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111

Review of the Japanese Green Building Program and the Domestic Wood Program

Ivan Eastin

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Center for International Trade in Forest Products

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Center for International Trade in Forest Products
College of Forest Resources
University of Washington
Box 352100
Seattle, WA 98195-2100

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Executive Summary

Japan is a timber deficit country that requires substantial volumes of imported timber to meet its domestic demand for wood. To a large degree, wood demand in Japan is tied to housing starts where approximately 43% of new homes are framed with wood. This reliance on imported wood has always caused a tension in Japan where forests cover two-thirds of the country and there is an extensive sawmill industry skewed heavily to small, rural sawmills using outdated technology. A high cost structure has made both the forestry and sawmill industries uncompetitive on a global scale and, as a result, imported softwood lumber has come to dominate the Japanese market. Over the years, the Japanese government and the forest products industry have tried a number of strategies to improve the competitiveness of the forestry and sawmill sectors. Despite the closure of more than 10,000 sawmills over the past twenty years, the Japanese sawmill industry remains uncompetitive and plagued by small, inefficient sawmills located in rural areas far from the main demand markets. It is against this backdrop that the most recent regulatory initiatives to protect the domestic sawmill industry from international competition must be viewed. These regulatory initiatives include: 1) providing preferential treatment for domestic timber within the proposed CASBEE-Sumai green home building program, 2) using subsidies at the prefectural level to increase the share of domestic timber used in post and beam wooden homes to at least 50% and 3) and using subsidies at the national level to target an increase in the market share of domestic timber used in the post and beam industry from the current 30% to 60% by 2015.

Concerns about global warming and the environment and their commitments under the Kyoto Protocol have led the Japanese to develop a green building program, called CASBEE, to reduce the environmental footprint of commercial and residential buildings (CASBEE is the acronym for Comprehensive Assessment System for Building Environmental Efficiency). As part of its commitment as a signatory of the Kyoto Protocol, Japan is committed to reduce its emissions of greenhouse gases through a variety of strategies. The Kyoto Protocol was negotiated in Kyoto, Japan in December 1997 and came into force on February 16, 2005 following ratification by Russia on November 18, 2004. The Kyoto Protocol is an agreement under which industrialized countries commit to reducing their collective emissions of greenhouse gases by an average of 5.2% over the five year period 2008-2012 relative to the year 1990 (Wikipedia 2007). Japan, which became the 73rd signatory to the Kyoto Protocol on May 31st, 2002, has a target reduction of greenhouse gas emissions of 6% over the five year period. As part of its strategy to reduce greenhouse gas emissions, Japan has mandated that new commercial buildings incorporate energy efficiency in their design and operation.

The Japanese government has moved to improve the environmental performance of residential buildings with the drafting of the CASBEE-Sumai (Home) green building program. While the aim of the CASBEE-Sumai green building program is to reduce the environmental footprint of new homes, the program suffers from a weakness in that it is not based on a comprehensive Life-Cycle Inventory of the construction materials used to build Japanese homes. Additionally, the CASBEE-Sumai program has incorporated criteria which arbitrarily place imported wood at a competitive disadvantage by implying that wood harvested from Japanese forests is environmentally preferable to imported wood. These weaknesses of the draft program could be a source of confusion to architects and home builders regarding the overall environmental superiority of wood relative to other structural building materials. The two specific features of concern with the CASBEE-Sumai draft green building program are: 1) the specification of locally sourced wood (obtained from within a specific, but as yet undefined, distance from the building site) as being preferable to imported wood and 2) the determination that domestic timber is de-facto defined as being sustainable and harvested from sustainably managed forests without independent third-party verification of forest management practices.

The de-facto declaration that all domestic (Japanese) softwood is assumed to be derived from sustainably managed forests runs completely counter to the fundamental premise of sustainable certification:

transparency in certification programs, third-party verification and certification based on objective science. The lack of credible third-party verification of sustainability and legality also undermines consumer confidence since there is no guarantee that the wood being used is, in fact, legal or sourced from a sustainably managed forest. For example, a recent report in the Kyodo News (2008) on illegal logging in the Akan National Park in Hokkaido, Japan, illustrates the need for independent third-party certification programs, even in Japan. The decision to define domestic wood as sustainable violates the principal of reciprocity and places imported wood at a cost disadvantage in the marketplace since domestic lumber producers will not have to pay for the cost of certification for their lumber.

The fundamental reason for the preference of domestic wood over imported wood within the CASBEE-Sumai program appears to be to provide regulatory support for domestic wood processors whose lumber products are uncompetitive against imported wood. However, the blame for this lack of competitiveness cannot be placed at the feet of foreign manufacturers but rather at the reluctance of the domestic sawmill industry to implement the measures and investments required to achieve consolidation and modernization within an overly large and technically inefficient industry. For example, the pre-cutting industry, which manufactures the structural components for over 80% of the post and beam houses built in Japan, requires kiln dried lumber that is straight and machined to highly accurate tolerances as a raw material input to their manufacturing process. In response, most imported lumber now arrives in Japan kiln-dried and cut to the demanding specifications required by pre-cut manufacturers. Despite this change in material specifications within the largest demand segment for structural lumber, the domestic Japanese sawmill industry has been extremely slow to invest in new kiln drying capacity. In fact, by 2007, less than one-quarter of the structural softwood lumber produced in Japan was kiln-dried (22.6%) and only 16.5% of Japanese sawmills had invested in kiln drying facilities. Examples such as this clearly show that Japanese sawmills remain reluctant to invest in manufacturing technology to improve their competitiveness, preferring instead to rely on government regulation and subsidies to provide protection from more efficient foreign producers.

Some organizations in Japan have advocated using the CASBEE-Sumai program to provide preferential consideration for domestically manufactured wood products under the rationale that the increased carbon emitted during the international transport of lumber to Japan increases the carbon footprint of imported lumber, thereby making domestic softwood lumber a more environmentally preferable material. However, this argument overlooks the fact that most container ships carrying lumber products are returning to Japan on a backhaul leg after having delivered Japanese exports to their foreign destination. In addition, the argument for local wood further ignores the fact that ocean transport is an extremely efficient mode of transportation given the large size of the bulk ships used to transport logs and the container ships used to transport lumber. As a result, the amount of carbon emissions for these two transport modes (on a cubic meter per kilometer basis) are just 2.7% and 5.9%, respectively, of the carbon emissions generated from transporting lumber by truck in Japan. Thus, transporting the volume of structural lumber used in the typical Japanese post and beam house (14 m^3) from North America (either Seattle or Vancouver, BC) to Tokyo generates the same amount of CO_2 as shipping this volume of lumber just 112 km by truck in Japan. This analysis suggests that the international transportation of softwood lumber, at least from North America to Japan, might well produce less of an environmental footprint than transporting domestic lumber given the increase in transportation distance resulting from the widespread acceptance of precut lumber within the post and beam industry. A more detailed analysis of the distribution channels for domestic wood from forest to sawmill to wholesaler to precutting facility to building site should be performed to better understand the carbon trade-offs during transportation between domestic wood and imported wood.

Quantitative Impact of Domestic Wood Programs

There are two programs that could adversely affect the value of US softwood log and lumber exports to Japan. The first relates to the favorable consideration of domestic wood within CASBEE-Sumai and many subsidy programs. The second relates to a program supported by MAFF that aims to increase the market share of domestic wood use in the post and beam (P&B) industry from its current 30% to 60% by 2015. An economic analysis of these scenarios demonstrates that favoring the use of domestic lumber would not only impact the demand for imported lumber, but the demand for imported logs as well. Since the US is a large supplier of logs to Japan (approximately 2/3 of which are Douglas-fir), this would adversely impact both log and lumber imports from the US. The estimated impact of the domestic wood programs being proposed on the value of US lumber exports to Japan between 2007 and 2015 ranges from $84.5 million to $95.6 million. In the case of logs, the value of US exports could potentially drop by between $196 and $735 million between 2007 and 2015. The total impact on US softwood log and lumber exports to Japan ranges from $84.5 million and $735 million, depending on the success of these programs in promoting the use of domestic wood in place of imported lumber and the extent to which imported logs are replaced by domestic logs. Considering the current constraints on the ability of domestic timber to substitute for imported wood (e.g., timber supply, lower timber quality and lower mechanical strength, among others), it is more likely that the lower estimate of the reduction in the value of US log and lumber exports to Japan ($84.5 million) is more accurate. While this analysis is sensitive to a number of assumptions, it clearly shows that a program targeted towards substituting domestic wood for imported wood could have a substantial adverse impact on the US forest products industry.

Strategic Implications

The myopic strategy of protecting the inefficient and uncompetitive forestry and sawmill sectors in Japan through preferential regulatory policies (such as the de-facto specification of domestic wood as being sustainable managed) or by providing subsidies to achieve an arbitrary market share for domestic lumber within the post and beam construction sector ignores the superior environmental performance of wood relative to non-wood building materials. More importantly, these types of preferential programs have been specifically targeted to the post and beam market segment; a shrinking segment of the residential construction industry. As a result, these policies distract attention from opportunities to expand the demand for wood products in non-traditional market segments such as wood multi-family housing, hybrid construction and low-rise commercial construction. Housing start statistics clearly show that whereas the ratio of P&B housing starts has been declining over time, the ratio of housing starts in the multi-family (both mansion and apartments) sectors, where steel and concrete dominate, has been increasing.

If the Japanese forest products industry is truly interested in promoting the environmental benefits of wood, encouraging the adoption of a green building program and expanding the demand for domestically produced structural lumber, then they would do well to consider a strategy that grows the overall demand for structural lumber by promoting the increased use of structural lumber in non-traditional sectors of the market rather than encouraging an artificial competition between domestic wood and imported wood within the shrinking P&B segment of the residential construction industry. This promotional effort would utilize LCI data to document the superior environmental performance of wood frame multi-family and commercial (including hybrid) structures relative to non-wood structures. To support this effort, preliminary research should be done to identify: 1) the relative market shares of steel and concrete structural materials within these non-traditional market segments, 2) the material selection process used by architects and builders and 3) the factors that influence the material selection process.

Given the agenda of promoting domestic wood over imported wood, it is important for US wood products associations to maintain open communication with the CASBEE-Sumai committee to reinforce the message that the CASBEE-Sumai program should focus on rewarding the use of any wood over less environmentally friendly building materials. This should be reinforced by the message that wood houses use a broad range of sizes, qualities and wood species in their construction based on specific structural end-use requirements. Limiting the material selection to only locally produced lumber severely restricts the material options available to builders and may encourage them to use less environmentally friendly non-wood materials in place of other “non-local” wood products so that they can still meet the 50% local building material requirement and therefore qualify for prefectural subsidies. The bottom line is that these subsidy and regulatory programs distort the market and could encourage architects and builders to make material choices based not on the environmental performance of a specific material, but on a set of artificial proxies that reflect a political agenda rather than objective scientific environmental data.

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Introduction

Concerns about global warming and the environment and their commitments under the Kyoto Protocol have led the Japanese to develop a green building program, called CASBEE, to reduce the environmental footprint of commercial and residential buildings (CASBEE is the acronym for Comprehensive Assessment System for Building Environmental Efficiency). As part of its commitment as a signatory of the Kyoto Protocol, Japan is committed to reduce its emissions of greenhouse gases through a variety of strategies. The Kyoto Protocol was negotiated in Kyoto, Japan in December 1997 and came into force on February 16, 2005 following ratification by Russia on November 18, 2004. The Kyoto Protocol is an agreement under which industrialized countries commit to reducing their collective emissions of greenhouse gases by an average of 5.2% over the five year period 2008-2012 relative to the year 1990 (Wickipedia 2007). Japan, which became the 73rd signatory to the Kyoto Protocol on May 31st, 2002, has a target reduction of greenhouse gas emissions of 6% over the five year period. As part of its strategy to reduce greenhouse gas emissions, Japan has mandated that new commercial buildings incorporate energy efficiency in their design and operation.

Increased concern about the environmental footprint of residential homes has resulted in conflicting claims regarding the environmental performance of building materials. For example, aggressive advertising campaigns by both the steel and concrete industries have claimed the environmental superiority of these materials over wood. Generally these advertising claims ignore the life cycle costs associated with using each material and focus instead on the simplistic (yet effective) message that using steel or concrete to build a home will save a tree. More importantly, they create confusion in the minds of construction professionals and the general public regarding the real environmental merits of wood relative to non-wood substitute building materials. Decisions that discourage the use of wood are made each day at all levels of industry and government. While decisions may be motivated by a desire to protect the environment, the negative consequences associated with using less environmentally friendly non-wood substitutes are often not considered.

Green or sustainable buildings incorporate the environment, the economy and human aspects into the design and construction of a building. Green buildings are created from an integrated process where the site, the design, the construction, the materials, the operation, the maintenance, and the deconstruction and disposal of a building are all seen as having an effect on the environment, both in an ecological sense as well as the human environment. As a result of this integrated process, it is thought that buildings can be made more environmentally friendly, more cost-effective, more energy efficient and more resource efficient, while providing a healthier work or living environment. Green building programs are slowly but surely emerging across the US and internationally. These programs have been adopted to varying degrees across all levels of government, from the local level up through the federal level. Industry, trade and environmental organizations are also looking at promoting green building initiatives at a variety of levels. Most green building programs are organized by guidelines, usually accompanied by a checklist or a point system. Typically, the guidelines are divided into sections related to the construction process such as energy use, water efficiency, materials, indoor air quality, and construction waste.

Interest in the environmental performance of buildings in the US has led to the adoption of the LEED Rating System for commercial buildings and the development of a draft version of the LEED Rating System for residential buildings. However, both of these rating systems fail to take into account the full life cycle costs of building materials during the construction, use and disposal/recycling phases of a building, thereby unnecessarily restricting and disadvantaging wood building materials. They also provide preferential consideration to FSC certified wood while discriminating against wood certified under other third party certification programs. An alternative green residential building program, the NAHB's Model Green Home Building Guidelines provides a more equitable treatment of the environmental benefits of wood as a building material, while allowing the use of wood certified under all of the major certification programs.

Concern about the environmental footprint of commercial and residential buildings has also generated interest in green building systems in both Japan and China. This has led to the development of CASBEE which, in turn, has been selected as the green rating model to be used in China. However, recent reports suggest that some organizations in Japan would like to use the CASBEE program for residential construction (CASBEE-Sumai) to provide preferential consideration for domestically manufactured wood products. In order to ensure that the use of wood as a building material is not unduly restricted in Japan, it is important that the US forest products industry move proactively to promote the environmental benefits of US wood as a building material (using a full life cycle analysis as detailed in the recently completed CORRIM report) as well as to describe the role of wooden building materials within a well developed green building program. It is also important to understand the potential quantitative impact of any bias within CASBEE-Sumai that would provide preferential consideration for domestically produced wood products over imported wood products. Finally, it is important to ensure that CASBEE-Sumai support the use of certified wooden building materials from the major sustainable forest management programs.

In order to ensure a sound framework of information to support the policy recommendations provided in this report, the discussion will be organized in the following manner. The first two chapters provide an overview of the supply and demand for softwood logs and lumber in Japan followed by a description of the domestic softwood lumber industry. This section serves to place the role of imported wood within the proper context and demonstrate that imported wood has been successful because of the inefficient and uncompetitive forestry and sawmill industries in Japan. The next section discusses the CORRIM Life Cycle Inventory data for residential construction, emphasizing both CO_2 emissions and global warming potential of the three primary structural building materials: wood, steel and concrete. This section also includes a consideration of the CO_2 emissions associated with the transport of wood building materials from the US to Japan. The next section provides a general discussion of the proposed CASBEE-Sumai (Home) green building program, recognizing that the final program has not been released yet. This section also estimates the quantitative impact of policies that favor domestic wood on softwood log and lumber exports from the US to Japan through 2015. The report concludes with series of policy recommendations that support the continued use of wood as the preferred building material in Japan and ensure the equal treatment of imported and domestic wood in Japan in residential construction.

Research Objectives

The objective of the project is to determine how recent research conducted in the United States on life cycle inventory for residential building materials and green building programs can support the ongoing development of a green building program (CASBEE-Sumai) in Japan to the benefit of all wood products, including US wood products. The specific objectives of this project include: a) Analyze the CASBEE-Sumai (Home) green building program, b) Assess the strategic implications of a potential CASBEE-Sumai bias towards domestic species and the impact (quantitatively) on the competitiveness of imported timber, c) Extend the CORRIM Life Cycle Inventory (LCI) data to include international transport in energy and carbon data, d) Assess the impact of shipping wood building materials from the US to Japan on CO_2 and global warming potential, and e) Provide recommendations that support equal treatment for imported lumber and forest certification systems in Japan.

Japanese Timber Supply and Demand

Japan is a timber deficient country that requires substantial volumes of imported timber to meet its domestic demand for wood. To a large degree, wood demand in Japan is tied to housing starts where approximately 43% of new homes are framed with wood. This reliance on imported wood has always caused a tension in Japan where forests cover two-thirds of the country and there is an extensive sawmill industry skewed heavily to small, rural sawmills using out-dated technology. A high cost structure has made both the forestry and sawmill industries uncompetitive on a global scale and, as a result, imported softwood lumber has come to dominate the Japanese market. Over the years, the Japanese government and the forest products industry have tried a number of strategies to improve the competitiveness of the forestry and sawmill sectors. Despite the closure of more than 10,000 sawmills over the past twenty years, the Japanese sawmill industry remains uncompetitive and plagued by small, inefficient sawmills located in rural areas far from the main demand markets. This section of the report provides a summary of the role of timber imports in Japan as well as an overview of the Japanese sawmill sector and will help set the context for understanding the rationale behind the policies and subsidy programs that have been developed to improve the competitive position of the Japanese forestry and sawmill sectors.

Timber Self-sufficiency

During the post-war era, Japan went from being essentially self-sufficient in meeting its timber demands to relying on imports for more than 80% of its timber requirements (Figure 1). From 1955-2006, domestic timber production has steadily declined from approximately 65 million m^3 to less than 18 million m^3. Timber imports, on the other hand, have increased tremendously, jumping from 2.5 million m^3 in 1955 to almost 90 million m^3 in 1996 before dropping to 69 million m^3 in 2006. Overall, timber demand has generally followed the economy and housing starts, increasing during periods of economic growth and declining during periods of slow (or negative) economic performance. Even though timber demand suffered a sharp decline following the Asian economic crisis in 1997, most of the reduced demand was reflected in lower timber imports while the domestic supply of timber has actually been increasing since 2005, rising from 19.1% in 2004 to 20.5% in 2006.

Lumber Self-sufficiency

Japan's domestic lumber production presents a contrast to its overall timber self-sufficiency. Whereas almost 80% of the total wood supply is imported, only about 40% of Japan's softwood lumber demand is supplied by lumber imports (Figure 2). Despite Japan's relatively high level of self-sufficiency, the domestic lumber industry is characterized by declining production volumes as thousands of smaller, less efficient sawmills have closed down. The domestic sawmill industry was particularly hard hit by the Asian economic crisis, with the number of sawmills declining from 14,028 in 1996 to 12,810 in 1998. These sawmill closures resulted in large declines in productive capacity in 1997 and 1998.

Between 1990 and 2006, domestic lumber production dropped from 29.8 million m^3 to 12.7 million m^3, while lumber imports increased only slightly from 7.6 million m^3 to 8.1 million m^3. The combination of declining domestic production and increasing imports means that self-sufficiency declined from 76.3% in 1990 to 60% in 2006.

