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Review of Wood-Based Panel Sector in United States and Canada

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Abstract

Structural and nonstructural panels have been the fastest growing sector among wood products for the past two decades. The recent spate of plant construction and drop in product prices indicate slower growth and consolidation in the next 2 years. Growth in demand is unlikely to catch up with projected capacities until the next century, unless attrition of some existing capacity reduces industry growth. Among structural panels, costs of production are lowest for oriented strandboard, but there is a wide range among plants. Plywood costs are lowest in the U.S. South and highest in the West. Thus, the contraction of western plywood is likely to continue. Overcapacity also looms for nonstructural panels (particleboard and medium density fiberboard), but engineered structural wood products show opportunities for growth.

Keywords: Oriented strandboard, plywood, prefabricated I-joists, laminated veneer lumber, particleboard, medium-density fiberboard, capacity, costs, prices, markets

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English conversion factors

To convert	to	multiply by
centimeters (cm)	inches (in.)	0.394
cubic meters (m^3)	1,000 ft^2 (3/8 in.)	1.130
cubic meters (m^3)	cords	0.415
kilograms (kg)	pounds (lb)	2.204
meters (m)	inches (in.)	39.4
meters (m)	feet (ft)	3.281
metric tons (tonne)	pounds (lb)	2,204
$/m	$/ft	0.305
$/$m^3$	$/1,000 ft^2 (3/8-in.)	0.885
$/$m^3$	$/$ft^3$	0.028

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Review of Wood-Based Panel Sector in United States and Canada

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Introduction

In this decade, the defining issue for the forest products industry has been the curtailment of public timber supply. The greatest reductions have occurred in National Forest timber harvests, which are currently less than one-third the peak levels of the 1980s. This shortfall, combined with the economy's unabated demands for wood, has led to significant and sustained increases in the cost of timber (Fig. 1). However, a reduction in supply of a commodity is inevitably followed by a search for a replacement, and the forest products industry has been no exception. Many trends within the past decade are an outgrowth of changes in the timber supply; a unifying theme of this report is the restructuring of the wood products industry as it continues to make the transition from traditional raw materials to more abundant, lower cost alternatives. It is in that context that we review the evolution of the wood-based panels sector in the United States and Canada, focusing on capacity growth, manufacturing costs, markets, and trade for the veneered and nonveneered panel segments and their offshoots in engineered wood products.

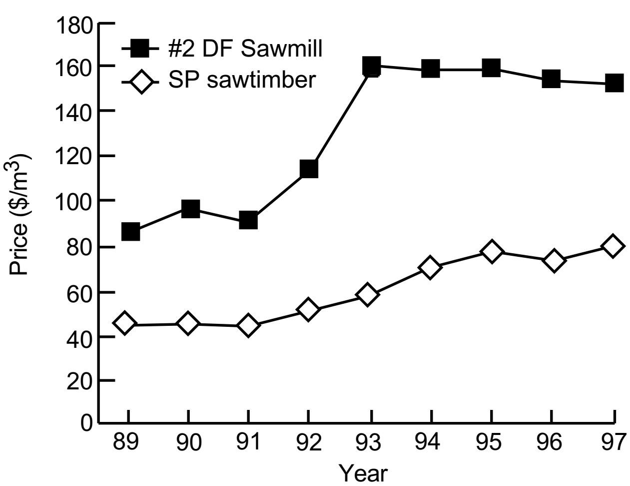

Figure 1—Douglas-fir (DF) and Southern Pine (SP) sawtimber prices. Sources: Timber Mart South (1997) and Log Lines (1997).

Oriented Strandboard

Oriented strandboard (OSB) has been one of the ways by which the forest products industry has responded to curtailed timber supplies. Because the OSB process is not dependent on large diameter, old-growth timber, the industry has been able to tap into the previously underutilized, low-cost hardwoods, which are located primarily in the eastern half of the continent. Possible future extensions of that resource include fast-growth hybrid poplars and other hardwoods grown agriculturally on short rotations.

Capacity

The primary output of OSB plants is sheathing, but there are specialty grades made for the Japanese market, for seismic or high wind areas (Structural-1), for overlaid panel siding, and for I-joist webstock. At the end of 1996, OSB capacity was more than 15 million m^3 and a total of almost 13 million m^3 of boards was being produced at 65 plants (Fig. 2). During the year, 11 new plants were opened, adding approximately 2.8 million m^3 of capacity (Adair 1997); expansion of several plants and the attainment of full operating potential by others that had opened in 1995, added a further 1.5 million m^3 of capacity. By autumn of 1996, market prices for OSB began to weaken under the weight of the increased supply. The subsequent descent of prices to levels below operating costs led to the permanent closure of three plants, with a capacity of around 0.3 million m^3. In addition, as many as 25 plants were temporarily idled for varying amounts of time between December 1996 and April 1997. The deterioration in

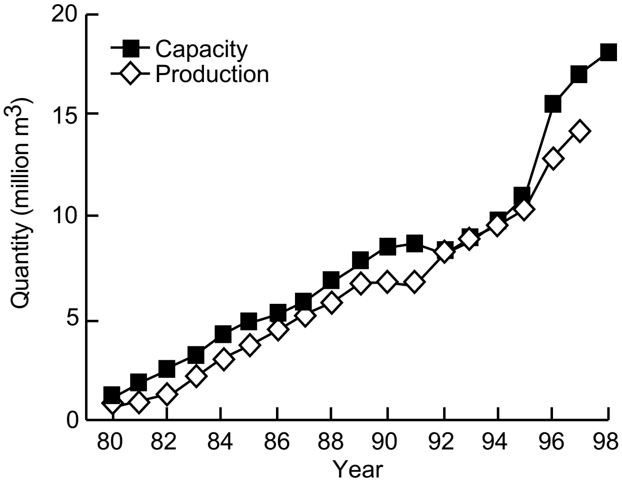

Figure 2—North American OSB capacity and production, 1980–1998.

profitability also led some to reappraise their expansion plans. The opening of two plants, originally scheduled for 1997, was postponed until 1998, and at least one retrofit of an existing mill was put off as well. Currently operating and planned sites are listed in Appendix A, Table A1.

Costs and Prices

As prices began to slide during 1996, the cost structure of the industry became a point of interest. The outlines of that structure began to come into focus with initial announcements of plant closures when prices fell below $150/m^3 (US North Central basis). Prices bottomed at approximately $115/m^3 as curtailments spread and the spring building season started.

Wood costs for OSB manufacturing vary according to plant location, wood species, and plant (wood use) efficiency. There is considerable variability in pulpwood prices across regions, with fiber in some areas costing up to 30% less than the highest price (Table 1). A common thread through all regions has been a substantial escalation in pulpwood costs over the past decade (Fig. 3). In terms of species, hardwoods have generally been less expensive than pine (Fig. 3), but many plants in the South use pine as their primary furnish nevertheless because of its greater availability. In the North, the availability of aspen has made this species the fiber of choice. Finally, wood use efficiency is influenced by such variables as wood species, log temperature, speed of cutting, board compaction, and other process variables. On average, wood use per cubic meter of board is estimated to be 1.8 m^3. Based on these prices and recoveries, average industry wood costs in 1996 were estimated at $53/m^3 of board, with a range from the mid-$40s to high $60s.

Table 1—Delivered 1996 pulpwood costs in various regions (US$/m^3)

Region	Softwoods	Hardwoods
Alabama, north	29	25
Arkansas, south	25	26
Florida, north	30	23
Georgia, north	28	23
Georgia, south	31	26
Louisiana, north	28	25
Louisiana, south	27	26
Maine	—	23
Michigan	—	27
Minnesota	—	25
Mississippi, north	26	22
North Carolina, east	22	22
Ontario	—	26
Quebec	29	—
North Carolina, east	22	22
South Carolina, east	27	26
South Carolina, west	23	22
Texas, north	25	23
Texas, south	26	23
Virginia, east	26	24
Virginia, west	24	—
Wisconsin	—	26

Sources: Timber Mart South (1997) and State (Provincial) Departments of Natural Resources.

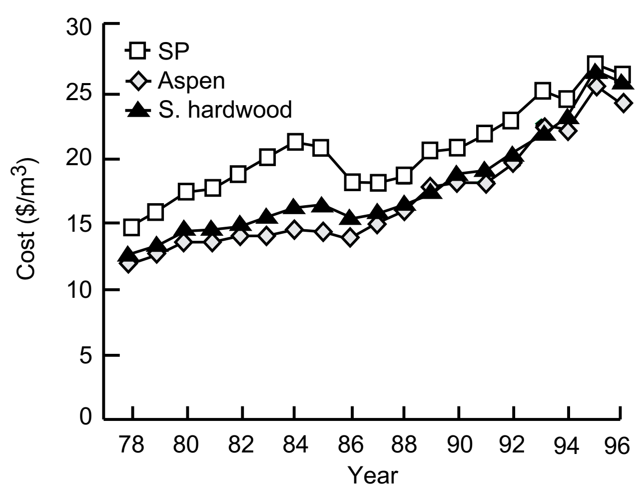

Figure 3—Delivered costs of softwood and hardwood pulpwood. SP is Southern Pine.

Table 2—Oriented strandboard (OSB) manufacturing costs and prices (US$/m^3)

Year	Power & fuel	Labor & mgmt.	Glue & wax	Other costs	Wood	Variable costs	Price
1976	5	14	23	16	24	83	122
1977	6	15	20	16	26	83	131
1978	7	17	15	16	27	81	139
1979	8	18	22	18	28	94	145
1980	9	20	27	21	30	107	123
1981	11	22	28	22	32	115	136
1982	13	26	28	23	31	121	144
1983	12	25	28	24	34	123	158
1984	12	25	28	24	35	124	140
1985	12	24	29	25	36	125	153
1986	11	24	24	23	35	117	146
1987	11	23	27	24	36	121	141
1988	11	23	28	25	37	124	123
1989	11	23	30	27	39	130	166
1990	11	23	23	26	40	123	124
1991	11	23	18	25	41	119	144
1992	11	23	18	26	43	121	208
1993	12	23	20	28	46	128	227
1994	14	23	22	28	47	130	252
1995	15	22	24	28	52	141	242
1996	15	21	25	26	53	141	184

Source: Forest Products Laboratory estimates.

Next to wood, adhesives and wax are the most expensive items in the manufacture of OSB (Table 2). For the industry as a whole, the estimated cost of glue and wax, including isocyanates used by some plants, was \$25/m^3 in 1996. Most plants use some form of phenol formaldehyde, which rose in price as a result of a rise in the cost of phenol (\$0.05/kg) resulting from limited production capacity. Since no new phenol plants are expected until 1998, the phenol market is likely to remain tight. However, this situation should change by the end of the decade. At least two large plants (Shell and Phenolchemie, 0.25 billion kg each), and possibly as many as four, may be constructed by the year 2000. (In this report, billion is used to denote 10^9.) The two plants alone would boost U.S. capacity by nearly a quarter.

Another large cost factor is labor, which is strongly influenced by plant size. Because of the efficiencies enjoyed by the bigger, newer plants, labor costs at some sites were estimated to be as low as \$13/m^3 in 1996, but averaged \$21/m^3 across the industry (Table 2).

Energy costs have been boosted in the last few years by requirements to control emissions of volatile organic compounds. Many older plants and all new ones in the United States have installed such equipment, which have high energy requirements. As a result, energy costs for 1996 were estimated at \$15/m^3, a significant rise compared to energy costs in the early 1990s (Table 2). Other manufacturing costs consist of operating materials and supplies, which were estimated at \$26/m^3. Costs for the industry show about a 30% increase since 1980, chiefly as a result of rising wood costs. Product prices increased sharply in the early 1990s, reversed course in 1995, dropped significantly in 1996, and, based on prices already seen, are going to fall again in 1997.

Softwood Plywood

Capacity

The softwood plywood sector in the U.S. South weathered the 1996 market downturn relatively well and all pine plants operated through the year's end. However, a number of plants have been idled or curtailed in 1997, ostensibly the result of log procurement difficulties; one plant was permanently closed in May. Pine capacity nevertheless remains at around 12.5 million m^3 (Fig. 4). In the West, however, the attrition of mills continued during 1996 with the closure or conversion of four plants; total capacity currently stands at approximately 6 million m^3. Data on past and projected capacity of softwood plywood manufacturing industries are listed in Appendix A, Tables A2 to A6.

Costs and Prices

As for OSB, wood has constituted the largest share of the cost of manufacturing plywood. In 1996, the delivered cost

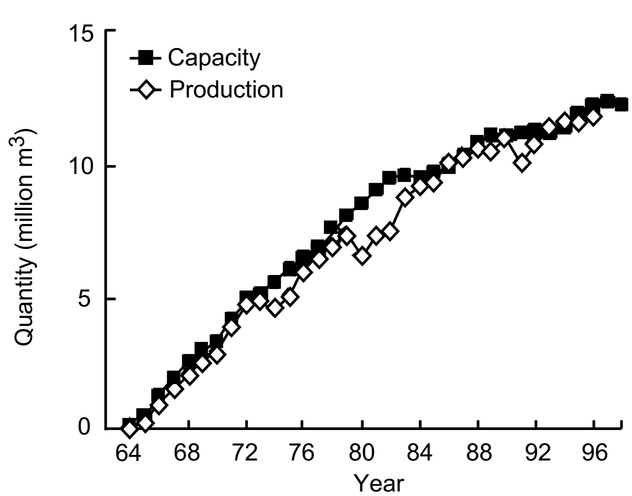

Figure 4—Southern plywood capacity and production.

Table 3—Plywood manufacturing costs by region, 1996 (US$/m³)

Region	Power & fuel	Labor & mgmt.	Glue[a]	Sup-plies	Net wood	Tariff	Vari-able costs
South	11	44	14	20	117	0	206
Inland West	8	51	16	19	119	0	214
Canada	10	64	16	21	113	4	228
West Coast	8	53	16	21	165	0	265

[a]Glue costs are based on three-ply construction for the South, four-ply for other areas.

for sawtimber-grade logs in the U.S. South was approximately $73/m³; the cost rose to about $80/m³ in the first quarter of 1997. By contrast, in coastal Oregon and Washington, the equivalent value for one grade of logs (Douglas-fir No. 2 sawlogs) was reported to be about $150/m³. After accounting for process losses (estimated average wood recovery factor >50%) and gains from residue sales, net wood costs in the South were estimated to be $117/m³ of product in 1996. Costs were similar for the inland West and Canada, but about 40% higher for the coastal West (Table 3).

Like wood, adhesives were a source of cost inflation in 1996, for the reasons cited for OSB. Costs of adhesives were based on three-ply construction for the South and four-ply for other regions. Manufacturing costs are summarized in Table 3 for all regions and in Table 4 for the U.S. South alone. In 1996, the total manufacturing cost for plywood in the South was estimated to be $206/m³ compared with a selling price of $231/m³. Profitability during 1996 fell from previous levels in the early part of the decade.

Structural Panels

Demand in New Residential Construction

In 1995, an estimated 11.0 million m³ of structural panels were used to build new single-family and multifamily houses in the United States (Adair 1996). Given the total U.S. structural panel production of 24.2 million m³ (Adair 1997), consumption for new residential construction was equivalent to more than 45% of total domestic production. Planned increases in structural panel capacity, specifically OSB, have caused concern regarding possible markets. New residential construction, although already a large market for structural panels, could potentially absorb large additional volumes. To estimate the possible volume, we examined published trends in market shares since 1968 for major applications

Table 4—U.S. South plywood manufacturing costs and prices (US$/m³)

Year	Power & fuel	Labor & mgmt.	Glue	Sup-plies	Net wood	Vari-able costs	Price
1964	4	16	3	4	18	46	61
1965	4	17	3	4	18	47	59
1966	4	17	3	5	20	49	62
1967	4	18	3	5	21	51	55
1968	4	19	3	5	23	54	74
1969	4	20	3	5	27	60	76
1970	4	21	3	6	26	60	62
1971	4	22	3	6	31	67	74
1972	4	23	4	6	36	73	103
1973	4	25	4	7	45	85	106
1974	5	27	7	7	48	95	95
1975	6	27	9	8	42	92	98
1976	7	29	8	8	52	104	131
1977	8	29	8	9	61	114	168
1978	8	30	6	9	76	130	184
1979	9	33	8	10	96	157	174
1980	11	35	10	11	85	152	179
1981	13	37	10	12	79	151	161
1982	15	40	10	13	63	140	160
1983	16	40	10	13	69	148	180
1984	15	41	10	14	66	146	169
1985	15	43	10	15	51	134	164
1986	14	45	9	16	49	132	168
1987	13	46	10	16	62	147	168
1988	13	46	11	17	63	150	159
1989	13	47	12	17	65	154	184
1990	13	47	10	18	69	157	168
1991	13	47	8	18	73	159	175
1992	13	48	8	18	85	172	226
1993	13	49	9	19	97	187	257
1994	13	49	10	20	116	207	274
1995	12	49	11	20	123	216	267
1996	11	44	14	20	117	206	231

Source: Forest Products Laboratory estimates based on industry contacts and price reports.

(Adair 1996, Anderson and McKeever 1991, APA 1996, Carney 1973, 1977, Felch 1970) (Tables 5 and 6).

Floor Systems

In 1995, structural panels captured 55% of the single-family and 54% of the multifamily floor sheathing market (Tables 5 and 6). Shares in both markets have been fairly constant since the late 1960s. The largest competitor to structural panel floor sheathing is the concrete slab, which is both a foundation and first-story floor system. Typically little, if any, wood is used in conjunction with a concrete slab. The annual percentage of concrete slab floor area varies, but it is generally around one-third of total floor area for both single-family and multifamily construction.

Oriented strandboard has steadily eroded softwood plywood's share in floor sheathing. The OSB market share rose from zero in 1976 to 24% in single-family houses and 30% in multifamily houses in 1995. However, these increases represented the lowest inroads among the main categories of sheathing. The accumulation of water from rain and melting snow on flooring during construction can cause edge swelling in all wood-based panels in general, but OSB in particular. Rather than risk later problems, many builders continue to use plywood even though its initial cost is greater. Nevertheless, OSB is likely to make additional inroads as a result of the widening cost differential.

Market potential for structural panels in floor systems in new single-family and multifamily dwellings was estimated to be nearly 2.1 million m^3 in 1995, with the most potential (79%) for new single-family construction (Tables 5 and 6). Market potential is defined here to be the sum of lumber and nonstructural panels being used, converted to the equivalent amount of structural panels, plus the amount that would be required to displace all nonwood building products. Displacement of the concrete slab by a traditionally framed and sheathed wood floor system, or a "hybrid" wood-sheathed or wood-slab floor system, would constitute the largest share (1.9 million m^3).

Exterior Wall Systems

In 1995, structural panels captured 52% of the single-family and 43% of the multifamily exterior wall sheathing markets (Tables 5 and 6). These percentages are substantially higher than those of previous years. During the 1970s, structural panels averaged about 16% of each market. Since 1976, markets have grown rapidly for OSB but also for foamed plastic sheathing, the single largest wall sheathing competitor for structural panels. The market share for softwood plywood increased during the 1980s but fell by 1995. Foamed plastic had captured about 30% of the market in 1995.

Trends in using OSB compared to softwood plywood for exterior wall sheathing closely parallel those for floor sheathing, with the exception of the rapid increase in the use of OSB and softwood plywood in 1988. We expect that OSB will continue to erode the market for softwood plywood wall sheathing, but foamed plastic sheathing will maintain its hefty share as a result of code-mandated levels of wall insulation.

Overall market potential for structural panels in wall sheathing was estimated to be nearly 2.2 million m^3 in 1995, with single-family wall sheathing accounting for 79% (Tables 5 and 6).

Roof Systems

Structural panels are the roof sheathing product of choice in the United States. Small amounts of lumber sheathing are used, primarily under tile or metal roofs, as are small amounts of other sheathing products. In 1995, structural panels accounted for 98% of single-family and 94% of multifamily roof sheathing (Tables 5 and 6).

The use of OSB roof sheathing has grown rapidly in recent years, primarily at the expense of softwood plywood. In 1976, softwood plywood accounted for about 84% and OSB only 1% of the single-family roof sheathing market and 87% and 1%, respectively, of the multifamily market. By 1995, softwood plywood's share fell to 37% for single-family and 19% for multifamily dwellings. Meanwhile, OSB rose to 61% and 75% of these markets, respectively. As the OSB market share approaches saturation, additional increases are likely to be smaller in comparison with past figures.

Structural panels have little more to gain in roof sheathing. Displacing lumber and other sheathing materials would result in a net gain of slightly less than 0.1 million m^3.

