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California's Forest Products Industry and Timber Harvest, 2012

Chelsea P. McIver, Joshua P. Meek, Micah G. Scudder, Colin B. Sorenson, Todd A. Morgan, and Glenn A. Christensen

Forest Service
Pacific Northwest Research Station
General Technical Report PNW-GTR-908
October 2015

Authors

Chelsea P. McIver is a research associate, **Joshua P. Meek** was a research assistant; **Micah G. Scudder** is a research associate, **Colin B. Sorenson** is a research economist, and **Todd A. Morgan** is the director of Forest Industry Research, Bureau of Business and Economic Research, Gallagher Business Building, University of Montana, Missoula, MT 59812. **Glenn A. Christensen** is a forester, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 620 SW Main St., Suite 400, Portland, OR 97205.

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Abstract

McIver, Chelsea P.; Meek, Joshua P.; Scudder, Micah G.; Sorenson, Colin B.; Morgan, Todd A.; Christensen, Glenn A. 2015. California's forest products industry and timber harvest, 2012. Gen. Tech. Rep. PNW-GTR-908. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 49 p.

This report traces the flow of California's 2012 timber harvest through the primary wood products industry and provides a description of the structure, condition, and economic impacts of California's forest products sector. Historical forest products industry changes are discussed, as well as trends in harvest, production, mill residue, and sales. Also examined are employment and worker earnings in the state's primary and secondary forest products industry.

Keywords: Bioenergy, employment, forest economics, lumber production, mill residue, mill capacity, wood products, timber harvest, timber processors, wood utilization.

Highlights

- A total of 77 primary forest products facilities operated in California during 2012. These included 30 sawmills, 26 bioenergy plants, 11 bark and mulch facilities, 2 veneer plants, and 8 manufacturers of other primary wood products.
- California's timber harvest was 1,425 million board feet (MMBF) Scribner in 2012, representing an 18 percent decline since 2006. Over 55 percent (785 MMBF) of the timber harvest came from five counties. For the first time since 1968, Shasta County provided the largest proportion at 16 percent (229 MMBF), followed by Humboldt County with a timber harvest of 215 MMBF.
- Eighty-three percent of California's 2012 timber harvest came from private lands, 14 percent came from national forests, and the remaining 3 percent came from other public sources. Nearly all (97 percent) of the timber harvested in California was processed within the state.
- Over half of the 360 million cubic feet (MMCF) of wood fiber (excluding bark) harvested in California in 2012 was used to generate energy, usually in the form of heat for steam or electricity. Another 32 percent of the volume became lumber, and the remaining 16 percent was used as raw material for a variety of other products.
- Total sales value for California's primary forest products was about $1.4 billion in 2012, with lumber accounting for 64 percent of the total. The majority (77 percent) of all products were sold in California. Two sectors accounted for nearly 90 percent of industry sales value: sawmills and bioenergy plants.
- California sawmills produced 1.9 billion board feet of lumber in 2012, just under 7 percent of U.S. production of softwood lumber and just over 5 percent of U.S. consumption.
- California's forest products industry's annual capacity to process sawtimber has decreased by more than 70 percent, from 6 billion board feet Scribner in the late 1980s to 1.8 billion board feet in 2012. Of this total capacity, 72 percent was utilized in 2012.

- Approximately 52,200 workers, earning $3.3 billion annually, are employed in the forest industry in California, including primary and secondary wood and paper products, private sector forestry and logging, and forestry support activities.
- California's primary facilities produced over 1.9 million bone-dry tons (1.6 million bone-dry units) of residue; 62 percent was utilized by the biomass energy sector, 26 percent by the landscape and other products sector, and 11 percent by the pulp and board sector; less than 1 percent went unutilized.

Contents

Introduction

This report describes the utilization of California's 2012 timber harvest and the conditions, structure, and operations of the state's primary forest products industry. Primary forest products manufacturers are firms that process timber into manufactured goods such as lumber or veneer, and facilities such as biomass power or particleboard plants that use the wood fiber residue directly from harvest sites or timber processors. Also described are recent and historical trends in the state's timber use, including raw material sources, inventory, growth, and harvest. Other areas covered in this report include the extent and efficiency of California's processing infrastructure and the volume and value of primary products and residues.

Information presented in this report is generated through a statewide census of California's manufacturers of primary forest products active in 2012. The census also includes data from firms in adjacent states utilizing raw material from California during the 2012 calendar year. The 2012 report focuses primarily on changes since the 2006 census (Morgan et al. 2012) with updated information through 2013 where available. Important relationships of current data to findings prior to 2006 have been noted. For a more detailed discussion of historical trends in timber harvesting and processing in California, see Morgan et al. (2012) and Morgan et al. (2004), which summarize previous applications of the statewide industry census.

The University of Montana's Bureau of Business and Economic Research (BBER) and the U.S. Department of Agriculture, Forest Service, Pacific Northwest (PNW) Research Station cooperated in the analysis and preparation of this report. The BBER, in cooperation with the Forest Inventory and Analysis (FIA) program at the PNW Research Station, has been studying the region's forest products industry since 1998. This report represents BBER's third such study of California's timber harvest and forest products industry since 2000.

Forest Industries Data Collection System

The Forest Industries Data Collection System (FIDACS) was developed by the BBER in cooperation with the FIA programs in the Rocky Mountain and PNW Research Stations to collect, compile, and report data from primary forest products manufacturers.

Primary forest products firms were identified through the use of various phone directories, industry associations, Internet searches, and through previous censuses. The written census questionnaires are distributed by mail, fax, or email and are administered over the telephone when necessary. A single questionnaire is completed for each wood-processing facility and includes the following information:

- Plant production, capacity, and employment.
- Volume of raw material received, by county and ownership.
- Species mix and proportion of standing dead timber received (if applicable).
- Finished product volumes, types (including energy), sales value, and market locations.
- Utilization and marketing of manufacturing residue.

Manufacturers who participated in the 2012 California forest industry census processed virtually all of the state's commercial timber harvest. Other data sources (Ehinger 2012, Random Lengths 1976–2013, WWPA 1964–2013) were used to estimate attributes for firms that did not participate in the survey. Additional information from federal, state, and private sources was used to verify estimates of the total timber harvest, lumber production, employment, and sales value of products.

Information collected through FIDACS is stored by the University of Montana's BBER. Because of the substantial detail on the industry and its timber use, there is a time lag between the date of the census and the publication of this report. To make this report more timely, results and a summary are made available online as they are compiled and reviewed (http://www.bber.umt.edu/fir). In addition, key data from other sources are included to provide the most recent measures of general industry activity, and references to other publications dealing with industry conditions are included. Additional information is available by request. However, individual firm-level data are confidential and will not be released.

The Operating Environment of California's Forest Products Industry

The last application of the FIDACS in California detailed industry operations during 2006, which marked the end of several years of very high housing starts and record consumption of wood products in the United States (Woodall et al. 2012). High housing and wood products demand were fueled not just by a strong economy, but by easily obtained credit and low interest rates, which contributed to speculative new home construction.

Annual U.S. housing starts fell from almost 2.1 million units in 2005 to 554,000 units during 2009, their lowest level in more than six decades (fig. 1). Associated with the housing collapse was an economic recession—often termed the "Great Recession"—that officially lasted from December 2007 to June 2009 (NBER 2010), but the impacts on home construction and demand for lumber and other wood products continued. The challenging economic conditions experienced by the forest products industry in 2009 improved only slightly during 2010 and 2011. Housing

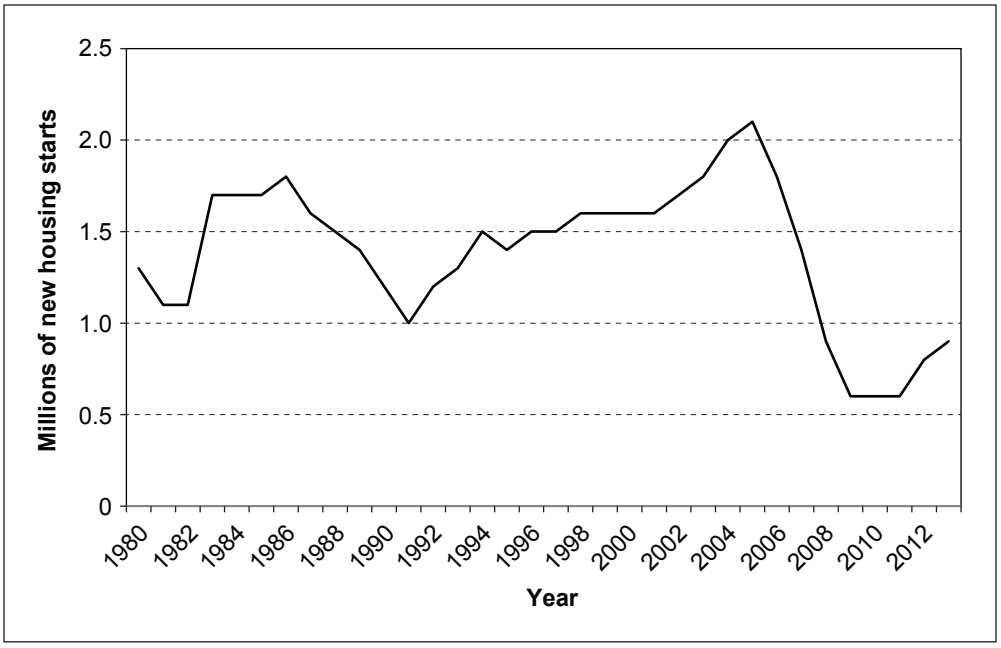

Figure 1—United States housing starts 1980–2013. Source: USDC CB 2013.

starts in the United States grew by less than 6 percent during 2010 and 2011, failing to reach 610,000 and remaining among the lowest levels since annual housing starts began being reported in the 1950s. Lumber consumption in the United States remained at historically low levels during this period as well (Keegan et al. 2012).

Through much of 2012, the economy grew slowly, with lackluster recovery in housing and demand for wood products.

Through much of 2012, the economy grew slowly, with lackluster recovery in housing and demand for wood products. Wood product markets in late 2012 and 2013 reflected the potential upside but also the uncertainty and volatility of recovering markets. As housing starts increased more than expected in the fourth quarter of 2012 and first quarter of 2013, lumber prices responded, reaching a high of over $435 per thousand board feet (MBF) lumber tally in March and April 2013—an increase of about $100 per MBF from second quarter 2012 (Random Lengths 1976–2013). Mills throughout North America geared up and increased production by bringing recession-idled capacity back into operation. The additional supply of lumber and a mid-year cooling of the U.S. housing market drove lumber prices down, hitting a 2013 low of $330 per MBF in June.

This type of volatility continued through 2013, exacerbated by strong export markets, although average 2013 lumber prices were the highest since 2006 (Random Lengths 2013). Markets are expected to continue to improve in 2014 and 2015, but with uncertainty in domestic homebuilding and international markets and considerable unutilized capacity to produce lumber in North America, wood products prices are expected to increase but remain volatile.

California's Timber Harvest, Products, and Flow

This section discusses the ownership of California's timberlands, historical trends in California's timber harvest, and the wood products industry's use of timber, focusing on the year 2012. It presents ownership and geographic sources of timber, species composition, types of timber harvested and processed, utilization of wood fiber from the harvest, and movement of timber both within California and between California and other states and countries.

Timber harvest data are available from several sources, including the California State Board of Equalization (annual) and the PNW Research Station (annual and periodic), and these sources were used for historical comparisons. However, the detailed 2012 harvest volumes presented in this report are the result of a full census of California and out-of-state mills receiving timber harvested in California during 2012. Differences may exist between the numbers published here and those published by other sources. These differences are often the result of differing reporting units and conversion factors, rounding error, scaling discrepancies among timber sellers (agencies and private owners) and between sellers and buyers, and other reporting variations.

California's Timberlands

California contains approximately 99.6 million acres of land area, of which 32.8 million acres are forested[1] (Christensen et al., in press; Miles 2008). Of the total forest land in California, private landowners hold 12.7 million acres (39 percent), national forest lands account for 15.6 million acres (48 percent), and other public lands account for the remaining 13 percent or 4.4 million acres. About 17 million of the 32.8 million forested acres in California are classified as timberland. Timberland is forest land that is producing or capable of producing more than 20 cubic feet of wood per acre per year at culmination of mean annual increment and excludes reserved lands, such as national parks and wilderness areas (Helms 1998). Within California, national forests contain 9.1 million acres (54 percent) of timberland, private landowners hold approximately 7.4 million acres (43 percent), and the remaining 3 percent (less than 1 million acres) is held by other public landowners, including the USDI Bureau of Land Management (BLM) and state and local governments.

[1] Forest land is defined as "land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and not currently developed for a nonforest use."

California's timberlands contained approximately 325 billion board feet Scribner of sawtimber (Christensen et al., in press). Sawtimber is timber of "sufficient size and quality to be suitable for conversion into lumber" (Random Lengths 1993). Sawtimber volume is calculated from growing-stock trees that are at least 11 inches diameter at breast height (d.b.h.) for hardwoods, and 9 inches d.b.h. for softwoods. Measured in board feet Scribner, live sawtimber on timberland consists of 92 percent conifers and 8 percent hardwoods. By species, Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) accounts for 32 percent of the Scribner board foot sawtimber volume on timberland. Other species contributing the majority of volume on timberland are true firs (*Abies* spp.) (22 percent), ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) and Jeffrey pine (*Pinus jeffreyi* Balf.) (16 percent), redwood *(Sequoia sempervirens* (D. Don) Endl.) (8 percent), and sugar pine (*Pinus lambertiana* Dougl.) (5 percent).

Harvest by Ownership

Timber harvested from California timberlands came from three broad land ownership categories: industrial timberland, nonindustrial private forest land, and public lands. California's timber harvest consisted largely of Douglas-fir, true firs, ponderosa pine, redwood, and sugar pine.

The timber volume harvested in California during 2012 was 1.4 billion board feet Scribner, a decline of about 17 percent from the 2006 harvest of 1.7 billion board feet and 36 percent less than the 2000 harvest of 2.2 billion board feet

The timber volume harvested in California during 2012 was 1.4 billion board feet Scribner (table 1), a decline of about 17 percent from the 2006 harvest of 1.7 billion board feet and 36 percent less than the 2000 harvest of 2.2 billion board feet (Morgan et al. 2004, 2012). The timber harvest during 2012 was less than 70 percent of the average volume of the previous 20 years, and less than 45 percent of the 50-year average.

As discussed in the previous section, the housing collapse and recession of 2007–2009 reduced demand for lumber, and timber harvests dropped to record low levels, with less than 1 billion board feet harvested in 2009 (California State Board of Equalization 1978–2013). Harvest levels rebounded somewhat in the following years, but continue to be the lowest on record since 1947.

Private lands have provided the majority of California's timber since the 1940s (fig. 2). However, during the 1960s, 1970s, and 1980s, as private harvest volumes declined, national forests became an increasingly important source of timber for California's industry and reached near parity during this time period. Since the late 1980s, both private and national forest harvests have declined with reductions in the harvest from national forests accounting for the majority of the difference. The

Table 1—California's timber harvest by ownership class, selected years

Ownership	2000	2006	2012
		Million board feet[a]	
Private	1,885.8	1,504.1	1,193.7
Industrial	1,075.2	942.7	1,000.5
Nonindustrial private	800.7	555.8	185.1
Tribal	9.9	5.6	8.1
Public	363.9	228.9	231.7
National forest	337.1	224.7	203.3
State	18.6	3.5	27.9
Bureau of Land Management	7.7	0.3	0.4
Other public	0.5	0.4	0.1
Total	2,249.7	1,733.1	1,425.4
		Percentage of harvest	
Private	83.8	86.8	83.7
Industrial	47.8	54.4	70.2
Nonindustrial private	35.6	32.1	13.0
Tribal	0.4	0.3	0.6
Public	16.2	13.2	16.3
National forest	15.0	13.0	14.3
State	0.8	0.2	2.0
Bureau of Land Management	0.3	*b*	*b*
Other public	*b*	*b*	*b*
Total	100	100	100

[a] Volume in Scribner Decimal C Log Rule, eastside variant.
[b] Percentage of harvest less than 0.05.
Source: Morgan et al. 2004, 2012.

major causes of the declines in national forest timber offerings since the 1980s have been social, political, and legal constraints on harvesting. For more information on California's historical timber harvest, refer to the 2006 report by Morgan et al. (2012).

