

**EMERGING OPPORTUNITIES:  
CERTIFICATION AND CARBON MARKETS**  
**MAINE FUTURE FOREST ECONOMY PROJECT**



**CURRENT CONDITIONS AND FACTORS INFLUENCING THE  
FUTURE OF MAINE'S FOREST PRODUCTS INDUSTRY**

**MARCH 2005**

**PREPARED FOR:**

**DEPARTMENT OF CONSERVATION – MAINE FOREST SERVICE  
AND  
MAINE TECHNOLOGY INSTITUTE**



**INNOVATIVE NATURAL RESOURCE SOLUTIONS LLC**  
107 ELM STREET, SUITE 100-E  
PORTLAND, ME 04101  
[www.INRSLLC.com](http://www.INRSLLC.com)

*This material was prepared with financial support from the Department of Conservation – Maine Forest Service and the Maine Technology Institute. However, any opinions, findings, conclusions, or recommendations expressed are those of Innovative Natural Resource Solutions LLC unless otherwise noted, do not necessarily reflect the views of the Maine Department of Conservation, the Maine Forest Service, the Maine Technology Institute, or the project's Advisory Committee, and do not constitute an endorsement of products or services mentioned.*

*The analysis contained in this report is based upon our best professional judgment and on sources of information that we believe to be reliable. However, no representation or warranty is made by Innovative Natural Resource Solutions LLC or other authors of this report as to the accuracy or completeness of any of the information contained herein. Nothing in this report is, or should be relied upon as, a promise or representation as to the future.*

*Cover photos by Maine Pulp & Paper Association, Small Woodland Owners Association of Maine and Innovative Natural Resource Solutions LLC (at Hillside Lumber). Used with permission.*

*Printed Under Appropriation 013-04A-5180-512-4099 FFE3*

*Developed Under a Cooperative Forestry Assistance Grant CFDA 10.664*

*The USDA Forest Service prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, and marital or family status (not all prohibited bases apply to all programs). Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).*

*To file a complaint of discrimination write: USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Ave, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice or TDD). USDA Forest Service is an equal opportunity provider and employer.*



**EMERGING OPPORTUNITIES:  
ROLE OF CERTIFICATION  
CARBON MARKETS**



## Role of Certification

### Introduction

Forest and related forest products manufacturing certification (certification<sup>191</sup>) programs have grown exponentially since their initial introduction in North America in the early 1990s. Their true effect in the marketplace, and their bottom-line effects, are less certain, however. Maine has been the leading U.S. state in implementation of certification programs.

### History of Certification

It is important to understand that the roots of modern certification lie early in the 20<sup>th</sup> century, beginning with early concerns about timber famines and subsequent threat of federal forest practice regulation in the 1930s. One outcome of those early concerns was the creation of the American Tree Farm System in 1940 and the first certified Tree Farm (Weyerhaeuser) in Washington State in 1941.

More recent source issues for certification began with the worldwide concern for tropical deforestation by the International Tropical Timber Organization (ITTO) in the 1980s, and subsequent failure of voluntary European tropical log importation bans. This was soon followed by the Earth Summit (UN Conference on Environment & Development) in Rio de Janeiro in 1992, which resulted in Agenda 21 for sustainable economic development and Statement of Forest Principles. Soon after, regional governmental processes as follow up to the Rio summit resulted in the Montreal Process (Criteria and Indicators for forest sustainability for North American temperate forests) and the Helsinki Protocol, a similar set of criteria for European temperate forests.

The Forest Stewardship Council (FSC), a non-profit entity founded by the environmental community along with some forest products industry leaders, was founded in 1993 to address the growing concern for unsustainable forest practices in tropical forests. Today, the FSC is one of the largest worldwide forest certification programs based on their 103 million acres of certified land worldwide.

