2 PROFILE OF THE PLYWOOD AND COMPOSITE WOOD PRODUCTS INDUSTRIES

2.1 Introduction

Through a 1998 information collection request (ICR), the EPA identified plants potentially impacted by the proposed NESHAP. This profile presents information on several industries that comprise the plywood and composite wood source category because they will be impacted by the regulation in some way. These industries fall into three categories based on their Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) classifications.

- Softwood plywood and veneer
- Reconstituted wood products
- Structural wood members

The industries are represented by the three SIC codes and four NAICS codes presented in Exhibit 2-1. The NAICS codes replaced SIC codes in federal statistical data beginning in 1997. The SIC code for Structural Wood Members, Not Elsewhere Classified (n.e.c.) was divided into two NAICS codes for Engineered Wood Members and Truss Manufacturing. The ICR surveyed 416 potentially impacted facilities (EPA, 1998) , and an additional 15 facilities were identified that either did not respond to the survey or have commenced operation since the date of the survey. The Agency determined that of these 431 facilities, 223 were impacted facilities, owned by 52 firms.

EPA expects this rule to primarily impact certain facilities engaged in the manufacturing of softwood plywood, reconstituted wood products, and structural wood members. Exhibit 2-1 shows, for each of the three industry categories, the number of facilities EPA expects will experience compliance costs as a result of this MACT standard and the total number of facilities. The total estimated capital costs associated with the new MACT standard are $479 million. The annualized costs for affected facilities are $138 million on an annual basis, including monitoring, reporting, and record keeping costs (in 1999 dollars). Some unaffected facilities will also have monitoring, reporting, and record keeping costs of approximately $4 million per year. Therefore, the total annualized compliance costs are $142 million (1999 dollars).

Including costs associated with monitoring, reporting, and record keeping requirements, EPA expects 88 softwood plywood and veneer facilities to experience approximately 22 percent of the costs, 38 oriented strandboard facilities to experience approximately 18 percent of the costs, 82 other wood composite (including medium density fiber (MDF), particle board (PB), and hardboard (HB)) to experience approximately 58 percent of costs, and engineered wood product facilities to bear the remaining 2 percent. Most of the discussions contained in this profile will emphasize the softwood plywood and reconstituted wood products industries because facilities in these industries will experience the greatest impacts associated with the new MACT standard. A discussion of the affected EWP facilities is presented in Section 4.4 of this chapter.

Exhibit 2-1: SIC & NAICS Codes for the Plywood and Composite Wood Industries					
SIC Code	**SIC Description**	**NAICS Code**	**NAICS Description**	**Impacted Facilities***	**Total Facilities in Category**
2436	Softwood Veneer and Plywood	321212	Softwood Veneer and Plywood	66	155
2493	Reconstituted Wood Products	321219	Reconstituted Wood Products	Total: 97	317
				OSB: 23	
				PB/MDF: 56	
				HB: 18	
2439	Structural Wood Members, Not Elsewhere Classified	321213	Engineered Wood Members (Except Truss)	3	53
		321214	Truss Manufacturing	0	992
* Does not include number of facilities with MRR costs only. Sources: MRI (1999), U.S. Environmental Protection Agency (1998), Dun & Bradstreet (1999a), U.S. Department of Commerce (1999a).					

Producers of plywood and composite wood products also engage in additional manufacturing activities including furniture and wholesale timber production. In some cases, their primary SIC code[1] may be one other than those listed in Exhibit 2-1. The facilities with a primary SIC codes other than for plywood and wood composite manufacturers are shown in Exhibit 2-2. The operations related to these other SIC codes are unlikely to be affected by the MACT standard. In addition, the number of facilities identified as potentially affected by this rule relative to the total number of establishments in all categories is extremely small (under one percent for all categories). Therefore, this profile focuses on the SIC and NAICS listed in Exhibit 2-1. In particular, the profile will focus on the softwood plywood and veneer and reconstituted wood products industries. All facilities that are impacted by the MACT standard are included in these analyses, regardless of their primary SIC or NAICS code.

[1]See section 2.4.3.1 for a description of how primary SIC codes were assigned to the surveyed facilities.

Exhibit 2-2: Other Primary SIC and NAICS Codes for the Plywood and Wood Composite Industries						
SIC	**Description**	**NAICS**	**NAICS Title**	**Facilities in ICR**	**Impacted Facilities**	**Total Facilities in Category**
2421	Sawmills and Planning Mills, General	321113 321912 321918 321999	Sawmills Cut Stock, Resawing Lumber, & Planning Other Millwork (including Flooring) All Other Miscellaneous Wood Product Manufacturing	32	13	5,815
2426	Hardwood Dimension and Flooring Mills	321113 321912 321918 387215	Sawmills Cut Stock, Resawing Lumber, & Planning Other Millwork (including Flooring) Showcase, Partition, Shelving, and Locker Manufacturing	5	0	833
2448	Wood Pallets and Skids	321920	Wood Container and Pallet Manufacturing	1	0	1,929
2499	Wood Products, Not Elsewhere Classified	321920 333414 339999 321999	Wood Container and Pallet Manufacturing Heating Equipment Manufacturing All Other Miscellaneous Manufacturing All Other Miscellaneous Wood Product Manufacturing	4	0	2,760
2511	Wood Household Furniture, Except Upholstered	337122 337215	Non-upholstered Wood Household Furniture Manufacturing Showcase, Partition, Shelving, and Locker Manufacturing	13	0	2,785
Sources: MRI (1999), U.S. Environmental Protection Agency (1998), Dun & Bradstreet (1999a), U.S. Department of Commerce (1999a).						

Section 2.2 of this chapter describes the supply side of the affected industries and characterizes the production process, the products concerned, and the costs of production. Section 2.3 examines the demand side of the affected industries, product uses, and consumers. Section 2.4 characterizes the facilities and firms that comprise the industry, their organization, and their financial conditions. Finally, Section 2.5 describes the markets and discusses domestic production and consumption, international trade, and prices.

2.2 The Supply Side

The following section contains information concerning the supply of plywood and composite wood products. This section describes the production processes of each of the aforementioned industries. It then presents the products, by-products, and co-products of each industry. Lastly, the costs of production for each of the three industries are presented. Factors, such as industry shipments, costs of materials, fuels and electricity, payroll, capital expenditures, and materials consumed are all examined.

2.2.1 Production Process

This section discusses three categories of plywood and wood composites production: plywood and veneer; particleboard, strand and fiber composites; and structural wood members. The construction of plywood, consists basically of combining an odd number of layers of veneer, with each layer having one or more plies. Hardwood plywood is generally made by applying a hardwood veneer to the face and back of a softwood plywood, MDF, or particleboard panel. The differences between the hardwood and softwood processes occur because of different inputs and markets. Particleboard, oriented strandboard, fiberboard, and hardboard are all processed similarly. These three types of reconstituted wood products are manufactured by combining fragmented pieces of wood and wood fiber into a cohesive mat of wood particles, fibers, and strands. Structural wood members are the products of multiple manufacturing techniques. This section describes the production of glue-laminated timber and the three types of structural composite lumber: laminated veneer lumber, parallel strand lumber, and laminated strand lumber.

2.2.1.1 General Considerations for Plywood and Wood Composites Manufacturing

Release of hazardous air pollutants (HAPs) is primarily associated with drying and pressing processes in the manufacturing of plywood and wood composites. Coating processes are intrinsically related to the manufacturing process and result in further emissions through drying and pressing. Conventional wood composites are generally made with a thermosetting or heat-curing resin or adhesive that holds wood fiber together. Commonly used resin-binder systems include phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, and propionaldehyde. A number of additives are used in the manufacturing of wood composites as well. Most notably, wax is used to provide finished products with resistance to water penetration. Other additives include preservatives, fire retardants, and impregnating resins.

While there is a broad range of plywood and wood composites and many applications for such products, this section of the profile groups the production processes of these products into three general categories: plywood and veneer; particle board, strand and fiber composites; and structural wood members. Further descriptions of the production processes for each of these categories are provided in this section.

2.2.1.2 Plywood and Veneer[2]

Construction of plywood relies on combining an odd number of layers of veneer. Layers consist of one or more than one ply with the wood grain running in the same direction. Outside plies are called faces or face and back plies, while the inner plies are called cores or centers. Layers may vary in number, thickness, species, and grade of wood. To distinguish the number of plies (individual sheets of veneer in a panel) from the number of layers (number of times the grain orientation changes), panels are sometimes described as three-ply, three-layer, or four-ply, three-layer.

As described above, veneer is one of the main components of plywood. Most softwood plants produce plywood veneer for their own use. Of facilities reporting drying of veneer, 86 percent of the veneer produced was used for in-facility plywood production. Only approximately 7 percent of the

[2]The descriptions contained in this section rely primarily on U.S. EPA's Lumber and Wood Products Sector Notebook (1995).

facilities in the ICR survey produced veneer solely for outside sales and non-internal plywood use (EPA, 1998).

The general processes for making softwood includes: log debarking, log steaming and/or soaking, veneer cutting, veneer drying, veneer preparation, glue application, pressing, panel trimming, and panel sanding. Softwood plywood is generally made with relatively thick faces (1/10 inch and thicker) and with exterior or intermediate glue. This glue provides protection in construction and industrial uses where moderate delays in providing weather protection might be expected or conditions of high humidity and water leakage may exist. Figure 2-1 below presents a diagram of the plywood production process.

Logs delivered to a plant are sorted, then debarked and cut into peeler blocks. Almost all hardwood and many softwood blocks are heated prior to peeling the veneer to soften the wood. The peeler blocks are heated by steaming, soaking in hot water, spraying with hot water, or combinations of these methods. Heated blocks are then conveyed to a veneer lathe. The block, gripped at either end and rotated at high speed, is fed against a stationary knife parallel to its length. Veneer is peeled from the block in continuous, uniform sheets. Depending on its intended use, veneer may range in thickness from 1/16 to 3/16 (1.6mm to 4.8mm) for softwood and much thinner for hardwood and decorative plywood uses (Youngquist, 1999). Slicing methods are also used to produce hardwood decorative veneers generally in thicknesses of 1/24 inch and thinner.

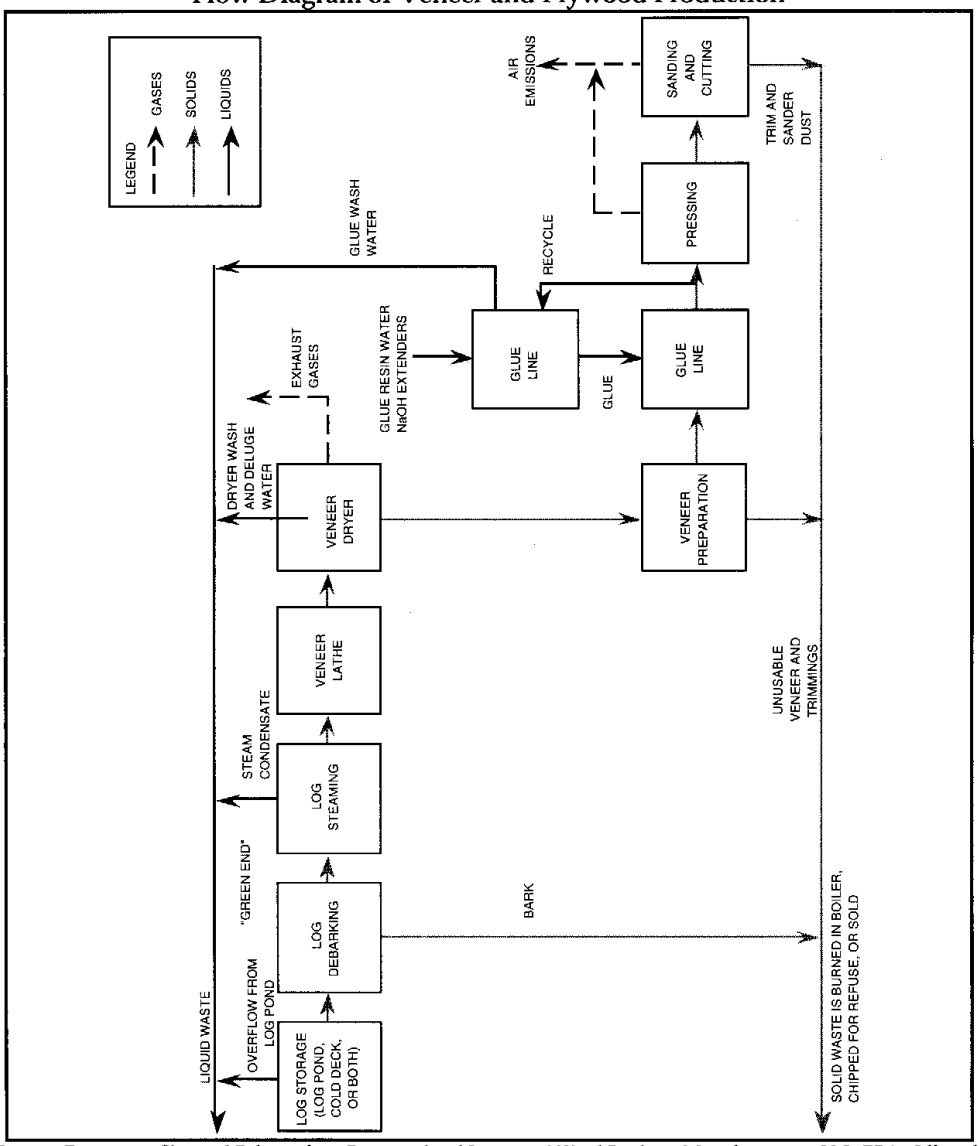
After peeling, the continuous sheets of veneer are transported by conveyor to a clipping station where it is clipped. In softwood mills and some hardwood mills, high-speed clippers automatically chop the veneer ribbons to usable widths and defects are removed. In many hardwood mills, clipping may be done manually to obtain the maximum amount of clear material. Wet clipped veneer is then dried. Proper drying is necessary to ensure moisture content is low enough for adhesives to be effective.

Dryers

Two types of dryers are used in softwood veneer mills: roller resistant dryers, heated by forced air; and "platen" dryers, heated by steam. In older roller dryers, also still widely used for hardwood veneer, air is circulated through a zone parallel to the veneer. Most plants built in recent years use jet dryers (also called impingement dryers) that direct a current of air, at a velocity of 2,000 to 4,000 feet per minute, through small tubes on the surface of the veneer. Veneer dryers may be heated indirectly with steam, generated by a separate boiler, which is circulated through internal coils in contact with dryer air. Dryers may also be heated directly by the combustion gases of a gas- or wood-fired burner. The gas-fired burner is located inside the dryer, whereas combustion gases from a wood-fired burner are mixed with recirculating dryer air in a blend box outside the dryer and then transported into the dryer. Veneer dryers tend to release organic aerosols, gaseous organic compounds, and small amounts of wood fiber into the atmosphere. Once dried, veneer is sorted and graded for particular uses.

Figure 2-1:

Flow Diagram of Veneer and Plywood Production



Source: Estimating Chemical Releases from Presswood and Laminated Wood Products Manufacturing, U.S. EPA, Office of Pesticides and Toxic Substances, March 1988.

Note: Many veneer and plywood plants are dry.

Source: U.S. EPA (1995).

Adhesives

Plywood manufacturing begins with the veneer sent to a lay-up area for adhesive application. Various adhesive application systems are used including hard rolls, sponge rolls, curtain coaters, sprayers, and foam extruders. The most common application for softwood plywood is an air or airless spray system, which generally uses a fixed-head applicator capable of a 10-foot wide spray at a nozzle pressure of 300 pounds per square inch (psi). The phenol-formaldehyde (PF) adhesives typical in softwood plywood manufacturing is made from resins synthesized in regional plants and shipped to individual plywood mills. At the mills, the resins are combined with extenders, fillers, catalysts, and caustic to modify the viscosity of the adhesive. This glue mixing has several additional effects: allowing the adhesive to be compatible with the glue application method (curtain, roll, spray, foam); allowing for better adhesive distribution; increasing the cure rate; and lowering cost.

Presses

Following the application of glue, the panels must be pressed. The purpose of the press is to bring the veneers into close contact so that the glue layer is very thin. At this point, resin is heated to the temperature required for the glue to bond. Most plywood plants first use a cold press at lower pressure prior to final pressing in the hot press. This allows the wet adhesive to "tack" the veneers together, permits easier loading of the hot-press, and prevents shifting of the veneers during loading. Pressing is usually performed in multi-opening presses, which can produce 20 to 40 4x8-foot panels in each two- to seven-minute pressing cycle.

Finishing

After pressing, stationary circular saws trim up to one inch from each side of the pressed plywood to produce square-edged sheets. Approximately 20 percent of annual softwood plywood production is then sanded. As sheets move through enclosed automatic sanders, pneumatic collectors above and below the plywood continuously remove the sander dust. Sawdust in trimming operations is also removed by pneumatic collectors. The plywood trim and sawdust are burned as fuel or sold to reconstituted panel plants.

2.2.1.3 Particle, Strand, and Fiber Composites[3]

This group of products falls into the SIC or NAICS code category of reconstituted wood products. The impacted facilities in this category manufacture the following products (MRI, 1999).

- Medium density fiberboard
- Oriented stand board
- Particleboard
- Hardboard

All particle, strand and fiber composites are processed in similar ways. Raw material for particleboard, oriented strandboard (OSB), fiberboard, and hardboard is obtained by flaking or chipping wood. The general process then includes wood drying, adhesive application, and forming a mat of wood

[3]The descriptions in this section rely primarily on Chapter 10 of the USDA's Forest Products Laboratory *Wood Handbook* (Youngquist, 1999).

particles, fibers, or strands. The mat is then pressed in a platen-type press under heat and pressure until the adhesive is cured. The bonded panel is finally cooled and further processed into specified width, length, and surface qualities. Specific details regarding the production processes for different products are provided below.

Particleboard

Generally, particleboard is produced by mechanically reducing wood materials into small particles, applying adhesive to the particles, and consolidating a loose mat with heat and pressure into a panel product. Particleboard is typically made in three layers with the faces consisting of finer material and the core using coarser material. Particleboard can also be made from a variety of agricultural residues, including kenaf core, jute stick, cereal straw, and rice husks depending on the region. EPA does not expect facilities that produce particleboard made from agricultural residues, also called agriboard, to experience compliance cost impacts associated with the new MACT standard. EPA expects only one facility that produces molded particleboard to experience compliance cost impacts (MRI, 1999).

