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The Impact of Green Building Programs on the Japanese and Chinese Residential Construction Industries and the Market for Imported Wooden Building Materials

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Abstract

Surveys were conducted in Japan and China of residential builders perceive and use green building programs in each country. In addition, builder's perceptions of the relative environmental performance of wood, steel and concrete building materials were collected. Finally, each program was evaluated to assess its potential to discriminate against imported building materials. The results suggest that builders in China are more aware of the green building program in their country than are home builders in Japan. Builders in both countries widely perceive that the environmental performance of wood is superior to that of steel and concrete across every measure of environmental performance. The results of this research clearly show that the adoption of green building programs in Japan and China could provide a variety of market opportunities for expanding US exports of value-added wooden building materials into these countries. However, an analysis of the CASBEE green building program in Japan shows that it has the potential to discriminate against imported wooden building materials.

Keywords
Green building, life cycle assessment, trade constraints, builder's perceptions, environmental performance

INTRODUCTION

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 building design, the construction, the materials, the operation, the maintenance, and the deconstruction and disposal of a building are all seen as being inter-related with the environment. Green building brings together the principles of sustainability and eco-friendly values in a bid to lighten the environmental impact of residential and commercial structures. 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 (Eastin 2008). Green building programs are slowly but surely emerging across the US and European landscapes and they have been introduced 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. Points are awarded for incorporating designs, products and technologies that improve the environmental performance of the structure and reduce waste.

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 funds and natural resources go further with green buildings.

Green building programs have been designed to work with existing building codes and they have been successful in promoting their environmental benefits through an effective communications strategy. A number of programs assume that the long-term cost savings achieved from green buildings are a sufficient incentive to create demand for them. Within the US there are several green building programs that are currently in use. The two major green residential building programs in use at the national level are the US Green Building Council's LEED for Homes program introduced in January 2008) and the National Association of Home Builders National Green Building Program (available since February 2008). Similarly, green building programs have been introduced in Japan and China (CASBEE 2006; CASBEE 2008a; CASBEE 2008b; PRC 2006). The Japanese green building program is called CASBEE-House (CASBEE 2008c) whereas the green building program in China is called the Chinese Evaluation Standard for Green Building (often called the Three Star System).

RESEARCH METHODOLOGY

To better understand how builders and architects perceive and use these housing programs in Japan, a series of surveys were conducted at a variety of professional conferences and trade shows. A total of 406 surveys collected from Japanese home builders and architects at the Tokyo Home Show (November 2009), the State of Washington/Evergreen Building Products Association's fall trade mission in September 2009 (which included seminars in Maebashi, Mito, Tokyo, Chiba, and Shizuoka), and the Architecture and Construction Materials show in Tokyo (March 2010). In addition, 150 surveys were collected from Chinese construction professionals during the Evergreen Building Products Association's US-China Build trade mission in Hangzhou, Wuhan and Qingdao, China in September 2009. Both surveys were designed to collect information to help better understand home builder's and architect's attitudes towards green building programs and their perceptions of the environmental attributes of wooden building materials relative to non-wood materials.

RESULTS and DISCUSSION

Level of Awareness and Perceived Effectiveness of Green Building Programs in China and Japan

In this section of the report we compare responses obtained in Japan and China across a number of common survey questions. A significantly higher proportion of respondents in China (94.3%) have heard about the green building program compared to Japan where only 35.2% of survey respondents had heard of the CASBEE-House green building program, Figure 1. However, the greater level of awareness in China does not translate into a higher level of usage. Survey results show that the proportion of respondents who reported having built a home using the green building program was almost the same in both countries; 10.7% in China versus 10.0% in Japan.

Building professionals in China and Japan were asked to assess the effectiveness of their green building programs based on their observation and experience. By a margin of almost 4 to 1, a substantially larger proportion of building professionals in China perceived that their green building program was effective compared to their Japanese counterparts, Figure 2. In contrast, less than 10% of Chinese building professionals felt the green building program in China was ineffective compared to almost 35% in Japan. Almost half of all respondents in both countries had a neutral perception towards the effectiveness of the green building programs in their countries.

