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Wood Use in Colorado at the Turn of the Twenty-First Century

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Abstract

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This study estimates the kinds, uses, amount, and retail value of wood products consumed annually in Colorado from 1997 to 2000. Colorado uses tremendous amounts of wood products, but it imports most of it from other states and countries despite the abundant forests in Colorado that are capable of providing many types of wood products.

Keywords: wood, wood use, lumber, logging, construction, forest health, fire

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Dr. Kurt Mackes is Assistant Professor in the Department of Forest Sciences. Dr. Mackes joined Dr. Lynch in this research as well as research related to wood utilization. He currently is the key contact for wood science research and information concerning this report.

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Executive Summary

Based on four years of analysis, this study *estimates* the kinds, uses, amount, and retail value of wood products consumed annually in Colorado. It also shows where these products came from.

At the turn of this century, during the years 1997 through 2000, Colorado was using on a yearly basis:

- 1.047 billion board feet of lumber valued at $628.6 million.
- 25.08 million board feet of timbers valued at $14.97 million.
- $16.86 million of other sawn wood products.
- 791.24 million square feet of panels valued at $267.8 million.
- 60.75 million board feet of roundwood valued at $62.3 million.
- 495,000 Christmas trees valued at $11.6 million.
- $32 million of wood energy products including firewood, firelogs, and wood pellets.
- 1.4 million cubic yards of mulch, chips, and sawdust valued at $14.2 million.

In addition, Colorado annually used $3.051 billion worth of value-added wood products including doors, cabinets, molding, flooring, windows, furniture, paper products, and engineered wood products and composites.

In most wood product categories, 90% to 100% of the materials were imported. Key states exporting wood products to Colorado included Oregon, Idaho, Washington, California, Montana, Louisiana, Arkansas, Minnesota, and Wisconsin. Canada provided 25% of lumber and 60% of structural panels consumed in Colorado. Mexico shipped firewood, rough lumber, and timbers valued at $220,000 per year and this amount is expected to increase under NAFTA.

In 1999, Colorado's forests produced 109.8 million board feet of wood used for lumber, timbers, firewood, and panels, or approximately 8% of the total amount of wood used in Colorado. Some of this wood was sent to Wyoming or New Mexico for processing. The location of some Colorado processing plants also resulted in products being shipped to adjacent states.

While Colorado has marvelous wood markets and abundant forests, it depends on other states and countries for the wood it uses. Significant amounts of money are transferred from Colorado's economy to other economies to pay for this wood. Excellent opportunities exist to improve forest health and reduce catastrophic fires by using wood, particularly small diameter trees, from Colorado forests.

Using imported wood has other policy and management implications as well. These concerns will be addressed in subsequent papers.

Wood Use in Colorado at the Turn of the Twenty-First Century

Dennis L. Lynch

Kurt Mackes

Introduction

Wood is one of the most useful natural materials available. It is easy to work with, possesses natural beauty, insulates efficiently, is relatively lightweight, and yet is quite strong. It is renewable: trees grow more of it each year and in the process cleanse the air, produce oxygen, sequester carbon, retain soil, and provide beautiful scenery. In Colorado, substantial population growth and natural resource consumption are occurring. This creates tremendous demand for wood-based construction materials and other types of wood products. Our study focused on several key questions about wood use:

- What amount of wood is consumed in Colorado each year?
- What are the principal uses for wood?
- What kinds of wood are used and where does it come from?
- How much money is spent on wood products each year?
- How much wood comes from Colorado and how much comes from other states or countries?

Methodology

When we started this study four years ago, we found little current information on wood consumption in Colorado. Previous studies had been very well done (Donnelly, Worth, Hasty, Aitken, and Morgan 1983; Smego, Switzer, Betters, Donnelly, and Worth 1984) but are now dated and only partially reflect the increasingly urban population that now characterizes Colorado. Finding and developing current data on wood use has been difficult and frustrating. The total picture still has not been fully developed and research will need to continue for some time. However, we compiled a good *estimate* of the major volumes and values of wood used in Colorado for publication, as well as a process to monitor, update, and improve these data in the future.

Measurements presented in this study may be confusing. Terms like board feet, square feet, lineal feet, and cubic yards are not common measurement units for many people. Board feet and cubic yards are measures of volume. One board foot is 12" wide, 12" long, and 1" thick. A cubic yard measures 3' by 3' by 3' and contains 27 cubic feet. While a square foot of panel is a measure of area, the industry uses 3/8" as a standard. Therefore, in a sense a square foot also has a volume aspect. A lineal foot is, of course, a measure of length. These measures are used because they are common to the industry and the data sources use them. Later, an attempt is made to place them in a different and perhaps more understandable perspective.

Retail values are used because wholesale values are difficult to obtain and to avoid betraying the confidences of the people interviewed. Retail values also best reflect the marketplace and competition that exists there. We calculated retail values by multiplying the amount (units) of a wood product consumed by the average unit value (retail) of that product. Generally, unless otherwise specified, we used the average retail value for the year in which we collected consumption data for the product.

This study provides only *estimates* of wood use in Colorado. Both usage and market values fluctuate considerably over time. Estimates are only valid for the time periods considered and represent only a snapshot in time. Although we attempted to be thorough in pursuit of information and accurate in calculations, developing exact numbers for all wood products used in Colorado was simply beyond the available time and budget. To develop the estimates in this report, the following sources were used:

- U.S. Census Bureau information on Colorado including population estimates, economic census reports related to different wood utilization, manufacturing aspects of the economy, and shipping data.
- An itemization by the National Association of Home Builders of materials used in the construction of an average three-bedroom home.
- Information from and telephone interviews with trade associations such as: Western Wood Products Association,

National Hardwood Lumber Association, American Plywood Association, Hardwood Plywood and Veneer Association, California Redwood Association, Engineered Wood Association, Southern Forest Products Association, Log Home Council, Wood Products Promotion Council, National Wood Pallet and Container Association, National Christmas Tree Association, American Forests and Paper Association, Pellet Fuels Institute, and Cedar Shake and Shingle Bureau.

- Reports developed by the Forest Products Laboratory, USDA Forest Service, Madison, Wisconsin.
- Articles from the Forest Products Journal that presented information on wood products and/or information on estimates of wood use.
- Scientific papers and reports from individual researchers and professional journals.
- Articles from trade journals.
- Written surveys sent to wood manufacturers and users.
- Telephone surveys of wood purchasers, sellers, users, installers, and producers.
- Telephone interviews with wood transportation agencies such as U.S. Bureau of Transportation Statistics, Department of Commerce, Federal Railway Administration, and transportation firms including railroad and trucking.
- Personal interviews with wood producers and forest management agencies.
- Field surveys to gather wood use data on-site.
- Estimates from experts who manage wood use for their organization.
- Retail values for wood products from major outlets.

How accurate are estimates, given all the different methods and data sources used? At this point, better sources of data could not be found. Where reliable data sources could not be located, the use is simply listed with comment. In situations where we had to choose between data sources and/or calculation methods, we chose the most conservative source or method. New information on more accurate data sources or methods of estimating use from readers are and will continue to be appreciated.

Sources:

Donnelly, D. M.; Worth, H. E.; Hasty, R.; Aitken, W. M.; Morgan, M. 1983. Wood product flows and market structure in the Rocky Mountain States. Res. Bull. RM-6. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Smego, J. H.; Switzer, W. E.; Betters, D. R.; Donnelly, D. M.; Worth, H. E. 1984. Timber utilization and marketing alternatives for Colorado and Wyoming. Res. Bull. RM-7. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Wood Use Estimates by Category

Residential Framing Lumber and Structural Panels

According to national sources, about 95% of the homes in the United States are built of wood. The National Association of Home Builders calculates that an average home contains 2,085 square feet of floor space, has three bedrooms and a double garage. Such a home is constructed by building a wooden floor frame over a concrete foundation. That frame is covered with floor sheathing and then the walls are framed. The walls support roof trusses and sheathing covers the entire exterior. Siding material covers the walls, and shingles or similar materials cover the roof. Framing lumber consists of 2-inch thick boards in widths of 4", 6", 8", 10", and 12" of varying lengths starting at 8 feet and increasing by two-foot increments. Studs, also known as 2"x4"s, are the most common boards used. Sheathing, which is typically either oriented strand board or plywood, varies in thickness from 3/8" to 3/4" and is 4' wide and 8' to 12' long. These may also be referred to as structural panels.

In 1998, a total of 51,156 dwelling units were constructed in Colorado. These consisted of single-family homes as well as multi-family structures. Using nationally recognized wood use figures for such dwellings, an estimated 602.7 million board feet of framing lumber was consumed in Colorado to construct floors, wall frames, and roof trusses. The retail value of this framing lumber was $370.4 million. A number of firms bring framing lumber into the state and manufacture value-added products (such as trusses). The value of the lumber is included in the above estimate, but the value-added portion of such products is not.

On a 3/8" thickness basis (the industry standard), 479 million square feet of sheathing was used for floors, walls, and roofs of new housing. The value of this sheathing was $143.1 million.

A total of 35.9 million square feet of wood-based exterior siding and 10.5 million square feet of wood shakes or shingles were also used in residential construction. The value of the exterior siding was $20.9 million and the value of the shakes and shingles was $16.6 million.

Virtually all (95%) of this home construction lumber, panels, siding, shakes, and shingles came from out-of-state. The specifics on the importation of lumber and other wood products into Colorado are discussed in the section “Where does the wood come from?”

The use of substitutes for wood, such as steel studs and plastic composite lumber, has been increasing. Therefore, some of the wood use estimated above is being taken over by substitutes. The Forest Products Journal (2000) reports that in

1992, about 3% of total U.S. national lumber consumption was being replaced by substitutes and this was expected to grow to as much as 11% by 2003. As of this writing, there is not a means of determining the amount of substitutes used in Colorado. If this could be done, estimate reductions might be in order. However, there are other uses for framing lumber not accounted for in this study, such as in the building of sheds and barns. Therefore, such framing lumber use may offset substitutes used in home construction.

Sources:

Anderson, L. O. Wood frame house construction. Agric. Handb. No.73. Washington, DC: U.S. Department of Agriculture, Forest Service.
Colorado Building Permit Statistics.
The Engineered Wood Association.
Forest Products Journal. 2000. Clippings. 50(6): 4.
McKeever, D. B.; Phelps, R. B. 1994. Wood products used in new single family house construction. Forest Products Journal. 44(11/12): 66–74.
National Association of Home Builders.
Southern Forest Products Association.
U.S. Census Bureau.
Western Wood Products Association.

Wood Components Used in Housing

Home construction utilizes wood products other than framing lumber, panels, siding, or shingles. In the interior of a home, wood paneling, millwork, molding, cabinets, doors, windows, and floor materials add utility, beauty, and warmth. According to figures adapted from the National Association of Home Builders to Colorado dwelling units constructed in 1998, additional wood components included:

- 551,000 interior doors,
- 229,600 closet doors,
- 183,700 exterior doors,
- 91,800 garage doors,
- 596,900 kitchen and bathroom cabinets,
- 25.6 million lineal feet of molding, and
- 6 million square feet of wood plank, strip, or parquet flooring.

Substitutes such as fiberglass, vinyl, metal, and plastics are being used in place of wood in many of these components. For example, 98% of all interior doors are wood, but only about 10% of exterior doors are made of wood; the balance are made of steel or fiberglass. The wood component portion of the items listed above are valued at approximately $2 billion and virtually all wood used in these components comes from out-of-state.

Approximately 711,000 windows were also used in dwelling units built in 1998. Window values are more difficult to estimate because of the tremendous variation in size, design, and construction materials. Substitutes such as metal, vinyl, and plastics are used in place of wood in many windows. However, approximately 35% of all windows sold are wood. The average cost of these windows was calculated at $135 each. This results in a retail value of $33.6 million for wood windows used in Colorado. All wood used in window manufacturing comes from out-of-state.