Exterior Siding

Structural panels play a small role in the residential exterior siding market. In 1995, structural panels were used for siding for just 9% of single-family and 4% of multifamily dwellings (Tables 5 and 6). During the 1970s and 1980s, structural panels maintained about one-fifth of the siding market for single-family construction. During this same period, the market share for multifamily construction declined steadily, from 38% to 15%. In general, the demand for all wood siding products has declined since the 1980s, in favor of metal, vinyl, and masonry siding. In 1995, nonwood siding materials accounted for more than 75% of all siding used for single-family construction and nearly 90% of that used for multifamily construction.

Table 5—Use of wood products and market potential of structural panels in new single-family residential construction in the United States

Application and wood product	Incidence of use (%) 1968	1972	1976	1988	1995	1995 Volume (1,000 m^3)	1995 Struct. panel potential (1,000 m^3)
Floor sheathing[a]							
Lumber	9	2	1	5	(b)	30.2	14.7
Structural panels	56	51	51	56	55	2,414.3	—
Softwood plywood	56	51	51	48	31	1,380.8	—
OSB	0	0	0	9	24	1,033.5	—
Nonstructural panels	14	11	12	9	9	95.5	95.5
Lightweight concrete	0	0	0	0	0	—	—
Concrete slab	21	36	36	30	35	—	1,540.3
Total	100	100	100	100	100	—	1,650.5
Exterior wall sheathing							
Lumber	(b)	(b)	(b)	2	(b)	2.2	1.4
Structural panels	15	16	16	33	52	1,914.3	—
Softwood plywood	15	16	16	26	19	810.1	—
OSB	0	0	0	7	33	1,104.1	—
Fiberboard	58	42	34	13	6	180.6	180.6
Foamed plastic	0	(b)	7	22	29	—	1,067.6
Foil-faced kraft	0	0	(b)	17	3	—	110.4
Gypsum, other	12	7	18	8	2	—	73.6
None	15	35	25	5	8	—	294.5
Total	100	100	100	100	100	—	1,728.1
Roof sheathing							
Lumber	24	9	14	6	1	69.4	57.6
Structural panels	76	91	85	91	98	4,329.2	—
Softwood plywood	76	91	84	70	37	1,751.8	—
OSB	0	0	1	21	61	2,577.5	—
Other	0	0	1	3	0	—	2.1
Total	100	100	100	100	100	—	59.7
Exterior siding							
Lumber	15	11	10	12	7	433.7	206.3
Structural panels	13	21	22	23	9	362.5	—
Softwood plywood	13	21	22	23	4	189.7	—
OSB	0	0	0	(b)	5	172.8	—
Hardboard	12	17	16	16	6	223.5	223.5
Nonwood	60	51	52	49	77	—	3,069.4
Vinyl, metal	9	13	14	15	29	—	1,157.2
Masonry, stucco	51	38	38	34	48	—	1,912.2
Other	0	0	0	0	1	—	28.3
Total	100	100	100	100	100	—	3,527.5
Total	—	—	—	—	—	—	6,966.0

[a]Includes subfloor and underlayment.

[b]Trace amount (<0.5%).

Table 6—Use of wood products and market potential for structural panels in new multi-family residential construction in the United States

Application and wood product	Incidence of use (%) 1968	1972	1976	1988	1995	1995 Volume (1,000 m^3)	1995 Struct. panel potential (1,000 m^3)
Floor sheathing[a]							
Lumber	2	1	2	6	(b)	6.4	3.3
Structural panels	49	47	51	52	54	602.2	—
Softwood plywood	49	47	51	46	24	274.9	—
OSB	0	0	0	7	30	327.4	—
Nonstructural panels	4	7	10	9	7	23.2	23.2
Lightweight concrete	(c)	11	5	7	3	—	8.6
Concrete slab	45	34	32	26	36	—	403.5
Total	100	100	100	100	100	—	438.6
Exterior wall sheathing							
Lumber	(b)	(b)	(b)	(b)	(b)	1.1	0.7
Structural panels	4	15	17	40	43	346.2	—
Softwood plywood	4	15	17	28	10	101.2	—
OSB	0	0	0	12	33	245.1	—
Fiberboard	33	42	32	11	5	39.1	39.1
Foamed plastic	0	(b)	2	18	34	—	273.1
Foil-faced kraft	0	0	0	13	1	—	8.1
Gypsum, other	35	8	18	13	8	—	64.4
None	28	35	31	5	9	—	72.5
Total	100	100	100	100	100	—	458.4
Roof sheathing							
Lumber	15	3	11	2	1	10.3	5.3
Structural panels	85	95	87	94	94	626.2	—
Softwood plywood	85	95	87	78	19	137.0	—
OSB	0	0	1	16	75	489.2	—
Other	0	2	2	4	5	—	26.6
Total	100	100	100	100	100	—	31.9
Exterior siding							
Lumber	31	4	9	16	2	27.1	14.4
Structural panels	5	38	32	15	4	32.6	—
Softwood plywood	5	38	32	15	2	22.5	—
OSB	0	0	0	(b)	2	10.1	—
Hardboard	0	9	7	11	5	38.0	38.0
Nonwood	59	43	49	58	89	—	724.6
Vinyl, metal	4	2	12	14	41	—	333.8
Masonry, stucco	55	41	37	44	48	—	390.8
Other	5	6	3	(b)	(b)	—	0
Total	100	100	100	100	100	—	777.0
Total	—	—	—	—	—	—	1,706.0

[a]Includes subfloor and underlayment.
[b]Trace amount (<0.5%).
[c]Included with concrete slab.

Nearly the same amount of softwood plywood and OSB was used for siding for single-family (4% and 5%, respectively) and multifamily (2% each) construction in 1995. Little change is expected in the mix and amount of structural panels used for exterior siding.

Since structural panels had such a small market share in 1995, the potential market is large. Capturing the lumber and hardboard markets would result in a gain of 0.5 million m^3, while capturing the nonwood siding market would result in a gain of 3.8 million m^3 (Tables 5 and 6).

Overall Market Potential

The estimated maximum theoretical market potential for structural panel sheathing and siding in new residential construction was estimated to be 8.7 million m^3 in 1995. Overall, exterior siding accounted for nearly half of this potential; floors and exterior walls each accounted for about a quarter of the market potential. Additionally, the potential for roofs was negligible (Fig. 5). The potential for wood fascia, soffits, and I-joist markets is growing. In terms of construction type, new single-family construction accounts for 80% of the total market potential. Of course, it is unlikely that all the potential will be realized, and achieving even a part will not happen spontaneously. Concerted promotional efforts, research into improved products and performance, and competitive pricing are necessary to capture additional market share.

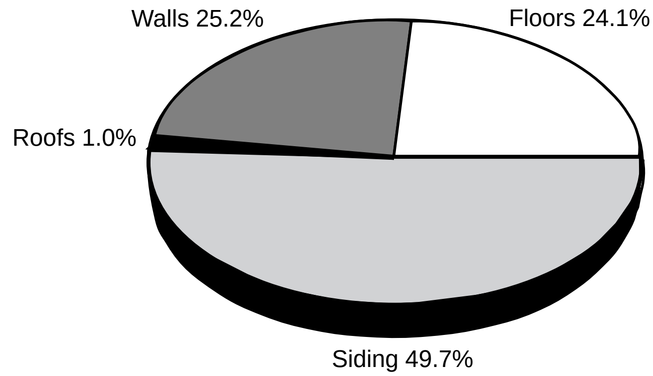

Figure 5—Breakdown of structural panel market potential in new U.S. residential construction in 1995.

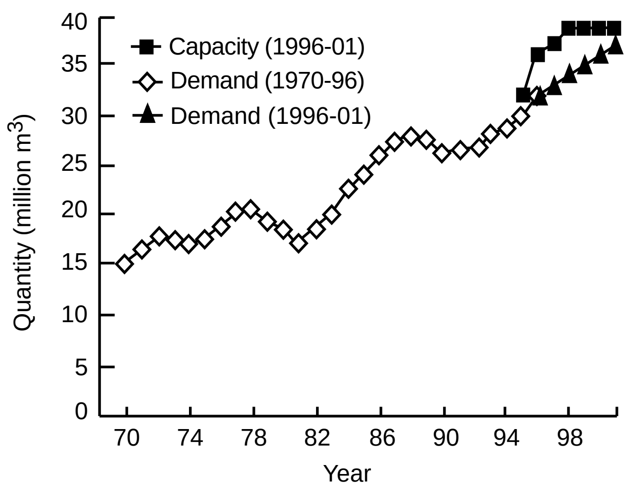

Figure 6—Past structural panel capacity compared to projected market growth.

Demand and Supply

To place the demand and supply for structural panels in perspective, we charted the combined evolution of plywood and OSB (including waferboard) consumption from 1970 to 1996 (Fig. 6). Over this period, the annual rate of growth averaged 3%. We projected future demand by extending the 1996 base by this growth factor through 2001. We then superimposed the capacity of currently operating and announced plants, assuming no attrition of existing mills or cancellation of planned projects. The results showed that, at the historical growth rate of demand, the 1995 capacity utilization rate of 95% would not be reached again until the year 2001. This implies that the structural panel markets would be oversupplied for about 4 years. Such an extended period of weakness would test the endurance of many firms, and it is likely that the demand/supply imbalance will be corrected by some attrition in both the plywood and OSB sectors.

Prefabricated I-Joists

Although wood I-joists have been manufactured for the better part of 30 years, until recently the I-joist market was largely the domain of one company (Leichti and others 1990). Within the past 5 years, several other firms have entered the market on a large scale, buying out independent operations or setting up their own plants. I-joists have become very visible in the field of light-frame construction and are being sold in building material centers alongside conventional wood joists. The emergence of reconstituted joists raises the possibility that wide dimension lumber will be the next established wood product to be displaced by an engineered wood substitute made in part from small-diameter trees.

I-joists consist of two wide flanges connected by a thinner wood web. Depth ranges from 15 to 72 cm, but most commonly falls between 23 and 46 cm. Length reaches 24 m. I-joists can be placed into two principal groups based on the type of flange: lumber or laminated veneer lumber (LVL). Most lumber-flange I-joists are made from machine stress rated (MSR) grades, but visually graded No. 2 and Better lumber is also employed, depending on the market being targeted. For the web, a specialty grade of OSB is the predominant material. Initially, plywood was the main web material, but plywood is now relegated to a small share, principally in those markets where regulations mandate its use.

Markets

I-joists are used predominantly for floor framing and secondarily for roofs. The markets for I-joists can be roughly divided into two categories according to complexity of use: (1) industrial, commercial, and large residential construction and (2) low-rise residential construction.

Industrial, commercial, and large residential projects constitute the smaller but more challenging end-use segment for I-joists—spans are longer, loads are heavier, and overall framing complexity is greater. Engineering analysis and support is often needed to ensure safe and successful product application.

Low-rise residential construction generally involves simpler designs and offers a greater potential for large volume sales of a standardized commodity. With this in mind, some fabricators are producing lumber flange I-joists for the residential market, often using lower cost visual grades and shorter lengths (≤7.3 m) than those generally used for I-joists. These special I-joists are intended as one-for-one replacements for lumber. Their engineering design properties are lower than those of I-joists made with LVL or MSR flanges, but they maintain the general attributes of dimensional stability, straightness, light weight, and uniformity. Moreover, lumber-flange I-joists are less expensive. At the opposite end of the spectrum, LVL flange I-joists have the highest design properties, but they are costly. LVL flange I-joists are most economical when their design attributes are taken advantage of to widen spacing or extend spans. Presently, most I-joists are produced with LVL or MSR lumber.

Savings in Wood

From the resource perspective, one desirable feature of engineered wood I-joists is that they economize on the use of fiber. Even when I-joists are used as a one-for-one substitute for lumber, the fiber savings can be significant because thin material is used for the web, there is less scrappage, and joist ends do not need to overlap. Wood contents for various configurations of I-joists are listed in Table 7. Some key assumptions in the calculations were as follows. For 49-cm on-center (o.c.) spacing, wood volume in I-joists was reduced by 17% to reflect lower material use per unit area of floor, and the same subfloor thickness as that for 41-cm spacing was assumed. Solid lumber volume was increased by 17% to reflect joist lapping. Fiber volume in the OSB webs was increased by 80% to reflect fiber losses and panel densification.

The amount of fiber savings depends on joist type and spacing. In about two-thirds of U.S. residential construction, framing members are spaced 41 cm apart. At that spacing, fiber savings are greatest when LVL or nominal 2 by 2 lumber flanges are employed.[1] Although members can be spaced 61 cm apart (as they are in about 12% of floors), this spacing is not used extensively because of the perception that such floors are too bouncy. Thicker subfloor requirements also limit overall fiber savings. As a compromise, 49-cm spacing is often employed (in about 14% of floors). (As with other spacings, the 49-cm spacing divides into even 244-cm modules.) If the same sheathing thickness is used, I-joists can result in fiber savings of almost 50%.

Table 7—Equivalent wood volumes of various joist types (m^3/m)

Joist spacing (cm o.c.)	Solid lumber[a,b] (2 by 10)	Lumber-flange I-joist[b] 2 by 2 flanges	Lumber-flange I-joist[b] 2 by 3 flanges	LVL-flange I-joist[b] 1.75 by 1.5 flanges
41	0.0104	0.0067	0.0086	0.0067
49	—	—	—	0.0056

[a]Nominal 2 by 10 in. = standard 38 by 235 mm.
[b]Volumes based on actual (not nominal) measurements.

Monetary Savings

I-joists are sold on the basis of greater utility to builders because of labor savings, reduced waste, and fewer callbacks. However, differences in performance confound comparisons between solid wood and I-joist systems. Floor joists are designed as simply supported, single-span beams. Of the two main design criteria of strength and stiffness, stiffness is often the limiting factor and the full strength of the joist is not utilized. However, one way in which stiffness can be increased is by making members over adjacent spans continuous (Soltis 1985). This accounts in part for the higher stiffness of floors made with I-joists, which, because they are available in longer lengths, are able to continuously span the entire distance between foundation walls. To give comparable lumber performance, either larger (deeper) joists have to be employed, spacing has to be reduced, or continuity of I-joists must be imitated by lapping and nailing adjacent pieces over the center girder. Current framing practices call for a minimal 0.1-m overlap. This overlap has a negligible effect on stiffness because the potential benefit (the moment connection) is a function of the length of the overlap at the bearing point. In this comparison, we based our calculations on lumber and I-joists with equal depths but assumed a lumber overlap of 1.2 m instead of the nominal 0.1 m, obtained by using the next length increment.

[1] Nominal 2 by 2 lumber = standard 38 by 38 mm. Hereafter referred to as 2 by 2.

Table 8—Equivalent in-place cost estimates for various joist layouts

Joist type and spacing	Total volume (lineal meters)	Cost ($/m) Material	Labor	Equipment	Total
2 by 10 lumber, 41 cm	265	3.41	1.51	0.07	1,320
I-joist					
Lumber flange, 41 cm	227	3.94	1.85	0.22	1,365
LVL flange, 49 cm	190	4.92	1.85	0.22	1,330

Source: R.S. Means (1997). I-joist labor and equipment costs include cost of two joist hangers per beam. Calculations were based on 12 by 7 m platform.

In terms of labor, the Means construction estimating manual assigns equal requirements per unit of length for both solid wood and I-joist systems (R.S. Means 1997). This method may understate I-joist costs because their cross-sectional shape mandates the use of specialized hardware. Blocking and web stiffeners under bearing points and concentrated loads may also be necessary. However, the I-joist system has the advantages of lighter weight and easy access for wiring through the webs.

In terms of waste, a common concern for builders is losses resulting from the inconsistent quality of lumber, but these concerns have not been determined systematically. As noted previously, solid wood joists are overlapped with adjacent in-line joists by at least 10 cm. Since lumber is sold in 0.6-m increments, this can lead to more overlap than required, although this is often unnecessary because the sheathing and header joists push the joists far enough from the wall edge to achieve the 10-cm overlap at the center. I-joists can be used more efficiently than solid lumber because they are sold in longer lengths and can be used to span greater distances continuously. The material savings potential of this feature is compounded by the possibility of wider spacing.

In terms of callbacks, the advantage of I-joists is based on the perceived decline in sawn lumber quality as expressed in greater incidence of wane, cupping, twisting, bowing, knots, splits, and warp, and the dimensional changes that solid-sawn joists undergo in service as they dry (which lead to shrinkage gaps, loosening of nails, and squeaky floors).

Taken together, the estimated in-place costs for various floor framing alternatives are shown in Table 8. At recent prices for 2 by 10 lumber,[2] these data show that costs for floor I-joists are roughly on par with costs for 2 by 10 construction, even when I-joists are substituted one-for-one for solid-sawn joists. However, when more expensive I-joists with LVL flanges are used, wider spacing becomes necessary to stay competitive with lumber. The savings from potentially fewer callbacks are unknown, but this could add to cost advantages for I-joists. Figure 7 illustrates the cost sensitivity of I-joist systems to variations in lumber prices. The chart is predicated on the simplifying assumptions that prices of various lumber sizes move in tandem and that LVL prices are independent of changes in lumber markets. At a delivered price below $3.45/m, the lumber system is the least costly; above $3.65/m, lumber is the most costly.

Profitability

Wood I-joists have been traditionally marketed at substantial premiums over sawn joists. Those premiums began to shrink as dimension lumber prices escalated in the 1990s and I-joist markets became more competitive (Fig. 8). In the spring of 1997, a spot check of dealers revealed that 24-cm-deep I-joists ranged in price from $5.90/m for brand-name products to $4.55/m for similar joists on special sale. A moderate quote was $5.25/m, with unspecified discounts for volume orders. At the lower end of the range, I-joists with narrow lumber flanges could be bought for $3.95/m.

Manufacturing costs of 24-cm-deep I-joists vary according to type and grade of flange material. The main cost components, based on lumber and OSB prices as of March 1997, are listed in Table 9. It is noteworthy that flange and web costs constitute from two-thirds to four-fifths of direct manufacturing costs, while labor costs account for only a small fraction. Overall, at current selling prices, all manufacturing options meet a target profit margin of 25% and leave a cushion to buffer cost fluctuations.

[2]Nominal 2 by 10 lumber = standard 38 by 235 mm. Hereafter referred to as 2 by 10.

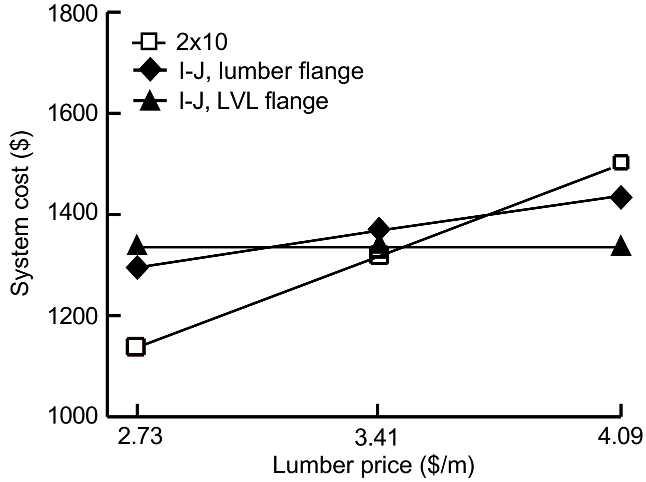

Figure 7—Sensitivity of I-joist system costs to lumber price change.

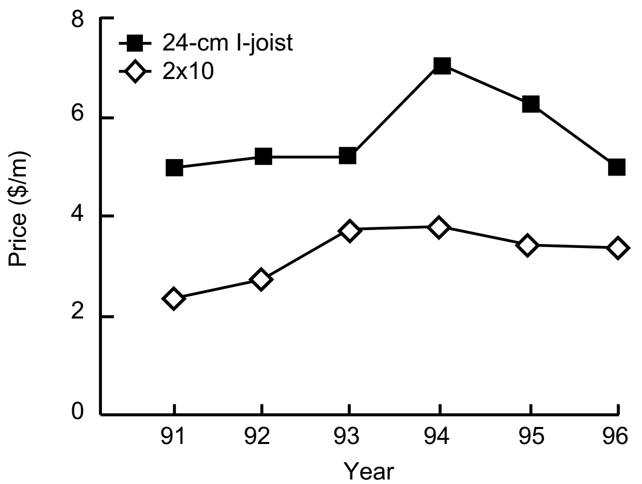

Figure 8—Builder purchase prices for I-joists and 2 by 10 Spruce–Pine–Fir joists (R.S. Means 1997).