The raw materials, or "furnish," that are used to manufacture reconstituted wood products can be either green or dry wood residues. Green residues include planer shavings from green lumber and green sawdust. Dry process residues include shavings from planing kiln-dried lumber, sawdust, sander dust, and plywood trim. The wood residues are ground into particles of varying sizes using flakers, mechanical refiners, and hammermills, and are then classified according to their physical properties.

After classification, the furnish is dried to a low moisture content (two to seven percent) to allow for moisture that will be gained by the adding of resins and other additives during blending. Most dryers currently in operation in particle and fiber composite manufacturing plants use large volumes of air to convey material of varied size through one or more passes within the dryer. Rotating drum dryers requiring one to three passes of the furnish are most common. The use of triple-pass dryers predominates in the United States. Dryer temperatures may be as high as 1,100 - 1,200° F with a wet furnish. However, dry planer shavings require that dryer temperatures be no higher than 500° F because the ignition point of dry wood is 446° F. Many dryers are directly heated by dry fuel suspension burners. Others are heated by burning oil or natural gas. Direct-fired rotary drum dryers release emissions such as wood dust, combustion products, fly ash, and organic compounds evaporated from the extractable portion of the wood. Steam-heated and natural gas-fired dryers will have no fly ash.

The furnish is then blended with synthetic adhesives, wax, and other additives distributed via spray nozzles, simple tubes, or atomizers. Resin may be added as received (usually as an aqueous solution), or mixed with water, wax emulsion, catalyst, or other additives. Waxes are added to impart water repellency and dimensional stability to the boards upon wetting. Particles for particleboard are mixed with the additive in short retention time blenders, through which the furnish passes in seconds. The furnish and resin mixture is then formed into mats using a dry process. This procedure uses air or a mechanical system to distribute the furnish onto a moving caul (tray), belt, or screen. Particleboard mats are often formed of layers of different sized particles, with the larger particles in the core, and the finer particles on the outside of the board. The mats are hot pressed to increase their density and to cure the resin. Most plants use multi-opening platen presses. Though more popular in Europe, the continuous press is currently being used in particleboard plants in the United States.

Primary finishing steps for all reconstituted wood panels include cooling or hot stacking, grading, trimming/cutting, and sanding. Cooling is important for UF-resin-cured boards since the resin degrades at high temperatures after curing. Boards bonded using PF resins may be hot-stacked to provide additional

curing time. Secondary finishing steps include filling, painting, laminating, and edge finishing. The vast majority of manufacturers do not apply secondary finishes to their panels; panels are finished primarily by end-users such as cabinet and furniture manufacturers. Panels are also finished by laminators who then sell the finished panels to furniture and cabinet manufacturers.

Oriented Strandboard (OSB)

OSB is an engineered structural-use panel manufactured from thin wood strands bonded together with waterproof resin under heat and pressure. OSB manufacturing begins with debarked logs usually heated in soaking ponds sliced into wood strands typically measuring 4.5 to 6 inches long (114 to 152mm). Green strands are stored in wet bins and then dried in a traditional triple-pass dryer, a single-pass dryer, a combination triple–pass/single-pass dryer, or a three-section dryer. A recent advance in drying technology is a continuous chain dryer, in which strands are laid between two chain mats so the strands are held in place as they move through the dryer.

After drying, blending and mat formation take place, blending of strands with adhesive and wax takes place in separate rotating blenders for face and core strands. Different resin formulations are typically used for face and core layers. Face resins may be liquid or powdered phenolics, while core resins may be phenolics or isocyantes. Mat formers take on a number of configurations to align strands along the length and width of the panel. Oriented layers of strands are dropped sequentially (face, core, face, for example), each by a different forming head. The mat is then transported by conveyer belt to the press. Hot pressing involves the compression of the loose layered mat of oriented strands under heat and pressure to cure the resin. Most plants utilize multi-opening presses that can form as many as sixteen 12- by 24-ft (3.7- by 7.3m) panels simultaneously. Recent development of a continuous press for OSB can consolidate the oriented and layer mat in 3 to 5 minutes.

Fiber Composites

Fiber composites include hardboard, medium-density fiberboard (MDF), fiberboard, and insulation board. In order to make fibers for these composites, bonds between the wood fibers must be broken. This is generally done through refining of the material, which involves grinding or shearing of the material into wood fibers as it is forced between rotating disks. Refining can be augmented by water soaking, steam cooking (digesting), or chemical treatments as well.

Fiber composites are classified by density and can involve either a wet process or a dry process. High and medium density boards, such as hardboard and MDF, apply a dry process. Wet processes can be used for high-density hardboard and low-density insulation board (fiberboard). Dry process involves adhesive-coated fibers that are dried in a tube dryer and air-laid into a mat for pressing.

Wet processes differ from the dry processes. This process involves the utilization of water as a distributing medium for fibers in a mat. Further differences lie in the lack of additional binding agents in some wet processes. The technology is very much like paper manufacturing in this pulp-based aspect. Natural bonding in the wood fibers occurs in this process. Refining in this process relies on developing material that can achieve this binding with a degree of “freeness” for removal from mats. The wet process involves a continuously moving mesh screen, onto which pulp flows. Water is drawn off through the screen and through a series of press rolls. The wet fiber mats are dried in a conveyor-type dryer as they move to the press. Wet process hardboard is then pressed in multi-open presses heated by steam. Fiberboard is not pressed.

Manufacturers use several treatments alone or together to increase dimensional stability and mechanical performance of both wet and dry process hardboards. Heat treatment exposes pressed fiberboard to dry heat, reducing water absorption and improving fiber bonding. Tempering is the heat treatment of pressed boards preceded by the addition of oil. Humidification is the addition of water to bring board moisture content into equilibrium with the air.

2.2.1.4 Structural Wood Members[4]

Structural wood members, such as glue-laminated timbers and structural composite timber, are manufactured using a number of methods. Glue-laminated timber, or glulam, is an engineered product formed with two or more layers of lumber glued together in which the grain of all layers, called laminations, is oriented parallel to the length of the lumber. Glulam products also include lumber glued to panel products, such I-joists and box beams. Structural composite lumber consists of small pieces of wood glued together into sizes common for solid-sawn lumber.

Glue-Laminated Timber (Glulam)

Glulam is a material that is made from suitably selected and prepared pieces of wood, either straight or curved, with the grain of all pieces essentially parallel to the longitudinal axis of the member. The manufacturing process for glulam involves four major steps: (1) drying and grading, (2) end jointing, (3) face bonding, and (4) finishing and fabricating.

Structural Composite Lumber

The are three major types of structural composite lumber: laminated veneer lumber, parallel strand lumber, and laminated strand lumber. Each is described in more detail below, however, the general manufacturing process for these composites is similar.

Laminated veneer lumber (LVL) is manufactured by laminating veneer with all plies parallel to the length. This process utilizes veneer 1/8 to 1/10 inches. (3.2 to 2.5 mm) thick, which are hot pressed with phenol-formaldehyde adhesive to form lumber of 8 to 60 feet (2.4 to 18.3 m) in length. The veneer used for LVL must be carefully selected to achieve the proper design characteristics. Ultrasonic testing is often used to sort veneer required for LVL. Once the veneer has been selected, end jointing occurs followed by adhesive application and continuous pressing.

Parallel strand lumber (PSL) is a composite of wood strand elements with wood fibers primarily oriented along the length of the member. PSL is manufactured using veneer about 1/8 inch (3 mm) thick, which is then clipped into 3/4 inch (19 mm) wide strands. The process can utilize waste material from a plywood or LVL operation. Strands are coated with a waterproof structural adhesive, and oriented using special equipment to ensure proper placement and distribution. The pressing operation results in densification of the material. Adhesives are cured using microwave technology. As with LVL, the continuous pressing method is used.

Laminated strand lumber (LSL) is produced using an extension of the technology used to produce oriented strandboard structural panels. LSL uses longer strands than those commonly used in OSB

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[4]The descriptions in this section rely primarily on Chapter 11 of the USDA's Forest Products Laboratory *Wood Handbook* (Moody and Liu, 1999).

manufacturing. LSL is pressed into a billet several inches thick in a steam-injection press, as opposed to an OSB panel pressed in a multi-opening platen press. The product also requires a greater degree of alignment of the strands at higher pressures, which result in increased densification.

2.2.2 Products, By-Products, and Co-Products

Exhibit 2-3 presents products, corresponding SIC and NAICS codes, and product examples of the plywood and composite wood products industry.

The plywood and composite wood products industries have unique manufacturing processes in their use of waste wood products as an input for additional products. Planer shavings, sawdust, edgings, and other wood by-products are inputs to many wood composites. Structural wood members were developed in response to the increasing demand for high quality lumber when it became difficult to obtain this type of lumber from forest resources. Therefore, many of the by- and co-products from one process may be used in another.

Exhibit 2-3: SIC and NAICS Codes and Products

Product Description	SIC	NAICS	Example Products
Softwood Veneer and Plywood	2436	321212	Panels, softwood plywood Plywood, softwood Softwood plywood composites Softwood veneer or plywood Veneer mills, softwood
Reconstituted Wood Products	2493	321219	Board, bagasse Flakeboard Hardboard Insulating siding, broad-mitse Insulation board, cellular fiber or hard pressed Lath, fiber Medium density fiberboard (MDF) Particleboard Reconstituted wood panels Strandboard, oriented Wafer-board Wall tile, fiberboard Wallboard, wood fiber
Structural Wood Members, Not Elsewhere Classified	2439	321213	Arches, glue-laminated or pre-engineered wood Fabricated structural wood members Finger joint lumber manufacturing I-joists, wood Laminated structural wood members Laminated veneer lumber Parallel strand lumber Structural wood members (except trusses)
		321214	Floor trusses, wood, glue-laminated or pre-engineered Roof trusses, wood, glue-laminated or pre-engineered

Source: U.S. Department of Labor, OSHA (no date).

Exhibit 2-4 provides ratios of specialization and coverage (product mix) calculated by the U.S. Census Bureau for the last three Censuses of Manufacturers. The Census assigns a "primary" SIC code to each establishment which corresponds to the SIC code for the largest (by value) single type of product shipped by the establishment. The products shipped from that establishment that are classified in the same industry as the establishment are considered "primary," and all other products shipped by the establishment are considered "secondary." The Census then calculates various measures to illustrate the product mix between primary and secondary products in each industry. The specialization ratio represents the ratio of total primary product shipments to total product shipments for all establishments classified in the industry. The coverage ratio represents the ratio of primary products shipped by the establishments classified in the industry to the total shipments of these products shipped by all establishments classified in all industries.

As Exhibit 2-4 illustrates, all three industries have specialization ratios well above 80 percent and coverage ratios above 90 percent. This implies that most establishments with these SIC codes are highly

specialized, and that most product shipments of each type originate in establishments with these SIC codes. Therefore, the Census data on these SIC and NAICS industries provide information on the primary production of facilities engaged in plywood and wood composite manufacturing. These ratios have been stable over time.

Exhibit 2-4: Specialization and Coverage Ratios, 1982 - 1997

SIC	NAICS	Description	1982	1987	1992	1997
2436	321212	*Softwood Veneer and Plywood*				
		Primary products specialization ratio	87	87	84	88
		Coverage ratio	96	95	94	95
2493	321219	*Reconstituted Wood Products*				
		Primary products specialization ratio	96	97	96	97
		Coverage ratio	97	95	95	97
2439	321213	*Structural Wood Members, N.E.C./Engineered Wood Members*				
		Primary products specialization ratio	96	97	96	95
		Coverage ratio	95	97	97	96
2439	321214	*Structural Wood Members, N.E.C./Truss Manufacturing*				
		Primary products specialization ratio	96	97	96	96
		Coverage ratio	95	97	97	94

Source: U.S. Department of Commerce (1999a and 1995b).

2.2.3 Costs of Production

Exhibit 2-5 provides information on the overall value of shipments (VOS) and production costs (a component of operating expenses) by SIC code as reported by the Bureau of the Census. Typical of many intermediate goods, the cost of materials is the largest portion of production costs, with payroll constituting 15-20 percent of VOS. In particular, timber supply plays a large role in industry costs. In this decade, reductions in public timber supply, especially reductions in National Forest timber harvests, combined with the economy's continued demands for wood has led to substantial increases in the cost of timber (Spelter, 1997).

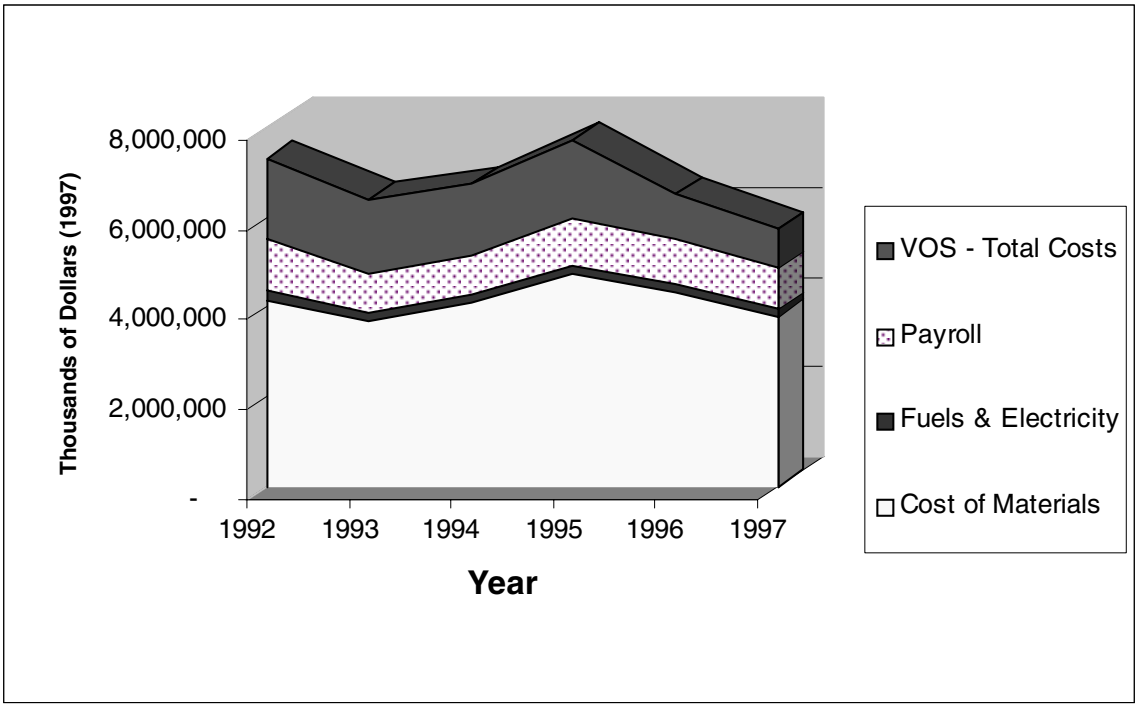
Exhibit 2-5: Summary of Annual Costs and Shipments, 1992 -1997
(Thousands of 1997 Dollars)

	1992	1993	1994	1995	1996	1997	% Change
Softwood Veneer and Plywood (SIC 2436, NAICS 321212)							
Industry Shipments	7,321,641	6,400,683	6,755,571	7,725,037	6,525,702	5,748,047	-21.5%
Cost of Materials	4,169,048	3,671,638	4,097,921	4,736,984	4,330,167	3,795,985	-8.9%
Fuels & Electricity	220,039	178,592	178,601	183,507	176,759	161,239	-26.7%
Payroll	1,112,158	897,839	883,819	1,047,092	1,006,792	912,613	-17.9%
Ratio of Costs to Shipments	75%	74%	76%	77%	84%	85%	
Reconstituted Wood Products (SIC 2493, NAICS 321219)							
Industry Shipments	5,350,565	4,951,902	5,517,234	5,827,821	5,561,099	5,278,809	-1.3%
Cost of Materials	2,400,670	2,144,060	2,342,362	2,582,565	2,697,471	2,633,139	9.7%
Fuels & Electricity	327,706	250,814	268,934	316,876	321,390	350,950	7.1%
Payroll	825,718	699,627	707,179	810,753	855,237	798,767	-3.3%
Ratio of Costs to Shipments	66%	62%	60%	64%	70%	72%	
Structural wood members (SIC 2439, NAICS 321213 and 321214)							
Industry Shipments	3,367,525	3,281,578	4,295,002	4,739,339	5,096,809	5,112,873	51.8%
Cost of Materials	1,958,576	1,966,635	2,584,765	2,863,098	3,154,297	3,007,103	53.5%
Fuels & Electricity	35,486	33,406	34,585	39,595	42,621	42,090	18.6%
Payroll	692,377	604,180	740,318	867,510	947,403	954,694	37.9%
Ratio of Costs to Shipments	80%	79%	78%	80%	81%	78%	

All dollars adjusted to 1997 using Producer Price Index for Lumber and Wood Products (SIC 24).
Source: U.S. Department of Census (1999a).