Perceived Importance of Environmental Attributes in China and Japan

Survey respondents in both countries were asked to rate a set of environmental attributes in terms of how important they were in influencing their material purchasing decision. The environmental attributes included in both surveys were: 1) using energy efficient materials and products, 2) using renewable materials, 3) using water saving appliances and fixtures and 4) using recycled materials, Figure 3. A comparison of the results obtained from both surveys shows that the importance ratings are extremely similar. The singular exception is for the attribute "use renewable raw materials" which the Chinese respondents rated substantially higher. Overall, it would seem that builders and design professionals in both countries view the

environmental attributes in a similar way. This suggests that a similar marketing message emphasizing common environmental attributes might be effective in promoting wood building materials in both countries.

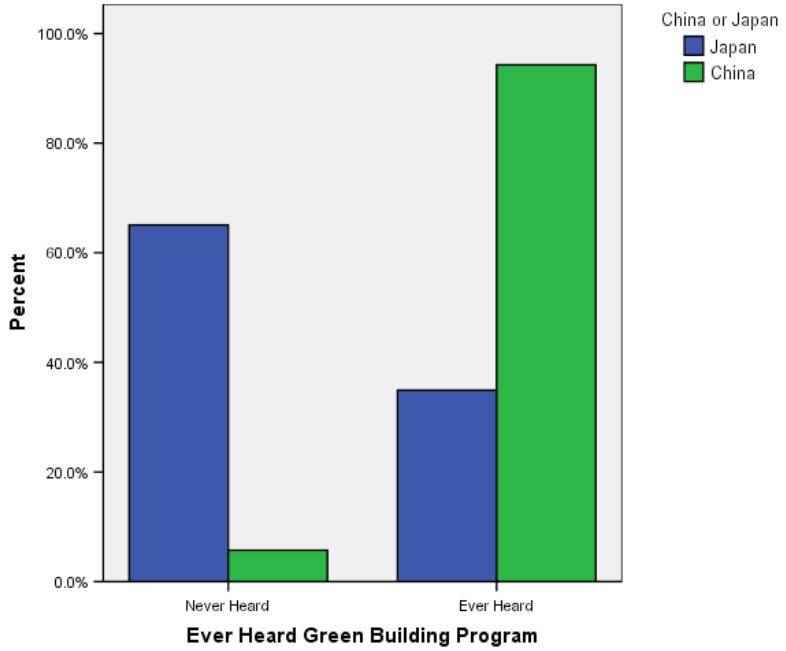

Figure 1. Comparative levels of awareness of green building programs in China and Japan.