Capacity

Capacity estimates for many I-joist sites are tentative because not all producers reveal their plant capacities. Also, there is no prevailing standard operating rate for the industry, such as in OSB manufacturing, where plants are run virtually around the clock. In many cases, the capacities cited here are based on one shift/day and could be doubled by the simple expedient of adding an extra shift. Large plants have line speeds in excess of 90 m/min, which translates to an effective annual capacity of 10.7 million m per shift (Walters 1996). Some smaller plants operate at ≤15 m/min, in which case the capacity on a one-shift/day basis is only 1.8 million m.

Many entrepreneurs have entered the industry over the years, but many have also left, through closure or merger.

Table 9—Estimated costs for various types of wood I-joists

	Costs for 24-cm wood I-joists ($/m)[a]		
Item	2 by 2 Std & Btr flanges	2 by 3 MSR flanges	1.75 by 1.5 LVL flanges
Flange, fob price	0.82 (0.25)	1.61 (.49)	2.00 (0.60)
Flange, shipping	0.16 (0.05)	0.23 (.07)	— —
Fingerjointing	— —	0.06 (.02)	— —
Adhesive, flange & web	0.13 (0.04)	0.13 (.04)	0.13 (0.04)
OSB, fob price	0.26 (0.08)	0.26 (.08)	0.26 (0.08)
OSB, shipping	0.06 (0.02)	0.06 (.02)	0.06 (0.02)
Labor	0.20 (0.06)	0.06 (.02)	0.06 (0.02)
Engineering staff	0.10 (0.03)	0.06 (0.02)	0.06 (0.02)
Supplies	0.13 (0.04)	0.13 (0.04)	0.13 (0.04)
Overhead	0.16 (0.05)	0.13 (0.04)	0.13 (0.04)
Subtotal	2.02 (0.62)	2.73 (0.84)	2.83 (0.86)
Profit margin (25%)	0.51 (0.16)	0.68 (0.21)	0.71 (0.22)
Shipping to dealer	0.26 (0.08)	0.29 (0.09)	0.26 (0.08)
Dealer markup	0.69 (0.21)	0.80 (0.24)	0.85 (0.26)
Total	3.48 (1.06)	4.50 (1.37)	4.65 (1.42)
Selling price	3.94 (1.20)	4.92 (1.50)	4.92–5.90 (1.50–1.80)
Cost cushion	0.46 (0.14)	0.43 (0.13)	0.27–0.85 (0.08–0.38)

[a]Values in parentheses are cost per lineal foot. Data in first column are based on six manufacturing employees, three engineering support staff, and annual output of 1.2 million m. Other data are based on 14 manufacturing employees, 16 engineering support staff, and annual output of 9.8 million m.

Both large and small lines currently coexist because the economies achievable by large-scale production are relatively small compared to the costs of the underlying material. Small lines have lower staffing requirements and carry a lighter capital burden, thus providing a low-cost means of entry into the industry, but on a per unit basis both of these costs are higher than those for big plants. A number of small lines that had been taken over by competitors were eventually closed, which suggests that as the sector matures, throughput and unit cost considerations will become more important in determining the size and scope of the industry.

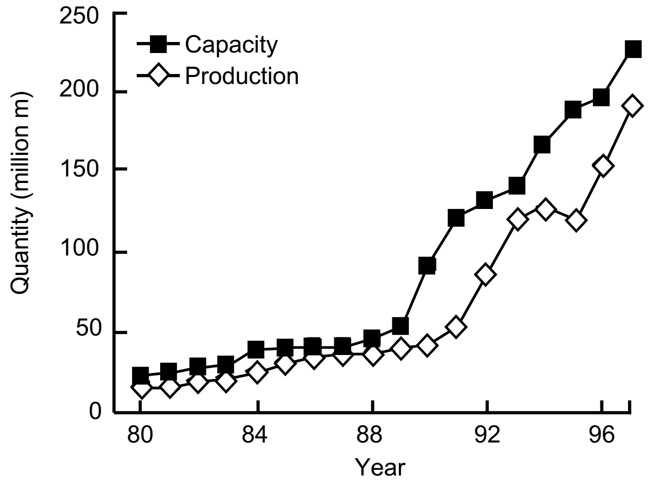

Figure 9—I-joist capacity and production in North America.

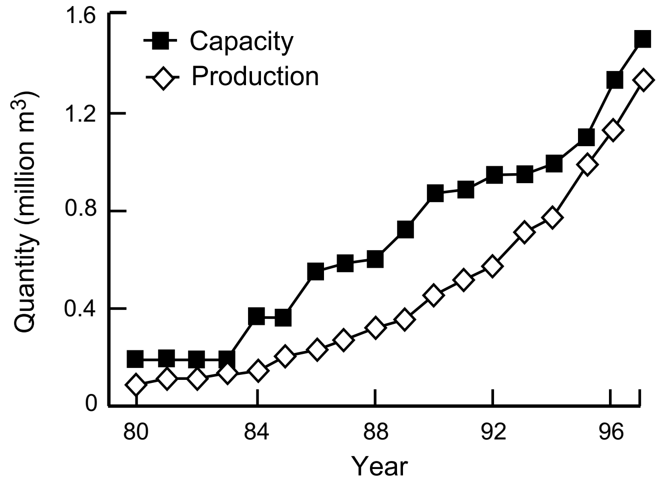

Figure 10—LVL capacity and production in North America.

For the time being, however, customer service and engineering support appear to be as important as low costs in the success of an I-joist enterprise. Estimated capacity and production for various I-joist plants are listed in Appendix A, Table A7.

The I-joist industry is rapidly expanding (Fig. 9), much as OSB expanded a decade ago or particleboard and plywood in the 1960s and 1970s. I-joists are estimated to have captured only one-seventh of the floor framing market (Wood Truss Council 1997), suggesting considerable room for growth. Currently, the industry leader is engaged in a $45 million expansion program that will add capacity in the future. Another source of activity stems from franchised miniplants geared to serve regional markets.

Laminated Veneer Lumber

The growth of the laminated veneer lumber (LVL) industry has paralleled the growth of I-joists since about half of LVL production is used to fabricate I-joists. LVL beams are also used independently as girders, for long spans, and for heavy loads. LVL is an all-veneer structural wood product composed of thin veneers oriented in the same direction. The veneers are C or D visual grades that are acoustically regraded to segregate the strongest sheets for the outer plies where they maximize overall beam strength and stiffness (Vlosky and others 1994).

The current LVL industry consists of nine firms that operate 17 plants (Appendix A, Table A8). Estimated industry capacity in 1997 was 1.5 million m^3, of which TrusJoist–McMillan accounted for almost half. Boise Cascade, Sunpine (slated to start in September 1997), Louisiana–Pacific, Tecton (now an L–P subsidiary), Georgia–Pacific, and Willamette make up the bulk of the remainder. Union Camp is slated to enter the field in 1998 with a large plant in Alabama. Estimated capacity and production are shown in Figure 10. Manufacturing costs of a 160,000-m^3 plant using West Coast log prices are listed in Table 10. The table shows total operating costs of $465/$m^3$. This figure contrasts with the current listed dealer-selling price (fob mill price plus shipping plus dealer markup) of around $900/$m^3$ and recent fob mill price of $550/$m^3$. On a lineal basis, LVL costs to builders have been recently quoted at $10/m for 2 by 10 beams. At such prices, LVL beams are considerably more expensive than solid-sawn beams of similar dimensions, although builder discounts probably reduce that cost somewhat.

Table 10—Operating inputs and costs for 160,000-m^3 LVL plant[a]

Item	Amount	Cost ($/unit)	Total cost (million $)
Logs (1,000 m^3)	328	150	49.2
Resin solids (million kg)	3.68	0.88	3.25
Fillers (million kg)	1.42	0.33	0.47
Soda ash (million kg)	0.23	0.29	0.07
Staffing	147		6.0
Energy & fuel	—	—	2.0
Materials & supplies	—	—	3.5
Overhead	—	—	1.0
Depreciation	—	—	8.0
Total output (m^3)	158,000	465	73.5

[a]Source: Forest Products Laboratory estimates based on Durand Raute (1995).

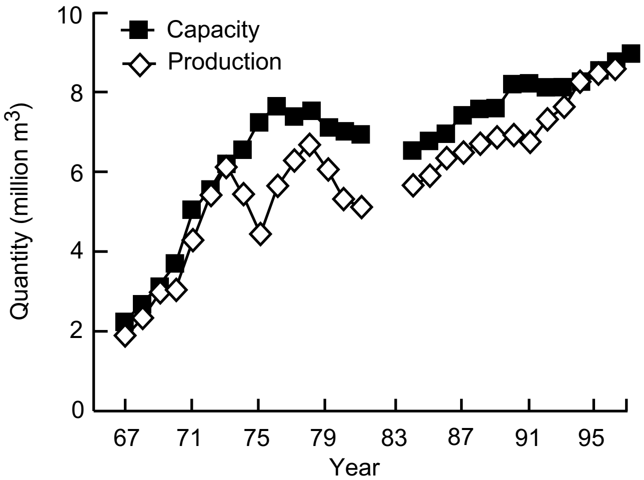

Figure 11—U.S. particleboard capacity and production.

Particleboard

Capacity

The manufacturing of particleboard in the United States began on a large scale after World War II as a low-cost replacement for lumber and plywood. In industrial markets, the primary use of particleboard is core material for doors, furniture, and cabinets. In housing construction, particleboard is used for floor underlayment, floor decking in mobile homes, and stair treads. After initial rapid growth in the 1960s, the particleboard industry settled down to slower but steadier expansion in the 1970s and 1980s (Fig. 11). The industry has continued to grow moderately. In 1996, one new plant was constructed, but another facility closed in Virginia at the end of the year. One new plant is due to start in 1997. Total U.S. capacity will then consist of 46 plants with the ability to produce almost 9 million m^3.

The Canadian particleboard industry has shared in this growth even in the midst of some plant attrition. There are currently eight plants with approximately 2.5 million m^3 of capacity. Past and projected capacities of Canadian and U.S. plants are listed in Appendix A, Table A9. This listing does not include several small plants that utilize agricultural residues as the fiber furnish. At least two such facilities are operational, in North Dakota and Texas. Two additional plants have been announced, one a large 250-thousand-m^3 plant in Manitoba and another of unspecified capacity in Minnesota.

Costs and Prices

Costs of particleboard manufacturing are listed in Table 11. Unlike plywood and OSB, particleboard is made primarily from lumber and plywood residues. Approximately 0.8 tonnes of fiber are required to make an average cubic meter of product, or 1.2 tonne of fiber per tonne of board. The cost of that fiber has increased to approximately $36/tonne ($31/m^3 of product) from less than $11/tonne ($9/m^3 of product) in the 1960s (Fig. 12). In 1996, total manufacturing costs, excluding depreciation and overhead, were estimated at $128/$m^3$ as compared to an average selling price of $165.

Table 11—U.S. particleboard industry costs and prices ($/$m^3$)

Year	Power & fuel	Labor & mgmt.	Glue & wax	Other costs	Wood	Variable costs	Price
1972	2	17	9	8	8	44	54
1973	3	19	13	9	9	52	64
1974	3	19	18	11	10	61	66
1975	4	19	22	11	10	66	61
1976	5	19	18	10	11	64	65
1977	6	20	15	10	12	63	77
1978	6	23	16	11	14	71	124
1979	7	23	19	13	18	80	96
1980	9	24	22	14	20	89	102
1981	11	26	22	15	23	98	106
1982	13	28	22	16	25	104	111
1983	13	28	23	16	23	103	114
1984	13	28	23	16	25	106	123
1985	13	28	23	16	21	101	115
1986	11	28	22	15	22	98	120
1987	11	28	21	15	23	98	127
1988	11	29	24	15	22	101	127
1989	11	29	23	16	23	103	129
1990	11	30	23	16	24	104	122
1991	11	30	23	16	26	107	120
1992	11	32	21	16	28	108	129
1993	11	32	24	17	29	114	152
1994	10	33	25	18	31	117	171
1995	10	34	25	18	31	119	173
1996	11	35	32	19	31	128	165

Medium Density Fiberboard

Capacity

The first North American medium density fiberboard (MDF) plant was started in 1966 in New York. The number of

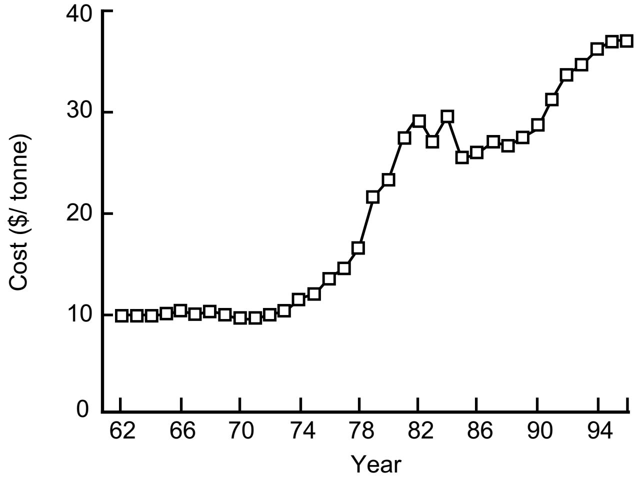

Figure 12—Cost of wood fiber for particleboard, U.S. average.

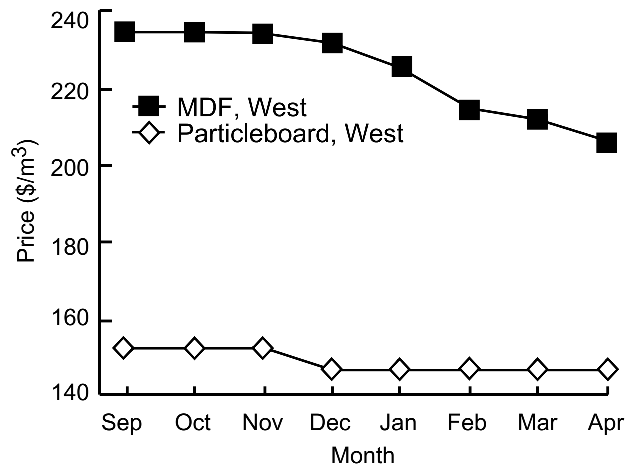

Figure 14—Particleboard and MDF market prices, 1996–1997.

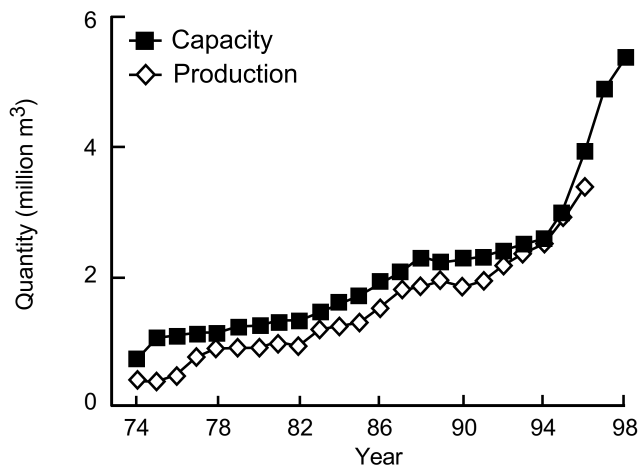

Figure 13—Medium density fiberboard (MDF) capacity and production in North America.

plants increased to 18 by 1994, representing a capacity of more than 2.5 million m^3. Subsequently, many new plants were announced—two became operational in 1995—raising capacity to 3 million m^3. In 1996, six plants were started and one was closed, increasing industry capacity by 1 million m^3. Two new plants are scheduled for 1997 and two for 1998, when capacity will exceed 5 million m^3 (Fig. 13).

Two features of the new plants stand out. First, continuous presses have become the standard, replacing batch presses in older plants. Second, as in other panel sectors, size norms for plants have increased. The trend to higher productivity mirrors that in OSB and suggests the same economy-of-scale considerations. As a means of market diversification, some plants are making moisture-resistant boards for exterior applications using more costly phenol–formaldehyde resins. Plants for manufacturing MDF are listed in Appendix A, Tables A10 and A11.

Costs and Prices

Although the production processes are similar to those used for particleboard, the costs of making MDF are higher. Census figures show that average labor productivity for MDF is lower and energy consumption for fiber preparation is higher. Resin and wax consumption are also somewhat higher. MDF boards have been priced at substantial premiums over prices for particleboard, but that premium began to narrow in the fall of 1996 as expanding MDF capacity began to affect the panel markets (Fig. 14). These trends have put the two products into increased competition and suggest upcoming pressure on MDF profitability.

Trade in Wood-Based Panels

With the large expansion in U.S. and Canadian wood-based panel capacity, one area viewed as having the potential to absorb some of this new production is the overseas market. The fast growth of some foreign economies, particularly those in Far East Asia, certainly raises questions about how great a potential overseas markets represent. Recent export promotion activities have focused on securing footholds in these markets and realizing some of the potential.

In 1996, U.S. exports of structural panels, particleboard, and MDF amounted to a total of 1.7 million m^3, representing about 5% of U.S production. Close to 30% of U.S. exports were shipped to Canada, while the major portion (1.3 million m^3) was shipped to other foreign markets. (See Appendix B, Table B1, for details on trade in relationship to production and consumption of wood-based panels.)

The situation is different in Canada, where exports of wood-based panels reached 6.0 million m^3 in 1996. Compared to the United States, Canadian exports represented a much greater share of production—almost two-thirds. Most of these exports (85%) were shipped to the United States.

With respect to imports of wood-based panels, the situation in the United States and Canada is similar. In both countries, imports satisfy close to 15% of supply for domestic consumption, and almost all imports (close to 95%) are shipped across the U.S.–Canada border.

The United States also imports softwood plywood from Mexico, Indonesia, and Brazil (USDA FAS 1997) and particleboard from Mexico, Brazil, and Europe (U.S. Department of Commerce 1997). Canada imports small quantities of softwood plywood from Brazil, particleboard from Europe, and MDF from Far East countries and Brazil (Statistics Canada 1997b).

Trends in Exports

Recent trends in exports have been markedly different in the United States and Canada, especially after subtracting trade between the two markets (Figs. 15 and 16). One similarity, however, is the recent increase in exports to Far East markets, such as Japan, South Korea, Taiwan and Hong Kong.

South Korea and Taiwan are fast-growing economies with potentially strong construction activity. The use of wood products for construction in these markets depends in part on changing cultural traditions that favor nonwood products such as cement, training construction labor in the use of wood products, and changing building codes, especially to allow wood use in multi-story buildings (USDA FAS 1996b).

U.S. and Canadian marketing efforts in Japan have made much progress, resulting in acceptance of a broader range of wood construction material from North America, such as softwood plywood and OSB (USDA FAS 1996b,c). As a result of ongoing trade negotiations, Japan has been moving toward greater use of performance-based product standards for construction materials. In addition, its process for writing standards has become more transparent. These actions have facilitated exports to Japan (Hicks 1997).

As Figure 15 shows, U.S. exports of softwood plywood have been slowly decreasing in recent years. This trend reflects a decrease in exports to the European Union (EU), which has traditionally been the largest U.S. export market, and a sharp decrease in exports to Mexico, following the currency devaluation in 1994. Not reflected in the general trend, however, are steady increases in exports to the Caribbean and a small but steady presence in Japan. (See Appendix B, Table B2, for sources of data and trends by major export market.)

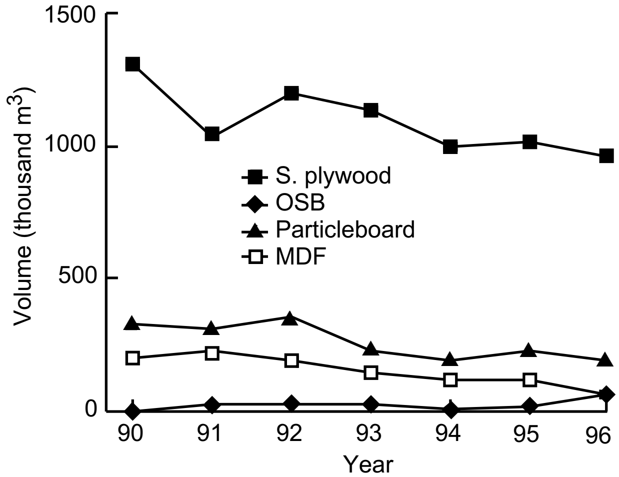

Figure 15—U.S. exports of wood-based panels to world markets, excluding Canada.

