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FOREST
TRENDS

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# GETTING IT RIGHT:

## EMERGING MARKETS FOR STORING CARBON IN FORESTS

Michael Totten

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TRENDS

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Photo by Marta Miranda, World Resources Institute

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# TABLE OF CONTENTS

## ABOUT FOREST TRENDS

Forest Trends is a coalition of individuals from private, public, and non-profit institutions brokering information and relationships to encourage strategic changes in the marketplace that will help sustain forest ecosystems.

The mission of Forest Trends is to maintain and restore forest ecosystems by promoting incentives that diversify trade in the forest sector, moving beyond exclusive focus on lumber and fiber, to a broader range of products and services.

Forest Trends seeks to accelerate the evolution of economic systems in which:

- Commerce sustains forest ecosystem services (i.e., watershed protection, biodiversity)
- Companies that manage forest ecosystems in a sustainable fashion receive market recognition, and
- An equitable share of the benefits generated from forest-based commerce is returned to local communities.

To achieve these objectives, Forest Trends advocates:

- Forest management practices that significantly reduce negative environmental and social impacts and that can be independently verified by third parties.
- Markets for ecosystem services (e.g., water services, biodiversity, ecotourism, carbon storage) that require the maintenance or restoration of natural forest ecosystems.
- Value chain efficiencies that realize the full value of resources harvested, from the forest floor to the living room floor, that come from sustainably managed forests.
- Alternatives to virgin wood fiber from natural forests (e.g., through better management of secondary forests, restoration of degraded forests, greater reliance on fiber farms, agricultural wastes, and post-consumer recycling), and the reduction of overall consumption without any loss in the quality of products or services.

For more information about Forest Trends, please visit our website: **http://www.forest-trends.org**.



## ABOUT WORLD RESOURCES INSTITUTE

World Resources Institute is an independent center for knowledge on global environmental and development issues.

WRI's mission is to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. WRI provides objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development. We build bridges between ideas and action, meshing the insights of scientific research, economic and institutional analyses, and practical experience with the need for open and participatory decision-making.

WRI's program promotes people's livelihood, health, and well-being as the primary goal of environmental protection. We focus our activities around four themes:

Biological resource stewardship. Biological resources provide the flow of goods and services that sustain human life. Stewardship of these resources by careful management, use, and restoration underlies every strategy for achieving economic, social and environmental sustainability. WRI's work focuses on halting the degradation of biological resources, particularly in forests and agriculture, and enhancing their contribution to economic development.

Climate protection. Climate change is a global problem that, if unaddressed, could undermine progress on every aspect of human development and ecosystem protection. WRI's work seeks to prevent human-caused climate change by promoting cooperation among businesses and nations, rich and poor, in implementing international agreements, fostering economic opportunity, and developing cleaner energy sources and technology.

Development paths. Much of our economic growth today is environmentally unsustainable. Intensive use of agrochemicals threatens agricultural production; changing land use degrades hydrological systems; and fossil fuel consumption jeopardizes human health and contributes to climate change. WRI works with a worldwide network of partner organizations to help promote development policies that reduce poverty, improve livelihoods, and protect the environment.

Sustainable enterprise. Businesses and financial markets have the power to reduce the intensive use of materials, to detoxify commerce, to redress damage from the use and disposal of products, and to restore economic opportunity to the disenfranchised. WRI fosters sustainable enterprises by helping to provide the management strategies and incentives that will enable firms to build future profitability around environmentally friendly products and processes.

For current information about WRI staff, programs, contributors, and financial statements, visit our website at **http://www.wri.org**.

## ACKNOWLEDGEMENTS

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**Getting It Right: Emerging Markets For Storing Carbon in Forests** is part of initial research mounted by Forest Trends, in conjunction with the World Resources Institute. We have tried, in the pages that follow, to set out the potential for businesses and the environmental community to find common solutions that use forests to mitigate the climate-warming dangers of greenhouse gases. While there are a number of outstanding issues that still need to be resolved around measurement, time frames, methodologies, and verification, the momentum to create a market for forests as sinks of carbon emissions is clearly accelerating. Recent serious interest from major insurance companies is a strong signal of this momentum.

The Kyoto Protoco—the global agreement on emissions reductions—is the political backdrop of this issue. While ratification of this agreement by the United States remains a significant question, it is certain that some sort of instrument for regulating emissions will be adopted. Companies are going to have to pay close attention to their carbon emission levels—from creation to disposal—and will need to redefine their corporate activities accordingly.

The opportunity for all stakeholders, including business, is to engage the political process to make sure the rules are set right and operationalized. With the "right rules" there can be a clear co-benefit for climate mitigation, efficient commerce, and forest conservation. We at Forest Trends are dedicated to seeing the successful articulation of a carbon market that further recognizes the many values of standing forests.

**Michael Jenkins**

*Executive Director*
Forest Trends

OVERVIEW

## A CHANGING CLIMATE IS CHANGING MARKET OPPORTUNITIES

A scientific consensus that rising levels of greenhouse gas emissions are changing the world's climate has triggered wide-ranging reactions in the marketplace and in international politics. In hurricane zones and areas affected by El Niño risks from abnormal weather are rising, and insurance companies are raising their rates. Increasing numbers of Fortune 500 companies are adopting emission reduction plans. The Kyoto Protocol on Climate Change is working to create a regulated market for some 1 billion tons a year in carbon reductions, and corporations and national governments are building emissions trading systems to take advantage of that market.

GHG emissions rapidly disperse into the planet's atmosphere, unlike smog pollutants, which tend to hover over local airsheds (e.g., Los Angeles, Bangkok, Mexico City). Two implications follow from this: it does not matter where emissions are reduced on the planet, any reduction anywhere is equally valuable; and if it is cheaper to reduce emissions somewhere else in the world, seek out this least-cost option. These insights, along with the huge successes achieved in sulfur, lead, and CFC trading to comply with stringent regulations, have been the driving force behind the concept of international emission trading. This concept was also included in the Kyoto Protocol and pending U.S. legislation on credit for early action.

A significant market is emerging in ways to reduce greenhouse emissions—or store carbon to offset them. By acting now, your company may be able to reduce its risk exposure, hedge against future risks, prevent future costs, capture cost savings, and even develop new revenue streams. Furthermore, by being an early mover on this issue, your company can turn disadvantages into a competitive advantage by helping to shape the value chain as markets and policies continue to evolve. In a changing world market the best defense remains an intelligent offense. Applying current and emerging market opportunities could significantly enhance your company's strategic and tactical ability to compete in a carbon-constrained business environment.

Getting It Right is designed to explain why and how companies should engage in this issue, looking specifically at the importance of forests in this new market. Forests offer one of the most cost-effective opportunities for storing or sequestering carbon. This report is directly relevant to companies in any industry—not just forest products. Indeed, there are clear co-benefits to be gained from companies interested in carbon offsets, and forestland managers and conservationists in temperate and tropical settings in need of financial support.

This report is also an introduction to **Forest Trends**, a new organization that can help you with the tools your company will need to move forward.

There are several questions you should ask yourself about the business opportunities of climate change. This report will address them:

- What evidence is there that there is a major market transformation underway?
- What assurances do I have that this is a long-term market, not a passing trend?
- Where are the best business opportunities?
- What options does my company have to capture these opportunities?
- Where are the risks from this strategy, and can we effectively manage them?
- What should be our next steps?

### HIGHLIGHTS AND FINDINGS

Human activity has resulted in the release of more than one-third of a trillion tons of carbon emissions over the past century, and "business-as-usual" economic activity over the next 50 years could witness the release of a further 1 trillion tons. It is this trend that is driving climate change, the threat of enormous economic losses, and the reactions from markets and governments.

Markets are responding to the risks and costs arising from the increased frequency and severity of weather related incidents: scores of cities and corporations are adopting substantial emission reduction targets, and a rising tide of individual and institutional consumers are purchasing climate-friendly "green" power and fuels. Carbon shadow pricing is driving a trend toward power plants that use lower-carbon fuels. A growing number of companies buying and selling carbon offsets, and governments—such as Costa Rica, and the Australian state of New South Wales—are establishing marketable emissions trading regimes. Private firms, including BP Amoco and Shell, are setting up internal emission trading systems.

Governments are taking action in state, national and international arenas: 84 countries have become signatories to the Kyoto Protocol, and several countries have implemented hefty carbon taxes. Already, Denmark is establishing an emissions cap and implementing a trading system. Some U.S. states, such as Oregon, are establishing power plant siting criteria that favor low-carbon fuels, and legislation is pending in the U.S. Congress to encourage corporations to take early action to reduce their carbon emissions.

Forestlands offer a cost-effective option for offsetting carbon emissions. Carbon can be stored by preserving and protecting frontier forests, buying back logging concessions, using reduced-impact logging methods and managing forests sustainably, bringing degraded lands into plantation production, planting trees on pasturelands, agro-forestry on farms, and using fast-growing tree species for bioenergy to displace the use of fossil fuels.

The Kyoto Protocol encourages some use of forests, including reforestation and afforestation, and forthcoming clarification of the Protocol's language regarding land-use changes and forests may greatly expand these options (e.g., preservation).

There are several ways to gain climate benefits and potential profits from forest carbon: preserving and protecting the massive carbon repositories in existing forests—especially primary rain, ancient, and old-growth forests; practicing improved low-impact logging or sustainable forest management; and reclaiming degraded lands with fast-growing tree species.

Each class of forest carbon storage offers a different level and timing of carbon benefits, with different costs and risks. Old-growth or frontier forests, for example, offer large up-front carbon offset opportunities because of the immense amount of carbon they store in the soil and in above- and below-ground vegetation. In contrast, fast growing tree species planted on degraded lands start out with low storage levels, but steadily sequester carbon, so that several decades or a century out, carbon benefits accrue to a significant level.

Carbon-intensive businesses in transition to less-intensive technologies, but in need of large near-term carbon offsets during their transition periods, will find greater value in forest preservation projects that offer immediate benefits. Alternatively, companies looking to offset future carbon emissions can turn to options such as forest plantations, which will provide increasing offsets over several decades to a century.

# DEFINING THE MARKET

## CLIMATE CHANGE

Global, regional and local markets are changing for those industries that emit greenhouse gases.[1] The markets, not just governments, are reacting to a continuous stream of events related to the world's changing climate. Among scientists and economists there is a consensus that deep reductions in global emissions will have to occur to prevent extraordinary economic losses from climate change.[2]

Markets in transformation raise uncertainty, posing new risks and new opportunities for companies. The threat of loss is especially acute for the several thousand companies whose commercial livelihoods center on trading or using carbon-intensive resources. At the same time, value is being created and presents the promise of gains for those companies that are better prepared, strategically and tactically, than others.

The emerging market for climate-friendly products and services is being driven by a mix of rising consumer demand, increasing government regulations, and a growing list of corporate commitments and product offerings that raise standards for their competitors. The 1997 Kyoto Protocol, when ratified, will institute national greenhouse gas emission caps.

In a changing world market, the best defense remains an alert awareness of how change presents possibilities for better strategic positioning and for garnering new competitive advantages. This means becoming actively engaged where opportunities exist. That is what this report is about. It will assist you in the intelligence gathering process critical to identifying investment opportunities and low-cost, low-risk hedging strategies; managing risk; building brand recognition; retaining customers, and capturing new markets in a climate-changing world. More specifically, this report focuses on one of the most promising, but under-explored options—the carbon forest market.

The global economy is transforming the world's climate, and the world's economy is, in turn, being transformed by climate change. Human activity has resulted in the release of more than one-third of a trillion tons of carbon into the atmosphere over the past century, and "business-as-usual" economic activity over the next 50 years could witness the release of another 1 trillion tons.[3] [4]

The release of such vast quantities of greenhouse gases (GHGs), which remain resident in the atmosphere for a century, considerably increases the risks of more frequent and more severe climate- and weather-related episodes.[4]

**1** The major greenhouse gases released by human activity include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O_2$) and chlorofluorcarbons (CFCs).

**2** The Intergovernmental Panel on Climate Change (IPCC), a scientific body set up to provide assessments to policymakers on the results of ongoing climate change research, project a need to cut emissions 60 to 80 percent below 1990 global levels to stabilize atmospheric GHG emissions at a safe level. More than 2,400 scientists and 2,600 economists, including 8 Nobel Prize winners, signed statements supporting the IPCC's 1995 report. [52, 12]

**3** Metric ton units in this report refer to carbon. For comparison, 1 ton of carbon (C) equals 3.67 tons of carbon dioxide ($CO_2$), or alternatively, 1 ton of $CO_2$ equals 0.27 tons of carbon.

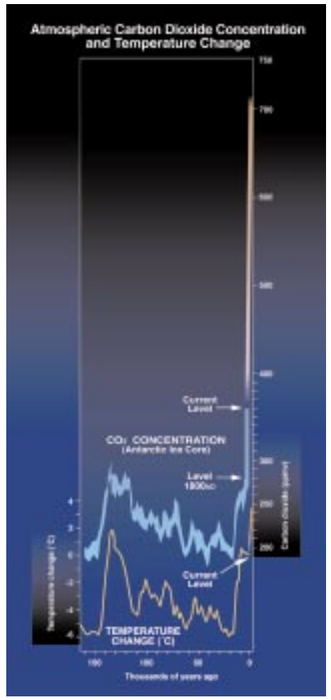
**4** According to the IPCC reports, climate change will include increased frequency and severity of storms, hurricanes, avalanches, droughts, wildfires, floods, heat waves, species and habitat loss, outbreaks of pests, pathogens and diseases, and other threats to human health. [24, 26]



**5** Technically, there are many possibilities. Other possible options, for example, are de-carbonization of fossil fuels to produce hydrogen, with the $CO_2$ waste stream sequestered by injection underground for enhanced methane recovery, or in the ocean [70], or soil carbon buildup through implementation of sustainable agriculture practices.