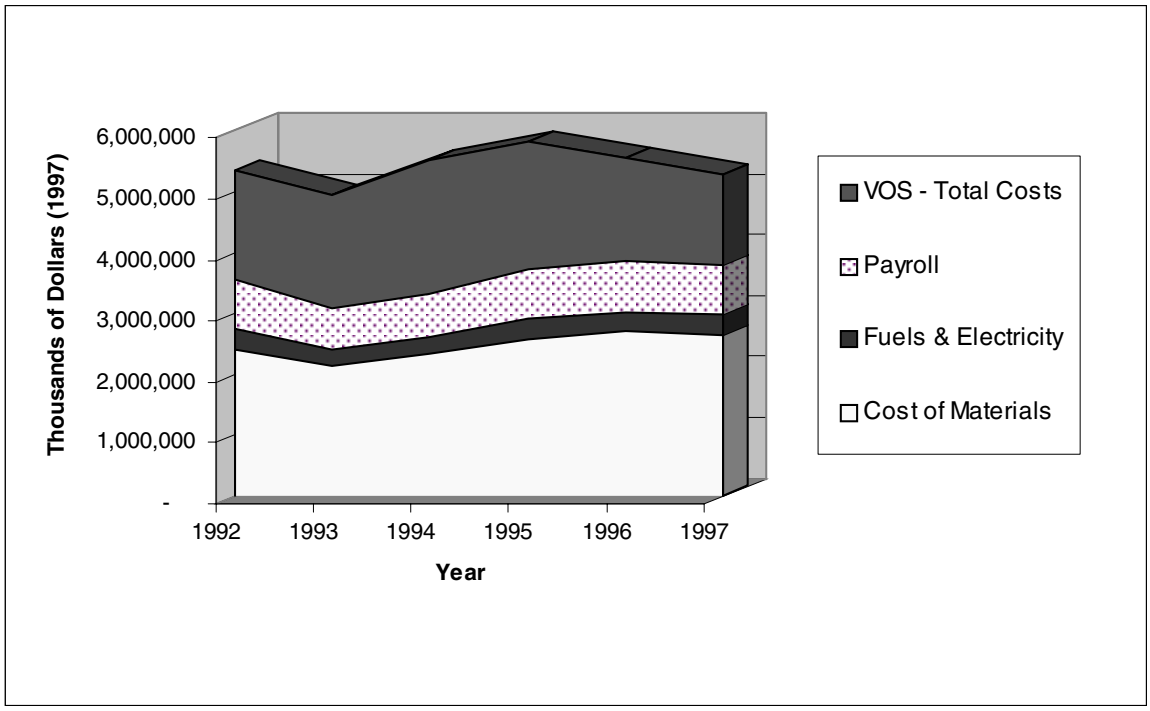
From these data, one can estimate the sector-wide ratio of production costs to VOS. The ratio of costs (materials, fuels and electricity, and payroll) to the VOS has been increasing over the 1992 to 1997 period for softwood plywood and veneer and reconstituted wood products. The data in Exhibit 2-5 show that 1997 cost to shipment ratios range between 72 percent (reconstituted wood products) and 85 percent (softwood veneer and plywood). This measure indicates the proportion of the revenues received for the goods produced that are associated with production expenses (materials, fuel and electricity, and payroll). Figures 2-2 and 2-3 present cost and VOS data for the softwood plywood and reconstituted wood products industries, respectively.

Figure 2-2: Softwood Plywood and Veneer Value of Shipments and Production Costs, 1992 - 1997



Source: U.S. Department of Commerce (1999a).
Note: Total costs in this figure is the sum of payroll, fuels & electricity, and materials costs.

Figure 2-3: Reconstituted Wood Products Value of Shipments and Production Costs, 1992 - 1997



Source: U.S. Department of Commerce (1999a).
Note: Total costs in this figure is the sum of payroll, fuels & electricity, and materials costs.

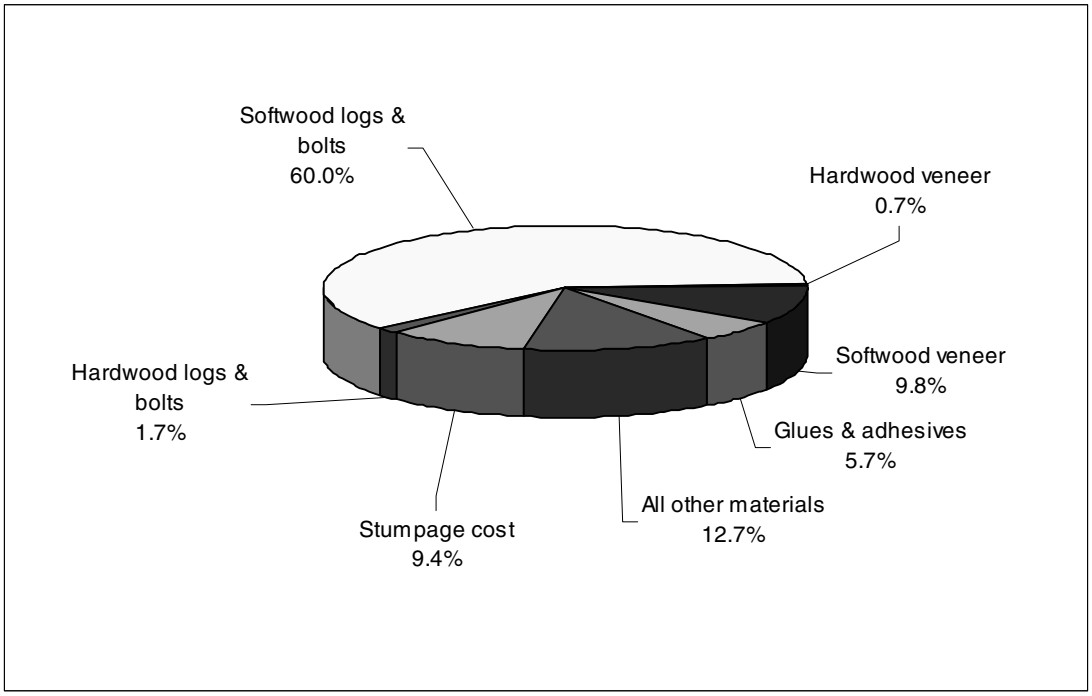
The cost to shipment ratio does not reflect other operating expenses such as non-payroll employment expenses, taxes, interest, or depreciation. Nor does it indicate whether the expenses are of a variable or fixed nature. However, it does provide an approximate measure of how much cash, at a gross level, the industries are generating to cover all operating expenses, use for capital investment, and provide a return to owners. While this measure is somewhat crude, it indicates that the impacts of the rule may potentially be more significant for the softwood plywood and veneer industry than for reconstituted wood products.

Exhibit 2-6 and Exhibit 2-7 provide information on materials consumed by kind in 1997 for the three sectors. In softwood plywood and veneer manufacturing, 81.6 percent of material costs result from timber and veneer purchasing. Glues and adhesives represent 5.7 percent of the material costs in the softwood plywood and veneer industry.

Exhibit 2-6: Materials Consumed By Kind for Softwood Plywood and Veneer, 1997		
Materials Consumed	**Delivered Cost ($1,000)***	**% of Total Materials**
Stumpage cost (cost of timber, excluding land, cut and consumed at same establishment)	346,854	9.4%
Hardwood logs and bolts	64,617	1.7%
Softwood logs and bolts	2,218,800	60.0%
Hardwood veneer	27,355	0.7%
Softwood veneer	363,583	9.8%
Glues and adhesives	210,105	5.7%
All other materials	471,717	12.7%
TOTAL	3,703,031	100%
* Excludes costs of resales and contract work. Source: U.S. Department of Commerce (1999a).		

Figure 2-4 shows the percentage materials consumed by kind by the softwood plywood and veneer industry in 1997.

Figure 2-4: Materials Consumed by Softwood Plywood and Veneer Products, 1997

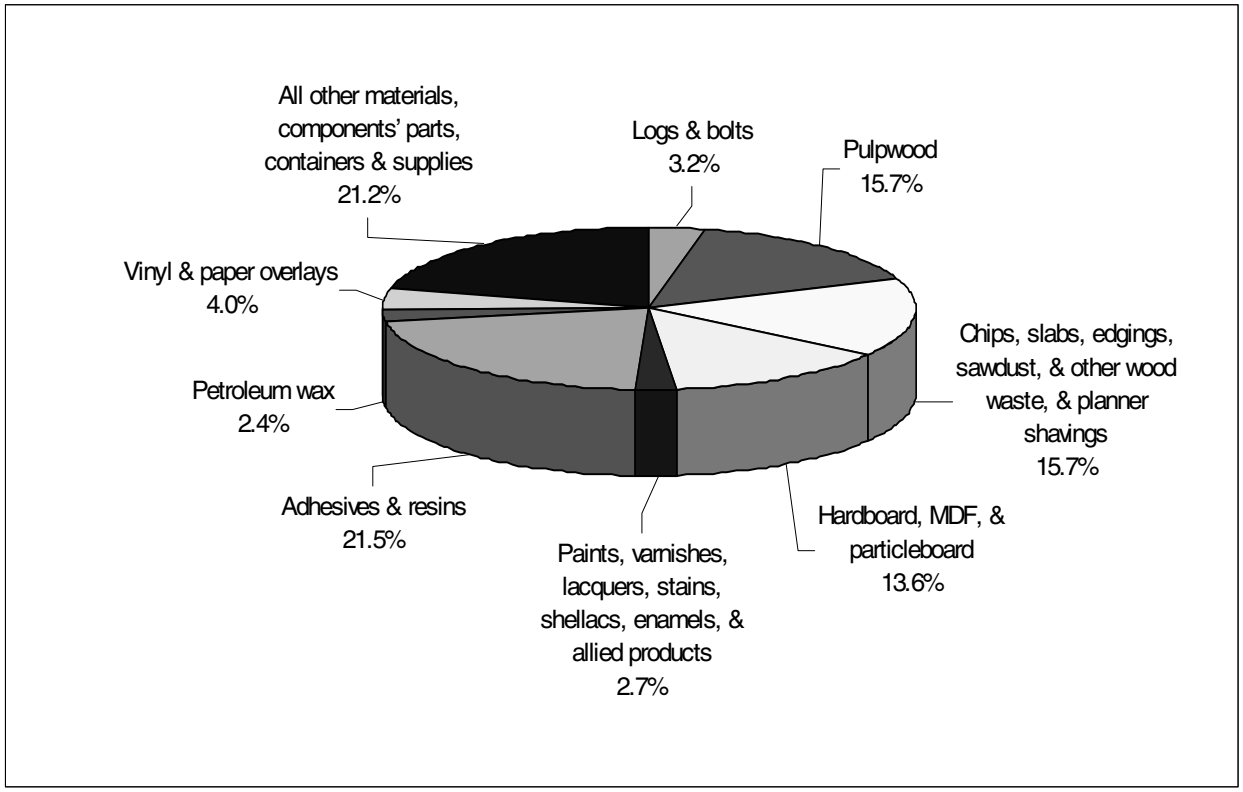


Source: U.S. Department of Commerce (1999a).

Exhibit 2-7: Materials Consumed by Kind for Reconstituted Wood Products, 1997		
Material Consumed	**Delivered Cost ($1,000)***	**% of Total Materials**
Logs and bolts	80,891	3.2%
Pulpwood	400,579	15.7%
Chips, slabs, edgings, sawdust, and other wood waste, and planer shavings	399,446	15.7%
Hardboard, MDF, and particleboard	346,052	13.6%
Paints, varnishes, lacquers, stains, shellacs, enamels, and allied products	69,488	2.7%
Adhesives and resins	548,553	21.5%
Petroleum wax	61,173	2.4%
Vinyl and paper overlays	101,405	4.0%
All other materials, components parts, containers and supplies	538,183	21.2%
TOTAL	2,545,770	100%
* Excludes costs of resales and contract work. Source: U.S. Department of Commerce (1999a).		

As with the plywood industry, timber products are the largest portion of costs for the reconstituted wood product industry. Logs, pulpwood, wood materials, and other wood products account for a combined 48.2 percent of material costs. Unlike plywood and veneer manufacturing, reconstituted wood products have higher material costs for adhesives and resins, compromising 21.5 percent of costs. Figure 2-5 shows the percentage of materials consumed by kind by the reconstituted wood products industry for 1997.

Figure 2-5: Materials Consumed by Reconstituted Wood Product Producers, 1997



Source: U.S. Department of Commerce (1999a).

Wood costs for plywood and wood composite manufacturing vary according to plant location, wood species, and facility efficiency. While there may be considerable variability in wood prices across regions, the last decade has seen substantial increase in wood prices across all regions. Wood use efficiency depends on wood species used, log temperature, speed of cutting, board compaction, and other process variables. Next to wood, adhesives and wax play an important role in industry costs, especially for the production of reconstituted wood products such as OSB, particleboard, and MDF (Spelter et al, 1997).

In 1995, sixteen percent of the output from the adhesive and sealant industry, SIC 2891, went to the wood products market. As such, a MACT standard that greatly reduces the demand for adhesives and sealants (or coatings) could potentially have a significant impact in the adhesive and sealant industry (Abt Associates Inc., 1997). The response on the part of the softwood plywood and veneer and reconstituted wood products industries will depend on the final requirements of the MACT standard and the attractiveness of comparable resin, adhesive and sealant products that do not contribute to HAP emissions. There will be many constraints on the ability of the impacted industries to switch away from current adhesives, as their products generally must meet certain requirements related to building codes. These properties are discussed in the next section.

2.3 The Demand Side

The following section contains information concerning the demand for plywood and veneer, reconstituted wood products, and structural wood members. The characteristics of plywood and wood composites are examined first, highlighting the numerous uses of these types of wood products. The consumers and users of plywood and wood composites are then examined, specifically analyzing the distribution of consumption. Substitution possibilities are addressed, looking at both wood and non-wood options. Lastly, the elasticities of demand of the plywood and composite wood products industries are discussed.

2.3.1 Product Characteristics

Plywood and composite wood products provide a more stable product over solid wood by reducing the variations between wood species, among trees of the same species, and even between wood from the same tree. Unlike solid wood which is evaluated at a cellular level, composite wood is evaluated at fiber, particle, flake, or veneer level. Properties of products can be changed by combining, reorganizing, or stratifying these different elements. Control of the size of particles used in producing composite wood products provides the chief means by which materials can be produced with predetermined properties (Youngquist, 1999).

Strength is a crucial factor in determining the applicability of plywood and wood composites to structural and other manufacturing uses. Stiffness and strength properties of a wood product depend primarily on the constituents from which these products are made. The basic wood elements can be made in a great variety of sizes and shapes, and may utilize any number of wood species. Plywood can be manufactured from over 70 species of wood. The choices available for wood composites is almost unlimited. Types of adhesives and bonding-agents also play an important role in the strength of a composite wood product.

Durability will also determine the market for wood composites. Panels used for exterior applications will have a fully waterproof bond and are designed for permanent exposure to weather and moisture. Interior panels may lack the waterproof bond and be manufactured with glue products designed for interior use.

Depending on the wood composite, a range of sizes and thicknesses are available. The range of structural applications for which these products are used requires production of several standardized sizes as well as custom-made pieces. Sizes and thicknesses will depend on the type of wood composite product and the market for which it is primarily produced.

Wood panels and other composite wood structures are subject to performance-type standards as outlined by various industry organizations. A number of organizations including American Plywood Association - The Engineered Wood Association, Composite Panel Association (CPA), American Hardboard Association, and others monitor products produced by their member firms to assure high-quality production and industry conformity with testing and performance standards.

2.3.2 Consumers and Uses

Exhibit 2-8 shows industry output by SIC code. Output of plywood and veneer goes mainly to the construction sector, primarily to the residential housing and repair industries. Almost one third of plywood goes to the manufacturing sector, part of which is used as an input for other plywood

production, and part of which goes for furniture and other durable goods manufacturing. The "Other" category is made up of foreign trade, inventory change, and wholesale trade. The outputs for reconstituted wood products, including particleboard, are more evenly split between construction and manufacturing, The "Other" category for reconstituted wood products is made up of sales to state and local government, foreign trade, and services (Gale Business Resources, 1999).

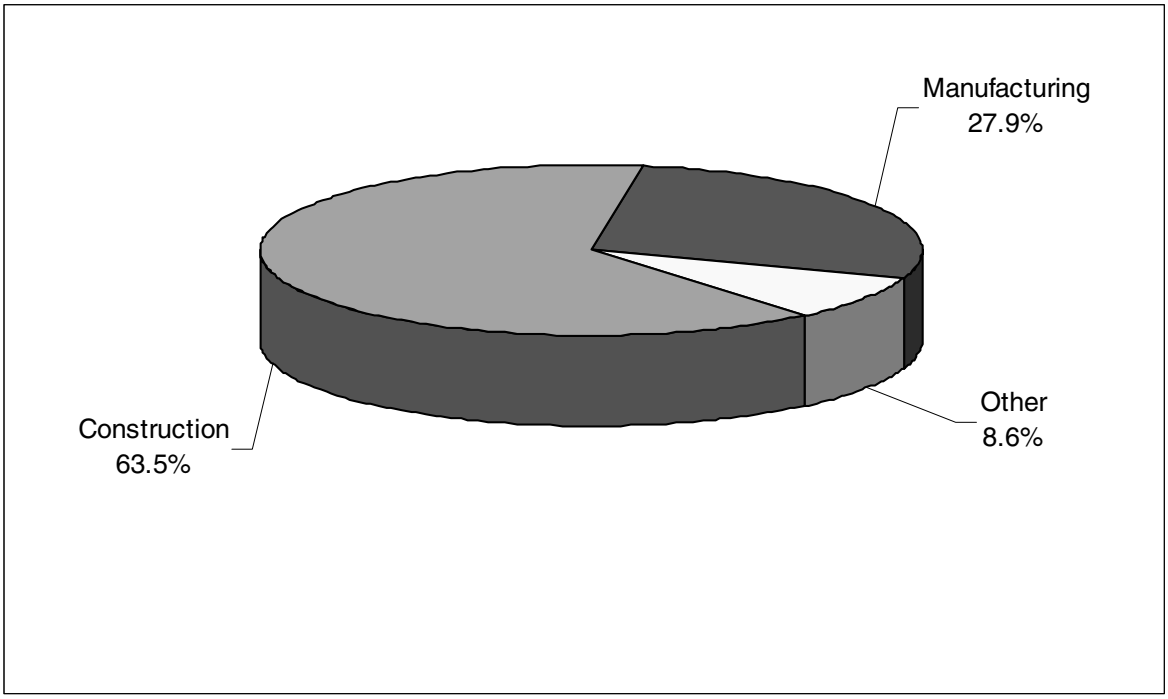
Exhibit 2-8: Consumption of Industry Outputs, by SIC Code

SIC	SIC Description	Construction	Manufacturing	Other
2436	Softwood veneer and plywood	63.5%	27.9%	8.6%
2493	Reconstituted wood products	45.7%	47.6%	6.7%
2439	Structural wood members	94.8%	0.6%	4.6%

Source: Gale Business Resources (1999).

The major use of structural panel products is for construction activities. Panel products include those products such as plywood, OSB, particleboard, and others formed as a panel. These products may be used for floor systems, exterior walls, roofing, and exterior siding. Figure 2-6 shows the industry outputs by percentage for the softwood plywood and veneer industry.

