



# FORESTS, CARBON AND CLIMATE CHANGE

Exploring the  
Role of Trees  
In Reducing  
Atmospheric  
Carbon

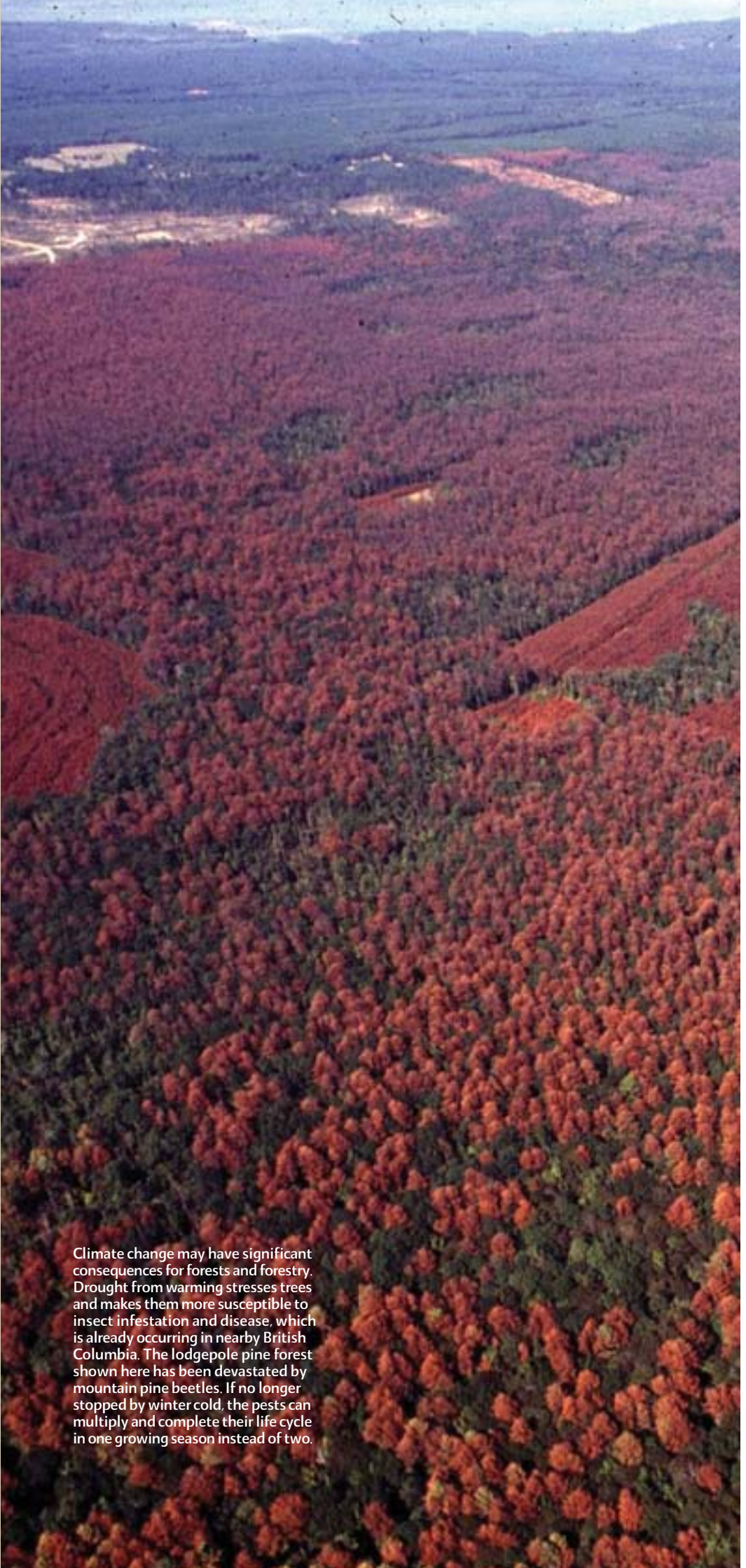
A Special Report  
From the Oregon  
Forest Resources  
Institute

**T**hrough millions of years of cooling and warming cycles on earth, vegetation and wildlife have responded by moving or adapting, and forests are no exception. Research has confirmed a correlation between atmospheric carbon dioxide and cooling/warming periods. It has also revealed that current atmospheric carbon dioxide levels are extremely high and are increasing rapidly. At the same time, humans have removed 50 percent of the world's forest cover over the past 8,000 to 10,000 years, most of it in the last few centuries since the start of the industrial era.

Forests are a major force in removing and storing carbon from the atmosphere. This is important to Oregon because of the state's vast and rich forest resources. This special report takes a look at current scientific research related to carbon and climate change and the role forests can play in reducing the accumulation of carbon in the atmosphere. This subject is much too large to be fully addressed in the confines of a brief report like this one, and the Oregon Forest Resources Institute (OFRI) has published a more comprehensive report, *Forests, Carbon and Climate Change: A Synthesis of Science Findings*. Copies are available from OFRI.

## HIGHLIGHTS

- Scientists know more about climate change than ever before. While carbon dioxide (CO<sub>2</sub>) levels in the atmosphere have fluctuated throughout history, current levels are higher than any time in the last 420,000 years and are increasing at an unprecedented rate.
- Forests play a major role in keeping CO<sub>2</sub> out of the earth's atmosphere, yet we also know that human activities over the past 8,000 to 10,000 years have reduced the earth's forests by half. Most of this has occurred since the advent of the industrial age through conversion of forests to such non-forest uses as agriculture and urban development.
- Nearly half of Oregon's land is forested, so forestry in the state has a distinct role to play in offsetting CO<sub>2</sub> released into the atmosphere through the burning of fossil fuels.
- Wood from trees continues to store atmospheric carbon after it is made into lumber and other products. That is one reason why wood is an environmentally preferable building material when compared with products like concrete and steel, which do not store carbon and which require the intense use of carbon-emitting fossil fuels in their production.
- Wildfire is a major contributor to atmospheric carbon, so thinning overly dense forests to restore their health and fire resilience can have a significant effect on climate change.
- Oregon is studying the potential for converting woody biomass from thinning overcrowded forests into renewable energy, which can further reduce the emission of CO<sub>2</sub> into the atmosphere from the burning of fossil fuels.
- Oregon has set out on a bold journey toward reducing carbon dioxide emissions with an ambitious goal of reaching a climate stabilization level by 2050.
- Given Oregon's massive forest resources and its world-renowned forestry research complex at Oregon State University, the forest sector clearly has the potential to play a major role in reaching that goal.