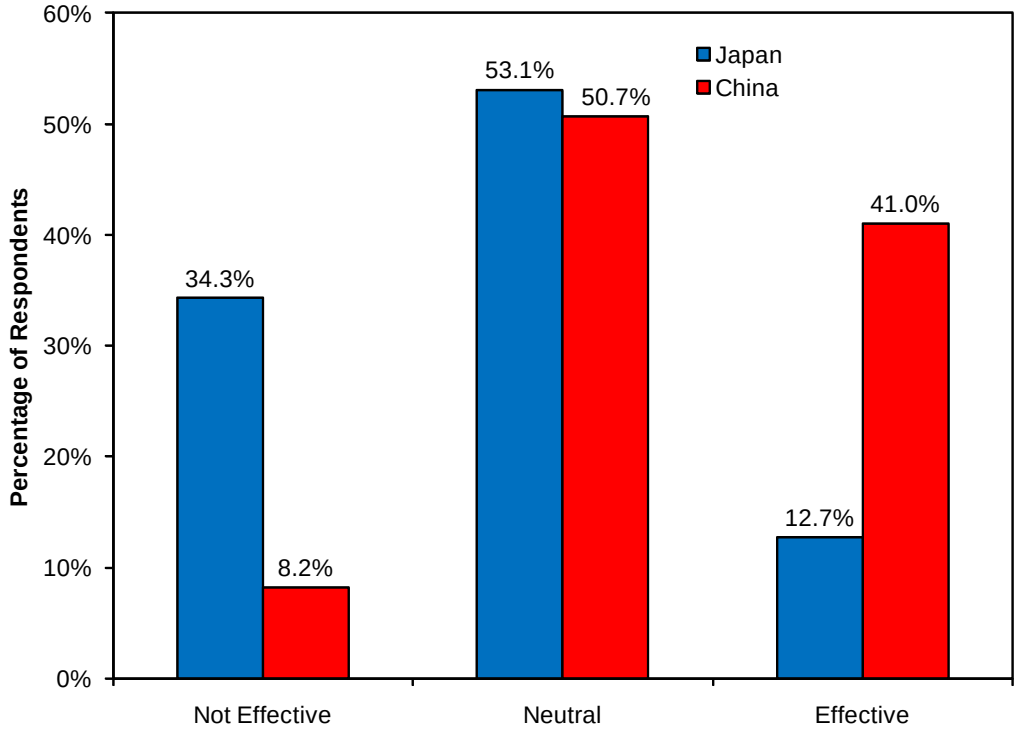

Figure 2. Perceived effectiveness of green building programs in Japan and China.

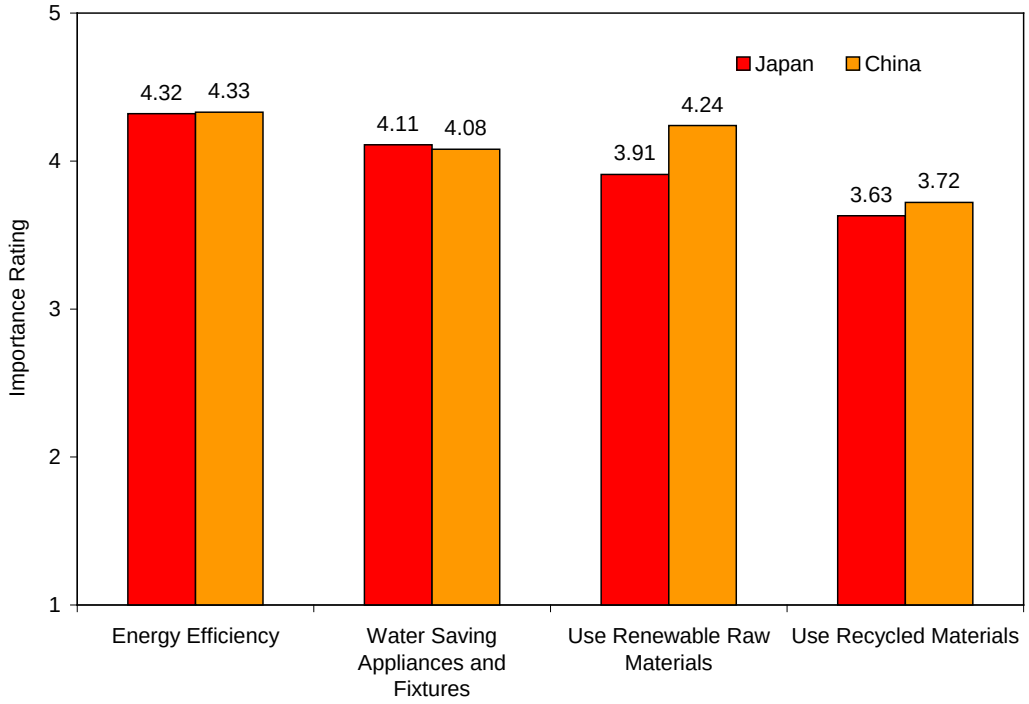

Figure 3. Comparative average importance ratings for the four environmental attributes in China and Japan.

Perceived Environmental Performance of Structural Building Materials in China and Japan

Environmental attitudes of material choices (lumber, concrete and steel) were compared between respondents in China and Japan, Figure 4. An analysis of the normalized data using a two-way ANOVA was performed to look for significant differences between materials (material effects) and significant differences between materials based on the nationality of the survey respondent (interaction effect between country and material).