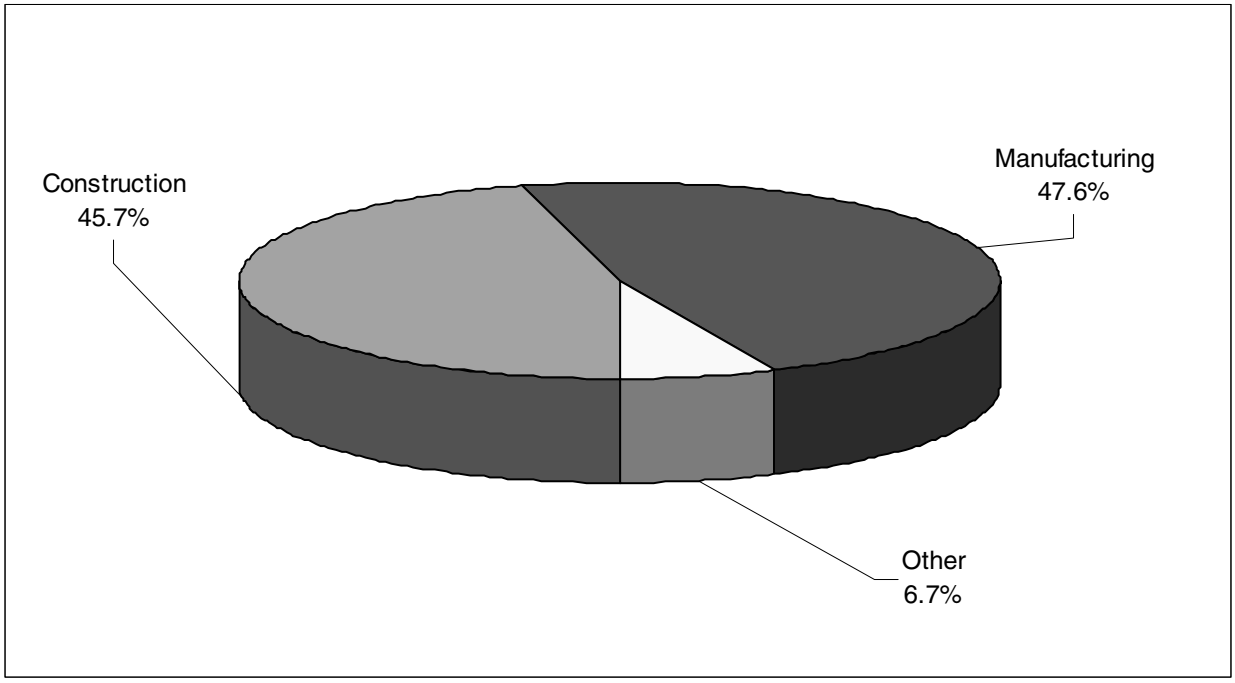
Figure 2-6 Industry Outputs of Softwood Plywood and Veneer Industry



Source: Gale Business Resources (1999).

Figure 2-7 shows the industry outputs by percentage for the reconstituted wood products industry.

Figure 2-7: Industry Outputs of Reconstituted Wood Products Industry



Source: Gale Business Resources (1999).

MDF and particleboard are two products of the reconstituted wood products industry. Exhibits 2-9 and 2-10 below show the downstream uses of MDF and particleboard in 1997. For each of the products, about 20 percent of the output is used for household furniture, and the remainder is used for construction, shelving, cabinetry and other customized applications.

Exhibit 2-9: MDF Shipments by Downstream Market, 1997

Downstream Use	Million ft^2	Percent
Household Furniture	247.8	19%
Custom Laminators	208.6	16%
Stocking Distributors	286.9	22%
Kitchen and Bath	65.2	5%
Molding	130.4	10%
Millwork	65.2	5%
Partitions and fixtures	65.2	5%
All Other	182.6	14%
Other (n.e.c.)	52.2	4%
Total	1,304.0	100%

Source: Composite Panel Association (1998).

Exhibit 2-10: Particleboard Shipments by Downstream Market, 1997		
Downstream Use	**Million ft^2**	**Percent**
Household Furniture	889.0	20%
Custom Laminators	711.2	16%
Stocking Distributors	755.7	17%
Kitchen and Bath	711.2	16%
Flooring Products	400.1	9%
Office Furniture	266.7	6%
Door Core	177.8	4%
All Other	400.1	9%
Other (n.e.c.)	133.4	3%
Total	4,445.2	100%
Source: Composite Panel Association (1998).		

Construction Activities

Over sixty percent of the softwood plywood and veneer industry output and approximately 50 percent of the reconstituted wood products industry output goes to the construction sector, primarily to the construction, remodeling and repair of single and multiple family dwellings. The majority of the work performed by the construction sector is associated with single family dwellings, and the largest share of their costs is associated with materials such as wood-based materials. As Exhibit 2-11 shows, housing starts have been quite strong since 1996 and are expected to continue through at least this year. Housing start activity is closely linked to general economic conditions, employment, income, and interest rates. Renovation and remodeling expenditures have declined in real terms, as would be expected. Generally, more renovation and remodeling takes place during periods when fewer new houses are being constructed (U.S. Department of Commerce, 1995a).

Exhibit 2-11: Housing Market Indicators, 1988 - 1997			
Year	**New Housing Units (thousand)**	**Renovation and Remodeling Expenditures (million current $)**	**Renovation and Remodeling Expenditures (million 1992 $)**
1988	1,706	101,117	110,874
1989	1,574	100,891	106,425
1990	1,381	106,773	109,175
1991	1,185	97,528	98,813
1992	1,411	103,734	103,734
1993	1,542	108,304	104,339
1994	1,761	115,030	106,411
1995	1,694	111,683	99,362
1996	1,838	114,919	99,756
1997	1,828	118,423	99,431
Source: Howard (1999).			

Because economic conditions can vary between regions in the U.S., the impact of housing starts on demand for wood-based construction materials can vary. This regional variation is further amplified by differing local preferences, housing codes, and availability of specific wood-based products.

Wood Furniture Industry

The wood furniture industry produces output for a high value added market. Exhibit 2-12 below shows the value of shipments from the household furniture sector. Wood household furniture is a portion of this sector. Domestic shipments and apparent consumption of household wood furniture have experienced modest growth since 1989, indicating that the shipments from the softwood plywood and veneer and reconstituted wood products industries to the furniture sector has had limited experience for growth.

Exhibit 2-12: Trade for Household Furniture (SIC 251), 1989 -1996 (Millions of 1997 Dollars)*

	1989	1990	1991	1992	1993	1994	1995	1996	% Change
Value of product shipments	23,056	22,477	21,521	21,949	22,823	24,038	24,355	na	6
Value of imports	3,301	3,200	3,117	3,368	3,723	4,201	4,586	5,047	53
Value of exports	565	884	1,091	1,252	1,298	1,385	1,361	1,342	237
Apparent Consumption	25,792	24,793	23,547	24,065	25,248	26,854	27,580	na	7

*Values adjusted to 1997 dollars using PPI for Furniture and Household Durables
Source: U.S. Department of Commerce (1999a).

Wood furniture manufacturers constitute a large portion of the demand, 20 to 30 percent, of the wood-based products other than structural panels and structural members. Much of the growth in retail demand is being met by imports. This translates into a large lost opportunity for domestic furniture manufacturers, as well as for their suppliers, including the industries that are the subject of this profile. The potential causes for this increase in imports are lower material and labor costs in exporting countries, and declining availability of timber products to domestic producers (CINTRAFOR, 1999 and Dirks, 1991).

The 1992 Census of Manufacturers showed that 21 percent of the delivered cost of materials in the manufacture of wood household furniture is associated with plywood and composite wood products. As a result, significant price changes in the cost of plywood and composite wood products have the potential to affect production costs of wood household furniture. As the demand for wood household furniture is highly elastic with respect to price (see discussion in section 2.3.4), increased input costs could affect both the demand for wood household furniture and for plywood and wood composites supplied to furniture manufacturers.

2.3.3 Substitution Possibilities

The basic substitution in these industries is between different wood products, although non-wood substitutes exist as well for some applications. Composite wood products were originally manufactured in response to the growing demand for wood products as the availability of larger sized timber declined. As new wood composites products were developed, they further replaced sawn lumber and other types of wood products. Plywood and veneer production lost market share during the late 1980s and early 1990s to new products that are categorized as reconstituted wood products, largely as a result of several

challenges: legislation protecting federal timber lands; recession in the early 1990s; price increases and instability; and supply shortages. To provide an indication of the structural uses of wood panel products and substitutes, Exhibit 2-13 outlines the use of various products in new single-family and multi-family residential construction in the United States.

Exhibit 2-13: Use of Wood and Non-wood Products in Residential Construction 1976 - 1995

Application	Incidence of Use (%)					
	Single-family houses			Multi-family houses		
	1976	1988	1995	1976	1988	1995
Floor Sheathing						
Lumber	1	5	-	2	6	-
Structural Panels	51	56	55	51	52	54
Softwood Plywood	51	48	31	51	46	24
OSB	0	9	24	0	7	30
Nonstructural Panels	12	9	9	10	9	7
Lightweight Concrete	0	0	0	5	7	3
Concrete Slab	30	30	35	32	26	36
Exterior Wall Sheathing						
Lumber	-	2	-	-	-	-
Structural Panels	16	33	52	17	40	43
Softwood Plywood	16	26	19	17	28	10
OSB	0	7	33	0	12	33
Fiberboard	34	13	6	32	11	5
Foamed Plastic	7	22	29	2	18	34
Foil-faced kraft	-	17	3	0	13	1
Gypsum, other	18	8	2	18	15	8
None	25	5	8	31	5	9
Roof Sheathing						
Lumber	14	6	1	11	2	1
Structural Panels	85	91	98	87	94	94
Softwood Plywood	84	70	37	87	78	19
OSB	1	21	61	1	16	75
Other	1	3	0	2	4	5
Exterior Siding						
Lumber	10	12	7	9	16	2
Structural Panels	22	23	9	32	15	4
Softwood Plywood	22	23	4	32	15	2
OSB	-	-	5	0	-	2
Hardboard	16	16	6	7	11	5
Non-wood	52	49	77	49	58	89
Vinyl	14	15	29	12	14	41
Masonry, stucco	38	34	48	37	44	48
Other	0	0	1	3	-	-

Source: Spelter et al. (1997).

Structural wood panels hold the majority of the market share for floor, exterior wall, and roof sheathing in single and multi-family housing construction. The major substitution effect in this market has occurred between OSB and softwood plywood, with OSB capturing much of the market from softwood plywood by 1995. Much of the trade-off between softwood plywood and OSB is due to lower cost for OSB.

However, questions of exterior durability with OSB have led many builders to continue plywood use despite higher initial costs.

Fiberboard has also seen reduction in market share for exterior wall systems due to increases in OSB use. Non-wood products, mainly masonry, have captured 77 percent of the market for exterior siding, greatly reducing the market share of structural panels in this market. Other major substitutes include concrete slab for floor sheathing and foamed plastic, which gained major shares of the exterior wall sheathing market from wood-based structural panels.

2.3.4 Demand Elasticities

The price elasticity of demand is the percentage change in the quantity of product demanded by consumers divided by the percentage change in price. Demand curves slope downward, signifying a negative response (less demand) to an increase in price. If demand is elastic (an absolute value of greater than one) a small price increase will lead to a relatively large decrease in demand. Conversely, if demand is inelastic with respect to price, or an absolute value less than one, the quantity demanded will change very little relative to a change in price.

For the purposes of performing an economic analysis, short-term price elasticities are relevant as impacts of the regulation fall directly on the entities owning facilities faced with compliance responsibilities. In appropriating compliance costs to facilities impacted by this rule, the economic analysis assumes that these facilities have a fixed capital stock in the short term. This method allows an evaluation of the severity of impacts using static measures of profit and loss. This "non-behavioral" approach differs from other behavioral approaches that take into account adjustments made by producers, such as changing input mixes, that can generally affect the market environment in which they operate over the longer term.

In the case of plywood and reconstituted wood production that is going to the construction industry, the overall price elasticity of demand for these products is relatively inelastic. This is because the wood product component of construction is fixed once the decision to construct has been made. The other factors that contribute to the inelastic nature of demand for structural wood panels include local building codes, home buyer and home owner preferences, and building industry investment in the training and infrastructure required to construct with wood panels as opposed to a substitute.

The demand for each individual type of product may differ, depending on several factors, including the product's own-price elasticity, the availability and price of other wood based and non-wood products with comparable characteristics, and the availability and price of imported products. Cross price elasticities are often difficult to identify or estimate. However, if available, cross price elasticities of substitutes and imports might be considered when developing an approach to the economic analysis. For example, analysis of the softwood plywood market may incorporate the cross-price elasticity of OSB, a major substitute for plywood. When analyzing the OSB market, the converse would also be true. Even if such cross price elasticities were available, other considerations would also determine whether the economic analysis incorporates the market substitution dynamic.

We examined several recent and historical studies of price elasticities of demand. Most of these studies were concerned with the softwood lumber sector, most likely due to the limited availability of relevant price and consumption information at a disaggregated product level. Our review focused on the 1996 study by Joseph Buongiorno, a forestry economist, who noted that previous econometric studies of the wood products sector have produced estimates of demand elasticities for softwood lumber, a product

with similar demand drivers, inputs, input costs, and uses, between zero and -0.9[5]. Buongiorno also reported that other studies have estimated the cross elasticity of lumber with respect to the price of plywood to be between 0.5 and zero. Buongiorno developed a model using a price-endogenous linear programming system (PELPS) that endeavored to address the entire wood products market using a system dynamics approach. The results of this model included short-term price elasticities of demand for wood-based products, as shown in Exhibit 2-14.

Exhibit 2-14: Demand Elasticities

Product	Price Elasticity of Demand
Plywood	-0.16
Fiberboard	-0.10
Particleboard	-0.27

Source: Buongiorno (1996).

Buongiorno's results provide the basis for imputing price elasticities for the other products that are the subject of this MACT standard. In addition, further review of identified studies may produce information useful in the final determination of appropriate elasticities for use in the economic analysis of the impacts of a MACT standard on the softwood plywood and reconstituted wood products industries.

In the case of softwood plywood and reconstituted wood production going to the furniture industry, the price elasticity of demand is highly elastic. This is because the price elasticity of demand for wood furniture is highly elastic itself and the softwood plywood and reconstituted wood component of production costs for wood furniture is also quite high, over twenty percent. The EPA's study of the economic impacts of alternative NESHAPS on the wood furniture industry estimated the price elasticity of demand for wood furniture as -3.477 (U.S. EPA, 1992). This result forms the basis for a derived price elasticity of demand for use in the economic analysis of the impacts of the MACT standard.

2.4 Industry Organization

The following section contains information pertaining to the organization of the plywood and veneer, composite wood , and structural wood members industries. This section will provide the basis for understanding the following.

- The industry structure
- The characteristics of the manufacturing facilities
- The characteristics of the firms that own the manufacturing facilities

A detailed examination of these three topics is essential, as it provides the basis for much of the approach to estimating economic impacts of the MACT standard. In addition, this section also provides detailed information about facilities and firms that are important inputs to the analysis itself as well as to analysis of how the MACT standard might affect firms of different sizes.

[5]The majority of studies reviewed estimated price elasticity of demand as being between -0.15 and -0.4.

2.4.1 Industry Structure

Exhibit 2-15 shows concentration ratios by SIC code for the three census years, 1982, 1987, and 1992. The m-firm concentration ratios are equal to the sum of the market shares for the largest m number of firms in the industry. A market is generally considered highly concentrated if the 4-firm concentration ratio is greater than 50 percent. Exhibit 2-15 also shows the Herfindahl-Hirschman (HH) index, which is an alternative measure of concentration equal to the sum of the squares of the market shares for the 50 largest firms in the industry. The higher the index, the more concentrated the industry is at the top. The U.S. Justice Department uses 1,000 as a benchmark for the presence of market concentration, where any industry with a Herfindahl-Hirschman index less than 1,000 is considered to be unconcentrated (Arnold, 1989).

Exhibit 2-15: Concentration Ratios by SIC Code, 1982-1992*

Year	Number of Companies in Industry	*Percent of value of industry shipments shipped by the largest (in terms of shipment value)*				Herfindahl-Hirschman Index**
		4 Companies	8 Companies	20 Companies	50 Companies	
Softwood Veneer and Plywood (SIC 2436)						
1982	135	41	56	74	92	619
1987	131	38	56	74	93	571
1992	123	47	66	82	96	797
Reconstituted Wood Products (SIC 2493)						
1982	N/A					
1987	158	48	65	82	95	743
1992	193	50	66	81	94	765
Structural wood members (SIC 2439)						
1982	649	15	22	35	50	104
1987	831	13	18	30	44	92
1992	830	19	25	34	46	166

*The latest year for which data is currently available.
**The index is based on the 50 largest companies in each SIC code.
Source: U.S. Department of Commerce (1992).

The concentration ratios presented in Exhibit 2-15 show very little evidence of market concentration in the plywood and composite wood products industries. Four-firm concentration ratios for the three sectors are below 50 with the exception of reconstituted wood products (classified as "General" in the ICR survey) which is 50. The HH indices for all SIC codes are well below the benchmark of 1000. While concentration appears to have increased in general between 1982 and 1992, there is no clear trend as all appear to have been less concentrated in 1987.

2.4.2 Manufacturing Plants

Through an ICR, the U.S. Environmental Protection Agency identified plants potentially affected by this rule. EPA categorized the surveyed facilities according to their production processes and developed estimates of compliance costs for each facility. Exhibit 2-16 below presents information on the number of potentially impacted facilities, and their corresponding primary SIC code. The exhibit also shows the percent of potentially impacted facilities as a percent of total facilities for each SIC.

Exhibit 2-16: Facilities with Compliance Cost Impacts					
		Facilities			
SIC Code	Description	Impacted*		Total in SIC	% of Total
2436	Softwood Veneer and Plywood	66		155	42.6%
2493	Reconstituted Wood Products	Total	97	317	30.6%
		OSB	23		
		PB/MDF	56		
		HB	18		
2439	Structural Wood Members	3		53	5.7%

* Does not include number of facilities with MRR costs only.
Note: Percentages represent survey facilities' share of total facilities in the category.
Sources: U.S. Environmental Protection Agency (1998), U.S. Department of Commerce (1999a), MRI (1999).

