

Over the past 100 years consumption of wood products has more than doubled. At the same time:

- U.S. forests occupy over 765 million acres of land or 72% of the "original" forest area [1]
- We have set aside 34% of that forest to be reserved from harvest,
- Over 10 million private landowners own 56% of forestland,
- The total volume of wood on U.S. forestlands ***has increased by over 57% since 1953***

Each year we harvest **13 billion** cubic feet resulting in *a net increase of over 13 billion cubic feet annually*

[1] In this use "original" refers to time of European settlement.

Forests and Wood = Carbon storage systems

9,500 MJ solar energy
0.9 t CO_2
0.5 t water
Nutrient elements N, P, K, Mg, Ca

$6\,CO_2 + 12\,H_2O$ $C_6H_{12}O_6 + 6\,O_2 + 6\,H_2O$

1 m^3 of wood = 9,500 MJ stored solar energy
0.7 t oxygen
0.3 t water

The sustainable use of wood helps to moderate the rise of CO_2 levels in the earth's atmosphere, thus partially mitigating the greenhouse effect. Currently, America's forests store 2.5 trillion metric tons of carbon. These forests capture nearly 13 percent, or 800 million metric tons of total U.S. CO_2 emissions annually.

Forests, and the wood they provide, store carbon for the long term. Trees, the lumber and other wood products made from them, and the wood used in buildings – each provides a carbon storage system.

Trees absorb CO_2 and lots of it, and store carbon within their wood for along period of time as biogenic carbon. One-half of the dry-weight of wood is carbon. So when a tree is used to produce wood for a table, desk, or dresser, what is created is not only a useful piece of furniture, but a carbon repository as well. Many buildings are built from wood, and the wood-made items in them last for generations or even hundreds of years. Every tree trunk used to provide wood for society creates space for new trees and increases the total amount of carbon storage available. Carbon is eventually released back into the atmosphere in the form of CO_2 when a tree dies and decomposes or is consumed in a fire.

Carbon Storage

U.S. Forests store about 67 Tons C/acre.

An average U.S. single-family home stores about 9.3 tons of C (34 tons of CO_2) in the building structure.

Massive quantities of carbon are stored in the 116 million homes in the U.S. (single and multi-family) that are dominantly built of wood.

Approximate CO_2 emissions

in tons, primarily from fossil fuel sources:

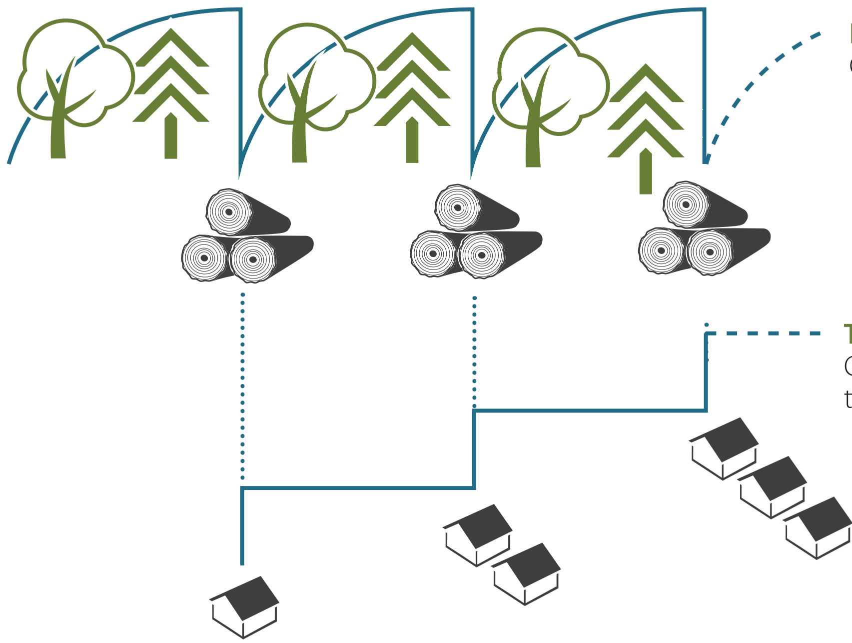
- Driving a car for a year releases 5.1 tons of CO_2.
- Flying from Los Angeles to New York releases about 2-3 tons of CO_2.
- Operating an average household for a year results in 14.5 tons of CO_2 emissions.

2.4 tons of CO_2 are absorbed to create 100 ft^3 of wood

6 billion tons of CO_2 emissions/year in the U.S. from fossil fuels

Wood is inherently one of the best building products ever. From an environmental perspective, how can you have anything better in many ways?