Since 2000, the share of the harvest from industrial lands has grown from less than 50 percent in 2000 to 70 percent in 2012. At the same time, the share and total harvest from nonindustrial private lands has decreased dramatically from 35.6 percent (800 MMBF) in 2000 to 13 percent (185 MMBF) in 2012. This latter trend can be attributed to a variety of factors, including changes in California's regulatory environment dating back to the 1990s (Thompson and Dicus 2005); changes in

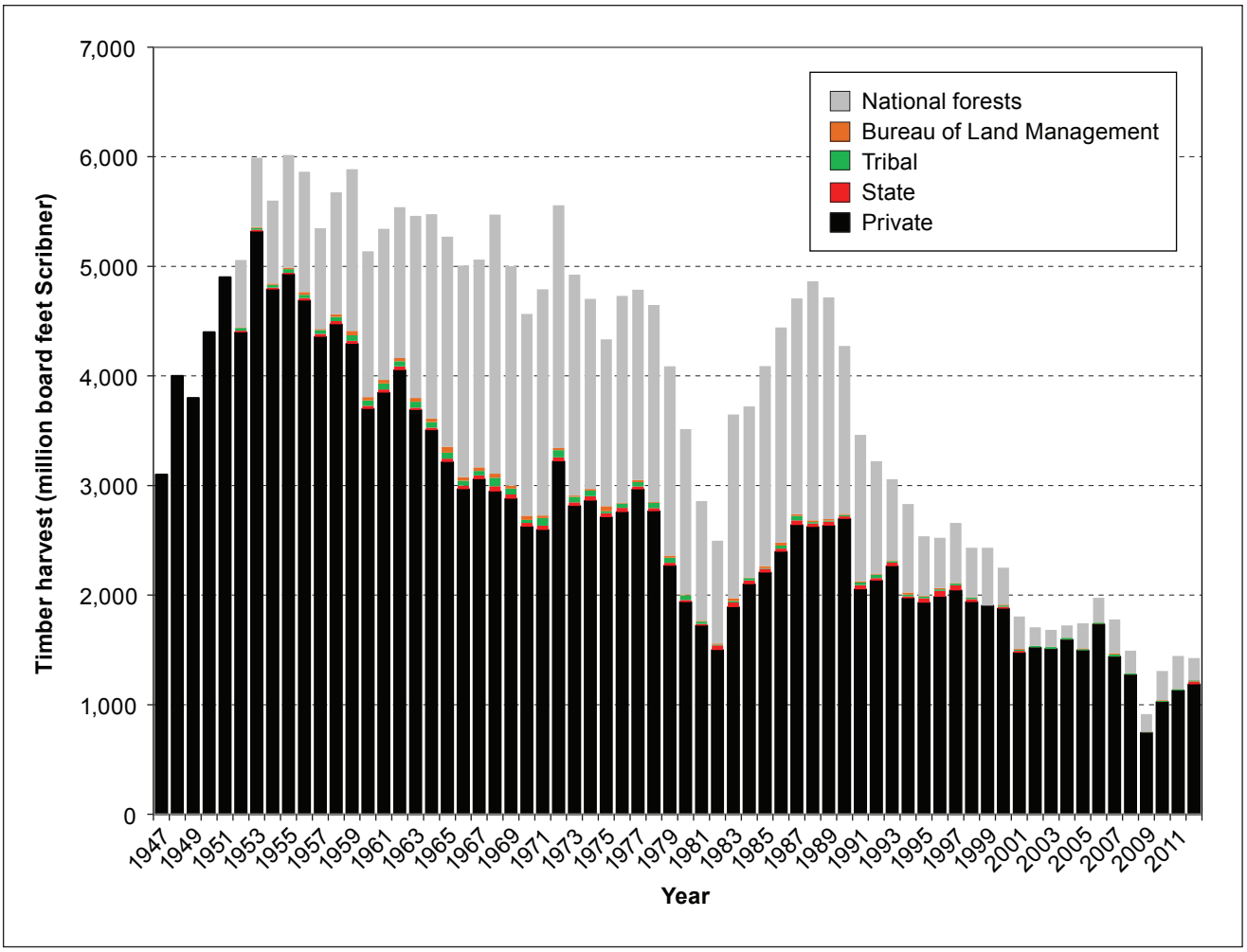

Figure 2—California's timber harvest by ownership class, 1947–2012.

land ownership patterns and landowner preferences; and the recent recession and poor markets for wood products, which put downward pressure on the price paid to landowners selling logs, making harvesting financially unfeasible. Combined, the harvest from industrial and nonindustrial private lands in 2012 accounted for 84 percent of the total harvest in California, even though private timberlands only make up 43 percent of the total timberland in the state (fig. 3). The majority of timberland acres and volume in the state are managed by the U.S. Forest Service and other public owners (e.g., the BLM and the state of California), but public lands accounted for only 16 percent of the total 2012 harvest.

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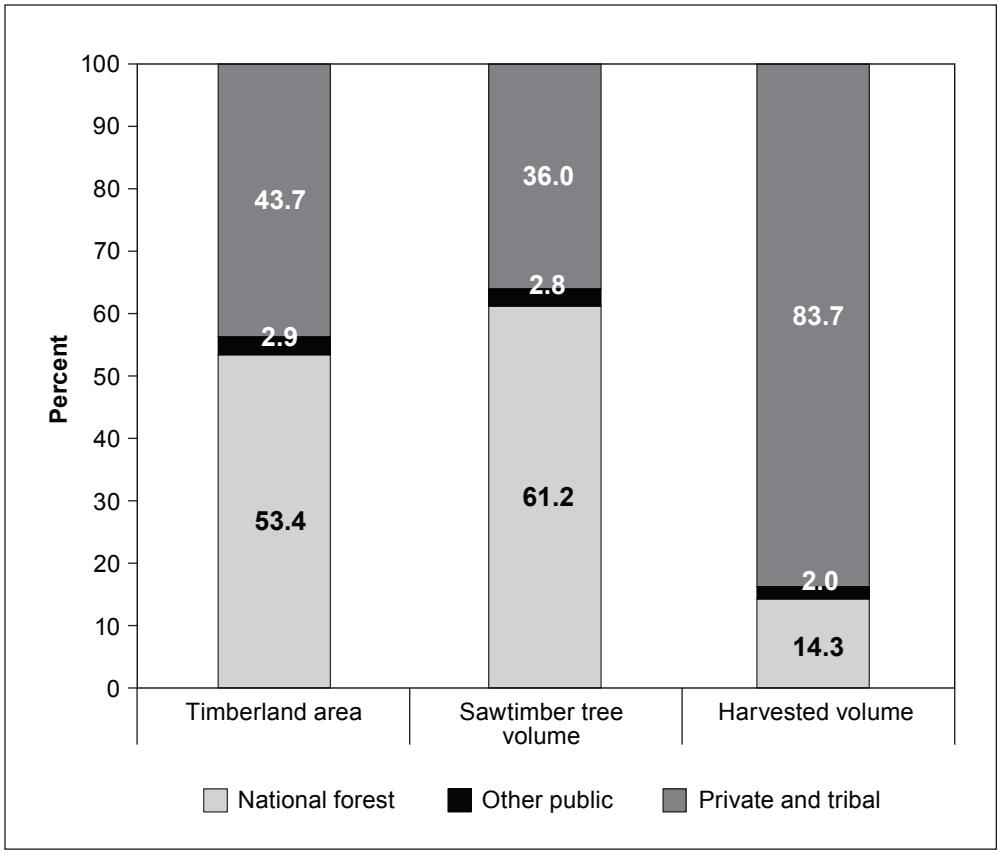

Figure 3—Characteristics of California's timberland by ownership class, 2012. Sawtimber is timber of "sufficient size and quality to be suitable for conversion into lumber."

Harvest by Geographic Source

Six multicounty resource areas are used to describe major wood-producing regions in California (fig. 4): North Coast, Northern Interior, Sacramento, San Joaquin, Central Coast, and Southern California. In 2012, 88 percent (1.3 billion board feet Scribner) of California's total timber harvest came from the North Coast, Northern Interior, and Sacramento regions (table 2). Historically, these regions have provided more than 85 percent of California's timber harvest (Barrette et al. 1970; California State Board of Equalization 1978–2013; Hiserote and Howard 1978; Howard 1972, 1984; Howard and Ward 1988, 1991; Morgan et al. 2004, 2012). The majority of the remaining timber harvest in 2012 came from the San Joaquin region.

Five counties in northern California accounted for over 55 percent of California's total timber harvest in 2012 (table 3). For the first time since 1968, Shasta County provided the largest proportion at 16 percent (229 MMBF), followed by Humboldt County with a timber harvest of 215 MMBF. Humboldt County has typically provided the largest share of the harvest, around 20 percent of the annual total.

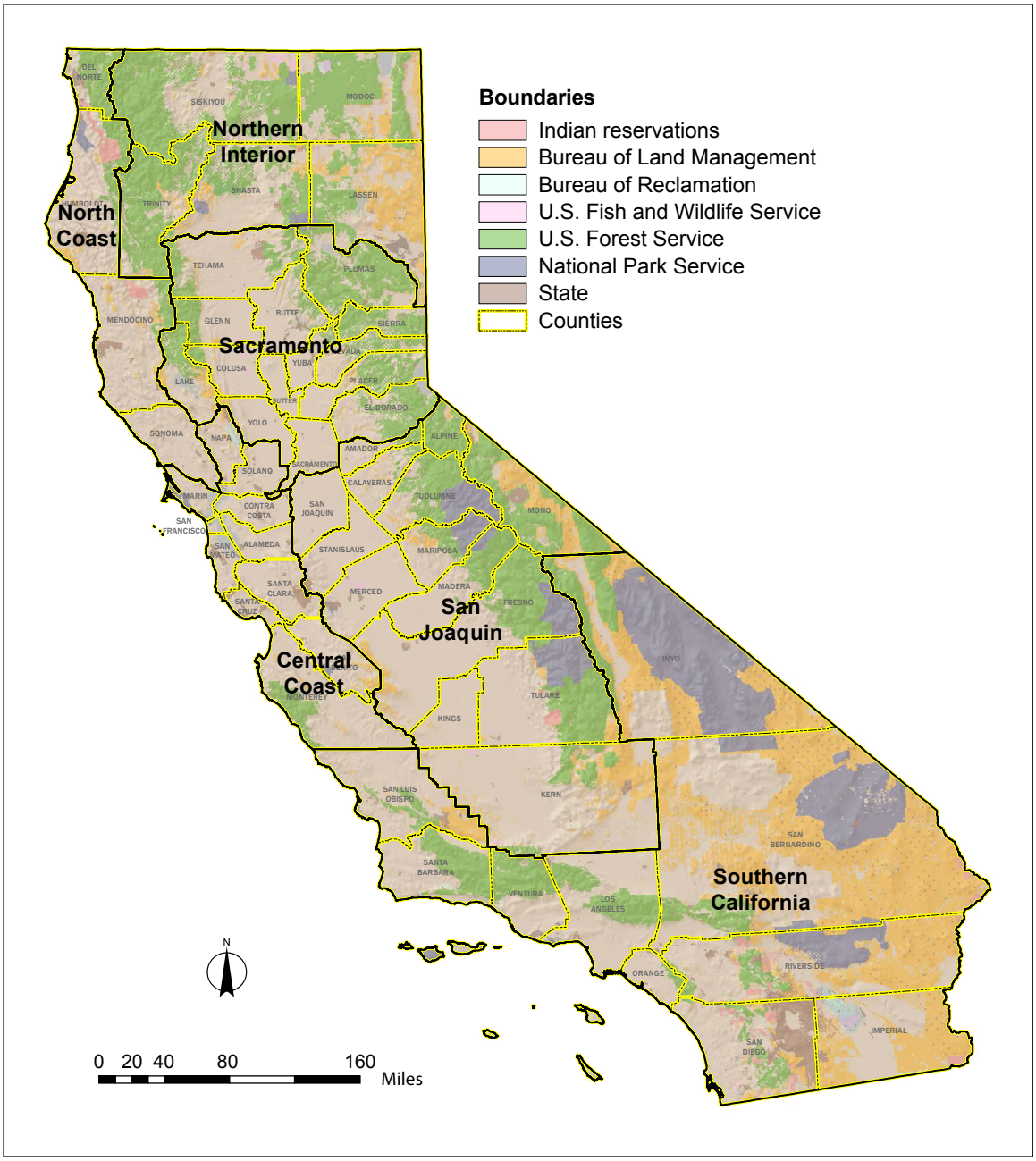

Figure 4—California's forest resource areas.

Other counties that have also generally been top producers include Mendocino, Plumas, Shasta, Siskiyou, and Trinity (Barrette et al. 1970; Hiserote and Howard 1978; Howard 1972, 1984; Howard and Ward 1988, 1991; Morgan et al. 2004, 2012; Ward 1995, 1997).

Table 2—California's timber harvest by county, selected

Resource area	2000 volume[a]	2000 percentage of total	2006 volume[a]	2006 percentage of total	2012 volume[a]	2012 percentage of total
	Million board feet	*Percent*	*Million board feet*	*Percent*	*Million board feet*	*Percent*
Central Coast:						
Napa	—	—	0.3	*b*	—	—
San Benito	—	—	0.1	*b*	—	—
San Mateo	5.6	0.3	4.4	0.3	4.5	0.3
Santa Clara	4.2	0.2	4.4	0.3	3.5	0.2
Santa Cruz	19.6	0.9	9.7	0.6	15.7	1.1
Total Central Coast	29.4	1.3	18.8	1.1	23.7	1.7
North Coast:						
Del Norte	50.4	2.2	17.6	1.0	19.3	1.4
Humboldt	435.3	19.3	345.7	19.9	215.1	15.1
Mendocino	193.5	8.6	123.1	7.1	108.8	7.6
Sonoma	28.1	1.2	9.9	0.6	8.2	0.6
Total North Coast	707.2	31.4	496.3	28.6	351.4	24.6
Northern Interior:						
Lassen	69.3	3.1	77.9	4.5	83.8	5.9
Modoc	49.9	2.2	26.3	1.5	46.2	3.2
Shasta	194.3	8.6	209.0	12.1	229.1	16.1
Siskiyou	209.7	9.3	196.0	11.3	147.9	10.4
Trinity	99.6	4.4	98.0	5.7	60.4	4.2
Total Northern	622.6	27.7	607.2	35.0	567.5	39.8
Interior:						
Sacramento:						
Butte	86.4	3.8	89.2	5.1	52.5	3.7
El Dorado	106.7	4.7	99.1	5.7	50.1	3.5
Glenn	24.7	1.1	4.9	0.3	3.6	0.2
Lake	9.6	0.4	1.6	0.1	b	b

Table 2—California's timber harvest by county, selected (continued)

Resource area	2000 volume[a]	2000 percentage of total	2006 volume[a]	2006 percentage of total	2012 volume[a]	2012 percentage of total
	Million board feet	*Percent*	*Million board feet*	*Percent*	*Million board feet*	*Percent*
Nevada	59.6	2.6	39.4	2.3	19.0	1.3
Placer	40.4	1.8	47.4	2.7	21.4	1.5
Plumas	193.8	8.6	122.4	7.1	82.3	5.8
Sierra	33.1	1.5	16.3	0.9	30.5	2.1
Tehama	105.3	4.7	45.7	2.6	62.6	4.4
Yolo	2.6	0.1	—	—	—	—
Yuba	36.9	1.6	7.2	0.4	20.9	1.5
Total Sacramento	699.0	31.1	473.3	27.3	342.8	24.0
San Joaquin:						
Alpine	—	—	[b]	[b]	—	—
Amador	22.8	1.0	28.7	1.7	13.5	0.9
Calaveras	67.0	3.0	34.9	2.0	41.4	2.9
Fresno	19.8	0.9	5.9	0.3	6.8	0.5
Kern	3.6	0.2	—	—	2.8	0.2
Madera	4.8	0.2	0.1	[b]	16.2	1.1
Mariposa	3.6	0.2	3.7	0.2	4.5	0.3
Merced	0.3	*b*	—	—	—	—
Tulare	8.9	0.4	7.7	0.4	5.0	0.3
Tuolumne	60.7	2.7	47.2	2.7	45.2	3.2
Total San Joaquin	191.4	8.5	128.1	7.4	135.3	9.5
Southern California:						
Inyo	—	—	—	—	3.4	0.2
San Bernardino	—	—	9.55	0.55	1.2	0.1
Total Southern California	0	0	9.6	0.6	4.6	0.3
State total	2,249.7	100	1,733.1	100	1,425.4	100

— = year in which no harvest volume was reported for this county.
[a] Volume in Scribner Decimal C Log Rule, east-side variant.
[b] Volume is less than 0.05 million board feet or percentage of total harvest is less than 0.05 percent.
Source: Morgan et al. 2004, 2012.