There are two fundamental ways to reduce or offset carbon emissions: displace the use of fossil fuels and reverse the loss of forests.[5] The portfolio of options to achieve this (e.g., energy efficiency, renewable resources, forest preservation, reforestation, and sustainable forest management) reflect a wide variation in availability, costs, and risks, as well as levels and timing of opportunities.

Energy efficiency investments, for example, have a stellar quarter century record that, in the United States alone, has accrued several hundred billion dollars per year in monetary savings while displacing the need for the equivalent of 16 million barrels of oil per day. While mainly done to reduce vulnerabilities to oil imports and high energy costs, the improvements also captured valuable environmental benefits by cutting acid rain, smog, and greenhouse gases by more than a third. In spite of these tremendous gains, a very sizable pool of energy efficiency investments remains one of the most cost-effective options for achieving significant carbon reductions in industrialized and developing countries alike. [2]




http://www.whitehouse.gov/Initiatives/Climate/Figure10.gif

## STORING CARBON IN FORESTS

Another sizable pool of low-cost carbon offset opportunities is available in preserving, conserving, expanding, and sustainably managing the world's forests. One of the great virtues of carbon storage and sequestration is that $CO_2$ is perfectly fungible: atmospheric carbon generated in, say, Illinois can perfectly well be "offset" anywhere in the world. And forests are one of the best "sinks" for storing that carbon.

Preserving, conserving, expanding, and sustainably managing the world's forests can improve bottom lines and provide a bonus of secondary benefits, including reducing flooding and improving urban water supplies by protecting watersheds, maintaining biodiversity, and improving soil fertility and wood supplies. [18]

Forest carbon storage and sequestration offer companies opportunities that can provide additional revenue streams in their business equations. For companies with carbon-intensive operations, forest investments represent low-risk, low-cost options to include in their portfolios as a hedge against a carbon-constrained business environment. The experience of the past several decades strongly points to the forest sector

## WHAT ARE CARBON SINKS, SOURCES AND FLUXES?

Global carbon is stored in many different stocks, including oceans, the atmosphere, soils, plants, rocks, and fossil fuels (coal, oil, and natural gas). A stock that is absorbing carbon is called a "sink" and a stock that is releasing carbon is known as a "source." Carbon "fluxes" represent the flow over time from one stock to another, such as fossil fuel combustion releasing carbon to the atmospheric stock, or plant photosynthetic growth absorbing atmospheric carbon into the terrestrial stock. [7]

Forest carbon stocks vary tremendously, depending on latitude, climate, ecosystem (e.g., tropical, temperate, or boreal), species mix, and soil regime. For example, a 450-year old temperate natural Douglas Fir-Hemlock forest in Canada has more than 600 tons of carbon per hectare (tC/ha), whereas an all-year tropical moist primary forest in Brazil may have 300 tC/ha, and a tropical seasonal forest in Africa or an industrial poplar plantation in Europe may have 140 tC/ha. [6,22]

Humans annually release 7 to 8 billion tons of carbon (gigatons, or GtC) of global greenhouse gas emissions — 6 GtC from combusting fossil fuels and another 1 to 2 GtC from burning forests, land clearing, and soil erosion. Of this amount, the oceans absorb about 2 GtC and plant growth absorbs another 1.5 to 2.5 GtC. As a result, about 3.5 GtC are added to the atmosphere each year.

as among the least cost—and immediately available—options for offsetting carbon emissions. Companies in both sectors can get a jump on what many experts see as a major market mechanism for compensating for $CO_2$ emissions by developing a state-of-the-art understanding about this emerging forest carbon market, and actively engaging in project development.

Project involvement offers win-win outcomes for both industries. For carbon-intensive businesses, this hedging strategy lowers financial exposure to future policy costs, represents low-cost research and development experience, and can give these businesses an informed seat at the table in the debate over emissions trading as a cost-effective method of greenhouse gas mitigation superior to, say, taxes.

For sustainable forest enterprises, providing a carbon offset outsourcing service is a direct byproduct of standard operations. Marketing this byproduct helps to position these firms as responsible managers of healthy forests. They can also reap healthy investment returns, accrue an additional stream of revenues from offset services, and garner public recognition for their efforts. [58] The figure below shows such a win-win business arrangement.

Standard forestry investment funds have typically achieved annualized returns in excess of 14 percent over the last decade—well above returns on the S&P 500 index for the same period. They also experience lower volatility than stock markets, with solid long-term returns.



Sustainable forestry offers even better investment opportunities:

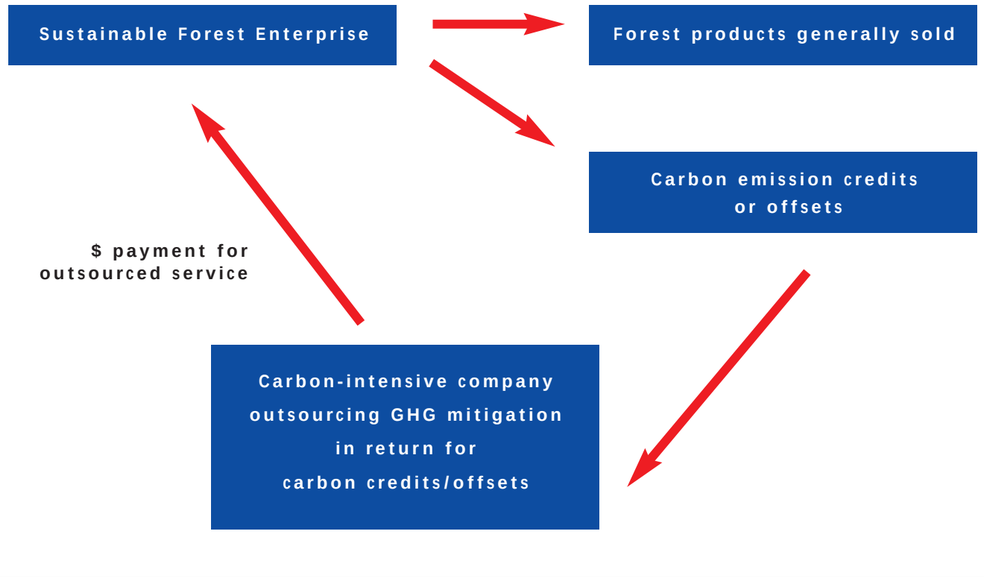
- Many forests are poorly managed. Sustainable management and harvesting can improve financial returns by raising efficiency.
- Capturing undervalued forest assets. As world business and consumers move to environmentally sensitive sources, sustainably managed forests will offer a range of certified products and services.

It is anticipated that the global trade in carbon emissions and reductions driven by national and global emission policy shifts such as the Kyoto Protocol will amount to tens of billions of dollars by 2010. Carbon trading may very well become one of the major industries of the 21st Century. Estimates based on the size of the potential carbon trade in North America and Europe indicate that it could be worth $30 to $100 billion when fully operational. [14]

The market clearing price with full carbon trading in the United States could go to $30 to $40 per ton, and to as high as $70 to $80 per ton in the European and Japanese markets. [74]

Opportunities abound for companies to use their investments and marketing positions to influence this enormous carbon market.

### CARBON TRADING WINNERS




Source: modified from [58]

## MARKETPLACE DEVELOPMENTS

A growing number of national, state, and local governments, corporations, non-governmental organizations (NGOs), and consumers are convinced that preventing or reducing greenhouse gas emissions is preferable to waiting and reacting to a stream of costly weather events whose increasing frequency and severity have already led insurance companies to increase rates and decrease coverage in risk-prone areas. [21]. The climate-friendly actions they are taking include:

**Policy Commitments** Cities for Climate Protection is an international campaign involving 150 cities whose combined $CO_2$ output represents 5 to 10 percent of the world's total greenhouse gases. Participating cities pledge to develop local action plans to reduce emissions of toxic pollutants—with special emphasis on $CO_2$—under the "Municipal Leaders' Declaration of Climate Change and the Urban Environment."

**Corporate Commitments** Hundreds of companies are committing themselves to limit, reduce or offset their carbon emissions. The global independent power producer AES, has been in the forefront for a decade with voluntary forest offset projects that offset the carbon emissions of a number of its power plants. Most notable, as of early 1999, were the pledges by several of the world's largest petrochemical companies—BP Amoco, Dupont, and Shell International—to cut their emissions 10 percent below 1990 levels. Interface, one of the world's largest petrochemical-based carpet and flooring companies, went further by announcing a commitment to zero carbon emissions.[6]

**Green Fuels** Consumers are purchasing climate-neutral gasoline from UK-based Tesco gas stations at a premium price, with the carbon emissions offset through a forest preservation and planting program; consumers can participate in a similar program known as Green Fleet in Australia.

**Actual Market Prices** Some economists estimate that business is already imputing a shadow price value of $17 per ton of carbon by revealing their preference for less carbon-intensive energy sources, such as natural gas, in new power plant projects. [32]

**State Regulations** Responding to the environmental implications of a more competitive power market, some U.S. states, such as Oregon, are mandating carbon offsets for new fossil-fuel generating facilities, providing a competitive edge for less carbon-intensive generating options.

**Carbon Taxes** Italy, Norway, and Sweden are imposing emission taxes, some equivalent to more than $50 per ton of carbon.

**Tax Shifts** Spain, Denmark, and Sweden recently have combined cuts in payroll or income taxes with increases in carbon-intensive energy taxes. More broadly, over the past decade a number of European countries have placed increasing emphasis on "environmental" or "green" taxes. Scandinavian countries have been in the lead, but it is also noticeable in Austria, Belgium, France, Germany, the Netherlands, and the United Kingdom. Energy taxes rank among the highest green taxes (5.2 percent for the European Union on average) and up to around 10 percent in Portugal and Greece and 6 to 7 percent for Italy and the UK. [15]

**Green Power Consumer Purchases** As utility restructuring and deregulation opens electricity markets, a growing tide of consumers is showing a willingness to pay a premium for climate-friendly power. Even in states where green power is yet to be offered, state regulators adopting restructuring plans have included information disclosure on utility bills as a key part of creating meaningful customer choice. [35, 36]

### CUSTOMERS SWITCHING TO CARBON-FREE GREEN POWER

California stands in the forefront of green power purchasing. By early 1999, nearly 100,000 residential customers had switched to green power, paying a premium of one cent per kilowatt-hour (kwh). Some high-profile nonresidential customers, including businesses, churches, and municipalities, have also chosen to use green power. In May 1998, Toyota Motor Sales USA became the first large business customer to commit to green power when it announced its intent to purchase 12 megawatts to serve four of its California facilities. And in July, Patagonia became California's first business customer to commit to purchase 100 percent of its electricity needs, or about 1 million kwh per year, from newly installed wind turbines.

Santa Monica became the first city to switch all of its municipal facilities to 100 percent green power when city staff signed a one-year contract to purchase 5 megawatts of geothermal power at a 5 percent premium. And last fall, the California Episcopal Diocese adopted a resolution instructing the state's 87 churches to buy renewable power. So far, seven Bay Area Episcopal churches have voted to switch to green power. [68]

## AHEAD OF THE CURVE: EARLY ADAPTERS PIONEER A NEW MARKET

Forest owners and $CO_2$-emitting firms—mostly utility companies—in several countries are pioneering the carbon offset market. Much of this is being driven by national laws and international treaties that presage worldwide enforcement of greenhouse gas emission limits. By March 1999, one year after the Kyoto Protocol was officially opened for signature, 84 nations had signed the legally binding agreement, committing them, upon ratification, to an average of 5.2 percent reductions in greenhouse gas emissions below 1990 levels over 2008 to 20012. The binding commitments for industrialized nations will result in a collective reduction of roughly 1 billion tons of carbon per year by 2012. In 1999, Denmark took the lead in establishing a national carbon emissions

[6] Recently, a major sector, the electronics industry, publicly positioned itself as comprised of companies producing goods and services that are climate-friendly and provide cost-effective climate protection. [23]

PIONEERS

cap and trading system, even prior to ratification of the Kyoto Protocol. Legislation has been introduced in the U.S. Congress to encourage businesses to initiate carbon-reducing and offset activities by giving them credit for voluntary early actions.

In 1997 Costa Rica became the first country in the world to turn its forests into marketable carbon sinks by issuing "Certified Tradable Offsets" (CTOs), based on a forest carbon sequestration program with performance guarantees, carbon reserve pools, and third party certification.