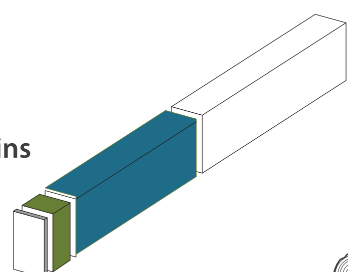
Scot Horst, Senior VP for LEED



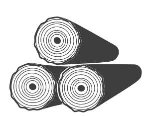
Forests as carbon stores
Growth and removal

Timber products as carbon stores
Constant growth
thanks to long-term use

100 ft³ of wood contains
(absolutely dry)



0.65 tons of carbon
0.55 tons oxygen
0.1 tons of hydrogen
minor amounts of other elements



800 million metric tons of CO_2 are sequestered each year by forest growth in the U.S.

Up to 10-45 million tons of CO_2 are fixed each year through the use of timber products manufactured from this forest growth

Wood = Stored Energy

The unique benefits of wood result from how it is made – within forests using solar energy. Solar energy drives the process of photosynthesis and wood formation. Transformation of wood into useful building materials takes relatively little additional energy. In fact, more than one-half of the energy used in manufacturing wood products in the U.S. is bioenergy, produced from tree bark, sawdust, and by-products of pulping in papermaking processes; and in some regions over two-thirds of the energy used in the manufacturing process is produced in this way.

Compared to products made from non-renewable materials, forest products contain relatively little embodied energy. Embodied energy is the energy used throughout a product's entire life cycle, including manufacture, transport, use, and disposal.

The energy required to manufacture wood products is generally about half as much as contained in them. Consider a glued laminated timber (beam), for example. The process of harvesting and drying the raw material, then manufacturing the glulam, consumes less energy than that which has previously been absorbed into the product. And what's more, trimmings and other scraps generated in converting round logs to timbers are used in making other wood products – particleboard, fiberboard, and paper – or is used in generating fossil fuel-free energy. The products themselves, once they reach the end of their life cycle, can be recycled or used to generate energy.

Over half the solar energy stored in wood is retained throughout the product's life cycle and can be utilized, with little loss, for thermal or electrical energy generation once the end of the life cycle is reached.

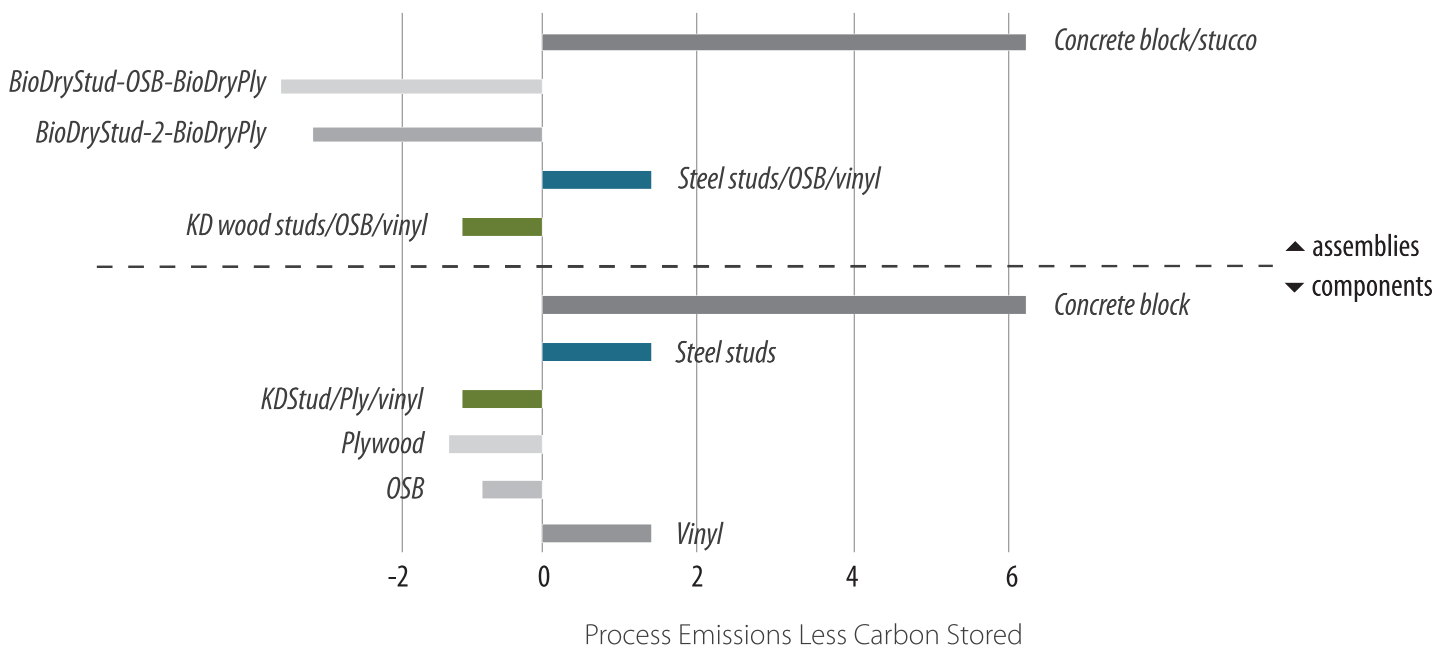
The energy stored in 10,000 ft^3 of wood is enough to light 100 average homes for more than 9 years.