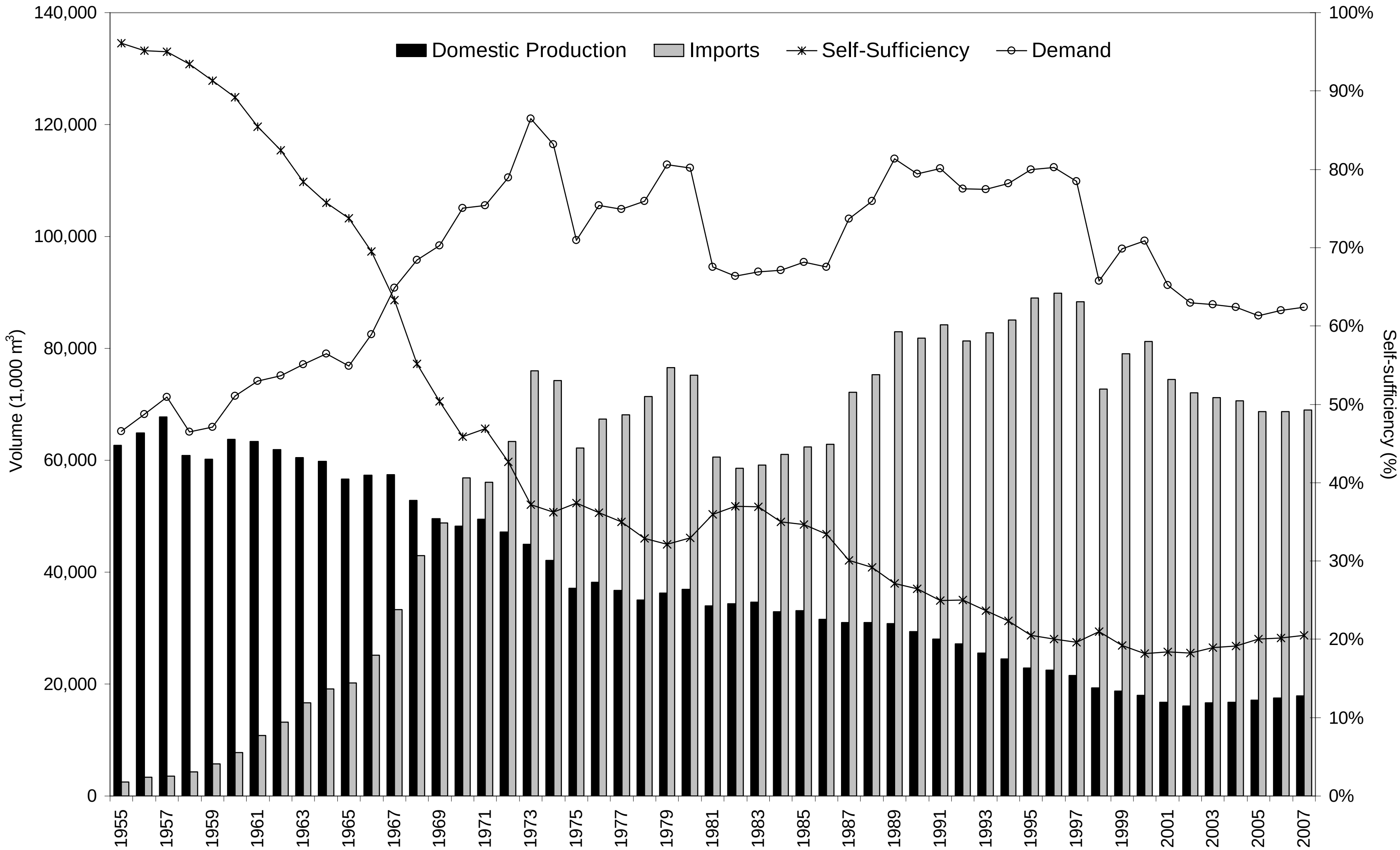

Figure 1. The trend in Japanese timber self-sufficiency and imports, 1955-2007e.

Source: CINTRAFOR database. (Note: 2007 data is an estimate by MAFF)

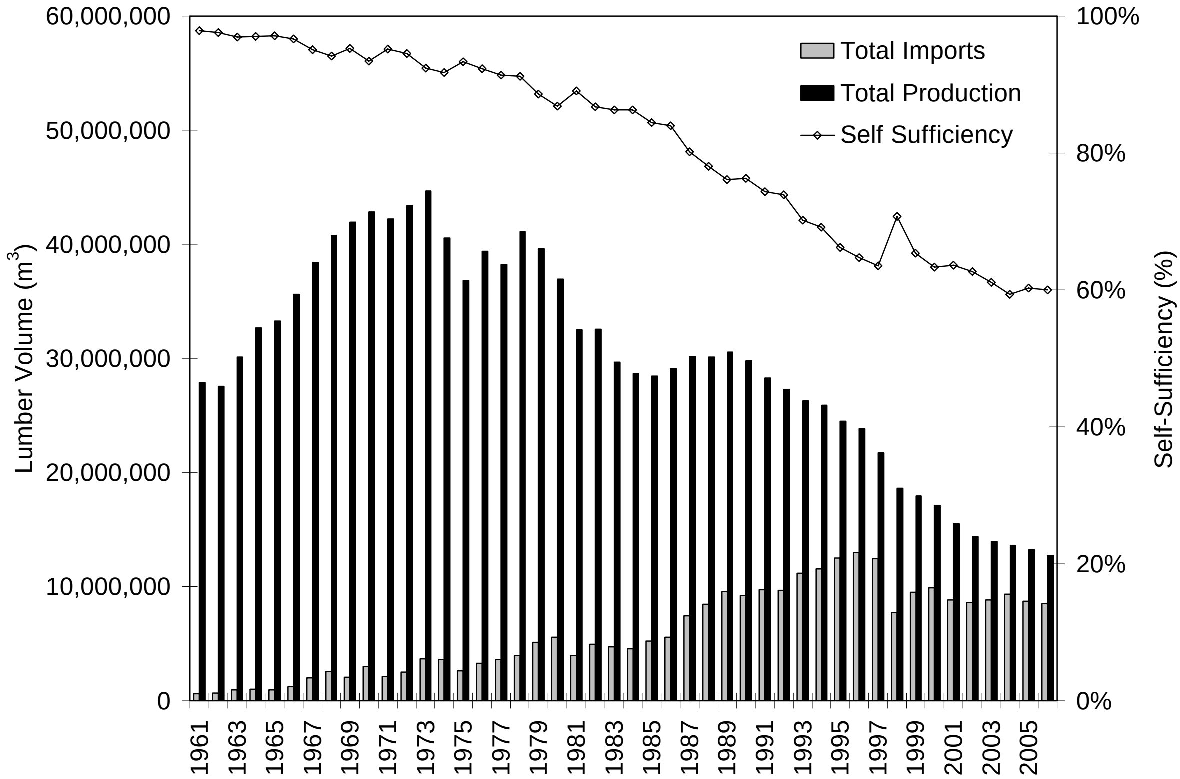

Figure 2. Japanese total production, imports, and self-sufficiency of lumber, 1961-2006.
Source: CINTRAFOR database

Softwood Log Imports

While there are a number of species of softwood logs imported into Japan, the primary species are Douglas-fir (DF) from the US and Canada, Russian larch and radiata pine from New Zealand. However, DF has traditionally been the preferred species for structural components in post and beam homes and has been used extensively within the residential construction industry in Japan. Much of the preference for DF is related to its high strength characteristics as well as its dimensional stability, durability, straightness and attractive appearance. The ready availability of close grained old-growth DF logs and lumber in the past helped to reinforce the strong preference for this species. In fact, the preference for DF lumber has been so strong that an important segment of the Japanese sawmill industry has developed to process imported DF logs into structural lumber for the post and beam home building industry.

Japanese imports of DF logs from the US have been declining while exports from Canada have increased since 1990. The decline of total DF log imports began in 1989 when exports of DF logs to Japan peaked at 6.8 million m^3 (Figure 3). Following the imposition of a ban on log exports from US federal and state forests in 1989, Japanese imports of DF logs from the US declined by 62%, totaling just under 3 million m^3 in 2006. The US has remained the primary supplier of DF logs to Japan because of the restrictive log export regulations in Canada that are applied to logs harvested from provincial forests. While a similar export ban on logs from public lands in the US was put in place in 1989, the large area of private industrial forests in the US Pacific Northwest was not affected and has helped to partially offset the US log export ban. However, structural changes in the Japanese market continue to reduce the demand for DF logs. While Canadian exports of DF logs from private forests have increased since 1997, the existing log export constraints most likely preclude a significant expansion of Canadian log exports, and there is

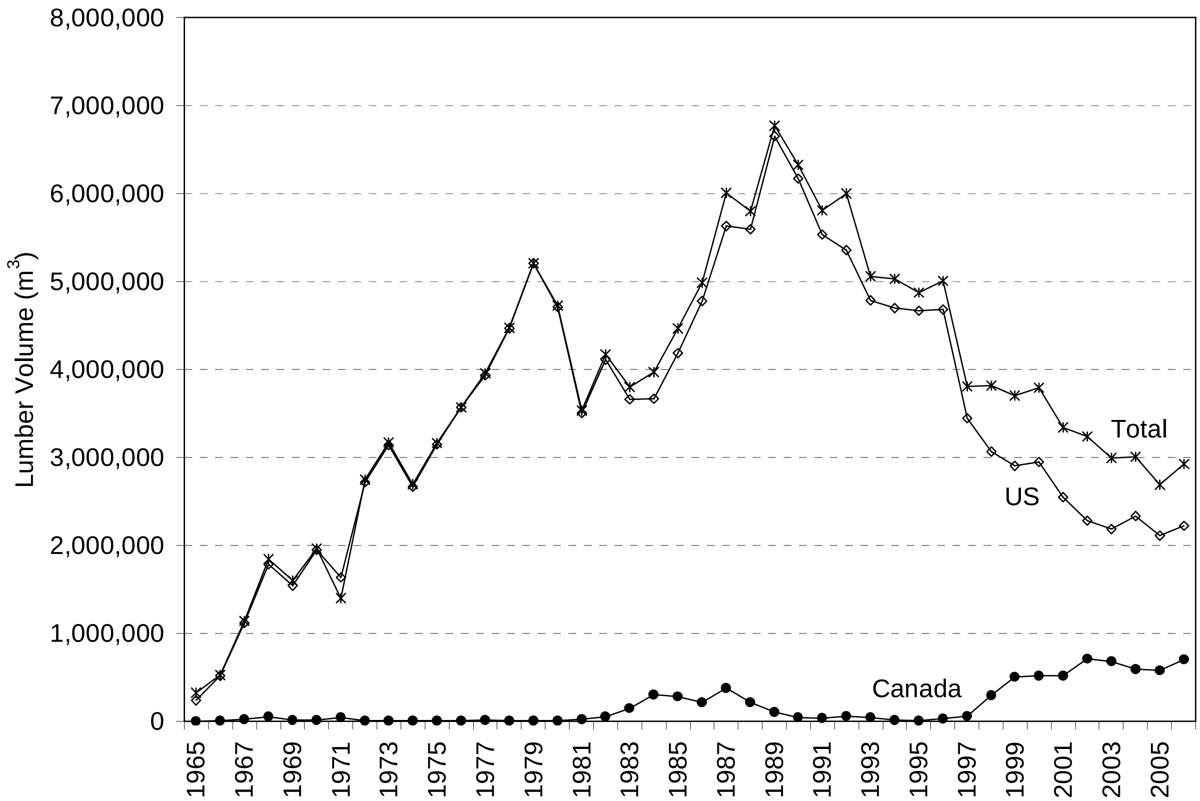

Figure 3. Japanese imports of Douglas-fir logs.
Source: Japan Customs Association, various years.

a strong movement in British Columbia to ban log exports both from provincial and privately owned forests.

Softwood Lumber Imports

The import data shows that softwood lumber is the dominant lumber product imported into Japan and the ratio of softwood lumber imports to total lumber imports has increased steadily from 78% in 1989 to 94.7% in 2006 (Figure 4). However, the composition of softwood lumber imports has changed dramatically over the past 15 years, a fact that is often obscured by the overall trend in import volumes. The fact that imports of softwood lumber increased by just 4.9% between 1991 and 2006 (from 8.1 million m^3 to 8.5 million m^3) suggests that softwood lumber imports into Japan have changed little over this time (Figure 4). In reality, a closer look at the Japanese import statistics presents a much different story. Imports of softwood lumber grew rapidly during the period 1990-1996, driven largely by high levels of housing starts. The Asian economic crisis caused a substantial drop in softwood lumber imports (36%) in 1998 although softwood lumber imports had recovered by 18.3% by 2006.

The past decade has seen a tremendous shift in the structure of softwood lumber imports into Japan (Figure 5). During the period 1990-2006, the US has seen its share of softwood lumber imports plummet from 27.8% to 1.1%. The Canadian market share, which averaged 53% during the period 1990-1998, declined to 43% during the period 1998-2006. In contrast to the US and Canadian experiences, imports from Europe shot from essentially zero in 1992 to reach a 31.9% market share in 2006. Similarly, imports from Russia increased from 3.5% to 13% between 1992 and 2006 (Figure 6).

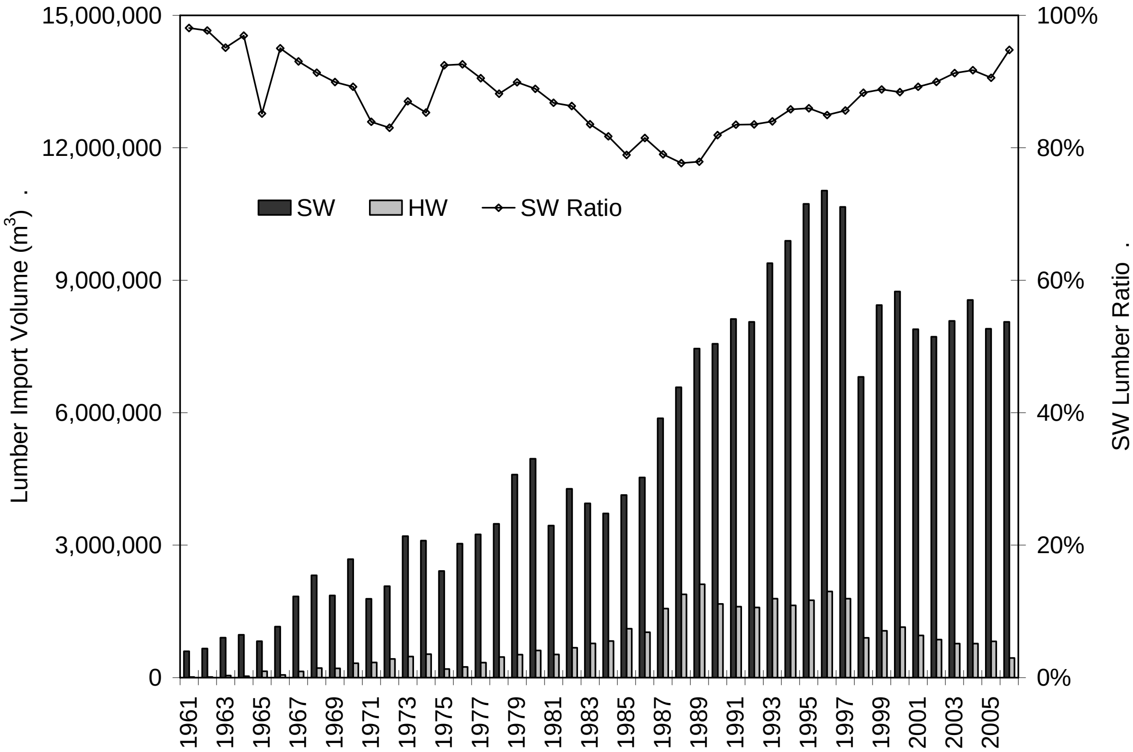

Figure 4. Japanese imports of softwood and hardwood lumber from 1961-2005.
Source: Japan Customs Association, various years.

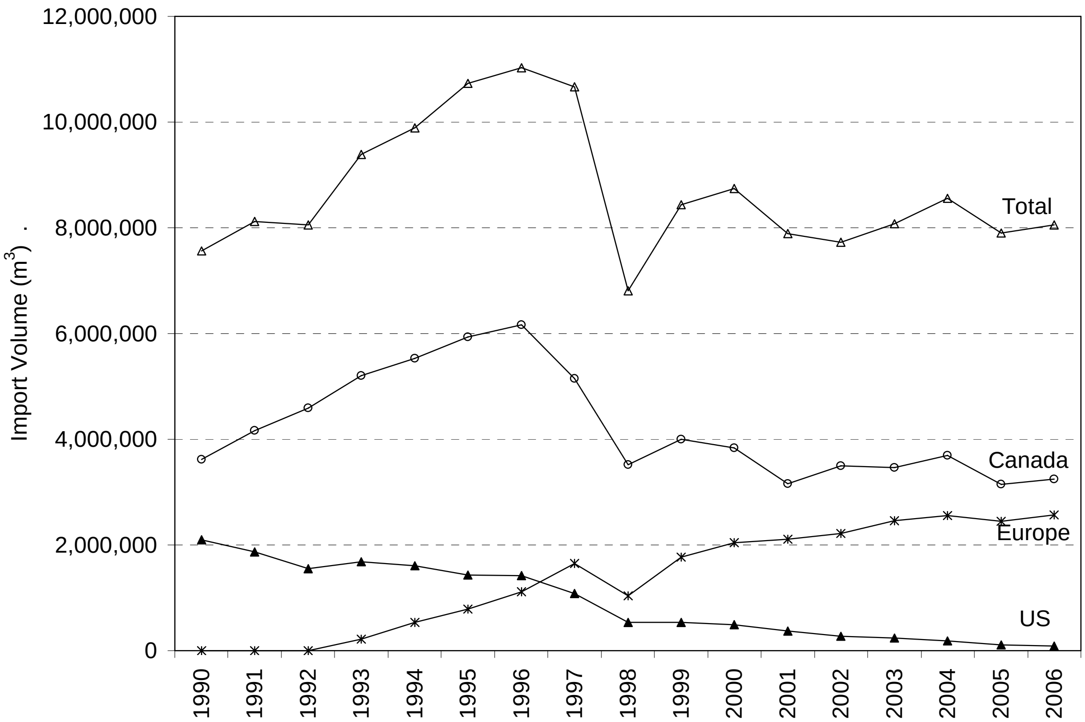

Figure 5. Japanese softwood lumber imports by source, 1990-2006.
Source: Japan Customs Association, various years.

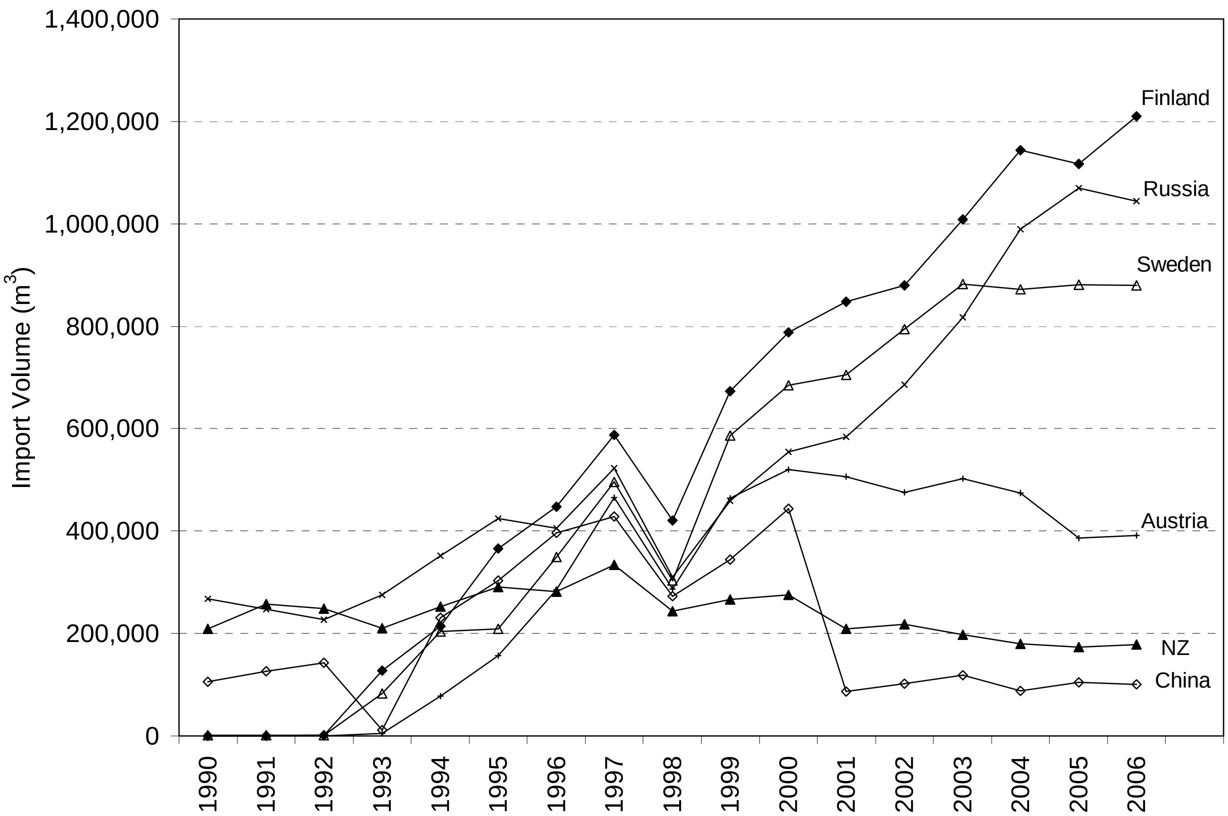

Figure 6. Japanese softwood lumber imports from non-North American sources, 1990-2006.
Source: Japan Customs Association, various years.

Of greater concern from the US perspective is the fact that as Japanese lumber imports increased following the Asian crisis, US exports of softwood lumber continued to decline. In contrast, lumber imports from a wide variety of non-North American suppliers registered significant increases over the period 1998-2006 (Figure 6). For example, the main European suppliers of Finland, Sweden, and Austria, increased their exports to Japan by 187%, 190%, and 36%, respectively, between 1998 and 2006. More importantly, their share of the Japanese imported softwood lumber market increased substantially over this period, with Sweden increasing their market share from 4.5% to 10.9%, Finland increasing from 6.2% to 15%, and Austria moving from 4.2% to 4.9%.