Climate change may have significant consequences for forests and forestry. Drought from warming stresses trees and makes them more susceptible to insect infestation and disease, which is already occurring in nearby British Columbia. The lodgepole pine forest shown here has been devastated by mountain pine beetles. If no longer stopped by winter cold, the pests can multiply and complete their life cycle in one growing season instead of two.

## CARBON AND CLIMATE

Over centuries and millennia, climate variations on earth have set trees and other vegetation into motion across the landscape, on journeys of sometimes thousands of miles – up and down mountains, across plains – pushing them together or dividing them into scattered populations as they sought a livable environment. Climate change has sent glaciers grinding south and retreating north more than 40 different times, raising and lowering sea levels and moving our coastlines miles out to sea and back again. It has altered the course of rivers and dramatically rearranged our geography. And each of these shifts precipitated changes in local and regional flora and fauna, with species migrating to areas more favorable to their survival or becoming extinct for lack of mobility or suitable habitat.

With this history of natural climate variability, why is there so much discussion today about global climate change? And more to the point of this special report, what role do forests play in this process and why is the professional forestry community following developments so carefully? The reasons are many and complex, but the short answer is that scientists know more about climate change than ever before. With their ability to determine past levels of carbon dioxide in the earth's atmosphere, they have discovered that current levels are the highest they have been in hundreds of thousands of years and are increasing rapidly.

Forests play a major role in reducing atmospheric carbon dioxide (CO<sub>2</sub>), yet we also know that human activities over the past 8,000 to 10,000 years have reduced the earth's forests by half, most of it relatively recently since the advent of the industrial age. Because Oregon is so heavily forested, and wood products combined with forest management strategies do offer options to store more carbon, forestry in the state may have a distinct role in addressing the problem.

### **The Complexity of the Carbon Question**

Establishing a comprehensive picture of atmospheric carbon dioxide is difficult at best. At any given moment on the earth, carbon is being stored and released into the atmosphere simultaneously. Certain living and non-living entities are absorbing and storing (sequestering) carbon while others are releasing it. Trees and other live plants take in carbon, while those same organisms release it in the process of decaying. Some of what is released goes into the atmosphere and some is absorbed in other entities, like the ocean. The process is anything but static.

As we all learned in school, carbon is the essential element of life. Plants convert atmospheric carbon from CO<sub>2</sub> into sugars through photosynthesis. Animals eat plants and give off CO<sub>2</sub> to the atmosphere through respiration.



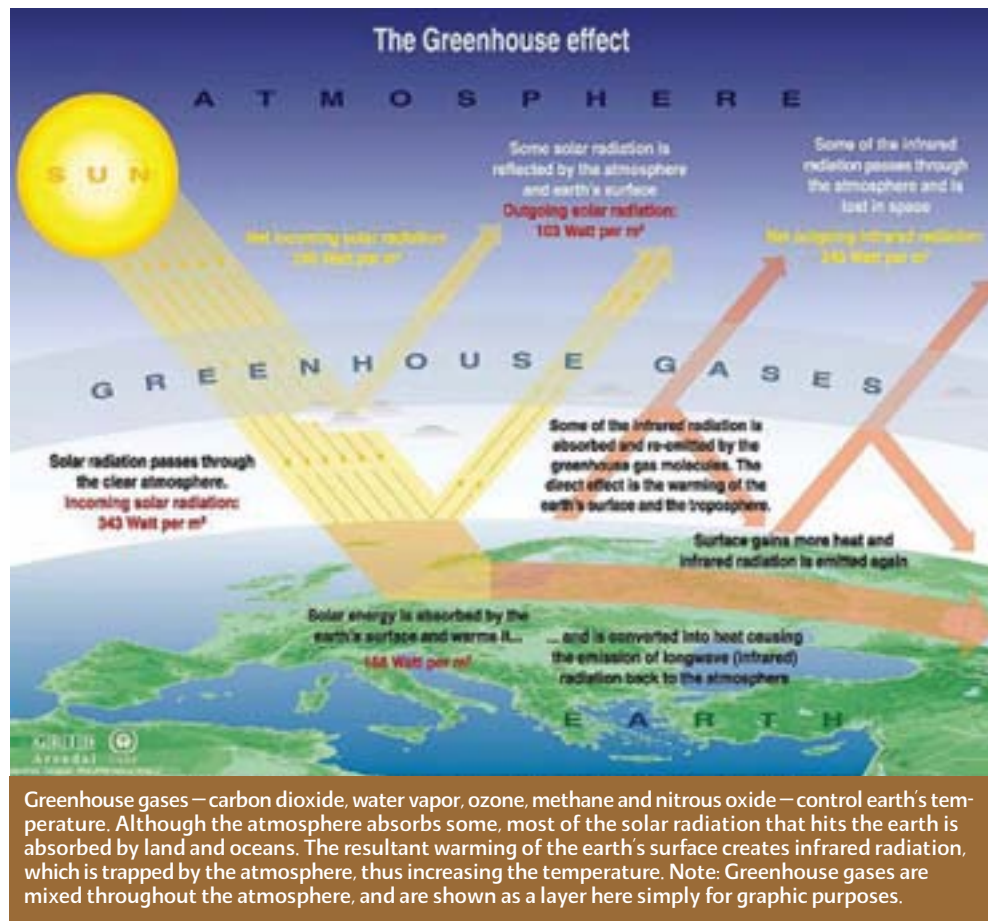
**Hal Salwasser**

Dean  
College of Forestry  
Oregon State  
University  
Corvallis

**"Climate sets the context for livability. It affects the means by which all organisms pursue their existence. It also affects the kinds of forests that occur in different places and at different times across the land surface of our planet. And, as we are increasingly aware, climate not only affects forests, but forests affect climate. Carbon is a key component of all life's building blocks, including fats, carbohydrates and proteins. Along with water and oxygen, it is also one of the prime linkages between forests and climate."**