Wood-based construction consumes much less energy than concrete or steel construction. Through efficient harvesting and product use, more CO_2 is saved through the avoided emissions, materials, and wood energy than is lost from the harvested forest.

Yale News

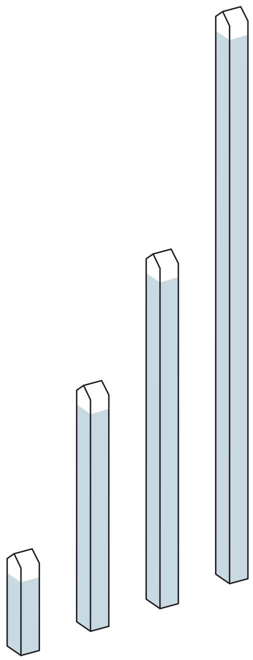
When wood products are manufactured, low energy consumption (and very low fossil fuel consumption) results in much lower greenhouse gas emissions than when alternative materials are produced. For wood products and wall assemblies, carbon emissions (or CO_2 equivalent emissions) are typically less than zero, meaning that more carbon is contained within the wood itself than is released into the atmosphere in the course of its manufacture. That is not the case for typical substitutes such as steel and concrete.

Net Product Carbon Emissions: Wall Structure (kgCO_2/ft^2 of wall)



Source: Lippke & Edmonds, 2009

Building with wood = Proactive Climate Protection



Increasing the use of wood in commercial/ industrial, health care, and government buildings would significantly reduce the **climate change impact** of building construction and **increase carbon storage** in the nation's building stock.

Individuals and organizations are paying particular attention to evaluating not only the technical suitability of raw materials, but their environmental characteristics as well. The benefits of energy-efficient buildings are already well known, including reduced energy consumption and related low costs of operation. However, operational energy-efficiency is not the whole story. Buildings of the future must also be constructed from materials that require minimal energy (and especially fossil fuel energy) to manufacture, erect, refurbish, convert and demolish. In this way, CO_2 emissions can be reduced not only when the buildings are in use, but throughout the life cycle of the buildings and their materials. Using wood in the structure of a building has significant climate protection benefits, in particular because it can replace building materials that consume a lot of energy (usually from fossil fuels) during manufacture.

In the U.S, it is common to build homes with wood as the main material. About 80 percent of housing units are primarily built of wood, providing millions of tons of carbon benefit, including both carbon stored in wood itself and emissions avoided. The current inventory of wood structures in the U.S. is estimated to store 1.5 billion metric tons of carbon equivalent to 5.4 billion metric tons of CO_2.

Increasing the use of wood in construction could enhance carbon storage in the nation's building stock. For example, increasing wood use to the maximum extent feasible in multi-family housing, low-rise nonresidential construction, and remodeling could result in a carbon benefit equal to about 21 million metric tons of CO_2 annually; this would be equivalent to taking 4.4 million automobiles off the road indefinitely.

Effects	Wood's Impact as Building Material
Carbon storage	✓
CO_2 emission prevention due to substitution	✓
Energy gain at end of life cycle	✓
Insulation value as compared to major competing materials	✓

Wood in Commercial Buildings = Climate Protection Opportunity

The U.S. building stock is aging. The average life expectancy of nonresidential buildings in the U.S. is 24 years, yet 40% of those buildings today are over 50 years old. The vast majority are in need of energy efficiency improvements. The building methods of the past are putting pressure on businesses and local authorities whose offices, factories, schools, public halls and administration buildings cost an enormous amount of money to operate. If the costs are compared over the long term, it often makes more sense to refurbish a building than to continue to operate it in its current state.

Over the next 10 years it is likely that more than 3 trillion dollars will be spent building, or substantially renovating nonresidential buildings in the U.S. How this building and renovation is carried out matters. Highly insulated modern designs, with generally prefabricated wood elements such as wall panels and trusses, which can be rapidly installed on site, represent an alternative and/or complement to standard concrete and steel nonresidential construction. The benefits include lower energy consumption and carbon emissions.