Table 3—Percentage of total harvest for California's leading timber harvest counties, 1968–2012

County	Volume[a]	Percentage of total	County	Volume[a]	Percentage of total
	Million board feet	*Percent*		*Million board feet*	*Percent*
1972:			1992:		
Humboldt	1,079.0	19.9	Humboldt	502.2	15.6
Mendocino	523.1	9.6	Mendocino	271.6	8.5
Siskiyou	518.7	9.5	El Dorado	195.1	6.1
Del Norte	354.5	6.5	Lassen	158.8	4.9
Trinity	349.9	6.4	Shasta	142.9	4.4
Total county	2,825.2	52.0	Total county	1,270.6	39.5
California total	5,435.2		California total	3,214.0	
1976:			1994:		
Humboldt	1,073.3	22.7	Humboldt	559.6	19.7
Mendocino	489.2	10.3	Plumas	163.5	5.8
Shasta	359.3	7.6	Shasta	147.5	5.2
Siskiyou	337.1	7.1	Lassen	123.3	4.3
Del Norte	236.4	5.0	Trinity	117.2	4.1
Total county	2,495.3	52.7	Total county	1,111.1	39.1
California total	4,731.0		California total	2,839.0	
1982:			2000:		
Humboldt	456.2	18.3	Humboldt	435.3	19.3
Mendocino	448.1	17.9	Siskiyou	209.7	9.3
Plumas	164.7	6.6	Shasta	194.3	8.6
Trinity	161.2	6.5	Plumas	193.8	8.6
Tehama	148.3	5.9	Mendocino	193.5	8.6
Total county	1,378.5	55.2	Total county	1,226.6	54.5
California total	2,497.0		California total	2,249.7	
1985:			2006:		
Humboldt	608.1	15.0	Humboldt	345.7	20.0
Mendocino	435.1	10.7	Shasta	209.0	12.1
Shasta	204.1	5.0	Siskiyou	196.0	11.3
Plumas	202.2	5.0	Mendocino	123.1	7.1
Siskiyou	201.8	5.0	Plumas	122.4	7.1
Total county	1,651.3	40.7	Total county	996.2	57.5
California total	4,056.0		California total	1,733.1	
1988:			2012:		
Humboldt	769.0	15.9	Shasta	229.1	16.1
Mendocino	499.1	10.3	Humboldt	215.1	15.1
Siskiyou	295.6	6.1	Siskiyou	147.9	10.4
Trinity	272.1	5.6	Mendocino	108.8	7.6
Plumas	271.5	5.6	Lassen	83.8	5.9
Total county	2,107.3	43.5	Total county	784.7	55.1
California total	4,840.0		California total	1,425.4	

Source: Barrette et al. (1970), Hiserote and Howard (1978), Howard (1974, 1984), Howard and Ward (1988, 1991), Morgan et al. (2004, 2012), Ward (1995, 1997).

[a] Volume in Scribner Decimal C Log Rule, east-side variant.

Harvest by Species

During 2012, Douglas-fir, true firs, ponderosa pine, redwood, and sugar pine were the most commonly harvested tree species, accounting for 93 percent of California's total harvest volume (table 4). These species have dominated California's harvest, consistently accounting for 85 percent or more of the total (table 5). Douglas-fir returned to become the leading tree species harvested in 2012, after falling to second place in 2006. However, the trend toward increasing the proportion of true firs being harvested continued in 2012, with only a slight decrease from 28 to 27 percent. These recent changes are in line with long-term trends, which show proportionate decreases in the volume of redwood and increases in the volume of true firs harvested with the pines maintaining a relatively consistent share.

Douglas-fir, true firs, ponderosa pine, redwood, and sugar pine were the most commonly harvested tree species, accounting for 93 percent of California's total harvest volume.

Harvest by Product Type

Products directly manufactured from timber are referred to as primary products. These include lumber, plywood, veneer, posts and poles, pilings and timbers, house logs, and log furniture. Products made from chipping or grinding timber, as well as from the residues (e.g., bark, sawdust, and planer shavings) generated in the production of primary products, also are included. These reconstituted primary products include pulp and paper, particleboard, medium-density fiberboard, hardboard, fuel pellets, and bioenergy. Other primary products made from mill residues include decorative bark, mulch, soil amendments, and animal bedding.

Table 4—California's timber harvest by species, 2012

Species	Volume[a]	Percentage of total
	Million board feet	*Percent*
Douglas-fir	405.2	28.4
True firs	380.2	26.7
Ponderosa pine	251.1	17.6
Redwood	209.0	14.7
Sugar pine	86.4	6.1
Incense-cedar	70.1	4.9
Lodgepole pine	14.7	1.0
Western hemlock	4.0	0.3
Other softwoods[b]	3.4	0.2
Hardwoods	1.4	0.1
All species	1,425.4	100

[a] Volume in Scribner Decimal C Log Rule, east-side variant.
[b] Other softwoods include Jeffrey pine, spruces, giant sequoia, and other coniferous species.

Table 5—Percentage of California's timber harvest by species, 1968–2012[a]

Species	1968	1972	1976	1982	1985	1988	1992	1994	2000	2006	2012
						Percent					
True firs	22.4	21.8	19.9	21.1	22.0	23.0	22.9	25.6	19.0	28.3	26.7
Douglas-fir	32.2	26.9	27.4	22.9	24.1	26.5	23.2	26.7	27.6	24.2	28.4
Ponderosa and sugar pine	23.7	25.3	25.4	27.0	26.3	26.9	23.4	22.0	23.8	23.1	23.7
Redwood	18.2	18.7	19.5	24.3	22.6	18.2	24.9	21.9	16.7	14.3	14.7
Other softwoods[b]	3.3	3.0	3.6	0.5	1.4	1.3	1.3	1.3	7.7	5.4	1.5
Incense-cedar	[c]	4.1	4.1	3.9	3.0	3.7	4.3	2.4	4.7	4.8	4.9
Hardwoods	0.2	0.2	0.2	0.4	0.5	0.5	[d]	[d]	0.5	[d]	[d]
Total	100	100	100	100	100	100	100	100	100	100	100

[a] Harvest for years prior to 2000 does not include timber delivered to out-of-state mills.
[b] Other softwoods include western hemlock, lodgepole pine, spruces, and other coniferous species.
[c] Included in "Other softwoods."
[d] Less than 0.05 percent.
Source: Barrette et al. 1970; Hiserote and Howard 1978; Howard 1974, 1984; Howard and Ward 1988, 1991; Morgan et al. 2004, 2012; Ward 1995, 1997.

Timber harvested in California in 2012 falls into four general timber product categories: sawlogs (timber used to produce lumber and other sawn products), veneer logs (timber sliced or peeled to make veneer for plywood or laminated veneer lumber), bioenergy (timber burned industrially to generate electricity or steam), and other products. Timber harvested for export is addressed separately under the "Timber Flow" section of this report.

Sawlogs accounted for 83 percent (1,180 MMBF) of the harvest in 2012, marking the smallest proportion on record. Historically, sawlogs have accounted for more than 85 percent of the total annual harvest (table 6). Veneer logs accounted for 10 percent of the total harvest through the 1970s. Since the 1980s, however, veneer logs have accounted for only 4 to 8 percent of California's annual timber harvest with the 2012 veneer log harvest at 8 percent.

Generally, timber harvested for products other than lumber and veneer has represented a small portion of California's annual total harvest. Bioenergy has been an expanding use of California's timber in recent years, with 8 percent (116 MMBF) of the harvest volume delivered to bioenergy producers in 2012—up from only 3.6 percent (62 MMBF) in 2006 and 2.4 percent (55 MMBF) in 2000. Prior to 2000, mill surveys did not identify timber harvested specifically to produce energy. Pulpwood has historically accounted for less than 2 percent of the annual harvest volume because of the pulp and board sector's heavy reliance on mill residues. In 2009, California's last remaining pulp mill in Samoa was closed, resulting in the first census without any pulpwood harvested. Logs harvested for other products

Table 6—Percentage of California's timber harvest by product type, 1968–2012[a]

Product type	1968	1972	1976	1982	1985	1988	1992	1994	2000	2006	2012
						Percent					
Sawlogs	86	86	86	91.2	92	92.5	99.3	92.9	89.8	88.1	82.8
Veneer logs	10	12	11.5	6.1	5	4.7	*b*	5.2	7.4	8.0	8.4
Pulpwood	1	1.5	0.1	1.1	0.8	1.1	*c*	*c*	*c*	*c*	—
Other[d]	3	0.5	2.4	1.6	2.2	1.7	0.7	1.9	0.4	<0.3	0.6
Bioenergy	*e*	*e*	*e*	*e*	*e*	*e*	*e*	*e*	2.4	3.6	8.2
Total	100	100	100	100	100	100	100	100	100	100	100

— = no reported data.
[a] Harvest for years prior to 2000 does not include timber delivered to out-of-state mills.
[b] Included in "sawlogs."
[c] Included in "other."
[d] Includes utility poles, houselogs, log furniture, firewood, shakes and shingles, post and poles, and log exports; does not include bioenergy.
[e] Not reported prior to 2000.
Source: Barrette et al. 1970; Hiserote and Howard 1978; Howard 1974, 1984; Howard and Ward 1988, 1991; Morgan et al. 2004, 2012; Ward 1995, 1997.

such as utility poles, firewood, small posts and poles, and house log components, have accounted for less than 3 percent of the annual harvest.

Product Type by Ownership Class

As discussed earlier, most of the volume harvested in 2012 came from private timberlands (table 7). Sawlogs were the most harvested product from all ownership groups. However, this product type experienced the steepest declines of any category (-23 percent), compared to veneer and other logs (-9 percent) and an **increase** of 186 percent in the harvest for bioenergy. In 2012, industrial lands provided the majority (72 percent) of California's saw, veneer, and other log harvest, compared to only 54 percent in 2006. Conversely, industrial lands contributed 55 percent (64.2 MMBF) of bioenergy logs, compared to 73 percent (45 MMBF) in 2006. Public lands, primarily national forests, made up the remaining volume of bioenergy logs, with 51.9 MMBF or 45 percent, up from only 21 percent in 2006.

Product Type by Species

In 2012, Douglas-fir and true firs were the species most harvested across all products (table 8). The harvest of true firs for veneer and other products increased since 2006 from 32 MMBF to 56 MMBF, while all other species declined. Whereas other softwoods were the leading species harvested for bioenergy in 2006, Douglas-fir, true firs, and ponderosa pine accounted for the majority (83 percent) of the harvest for bioenergy in 2012. Similarly to 2006, hardwoods comprised very little (less than 2 percent) of the 2012 harvest and were primarily used for bioenergy.

Table 7—California's timber harvest by ownership class and product type, 2012.

Ownership source	Sawlogs	Veneer and other[a]	Bioenergy	All products
		Million board feet[b]		
Private timberlands:	1,008.6	112.6	64.5	1,185.6
Industrial	848.4	88.0	64.2	1,000.5
Nonindustrial and tribal	160.2	24.6	0.3	185.1
Public timberlands:	171.1	16.8	51.9	239.8
National forests	144.1	16.8	42.4	203.3
Other public	27.0	—	9.4	36.5
Total	1,179.7	129.3	116.3	1,425.4
		Percent		
Private timberlands:	85.5	87.0	55.4	83.2
Industrial	71.9	68.0	55.1	70.2
Nonindustrial and tribal	13.6	19.0	0.3	13.0
Public timberlands:	14.5	13.0	44.6	16.8
National forests	12.2	13.0	36.5	14.3
Other public	2.3	—	8.1	2.6
Total	100	100	100	100

— = no reported data.
[a] Other product types include house logs, firewood, furniture logs, and utility poles.
[b] Volume in Scribner Decimal C Log Rule, east-side variant.

Timber Flow

This section briefly details the movement of timber among California's wood-producing regions, resource areas, and individual counties, as well as between California, other states, and other countries. Because this study tracks timber flowing into and out of the state, there are slight differences in the amount of timber harvested versus that received by facilities in the state.

In 2012, California's sawmill, veneer, and other plants received 1,393 MMBF of logs (table 9). Of that volume, 83 percent came from private timberlands, about 15 percent from national forests, and 2 percent from other ownerships. Bioenergy facilities in California received about 116 MMBF (1.45 million bone-dry tons) of timber, in addition to mill residue. Approximately 55 percent of the timber received by bioenergy facilities came from industrial lands, about 37 percent from national forests, and the rest from nonindustrial private and other public sources. The residue-utilizing sector (i.e., reconstituted board and decorative bark facilities) did not receive any timber and used mill residues exclusively for their raw material.

The period from 2006 to 2012 marked a reversal in many timber flow trends. Most of the timber used by California's primary wood products industry was harvested from within the state. California timber-processing facilities received nearly 1.4 billion board feet Scribner of timber in 2012. Slightly less than 4 MMBF,

Table 8—California's timber harvest by species and product type, 2012

Species	Sawlogs	Veneer and other[a]	Bioenergy	All products
		Million board feet[b]		
Douglas-fir	319.4	51.7	34.1	405.2
True firs	290.1	55.5	34.6	380.2
Ponderosa pine	209.9	13.6	27.6	251.1
Redwood	208.8	0.2	—	209.0
Sugar pine	76.7	3.9	5.9	86.4
Incense-cedar	65.6	0.1	4.3	70.1
Other softwoods[c]	5.3	4.4	8.5	18.2
Western hemlock	4.0	—	—	4.0
Hardwoods	[d]	—	1.3	1.3
All species	1,179.7	129.4	116.3	1,425.4
		Percentage of total		
Douglas-fir	27.1	40.0	29.3	28.4
True firs	24.6	42.9	29.7	26.7
Ponderosa pine	17.8	10.5	23.7	17.6
Redwood	17.7	0.1	—	14.7
Sugar pine	6.5	3.0	5.1	6.1
Incense-cedar	5.6	0.1	3.7	4.9
Other softwoods[d]	0.4	3.4	7.3	1.3
Western hemlock	0.3	—	—	0.3
Hardwoods	[d]	—	1.1	0.1
All species	100	100	100	100

— = no reported data.
[a] Other product types include house logs, firewood, log furniture, and utility poles.
[b] Volumes in Scribner Decimal C Log Rule, east-side variant.
[c] Includes lodgepole pine, Jeffrey pine, giant sequoia, and western redcedar.
[d] Values less than 0.1 thousand board feet.

or less than 0.05 percent, of timber processed in California came from out of state, a significant decrease from the 126.5 MMBF of timber imported from other states in 2006. Conversely, 36.2 MMBF (3 percent) of California's timber harvest was shipped out of state to be processed (table 10), down from 66.6 MMBF in 2006. More than 99 percent of the timber that flowed into California and all the timber that flowed out were saw and veneer logs. These volumes do not include logs exported internationally from California's customs districts (see "International and interstate timber flow" section).

Intrastate timber flow—

This section briefly examines the flow of California timber to mills within the state. Several counties have too few timber-processing facilities to avoid disclosure of firm-level data, so individual county statistics are not reported for all counties (table 11).

Table 9—California timber receipts by ownership class and product, 2012

Ownership source	Sawlogs	Veneer and other[a]	Bioenergy	All products
		Million board feet[b]		
Private timberlands:	1,003.4	93.5	64.5	1,161.3
Industrial	837.4	88.0	64.2	989.5
Nonindustrial and tribal	166.0	5.5	0.3	171.8
Public timberlands:	163.3	16.4	51.9	231.6
National forests	144.4	14.8	42.4	201.6
Other public	19.0	1.6	9.4	30.0
Total	1,166.7	109.9	116.3	1,392.9
		Percentage of total		
Private timberlands:	86.0	85.1	55.4	83.4
Industrial	71.8	80.1	55.1	71.0
Nonindustrial and tribal	14.2	5.0	0.3	12.3
Public timberlands:	14.0	14.9	44.6	16.6
National forests	12.4	13.5	36.5	14.5
Other public	1.6	1.4	8.1	2.2
Total	100	100	100	100

[a] Other product types include house logs, firewood, log furniture, and utility poles.
[b] Volumes in Scribner Decimal C Log Rule, east-side variant.

Table 10—Interstate timber flow into and out of California, 2012

Timber products	Log flow into California	Log flow out of California
	Million board feet[a]	
Saw and veneer logs	3.6	36.2
Other logs	<0.1	—
Total	3.7	36.2

— = no volume reported.
[a] Volume in Scribner Decimal C Log Rule, east-side variant.