“While there is not scientific consensus about all the causes and implications of global climate change, there is agreement that the relationships between forests and carbon, carbon and climate, and climate and forests are very important to understand at this juncture. It is also clear that Oregon is a forest-rich state, poised with opportunities for forests, forestry, and forest product enterprises to profit from positive roles in maintaining a livable climate.”

*Forests, Carbon and Climate Change: A Synthesis of Science Findings*



Plants also give off CO<sub>2</sub> through respiration, but in amounts lower than the CO<sub>2</sub> uptake during photosynthesis. And all organisms give off carbon when they die or decay.

Furthermore, we cannot look at the carbon question from an Oregon perspective only and draw meaningful conclusions. We need to see and understand the issue globally. For example, if we succeed in sequestering carbon in our own forests, but forestland is being lost to agriculture or development in other parts of the world, we will not have addressed the problem sufficiently. And when we import wood products from countries that do not have sustainable forest practices, we may in reality be putting more carbon into the atmosphere, particularly when we consider the burning of fossil fuel to transport that material here.

### Carbon and Temperature

We now know that there is a relationship between temperature and the amount of carbon in the atmosphere. Of the five greenhouse gases (those in the atmosphere that warm the earth because they let in light but do not let out heat), CO<sub>2</sub> is the most prevalent. Recent research has enabled scientists to determine historic CO<sub>2</sub> atmospheric levels as well as rates of increase and decrease, and these

data have helped put the situation today in historical perspective. Mark Harmon, professor of forest science at Oregon State University, explains: “Gases trapped in snow and ice in glacial deposits have yielded very precise and accurate measurements of past carbon dioxide concentrations and provide certain evidence that while concentrations have fluctuated in the past, current levels are higher than any time in the last 420,000 years and are increasing at an unprecedented rate.” Furthermore, he says: “Human-related inputs of carbon dioxide are so high at this point that natural processes cannot change the resulting overall increase in atmospheric concentrations.”

## CARBON ON EARTH

We know that there is carbon in the atmosphere, but how does it get there and what controls its levels? Carbon is not that large a percentage of all the earth’s elements, but it is part of all living organisms. It occurs in the earth, the oceans and the air. For a simplistic comparison, here is an approximate breakdown of carbon amounts (pools) in Pg (petagrams, or 1.1 billion U.S. tons):

**65,000,000 Pg – Geologic Carbon Pools.** Far and away the largest pool, occurring in the earth itself. Fossil fuels, for example, are in this category but only store an estimated 4,000-5,000 Pg of the total geologic pool. When we remove them and use them for transportation, heating or energy, we are transferring carbon from the earth to the atmosphere.

**39,000 Pg – Oceanic Carbon Pools.** This is the largest of the biologically related pools.

**2,190 Pg – Biosphere Carbon Pool.** This represents the carbon stored terrestrially in living and non-living organic matter. Nearly half of this pool is stored in the world’s forest ecosystems.

**750 Pg – Atmospheric Pool.** Although this is the smallest pool, it is the one that humans can affect the most. Even minute changes in the other pools can have a very large effect on CO<sub>2</sub> levels in the atmosphere.

It is this latter pool – atmospheric CO<sub>2</sub> – that has been the subject of so much concern recently, because CO<sub>2</sub> and the other greenhouse gases tend to trap heat by allowing shortwave sunlight energy to pass through to the earth’s surface without allowing the longwave heat energy to leave. Through sophisticated techniques, scientists are now able to ascertain past carbon dioxide levels in the atmosphere by drilling thousands of feet into ice and snow and analyzing core samples. With almost tree-ring accuracy, researchers can go back into geologic time and determine atmospheric CO<sub>2</sub> levels. The results have shown carbon’s cyclic nature, with sometimes large fluctuations.



**Mark Harmon**  
Professor of Forest  
Science  
Oregon State  
University  
Corvallis

**“Humans release carbon dioxide through burning fossil fuels, manufacturing cement and converting land cover types with high carbon stores (forest) to those with lower stores (agricultural land). For thousands of years before the industrial revolution, humans were clearing forests for agriculture, but at a rate that could generally be absorbed by other carbon pools such as the ocean. At the start of the industrial revolution, changes in land use constituted the major human-related release of carbon dioxide to the atmosphere. Although land use-related releases have quadrupled from 0.5 Pg/year to a current value of 2 Pg/year, release from fossil fuels and other industrial uses have increased from virtually zero to over 6.5 Pg/year in the same time period.”**

“Human population growth, expansion and land transformation have likely resulted in the loss of 50 percent of the forest cover that existed 8,000 years ago. ... We face large challenges to perpetuate the remaining 9.8 billion acres of forest as forest – an even greater challenge when the world population is 6.5 billion, heading toward perhaps 8 to 10 billion by mid-century. Only by keeping forestland in forests can we ensure that forests and forest products can contribute to desired future climate trends.”