In 1995, the forest products industry in the United States launched its own program, the Sustainable Forestry Initiative (SFI). The early program, with self-verification as its core, resulted from the industries interest in improving its image and “social license” to practice forestry in the United States. Concern for the proliferation of state forest practices acts and related regulation, in part, prompted this “self-policing” approach in improving practices through an industry-based program. In 1999 it became a full

---

<sup>191</sup> *Certification* here means forestlands verified to a sustainable forestry standard by an independent third-party audit. The term also refers to the related tracking system of wood coming from certified forests (called chain-of-custody by some systems) or log procurement systems for forest products manufacturing under the Sustainable Forestry Initiative. ISO 14001- type process certification which, when not coupled with a sustainable forestry standard, usually do not lead to certified products in the market, are not included.



certification program with the advent of third-party auditing requirements. The SFI is closely linked to the ISO 14001 Environmental Management System standard – a program that certifies a company or entity system for environmental issues management. The SFI covers the U.S. and Canada. In Canada, the Canadian Standards Association (CSA) launched a forest certification standard in 2000. The CSA program covers Canada and is closely connected to ISAO 14001.

Many other certification programs have been launched, chiefly in Europe, Australia and New Zealand and Malaysia, among other locations. Many of these systems are now certified under the umbrella Programme for the Endorsement of Forest Certification Schemes (PEFC) – a program that requires the certification systems themselves to meet a certain standard focused on both process and content issues.

An historical look at certification would be incomplete without at least a notation about the role the environmental community has played in the development of forest certification. Especially in the earlier years of certification in the 1990s, large portions of the worldwide environmental community supported only one certification system – the FSC. In the U.S. this has also been true and, the more radical members of the environmental community have not only supported FSC, but have also spent significant resources voicing strong public concerns about other certification systems – chiefly the SFI. While those concerns have lessened as the various certification systems have evolved, there remains a strong preference by the environmental community for the FSC.

While the initial concerns for the conservation of tropical forests resulted in the creation of several of the early forest certification systems, this issue is no longer driving certification. Temperate forests now make up the majority focus of certification in the world. As yet, recognition of forest certification and demand of any significance for products from certified forests by the consumer is negligible worldwide. Studies show (see next section) that awareness and demand at the consumer level is likely strongest in the United Kingdom.



## Status of Certification

Approximately 235 million hectares (587 million acres)<sup>192</sup> of the world's forests are currently certified by one of the major certification systems -- primarily Forest Stewardship Council (FSC) worldwide, Sustainable Forestry Initiative (SFI) in the United States and Canada, Canadian Standards Association (CSA) in Canada only, Programme for the Endorsement of Forest Certification Schemes (PEFC) worldwide (formerly Pan European Forest Certification system) and the American Tree Farm System (ATFS) in the United States. This acreage has grown by over 100 million hectares in the last 16-18 months, from 2003 to late 2004. In 1999, certified acreage worldwide was less than 20 million hectares or 50 million acres (primarily FSC).

The PEFC is a system to certify national certification systems, so it includes many different national systems in Europe and elsewhere. The American Tree Farm System, directed primarily at family forests or smaller acreages, is not a true third-party system but a new group certification sub-program of the ATFS is.

Worldwide, the major forest certification programs currently have approximately the following acreages under certification: FSC – 106 million acres; PEFC – 130 million acres; SFI – 94 million acres; ATFS – 33 million acres (mostly second-party certified under their Tree Farm Inspector program).

Geographically, more than 90% of the total forest area certified in the world is still in the northern hemisphere, with about half of the certified forest area located in Europe and over 40% in North America. Developing countries account for only around 10% of the total forest area certified – mostly plantations in Brazil, Gabon and South Africa. This imbalance between developed and developing countries has changed rapidly. In 1996 the share of the total in developing countries was approximately 70%<sup>193</sup>.

In Maine, the first certified acreage was the 970,000-acre Pingree Heirs ownership certified to the FSC Standard in 1992 (the second certified ownership in the United States).

---

<sup>192</sup> Ben Gunneberg, Secretariat-General, Programme for the Endorsement of Forest Certification Schemes, in a presentation at The Sustainable Forestry Initiative Program 2004 Annual Conference, Austin, Texas, September 22, 2004.