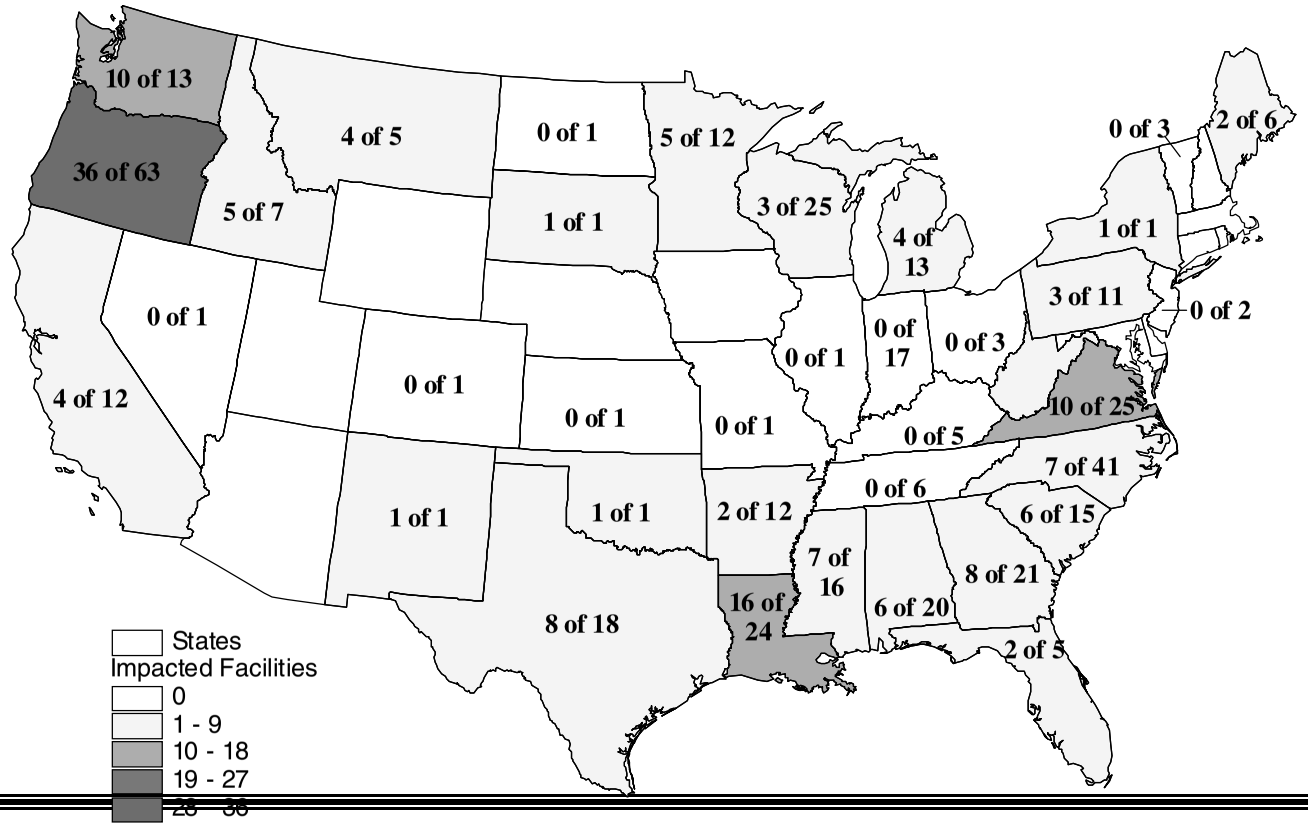
2.4.2.1 Location

Nationally, facilities that produce softwood plywood and reconstituted wood products are clustered in distinct geographic regions of the South, Pacific Northwest, and the upper Mid-West of the U.S. Based on the 1997 Census of Manufacturers, the softwood plywood and veneer facilities have the highest employment in Oregon, Washington and Louisiana. The Census showed that reconstituted wood product facilities had the highest employment in Oregon, California, North Carolina, Texas, and Michigan (source: U.S. Department of Commerce, 1999a).

Figure 2-8[6] is a map of locations of impacted and total ICR facilities as identified by EPA (MRI, 1999, EPA, 1998). For this figure, all types of facilities are combined. The map shows the state-by-state distribution of the potentially impacted facilities relative to the total ICR facilities in the state. The states with the greatest number of potentially impacted facilities are Oregon (36), Louisiana (16), Georgia (8), Mississippi (7), Virginia (10), Texas (8), and North Carolina (7). Major producing states where impacted facilities constitute a significant portion of all facilities in the state include Louisiana (66 percent), Oregon (57 percent), Washington (77 percent), Georgia (38 percent) and Texas (44 percent).

[6] Map developed based on original survey database dated July 23, 1999.

Figure 2-8: Plywood and Wood Composite Facility Locations
(Potentially Impacted Facilities and Total ICR Facilities by State)
Sources: U.S. Environmental Protection Agency (1998), MRI (1999)



2.4.2.2 Production Capacity and Utilization

Exhibit 2-17 shows the capacity utilization rates by SIC code and for all manufacturing industries for 1992 through 1997. The rates for softwood plywood and veneer, and reconstituted wood products are significantly higher than the average for all lumber and wood products and for all industries. Capacity utilization for structural wood members is below industry averages but has increased over the 1992 - 1997 period.

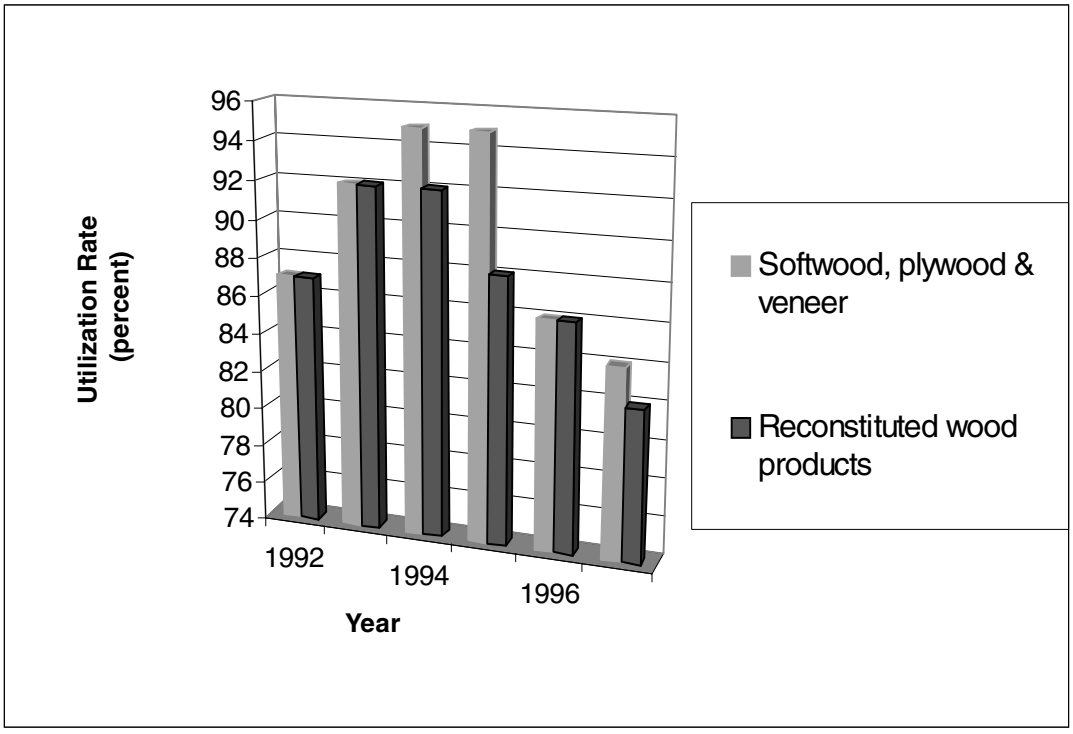
Exhibit 2-17: Full Production Capacity Utilization Rates, Fourth Quarters, 1992 - 1997

SIC	SIC Description	1992	1993	1994	1995	1996	1997	Change
2436	Softwood Veneer and Plywood	87	92	95	95	86	84	-3.4%
2493	Reconstituted Wood Products	87	92	92	88	86	82	-5.7%
2439	Structural Wood Members	65	66	66	74	77	72	10.8%
24	*All Lumber and Wood Products*	*80*	*81*	*80*	*77*	*78*	*75*	*-6.3%*
2000-3999	*All Manufacturing Industries*	*77*	*78*	*80*	*76*	*76*	*75*	*-2.3%*

Source: U.S. Department of Commerce (1997).

Figure 2-9 presents the capacity utilization rates of softwood plywood and veneer and reconstituted wood products from 1992-1997.

Figure 2-9: Full Production Capacity Utilization, Fourth Quarters, 1992-1997



Source: U.S. Department of Commerce (1997).

The capacity utilization for softwood plywood and veneer, and reconstituted wood peaked in 1994, consistent with utilization peaks for all manufacturing industries. Interestingly, utilization rates for reconstituted wood product facilities declined, while softwood plywood and veneer was unchanged in

1995, the year that shows the highest value of shipments for all (see Exhibit 2-17). This may be explained, in part, by capacity expansions driven by the increased capital expenditures by softwood plywood and veneer producers in 1994 and subsequent years.

The ICR provided further information on capacity utilization. A sample of general facilities responding to questions regarding their production processes reported production and capacity. From this data, capacity utilization for general facilities was 78 percent, slightly below the figures in Exhibit 2-17

2.4.2.3 Employment

Exhibit 2-18 provides information on employment at the softwood plywood veneer and reconstituted wood products facilities responding to the ICR in 1998.

Exhibit 2-18a: 1998 Employment at Facilities with Expected Compliance Cost Impacts

	Softwood Plywood and Veneer		Oriented Strandboard		Medium Density Fiberboard/ Particleboard	
Number of Employees	Facilities in Size Category	% of All Impacted Facilities	Facilities in Size Category	% of All Impacted Facilities	Facilities in Size Category	% of All Impacted Facilities
Not reporting	2	3.0%	0	0.0%	0	0.0%
<50	0	0.0%	0	0.0%	1	1.8%
50 to 99	0	0.0%	0	0.0%	12	21.4%
100 to 249	18	27.3%	21	91.3%	30	53.6%
250 to 499	34	51.5%	1	4.3%	2	3.6%
500 to 999	11	16.7%	1	4.3%	8	14.3%
1,000 to 1,499	1	1.5%	0	0.0%	2	3.6%
>1,500	0	0.0%	0	0.0%	1	1.8%
TOTAL	66	100%	23	100%	56	100%

Sources: U.S. Environmental Protection Agency (1998), MRI (1999).

Exhibit 2-18b: 1998 Employment at Facilities with Expected Compliance Cost Impacts

	Hardboard		Engineered Wood Products		Total Facilities	
Number of Employees	Facilities in Size Category	% of All Impacted Facilities	Facilities in Size Category	% of All Impacted Facilities	Facilities in Size Category	% of All Impacted Facilities
Not reporting	0	0.0%	0	0.0%	2	1.2%
<50	0	0.0%	0	0.0%	1	0.6%
50 to 99	1	5.6%	0	0.0%	13	8.0%
100 to 249	8	44.4%	1	33.3%	77	47.2%
250 to 499	4	22.2%	2	66.7%	41	25.1%
500 to 999	5	27.8%	0	0.0%	25	15.3%
1,000 to 1,499	0	0.0%	0	0.0%	3	1.8%
>1,500	0	0.0%	0	0.0%	1	0.6%
TOTAL	18	100%	3	100%	166	100%

Sources: U.S. Environmental Protection Agency (1998), MRI (1999).

Potentially impacted facilities engaged in the production of plywood and composite wood products tend to be small- to medium-sized. Just over half of the facilities reported having less than 250 employees. Softwood plywood producers tend to have larger facilities, while facilities producing reconstituted wood products tend to be smaller.

2.4.2.4 Facility Population Trends

Plant age may be of particular significance to potential regulatory impacts. Older plants may be less efficient as compared with newer plants utilizing technological improvements in production efficiency. One example mentioned earlier is the development of the continuous press, enabling recently constructed plants to produce more panel products in less time than older manufacturers. Newer plants may utilize better volatile organic compound emission control technologies and have adapted their processes to meet indoor air quality requirements.

While specific age information for all facilities is not available, an analysis performed by Spelter et al. (Spelter, 1997) provides insights into the changing nature of plywood and composite wood facilities over time. In their analysis, they traced the number of mills, average mill capacity, and capacity utilization over the course of 20 or more years. The analysis does not present information on specific plant closures and openings over time, but presents the total number of operating mills, which reflects the net change resulting from both closures and openings. Exhibit 2-19 provides information on the results of the analysis for selected years from 1977 to 1997, using census years to provide some comparison to overall industry figures presented elsewhere in this chapter.

Exhibit 2-19: Number of Mills, Average Capacity and Utilization, 1977 - 1997						
	1977	**1982**	**1987**	**1992**	**1997**	**% Change**
Softwood Plywood						
Number of Mills	62	69	58	56	57	-8%
Average Mill Capacity (1000 m^3)	110	138	180	201	215	95%
Capacity Utilization	97	79	99	95	97	0%
Oriented Strandboard						
Number of Mills	8	21	39	44	66	725%
Average Mill Capacity (1000 m^3)	88	115	148	187	259	194%
Capacity Utilization		44	90	99	84	91%
Particleboard						
Number of Mills	54	43	44	45	45	-17%
Average Mill Capacity (1000 m^3)	137	151	168	181	196	43%
Capacity Utilization	86	87	89	89	97	13%
Medium-density Fiberboard						
Number of Mills	12	13	17	17	26	117%
Average Mill Capacity (1000 m^3)	95	105	122	141	151	59%
Capacity Utilization	69	66	87	91	86	25%
Laminated Veneer Lumber						
Number of Mills		2	6	12	17	750%
Average Mill Capacity (million m^3)		0.078	0.075	0.063	0.085	9%
Capacity Utilization		73	60	75	93	27%
Engineered Joists						
Number of Mills		12	12	18	35	192%
Average Mill Capacity (million meters)		3	4	5	9	200%
Capacity Utilization		69	73	90	58	-16%

*Information not available for some years. For softwood plywood, particleboard, and MDF, 1997 figures are from 1996. For particleboard, 1984 figures are used for 1982.
Source: Spelter et al. (1997).

Average facility capacity has shown substantial increases over the last twenty years for all product groups. While the number of softwood plywood facilities declined by 8 percent between 1977 and 1997, the average mill capacity increased substantially, nearly 100 percent. Particleboard has experienced some capacity growth while the number of plants has declined.

The OSB industry has shown the largest increase in per facility capacity, 194 percent, along with large net additions of facilities. Most notably, there were nine more OSB plants than softwood plywood plants in 1997, whereas in 1977 plywood plants outnumbered OSB plants nearly 8 to one. Recent facility additions for OSB and MDF show these sectors have newer facilities, while the softwood plywood and particleboard industries are generally composed of older facilities.

A review of recent capital investment trends provides some insights into the facility population trends of the softwood plywood and reconstituted wood products industries. Exhibit 2-20 shows capital

expenditures by industry sector. Capital expenditures have seen substantial overall increases in the last five years for all three sectors, indicating increasing investment, particularly in the reconstituted wood product and structural wood members sectors. However, investment by the softwood plywood and veneer and reconstituted wood products sectors declined sharply from 1996 to 1997. This trend indicates the connection between declining capital expenditures and the sharp increase in products costs' share of the value of shipments (as shown in Exhibit 2-5) that began after 1995. If such conditions in the baseline continue into the future, it is possible that certain firms may experience difficulty accessing capital to cover these costs in addition to compliance costs associated with the MACT standard.

Exhibit 2-20: Summary of Capital Expenditures, 1992 - 1997 (Thousands of 1997 Dollars)

	1992	1993	1994	1995	1996	1997	% Change
Softwood Plywood & Veneer	110,125	128,490	159,685	192,090	212,277	168,142	52.7%
Reconstituted Wood Products	159,330	185,452	353,665	367,057	583,659	329,744	107.0%
Structural Wood Members*	47,420	70,659	220,523	143,523	108,889	138,880	192.9%

All dollars adjusted to 1997 using GDP Deflator.
* 1997 figure is sum of capital expenditures for NAICS 321213 and 321214.
Source: U.S. Department of Commerce (1999a).

For softwood plywood, the level of capital investment constitutes only 3 percent of the industry's total value of shipments. With the number of mills in decline and average mill capacity growing, it appears that the majority of capital expenditures made by the softwood plywood industry occur at existing plants. This conclusion is supported by *U.S. Industry & Trade Outlook '99*, which reported that only one new softwood plywood facility has opened in the last 10 years (U.S. Department of Commerce, International Trade Administration, 1999).

Conversely, results of the growing capital investments made by the reconstituted wood products industry can be observed in the large increases in the number of OSB and MDF plants, and the rising average plant capacities of reconstituted wood products producers. As a group, these producers invested 6 percent of the value of shipments in 1997, twice the investment rate of the softwood plywood producers. For example, in September of 1999, Willamette Industries announced that it will build an $85 million particleboard plant in South Carolina. The plant will have a capacity of 210 million square feet per year and will be in operation in late 2001.

2.4.3 Firm Characteristics

Several factors will likely be of importance in determining the distribution of impacts generated by the proposed MACT standard on companies. Size may play a role in a company's ability to absorb an increase in compliance costs. Ownership is a second factor that may play a role. Because firms have different legal and financial guidelines based on ownership, their approaches to complying with the MACT standard may vary. Vertical and horizontal integration, or lack there of, in plywood and composite wood product firms may affect the manner in which they absorb the potential costs of the MACT standard. Lastly, the overall financial condition of the plywood and composite wood industries is assessed, attempting to determine the industry's ability to withstand adverse conditions.

2.4.3.1 Size Distribution

Firm size is likely to be a factor in the distribution of the impacts of the proposed MACT on companies. Under the Regulatory Flexibility Act (RFA) and its 1996 amendment, SBREFA, SBA definitions are used to designate which businesses are considered to be small. The SBA has set size standards under the NAICS system, using various thresholds for the number of employees or revenues.