Sources:

Forest Products Journal. 1999. Clippings–Structural wood market forecast. 50(1): 5.
Home Depot Cabinet Department.
Lynch, D. 1999. Personal survey of Colorado millwork and flooring firms.
Lynch, D. 1999. Telephone dwelling units survey for Colorado cities.
Mackes, K. 1999. Survey of county building permits.
McKeever, D. B.; Phelps, R. B. 1994. Wood products used in new single-family house construction: 1950 to 1992. Forest Products Journal. 44(11/12): 66–74.
National Association of Home Builders. 1998. Materials used in constructing a single family home. Personal communication with Economics Department.
U.S.Census Bureau. 1995. American Housing Survey.
U.S.Census Bureau. 1997. Industry Statistics for Selected States. Wood, Window and Door Manufacturing. Manufacturing-Industry Series.
U.S.Census Bureau. 1997. Industry Statistics for Selected States. Cut Stock, Resawing Lunber, and Planing. Manufacturing-Industry Series.
U.S.Census Bureau. 1997. Industry Statistics for Selected States. Other Millwork (including flooring). Manufacturing-Industry Series.
U.S.Census Bureau. 1997. Industry Statistics for Selected States. Wood Kitchen Cabinet and Countertop Manufacturers. Manufacturing-Industry Series.

Log Home Construction

Nationally, more than 22,000 log homes were built in 1998, accounting for 6.5% of all custom homes built in the United States (Log Home Council). That was a 41% increase over 1988. Colorado topped all other states with 1,500 homes built here. There are approximately 350 log homebuilders in Colorado, usually at least one in every mountain community. Many represent firms from out-of-state and import log homes in kit form. In fact, most local builders import their logs from out-of-state, because homeowners want massive logs not available from Colorado forests. Logs may be native peeled or milled and common species used are lodgepole pine, Engelmann spruce, Douglas-fir, and ponderosa pine as well as various other species from many locations. States and countries that send logs to Colorado include Oregon, Washington, Idaho, Montana,

Utah, Wyoming, Wisconsin, Pennsylvania, Canada, and Finland. Also, log homebuilders indicated that the sizes of these homes are increasing. The mountain cabin or 2,000 square foot log home is small by today's standards. Trophy homes are not uncommon. Approximately 4.05 million lineal feet of logs are used annually in Colorado for log home construction. That is equivalent to 19.2 million board feet. The value of logs used in the Colorado log home market was $37.5 million in 1998. The value of other wood construction products used in log home construction is valued at an additional $25.5 million based on the cost of log home shells prior to construction.

Sources:
Log Home Council.
Telephone survey of over 50 Colorado log homebuilders.

Mobile Home Construction

Mobile homes provide affordable and relatively transportable housing for many citizens. Approximately 4,600 mobile homes (1,300 singlewide and 3,300 doublewide) were put in place in Colorado in 1998. There are three firms in Colorado that build mobile homes. In 1997, these firms produced approximately 3,232 mobile home units valued at $60,281,000. The value added by manufacturing amounted to 39% and the cost of materials amounted to 61% of that figure. During 1997, these firms used:

- 9.75 million board feet of lumber,
- 1.75 million square feet of plywood,
- 3.15 million square feet of particleboard, and
- 4.21 million square feet of oriented strand board.

These products are valued at $10.6 million.

Sources:
Dickerhoof, H. Edward. 1978. Use of wood in mobile homes is increasing. Res. Bull. FPL-4. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 20 p.
Mackes, K. 2000. Telephone survey of Colorado mobile home manufacturers.
U.S. Census Bureau. 1997. Manufactured home (mobile home) manufacturing. Industry Series.

Commercial, Industrial, and Institutional Building Construction

In 1997, the latest data available, Colorado construction contracts amounted to nearly $3.3 billion, down sharply from $6.5 billion in 1996. Estimates of wood use in this category were made using previous studies that profiled wood use in nonresidential building construction. Wood products used in commercial, industrial, and institutional construction in 1997 included:

- 35.8 million board feet of lumber,
- 38.3 million square feet of structural panels,
- 400,000 square feet of particle and hard board,
- 2.7 million linear feet of I-joists,
- 3.8 million board feet of glulam lumber, and
- 65,100 square feet of structural composite lumber (SCL).

The estimated value of this material is $55.14 million.

Sources:
Home Depot Commercial Wood Products Department.
McKeever, D.; Adair, C. 1995. Wood products used in new nonresidential building construction. APA–The Engineered Wood Association.
Spelter, H. 1985. A profile of the nonresidential nonbuilding construction market for lumber and plywood. Res. Bull. FPL-16. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 6 p.
Spelter, H.; Anderson, R. 1985. A profile of wood use in nonresidential building construction. Resour. Bull. FPL-15. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 22 p.
U.S. Census Bureau. 1997. Bridge and tunnel construction. Industry Series.
U.S. Census Bureau. 1997. Water, sewer and pipeline construction. Industry Series.
U.S. Census Bureau. 1998. Construction and housing: Section 25: Statistical abstract of the U.S.

Residential Home Remodeling

In addition to new construction wood use, homeowners continually repair and remodel their houses. In 1998, 228 million board feet of lumber were used for additions, alterations, replacements, roof repairs, and other projects. A total of 135 million square feet of structural panels and 75 million square feet of non-structural panels were also used for repair and remodeling. The retail value of all remodeling material is estimated at $255 million. It was not possible to make estimates for other wood products used in remodeling such as millwork, flooring, or cabinets.

Sources:
McKeever, D. B.; Anderson, R. G. 1991. Wood products used for residential repair and remodeling in the United States. Resour. Bull. FPL-19. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 25 p.

U.S. Census Bureau. 1998. Expenditures for residential improvements and repairs. Manufacturing and Construction Division.

Landscape Timbers

Landscape timbers are used for building retaining walls, decorative landscaping, and a variety of other uses. Timbers are typically treated to resist decay and are made from fir, hemlock, red pine, lodgepole pine, southern yellow pine, and ponderosa pine. At present, the preferred species is southern yellow pine because it treats well. Landscape timbers may be sawn on four sides, sawn only on two sides, or may be recycled railroad ties. It was conservatively estimated that 10 million board feet of manufactured landscape timbers were used in association with new residential construction and residential remodeling in 1999. Railroad ties may be reused for landscaping. These are usually creosote treated hardwood ties removed during railway maintenance. Survey work suggests that an additional 1 million board feet of used railroad ties could be added to that estimate, for a total of 11 million board feet. The survey information coupled with national studies indicates that Colorado's use of all types of landscaping timbers could be as high as 18 million board feet. However, it was not possible to substantiate that number with Colorado firms manufacturing and selling timbers. It appears that 95% of the timbers used come from out-of-state. Fir and hemlock are typical of the Northwest, red pine comes from the Lake States, lodgepole pine from the Northern and Central Rockies, southern yellow pine from the Southeastern United States, and ponderosa pine usually comes from Colorado or adjacent states. Southern yellow pine is currently the dominant species used, coming primarily from Arkansas, Maryland, and Virginia. Landscape timbers also come to Colorado from as far away as Oregon, Canada, and Mexico. The retail value of all landscape timbers sold in Colorado was $5.6 million in 1999.

Sources:

Mackes, K. 1999. Field survey of new residential construction in Front Range counties.

Mackes, K.; Lynch, D. 1999. Personal interviews with three landscape timber manufacturing firms in Colorado.

McKeever, D. B.; Anderson, R. G. 1991. Wood products used for residential repair and remodeling in the United States. Res. Bull. FPL-RB-19. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

U.S. Census Bureau. 1999. Railroad shipping data.

Landscape Mulch

In Colorado, wood mulch is used as decorative and water-conservation material in landscaping. Some mulch such as western red cedar (imported from Idaho) and redwood mulch (imported from California) is used because it initially has an appealing red color but tends to bleach out to a shade of gray in about three years. It was estimated that approximately 80,000 cubic yards of mulch is imported annually with a retail value of $2.8 million. Imported mulch is gradually being replaced by mulch made from urban tree wastes and coated with a clay-based paint to achieve several pleasing landscape colors. A study prepared by the NEOS Corporation in 1997 for the Colorado Front Range Wood Resource Assessment found that approximately 23,500 bone dry tons (approximately 50,000 cubic yards) were used by mulch production sources. The estimated value of this recycled mulch is $1.3 million. Therefore, more than 130,000 cubic yards of landscape mulch was used in Colorado in 1997. About 60% came from out-of-state and the remainder came primarily from urban tree wastes within the state. This is probably an underestimate of the amount of landscape mulch used in Colorado since many municipalities and tree service companies create their own mulch by chipping tree wastes. However, as of this writing, these are the best data available on commercial use.

Decorative bark from Douglas-fir and ponderosa pine is also imported from Oregon. This is typically sold in bags through garden stores. Aspen bark and ponderosa pine bark is brought to the Front Range in bulk from the western slope of Colorado. As of this writing, estimates of quantities and values for this material cannot be made. However, it appears that demand exceeds supply for in-state bark products.

Sources:

Lynch, D. 1999. Telephone and personal interviews with six Colorado landscaping materials firms.

NEOS Corporation. 1997. Colorado Front Range wood resource assessment.

U.S. Census Bureau. 1999. Railroad shipping data.

Wood Fencing

Agricultural

Approximately 300,000 posts are used each year in agricultural fencing in Colorado. Agricultural fence posts are purchased primarily on post length rather than diameter. However, the buyer typically specifies minimum diameters for posts. Of the 300,000 posts used, about 100,000 are 4" to 6" in diameter and 8' long. About 150,000 posts are from 3" to 5" diameter and are 6.5' long; the remaining 50,000 posts are of varying sizes ranging from 3" to 8" diameter and from 10' to 12' long. The preferred species (about 90% of the market) is lodgepole pine because of its relatively uniform diameter, strength properties, and treating properties. The estimated retail value of agricultural fencing is $ 2.3 million and the volume of wood consumed is 2.25 million board feet.

Source:

Lynch, D. 1999. Telephone survey of three agricultural fence construction firms.

Residential

Fences constructed in association with residences include wood picket (board), wood rail, wood pole, plastic, and metal. Split-rail fences predominate as a front yard fence while other fence types are used for backyards. Wood picket fences are most frequently used for backyards. Western red cedar is preferred because of its beauty and durability. Redwood is also used. Cedar and redwood tend to fade to a gray color in about three to five years. As a result, homeowners may select fencing made from other species such as pine, which is cheaper and durable given the arid Colorado climate. Treated posts are used to support such fences. Some pine (*Pinus radiata*) fencing material comes to Colorado from South America. Wood pole fences are made from treated lodgepole pine. Increasingly, substitutes for wood such as plastic or vinyl are being promoted and used. It was estimated that:

- 38.6 million board feet of lumber are used annually for wood picket fencing,
- 978,000 board feet are used for wood rail fence, and
- 224,000 board feet are used for residential wood pole fencing.

The value of residential fencing material was estimated at $25 million.

Sources:

Home Depot computer program for estimating material quantities and costs.

Mackes, K. 1999. Field survey of new residential construction in the Front Range of Colorado.

Mackes, K.; Lynch, D. 1998 and 1999. Telephone and personal interviews with over 15 Colorado fencing firms.

McKeever, D. B.; Anderson, R. G. 1991. Wood products used for residential repair and remodeling in the United States. Res. Bull. FPL-RB-19. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Decking

In the United States, 25% of all homes have decks. The majority of decks built during new construction or added in residential remodeling are made from redwood lumber. Since it is becoming increasingly difficult to secure redwood decking, some homeowners elect to use treated wood species (such as southern yellow pine) or composite decking lumber (currently about 5% of the market). A 1999 survey estimated that 800 million to 1.2 billion board feet of lumber is used annually in the United States for decking. Approximately 40% of decks were do-it-yourself projects (costing $12 to $18 per square foot) and 60% were contracted (costing $18 to $25 per square foot). The average cost of a deck was $5,927. In 1999, a total of $3 billion was spent in the United States on deck construction.

In 1998, decks were built on 12,789 new residential units in Colorado. The average deck size according to national surveys is 395 square feet. A computer program for decks was used to estimate the amount of lumber used in a deck of this size. From this, it was concluded that a total of 27.5 million board feet of lumber were used for decks built on new construction.

Based on national remodeling and repair data, it was calculated that 44.7 million board feet of decking lumber was used in Colorado to add decks to existing residences. Using import information from California, it appears that 63% of this lumber was redwood. The total retail value of deck lumber for new construction and remodeling was $47.4 million.

Sources:

California Redwood Association. 1996 and 1997 shipping data.

Mackes, K.; Lynch, D. 1998 to 1999. Telephone interviews with approximately 10 Colorado decking suppliers.

Morris, M. 2000. Decks that don't show their age. Todays Homeowner Magazine. June: 60.

Qualified Remodeler Magazine. 1999. Decking survey.

U.S. Census Bureau. 1998. Housing data by state.