In June 1998 the New South Wales state government signed Australia's first carbon credit trades as part of a program to offset carbon emissions. The NSW government is intent on creating a new industry and jobs around "greenpower." The NSW State Forests, working with Bankers Trust and the NSW Treasury, has developed a carbon forestry investment memorandum that will be marketed worldwide. It provides for a joint carbon-forestry investment product that provides an 8 to 10 percent rate of return, but with an upside being the carbon credits generated in the new sinks. A different model is being developed by Canada's Ontario Province, which is operating a Pilot Emission Reduction Trading Project. [34,45]

The World Bank is launching a Prototype Carbon Fund to finance developing country projects that reduce or sequester GHG emissions. The projects and upward of $150 million of funding will be additional to the Bank's regular lending activities. [73]

A number of utility consortia—E7, Gemco, Utilitree—have pursued carbon emission offsets through forest projects. One of the first, the Dutch Electricity Generating Board, a consortium of four Dutch electricity companies, has operated the FACE (Forests Absorbing $CO_2$ Emissions) Foundation since the early 1990s, in anticipation of environmental legislation. With a $180 million multi-year budget, FACE has established a portfolio of forestry projects around the world to accrue carbon offsets equivalent to the emissions from fossil-fuel power plants to be sited in the Netherlands. [16]

Carbon trading markets are also being established in the United States and Europe. In 1998, the International Petroleum Exchange, Europe's leading energy futures and options exchange and the second largest in the world, proposed establishment of a market in trading $CO_2$ emissions in the European Union. The proposal is currently pending. In the United States, financial service firms that earlier pioneered emissions trading in sulfur, lead, and ozone, such as Environmental Financial Products and Cantor Fitzgerald, have established carbon trading options. [51, 9]

Environmental trading systems are based on the creation of property rights that can then be bought and sold. For example, the Clean Air Act enacted by the U.S. Congress established the sulfur dioxide trading system based on "emissions allowances"—permission granted by the U.S. Environmental Protection Agency for electric utilities and other companies to emit sulfur dioxide into the atmosphere. A national cap on sulfur dioxide emissions was enacted, and then 110 of the dirtiest coal-burning units nationwide were allocated emission allowances. This created an open national market to buy and sell emission allowances. In effect, a utility with a high cost of compliance to clean up its dirty plants could, instead, pay another utility with lower compliance costs to cut its emissions below the required level.



An EPA fine for excessive sulfur dioxide emissions totals around $2,000 per ton. But the market price for tradable emission allowances, which started out in the $400 range, continues to drop. "The marginal cost of cleaning up $SO_2$ emissions is now 3 to 4 percent of the level of fines," says Richard Sandor, who helped set up the Chicago Board of Trade emissions market.

## THE RISKS OF INACTION

Carbon-intensive firms that wait passively to see how these trends mature may find themselves behind, rather than ahead of the curve. This can prove very risky. A 1996 report on utility restructuring noted that the electric power industry is entering its second century,

"in the grip of unprecedented competitive pressures. Power plants that have been shielded by regulation from many financial risks soon will have to survive on their own merits in an unforgiving marketplace. Financial analysts produce numerous assessments of generators' prospects for success, illuminating every element of owners' fixed and variable cost profiles and their access to both retail and wholesale markets. But almost without exception, analysts and indices continue to overlook variations in generators' exposure to significant financial risks associated with future environmental regulation." [41]

Some U.S. power plants, for example, emit more than 25 times as much carbon dioxide per dollar of operating revenue as other plants.[7] In a more competitive power market these higher exposure ratios create higher-risk enterprises that face many times the financial vulnerability to carbon dioxide regulations.

Electric utilities are not alone in their exposure to risks associated with future environmental regulation and green energy market demand. Similar issues will arise in many transportation and heavy industrial sectors dependent on carbon-intensive use of resources. A path-breaking 1994 financial analysis by the Delphi Group puts this risk clearly into focus. Simply stated, the risk to the equity price of $CO_2$-emitting companies is inadequately discounted given anticipated emission policy shifts that will create a carbon-constrained business environment. As a result, these portfolios are currently overvalued by financial markets. [33]

The timing of these policy shifts is not now clear, and will vary as local, national, regional, and global regulations come into effect. The ramifications, however, are clear: within a very few years fund managers will need to pursue low-risk options as a means of hedging their exposure to carbon-intensive companies. [33, 58]

Thus, for an increasing number of businesses, due diligence suggests it is time to become much more familiar with the pool of available carbon-reducing and carbon offset opportunities, and to determine which of these options constitute low-cost, low-risk hedging strategies.

**7 This is known as their carbon exposure ratio.**

# DRIVING THE MARKET

## THE KYOTO CLIMATE TREATY

The real surge in carbon offset and GHG reduction trading will occur when the Kyoto Protocol enters into force. By March 1999, one year after the Protocol was officially opened for signature, 84 countries had signed the legally binding agreement. The treaty enters into force when 55 of these signatories, representing 55 percent of global greenhouse gas emissions, have subsequently ratified it.

Ratifying the treaty effectively amounts to establishing a regulated market in GHG emissions. The legally binding reduction commitments for industrialized nations amount to a 30 percent reduction from their anticipated growth in GHG emission levels over the next decade. These Quantified Emission Limitation and Reduction Commitments known as QELRCs are equivalent to an average reduction of 5 percent below 1990 levels.

### KYOTO PROTOCOL IMPLEMENTATION MECHANISMS

The Kyoto Protocol provides three **cooperative implementation mechanisms** that industrialized countries can use to supplement domestic actions for fulfilling their legally binding commitments to reduce GHG emissions:

**Joint Implementation (JI)** is a project-based approach that enables one industrialized country financing a GHG-reducing project in another industrialized country to receive "emissions reduction units" (ERUs) representing the emissions not generated by the second country **(Article 6 of the Agreement)**.

**Clean Development Mechanism (CDM)** allows industrialized countries to accrue "certified emission reduction units" (CERs) in return for financing carbon reduction project activities in developing countries that help further their sustainable development **(Article 12)**.

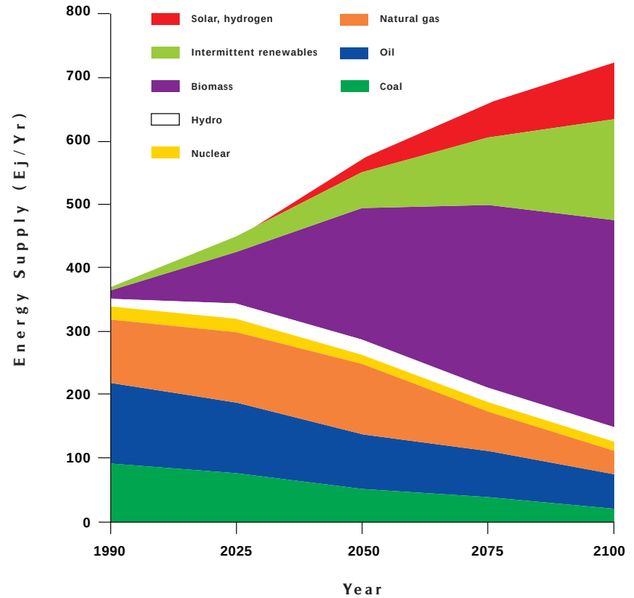
**International Emissions Trading (IET)** enables industrial country signers of the Kyoto Protocol to use GHG emissions trading to fulfill their legally binding commitments, so that countries that reduce their emissions below the quotas can sell the excess to other countries in need of credits **(Article 17)**. [29]

The reduction goal creates a global market of roughly 1 billion tons of carbon per year. Reduction levels vary from nation to nation—7 percent for the United States, 8 percent for the European Union, 6 percent for Japan, and an 8 percent increase for Australia. The Kyoto Protocol gives industrial countries several Cooperative Implementation Mechanisms, also known as "flexibility mechanisms," that can be used to fulfill their emission reduction commitments, as supplements to domestic actions (see box).

The ratified treaty will affect the value chain of every carbon-intensive company (the value systems that tie firms to upstream suppliers and downstream customers), and the profit pools of industry sectors (e.g., the operating margins and share of industry revenue that go to fuel suppliers, petrochemical feedstock users, utilities).

The domestic actions that industries will take as part of national commitments, as well as actions that they may take through the flexibility mechanisms, represent obvious business opportunities and vehicles for companies to create value. This is already exemplified in the aggressive actions being pursued by Fortune 100 companies such as BP Amoco and Shell. Both companies have set GHG goals of 10 percent reductions below 1990 levels. Both are establishing internal carbon trading systems, capturing no- and low-cost efficiency gains that reduce emissions while providing robust returns on investment, and potential new business opportunities. And both companies are positioning themselves with significant stakes in climate-friendly, renewable energy enterprises.

### IPCC CHART ON ENERGY FOR 21ST CENTURY




Source: IPCC (Intergovernmental Panel on Climate Change) Climate Change, 1995 impacts, adaptations and mitigation of climate change: Scientific Technical Analysis: Cambridge University Press.

Shell's new value chain builds on several decades of involvement in forestry. It is positioning itself as a global business developer using forest carbon offsets as an integral component in developing a market in climate-neutral, biomass-based fuels. Shell's internal assessments—and the 1995 scientific-technical assessment by the Intergovernmental Panel on Climate Change (IPCC)—indicate that biomass could become the primary fuel of the next century, providing more than half the world's energy services. [56, 26]

Shell and BP Amoco are among a host of companies ahead of the curve in developing projects and new business opportunities around carbon reductions and offsets. However, as the primary driver and shaper of the emerging market in carbon trading, the Kyoto Protocol has a number of rules that constrain the kinds of carbon projects that will qualify for credit. And some of the rules are in the process of being further clarified, which may further constrain or expand business opportunities. There are a number of specific milestones in the next several years that will address these important points.

Among the most pressing issues in need of resolution are: [6]

## Baselines and Additionality

Key to the success of any carbon reduction or offset project accruing credits under the Kyoto Protocol is agreement on how to establish baselines for judging project emissions and estimate whether a project achieves additional reductions beyond what would occur in its absence. The debate focuses on how to make the rules for determining baselines and additionality as simple and transparent as possible, to minimize transaction costs without compromising the environmental integrity of projects. If the rules are too simple, there is the potential for "gaming," where both carbon credit buyers and sellers have an incentive to create inflated baseline emissions to derive more credits for trade. If too complicated, high transaction costs may scare off investment and lose some very cost-effective credits for trade. A number of innovative approaches for establishing simple, but effective, baselines are under discussion. [61]

## Status of Land-Use Change and Forest projects

Great ambiguity remains as to what kinds of land-use change and forestry (LUCF) projects will be eligible under the Co-operative Implementation Mechanisms.

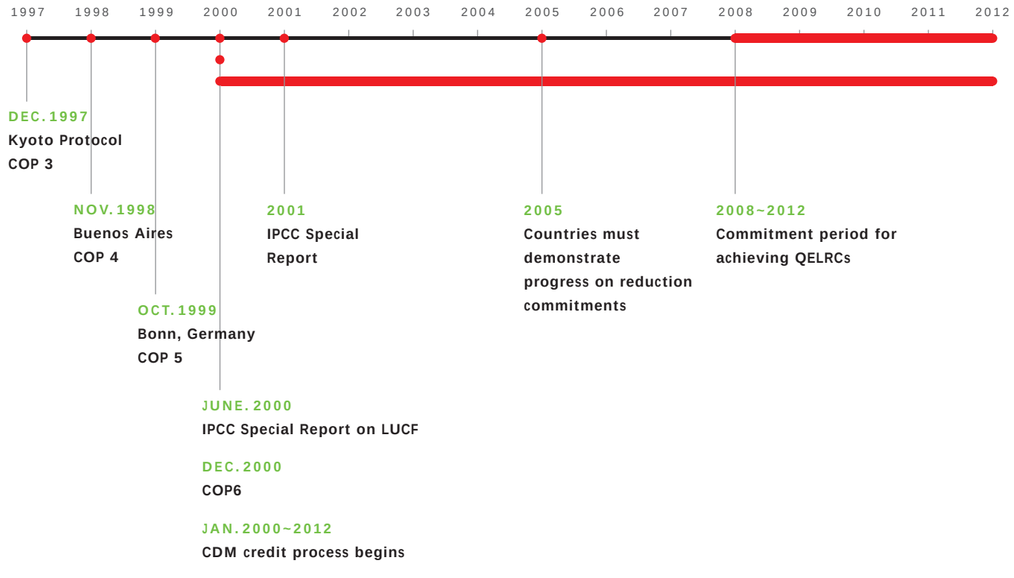
### SHELL INTERNATIONAL'S NEW CORE BUSINESS ON RENEWABLES

Launched in October 1997, Shell International Renewables comprises the company's fifth core business. Over the next five years the group will invest more than half a billion dollars into the development of renewable resources. Shell scenarios indicate that renewable sources are expected to provide between 5 percent and 10 percent of the world's energy within 25 years, perhaps rising to 50 percent by 2050. Shell's focus on renewable resources is considered "as another step in shaping its portfolio of energy capabilities to supply anticipated world demand in a sustainable and economically viable way."

The company is building a bioenergy business based upon its nearly two decades of research and development in forestry. The wood for biomass would come from purpose-built plantations that would be sustainably managed. Replanting the trees will absorb the carbon dioxide liberated during combustion, providing a climate-neutral fuel source to displace fossil fuels. Shell is also researching and developing ways to minimize environmental problems associated with plantations, through such measures as including biodiversity-rich natural forest buffer zones around plantations. Prospects for biomass range from small-scale systems to large-scale power generation with a connection to the electricity grid. The main market for smaller-scale systems will be in the developing world, bringing electricity to those who are not connected to an electricity grid. [56]



### INTERNATIONAL CLIMATE CHANGE TREATY MILESTONES




The Protocol's current Joint Implementation provisions allow industrialized countries and Eastern European nations to trade in carbon emission reductions or offsets generated from land-use change and forestry projects. [29] It is anticipated that further clarification by the Conference of Parties to the Protocol will add carbon trading with developing countries in land use/forestry projects through the Clean Development Mechanism.

While the term "carbon stock" in forests is not defined in the Kyoto Protocol, Article 3 explicitly includes deforestation, reforestation, and afforestation activities in determining national emission reductions since 1990 for the first commitment period.