<sup>193</sup> Forest Products Annual Market Analysis 2002-2004, United Nations, Geneva, 2003



In Maine today, the certified forest acreage is as follows<sup>194</sup>:

### Landowners and Mills in Maine with Third Party Certification of Sustainable Forest Management

	Acres	Certification or Verification System			
		FSC	SFI	ISO	Tree Farm
<b>Certified Landowners</b>					
Baskahegan Land Company	101,000	X			
Baxter State Park Scientific Forest Management Area	29,600	X <input type="checkbox"/>			
Bayroot Timber LLC	500,000				
Hancock Land Company	33,000	X			
International Paper Company	1,205,000		X	X	
Irving Woodlands LLC	1,550,000		X	X	
Maine Department of Conservation Bureau of Parks and Lands	485,000	X <input type="checkbox"/>	X		
NexFor / Fraser Papers	238,000		X <input type="checkbox"/>	X	
Non-Industrial Private Forest Landowners	300,000				X
Plum Creek Timber	953,492		X <input type="checkbox"/>		
Robbins Lumber	30,000		X		
Seven Islands/Pingree Associates	941,000	X	X		
The Nature Conservancy	170,000	X			
Typhoon LLC	430,144		X		
<b>Certified Land Managers for Multiple Landowners</b>					
Mid Maine Forestry	7,042	X <input type="checkbox"/>			
Two Trees Forestry	17,228	X <input type="checkbox"/>			
Hancock Land Company	1,000	X <input type="checkbox"/>			
New England Forestry Consultants, Inc		X <input type="checkbox"/>			
<b>Group Certifications</b>					
SWOAM – ATFS Group	30,000				X

<sup>194</sup> ME Department of Conservation website and follow-up communication, January 10, 2005



	Acres	Certification or Verification System			
		FSC	SFI	ISO	Tree Farm
<b>Certified Mills</b>					
A.E. Sampson & Son, Ltd		X			
Columbia Forest Products		X			
Georgia Pacific Corporation			X		
Louisiana-Pacific Corporation			X		
J. M. Huber Corporation - Wood Products			X		
H. A. Stiles Company (HASCO)		X			
International Paper			X		
Maine Ornamental Woodworkers, Inc.		X			
Maine WoodNet Certified Group		X			
Maine Woods Company LLC		X			
MeadWestvaco <sup>195</sup>			X		
SAPPI			X		

<sup>195</sup> On January 18, 2005 Mead Westvaco announced plans to sell its paper division, including the mill in Rumford, to the investor group Cerberus Capital Management L.P.



### ***Governor Baldacci Initiative***

In June of 2003, Maine Governor John Baldacci launched the Maine Forest Certification Initiative. According to the Governor's announcement on the effort, the purpose of this initiative was to "help grow Maine's forest industry by distinguishing Maine products in the marketplace while improving forest management on the ground."

Maine has the highest percentage of certified forestland in the nation at approximately 35%. Striving to be the leading state in forest certification may provide market advantages to Maine but more must be done than just adding certified acreage. An obvious non-market benefit to the public includes more sensitive forest management being implemented. The Governor said in his release on the effort that "certification has been a significant force for improving forest management in Maine, increasing the attention paid to balancing harvest with growth, maintaining water quality, and achieving other environmental objectives."

Governor Baldacci also intended the Maine initiative to lessen the need for additional forest management regulations, using, instead, a market-based approach.

The core of the initiative is "to increase the amount of certified forestland in Maine from 6.5 million acres to at least 10 million acres by the end of 2007."

#### **The Governor also identified several actions that would be taken by the State to help achieve this goal, including:**

1. Certifying actively managed State lands, including approximately 100,000 acres managed by the Department of Inland Fisheries and Wildlife;
2. Giving preference in State purchasing to certified wood and paper whenever practicable;
3. Providing technical assistance, outreach, and encouragement for landowners large and small seeking to become certified;
4. Providing preference in Maine Forest Service cost share programs for landowners, resource managers, and loggers entering certification systems;
5. Paying part of the cost for foresters to become certified resource managers, and encouraging the expansion of the Master Logger Certification Program and the Small Woodland Owners Association of Maine's initiative to enroll small woodland owners in the Tree Farm Program using Tree Farm's new 2004 standards.



## Prospects for the Future of Certification

In 2004, demand for Certified Forest Products (CFPs) by private end consumers remains an insignificant factor in the worldwide market for these products. Nevertheless, worldwide, general consumer sentiment on deforestation, forest degradation, loss of biodiversity and, notably, on tropical deforestation, keeps the sector under pressure to act.<sup>196</sup> Wholesale markets for wood and paper products, however, are increasingly demanding certified product although price premiums for certified product are not significant.

Research also shows that, other things being equal, consumers in the U.S. and elsewhere prefer CFPs over identical non-certified products<sup>197</sup>.