Carbon Storage

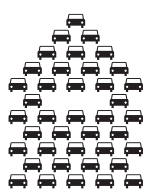
Increasing the use of wood raises the amount of carbon stored in the long term with direct positive effects on the climate

Lightweight

Wood is particularly advantageous when adding stories to existing buildings, since its low density means there is often no need to reinforce the supporting framework of the primary structure.

Natural Insulation

Due to its low thermal conductivity (approximately 0.13 W/mK) wood lends itself to the creation of designs utilizing a highly insulated building envelope with less concern about thermal bridging issues than when building with other materials. Not surprisingly, nearly all Passive Houses globally are built from wood.



Every 10,000 ft^3 of wood used in a nonresidential structure stores roughly the same amount of CO_2 as taking 50 cars off the road in the U.S. for a year.

Innovative wood construction systems are highly flexible, are easily combined with use of other materials, and provide an excellent approach to extending and adding stories to existing buildings. Prefabricated wood components such as wall panels and trusses, as well as engineered products such as laminated beams and cross-laminated timbers (CLT) are lightweight relative to their strength and particularly well suited to buildings that cannot support heavy extensions and loads. Existing buildings can often be retained or even expanded in a cost-effective manner, with reduced need for demolition and rebuilding work.

Earthquake resistance

In wood-framed buildings, walls and floors transfer lateral loads induced by seismic forces, resulting in superior performance and safer structures.

Durability

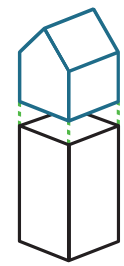
Wood protection measures implemented by design and the use of innovative methods such has thermal modification mean that wood can be a durable material even without the use of chemicals. The longevity of wood structures can equal or exceed that of other materials.

Fire protection

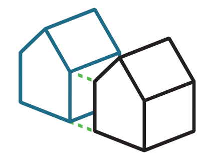
When wood of large cross-section is exposed to heat or flame the outer layers char, forming a self-insulating layer. As a result, these timbers can deteriorate more slowly, even in an intense fire, providing a significant and predictable safety factor. Also, wood exposed to heat does not melt or deform and has low linear expansion.

Good internal climate

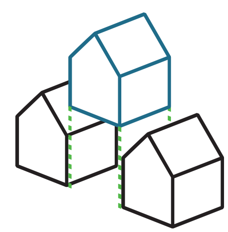
Thanks to its ability to help regulate humidity, wood contributes to a comfortable environment. And with its warm, natural appearance and the sheer variety available in terms of both look and feel, the presence of wood within a building, especially in interior finishes, really speaks to the senses.