*Forests, Carbon and Climate Change: A Synthesis of Science Findings*

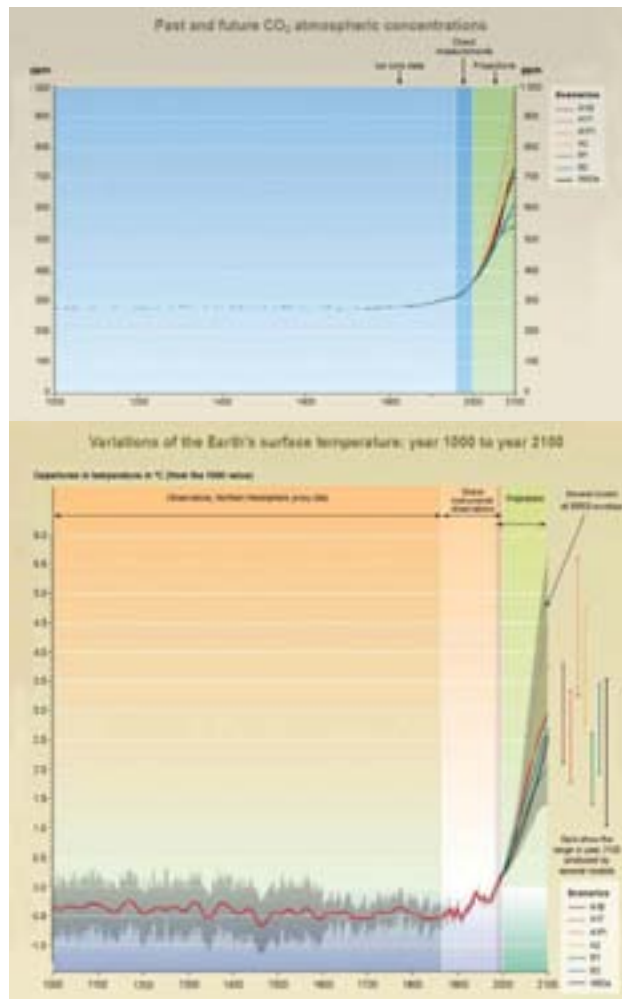
### Carbon Dioxide and Forests

The carbon dioxide level of the atmosphere today is about 370 parts per million (ppm). Looking back some 400,000 years, levels have cycled between 170 and 300 ppm, with peaks about every 100,000 years. It is at this scale that one can begin to see the influence of forests on atmospheric carbon. Between 8,000 and 10,000 years ago, as the human race evolved away from nomadic existence toward more stationary communities, a process of deforestation began to occur. This was due in part to population growth and larger and more permanent clearings for agriculture and development.

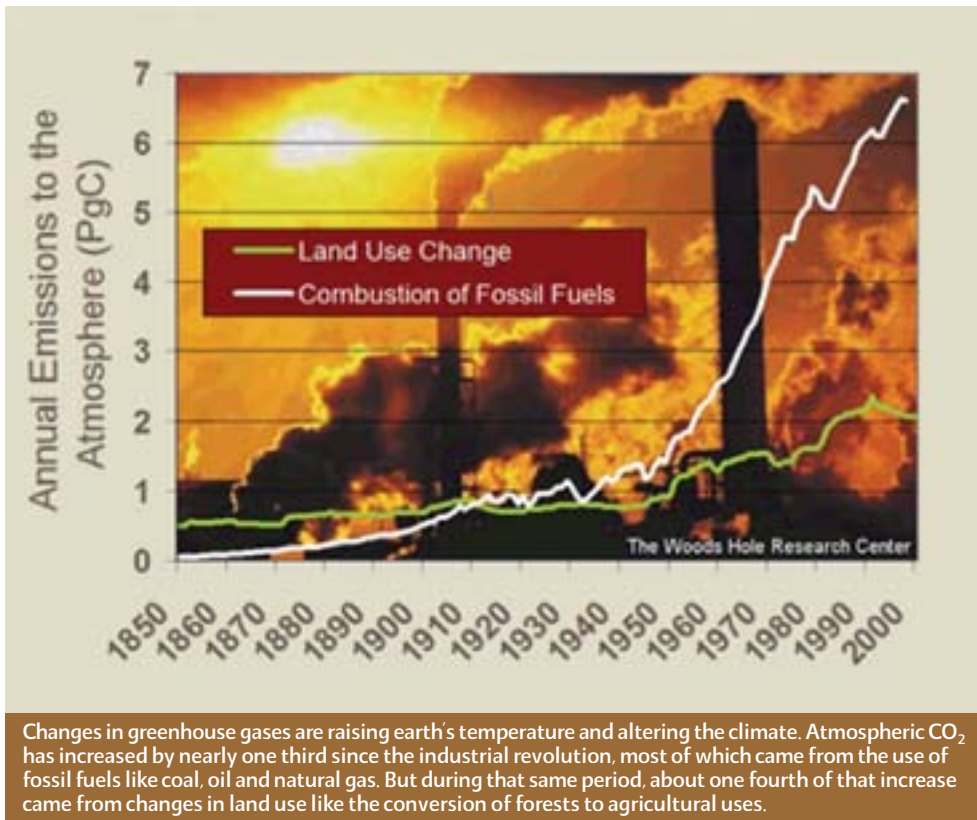
Since that time, cumulative forest losses have become massive, but most of the loss has occurred since the advent of the industrial era about 300 years

ago. It is estimated that today we have about 50 percent of the forest cover that existed 8,000 years ago. Says Mark Harmon: “Starting in approximately 1850, clearing of forests by humans and release of fossil fuel-related carbon have caused an upward increase in carbon dioxide concentrations from 285 ppm to 370 ppm today – a 30 percent increase. This concentration is 70 ppm higher than the cycle peaks in the recent geologic past and is increasing at greater than 90 times the rate observed in past cycles.”