Weissenbacher, W. 2000. Computerized deck construction estimate. Home Depot.

Wood Furniture

Non-upholstered wood household furniture manufactured in Colorado in 1997 had a cost of materials estimated at $47 million with a value of shipments estimated at $78.7 million. Living room, family room, and den furniture amounted to $13.3 million in value. Dining room and kitchen furniture amounted to $6.9 million in value. Bedroom, childrens, and outdoor furniture accounted for the balance of $58.5 million. All of the hardwood used in this industry came from out-of-state. Softwoods, including aspen or pine, may have come from within Colorado where a number of furniture manufacturing businesses produce custom-made, highly unique furniture for use in log homes or mountain dwellings. Dead standing aspen or lodgepole pine is preferred for this rustic furniture. As of this writing, it is not possible to estimate the volume of wood used by this industry in Colorado.

A study related to upholstered furniture manufacturing has not been attempted. However, a Census Bureau manufacturing survey indicated that less than $2 million worth of upholstered furniture was produced in Colorado.

Sources:

Mackes, K.; Lynch, D. 1998 to 1999. Telephone and personal interviews with over 10 Colorado wood furniture firms.

U.S. Bureau of Census. 1997. Nonupholstered wood household furniture manufacturing. Manufacturing-Industry Series.
U.S. Census Bureau. 1997. Upholstered household furniture manufacturing. Manufacturing –Industry Series.

Utility Poles

Most cities either bury utility lines or use fiberglass or metal poles, but in rural areas wood poles still predominate. Since lines must be installed over long distances, the relatively durable, flexible wood pole is preferred. There are 25 Rural Electric Association Cooperatives in Colorado that maintain 73,355 miles of line. In addition, Excel Energy (Public Service) utilizes wood poles in some of its installations. Approximately 70% of these poles are Class 6 poles, 35' in length with an 8-12" top and 14"-16" butt. Approximately 30% are 40' to 50' in length. Western red cedar is preferred, but this species is becoming scarce and expensive. Therefore, most poles are southern yellow pine, Douglas-fir, or lodgepole pine that have been treated with creosote or penta. Tri-State Generation and Transmission Association uses wood poles 70' in length on several of its transmission lines.

In 1998, approximately 144,000 wooden utility poles were used for new construction or replacement in Colorado. These were valued at approximately $16.9 million and contained a minimum of 27.4 million board feet. Approximately 30% of these poles came from the Pacific Northwest including Canada and the remaining 70% came from Southeastern states, particularly Alabama, South Carolina, and Florida. Very few came from Colorado. This has not always been the case. Lodgepole pine from Colorado makes an excellent utility pole. In years past, trees from forests near Granby were used for poles and shipped to Denver for treating. It should be noted that there is also strong competition for similarly sized trees for log home construction.

Sources:

Lynch, D. 1997 to 1998. Survey of Colorado REA Cooperatives, Western Supply Company, and Koppers Company.

Wood in Transportation

Railroad Ties

Nationally, wooden crossties, switch ties, and bridge ties constitute critical structural components of railways. Annual demand is primarily for replacement ties rather than new construction. Wood ties currently dominate the market, with a 93% market share. Other materials, such as concrete, make up the difference. Historically, the advantages of wood ties have been cost competitiveness, light weight, ease of manufacture, and ease of installation. Wooden crossties are set on 19.5" centers at a rate of approximately 3,250 per mile. However, the average number of crossties per mile, nationally, is 3,037. There are approximately 225,780 miles of railroad track in the United States with an approximate total of 685.7 million crossties. The annual replacement rate has averaged approximately 2% for the last 45 years. A conservative value is $25 per unit f.o.b. the treatment plant (Deckard and McCurdy 1999).

Mainline railroad ties are typically 6" x 8" by either 8' 6" or 9' in length and 7" x 9" x 8' 6" or 9' in length. Switch ties can range from 10' to 29' in length, but typically are from 10' to 18' in length (in one-foot increments). Bridge ties are 8" x 10" by either 8'6" or 9' in length. Ties can only have limited knots in the rail bearing area and must be relatively free of defects such as wane, cross grain, shake, splits, or checks.

There are approximately 3,025 miles of railroad track in Colorado. Using national averages, there are an estimated 9.2 million ties currently in place in Colorado. At the 2% replacement rate identified by Deckard and McCurdy (1999), a total of 183,738 new ties are needed each year in Colorado. These have a conservative value of $4.6 million and contain an estimated 8.2 million board feet of wood. Currently, hardwoods from out-of-state are preferred (ranging from 52% to 99% of the ties used by different railroads), but ponderosa pine, lodgepole pine, and Douglas-fir are also desirable species. Railroads stated that their preference for hardwoods occurs, in part, because they have difficulty procuring ties from Colorado forests. Last year only 44,000 ties came from Colorado forests and those were cut primarily from state and private forestlands. The demand for railroad ties should increase in Colorado during the coming years as major railroad reconstruction projects are planned east and west of Denver. Local production of ties within a 300 to 500 mile radius of Denver would be of interest to railroads and strength testing of Colorado wood could help promote the use of crossties from Colorado forests.

Sources:

Deckard, D. L.; McCurdy, D. R. 1999. An empirical test of the materials supply strategy construct with application to the U.S. railroad industry. Forest Products Journal. 49(11/12): 45–50.
Lynch, D. 1998 to 1999. Telephone interviews with Union Pacific Railroad, Burlington Northern-Santa Fe Railroad, Federal Railway Administration, Colorado Department of Transportation, and Koppers Industries Inc.

Street and Highway Construction

There are 9,100 miles of state administered highways in Colorado. These include interstate, arterial, major, and minor collectors and local highways. In 1997, Colorado spent over $1 billion for street and highway construction projects. Lumber, bridge timbers, pilings, fence posts, guardrail posts, signs, signposts, and a variety of other wood products are used in street and highway construction. Estimated wood product usage for state and interstate highways in 1997 was:

- 6.9 million board feet of lumber and bridge timbers,
- 2.32 million lineal feet of pilings (approximately 10.9 million board feet),
- 3.4 million board feet of guardrail,
- 79,685 board feet of sign posts,
- 79,365 fence posts (approximately 794,000 board feet) and
- 18.3 million square feet of wood based panels.

The estimated value of this material was $26.8 million. Volume or value information on wood use for county, city, and community streets or highways was not available.

In discussions with Colorado Department of Transportation (CDOT), it became clear that wooden signposts are being replaced in many areas by steel posts. A recent survey by Smith, et al (2000) found that highway decision makers rated wood lower in overall material performance than concrete, steel and aluminum, but higher than plastic. The most important factors in material choice were durability, maintenance, and cost. They suggest that wood durability could be improved by use of wood treating chemicals. They also stressed that wood use could be encouraged in aesthetic settings and where long-term durability is not an issue, such as in formwork, falsework, or temporary bridges. Based on discussions with CDOT, it was determined that most guardrail and signpost losses are not due to decay or weathering but to vehicle accidents. Keeping material costs low while maintaining acceptable quality may, therefore, be a more significant issue than improving durability in situations where the expected life of the material is short.

Sources:

Lynch, D. 2000. Telephone surveys with Colorado Department of Transportation (CDOT) and Western Consolidated of Rapid City, SD.

Lynch, N.; Lynch, D. 2000. Colorado highway sign post field survey.

Reid, W.; McKeever, D. 1978. Wood products and other materials used in constructing highways in the United States. Resour. Bull. FPL-5. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 19 p.

Smith, R. L.; Spradlin, W. E.; Alderman, D. R.; Cesa, E. 2000. Perceptions of wood in the highway infrastructure market. Forest Products Journal. 50(6): 23–31.

U.S. Census Bureau. 1997. Highway and street construction. Industry Series.

U.S. Department of Transportation. 1995. State highway agency administered roads and highways. Table HM 80.

Truck Transportation

Wood is used in a variety of ways by truck transportation firms operating in Colorado. Flatbed truckers hauling steel products are the primary users of wood. This wood is referred to by the industry as “dunnage” and consists of lumber, in the form of 4x4s, 2x4s, 1x4s, and 3x3s. Dunnage is commonly used to support loads and act as spacers between lifts. Lumber is used to construct crates for steel products. Pallets and reels are also used. An estimated 1.1 million board feet of lumber are used annually in truck transportation. This excludes pallets, which are covered in the following section. The value of this lumber is estimated at $657,000.

Sources:

Lynch, D. 1999. Telephone interviews with over 25 Colorado trucking firms.

Railway Shipping

When shippers transport products by rail, they often line the interior of freight cars with plywood or oriented strand board panels to avoid contact with the freight car walls. This depends, of course, on the product and the potential for damage either to the product or the freight car. The shipping of steel products is an example. The panels are typically low grade or defective. As of this writing, there is not enough data from Colorado shippers using such panels to make an estimate of total use. However, it has been confirmed that at least 230,400 square feet of 3/8" or 1/2" panels are currently used per year. The estimated value of this material is $57,750.

Sources:

Lynch, D. 2000. Telephone interviews with six (two major and four smaller) railroads and shippers.

Pallet Lumber

The National Wooden Pallet and Container Association (Timber Producer 1999) reports there are approximately 1.9 billion pallets in use throughout the United States. Each year 400 million new pallets are produced and about 175 million are repaired or recycled. Another 190 million are disposed of in landfills and 35 million are diverted from the waste stream and reprocessed into other products. Since 1993, the percentage of pallets put in landfills has been reduced from 59% to 28%. The statistics also show a net loss of 100 million pallets each year due to recycling, abandonment, loss, taken from the country, or burning.

It was conservatively estimated, based on a survey of all known pallet producers in the state, that 2.5 million new pallets were manufactured in Colorado in 1997. This pallet production required 50 million board feet of lumber. Nearly 93% of this lumber came from out of state. Softwood lumber from the Pacific Northwest, Inland Empire, and Canada is used to make 80% of the pallets manufactured in Colorado. Hardwood lumber from Nebraska, Kansas, and Missouri is used for the balance of pallet production. The majority of lumber used in pallet manufacture is low-grade green or air seasoned lumber, among the lowest quality lumber produced. In the survey, mills were asked if they produced pallet lumber and one response was, “not intentionally.” Approximately 90% of the pallets

manufactured here are sold within the state. With one exception, all Colorado pallet manufacturers indicated they would use wood from Colorado forests if it were available. Generally, all commercial timber species found in Colorado are suitable for making pallets. Reasons cited for the low volume of Colorado wood used in manufacturing pallets were:

- high stumpage costs and inconsistent supply of timber from federal lands;
- threat of appeals, lawsuits, and delays brought by environmental groups; and
- the perceived poor quality of some Colorado wood, particularly ponderosa pine, from Front Range forests.

The pallet industry in Colorado has estimated gross sales of approximately $16.25 million each year and the value of wood used at $11 million.

Sources:

Mackes, K. 1997. A study of pallet production in Colorado. Report by KH Consulting to Colorado State Forest Service, Colorado State University.

Mackes, K. 1998. A profile of wood supplied to pallet manufacturers by sawmills along the Front Range of Colorado. Report to Colorado State Forest Service, Colorado State University.

Mackes, K. H.; Lynch, D. L. April 2000. An assessment of pallet lumber supply and manufacturing in Colorado. Forest Products Journal. 50(4): 77–80.

Resource Recovery Report. November 1999.

Timber Processing Magazine. October 1999. Report from National Wooden Container and Pallet Association.

U.S. Census Bureau. 1997. Wood container and pallet manufacturing. Manufacturing-Industry Series.

Wood Use in Mining

Coal Mining

Underground mining

Colorado had 10 active underground coal mines in 1999 that produced 20,470,268 tons of coal. While wood use in underground mining has decreased from past levels, a substantial amount of wood is still being used. Underground coal mines may be classified either as room and pillar or long wall mines, depending on the type of roof plan used. Room and pillar mines typically use less wood than long wall mines because pillars of coal are left as support material. Long wall mines employ numerous roof support devices. However, each mine has its own roof plan and means of support, so every mine uses a different amount of wood. Some mines use small round logs known as “props” for roof support. However, many mines use “cans,” a steel sleeve filled with concrete, topped with wooden cribbing and cap boards with wedges as roof support. Props are unpeeled logs with a small end diameter of 6" and a length ranging from 5 to 11 feet. Cribbing consists of sawn timbers that vary from 5"x 5" x 24" to 8"x8"x48". Cap boards and wedges are used above the cribbing in contact with the mine roof. It is very important that props, cribbing, cap boards, and wedges are dry and without rot or defects. Varying amounts of rough sawn lumber and timbers are also used in mining. The amounts vary significantly by mine. In addition, small amounts of finished lumber and panels are also used.