In determining the size of a company, the SBA treats a facility that has a substantial portion of its assets and/or liabilities shared with a parent company as part of that company. In this analysis, the company's primary NAICS code is used to determine the appropriate SBA threshold.

Exhibit 2-21 provides information on firm size for plywood and wood composite firms owning facilities with expected compliance cost impacts. In the ICR, facilities were asked to provide information on employment size for domestic parent firms. Many facilities did not report information on the *ultimate domestic parent*. For this reason, information on ultimate domestic parent primary SIC and NAICS code and employment size were obtained from Dun and Bradstreet's DUNS Database. Exhibit 2-21 shows the number of firms and the facilities owned by the firms in the first two data columns. In the absence of Dun & Bradstreet information on the owner, the facility's primary SIC and NAICS code from Dun & Bradstreet was used to determine the appropriate SBA threshold. Based on this SIC code, facility employment information from the ICR was used to make a size determination. Exhibit 2-21 shows the number of firms and the facilities owned by the firms in the third and fourth data columns. In the absence of facility primary SIC code from DUNS, the standard for lumber and wood products (all SIC 24 codes) of 500 employees was used as the threshold. A full list of the facilities and their size determination is provided in the economic impact analysis for this proposed rule.

Exhibit 2-21: Size Distribution of Firms Owning Facilities with Expected Compliance Cost Impacts

	SIC Based on DUNS		SIC Based on ICR		Other Sources		Total			
Size	Firms	Facilities Owned by Firms*	Firms	Facilities Owned by Firms*	Firms	Facilities Owned by Firms*	Firms	%	Facilities Owned by Firms*	%
Small	8	10	5	5	6	7	19	35.2%	22	8.4%
Large	29	231	4	8	2	2	35	64.8%	241	91.6%
Total	37	241	9	13	8	9	54	100%	263	100%

* Includes all facilities reported, impacted and non-impacted.
Sources: U.S. Environmental Protection Agency (1998), MRI (1999). SBA Size Standards from SBA website: http://www.sba.gov/regulations/siccodes/.

While over 35 percent of firms in the industry are considered small, 91 percent of facilities are owned by large firms. Given the concentration ratios presented in Exhibit 2-15, there does not appear to be any significant market power to these larger firms. However, the ability of larger firms to deal with compliance costs, as compared to smaller firms, may have impacts on the industry organization.

The larger parent firms have both impacted and non-impacted facilities. Firms such as Georgia-Pacific (43 ICR facilities), Louisiana-Pacific (32 ICR facilities), Willamette Industries (23 ICR facilities), Columbia Forest Products (13 ICR facilities), Weyerhaeuser (19 ICR facilities), and Boise-Cascade (12 ICR facilities) may be able to make trade-offs between facilities and shift production to more efficient facilities in response to compliance costs associated with the MACT standard.

2.4.3.2 Ownership

The form of firm ownership has a set of legal and financial characteristics that may influence a firm's regulatory compliance alternatives. The legal form of ownership impacts the cost of capital, availability of capital, and effective tax rate faced by the firm. Debt-equity issues for these firm types will play a role in financing capital-intensive controls. Firm ownership may generally be one of three types.

- Sole proprietorships (companies with a private single-owner)
- Partnerships (non-corporate firms with more than one owner)
- Corporations (publically or privately owned companies formed through incorporation)

Exhibit 2-22 provides information on ownership type for the lumber and wood products industry. While specific information by 4-digit SIC or 5-digit NAICS is not available, the table provides a general sense of ownership types in the industry, assuming that ownership structure for the three industries profiled is similar to that of the overall lumber and wood products industry.

Exhibit 2-22: Types of Firm Ownership for Lumber and Wood Products (SIC 24/NAICS 321), 1992

	Corporation	Sole Proprietorship	Partnerships	Other/ Unknown
Single-Facility Firms	1,291	14,909		
Multi-Facility Firms	17,617	61		
All Firms	18,908	10,447	2,336	2,187

Source: U.S. Dept. of Commerce (1992).

Over ninety percent of single facility wood and lumber products firms are owned by sole proprietorships, partnerships, or some other/unknown entity. Nearly all multi-facility firms are owned by corporations. Just over half of all lumber and wood products firms are a corporation, while the remainder are sole proprietorships (30 percent), partnerships (7 percent), or other (6 percent). These data support the conclusion that single-facility firms owned by sole proprietors are more likely to be classified as small businesses, while multi-facility firms owned by corporations are more likely to be classified as large businesses.

2.4.3.3 Vertical and Horizontal Integration

The data presented in Section 2.2 on concentration and specialization ratios for the plywood and composite wood industries, combined with the information on establishment size and ownership type demonstrate that the majority of firms in the three industries examined in this profile are predominantly not, or minimally, vertically or horizontally integrated. However, there are several exceptions to this conclusion. The six largest firms that own multiple facilities are for the most part both vertically and horizontally integrated. These firms, described in more detail below, are large multi-billion dollar concerns that are vertically integrated through their ownership of timberland, their production facilities, and their involvement in product distribution. Their horizontal integration is attributed to their other product lines, generally pulp and paper.

Georgia-Pacific, a large, horizontally and vertically integrated firm, manufactures and distributes building products, pulp and paper, and resins. The company's wood product line includes wood panels, plywood, and hardboard. It also produces lumber, gypsum products, chemicals, and packaging. Georgia-Pacific grows and sells timber, and participates in several other activities related to forestry management. Its 1998 net sales revenues exceeded $13 billion, and it has 45,000 employees at 400 locations. Its building products division reported record profits during the second quarter of 1999. It currently has plans to build an OSB plant in Arkansas and recently merged with Unisource, a major distributor of imaging paper and supply systems (Financial Times, 1999b; PR NewsWire, 1999b).

Louisiana-Pacific is principally a manufacturer of building products, but also produces pulp and building insulation, and owns almost one million acres of timberland. Its sales of structural lumber, industrial panels, and exterior building products made up nearly 75 percent of the company's revenues, which reached $2.3 billion in 1998. The company manufactures OSB, I-joists, LVL, MDF, fiberboard, particleboard, hardboard, softwood plywood and hardwood veneer. Louisiana-Pacific has been involved in a series of mergers and acquisitions that include Le Goupe Forex of Canada, Evans Forest Products, and ABT Building Products (Louisiana-Pacific, 1999; Financial Times, 1999c).

Willamette Industries, a forest products manufacturing company, has three main lines of business: brown paper, white paper, and building products. The building products division manufactures plywood, lumber, particleboard, MDF, OSB, LVL and I-joists, among others. Approximately one third of the company's $3.7 billion in total revenue is from its building materials segment. Most of Willamette's recent merger and acquisition activity has been with firms in France and Mexico. It also owns plants in Ireland and 1.8 million acres of timberland in the U.S. (Financial Times, 1999d; PR NewsWire, 1999c, 1998, 1997).

Columbia Forest Products describes itself as North America's largest manufacturer of hardwood veneer, and laminated products. They sell their products through a network of wholesale distributors, mass merchandisers and major original equipment manufacturers (OEMs). Their products include decorative, interior veneers and panels used in high-end cabinetry, fine furniture, architectural millwork and commercial fixtures. Columbia Forest Products is an employee-owned company with 13 plants in the U.S. and four in Canada (Columbia Forest Products, 1999).

Weyerhaeuser is an integrated international forest products company. It is involved in growing and harvesting timber, and the manufacturing and distributing of several categories of forest products. Among its wood products are plywood, OSB, and wood composites. The company bills itself as the world's largest private owner of saleable softwood timber and the country's largest producer of softwood lumber and pulp. In addition, it is the top U.S. exporter of forest products. The company has approximately 36,000 U.S. and Canadian employees and sales of $11 billion, ten percent of which comes from exports (Weyerhaeuser, 1999).

Boise Cascade, an integrated international paper and forest products company, manufactures and distributes paper and wood products, distributes office products and building materials, and owns and manages over 2 million acres of timberland. Its building products include lumber, plywood, particleboard, veneer, and engineered wood products. Sales of these products constitute 27 percent of the company's $6.2 billion annual revenue (Financial Times, 1999a; PR NewsWire, 1999a).

2.4.3.4 Financial Condition

The financial condition of an industry's firms will affect the incidence of impacts of the costs associated with complying with a new MACT standard. While information necessary to determine which specific firms might experience adverse impacts is not available, one can examine industry-wide indicators of financial condition. Each year, Dun & Bradstreet (D&B) publishes *Industry Norms & Key Business Ratios*, which reports certain financial ratios for a sample of firms in the industry. This section focuses on measures of profitability and solvency.

Profitability Ratios

The return on sales ratio, also known as the net profit margin, is an indicator of a firm's ability to withstand adverse conditions such as falling prices, rising costs, and declining sales, and is calculated by dividing net profit after taxes by annual net sales.

Return on assets is calculated by dividing a firm's net profit after taxes by its total assets. This ratio is a key indicator of both profitability and operating efficiency by comparing operating profits to the assets available to earn a return. According to Dun & Bradstreet, companies that use their assets efficiently will have a relatively higher return on assets than those firms that do not use their assets efficiently.

The return on equity shows the profitability of the company's operations to owners, after income taxes, and is calculated by dividing net profit after taxes by net worth. According to Dun & Bradstreet,

this ratio is looked to as a 'final criterion' of profitability, and a ratio of at least 10 is regarded as desirable for providing dividends plus funds for future growth.

Solvency Ratios

The current ratio is calculated by dividing a firm's current assets by its current liabilities. This is a measure of liquidity that gauges the ability of a company to cover its short-term liabilities. The standard guideline for financial health is 2. The quick ratio is slightly different than the current ratio, because it does not include inventories, advances on inventories, marketable securities, or notes receivables. The quick ratio measures the protection afforded creditors in cash or near-cash assets. Any time this ratio is 1 or greater, the firm is said to be in a liquid condition.

Exhibit 2-23 shows various measures of the financial condition of the plywood and composite wood industry over the period 1995 to 1997. The trends shown in Exhibit 2-23 confirm that the softwood plywood and reconstituted wood products industries have experienced a profit squeeze due to increasing costs and falling prices in recent years.

Exhibit 2-23: Indicators of Financial Condition, 1995-1997*

Indicator	Softwood Plywood and Veneer			Reconstituted Wood Products			Structural Wood Members
	1995	1996	1997	1995	1996	1997	1998
Return on Sales	5.8	3.6	1.7	3.8	3.1	3.5	5.0
Return on Assets	15.7	13.5	6.0	7.8	5.9	3.5	13.0
Return on Equity	28.7	22.9	8.7	15.2	10.0	5.7	NA
Current Ratio	3.2	2.6	2.7	2.8	2.7	1.7	2.3
Quick Ratio	1.1	1.3	1.2	1.8	1.2	1.1	1.3

*Includes 1998 data for Structural Wood Members, the only data reported for this sector.
Source: Dun & Bradstreet (1999). Indicator values are based on median values of the industrial sample.
For SIC 2436, there were 14 establishments in the sample in 1995, 15 in 1996, and 11 in 1997. For SIC 2493, there were 28 establishments in the sample in 1995, 30 in 1996, and 31 in 1997. For SIC 2439, there were 135 establishments in 1998.

The softwood plywood and veneer industry has not maintained its relatively strong degree of financial health, with many of its profitability indicators significantly lower in 1997 than in 1995. In particular, the softwood plywood and veneer industry experienced 60 to 70 percent declines in all three profitability ratios. The falling profitability of this industry is now at a level that indicates the presence of firms that are not using their assets efficiently, are not providing the cash needed for future growth, and may more acutely experience adverse conditions associated with MACT standard compliance costs. The currently low net profit margin is indicative of an industry that is experiencing increasing production costs as a percentage of its value of shipments and falling capacity utilization (Exhibits 2-5 and 2-18).

The reconstituted wood products industry also saw fairly dramatic decreases in its financial indicators over the time period shown, resulting in a relatively low return on assets and return on equity, as well as a current ratio lower than generally considered healthy. These indicators are consistent with recent trends in the industry associated with increases in production costs relative to the value of shipments (Exhibit 2-5), rapid expansion of production capacity (Exhibit 2-20) and competitive pressures on prices from overseas producers. This industry also includes firms that are not using their assets efficiently or providing the cash needed for future growth. The reconstituted wood products industry's profit margin is also somewhat low, but typical of all firms in the lumber and wood products sector (Dun and Bradstreet, 1999b).

In the fall 1999 issue of Engineered Wood Products Journal, industry analyst Evadna Lynn discussed investor response to the industry's current financial performance (APA, 1999c). Lynn attributes several recent trends to stockholder pressure for improved financial performance.

- Separating timber assets
- Corporate restructuring
- Cost control through consolidation

These trends have contributed to a dynamic market structure in recent years. By selling or otherwise spinning off timber assets, forest products companies are converting them to cash and improving financial performance. Restructuring activities have focused on gaining higher returns from core business activities through the closure or divestiture of less profitable facilities or products. Some of the divested facilities, particularly plywood mills, have been reopened by new owners as sawmills. The industry has seen several major corporate mergers and acquisitions in the late 1990s, including: Weyerhaeuser and MacMillan Bloedel, International Paper and Union Camp, and Louisiana Pacific and Le Groupe Forex (of Canada). Most post-merger cost reductions are gained from streamlining operations, including closure of production facilities (APA, 1999c; International Paper, 1998).

2.5 Markets

This chapter discusses general market conditions for the plywood and composite wood products industries. In particular, this chapter discusses market structure, provide background on current market volumes, prices, and international trade. It also presents information on future market volumes, prices and international trade. The purpose of this chapter is to describe the current status of the industry and to support the development and implementation of the economic impact analysis that is summarized in this RIA.

2.5.1 Market Structure

Based on the data, background and analyses reviewed while preparing this industry profile, it is reasonable to conclude that these industries exhibit clear signs of a competitive market for the products that are the subject of this MACT standard. There are several reasons for this conclusion. First, as discussed in section 2.4.2, the plywood and composite wood products industries are unconcentrated. There is little concentration of market power evidenced by each separate industrial category having a 4-firm concentration ratio of 50 or below (often well below) and HH indices below the 1000 benchmark. Next, the output of several of the production sectors are substitutes for each other, putting competitive pressures on suppliers. There are also competitive pressures from alternative products, either traditional sawn lumber or non-wood materials. This chapter will focus on other factors of the competitive nature of these industries. For the most part, the markets for these goods also experience competitive pressures by the presence of imported products. Finally, several industry experts have observed trends where prices of the products respond negatively to the presence of excess capacity. The remainder of this chapter will provide additional details related to these observations on industry competitiveness.

2.5.2 Market Volumes

This section will present a discussion of market consumption and production volumes for the three industrial sectors examined in this study. For the most part, this discussion will rely on the data contained in Exhibit 2-24 and Exhibit 2-25. Exhibit 2-24 shows the value of product shipments by product class for the period 1989 to 1995[7] as reported by the International Trade Administration of the U.S. Department of

[7] 1995 is the latest year for which data is available.

Commerce. Note that value of shipments data for Structural Wood Members is not available for inclusion in this table. Exhibit 2-25 shows the physical volume of output produced, traded and consumed between 1988 and 1997 for selected products as reported by Spelter et al. in their 1997 statistical report. International trade is discussed later in the section.

Exhibit 2-24: Trade Balance and Selected Statistics, Thousands of 1997 Dollars

	1989	1990	1991	1992	1993	1994	1995	% Change
Softwood Veneer and Plywood (SIC 2436, NAICS 321212)								
Value of product shipments	7,125	6,887	6,185	6,422	5,643	5,885	6,671	-6%
Value of imports	81	69	55	79	82	100	111	37%
Value of exports	452	509	428	452	391	333	375	-17%
Trade Surplus (Deficit)	371	440	373	372	310	234	263	-29%
Apparent Consumption	6,755	6,447	5,812	6,050	5,333	5,651	6,407	-5%
Ratio of Imports to Consumption	0.01	0.01	0.01	0.01	0.02	0.02	0.02	45%
Ratio of Export to Product Shipments	0.06	0.07	0.07	0.07	0.07	0.06	0.06	-11%
Ratio of Imports to Exports	0.18	0.14	0.13	0.18	0.21	0.30	0.30	65%
Reconstituted Wood Products (SIC 2493, NAICS 321219)								
Value of product shipments	5,013	4,761	4,743	5,359	4,940	5,511	5,772	15%
Value of imports	461	409	364	540	616	861	1,080	134%
Value of exports	261	334	350	328	271	301	345	32%
Trade Surplus (Deficit)	(200)	(75)	(14)	(212)	(345)	(560)	(735)	268%
Apparent Consumption	5,213	4,836	4,757	5,572	5,285	6,070	6,507	25%
Ratio of Imports to Consumption	0.09	0.08	0.08	0.10	0.12	0.14	0.17	88%
Ratio of Export to Product Shipments	0.05	0.07	0.07	0.06	0.05	0.05	0.06	15%
Ratio of Imports to Exports	1.76	1.22	1.04	1.65	2.27	2.86	3.13	77%

Source: U.S. Department of Commerce, International Trade Administration (1998).