During 2012, 49 percent of harvested timber was processed in its county of harvest, and approximately 87 percent was processed in the resource area of harvest.

As a result of the Great Recession and weak lumber markets, timber did not travel as far as in previous census years, and importation of timber from other states was minimal. During 2012, 49 percent of harvested timber was processed in its county of harvest, and approximately 87 percent was processed in the resource area of harvest (see fig. 4). This was a reversal from previous trends in which the proportion of timber processed within its county of harvest declined from 74 percent in 1968 to 46 percent in 2006. Likewise, the proportion of timber processed within its resource area of harvest had dropped from 92 to 82 percent (Barrette et al.1970, Morgan et al. 2012).

Table 11—California timber flow by resource area, 2012

Harvest area	Receiving area: North Coast and Central Coast[a]	Northern Interior[b]	Sacramento[c]	San Joaquin[d] and Southern California[e]	Out of state	Total harvest
			Million board feet Scribner			
North Coast and Central Coast[a]	348.8	22.6	1.1	0.3	2.3	375.1
Northern Interior[b]	12.7	466.1	78.7	—	9.9	567.5
Sacramento[c]	—	47.6	292.7	1.9	—	342.3
San Joaquin[d]	—	—	7.6	127.7	—	135.3
Southern California[e]	—	—	—	4.6	—	4.6
Out of state[f]	—	1.8	1.9	—	N/A	3.7
Total received	361.5	538.1	382.0	134.6	12.2	

— = no reported data.
N/A = not applicable.
[a] North Coast and Central Coast regions are combined to avoid disclosure; North Coast includes Del Norte, Humboldt, Mendocino, and Sonoma Counties, and Central Coast includes Napa, Solano, Marin, Contra Costa, Alameda, San Francisco, San Mateo, Santa Clara, Santa Cruz, San Benito, and Monterey Counties.
[b] Northern Interior region includes Lassen, Modoc, Siskiyou, Shasta, and Trinity Counties.
[c] Sacramento region includes Butte, Colusa, El Dorado, Glenn, Lake, Nevada, Placer, Plumas, Sacramento, Sierra, Sutter, Tehama, Yolo, and Yuba Counties.
[d] San Joaquin region includes Alpine, Amador, Calaveras, Fresno, Kern, Kings, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tulare, and Tuolumne Counties.
[e] Southern California region includes Imperial, Inyo, Los Angeles, Orange, San Luis Obispo, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura Counties.
[f] Out-of-state region includes Oregon and Nevada.

Timber harvest volume not processed within its county or resource area of origin has tended to be delivered to mills in the north or western parts of the state or to Oregon. This trend continued in 2012 with the Northern Interior resource area shipping the largest volume of timber to be processed out-of-area, mostly to Oregon and the Sacramento resource area.

International and interstate timber flows—
Interstate and international timber flow trends also experienced significant change. In contrast with previous years, mills participating in the 2012 survey did not report using any foreign timber, whereas during 2000 and 2006, California timber processors used 20.6 MMBF and 59.7 MMBF of timber from Canada, respectively. This trend is consistent with the overall reduction in the distance timber travelled during 2012 compared to 2000 and 2006. Reports prior to 2000 do not indicate any timber entering California from international sources, although timber entering California from other states increased substantially from the late 1960s through the 1990s (Barrette et al. 1970; Hiserote and Howard 1978; Howard 1972, 1984; Howard and Ward 1991; Ward 1995, 1997).

According to Zhou (2013), the U.S. International Trade Commission, and other sources, during the last 4 years California customs districts experienced significant growth in international forest product exports across multiple sectors (fig. 5). To identify these changing export trends by product type and destination, export data were analyzed from a resource bulletin published by Zhou (2013). The export data assessed from this resource bulletin originated from data supplied by the U.S. International Trade Commission and the U.S. Department of Commerce. Note that these data reflect forest product volumes and values that were exported **through** California customs districts. These customs districts encompass selected ports in their surrounding regions. What is not known is how much of the forest product volumes and values originated from timber harvested or products manufactured in California. For this reason, volumes and trends in this section are discussed separately from the FIDACS mill census data.

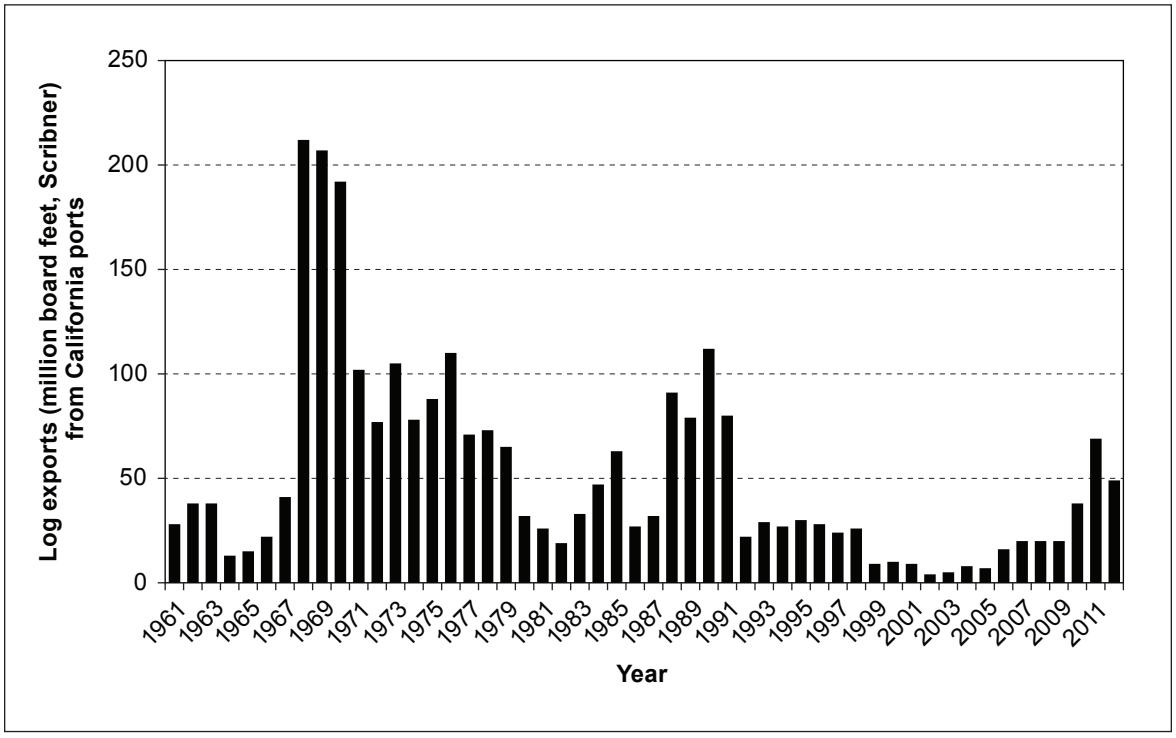

Figure 5—California log exports, 1961–2012. Source: Zhou 2013.

During 2012, softwood log exports through California ports totaled about 49 MMBF, representing a 145-percent increase from 2009 (table 12) (Zhou 2013). Nearly 43 MMBF of the softwood log volume are estimated to have been exported by the San Francisco customs district, with the remaining 6 MMBF leaving from

Table 12—California forest products maritime exports by product type, 2009–2012

Forest product type	2009	2010	2011	2012
Softwood logs (MMBF Scribner)[a]	20	38	69	49
Softwood lumber (MMBF lumber tally)[a]	109	122	223	194
Plywood (MMSF)[b]	58	54	58	79
Wood chips (Short tons)[c]	8,971	19,991	24,116	40,140
		2012 dollars		
Softwood logs average value per MBF[a]	653	504	593	505
Softwood lumber average value per MBF[a]	685	753	560	610
Plywood average value per MSF[b]	422	391	382	411
Wood chips average value per short ton[c]	43	47	48	40

[a] MBF = thousand board feet; MMBF = million board feet.
[b] MSF = thousand square feet; MMSF = million square feet.
[c] Short ton = 2,000 lbs.

districts in San Diego and Los Angeles. The primary destination for California's softwood log exports was China, which received more than 99 percent of the volume. Hardwood logs exported through California in 2012 totaled about 28 MMBF. About 87 percent of the hardwood log volumes left through the customs districts in San Diego and Los Angeles, with the remaining amount attributed to the San Francisco customs district. The primary destinations for the hardwood log exports were China and Japan, receiving 33 percent and 28 percent of the total volume, respectively. The average value of hardwood logs exports from California in 2012 was $2,373 per MBF (Zhou 2013). Total international log exports through California customs districts during 2012 (77 MMBF) represent a volume equivalent to 5 percent of California's total timber harvest.

Softwood lumber exports through California ports during 2012 totaled about 194 MMBF, representing growth of 78 percent from 2009. About 58 percent of this volume left through ports in the San Diego and Los Angeles customs districts, with the remaining being exported by the San Francisco customs district. The primary destination was China, representing about 21 percent of the total softwood lumber export volume (Zhou 2013). Softwood lumber exports through California ports in 2012 were equivalent to roughly 10 percent of California lumber production; however, the export data do not indicate where the lumber was actually manufactured. Once again, the log and lumber exports discussed here may originate from any location in the United States and merely indicate the changing volumes of material being exported through California and other west coast ports.

End Uses of California's 2012 Timber Harvest

This section traces California's timber harvest through the various primary processing sectors. Timber, primary wood products, and mill residues from manufacturing are commonly quantified in different units of measure. Timber inputs are generally reported in board feet Scribner west-side or east-side log rule. Volumes of mill outputs are provided in the measurement unit common to each product, such as board feet lumber tally or square feet of plywood 3/8-inch basis. Mill residue is commonly reported in bone-dry units (BDU) or bone-dry tons (BDT). In this section, all volumes are expressed in cubic feet because expressing input, output, and residue volumes in a common unit of measure allows for more complete accounting of wood fiber from harvest through primary processing.

In this report, 1 BDU of residue is assumed to contain 96 cubic feet of wood; 1,000 board feet (MBF) lumber tally is assumed to contain approximately 60 cubic feet of wood; and board-foot-Scribner-to-cubic conversions for timber vary by timber product type, which reflect log size and quality. See Keegan et al. (2010a, 2010b) for more detail on the conversions and relationships of timber, lumber, and mill residue volumes.

The following conversion factors were developed using log size specifications as well as product and residue recovery information developed from the 2012 mill survey in California:

- 5.44 board feet per cubic foot for sawlogs
- 5.0 board feet per cubic foot for veneer and other logs
- 1.0 board feet per cubic foot for bioenergy logs

To help clarify how board feet are related to cubic feet in the context of milling operations, consider this example:

Examining California's sawmill sector, the estimated recovery of board feet lumber tally per board feet Scribner achieved by California sawmills in 2012 was 1.63. Based on this recovery, 1,000 board feet (1 MBF) Scribner of logs would yield 1,630 board feet lumber tally of dry planed lumber. Assuming that 1 MBF of lumber contains 60 cubic feet (57.5 cubic feet of lumber and 2.5 cubic feet lost to shrinkage after milling), 1.63 MBF lumber tally would contain $1.63 \times 60 = 97.8$ cubic feet of solid wood. The remainder of the log inside bark would be in various forms of mill residue (excluding bark). The average for all sawmills in California in 2012 was 0.55 BDUs of mill residue in the form of sawdust, planer shavings, and chippable residue. A BDU of residue is 2,400 lbs of oven-dry wood and contains 96 cubic feet of solid wood fiber. A recovery of 1.63 MBF of lumber generates $1.63 \times 0.55 \times 96 = 86$ cubic feet of total residue. The residue and the green lumber together

account for all of the wood fiber in the 1,000 board feet Scribner of logs used to produce lumber. There are therefore 183.9 cubic feet of solid wood in the average sawlog processed in California, yielding 1,000/183.9 = 5.44 board feet Scribner per cubic foot of logs processed into lumber. This board foot/cubic foot ratio was used to calculate the volume of cubic feet in California's sawlog harvest. See Keegan et al. (2010a) for more detail on the calculation of cubic feet in a given board foot volume of logs.

Figure 6 outlines timber flows by sector beginning with total statewide harvest and ending with finished primary products. California's 2012 timber harvest was approximately 360 million cubic feet (MMCF) of bole (wood) volume and 61 MMCF of bark that went to timber-processors and residue-utilizing facilities both within and outside the state. Of this volume, approximately 217 MMCF (60 percent of bole volume) went to sawmills and was processed into lumber and other sawn products, and about 27 MMCF (7 percent of bole volume) went to veneer and other products such as utility poles, log furniture, and firewood (fig. 6). An additional 17.4 MMCF of residue from the sawmill, veneer, and other sectors flowed to pulp and board plants in California, Oregon, and Washington. Bioenergy plants producing electricity received 116 MMCF of timber and 32.5 MMCF of mill residue from other plants processing California timber, accounting for 41 percent of total cubic bole volume harvested. An additional 37 MMCF of residue from sawmills and other primary processors was utilized onsite for heat and steam generation.

Forty-one percent of the total cubic bole volume harvested in California was used by bioenergy plants to produce electricity.

Of the 217 MMCF of timber received by sawmills, 110 MMCF (51 percent of bole volume) became finished lumber, and about 5 MMCF was lost to lumber shrinkage, with 101 MMCF remaining as mill residue. Most of the mill residue generated by sawmills processing California timber was used to produce energy, both internally (34.3 MMCF) and at bioenergy facilities (29.6 MMCF). An additional 21.5 MMCF was sold to landscape material manufacturers. The majority of the remaining mill residue went to pulp and board facilities in California and other states (16 MMCF). A very small amount, less than 0.2 MMCF, of residue from processing California timber into lumber, was unused in 2012.

During 2012, 27 MMCF of wood fiber was delivered to veneer and other facilities in California. These facilities produced 16.8 MMCF of finished product, with 2.9 MMCF of residue going to bioenergy plants, 3 MMCF used for landscaping, 1.4 MMCF going to board plants, and 2.7 MMCF used for internal energy. Since 2006, the proportion of wood fiber from California used by the bioenergy sector, both in the form of roundwood and mill residue, nearly doubled.

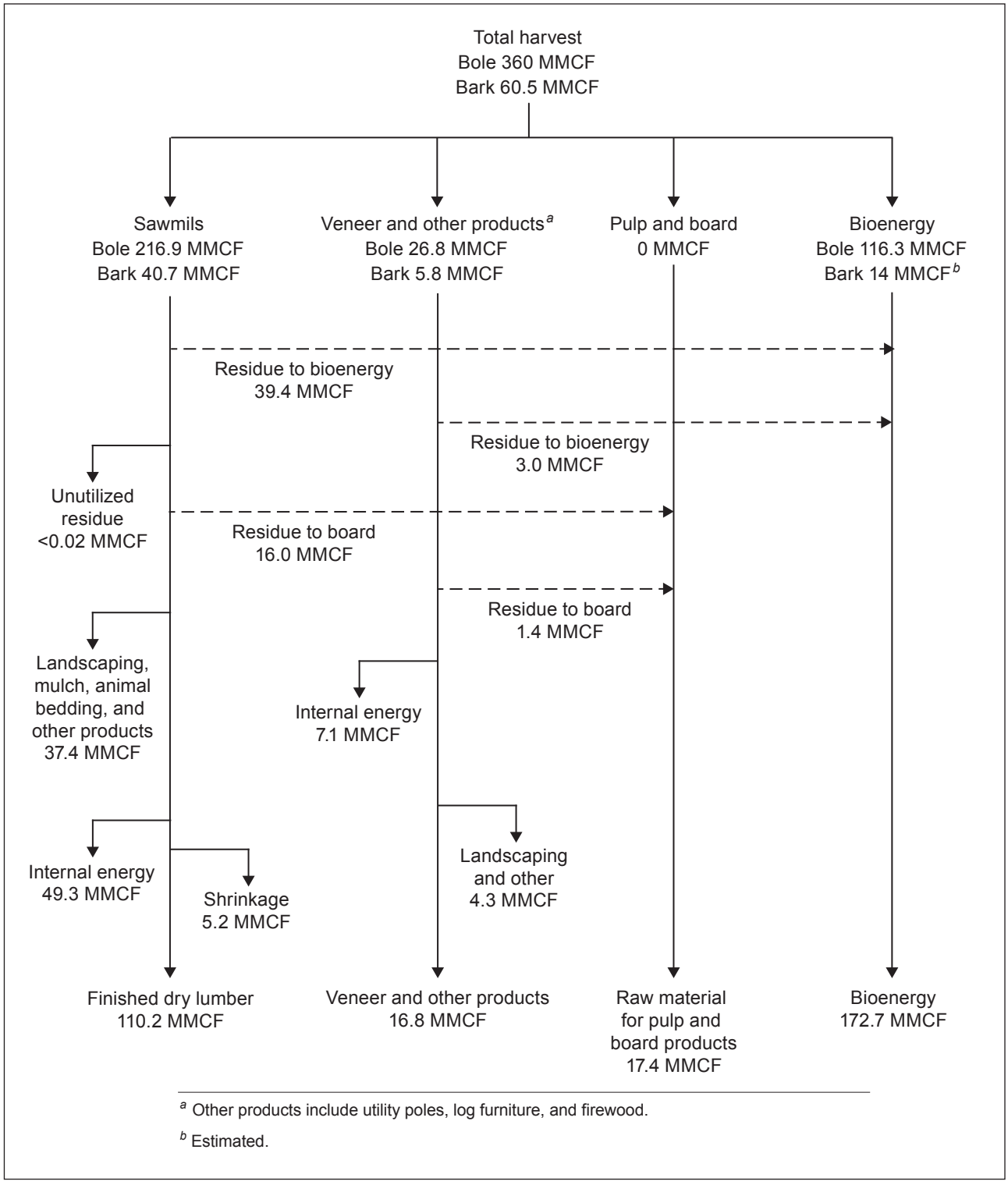

Figure 6—Utilization of California's timber harvest, 2012. MMCF = million cubic feet.