Forest conservation activities were also considered among those eligible for the Activities Implemented Jointly (AIJ) pilot phase under the 1992 UN Framework Convention on Climate Change. Indeed, Article 4(d) of the Framework Convention commits all parties to promote sustainable management and conservation of forests and other ecosystems that serve as carbon sinks. [6] Most AIJ projects, however, do not include soil in their net carbon storage estimates, although soils can be significant carbon sinks or sources. [4, 40]

Currently, the Protocol recognizes additions (re-and afforestation) and subtraction (deforestation) from forest sinks, but does not recognize forest conservation or reduced impact logging types of projects. According to Article 3 of the Protocol, the extent and scope of LUCF projects are contingent on additional decisions by the Conference of Parties on:

"modalities, rules and guidelines as to how and which additional human-induced activities related to changes in greenhouse gas emissions and removals in the agricultural soil and land use change and forestry categories, shall be added to, or subtracted from the assigned amount for Parties included in Annex I."

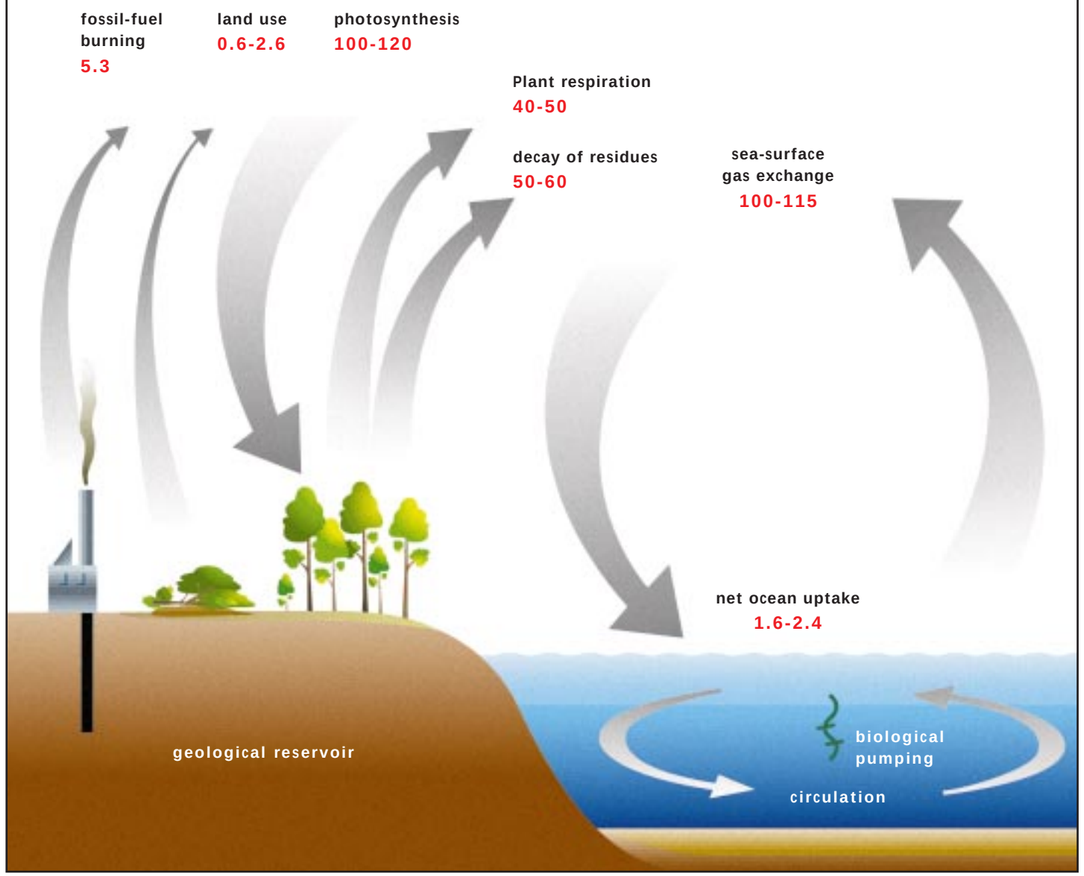
**These decisions will occur after submission of a June 2000 forestry report by the IPCC, which is tasked with clarifying LUCF issues—and providing definitions for the ambiguous terms afforestation, deforestation, and reforestation.**

# CARBON, CLIMATE, AND FORESTS: THE CONNECTIONS

[8] Global forest vegetation (including above and below ground living and dead mass and debris) and soils (to 1 meter depth) totals 987 billion tons of carbon. [11]

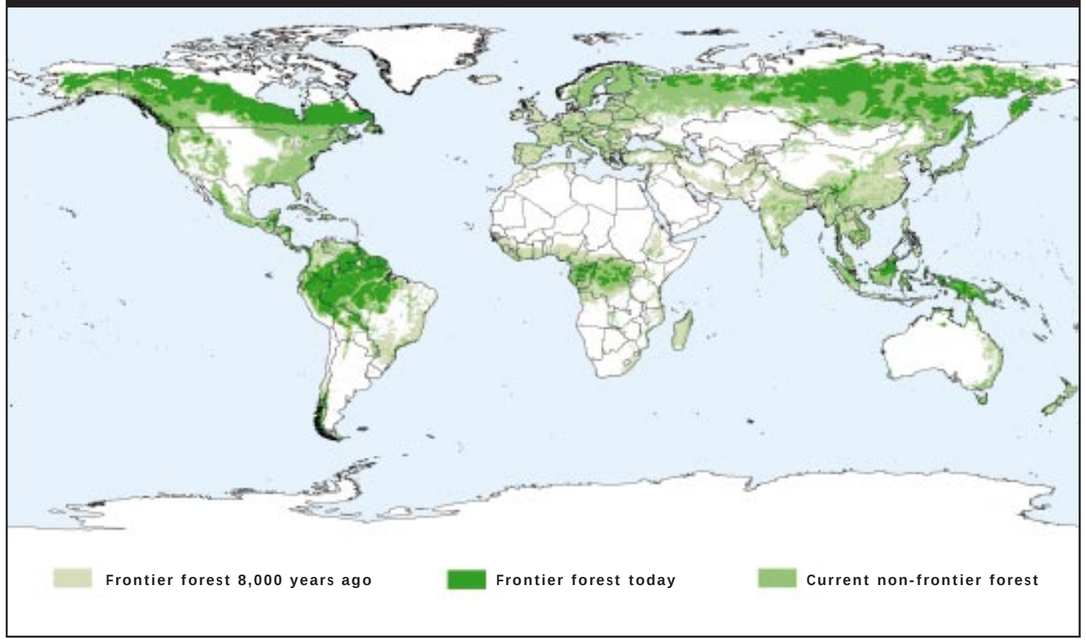
Forests store two-thirds of terrestrial carbon—nearly 1 trillion tons.[8] Of all the plant kingdom, forests provide the most long-lived storage sink in the carbon cycle, tying carbon up in wood and soil accumulation for several hundred years before returning it to the atmosphere by respiration, decomposition, erosion, or burning.

## THE GLOBAL CARBON CYCLE




Source: http://www.esd.ornl.gov/iab/iab2-2.htm

## FRONTIER FOREST




Source: Bryant, Dirk, Daniel Nielsen and Laura Tangley, The Last Frontier Forests, World Resources Institute, Washington, DC, 1998.

Native forests cover some 3,400 million hectares worldwide. An additional 1,700 million hectares of other wooded lands have some forestry aspects (e.g., woodland, scrub, shrub, and brushland). There are roughly 100 million hectares of trees in plantations. [67]

Historically, forests have been a net source of atmospheric $CO_2$, as 80 percent of the world's original forest cover has been lost. [4] Moreover, under "business-as-usual" the world could lose 650 million hectares of tropical forest over the next 60 years, releasing up to 77 billion tons of carbon emissions in the process. [65]

The greatest forest-driven effect on the climate would come from ceasing tropical deforestation—which releases 1.6 billion tons of carbon each year. This would provide further benefits, including preserving biodiversity and watersheds, and retaining soil and stormwater. [8, 18]

Globally, six hectares are deforested for every hectare planted. The situation in Africa is far worse: only one hectare is planted for every 32 hectares deforested. In total, the world is losing tropical forests at the alarming rate of some 15 million hectares a year. [65]

# CLASSES OF CARBON FOREST OPPORTUNITIES

The key carbon offset opportunities related to tropical, temperate, and boreal forests, include:

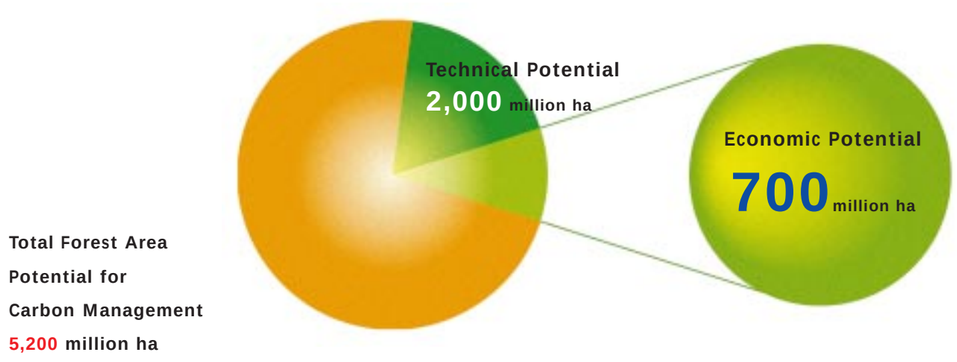
- **Maintaining** current carbon stocks by preserving and protecting forests;
- **Increasing** the reservoirs of biotic carbon through a combination of sustainable forest management practices, regenerating forests, reforesting degraded lands with plantations, and agroforesting farmlands;
- **Displacing** fossil fuels with sustainably produced forest biomass.

The technical potential for forest carbon management is enormous. More than two billion hectares of deforested or degraded land area are technically suitable for sustainable forest management. [11] Detailed studies indicate that some 700 million hectares of land might be economically attractive for forest carbon programs, resulting in 60 to 87 billion tons of carbon cumulatively conserved and sequestered by 2050. This is equivalent to about 11 to 15 percent of fossil fuel emissions over this time period. [7, 75]

Other studies identify an additional 29 billion tons of carbon emissions that could be avoided if woody biomass was used as a substitute for fossil fuels. [50]

These may be upper bounds, given that other studies suggest the land base estimates for expanding carbon sinks via forest are grossly overestimated when overlayed with tenure, institutional capacity, ecological, and other socioeconomic constraints. [66, 54]

**GLOBAL TOTAL, TECHNICAL & ECONOMIC POTENTIAL FOREST AREA FOR CARBON MANAGEMENT (MILLION HECTARES)**






There are distinct classes of carbon forestry, some far superior to others in offering greater value and lower risk to the investor, society, and the environment. Other options may offer good benefits but greater risks, while some options are clearly inferior in benefits, costs, and risks.

For example, the current widespread practice of replacing or degrading frontier forests creates significant carbon losses—even if the areas are replanted with fast-growing tree species[9]—and threatens the loss of other valuable ecosystem services such as biodiversity preservation and watershed protection, and the loss of potential revenue streams from non-timber forest products, recreation, and eco-tourism.

Thus, the forest carbon market opportunity should be as much about gaining climate benefits by preserving and protecting the massive carbon repositories in primary rain, ancient, and old-growth forests as about reclaiming degraded lands with fast growing tree species to increase carbon repositories.

Each class of carbon forestry offers a different level and timing of carbon benefits, at different costs and risks. Old-growth or frontier forests, for example, offer large up-front carbon offset opportunities because of their immense carbon storage in the soil and in above- and below-ground vegetation. In contrast, fast growing tree species planted on degraded lands start out with low storage levels, but steadily sequester increasing levels of carbon so that several decades or a century out carbon benefits accrue to significant levels. [18]

Carbon-intensive businesses in transition toward greener technologies, but in need of large, near-term, carbon offsets during this transition period will find the greatest value in forest preservation projects that offer immediate benefits. Alternatively, companies looking to offset future carbon emissions can turn to options such as forest plantations designed to grow offsets over the next several decades or century.

Carbon forest market opportunities exist in a range of classes, including:

- Preserving and protecting frontier forests
- Buying back logging concessions in biologically rich areas
- Reduced-Impact Logging (RIL)
- Sustainable Forest Management (SFM)
- Managing wildfire threats
- Bringing degraded lands into production
- Afforestation of pasture and marginal agricultural lands
- Use of sustainably grown biomass to displace fossil fuels
- Agroforestry on farms
- Urban forestry

**9** Harmon et al. [22] estimated that the conversion of 5 million hectares of old-growth forests to younger plantations in western Oregon and Washington over the past century has added 1.5 to 1.8 billion tons of carbon into the atmosphere.

# REACHING THE MARKET

## WHERE AND WHAT?

Most nations—developed, transition, or developing—harbor opportunities for increasing forest carbon, whether they are located in low (tropical), mid (temperate) or high (boreal) latitudes.

Experience over the past decade through international programs such as Activities Implemented Jointly (AIJ)[10] has shown that tropical developing countries offer some of the lowest-cost carbon offset opportunities. This is due to lower costs for land and labor, despite higher transaction costs and risks relative to developed countries (see risks section below).

Investment opportunities can vary widely, even within a specific region. Each location offers a different number, type and size of potential projects, and a range of costs, risks, uncertainties, returns on investment, and timing. Projects may also each offer different levels of indirect benefits (e.g., biodiversity or watershed protection), or pose distinct opportunity costs.