The results of the statistical analysis showed that the perceived energy use for the three material choices was significantly different ($p<.001$), while at the same time the interaction between country and material displayed a significant difference as well ($p=.009$). The responses of Chinese and Japanese building professionals regarding energy use during the manufacturing process were very similar for both wood and steel while their perceptions of the energy use in manufacturing for concrete were significantly different, with Japanese respondents rating it much higher than their Chinese counterparts. Respondents in both countries perceived that wood used significantly less energy during the manufacturing process than both steel and concrete. They also perceived that steel used the greatest amount of energy. In contrast, a significantly higher proportion of Chinese respondents perceived concrete as using a medium amount of energy during manufacturing than did Japanese respondents.

The results of the statistical analysis also show that the perceived level of pollution associated with the three material choices was significantly different ($p<.001$), while at the same time the

interaction between country and material was not significantly different (p=.310). Both Chinese and Japanese respondents perceived that the manufacturing process for wood generated a significantly lower amount of pollution than either steel or concrete, Figure 5. Both sets of respondents also rated steel as generating the highest amount of pollution during manufacturing although they differed with respect to the amount of pollution generated from concrete manufacturing; with the Chinese being equally split between a high amount of pollution and a medium amount whereas the majority of the Japanese respondents rated it as medium.

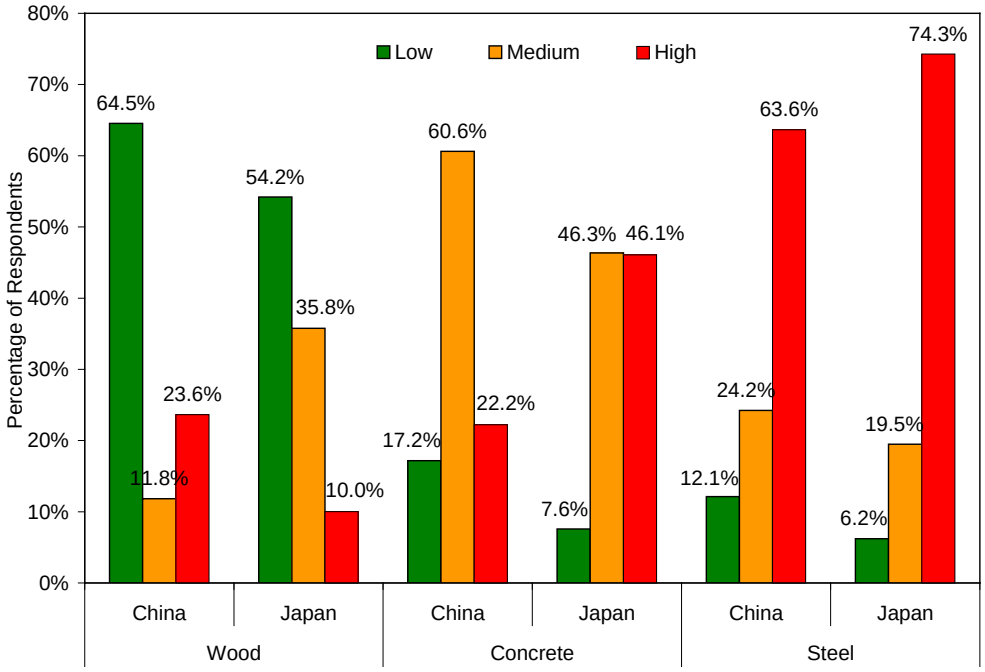

Figure 4. Respondent's perceptions of the relative energy use during the manufacturing process for wood, steel and concrete (Japan versus China).