Ronald Neilson, bioclimatologist with the U.S. Forest Service Pacific Northwest Research Station, says that “several different research models have indicated that we are



We now know that there is a relationship between temperature and the amount of carbon in the atmosphere. These two graphs show the correlation of CO<sub>2</sub> and temperature over the last millennium with projections for the next century. Recent ice core research has enabled scientists to determine historic CO<sub>2</sub> atmospheric levels as well as rates of increase and decrease, and these data have helped put a historical perspective on climate change. According to Dr. Mark Harmon of Oregon State University, we now can see that current carbon dioxide levels are higher than any time in the last 420,000 years and are increasing at an unprecedented rate.

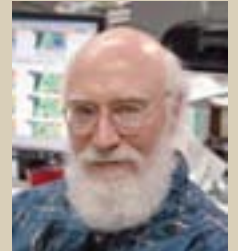


in the midst of human-induced warming. We're nearly as hot or hotter now than we were at the middle Holocene thermal maximum 5,000 to 6,000 years ago when the northern tree line was 90 miles north of where it is now, and Oregon will continue to warm at the same rate for the next hundred years."

## FORESTS AND CARBON

If forests sequester carbon, then at the most basic level, having more forest cover would be a positive force in lowering atmospheric carbon levels. So conversion of lands currently in other uses to forests through tree planting and stand establishment practices, reforestation quickly and aggressively after harvest or natural disturbance, keeping forestland in forest use and managing forests for fire resilience would all have obvious positive effects. Beyond that, recent research by forest scientists has confirmed that products made from trees continue to store the carbon.

Against this backdrop are some hard facts. To get a perspective on the state of the world's forests, the Food and Agriculture Organization of the United Nations estimates that each year we lose about 45 million acres of forestland worldwide – more than 1.5 times the total amount of forestland in Oregon. Nationally, according to the Pacific Forest Trust, we lose 4,000 acres of forestland every day to development. Clearly, this is a disturbing trend as it relates

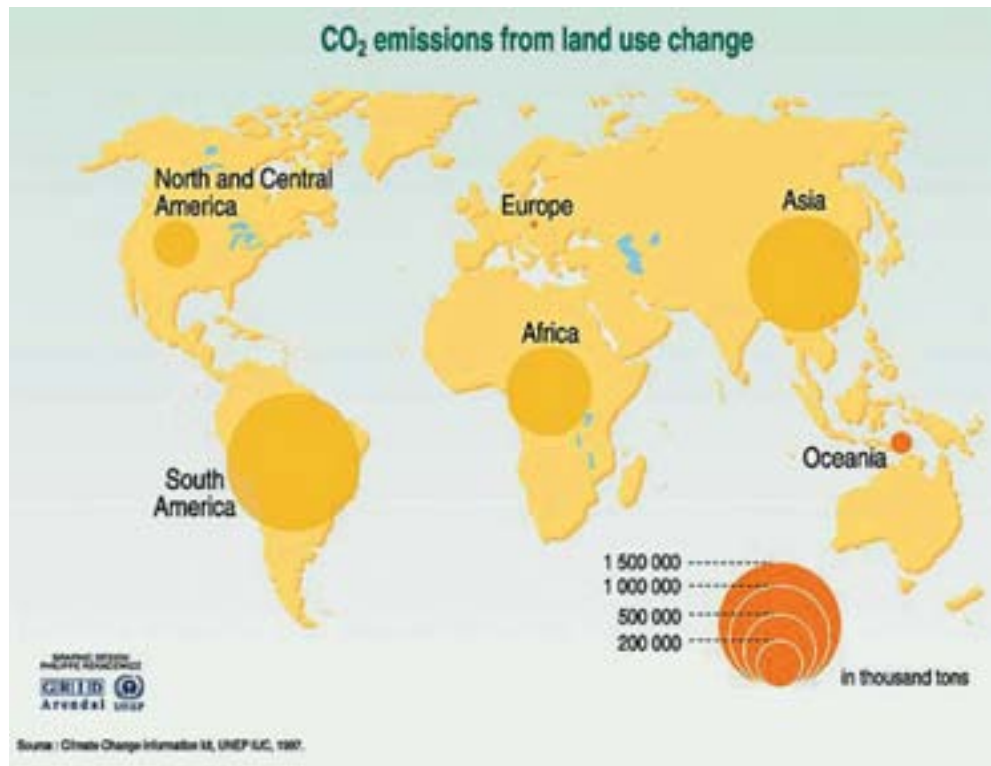


**Ron Neilson**  
 Bioclimatologist  
 Pacific Northwest  
 Research Station  
 U.S. Forest Service  
 Corvallis

**Ron Neilson, along with many of his colleagues in the scientific community, is absolutely convinced that global warming is a reality, and accounting for this future climate change will be an important part of forest stewardship in the coming years. "In nearly all forests," according to Neilson, "the trees will grow to a size where they use nearly all water available in the soil. In most projections, future climate change would both lengthen the growing seasons – thus creating a need for more water – and increase the demand for water during the hotter summers. This combination can reduce the 'carrying capacity' or amount of forest that can be supported by the available water. The drought-stressed trees will become weak and susceptible to insect attacks and disease." Neilson believes thinning in overstocked interior forests can better prepare them for the future, but what we have done to date is not sufficient.**

“Humans have the potential to influence fossil fuel release and change land use to enhance carbon sequestration. ... While the future range of atmospheric carbon dioxide is high, and the pattern of increase is strongly dependent on how quickly alternative energy sources are used, the overall outlook is one of increased carbon dioxide concentrations for the foreseeable future.”

*Forests, Carbon and Climate Change: A Synthesis of Science Findings*



Increases in atmospheric CO<sub>2</sub> levels are mainly a result of deforestation for agriculture and other non-forest development, including associated infrastructure like roads and power lines. For example, when large areas of rainforest are converted, grasslands have considerably less capacity to store carbon dioxide.

to carbon sequestration. However, due to Oregon’s land use laws during the past 30 years, significantly less loss of forests to non-forest uses has occurred here than in surrounding states.