An analysis of forest carbon savings in 52 tropical countries, incorporating socio-economic, political, and environmental constraints, was conducted by Trexler and Haugen in 1994. [65] Assuming realistic implementation schedules for the most promising forest practices on available land, coupled with policies addressing such issues as land-titling, tenure, and counter-productive subsidies that drive deforestation, the authors concluded that the following carbon offset opportunities were possible:

**Tropical Forestry Opportunities for Mitigating Climate Change (1995-2045)**
(Cumulative tons of carbon and hectares)

| Option | Low C Estimate (million tons) | High C Estimate (million tons) | Hectares (1000's) |
|---|---|---|---|
| Slowed Deforestation | 8,620 | 16,640 | 138,076 |
| Regeneration | 9,910 | 22,930 | 216,735 |
| Farm Forestry | 630 | 1,580 | 60,876 |
| Plantations | 2,430 | 5,320 | 66,842 |
| **TOTAL** | **21,590** | **46,470** | **482,520** |

**Source: Trexler, Mark and Christine Haugen, Keeping It Green: Tropical Forestry Opportunities for Mitigating Climate Change, World Resources Institute, Washington, DC, 1995.**

**[10] AIJ was a voluntary, participatory program initiated by the (UNFCCC) in 1993 as a pilot phase for bilateral agreements between industrial country investors and project hosts in developing countries that potentially could provide projects for carbon emissions reductions to the investors at a lower cost than domestic abatement.**

CATEGORIES

Country-specific estimates have been calculated for each forest carbon offset category. These provide useful insights on the scale of opportunities within and across regions. In sheer volume of forest carbon offset potential, the 20 most significant tropical countries include:

**20 Most Significant Tropical Countries for Carbon Retention/Sequestration**

Million tons of carbon storable through new growth + slowed deforestation 1990-2050

| Rank | Country | Low C Estimate | High C Estimate |
|---|---|---|---|
| 1 | Brazil | 5,400 | 14,000 |
| 2 | Indonesia | 5,400 | 14,000 |
| 3 | Zaire | 1,700 | 2,500 |
| 4 | India | 880 | 1,900 |
| 5 | Malaysia | 1,000 | 1,900 |
| 6 | Mexico | 460 | 1,700 |
| 7 | Philippines | 840 | 1,600 |
| 8 | Colombia | 630 | 1,300 |
| 9 | Vietnam | 620 | 1,300 |
| 10 | Papua New Guinea | 630 | 1,200 |
| 11 | Côte d'Ivoire | 590 | 1,100 |
| 12 | Laos | 530 | 1,000 |
| 13 | Cameroon | 520 | 970 |
| 14 | Myanmar | 390 | 950 |
| 15 | Peru | 600 | 950 |
| 16 | Venezuela | 440 | 940 |
| 17 | Tanzania | 200 | 870 |
| 18 | Ethiopia | 300 | 720 |
| 19 | Ecuador | 320 | 640 |
| 20 | Thailand | 170 | 630 |

Source: Trexler, Mark and Christine Haugen, Keeping It Green: Tropical Forestry Opportunities for Mitigating Climate Change, World Resources Institute, Washington, DC, 1995.



While tropical forests offer huge carbon offset opportunities, there are also substantial forest carbon conservation and sequestration opportunities in temporal and boreal forests, which are economically attractive and pose lower risks. According to a 1990 U.S. Department of Agriculture assessment, roughly 80 million hectares of farmland are suitable for afforestation. Nearly 400 million tons of carbon could be sequestered at a cost of roughly $20 per ton. Other analysts calculate the costs to be much lower—between $4 and $7.50 per ton of carbon ($1989). [10, 53]

Carbon offset projects in tropical countries potentially offer some of the lowest cost project opportunities. Economic analyses, as well as empirical results from existing projects (see below), indicate that costs range from less than $1 per ton of carbon (tC) to prevent deforestation, to less than $5 per tC for establishing plantations on degraded land. [5, 11]

However, one must keep a key caveat clearly in mind: neither the carbon offset costs nor the carbon savings of existing projects can be used as the basis for accurate forward comparisons. These projects represent the earliest stage of the carbon forestry market, when measurement and reporting methodologies were not standardized, but still in an evolving state. Some projects included all development costs, while others did not factor in grants or preparatory support work provided by partners such as non-governmental organizations, government agencies, and private corporations. Some projects factored in soil and underground carbon storage, while others only considered above-ground carbon accumulation in biomass. Some rigorously considered problems of "leakage and additionality."[11] Others did not, or did so less rigorously. [71]

Rapid progress is being made in establishing agreed methodologies for all facets of carbon forest projects. This includes standardizing calculations of carbon baselines, costs and savings, and establishing rigorous procedures for measuring, monitoring, evaluating, reporting, verifying, and certifying carbon baselines and accumulated benefits. [69, 30]

**11** Leakage refers to unexpected carbon losses related to a particular carbon offset project. The leakage may be due to unforeseen circumstances that were beyond the control of a forest conservation or sequestration project. Unforeseen events include extreme weather, political instability, climate change, pests, disease, fire, or cancellation of contracts that lead to logging. Research on leakage suggests that it can be anticipated and avoided through good project design. Additionality refers to carbon accounting procedures whereby projects must demonstrate real, measurable, and long-term results in reducing or preventing carbon emissions that would not have occurred in the absence of the carbon project.

COUNTRIES

# LEARNING FROM EXPERIENCE

## CASE STUDIES

There is now more than a decade of accumulated experience with forestry carbon offset projects. One 1998 study shows that many carbon offset projects can show net profits at suitable discount rates (see table on page 28). In 1988, AES, one of the world's largest independent power suppliers, pioneered the first large-scale carbon offset project in collaboration with the World Resources Institute (WRI), CARE (Cooperative for Assistance and Relief Everywhere) the international poverty-relief NGO, and communities in Guatemala. AES sought a forest carbon offset for the 14.1 million tons of carbon (52.1 million tons of $CO_2$) that would be released during the 40-year life span of its new coal-fired power plant in Connecticut. The original goal was to plant 51 million trees over ten years on 186,000 hectares.

CARE designed and helped implement the offset project, which included creating community woodlots, introducing agroforestry practices, terracing vulnerable slopes, and providing training for community forest fire brigades. The estimated cost of the project ranged from $6.6 to $14 million, depending on the value placed on CARE volunteer labor. WRI initially calculated that the project would sequester some 16.3 million tons of carbon over 40 years at a cost of $0.23 to $0.50 per ton of carbon ($1989). Subsequent analysis in 1994 revised the carbon sequestration estimates upward based on greater realized savings. [5, 17, 62]

The past decade's experience with forest carbon offset projects is instructive, the caveat being that project results are not fully predictive in terms of cost per ton of carbon saved. The value these projects offer is to show the range of options and the kinds of carbon savings potential. The following section profiles 13 projects.

## PRESERVING AND PROTECTING FRONTIER FORESTS: PARAGUAY, COSTA RICA, AND BELIZE

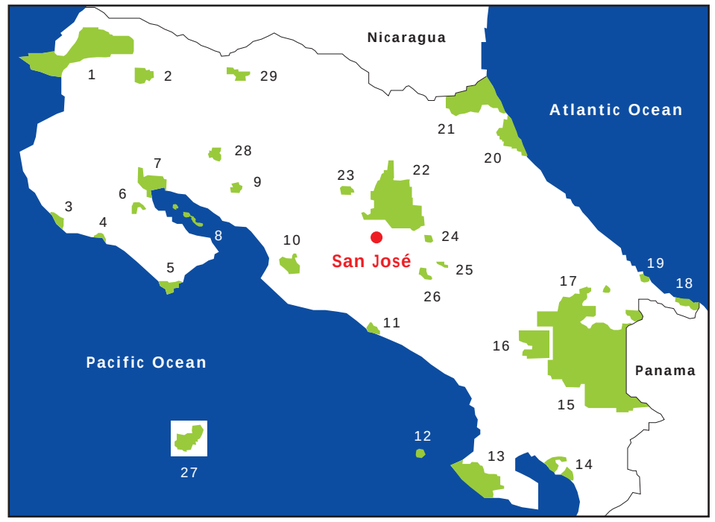
### PARAGUAY

To offset the 14.5 million tons of carbon emissions from its 180-MW coal-fired power plant on Oahu, Hawaii, AES joined with The Nature Conservancy to establish a protective reserve in Paraguay. The 60,000-hectare tract helps protect one of Latin America's last remaining major areas of undisturbed dense tropical forest. Based on a $3.8 million total investment, the cost of avoided carbon was calculated at $0.25 per ton ($1992). AES's $2 million part of the investment, for which it received all the carbon credits, reflected a carbon offset cost of $0.14 per ton, over the 35-year life span of the offset agreement. [38]

### COSTA RICA

Costa Rica has been a world leader in defining and promoting forest carbon offset projects. One innovative project, "CARFIX," is achieving multiple goals, including forest preservation, carbon sequestration, and reducing soil erosion and water degradation.

The combination forest preservation and sustainable forest management project is located in the buffer zone of a World Biosphere Reserve, the Braulio Carrillo National




Braulio Carrillo National Park is No.22

PROTECTING

Park. The 44,000-hectare Braulio Carrillo is covered with wet tropical and premontane forests, very little of which has even been explored. Many of Costa Rica's endangered animals live within the park, including tapirs, jaguars, and quetzal birds.

Project activities include forest preservation, regeneration, reforestation, reduced-impact logging, and sustainable forest management as a means of halting forest conversion to agricultural lands. Income from the carbon sequestration and sustainable forestry is being used to replace farmer incomes foregone from marginal agricultural activities. An investment of $12.5 million in the 290,000 hectare area is projected to sequester 7.6 million tons of carbon at a cost of $1.46 per ton.

### BELIZE

The carbon sequestration project in Belize's Rio Bravo Conservation and Management Area (RBCMA), located near the borders of Guatemala and Mexico, is an example of simultaneously gaining several valuable benefits. Without the carbon project, more than 5,000 hectares of forest lands adjacent to Rio Bravo were in danger of being converted to farmland. Rio Bravo has one of Belize's best stocked areas of mahogany, cedar, and other commercially valuable trees. In addition, its abundant wildlife includes one of the largest populations of jaguars in Central America.

Beginning in 1995, a coalition including The Nature Conservancy, and a consortium of electrical utilities—Wisconsin Electric Power Company, Detroit Edison Company, Cinergy Corporation, PacifiCorp, Suncor, and Utilitree—raised $5.7 million to add 13,200 hectares to the 104,000-hectare Rio Bravo area.

Belize has gained watershed protection and biodiversity preservation. Some 70 species of mammals, including 15 being monitored with concern by international groups, are resident in Rio Bravo.

Community development gains are expected to occur from eco-tourism and sustainable logging of certified timber from a portion of the land. At the same time, the utility companies have gained low-cost emission offsets. More than 1.6 million tons of carbon will be sequestered at a cost of $3 per ton.

## BUYING BACK LOGGING CONCESSIONS IN BIOLOGICALLY RICH AREAS: BOLIVIA

The Noel Kempff Mercado National Park in Bolivia is a notable and highly unique carbon offset example. A consortium led by American Electric Power (AEP), PacifiCorp, and BP America, in collaboration with The Nature Conservancy, invested $9.5 million to pay forest companies to permanently retire the logging rights to 640,000 hectares.

The investment more than doubled the size of the now 1.5 million hectare park. The land is being allowed to naturally regenerate, increasing stored carbon as it reforests.

For the companies, investing in forest preservation and restoration offered a highly cost-effective way to offset their greenhouse gas emissions. The cost of abatement was just $0.63 cents per ton of carbon ($1997), while an immensely rich biodiversity area was preserved, and Bolivia became the recipient of another spectacular natural site for promoting eco-tourism.

## REDUCED-IMPACT LOGGING: MALAYSIA

Conventional logging operations can significantly alter a forest's physical structure. Removal of as little as 3 percent of the trees can reduce canopy cover by 50 percent, and in some cases up to 75 percent. The impact on undergrowth can also be significant: removal of just three trees per hectare can destroy nearly 40 percent of the undergrowth. [47, 48, 49] Shifting to Reduced-Impact Logging (RIL) practices can reduce logging damage by as much as 50 percent through pre-cutting vines, directional felling, and planned extraction of timber on properly constructed and utilized skid trails.

New England Electric Systems (NEES) of Massachusetts, invested $450,000 in a RIL project in Sabah, Malaysia, in 1992. The 1,400-hectare project was carried out by Innoprise Corp., a semi-government forestry organization, which has the largest forest concession in the state of Sabah (1 million hectares). In addition to saving carbon, the project involves developing guidelines and procedures for RIL techniques.

Components of RIL are neither unique nor original, although RIL rarely is used on a commercial logging scale in tropical forest conditions. Compared to other carbon offset programs, such as afforestation, RIL offers investors lower risk advantages. A very large percentage of the carbon savings occur immediately, rather than spread over 30 to 100 years. This lessens the risk of project failure for investors. [38, 48]

The NEES pilot project was completed in 1995, and reduced logging damage by 50 percent. This saved roughly 40 tons of carbon per hectare (58,000 tons over the 1,400 ha area) at a cost of $7.60 per ton of carbon saved at two years after logging. Higher savings are expected in the longer term. [38]

In addition to providing an attractive forest carbon offset option, RIL practices provide other benefits, such as retaining biodiversity values, minimizing fire risks, and maintaining topsoil integrity. They will also lead to better stocked forest stands that are less damaged, faster growing, and will produce greater volumes and higher-value forest products in the future.

The successful NEES project is being expanded by the UtiliTree Carbon Company, a consortium of 40 utilities. The expanded project will be carried out on another 1,000 hectares. Expected benefits include offsetting 40,000 tons of carbon by the year 2000, and 102,000 tons of carbon over the 40-year life of the project.