In total, 421 MMCF of wood fiber, including bark, was harvested from California timberlands in 2012. The timber was utilized as follows:

- 110 MMCF became finished lumber.
- 229 MMCF were used to generate biomass energy, usually in the form of steam or electricity.
- 17 MMCF were used as raw material to produce pulp and paper or reconstituted board products such as particleboard or medium-density fiberboard (MDF).
- 17 MMCF became veneer and other products such as utility poles, log furniture, and firewood.
- 42 MMCF went to other uses such as animal bedding, decorative bark or mulch.
- 5 MMCF were lost in shrinkage from green to dry lumber.

Figure 7a demonstrates the final disposition of wood fiber harvested in California during 2012 and figure 7b demonstrates the final disposition of residues generated by California's primary wood products sector (including bark).

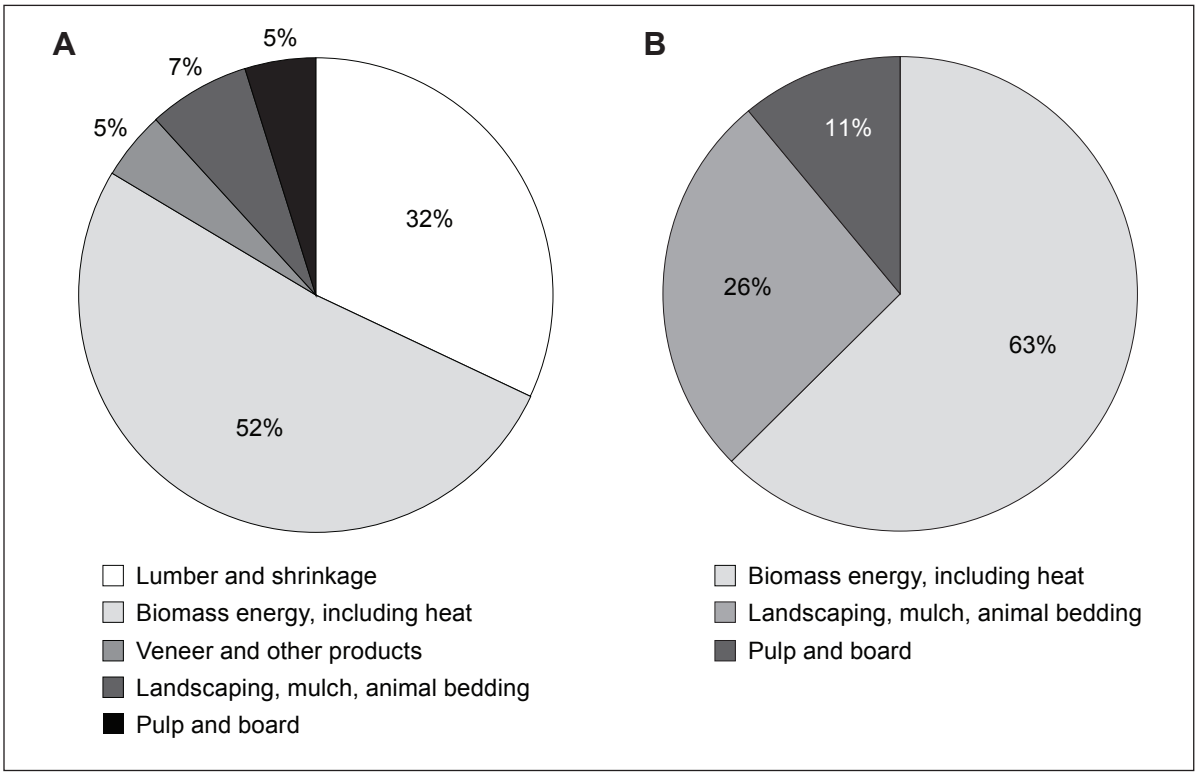

Figure 7—(A) Final disposition of wood harvested in California by industry sector, 2012; (B) final disposition of mill residue in California, 2012. In chart A, values total more than 100 because of rounding.

California's Forest Products Industry

Both the 2006 and 2012 censuses identified 77 active primary wood products manufacturers, but the composition of the industry has changed considerably.

The 2012 FIDACS census identified 77 active primary wood and paper products facilities in California, consistent with the 77 in 2006, but significantly down from 262 operational facilities in 1968 (table 13; fig. 8). The bulk of the losses over the past 44 years have occurred in the lumber-producing (i.e., sawmill), veneer and plywood, and pulp and board sectors. Conversely, there has been an increase in the bioenergy and "Other" sectors owing in part to diversified markets, changes in resource utilization and availability, and advancements in manufacturing technology. Since the 2006 mill census, the state lost three sawmills and three pulp and board facilities, but gained one bioenergy facility, one decorative bark facility, and four facilities falling in the "Other" category. More detail on individual sectors is provided in the subsequent discussion.

The higher number of timber-processing facilities in 2000 versus the 1994 survey was due primarily to the inclusion of the bioenergy and decorative bark sectors in the 2000 and 2006 censuses, offsetting declines in the number of sawmills and pulp and board facilities (Morgan et al. 2004, Ward 1997). Further, efforts to conduct a more comprehensive census of the industry occurred between 2000 and 2012, thus capturing a higher percentage and number of smaller mills and "Other" facilities. Although this change in research protocol may have resulted in finding more mills, the downward trends in the number of facilities, volume of timber processed, and capacity have continued through present time, mirroring trends in other Western States. Explanations for these trends include:

- A steep reduction in available timber supply resulting from reduced harvest levels on federal and nonindustrial private lands.

Table 13—Active California primary wood products facilities by sector, 1968–2012

Industry sector	1968	1972	1976	1982	1985	1988	1992	1994	2000	2006	2012
Sawmills	216	176	142	101	89	93	56	53	47	33	30
Veneer and plywood	26	25	21	10	6	6	3	4	2	2	2
Pulp and board	17	18	7	10	11	11	9	12	7	4	1
Bioenergy	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	25	25	26
Decorative bark	[b]	[b]	[b]	[b]	[b]	[b]	[b]	[b]	10	10	11
Other[a]	3	13	13	9	9	9	5	6	2	3	7
Total	262	232	183	130	115	119	73	75	93	77	77

[a] Other includes log home accent producers, shake and shingle manufacturers, fuel pellet producers, as well as post, pole, and piling manufacturers.
[b] Data unavailable for bioenergy and decorative bark sectors for 1968–1994.
Source: Barrette et al. 1970; Hiserote and Howard 1978; Howard 1974, 1984; Howard and Ward 1988, 1991; Morgan et al. 2004, 2012; Ward 1995, 1997.

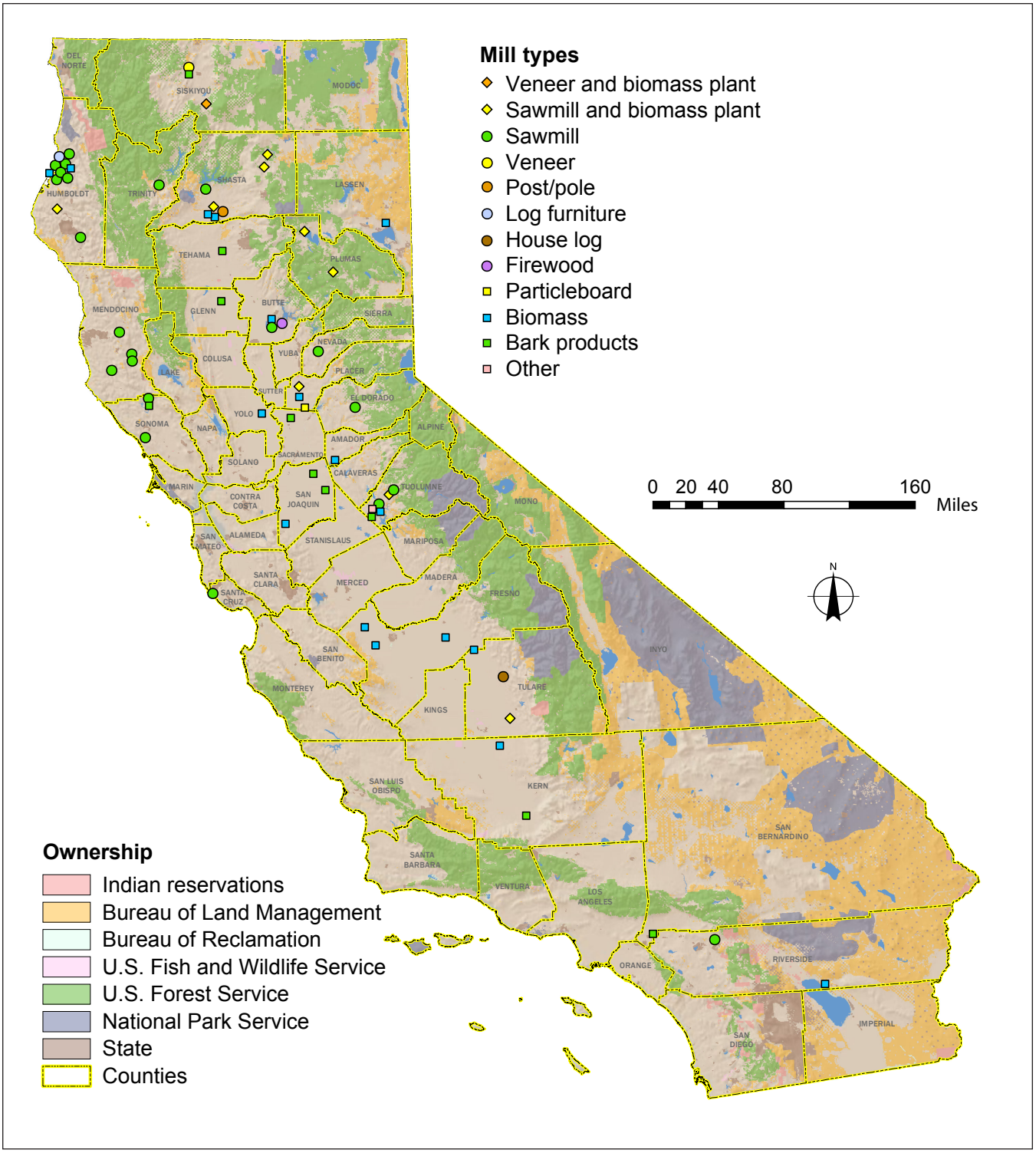

Figure 8—California's active timber-processing facilities, 2012.

- An intensive regulatory environment, shifting consumer preferences, and unfavorable market conditions that culminated with severe recessions in 1980 and 2007.
- Concentration of production into large, capital-intensive, more-efficient mills.

Factors affecting the structure and size of California's industry are discussed in more detail in the "Trends and Capacity by Sector" section.

Industry Concentrations

Wood product manufacturing facilities operated in 30 of California's 58 counties in calendar year 2012.

Wood product manufacturing facilities operated in 30 of California's 58 counties in calendar year 2012 (table 14; fig. 8). There were 12 active primary timber-processing facilities in Humboldt County in 2012, up from 10 facilities in 2006. Shasta County retained the same number of active facilities from 2006 at 10 operational facilities. Tuolumne had seven processors, one more than in 2006; and Tulare had four facilities in 2012 versus five in 2006. Mendocino and Sonoma Counties both had four facilities in 2006, and by 2012, had two and four, respectively.

Sales Value, Product Markets, and Market Areas

Total sales value reported by California's primary forest products producers in 2012 was about $1.4 billion, down (in constant dollars) from $1.7 billion in 2006 and nearly $3 billion in 2000.

The total sales value reported by California's primary forest products producers in 2012 was about $1.4 billion, down (in constant dollars) from $1.7 billion in 2006 and nearly $3 billion in 2000. Table 15 shows that product sales were led by the sawmill sector, followed by bioenergy, residue-utilizing, and veneer and other primary wood products sectors. Sales values decreased across all industries from 2006, with the exception of the bioenergy sector, which increased by 44 percent. The economic impacts of each sector are discussed more thoroughly in subsequent sections.

Table 16 reports the sales value and geographic destination (fig. 9) by product type for California's primary finished wood products. Mills usually distribute their products either through their own distribution channels or through independent wholesalers and selling agents. Because of subsequent transactions, the geographic destination reported here may not reflect final delivery points of shipments.

Sales of lumber and sawn products accounted for 64 percent of total sales, at over $876 million. Bioenergy sales made up 24 percent ($327.5 million), the residue-utilizing sector accounted for 9 percent ($122.8 million) of sales, and other products made up the other 3 percent ($44.3 million). At just over $1 billion and over 76 percent of total sales, California is its own largest market for finished primary wood products. The majority of the lumber, as well as all of the energy and electricity produced by the bioenergy sector, are used in-state. The sales value from the residue-utilizing sector dropped by 60 percent between 2006 and 2012. In 2006, just over half the output from the residue-utilizing sector was retained in-state;

Table 14—Active California primary wood products facilities by county and sector, 2012

County	Sawmills	Veneer	Medium-density fiberboard and particleboard	Bioenergy	Decorative bark	Other[a]	Total
Amador	—	—	1	1	—	—	2
Butte	1	—	—	—	—	1	2
Del Norte	—	—	—	—	—	—	0
El Dorado	1	—	—	—	—	—	1
Fresno	—	—	—	2	—	—	2
Glenn	—	—	—	—	1	—	1
Humboldt	8	—	—	3	—	1	12
Kern	—	—	—	1	1	—	2
Lassen	—	—	—	1	—	—	1
Madera	—	—	—	1	—	—	1
Mendocino	2	—	—	—	—	—	2
Nevada	—	—	—	—	—	—	0
Placer	1	—	—	2	1	2	6
Plumas	2	—	—	2	—	—	4
Riverside	1	—	—	1	—	—	2
Sacramento	—	—	—	—	1	—	1
San Bernardino	—	—	—	—	1	—	1
San Joaquin	—	—	—	1	2	—	3
Santa Cruz	1	—	—	—	—	—	1
Shasta	4	—	—	5	—	1	10
Sierra	—	—	—	—	—	—	0
Siskiyou	—	2	—	1	1	—	4
Sonoma	3	—	—	—	1	—	4
Sutter	—	—	—	—	—	—	0
Tehama	—	—	—	—	1	—	1
Trinity	1	—	—	—	—	—	1
Tulare	1	—	—	2	—	1	4
Tuolomne	3	—	—	2	1	1	7
Yolo	—	—	—	1	—	—	1
Yuba	1	—	—	—	—	—	1
2012 total	30	2	1	26	11	7	77
2006 total	33	2	4	25	10	3	77
2000 total	47	2	5	25	10	4	93

— = no reported data.

[a] Other includes log home accent producers, shake and shingle manufacturers, firewood, animal bedding, fuel pellet, and post, pole, and piling manufacturers.

Source: Morgan et al. (2004, 2012).

Table 15—Sales value of California's primary wood products, selected years

Product	2000	2006	2012
		Thousand 2012 dollars	
Lumber, timbers, and associated products	1,926,151	1,110,138	876,389
Bioenergy	335,917	227,055	327,458
Residue-utilizing sector[a]	598,928	290,094	122,770
Veneer and other primary wood products[b]	99,450	108,558	44,328
Total	2,960,446	1,735,845	1,370,945

[a] Residue-utilizing sector includes pulp, paper, and board manufacturers, fuel pellet producers and decorative bark.
[b] Veneer and other products include log home accents, peeler cores, posts, poles, pilings, animal bedding, and veneer.
Source: Morgan et al. 2004, 2012.