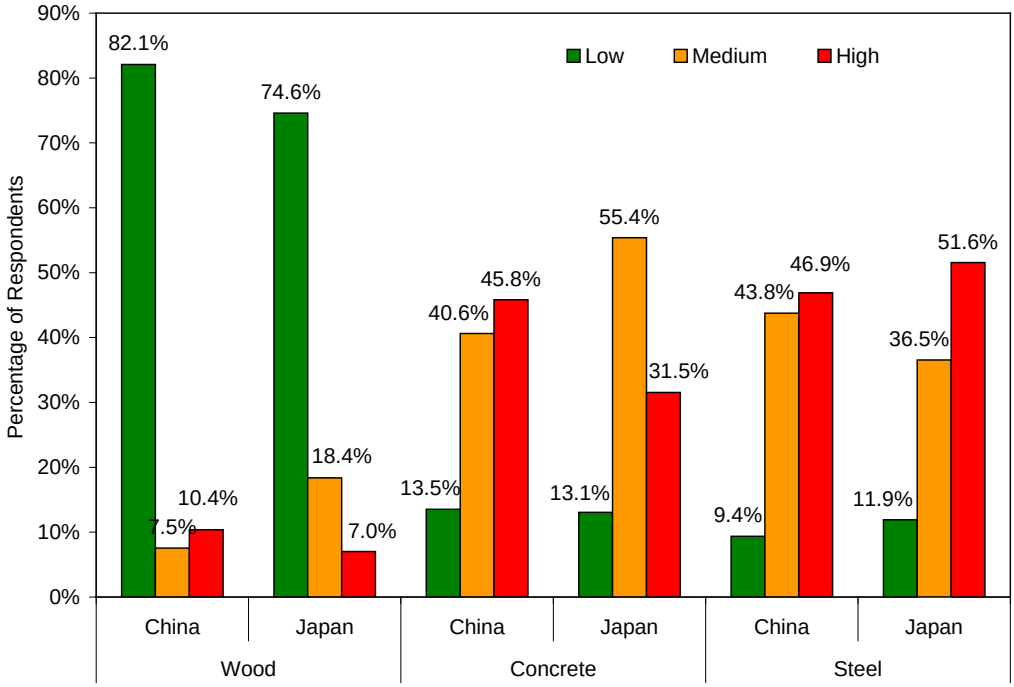

Figure 5. Respondent's perceptions of the level of pollution generated during the manufacturing process for wood, steel and concrete (China versus Japan).

Respondents perceptions of the overall sustainability of the three materials was a bit more ambiguous, although the majority of respondents from both countries perceived that wood had the highest level of sustainability and concrete had the lowest level of sustainability, Figure 6. The statistical analysis showed that there were significant differences between the ratings provided for the different materials (p=.000). Similarly, there was also a significant difference in the interaction between country and material responses (p=.018). Finally, a majority of respondents from both countries rated the energy efficiency of wooden building as being high and clearly superior to either steel or concrete, Figure 7. Steel structures were rated as having the worst energy efficiency by both sets of respondents, with concrete building being rated as medium in terms of energy efficiency The statistical analysis showed that there were significant differences between the ratings provided for the different materials (p=.000). Similarly, there was also a significant difference in the interaction between country and material responses (p=.000).

Overall, these results showed that wood was clearly perceived by respondents from both China and Japan as providing superior environmental performance relative to steel and concrete) across all four of the environmental attributes being evaluated. In general, concrete was rated as providing medium environmental performance across all of the environmental attributes (with the exception of resource sustainability) while steel was rated as providing the worst environmental performance on all environmental measures with the exception of resource sustainability where it was rated as being medium.