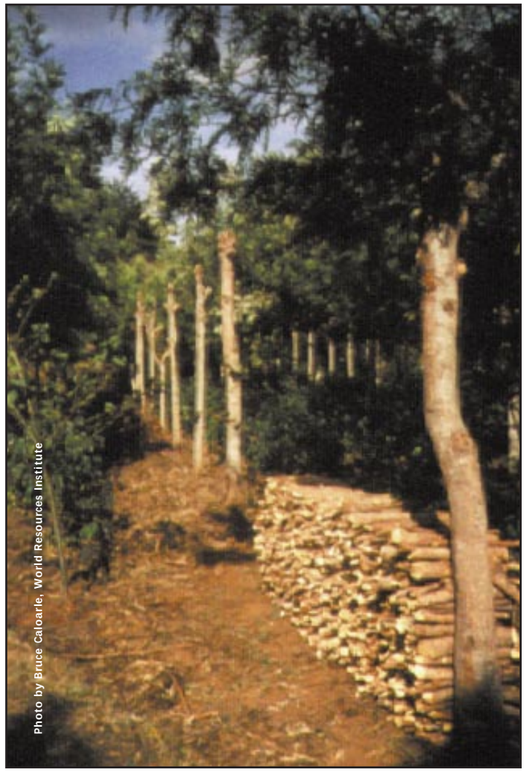


Photo by Bruce Caloarie, World Resources Institute

## Estimated Net Costs of Carbon Offset Measures

| Country | Project Type | Discount Rate* | Net Cost/ton of carbon offset ($US 1997)** |
|---|---|---|---|
| **Brazil** | | **12%** | |
| | Plantation: Pulp | | -7.2 |
| | Plantation: Charcoal | | -0.5 |
| | Plantation: Sawlogs | | -14.7 |
| | Forest Management | | Net Carbon Loss |
| **Thailand** | | **10%** | |
| | National Parks | | 1.7 to 3.3 |
| | Wildlife Sanctuaries | | 2.3 to 4.3 |
| | Watershed Protection Areas | | 0.9 to 5.4 |
| | Community Woodlot: Eucalyptus | | 1.0 |
| | Semi-Public Plantation: Eucalyptus | | -3.8 |
| | Private-Sector Plantation: Eucalyptus | | -13.0 |
| | Semi-Public Plantation: Teak | | -2.5 |
| | Community Plantation: Teak | | -18.5 |
| | Agroforestry: Eucalyptus/Maize | | -1.2 |
| | Agroforestry: Eucalyptus/Fruit Trees | | -25.6 |
| **Tanzania** | | **10%** | |
| | Protected Area | | 1.3 |
| | Agroforestry: Eucalyptus/Maize | | -1.8 |
| | Public Plantation: Eucalyptus | | 0.1 |
| **China** | | **Not indicated** | |
| | Plantation | | -12.4 to 1.8 |
| | Agroforestry | | -13.1 to -1.4 |
| **Mexico** | | **10%** | |
| | Natural Forest Management: Temperate | | -8.3 |
| **India** | | **12%** | |
| | National Parks | | 10.4 |
| | Natural Regeneration of Degraded Forest (w/ Harvesting) | | -1.8 |
| | Enhanced Regeneration of Degraded Forest (w/ Harvesting) | | -0.4 |
| | Agroforestry | | -4.5 |
| | Community Woodlot | | -0.8 |
| | Soft Wood Plantations | | -1.6 |
| | Timber Plantation | | -0.6 |

***The rate of return offered by comparable investment alternatives, used to calculate the present value of investments.**

**** Negative net costs indicate profits.**

**Source: Frumhoff, Peter, D. Goetze, J. Hardner, Linking Solutions to Climate Change and Biodiversity Loss Through the Kyoto Protocol's Clean Development Mechanism, UCS Reports, Union of Concerned Scientists, Cambridge, Mass., Oct. 98.**



# SUSTAINABLE FOREST MANAGEMENT: THE UNITED STATES

## FOREST FOREVER FUND

The Pacific Forest Trust's Forests Forever Fund project, "Maximizing Carbon Storage through Forest Stewardship," is pioneering forest carbon storage through improving forest management.

The project aims to increase carbon sequestration in a prime redwood forest in Northern California by at least 28,000 tons of carbon by the year 2000, and 65,400 tons of carbon by 2095 through ensuring forest management that increases older age stands, reduces soil carbon loss, and restores natural forest composition.

The project uses a highly sophisticated computer model, STANDCARB, to simulate forest dynamics under different management scenarios to project changes in carbon stores over time. The model was specifically designed to estimate carbon flux in 26 commercial Pacific Northwest species.

The project involves acquiring restricted rights from a willing landowner, in the form of a conservation easement held by the Pacific Forest Trust. The easement guides forest management to achieve carbon storage goals. The project pays the opportunity costs of a foregone harvest landowners would otherwise need, yet allows for ongoing harvests that maximizes their long-term returns and achieves environmental gains that they could not otherwise afford.

Conservation easements create a permanent carbon sink, where gains will not be lost with new landowners or project termination. As the easement holder, PFT is legally bound to carry out annual monitoring and enforcement of the easement into perpetuity.

The project achieves multiple additional environmental and social gains, protecting a vital watershed for Mendocino County; restoring and protecting salmon habitat; enhancing and protecting habitats for threatened and endangered species; protecting biological diversity and habitat connectivity; ensuring long-term supplies of high-quality timber, forest-dependent jobs, and preserving production timberlands.

## WESTERN OREGON CARBON SEQUESTRATION PROJECT

Another example from the United States is the Western Oregon Carbon Sequestration Project. It is sequestering carbon by planting trees on 375 hectares of cutover non-industrial timberland in western Oregon that otherwise would not be replanted. These lands are among the most productive timberlands in the United States. If the stands are harvested, much of the timber will likely be used for long-term purposes such as construction that will continue to keep carbon sequestered. [63]

Principal participants in the project are Trexler and Associates, Inc., Oregon Woods, Inc., and participating landowners. By 2062, the project will sequester a cumulative total of 152,000 to 202,000 tons of carbon.

The project will yield environmental and economic benefits beyond carbon sequestration, including expanding wildlife habitats, improving water quality, and reducing the risk of soil erosion. Additionally, the project will increase regional timber supply and create new jobs from future employment in the forest products industry.

# BRINGING DEGRADED LANDS INTO PRODUCTION: BRAZIL AND THE RUSSIAN FEDERATION

## BRAZIL

In late 1998, Peugeot announced an investment of $10.8 million to create a carbon sink by planting 10 million trees on 12,000 hectares in Juruena, in Mato Grosso State. Its primary objective is to create carbon storage capacity by recreating a tropical forest ecosystem that matches the old-growth forest's biodiversity as closely as possible. [44]

The large-scale project will store 50,000 tons of carbon a year, at an anticipated cost of $1.30 per ton. A system of internal and external assessments through independent audits is planned to ensure that the agreed targets are met.

Special care is being taken to integrate the project into the region's socioeconomic environment. The carbon sink will include three components:

- 5,000 ha of previously deforested pastures will be integrally reforested with native fast-growing species;
- 7,000 ha of natural and secondary forest will be managed and rejuvenated; and,
- An agroforestry buffer zone of neighboring colonists, who will be provided with long-term technical assistance by Instituto Pró-Natura.

Most of the 10 million trees will be planted in the first three years. Five tons of seeds from nearly 20 different species were collected from the old-growth forest surrounding the areas to be planted. The collection drive received substantial support from local and regional officials, including the Ministry of Agriculture, and the local population, which participated enthusiastically. Many people from Juruena and Cotriguaçu were able to earn extra income from the collection drive, reflecting the project's contribution to the local economy.

## RUSSIAN FEDERATION

The RUSAFOR Afforestation Project was launched in 1993 in Saratov, Russia, 700 miles southeast of Moscow, through a cooperative agreement between the Russian Federal Forest Service, Oregon State University, the Environmental Defense Fund, and the U.S. Environmental Protection Agency.

The carbon sequestration project has focused on reversing soil erosion and increasing carbon on marginal agricultural land and previously burned forest stands by establishing broadleaf and pine plantations on four sites totaling 900 hectares. Carbon emissions accrue from reduced soil erosion and biomass decay, and from carbon sequestration due to tree growth and soil carbon accumulation.

Nearly 80,000 tons of carbon will be cumulatively sequestered, at a cost of roughly $3.75 per ton.

## AFFORESTATION ON PASTURELANDS: AUSTRALIA

In June 1998, New South Wales (NSW) signed Australia's first carbon credit trades as part of a program to offset carbon emissions. The NSW government is intent on creating a new industry and jobs around "greenpower." The State Forests of NSW have entered into strategic partnerships with two NSW electric utilities, Pacific Power, and Delta Energy, that use plantations to offset the utilities' greenhouse gas emissions.

Pacific Power purchased 4,500 tons of carbon rights from 1,000 hectares of eucalyptus hardwood plantations established by State Forests of NSW on former pasturelands. Pacific Power has a first right of refusal to extend the purchase over the subsequent 9 years, which would secure an additional 54,000 tons of carbon.

Delta Energy entered into a Softwood Plantation Deed with State Forests, purchasing 5,775 tons of carbon rights over 30 years resulting from 41 hectares of softwood plantations (*Pinus radiata*) that State Forests will plant and manage on Delta Energy's pasturelands.

NSW State Forests, working with Bankers Trust and the NSW Treasury, has developed a carbon-forestry Investment Memorandum that will be marketed worldwide. It provides for a joint carbon-forestry investment product that yields an 8 to 10 percent rate of return, but with an added bonus being the carbon credits generated in the new sinks.

The product is designed to create a pool structure for carbon management. The carbon credits, or rights, described in the certificates can be transferred or resold to investors or other organizations requiring certified emission offsets. The NSW carbon credit trade deals are regarded as a learning experience, in advance of a formally recognized global carbon-trading scheme. [34]

## AGROFORESTRY ON FARMS: MEXICO

Agroforestry is a highly effective technique for raising productivity and reducing pressure on forests. The practice involves integrating tree growing with agricultural crops or livestock. Agroforestry is particularly valuable for resource-poor farmers unable to afford the high cost of fertilizers, pesticides, improved seeds, and other modern farm inputs. Agroforestry is also valuable for producing multiple outputs that include wood products, firewood, poles and posts, tree fruits, and animal fodder.

Successful agroforestry projects have achieved 25 to 100 percent increases in crop production by planting multi-purpose trees to reverse soil erosion, build up soil fertility, and improve micro-climates for crops and livestock.

Representative of agroforestry as a carbon offset opportunity is the Scolel Té carbon sequestration project undertaken in nine Mayan indigenous communities in the highland and lowland eco-regions of Chiapas, Mexico. Scolel Té (a Mayan phrase for "growing trees") focused on preventing further loss of carbon through forest reforestation and agroforestry. Without the sustainable forest management program it was estimated that a 2 to 3 percent annual loss of forest would occur.

The 2,200 hectare area includes a range of projects, such as live fences, enriched fallow areas, coffee/shade trees, and reforestation and forest preservation silviculture projects.

This will result in 333,000 tons of cumulatively sequestered carbon over three decades at an approximate cost of $10 per ton. One of the funders of this project was the International Automobile Federation, which is committed to offsetting the carbon emissions resulting from sponsored car races.

## CRITERIA FOR GOOD FOREST CARBON PROJECTS

What constitutes a sound forest carbon project? Frameworks of positive project attributes developed by experts include a number of basic assessment principles for analyzing forestry-based carbon offset projects. [28, 59, 64, 18, 19] They include:

- Credibility
- Simplicity
- Supportive political context
- Projects must have a demonstrably incremental effect compared to the baseline
- Cost effectiveness
- Benefits must be verifiable and measurable
- Projects must provide positive secondary benefits (e.g., help further a nation's sustainable development goals as required of CDM projects in the Kyoto Protocol, or provide biodiversity gains, as promoted under the Convention on Biological Diversity)
- Reliable teaming partners
- Local community support
- Replicability

There is great sensitivity among stakeholders regarding the integrity of these criteria. Too many past forest-related projects have been pursued without consideration of the adverse effects on local communities, or the negative impact on watersheds, soils, and biologically rich habitats. Any company intent on retaining, if not enhancing, its "reputational capital" with its shareholders, investors, consumers, and the regulatory environment in which it operates, will factor in the need to engage stakeholders from the outset.

Tree plantations provide an instructive example. Intensive forest plantations consisting of fast-growing species located on degraded lands have been singled out as offering a considerable carbon offset opportunity. The World Commission on Forests and Sustainable Development (WCFSD) reports research indicating that all of the world's projected demand for pulpwood (comprising half of all demand for wood products) could be met by plantations that would occupy only 3 percent of the world's forest area. [75]

In recent decades the majority of plantations have been developed on natural and primary rainforest lands, devastating both the ecology and the forest-dependent economies of the local communities. Here, as well, criteria are recommended for well framed projects. Hindsight on plantation projects that were plagued from the start with social and environmental problems, suggests that burdensome transactions costs and loss of reputational capital can be prevented or kept to a minimum by adhering to rigorous project criteria. The WCFSD flags five concerns in evaluating worthwhile tree plantation projects. Sound projects:

- Are only established on degraded forest land or non-forest land; are an integral part of a broader, participatory land use plan;
- Do not involve the clearing of natural forests;
- Are accepted as an appropriate land use by the local population; and
- Have positive ecological and social impacts, to the degree possible.

Scientists estimate that 100 to 200 million hectares of new forests are needed for each 1 billion tons of annually sequestered carbon [72]. Currently, only 5 million hectares are planted every year. If the number of plantations established for the next 30 years could be doubled, this would provide a carbon sink capable of sequestering one-eighth of the present global level of carbon emissions.