Glulam Imports

In contrast to the trend observed with softwood lumber, both imports and the domestic production of glulam lumber have increased rapidly since 1998 (Figure 7). The increased demand for glulam lumber is a result of the Kobe earthquake and the increased use of pre-cut structural components by post and beam homebuilders. Prior to the Kobe earthquake, most glulam lumber was used in non-structural applications in the furniture industry and in 1991 the ratio of structural glulam lumber within the total glulam supply was 27.8%. By 2006, this ratio had increased to 88.9%. The increased demand for structural glulam lumber in Japan has been met by a rapid increase in domestic production as well as a more moderate increase in imports. Domestic production of structural glulam lumber jumped 338% between 1996 and 2006, growing from 340,000 m^3 to more than 1.5 million m^3. At the same time, imports of structural glulam lumber increased by 248% to reach 805,562 m^3 in 2006. As a result of the rapid increase in domestic production of structural glulam lumber, Japan's self-sufficiency increased from 58% in 2000 to 69% in 2003 before slipping slightly to 65% in 2006.

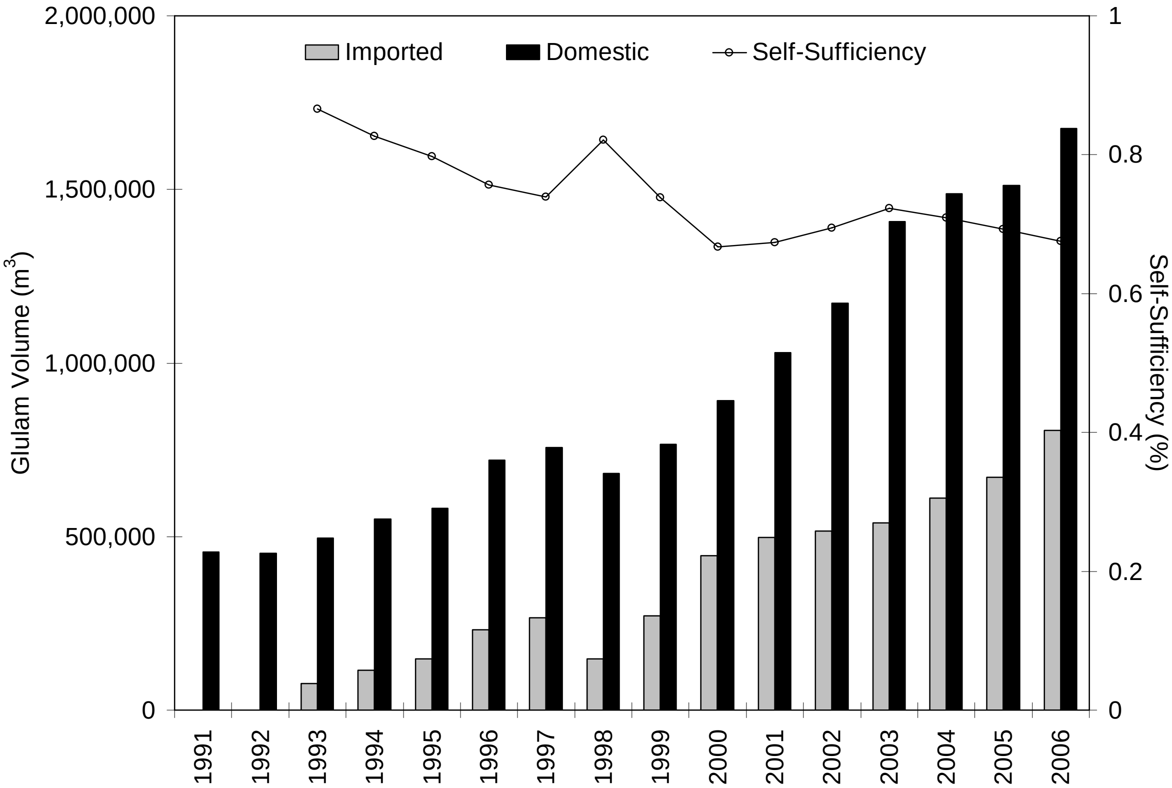

Figure 7. Japanese production, imports, and self-sufficiency of structural glulam lumber, 1991-2006.
Source: CINTRAFOR database

Following the Kobe earthquake, the US found itself in a strong position in the structural glulam market in Japan (Figure 8). As the demand for structural glulam lumber prepared to take off in 1993, the US was the dominant supplier in Japan with an 85.2% market share. Despite the fact that US exports of structural glulam lumber more than doubled between 1993 and 1996, growing from 50,412 m^3 to 119,365 m^3, the US share of the market dropped to 51.6% as new competitors began to enter the market. By 2006, the US share of the market was just 0.1%. In contrast, European suppliers held the dominant market share at 63.8% while China had increased its market share to 21.1%. The entrance of China into this market in 2001 greatly undermined both the US and European market positions. Between 2001 and 2006, the Chinese market share increased from 4.9% to 21.1% whereas the US market share dropped from 6.1% to 0.1% and the European market share dropped from 74.9% to 63.8%.

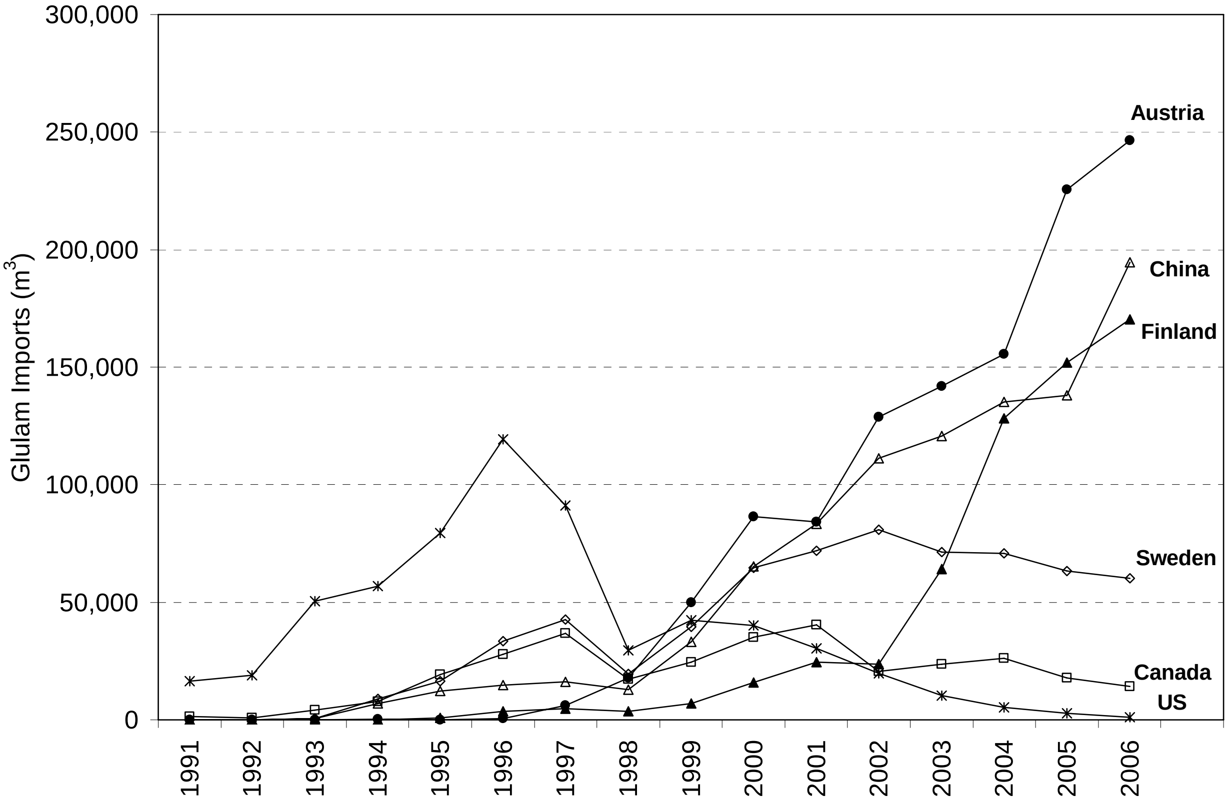

Figure 8. Structural glulam lumber imports by source, 1991-2006.
Source: Japan Customs Association, various years.

Summary of Wood Supply Trends in Japan

Analyzing the supply trends for softwood logs and lumber in Japan provides the background for understanding the policies being considered and/or implemented to provide subsidies and regulatory support for the domestic forestry and sawmill industries. Increasing softwood lumber and glulam imports into Japan have been a source of ongoing friction with the domestic sawmill and forestry industries. Superior production efficiency, lower product prices and higher product quality have allowed foreign suppliers to continuously expand their share of the market. The recent emergence of Russia as a supplier of softwood lumber and China as a supplier of glulam lumber has further exacerbated this issue. The recent announcement by Russia of a log export tax designed to increase its domestic wood processing infrastructure, and presumably the flow of softwood lumber into Japan, will disrupt log supplies to Japanese sawmills and plywood mills and increase the Russian exports of softwood lumber, veneer and plywood to Japan. In response to increasing imports, the Japanese softwood lumber and forestry industries have consistently demanded a variety of market protection regulations and subsidies over time to protect them from competition with more efficient foreign processors. The most recent protections include subsidies from the Ministry of Agriculture, Forestry and Fisheries (MAFF) to support the consolidation and infrastructure modernization within the sawmill industry and promote the research and development of new engineered wood products as well as subsidies designed to expand production and distribution efficiencies within the forestry and forest products sector. In addition, the proposed CASBEE-Sumai green building program is proposing to award additional points to wooden homes built using local wood sourced from within 500 kilometers of the construction site. The following section will provide a competitive assessment of the Japanese sawmill industry and discuss the implications of the structure of the industry on the continued requests for protection by the domestic industry.

Japanese Softwood Lumber Industry

Driving much of the pressure for subsidies and regulatory protections in Japan has been the sawmill sector. The lumber industry in Japan has traditionally been characterized by small-scale "mom and pop" sawmills operating within very localized, rural markets. These mills typically process locally produced logs into lumber for use by local home builders. Most of their lumber is sold to local wholesalers who perform many of the marketing functions for the sawmill. As a result, most small sawmills have a poor understanding of the markets and demand for their products. Increasing competition from imported lumber has contributed to the problems confronting local sawmills, as has the closure of a large number of small rural sawmills over the past twenty years due to the combination of outdated sawmill technology and the high cost of domestic logs. These small rural sawmills were often family run and the continued movement of population from the rural areas to the big cities has caused many of these small sawmills to close when the owner retires.

Large sawmills located in the industrial zones of large port cities have to a large extent replaced small rural sawmills, at least in terms of production volumes. These larger sawmills often process a combination of imported logs and domestic logs, although some of the largest sawmills process imported logs almost exclusively. These mills are larger, more efficient, with more modern equipment and better access to capital than the small local mills. However, these large mills are also confronted with the rising costs of production that have plagued the small rural mills and they are also finding themselves at a competitive disadvantage to foreign lumber producers.

Demographics of the Japanese Softwood Lumber Industry

Number of sawmills, by region

The number of sawmills in Japan has declined steadily since 1963 while lumber production has been falling since 1973 (Figure 9). The number of sawmills in Japan, which totaled 25,295 in 1963, fell to just 8,588 in 2006. As a consequence, lumber production has declined from a high of 45.3 million m^3 in 1973 to 12.7 million m^3 in 2006. It is interesting to note that while the number of sawmills has declined by 64.2% since 1973, the decline in lumber production over the same time period has been a much higher 71.9%. Clearly, mills closures have not been limited to just the small, rural "mom and pop" sawmills.

The number of sawmills in 2006 totaled 8,588, a decline of 38.8% from 1996. Meanwhile, the number of employees in the sawmill industry fell to 55,118 in 2004 (the most recent year data is available), a decline of 44.1% since 1996, Table 1. Similarly, lumber production declined 47.4% between 1996 and 2006. The data presented in Table 1 shows that substantial numbers of mill closures occurred across every region of Japan. The decline in regional lumber production ranged from 21.8% in the Chugoku region to 52.8% in the Kinki region, Table 1. This trend has been extremely worrisome to the Japan Forestry Federation and MAFF, and many efforts have been made to support the forestry and sawmill industries in rural regions.

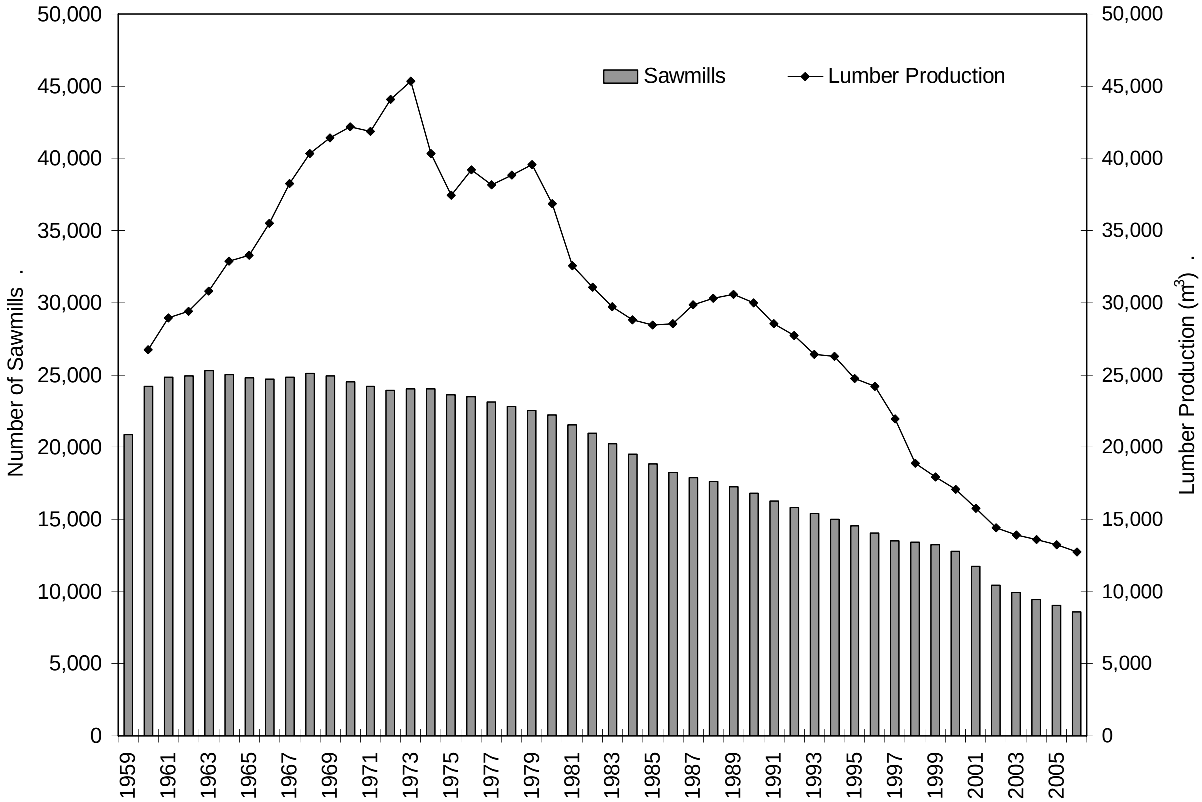

Figure 9. Number of sawmills and lumber production in Japan, 1959-2006.
Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Several measures of sawmill productivity are provided in Table 2, although the reader should keep in mind that these numbers are averages. Given the wide variation in sawmill size in Japan it is perhaps better to consider the lumber production per employee data. Based on this data, it would appear that the more productive sawmills are located on the island of Hokkaido and in the Chugoku and Shikoku regions. In contrast, sawmills with the lowest productivity tend to be located in the Kanto, Kinki and Chubu regions. The data also suggests that the number of workers and the average lumber production of sawmills in every region has declined since 1996. As a result, sawmill productivity (measured in terms of lumber production per employee) has also declined in many regions although the reverse is true for Hokkaido and Chugoku.

Table 1. Number of sawmills, employees, and lumber production (m^3) in Japan, by region.

Region	1996			1999			2004		
	Sawmills	Employees	Production	Sawmills	Employees	Production	Sawmills	Employees	Production
Total	13,990	99,464	24,206,000	12,247	78,757	18,165,000	9,407	55,118	13,603,000
Hokkaido	482	7,149	2,115,000	388	5,346	1,615,000	269	3,600	1,276,000
Tohoku	2,014	15,467	3,778,000	1,776	12,093	2,757,000	1,356	7,878	1,842,000
Kanto	1,694	8,929	1,552,000	1,464	7,125	1,130,000	1,121	4,714	802,000
Chubu	3,784	22,779	4,773,000	3,294	17,987	3,466,000	2,505	12,201	2,344,000
Kinki	2,234	14,167	3,075,000	2,006	11,408	2,102,000	1,531	8,023	1,363,000
Chugoku	1,044	8,831	2,894,000	910	7,077	2,402,000	707	5,493	2,282,000
Shikoku	827	7,139	2,481,000	713	5,670	1,829,000	587	4,197	1,326,000
Kyusu-Okinawa	1,911	15,003	3,538,000	1,696	12,051	2,864,000	1,331	9,012	2,368,000

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Table 2. Productivity of Japanese sawmills between 1996 and 2004.

Region	Production per Sawmill (m^3)			Production per Employee (m^3)		
	1996	1999	2004	1996	1999	2004
Total	1,730	1,483	1,446	243	231	247
Hokkaido	4,388	4,162	4,743	296	302	354
Tohoku	1,876	1,552	1,358	244	228	234
Kanto	916	772	715	174	159	170
Chubu	1,261	1,052	936	210	193	192
Kinki	1,376	1,048	890	217	184	170
Chugoku	2,772	2,640	3,228	328	339	415
Shikoku	3,000	2,565	2,259	348	323	316
Kyusu-Okinawa	1,851	1,689	1,779	236	238	263

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Sawmills processing imported logs tend to have a higher level of lumber production, as the log input data suggests (Tables 3 and 4). In 2004, the average annual lumber production for mills that process domestic logs was 887 m^3, while it was 1,429 m^3 for mills that process imported logs. This is hardly surprising, given the fact that imported sawlogs, in general, have a larger diameter and are higher quality than domestic sawlogs. As a result, we would expect that sawmills processing imported sawlogs would be more efficient with a higher level of productivity. It is interesting to note that in 2004, the volume of domestic logs being processed exceeded the volume of imported logs being processed for the first time in more than a decade. The highest share of imported logs are found in the Chubu and Chugoku regions and the share of US logs in the imported log mix exceeds 50% in every region except Hokkaido, Tohoku and Chubu (Table 5).

Number of sawmills, by size

As discussed earlier, many of the sawmills in Japan are extremely small and inefficient "mom-and-pop" type operations. This is a carryover from the period extending roughly from 1950-1975 when most of the single family houses in Japan were built using the traditional post and beam method. The structural components for traditional post and beam houses built during this period were generally produced by skilled carpenters who cut the many structural members with their complicated joints and connectors by hand on the construction site. Most of these houses had very traditional architectural designs and utilized extensive amounts of interior wood paneling, moulding and millwork, particularly in the tatami room. It was this demand for high quality moulding and millwork lumber products that supported the development of the sawmill sector that exists in Japan today. Unfortunately, the transition of the homebuilding industry away from fabricating structural components on the construction site to the production of structural components by highly precise CAD/CAM machine centers in precut facilities had an adverse impact on these smaller traditional sawmills which could not produce the kiln dried lumber to the exacting specifications of the post and beam precut manufacturers. Similarly, the declining demand for traditional tatami rooms among younger Japanese home buyers who prefer a western style-architectural design with a more open floor plan, further reduced demand for the lumber produced by these smaller sawmills. The demographic data presented in Table 6 substantiates the small size of most sawmills in Japan, implying that most of these sawmills were producing highly specialized lumber for use within local markets. Even following the closure of a huge number of sawmills over the past decade, fully 59.5% of the sawmills in Japan still employ four or less workers while an additional 25.4% employ between 5 and 9 workers. In contrast, less than 4% of all sawmills operating in Japan today employ twenty or more workers. Clearly the sawmill industry in Japan continues to be characterized by the small "mom-and-pop" sawmills located primarily in rural areas and processing domestic *sugi* and *hinoki* logs for use by local builders.

Table 3. Summary of softwood sawmills in Japan, by region, 2004

Region	Domestic Sawmills	Imported Sawmills	Domestic Lumber Production	Imported Lumber Production	Production/Mill (Domestic Logs)	Production/Mill (Imported Logs)	Domestic to Imported ratio
Total	8,127	4,474	7,209	6,394	887	1,429	62.1%
Hokkaido	218	145	989	287	4,537	1,979	229.2%
Tohoku	1,246	679	1,181	661	948	973	97.4%
Kanto	957	389	559	243	584	625	93.5%
Chubu	2,060	1,654	735	1,609	357	973	36.7%
Kinki	1,303	748	637	726	489	971	50.4%
Chugoku	633	356	478	1,804	755	5,067	14.9%
Shikoku	468	226	606	720	1,295	3,186	40.6%
Kyusu-Okinawa	1,242	277	2,024	344	1,630	1,242	131.2%

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Table 4. Log input volumes for sawmills in Japan, by region and log type (1996 vs 1999 vs 2004).