Table 16—Destination and value of California's primary wood products sales, 2012

Product	California	Far West	Rockies	North Central	North-east	South	Other[a]	Total
				Thousand 2012 dollars				
Lumber, timber, and associated products	614,082	34,232	78,896	66,722	10,542	55,597	16,318	876,389
Energy and electric	327,458	—	—	—	—	—	—	327,458
Residue-utilizing sector[b]	110,534	3,617	4,512	1,534	1,053	1,520	—	122,770
Veneer and other primary wood products[c]	4,490	39,838	—	—	—	—	—	44,328
2012 all primary wood products	1,056,564	77,687	83,408	68,256	11,595	57,117	16,318	1,370,945
2006 all primary wood products	1,209,892	171,448	94,101	76,518	33,850	25,131	124,906	1,735,845
2000 all primary wood products	1,830,765	340,357	228,593	275,313	108,397	77,053	99,968	2,960,446
				Percentage of 2012 sales				
Lumber, timber, and associated products	44.8	2.5	5.8	4.9	0.8	4.1	1.2	63.9
Energy and electric	23.9	—	—	—	—	—	—	23.9
Residue-utilizing sector[b]	8.1	0.3	0.3	0.1	0.1	0.1	—	9.0
Veneer and other primary wood products[c]	0.3	2.9	—	—	—	—	—	3.2
All primary wood products	77.1	5.7	6.1	5.0	0.8	4.2	1.2	100

— = no reported data.
[a] Other destinations include Pacific Rim and Canada.
[b] Residue-utilizing sector includes facilities that use residues from the manufacture of lumber and other products, including pulp mills, board facilities, fuel pellet producers and bark plants.
[c] Veneer and other primary wood products include log home accents, peeler cores, animal bedding, utility poles, firewood, furniture, and veneer.
Source: Morgan et al. (2004, 2012).

Figure 9—Shipment destinations of California's primary wood products.

in 2012, 90 percent was used in-state. This change is due, in part, to the loss of California's last remaining pulp facility, which exported nearly all of its output.

Veneer and other primary wood products are sold in higher proportions out of state, with just 10 percent of veneer and other products sold in California and the remaining 90 percent going to the Far West states. The sale of veneer to plywood and laminated veneer lumber (LVL) mills in Oregon accounts for much of this trend.

The destination make-up of California's primary wood products has changed since 2006. In a departure from 2006, the Rocky Mountain States make up the second largest market for primary wood products made in California. The region accounted for over 6 percent of total sales values, the majority of it (96 percent) in the form of lumber. Sales to the Northeast, Far West states, and other countries declined significantly, while sales to the South more than doubled. The Far West states made up the third largest market for primary wood products made in California, at $78 million or just under 6 percent of 2012 sales, primarily through lumber and veneer sales. The North Central states comprise 5 percent of total sales value at over $68 million, again most of it as lumber (99 percent). Sales to the South

exceeded $57 million, or a little over 4 percent, while sales to the Northeast totaled over $11 million, 1 percent of total California primary wood product sales.

International exports reported by participating mills constituted a smaller percentage of California's total primary wood products sales in 2012 relative to earlier years. An estimated $16 million in products went to Canada and the Pacific Rim countries, about 1.2 percent of total sales; this compares to $125 million or 7 percent in 2006, and $77 million or 4 percent in 2000. In 2012, all of the sales to foreign countries were from the sawmill sector, whereas the bulk ($103 million) of sales to foreign countries during 2006 was generated from the residue-utilizing sector.

Trends and Capacity by Sector

Sawmill Sector

The sawmill sector continues to be the largest component of California's forest products industry, producing 1.9 billion board feet of lumber with sales of $876 million.

The sawmill sector continues to be the largest component of California's primary forest products industry in terms of sales value (tables 15 and 16) and volume of timber processed (table 9). The 30 sawmills operating in California during 2012 accounted for slightly less than 7 percent of domestic softwood lumber production, which equates to about 5 percent of U.S. lumber consumption (WWPA 1964–2013).

Lumber production in California peaked in the late 1950s and has generally been declining since (fig. 10), following trends similar to those experienced in other Western States over the course of the 20th century (Morgan et al. 2012). Lumber production and prices have been defined by volatility since 2000. Lumber production for 2000 dropped to 3.1 billion board feet with a sales value of $1.8 billion. The declines continued into the first decade of the 21st century; despite very strong housing and lumber markets in 2004 and 2005, output and sales value were below 2000 levels. With weakening markets in 2006, output fell to 2.5 billion board feet, and lumber sales value was at $1.3 billion (fig. 11). The housing and lumber market bottomed out in 2009, seriously affecting the remaining forest products industry in California. As evidenced by figures 10 and 11, while production and sales have remained relatively low compared to mid-20th century levels, the industry began a slow recovery starting in 2010. In 2012, California produced 1.9 billion board feet of lumber with sales of $876 million, a 78-percent increase over the lowest point of the Great Recession in 2009, but only 57 percent of pre-recession (2004) sales.

Veneer and Plywood Sector

Currently there are no plywood plants in California and only two plants producing veneer for further manufacture into plywood and LVL by mills located in Oregon. The plywood sector was relatively short lived in California. It emerged and almost completely disappeared in the course of 60 years (Morgan et al. 2004). With strong

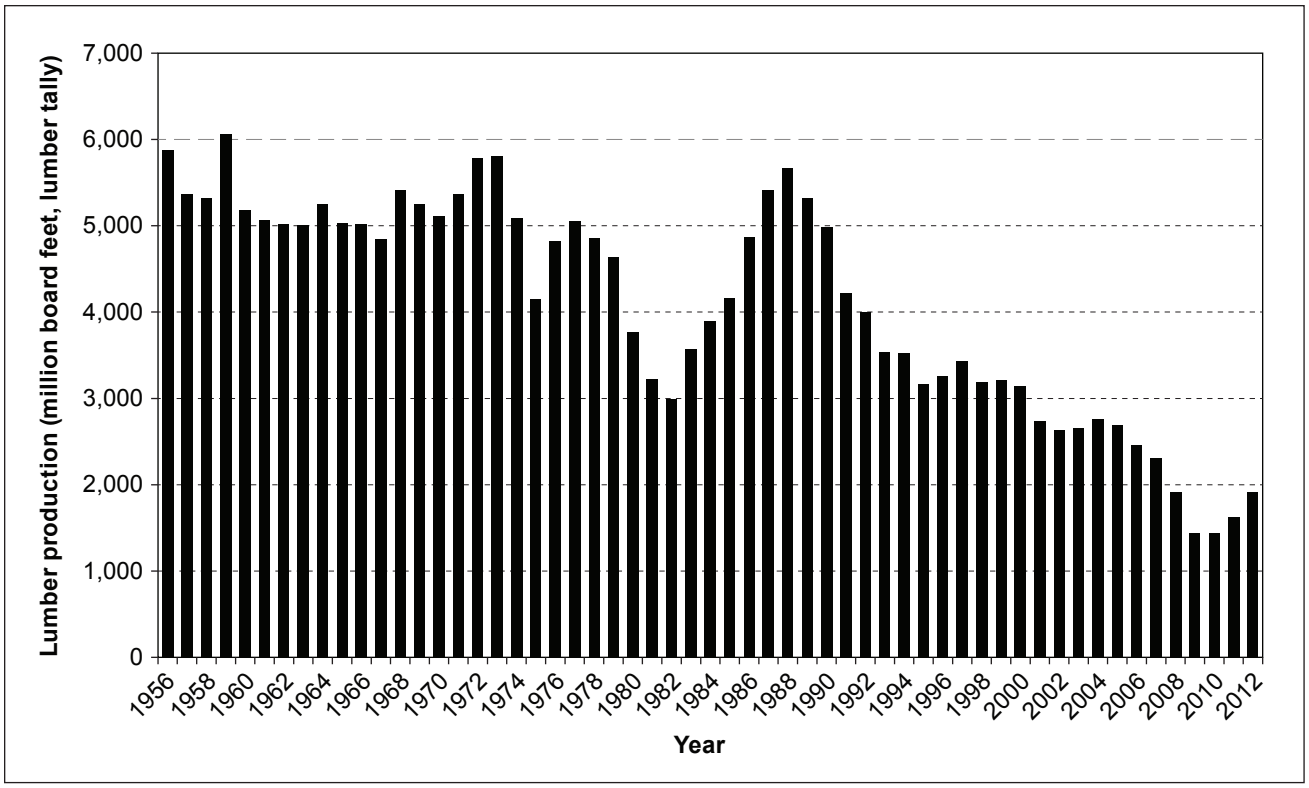

Figure 10—California's lumber production, 1956–2012.

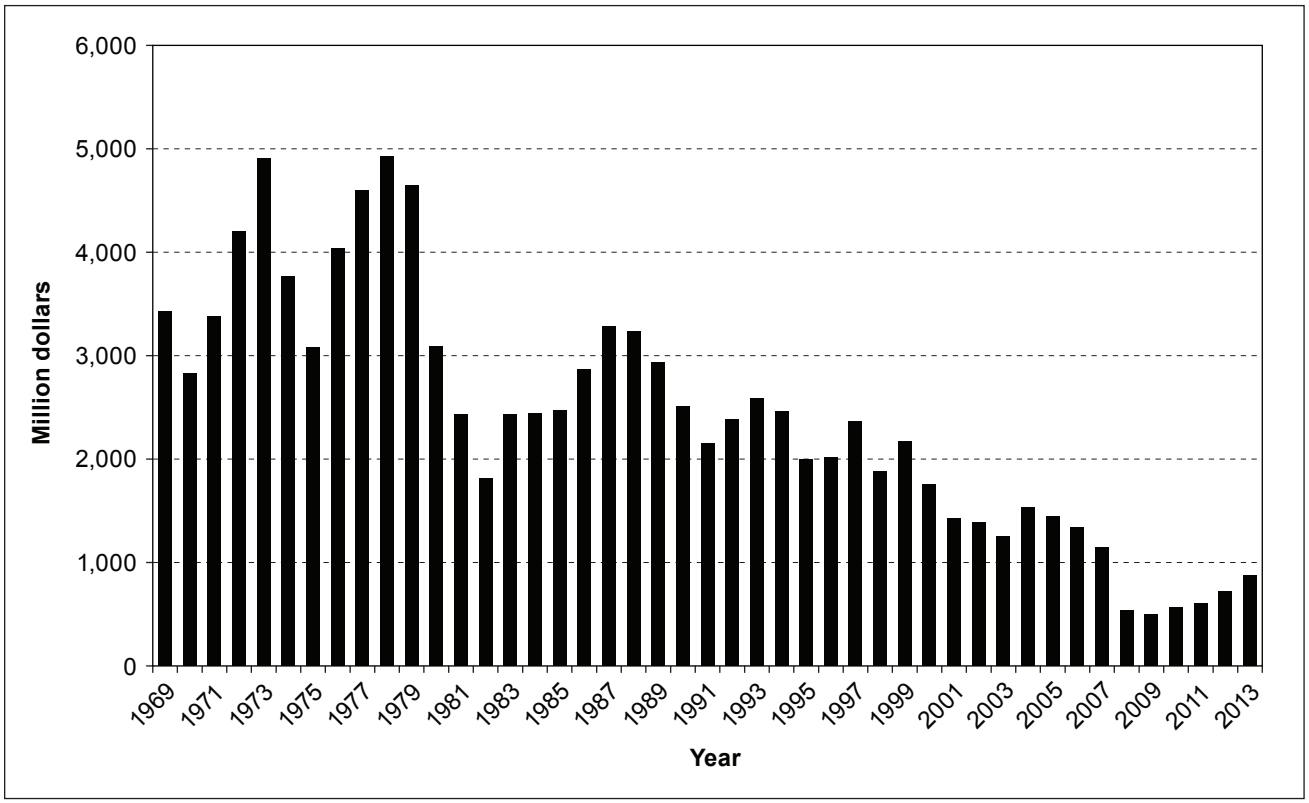

Figure 11—California's inflation-adjusted lumber sales, 1969–2012.

wood markets and the development of technology to make quality plywood out of abundant large-diameter Douglas-fir timber, California plywood production grew rapidly in the 1950s and early 1960s, peaking in 1964 at 1.3 billion square feet (3/8-inch basis). A number of factors have accounted for the decline and near disappearance of California's plywood and veneer industry. Howard (1972) pointed out that large-diameter Douglas-fir logs became less available. At the same time, spikes in log exports in the late 1960s and early 1970s brought increased competition for logs (Morgan et al. 2004). More recently, substitute products such as oriented strand board captured large portions of construction markets once dominated by plywood. Additional details regarding California's current plywood and veneer sector cannot be discussed to avoid disclosure of firm-level information.

Residue-Utilizing Sector

In 2012, there were 14 facilities in California manufacturing products from the mill residue generated at sawmills and other plants that process timber. These included two animal bedding facilities, a particleboard facility, a fuel pellet producer, and 11 bark plants producing landscaping products such as decorative bark and mulch. Since 2000, the number of manufacturers using mill residues has declined from 17 to 14. Between 2006 and 2012, the number of facilities dropped from 15 to 14, but the composition of the sector has changed drastically. Since the last report, California has seen the closure of two particleboard plants, one MDF plant, and one pulp mill. However, this period also saw the addition of one bark plant, one fuel pellet producer, and one producer of animal bedding from mill residue.

California's 2012 timber harvest included approximately 61 MMCF of bark, of which roughly 47 MMCF was used to produce energy and about 14 MMCF was used for other products such as mulch and landscaping bark. As with other mill residue in California during 2012, only a very small amount (less than 0.1 MMCF) of bark was not used.

Bark facilities are a relatively new addition to California's forest products industry. Prior to the early 1970s, the bark removed from timber during the production of lumber and other primary products was usually burned onsite for fuel, buried in landfills, or burned as waste. A market developed by the nursery and gardening industry led to the establishment of three decorative bark producers by 1975; this number grew to 10 by 2000 and is now up to 11 in 2012.

Sales for residue-utilizing manufacturers totaled nearly $123 million in 2012, down from nearly $290 million in 2006. Most of the decline in sales resulted from the closures of four pulp and board facilities in the state. Sales from bark producers totaled about $17 million in 2012, down from $40 million in 2006. The decline in

bark sales is likely because of the decline in timber harvest and processing statewide, making bark unavailable in some parts of the state, combined with reduced demand for decorative bark products resulting from the housing collapse.

Bioenergy Sector

In 2012, the bioenergy sector consisted of a variety of facilities, including cogeneration plants at timber-processing facilities such as sawmills that produced steam and electricity, as well as stand-alone facilities producing electricity using various mixes of urban and agricultural waste, sawmill residue, and timber. A total of 26 bioenergy facilities used some type of wood fiber, including timber, forest chips (i.e., trees or slash chipped in the forest), sawmill residue, and agricultural or urban waste (e.g., orchard clippings, fruit or nut shells/pits, construction and demolition waste). Seven facilities operated exclusively on sawmill residue (up from just two in 2006); 5 used a mixture of forest chips and sawmill residue; 10 used a mixture of agricultural waste, urban waste, and sawmill residue; and 4 facilities used forest chips, sawmill residue, and urban and agricultural waste. The diversity of facilities and inputs in the bioenergy sector reflect the increasing importance put on alternative energy sources in California through state and federal energy and pollution policies (e.g., California's AB 32 and Renewable Electricity Standard), as well as the advancements in technology allowing this to occur.

A total of 26 bioenergy facilities used some type of wood fiber, including timber, forest chips, sawmill residue, and agricultural or urban waste

The energy-producing capacity of the 26 bioenergy facilities that used wood fiber in 2012 totaled 551 megawatts (MW), up from 485 MW in 2006. An additional five facilities with a history of using forest or mill residues were idle in 2012 and had a combined capacity of 61.5 MW. In total, there are 5 facilities rated at 10 MW or less, 11 between 10 and 20 MW, and 15 greater than 20 MW—all using forest and/or mill residues. These producers sold over 3.4 million megawatt hours (MWh) of power in 2012. In 2006, 25 facilities produced close to 3.1 million MWh. One MWh equals between 1 and 2 month's power consumption for an average home in California (USDE EIA 2014). All of the energy produced was sold within the state of California, with a total sales value of $327.5 million (table 16). The sales value of electricity produced by bioenergy facilities increased 44 percent over 2006 sales, which was a combination of increased production as well as a 50-percent increase in the price paid per kilowatt hour (KWh) from $0.0645 in 2006 to $0.0966 in 2012. Measured in cubic feet, the bioenergy sector used about 41 percent of the wood fiber (excluding bark) from California's timber harvest and 63 percent of the bark residue produced. This includes over 116 MMCF (1.45 million BDT) of timber harvested for energy and 32.5 MMCF (162.5 thousand BDT) of residue from other primary processors.