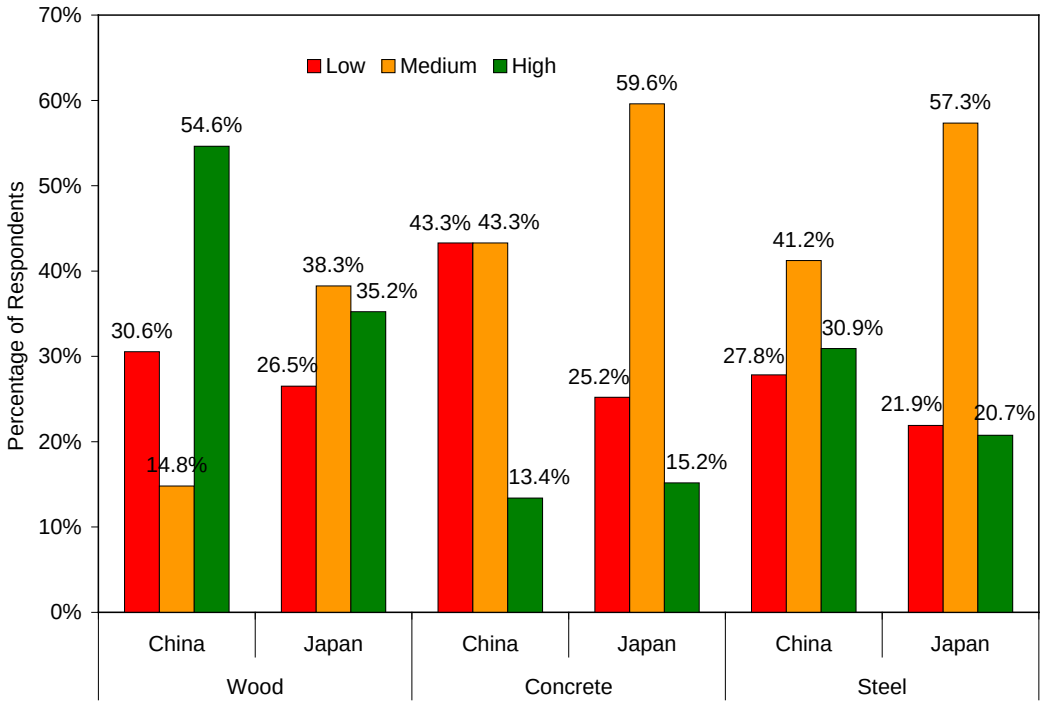

Figure 6. Respondent's perceptions of the relative resource sustainability for wood, steel and concrete (Japan versus China).

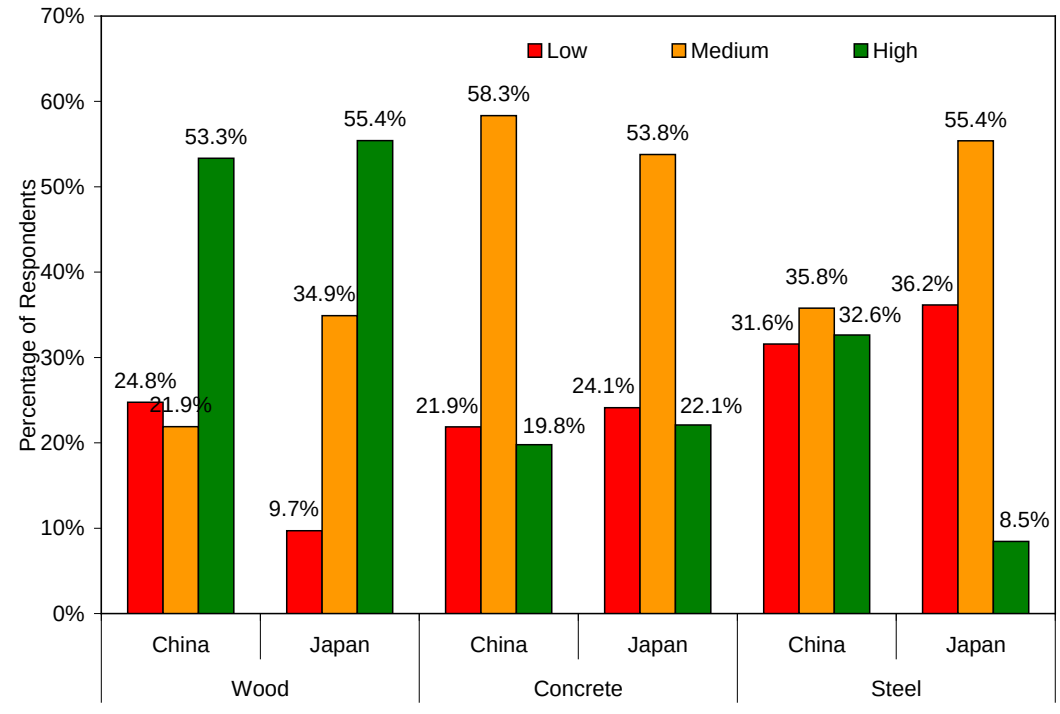

Figure 7. Respondent's perceptions of the relative energy efficiency of a home built using wood, steel and concrete as the structural building material.