## USING BIOMASS TO DISPLACE FOSSIL FUELS: HONDURAS

The use of wood wastes to generate electricity has a long-standing history, and is widely practiced by the forest products industries in many countries to generate onsite power and steam. When biomass for energy use is derived from replenished forest or agricultural stocks it is climate-neutral, in the sense that the carbon released during fuel combustion is reabsorbed in the new tree or crop growth. Indeed, energy analyses indicate that advanced generating and processing technologies, when combined with extensive energy efficiency improvements, will enable the U.S. forest products industry to move from its current high level of 74 percent onsite generation with wood wastes towards 100 percent, effectively displacing the need for any fossil fuels. [2]

A 15-MW wood waste-to-energy power plant located in a large forest products processing region of Honduras is indicative of opportunities in developing countries. By using wood wastes to displace fossil fuels, the cogeneration plants will reduce carbon emissions by 619,000 tons over 20 years. The project captures a number of other benefits, such as reducing environmental contamination due to previous incineration of open piles and disposal in nearby rivers. The project was sponsored by Edison Electric Institute's International Utility Efficiency Partnership.

## URBAN FORESTRY: THE NETHERLANDS

The FACE Foundation, operated by the Dutch Electricity Generating Board, a consortium of four Dutch electricity companies, has been planting trees in urban and rural areas to achieve carbon offsets since 1992. The target is to plant 5,000 hectares in the Netherlands. To date, roughly one-third of the 1,000 hectares planted have been in municipal areas. Working with the Municipality of Zwolle, FACE is planting 99 acres of woodlands on the town's southern perimeter. The planting is mixed, mainly oak, ash, and alder. [16]

Trees planted around buildings and in communities are particularly valuable in reducing greenhouse gases; they break up urban heat islands by shading buildings and concrete and lowering peak energy needs for air conditioning. According to the U.S. non-profit research group, American Forests, most cities could triple the amount of carbon sequestered by trees by planting all available sites with appropriate trees. Three well-placed shade trees around a house can cut air conditioning energy needs by up to 50 percent. Shelter belts and windbreaks around homes and buildings protect buildings from winter winds, helping to reduce the production of atmospheric carbon dioxide by conserving heating fuels. [3]

## JOINTLY IMPLEMENTED CARBON FOREST PROJECTS

Most of the jointly implemented carbon forest projects between investors and host countries noted above were driven by action taken at the 1993 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. The ratification of the UN Framework Convention on Climate Change (UNFCCC) by 170 countries established a voluntary, multilateral agreement to reduce global emissions of GHGs to 1990 levels by the year 2000. To advance this goal, the UNFCCC established a voluntary program known as Activities Implemented Jointly (AIJ).

The AIJ has served as a pilot phase for bilateral agreements between industrialized country investors and project hosts in developing countries who potentially could provide projects for carbon emissions reductions to the investors at a lower cost than domestic abatement. However, no formal credit trading took place. Rather, the purpose was to gain experience in operating economically viable forest carbon offset projects.

A review of carbon forest projects undertaken between 1990 and 1998 indicates a number of trends, including: more projects initiated over time; more land area in new projects over time; more investment commitment over time; and a seemingly higher carbon cost over time. [38]

The seeming trend towards higher carbon costs may simply be due to comparing projects in current rather than constant dollars, so that earlier projects only appear less costly, or a more thorough accounting of all transaction costs, some of which may have been left out in earlier project estimates. It may also be due to the higher cost of performing more thorough measuring, monitoring, evaluation, reporting, verification, and inclusion of third party certification.

## INTERNATIONAL CARBON EMISSION TRADING: COSTA RICA

The success of emission trading over the past decade has provided proof that the private sector can bring forth tremendous creativity in solving environmental problems if harnessed to a profit motive and price signals. Unlike computer model-driven analyses, which conclude that $100 to $300 in carbon taxes will be necessary to achieve Kyoto Protocol reductions, financial experts argue that trading could achieve the same results at an average of $20 per ton. [51]

Limits on emissions give GHGs market value. It then becomes possible to trade them like any other commodity, as recently proposed by the International Petroleum Exchange. [27]

Costa Rica became the first country to formally commoditize GHG reductions by creating a carbon trading infrastructure that offered the first security-like instruments backed by carbon offsets. This was done in anticipation of the international emission trading provision in the Kyoto Protocol.

Costa Rica's pioneering program includes three major innovations: (1) It is the first carbon sequestration program with performance guarantees and reserve pools; (2) the first to use third party certification, and (3) the first to take an international capital markets approach.

Key features of Costa Rica's program include a revolving fund approach to financing continued forest regeneration and protection, direct support for sustainable development, enormous environmental benefits beyond carbon, and a clear demonstration of the mutual benefits of North-South trading.

Using funds generated from a modest gasoline tax, Costa Rica began two innovative land conservation projects, one focused on stabilizing its national parks, and the other to support sustainable management practices on private lands.

Under the Protected Areas Program (PAP), the government purchases threatened parklands and biological reserves from private owners and non-government organizations, and transfers these to its Ministry of Environment and Energy for permanent protection. Under the Private Forestry Program (PFP), the government contracts with landholders to carry out sustainable forestry practices; the landholders receive monetary incentives in return for assigning the "environmental services" (carbon offsets) to the government. It is estimated that more than 15.6 million tons of carbon will be sequestered over the life of the projects.

The Costa Rican Office on Joint Implementation then bundles these environmental benefits into a standardized instrument, known as Certified Tradable Offsets (CTOs). A surplus of 15 percent of the carbon sequestered is maintained as a buffer against "leakage" risks and to raise the attractiveness of the CTOs. In January 1997, Costa Rica offered its first CTOs for sale - 200,000 tons of the CTOs were bought at $10 per ton by the Norwegian government, a consortium of Norwegian companies, including ABB, Kavaener Energy and Eeg-Henriksen Anlegg, and by the Chicago-based financial group, Environmental Financial Products. CTOs have also been sold to help finance the conservation of 530,000 hectares of new national parks and bioreserves.

Costa Rica uses the funds from CTO sales to secure additional CTOs. Some 2,000 small farmers who collectively own 150,000 hectares of land are being paid to adopt sustainable forest management practices. CTOs will be generated by two activities: carbon stored from avoided deforestation of primary forests as a result of the project, or sequestered on lands currently in secondary forest or pasture that are allowed to regenerate back to natural forest. The CTOs are independently certified by a third party, Société Générale de Surveillance (SGS) of Geneva. [57] SGS Forestry will be monitoring activities in 398 individual parcels scattered over 400,000 hectares of primary forest and 100,000 hectares of secondary forest and pasture.

Richard L. Sandor, chairman and CEO of Environmental Financial Products, a risk management firm specializing in the reinsurance, insurance, and commodity derivative markets (which purchased $1 million of CTOs), says "the credits allow Costa Rica to realize market value from a prime asset, the rain forests and other protected lands that cover about 25 percent of the country. The credits will be sold over the counter, but in several years may be ready to trade on an exchange." Then-Costa Rican President, José Figueres, termed the credits "the first tradable commodity of global benefit." [51]

# JUDGING

## RISK ASSESSMENT

Are there risks? Yes. As with any other venture, forest carbon business opportunities are not without risk. Can you get a hedge against these risks? Yes. There are classes of risks that can be managed. And, as noted at the outset of this report, carbon-intensive businesses already face a certain amount of risk from inaction, given the likelihood of various GHG emissions policy shifts going into effect at local, national, regional, and international levels. Forest carbon offset project risks can be categorized as the following:

**Project performance:** will the carbon savings persist over the contractual time scale of the project?

Carbon losses can occur as a result of uncontrollable circumstances such as wildfires, storms, or pest outbreaks. Improperly designed projects could fail to accrue the estimated carbon savings. There is a risk of cost escalation if monitoring, measurement, and verification costs are underestimated. There are economic and financial risks associated with the relative costs of investment capital, currency fluctuations, and fiscal policy.

**Political risk:** will governments establish the institutions and procedures and sector policies (fiscal, resource use allocation, etc.) needed to allow forest carbon projects to occur?

Unstable political environments may pose the risk of contracts being cancelled, nationalization of assets, or change of rules governing repatriation of capital.

**Institutional risk:** will unresolved issues in the Kyoto Protocol be settled in a timely manner (i.e., clarifying issues surrounding baselines, institutional structures, implementation methodologies, guidelines, and criteria)?

Clarity is required on the current ambiguous language in the Protocol about forestry projects in CDM operations, and the need for agreement on trading rules and regulations.

**Trading risk:** will the trade of carbon credits arising from forest carbon offset projects be adversely affected if each country chooses to install different responsibilities for buyer and seller liability, and fails to establish transparent and fair processes? [6]



# THE RISKS

Recent decades have witnessed a rich variety of novel instruments and techniques for managing market risks. A number of mechanisms are being devised for managing carbon project risks. Creating a diverse portfolio of projects and using insurance instruments can help guard against unforeseen events.

## THE WORLD BANK'S PROTOTYPE CARBON FUND

The World Bank is establishing an institutional model that shows how risk can be spread across a larger portfolio of projects, akin to a mutual fund. In the case of carbon trading, the Clean Development Mechanism (CDM) under Article 12 of the Kyoto Protocol could provide the vehicle for involving developing countries. [43] Any trades are predicated on the project not only serving the investors' needs for carbon offsets, but also furthering the host country's sustainable development goals.

Toward this end, the World Bank is launching a Prototype Carbon Fund (PCF) capitalized at $110 to $120 million, with a maximum potential of $150 million. The PCF will operate through 2012, at which point it will be terminated based on the assumption that the private financial sector will have evolved a liquid market for officially sanctioned GHG emission allowances and certified abatement credits.

The Bank's Prototype Carbon Fund has three objectives:

- Demonstrate how project-based CDM emission reduction transactions can promote and contribute to sustainable economic development;
- Provide the parties to the UNFCC an opportunity to "learn by doing" as they deliberate on the rules, regulations, and procedures that will govern project-based CDM emission reduction transactions; and,
- Provide an example of how the Bank can partner with public and private sector investors to mobilize new resources for developing countries while addressing global environmental concerns.

The PCF design emphasizes knowledge generation, synthesis of insights and lessons learned, and the dissemination of this knowledge through an electronic database that will be maintained through the course of the Fund's implementation. [73]

## CAN FOREST CARBON SAVINGS BE MEASURED AND VERIFIED?

Measurement and verification are absolutely central to ensuring that real carbon savings can occur, and have occurred. Concerns raised about measurement uncertainty are overstated. The IPCC reports a high confidence in site-level estimates of net carbon conserved or sequestered under particular management schemes. [26]

While measurement uncertainty is overstated, ongoing work needs to focus on how to increase accuracy while reducing measurement costs. Scientists and forest ecosystem professionals are refining methods for quantifying the carbon storage benefits of land-use projects. The system applies standard forestry methods for measuring and analyzing biomass, along with accepted principles of forest inventory, soil science, and ecological survey. [30, 69] The availability of sophisticated computer modeling, GIS and satellite mapping, and standardized field monitoring practices provide powerful tools for minimizing and managing project risks. Simulation models are used for quantifying carbon flows, which can input into the model all the tree biomass, dead woody material, soil carbon, and use of wood products, allowing remarkably accurate projections to be made.

### SGS, SOCIÉTÉ GÉNÉRALE DE SURVEILLANCE: A THIRD PARTY CERTIFIER

SGS Forestry, headquartered in Switzerland, is one among a fast-growing breed of third party certifiers. [57] SGS Forestry was contracted by the Costa Rican government to help in the certification process for the government's Certified Tradable Offsets (CTO) program.

SGS provides third party verification for national, regional and global greenhouse gas control systems and the development of tradable permits. The SGS Forestry service includes formal analysis of project concept and design, monitoring of project implementation, and quantification of projected and achieved carbon offsets. Certificates are issued to recognize amounts of carbon offsets achieved, as in the case of Costa Rica's Certified Tradable Offsets.

Third-party certification can improve confidence in carbon offset projects and the credibility of offset claims. In this way, the market value of carbon offsets can be maximized and the possibility of tradable carbon offsets realized.

Buyers obtain independent assurance that carbon offsets exist and that their quality is sound. Regulators have an effective and efficient way of screening potential projects and ensuring achievement of carbon claims. The SGS Forestry methodology is based on specially designed software to simulate future carbon flows. The software also helps to check data quality and can include the use of satellite image analysis to verify patterns of land use change.

The growth of certified forest products can play a very effective role in carbon offset projects emphasizing reduced-impact, sustainable forest practices. More than 10 million hectares of forestlands have been certified under Forest Stewardship Council (FSC) guidelines. A joint World Bank-World Wildlife Fund project aims to bring 50 million hectares under certification within the decade. This certification positions forest tracts as high quality prospects for offering carbon offsets. [76]

## SPREADING THE RISK

Specialist global insurers have a long record of designing risk management assessment tools and insurance pools to spread the risks of unforeseen events in inherently dynamic systems such as agriculture.

These insurance skills and tools are already being examined for application to forest carbon project risk management, and initially, these appear competitive to in-project risk retention strategies. In other cases, best practices in project development and management (particularly in relation to forest health issues—fire, pest, and wind) can minimize or eliminate some risks.

Risks arising from improperly defined key parameters in a project can be reduced or avoided by:

- Correctly defining the baseline from which additional carbon reductions will be measured;
- Choosing an appropriate project lifetime that accurately estimates the net reduction of greenhouse gases from the atmosphere;
- Properly defining project boundaries (e.g., in dynamic settings where population growth, agricultural productivity, fuelwood needs, and deforestation concerns interact, an agroforestry project's impacts will extend beyond the areas of direct intervention, and must be considered accordingly); and,
- Anticipating leakage from inappropriate project designs.