Other Sectors

The remaining primary wood products manufacturers identified in 2012 included one house log accent facility, one utility pole producer, one log furniture producer, one firewood facility, and one wood shaving facility that used timber for inputs. The number and type of facilities comprising California's "other" (wood product) manufacturers have varied through the years. Historical information on their operations is limited. These producers are typically small operations that come and go with demand for their products, making it challenging to determine the total number of facilities operating and obtain information from them. Because of the limited number of facilities, no production data for these firms can be reported, and sales data are included with the veneer sector.

Input and Output Capacity

This section focuses on two measures of capacity—input (timber processing) capacity and output (production) capacity—from 1988 through 2012 and the utilized proportion of that capacity. Output capacity is the most commonly used measure of capacity, measuring the volume of finished product a mill could produce in a given timeframe—generally per shift or per year. However, finished products are measured in a variety of units: board feet lumber tally (lumber), thousand square feet (plywood, veneer), lineal feet (house logs), etc., making it difficult to express the total capacity of the industry as a whole. Another way of expressing capacity is in input capacity, often measured as sawtimber-processing capacity, which is a measure of the volume of raw logs that a mill can process in a given timeframe—generally per year and measured in board feet Scribner. Capacity for 2012 was developed from the FIDACS census of California's forest products industry. Capacity for previous years was estimated from previous industry censuses (Howard and Ward 1991, Morgan et al. 2004, Ward 1995) and for intervening years based on reported mill closures, openings, and expansions (Ehinger 2012, Random Lengths 1976–2013, Spelter et al. 2009).

Sawtimber-Processing Capacity

California's sawtimber-processing plants include sawmills, veneer mills, house log facilities, and utility pole plants. Through the FIDACS census, California mills were asked for their 8-hour shift and annual production capacities given sufficient supplies of raw materials and firm market demand for their products. Large sawmills and veneer plants expressed annual production capacity equal to two to three 8-hour shifts daily for 240 to 300 operating days per year. Smaller mills generally reported annual capacity as only one shift per day, for not more than 250 days per year.

To combine capacity figures for the state's sawtimber users and to estimate the industry's total capacity to process sawtimber, capacity was expressed in units of raw material input (MMBF of timber Scribner Decimal C) and was called processing capacity. Sawmill capacity figures were adjusted to million board feet of timber Scribner Decimal C log scale by dividing production capacity in lumber tally by the mill's calculated lumber recovery per board foot Scribner. For veneer plants, production capacity in square feet of 3/8-inch veneer was divided by each mill's calculated veneer recovery figure. Capacities for utility pole plants were adjusted to thousand board feet Scribner by multiplying capacity in lineal feet by an average Scribner board-foot volume per lineal foot. For log home accents, an estimate was made using the average volume of a log that would be used for that product. These pieces were comparable in size to veneer and sawlogs.

California's capacity to process timber in 2012 was an estimated 1.8 billion board feet Scribner, of which 72 percent was used by mills processing just over 1.3 billion board feet.

California's capacity to process timber in 2012 was an estimated 1.8 billion board feet Scribner, of which 72 percent was used by mills processing just over 1.3 billion board feet (fig. 12). There has been a 70-percent drop in capacity to process sawtimber in California since 1988, when capacity was 6 billion board feet of log input, and mills processed approximately 4 billion board feet of timber. The major decline in capacity took place from 1988 to 1999 with a fall from 6 billion board

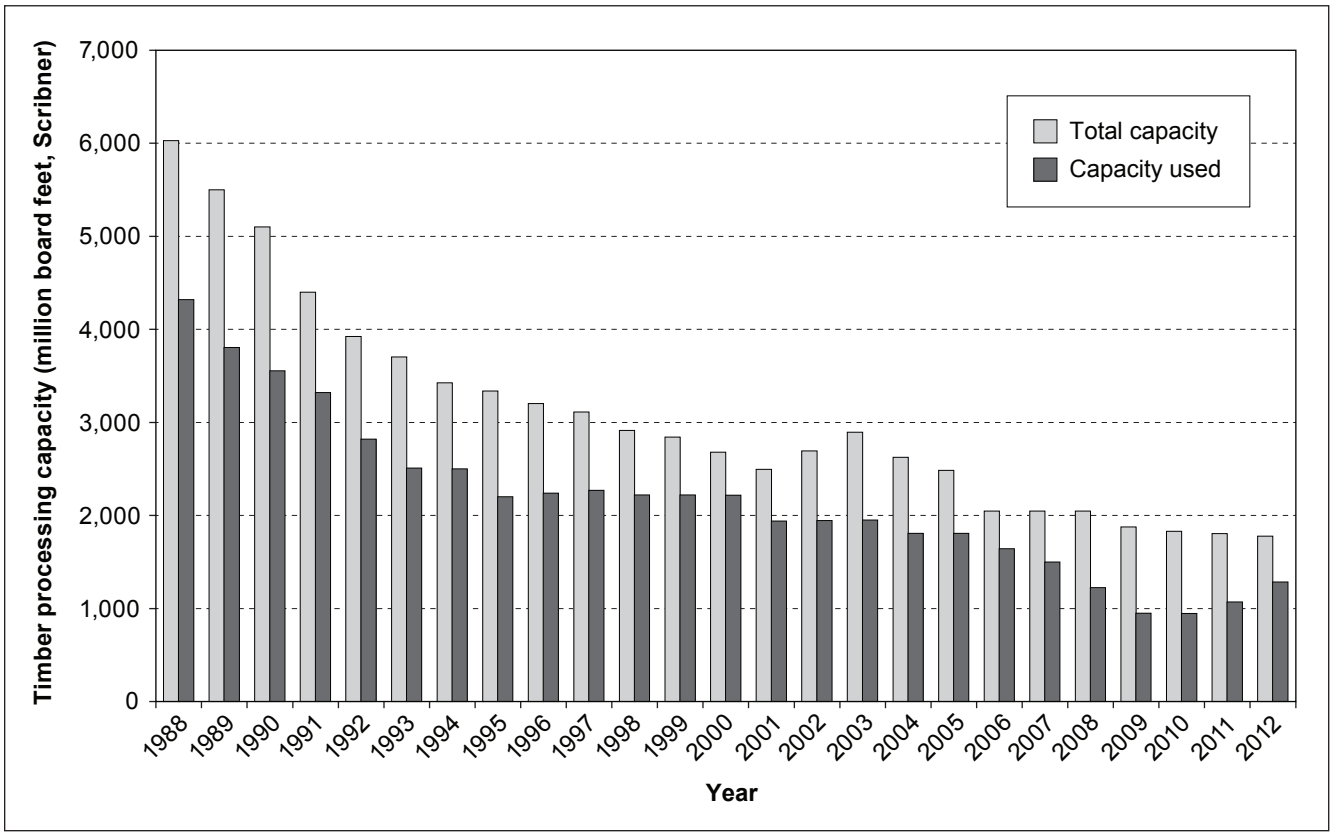

Figure 12—California's capacity for processing sawtimber, 1988–2012.

feet to 2.8 billion board feet (Morgan et al. 2004). The capacity decline in the 1990s resulted primarily from the decline of 2 billion board feet in federal timber offerings. Also negatively affecting capacity during the 1990s and beyond were a series of increased state regulations of timber harvest activities, which effectively reduced the available private timber volume and increased costs (Thompson and Dicus 2005). Changes in the use of private lands—such as development, urbanization, or purchases/set asides for parks or old-growth preservation—have also contributed to reduced timber harvest from private forest lands. During the recent poor markets, the portion of capacity used fell more dramatically than total capacity, from around 80 percent in the 2000 to 2006 period to an estimated 50 percent in 2009. As markets began to rebound, production and capacity utilization increased to 72 percent in 2012.

Lumber-Production Capacity

The concentration of capacity in the largest mills has increased from 58 percent in 2000 to 77 percent of sector capacity in 2012.

Capacity to produce lumber varies widely among California's 30 sawmills, and the proportion of capacity utilized is somewhat correlated with mill size (table 17). Total lumber production during 2012 was 1,917 MMBF, and production capacity was 2,468 MMBF lumber tally. Thus, approximately 78 percent of California's annual lumber-producing capacity was utilized, compared to 80 percent in 2006 and 81 percent in 2000. The majority, 1,896 MMBF (77 percent) of lumber-producing capacity, was concentrated in the 12 largest mills, with over 100 MMBF annual capacity. The degree of concentration of capacity among these mills increased from 2000, when 58 percent of capacity was in this size class. During 2012, these largest

Table 17—Number of active California sawmills, capacity, production, and proportion of capacity utilized by capacity size class, 2012

Production capacity size class	Number of mills	Production capacity	Percentage of total capacity	Average capacity per mill	Production	Percentage of total production	Average production per mill	Capacity utilized
		MMBF[a]	*Percent*	*MMBF*[a]	*MMBF*[a]	*Percent*	*MMBF*[a]	*Percent*
10 MMBF or less	8	25.5	1.0	3.2	14.8	0.8	1.8	58.1
Over 10 to 50 MMBF	4	87.6	3.6	21.9	74.1	3.9	18.5	84.6
Over 50 to 100 MMBF	6	458.0	18.6	76.3	350.0	18.3	58.3	76.4
Over 100 MMBF	12	1,896.4	76.9	158.0	1,478.1	77.1	123.2	77.9
2012 total	30	2,467.5	100	82.2	1,917.0	100	63.9	77.7
2006 total	33	3,067.2	100	92.9	2,453.3	100	74.3	80.0
2000 total	47	3,878.5	100	82.5	3,137.7	100	66.8	80.9

[a] Volume in million board feet (MMBF) lumber tally.
Source: Morgan et al. 2004, 2012.

mills accounted for 77 percent (1,478 MMBF) of lumber production in California, and utilized 78 percent of their lumber-producing capacity on average, down from 85 percent in 2006. Mills with capacities of 50 to 100 MMBF accounted for 458 MMBF (19 percent) of total capacity, produced 350 MMBF (18 percent) of the state's lumber, and on average utilized about 76 percent of their capacity. This size class lost the most mills between 2000 and 2006, going from 10 mills to 6. The remaining 12 sawmills accounted for approximately 5 percent (113 MMBF) of California's lumber-producing capacity and about 5 percent (89 MMBF) of the state's lumber production. These smallest mills utilized the smallest proportion (about 71 percent) of their available capacity.

Lumber Recovery Factors and Overrun

Product recovery ratios, or the volume of output per unit of input, are reported for California's sawmills as lumber recovery factors (LRFs) and overrun. The LRF is the lumber output (in board feet lumber tally) divided by the timber input (in cubic feet). Overrun is the volume of lumber (in board feet lumber tally) actually obtained from a log in excess of the estimated volume based on log scale (board feet Scribner). Both overrun and LRF are measures of mill efficiency. Although overrun is the more common measure, it is not as useful as LRF because of the weakness of the Scribner scale as a measure of log input. The average size of logs processed in California has almost certainly decreased over the past 50 years. As log diameters decrease, the Scribner log rule underestimates by an increasing amount the volume of lumber that can be recovered from a log, thus leading to increased overrun.

California mills produced an average of 8.87 board feet of lumber output per cubic foot of lumber input, an 11 percent increase since 2000.

The volume of sawtimber used by California's sawmills in 2012 was approximately 217 MMCF (fig. 6), and lumber production was 1,917 MMBF lumber tally. Thus the statewide LRF for California sawmills in 2012 was 8.87 board feet of lumber output per cubic foot of log input, an 11 percent increase since 2000 (Morgan et al. 2004, 2012).

Increases in LRF are attributable primarily to improvements in technology. Technological improvements have made California mills more efficient in numerous ways. For example, log size (diameter and length) sensing capabilities linked to computers determine the best sawing pattern for logs to recover either the greatest volume or greatest value from each log. Improved sawing accuracies have reduced the amount of size variation in sawn lumber, reducing the need for planing and increasing solid wood recovery. Thinner kerf saws reduce the proportion of the log that becomes sawdust, and curved sawing technology has increased recovery from logs with sweep and crook (Keegan et al. 2010a).

During 2012, California sawmills produced 1,917 MMBF lumber tally by processing 1,177 MMBF, Scribner Decimal C, of logs yielding an overrun of 63 percent

or 1.63 board feet of lumber per board foot Scribner of log input. A comparison of California sawmill overrun and LRF for various years is shown in figure 13.

Despite the long-term trend toward smaller logs discussed above, the average log size processed by California sawmills actually increased slightly from 2006 to 2012 (table 18). Seventy-five percent of logs processed by sawmills had a small-end diameter greater than 10 inches in 2012 versus 72 percent in 2006 (Morgan et al. 2012).

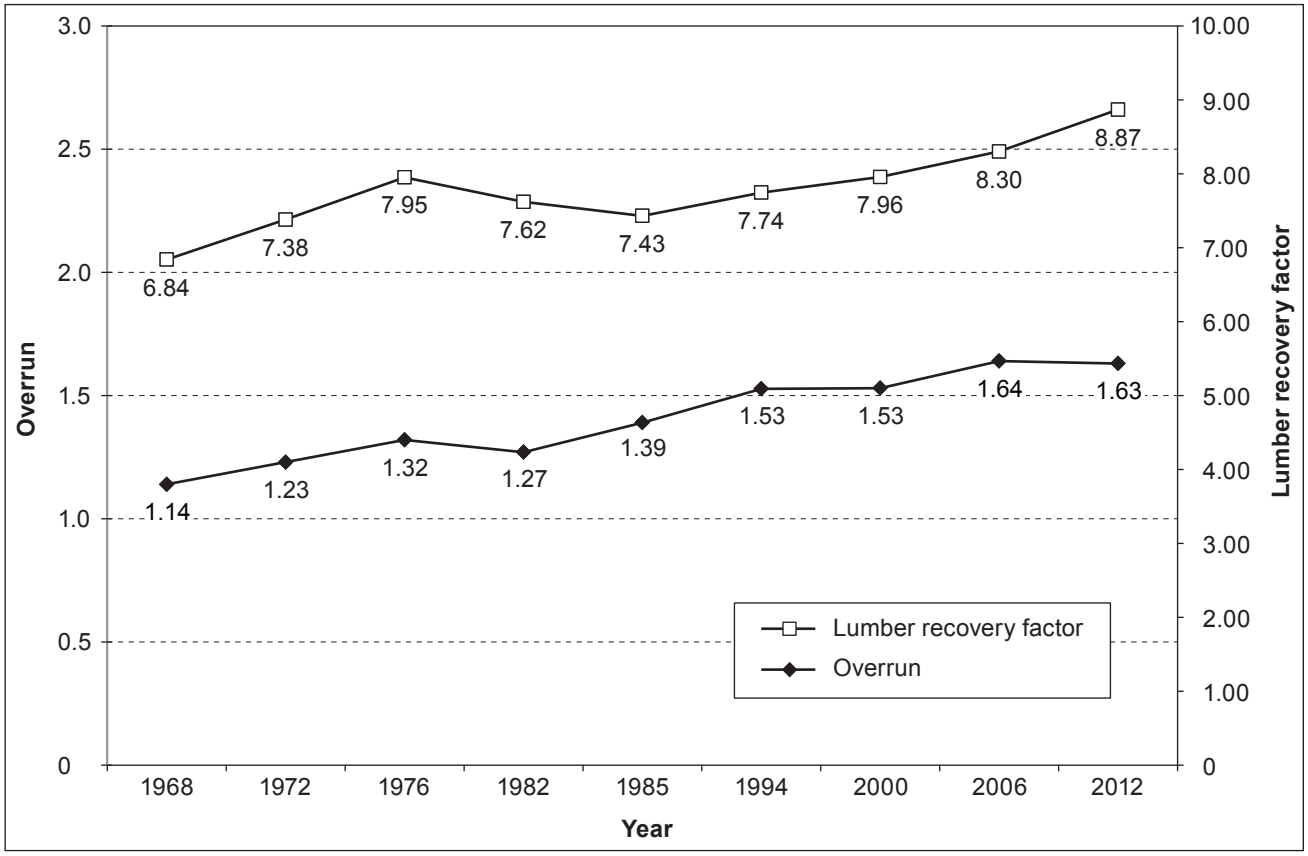

Figure 13—Lumber recovery factor and overrun in California, various years.