Exhibit 2-25: Production, Trade and Consumption Volumes for Selected Products (1988-1997)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	% Change
Softwood Plywood (M ft^3, 3/8 in basis)											
Product shipments	22,089	21,385	20,919	18,652	19,332	19,315	19,368	19,367	19,181	17,963	-19%
Imports	96	49	38	28	47	41	47	60	85	104	8%
Exports	1,004	1,442	1,613	1,322	1,442	1,409	1,211	1,267	1,248	1,548	54%
Apparent Consumption	21,181	19,991	19,344	17,358	17,937	17,946	18,474	18,160	18,018	16,519	-22%
Other Structural Panels (M ft^3, 3/8 in basis)											
Product shipments	4,604	5,105	5,418	5,613	6,653	7,002	7,486	7,903	9,314	10,534	129%
Imports	815	1,111	1,313	988	1,572	2,163	2,588	3,214	4,414	5,272	547%
Exports				57	49	60	78	82	157	167	193%*
Apparent Consumption	5,416	6,213	6,728	6,544	8,176	9,105	9,995	11,036	13,572	15,639	189%
Particleboard/Medium Density Fiberboard (M ft^3, 3/4 in basis)											
Product shipments	4,768	4,828	4,856	4,730	5,046	5,402	5,793	5,307	5,705	5,916	24%
Imports	1,634	425	363	293	405	572	775	840	814	963	-41%
Exports	163	333	373	369	394	318	297	319	154	188	15%
Apparent Consumption	6,239	4,920	4,746	4,654	5,057	5,656	6,271	5,828	6,365	6,691	7%
Hardboard (M ft^3, 1/8 in basis)											
Product shipments	5,118	5,196	5,025	4,895	5,273	5,248	5,206	4,930	5,280	4,501	-12%
Imports	633	718	689	571	571	639	1,119	1,152	1,183	1,306	106%
Exports	322	427	552	606	836	917	1,190	1,377	1,426	1,259	291%
Apparent Consumption	5,429	5,487	5,162	4,860	5,008	4,970	5,135	4,705	5,037	4,548	-16%

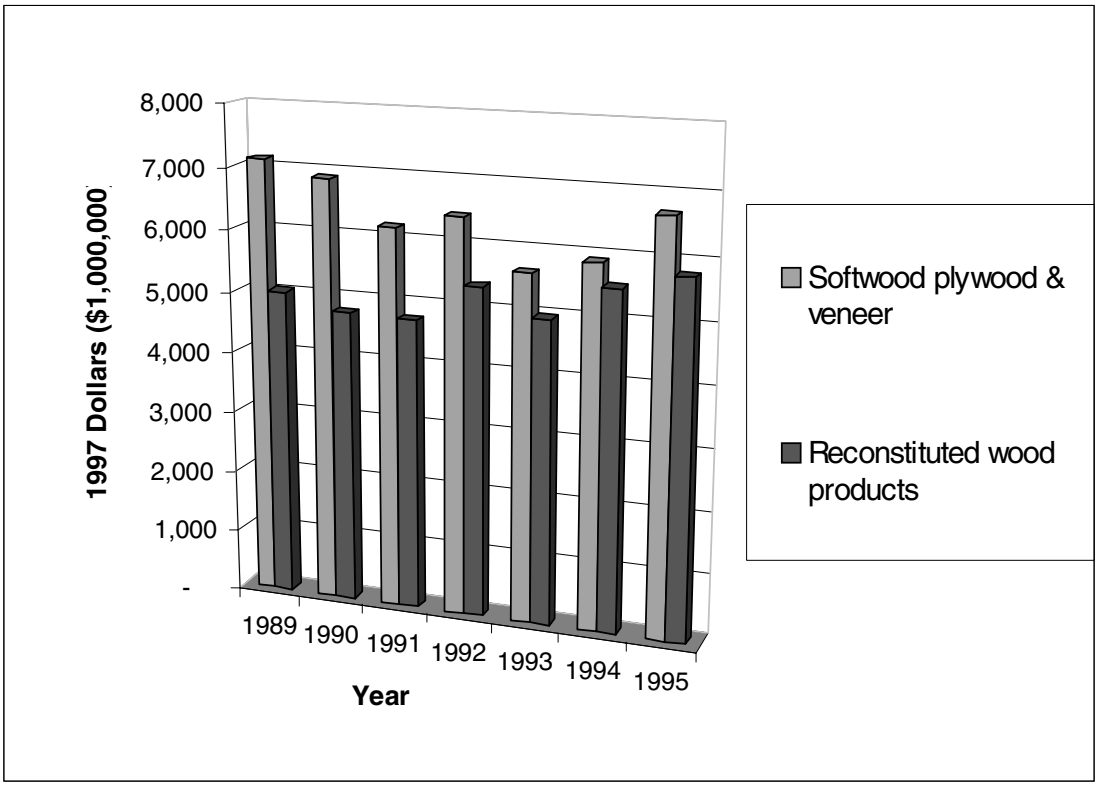
Source: Spelter et al. (1997).
* since 1991

2.5.2.1 Domestic Production

As Exhibit 2-24 shows, the value of shipments (representing production) of softwood plywood and veneer was slightly lower in 1995 than it was in 1989. During the period, production reached its lowest level in 1993 and then began to climb, in response to meeting demand from rising expenditures for renovation and remodeling and new housing starts. The value of shipments of reconstituted wood products rose 15 percent between 1989 and 1995, linked to the underlying growth in the construction sector and the growth in market share of structural panel products over softwood plywood.

Figure 2-10 compares the value of product shipments of softwood plywood and veneer to reconstituted wood products from 1989-1995.

Figure 2-10: Value of Product Shipments, 1989-1995



Source: U.S. Department of Commerce, International Trade Administration (1998).

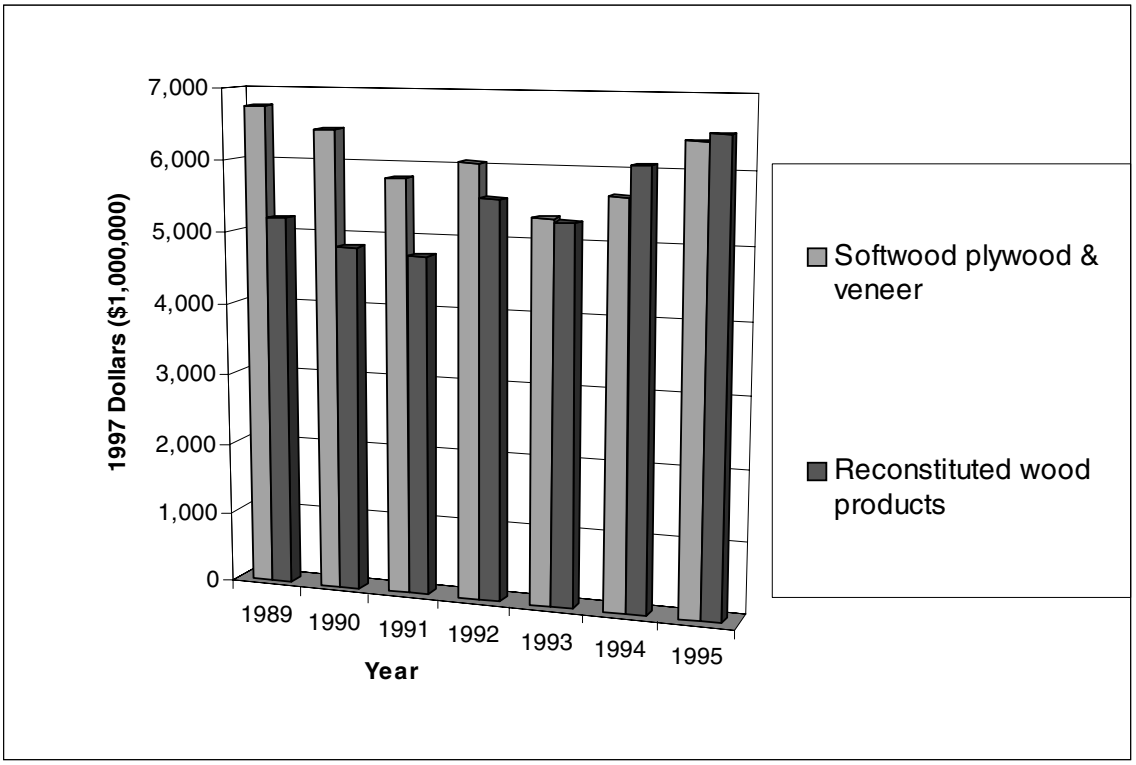
Trends in product shipments by volume (Exhibit 2-25) have been mixed for this group of industries. A statistical report produced by the U.S. Forest Service's Forest Products Laboratory (Spelter et al., 1997) focused on production of softwood plywood, Other Structural Panels (OSB and waferboard), particleboard and MDF as a group, and hardboard. Production by the Other Structural Panels category experienced high growth during the period, with 1997 production almost 130 percent greater than it was in 1988. Most of this increase can be attributed to the rapid increase in OSB's share of the structural panel market in recent years. Particleboard and MDF production grew a moderate 24 percent, while production of softwood plywood and hardboard declined by 19 percent and 12 percent respectively. Historically, softwood plywood production made a continuous steady climb through the late 1980's. At that point, the product began losing market share to OSB and production leveled off. This trend was accompanied by a certain amount of mill attrition (Spelter et al., 1997).

2.5.2.2 Domestic Consumption

Domestic, or apparent, consumption is the sum of domestic production and imports, less exports. The dollar value of apparent consumption (Exhibit 2-25) for softwood plywood and veneer was slightly lower in 1995 than it was in 1989. During the period, demand for softwood plywood and veneer dropped slightly in the early 1990s and reached its lowest level in 1993 and then began to climb. The value of domestic consumption of reconstituted wood products followed a similar pattern, increasing by 25 percent overall between 1989 and 1995. Drivers of consumption trends described here are the same as those presented in the previous section on production (increased demand for renovation, remodeling and new housing starts).

Figure 2-11 compares the apparent consumption of softwood plywood and veneer to reconstituted wood products from 1989-1995.

Figure 2-11: Apparent Consumption, 1989-1995



Source: U.S. Department of Commerce, International Trade Administration (1998)

Further examination of consumption volumes (Exhibit 2-25) shows the following trends for softwood plywood, other structural panels, particleboard and MDF as a group, and hardboard.

- By volume, apparent consumption of softwood plywood fell by over 20 percent in the last 10 years.
- At the same time, consumption of other structural panels increased by almost 200 percent.
- Particleboard and MDF were consumed at a slightly higher level in 1997 than they were in 1988, following a decline that ended in 1992.
- Hardboard consumption has fluctuated during the same 10 years, with a 16 percent decline from 1988.

Demand for softwood plywood and OSB combined experienced an annual average growth rate of 2-3 percent from 1970 to 1996 (Spelter et al., 1997). Most of this demand was met by increased production of OSB by both domestic and imported producers.

2.5.2.3 International Trade

Imports

Import value trends during the 1989-1995 period (Exhibit 2-24) show the constant dollar value of softwood plywood and veneer imports grew by 37 percent, particularly during the later years when the price for the commodity was rising rapidly and supplies of timber were declining. The ratio of imports to consumption of softwood plywood and veneer, while only 0.02, grew by 45 percent. The trade surplus for softwood plywood and veneer fell by 37 percent. Imports of reconstituted wood products more than doubled from 1989 to 1995 and the value of imports' share of consumption grew by almost 90 percent and the trade deficit nearly quadrupled.

Looking at import volumes (Exhibit 2-25) for softwood plywood, other structural panels, particleboard and MDF as a group, and hardboard, imports have made the biggest gains in the other structural panel category, taking advantage of the overall growth in demand for those products. Imports now supply over a third of the other structural panel market. Imports of hardboard have also grown, more than doubling in volume since 1988. There was a slight increase in imports of softwood plywood over the 10 years, and a decline of 40 percent in imports of particleboard and MDF. Exhibit 2-26 shows U.S. imports of by major region and trading partner.

Exhibit 2-26: 1997 U.S. Wood Products Imports by Region and Major Trading Partner

Trade Areas	Value* ($millions)	Share
NAFTA	8,128	85.1
Latin America	541	5.7
Western Europe	234	2.5
Japan/Chinese Economic Areas	35	0.4
Other Asia	458	4.8
Rest of World	150	1.6
World Total	9,554	100.0
Top 5 Countries		
Canada	7,991	83.6
Indonesia	340	3.6
Brazil	303	3.2
Mexico	137	1.4
Chile	108	1.1

*Includes Sawmills (SIC 2421), Softwood Plywood and Veneer (SIC 2436), Reconstituted Wood Products (2435), and Hardwood Plywood and Veneer (SIC 2435).
Source: U.S. Department of Commerce, International Trade Administration (1999).

Exhibit 2-26 shows that a vast majority, 85.1 percent, of U.S. imported wood products originated in the North American Free Trade Agreement (NAFTA) trade zone, of which only 1.5 percent originates in Mexico. The U.S. is also importing a significantly greater value of wood products than it is exporting. In 1997 the U.S. exported about $3,683 million of wood products while it imported $9,554 million.

Imports of softwood plywood and veneer grew by 24 percent from 1996 to 1997. Seventy-seven percent of U.S. softwood plywood and veneer imports are from Canada. This growth is consistent with the strong demand for softwood plywood and veneer during this period. The overall penetration of imports into the U.S. market is quite small (2 percent), which is attributed to the efficiency and low costs of U.S. softwood plywood and veneer producers (U.S. Department of Commerce, International Trade Administration, 1999).

Imports of reconstituted wood products grew by seven percent from 1996 to 1997. Seventy-eight percent of U.S. reconstituted wood products imports are from Canada. The overall penetration of imports into the U.S. market is significant (18 percent), which is attributed to recent capacity additions by Canadian reconstituted wood products producers (U.S. Department of Commerce, International Trade Administration, 1999).

Exports

Export trends during the 1989-1995 period (Exhibit 2-24) show the value of softwood plywood and veneer exports fell by 17 percent, particularly during the later years when the price for the commodity was rising rapidly and supplies of timber were declining. Economic crises in several Asian economies and the falling value of the Canadian dollar relative to the U.S. dollar played a role in this trend. The ratio of exports to value of shipments of softwood plywood and veneer fell by 11 percent. Exports of reconstituted wood products grew by 32 percent from 1989 to 1995 and the proportion of exports to shipments grew by almost 15 percent.

Export volumes (Exhibit 2-25) of hardboard quadrupled between 1988 to 1997, and constitute a significant portion of the total shipments from this industry. Exports of softwood plywood grew by 50 percent, and have become an increasingly important part of the sector's overall production. While total exports of other structural panels grew significantly, this market still remains a small portion of production. Exports of particleboard and MDF grew significantly through 1992 but have dropped steadily in recent years and are now just 15 percent higher than they were seven years ago. Exhibit 2-27 shows U.S. exports by major region and trading partner.

Exhibit 2-27: 1997 U.S. Wood Product Exports by Region and Major Trading Partner		
Trade Areas	**Value* ($millions)**	**Share**
NAFTA	1,001	27.5
Latin America	203	5.6
Western Europe	1,230	33.8
Japan/Chinese Economic Areas	837	23.0
Other Asia	205	5.6
Rest of World	161	4.4
World Total	3,638	100.0
Top 5 Countries		
Canada	800	22.0
Japan	636	17.5
Germany	292	8.0
United Kingdom	244	6.7
Mexico	202	5.5

*Includes Sawmills (SIC 2421), Softwood Plywood and Veneer (SIC 2436), Reconstituted Wood Products (SIC 2493), and Hardwood Plywood and Veneer (SIC 2435).
Source: U.S. Department of Commerce, International Trade Administration (1999).

By region, the U.S. exports its largest share (33.8 percent) of wood products to Western Europe. However, no single country in Europe imports the most significant share of U.S. wood products. Canada imports the largest share, 22 percent, due to two reasons. First, Canada's economy has strengthened. Second, on January 1, 1998 Canada completed its final stage of tariff removal as directed under the U.S.-Canada Free Trade Agreement. For the two aforementioned reasons, U.S. wood product exports to Canada increased 21 percent to $800 million in 1997 (U.S. Department of Commerce, International Trade Administration, 1999).

Continued growth in U.S. exports of wood products is dependent on an Asian economic revival, particularly in Japan's economy. In 1996, prior to the economic crisis, Japan was the largest importer of U.S. wood products. By 1997, Japan's share of U.S. wood product exports fell to 17 percent, a 24 percent decrease from the previous year. To further exacerbate the problem, U.S. exports to Japan are expected to decline an additional 30 percent in 1998 and 1999. Japan has undertaken several steps to revitalize its economy, such as the implementation of the Enhanced Initiative on Deregulation and Competition Policy. However, an increase in the Japanese consumption tax from 3 percent to 5 percent in 1996 is believed to have canceled out the potential gains of the Policy, resulting in the expected continuing decline in Japanese demand for U.S. plywood and wood products (U.S. Department of Commerce, International Trade Administration, 1999).

In 1997, exports of softwood plywood and veneer accounted for about 10.6 percent of wood product exports from the U.S. This was a 24 percent increase from the previous year, raising the total value of softwood plywood and veneer exports to $392 million, the highest level in eight years. Exports to the United Kingdom, Canada, and Germany, the top three importers of U.S. softwood plywood and veneer, experienced strong gains in 1997. A healthy European market has increased the demand for softwood plywood and veneer. In particular, the construction sector throughout Europe has seen an increase in activity. However, the recent strong performance of softwood plywood and veneer is not expected to

continue due to an increasing international acceptance of OSB, and increasing competition from Canada, Brazil, and Indonesia (U.S. Department of Commerce, International Trade Administration, 1999).

Reconstituted wood products accounted for about 9.75 percent of U.S. wood product exports in 1997. Both the value and volume of reconstituted wood product exports increased by 15 percent from the previous year. Canada, the United Kingdom, Mexico, and Japan are the largest export markets for U.S. reconstituted wood. The continuing increase in exports is mainly attributable to a growing international acceptance of OSB. Exports are expected to continue to grow in the upcoming years, but at a slower rate than they did in 1997 (U.S. Department of Commerce, International Trade Administration, 1999).

2.5.3 Prices

An index of the change in producer prices for lumber and wood products is shown below in Exhibit 2-28 This index was compiled by the Bureau of Labor Statistics.

Exhibit 2-28: Lumber and Wood Products Producer Price Index, 1988-1997 (1982 = 100)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	88-97
Lumber and wood products (SIC 24)	122.1	125.7	124.6	124.9	144.7	183.4	188.4	173.4	179.8	194.5	
Change from Previous year		2.9%	-0.9%	0.2%	15.9%	26.7%	2.7%	-8.0%	3.7%	8.2%	59.3%

Source: U.S. Bureau of Labor Statistics (1999).

The biggest annual price increases for lumber and wood products occurred in 1992 and 1993 and the overall price increase between 1988 and 1997 was nearly 60 percent. Another source, the Forest Products Laboratory (FPL), that is part of the U.S. Department of Agriculture, provides a statistical report with disaggregated price indices presented in Exhibit 2-29. Note that the base year of the BLS index is 1982 while the base year for the FPL data is 1992.