### Opportunities in Oregon

For Oregon and the other west coast states that are rich in forest resources, the role forestry can play in reducing atmospheric carbon is of key interest. This is evidenced even on the policy front, where California, Oregon and Washington have stepped out ahead of the federal government in addressing the issue. Forests contain about 75 percent of the earth’s biomass, so in a state like Oregon, with close to half its land in forest, the potential for more carbon storage is among the highest in the world.

Forest scientists here and elsewhere have been studying the issue for some time. While there is, as might be expected, some complexity and contradiction, there are forest management techniques that can help in sequestering carbon or reducing its emission into the atmosphere:

- reducing forest densities to keep trees healthy and minimize fire risk and insect problems (for example, the 2003 B&B Complex fire near Sisters emitted six times more carbon into the atmosphere than all other emission sources that year combined);

- reforesting quickly and aggressively after harvest or natural disturbance;
- keeping forestland in forest use (including finding ways to help private forest landowners compete more favorably with development);
- afforesting former forestlands that have been converted to non-forest uses;
- using wood products and energy generated from wood in lieu of using fossil fuel-intensive products such as steel and concrete and energy generated from fossil fuels; and
- changing forest management strategies to enhancing carbon sequestration through thinning, increasing the time between planting and harvesting (rotations) and other techniques.

Recent research points to heightened fire risk due to the unhealthy state of many drier Western forests, such as those in southern, central and eastern Oregon. A century of fire suppression, coupled in some areas with harvest practices that now are outdated, has left them overstocked and in a weakened state because vegetation and tree species that would normally have been controlled by natural periodic fires have moved into these forests to compete for precious water and nutrients with the native species like pine. Needed thinning and controlled burns are not occurring, either because of policy and other challenges to active management on federal lands or the lack of economic incentive, since some of the thinnings have no merchantable value. Many of Oregon's older forests and federal lands being managed for older forest habitats are presently heavily fuel-laden and at high risk of fire. Indeed, more acres of old forests were changed to shrubs and young forest as a result of wildfire in the past decade than by harvest. Oregon's drier old forests will be at even higher future risk as temperatures warm.

Each harvest creates what Mark Harmon calls a pulse in the carbon picture, temporarily diminishing forest carbon storage before increasing it. Furthermore, while removing a tree eliminates its ability to sequester carbon, the loss isn't total if the wood is made into a product like furniture, paper, plywood or home framing timber, in which case it retains its ability to store some of its carbon.

Reforesting quickly after a disturbance, be it fire or harvest, will obviously shorten the time until the new forest is again increasing its carbon storage. Reforestation after harvest has been required by the Oregon Forest Practices Act for some time. As for species diversity, many landowners try to create a natural species mix when reforesting, which not only improves adaptability to a changing climate, but also provides better wildlife habitat.

But there are associated problems with some of these strategies. For one thing, the inevitable warming that will take place in the coming decades will stress



**Jeffrey Kline**  
 Research Forester  
 Pacific Northwest  
 Research Station  
 U.S. Forest Service  
 Corvallis

**The loss of forestland to development is certainly a worry to many Oregonians, as population projections have the state's population growing as much as 53 percent by 2040. Jeffrey Kline is part of a team examining how best to plan for this population growth while preserving as many acres as possible in forestland. "As the general population becomes more affluent," said Kline, "people begin looking for bigger home sites, second homes and places to live farther from other population centers. This can be damaging from a carbon standpoint on many levels. Parcelization into smaller lots decreases the chances a forest will be managed in ways that promote fast tree growth. Fewer trees typically will be present after home construction, and more fossil fuels are burned as people travel to and from more remote properties."**

"Forests play a major role in the global carbon cycle by storing carbon in live plant biomass, dead plant material and soils. The amount stored represents the balance between absorbing CO<sub>2</sub> from the atmosphere and releasing carbon through respiration, decomposition and burning. While projections of the roles of forests in carbon exchange with the atmosphere are uncertain, there is a solid body of knowledge that demonstrates how forest harvest, re-generation and growth control the carbon balance on forest lands."

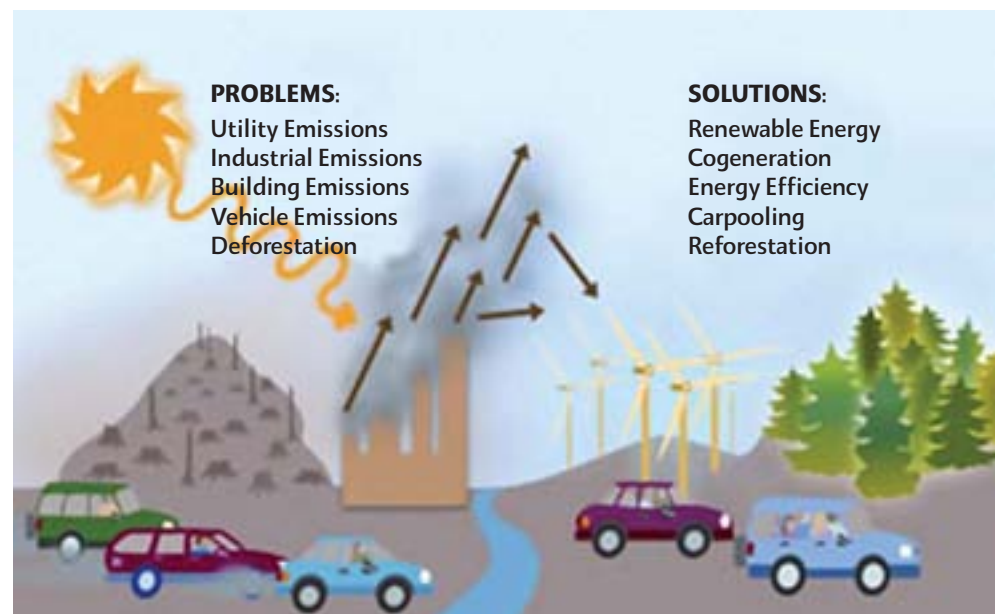
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trees through drought and other means, making them more vulnerable not only to fire, but to insect infestation and disease as well. As an example, Forest Service bioclimatologist Ronald Neilson points to nearby British Columbia, where mountain pine beetles are devastating weak, dry forests. A longer growing season means earlier green-up, but then the soils dry out before the end of the growing season, causing drought stress and reducing the resistance of trees to the bugs. In addition, the beetles that are usually stopped by winter cold survive the winter and can now multiply in number and complete their life cycle in one growing season instead of the usual two.