Table 18—Proportion of logs processed by sawmills by small-end diameter, 2006 and 2012

Small-end diameter (inches)	2006	2012
<7	0.09	0.07
7 to 10	0.19	0.18
Total <10	0.28	0.25
10 to 24	0.51	0.52
>24	0.21	0.23
Total >10	0.72	0.75

Mill Residue: Quantity, Type, and Use

In 2012, roughly 56 percent of the wood fiber (including bark) processed by primary forest products plants ends up as mill residue, down from 60 percent in 2006. This residue can either present difficult and expensive disposal problems or be used to create additional products or energy to generate revenue. California's substantial bioenergy industry is the largest consumer of wood residues generated in the state, whereas sawmills are the largest residue producers.

Roughly 56 percent of the wood fiber processed by primary forest products plants ended up as mill residue, down from 60 percent in 2006.

Three types of wood residues are typically created by California's primary wood products industry: coarse or chippable residue consisting of slabs, edging, trim, log ends, and pieces of veneer; fine residue consisting primarily of planer shavings and sawdust; and bark. The 2012 census gathered information on volumes and uses of mill residue. Actual residue volumes, reported in BDUs, were obtained from facilities that sold all or most of their residues. One BDU is the equivalent of 2,400 lbs of oven-dry wood. All mills reported, on a percentage basis, how their residue was used.

Residue volume factors, which express mill residue generated per unit of output produced, were derived from production and residue output volumes reported by mills. California's sawmills produce the majority of residues during their normal production process. Residue factors for 2000, 2006, and 2012, shown in table 19, represent statewide averages. During 2012, sawmills in California produced less residue per MBF of lumber produced with lower amounts of coarse residue and planer shavings generated. Several factors can contribute to changes in mill residue production. In general, changes in the size and species mix of logs received and products produced by sawmills can cause residue factors to change (Keegan et al. 2010a, 2010b). Improved milling technology tends to reduce the amount of planer shavings, sawdust, and coarse residue generated per unit of lumber, as do increases in average log size.

In 2012, over 99 percent of all residues were utilized to produce energy, landscaping products or as inputs for the pulp and board sector.

Table 19—California's sawmill residue factors, selected years

Type of residue	2000	2006	2012
	Bone-dry units per MBF[a]		
Coarse	0.41	0.37	0.33
Sawdust	0.15	0.15	0.14
Planer shavings	0.13	0.11	0.08
Bark	0.23	0.21	0.22
Total	0.92	0.85	0.77

MBF = thousand board feet.
[a] Bone-dry units (2,400 lbs of oven-dry wood) of the various residue types generated for every MBF of lumber manufactured.
Source: Morgan et al. 2004, 2012.

In 2012, California sawmills generated nearly 1.5 million BDUs of mill residue accounting for nearly 91 percent of all mill residues generated that year (table 20). The remaining 9 percent of mill residue production came from veneer plants, a utility pole facility, and a log home accent plant.

Coarse residue was the state's largest component of wood products residue (table 21). Facilities in California produced 729,798 BDU of coarse residue; only 328 BDU were not used for some purpose. About 63 percent of course residue was used to produce energy, 21 percent was used by pulp and reconstituted board plants, and about 16 percent was sold and used for other products.

Fine residues—sawdust and planer shavings—made up 26 percent of residue (415,473 BDU) in 2012. Sawdust composed 64 percent and planer shavings 36 percent of fine residue. All fine residue was used in some fashion, primarily as fuel (256,183 BDU) or landscaping and other products (134,520 BDU). California facilities generated 485,506 BDU of bark while processing timber in 2012—all but 0.3 percent of which was used by other sectors. Sixty-three percent of bark (304,776 BDU) was used for bioenergy, and 37 percent (179,438 BDU) was used as landscaping or soil additives.

Forest Products Industry Employment and Earnings

Data reported in the FIDACS mill census were used in conjunction with employment and earnings data from the U.S. Department of Commerce, Regional Economic Information System to identify employment and labor income for California's primary and secondary forest products industry. Although the U.S. government changed the way in which it reported economic data and classified employment by sector in 2001, the U.S. Department of Commerce Bureau of Economic Analysis has made state-level personal income information available

Table 20—Volume of wood residue generated by California's sawmills, 2012

Residue type	Wood residue			Percentage of type		Percentage of total
	Used	Unused	Total	Used	Unused	
	Bone-dry units[a]			*Percent*		
Coarse	640,757	312	641,069	99.95	0.05	43.44
Fine						
Sawdust	261,326	620	261,946	99.76	0.24	17.75
Planer shavings	148,225	250	148,475	99.83	0.17	10.06
Bark	423,097	1,287	424,384	99.70	0.30	28.75
All residues	1,473,405	2,469	1,475,874	99.83	0.17	100

[a] Bone-dry unit = 2,400 lbs of oven-dry wood.

Table 21—California's production and disposition of wood products residue, 2012

Type of residue[b]	Total utilized	Pulp and board	Energy	Landscape products, animal bedding, and other uses	Unutilized	Total produced
			Bone-dry units[a]			
Coarse	729,470	154,773	458,643	116,054	328	729,798
Fine						
Sawdust	265,176	3,477	207,787	53,912	620	265,796
Planer shavings	149,425	20,421	48,397	80,608	250	149,675
Bark	484,214	—	304,776	179,438	1,291	485,506
All residue	1,628,285	178,671	1,019,602	430,012	2,490	1,630,775
			Percentage of residue use by type			
Coarse	100.0	21.2	62.8	15.9	0.0	44.8
Fine						
Sawdust	99.8	1.3	78.2	20.3	0.2	16.3
Planer shavings	99.8	13.6	32.3	53.9	0.2	9.2
Bark	99.7	—	62.8	37.0	0.3	29.8
All residue	99.8	11.0	62.5	26.4	0.2	100

— = no reported data.
[a] Bone-dry unit = 2,400 lbs oven-dry wood.
[b] Includes residue from the manufacture of lumber, veneer, utility poles, log furniture, and house logs.

from 1990 through the present. This period formed the basis of the analysis in this section. For further reading on changes in governmental reporting systems for economic data, see Morgan et al. (2012).

The classification of forest industries used here follows the North American Industry Classification System (NAICS) available online via the U.S. Department of Commerce (USDC CB 2014). The forest products industry can be found in four categories: NAICS 113—forestry and logging; NAICS 1153—forestry support activities; NAICS 321—wood product manufacturing; and NAICS 322—paper manufacturing. These categories include employees who work in both the primary and secondary forest products sector, as defined elsewhere in this report. However, these four categories probably understate total employment in the forest products industry because they do not include a number of supporting activities. For example, log hauling (trucking) companies and forest management services performed by government employees are not included in these categories.

Over 52,000 workers were employed in the primary and secondary forest product sectors in 2012, with total earnings of more than $3.3 billion annually.

Based on the four NAICS sectors (113, 1153, 321, and 322), approximately 52,200 workers (USDC BEA 2013a) (fig. 14), earning more than $3.3 billion annually (USDC BEA 2013b) (fig. 15), were directly employed in the primary and secondary forest products industry in California during 2012. Consequently,

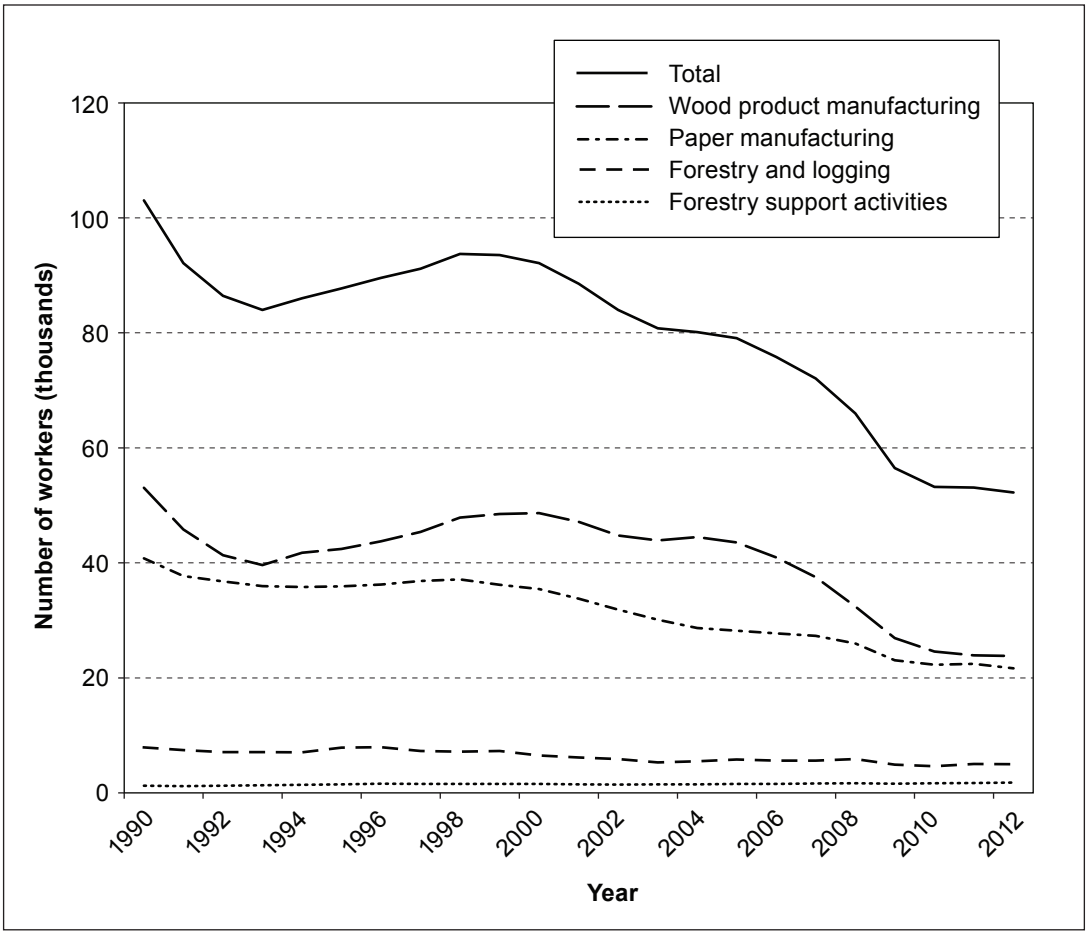

Figure 14—Employment in California's forest products industry, 1990–2012.

average earnings per worker across California's primary and secondary forest products industry were about $63,000 in 2012. This is a decrease of about 33 percent in employment and 25 percent in inflation-adjusted earnings in the industry since 2006.

About 13,100 workers were employed in the harvesting and processing of timber or in private sector land management in 2012 (i.e., the primary sector), and they earned about $670 million.[2] The remaining component of the industry can be classified as secondary and employed about 39,500 workers, with earnings of approximately $2.6 billion. The secondary wood and paper industry relies on the output of the primary industry from California and other parts of the world for raw materials.

Total employment in California's forest products industry has decreased dramatically since 1990, when employment was more than 103,000. Trends in

[2] All dollar amounts in this section are in constant 2012 dollars, unless otherwise noted.

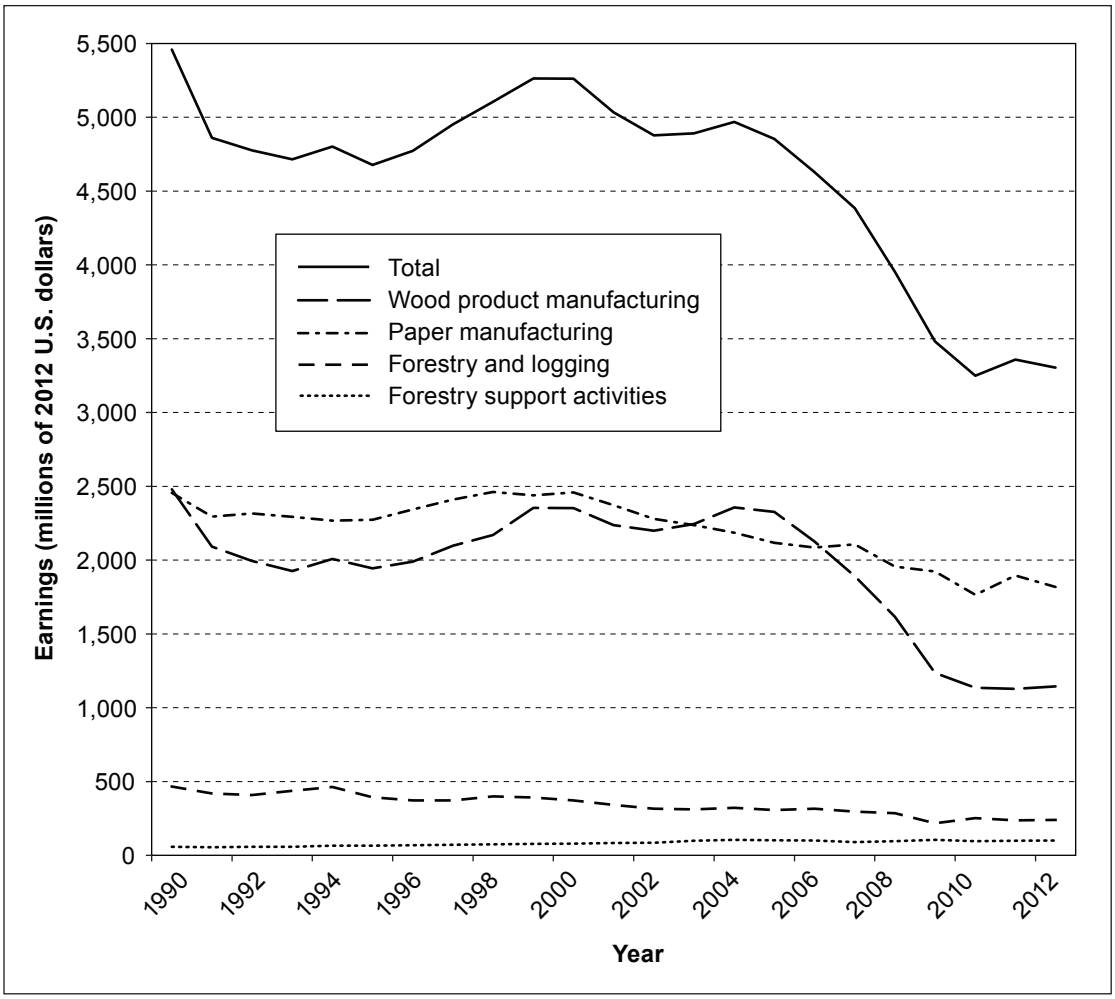

Figure 15—Inflation-adjusted earnings in California's forest products industry, 1990–2012.

earnings show similar declines from about $5.5 billion in 1990 to $3.3 billion in 2012. These long-term decreases have resulted almost entirely from losses in the primary industry. From 1990 to 2012, overall employment in California's wood and paper products industry declined by nearly 51,000 workers.

California's secondary wood and paper products industry is concentrated near population centers in the state's southern and central counties. The primary forest products industry is concentrated in the northern counties, closer to where timber harvesting occurs. The primary portion of the industry is integrally linked to forest management practices in the state, although this link is not as pronounced with the secondary industry. Consequently, policymakers and others with concerns for the wood products industry should be aware that statewide policies and legislation, whether related to the environment, labor, or industry, will generally have larger impacts on the residents of the northern counties than the state's population as a whole.

Acknowledgments

We thank all the participating wood products facility owners, managers, and staff who took the time to provide detailed information about their operations. In addition, we are grateful for comments and input provided by Steve Brink, California Forestry Association; Larry Swan, USDA Forest Service State and Private Forestry; Bill Stewart, University of California–Berkeley; the USDA Forest Service Forest Inventory and Analysis program; and all the reviewers of the manuscript and summary data tables.

Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.54	Centimeters (cm)
Feet (ft)	0.3048	Meters (m)
Square feet (ft^2)	0.0929	Square meters (m^2)
Cubic feet (ft^3)	0.0283	Cubic meters (m^3)
Cubic feet per acre	0.06997	Cubic meters per hectare
Pounds per cubic foot	16.018	Kilograms per cubic meter
British thermal units (Btu)	0.000293	Kilowatt hours (kWh)

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U.S. Department of Agriculture
Pacific Northwest Research Station
1220 SW 3rd Ave.
P.O. Box 3890
Portland, OR 97208–3890