The United Nations *Forest Products Annual Market Analysis 2002-2004* describes this consumer end challenge:

“Forest certification is increasingly becoming a main instrument for communication on sustainable forest management throughout the forest and trade sectors, with enhanced public relations efforts by programmes such as PEFC. However, consumer awareness of even the longest established logo on Certified Forest Products, that of the FSC, is still low in markets such as those in Germany, then Netherlands and Austria, with somewhat higher rates of logo recognition in more established markets, such as the United Kingdom, where increased logo recognition has been claimed by FSC, based on data from surveys. In Eastern Europe, the driving force for certification is not domestic consumer demand, but export markets and demand by certain major retailers. This retailer-driven demand can also be recognized in North America, although, according to experts, certification is not necessary for market access, and will not be in the near future. Many players active in the market see the lack of consumer awareness and interest as a major obstacle for market growth.”

One consumer sector that is creating additional demand for CFPs worldwide (including in the U.S.) is the government market sector. Several national Governments in European markets, including those of the United Kingdom, the Netherlands, Denmark, France and Germany, have announced public procurement policies that include criteria favoring the purchase of CFPs, notably from tropical countries. Similar policies exist at municipal levels in several European countries. The United Kingdom Government was one of the first to set up a procurement policy and issue a guidance document on timber procurement in 2000.

Governor Baldacci’s policy on state procurement of CFPs is one example of growing programs in the U.S. In 2003 and 2004, the City of New York developed its own

---

<sup>196</sup> Forest Products Annual Market Analysis 2002-2004, United Nations, Geneva, 2003

<sup>197</sup> Anderson and Hansen (2003). “Do Forest Certification Ecolabels Impact Consumer Behaviour? Results from an Experiment”; Research brief, May 2003, *Wood Science & Engineering*, Oregon State University.



procurement policy on wood and paper products, giving preference to certified product. More can be expected in the U.S. on this front.

Severely lacking worldwide, however, is advertising and marketing plans to develop product brand awareness of certified forest product by consumers. The Forest Stewardship Council has used well-known U.S. celebrities such as Jennifer Lopez to push its certified brand – though a sustained effort has not been seen. The backing organization that created the Sustainable Forestry Initiative, the forest products trade group American Forest and Paper Association, had developed a substantial multi-million dollar marketing program for its SFI brand in 2002 but never implemented it due to concerns over environmental organization protests with its on-product-label that was launched around that time.

While certification in the northern hemisphere seems to be reaching new plateaus, the situation in the tropics (where certification genesis really began) is much less sure. Growth in certified acres will not mirror that in the northern hemisphere. Government roles may be different there than in the north as illegal logging and lack of regulated business infrastructures make using private, market-based certification systems more difficult due to the plethora of opportunity for fraud and corruption.

### **Potential Benefits to Maine Forest Products Industry**

Forest certification has already yielded market benefits to Maine companies as at least one paper buyer for Time Inc. has stated in no uncertain terms that his company is purchasing more paper (in a reduced demand market) from Maine than before simply due to the large percentage of certified forested acres<sup>198</sup>. For most other markets, however, it is unclear what benefits certified forest products will yield to companies and the state as a whole.

Clearly forest management has improved on-the-ground in this surge of certified acres over the last 5 years especially, when certified acreage increased by several fold. All the major certification standards include clear criteria that address sustainability factors such as biodiversity conservation, special places conservation, water quality improvement, wildlife habitat protection and timber sustainability, among others. Mainers can be assured that these programs have made a difference in the future sustainability of the forests of the Pine Tree State. But will the programs themselves be sustained, thereby assuring this continuing conservation concern? Markets are key to trying to answer this question.

Most certified landowners will agree that market pull (even at the wholesale level) for certified product is meager at best. Maine's first acre to be certified was in 1992 – twelve years ago. The market potential for certified forest products was highly touted then and still may be realized, but not without serious action. Companies that have made the

---

<sup>198</sup> David Refkin, TimePaperCo at Blaine House Conference, November 17, 2003



commitment to certification need to see substantial changes in certified product market pull in order to stay in the certified forest game.