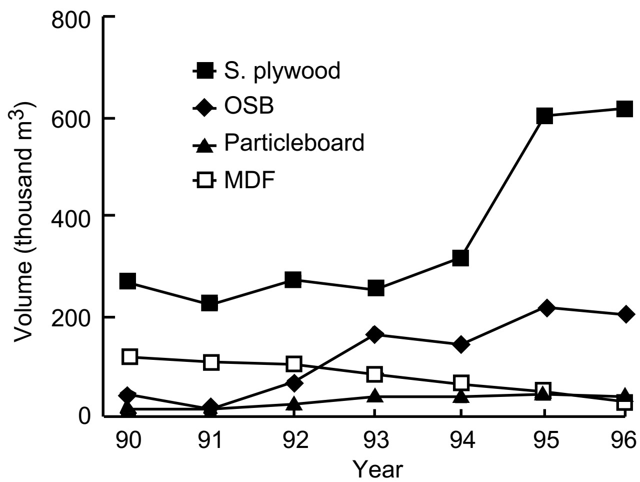

Figure 16—Canadian exports of wood-based panels to world markets, excluding United States.

U.S. exports of OSB (including waferboard) to offshore markets, though a very small fraction of total exports, have increased slightly, reflecting recent shipments to Japan, but exports to the EU have almost disappeared. On the other hand, U.S. exports of particleboard and MDF have been slowly decreasing, similar to the trend for softwood plywood. This decline reflects declining exports of particleboard to South Korea, Taiwan, and Japan, and MDF to the EU, South Korea, Taiwan, and Hong Kong.

In Canada, OSB exports predominate when exports to the United States are included. However, when exports to the United States are excluded, softwood plywood exports predominate (Fig. 16), as in the United States, though at a lower volume. Moreover, in contrast to the decreasing trend in the United States, Canadian exports of softwood plywood have been increasing dramatically in recent years. This reflects an increase in shipments to Japan (Appendix B, Table B2). Canadian exports of OSB and particleboard to offshore markets have been increasing as well, reflecting a slow increase in exports to South Korea, Taiwan, and Japan.

As in the United States, Canadian exports of MDF have decreased (Appendix B, Table B3). This trend may reflect recent increases in capacity worldwide; a 125% increase is expected between 1993 and 1997 (Wood Markets Quarterly 1997).

Softwood Plywood

Exports

As has been described, U.S. softwood plywood exports have predominated historically among wood-based panels and they still do, although OSB is slowly making inroads into this structural panel market. In 1996, 1.1 million m^3 of softwood plywood (60% of total wood panel exports) was exported to all foreign markets, including Canada. Excluding shipments to Canada, softwood plywood exports were slightly lower (1.0 million m^3), representing 76% of total panel exports.

In 1996, softwood plywood exports (0.6 million m^3) represented only 13% of total Canadian panel exports. However, when exports to the United States are excluded, softwood plywood exports constituted almost 70% of total panel exports.

In response to the relatively large U.S. domestic market, the U.S. softwood plywood industry is more domestically oriented than the Canadian industry. In 1996, U.S. exports of 1.1 million m^3 of softwood plywood represented only 7% of total production; the relatively constant production share during the 1990s was preceded by even lower shares of production in the 1980s. In Canada, on the other hand, exports represented 36% of production in 1996—a marked increase over previous years (Appendix B, Table B1).

The largest foreign market for U.S. softwood plywood has been the EU. However, recent trends have shown steadily decreasing exports there (Appendix B, Table B2). This decline may be due to the increasing self-sufficiency of the EU, as capacity and production among its members increases, and to imports from other sources, such as Brazil. Finland, which joined the EU in 1995 along with Austria and Sweden, added new softwood plywood capacity in 1995 and increased its production by 25%; an additional 10% increase had been expected in 1996. Most of Finland's production is targeted for export, primarily to the rest of the EU (USDA FAS 1996b).

Other significant foreign markets for U.S. exports include the Caribbean, where U.S. imports have increased, and Mexico, where U.S. imports may rebound as the country recovers from an economic crisis (Appendix B, Table B2).

For Canada, exports to the EU have been stagnant for the most part, whereas exports to Japan have been booming in recent years. In 1996, Japan emerged as Canada's biggest export market for softwood plywood (and the second biggest market for OSB, after the United States). Exports of plywood to Japan increased sharply in 1995, following the Kobe earthquake. In addition, Canadian market access was greatly enhanced when Japan's agricultural standards (JAS) were expanded to accept a wider range of Canadian plywood products into the building code (USDA FAS 1996b).

EU Tariff Quota

The tariff-free quota on softwood plywood imports into the EU is a factor that limits exports to the EU. It is currently set at 650 thousand m^3/year. Imports from non-European countries are admitted duty-free as long as the cumulative imports from all sources are below the quota. Once the quota is met, additional imports are subject to the existing tariff (Hicks 1997, USDA FAS 1996b).

One effect of the EU tariff quota is seasonal cycles in exports of softwood plywood to the EU. The quota on duty-free imports is exhausted early in the year, by March or April. This means that exporters try to schedule overseas shipments to the EU late in the year, in November or December, for arrival in January or February (Hicks 1997). Traffic is therefore especially heavy during these months and may affect short-term wood prices and transport costs.

In addition to increasing the quota to 650 thousand m^3, in December 1995 the EU agreed to accelerate the schedule for reducing tariffs on softwood plywood. As a result, the tariff rate in 1996 was reduced from 9.4% to 8.2%, instead of 8.8%. The EU-bound duty on softwood plywood and other wood-based panels, negotiated under the Uruguay Round, is 7%, to be reached by 1999 (Hicks 1997, USDA FAS 1996b).

OSB and Waferboard

Compared to plywood, the U.S. and Canadian OSB industries (including waferboard) have been relatively self-contained within North America. Exports of OSB, in both Canada and the United States, have been cross-border for the most part. In 1996, almost all U.S. and Canadian production was shipped to U.S. domestic markets—84% of Canadian production and 98% of U.S. production (Appendix B, Table B1). This action was in response to the large construction market in the United States.

In 1996, U.S. exports totaled 139 thousand m^3. Of this, close to 60% was shipped to Canada and most of the remainder was shipped to Japan. Canadian exports in 1996 totaled 4,127 thousand m^3; of this, 95% was shipped to the United States (Appendix B, Table B2). However, Canadian exports to other than U.S. markets have increased significantly in recent years (Fig. 16). These exports have gone mostly to Japan, South Korea, and Taiwan (Appendix B, Table B2).

Particleboard

As with OSB, most U.S.-produced particleboard, and a large share of Canadian production, is shipped to U.S. markets. In 1996, only 4% of U.S. production was shipped to foreign markets. In Canada, about half of total production was exported, almost all to the U.S. market. Most of Canada's remaining exports were shipped to Pacific markets, principally South Korea (Appendix B, Tables B1 and B3).

Export markets for the United States are more diversified than those for Canada. About half of total production is shipped to Canada and the remainder to Mexico and Pacific markets. Exports to South Korea, Taiwan, and Japan have been decreasing in recent years, while exports to Hong Kong have been slowly increasing (Appendix B, Table B3).

To the extent that particleboard can be used in building construction, it faces similar use constraints as do wood-based construction panels in such markets as Mexico, South Korea, and Taiwan. These constraints relate to unfamiliarity with using wood in home construction in places where homes have traditionally been built with concrete or other nonwood materials.

Medium Density Fiberboard

As with other panel products, trade in MDF has taken a larger share of production and consumption in Canada than in the United States. In recent years, U.S. exports of MDF have been 9% to 12% of total production, although they were only 5% of production in 1996. In Canada, exports have been 45% to 60% of total production in recent years; that share dropped to 33% in 1996 (Appendix B, Table B1.)

Trade in MDF between the U.S. and Canada has been increasing, while exports to offshore markets have been decreasing. The fraction of U.S. exports to Canada has increased steadily in the past decade; >50% of MDF was exported to Canada in 1996. Conversely, the fraction shipped to EU and Pacific markets has decreased, from 90% in 1990 to <50% in 1996. Similarly, the fraction of the Canadian market shipped to the U.S. market has increased to >80% of total exports, and the fraction shipped to EU and Pacific markets has decreased, from 73% in 1990 to <20% in 1996 (Appendix B, Tables B1 and B3).

There have been large increases in MDF capacity worldwide since 1993, and more are expected in the near term, especially in the United States and Canada. The consequent higher potential for production in major world markets means that competition will center on cost and quality of product and service (Wood Markets Quarterly 1997).

Major Trade Agreements

NAFTA

A major aspect of U.S. and Canadian trade of wood-based panels, as with other wood products, is the interdependence of the two trade markets. This interdependence was implicitly recognized by the enactment of the U.S.–Canada Free Trade Agreement (CFTA) in 1989, which was broadened in 1994 to include Mexico and became the North American Free Trade Agreement (NAFTA). The goal was to promote trade among the three partners by eliminating tariff and nontariff barriers over a 10-year period.

In accordance with CFTA, the United States and Canada enacted an agreement in 1993 by which they adopted common plywood standards for construction. The new standards were incorporated into the National Building Code of Canada, providing access for U.S. plywood into Canadian construction markets. The agreement also cut Canada's tariff on U.S. plywood in half, to 7.5% in 1993. The tariff has been steadily reduced since then, and it is to be eliminated by 1998 (USDA FAS 1994).

There are few remaining tariffs on wood products between the U.S. and Canada. In 1996, these included a Canadian tariff of 1.2% on U.S. MDF and tariffs of 0 to 4.5% on U.S. plywood; there were no tariffs on particleboard and OSB in 1996 (USDA FAS 1996b). The situation was similar for U.S. imports from Canada. Any remaining tariffs are to be eliminated by the end of 1997.

Uruguay Round Agreement

Tariff barriers have been declining worldwide for many years, especially in developed countries. This has been principally a result of continuing GATT negotiations, especially since the conclusion of the Tokyo Round in 1979 (Barbier 1996).

Major progress to reduce tariff and nontariff barriers even further has been achieved with the Uruguay Round Agreement. Completed in 1994 after 8 years of negotiations, the agreement involves more than 120 countries. The agreement took effect on January 1, 1995, and the World Trade Organization (WTO) was established.

The Uruguay Round Agreement has been especially important with respect to wood-based panels, which have been subject to much higher tariff rates worldwide than have other wood products, including paper and related products. Before 1995, the (trade-weighted) average tariff rate on wood-based panels in developed countries was 9.4%—the highest average rate among all wood and paper product categories. Under the Uruguay Round Agreement, most developed countries agreed to reduce tariff rates for wood-based panels by an (weighted) average of 31% over 5 years, to a rate of 6.5% (Barbier 1996, Hicks 1996).

Canada–Chile Free Trade Agreement

Canada and Chile signed a bilateral trade agreement in November 1996, to be enacted in June 1997. The agreement is patterned after NAFTA and is viewed as a step toward integrating Chile into NAFTA. The agreement will eliminate Canadian tariffs on wood products and most of Chile's tariffs. Tariffs on some panel products will be phased out over a 6-year period (USDA FAS 1996c).

Currently, Chile has an across-the-board tariff of 11% on all imports, which could potentially be increased to its bound rate of 25%. In addition, an 18% value-added-tax (VAT) is levied on goods sold in the domestic market (USDA FAS 1996b). The Canada–Chile Free Trade Agreement will significantly reduce tariff barriers to wood products trade. Canada currently exports small amounts of OSB to Chile, but there may be potential for increased exports.

Strong economic growth in Chile has stimulated the construction sector. Although domestic production of wood products is generally sufficient to meet overall demand, there is potential for imports, especially into the northern region. Chile's timber supply and wood products sector is largely centered in the south, and shipments to the far north are constrained by distance and transport costs.

General Observations on Trade

Recent trends in U.S. and Canadian trade in wood-based panels indicate that a large share of trade occurs between the two markets, especially in meeting domestic demand for imports. Most Canadian trade in OSB, particleboard, and MDF—both exports and imports—is closely tied to the U.S. market. However, Canadian efforts to diversify shipments, especially to markets in the Far East are resulting in steadily increasing exports to those markets. Canadian exports of OSB to Japan have been growing especially fast.

U.S. production of wood-based panels has been aimed mostly at the domestic market. A very small share of production is shipped to foreign markets, and a large part of these shipments, except for plywood, has been directed to Canada. Recent trends for the remaining exports to offshore markets have been slowly decreasing. With respect to U.S. exports of construction panels, especially plywood, this reflects decreasing exports to traditional European markets. However, exports to Mexico and the Caribbean have risen. There is also potential for U.S. exports to the Far East, although Canada is currently dominating trade to those markets.

U.S. and Canadian marketing efforts have been directed toward changing standards and building codes, particularly in Japan, to allow broader use of wood products from North America. Similar changes are being sought in other Far East markets, such as South Korea, with regard to permitting wood use in multi-story buildings. Efforts are also being directed toward orientation and training in the use of wood products in construction applications, where alternative materials have traditionally been used.

Conclusions

Our study of the status of and prospect for the structural and nonstructural panel industries leads to the following observations and conclusions:

- Panel manufacturers are increasingly leaning toward the use of wider and longer presses, which translates to increased volumes and economies of scale among newer plants, placing older plants at a disadvantage.

- Almost all medium density fiberboard (MDF) plants being built today involve continuous presses. Continuous presses are being developed for OSB plants as well, which, when perfected, will introduce a new element into OSB economics.

- The success and high profitability of OSB in the 1990s contained within it the sources of its current downturn. A two-tiered structure has emerged that consists of newer, larger, low-cost plants at one end and older, smaller, high-cost plants at the other. The prospects for the second tier could be enhanced by creative solutions that redirect output from oversupplied commodity sheathing to specialty items. Changes could include conversion to the production of beams or oriented strand lumber, or lamination of panels to match lumber thicknesses and cutting the billets to standard lumber widths. In either case, research and development is needed to ensure a satisfactory product.

- The production and use of engineered lumber products are accelerating. Unlike OSB, engineered wood products are in the early phase of their life cycle with considerable potential for growth. At current prices, I-joists appear to be competitive with lumber for floor framing.

- Among all panel sectors, the tendency has been toward increasing the size and scale of manufacturing plants. Companies that have survived over the long run typically have upgraded their facilities to keep pace with cost-reducing technologies. Economy-of-scale considerations have been less pronounced in the I-joist industry, but they may become more so as that sector grows and matures.

In conclusion, we note that the wood products industry has been rapidly adapting to the realities of constrained public timber supply. In the short term, the ability to utilize smaller trees, especially underused hardwoods in the eastern United States and small-diameter coniferous trees in eastern Canada, has allowed demands for products to be met by the redeployment of investments to the eastern half of the continent. But as the demands for wood products increase and the costs of these sources of fiber rise, other options may need to be considered. Of increasing interest to industry is the use of short-rotation hardwood woody crops (SRWCs), the fastest growing of which are the poplars and their various hybrid cultivars. Research results indicate that such plantations can yield 6 to7 times as much fiber as trees grown in natural forests.

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Appendix A—Panel Manufacturing Industries

The following tables show past and projected capacity of various wood-based panel industries.

Table A1—OSB capacity by year of plant construction (1000 m³)

Location	Company (former name)	Initial capacity	Year built	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Huds. Bay I	McM–Bloed	71	1964	71	71	71	71	71	71	71	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Huds. Bay II	McM–Bloed	97	1968	97	97	97	97	97	97	97	97	106	106	106	106	106	106	106	106	106	106	106	106	106	106
Gr.Rapids	Potlat (Bland)	89	1972	115	124	124	124	212	248	248	248	248	248	301	301	301	301	301	301	301	301	310	310	310	310
Timmins	Tembec (Mal)	62	1973	62	62	62	62	62	62	71	71	80	80	80	80	80	80	80	80	177	177	177	412	412	412
Longlac	Longlac (Weld)	97	1973	97	97	97	97	97	97	97	97	97	120	120	120	120	120	120	120	120	124	142	142	142	142
Thunder B	McM–Bloed	89	1974	97	106	106	106	106	106	106	115	142	142	150	150	150									
Thunder B	Gt.Lakes	111	1975	111	111	111	111	115	115	124	124	133	71												
Slave Lk	Weyerhaeus	97	1977	97	97	97	97	97	97	97	97	97	97	97	97	97	97			124	177	166	186	186	186
Hayward I	L–P	115	1978		115	115	115	115	115	115	133	142	150	155	159	177	204	204	204	204	204	212	221	221	221
Chath/Miram	Eagle (Atl Wfbd)	142	1979			142	142	142	142	142	142	159	159	177	177	195	195	133					48	250	301
LaSarre I	Norbd (Norm–P)	71	1980				71	71	71	71	71	80	89	89	89	89	89	89	89	89	89	89	27		
St. George	Malette	133	1980				133	133	133	133	133	133	142	142	142	142	142	142	142	142	142	142	266	266	266
Clairmont	Elmendorf	89	1981					62	89	89	89	89	89	89	44										
Woodland	G–P	124	1981					89	124	124	124	124	137	137	137	137	137	137	137	137	177	177	190	190	190
Bemidji	Potlatch	137	1981					80	137	137	142	150	159	168	173	177	195	195	199	204	208	212	212	212	212
Solway	Norbord	230	1981					212	230	230	230	230	230	230	230	230	230	230	230	239	239	266	294	335	335
Hayward II	L–P	115	1982						89	115	133	142	150	159	159	177	204	204	204	204	204	212	221	221	221
Houlton	L–P	115	1982						62	124	133	133	150	155	155	159	164	177	177	177	217	230	230	230	230
Val d'or	Norbd (Norm–P)	150	1982						75	150	150	150	150	150	150	150	150	150	150	150	150	150	235	235	235
Englehart	Grant	155	1982						155	155	155	155	155	168	177	177	177	177	177	177	195	195	239	239	239
Grayling	Weyerhaeus	266	1982						111	266	266	266	266	266	266	266	266	266	266	336	336	336	336	336	336
Dudley	G–P	111	1983							111	111	111	111	111	111	111	111	111	111	124	124	124	124	124	124
Corrigan	L–P	115	1983							89	124	124	124	128	128	128	124	119	119	119	119	133	133	133	133
Easton	Huber	119	1983							49	119	119	119	119	164	164	164	164	164	164	164	164	164	164	164
LeMoyen	Martin	124	1983							53	124	142	150	159	159	159	168	195	212	230	230	230	230	230	230
Cook	Potlatch	142	1983							142	155	159	164	168	168	168	168	168	186	212	212	215	215	215	215
Chilco	L–P	80	1984								80	89	97	106	111	115	119	111	111	111	111	133	133	133	133
Kremmling	L–P	97	1984								97	102	106	111	115	115	111	106							
Montrose	L–P	97	1984								97	102	106	111	115	115	106	106	106	106	128	128	128	128	128
Urania	L–P	106	1984								106	115	119	128	133	115	97	89	89	89	102	119	119		
Edson	Weyerhaeus	221	1984								221	221	221	221	221	221	221	221	221	221	292	288	288	288	288
Two-Harbor	L–P	89	1985									89	97	102	106	111	115	115	115	115	115	119	119	119	119
Grenada	G–P	221	1985									221	235	248	248	248	266	266	266	266	298	298	298	298	298
Skippers	G–P	221	1985									221	235	248	248	248	266	266	292	292	292	309	309	309	309
Dungannon	L–P	97	1986										97	106	106	106	106	106	106	106	106	111	111		
Elkin	Weyerhaeus	199	1986										199	199	199	199	199	199	199	217	230	230	266	266	266
New Waverly	L–P	80	1987											62	80	80	80	80	80	80	80	44	44		
Nacogdoch	I–P	168	1987											106	168	168	168	168	168	177	212	212	212	212	212
Dawson Cr.	L–P	221	1987											221	248	266	305	319	319	319	332	332	332	332	332
Drayton	Weyerhaeus	221	1987											115	221	221	230	235	310	310	310	310	310	310	310

Quitman	Langlade		119	1988												133	164	164	164	164	164	190	190	168	168	168
Chambord	Norbd (Norm–P)		230	1988												177	230	230	230		89	243	266	327	327	443
Sagola	L–P		230	1988												230	266	319	319	319	319	319	310	310	310	310
Englehart	Grant		279	1988												146	279	279	279	279	283	310	310	381	381	381
St. Michele	Lanofor		252	1989													252	252	252	257	270	270	270	336	336	336
Commerce	Huber		253	1989													253	253	253	253	253	253	253	253	253	253
Athens	L–P		283	1989													283	283	283	283	283	283	288	288	288	288
Newberry	L–P		106	1990														106	106	106	106	106	106	111	111	111
Bemidji	Potlatch		195	1990														195	195	199	204	208	220	220	220	220
Cordele	I–P		270	1990														243	270	270	270	270	270	270	270	270
Silsbee	L–P		283	1991															283	283	283	283	301	301	301	301
Tomahawk	L–P		106	1993																	106	124	133	133	133	133
Hanceville	L–P		283	1994																		236	310	310	310	310
100 Ml Hse	Ainsworth		292	1994																		89	323	283	283	283
Crystal Hill	Huber		301	1995																			221	301	301	301
Mt.Hope	G–P		314	1995																			183	314	314	314
LaSarre II	Norbord		319	1995																			66	177	310	310
Wawa	McM–Bloed		341	1995																			142	341	341	341
Guntown	Norbord		354	1995																			89	381	385	385
High prairie	Tolko Ind		420	1996																				420	420	420
Gr. Prairie	Ainsworth		478	1996																				478	478	478
Brookneal	G–P		319	1996																				319	319	319
Swan River	L–P		376	1996																				292	398	398
Roxboro	L–P		292	1996																				292	332	332
Jefferson	I–P		310	1996																				310	310	310
Arcadia	Willamette		266	1996																				177	266	266
Jasper	L–P		292	1996																				18	332	332
Ft Nelson	Slocan		394	1996																				310	394	394
Sutton	Weyerhaeus		398	1996																				168	398	398
Carthage	L–P		292	1997																					177	292
Barwick	Boise Casc		354	1997																					177	354
Sprint Cty, Tn	Huber		336	1997																					53	336
Maniwaki	Forex		443	1997																					177	443
Kenora, Ont	Tolko Ind		420	1998																						89
Hudson Bay	Saskf–McM		425	1998																						212
		1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total (1000 m^3)		504	615	615	748	881	1022	1226	1761	2425	3204	4062	4748	5152	5789	6727	7794	8383	8564	8246	8852	9766	10951	15276	16803	18110
Change ((1000 m^3)			111	0	133	133	142	204	535	664	779	858	686	404	637	938	1067	589	181	-319	606	914	1185	4325	1527	1245
Number of mills				7	8	9	10	12	16	21	26	31	34	36	39	43	45	47	47	44	47	49	54	65	66	69
Average mill capacity (1000 m^3)				88	93	98	102	102	110	115	123	131	140	143	148	156	173	178	182	187	188	199	203	235	259	270
Production (1000 m^3)								719	996	1065	1983	3038	3699	4493	5220	5722	6686	6769	6563	8162	8921	9641	10321	12929	14249	
Capacity utilization (%)								59	57	44	62	75	78	87	90	85	86	81	77	99	101	99	94	85	84	

Note: Production estimates courtesy of APA—The Engineered Wood Association.