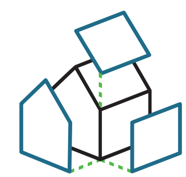
Adding stories



Extending



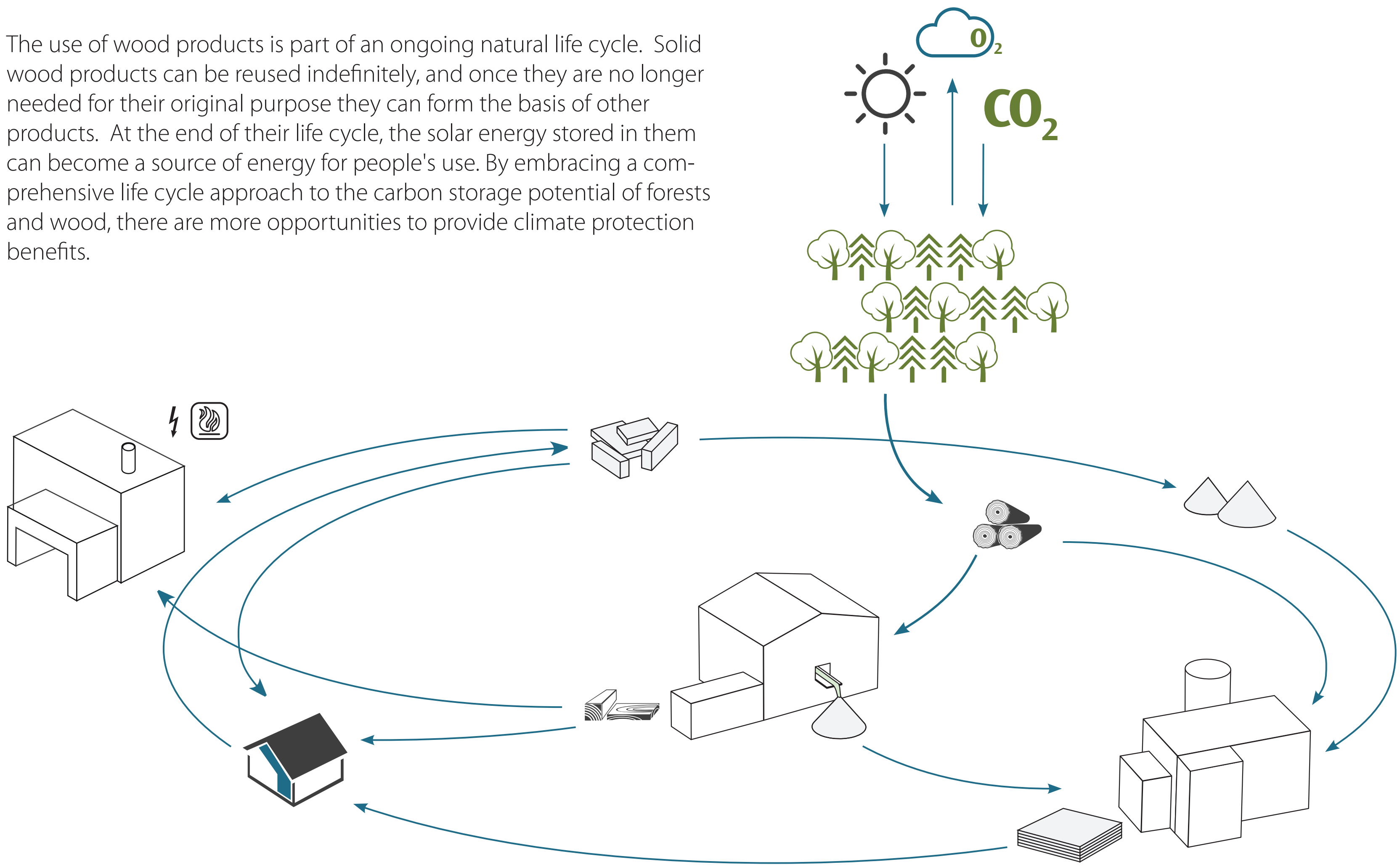
Filling a gap



Adding an envelope

Wood Life Cycle = Conservation, Energy-Efficiency, Recycling

The use of wood products is part of an ongoing natural life cycle. Solid wood products can be reused indefinitely, and once they are no longer needed for their original purpose they can form the basis of other products. At the end of their life cycle, the solar energy stored in them can become a source of energy for people's use. By embracing a comprehensive life cycle approach to the carbon storage potential of forests and wood, there are more opportunities to provide climate protection benefits.



Wood is the ideal life cycle material, particularly if it comes from well-managed forests. Wood is renewable and can be re-used or recycled time and time again. Though every raw material has its costs and implications, from a renewable, life cycle perspective, wood is as good as it gets.

Richard Donovan – Senior Vice President, Rainforest Alliance

Wood Construction = Climate Protection Projects

Building with wood =

Reduced energy requirements and CO_2 emissions due to insulation and low thermal conductivity PLUS low embodied energy and storage of carbon for life of building and beyond.

Wood Use = Less Impact

Building with non-renewable raw materials =

Reduced energy requirements and CO_2 emission thanks to insulation during the utilization phase

More and more, people are calling for environmentally friendly construction methods for their homes, offices, and public buildings. There are now over 30 voluntary green building programs in use throughout the U.S. and green building practices are being integrated into local building codes. Thus, town planners and approving authorities are in a position to create incentives for sustainable construction. The decisions that authorities make today will leave their mark on town and cityscapes for decades to come. If the goal is to build in a way that minimizes environmental impacts it is important to consider early in the design process the building's impact on both the economy and the environment throughout its entire life cycle. Incentivizing the use of wood in construction is a proven approach to reducing total impact. Early in a building's planning stage attention must be paid to the following:

- Embodied energy
- Global warming potential
- Flexibility of the materials to meet the needs of innovative designs without sacrificing environmental performance
- Environmental impacts throughout the life cycle of the building and its materials (i.e. Life Cycle Assessment or LCA)
- Economic costs throughout the life cycle of the building (i.e. Life Cycle Cost Assessment or LCCA)

Given the pervasive use of non-renewable and energy-intensive building materials currently used in non-residential construction, there is potential to reduce carbon emissions and increase carbon storage through greater use of wood in commercial/industrial, health care, government, and multi-family buildings as a climate protection solution. The projects on the next three pages provide examples of developments that successfully utilized greater use of wood in nonresidential buildings and incurred significantly fewer environmental impacts as a result.

In addition to the obvious opportunities for greater wood use in low-rise commercial/industrial, health care, and government buildings – the development of an increasing array of engineered wood products over the past several decades has made it technologically possible to create tall wood structures. The carbon implications are large.