The estimated annual use of wood products in Colorado mines is:

- 100,500 mine props (approximately 1 million board feet),
- 189,000 pieces of cribbing (approximately 2.4 million board feet),
- 121,500 cap boards (approximately 122,000 board feet),
- 300,350 wedges (approximately 150,000 board feet), and
- 2 million board feet of rough sawn lumber and timbers.

Finished lumber use is minor, probably less than 5,500 board feet per year. About 75% to 100% of the wood products used in mines during 1999 came from out-of-state, principally from Utah, Wyoming, and Oregon, but also from Washington, Idaho, and Montana. Mine companies indicated that they prefer to buy this material from within Colorado if a supply was available at a competitive price. The estimated value of this market is $3 million annually.

Surface mining

Contact with people involved in surface mining indicated that little wood is used either as lumber, timbers, panels, or mulch in mining or reclamation.

Hardrock Mining

There are approximately 340 to 350 hardrock mines in Colorado. The majority mine precious metals and may be essentially inactive as of this writing. Mines also produce molybdenum, zinc, lead, tungsten, limestone, marble, and other minerals. Many are small business operations, some with only two or three employees. The largest mine in Colorado is the Henderson mine which produces molybdenum. Mine timbers, cribbing, cap boards, wedges, and miscellaneous rough sawn and finished lumber may be used in these mines. Some of the products used include rough sawn timbers in dimensions such as 6"x8"x20', 2"x4"x16', 4"x4"x20', 2"x12"x20', and 3"x12"x20' pieces. A unique product used in hardrock mining is a vertical grain 1"x2"x14' piece known as a “bomb stick.” It is used to put dynamite into holes for blasting.

Due to the wide variation and number of mines in this industry it is very difficult to estimate the volume of material used. However, based on a survey of mine operators, it is very conservatively estimated that at least 100,000 board feet of wood are currently used, having a value of $40,000.

Sources:

Lynch, D. 2000. Telephone surveys of mine purchasing agents for all Colorado coal mines and approximately 10 hardrock mines, Colorado Division of Minerals and Geology, Office of Surface Mining, Reclamation, and Enforcement, Mine Safety and Health Administration, and interviews of forest product businesses supplying the mining industry.

Animal Bedding

Wood shavings and chips are used extensively for domestic livestock, pets (companion animals), and laboratory animal bedding in Colorado. A 1997 study by the American Veterinary Medical Association (AMVA) indicated that the most popular pets in the United States are, in order of popularity, dogs, cats, horses, fish, rabbits, small mammals, birds, and reptiles. The use of wood bedding material was investigated for those animals most likely to require it.

Cattle

Beef cattle seldom require bedding material and no data was found indicating that wood bedding materials are used on a regular or substantial basis. On the other hand, bedding material is very important to dairy cows. Dry bedding must be provided to protect cows and prevent mastitis, an inflammation of the udder caused by an infection that prevents milk production. A number of materials are used for bedding, such as rubber tire chips, cornstalks, straw from grain crops, and wood shavings or sawdust. Of this, dried wood shavings and/or sawdust are preferred. Green or wet sawdust is not used. In 1999, Colorado had 189 dairy farms with approximately 90,000 dairy cows. Of these, 80% of the farms used wood shavings or sawdust for bedding material. Bedding may be changed as often as three times per week or may not need changing depending upon weather conditions. An average dairy operation will use approximately 650 cubic yards per year. Therefore, 122,850 cubic yards of dry shavings and/or sawdust are used by the dairy industry in Colorado each year. On the western slope and in the San Luis Valley, material is obtained from local sources. In eastern Colorado most bedding material is trucked in from Wyoming, New Mexico, or from West Slope sources. The retail value of this material is approximately $860,000. After use, bedding material is mixed with cow manure to create compost that is sold to recover costs.

Sources:

Colorado Department of Health and the Environment. 2000. List of Colorado Grade A Dairy Producers.

Lynch, D. 2000. Telephone survey of four dairy bedding suppliers.

U.S. Census of Agriculture. 1997. Highlights of Agriculture.

Wailes, W., Dairy Extension Specialist. Colorado State University. [personal comm.]

Horses

Surveys conducted by Equine Science and Cooperative Extension at Colorado State University indicate that there are approximately 192,000 horses in Colorado (American Horse Council 1987; Swinker and Johnson 1995). Of these, approximately 17,000 horses are stall bedded using wood shavings and chips (80%) or sawdust (18%) for bedding. Wood is often preferred over straw, cow hay, bark, or cornstalks because it is less likely to contain harmful bacteria, fungi, or endotoxins (Tanner and Swinker 1998). Such pathogens can cause respiratory illness (chronic obstructive pulmonary disease) in horses. An average 1,000 pound horse can generate 8 to 10 tons of manure each year, accumulating at the rate of as much as 2 ft^3/day, including bedding (Swinker and Johnson 1995). Bedding consumption, as estimated by Swinker from surveys with horse owners, was 24.7 cubic feet per day for show or breeding horses. If this usage is correct, over 5.5 million cubic yards of wood chips and sawdust are used each year for stall bedded horses. However, in interviews with both wood bedding suppliers and stall cleaning businesses, these numbers were questioned. Some suggested that stall cleaning was really only done once a week. In that case, a total of 802,275 cubic yards per year would have been used. Since it cannot be determined which estimate is correct, the most conservative estimate that approximately 802,000 cubic yards are currently used for horse bedding is accepted. The retail estimated value of that quantity for 1999 is $8 million.

Sources:

American Horse Council. 1987. The economic impact of the U.S. horse industry. Washington, DC: Peat, Marwick, and Mitchell and Company, Policy Economics Group.

Lynch, D. Telephone survey of over 25 bedding suppliers and stall cleaning businesses.

Swinker, A., Equine Specialist. Fort Collins, CO: Colorado State University, Cooperative Extension.

Swinker, A.; Johnson, D. 1995. Equine industries manure disposal practices, variations and magnitude. The Professional Animal Scientist. 11: 210–213.

Swinker, A.; Tanner, M.; Johnson, D.; Benner, L. 1998. Composting characteristics of three bedding materials. Journal of Equine Veterinary Science. 18(7): 462–467.

Tanner, M.; Swinker, A.; [and others]. 1998. Effect of phone book paper versus sawdust and straw bedding on the presence of airborne gram-negative bacteria, fungi, and endotoxin in horse stalls. Journal of Equine Veterinary Science. 18(7): 457–461.

Tanner, M.; Swinker, A.; [and others]. 1998. Respiratory and environmental effects of recycled phone book paper versus sawdust as bedding for horses. Journal of Equine Veterinary Science. 18(7): 468.

Turkeys and Chickens

Colorado produces between 3.9 million (1997) and 4.9 million (1994) turkeys per year (USDA 1998). Eggs are typically imported from out-of-state and hatched in Colorado. The birds are raised for 22-23 weeks to the time of slaughter. Wood shavings are preferred bedding material, but shavings must be dry and free of bark to reduce mold spores. Approximately 45,000 cubic yards of shavings are used per year for turkey production. Most of these shavings come from out-of-state, but some shavings are supplied from southern and western Colorado.

About 3.8 million chickens are raised in Colorado for egg production (U.S.Census of Agriculture 1997). Nearly all egg producers use slatted floors in chicken houses and do not use wood shavings. However, a few producers provide scratch areas where wood chips and sawdust are used. Approximately 30,000 cubic yards of chips and sawdust are used per year for chickens. The retail value of bedding used for turkeys and chickens in 1999 was $900,000.

Sources:

Lynch, D. 1999. Telephone survey of one Colorado turkey and three chicken producers.

U.S. Census of Agriculture. 1997. Highlights of Agriculture: 1997 and 1992 Colorado, Livestock and Poultry.

USDA, National Agricultural Statistics Service. 1998. Turkeys: Final estimates by state, 1994-1997. Statistical Bulletin 945.

Small Mammals

The estimated number of Colorado households that own small mammals (such as rabbits, guinea pigs, ferrets, hamsters, gerbils, and other rodents including rats and mice) as pets (companion animals) was derived from a national survey of pet ownership by American Veterinary Medical Association (1997). It was estimated that pet ownership in Colorado includes:

- 75,100 rabbits,
- 16,600 guinea pigs,
- 12,000 ferrets,
- 28,500 hamsters,
- 11,600 gerbils, and
- 16,000 other rodents.

Aspen shavings and sawdust are considered by veterinarians to be a superior bedding for these animals, but it is not available at most outlets. Pine and cedar bedding are more available and widely used. It may also be more desirable to pet owners since pine and cedar odors tend to mask animal odors. Chlorophyll may be added to bedding, but the benefits are unclear. Changing bedding once a week is recommended for hamsters, gerbils, mice, and rats while changing twice a week is recommended for guinea pigs and rabbits, and changing three times a week is recommended for ferrets.

Bedding and litter are marketed in 500 cubic inch to 5 cubic feet bags. Based on estimates of Colorado pet populations and recommended pet care guidelines, bedding consumption approximates 282,370 cubic yards annually. It was likely that most of this bedding is sent to the landfill after use. The estimated 1999 retail value of small mammal bedding is $229 million. Manufacturers supplying Colorado outlets are primarily located in the North East-Central region including Michigan, Ohio, and Wisconsin.

Sources:

American Pet Products Manufacturers Association. 1997. National Pet Owners Survey.

American Veterinary Medical Association. 1997. U.S. Pet Ownership and Demographic Sourcebook.

Mackes, K. H.; Lynch, D. L. 1999. The use of wood shavings and sawdust as bedding and litter for small pet mammals in Colorado. Department of Forest Sciences Report.

Laboratory Animals

Aspen shavings and heat-treated hardwood chips are used extensively and almost exclusively for research animal bedding because aspen shavings and chips are absorbent and benign. Aspen does not give off aromatic hydrocarbons as do pine and cedar. Aromatic hydrocarbons can cause irritations and contribute to respiratory diseases in small mammals. Such introduced variables could affect research results. Aspen shavings and chips are purchased from out-of-state in bulk quantities packaged in 32 to 40 pound bags. White fir shavings also hold promise for bedding based on recent research (Mackes, et al., in press).

As of this writing, it has not been possible to determine the demographics of all research animals in Colorado. However, there is information for research facilities related to major universities and research hospitals in Colorado. Between 62.2 tons of aspen shavings and 263.7 tons of aspen-hardwood chips are used for animal bedding by these facilities annually. This is a volume of 1,860 cubic yards. All this bedding comes from out-of-state, principally from the northeastern states. The retail value of this material in 1999 was $132,600.

Sources:

Mackes, K.; French, E.; Lynch, D.; Ward, J. [In press]. The use of white fir as bedding for research animals. Forest Products Journal.

Mackes, K.; Lynch, D. 1999 and 2000. Telephone and personal interviews with University laboratory and health facility animal managers.

Christmas Trees

Christmas trees have been sold commercially in the United States since about 1850. Until fairly recently, all Christmas trees came from natural forests. Today there are about 15,000 tree growers in the United States with over one million acres planted to Christmas trees. Each year Christmas tree farmers plant about 56 million trees and the industry employs over 100,000 people. It takes six to ten years to produce a mature Christmas tree and almost all trees require shearing to attain a desirable shape. The industry refers to living trees as "real" trees versus artificial trees. They point out that real trees are a renewable and recyclable resource and that each acre of trees provides the daily oxygen requirement for 18 people.

Oregon, North Carolina, Pennsylvania, Michigan, Washington, and Wisconsin are the top Christmas tree producing states, but trees are grown in all 50 states. Oregon, the leading producer, sold about 8.6 million trees in 1998. Canada is also a large producer of trees. The top selling Christmas trees are balsam fir, Douglas-fir, Fraser fir, noble fir, Scotch pine, Virginia pine, and white pine.

A national survey of consumers indicated that 59% recycle their natural Christmas tree into biodegradable products like landscape mulch, erosion control, or wildlife habitat. In contrast, artificial trees contain non-biodegradable plastics and metals. The average life of an artificial tree is about 6 years, at which point it typically ends up in the landfill. Most artificial trees are manufactured in Korea, Taiwan, or Hong Kong.