SUMMARY OBSERVATIONS

Japan

While the CASBEE-House green building program is a voluntary program that was jointly developed by the residential construction industry and the Ministry of Land, Infrastructure and Transportation (MLIT), residential builders appear hesitant to adopt the program. Our 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-House program (including Mitsui Home, Sekisui House, Sumitomo Forestry, Misawa Home, and Daiwa Home, among others). Based on our discussions with industry experts, it appears likely that small local home builders and medium-sized regional home builders are less likely to use the CASBEE-House green building program to any large degree because the primary customers for these homebuilders are older homeowners who are typically replacing an existing older home. The consensus opinion among smaller homebuilders is that these customers are more conservative, less environmentally aware and less likely to be willing to pay a higher price to build a new house that is certified under the CASBEE-House program. In contrast, powerbuilders (medium-sized regional or national home building companies that specialize in spec home developments that are often sold to younger, first time home buyers) appear to be more willing 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.

However, the ultimate success and widespread acceptance of the CASBEE-House 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 using the program to any large degree, the managers we talked with noted that if one large company were to widely adopt the program, other large homebuilders 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-House program might transition 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.

Our research results support this observation. A surprisingly high proportion of survey respondents (69.7%) reported that they had never heard of the CASBEE-House green building program. Of those respondents who indicated that they had heard about CASBEE-House, the largest proportion reported that they had never used CASBEE-House. Overall, only 8.7% of the respondents indicated that they had built a home using the CASBEE-House green building program. Large builders were significantly more likely to have heard of CASBEE-House and to have built homes using the green building program than were either medium-sized builders or small komuten. In contrast to CASBEE-House, building professionals were much more likely to have heard about, and to have used, the 200 Year House program. Over 90% of builders had heard about the 200 Year House program while over 45% built houses using the program. In

contrast, just 70% of architects were aware of the 200 Year House program while only 14% reported using the program. Builders were significantly more likely to have heard about the 200 Year House program and to have used it. By the end of 2009, less than 500 houses had been built and certified under the CASBEE-House program whereas the number of houses built under the 200 Year House program exceeded 50,000.

The results of the survey data clearly show that Japanese building professionals perceive wood to be the most environmentally friendly structural building material across all six of the environmental performance measure included in the survey. In contrast, steel is perceived as being the least environmentally friendly structural building materials across most of the environmental performance measures, with the exception of "sustainability of the resource". Energy efficiency of the house was found to be the most importance environmental attribute and it was rated as being significantly more important than all of the other attributes. Using water saving appliances and fixtures was found to be the second most important environmental attribute

China

The new green building program in China, the Chinese Evaluation Standard for Green Building (Three Star System), has the potential to increase the demand for wooden building materials (both primary and secondary wood products) used in residential construction. The extent of its impact on demand is influenced by the degree to which it is accepted and utilized by developers, builders, architects and home buyers. However, the Chinese residential construction market differs significantly from that in Japan, both in terms of size, as well as the type of structural materials used and the type of residential buildings that are constructed. While single family houses are the major housing type in Japan, they represent only a small portion of the market in China, which is dominated by medium-rise apartments and condominiums. In addition, although wood frame construction is the major construction method in Japan, there is little wood frame construction in the residential sector in China. It is estimated that the number of detached single family homes built in China in 2009 was approximately 15,200 ~ 22,800, with less than 2,000 of these being wood frame construction (Fang 2010).

In China, almost 95% of respondents have heard of the green building program, a third planned to use the program and just over ten percent have used the green building program. Chinese builders report that the most important material attribute is using energy efficient products and materials, followed closely by using renewable materials. Both of these observations suggest that opportunities exist to market energy efficient wood products (e.g., wood windows and cellulose insulation) for use in multi-story, multi-family condominium and apartment buildings. The survey results obtained for the relative environmental performance of wood, concrete and steel clearly show that Chinese construction professionals perceive that wood and wooden structures provide superior environmental performance across a variety of environmental measures spanning the life cycle of a material. This trend is similar to the trend observed in Japan.