Table A2—Southern pine plywood capacity, by year of plant construction (1000 m³)

State	Location	Company (former name)	Initial capacity	Year built	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
AR	Fordyce	G–P	80	1964	53	80	106	106	106	119	119	133	133	133	133	133	150	159	168
TX	Silsbee	Kirby	32	1964	32	32	35	44	53	53	53	106	106	106	106	106	106	115	128
TX	Diboll	TE (SPPCo)	62	1964	44	62	62	62	62	62	62	62	106	106	106	106	106	106	106
TX	Lufkin, keltys	L–P (Angel)	53	1965		44	64	64	64	64	64	64	64	64	64	64	89	89	89
AR	Crossett #1	G–P	106	1965		53	115	115	115	128	137	137	137	137	155	177	177	177	177
LA	Ruston	Willam (Santm)	53	1965		31	62	62	71	71	71	75	75	75	75	75	75	75	75
AL	Fulton	Scotch	40	1965		40	53	53	71	71	89	89	89	89	89	89	115	135	135
LA	Oakdale	BC (Vanply)	89	1965		53	89	89	111	111	111	111	111	111	111	146	146	146	146
LA	Florien	BC (Vanply)	89	1965		44	89	89	111	111	111	111	111	111	111	146	146	146	146
NC	Plymouth	Weyerhaeus	64	1965		53	64	64	64	64	64	64	64	64	64	64	71	71	71
LA	Minden	Willam (Col)	53	1966			18	53	71	71	71	71	71	71	71	75	75	75	75
MS	Beaumont	Hood (Del pn)	80	1966			53	80	80	80	80	80	80	80	80	80	80	84	89
AR	Crossett #2	G–P	115	1966			80	115	115	128	128	133	137	137	155	177	177	177	177
MS	Louisville	G–P	80	1966			44	80	80	80	80	80	133	133	133	133	148	166	177
VA	Emporia	G–P	80	1966			80	89	97	115	133	0	142	142	142	142	142	142	142
GA	Savannah	G–P	49	1966			35	49	66	66	89	89	89	89	89	89	89	89	89
LA	Dodson	Willam (Hunt)	71	1966			18	71	71	115	115	115	115	115	115	115	115	115	115
LA	Winnfield	LP (Manville)	53	1966			27	53	53	53	89	89	89	89	89	89	89	89	89
LA	Haynesv	Santiam	27	1966			27	27	27	27	27	27	27	27	27	27	27	27	27
NC	Eliz. City	Triangle	27	1966			9	27	27	27	27	27	27	27	27	27	27	27	27
MD	Pocomoke	Chespk (USPly)	53	1966			53	53	53	53	53	53	53	53	53	53	80	80	80
LA	Hammond	CI (USPly)	89	1966			44	89	89	89	89	89	89	89	89	89	89	89	89
MS	Philadel	Weyerhaeus	27	1966			27	27	49	49	49	49	49	49	49	49	49	49	49
NC	Jacksonv	Weyerhaeus	53	1966			22	53	53	89	89	89	89	89	89	89	89	89	89
AR	Gurdon	IP (Arkla)	89	1967				35	106	106	106	106	106	106	106	0	0	0	0
NC	Moncure	Willam (BC)	53	1967				44	71	71	71	71	71	71	71	74	74	74	74
LA	Joyce	Riverwd (CZ)	62	1967				31	62	62	75	75	75	75	75	75	155	155	155
MS	Gloster	G–P	80	1967				80	80										
FL	Chiefland	G–P	80	1967				53	80	80	80	80	80	80	80	80	80	80	80
LA	Natchitoch	Willam (Sply)	53	1967				40	53	53	66	66	66	66	66	66	75	75	75
AL	Chapman	Union–Camp	106	1967				80	106	106	106	106	106	106	106	106	133	159	168
LA	Plain Deal	IP (Anthon)	53	1968					35	53	53	53	53	53	53	53	64	64	64
SC	Russelville	G–P	80	1968					80	97	119	133	133	133	133	133	133	133	133
GA	Cedar Spr.	G–P (Gt Northn)	53	1968					53	74	89	89	89	89	89	89	89	89	89
AL	Pine Hill	McM–Bloed	106	1968					71	106	106	106	106	106	106	106	119	133	133
GA	Waycross	C (USPly)	49	1968					49	49	49	49	49	49	49	49	49	66	66
MS	Gloster	G–P	44	1969						89	124	155	155	155	155	155	168	177	186
MS	Taylorsvil	G–P	80	1969						44	80	168	168	168	168	168	168	168	168
TX	Nacogdoch	I–P	89	1969						62	89	89	89	89	89	89	111	133	142
MI	Bessemer	Bessemer Ply	44	1969						35	44	44	44	44	44	44	44	44	44
AL	Cordova	Champion Int	44	1970							22	44	49	49	53	62	62	66	66
GA	Monticello	G–P	106	1970							53	106	106	106	159	177	195	212	221
LA	Urania	LP (G–P)	106	1970							62	124	124	177	177	177	181	186	195
AL	Andalusia	Independ	53	1970							27	53	53	80	80	80	80	80	80
FL	Pensacola	B–C	53	1971								53	80	80	80				
NC	Whiteville	G–P	66	1971								66	75	80	133	133	133	133	133
TX	New Waver	LP (G–P)	142	1971								89	150	155	159	177	177	177	177
MS	Wiggins	Hood (I–P)	89	1971								44	89	111	111	111	119	128	133
TX	Jasper	L–P (O–I)	89	1971								44	89	89	89	89	111	124	124
AR	Huttig	Manv (OlnM)	62	1971								31	62	62	62	62	66	66	71
AL	Livingston	MBI (Sumter)	80	1971								40	80	89	89	89	89	89	89
AR	Mt. Pine	Weyerhaeus	75	1971								40	75	75	75	75	75	75	75
AR	Dierks	Weyerhaeus	75	1971								44	75	75	75	75	75	75	75
OK	Wright Cty	Weyerhaeus	75	1971								40	75	75	75	75	80	84	89
TX	Corrigan	CI (G–P)	142	1972									71	142	168	168	168	177	177
SC	Holly Hill	Holly H.	89	1972									44	89	89	89	89	89	89
LA	DeQuincy	B–C	89	1973										35	89	89	89	89	106
GA	Warm Spr.	G–P	146	1974											87	146	164	173	177
TX	Pineland	Temple	106	1974											106	106	124	124	133
SC	Newberry	CI (USPly)	62	1974											62	133	133	133	133
SC	Prosperity	G–P	84	1975											0	84	84	84	84
AL	Talladega	G–P	106	1975											0	115	142	159	177
TX	Bon Wier	LP (Kirby)	142	1975											0	142	150	164	177
AL	Millport	Weyerhaeus	71	1977														71	71
AL	Peterman	G–P	204	1978															177
LA	Zwolle	Willamette	89	1978															80
LA	Taylor	Willamette	111	1978															111
TX	Camden	Champ. Int.	195	1979															
GA	Madison	GP (GA–Kraft)	199	1979															
LA	Logansport	LP (G–P)	142	1979															
AR	Gurdon	I–P	133	1979															
AR	Emerson	Willamette	133	1979															
NC	Dudley	G–P	89	1980															
TX	Cleveland	LP (Kirby)	159	1980															
SC	Chester	Willam (B–C)	133	1981															
FL	Havana	Coastal	111	1981															
LA	Pollock	Hunt Plywd	66	1981															
LA	Springhill	I–P	195	1981															
FL	Hawthorne	G–P	195	1982															
LA	Natalbany	Hunt Plywd	106	1988															
LA	Chopin	Martco	248	1995															
GA	Fitzgerald	Springfield	66	1995															
Total (1000 m³)					129	492	1274	1973	2601	2981	3415	4145	4867	5137	5622	6074	6498	6821	7345
Change (1000 m³)					129	363	781	699	628	380	435	730	721	270	485	452	424	323	524
Number of mills					3	10	24	31	36	39	43	53	55	56	62	61	61	62	65
Average mill capacity (1000 m³)					43	49	53	64	72	76	79	78	88	92	91	100	107	110	113
Production (1000 m³)					71	356	1009	1574	2100	2544	2934	3903	4707	4921	4540	5023	6030	6591	6990
Capacity utilization (%)					55	72	79	80	81	85	86	94	97	96	81	83	93	97	95

Note: Production estimates courtesy of APA—The Engineered Wood Association.

1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
168	177	199	204	204	226	226	226	230	252	257	252	252	252	252	252	270	270	270	270
133	133	133	133	133	133	142													
106	106	106	111	111	111	44													
89	89	97	124	124	124	137	150	150	150	150	168	168	142	142	150	155	155	155	155
177	177	177	195	212	212	221	243	266	270	274	279	279	279	279	292	292	292	292	292
75	75	75	75	75	89	102	115	115	115	115	133	155	155	155	155	155	155	155	155
135	159	177	204	204	204	204	212	212	212	235	235	235	235	235	251	257	257	257	257
146	146	155	155	155	155	155	164	177	221	230	230	230	252	252	264	278	283	285	283
146	146	155	155	155	155	155	164	199	235	257	261	263	263	263	270	274	274	274	274
71	71	71	71	71	89	89	89	97	97	97	97	97	97	97	97	111	124	124	124
75	75	75																	
89	89	89	89	89	89	106	106	124	124	124	124	124	124	155	161	178	178	178	178
177	177	177	195	212	212	221	243	266	274	279	283	283	283	283	301	305	305	283	283
177	177	248	248	248	248	248	257	257	257	257	258	258	258	258	258	258	258	258	258
142	142	142	142	177	204	221	221	235	235	257	261	266	281	281	281	281	281	281	281
89	89																		
115	115	115	133	133	133	133	142	159	168	174	173	173	173	173	173	197	197	197	197
89	89	89	89	89															
27																			
80	80	80	80	80	80	80	89	89											
89	89	89	89	89															
49	49	58	58	58	66	66	75	75	75	75	75	75	75	75		115	115	115	115
115	115	115	115	115	140	140	146	142	142	136	137								
74	74	74	80	80	80	84	84	84	84	96	97	97	97	97	119	119	119	119	119
155	166	166	166	166	166	173	173	173	173	173	173	173	175	175	175	186	186	186	186
80	80																		
75	75	75	75																
168	168	168	168	168	168	177	186	186	186	181	186	186	186	186	212	221	221	221	221
64																			
133	133	133	133	190	199	199	199	212	221	243	243	243	243	243	243	243	243	243	243
89	89	89	89	97	115	137	146	146	146	142	142	142	142						
133	133	133	133	133	133	133	142	142	142	119	119	122	124	142	142	142	142	142	142
66	66	66	66	66	73	76	80	89	89	89	89	89	87	133	137	133	133	133	133
186	204	204	204	204	212	239	248	248	248	230	248	248	248	248	248	257	261	261	261
168	221	221	221	221	217	217	226	266	310	310	305	305	305	305	323	323	323	323	323
142	0	0	142	142															
44	44	44	44	44	44	44	44	44	44	53	53	53	53	53	53	53	53	53	53
71	75	75	80	80	80														
230	230	230	239	257	266	266	283	283	283	274	274	274	274	274	230	239	239	239	239
195	195	195	195	195	195	195	204	204	221	239	239	239	239	239	239	212	212	212	212
80	80	80	80	80															
133	177	177	177	177	212	212	221	239	248	248	248	248	248	248	270	274	274	274	274
177	186	186	186	186	186	199	212	212	212	239	266	266	266	266	266	266	266	266	266
133	133	133	133	133	133	155	159	168	177	195	195	195	181	181	181	187	187	187	187
124	124	124	124	124	128	133	133	142	142	133	133	133	133	133	133	133	133	62	
71	71	71	71	80	89	89	89												
89	89	89	89	89	89														
75	75	75	75	80	89	97	106	106	106	106	106	106	106	106	142	159	159	159	159
75	75	75	75	84	97	97	106	106	106	106	106	111	111	111	158	158	158	158	158
93	97	97	97	97	102	106	106	106	106	106	106	106	142	142	142	146	146	146	146
177	177	195	204	204	204	204	208	239	257	264	264	266	266	266	266	292	292	292	292
89	89	89																	
111	111	111	89																
177	177	177	177	177	190	190	199	221	257	261	261	261	261	261	261	301	301	301	301
137	137	137	137	173	173	173	181	177	177	177	177	221	221	221	221	221	235	235	235
155	159	159	159	159	164	164	177	203	203	150									
106	115	124	124	124	124	124	128	155	164	190	199	218	218	218	218	218	218	218	218
177	195	195	195	195	200	200	212	221	248	274	274	283	289	289	289	289	289	289	289
177	190	195	204	204	204	208	243	243	243	243	243	243	243	243	243	243	243	243	243
71	71	71	71	71	80	80	84	89	105	110	111	115	115	115	115	128	140	140	140
204	204	204	204	204	204	204	208	208	235	266	274	274	274	274	274	274	274	274	274
93	93	93	93	93	95	95	102	133	155	159	164	164	169	169	199	200	200	200	200
115	115	115	115	115	115	133	142	164	186	177	177	186	186	186	186	186	186	186	186
195	204	221	230	230	230	252	266	279	279	281	279	279	279	279	279	310	310	319	319
159	199	199	199	208	230	239	243	243	243	274	274	274	310	319	319	319	319	319	319
106	142	150	150	150	150	168	177	177	177	221	212	221	221	221	221	212	212	212	212
133	159	186	204	208	208	217	230	230	230	230	230	230	243	243	252	252	252	252	252
111	124	133	133	133	133	142	150	155	159	164	164	168	170	170	177	208	208	208	208
	93	97	124	124	124	124	124	177	190	221	226	227	227	243	292	301	301	301	301
	159	195	221	221	230	248	266	274	266	266	266	266	266	266	266	230	199	266	266
		133	133	133	133	137	150	168	190	195	208	232	232	232	232	232	232	232	232
		111	111	111	124	124	124	124	124	124	127	126	135	144	142	155	177	177	177
		66	71	71	71	111	115	115	115	106	102	97	97	97	119	124	124	124	124
		195	195	195	204	221	226	235	248	239	239	239	243	243	266	283	283	283	283
			177	177	212	212	221	239	248	243	243	243	243	243	257	274	326	326	326
									53	124	133	137	137	137	137	137	137	137	137
																1	133	292	292
																48	66	66	66
8168	8533	9148	9516	9578	9537	9684	9965	10416	10823	11158	11141	11164	11275	11263	11549	12016	12256	12398	12336
823	366	615	368	62	-42	147	281	450	407	335	-17	23	111	-12	287	466	241	142	-62
68	68	70	69	67	63	61	59	58	58	58	57	56	56	55	54	57	57	57	56
120	125	131	138	143	151	159	169	180	187	192	195	199	201	205	214	211	215	218	220
7371	6543	7352	7484	8821	9204	9379	10111	10283	10618	10491	11010	10071	10766	11403	11628	11600	11860		
90	77	80	79	92	97	97	101	99	98	94	99	90	95	101	101	97	97		

Table A3—Western Washington plywood capacity, by year of plant closure (1000 m³)

Location	Company	Former name	Year opened	Year closed or production ceased	1965	1970	1975	1982	1985
Everett	Tidewater Plywood Inc.		1964	1965	58				
Darrington	Three Rivers Plywd & Timber Co	.	1955	1965	40				
Everett	Lowell Plywood Co.	Walton Plywood Co.	1924	1965	62				
Olympia	Georgia-Pacific Corp.	Capitol Plywood	1929	1967	53				
Olympia	Simpson Timber Co.	Washington Ven. Co. No. 1	1925	1967	31				
Olympia	St. Regis Paper Co.		1921	1967	106				
Aberdeen	Evans Prod, APCO Div.	Aberdeen Plywood Co.	1927	1968	44				
Aberdeen	Olympic Plywood Inc.	West Coast Plywood Co.	1936	1969	133				
Tacoma	St. Regis Paper Co.	Northwest Door Co.	1936	1969	58				
Tacoma	Scandia Ply	Forest Laminates	1966	1970		44			
Tacoma	Lyle Plywood Co.		1933	1970	18	9			
Tacoma	Farwest Plywood Inc.	Rainier Plywood Co.	1948	1974	22	22			
Tacoma	Industrial Lumber Products		1972	1975					
Everett	Everett Plywood Crop.		1923	1975	111	89	89		
Tacoma	Buffelen Woodworking Co.		1916	1975	31	0	31		
Centralia	Centralia Plywood & Ven.	Sylvan Products	1951	1978	75	75	53		
Chelatchie	International Paper Co.		1960	1979	75	75	75		
Kalama	Pope & Talbot Inc.	Columbia Veneer Co.	1949	1979	71	71	71		
Longview	Weyerhauser Co.		1947	1982	159	159	243	58	
Seattle	Champion International	U. S. Plywood	1929	1985	66	22	22	22	22
McCleary	Simpson Timber Co.		1912	1985	58	106	106	124	62
Aberdeen	Evans Prod, Harbor Div.	Harbor Plywood Co.	1925	1986	71	71	71	84	84
Tacoma	North Pacific Plywood Inc.		1921	1986	53	53	71	75	74
Lacey	Lacey Plywood Co., Inc.		1951	1988	44	44	53	66	66
Snoqualmie	Weyerhauser Co.		1959	1989	62	62	66	97	84
Stevenson	Stevenson Co-Ply Inc.	Stevenson Plywood Corp.	1949	1992	58	58	71	111	89
Tacoma	Pugent Sound Plywood Inc.		1942	1992	106	106	106	89	71
Anacortes	Custom Plywood Corp.	Anacortes Veneer Inc.	1939	1992	119	119	119	102	115
Elma	RHD Elma, Inc.	Elma Plywood Corp.	1952	1994	22	40	58	58	62
Washougal	Textured Forest Products	Ellison's Ind.	1971	1996			18	18	18
Olympia	Hardel Mutual Plywood Corp.		1950	1996	49	49	89	106	124
Vancouver	Fort Vancouver Plywood Co.	Vancouver Plywood Co.	1928	1996	111	115	133	155	106
Chehalis	Hardel Mutual Plywood Inc.		1997						
Bellingham	Mt. Baker Plywood Co.		1950		44	44	44	66	60
Hoquiam	Hoquiam Plywood Co.	Woodlawn Plywood Co.	1947		31	35	44	53	85
Pt Angeles	K-Ply Inc.	Peninsula Plywood Corp.	1941		89	89	89	89	71
Shelton	Simpson Timber Co.		1941		18	18	31	31	66
Total (1000 m³)					2146	1575	1752	1403	1259
Change (1000 m³)						-571	177	-350	-144
Number of mills					33	25	23	18	17
Average mill capacity (1000 m³)					65	63	76	78	74
Production (1000 m³)					1726	1377	1161	823	1049
Capacity utilization (%)					80	87	66	59	83

Note: Production estimates courtesy of APA—The Engineered Wood Association.