A Gallup poll conducted for the National Christmas Tree Association reported 33.7 million real Christmas trees were sold in the United States in 1998 and 35.4 million in 1999. Using national figures on a per capita basis, it was estimated that 495,000 real Christmas trees were sold in Colorado in 1998 and 526,000 trees were sold in 1999. The Colorado Christmas Tree Association estimated that 90% of the trees sold in Colorado came from out-of-state. Of the 10% sold that came from within Colorado, most were naturally grown on private, state, or federal lands and only a small portion were from Christmas tree plantations.

The retail value for 1999 sales in Colorado was conservatively estimated at $11.6 million.

Sources:

Evashenko, D. 2000. Personal interview. National Christmas Tree Association, St. Louis, MO.

Lynch, D. 2000 Telephone interviews with Colorado Christmas Tree Association Officers.

University of Illinois Extension. 2000. Christmas Trees and More Web site. Urbana, IL. http://www.urbanext.uiuc.edu/hort/trees.html

Paper Products

Estimates for all types of paper products, excluding hardboard, wet machine board, and construction grades, are based on national per capita consumption rates applied to Colorado population numbers. It includes mixed grades of paper, newspaper, phone books, corrugated cardboard, and paperboard. National per capita use estimates vary from 728 pounds per person (AF&PA) to 743 pounds (FPL) to 749 pounds (SAF). The 743 pound estimate by FPL for 1997, which includes 407 pounds of paper and 336 pounds of paperboard, is believed to be the most recent and accurate. FPL also estimates national paper and paperboard recycling rates at 45.2% for 1997 and 45.4% for 1996. FPL calculates that for each ton of paper or paperboard produced, approximately 63% is wood pulp, 36% is waste paper, and the balance is other fibrous material. Paper can be recycled only five to eight times before the fibers in the paper become too short and weak to be reused.

Based on Colorado's 1999 population estimates, current paper and paperboard consumption is calculated at 1,506,853 tons annually. Of this, 825,423 tons were paper and 681,430 tons were paperboard. If Colorado recycling corresponds to 1997 national trends, a total of 681,098 tons or approximately 336 pounds per person should have been recycled. As a cross check, Larimer County Recycling (LCR) estimates that 70% of the county residents participated in the recycling program in 1999. LCR recorded a total of 53,905,715 pounds of paper and paperboard recycled in 1999. That amounts to approximately 333 pounds per resident who participated and is quite close to the national rate.

To provide a rough approximation of the value of paper and paperboard used in Colorado, July 1999 prices of newsprint, uncoated and coated paper, directory, and kraft paper were used to develop a weighted average price of $768.40 per ton. July 1999 prices for linerboard, boxboard, carton stock, and corrugated material were used to develop a weighted average price of $484.50 per ton (Purchasing 1999). This is the value for stock prior to printing or fabrication into products. On that basis, the value for paper used in Colorado is approximately $634.26 million and the value of paperboard is approximately $330.15 million.

Sources:

American Forests and Paper Association (AF&PA). Personal correspondence.

Howard, J. L. 1997. U.S. timber production, trade, consumption and price statistics 1965-1997. Gen. Tech. Rep. FPL-GTR-116. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 76 p.

Lynch, D. 1999. Interviews with Larimer County Recycling.

Purchasing Magazine.1999. Economy: Prices for paper and newsprint. Web site.

Society of American Foresters (SAF) Web site. http://www.safnet.org/

Firewood

Firewood use in Colorado reached a peak during the energy shortage years of the 1970s and 1980s. Ryan and Betters (1982) surveyed households and fuelwood vendors in the state. They found that during the period 1977 to 1980, fuelwood consumption ranged from 660,200 cords to 1,027,000 cords. The percent of households burning wood ranged from 33% in the northern Front Range to 71% in mountain communities. Households typically burned an average of 1.9 to 2.2 cords annually during that period. In 1982, McLain and Booth conducted a random survey of households and estimated Colorado's fuelwood harvest at 504,679 cords. In 1986, Olsen and Betters (1989) conducted a survey of domestic fuelwood consumption and supply in Colorado. They found that between 1983 and 1986, total fuelwood consumed declined from 1,111,000 cords to 1,107,000 cords. During that period, 53% to 56% of households burned an average of 1.6 cords annually. The average price paid for cord at that time was $91. They noted that consumption appeared to be trending lower.

Since that time, air pollution restrictions and incentives for citizens to convert to cleaner burning heating devices (gas log fireplaces, pellet stoves, etc.) have substantially reduced firewood consumption. In 1999, approximately 8,911 cords of firewood were cut from National Forest lands and 13,504 cords were cut from state and private forestlands for a total of 22,415 cords.

The current firewood market can be divided into:

- Consumer purchases of small bundles (approximately 1 cubic foot per bundle) at major supermarkets or convenience stores.
- Bulk purchases (by the cord) by serious firewood users from local firewood dealers.
- Individuals harvesting their own firewood under permit from public lands or from private landowners.

A survey of major supermarket-convenience stores in Colorado found that approximately 8,000 cords are sold in small bundles to consumers each year. Approximately 60% of this firewood (4,800 cords) came from within Colorado and 40% (3,200 cords) came from Idaho, Montana, and Canada. Surprisingly, one chain of supermarkets sells Canadian firewood during the summer to campers in the mountains of Colorado. Firms within Colorado that produce firewood for the small bundle market indicated that they typically couldn't get a consistent supply of wood from Colorado forests to meet the demand. The estimated retail value of 1999 small bundle sales was $2.96 million.

On the other hand, the bulk firewood market and individual firewood harvest is very fragmented and difficult to survey. Oak firewood is coming in bulk from Mexico and being used by ski area resorts in the winter (Aguirre-Bravo 2000). Betters, Markstrom and Aukerman (1990) noted from their survey that there appeared to be a recreational value of from $6 to $12 per cord associated with fuelwood collecting by individuals. About 25% of the people surveyed indicated that "pleasure of collecting" was a key reason for fuelwood gathering. Using data from private, state, and federal forest managers, 17,715 cords were sold in the bulk market or harvested by individuals statewide in 1999. The retail value of this material was $17.7 million.

Therefore, the volume of all firewood used in Colorado from forestlands or imported from other states was 30,415 cords or approximately 15 million board feet. Note that this does not include firewood from orchards, municipal tree wastes, windbreaks, firewood sales from private lands that were not administered by Colorado State Forest Service, or hardwood firewood imported in bulk from out-of-state. Some small bundle firewood may have come from wood residues (such as slabs and end pieces) remaining after sawmilling but no estimates of quantities could be developed.

Sources:

Aguirre-Bravo, C. 2000. Personal communication. Rocky Mountain Research Station. USDA Forest Service.

Betters, D. R.; Markstrom, D.C.; Aukerman, R. 1990. Cost, time, and benefit measures for personal use fuelwood collection in Colorado. Res. Pap. RM-287. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Lynch, D. 1999. Survey of harvest data from federal, state, and private land managers.

Lynch, D. 1999. Telephone survey of approximately 10 supermarket and convenience outlets and telephone and personal interviews with over 10 firewood producers.

McLain, W. H.; Booth, G. D. 1985. Colorado's 1982 fuelwood harvest. Resour. Bull. INT-36. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 11 p.

Olsen, W. K.; Betters, D. R. 1989. Domestic fuelwood consumption and supply in Colorado: Characteristics, trends and projections. Tech. Bull. TB89-1. Fort Collins, CO: Colorado State University, Agricultural Experiment Station.

Ryan, P. P.; Betters, D. R. 1982. Characteristics of domestic fuelwood consumption and supply in Colorado. Bulletin 581S. Fort Collins, CO: Colorado State University, Agricultural Experiment Station.

Firelogs

Firelogs are manufactured from wood fiber residues, such as sawdust, that have been compressed into a log shape. Firelogs were first manufactured in the 1920s. However, successful commercialization did not occur until 1931 when the Potlatch Corporation developed the Pres-to-log® made

entirely from wood fiber. When wood fiber is compressed it heats and exudes lignin from the wood cell walls. In this log, lignin acted as a binder or glue for the sawdust particles. Initial production in 1931 amounted to 375,000 firelogs and by 1942 production reached 42.6 million. A derivative firelog was developed in 1963, known as a chem-firelog. It is a combination of compressed wood fiber and petroleum based wax. The addition of wax improves binding of particles, improves handling properties during transport, and results in different burning characteristics. Some chem-log manufacturers claim their products generate 60% fewer emissions than conventional firewood.

Commercialization of the chem-firelog began in 1968 with production of the Duraflame® firelog. Currently, six companies compete nationally in the market producing brands such as Pres-to-log®, Duraflame®, Pine Mountain®, Starterlog®, Northland®, Hearthside®, and private labels associated with supermarkets. A firelog manufacturing firm operated in Colorado during the 1980s but reportedly was forced to close because of a lack of consistent raw material supply. The growth rate for firelog sales during the 1990s averaged 9.7% per year and total national sales in 1998 exceeded $135 million. Approximately 70% of firelog sales occur at supermarkets as a result of impulse buying during winter storms. Sales may start as early as September and last until March or April. Winter weather and attractive displays are critical to sales.

Based on a survey, 1.2 million firelogs were purchased in Colorado during 1999 and 100% of these came from out-of-state. The retail value of this imported product amounts to more than $2.5 million.

Sources:

Lynch, D. 1999. Telephone survey of approximately 10 supermarket and convenience stores.

Shook, R. S. 1999. Profile of the Pacific Coast manufactured firelog market. Forest Products Journal. 49(11/12): 35.

Supermarket Business Trade Journal. July 1995. Hot topic.

Supermarket Business Trade Journal. August 1996. Placing for the storm.

Wood Pellets

Pellet stoves offer enjoyable heating with minimal air pollution. In 1992, Colorado sponsored the "Great Stove and Fireplace Changeout" as an effort to reduce air pollution from open fireplace and wood stove burning. Wood pellet stoves were one response to that program. In 1993, the NEOS Corporation published a study of the potential for pellet producing plants in Colorado. The study estimated that 44,000 tons of wood pellets were being consumed annually in Colorado at that time. They estimated demand could increase to as much as 300,000 tons and opportunities for pellet production within the state were analyzed. Several potential plant locations were reviewed in considerable depth, but a lack of a consistent supply source of raw material kept any from being built.

Currently, 100% of all wood pellets come from out-of-state. Pellets come primarily from South Dakota, Wyoming, Utah, Arizona, and Arkansas. However, the demand envisioned in 1992 failed to materialize. Wood pellet consumption in the state during 1999 amounted to 50,000 tons, based on interviews with the Pellet Fuels Institute and pellet manufacturers supplying Colorado. Since 1999 was a mild winter, it is likely that during an average winter, pellet consumption would approximate 60,000 tons. The retail value of the 1999 consumption is estimated at $8.8 million.

Sources:

Lynch, D. 1999. Telephone interviews with over 10 pellet sales outlets in Colorado.

Lynch, D. 1999. Telephone interview with Pellet Fuels Institute, Arlington, VA.

Lynch, D. 1999. Telephone survey of five pellet manufacturers in Wyoming, South Dakota, Arizona, and Utah.

NEOS Corporation. 1993. Wood pellet manufacturing in Colorado: An opportunity analysis. State of Colorado, Office of Energy Conservation.

Biomass Energy from Wood Wastes

Biomass fuels amount to about 3% of total U.S. energy consumption. Most consumption occurs in the South (49%) while the West consumes about 21%. Biomass wastes consist of municipal solid waste, manufacturing waste, agricultural waste and wood residues. In 1992, an estimated 457 trillion Btu of energy was produced from solid waste. Mass burning of municipal solid waste provided 68% of this energy, burning of manufacturing wastes supplied 17%, and landfill gas recovery supplied 15%. The largest portion of this energy was consumed in the Northeast. Total wood biomass consumption in 1992 produced 2,249 trillion Btu. The industrial sector was the largest wood biomass consumer, accounting for about 71% of the U.S. total.