Strategic Recommendations

A number of programs (including green building programs) focused on improving the environmental performance and energy efficiency of homes have been adopted in China and Japan. This research found that builders, architects and design professionals in both countries perceive wood to be the most environmentally friendly building material, and that homes built from wood are more energy efficient than homes built from steel or concrete. These trends set the stage for promoting the superior environmental performance of value-added wood building materials such as wood windows and doors. For example, the Eco-Point program in Japan provides a unique opportunity to promote energy efficient US wooden windows in the new home construction sector as well as the growing repair and remodel sector in Japan.

The results of this research project clearly show that there are a variety of market opportunities for expanding US exports of value-added wooden building materials into Japan and China. Perhaps the best market opportunity exists for increasing exports of wood windows given the emphasis in both countries on increasing the energy efficiency of new buildings. This will be easier to accomplish in China than in Japan where restrictive fire codes require the certification of wood windows used in fire and quasi-fire zones. In addition, the green building programs in Japan and China provide a good market opportunity to expand exports of cellulosic insulation, structural insulated panels and value-added wood products used in interior applications that are made from certified wood (e.g., wood cabinets and flooring). Finally, good opportunities exist to increase exports of certified structural wood products such as glue-laminated beams, metric sized lumber, dimension lumber and treated lumber using the new generation of less toxic wood preservatives.

In order to increase the exposure of US value-added wood products among building professionals in Japan and China, US exporters should strongly consider participating in the wide variety of trade shows and trade missions by joining industry associations that are active in international markets and have a proven track record of providing access to qualified buyers in these countries. For example, the Evergreen Building Products Association offers trade missions to Japan and China several times a year. Similarly, the State of Washington sponsors trade missions for wood products manufacturers in Japan. Finally, industry associations such as the Softwood Export Council and the American Hardwood Export Council provide opportunities for US companies to rent booth space within the US Wood Pavilion at trade shows in Japan and China (such as the Japan Home and Building Show in Tokyo, the KH Housing Fair in Seoul and Interzum China in Shanghai). All of these associations provide tremendous logistical support for US exporters and manufacturers of wood building materials, allowing them to focus their energy on meeting potential customers for their products.

Efforts to reinforce these favorable perceptions of wooden building materials and continue to educate Japanese and Chinese building professionals regarding the superior environmental superiority of wood as a building material relative to steel and wood are important in strengthening the position of US wood building materials. Companies should consistently reinforce this message in their promotional literature, sales presentations, and meetings with potential customers. Further, the Evergreen Building Products Association and the State of Washington conduct trade missions in China and Japan targeted towards building professionals.

It would be useful to include a brief summary of the results of CORRIM LCA research on the environmental performance of wood building materials relative to non-wood building materials. This type of brief presentation can underscore the superior environmental performance of wood building materials including their effectiveness in increasing the energy efficiency of the houses and apartments. It can also demonstrate the benefits of incorporating cradle to grave life cycle assessment methodologies that take into account the entire range of environmental impacts of building materials, into green building programs.

US and Canadian industry associations have been working to gain approval of a 2x4 wood frame construction building code in China. Now that this has been achieved, US industry groups should consider working with the Canadians to develop the market for multi-story, multi family wood frame apartment buildings and low-rise public buildings (e.g., clinics and schools) in China. This effort should focus on exploiting the inherent advantages of wood frame construction in terms of earthquake resistance and energy efficiency. At the same time, they should continue their efforts to expand the use of wood in hybrid construction, in interior applications in condominium and apartment buildings, and in exterior landscaping projects.

US industry groups should also be working with the US government in Japan to address the issue of prefectural subsidies aimed at increasing the use of domestic wood in residential homes, the de-facto certification of domestic forests as being sustainably managed and prescriptive targets for increasing the market share of domestic wood within the post and beam housing sector.

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