### **The Potential of Biomass**

Many see the recent interest in biomass-fueled electric power plants and biofuels as creating a use for the residuals of thinning, and biomass itself is a positive force in reducing atmospheric carbon dioxide. The burning of wood, of course, does release carbon into the atmosphere, but no more than was taken from the atmosphere by plants in the first place. In a biomass plant, wood is burned in the cleanest way possible and, more importantly, the biomass energy created offsets the need to use fossil fuel to create that energy.

In addition, the technology has existed for years for cogeneration, where mill waste is used as fuel to generate electricity and to produce heat for drying lumber. The use of biomass from mill waste and forest thinnings for cogeneration is increasing due to the rising costs of fossil fuels and energy. Biomass also has the



There are solutions to human-caused increases in atmospheric CO<sub>2</sub> levels. Over the last decade or so, the concept of carbon credits has joined the array of solutions that offset carbon emissions. The theory behind organizations like Oregon's Climate Trust is that businesses and other entities that put carbon dioxide into the atmosphere can offset emissions by funding projects in any part of the world that sequester an equal amount of carbon.

potential to fuel integrated biorefineries that produce liquid fuels and high-value chemicals along with electricity. The Oregon Department of Forestry is joining the Oregon Department of Energy to lead Oregon toward removing the obstacles to using woody biomass for energy. And Weyerhaeuser Company is already studying integrating biorefining methods into its paper-making processes.

### **Wood as a Green Building Material**

In our quest to minimize the release of greenhouse gases into the atmosphere, we should not overlook the positive impact of wood as a green building material. Wood products can reduce atmospheric carbon dioxide by storing carbon, and wood can be substituted for fossil-fuel intensive products like concrete and steel in housing construction.

The Consortium for Research on Renewable Industrial Materials (CORRIM), formed in 1996 by 15 research institutions to measure and document the environmental performance of all wood products, conducted an experiment to assess the environmental impact of houses designed of various materials in both cold and warm climates – the cold climate house to compare wood- and steel-framed construction, and the warm climate house for wood- and concrete-framed comparisons. Taking into account numerous raw material and manufacturing criteria for wood, concrete and steel, wood was determined to be the material of choice for building “green.” A primary reason for this is that less fossil-fuel energy is used in the manufacture of wood products, so less carbon is released to the atmosphere.

In addition, building products made from wood represent important markets for private forest landowners, helping ensure that they can earn a return on their forest investment. This is probably the single most important factor in keeping forestland in forest use. So the utilization of wood products creates a double win as far as the atmosphere is concerned. Not only is wood the preferred green building material, its use encourages landowners to manage and keep forestlands in forest use.

## **EMERGING MARKETS FOR CARBON**

Because the amount of carbon in the atmosphere is a global phenomenon, it is true that added emissions in one place will not increase CO<sub>2</sub> buildup if somewhere in the world there is a counterbalancing reduction. This is the basic theory behind a whole market-based system of buying and selling carbon “offsets.” In 1997, Oregon became the first state in the nation to pass CO<sub>2</sub> regulations, requiring large power generators to offset part of their emissions by paying a



**Jim Wilson**  
Professor Emeritus  
College of Forestry  
Oregon State  
University  
Corvallis

**“Wood presents opportunities for reducing global warming by growing more trees, managing the forest, producing wood products that are used in long-term applications, using more wood to build houses rather than fossil-fuel intensive alternates like steel and concrete, and substituting the use of wood fuel for fossil fuels. This can be good for the environment and still be economical to do when considering the high price of fossil fuels, tax incentives and carbon credits. Policies and practices are needed to further promote the use of wood for this purpose.”**



**Mike Cloughesy**  
Director of Forestry  
Oregon Forest Resources  
Institute  
Portland

**“Nationwide, more than a million acres of forestland were converted to non-forest uses each year between 1992 and 1997, and forestlands remain the nation’s largest source of land for development. Oregon has retained most of its forest land base, which is about 49 percent of the state’s land area. However, Oregon’s population is expected to grow 53 percent by 2040, and this will inevitably lead to greater development pressure on our forests. When forest cover is permanently lost, sequestered carbon is released into the atmosphere. Helping ensure that private forest landowners can earn a return on their investment is probably the single most important factor in keeping forestland in forest use.”**



The Climate Trust is a non-profit group in Portland that uses a business-oriented approach to buy carbon offsets throughout the region. Although their projects span a large range of areas, carbon sequestration through reforestation and afforestation accounts for a significant portion of their activities. Alexia Kelly, research associate, and Matthew Tidwell, offset projects coordinator, are pictured here going over their model for an offset project – basically how many years the project will last, multiplied by how much carbon dioxide will be offset each year. A recent project, for example, provided funding and landowner incentives to reforest a riparian area in part of the Deschutes River Basin, and over a period of 50 years is expected to offset 234,000 metric tons of carbon dioxide.

fee to a qualified non-profit organization to fund or originate projects here or in other parts of the country or world that avoid, sequester or displace an equal or greater amount of carbon dioxide.

The Climate Trust was chartered in Oregon as such an organization in 1997, and since that time it has become one of the largest institutional buyers of offsets in the world. It has invested \$6.4 million into 14 diverse projects around the world, offsetting over 2.2 million metric tons of carbon dioxide. The Trust also serves businesses and individuals.