Region	1996 Log Sources (1,000 m^3)				1999 Log Sources (1,000 m^3)				2004 Log Sources (1,000 m^3)		
	Total	Domestic	Imported		Total	Domestic	Imported		Total	Domestic	Imported
Total	35,545	16,154	19,391		27,449	13,246	14,203		21,705	11,469	10,236
Hokkaido	3,713	2,526	1,187		2,952	2,068	884		2,432	1,923	509
Tohoku	5,615	3,062	2,553		4,224	2,445	1,779		2,929	1,936	993
Kanto	2,166	1,223	943		1,591	978	613		1,185	837	348
Chubu	6,984	1,726	5,258		5,267	1,366	3,901		3,639	1,120	2,519
Kinki	4,420	1,647	2,773		3,097	1,331	1,766		2,040	953	1,087
Chugoku	4,337	1,102	3,235		3,677	897	2,780		3,892	739	3,153
Shikoku	3,369	1,308	2,061		2,550	1,050	1,500		2,047	929	1,118
Kyusu-Okinawa	4,941	3,560	1,381		4,091	3,111	980		3,541	3,032	509

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Table 5. Ratio of specific log imports to total log imports.

Region	1996 Domestic Ratio	1996 Imported Ratio	1996 US Share of Imports	1999 Domestic Ratio	1999 Imported Ratio	1999 US Share of Imports	2004 Domestic Ratio	2004 Imported Ratio	2004 US Share of Imports
Total	0.45	0.55	0.66	0.48	0.52	0.60	0.53	0.47	0.58
Hokkaido	0.68	0.32	0.49	0.70	0.30	0.30	0.79	0.21	0.29
Tohoku	0.57	0.43	0.67	0.59	0.41	0.57	0.66	0.34	0.39
Kanto	0.49	0.51	0.80	0.52	0.48	0.76	0.71	0.29	0.72
Chubu	0.26	0.74	0.57	0.29	0.71	0.54	0.31	0.69	0.31
Kinki	0.32	0.68	0.71	0.37	0.63	0.68	0.47	0.53	0.58
Chugoku	0.40	0.60	0.75	0.42	0.58	0.74	0.19	0.81	0.85
Shikoku	0.32	0.68	0.66	0.34	0.66	0.64	0.45	0.55	0.62
Kyusu-Okinawa	0.61	0.39	0.64	0.65	0.35	0.52	0.86	0.14	0.61

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Table 6. Number of sawmills in Japan, by number of employees and region, 2004.

Region	Sawmills	<4	5-9	10-19	20-29	30-49	50+
Total	9,407	5,593	2,393	1,051	237	97	36
Hokkaido	268	37	76	109	31	11	4
Tohoku	1,353	797	364	139	35	12	6
Kanto	1,121	796	229	76	12	4	4
Chubu	2,509	1,612	624	222	27	17	7
Kinki	1,530	969	383	130	28	17	3
Chugoku	710	388	199	83	24	10	6
Shikoku	585	293	166	86	27	10	3
Kyusu-Okinawa	1,331	701	352	206	53	16	3

Source: Japan Ministry of Agriculture, Forestry and Fisheries, various years.

Summary of Trends in the Japanese Sawmill Industry

There are a variety of factors that have adversely affected the competitiveness of Japan's sawmill industry. These factors include the structure of the industry itself, including rising production costs and the small, regional structure of the sawmill industry, lack of investment in processing technology, regulatory reform within the residential construction industry that has affected the demand for lumber produced from domestic species like *sugi*, the transition to pre-cut structural components in the post and beam industry and increased imports of low cost, high quality lumber.

Foreign suppliers continue to increase their lumber exports to Japan. Often this foreign lumber is lower priced and higher quality than domestically produced lumber and local sawmills find themselves at a competitive disadvantage in many of the larger urban markets, particularly within the new price sensitive market environment that exists within the homebuilding sector. While competition is somewhat less intense in rural markets, many foreign suppliers are actively looking to expand their sales into these markets as well. There is little doubt that competition within the Japanese lumber market will continue to increase. The increasingly competitive business environment will force more consolidation and closures within Japan's sawmill industry, particularly within the small ‘mom-and-pop’ segment of the industry.

Thus, in order to remain viable, domestic lumber manufacturers must develop a strategy that will allow them to compete within the new business environment. However, rather than undertake the reforms and consolidation required to become internationally competitive, many companies and industry associations within the Japanese sawmill and forestry sectors continue to seek regulatory relief from competition through a variety of non-tariff regulatory constraints and subsidies. For example, the pre-cutting industry, which manufactures the structural components for over 80% of the post and beam houses built in Japan, requires kiln dried lumber that is straight and machined to highly accurate tolerances as a raw material input to their manufacturing process. In response, most imported lumber is now kiln-dried and cut to the specifications required by pre-cut manufacturers. However, despite this change in material specification within the largest demand segment for structural lumber, the domestic Japanese sawmill industry has been extremely slow to change. In fact, by 2007, less than one-quarter of the structural softwood lumber produced in Japan was kiln-dried (22.6%) and only 16.5% of Japanese sawmills had invested in kiln drying facilities. Examples such as this clearly show that many Japanese sawmills continue to rely on government regulation and subsidies to provide a competitive advantage rather than investing in processing technology to improve their competitiveness.

These regulatory constraints and subsidies cover a range of options. For example, in 2004 a new association was formed to promote the use of domestically produced timber, particularly sugi and hinoki, within the Japanese market. This association, (named the Domestic Wood Lumber Association), was also tasked with developing exports markets for sugi logs, particularly in China (JLR 2005). The initial membership of this association was 27 companies. In response, log exports from Japan to China, while still small, jumped from 7,000 m^3 in 2003 to 30,000 m^3 in 2006. As a result of efforts by this association, many prefectures and local governments currently offer subsidies to wooden home builders who utilize a specific percentage of domestic timber in the homes they build (generally 50% or more). By the end of 2006, it was reported that there were 66 local governments and 36 prefectures providing some type of subsidy to encourage the increased use of domestic timber in wooden houses (JLJ 2006).

Some examples of programs that subsidize the use of domestic lumber include the following. Mie Prefecture has a prefectural certification system for Japanese cedar, Japanese cypress and other wood products manufactured within the prefecture. The new program, Wood of Mie, provides ￥360,000 per single family dwelling with a floor space of between 80m^2 to 175m^2 which uses 50% or more certified Mie lumber for posts, beams, wall or floor. Similarly, Ibaraki Prefecture provides a ￥200,000 subsidy through its Wood Care Action Program Ibaraki. In order to qualify for the subsidy, the wooden house must be built in a pre-designated area and must use 50% or more “Ibaraki” wood originating from Ibaraki prefecture. A further aim of the Wood care Action program is to increase the share of wooden houses built within Ibaraki prefecture to 66% by 2010 (AF&PA 2006).

In 2006 the Forestry Agency introduced a program euphemistically called the “New Production System” that is aimed at increasing the demand for domestic lumber through a program of subsidies targeted at streamlining the lumber distribution system and increasing the competitiveness of lumber manufacturers (JLJ 2006). The goals of the program are to: 1) improve the efficiency of the lumber distribution system, 2) encourage consolidation and the formation of lumber processing cooperatives, 3) improve the supply of timber to domestic processors and 4) support the profitability of forest owners practicing sustainable forest management (JLJ 2007).

It is against this backdrop of expanding non-tariff regulatory constraints and subsidy programs that the Japanese have developed and introduced the CASBEE-Sumai (Home) green building code for residential construction. While CASBEE-Sumai is generally a good effort to move towards a green building program that reduces the environmental footprint of new residential homes, early drafts of the program show that it would provide preferential treatment for domestic wood in an effort to expand the demand for domestically produced wood. In this sense, CASBEE-Sumai has moved beyond an objective program based on life cycle inventory (LCI) data to a program that reflects political and economic considerations that are at odds with the objectives of an LCI-driven green building program. The following section will provide a more detailed discussion of life cycle inventory and the CASBEE-Sumai green building program.

Life Cycle Inventory (LCI) Analysis

Public interest in the environmental impacts of forest management and home building has reached new heights, resulting in a demand for strategies and policies to improve environmental performance in these industries. Unfortunately, the environmental consequences of changes in forest management, wood products manufacturing, and building construction are often poorly understood, resulting in public policies that may be detrimental to local or global environmental quality. This situation is greatly exacerbated by an almost total lack of up-to-date, scientifically sound, product life-cycle data in many developed countries, particularly life-cycle inventory data regarding wood-based building materials.

Understanding the full range of environmental burdens associated with building materials, including raw material extraction, the manufacture of building materials, construction processes (both residential and commercial), operation of the structure, maintenance of the structure and disposal of the structure has become more important in recent years. Extensive publicity about global warming in general, and carbon emissions in particular, has made consumers more aware of the types of impacts their purchases can have on the environment.

Environmental concerns about forests and wood products have a direct and significant impact on the US building materials and home building industries. Timber harvest restrictions are quickly reflected in the availability of wood, and in turn, the price of building materials. Higher prices can influence consumers and home builders to switch to lower priced wood imported from other countries (often with less restrictive environmental regulations) or non-wood substitute materials. The environmental consequences of these purchase decisions are often ignored because of the lack of life-cycle inventory data. For example, purchasing lower cost imported wood can result in a greater environmental impact when the wood is imported from a region where the environmental impacts associated with harvesting and processing timber exceed those in the US. Similarly, the converse can also be true and the environmental impact of using imported wood may actually be lower (or equivalent) than using domestically harvested and processed wood products. Utilizing a life-cycle inventory approach can help the end-user better assess the total environmental impact of their purchase decision.

Decisions that discourage the use of wood building materials are made each day at all levels of industry and government. While these decisions may be motivated by a desire to protect the environment, the full negative consequences associated with using non-wood materials are often not considered. The decision to favor non-wood building materials is often based on incomplete information (or the consideration of misinformation) suggesting that non-wood substitute materials are more environmentally friendly than wood materials. The most commonly cited reasons for favoring non-wood building materials include the following: 1) using non-wood materials saves trees, 2) the major non-wood materials incorporate recycled material in their production, and 3) a lack of life cycle inventory data for the major wood and non-wood building materials prevents a complete analysis of the environmental impact of these building materials.

The first two reasons are disingenuous and ignore the true environmental impacts associated with the entire life cycle of using different building materials. The life cycle inventory (LCI) of building materials considers the entire environmental impact of using a specific material throughout its entire life cycle (Figure 10). Considering only a portion of the life cycle provides a distorted assessment of the environmental impact associated with using a specific building material and makes it impossible to compare the environmental impact of different materials used in the same end-use application.

While the total environmental impact of using materials involves impacts to soil, water and air, this report will focus its discussion and analysis on air emissions because of their contributions to global warming. A recent report by the Intergovernmental Panel on Climate Change (2001) notes that the major contributors to global warming include carbon dioxide, methane, and nitrous oxide emissions. However, each of these does not generate the same impact on global warming. For example, the global warming potential of carbon dioxide is 23 times that of methane and 296 times that of nitrous oxide. The relative contribution of these emissions to global warming can be expressed (in terms of carbon dioxide weight equivalence) using the global warming potential index (GWPI) below. It is clear from the global warming potential index that carbon dioxide is the major contributor to global warming and, as a result, most life cycle inventory programs focus on tracking and documenting the carbon dioxide emissions generated by a product through its entire life cycle. Thus, carbon dioxide emissions will also be the focus of the discussion in this report as well.

GWPI = CO_2 kg + (CH_4 kg x 23) + (N_2O kg x 296)

where:

GWPI: Global Warming Potential Index (CO_2 weight equivalence)
CO_2 : carbon dioxide
CH_4: methane
N_2O: nitrous oxide

The decision to avoid using wood building materials may in fact be counterproductive to the intent of improved environmental performance of a structure and could result in increased emissions of CO_2 and other greenhouses gas emissions. Wood products are environmentally preferable over both steel and concrete because of the smaller carbon footprint generated by using these products that can be attributed to the various pools of carbon that are directly sequestered in the forest as well as the carbon that is sequestered in the wood products (both short and long lived wood products) as well as the avoided carbon emissions that result from using wood products in place of more carbon intensive products such as steel or concrete. It is critical that a better information base of quantitative data regarding the environmental impacts of a variety of building products be developed and considered in the material specification process in Japan. In the US, this has been accomplished for the residential construction sector by the Consortium for Research on Renewable Industrial Materials (CORRIM), a not-for-profit consortium of 13 US and Canadian universities and research organizations.

The CORRIM research results show that for single-family houses, the substitution of steel or concrete for wood in structural framing end-uses involves as little as 6-10% of the mass of a house since so many components are common between the construction systems, such as concrete foundations, windows, gypsum wallboard covering and roofing. Despite this, the difference in the environmental performance of a residential structure using these different structural materials is much greater than the mass ratios would suggest. Considering only the wall and floor subassemblies (where wood, steel and concrete substitute for each other) results in a much worse percentage comparison for concrete and steel relative to wood across virtually all of the environmental measures (Figures 11 and 12).

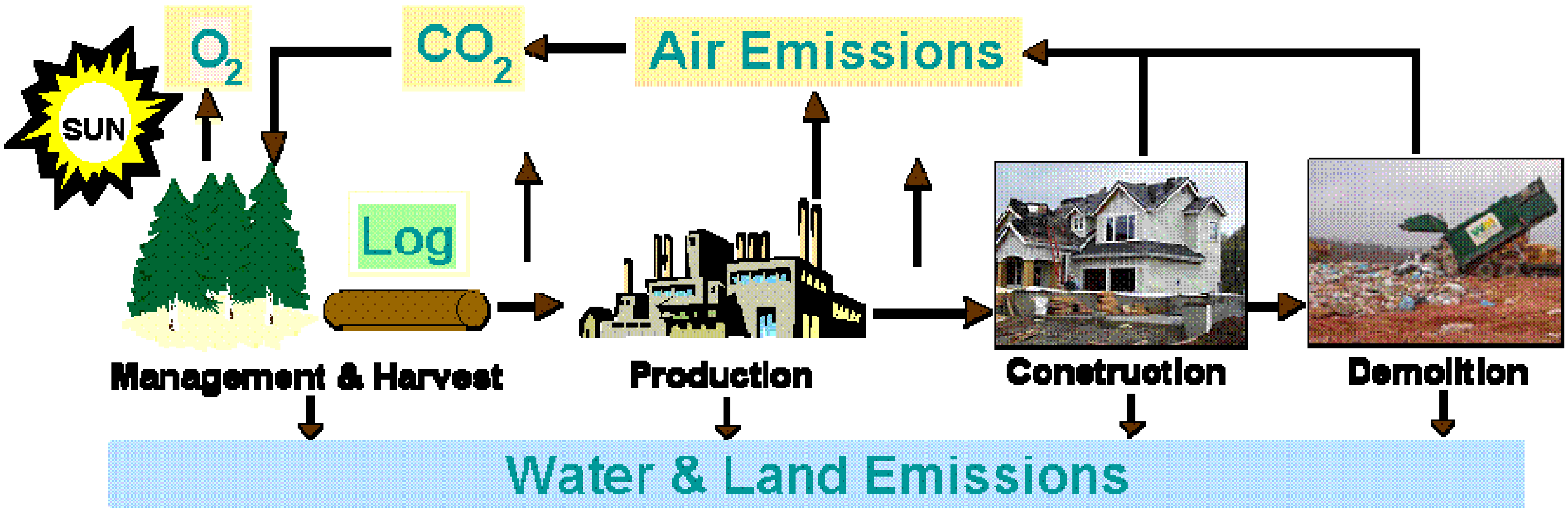

Figure 10. Schematic illustration of the scope of the life cycle inventory process.
Source: CORRIM 2005

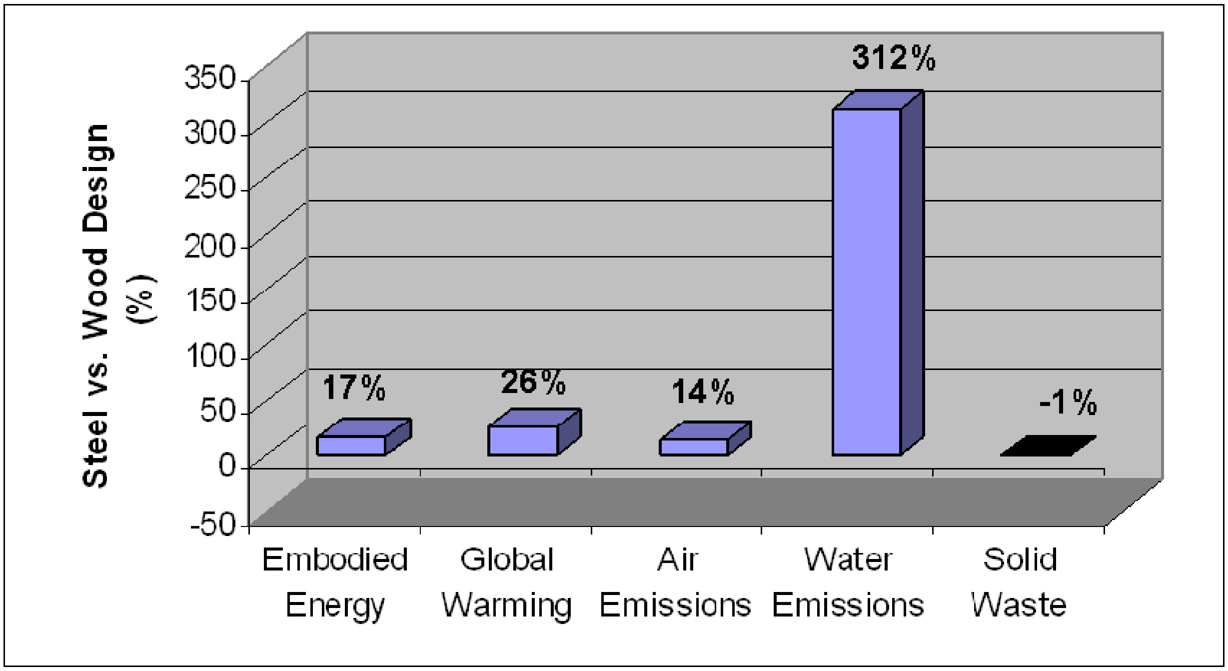

Figure 11. Summary environmental performance measures for a wood vs steel frame house.
Source: CORRIM 2005

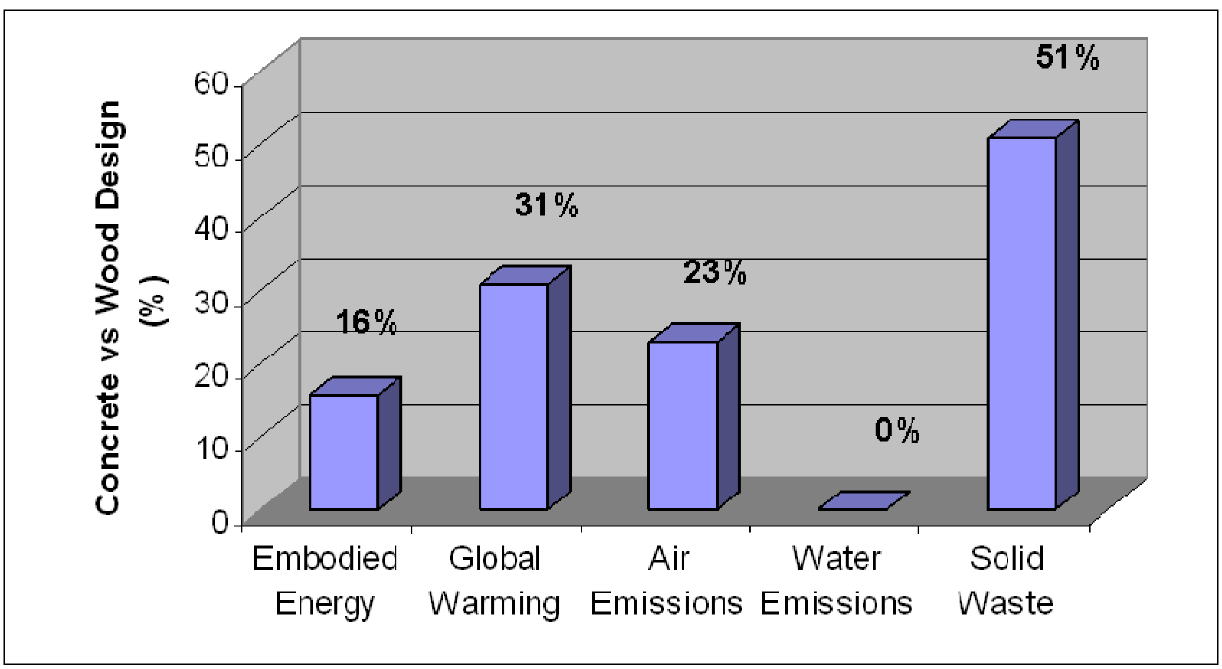

Figure 12. Summary environmental performance measures for a wood vs concrete house.
Source: CORRIM 2005

Comparing a wood framed house with a steel framed house shows that, with the exception of solid waste, the environmental performance of the wood framed house is substantially better than the steel framed house (Figure 11). Manufacturing the steel required to frame a single family house requires 17% more embodied energy and generates 26% more global warming emissions, 14% more total air emissions and 312% more water emissions than it does to manufacture the wood required to frame the same house. Similarly, manufacturing the concrete required to build a single family house requires 16% more embodied energy and generates 31% more global warming emissions, 23% more total air emissions and 51% more solid waste than it does to produce the wood required to frame the same house (Figure 12).