Several studies have been done in Colorado examining wood waste potential as an energy source (Ward et al. 2000). Certainly the volume of yard wastes, municipal tree wastes, and construction wood wastes are a concern for landfill operators across the state. The ultimate degradation of such wastes into carbon dioxide and methane gases is an additional concern. Alcohols, such as ethanol and methanol, can be produced from biomass feedstocks. Biomass-derived alcohols are renewable and are used as an additive to gasoline. Ethanol has been marketed since 1979 in Colorado as an octane enhancer. Production from agricultural products approximates 1.5 million gallons. Ethanol production from wood waste has been investigated enthusiastically, but questions about plant construction costs, government subsidies, and raw material supply have caused concern. As electric power deregulation moves across the country, opportunities for the use of renewable

energy sources, including wood biomass fuels, become more interesting. The use of wood waste as a source of energy for a variety of manufacturing applications is also intriguing. At one time during the 1970s energy crisis, wood wastes were used for heating greenhouses in Colorado. Wood waste energy for cement manufacture is currently under study by the authors and the industry at the time of this publication.

As of this writing, however, there is no documented evidence of wood biomass being used in Colorado as a commercial energy fuel. Low cost, high quality fossil fuels remain competitive in the marketplace and some wood wastes have the potential to be converted into higher value products (Cesa et al. 1994).

Sources:

Cesa, E. T.; Lempicki, E. A.; Knotts, J. H. 1994. Recycling municipal trees. Publication NA-TP-02-94. U.S. Department of Agriculture, Forest Service, Northeastern Area.

Coloradans for Clean Air. 1997. Ethanol fuel.

National Renewable Energy Laboratory. 1996. Biofuels research at NREL.

NEOS Corporation. 1997. Colorado Front Range wood resource assessment.

U.S. Department of Energy. 1994. Estimates of U.S. biomass energy consumption–1992.

Ward, J. E.; Mackes, K. H.; Lynch, D. 2000. Availability of wood wastes and residues as a potential fuel source. Fort Collins, CO: Colorado State University, Department of Forest Sciences.

Other Wood Products Used in Colorado (Evidence is insufficient to estimate volumes and values)

Charcoal and Fire Starters

All charcoal, flavoring chips, and fire starters come from out-of-state. Charcoal and flavoring chips are made from hardwoods not indigenous to Colorado. While there are possibilities for using hardwood residues left over from other product manufacturing in Colorado, currently all firestarters are manufactured by firelog companies from out of state.

Sources:

Telephone interviews with four firestarter manufacturers.

Wood Toys and Playground Equipment

A number of artisans and woodworkers make wooden toys in Colorado. Some of these toys are hand-carved works of art that have the potential to become family heirlooms. At this point, it is not possible to estimate the volume of wood used or the value of these products.

Wooden playground equipment is often made of treated southern yellow pine from out- of-state. Equipment built within the state from landscape timbers is included in the landscape timber estimate. Otherwise, it is not currently possible to estimate the volume of this use and its value.

Sources:

Personal interviews with numerous (at least 50) artisans and woodworkers, materials from wooden playground equipment manufacturers.

Wood Sheds and Barns

Firms and homeowners construct wooden sheds for backyard storage of garden items, dog houses, horse barns and shelters, and playhouses for children. Some of the material for these uses may be included in remodeling figures, but there is not a specific estimate of the volumes or values associated with these uses.

Tourist and Gift Items

A survey of Colorado wood items marketed as tourist or gift items in 1995 was conducted. While it was extremely difficult to fully estimate the total volume or total value of wood used, it was possible to develop some insight into the market. There are four firms in Colorado who make tourist and gift items from Colorado wood and sell them on a statewide basis. These consist of a variety of items such as wooden bowls, candle holders, vases, bolo ties, napkin holders, and jewelry boxes. Most of the wood used is dead, dry aspen and comes primarily from within Colorado. There are also many local artisans who sell products through gift stores located near their homes. These products are made from a variety of Colorado woods including aspen, juniper, bristlecone pine, lodgepole pine, and ponderosa pine. This market is very substantial in size, but it is too individualized to estimate without a very intensive and costly survey.

In the course of the survey, a much larger number of firms and artisans who make wooden items for the tourist or gift market out of woods from out-of-state or out-of-country were identified. Some of this wood may be included in estimates of hardwood lumber shipments into the state, but no specific information on volumes or values used were determined.

Sources:

Field survey by Sara McConahy and Dennis Lynch.

Hobby Woodworking

Individuals enjoy woodworking as a hobby across the state. They make furniture, woodcarvings, turned objects, wood toys, art objects, and a wide variety of other wooden items for personal use. Most of the wood used by hobbyists is hardwood

imported from out-of-state or out-of-country. No volumes or values for these uses of wood have been determined.

Sources:
Personal interviews with numerous wood working club representatives and firms supplying wood to hobbyists.

Wood for Packaging

As a part of the tourist and gift item survey, wood used for packaging was investigated. Small wooden crates and boxes are currently used to attractively package items like soap, chocolates, candy, and food. Nearly all wood packaging examined was made out-of-state and imported into Colorado. As a part of the study, examples of packaging were designed and made using wood residues from Colorado mills. (Unfortunately these examples were lost in the Colorado State University flood of 1997). From this study, Colorado wood residues are suitable for packaging specialty items like salsa, chocolates, soap, or handmade jewelry. Information on volumes or values of material used is not available as of this writing.

Sources:
Field survey by Sara McConahy.
Personal interviews with numerous firms using wood packaging. Examples of wood packaging were designed and constructed by Dave Travis, Mount Simon Woodworking.

Wooden Boxes, Tubs, Crates, Baskets, and Barrels

Stores often use wooden boxes, tubs, crates, baskets, and barrels for displays. Gardeners use boxes and tubs for flower plantings. Boxes, crates, and baskets are also used for gathering and shipping fruit and vegetables. Certain Colorado tree species would be excellent for use in such products. As of this writing, no firms in the state make such products. Therefore these products come entirely from out-of-state, but none of the volumes used or the values are currently available.

Source:
Field surveys of numerous stores (more than 100).

Wood Chemicals and Extractives

Many chemicals and extractives come from wood. Examples are the flavoring for gin that comes from juniper berries, a wood extractive used in chewing gum, various aromas created from resins, as is turpentine, a paint solvent. In this study, no attempt was made to include chemicals or extractives due to the sheer complexity of this industry. Some discussions did occur with people operating cottage industries in Colorado who use wood to create extractives or aromas. However, significant quantities come from out-of-state.

Sources:
Lynch, D. 1998. Interviews with three small business owners.
Schroeder, H. 1998. Personal interview. Fort Collins, CO: Colorado State University.

Specialty Forest Products

Forests produce a host of products that make our lives more interesting and pleasant. Mushrooms, berries, herbs, wreaths, and decorative items are examples from the specialty forest product industry. While there is an awareness of this industry and its importance, these forest products were not included in this study. In some western states, cottage industries create substantial income from specialty forest products and these can be very desirable small businesses for rural communities.

Source:
Thomas, M. G.; Schumann, D. R. 1993. Income opportunities for special forest products. Ag. Info. Bull. 666. Washington, DC: U.S. Department of Agriculture, Forest Service.

Others

An amazing number of unique wooden objects are used in Colorado. Wood products such as coffins, fence stays, survey stakes, lath, tableware, trivets, plaques, paddles, etc., are being produced. The discovery of additional items not considered previously has been a constant source of surprise. Therefore, if a wooden item is not found in this study there is simply no information on volumes or values available on it as of this writing.

Summary of Volumes and Values for Wood Products

Table 1 summarizes the volumes and retail values of primary wood products annually consumed in Colorado. The annual consumption of various primary wood market segments is also presented in figures 1-5. A summary of end use values for primary products by end use is presented in figure 6. Table 2 summarizes the volumes and retail values of value-added products consumed annually in Colorado. Figure 7 gives a comparison between the value of primary and secondary wood products consumed annually in Colorado. The retail values of wood products presented in these tables and figures are estimated using the year 2000 as a base. For purposes of this study, primary products are those that have undergone simple processing from the log or from wood residues. Value-added products take primary materials and, using additional processing, create more valuable products.

Table 1. Volume and value (2000) of primary products annually consumed in Colorado.

Products	Volume (millions)	Retail value in 2000 (million dollars)
Lumber	Board-feet	
Residential framing	602.700	$370.40
Mobile home	9.750	$5.99
Commercial-industrial	35.800	$22.00
Residential remodeling	228.000	$140.11
Residential fencing	38.600	$25.00
Decking	72.200	$47.40
Highway	6.900	$5.10
Truck transportation	1.100	$0.66
Pallet	50.000	$11.00
Mining rough sawn and finished	2.106	$0.90
Subtotal	1047.156	**$628.56**
Timbers	Board-feet	
Landscape	11.000	$5.60
Railroad ties	8.200	$4.60
Highway guard posts	3.400	$3.40
Highway sign posts	0.080	$0.05
Mine cribbing	2.400	$1.32
Subtotal	25.080	**$14.97**
Other sawn products		
Shakes & shingles	10.5 square feet	$16.60
Mining capboards & wedges	.272 bd-ft	$0.26
Subtotal	dissimilar units	**$16.86**
Panels	Square feet	
Residential sheathing	479.000	$142.10
Residential siding	35.900	$20.90
Mobile home	9.110	$2.34
Commercial-industrial panels	38.300	$19.20
Commercial-industrial hardboards	0.400	$0.20
Residential remodeling panels	135.000	$67.80
Residential remodeling hardboard	75.000	$6.00
Highway panels	18.300	$9.20
Railway shipping	0.230	$0.06
Subtotal	791.240	**$267.80**
Roundwood	Board-feet	
Log home logs	19.200	$37.50
Agricultural fencing	2.250	$2.30
Utility poles	27.400	$16.90
Highway pilings	10.900	$4.90
Mine props	1.000	$0.71
Subtotal	60.750	**$62.31**
Christmas trees	Trees	
Subtotal	0.495	**$11.60**
Wood energy		
Firewood	.026 cords	$20.70
Firelogs	1.2 logs	$2.50
Pellets	.05 tons	$8.80
Subtotal	dissimilar units	**$32.00**
Mulch, chips & sawdust	Cubic yards	
Landscape mulch	0.130	$4.10
Dairy cattle bedding	0.123	$0.86
Horse bedding	0.802	$8.00
Small mammal bedding	0.282	$0.23
Turkey & chicken bedding	0.079	$0.90
Laboratory animal bedding	0.002	$0.13
Subtotal	1.418	**$14.22**
	$ Grand Total =	**$1,048.32**

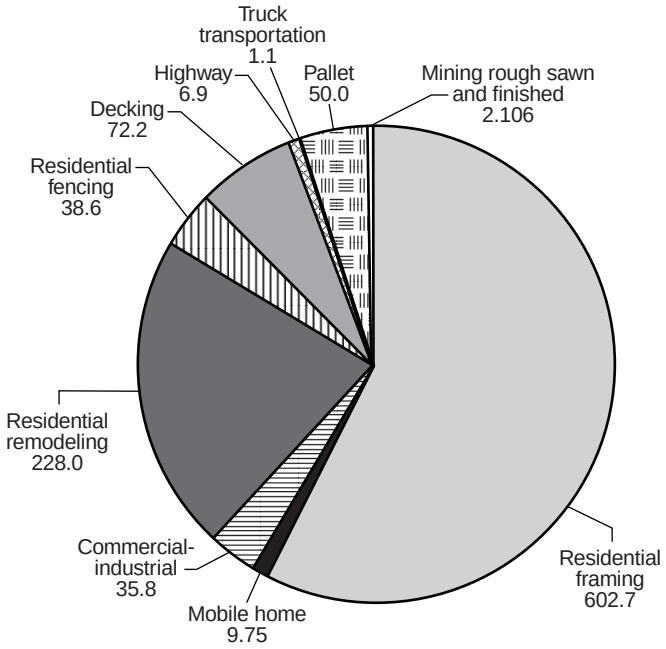

Figure 1. Annual Colorado consumption of lumber separated by end use. Units in million bd-ft. Total volume = 1047.156 million bd-ft.

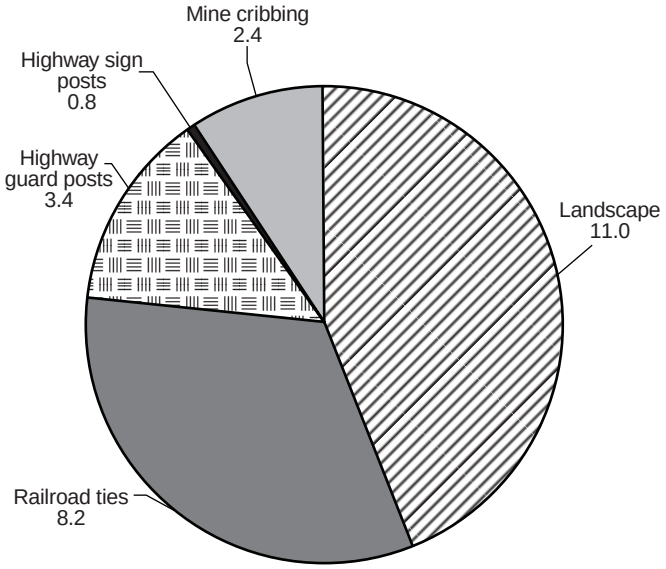

Figure 2. Annual Colorado consumption of timbers separated by end use. Units in million bd-ft. Total volume = 25.08 million bd-ft.