The carbon market concept is still in its infancy, but for Oregon and the enormous carbon storage capacity of its rich forest resources, there is certainly economic potential for forest landowners. For example, one of the Climate Trust-funded projects, the Deschutes River Basin Riparian Restoration, has planted trees to restore forest cover in riparian areas of the Deschutes River watershed. The project has the added benefit of diversifying wildlife habitat and improving water quality.

Another example of a carbon offset program is the Oregon Department of Forestry’s Forest Resource Trust, which is endowed with \$1.5 million by the Klamath Cogeneration Project to convert marginal agriculture, pasture and

brush land back to healthy, productive forestland by planting trees and controlling competing vegetation and animal damage. An advisory committee is evaluating potential statutory changes to make the program more practical for family landowners in order to increase their participation and enhance the program's carbon offset performance.

Ecotrust, an Oregon conservation organization, has recently put together a private equity forestland investment fund, Ecotrust Forests LLC, designed in part to take advantage of other revenue sources like conservation easements and carbon sequestration offsets in its business plan. Carbon sequestration offsets are payments by entities that put carbon dioxide into the atmosphere (e.g., those that burn fossil fuels) to those who offset the effect with resources that remove carbon from the atmosphere. According to Bettina von Hagen, Ecotrust vice president for forestry and natural capital fund, the venture will test the viability of "an ecosystem-based forest management approach that relies on longer rotations, thinnings and enrichment plantings to increase structural and functional diversity, while resulting in higher carbon storage." The hope is that taking advantage of carbon market opportunities will offset the income being delayed by extending rotation lengths.

## COMMITMENT AT THE POLICY LEVEL

In keeping with its tradition of policy innovation, Oregon has stepped out to lead in addressing carbon and global warming. One major effort, widely considered among the boldest in the country, is a tri-state (California, Oregon and Washington) initiative on climate change that commenced in 2003 shortly after Oregon Governor Ted Kulongoski took office. The West Coast Governors' Global Warming Initiative takes direct aim at reducing greenhouse gas emissions. The following year it issued a set of recommendations, among them the inception of a carbon allowance program that would permit new power plants and other sources of greenhouse gas emissions to purchase carbon offsets, thus funding biomass and other CO<sub>2</sub>-reduction efforts.

The following year Governor Kulongoski appointed a group of utility executives, farmers, local government officials and scientists – as well as members of the business, environmental and religious communities – to prepare a Global Warming Strategy for Oregon. Implicit in the group's mandate was acknowledgment that while worldwide CO<sub>2</sub> emissions per capita were about 4 metric tons per year, in Oregon that number was nearly 17 metric tons.

Among its recommendations for biological sequestration, three of the six proposed measures relate to forestry: reducing wildfire risk by creating a market



**Jim Cathcart**  
Forest Resource Trust  
Manager  
Oregon Department  
of Forestry  
Salem

**"Carbon accounting – which includes estimating, measuring, reporting and monitoring of CO<sub>2</sub> emission reductions – is critical to the sale, trade or registration of these emission reductions. Determining the amount of emission reduction benefit (i.e., carbon offset) from forest activities can appear at first to be nothing more than trying to sell 'thin air.' What needs to be recognized is that selling carbon offsets is no different from selling any other commodity accruing to the forest as a result of management action – and that is, if you can't measure it, you can't sell it."**



**Gail Achterman**

Director  
Institute for Natural  
Resources  
Oregon State  
University  
Corvallis

**“There is a growing recognition of the fundamental need for real, meaningful emission reductions and a realization that Oregon can capture economic opportunities by doing so. Fortunately, through all of the efforts at the legislative, administrative, local government, academic and citizen levels, Oregonians are grappling with what they can do to reduce greenhouse gas emissions and address the impacts of climate change. On a regional and national level, Oregon is assuming a leadership role in addressing the issue, with plans to stop the growth of greenhouse gases and even begin to reduce them by 2010.”**

for woody biomass from thinning overcrowded forests, considering greenhouse effects in farm and forest land use decisions, and increasing tree planting on under-producing lands. For greenhouse gases in the long view, the report calls for emission increases to stop and emission reductions to begin by 2010, achieving a 10 percent reduction by 2020, and a 75 percent reduction by 2050.

In 2006, the governor created a 33-member Renewable Energy Working Group to integrate the plan and guide the implementation of the Renewable Energy Action Plan. The governor also created a separate Forest Biomass Working Group to expand the market for biomass in Oregon and develop proposals for meeting the plan’s renewable energy goals.

## LOOKING TO THE FUTURE

Oregon has set out on a bold journey toward reducing carbon dioxide emissions with an ambitious goal of reaching a climate stabilization level by 2050. Given Oregon’s massive forest resources and its world-renowned forestry research complex, the forest sector clearly has the potential to play a major role in reaching that goal.

The carbon market concept, though still in its infancy, may well prove to have the ability to provide a revenue stream for forest landowners that is large enough to cover all the costs of maximizing carbon sequestration in their forests. Forestry does present certain unique challenges when it comes to carbon credits, such as whether such carbon storage is permanent. For example, if a landowner embarks on an afforestation project that burns in a catastrophic fire, some of the carbon that was sequestered in the trees is released back into the atmosphere. There are other such examples, but the sequestration ability of our forests is so large that organizations like the Climate Trust have been willing to fund forestry offset projects to see how they perform and to understand underlying risks – both natural and contractual.

Hal Salwasser, dean of the OSU College of Forestry, summed it up this way: “What we know so far is that forests are significant carbon pools, and they can be managed to be even more significant in the future. We know that managing forests for carbon storage, as well as for wood and other ecosystem services, has co-benefits that generally improve our quality of life. And we know that forests managed and conserved to sustain a multitude of values, uses, products and services also help maintain economic and community vitality in our state. The potential of our forests to help us reach our greenhouse gas reduction goals warrants serious policy consideration as Oregon explores its forest futures.”





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