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
66										
89										
115	111	111	111	111						
74	93	124	124	80						
106	127	127	127	124						
71	71	71	81	81	81	81				
18	18	18	18	18	18	18	80	80		
161	150	133	133	133	127	161	143	80		
124	142	142	142	142	115	106	97	22		
									53	111
60	60	31	62	62	62	62	62	66	66	66
89	93	93	93	89	80	75	75	75	75	75
71	71	71	71	53	53	44	44	44	44	44
104	111	111	111	124	148	146	146	146	146	146
1147	1046	1030	1072	1015	684	694	648	513	385	443
-112	-101	-15	42	-57	-331	10	-46	-135	-128	58
13	11	11	11	11	8	8	7	7	5	5
88	95	94	97	92	86	87	93	73	77	89
980	819	675	597	538	520	497				
85	78	66	56	53	76	72				

Table A4—Western Oregon plywood capacity, by year of plant closure (1000 m³)

Location	Company	Former name	Year opened	Year closed or production ceased	1965	1970	1975	1982
Springfield	Georgia Pacific Corp., No. 1	Springfield Plywood Corp.	1940	1970	44	53		
Eugene	Champion International	Eugene Plywood Co.	1940	1970	80	80		
Merlin	Merlin Forest Products Co.		1963	1970	18	18		
White City	Sel-Ply Products		1968	1970		44		
Mohawk	Georgia Pacific Corp.	McKenzie River Plywood	1959	1971	75	75		
White City	Fir-Ply Inc. No. 2	Oregon Veener Co.	1957	1973	58	58		
Geribaldi	Oregon Wash Plywd Inc.	Nicolai Plywood Co.	1946	1974	80	80		
Port Orford	West. States Plywd Co-Op		1953	1974	62	62		
Coquille	Roseburg #5	Douglas Fir Plywood Co.	1961	1974	106	106		
Medford	Timber Products Co.	Veneer Products Co.	1947	1975	80	80	40	
Mapleton	Champion International	U.S. Plywood	1948	1975	75	89	190	
Gold Beach	Pacific Teollisus, Inc.		1974	1975			66	
Portland	Publishers Paper Co.	Dwyer Lumber Co.	1958	1977	53	97	111	
Eugene	Treplex Inc. No. 1	Giustina Bro. Lumb & Plywd Co.	1957	1978	62	71	75	
White City	Southwest Forest Ind No. 5	Fir Ply Inc. No. 1	1955	1979	84	97	106	
Coos Bay	Georgia Pacific Corp.		1959	1979	128	128	128	
Corvallis	Brand-S Corp Benton Div	Corvallis Plywood	1953	1980	66	66	75	
Independance	Boise Cascade Corp.	Inply Corp.	1959	1980	115	115	115	
Lyons	Mt. Jefferson Lumber Co.		1967	1980		35	35	
Gardiner	International Paper Co.		1951	1981	84	84	84	
Corvallis	Boise Cascade Corp.	Plywood Products Corp.	1954	1981	142	142	142	
McMinnville	Coast Range Plywood Inc.	Yamhill Plywood Co.	1955	1981	40	40	53	
Tillamook	Louisiana-Pacific Corp.	Tillamook Veneer Co.	1958	1981	89	89	89	
Valsetz	Boise Cascade Corp.	Valsetz Lumber Co.	1959	1981	62	62	71	
Junction City	Bohemia Inc.	Hult Lumber Co.	1960	1981	58	58	80	
Portland	Alpine Veneers Inc.		1969	1981		58	66	
Cottage Grove	Weyerhauser Co.	W. A. Woodward Lumber Co.	1956	1982	66	75	80	80
Brownsville	Oregon Strand Board	Plyboard Corp.	1981	1982				22
White City	Southwest Forest Ind No. 6	Empire Plywood	1955	1983	89	115	115	115
Westfir	Premier Plywood Corp.	Edward Hines Lumber Co.	1951	1984	53	53	62	66
Toledo	Georgia Pacific	C.D. Johnson Lumber Co.	1953	1984	80	119	124	124
Springfield	The Murphy Co.	Natron Kilns Inc.	1955	1984	89	89	89	97
Lebanon	Willamette Industries Inc.	West Veneer & Plywd Co.	1949	1985	71	71	71	97
Springfield	Weyerhauser Co.		1952	1985	71	71	75	111
Grants Pass	Southwest Forest Ind No. 4	Custom Plywood No. 1	1955	1985	84	97	106	115
Coos Bay	Montmore Timber Prod, Inc.	Coos Head Timber Co.	1956	1987	35	35	40	40
Grants Pass	Southern Oregon Plywd Co.		1949	1988	66	80	80	97
Albany	Boise Cascade Corp.	Coquille Valley Plywd	1960	1988	71	71	71	
Willamina	Conifer Plywood Co.	Pacific Plywood Corp.	1939	1989	75	89	102	
Albany	Simpson Timber Co.		1941	1989	58	58	58	66
Eugene	Falcon Manufacturing Corp.	Eugene Plywood Co.	1956	1989	71	71	133	
Gold Beach	Gold Beach Plywood, Inc.	U. S. Plywood	1960	1989	106	106	124	146
Cresswell	Cress Ply Inc.	Commercial Plywood	1966	1989		44	66	
Coquille	Georgia Pacific Corp.	Smith Wood Products Co.	1936	1990	159	168	168	177
Lebanon	White Plywood Co.	Cascade Plywood Corp.	1941	1990	168	177	190	235
Milwaukie	Murphy Plywood	West Door & Plywd Corp.	1950	1990	106	89	89	
Culp Creek	Bohemia Inc.		1959	1990	53	58	75	84
North Bend	Sun Plywood Inc.	Weyerhauser Co.	1963	1990	58	133	133	133
Astoria	Astoria Plywood Corp.		1951	1991	71	71	80	89
Drain	Bohemia Inc.	Drain Plywood Co.	1958	1991	62	62	71	89
Lebanon	Willamette Industries Inc.	Santiam Lumber	1961	1991	62	75	97	97
Medford	Kogap Mfg. Co.		1974	1991			133	199
Roseburg	Seneca Sawmill	U. S. Plywood	1958	1992	102	111	133	186
Merlin	Miller Redwood Co.	Bate Lumber Co.	1956	1993	71	71	71	71
Vaughn	Willamette Industries Inc.	International Paper Co.	1956	1993	71	71	71	
Medford	Medford Corp.		1961	1993	89	124	133	186
St. Helens	Pac Western Forest Ind Inc.	Crown Zellerbach Corp.	1962	1993	75	75	106	142
Albany	Stone Forest Industries, Inc.	Hub City Plywood Corp.	1955	1994	164	164	164	164
Sweet Home	Linn Forest Products	Mid-Plywood Inc.	1959	1994	44	44	58	58
Sweet Home	Willamette Industries Inc.	Santiam Lumber Inc.	1959	1994	62	62	71	102
Philomath	Brand-S Corp Leading Div	Leading Plywood Co.	1963	1994	89	89	89	89
Grants Pass	Timber Products Co.	Grants Pass Plywood	1953	1996	97	97	97	97
Green	Roseburg #3	Umpqua Plywood	1946		75	97	97	97
Eugene	Lane Plywood Inc.	Willamette Plywood Inc.	1950		133	133	142	150
Brookings	South Coast Lumber Co.	Brookings Plywood Corp.	1952		80	89	89	89
White City	Med-Ply	Medford Veneer & Plywd Cp	1952		58	58	71	84
Dillard	Roseburg #1		1952		71	66	133	133
Coquille	Roseburg #6	Coquille Plywood, Inc.	1952		62	62	97	119
Portland	Linnton Plywood Assn.		1953		66	75	89	115
Eugene	Emerald Forest Products	Snellstrom Lumber Co.	1953		71	84	89	119
Sutherlin	Murphy Co.	Sutherlin Plywood Corp.	1954		89	106	111	111
Dallas	Willamette Industries Inc.	Willamette Valley Lumber Co.	1955		128	128	133	133
Dillard	Roseburg #2		1956		106	133	133	133
White City	TImber Products Co.	White City Plywood Co. No. 1	1957		84	84	84	84
Foster	Willamette Industries Inc.	Willamette National Lum Co.	1958		111	124	133	133
Springfield	Springfield For Prod Inc.	G-P, No. 2	1960		142	142	142	150
Springfield	Rosboro Lumber Co.		1960		58	58	75	119
Grants Pass	Fourply Inc.	Veneer Products Co.	1961		89	89	89	97
White City	Boise Cascade Corp.		1962		89	89	89	89
Grants Pass	US Forest Industries	Stone Forest Industries, Inc.	1962		133	133	133	133
Glendale	Superior Plywood Co.	Glendale Plywood Co.	1963		58	62	142	142
Mill City	North Santiam Plywood Inc.		1964		106	106	106	119
Medford	Boise Cascade Corp.	Elk Lumber Co.	1964		80	159	212	243
Springfield	Willamette Industries Inc.	Mohawk Veneer	1966			58	66	93
Riddle	Roseburg #4		1970			177	221	274
Harrisburg	Eagle Veneer Inc		1991			0	0	0
Total (1000 m³)					7053.5	7177.4	7619.9	6332.2
Change (1000 m³)						124	443	-1288
Number of mills					88	83	76	54
Average mill capacity (1000 m³)					80	86	100	117
Production (1000 m³)					6876.5	6289.7	5672.9	4224.1
Capacity utilization (%)					97	88	74	67
Note: Production estimates courtesy of APA—The Engineered Wood Association.					1965	1970	1975	1982

1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
89											
89											
159											
40											
96	97										
	71										
	106	106									
64	62	62									
71	71	71									
	146	22									
53	44	35									
159	248	177	89								
221	221	221	221								
89	89	89	27								
85	96	89	44								
133	106	133	66								
97	115	115	115	115							
93	122	119	119	119							
116	124	142	142	71							
221	310	310	310	310							
150	177	181	181	177	177						
89	80	80	80	80	85	85					
102	106	106	115	115	124	133					
188	204	204	204	204	124	124					
142	195	195	195	195	195	195					
164	177	177	177	177	177	177	177				
58	66	66	66	66	66	66	66				
137	155	155	155	155	155	155	155				
111	115	115	124	124	124	124	124				
89	85	97	117	117	89	89	106	80	89		
133	177	212	195	195	177	177	204	204	204	204	204
133	164	164	164	164	164	164	93	93	93	93	93
119	133	133	133	133	111	106	111	111	111	111	111
89	93	106	106	93	106	106	106	111	106	106	106
195	188	188	188	188	188	188	188	188	188	188	188
159	199	199	199	199	199	199	199	199	199	199	199
89	96	96	96	96	89	66	42	53	66	66	66
119	133	133	133	133	133	138	168	177	177	177	177
149	149	149	149	127	127	127	133	133	133	133	133
137	168	168	168	168	168	168	133	133	134	134	134
142	142	142	0	159	159	168	168	173	173	173	173
50	47	53	53	53	58	69	66	72	76	76	76
123	124	124	124	124	124	124	127	124	86	86	86
142	159	168	168	177	195	212	230	221	196	196	196
89	89	89	89	89	89	89	0	66	66	66	66
133	106	115	133	133	106	106	106	106	106	106	106
93	142	142	142	142	142	142	142	173	180	180	180
133	124	142	159	159	159	155	155	152	155	155	155
170	186	177	186	186	186	186	195	195	168	168	168
149	149	159	159	150	150	159	159	159	159	159	159
232	288	288	288	288	288	286	310	319	338	341	341
100	111	111	111	111	111	111	112	111	108	108	108
310	443	443	416	416	363	381	381	381	381	381	381
0	0	0	0	31	31	31	31	31	31	31	31
6287.1	6992.4	6764.1	6102.1	5735.7	4935.6	4804.7	4186.1	3762.1	3721.4	3635.6	3635.6
-45	705	-228	-662	-366	-800	-131	-619	-424	-41	-86	0
51	50	48	43	38	34	33	29	25	25	24	24
123	140	141	142	151	145	146	144	150	149	151	151
5576.4	6570.2	5534.8	4850.7	3928.5	3830.3	3239.1	3373.6				
89	94	82	79	68	78	67	81				
1985	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998

Table A5—Inland U.S. West plywood capacity, by year of plant closure (1000 m^3)

State	County	Town	Current mill name	Original mill name	Year opened	Year closed or softwood production ceased	1965	1970	1975	1982	1985
MT	Missoula	Bonner	Stimson Lumber Co.	Champ Int Corp.	1974				266	310	282
OR	Klamath	Klamath Falls	Collins Pine	Weyerhaeuser	1971				80	80	80
ID	Payette	Emmett	Boise Cascade Corp.		1971				89	106	133
WA	Okanogan	Omak	Omak Wood Products	Bico-Kinzua	1970			102	106	128	164
WA	Stevens	Kettle Falls	Boise Cascade Corp.		1967			89	97	106	139
ID	Clearwater	Pierce	Potlach Corp.		1966			133	133	133	130
OR	Deschutes	Redmond	Crown Pacific	Brooks-Willamette	1965		100	102	111	133	150
MT	Flathead	Columbia Falls	Plum Creek	Plum Creek Lumber	1965		62	89	89	89	102
ID	Benewah	St. Maries	Potlach Corp.	St. Maries Plywood Co.	1964		53	111	111	164	156
OR	Union	Elgin	Boise Cascade Corp.		1964		75	133	133	97	133
MT	Lincoln	Libby	Stimson Lumber Co.	J. Neils Lumber Co.	1962		62	71	71	71	75
WA	Yakima	Yakima	Boise Cascade Corp.		1962		53	115	115	115	133
MT	Flathead	Kalispell	Plum Creek	C & C Plywood Corp.	1960		89	89	89	89	102
WA	Klickitat	Bingen	S.D.S Lumber Co.	Bingen Plywd & Ven Co.	1958		53	53	53	111	64
OR	Harney	Warm Springs	Warm Sprs. For Prod	Jefferson Plywood Co.	1956	1992	53	53	44	44	71
CA	Tehama	Red Bluff	Roseburg	Interstate Container Corp.	1956	1992	49	58	58	71	69
ID	Lewis	Lewiston	Potlatch Corp.		1952	1988	89	133	133	142	133
CA	Calaveras	Standard	Fibreboard Corp.	Pickering Lumber Co.	1960	1987	58	58	66	66	66
CA	Calaveras	Martell	American For Prod Co.	Winton Lumber	1959	1985	53	66	66	84	
ID	Kootenai	Post Falls	Idaho Veneer Co.		1964	1985	4	4	4	13	
CA	Shasta	Shasta	Champ Int	Shasta Plywood Inc.	1952	1984	89	89	89	119	
OR	Harney	Hines	Hines Lumber Co.		1965	1982	53	53	71	71	
CA	Humboldt	Scotia	Pacific Lumber Co.		1966	1982		62	62	62	
CA	Humboldt	Eureka	Simpson Timber Co.	Mutual Plywood Corp.	1950	1981	89	66	66		
MT	Missoula	Missoula	Evans Products Co.	Van-Evan Co.	1960	1980	115	115	115		
CA	Humboldt	Arcata	Simpson Timber Co.	Humboldt Plywood	1947	1979	80	106	106		
CA	Sonoma	Cloverdale	Cloverdale Products Co.	Cloverdale Plywd Co.	1957	1979	44	44	35		
WA	Spokane	Spokane	Boise Cascade Corp.	Suntex Plywood	1968	1979		44	80		
OR	Wheeler	Kinzua	Kinzua Corp.		1974	1979			115		
CA	Mendicino	Ft. Bragg	Lousiana-Pacific Corp.	Boise Cascade Corp.	1969	1977	97	111	111		
OR	Baker	Baker	Ellingson Bros Timbr Co.		1964	1975	75	75	75		
CA	Del Norte	Crescent City	Standard Plywood Co.	Std Veneer & Timber Co.	1954	1975	62	62	62		
CA	Humboldt	Fortuna	Fortuna Veneer Co.		1955	1975	106	106	106		
CA	Siskiyou	Weed	International Paper Co.		1911	1975	58	62	62		
CA	Humboldt	Arcata	Orleans Ven & Plywd Co.	Durable Plywood Co.	1955	1974	62	62			
OR	Klamath	Klamath Falls	Columbia Plywd Corp.	Kalpine Plywood	1957	1972	44	44			
MT	Lake	Polson	Pack River Plywd Co.		1970	1972		58			
MT	Flathead	Whitefish	Montana Plywood Inc.		1958	1970	13	13			
CA	Humboldt	Eureka	Simpson Timber Co.		1948	1969	66				
CA	Del Norte	Crescent City	N California Plywood Inc.	Paragon Plywood Inc.	1952	1967	84				
CA	Humboldt	Arcata	Arcata Plywood Corp.		1952	1967	62				
MT	Lake	Polson	Champ Int	Polson Plywood	1956	1967	58				
CA	Santa Clara	Santa Clara	Tri State Plywood Co.		1954	1967	44				
CA	Sonoma	Cloverdale	Lindroth Timber Products	KVV California Mills	1959	1966	44				
CA	Trinity	Salyer	Carolina-California Plywd		1958	1966	62				
CA	Humboldt	Redcrest	Pacific Lumber Co.	Hampton Plywood Co.	1959	1965	31				
CA	Los Angeles	Torrance	Plywood Mfg. of Calif.	Western Pacific Plywd	1953	1965	53				
CA	Shasta	Burney	Lorenz Lumber Co.		1963	1965	44				
Total (1000 m^3)							2388	2628	3067	2403	2181
Change (1000 m^3)								241	438	-664	-222
Number of mills							38	34	34	23	18
Average mill capacity (1000 m^3)							63	77	90	104	121
Production (1000 m^3)							1331	1558	1924	1419	1941
Capacity utilization (%)							56%	59%	63%	59%	89%

Note: Production estimates courtesy of APA—The Engineered Wood Association.