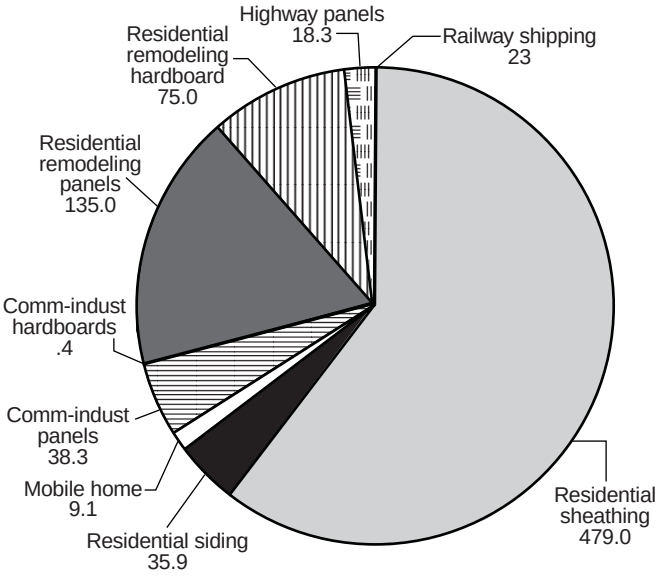

Figure 3. Annual Colorado consumption of panels separated by end use. Units in million sq-ft. Total volume = 791.240 million sq-ft.

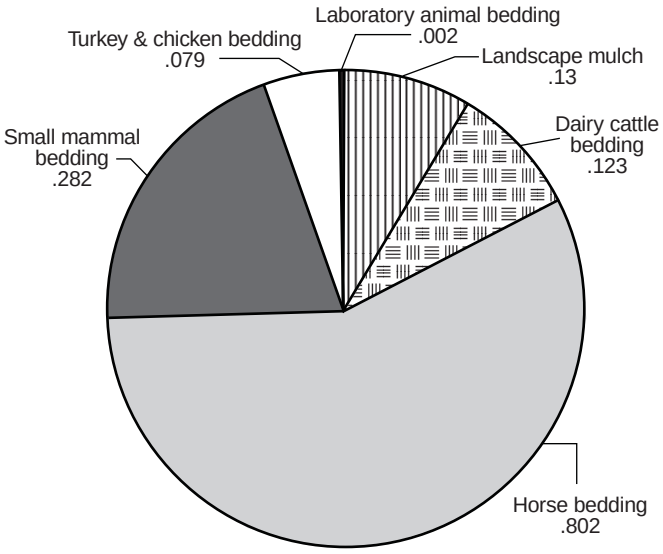

Figure 5. Annual Colorado consumption of mulch, chips, and sawdust separated by end use. Units in million cubic yards. Total volume = 1.414 million cubic yards.

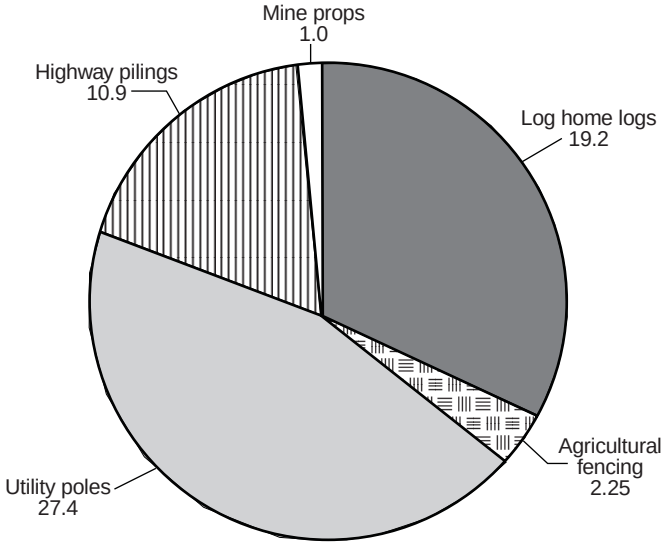

Figure 4. Annual Colorado consumption of roundwood separated by end use. Units in million bd-ft. Total volume = 60.75 million bd-ft.

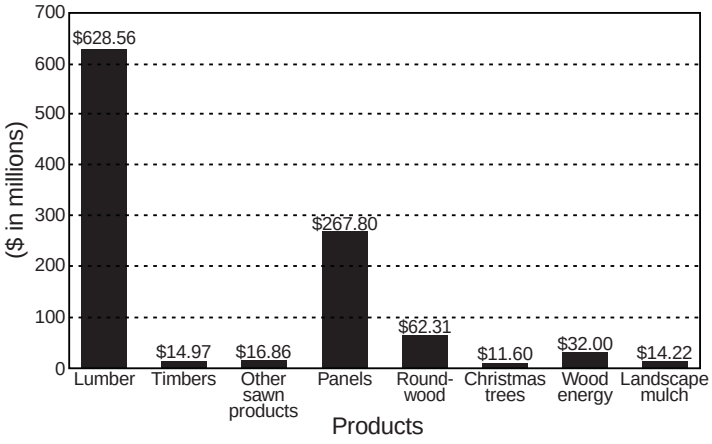

Figure 6. Summary of retail values (2000) for primary products consumed annually in Colorado.

Table 2. Volume and value (2000) of value-added products annually consumed in Colorado.

Products	Volume (millions)	Retail value in 2000 (million dollars)
All doors	.792 each	$133.80
Cabinets	.596 each	$1,821.40
Molding	25.6 linear feet	$24.10
Flooring	6 sq-ft	$13.00
Windows	0.711	$33.60
Furniture	Unknown	$47.00
Paper	.825 tons	$634.26
Paperboard	.671 tons	$330.15
I-Joists	2.7 linear feet	$4.90
Glulam lumber	3.8 bd-ft	$8.60
Composites	.065 sq-ft	$0.20
	Total	**= $3,051.01**

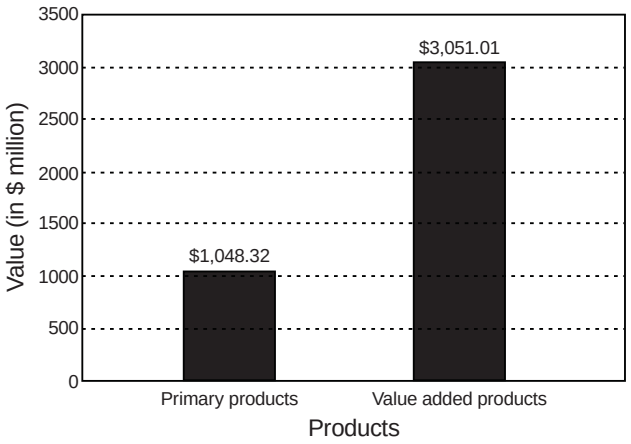

Figure 7. Value of primary products (2000) compared to value added products consumed annually in Colorado.

Understanding the Numbers

Nearly everyone finds it difficult to mentally visualize the tremendous quantities estimated in this report. In this section, quantities are calculated in terms that are easier to visualize.

- In 1998, a total of 51,156 dwelling units (single family and multi-family units) were constructed in Colorado (U.S.Census Bureau). That is equivalent to building a new Fort Collins (44,489 total dwelling units) and a new Canon City (estimated 6,120 dwelling units). Consider too that Colorado is projected to gain 1.5 million new residents over the next 20 years, which will sustain demand for dwelling units.
- Enough board feet of framing lumber in new residential construction is used in Colorado each year to reach 40% of the distance to the moon. If residential remodeling, mobile home construction, commercial-industrial construction, decking, street and highway construction, truck transport, pallet lumber, and residential fencing to residential construction is added, the lumber use would reach over 80% of the way to the moon.
- The use of structural panels in residential construction would cover over 4,954 football fields. All of the panels and the exterior siding used for all purposes each year in Colorado would cover 13,715 acres of land. That is just slightly less than the area of Golden Gate State Park (14,000 acres).
- Wood flooring used in residential construction is sufficient to floor Concourses A, B, and C at Denver International Airport 1½ times.
- Each year 767 miles of logs averaging 10" in diameter are used for log home construction. That's equivalent to the distance from Denver to Las Vegas.
- Enough landscape mulch was imported into Colorado in 1999 to cover Coors field to a depth of 16 feet (the height of the wall in right field) and 8 feet above the walls in center and left fields.
- Laid end-to-end, the landscape timbers used last year could extend from Denver to the border with Mexico at El Paso, Texas.
- Utility poles used for new construction or replacement are sufficient to build 7,200 miles of electric line, enough to extend around the circumference of the moon.
- The 2.5 million pallets manufactured in Colorado would cover the surface of approximately 765 acres of land. Or, if laid side by side, they would extend 1,894 miles. That is 444 miles more than the length of the Arkansas River from its origin near the Continental Divide above Leadville to its junction with the Mississippi (1,450 miles).
- Railroad ties used in one year could supply a light rail system from Denver to the Eisenhower tunnel.
- Underground mining uses small diameter trees (6 inches in diameter on the small end and from 5 to 11 feet long) for props. If 63 of these trees per acre were thinned from

Colorado forests, good health could be restored to 1,596 acres of forest each year. Enough cribbing is used in coal mining to build a small wall of varying heights almost completely around the Great Sand Dune National Monument.

- Enough wood shavings and chips for horse bedding is used each year to cover the 306 acre main campus at the University of Colorado in Boulder to a depth of over 1 ½ feet deep. Enough turkey, chicken, and laboratory animal bedding was used last year to fill the Great Hall at Denver International Airport to a depth of 19 feet. Small mammal (pet) bedding would have covered all five runways at DIA (each runway is 12,000 feet long and 150 feet wide) to a depth of over 10 inches.
- A fence with wood posts on 10-foot centers could be constructed along the Kansas and Utah borders with material used for agricultural fencing. Residential fencing would extend for 780 miles, enough to fence the Wyoming, Nebraska, and New Mexico borders.
- Christmas trees used in Colorado in 1999 could have been grown on just 773 acres of land. That is an area 2.4 times the size of Denver's City Park.
- A family of four would need a 1½ ton truck to haul away the paper they use in one year. United Airlines has the capacity to handle 300 tons of mail and freight per day at DIA. At that rate, it would take United 13.8 years to haul all the paper products used in Colorado each year.
- Firewood imported into Colorado could have supplied every family in Jackson County with 5.2 cords of firewood, almost enough to last a year (it gets cold in Walden in the winter). If the manufactured firelogs used in Colorado were laid end to end, they would reach 255 miles, a little more than the distance from Denver to Grand Junction. The scoreboard at the Pepsi Center weighs approximately 30 tons. In Colorado, 2,000 times that weight in wood pellets are used during an average year.

Where Does the Wood Come From?

At several points in this paper it has been stated that wood came from out-of-state, but in some cases specifics were not provided. Exactly where does this wood come from? To determine this, we searched many data sources, appealed for help from statisticians in several regions of the country, and looked for available transportation data. This is what we found:

Softwood Lumber From the West, South, and Canada

Softwood lumber information reported here principally includes pine, fir, hemlock, and spruce species that have been kiln dried, planed, and graded. It includes all lumber dimensions, but not timbers. It does not include redwood lumber from California. While a major portion is framing lumber, no data is available to verify this.

Regional percentages, presented in figure 8, are based on 777 million board feet of lumber, tracked by Western Wood Products Association (WWPA), Statistics Canada (SC), and Southern Forest Products Association (SFPA), directly shipped by rail and truck to Colorado in 1999. But the percentages do not include amounts shipped to another state and then rerouted to Colorado. Based on figure 8, most lumber shipped to Colorado (65%) still comes from the Western region. However, according to SFPA (2000) data, from 1990 to 1999, softwood lumber production increased in Canada and the South as production declined in Colorado and the Western region.