Leakage is a potentially serious problem that could result in paying for emission reductions in one location, only to experience an increase in emissions in another. As an example, if a forested area used by the local community for fuelwood collection is placed in a protected park area, the community will gather fuelwood in an adjacent forest area. This simply shifts the source of carbon emissions. Project design must thus satisfy community needs (e.g., through monetary incentives or by including fuelwood agroforestry components in projects). This is exactly what was done in successful projects noted above in Costa Rica, Belize, Guatemala, and Mexico.

Leakage can also be positive. For example, the AES-CARE-Guatemala carbon offset project was actually sequestering more carbon than the company had paid for, according to a mid-term review completed in 1995-96. [5] Similarly, the Sabah RIL project has triggered replication in other countries, in part because of its sound economic value.

Political risk can be reduced by using bilateral and multilateral instruments to cover overall governmental commitments and specific policy risks. These political risk instruments can be structured so that they dovetail with commercial risk instruments to create comprehensive risk mitigation packages. The World Bank's Prototype Carbon Fund could play an effective role in this regard.

## BENEFITING FROM RISK MANAGEMENT

Risk management mechanisms are available and offer multiple benefits. Transferring risk out of a single project or a small portfolio of projects limits participants' financial exposure. In this way, risk management not only increases the performance and viability of diverse projects (and therefore investor liquidity), but also heightens the investment value and facilitates trade and financial flows.

Insurance, whether as a vehicle to provide additional credits or as a means to compensate foregone investment costs, can be of significant value to the buyer, seller, or investor. If a forest burns down before the end of the commitment period, private risk insurance can mitigate the risk. This is done by holding unregistered carbon offsets somewhere else in the world at a level commensurate with the risks assessed based on actuarial analysis.

Similarly, to buffer against possible carbon leakage, a contingency pool of carbon credits can be set up, comprised of a fixed ratio of a project's total offsets. Costa Rica, for example, is setting aside approximately 15 percent of its protected forests as "insurance" against possible forest loss under its "certified tradable offsets" (CTO) program. Costa Rica further combines this "insurance" with a risk-reducing portfolio consisting of a pool of bundled projects.

Some risk reduction is being achieved through bank guarantees and financial institution conditions on developing countries. Other risks are being addressed through private insurance. Compliance incentives offer another potentially effective means of controlling leakage. If political and commercial insurance instruments are simultaneously combined, then they provide an incentive for public and private sector compliance to policies that have additional benefits, such as biodiversity conservation, de-desertification, and rural poverty alleviation.

The bottom line is that risks can be sorted into classes, and the cost of risk mitigation is manageable through currently available or newly emerging tools that can be applied to specific projects. It would be wrong to presume that all, or even most forest carbon business opportunities, are risky.

# MITIGATE

# CAPTURING THE BUSINESS OPPORTUNITIES

The foregoing has suggested that there are discernible trends toward a carbon-constrained business environment. Some businesses, such as the global independent power supplier, AES, have taken these trends in stride. Beginning in the late 1980s, AES initiated forest projects that offset the emissions of their fossil-fired power plants at a cost of roughly 50 cents per ton of carbon. A decade later, despite inflation, AES was entering into forest offset projects at a cost below 20 cents a ton. [1] Clearly the firm's accumulated experience with forest offsets is paying cost-cutting dividends.

This report has also highlighted the numerous opportunities that forestlands represent for achieving carbon offsets at economically attractive costs. There is value to be gained by forestland owners and managers who build relationships with carbon-intensive companies in search of ways to sequester or offset carbon emissions.

Monitoring these trends ensures that your company is alert to low-risk, low-cost hedging strategies and potentially profitable opportunities and new business ventures. Actually capturing these new business opportunities will require taking a fresh new look at the value chains and value systems from which your industry has traditionally operated and made decisions. As this report has shown, this is exactly what companies like BP Amoco, Shell International, Dupont, Interface, Toyota, and other carbon-intensive firms are in the process of doing.

**"Perfection is Impossible, Delay Unacceptable**
**Imperfection is Inevitable: start [trading] now, improve as we go."**

Richard Sandor, CEO, Environmental Financial Products
*Market-Based Solutions to Climate Change*



GLOSSARY

## GLOSSARY OF CARBON, FOREST, AND CLIMATE TERMS

**Additionality**—environmental or emissions additionality refers to the carbon accounting procedures being established under the Kyoto Protocol, whereby projects must demonstrate real, measurable, and long-term results in reducing or preventing carbon emissions that would not have occurred in the absence of CDM activities. Proof of additionality is critical because developing countries do not have legally binding reduction commitments by which to judge changes in national baselines. This makes project baselines essential, as well as the ability for independent verification of a project's real, measurable results. [43]

**Afforestation**—refers to the planting of trees on land which was not previously forested, e.g., pasture or unusable agriculture lands.

**Agroforestry**—is an effective technique to raise farm productivity and reduce pressure on forests. The practice involves integrating tree growing with agricultural crops or livestock. Successful agroforestry projects have achieved 25 to 100 percent increases in crop production by planting multi-purpose trees to reverse soil erosion, build up soil fertility, and create an improved micro-climate for crops and livestock.

**AIJ—Activities Implemented Jointly**—a voluntary, participatory program initiated by the UNFCCC in 1993 as a pilot phase for bilateral agreements between industrial country investors and project hosts in developing countries who potentially could provide projects for carbon emissions reductions to the investors at a lower cost than domestic abatement.

A major difference between AIJ and JI under Article 6 of the Kyoto Protocol is that the former involved no credits or certified reductions. Another key difference is that AIJ projects were designed to help developing country hosts benefit from new investment that increased economic productivity and reduced local environmental problems. In contrast, JI projects can be undertaken only between industrialized countries. The CDM under Article 12 of the Kyoto Protocol now functions as the mechanism for collaborative projects between industrialized and developing countries.

**Annex I countries**—the list of industrialized countries agreeing to legally binding reductions of GHG emissions below 1990 levels, under the 'Berlin Mandate' adopted by the UNFCCC in 1995.

**Annex B countries**—the list of countries that can participate in emissions trading under Article 17 of the Kyoto Protocol, and their specific reduction commitments, or QELRCs.

**Assigned Amounts**—under the Kyoto Protocol, each industrialized nation is allocated an "assigned amount" of GHG emissions for the 2008 to 2012 commitment period. Assigned amounts represent what a country can legally release during this five year period.

**Berlin Mandate**—adopted at the first meeting of the FCCC Conference of Parties (COP 1) in Berlin in 1995, which required industrialized countries to agree to legally binding reductions of GHG emissions below 1990 levels.

**CBD—Convention on Biological Diversity**—170 nations have become signatories to the CBD, which entered into force at the end of 1993, in order to arrest the staggering loss of the world's life and genetic resources. The current extinction rate has been conservatively estimated to be 50 to 100 times the average expected natural rate. In tropical rainforests the rate of species extinction is 10,000 times faster than the average expected natural rate. Scientists warn that one in five species could go extinct within the next 30 years. IPCC scientists also warn that climate change will worsen this problem.

**Carbon dioxide** ($CO_2$)—roughly 3.7 units of $CO_2$ equal 1 unit of carbon (C), or alternatively, 1 unit of $CO_2$ equals 0.27 units of C. $CO_2$ plays a critical role in creating and regulating the earth's climate. Although $CO_2$ only constitutes 360 parts per million (ppm) volume of the earth's atmosphere, scientists are warning that carbon emissions should be reduced 60 to 80 percent below 1990 levels in order to stabilize atmospheric concentrations at 550 ppm.

**Carbon flux**—carbon "fluxes" represent the flow over time from one carbon stock to another, such as fossil fuel combustion releasing carbon to the atmospheric stock, or plant photosynthetic growth absorbing atmospheric carbon into the terrestrial stock.

**Carbon sequestration**—the incremental addition to a carbon stock. Sequestration and stocks are often confused. For example, a 450-year old *Pseudotsuga-Tsuga* (Douglas Fir/Hemlock) forest in Canada has a very large accumulated stock (600 tons per hectare, tC ha) with a low annual sequestration rate of about 3 tC/ha. In contrast, a pasture of Panicum and Brachiaria grasses in Brazil might have up to 70 tC/ha, but when converted through an afforestation effort with fast-growing tree species may experience a sequestration rate of 8 tC/ha per year. [11]

**Carbon stocks, sinks, and sources**—a stock that is absorbing carbon is called a "sink" and a stock that is releasing carbon is known as a "source." The global carbon cycle continually experiences fluxes, or flows, between the carbon stocks stored in oceans, land, and the atmosphere. It is estimated that changes in carbon stocks from 1850 to 1995 have added some 160 billion tons of carbon (gigatons, GtC) into the atmosphere: 368 GtC were released from industrial emissions and land-use changes, while 206 GtC have been absorbed by ocean and terrestrial sinks. The big concern is that "business-as-usual" economic development over the next 100 years could increase stock emissions 600 percent, to some 1,000 GtC. [4]



**CDM**—Clean Development Mechanism—defined in Article 12 of the Kyoto Protocol, the CDM is a project-based mechanism whereby Annex I (industrialized) countries can accrue "certified emission reduction units" (CERs) in return for financing carbon reduction project activities in non-Annex I (developing countries) that help further their sustainable development.

**CERs—Certified Emission Reduction units**—the tradable unit in a Clean Development Mechanism project, as defined in Article 12 of the Kyoto Protocol.

**CIMs—Cooperative Implementation Mechanisms**—the three mechanisms included in the Kyoto Protocol which may be used by Annex B Parties (industrialized countries) to supplement domestic actions to fulfill their quantified emission limitation and reduction commitments (QELRCs). They include the Clean Development Mechanism (CDM), Joint Implementation (JI), and International Emissions Trading (IET). Also referred to as the "Kyoto Mechanisms" or "Flexible Mechanisms."

**Cubic meter (m3)**—a common measure used in forestry. One m3 of wood contains roughly half a ton of carbon.

**ERU—Emission Reduction Units**—the tradable unit in a Joint Implementation (JI) project, as defined in Article 6 of the Kyoto Protocol.

**Flexibility Mechanisms**—also called the "Kyoto Mechanisms," refers to the three Cooperative Implementation Mechanisms (CIMs) in the Kyoto Protocol: International Emissions Trading, Joint Implementation and the Clean Development Mechanism.

**FCCC—United Nations Framework Convention on Climate Change**—the FCCC, along with the Convention on Biological Diversity (CBD), were two agreements to emerge from the 1992 U.N. Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil. The FCCC established a voluntary multilateral agreement to reduce industrialized nations' emissions of GHGs to 1990 levels by the year 2000, which has been ratified by 170 countries.

**GHG—Greenhouse Gases**—are radiatively active trace gases in the atmosphere that trap infra-red heat. The earth absorbs the sun's short-wave, ultraviolet radiation and emits long-wave, infra-red radiation to outer space. The absorption of radiation causes warming. How much infra-red energy escapes to outer space is strongly affected by the composition of the earth's atmosphere. Clouds ($H_2O$) and accumulating gases in the atmosphere, such as carbon dioxide ($CO_2$), methane ($CH_2$), nitrous oxides ($N_2O$), and chlorofluorocarbons (CFCs) absorb some of this outgoing infra-red radiation. In addition to carbon dioxide, prominent GHGs related to forests include methane and nitrous oxides, which are released in the clearing and burning of forests.

**IET—International Emissions Trading**—as defined in Article 17 of the Kyoto Protocol, Annex B Parties may participate in GHG emissions trading as a means of

fulfilling part of their quantified emission limitations and reduction commitments (QELRCs), whereby companies or countries that achieve an excess of emissions reductions can sell them to other companies or countries in need of low-cost credits.

**IPCC—Intergovernmental Panel on Climate Change**—established as a special body by the UN Environment Programme and the World Meteorological Organization to provide assessments to policymakers of the results of ongoing climate change research, which is posted at *http://www.ipcc.ch/*

**JI—Joint Implementation**—as defined under Article 6 of the Kyoto Protocol, is a project-based approach for achieving GHG reductions between Annex B Parties. "Any such project that provides a reduction in emissions by sources, or an enhancement of removal by sinks, that is additional to any that would otherwise occur," Article 6.1(b). JI enables, for example, country-X to finance implementation of a project in country-Y in order to receive "emissions reduction units" (ERUs), which are a portion of country-Y's assigned amount.

**Kyoto Protocol to the UNFCCC**—establishes legally binding commitments for Annex I countries to collectively reduce GHG emissions by more than 5 percent below 1990 levels by 2008 to 2012, and establishes a set of mechanisms—IET, JI, and CDM—that allow countries to achieve their commitments at the lowest possible cost. As of March 1999, one year after the Protocol was open for signing, 84 countries had become signatories.

**Leakage**—refers to unexpected carbon losses related to a particular carbon offset project. The leakage may be due to unforeseen circumstances that were beyond the control of a forest conservation or sequestration project. Unforeseen events include extreme weather, political instability, climate change, pests, disease, fire, or cancellation of contracts that lead to logging. Research on leakage suggests that it can be anticipated and avoided through good project design. Where leakage is unavoidable, net carbon estimates can be revised, incorporating leakage effects.

**QELRCs—Quantified Emission Limitation and Reduction Commitments**—listed in Annex B of the Kyoto Protocol, QELRCs are the amount of GHG emissions which a country must not release, hence reduce. These differ from nation to nation—reductions of 7 percent for the U.S., 8 percent for the European Union, 6 percent for Japan, but an 8 percent increase for Australia—with the aggregate reduction goal being 5.2 percent below 1990 levels, to be achieved by the 2008 to 2012 period. Also referred to as QELROs (O for Obligations), the term used in international negotiations prior to the Kyoto Protocol.



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