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
304	310	310	310	310	310	310	303	303	303	303
111	111	111	111	142	142	146	150	150	150	150
140	150	150	150	159	159	164	177	159	159	159
159	159	159	159	133	133	195	195	195	195	195
150	168	168	177	186	190	204	204	208	208	208
133	133	133	133	133	133	133	133	137	137	137
150	159	159	159	159	155	133	133	115	115	115
133	133	133	133	133	143	135	151	151	151	151
157	127	127	127	133	133	133	140	140	140	140
140	140	140	140	140	140	150	156	161	165	165
112	133	133	133	133	133	146	146	146	146	146
146	142	142	142	142	142	142	142	122	173	173
97	106	106	106	115	117	133	131	131	131	131
71	71	71	71	71	66	66	66	66	66	66
75	75	75	75	75						
80	102	102	102	102						
122										

2280	2218	2218	2227	2264	2095	2189	2226	2185	2239	2239
99	-62	0	9	37	-169	94	37	-41	54	0
17	16	16	16	16	14	14	14	14	14	14
134	139	139	139	141	150	156	159	156	160	160
2004	2177	2070	2007	2089	2019	1991	0	0	0	0
88%	98%	93%	90%	92%	96%	91%				

Table A6—Canadian plywood capacity, by year of plant closure (1000 m³)

Prov.	Location	Company	Year opened	Year closed or production ceased	1975	1980	1985	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
BC	Victoria	BC Forest Prod		1984	111	111													
BC	Nelson	Kootenay		1984	75	80													
NB	McAdam	St. Croix	1977	1984		89													
ON	Cochrane	Normick		1984	53	16													
BC	Nelson	BC Timber	1980	1986		80	80												
BC	New Westminster	Crown Forest Ind		1987	115	71	71	42											
BC	Surrey	Weldwood		1987	81	115	115	96											
AB	Grande Prairie	North Canadian For Ind		1989	71	68	62	62	60										
AB	Fort MacLeod	Crestbrook		1991	44	44	44	40	35	35	26								
BC	Port Alberni	MacMillan Bloedel		1991	162	162	162	156	159	159	159								
BC	Vancouver	MacMillan Bloedel		1991	100	106	106	96	106	106	106								
BC	New Westminster	Fletchers Challenge		1992	80	80	80	102	89	89	106	106							
BC	Vancouver	Evans Forest Prod.	1989	1992						137	137	137							
BC	Victoria	Victoria Plywood		1992	53	53	44	80	53	62	62	62							
BC	Vancouver	West Coast Plywood		1993	164	164	164	165	177	168	168	168	133						
BC	Golden	Evans Forest Prod.	1932	1996	106	106	115	121	121	124	142	142	135	135	135	135	135		
AB	Edmonton	Zeidler Forest Ind.	1934		84	102	110	106	89	97	106	106	124	150	155	155	177	177	177
BC	Williams Lake	Weldwood	1977			119	133	191	168	159	155	155	155	155	155	155	155	155	155
BC	Fort Nelson	Slocan Forest Prod.	1978			89	106	106	106	106	106	133	159	159	165	165	165	165	165
BC	Kelowna	Riverside Forest Prod.	1947		62	71	75	118	124	124	124	111	111	111	111	111	124	124	124
BC	Heffley Cr/Kamlps	Tolko			66	89	102	106	137	133	133	133	133	106	106	146	146	146	146
BC	Prince George	North Central Plywoods	1973		97	133	137	143	150	150	150	150	150	155	159	159	159	159	159
BC	Quesnel	Weldwood			124	128	133	143	150	146	146	150	150	150	150	150	150	150	150
BC	Richmond	Richmond Plywood	1956		177	146	146	159	177	177	177	177	171	177	209	209	209	209	209
BC	Savona	Ainsworth	1956		40	32	44	49	54	49	49	49	58	71	71	66	66	66	66
BC	New Westminster	Cantree>Slocan			80	80	133	140	140	133	133	133	115	97	97	97	97	97	97
BC	Armstrong	Riverside Forest Prod.	1948		119	142	142	150	150	159	159	159	177	195	195	195	199	199	199
BC	Canoe	Federated Co-op.	1945		53	62	64	86	85	84	84	84	89	89	96	96	96	96	96
ON	Nipigon	MacMillan Bloedel			23	23	23	23	23	23	23	23	23	34	34	34	34	34	34
SK	Hudson Bay	Saskfor McMillan	1946		64	64	72	72	73	71	71	71	71	75	73	75	75	75	75
Total (1000 m³)					2205	2621	2462	2551	2429	2492	2522	2249	1952	1858	1910	1947	1987	1852	1852
Change (1000 m³)						417	-160	89	-122	64	30	-273	-296	-95	52	37	40	-135	0
Number of mills					25	29	25	24	22	22	22	19	16	15	15	15	15	14	14
Average mill capacity (1000 m³)					88	90	98	106	110	113	115	118	122	124	127	130	132	132	132
Production (1000 m³)							1958		2162	1281	2033	1706	1837	1838	1859	1831	1814		
Capacity utilization (%)							80		89	51	81	76	94	99	97	94	91		

Note: Production estimates courtesy of APA—The Engineered Wood Association.

Table A7—Engineered joist capacity, by year of plant construction (million meters)

State/ prov.	Location	Company (former name)	Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
OR	Eugene	TJ–McMillan	77	1.5	5.5	5.5	5.5	5.5	5.5	7.3	7.3	7.3	7.3	9.1	9.1	18.3	18.3	18.3	18.3	32.0	32.0	32.0	60.0	60.0	60.0
OR	Tualatin	Wood–I	77	0.3	0.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5													
OH	Delaware	TJ–McMillan	78		0.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5								
OR	Tualatin	Willamette (TimJoist)	79			0.6	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1								
CA	Santa Rosa	Std. Structures	80				3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
AB	Claresholm	TJ–McMillan	80				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
GA	Valdosta	TJ–McMillan	80				3.0	4.6	5.5	6.1	7.3	7.3	7.3	7.3	7.3	7.3	9.1	9.1	9.1	9.1	9.1	9.1	30.5	45.0	60.0
NC	Oxford	TJ–McMillan (Alpine)	80				0.6	0.9	1.2	1.5	1.5	1.5	3.4	3.4	3.4	3.4	3.4	3.4	5.5	5.5	5.5				
UT	W Jordan	Wood–I West	80				0.6	0.6	0.6	0.6	0.6														
CO	Denver	Wood–I–Denver	81					0.3	0.3	0.3	0.3	0.3													
AZ	Phoenix	Wood–I–Arizona	81					0.6	0.6	0.6	0.6	0.6	0.6												
FL	Ocala	GP (Sun Enterprises)	83							2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	3.7	3.7	3.7	3.7	3.7
AB	Calgary	Jager	84								1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	6.1	6.1	6.1	6.1	6.1	6.1
OR	Stayton	TJ–McMillan	84								7.3	7.3	7.3	7.3	7.3	7.3	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
NC	Wilmington	LP (Mitek)	85									3.0	3.0	3.0	3.0	3.0	5.5	5.5	4.0	6.1	6.1	6.1	6.1	7.6	7.6
PQ	Bernieres	TJ–McMillan (Nordell)	87											3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4			
WI	Superior	Superior (Bear Paw)	88												0.3	0.3	0.3	0.3	0.7	0.7	0.7	0.7	0.7	1.8	1.8
ID	Priest River	LP	89													4.6	4.6	4.6							
NM	Albuquerque	Wadena (Weyerh, Am)	89													1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
WA	Chehalis	Web Joists, Inc.	89													0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
OR	White City	Boise Cascade	90														4.6	9.1	9.1	9.1	18.3	18.3	22.3	22.3	22.3
CA	Red Bluff	LP	90														3.0	3.0	3.7	9.1	6.1	6.1	6.1	9.1	9.1
PQ	Blainville	Jager	91															1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
NV	Woodburn	Willamette	91															6.4	6.4	7.3	7.3	8.8	18.3	18.3	18.3
OR	Fernley	LP	92																3.7	4.6	4.6	6.1	6.1	6.1	6.1
LA	Natchitoches	TJ–McMillan	93																	6.1	30.5	30.5	30.5	30.5	30.5
AB	Calgary	Nascor	94																		0.6	1.2	1.2	1.2	1.5
ON	Ottawa	Nascor–Kott Lumber	94																		0.6	1.2	1.2	1.2	1.5
OR	Hines	Tecton Lam.	94																		7.6	15.2	15.2	15.2	15.2
NC	Roxboro	GP (Arrowood)	95																			4.6	6.7	6.7	6.7
MB	Winnipeg	Nascor–All Fab	95																			0.6	1.2	1.2	1.2
BC	Ft St James	Nascor–Apollo F P	95																			0.6	1.2	1.2	1.2
ON	Thunder Bay	Nascor–DF floor jsts	95																			0.6	1.2	1.2	1.2
NJ	Salem	Nascor–GE Fabricators	95																			1.2	1.2	1.2	1.2
NC	Charlotte	Nascor–SE Materials	95																			1.2	1.2	1.2	1.2
TN	Cleveland	Nascor–Tri State Truss	95																			1.2	1.2	1.2	1.2
LA	Lena/Alexand	Boise Cascade	96																				9.1	18.3	18.3
BC	100 Mile Hse	Ainsworth	97																					0.9	3.0
NB	St Jacques	Alliance FP–Joists	97																					7.6	9.1
PQ		Maibec	97																					0.6	0.6
IN	Otterbein	Nascor–K&A Compnts	97																					0.3	0.9
IL	Harrisburg	Nascor–Southern Truss	97																					0.3	1.2
PQ	Degelis	Poutrelles Int	97																					3.0	3.0
KY	Hazard	TJ–McMillan	97																					8.8	27.4
SE	To be announ	TJ–McMillan	98																						9.1
AL	Thorsby	Union Camp	98																						7.6
SE	To be announ	Willamette	98																						7.3
Total capacity (million m)				1.8	6.4	9.1	21.6	24.4	25.6	30.8	40.8	44.8	44.8	49.4	49.7	65.5	79.2	88	90.2	122.5	163.1	179.5	252.1	303.1	366.7
Production (million m)							15.2	15.2	18.3	21.3	24.4	30.5	33.5	36	42.7	52.4	53.6	55.5	80.8	98.5	123.4	121	151.5	174.3	
Capacity utilization (%)							70	63	71	69	60	68	75	73	86	80	68	63	90	80	76	67	60	58	
Number of plants				2	3	4	9	11	11	12	14	14	12	12	13	16	18	18	18	19	22	28	28	35	38

Note: Production estimates courtesy of APA-The Engineered Wood Association and William Walters. Capacity estimates courtesy of William Walters, company reports and other individuals.

Table A8—LVL industry capacity, by year of plant construction (million m³)

State/ Prov.	Location	Company (former name)	Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
OR	Eugene	TJ–McMillan	70	0.015	0.015	0.030	0.029	0.045	0.045	0.057	0.057	0.057	0.057	0.057	0.057	0.085
OR	Junction City	TJ–McMillan	78									0.002	0.074	0.087	0.087	0.071
NC	Wilmington	LP (Mitek)	86													
LA	Natchitoches	TJ–McMillan	86													
NC	Roxboro	GP (Arrowd)	87													
OR	Hines	LP (Tecton)	87													
GA	Valdosta	TJ–McMillan	89													
OR	Stayton	TJ–McMillan	89													
OR	Winston	Willamette	89													
OR	White City	Boise–Casc	90													
QU	Ville Marie	Tembec	90													
NV	Fernley	LP	92													
OR	Brookings	S Coast L	94													
WV	Buckhannon	TJ–McMillan	95													
LA	Lena	Boise–Casc	96													
OR	Albany	Willamette	96													
AT	R Mtn Hse	Sunpine	97													
SE	To be announced	TJ–McMillan	98													
AL	Thorsby	Union Camp	98													
LA	Simmsboro	Willamette	98													
AK	Ketchikan	LP	99													
Total				0.015	0.015	0.030	0.029	0.045	0.045	0.057	0.057	0.059	0.131	0.144	0.144	0.156
Production (million m³)														0.085	0.113	0.113
Capacity utilization (%)														59	79	73
Number of plants				1	1	1	1	1	1	1	1	2	2	2	2	2

Note: Production estimates courtesy of APA—The Engineered Wood Association.

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	0.113	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.127	0.158	0.158	0.158	0.158	0.158	0.158
	0.071	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.108	0.108	0.108	0.108	0.108	0.108
				0.054	0.054	0.054	0.054	0.054	0.054	0.048	0.051	0.085	0.065	0.088	0.088	0.088
				0.028	0.057	0.057	0.113	0.113	0.113	0.113	0.113	0.170	0.204	0.204	0.204	0.204
					0.034	0.034	0	0	0	0	0	0.017	0.034	0.079	0.079	0.079
					0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
							0.113	0.113	0.113	0.113	0.113	0.113	0.119	0.119	0.119	0.119
							0.057	0.057	0.000	0	0.068	0.068	0.068	0	0	0.068
							0.034	0.034	0.034	0.034	0.034	0.034	0.051	0.045	0.045	0.045
								0.085	0.085	0.085	0.113	0.113	0.170	0.170	0.170	0.170
								0.018	0.018	0.018	0.018	0.018	0.018	0.020	0.020	0.020
										0.042	0.042	0.062	0.045	0.071	0.071	0.071
												0.011	0.028	0.028	0.028	0.028
													0.028	0.068	0.068	0.068
														0.062	0.125	0.125
														0.017	0.042	0.042
															0.023	0.079
																0.068
																0.079
																0.045
	0.184	0.212	0.212	0.294	0.447	0.447	0.674	0.777	0.720	0.757	0.910	1.048	1.187	1.327	1.437	1.754
	0.142	0.142	0.198	0.226	0.269	0.311	0.340	0.453	0.509	0.566	0.713	0.767	0.979	1.115	1.330	
	77	67	93	77	60	70	50	58	71	75	78	73	82	84	93	
	2	2	2	4	6	6	9	11	11	12	12	13	14	16	17	20

Table A9— U. S. particleboard capacity, by year of plant construction (1000 m^3)

State	Location	Company (former name)	Year Built	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
CA	Arcata	L–P (Sierra-P)		80	124	124	124	124	124	124	124	150	301	266	221	221	221	221
OR	Brownsville	Forr (Browns)		53	53	53	53	53	53	53	53	18						
CA	Chester	Collins Pine		42	42	42	42	42	42	42	42	44	50	57	53	64	64	64
CA	Crescent city	Hambro		21	21	41	41	41	41	41	41	44	46	50	50	60	62	53
Ark	Crossett	G–P		74	74	112	112	112	112	127	127	186	186	186	227	212	239	168
OR	Dillard	Permaneer		44	44	44	44	44	44	53	53	53	53					
OR	Eugene	Willam (Boh)		64	89	89	89	89	89	89	89	117	117	115	115	115	115	115
NC	Farmville	IP (Formica)		71	71	71	106	124	124	124								
MI	Gaylord	Champion		71	71	177	177	177	177	191	191	191	191	191				
Ark	Hope	S. Plaswood		21	21	25	25	25	25	25	25	25						
Ala	Hunstville	Giles-Kend		12	12	12	12	12	12	12	12	12	12	12	12	18	18	18
TX	Jacksonville	Wynnewood		21	21	21	21	21	21	21	32	32	32					
WA	Longview	I–P		12	21	21	21	18	18	18	18	18	19	19	19			
WI	Marinette	Rodman		27	35	35	42	42	42	42	42	42	42	42	44	32	44	42
OR	Medford	Timber prod		71	106	106	106	106	106	142	142	142	143	143	135	142	149	170
OR	N Bend	Weyerhaeuser		62	62	62	62	62	62	124	124							
CA	Redding	Champion		124	124	124	124	124	124	124	124	124	150					
CA	Redlands	Golden State		46	46	46	53	53	53	64	64	64						
OR	Sweet Home	Smurfit (Publ.)		21	21	21	21	35	35	35	35	35	27	27	23	28	28	
Ark	Truman	Singer		9	9	9	9	18	18	27	39	39	39	27	39	35	28	39
PA	Tyrone	Westvaco		44	44	44												
OR	White City	Down River		80	80	80	80	80	80	80	80	80	133	124	124	89	142	133
VA	South Boston	G–P (Cham)		53	53	53	53	53	53	53	53	113	113	124	133	136	149	149
VA	Waverly	I–P (Masonite)		106	106	106	106	106	106	106	106	142	142	159	159	172	172	177
IN	Seymour	Swain	1947	21	21	21	21	21	21	27	27	27	27	27	27	27	27	27
MS	Meridien	Kroehler	1959	21	21	21												
OR	Albany	Willamette	1960	177	177	177	177	294	294	294	294	294	299	314	312	303	297	303
OR	Oakridge	Pope–Talb	1963	42	42	53	53	53	53	53								
NC	Lenoir	Nu–Wood	1964	13	13	27	27	27	27	27	27	30	30	30	44	41	42	42
OR	Springfield	Weyerhaeuser	1965	53	53	53												
OR	Bend	Willam (Brooks)	1966	80	80	80	195	195	195	195	195	248	248	257	253	266	239	248
OR	LaGrande	Boise	1966	115	115	115	115	212	212	266	266	266	266	271	294	269	271	273
Ky	Middlesboro	Tenn–Flake	1967	53	89	89	89	89	89	89	89	89						
WI	Marshfield	Weyerhaeuser	1967	67	67	67	67	67	106	106	106	110	110	113	124	112	117	115
MS	Louisville	G-P	1967	106	127	127	127	127	159	159	159	159	161	161	188	159	177	131
TX	Silsbee	Evans Pr	1967	80	124	124	127	127										
GA	Adel	Weyerhaeuser	1968		62	62	62	62	89	89	89	89	133	133	133	124	124	133
Ark	Malvern	I–P	1968		124	124	124	124	124	124	124	124						
GA	Vienna	G–P	1969			133	133	159	159	159	159	159	177	181	181	186	186	186
MS	Oxford	G–P (Cl)	1969			177	177	177	195	195	204	212	212	212	212	232	269	274
NM	Albuquerque	Ponderosa (Mexw)	1970				53	53	53	53	53	53	80	80	74	80	80	80
OR	Springfield	Weyerhae	1970				159	159	159	159	159	159	177	186	186	177	186	177
SC	Greenwood	I–P	1970				124	124	124	124	124							
AZ	Flagstaff	SWFI	1970				133	133	133	133	133	133						
MT	Missoula	L–P (Evans Pr)	1970				142	142	142	142	150	159	170	170	177	170	177	177
OR	Roseburg/Dil	Roseburg	1971					177	177	177	177	266	489	489	489	510	510	510
OR	Klamath Falls	Weyerhaeuser	1971					99	99	127	127	168	168	168	170	165	168	177
LA	Urania	L–P (G–P)	1971					127	127	168	168	168	168	159	159	159	159	177
MS	Taylorsville	G–P	1971					129	129	212	212	212	212	212	212	198	186	152
TX	Diboll	Temple	1971					142	142	142	142	177	177	159	159	177	177	177
SC	Russelville	G–P	1971					168	168	168	168	168	212	192	196	191	186	191
LA	Lillie	Willam (Olinkr)	1971					177	177	177	177	177	177	177	177	177	177	177
CA	Chowchilla	Wickes	1972						28	57	57	57	64	60	65	64	64	65
LA	Ruston	Willamette	1972						106	106	106	106	120	113	110	115	117	142
VA	Franklin	Union Camp	1972						106	106	124	124	149	149	135	138	142	133
CA	Ukiah	L–P (G–P)	1972						142	142	142	142	143	142	142	142		
CA	Martell	G–P (AFPC)	1972						159	159	159	159	168	170	165	172	204	195
IN	Evanston	Swain	1973							21	21	21	21	22	21	19	23	27
FL	Greenville	Fla–ply	1973							18	18	18	18	18	14	42	28	19
VA	Stuart	I–P (Stuart)	1973							106	106	106	106	106	89	80	97	106
TX	Corrigan	L–P (G–P)	1973							80	159	159	177	177	177			
Ala	Monroeville	T–I (Olinkr)	1974								35	142	186	177	177	177	177	177
Ala	Pine Hill	McM–Bloed	1974								177	177	177	177	177	177		
MN	Virginia	Publishers	1974								21	21	21	21	14	14	14	
TX	Silsbee	L–P (Kirby)	1974								124	124	124	127	127	127	127	127
GA	Thomson	Temple	1974								53	177	177	159	177	177	177	177
Ala	Eufala	L–P	1975									191	191	177	177			
ID	Post Falls	Potlatch	1975									89	101	106	120	120	120	127
NC	Lenoir	Broyhill	1976										48	74	48	35	44	44
OR	Philomath	Smurfit (Publ.)	1976										30	30	34	30	30	35
NM	Navajo	Navajo FP	1976										53	53	53	51	51	44
MI	Gaylord	G–P (Cham)	1978												290	304	319	310
SD	Rapid City	Merrillat	1984															
VA	Galax	Webb	1985															
VA	Ridgeway	Triwood, Inc	1985															
NC	Moncure	Weyerhaeuser	1987															
PA	Mt Jewett	Allegheny	1990															
Ark	Hope	Temple Inland	1996															
TX	Eastern Tx	I–P	1997															
		Others		177	142	124	89	89	89	89	89	89	89	89	89	89	89	89
Total (1000 m^3)			2023	2236	2610	3092	3717	5014	5544	6163	6535	7218	7651	7380	7521	7119	7007	6892
Change (1000 m^3)			2023	212	374	482	625	1297	529	619	372	683	433	-271	141	-402	-112	-115
Number of mills			46	46	46	51	55	59	62	62	62	58	57	54	54	52	50	47
Average mill capacity (1000 m^3)			44	49	57	61	68	85	89	99	105	124	134	137	139	137	140	147
Production (1000 m^3)			1678	1901	2462	2977	3066	4175	5450	6124	5443	4430	5645	6317	6682	6089	5310	5151
Capacity utilization (%)			83	85	94	96	82	83	98	99	83	61	74	86	89	86	76	75

Note: Production estimates courtesy of Composite Panel Association.