Exhibit 2-29: Producer Price Indices of Plywood and Wood Composite Products (1992 =100)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	88-97
Softwood Plywood	74.2	84.5	81.4	82.2	100.0	115.4	120.3	128.0	118.3	119.3	
Change from Previous year		0	0	0	0	0	0	0	0	0	1
Particleboard	103.4	106.0	96.7	96.5	100.0	114.8	128.5	128.4	123.3	117.6	
Change from Previous year		0	0	0	0	0	0	0	0	0	0
Hardboard	100.8	100.9	98.6	96.7	100.0	106.5	109.1	113.2	115.8	119.0	
Change from Previous year		0	0	0	0	0	0	0	0	0	0

Source: Howard (1999).

Softwood plywood experienced the biggest price increase, 61 percent over the 1988 to 1997 period, with volatile price changes within the period with the biggest annual increases came in 1992 and 1993. Overall prices for particleboard rose 14 percent, but the large price increases in 1993 and 1994 have been offset by price declines in the last three years presented. Hardboard prices grew by 18 percent, with mostly steady annual price increases from 1994 on.

The market conditions and the factors that affect softwood plywood prices, supply and demand are somewhat analogous to those that affect prices for softwood lumber. For example, the cost of timber and transportation, foreign supply and demand, inventory levels as well as construction-driven demand are factors that affect market prices for softwood lumber, as well as softwood plywood and other structural panels.

A recent study produced by WEFA (Wharton Economic Forecast Associates) on trends in the softwood lumber market provides some clues about the future of the three industries examined here. Softwood lumber prices have climbed steadily since November of 1998. This climb included some higher than expected price increases in the early summer of this year. The WEFA report cites strong domestic demand related to housing construction as one underlying cause of the price increases in softwood lumber. Current price conditions are partially explained by the expectation that housing demand has peaked while remaining strong, exports to Asia will increase as those economies recover, and imports from Canada will decrease.

For the most part, the WEFA report indicates that the construction industry has responded to climbing prices by switching to "just-in-time" buying of products. Buyers are hoping that prices will begin falling and are postponing inventory build-up during this period of climbing prices. Another short-run factor affecting prices during the second quarter of this year was a constraint on truck and rail transportation availability. WEFA concludes that the market has reached equilibrium for the moment, although this could change if inventories increase at the same time that construction-driven demand levels off or falls (WEFA, 1999).

Exhibit 2-30 presents the industry-reported free on board (f.o.b.) prices of southern plywood, OSB and particleboard from 1989 to 1996. These are the product prices prior to shipping costs and distributor mark-ups. On an adjusted basis, these prices reflect the trends demonstrated in the previous exhibit, with large price increases during early 1992, falling back to or below 1989 levels by 1996.

Exhibit 2-30:
F.O.B. Prices of Southern plywood, OSB, and Particleboard
($ per cubic meter)

Year	Southern plywood		OSB		Particleboard	
	As Reported	Adjusted $1997	As Reported	Adjusted $1997	As Reported	Adjusted $1997
1989	184	229	166	206	129	160
1990	168	200	124	148	122	145
1991	175	201	144	165	120	138
1992	226	252	208	232	129	144
1993	257	279	227	247	152	165
1994	274	291	252	268	171	182
1995	267	277	242	251	173	180
1996	231	235	184	187	165	168
89-96		2.8%		-10.1%		4.5%

Prices adjusted by the GDP deflator.
Source: Spelter, et al. (1997).

Softwood Plywood

Long-term price trend data presented in the report "Review of the Wood Panel Sector in the U.S." showed a fairly stable price pattern for softwood plywood between 1977 and 1991. At that point, prices increased steadily from 1992 to their peak in 1994. Prices declined over 15 percent from 1994 to 1996. The report authors observe that with softwood plywood prices at their current high levels, producers will have a difficult time competing against the newer, more cost effective OSB producers. However, the authors note that softwood plywood producers may be able to hang on to market share and justify the higher prices by differentiating their product as a premium construction material (Spelter et al., 1997).

Oriented Strand Board

The "Review of the Wood Panel Sector in the U.S." report presents OSB price data over time that shows a 27 percent decline in price during 1995 and 1996, after a continuous trend of price increases since 1977. The report's authors attribute this weakening to a rapid increase in capacity that contributed to an increase in production, putting downward pressure on prices. Due to the ability of users to substitute plywood for OSB, these low OSB prices have only added to the growing market share enjoyed by OSB. Falling prices have cut into the net revenues of OSB producers, after a period from 1992 to 1995 where the industry enjoyed excellent cost/price margins, drawing more investment to OSB production capacity (Spelter et al., 1997).

Particleboard

Particleboard price data from 1984 to 1992 presented in the report, "Review of the Wood Panel Sector in the U.S." show some variation within a relatively small range, with a substantial price increase in the years 1993 to 1995, declining slightly in 1996. The price trend for particleboard from 1977 to 1996 is very similar to that of plywood. One reason for this similarity is the close relationship of particleboard input costs to the plywood manufacturing industry. About 25 percent of industry production cost is for wood inputs, which are primarily made up of wastes from lumber and plywood production (Spelter et al., 1997).

Medium Density Fiberboard (MDF)

Producer-reported MDF prices were $235 per ton in September of 1996 and declined by 15 percent to $205 per ton as of April, 1997. Despite this drop, there continues to be a price gap between MDF and less costly particleboard, although increasingly narrow. The price drop was attributed to MDF production capacity expansions that resulted in an increase in supply, putting pressure on the profits of MDF producers (Spelter et al., 1997).

Structural Wood Members

Producer-reported prices for I-joists reach a high in 1994 and have been declining since that time. Recent price conditions have made I-joists more competitive with traditional 2" by 10" lumber on an installed cost basis, typically for floor framing applications. In particular, I-joists are price competitive with lumber when lumber prices are high. However, precise estimates of market prices are difficult to obtain. The authors found that prices varied depending on whether the product was being sold under a brand name, on sale, or under a volume discount. Laminated veneer lumber, presented in the Review at $\$550/m^3$ f.o.b., is generally more expensive than 2" by 10" lumber, and is used mostly for structural applications or as an input to I-joists (Spelter et al., 1997).

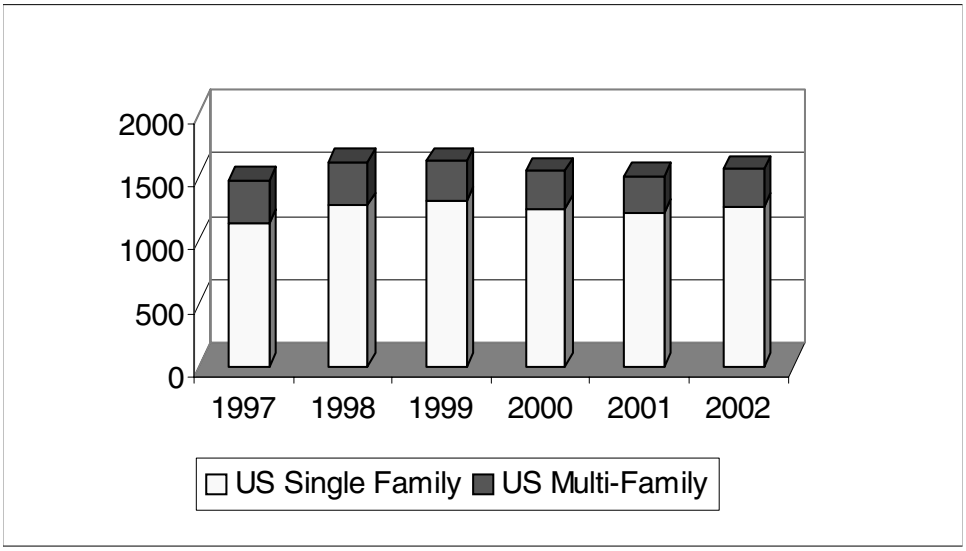
2.5.4 Market Forecasts

Production and Consumption

A study published by WEFA in the summer of 1999 examined housing starts and concluded that housing starts will decline throughout 1999, resulting in a decline in lumber demand (WEFA, 1999). However, housing starts continue to remain strong well into 1999, keeping demand for lumber and other wood products for construction strong as well. The WEFA study also noted that another factor affecting demand for softwood lumber is interest rates and concluded that rising interest rates could have a dampening effect on demand. Higher interest rates will not only affect the affordability of new homes, but also will curtail purchases of existing homes and mortgage refinancing activity, both major sources of demand for materials used in home remodeling. Based on the relationship between housing starts, purchases of existing homes, and remodeling and renovation (the construction-based demand for plywood and other products examined in this profile), this decline in demand can be expected to affect the plywood and wood composite industries, as 60 to 70 percent of their output goes to the construction sector. WEFA expects the industry to experience most of this decline in 2000 (WEFA, 1999).

The most recent wood products market outlook published by APA - The Engineered Wood Association (APA) shows U.S. housing starts exceeding expectations in 1999 (APA, 1999d). Similar to the WEFA study, the forecast expects higher interest rates in the future to play a role in reducing future housing demand in the period from 2000 to 2002. The report also forecasts the same trends for residential improvements and repairs, but notes the long-term outlook for remodeling to be good as home ownership increases. Figure 2-12 below provides information from the APA on U.S. housing starts. The APA forecast also reports the industrial outlook is good for other wood-consuming sectors. The APA expects demand for furniture and fixtures to remain healthy, but not at peak levels as existing home sales will be declining from the current peak rates. Nonresidential construction is forecasted to peak in 1999 and 2000 with declines in 2001 and 2002. Increased school construction will be a driving factor in the upward trend for nonresidential construction (APA, 1999d).

Figure 2-12: APA Projected Housing Starts (000s)



Source: APA (1999d).

In addition to providing overall forecasts for the market demand, the APA outlook includes detailed forecasts of the demand for and production of structural panels, specifically softwood plywood and OSB.[8] These forecasts, summarized in Exhibit 2-31, show the demand from each of the major markets for structural panels, in order of their share of market demand: new residential construction, remodeling, industrial uses including furniture and materials, nonresidential construction, and foreign demand. The industrial use category will have the largest domestic demand increase over the forecast period, 8 percent. Foreign demand shows significant increase of 78 percent. However, reductions in U.S. production as imports gain a large market share point to increased pressure from imports.

Exhibit 2-31: APA Forecasted Structural Panel Production and Demand (million sq. ft. 3/8" basis)

	1999	2000	2001	2002	% Change
New Residential	18,415	17,715	17,585	18,435	0.00
Remodeling	7,440	7,440	7,475	7,550	1%
Industrial/Other	6,575	6,720	6,875	7,085	8%
Nonresidential	3,800	3,800	3,735	3,670	-3%
Domestic Demand	**36,230**	**35,675**	**35,670**	**36,740**	1%
Foreign Demand	990	1,275	1,705	1,760	78%
Total Demand	**37,220.00**	**36,950.00**	**37,375.00**	**38,500.00**	3%
Imports (Canada only)	(7,345)	(7,400)	(8,300)	(9,330)	27%
Total Domestic Production	**29,875.00**	**29,550.00**	**29,075.00**	**29,170.00**	-2%
Plywood	18,135	17,450	16,575	16,295	-10%
OSB	11,740	12,100	12,500	12,875	10%

Source: APA (1999d).

[8]While the report does not specify whether the forecast is exclusively for softwood plywood or includes hardwood plywood, it is assumed to cover softwood plywood only, as hardwood plywood is typically not used for structural panels.

The APA forecasts for panel capacity and production provide additional insight into substitution between softwood plywood and OSB. Exhibit 2-32 below shows these projected trends. Softwood plywood shows significant decreases in capacity (down 24 percent) and production (down 16 percent) from 1992 to 2002. Meanwhile, OSB has shown significant increases in capacity and production and is projected to continue to capture the market for structural panels. The relatively constant capacity utilization in the plywood sector with significant decreases in production supports the forecast of expected plant closures in the future, while the opposite is true for OSB with expected increases in the number of facilities.

Exhibit 2-32: APA Actual and Forecasted Structural Panel Capacity and Production (million Sq Ft, 3/8" Basis)

	Plywood			OSB		
	Capacity	**Production**	**Utilization**	**Capacity**	**Production**	**Utilization**
1992	23,700	19,332	82%	7,040	6,653	95%
1993	23,300	19,315	83%	7,560	7,002	93%
1994	21,875	19,638	90%	7,920	7,486	95%
1995	22,070	19,367	88%	8,830	7,903	90%
1996	21,150	19,181	91%	11,285	9,314	83%
1997	19,275	17,965	93%	11,575	10,534	91%
1998	19,075	17,776	93%	12,050	11,227	93%
1999	19,275	18,135	94%	12,250	11,740	96%
2000	18,835	17,450	93%	13,120	12,100	92%
2001	18,260	16,575	91%	13,725	12,500	91%
2002	18,010	16,295	90%	14,380	12,875	90%
% Change	-0.24	-0.16		1.04	0.94	

Shaded areas represent estimated values.
Source: APA (1999d).

The spring edition of the APA's on-line Engineered Wood Journal reports that the expectation of overall production of structural panels in 1999 would be roughly the same as it was in 1998 (APA, 1999b). However, the long term prospects for the softwood plywood and veneer sector indicates that the industry is in for a difficult time. APA members are bracing for a battle to preserve market share, a particularly challenging goal in the face of expected declines in housing starts. Further, the APA's spring journal focuses on the multiple pressures on its market share. A primary source of pressure is from the expanding sentiment that wood products are not environmentally sensitive. They are concerned that environmental advocacy groups are becoming increasingly successful at convincing major corporations that the use of wood products should be curtailed in order to preserve trees and forested land (APA, 1999b).

Shipments of reconstituted wood products are expected to increase 4 percent in 1998 and 1999 according to the U.S. Industry and Trade Outlook 1999. Strong demand in the furniture market has proved beneficial to particleboard, MDF, and hardboard producers. For reconstituted wood products, the forecast predicts an increase in growth of 3.3 percent per year from 1998 to 2003 as furniture markets

and residential construction remain healthy (U.S. Department of Commerce, International Trade Administration, 1999).

In their article, "A Look at the Road Ahead for Structural Panels, " authors Spelter and McKeever compare the situation of the OSB industry in 1996 to that of the MDF industry in the 1970's. The MDF industry experienced a major upheaval in the 1970's when an economic slump hit the U.S. right when the industry had added a significant amount of capacity. In this article, Spelter looks at whether the OSB industry is in danger of experiencing the same process. While the OSB industry's capacity additions reflect those of the MDF industry, the economic conditions in the late 1990's lead the author to conclude that the OSB industry conditions probably will not lead to closures like those experienced by the MDF sector in the seventies. However, Spelter does not expect that the OSB producers will continue to enjoy the gains in market share they have experienced over the last 10 to 15 years. He cites the near 100 percent market share held by OSB in the northeast and the Midwest as the peak of growth opportunity in those markets. Further, the market share split in the south and west may have stabilized due to the entrenchment of softwood plywood in those areas (Spelter and McKeever, 1996).

At the same time, manufacturers of substitutes for wood-based construction such as steel, cement and plastic, are aggressively pushing their products hard on the construction industry using the argument that their products are environmentally friendly, and have advantages in the areas of price stability, quality, and performance. In-roads by these competing non-wood substitutes are expected to continue as overall costs for wood-based products continue to climb and the underlying price advantage that wood-products have traditionally held is undermined. Other concerns expressed the Engineered Wood Journal include having adequate supply of timber in the long run to meet producers' needs (APA, 1999b).

International Trade

The hope for the plywood and composite wood products export markets is that declining domestic prices and economic recovery, particularly of the Asian economies, will boost the demand for U.S. produced wood-based products. This is of particular importance to the softwood plywood industry, as they are currently exporting approximately 10 percent of their production. Another international driver of demand for domestically produced wood-based building products is the effect of regulatory changes in countries such as Japan and Korea to promote wood-based housing construction. WEFA attributes most of the increases in exports from North America during 1999 to the U.S. rather than Canada. Continued growth in this market is limited by expected falling housing starts in Japan (WEFA, 1999). Any future changes in the U.S.-Canadian exchange rate will likely have a positive effect on exports in the short-term (in the next 2-3 years), as will any modifications to tariff structures in place for U.S. exports.

The APA outlook includes an international forecast that projects a positive outlook for wood product exports from 2000 to 2002. This projection is based on expectation that the markets in Europe, Mexico, South America, and Japan will pick up in 2000, causing a weaker dollar and better overall climate for exports as (APA, 1999d). The strength of the dollar in 1999 placed U.S. wood products at a disadvantage in world markets, but APA projects significant increases in exports from 2000 to 2002 (see Exhibit 2-31 for structural panel export forecast). The 1999 fall edition of the APA's Engineered Wood Journal pointed to continuing pressures on U.S. exports coming from recent increases in European production capacity as posing a sizeable challenge to structural wood panel products in the U.S. (APA, 1999c).

The *U.S. Industry & Trade Outlook* notes growth in European markets and removal of tariff barriers throughout the world as contributing to modest growth in the wood products industry. At the same time, the report cautions that economic conditions in Asia, especially Japan, may be of some concern. While OSB is making significant strides in residential construction in Japan and elsewhere, an Asian recession

could threaten this progress. Softwood plywood is still considered the material of choice in many markets unfamiliar with OSB. Nontraditional markets such as South America, eastern Europe, and China could provide significant opportunity for growth in the wood products industry, especially softwood plywood (U.S. Department of Commerce, International Trade Administration, 1999).

Prices

The recently published WEFA report on softwood lumber forecasts a 5 percent increase in the price index for those products during the third quarter of 1999 from the previous quarter. Because of the expected leveling off or decline in construction, prices are expected to decline during the year's fourth quarter. Based on WEFA's forecast, overall annual prices in 1999 are expected to be about 8 percent higher than they were in 1998. Year 2000 prices are forecast to rise only marginally over 1999.

The "Review of the Wood Panel Sector in the U.S. and Canada" presents a forecast for structural wood panels (softwood plywood and OSB combined). In the 1997 report, Spelter and his co-authors assume that the long run average annual growth in demand for softwood plywood and OSB combined will continue at the historical 3 percent rate. Using that assumption, these industries will have excess capacity until 2001, when capacity utilization reaches 95 percent (Spelter et al., 1997).

This forecast concluded that current and planned production capacity will exceed demand until 2001. This excess capacity will continue to put downward pressure on prices, a trend that began in 1996. The report authors expect that this price pressure will result in a market correction, requiring both the plywood and the OSB sectors to adjust capacity through the closure of some high cost, low productivity plants.

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