The environmental performance data has been broken down by end-use application within the home in Figures 13 through 15. Figure 13 shows the global warming potential for the steel and wood wall components, including an analysis using both green lumber and kiln-dried lumber. The bottom section of the bars is essentially same, reflecting the commonality of the materials used for the vapor barrier, gypsum wallboard and vinyl siding in both the wood and steel frames houses. While there is a small difference in the plywood and fiberglass insulation, the major difference can be seen in the global warming emissions associated with the steel versus the lumber used in the wall assembly. A similar trend can be seen in Figure 14 which shows the huge increase in global warming emissions associated with the concrete wall assembly relative to the wood framed wall assembly. Finally, Figure 15 shows the same type of analysis for the floor systems using the three different structural materials.

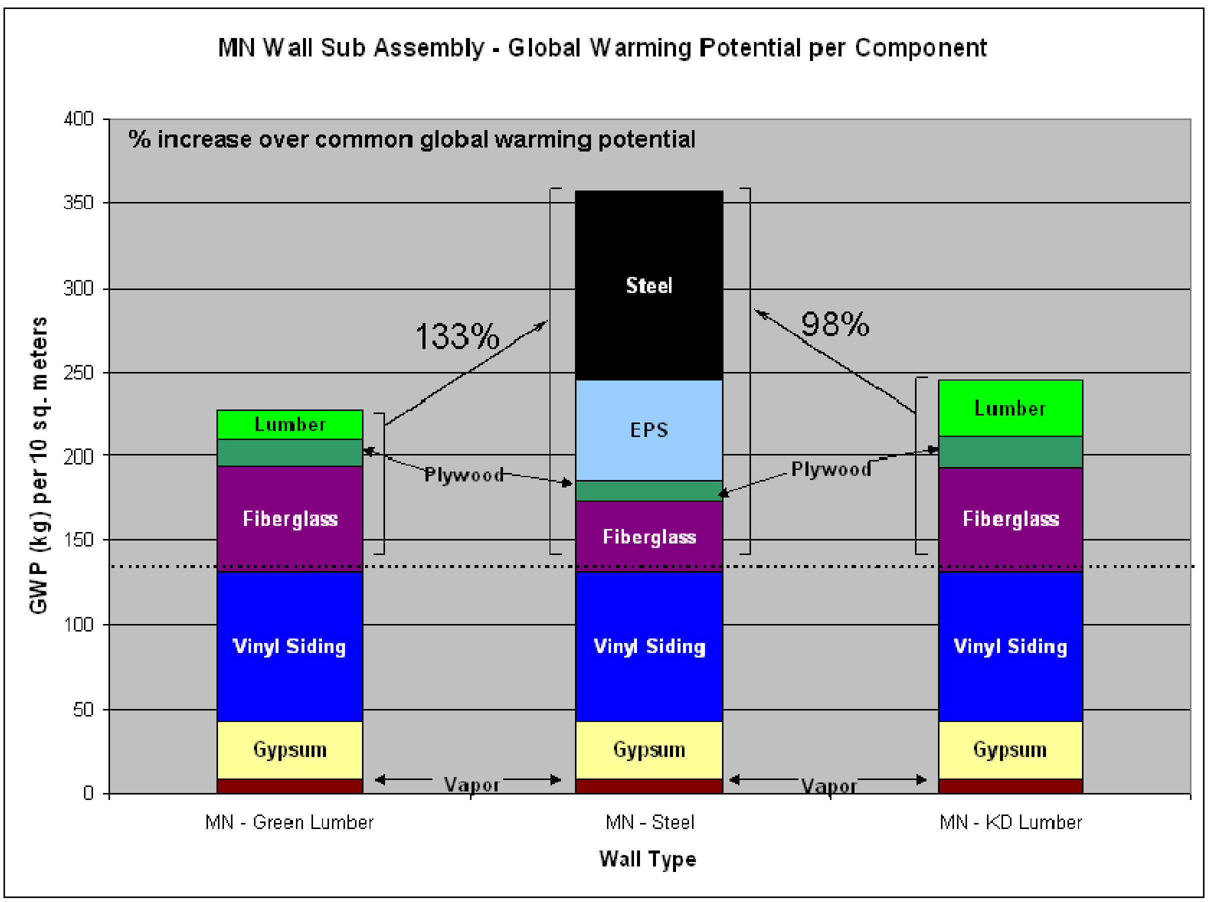

Figure 13. Comparison of global warming potential for wood vs steel framed walls.
Note that MN is an abbreviation for the city of Minneapolis where the wood and steel framed houses were located. Source: CORRIM 2005

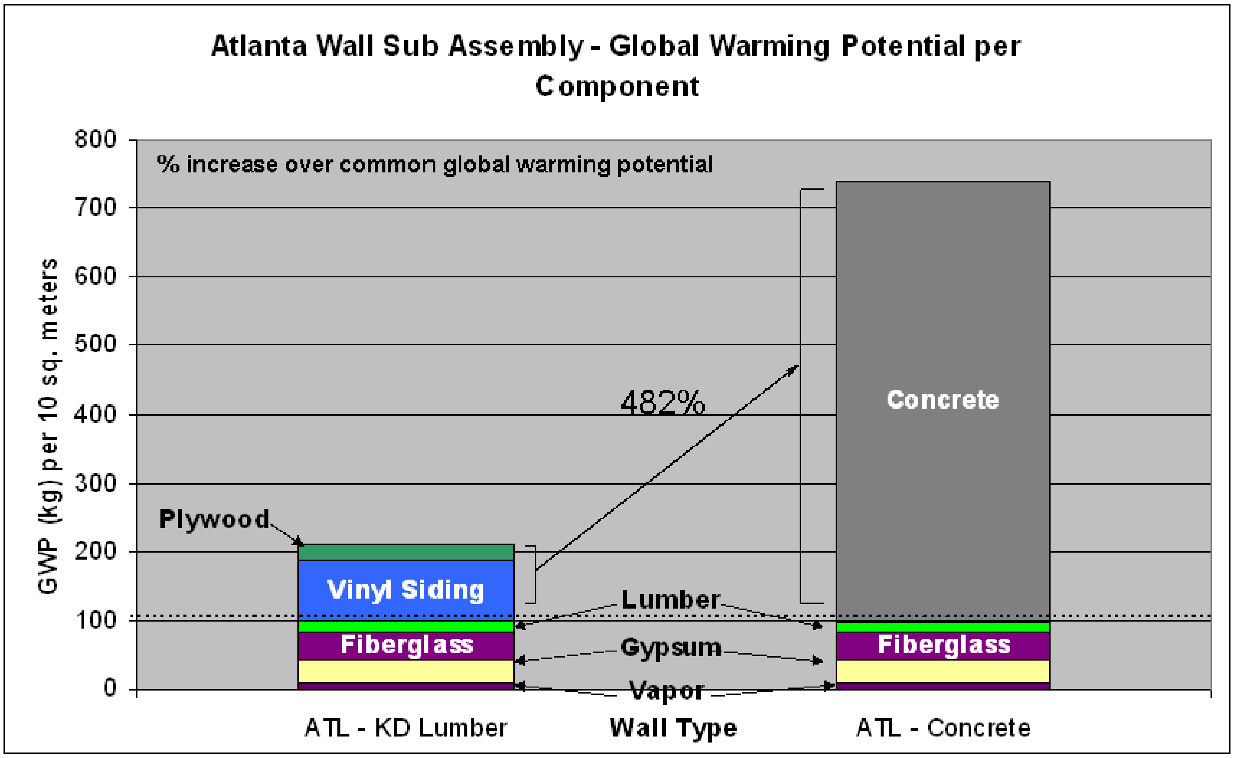

Figure 14. Comparison of global warming potential for wood framed vs concrete walls.
Note that ATL is an abbreviation for the city of Atlanta where the wood framed and concrete houses were located
Source: CORRIM 2005

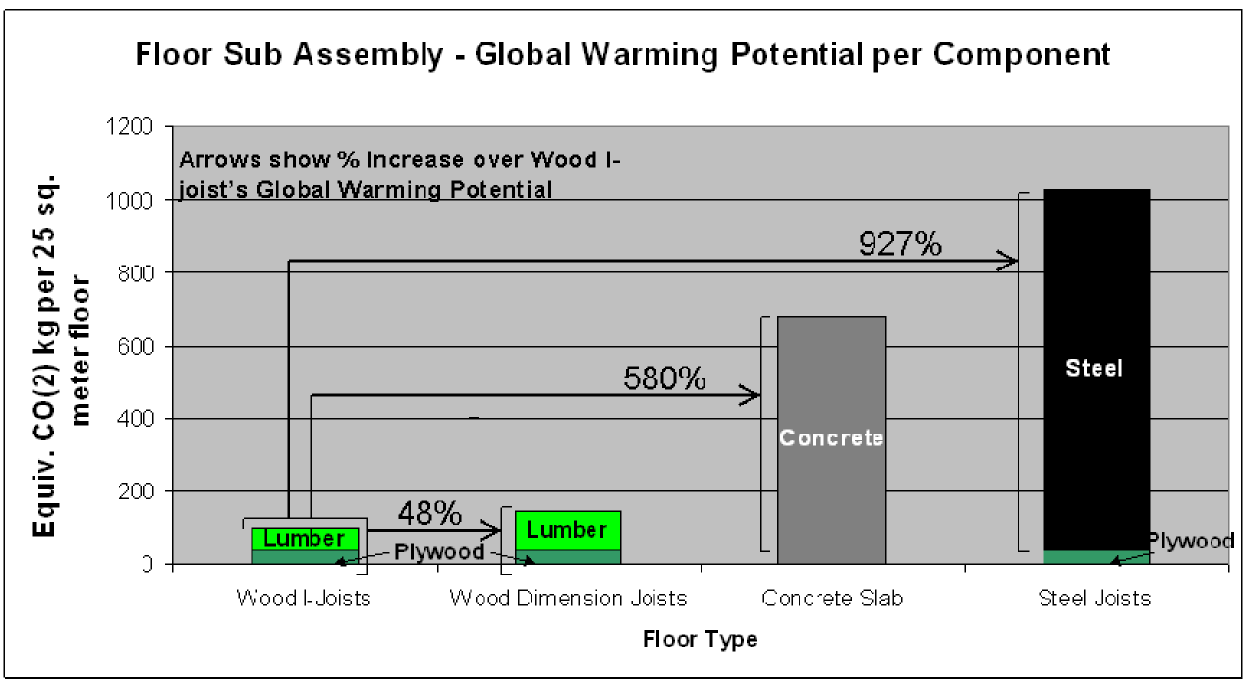

Figure 15. Comparison of global warming potential for floor sub-assemblies using different materials.
Source: CORRIM 2005

Carbon emissions are an important consideration when using renewable resources as indicated in the global warming potential index formula presented above. Figure 16 summarizes the various pools of carbon that are sequestered in the forest, the carbon stored in the wood products (both short and long-lived wood products) and the avoided carbon emissions that result from using wood products in place of more carbon intensive products such as steel or concrete. This diagram shows the change in carbon that occurs during two forest rotations.

The three major pools of carbon in a forest consist of: 1) the carbon sequestered in the forest itself, 2) the carbon sequestered in the wood products harvested from the forest and 3) the carbon emissions that are avoided by substituting wood products for steel or concrete (both of which emit significantly higher amounts of carbon dioxide and other greenhouse gases during their extraction and production than does an equivalent amount of lumber).

The first pool of carbon, that stored or sequestered within the forest, is represented by the light grey shaded area located on the bottom of Figure 16. This pool of carbon drops each time the forest is thinned or harvested and wood material is removed from the forest. The harvested material is converted into wood products which continue to store the carbon that was sequestered within the tree. These wood products can be either long-lived products such as softwood lumber used to build houses or short-lived products such as wood waste that is ultimately burned as fuel or used for animal bedding or landscaping material. The carbon sequestered in the wood products is represented by the black area and it is important to note that these black areas decline over time as the short-lived wood products decay or are burned and the sequestered carbon is released back into the atmosphere as carbon dioxide. An analysis of these two carbon pools shows that when a forest is harvested, much of the carbon is exported to long-lived products and there is a modest increase of sequestered carbon in the combined forest and wood product pools over time. This is in contrast to the steady state amount of carbon that is sequestered within a mature, old-growth forest.

However, of greater importance is the fact that, as wood products substitute for more carbon intensive materials (such as steel or concrete), there is a substantial avoidance of carbon emissions that is achieved by avoiding these much more fossil-fuel intensive building materials. The avoided carbon emissions achieved by using wood in place of steel or concrete are represented in Figure 16 as the medium grey areas along the top of the figure. The combined pools of carbon in the forest show an increasing trend over time, and represent an important consideration in the formulation of a carbon policy. This analysis clearly suggests that using wood products in preference to steel framing and concrete in residential construction provides three important environmental benefits. The first is the increased carbon sequestration that occurs in the forest following a timber harvest while the second can be attributed to the carbon storage role played by long-lived wood building materials and the third is related to the avoided carbon emissions resulting from the substitution of wood products in place of steel framing and concrete. All of these benefits argue for the increased use of wood over non-wood substitute materials (not withstanding the fact that the LCI analysis further supports the use of wood over non-wood materials).

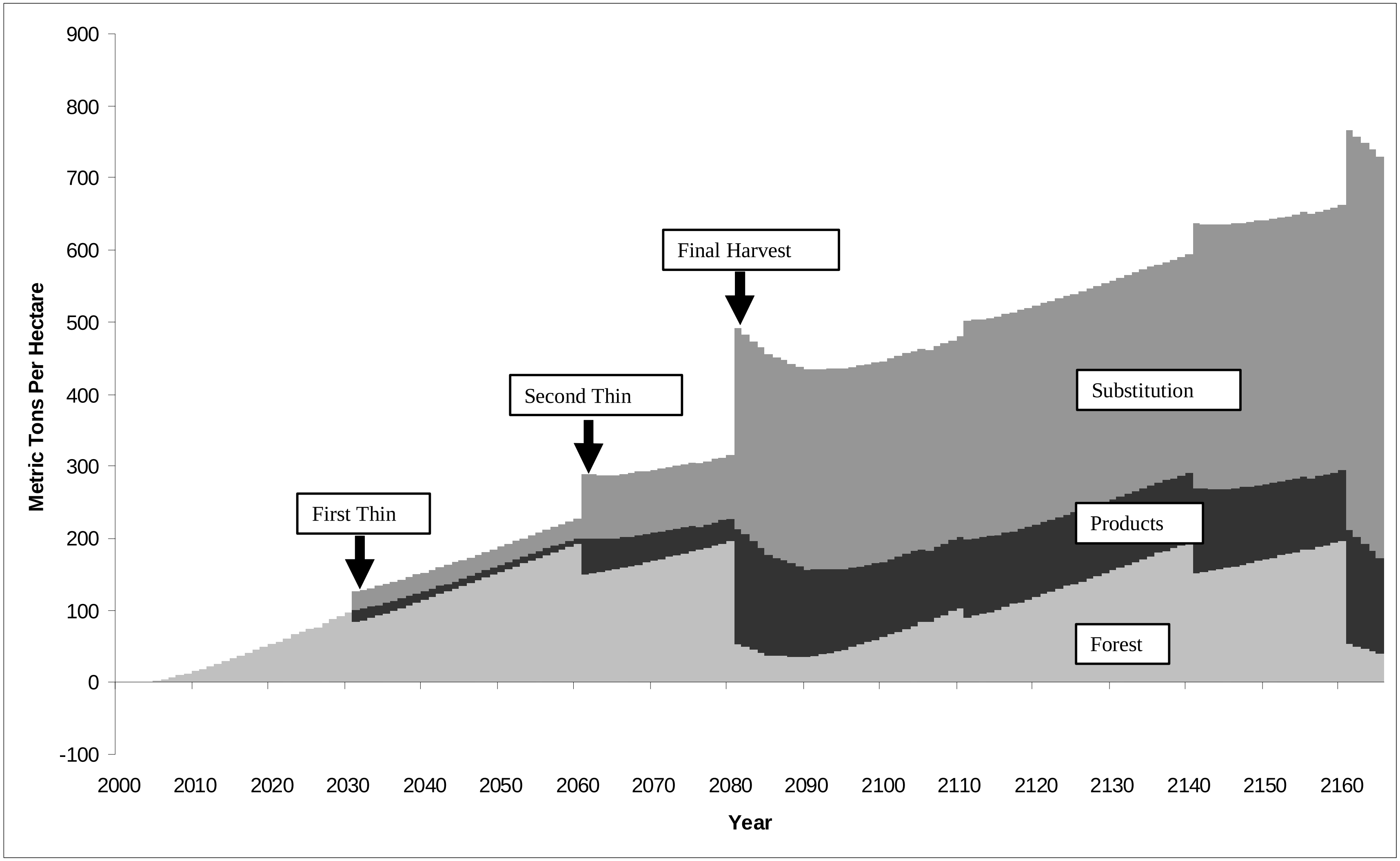

Figure 16. Carbon in forest, product, and substitution (avoided concrete) pools: 80-year rotation.
Source: CORRIM 2005

LCI and International Trade

This section will extend the CORRIM LCI analysis to consider the CO_2 emissions associated with the international ocean transportation of wooden building materials from Seattle to Tokyo, Japan. Using the CORRIM LCI data in conjunction with the transportation emission data compiled from the ATHENA Institute, the Environmental Protection Agency and the WoodMiles Forum allows for the estimation of the CO_2 emissions associated with transporting the lumber used in a wood frame house from Seattle to Tokyo. For this analysis, it is more useful to utilize lumber volume on a house basis rather than a cubic meter basis so that the analysis can accurately reflect the cradle-to-grave CO_2 emissions for the wood from the forest through the completion of the construction of the house. This section will then build upon the CORRIM analysis to compare the international transportation of US wooden building materials to Japan with the transportation of domestically harvested and produced wooden building materials within Japan from the perspective of CO_2 emissions. Most of the information for this latter analysis of domestic wood is based on a review of the research published by the WoodMiles Forum in Tokyo (http://www.woodmiles.net/english/index.html).

The WoodMiles Forum was developed in Japan and has nominally been introduced as a way of helping to meet Japan's CO_2 emissions reductions as mandated within the Kyoto Protocol. However, a careful reading of most of the material related to the WoodMiles Forum suggests that an equally important reason is to provide a platform for promoting the increased use of domestic wood within an environmental rather than market-based framework.

The international transportation of building materials generates additional carbon emissions which increase the environmental footprint of internationally traded building materials. However, given the large carrying capacity of bulk and container ships, the additional emissions (when assigned on a unit basis) are generally quite small. It is also important to consider the directionality of trade when assigning emissions and developing an equitable estimation of the emissions attributable to the transportation of building materials. For example, consider that most container shipments between Japan and the west coast of the US are primarily moving west to east (from Japan to the US) to deliver Japanese exports to the US. Since these container ships will be returning to Japan to pick up a new shipment of products regardless of whether or not they have a backhaul load, they often make the return trip with less than a full load. Given that these ships have to return to Japan irrespective of whether they have a load, we should logically consider only the incremental emissions attributable to the additional load caused by the wood products in our calculations rather than assign the entire amount of emissions generated during the return trip to the wood products being carried back to Japan. Discussions with several logistics managers for international shipping lines (e.g., Naodan, NYK Global Bulk Shipping Line, WSL, and PNW Asia Shippers Association) indicate that the difference in fuel use (and the resultant CO_2 emissions) between an empty container vessel and a fully loaded container vessel returning to Japan is only about 15%, which would result in substantially less CO_2 emissions being attributed to wood products that are transported to Japan on the backhaul leg of a return trip. Providing for a more equitable distribution of CO_2 emissions places imported logs and lumber in a much more favorable position relative to domestically harvested and processed timber products in Japan relative to their carbon load.

However, irrespective of this consideration, it is useful to develop a better understanding of the total carbon emissions that would be generated during the international transportation of wood products. To estimate the relationship between the cradle-to-gate CO_2 emissions associated with a wood frame house and the amount of CO_2 emitted while transporting the same volume of lumber from North America to Tokyo reference will be made to the CORRIM data. Statistics published by the Western Wood Products Association and APA-the Engineered Wood Association indicate that the typical single family wood frame house built in the US has a floor area of 2,400 square feet, requiring 15,000 board feet (35.4 m^3) of lumber, 4,137 square feet (3.7 m^3) of plywood and 8,682 square feet (7.7 m^3) of OSB.

Table 7. Volume of wood products and CO_2 emissions from cradle-to-gate for a typical 2,400 square foot house in the US.