1982/83	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	138	138	177	177	204	212	230	230	230	230	230	230	230	230
	67													
	44	53	53	62	62	64	64	62	62	62	62	62	62	62
	106	127	127	131	133	142	142	142	142	142	142	89		
	21	18	32	32	11	11	11	11	11	11	11	11	11	11
	62	62	62	62	76	76	76	76	76	76	76	76	76	76
	170	170	170	170	170	170	170	170	170	170	170	170	170	170
											39	39	39	39
	177	177	191	191	191	191	191	191	191	191	191	198	198	
	170	170	172	173	173	173	182	177	177	177	177	184	184	184
	27	27	30	30	30	30	30	30	30	30	30	28	28	28
	315	301	319	335	336	336	375	381	381	381	381	372	372	372
	42	42	42	42	42	41	41	28	28	28	28	41	41	41
	251	266	301	301	301	301	301	301	301	301	301	283	283	283
	294	315	320	319	319	326	331	331	327	327	327	345	345	345
	113	113	113	124	124	124	124	124	124	124	124	142	142	142
	119	166	172	219	219	182	182	209	209	209	230	230	230	230
	133	133	133	133	152	158	163	163	165	165	165	186	248	248
	191	198	202	205	212	209	202	198	204	204	204	219	219	219
	310	342	354	354	354	354	354	354	310	310	354	354	354	354
	80	85	85	85	85	80	89	89	89	89	89	89	89	89
	170	170	170	170	177	186	230	230	230	230	230	248	266	266
	170	170	177	266	266	266	266	266	266	266	266	266	266	266
	531	531	558	602	602	602	620	620	620	620	646	726	726	726
	177	177	177	177	177	184	184	186	186	186	195	248	248	248
	127	186	189	195	200	212	205	221	221	221	248	274	274	274
	159	181	186	186	186	195	195	202	195	195	195	195	195	195
	195	212	223	223	216	221	221	221	221	221	221	278	278	278
	177	158	168	177	177	177	177	186	195	195	195	212	221	230
	145	149	159	172	172	172	181	181	177	177	177	177	177	177
	154	150	154	159	163	163	159	159	159	159	159	221	221	221
	186	204	204	230	230	248	248	248	248	248	248	266	266	266
	21	27	32	32	32	32	32	32	32	32	32	28	28	28
	30	30	25	25	25	25	30	30	30	30	30	30	30	30
	97	97	97	135	135	135	138	138	138	138	138	127	127	127
	184	177	212	212	204	204	212	212	212	212	212	212	266	266
	127	127					124	124	124	124	124	142	142	142
	159	191	181	181	181	186	186	193	193	193	193	193	193	193
	133	133	133	135	135	135	133	129	129	129	129	129	129	129
	44	55	55	55	55	51	50	53	53	53	53	71	71	71
	39	39	50	50	50	50	50	50	60	60	60	60	60	60
	64	67	67	67	67	64	71							
	354	354	366	366	443	427	427	425	425	425	425	435	435	435
	156	115	150	154	166	168	168	186	186	186	186	168	168	168
		32	27	28	28	25	27	28	28	28	28	28	28	28
		35	35	35	35	35	35	35	35	35	35	35	35	35
				159	159	159	168	186	186	186	186	186	266	266
							329	329	329	329	329	329	329	329
														301
														301
	71	71	71	71	71	71	71	35	35	35	35	35	35	35
	6501	6740	6921	7406	7544	7569	8192	8170	8138	8138	8305	8668	8800	9213
NA		239	181	485	138	25	623	-21	-32	0	166	363	133	412
NA	43	44	43	44	44	44	46	45	45	45	46	46	45	46
NA	151	153	161	168	171	172	178	182	181	181	181	188	196	200
	5657	5896	6377	6560	6777	6852	6876	6779	7207	7531	8204	8408	8496	
	87	87	92	89	90	91	84	83	89	93	99	97	97	

Table A10—Canadian particleboard capacity, by year of plant construction (1000 m³)

Prov-ince	Location	Company	Year built	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
BC	Grand Forks	CanPar	1976														35	44
BC	Vancouver	McM-Bl	1962	37	37	37	57	71	71	71	78	78	85	85	89	92	92	96
BC	Smithers	Northwest P	1983															
MA	Sprague	Weldwood	1962	21	21	21	35	35	37	35	35	35	35	35	35	35		
MA	Winnipeg	Palliser	1994															
NB	St Stephen	Flake Bd	1960	35	35	35	44	60	53	48	48	48	48	48	48	48	53	53
ON	Sturgeon F	Abitibi	1958	35	35	35												
ON	Bancroft	Comb/GP	1991															
ON	Huntsville	Domtar	1974											74	74	74	74	74
ON	Hearst	Levesque	1976												80	80	80	80
ON	Timmins	Mallette	1972								64	64	64	64	64	64	64	64
ON	Atikokan	Proboard	1976												80	80	80	81
ON	New Liskeard	Rexwood	1964	18	18	44	44	44	44	44	53	53	62	62	62	62	62	62
QU	Val d'Or	Forpan	1964														150	150
QU	Sayabec	Panval	1983															
QU	Lac des Iles	Sogefors	1960	27	27	27	71	71	71	80	80	89	97	97	97	97	92	92
QU	Lac-Megantic	Tafisa	1992															
Total (1000 m³)				173	173	200	251	281	276	278	358	366	391	466	628	632	782	797
Change (1000 m³)					0	27	51	30	-5	2	80	9	25	74	163	4	150	14
Production (1000 m³)															496	519	637	710
Capacity utilization (%)														0	79	82	81	89

Note: Production estimates courtesy of Composite Panel Association.

1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
53	53	71	71	71	74	74	80	80	115	115	126	147	147	147	177	177	177
96	96	96	96	96	96	96	96	101	101	97	96	99	99	99	96	96	96
			89	80	76	74	71	62	62	53	44	44	44	44	64	64	64
														53	53	53	53
71	71	71	71	71	80	124	142	142	142	145	149	149	149	149	159	168	168
											188	188	188	248	251	251	251
74	74	80	80	80	80	80	80	89	89	133	177	177	177	177	230	230	230
80	97	97	97	97	97	103	103	103	103	101	101	110	110	110	101	101	101
64	64	64	64	64	64	64	64	67	57	53	50						
89	89	97	124	124	124	124	124	124	124	110	110	110	110	110	150	150	150
62	62	62	62	62	71	71	80	115	115	115	115	115	115	115	113	113	113
150	150	150	150	212	230	248	248	248	266	274	289	301	301	301	400	400	400
			177	177	177	177	177	177	177	195	212	212	212	212	241	241	241
110	110	115	119	119	159	159	159	159	106								
												147	147	147	227	227	227
848	866	903	1198	1251	1328	1393	1421	1466	1455	1391	1655	1798	1798	1912	2262	2271	2271
51	18	37	296	53	76	65	28	44	-11	-64	264	143	0	113	350	9	0
720	715	563	717	843	1044	1138	1354	1212	1278	1145	1058	1205	1421	1476	1682	1770	1770
85	83	62	60	67	79	82	95	83	88	82	64	67	79	77	74	78	78

Table A11—MDF capacity by year of plant construction (1000 m³)

State	Location	Company (former name)	Year built	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
NY	Deposit	Norbord	1966	50	50	50	50	50	50	50	50	50	44	44	50	50	50	
VA	Bassett	Bassett	1969	35	35	35	35	35	35	39	42	42	39	39	39	39	39	39
MS	Meridian	Kroehler	1970		33	33	33	33	33	33	33	33	33					
OR	Oakridge	Pope-Talbot	1971			53	53	53	78	78								
NC	Moncure	Weyerhaeus	1971			110	110	110	110	110	110	106	106	106	106	106	106	106
OK	Broken Bow	Pan Pac (Weyer)	1972				127	127	127	127	127	150	124	124	124	124	124	126
NC	Spring Hope	I-P (Masonite)	1973					71	97	106	124	124	127	131	131	131	131	131
SC	Marion	I-P (Masonite)	1974						101	101	101	101	97	97	101	101	101	101
MT	Columbia Falls	Plum Creek	1974						124	124	124	124	133	135	142	142	142	142
SC	Hollly Hill	G-P (HH)	1975							89	89	89	106	106	110	110	110	143
CA	Oroville	L-P	1975							89	89	89	89	89	89	89	89	89
OR	Medford	Medite	1975							114	114	124	142	142	142	142	142	150
CA	Rocklin	Bohemia (Fbd, S. Pine)	1976								106	106	106	120	133	133	133	142
AL	Eufala	L-P	1979											106	106	106	106	106
AL	White Court	W Fras (Blue Rdg)	1981													80	90	90
AR	Malvern	Willamette	1983															71
NM	Las Vegas	Medite	1984															
MI	Newberry	L-P	1985															
PQ	Mont-Laurier	Unibd (Panfibre)	1986															
SC	Bennetsville	Willamette	1990															
NB	St. Stephen	Flakeboard	1991															
LA	Urania	L-P	1993															
PA	Mt Jewett	Allegheny	1995															
OR	Eugene	Willamette	1996															
GA	Monticello	G-P	1996															
ON	SaultSteMarie	G-P	1996															
PA	Shippenville	MB/Clarion	1996															
ON	Pembroke	MB/FIDEV	1996															
BC	Quesnel	West Fraser	1996															
PQ	La Baie	Uniboard	1997															
NY	Lackawana	Canfibre	1997															
AR	ElDorado	Temple–Inl/Deltic	1997															
PQ	Shawinigan	G. Crete & Fils Ltd.	1997															
BC	Prince George	Canfor/Sinclair	1998															
GA	Willacoochie	Langlade	1998															
Total (1000 m³)				85	118	281	408	479	755	1059	1109	1138	1146	1239	1271	1351	1361	1435
Number of mills				2	3	5	6	7	9	12	12	12	12	12	12	13	13	13
Production, total (1000 m³)									393	381	496	781	940	938	908	991	903	1195
Capacity utilization (%)									52	36	45	69	82	76	71	73	66	83
Production, U.S. (1000 m³)									393	381	496	781	940	938	908	938	832	1115
Production, Canada (1000 m³)																53	71	80
Price ($/cm)				116	93	88	91	108	110	100	110	116	128	152	166	192	183	185

Note: Production estimates courtesy of Composite Panel Association.

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
		97	97	97	97	96	97	97	106	113	110	110	110	110
39	39	39	39	37	37	37	37	37	37	37	37	37	37	37
124	124	124	124	124	124	133	142	142	142	142	133	133	133	133
133	133	133	133	225	225	53					65	239	239	239
127	131	110	110	110	110	119	122	122	122	122	122	122	122	122
101	101	101	101	101	101	112	112	112	112	122	133	133	133	133
142	142	142	150	156	154	177	195	195	195	218	218	218	218	218
143	143	143	143	177	170	177	177	177	177	177	177	177	177	177
89	89	89	89	78	78	78	78	78	78	78	78	89	89	89
150	150	156	156	165	168	177	170	170	170	170	177	177	177	177
142	133	142	145	145	156	156	150	156	156	165	165	165	165	165
124	124	124	124	212	212	221	221	230	230	230	239	239	239	239
90	90	90	106	106	106	106	106	106	106	115	195	195	195	195
80	87	103	212	212	212	212	212	212	212	212	216	219	283	283
142	142	142	142	150	159	159	159	159	159	159	159	159		
	89	89	89	106										
		106	106	106	106	112	112	112	112	119	124	124	124	124
						177	177	212	212	212	216	230	257	257
							71	85	97	97	101	145	145	154
									89	106	89	89	89	89
											177	177	177	177
												80	106	106
												142	283	283
												266	266	266
												71	177	230
												124	253	230
												71	177	212
													110	219
													34	34
													133	266
													124	124
														250
														212
1625	1715	1928	2066	2308	2216	2301	2338	2402	2512	2595	2929	3928	4772	5547
14	15	17	17	17	16	17	17	17	18	18	20	26	29	31
1243	1319	1522	1788	1867	1936	1883	1922	2189	2335	2524	2912	3372		
76	77	79	87	81	87	82	82	91	93	97	99	86		
1165	1241	1416	1628	1690	1751	1715	1729	1933	2078	2241	2611	2699		
78	78	106	159	177	186	168	193	257	257	283	301	673		
193	200	193	190	181	183	185	185	190	207	244				

Appendix B—Trade of Wood-Based Panel Products

Table B1provides data on production and consumption of wood-based panels in terms of exports and imports within the United States and Canada. Data on major foreign markets for various Canadian and U.S. panel products are shown in Tables B2 and Table B3.

Table B1—Trade as a part of production and consumption of wood-based panels (1000 m^3)[a,b]

	Canada					United States				
	1992	1993	1994	1995	1996[c]	1992	1993	1994	1995	1996[c]
Softwood plywood (HS code 441219)										
Production total	1,838	1,824	1,834	1,831	1,814	17,109	17,094	17,380	17,140	16,975
Exports	289	272	342	626	646	1,276	1,247	1,072	1,121	1,105
Percent of production	16%	15%	19%	34%	36%	7%	7%	6%	7%	6.51%
Percent to U.S./Canada	4%	6%	6%	4%	4%	6%	9%	7%	10%	15%
Supply for domestic consumption	1,632	1,664	1,561	1,318	1,335	15,874	15,883	16,349	16,070	15,938
Imports	83	112	69	113	167	41	36	41	53	68
Percent of domestic supply	5%	7%	4%	9%	12%	0.3%	0.2%	0.3%	0.3%	0.4%
Percent from U.S./Canada	100%	100%	100%	99%	99.7%	31%	44%	50%	47%	42%
OSB (HS code 441011)										
Production total	2,049	2,751	3,016	3,374	4,685	5,888	6,197	6,625	6,994	8,243
Exports	1,464	2,081	2,434	3,066	4,127	43	53	69	72	139
Percent of production	71%	76%	81%	91%	88%	1%	1%	1%	1%	2%
Percent to U.S./Canada	95%	92%	94%	93%	95%	55%	69%	93%	83%	58%
Supply for domestic consumption	609	706	647	368	638	7,236	8,058	8,846	9,767	12,011
Imports	24	36	65	60	80	1,391	1,914	2,290	2,845	3,907
Percent of domestic supply	4%	5%	10%	16%	13%	19%	24%	26%	29%	33%
Percent from U.S./Canada	100%	100%	98%	100%	100%	96%	84%	91%	90%	100%
Particleboard (HS code 441019)										
Production total (U.S. shipments)	1,207	1,422	1,477	1,935	2,072	7,044	7,507	8,039	7,434	7,742
Exports	598	887	1,011	1,205	1,058	478	373	336	375	346
Percent of production	50%	62%	68%	62%	51%	7%	5%	4%	5%	4%
Percent to U.S./Canada	96%	95%	96%	96%	96%	27%	39%	46%	40%	54%
Supply for domestic consumption	694	637	580	832	1,222	7,201	8,055	8,940	8,420	8,579
Imports	85	102	114	102	208	635	921	1,237	1,360	1,183
Percent of domestic supply	12%	16%	20%	12%	17%	9%	11%	14%	16%	14%
Percent from U.S./Canada	89%	92%	95%	97%	90%	51%	50%	37%	42%	85%
MDF (HS codes 441121, 441129)										
Production total (U.S. shipments)[d]	290	320	353	292	469	1,887	2,055	2,213	1,959	2,169
Exports	170	154	168	148	157	220	189	190	190	114
Percent of production	59%	48%	47%	51%	33%	12%	9%	9%	10%	5%
Percent to U.S./Canada	37%	44%	61%	65%	82%	16%	25%	39%	41%	51%
Supply for domestic consumption	161	222	261	222	378	1,748	1,958	2,158	1,895	2,313
Imports	41	56	76	78	66	81	92	134	126	258
Percent of domestic supply	26%	25%	29%	35%	17%	5%	5%	6%	7%	11%
Percent from U.S./Canada	99.6%	99%	99.7%	99%	94%	60%	57%	59%	59%	50%

[a]Percentages are shown in decimals where whole numbers could be misleading.
Conversion factors: 1,000 ft^2, 1/8 in. = 0.295 m^3; 1,000 ft^2, 3/8 in. = 0 .885 m^3; 1,000 ft^2, 3/4 in. = 1.770 m^3.

[b]Sources: Adair (1997), AF&PA (1993–1996), USDA FAS (1997), Statistics Canada (1994, 1995,1997a,b,c), Composite Panel Assoc. (1997), Wood Technology (1996).

[c]Preliminary data.

[d]Canadian production statistics for MDF include all fiberboard grades—high and medium density (HS codes 441110, 441120). Trade statistics for MDF calculated using 1.2987 m^3/tonne, which assumes a density of 770 kg/m^3.

Table B2—Major foreign markets for Canadian and U.S. softwood plywood and OSB (1,000 m^3)

	1990	1991	1992	1993	1994	1995	1996[a]
Softwood plywood (HS 441219; SIC 2436)							
U.S. export markets							
Canada	122	140	80	110	72	112	166
Mexico	60	138	181	186	151	34	69
Caribbean	83	83	82	94	92	120	125
European Union (15)	1,054	750	893	797	720	814	685
Japan	15	20	7	15	10	12	27
Total U.S. exports	1,428	1,170	1,276	1,247	1,072	1,121	1,105
Less exports to Canada	122	140	80	110	72	112	166
U.S. exports to other markets	1,306	1,030	1,196	1,137	1,000	1,009	939
Canadian export markets							
U.S.	16	8	13	16	21	25	29
European Union (12)	184	155	195	135	157	295	139
Japan	60	66	73	98	152	278	448
Total Canadian exports	286	236	289	272	342	626	646
Less exports to U.S.	16	8	13	16	21	25	29
Canadian exports to other markets	270	228	275	256	321	601	617
OSB and waferboard (HS 441011)							
U.S. export markets							
Canada	18	36	24	37	64	60	80
Mexico	NA	0.2	3	1	0.3	0.2	7
European Union (15)	NA	10	15	10	0.6	1	0.2
Japan	NA	0.3	0.2	2	3	8	44
Total U.S. exports	NA	50	43	53	69	72	139
Less exports to Canada	18	36	24	37	64	60	80
U.S. exports to all other markets	NA	15	19	16	5	12	59
Canadian export markets							
U.S.	1,141	874	1,392	1,914	2,289	2,846	3,923
European Union (12)	36	5	17	10	3	3	4
Japan	9	12	50	118	129	169	161
S. Korea & Taiwan	1	1	3	36	10	39	28
Total Canadian exports	1,187	894	1,464	2,081	2,434	3,066	4,127
Less exports to U.S.	1,141	874	1,392	1,914	2,289	2,846	3,923
Canadian exports to other markets	46	20	72	167	145	220	204

[a]Preliminary data. Sources: USDA FAS (1994, 1996d,1997), Statistics Canada (1997b).

Table B3—Major foreign markets for Canadian and U.S. particleboard and MDF (1,000 m^3)

	1990	1991	1992	1993	1994	1995	1996[a]
Particleboard (HS441019; SIC2493)							
U.S. export markets							
Canada	117	92	130	146	156	151	188
Mexico	61	55	76	58	72	64	50
South Korea	126	111	113	60	26	65	17
Taiwan	60	86	93	63	40	41	33
Japan	33	26	20	11	11	8	9
Hong Kong	4	8	17	13	18	29	32
Total U.S. exports	440	400	478	373	336	375	346
Less exports to Canada	122	92	130	146	156	151	188
U.S. exports to other markets	318	308	348	227	180	223	158
Canadian export markets							
U.S.	365	329	573	845	970	1,155	1,017
South Korea	18	19	20	33	35	46	31
Taiwan & Hong Kong	0.3	0.1	5	7	2	3	9
Total Canadian exports	385	349	598	887	1,011	1,205	1,058
Less exports to U.S.	365	329	573	845	970	1,155	1,017
Canadian exports to other markets	19	20	25	42	41	50	41
MDF (HS441121, 441129; SIC2493)							
U.S. export markets							
Canada	21	26	35	48	73	77	57
Mexico	3	2	17	7	13	4	9
European Union (15)	27	26	16	6	1	10	1
South Korea	30	47	35	30	25	27	5
Taiwan & Hong Kong	82	91	67	53	34	28	18
Japan	21	18	12	15	20	14	11
Total U.S. exports	220	253	220	189	190	190	114
Less exports to Canada	21	26	35	48	73	77	57
U.S. exports to other markets	198	227	185	141	116	113	57
Canadian export markets							
U.S.	45	31	63	68	102	97	128
Japan	12	18	20	19	22	5	7
South Korea	5	11	4	5	7	2	2
Taiwan & Hong Kong	47	25	22	28	20	12	9
Greece, Sweden, Finland, Netherlands	33	36	39	13	6	5	2
Total Canadian exports	165	143	170	154	168	148	157
Less exports to U.S.	45	31	63	68	102	97	128
Canadian exports to other markets	120	112	107	86	65	52	29

[a]Preliminary data. Sources: USDA FAS (1994, 1996d,1997). Statistics Canada (1997b).