Several key actions are needed to realize the potential that exists for Maine certified forest products:

1. State government in Maine needs to get very serious about its interest in being a certified product consuming market leader. Very specific certified product purchasing targets must be set and met beginning immediately.
2. Maine certified companies must pressure the certification programs (chiefly the Forest Stewardship Council and Sustainable Forestry Initiative) to invest in serious marketing of these programs and their brands to the consuming public.
3. Maine state government should develop its own marketing initiative to reach consumers in Maine and surrounding states and provinces, at least.
4. Maine state government should continue to work with entities involved in the certification of small acreage lands (family forest owners) but should act as facilitator only in order to keep the certification programs private and market driven.
5. The private sector needs to increase the number of mills that are certified under the various certification programs because in order to get certified forest products from the woods to the marketplace, certified mills are an essential pass-through point.

## **Conclusions**

Forest certification continues to grow in the northern hemisphere but lack of consumer awareness of the programs and the values they deliver may cause certification reductions in the next five years. The key actions needed to prevent a peaking of this market-based phenomenon is aggressive marketing to wholesalers and especially consumers by all involved parties. Certification may provide opportunities to distinguish Maine forest products in the marketplace regionally and globally, but not without very active participants working to create significant consumer pull.



## Emerging Opportunities for the Forest Products Industry from Carbon Sequestration

Emerging opportunities may exist for the sequestration of carbon in U.S. forests as part of a strategy to mitigate greenhouse gas emissions. Unfortunately, there is no true “market” for greenhouse gas emissions reductions in the U.S., meaning that investments in actions to increase carbon sequestration or to offset greenhouse gas emissions remain speculative.<sup>199</sup> As markets develop, however, the forest products industry may be in a position to benefit from carbon sequestration because processing wood into long-lived products such as lumber and furniture can enhance carbon sequestration from terrestrial ecosystems.<sup>200</sup> Furthermore, wood consumption in the U.S. increased to 18.1 billion cubic feet in 1997 from 12.1 billion cubic feet, offering an opportunity to leverage the environmental benefits of wood products to a growing consumer base.<sup>201</sup>

### Opportunities

In addition to the long-lived nature of many wood products, wood possesses characteristics that make it an attractive alternative to other materials such as steel, plastics and concrete. Wood products have two main advantages: the first is that they are produced from a renewable resource. The *net* emission of carbon dioxide to the atmosphere from burning wood is zero, if the area producing the wood is managed sustainably. This is because new growth in a sustainably managed forest will sequester carbon to offset emissions. Second, wood products often require less energy in their production.<sup>202</sup> As the tables below demonstrate dramatically, wood shows much less environmental impact than steel in the areas of energy consumption and air and water pollution.<sup>203</sup>

<b>Energy Consumed in Manufacturing Wood vs. Steel-Framed Interior Walls (GJ)</b>		
	<b>Wood Stud Wall</b>	<b>Steel Stud Wall</b>
Extraction	0.7	1.2
Manufacturing	2.1	9.7
Construction	0.6	0.6
<b>Total</b>	<b>3.4</b>	<b>11.5</b>

<sup>199</sup> Peter Zaborowsky and Jeffrey Reamer. Reality check for the U.S. GREENHOUSE GAS market. *Evolution Markets Executive Brief*. 2004.

<sup>200</sup> Northeast State Foresters Association. Carbon sequestration and its impacts on forest management in the Northeast. December 19, 2002.

<sup>201</sup> Edited by Michael Strigel and Curt Meine. Report of the intelligent consumption project. A collaborative project of the Wisconsin Academy of Sciences, Arts and Letters. USDA Forest Service, Forest Products Laboratory. May 2001.

<sup>202</sup> Peterson, A.K. and B. Solberg. Substitution between floor constructions in wood and natural stone: comparison of energy consumption, greenhouse gas emissions, and costs over the life cycle. *Can. J. of For. Res.*, 33: 1061-1075. 2003.

<sup>203</sup> Doug MacCleery. *Resource Consumption, the Land Ethic, and NIMBYism*. Presentation to the New England Society of American Foresters, March 18, 2003.