	Volume	Cubic Meters	CO_2 equivalent
Structural Lumber	15,000 board feet	35.38	8,610
Structural Plywood	4,140 square feet	3.66	1,128
Structural OSB	8,682 square feet	7.68	5,341
Total		**46.72**	**15,079**

1: 1,130.07 square feet panel (3/8" basis) per m^3
2: 424 board feet lumber tally per m^3
3: 574 kg CO_2 emission output per mbf of planed KD lumber (CORRIM 2005)
4: 323 kg CO2 emission output per cubic meter of plywood (CORRIM 2005)
5: 696 kg CO2 emission output per cubic meter of OSB (CORRIM 2005)
Source: CORRIM 2005

Converting these wood volumes to cubic meter measure shows that there is almost 47 m^3 of structural wood used in the typical US single family house (Table 7). The amount of CO_2 emissions generated from cradle to gate for the lumber and structural panels used in the typical US house totals 15,079 kg CO_2 equivalent.

The volume of structural wood used in a single house in North America is roughly equivalent to the volume of wood products that can be carried in a 40 foot high-cube container (50 m^3). To calculate the amount of additional CO_2 emissions generated while transporting the volume of softwood lumber used in a North American house between North America and Japan, we reference the Athena Institute transportation emission calculator (Version 1.0). To transport a 40 foot hi-cube container of wood products between North America and Tokyo on a medium size container vessel (2,000-8,000 metric tons) would generate a total of 1,781 kg CO_2 equivalent (using a CO_2 conversion factor of .015 kg CO_2/ton.km). Thus the analysis of the CO_2 emissions associated with transporting the lumber used in the wood framed house would amount to just 11.8% of total CO_2 emissions generated during the entire cradle-to-gate life cycle of the wooden structural materials.

Next, we can place the amount of CO_2 emissions generated during the ocean transportation phase into perspective for the purpose of comparing imported lumber to domestically harvested and processed lumber used in wood frame post and beam construction in Japan. To do this, we calculate the amount of CO_2 emissions associated with transporting 14 m^3 of structural lumber (the volume of structural lumber used in the typical post and beam house in Japan, Table 3) from North America to Tokyo (7,553 kilometers). In order to ensure comparability with Japanese data we will utilize the CO_2 conversion factors derived by the WoodMiles Forum (2005). Using a conversion factor of .01095 kg-CO_2 per m^3.kilometer we calculate that the amount of CO_2 emitted on this ocean journey would be approximately 1,158 kg. Now, let's assume that this same volume of lumber was loaded onto diesel trucks, using a conversion factor of .18515 kg-CO_2 per m^3 kilometer for road transport in Japan. The typical diesel truck used to transport lumber to a building site carries approximately 7 m^3 of lumber and would require 2 round trips to transport the structural lumber used in a single house from a precutting facility to the construction site. If the construction site were located just 112 kilometers from the precutting facility, the total amount of CO_2 emitted by the truck in transporting 14 m^3 of lumber to the building site would be 1,161 kg-CO_2, the same amount of CO_2 emissions as was generated during the entire ocean transport phase.

Another way of comparing the relative carbon footprints of imported and domestic wood is to consider the relative lengths of the distribution channels. A 2006 survey of the sawmill industry in Washington state found that sawmills in Western Washington source approximately 75% of their logs from within a

50 mile (80 kilometer) radius of the sawmills. In addition, the average sawmill is generally located within 50 kilometers of the nearest port. The entire distribution channel length for US lumber imported into Japan is equal to approximately 242 kilometers (the 80 kilometer log trip to the sawmill, the 50 kilometer trip to the port and the 112 kilometer equivalent road distance for the ocean freight). This distance should be compared to the length of the distribution channel for domestic wood in Japan from the forest to a log auction yard to a sawmill to a lumber wholesaler to a precut manufacturing facility and finally to a residential construction site. Given the higher transportation efficiencies of ocean transport relative to road transport (in terms of CO_2 emissions per kilometer traveled) and the extended lumber distribution channel in Japan , a strong argument could be made that shipping lumber from North America to Japan might be more efficient and less environmentally harmful (in terms of total CO_2 emissions) for residential construction projects located within the major metropolitan areas where the bulk of the residential construction occurs in Japan.

However, to engage is these types of comparisons misses the greater point. That is, the forestry and wood products industries should not be engaging in costly battles to demonstrate that one type of wood (e.g., domestically produced wood) is more environmentally friendly than another type of wood (e.g., imported wood). At the end of the day, an unbiased assessment of the economic and environmental benefits of using domestic and imported wood products will likely show that the economic benefits are clear (hence the dominance of imported wood in Japan) while the environmental benefits are relatively similar. As a result, the only way to substantially boost the demand for domestically manufactured wood products, if the target market is narrowly defined as the post and beam market segment, is through subsidies or regulatory constraints that artificially increase the competitiveness of domestically manufactured wood products.

Ultimately, however, this is a myopic exercise that contributes to creating confusion in the minds of consumers, architects, home builders and home buyers and misses communicating the broader environmental message that wood is the superior environmental material for building a home relative to non-wood substitutes. There is absolutely no doubt that wood is the most environmentally friendly structural building material available on the market. Given the huge environmental benefits of using wood in residential construction, particularly with respect to steel framing and reinforced concrete (as clearly demonstrated by the CORRIM LCI results), the wood products industry in Japan would be better off focusing their attention on substituting wood for non-wood building materials (both in the single family and multi family residential markets as well as commercial).

The benefits of this type of strategy are two-fold: first, substituting wood for non-wood building materials in residential construction is an easier case to make to the public and is a much more effective way for Japan to move towards reducing carbon emissions and meeting their Kyoto CO_2 targets, and second, the number of non-wood residential housing units built in Japan exceeds the number of wood frame housing units. More importantly, this strategy would allow the Japanese forest products industry to grow the total demand for lumber (which would result in an increased demand for domestic and imported lumber) rather than compete for market share with foreign lumber suppliers within a shrinking segment of the residential construction market through the imposition of market distorting subsidies and non-tariff barriers.

To illustrate this point, Figures 17 through 19 show the trends in total housing starts, wooden housing and the use of the major structural materials in the residential construction sector in Japan. From Figure 17, two trends can be clearly seen that should be cause for great concern within the Japanese forest products industry. First, over time, the share of wooden housing to total housing has plunged from 77% in 1965 to a low of 43.3% in 2006. Therefore, within the current market structure and regulatory regime in Japan, wood is increasingly being replaced by non-wood materials in residential construction. Second, even as housing starts have begun to revive as the economy recovers, wood housing has continued to lose market share, reaching a low point in 2006 that is projected to continue into 2007, despite the fact that P&B starts have increased slightly since 2004 (Figure 18).

The trends in material usage for structural applications in residential construction show that while steel framed housing starts have declined since the early 1990s, the use of reinforced concrete has increased by 50% (Figure 19). On the wood side, both P&B and prefabricated wood housing have declined slightly over the past 15 years, whereas 2x4 housing has more than doubled. On a more positive note, 2x4 housing starts, at 105,390 houses in 2006, represented 8.2% of total housing starts and 18.8% of wooden housing starts.

The ownership pattern for residential housing starts shows that whereas new houses built for owners (replacement housing) have been declining steadily since 1996, houses built for sale (spec homes) and housing units built for rent (mansions or condominiums) have been increasing over the past 10 years (Figure 20). As a result, the share of residential houses built for owners dropped from 39% to 28% between 1996 and 2006 while the market share for spec homes and mansions increased from 21% to 29% and 38% to 42%, respectively. More importantly, while the vast majority of homes built for owners are wooden, a higher percentage of spec homes, and particularly mansions, are built using non-wood materials. Given the newly awarded building approval for 4-story homes and hybrid housing in quasi-fire protection districts and fire protection districts, these market segments offer a tremendous opportunity to expand the use of softwood lumber in Japan.

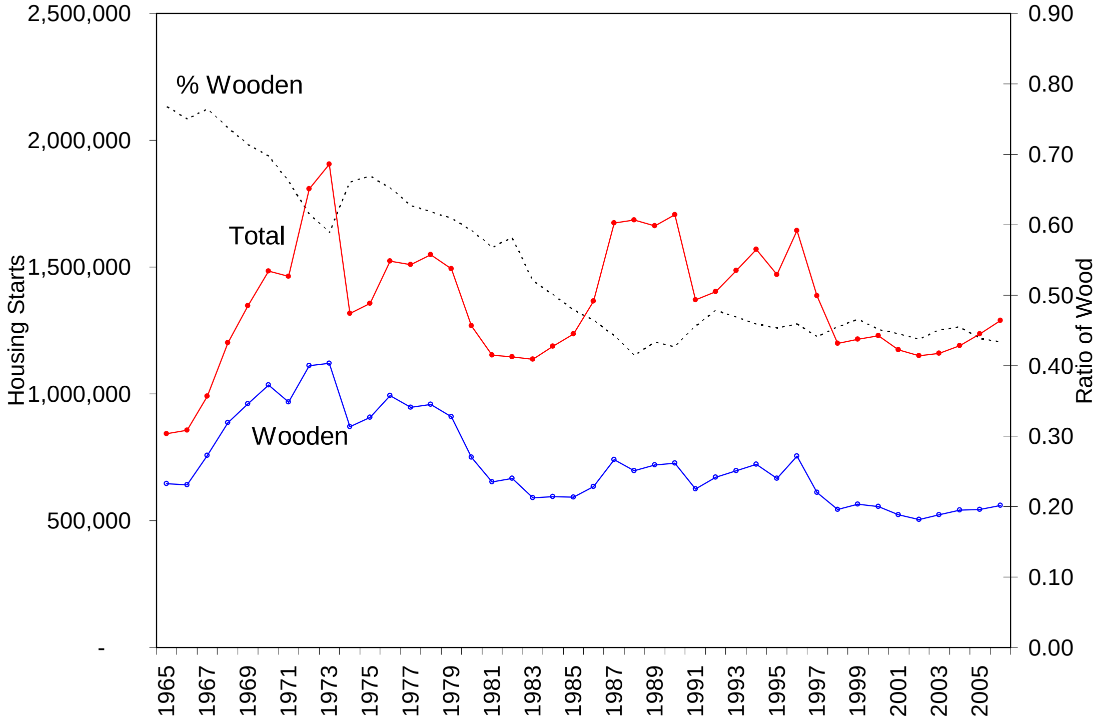

Figure 17. Ratio of wood and non-wood housing starts in Japan.
Source: Japan Lumber Journal, various years.

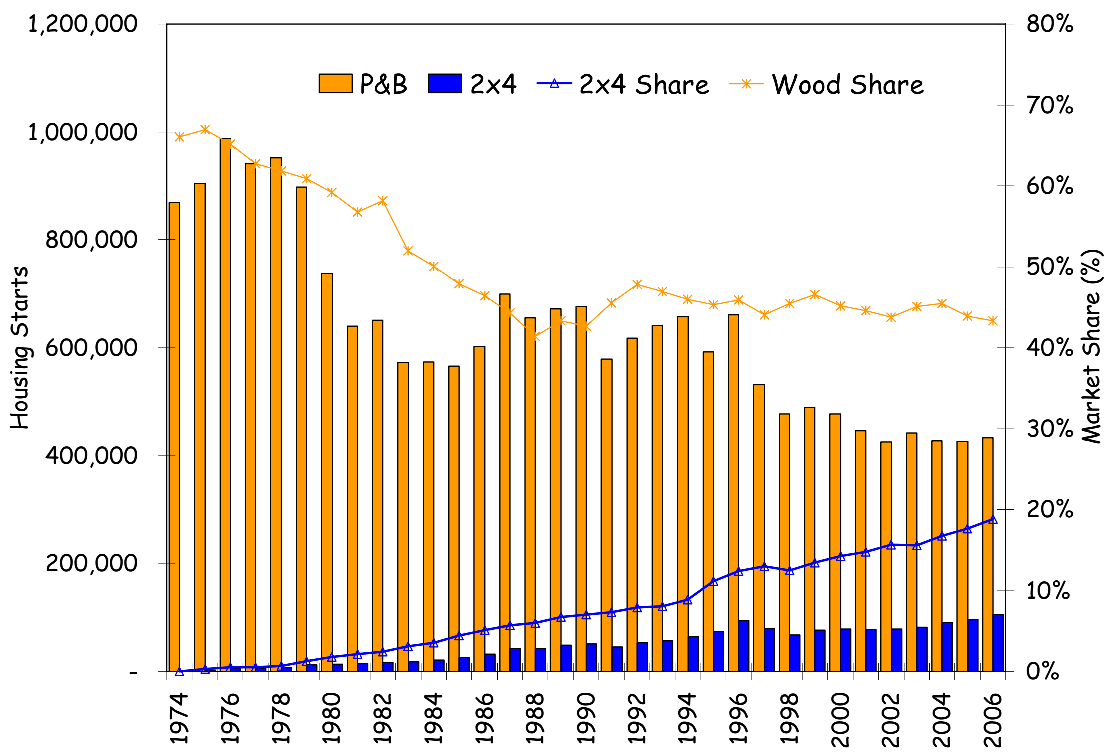

Figure 18. Comparison of housing Post and beam and 2x4 housing starts.
Source: Japan Lumber Journal, various years.

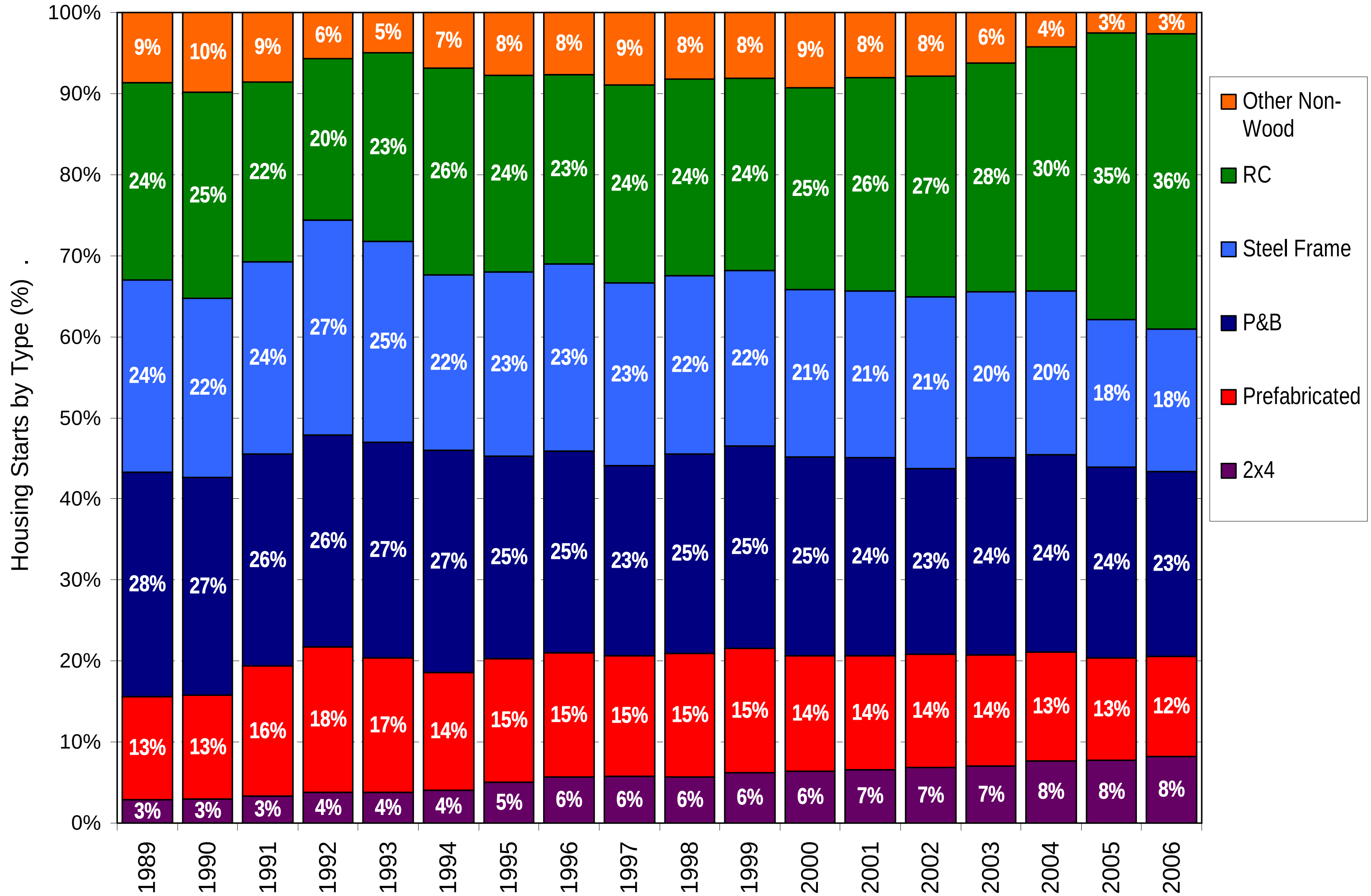

Figure 19. Trend of major building technologies used within the residential construction sector in Japan.
Source: Japan Lumber Journal, various years. (RC= reinforced concrete; P&B=post and beam)

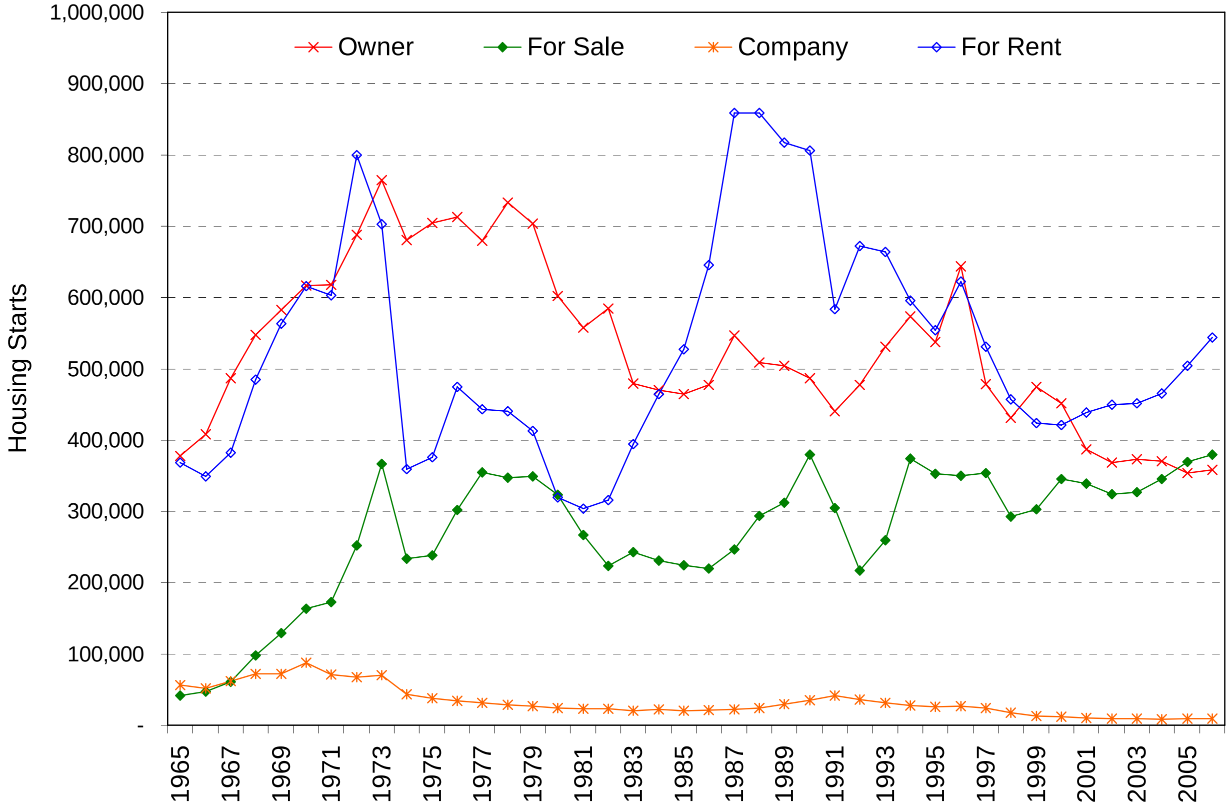

Figure 20. Trends in ownership for new residential construction over time.
Source: Japan Lumber Journal, various years.

Green Building Programs and CASBEE-Sumai

This section of the report will consider the green residential building program being drafted in Japan. In particular, the discussion will focus on specific elements of the draft program that could potentially constrain the market for imported wood products. Two program elements of particular concern are the de-facto classification of domestic forests as being sustainable managed and the specification of arbitrary sourcing distances for building materials.