Stella, Marina del Rey, CA

Completed in 2013, the Stella apartment project is an urban infill complex designed by DesignARC, Ariel Fox Design, and Arroyo Interior Design. The building includes 244 units and resort style amenities such as a fitness center, heated saltwater pool, lounges, business center and conference room, private movie theatre, and yoga studio. The sleek, contemporary styled project consists of two nested wood-framed L-shaped structures, oriented for maximum access to light and views. The complex includes two apartment towers, one five-story and one four-story, atop a single, one-story concrete podium, totaling 650,466 square feet.

A wide range of wood products were used in the construction of the project, including traditional Douglas-fir dimension lumber as well as engineered wood products such as parallel strand lumber (PSL), laminated veneer lumber (LVL), glued laminated timber (glulam) beams, I-joists, plywood and oriented strand board (OSB). The building was also panelized offsite to speed the construction process. The developers estimate that wood panelization saved between one and two months construction time. GLJ Partners, the developer and general contractor also noted that, "As developers, we're trying to maximize our height and the number of units we can get on a site. Wood allows us to do that quickly and affordably."

Courtesy of: DesignARC,
photo Lawrence Anderson, www.lawrenceanderson.net

Used 2.3 million board feet of wood

Wood stores 4,495 metric tons of CO_2

CO_2 **Avoided 9,554 metric tons of CO_2 emissions**

Total Carbon benefit is 14,049 metric tons of CO_2

Equivalent to taking 2,683 cars off the road for a year

* The data in these graphics refers to CO_2 Equivalent.

Source: WoodWorks case study, http://www.woodworks.org/wp-content/uploads/Stella-CaseStudy-WEB.pdf

University of Washington West Campus Student Housing, Seattle

University of Washington West Student Housing Project, completed in 2012, is a five-building, 668,000 square foot mixed use urban development, combining 1650 bed dormitory space with apartments, restaurant, grocery store, café and other commercial spaces. The University challenged the design team at Mahlum Architects to create a community that could be built within a tight budget, yet provide iconic identity, exceptional energy efficiency and integrated sustainability. Mahlum Architect's decision to use wood as the primary structural material achieved that and more. Wood framing also gave them design flexibility, increased speed of construction, cut overall carbon emissions and utilized local materials and a skilled labor force. Careful attention to detailing created an air- and water-tight, thermally efficient building envelope, providing long-term durability and energy efficiency for the University.

Although the International Building Code (IBC) allows five stories of Type III wood-frame construction, Seattle's building code is unique in that it allows five stories of wood with a Type VA structure when the building has an NFPA-compliant sprinkler system. With this in mind, Mahlum Architects worked with engineers at Coughlin Porter Lundeen to make the most of the urban campus environment, designing each of the five buildings in this award-winning project with five stories of wood-frame construction over a two-story concrete podium.

The five buildings are testament to the fact that wood construction can not only save time and money, but also create elegant, durable, urban structures that contribute positively to city and campus vitality. There are a number of additional student housing projects under development at UW, and all will be built with wood.

Courtesy of: Andrew McIntyre, LEED® AP, BD+C
W.G. CLARK CONSTRUCTION
Image is of similarly constructed building on U of W campus

Used 208,320 cubic feet of wood

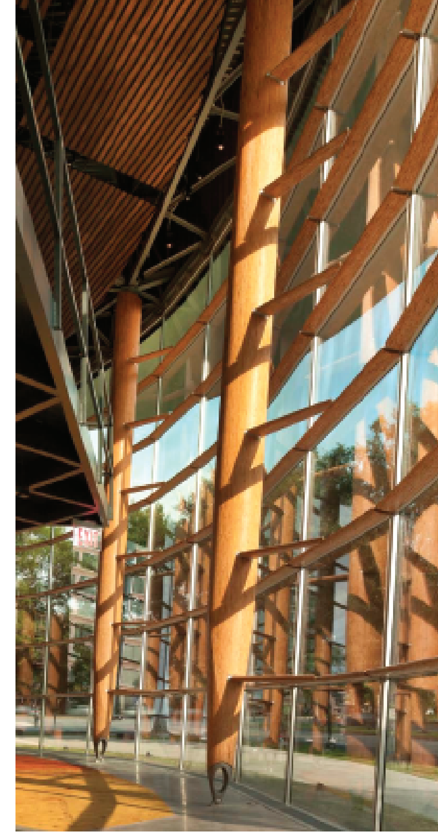
Stores 4,466 metric tons of CO_2

Avoided emissions of 9,492 metric tons of CO_2 emissions

Total Carbon Benefit of 13,958 metric tons of CO_2

Equivalent to taking 2,736 cars off the road for a year

* The data in these graphics refers to CO_2 Equivalent.