<b>Air Pollution Produced in Manufacturing Wood vs. Steel-Framed Interior Wall</b>		
<b>Emission/Effluent</b>	<b>Wood Wall</b>	<b>Steel Wall</b>
CO2 (kg)	305	965
CO (g)	2,450	11,800
SOX (g)	400	3,700
NOX (g)	1,150	1,800
Particulates (g)	100	335
VOCs (g)	390	1,800
Methane (g)	4	45

<b>Water Pollution Produced in Manufacturing Wood vs. Steel-Framed Interior Wall</b>		
<b>Emission/Effluent</b>	<b>Wood Wall</b>	<b>Steel Wall</b>
Suspended Solids (g)	12,180	495,640
Non-ferrous metals (mg)	62	2,532
Cyanide (mg)	99	4,051
Phenols (mg)	17,715	725,994
Ammonia (mg)	1,310	53,665
Halogenated organics (mg)	507	20,758
Oil and grease (mg)	1,421	58,222
Sulphides	13	507

Some analysis of energy and material use comes from the methodology of Life Cycle Analysis, or LCA. LCA accounts for resource use and emissions from production, use, and waste handling of materials, also known as a “cradle to grave” analysis.<sup>204</sup> Analyses of energy use and cost-effectiveness of wood products are not yet well developed, however, researchers are beginning to show that wood is often a good alternative to other materials. For example, a recent study shows that floor covering in solid oak produces less greenhouse gas emissions than products such as linoleum, vinyl, carpet in polyamide, and carpet in wool.<sup>205</sup> The authors note that wood tends to be more expensive than these alternatives but that cost considerations could be offset by taxes on greenhouse gas emissions (N.B., these taxes do not currently exist, and are not a leading part of current U.S. policy dialogue). Another study by the same authors shows that wood flooring is more energy intensive than stone flooring but that the wood option has lower greenhouse gas emissions.<sup>206</sup> More work remains to be done on the potential for substitution of other materials with wood products. Much depends on the type of wood product, its longevity, and its disposal at the end of its life, particularly whether the product is disposed of in a landfill or burned.

<sup>204</sup> Peterson, Ann Kristin and Birger Solberg. Greenhouse gas emissions and costs over the life cycle of wood and alternative flooring materials. *Climatic Change*, 64: 143-167. 2004.

<sup>205</sup> Peterson, Ann Kristin and Birger Solberg. Greenhouse gas emissions and costs over the life cycle of wood and alternative flooring materials. *Climatic Change*, 64: 143-167. 2004

<sup>206</sup> Peterson, A.K. and B. Solberg. Substitution between floor constructions in wood and natural stone: comparison of energy consumption, greenhouse gas emissions, and costs over the life cycle. *Can. J. of For. Res.*, 33: 1061-1075. 2003.



## Challenges

Three main challenges exist for the forest products industry to take advantage of markets for carbon sequestration. First, LCA of forest products is still in its infancy and the cost-benefit advantage of wood over other products is not always straightforward. Second, there is no recognized accounting system that certifies the amount of carbon stored in wood products. Third, accounting for carbon in wood products is predicated on predictions about the longevity of any particular wood product. Statistics on the production and international trade rates of wood products are compiled, but little is known about the decay and disposal rates of harvested wood products.<sup>207</sup> Additionally, the use of wood residues as bioenergy could be better utilized to displace fossil energy. One study shows that these factors may be more important in the total greenhouse gas balance of utilization of wood products than the carbon sink impact.<sup>208</sup>

## Outlook

Evidence that markets for carbon sequestration will benefit producers of wood products such as sawmills and other manufacturers remains limited and mostly anecdotal. There is growing evidence that for many purposes the production of wood products is more energy efficient and the products longer lasting than other materials, however, use of wood is dependent on cost-competitiveness. Additionally, relatively little is known about the longevity of various wood products. Still, increased use of wood-based products could be one of the many pathways for increasing carbon sequestration and mitigating greenhouse gas emissions. In the short term, opportunities exist to market the energy efficient aspects of wood products for certain uses. In the longer term and if markets for carbon sequestration develop, opportunities may exist to market the role of wood products as carbon sinks and hence as a pathway for greenhouse gas emissions avoidance.

---

<sup>207</sup> Pingoud, K., et al. Carbon dynamics in wood products. *Mitigation and Adaptation Strategies for Global Change*, 6: 91-111. 2001.

<sup>208</sup> Pingoud, K., et al. Carbon dynamics in wood products. *Mitigation and Adaptation Strategies for Global Change*, 6: 91-111. 2001.