Green or sustainable building programs incorporate the environment, the economy, and human aspects into the design and construction of a building. Green buildings are created through an integrated process where the site, the design, the construction, the materials, the operation, the maintenance, and the deconstruction and disposal of a building are all seen as being interrelated with the environment. As a result of this integrated process, it is thought that buildings can be made more environmentally friendly, more cost-effective and more resource and energy efficient, while providing a healthier living and working environment. Green building programs are slowly but surely emerging across the US and European landscapes and they are being considered in Japan and China. These programs have been adopted to varying degrees across all levels of government. Industry, trade and environmental organizations are also looking to promote green building initiatives at a variety of levels. Most green building programs are designed or organized by guidelines, usually accompanied by a checklist or a point system. Typically, the guidelines are divided into sections such as energy use, water use, materials, indoor air quality, and construction waste and points are awarded for incorporating designs, products and technologies that improve the environmental performance of the structure.

In general, there are two types of green building programs, voluntary and mandatory. Overall, a majority of the green building programs have been implemented on a voluntary basis. At the local level, cities are starting to adopt these programs and make them mandatory for publicly funded buildings. Government agencies are adopting these programs and requiring this type of building for two reasons; either as a model to demonstrate and encourage green building practices by the private sector, or, simply because they believe this type of building is more efficient from both an environmental and economic perspective. As a result, municipalities perceive that public and natural resources go further with green buildings.

Green building programs have begun to be designed to work with existing building codes and they have been successful in promoting their environmental benefits through a campaign of effective communication. A number of programs assume that the long-term cost savings from green buildings is a sufficient incentive to create a demand for them. Within the US, there are several green building programs that are either currently in use or are scheduled to be released by the end of 2007. The two green residential building programs that are available at the national level are the US Green Building Council's LEEDS for Homes program and the National Association of Home Builders Model Green Home Building Guidelines. While the LEEDS program is still in a draft format, the NAHB program is already being used by homebuilders. According to the NAHB Green Building website:

> *"The exploding market for sustainable, environmentally friendly and recycled building products, along with the greater availability of educational opportunities for builders, has accelerated green building's acceptance rate. By the end of 2007, more than half of NAHB's members, who build more than 80 percent of the homes in this country, will be incorporating green practices into the development, design and construction of new homes.*
>
> *NAHB's voluntary Model Green Home Building Guidelines are designed to be a tool kit for the individual builder looking to engage in green building practices and home builder associations (HBAs) looking to launch their own local green building programs. Since their debut in 2005, the Guidelines have helped move environmentally friendly home building concepts further into the mainstream marketplace.*

Currently, there are approximately 50 locally grown green building programs across the country, many of which are run by the local home builders' association (HBA). Eleven of these programs are voluntary, HBA-driven efforts, based on the NAHB Model Green Home Building Guidlelines; and approximately ten additional Guidelines-based programs are under development.”
http://www.nahb.org/publication_details.aspx?publicationID=1994&sectionID=155

Development of CASBEE-Sumai

There is currently one national green building program for residential housing under development in Japan. This program is called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) – Sumai (Home). The development of this program was begun in 2001 as a collaborative project between industry, government and academia and funding for the program is provided by the residential construction industry (50%) and the federal government (50%). The policy directions for the guidance of the development of the CASBEE-Sumai program included: 1) the application of a market mechanism, 2) minimizing the role of government, 3) encouraging change through the disclosure of information rather than government regulation, and 4) supporting the integration of building technologies to reduce the environmental footprint of a house. The CASBEE-Sumai green building program, a draft of which was released in July 2007, is designed to be a voluntary program, although it is likely that subsidies at either the local or national level (or both) will be made available to promote the program and encourage builders to incorporate green building considerations into the homes they design and build.

While the CASBEE-Sumai program is a voluntary program that is being jointly developed by the residential construction industry and the Ministry of Land, Infrastructure and Transportation (MLIT), the residential construction industry appears hesitant to adopt the program. Initial interviews with managers of several large home builders indicated that the major home building companies have been involved, to varying degrees, in the development of the CASBEE-Sumai program (including Mitsui Home, Sekisui House, Sumitomo Forestry, Misawa Home, and Daiwa Home among others). Based on our discussions with industry experts, it appears that small local home builders and medium-sized regional home builders are less likely to use the CASBEE-Sumai green building program to any large degree. The primary customers for these homebuilders are older homeowners who are generally replacing an existing home. The consensus opinion is that these customers are more conservative and are less likely to pay a higher price to have their home certified under the CASBEE-Sumai program.

In contrast, powerbuilders (medium-sized regional or national home building companies that specialize in spec home developments) appear to be more likely to use the program as a way to differentiate their homes from those of their competitors and also because their primary customers tend to be younger, more educated homebuyers who are more concerned about the environment. The ultimate success and widespread acceptance of the CASBEE-Sumai program will rest upon its acceptance by the large national home builders.

While our discussions with managers at several large home building companies suggest that most large home building companies are not likely to use the program, at least initially; the managers we talked with noted that if one large company were to adopt the program, then others would likely follow suit to prevent their competitor from gaining a marketing advantage with potential home buyers. There was also some concern among industry managers that the CASBEE-Sumai program might be transitioned from a voluntary program to a mandatory program similar to the process that has occurred with the Green Procurement program, although this is probably more of a concern in the commercial construction sector than the residential construction sector.

CASBEE-Sumai is similar in structure to green building programs in the US (e.g., NAHB Green Home Building Guidelines) in that the home building process is subjected to a series of guiding principles that are applied to the various stages of the construction process. While the specific stages of the construction process may vary somewhat depending on the green building program being consulted, they typically include the following: 1) lot design, preparation and development, 2) resource efficiency, 3) energy efficiency, 4) water efficiency, 5) indoor air quality, 6) operation, maintenance and homeowner education, and 7) global impacts. Most green home building programs typically award points to homes that incorporate green design concepts, materials, products and technologies. Based on the total number of points accumulated, a house is awarded a specific rating that reflects its environmental performance.

While a detailed description and assessment of the CASBEE-Sumai green building program is beyond the scope of this project, there are several aspects of CASBEE-Sumai that could adversely influence the demand for US wood products and these will be discussed in the following section of this report. The specific components of the program that will be addressed include: a) the differential treatment of wood sourced from domestic forests as preferred to imported wood, b) the inclusion of transportation distance as a main criteria of environmental performance, and c) the absence of a cradle-to-grave LCI assessment that takes into account the environmental performance of building materials throughout its life-cycle.

Sustainable Forest Management Programs and Certified Wood

When specifying materials, green building programs are typically designed loosely, allowing architects and builders considerable flexibility in specifying the most appropriate materials while still being able to meet the environmental criteria required to obtain the desired environmental rating. The guidelines for green building programs often identify the range of material options available. Architects and builders have expressed a clear desire that green building programs should be designed to guide, not dictate, the specification of the house design, the construction materials and construction techniques. However, in some green building programs certain building materials are implicitly identified as being more favorable based on the number of points awarded for their use (e.g., engineered wood products) or they are explicitly specified based on some set of criteria.

Most green building programs discourage using wood products harvested from old growth forests, favoring rather the use of recycled wood products or wood products derived from sustainably managed forests and plantations. As a result, the use of commodity softwood lumber is typically not a material choice that gains many points within a green building program. However, third-party certified softwood lumber that is verified as having been harvested from a sustainably managed forest is widely recommended and always preferred when lumber is used. Within the context of a green building program, it is important that all third-party forest certification programs be designated as being acceptable in order to ensure transparency in the program and increase the availability of certified wood in the marketplace. Exclusion of some third-party sustainable forest management programs based on political or social reasons, rather than an objective science-based assessment of each program, undermines the neutrality of the process, limits the adoption of sustainable forest management practices and unduly restricts the availability of certified wood products in the marketplace.

Within CASBEE-Sumai, preference is given for the use of locally harvested wood. In the most recent draft of CASBEE-Sumai, two types of wood are distinguished: regionally distributed wood (*chiki zai*)and locally sourced wood (*giba sansai*). A house built using domestic wood from outside the region of use or imported wood would not qualify for the local wood provision and thus would gain no additional points under the CASBEE-Sumai program. In contrast, a home built using locally sourced wood in the structure OR for the interior finishes would be awarded a point in the CASBEE-Sumai program. If the home was built using locally sourced wood for the structure AND the interior finishes it would be awarded two points. Note that the most recent draft (July 2007) does not specify that a certain percentage of locally sourced wood must used and the use of even a small amount of locally sourced wood would presumably qualify. This is a major change from the earlier draft which specified that at least 50% of the house must use locally sourced wood to qualify.

Furthermore, CASBEE-Sumai de-facto defines domestically harvested wood as being sustainably managed, with no requirement that sustainability be verified by a third-party certification program. In contrast, all imported wood must be certified as being sourced from sustainably managed forests in order to qualify for the sustainable material rating. The arbitrary decision to define domestic wood as sustainably harvested undermines the principle of transparency and scientific objectivity enshrined in most credible sustainable forest management programs. The lack of credible third-party verification of sustainability and legality also undermines consumer confidence since there is no guarantee that the wood being used is, in fact, legal or sourced from a sustainably managed forest. This problem was highlighted in a recent report in the Kyodo News (2008) on the illegal logging of almost 700 trees in the Akan National Park in Hokkaido, Japan, illustrates the need for independent third-party certification programs, even in Japan. The decision to define domestic wood as sustainable also places imported wood at a cost disadvantage in the marketplace since domestic lumber producers will not have to pay for the cost of certifying their lumber. All of those factors run counter to the stated objective of green building programs of improving the environmental performance of the forestry and home building industries.

Domestic versus Imported Wood

While some green building programs use distance traveled as a criteria for specifying the environmental benefits of wood products, not all programs utilize this criteria…and for good reason. There simply is little scientific basis for discouraging the use of wood in favor of locally sourced wood or, when local wood is not available or the wrong product types/product quality are the only choices available, of non-wood substitutes materials. Regardless of where a wood product originates (assuming it is legally sourced and harvested from a sustainably managed forest), it is always environmentally preferable to non-wood substitutes such as steel or reinforced concrete. Most of the time, the broad mix of construction materials required to build a house will not all be available locally. In this case, the requirement to source locally could conceivably result in a builder specifying a less environmentally friendly non-wood material in place of a wood product simply to meet the distance requirement. Introducing this type of trade-off into the material specification process clearly has the potential to distort the material specification decision. In general, the market (through higher transportation costs and therefore higher product prices) will limit the economic distance that wood products can travel and still remain competitive within a specific market. By artificially limiting the wood supply in a specific location, green building codes drive up the price of lumber and misguidedly encourage builders to favor less environmentally friendly product choices with the result being a less than optimal material specification decision.

A strong case in point is the use of the Japan WoodMiles Forum information to justify favoring local wood over imported wood in Japan. Since there is not a sufficient volume of timber harvested within Japan to meet the demand of the home building industry, a bias towards locally sourced wood could very likely have the effect of driving up wood prices within a local market to the point where home builders begin specifying lower-priced non-wood substitute materials that carry a higher environmental load. As mentioned previously, imported wood has a similar CO_2 emission loading to domestically produced wood in Japan. This is particularly true given the fact that the distribution channel for wooden building materials in the post & beam home building industry has become more extended with the widespread acceptance of pre-cut building components. As a result, locally harvested timber very often ends up traveling longer distances to go from the forest to the sawmill to the precut manufacturer before arriving at the jobsite.

Another factor not mentioned previously is the huge domestic sawmill industry in Japan that is reliant either wholly or to a large extent on imported logs. While the lumber produced in these sawmills might be technically described as locally produced, this distinction is hazy and disingenuous at best. In 2004 there were 4,474 sawmills in Japan that relied on imported logs for at least 50% of their raw material input. Further, MAFF statistics show that in 2004, 53% of the total log input in Japanese sawmills was derived from domestic forests whereas 47% of the total log input was from imported logs (58% of which came from the US). As a result, 7.2 million m^3 of lumber production was derived from domestically sourced logs while 6.4 million m^3 of lumber was produced from imported logs. A bias towards locally sourced wood would disadvantage imported wood by rewarding the use of domestic wood within the CASBEE-Sumai green building program and clearly result in higher lumber prices, supply discontinuities within specific regions and potentially skew the material selection process towards less environmentally friendly non-wood materials.

Estimating the Quantitative Impact of the CASBEE-Sumai and Domestic Wood Program on US Wood Exports to Japan

Despite the closure of more than 10,000 sawmills over the past twenty years, the Japanese sawmill industry remains uncompetitive and plagued by small, inefficient sawmills, may of which are located in rural areas far from the main demand markets. It is against this backdrop that the most recent regulatory initiatives to protect the domestic sawmill industry from international competition must be viewed. These regulatory initiatives include: 1) providing preferential treatment for domestic timber within the proposed CASBEE-Sumai green home building program, 2) using subsidies at the prefectural level to increase the share of timber used in wooden homes to at least 50% and 3) and using subsidies at the national level to target an increase in the market share of domestic timber used in the post and beam industry from the current 30% to 60% by 2015. This combination of regulatory subsidies and non-tariff barriers could have a significant impact on US exports of softwood logs and lumber.

Before we can estimate the quantitative impact of the domestic wood programs on US softwood log and lumber exports to Japan, it is useful to understand the types and volumes of specific wood products used in building post and beam houses. Table 8 provides a description of how material usage has been changing within the residential post and beam industry (the main driver of softwood lumber demand in Japan). The effort to increase the demand for domestic wood would impact both glue laminated lumber and solid sawn lumber in this market.

Table 8. Changing ground sill (dodai) material use within the post and beam industry (%).

Product	Species	2005	2004	2003	2002	2001
Post	**Glulam**	**61.5**	**66.1**	**63.7**	**71.9**	**71.5**
(Hashira)	(Eur. Whitewood)	29.6	36.9	39.3	23.2	41.9
	(Eur. Red Pine)	14.6	15.2	15.4	11.9	--
	(J. Species)	--	4.0	--	--	--
	Solid Sawn	**38.5**	**33.9**	**36.3**	**28.1**	**28.5**
	J. Cypress, KD	22.8	14.8	14.7	15.0	18.0
	J. Cedar, KD	12.9	14.9	18.8	9.6	3.9
	Other	2.8	4.2	2.8	3.5	6.7
Structural Beam	**Solid Sawn**	**25.7**	**25.7**	**41.6**	**33.5**	**38.7**
(Hirakaku)	Douglas-fir, Green	1.0	2.3	3.8	8.4	9.8
	Douglas-fir, KD	25.8	17.0	37.8	25.1	28.9
	J. Cedar, KD	8.0	6.4	--	--	--
	Glulam	**63.1**	**70.2**	**55.8**	**62.4**	**56.3**
	(Douglas-fir)	14.0	13.6	4.5	6.1	10.0
	(E. White Wood)	30.7	21.0	25.5	8.1	19.8
	(Eur. Red Pine)	18.4	35.6	25.8	25.6	16.0
	Other	2.1	4.1	2.6	4.1	5.0
Sill Plate	**Solid Sawn**	**64.6**	**57.1**	**57.0**	**65.4**	**72.2**
(Dodai)	Hemlock (treated)	11.1	15.4	23.0	33.3	36.0
	Yellow Cedar	23.7	17.7	15.1	18.3	23.1
	J. Cypress	24.0	24.0	18.9	13.8	13.1
	DF (treated)	5.8				
	Glulam	**27.7**	**30.2**	**28.9**	**24.8**	**15.9**
	Yellow Cedar	14.9	12.5	11.5	8.8	--
	J. Cypress	12.8	12.5	--	--	--
	Other	7.3	12.7	14.1	9.8	11.9

Source: Japan Lumber Reports 2006 (Number 464) and various.

Table 9 provides an estimate of the material use in specific structural end-use applications in post and beam houses both at the house level and at an aggregate demand level for the entire post and beam housing sector, while Figure 21 provides an illustration of where each component is used within a lost and beam house. At the aggregate level it can be seen that demand for structural lumber in post and beam housing totaled about 5.9 million m^3 in 2006. Using the information in Tables 8 and 9 allows us to estimate the current demand for domestic wood in post and beam housing and to approximate the demand for domestic wood in 2015. In 2006 the post and beam industry used approximately 1.77 million cubic meters of domestic lumber and 4.12 million cubic meters of imported lumber to build 432,731 houses. The following analysis will consider the impact of increasing the market share for domestic wood in the post and beam market from 30% to 50%[1] in the event that: a) P&B housing starts remain at 432,173 (the base case and most likely scenario) and b) P&B housing starts drop to 400,000 by 2015 (drop case).

[1] A market share of 50% was chosen as a conservative estimate for the analysis because many prefectural subsidy programs require at least 50% domestic wood use while the MAFF program targets a 60% market share in post and beam by 2015.

Table 9. Estimates of total structural lumber use in post and beam construction, 2006.

Structural Member	English Translation	Lumber Volume per house	Total Lumber Volume
Dodai	Ground sill	0.8 m^3	346,000 m^3
Tsuka	Floor post	0.2 m^3	87,000 m^3
Obiki	Girder	0.2 m^3	87,000 m^3
Neda	Joist	0.7 m^3	303,000 m^3
Sub-Total	***Floor System***	***1.9 m^3***	***823,000 m3***
Toshibashira	Balloon Post	0.7 m^3	303,000 m^3
Kudabashira	Post	1.7 m^3	736,000 m^3
Mabashira	Non-structural stud	1.7 m^3	736,000 m^3
Sujikai	Diagonal wall brace	0.5 m^3	216,000 m^3
Sub-Total	***Wall System***	***4.6 m^3***	***1,991,000 m3***
Hirakaku	Structural beam	5.0 m^3	2,164,000 m^3
Sub-Total	***Structural Beams***	***5.0 m^3***	***2,164,000 m3***
Keta	Top plate	0.4 m^3	173,000 m^3
Koyazuka	Roof support post	0.4 m^3	173,000 m^3
Moya	Purlin	0.7 m^3	303,000 m^3
Tarouki	Rafter	0.5 m^3	216,000 m^3
Munagi	Ridge beam	0.1 m^3	43,000 m^3
Sub-Total	***Roof System***	***2.1 m^3***	***908,000 m^3***
Total		**13.6 m^3**	**5,886,000 m^3**

Notes: Lumber volume is based on 432,731 post and beam housing starts in 2006.
Source: Sojitz Lumber Co. (Lumber volumes by application)

JAPANESE POST & BEAM CONSTRUCTION

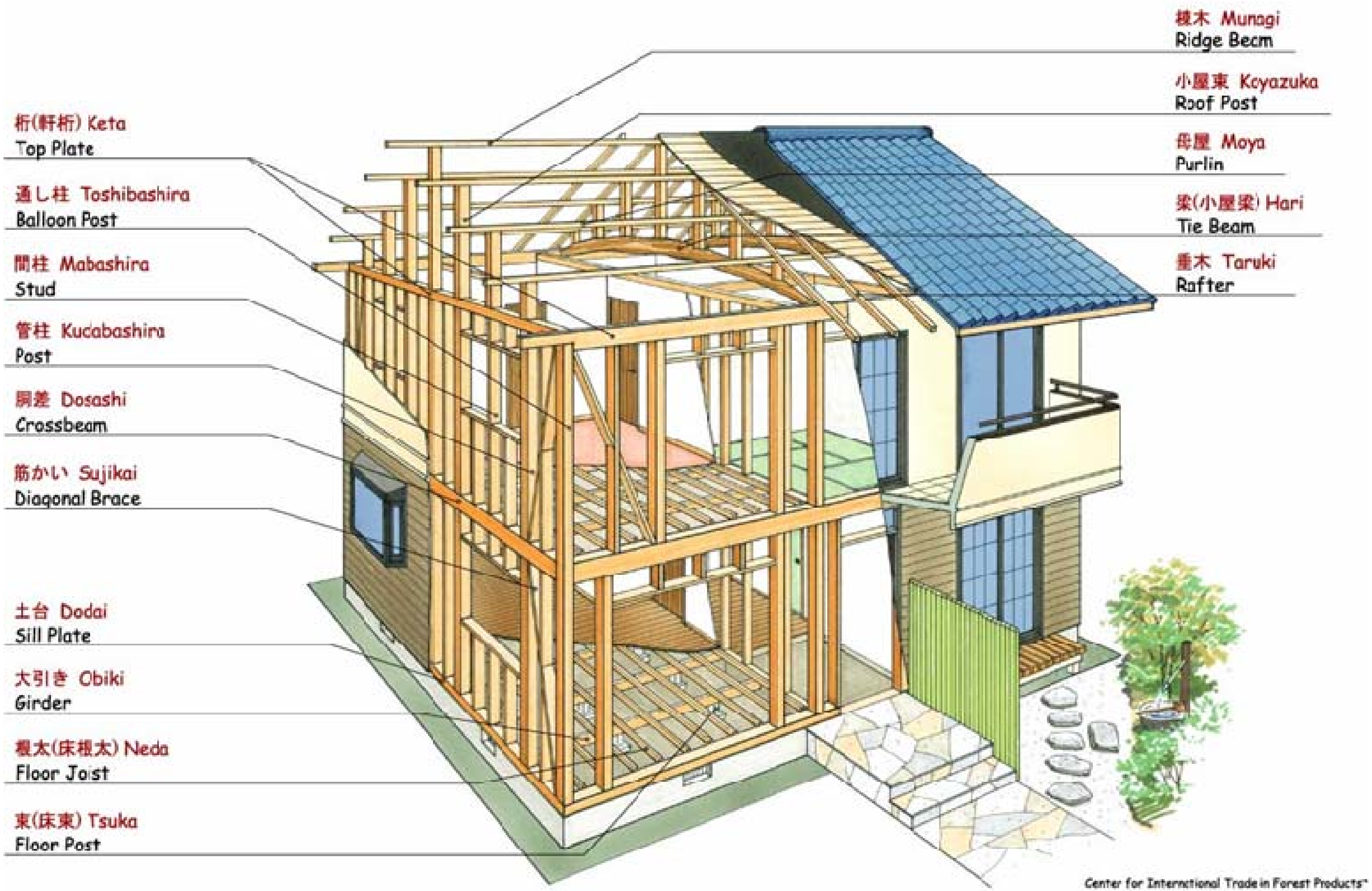

Figure 21. Structural components of the Japanese post and beam house.