Arena Stage, Washington, DC

Completed in 2010, the Arena Stage at the Mead Center for American Theatre is a three-theater complex consisting of an intricate timber-backed glass façade supporting a steel roof. The project was built to preserve two historic theatres, the Fichandler Stage and Kreeger Theatre, which were largely untouched in the renovation. A new small experimental theatre, "The Kogod Cradle" was also added. The theatre complex includes a restaurant, rehearsal rooms, classrooms and offices. A large central lobby links the three theatres.

Designed by Bing Thom Architects of Vancouver and built in Washington, D.C., the project was the first modern structure of its size in the U.S. capital to use heavy timber components. It was also the first hybrid wood-glass enclosure in the U.S. to envelop existing structures. The 200,000 square foot facility utilizes insulated glass walls to provide acoustic separation from nearby Reagan National Airport. A series of large parallel strand lumber (PSL) muntin arms and columns support the glass façade and a dramatic 500-foot-long cantilevered roof. Weighing 10,000 pounds each, the wood columns were shaped into elliptical cross sections to maximize structural strength and beauty. Wood was also used to absorb and disperse sound in the new "Cradle" and lobby. Michael Heeney, principal and executive director for Bing Thom Architects commented, "We didn't have money for finishes, so the structure had to be beautiful, and wood made perfect sense."

Courtesy of: Bing Thom Architects, photo Nic Lehoux

Used 8,800 cubic feet of wood

Stores 215 metric tons of CO_2

Avoided 460 metric tons of CO_2 emissions

Total Carbon Benefit of 675 metric tons of CO_2

Equivalent to taking 129 cars off the road for 1 year

* The data in these graphics refers to CO_2 Equivalent.

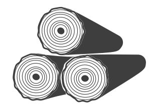
Source: WoodWorks case study, http://www.woodworks.org/wp-content/uploads/CS-Arena-stage.pdf

Building with Wood = Long-Term Positive Effects

Building with wood is an active form of climate protection. Wood is the only building material that is renewable, that can be produced using minimal amounts of fossil energy, that stores massive quantities of carbon for long periods of time, and that can be reused again and again before the solar energy stored within it is recovered for energy production.

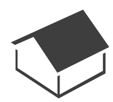
Given the pervasive use of non-renewable and energy-intensive building materials currently used in non-residential construction, there is potential to reduce carbon emissions and increase carbon storage through greater use of wood in commercial/industrial, health care, government, and multifamily buildings as a climate protection solution. A first step toward a climate protection solution is to encourage the use of wood in federal and other public buildings. Public buildings represent one of the most immediate non-residential carbon benefit opportunities. Federal agencies have a goal of reducing emissions by 17 percent by 2020 and the use of greater quantities of wood in federal buildings would contribute to achievement of this goal."

Forest

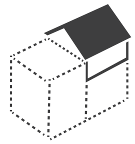


Wood as a raw material

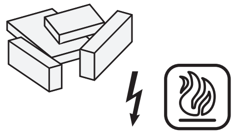
Wood as a building material



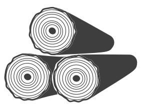
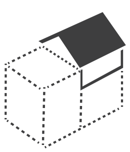
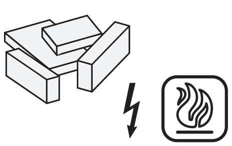
Timber construction



Modernization
Refurbishment
Urban densification



Demolition
Recycling
Energy recovery

	Energy effect	Carbon effect	Value-added effect
	Stores solar energy	Removes C from the Atmosphere	Supplies the raw material wood; adds value to forests and reduces potential for conversion
	Often available locally; short transport distances possible	C is transferred into the raw material	Strengthens rural economies
	Low embodied energy	Stores C; replaces other construction materials that have greater environmental impact	Strengthens the U.S. Forestry economy; supports goal of energy independence
	Low thermal conductivity and thermal bridging	Stores C; Reduces required insulation and associated GHG emissions	Buildings can be more cost effective and provide a healthy living environment
	Lightweight and easy to transport	Increase in C storage	Increasing use of prefabrication; innovative and intelligent product know-how; saves resources and retains value
	Low energy recycling or emissions neutral energy recovery	Extended C fixation due to recycling	Innovative solutions for a circular economy that looks to the future

Literature

Alvarez, M. 2007. The State of America's Forests. Bethesda, MD: Society of American Foresters

Birdsey, R., et al. 2006. Forest carbon management in the United States: 1600–2100. ***J. Environ. Qual.*** 35:1461–1469.