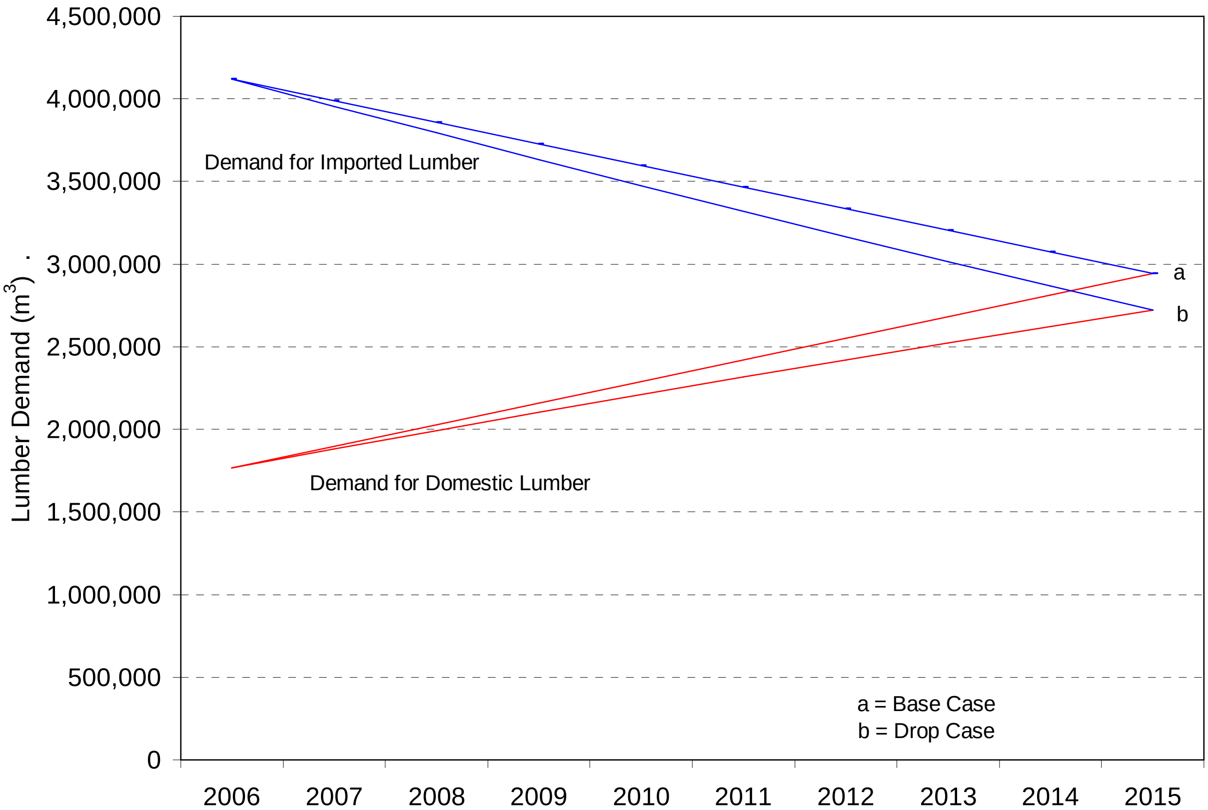

Figure 22. Demand for domestic and imported lumber within the P&B industry through 2015.

The impact of increasing the market share of domestic wood to 50% on total softwood lumber imports for both cases is shown in Figure 22. The analysis shows that the demand for domestic lumber would increase by between 1.2 million m^3 (drop case) and 1.4 million m^3 (base case) by 2015. In contrast, total softwood lumber imports would drop by between 1.2 million m^3 (drop case) and 1.4 million m^3 (base case). Total softwood lumber imports would drop from 4.1 million m^3 in 2007 to 2.9 million m^3 in 2015 in the case of constant P&B housing starts (the most likely scenario).

Increasing the use of domestic lumber would not only impact the demand for imported lumber, but the demand for imported logs would decline as well. Since the US is a large supplier of logs to Japan (approximately 2/3 of which are Douglas-fir logs), this would adversely impact both log and lumber imports from the US. Table 11 provides a summary of the potential impact of CASBEE-Sumai on US log and lumber exports to Japan if the market share of domestic wood were to increase from the current 30% to 50%. In the case of the lumber, the estimates look at the two cases where P&B housing remain constant over the 2007-2015 time frame as well as if they were to decline by 7.6% to 400,000 P&B starts by 2015. The cumulative impact on the value of US lumber exports to Japan over the period 2007-2015 would range between \$54.5 million to \$67.2 million (Figure 23 and Table 11).

Table 10. Change in domestic lumber production and lumber imports as a result of domestic market share in P&B segment increasing from 30% to 50% (cubic meters)

	Base Case			Drop Case		
	Domestic	Imported	Imports from US	Domestic	Imported	Imports from US
2006	1,765,542	4,119,599	121,794	1,765,542	4,119,599	121,794
2007	1,896,323	3,988,818	119,665	1,880,386	3,955,295	118,659
2008	2,027,104	3,858,037	115,741	1,993,032	3,793,189	113,796
2009	2,157,885	3,727,256	111,818	2,103,479	3,633,282	108,998
2010	2,288,666	3,596,475	107,894	2,211,728	3,475,573	104,267
2011	2,419,447	3,465,694	103,971	2,317,779	3,320,062	99,602
2012	2,550,228	3,334,914	100,047	2,421,632	3,166,749	95,002
2013	2,681,009	3,204,133	96,124	2,523,286	3,015,634	90,469
2014	2,811,790	3,073,352	92,201	2,622,742	2,866,718	86,002
2015	2,942,571	2,942,571	88,277	2,720,000	2,720,000	81,600

Base case has P&B housing starts remain constant at 2006 level (432,731)

Drop case has P&B housing starts dropping to 400,000 by 2015

Table 11. Decline in US softwood log and lumber export values to Japan

	Base Lumber Loss	Drop Lumber Loss	10% Log Loss	30% Log Loss
2006	$0	$0	$0	$0
2007	$1,065,447	$723,674	$4,485,407	$15,245,344
2008	$2,718,148	$2,057,011	$8,920,977	$31,239,063
2009	$4,348,436	$3,390,349	$13,307,263	$46,776,782
2010	$5,956,314	$4,723,687	$17,644,812	$61,872,953
2011	$7,541,779	$6,057,024	$21,934,166	$76,541,547
2012	$9,104,834	$7,390,362	$26,175,860	$90,796,070
2013	$10,645,477	$8,723,700	$30,370,425	$104,649,578
2014	$12,163,709	$10,057,037	$34,518,383	$118,114,689
2015	$13,659,529	$11,390,375	$38,620,253	$131,203,605
Total Loss	**$67,203,673**	**$54,513,220**	**$195,977,546**	**$676,439,630**

Base case has P&B housing starts remain constant at 2006 level (432,731)

Drop case has P&B housing starts dropping to 400,000 by 2015

10% log loss case assumes US softwood log exports decline by 10% in response to 10% market share increase for Japanese domestic lumber (less than the target share for domestic lumber)

30% log loss case shows US softwood log exports declining by 30% in response to 30% market share increase for Japanese domestic lumber (target share is achieved for domestic lumber)

In the case of logs, we considered two different alternatives since the relationship between log usage and housing starts is less clear. First we look at the drop in DF log exports resulting from an increase in the domestic lumber market share from 30% to 50% as opposed to a more moderate case where the market share of domestic lumber only increases from 30% to 40% within the P&B sector over the period 2007-2015. We focus on DF log exports because we know that most of the DF lumber produced within Japan is used by the P&B industry while the end-uses for SPF, Sitka spruce and hemlock logs is less clear. The analysis for log exports to Japan shows that if US log exports to Japan declined by 20% (corresponding to the projected increase in domestic timber use), then the value of US log exports would drop by approximately $676 million over the period 2007-2015. In contrast, US log export values would decline by approximately $196 million over the same time period if the volume of log exports dropped by only 10%.

Over the entire 2007-2015 time period considered in the analysis, the phasing in of the various subsidy programs could potentially increase the consumption of domestic wood from 30% to 50% of the raw material mix in the P&B home building industry and could reduce US log and lumber exports to Japan by between $251 million and $743 million. However, it should be noted that there is considerable uncertainty regarding how domestically produced lumber processed from imported logs will be treated within CASBEE-Sumai. In the case that lumber produced from imported logs were to be considered to be domestically produced, these subsidy programs would have little impact on the value of US log imports into Japan while the value of US lumber imports would decline by as much as 54.5 million over the period 2008-2015.

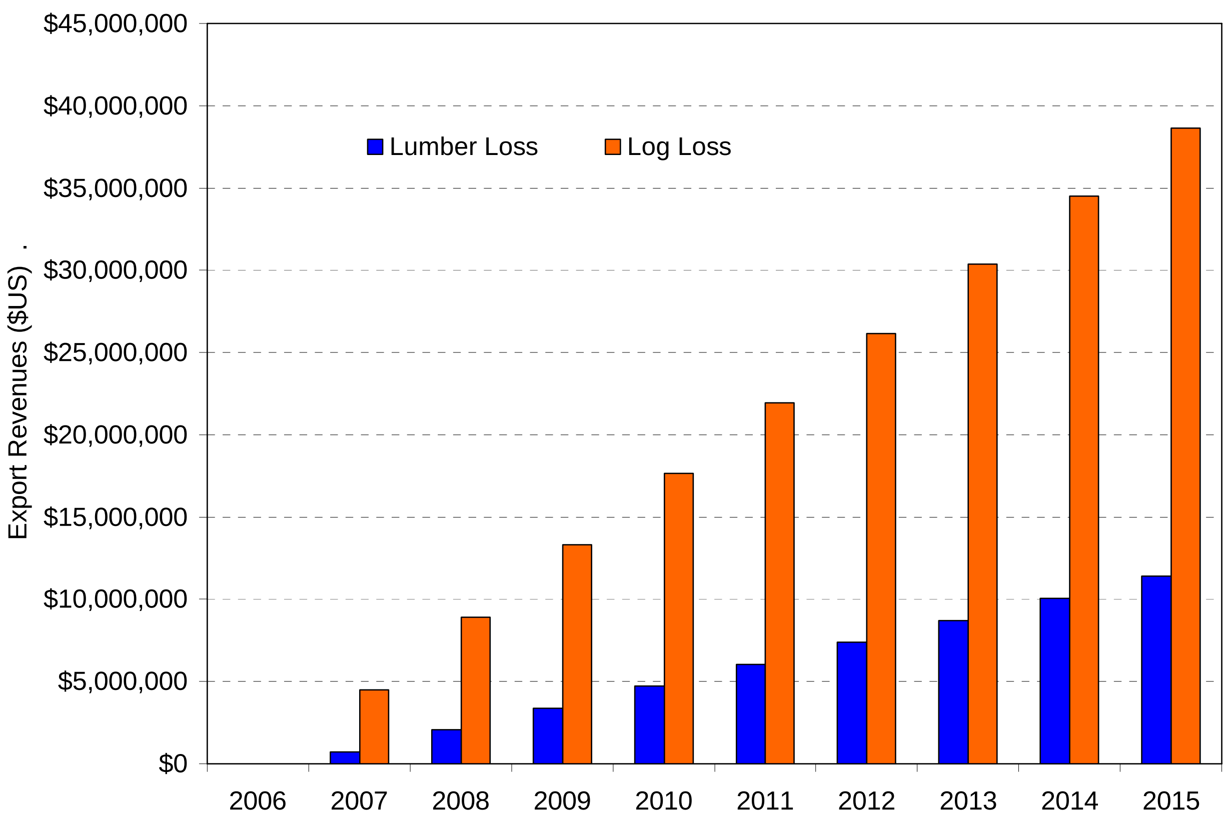

Figure 23. Projection of annual lost revenue for US log and lumber exporters to Japan.

If this were not the case, and lumber produced from imported logs was not considered to be domestically produced, then the value of log imports from the US into Japan could well decline. Using the base case for lumber exports and the 10% case for logs (a more conservative set of assumptions) suggests that the US forest products industry could see losses of approximately $54 million in lumber exports and $196 million in log exports (Figure 23). While this analysis is sensitive to a number of assumptions, not the least of which is uncertainty as to whether the Japanese forest sector can even provide enough timber to supply 50% of the raw material requirements of the P&B industry, it clearly shows that a program of subsidies targeted towards substituting domestic wood for imported wood could have a devastating impact on US forest products exports.

Summary

Japan is a timber deficit country that requires timber imports to supply the domestic demand for wood. To a large degree, the domestic demand for wood in Japan is tied to housing starts where approximately 43% of housing starts are built with wood. Recent concerns about meeting their international obligations under the Kyoto Protocol with respect to global warming and the environment have led the Japanese to consider adopting a green building code (called CASBEE-Sumai) to reduce the environmental footprint of residential homes.

The most recent draft of the CASBEE-Sumai program has incorporated two features which place some types of wood at a competitive disadvantage by implying that some types of wood are preferable to others. This arbitrary distinction could be a source of confusion to home builders regarding the overall environmental superiority of wood relative to other structural building materials. The two features of concern that have been incorporated into the CASBEE-Sumai draft building program are: 1) the specification of local wood sourced from within a specific distance of a building site as being preferred to imported wood and 2) the determination that domestic timber is de-facto defined as having been harvested from sustainably managed forests. In addition, arbitrary market share targets for domestic wood use in post and beam homes have been proposed at both the prefectural and national levels.

The first feature of the CASBEE-Sumai green building program has been shown to be misguided in the sense that it does not take into account the role of the market and mismatches between the supply of specific wood products and the market requirements within local markets. Home builders within regional markets often do not have access to the entire range of structural wood products required to build a house from local processors, and as a result, penalizing them for sourcing wood materials from outside their local area sends the wrong environmental message about wood and could encourage them to specify less environmentally friendly non-wood building materials.

The fundamental reason for this feature of the CASBEE-Sumai program is to provide support for domestic wood processors whose lumber products are uncompetitive against imported wood. However, the blame for this lack of competitiveness cannot be placed at the feet of foreign manufacturers but rather is attributable to the reluctance of the domestic sawmill industry to implement the measures and investments required to achieve consolidation and modernization within an overly large and technically inefficient industry. For example, the pre-cutting industry, which manufactures the structural components for over 80% of the post and beam houses built in Japan, requires kiln dried lumber that is straight and machined to highly accurate tolerances as a raw material input to their manufacturing process. In response, most imported lumber now arrives in Japan kiln-dried and cut to the specifications required by pre-cut manufacturers. However, despite this change in material specification within the largest demand segment for structural lumber, the domestic Japanese sawmill industry has been extremely slow to invest in new kiln drying capacity. In fact, by 2006, less than one-quarter of the structural softwood lumber produced in Japan was kiln-dried (22.6%) and only 16.5% of Japanese sawmills had invested in kiln drying facilities. Examples such as this clearly show that Japanese sawmills are reluctant to invest in manufacturing technology to improve their competitiveness, preferring instead to rely on government regulation and subsidies to protect them from more efficient foreign producers.

Adopting a green building program that promotes domestic wood over imported wood is the wrong strategy and could well end up raising lumber prices and limiting the supply of wood in some markets and ultimately favor the use of less environmentally friendly materials such as steel and concrete. In fact, the transportation analysis in this report clearly shows that within a radius of approximately 100 kilometers of a container port, North American wood may actually have a smaller carbon footprint and be more environmentally friendly than most domestically sourced wood which has been transported from a rural forest location to a sawmill to a precutting facility before finally being shipped to a job site.

Strategic Recommendations

The myopic strategy of protecting the inefficient and uncompetitive forestry and sawmill sectors in Japan through preferential regulatory policies (such as the de-facto specification of domestic wood as being sustainable managed) or by providing subsidies to achieve a specific (and arbitrary) market share for domestic lumber within the post and beam residential construction sector ignores the superior environmental performance of wood products relative to non-wood building materials. More importantly, these types of preferential programs have been specifically targeted to the post and beam market segment; a shrinking segment of the residential construction industry. As a result, these policies distract attention from opportunities to expand the demand for wood products in non-traditional market segments such as wood multi-family housing, hybrid construction and low-rise commercial construction. Housing start statistics clearly show that whereas the ratio of P&B housing starts has been declining over time, the ratio of housing starts in the multi-family (both mansion and apartments) sectors, where steel and concrete dominate, has been increasing.

Wooden three and four story buildings, built using the P&B construction method, as well as up to five story hybrid structures are some of the building types that can now be built in quasi-fire and fire protection districts as a result of the fire-resistive construction approval issued by the Ministry of Land, Infrastructure and Transportation in Japan. This makes it possible for multi-family apartments, kindergartens and nursing homes to also be built using both the P&B and 2x4 construction systems in fire protection zones if the approved specifications are used (AF&PA 2006). As of July 20, 2006, three hundred and thirty-two (332) 2x4 buildings have been registered as fire-resistive buildings (i.e., 214 single houses, 81 apartment houses, 4 social and welfare accommodations, 24 office-residential buildings, 2 commercial buildings and 7 other types of buildings). Fourteen (14) of these buildings were four-story buildings while one was a five-story building. The number of 2x4 wooden buildings built within fire protection districts was 284 out of the total of 332 buildings (approximately 86%). It has been reported that most of the fire-resistive buildings were registered in the Kanto (Tokyo) region (AF&PA 2006).

If the Japanese forest products industry is truly interested in promoting the environmental benefits of wood, encouraging the adoption of a green building program and expanding the demand for domestically produced structural lumber, then they would do well to consider a strategy that grows the overall demand for structural lumber by promoting the increased use of structural lumber in non-traditional sectors of the market rather than encouraging an artificial competition between domestic wood and imported wood within the shrinking P&B segment of the residential construction industry. This promotional effort would utilize LCI data to document the superior environmental performance of wood frame multi-family and commercial (including hybrid) structures relative to non-wood structures. To support this effort, preliminary research should be done to identify: 1) the relative market shares of steel and concrete structural materials within these non-traditional market segments, 2) the material selection process used by architects and builders and 3) the factors that influence the material selection process.

To date, there has not been a cradle-to-grave LCI assessment of the structural building materials used in the post and beam or the 2x4 segments of the residential construction industry. In order for the Japanese forest products industry and research organizations to establish and document the environmental benefits of wood as a construction material in Japan, they might consider joining the CORRIM research consortium to expand the CORRIM research agenda to include an LCI analysis for single family P&B and 2x4 homes in Japan as well as wood frame multi-family housing or commercial structures built in Japan.

Irrespective of Japanese participation with CORRIM, it would be very useful for the US wood products industry to translate the results of the CORRIM LCI research into Japanese as a series of Fact Sheets and streaming video presentations describing the environmental benefits of wood construction relative to steel and reinforced concrete. This information could be distributed or presented at trade shows and technical seminars targeted towards builders and architects. . It would also be important to present this information to public research organizations and the relevant Ministries in Japan to encourage their cooperation with CORRIM as a strategy for incorporating LCI analysis in material specification decisions and green building programs in Japan.

Given the traditional preference for living in a wooden house and the increasing concern of consumers regarding the environmental impact of houses, combining the results of a life-cycle inventory of wood and non-wood materials in residential construction in Japan with a strong promotional campaign by the wood industry could be effective in raising awareness about the environmental benefits of using wood to build homes, mansions and apartments among potential home buyers, architects and builders. The basic message of this campaign would incorporate the LCI results to emphasize the fact that (any) sustainable harvested wood is environmentally preferable to non-wood building materials.

Given the agenda of some groups to promote domestic wood over imported wood, it is important for US wood products associations to maintain open communication with the CASBEE-Sumai committee to reinforce the message that the CASBEE-Sumai program should focus on rewarding the use of any wood over less environmentally friendly structural building materials. This should be reinforced by the message that wood houses use a broad range of sizes, qualities and species of lumber in their construction based on specific structural end-use requirements. Limiting the material selection to only locally produced lumber severely restricts the material options available to builders and may encourage them to use less environmentally friendly non-wood materials in place of other “non-local” wood products so that they can still meet the 50% local building material requirement and therefore qualify for prefectural subsidies. The bottom line is that these subsidy and regulatory programs distort the market and could encourage architects and builders to make material choices based not on the environmental performance of a specific material but on a set of artificial proxies that reflect a political agenda rather than objective scientific environmental data.

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