Green, Michael. 2012. The case for Tall Wood Buildings. www.woodworks.org/download.php?file=152

Mahlum, Walsh Construction Co. and Coughlin Porter Lundeen. 2014. CLT Feasibility Study: A Study of Alternative Construction Methods in the Pacific Northwest. (http://www.mahlum.com/pdf/PNWCLTFeasibilityReport.pdf)

O'Connor, J. 2004. Survey of Actual Service Lives for North American Wood Buildings. Las Vegas: Wood Frame Housing Disaster and Durability Issues Conference.

Smith, W., Miles, P., Perry, C., and Pugh, S. 2009. ***Forest Resources of the United States***, 2007. USDA For. Serv., Gen. Tech. Rep. WO-78, Washington, DC. 336 p.

Woodworks. 2011. http://www.woodworks.org/wp-content/uploads/CS-Arena-stage.pdf

Buildingsonfire.com. 2012. Multistory Wood Buildings. http://buildingsonfire.com/multi-story-wood-construction-insights

Naturally Wood. 2010. http://naturallywood.com/sites/default/files/Six-storey-wood-structure.pdf

Perkins+Will. 2014. Summary Report: Survey of International Tall Wood Buildings. http://www.rethinkwood.com/sites/default/files/wood-resourse-pdf/Survey%20Tall%20Wood_REPORT%20WITHOUT%20APPENDICIES_web.pdf

Skidmore, Owings & Merrill, LLP. 2013. Timber Tower Research Project. http://www.som.com/ideas/research/timber_tower_research_project

U.S. Department of Energy. 2014. http://www.fueleconomy.gov/feg/climate.shtml http://coolclimate.berkeley.edu/footprint)

University of California-Berkeley. 2014. Cool Climate Network. http://coolclimate.berkeley.edu/footprint

Lippke, B. and Edmonds, L. 2009. Life Cycle Assessments of Subassemblies Evaluated at the Component Level. Consortium for Research on Renewable Industrial Materials. (http://www.corrim.org/pubs/reports/2010/phase2/Module_I.pdf)

Guide

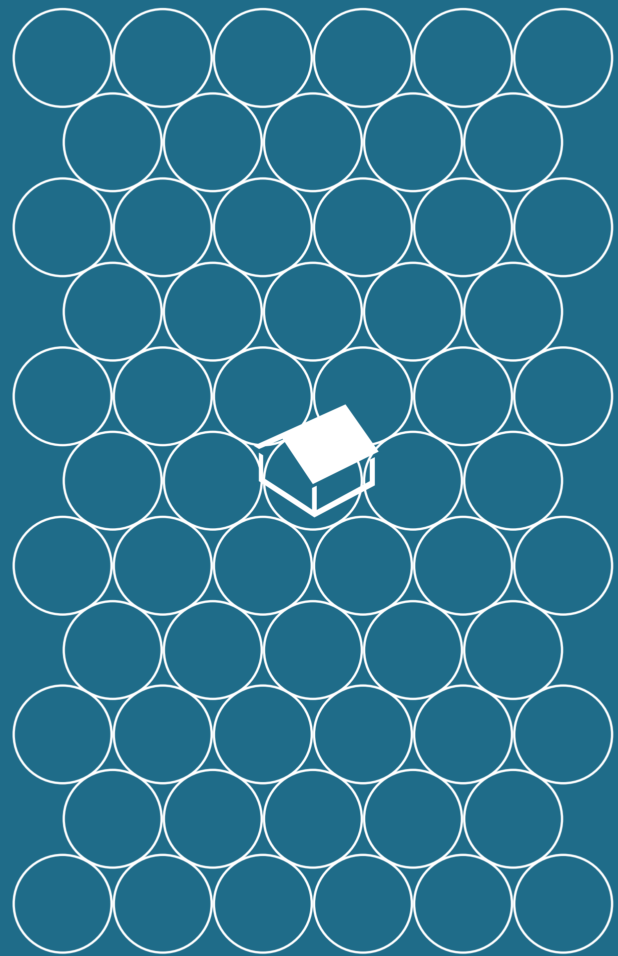
Dovetail Partners, Inc.
State University of New York (SUNY)

Editors: Jeff Howe, Kathryn Fernholz
Project Management: Robert Malmsheimer, Jim Bowyer
Design: Based on the work of Holzforschung Munchen and Technische Universitat Munchen, Germany, with additional work by George Jerzy Hornik

This edition was funded by Binational Softwood Lumber Council

BSLC Binational Softwood Lumber Council

ESF State University of New York College of Environmental Science and Forestry



Every minute, on average, over 24,000 cubic feet of wood are removed from U.S. forests
to build homes, make furniture, manufacture paper, and create hundreds of other products.
In that same average minute, new growth adds over 50,000 cubic feet of wood to the nation's forests.

766 million acres of forestland in the U.S.
= 33% of Nation's total area