The percentage of lumber shipments from the Western region, Canada, and the Southern region are presented in tables 3, 4, and 5. Percentages by state or province are based on two comparative years of data, 1996 and 1997, for the West and Canada. Data for the South is based on 1999 rail shipment data that accounts for 57% of the southern pine lumber shipped to Colorado. Truck shipment origin and destination data is not currently available.

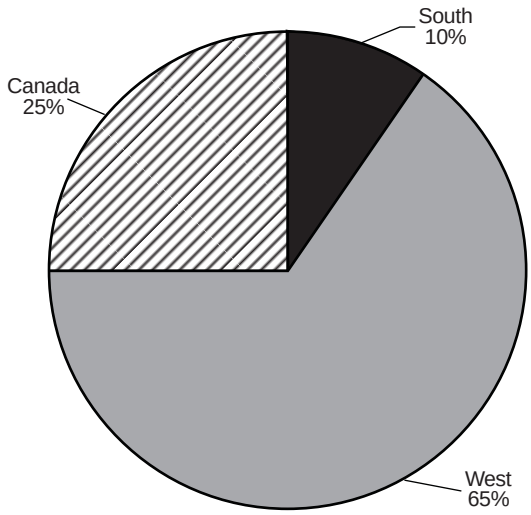

Figure 8. Percentage of lumber directly shipped to Colorado by region.

Table 3. Percentage of lumber shipments from the Western region by state.

State	Percentage directly shipped
Idaho	31 - 34%
Oregon	22 - 23%
Washington	19 - 20%
California	12 - 15%
Montana	10%
Wyoming	0.6 - 0.8%
Colorado	0.6 - 0.7%
South Dakota	0.40%

Table 4. Percentage of lumber shipments from Canada by province.

Province	Percentage directly shipped
British Columbia	73 - 76%
Alberta	10 -14%
Quebec	7 -9%
Ontario	3 - 4%
Saskatchewan	1 -3%
Manitoba	0.2 -0.4%

Table 5. Percentage of lumber shipments from the Southern region by state.

State	Percentage directly shipped
Louisiana	48%
Arkansas	23%
Texas	9%
Mississippi	7%
Alabama	4%
Oklahoma	3%
Maryland	2%

Wood Products From Mexico

Between January 1995 and December 1999, Mexico shipped 1,993.9 tons of wood products valued at $1.1 million to Colorado by truck and rail. This is an average of 399 tons valued at $220,456 per year. Based on contacts in the market, these wood products were primarily firewood, rough lumber, and landscape timbers.

Panels

Approximately 145 million square feet of oriented strand board panels are manufactured in Colorado each year. If all of these panels stayed in state, they would only meet 21% of the annual need for structural panels in Colorado. However, not all of these panels stay in Colorado because of the OSB plant location in relation to Nevada, Utah, Arizona, and New Mexico markets. In any event, more than 79% of structural panels used in Colorado come from out-of-state.

Rail shipment data confirm that 60% of the structural panels shipped by rail to Colorado come from Canada. These panels are primarily oriented strand board (OSB). The provinces directly shipping OSB to Colorado are summarized in figure 9. Manitoba followed closely by Ontario and Alberta account for most of the Canadian shipments to Colorado. The remaining 40% of the structural panels shipped by rail from within the United States are 53% plywood and 47% OSB. Principal plywood shipping states are summarized in figure 10 and principal OSB shipping states in figure 11. Oregon ships the most plywood and Minnesota the most OSB. Hardboard panels are almost entirely shipped from Oregon. Almost all particleboard (97.5%) comes from within the United States. Canada provides only 2.5% to Colorado. Major particleboard shipping states are summarized in figure 12. Oregon accounts for the majority of shipments. Only three Canadian provinces, Alberta, British Columbia, and Quebec, ship particleboard to Colorado. The percentage of particleboard shipments from these provinces is summarized in figure 13.

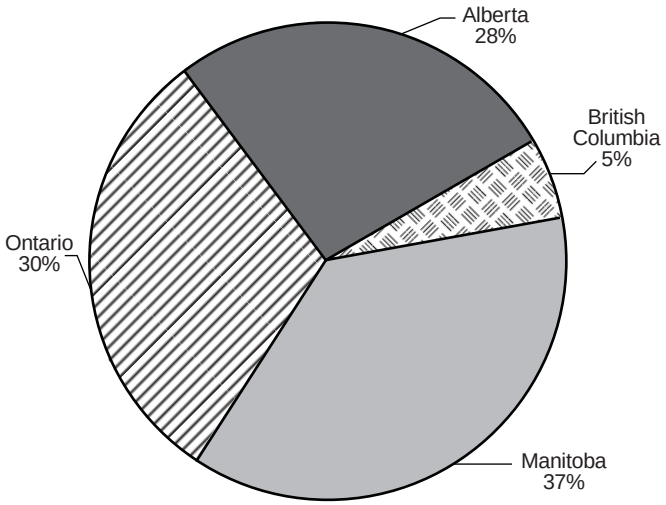

Figure 9. Distribution by province of Canadian OSB shipments to Colorado.

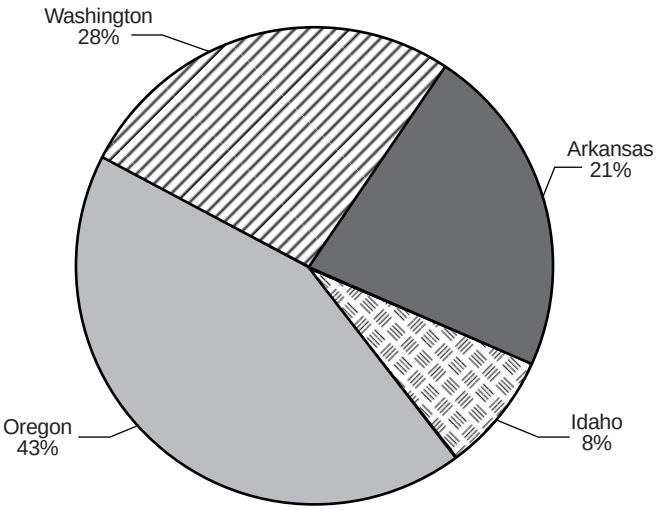

Figure 10. Distribution by state of U.S. plywood shipments to Colorado.

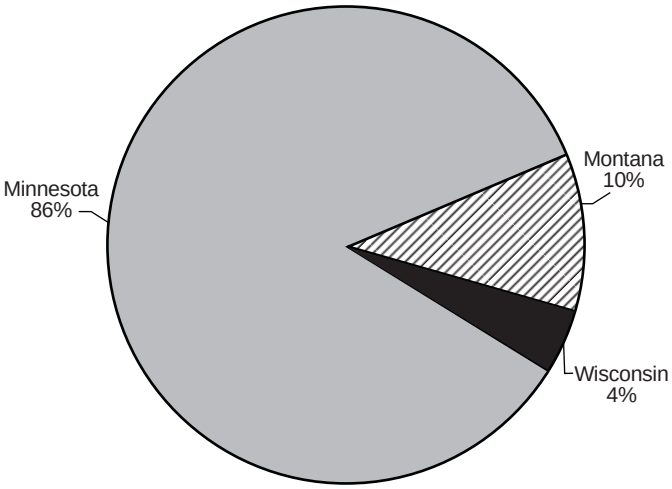

Figure 11. Distribution by state of U.S. OSB shipments to Colorado.

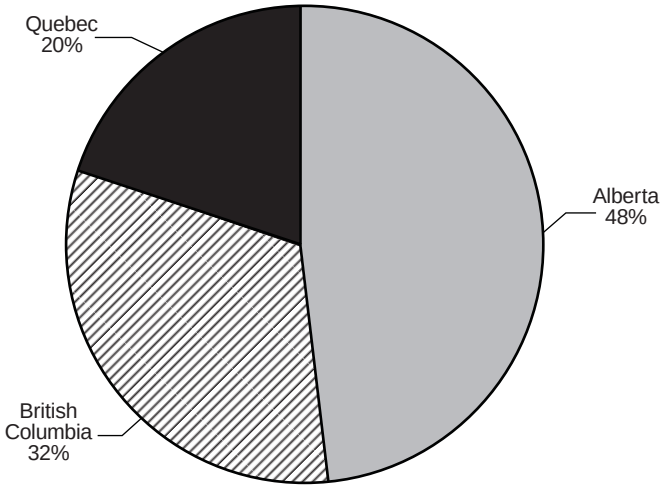

Figure 13. Distribution by province of Canadian particleboard shipments to Colorado.

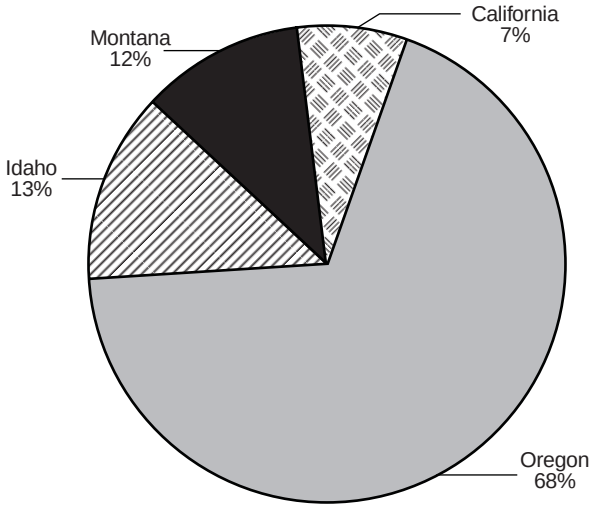

Figure 12. Distribution by state of U.S. particleboard shipments to Colorado.

Production of Wood Products From Colorado Forests

Colorado has a total land area of 66.4 million acres. Of this area, 21.3 million acres, or about 32% of the state, are at least 10% stocked with forest trees of any size and thus classified as forest land. This includes federal, state, and private lands commonly recognized as being forested. However, it also includes areas that may not be thought of as forested, such as pinyon-juniper or gambel oak woodlands and some riparian areas of cottonwood, box elder, and willow. Of the total forested area, approximately 11 million acres are considered noncommercial. While some forest products, such as firewood, berries, nuts, mushrooms, decorative materials, Christmas trees, etc., are harvested from many of these areas, the commercial wood harvest comes from lands designated as suitable for timber production in forest plans. Timberlands are those forest areas capable of growing 20 cubic feet or more of commercial wood per year. Of the total forested area, approximately 10 million acres could meet these criteria as timberlands. However, because of a number of special designations, restrictions, and reservations, a very small amount of these lands are actually managed for timber production.

In Colorado there are 13.7 million acres of National Forest land. These lands were originally identified as the best forest lands in Colorado and were reserved from the public domain primarily for timber and water purposes. The gross annual growth on these lands was 1.3 billion board feet and the annual mortality was 412 million board feet in 1999 (USFS TRACS 2000). During 1999, only 51.5 million board feet of timber were cut from 2.8 million

acres of National Forest lands designated by forest plans as available for timber harvest (Deickman 2000). Of this area, 988 thousand acres are actually designated by forest plans for timber emphasis (USFS TRACS 2000). For purposes of comparison, there are 3.3 million acres of wilderness in Colorado, almost all of which is managed by the USDA Forest Service (Wilderness Society 2000).

There are less than 8 million acres of private and state forested lands in Colorado (CSFS 1981). State forest lands were part of land grants from the public domain made at statehood or to support education. Some state forest lands were acquired later in land exchanges with National Forests. Private forests were included with lands originally homesteaded for agriculture or claimed for mining purposes. About 446,000 acres of forest are state owned and 7.4 million acres of forest are privately owned. Only 3.4 million acres of state and private forest lands are considered capable of meeting commercial timberland status. Much of the capable private land is not managed for timber production or has been subdivided and developed to the point that management for timber purposes alone is not feasible. Based on studies and analysis done by the Colorado State Forest Service, there are approximately 50,000 private forest owners in Colorado who hold 10 or more acres of forest land (Schwolert 2000).

A total of 38.3 million board feet were cut from Colorado State Forest Service (CSFS) administered state and private lands. These lands have forest management plans prepared by CSFS (Schwolert 2000). Based on industry contacts it was estimated that an additional 20 million board feet were cut from private lands under contracts between landowners and timber companies. These landowners may have plans prepared by consulting foresters or timber company foresters. Thus, state and private forest lands produced a total of 58.3 million board feet in 1999.

Therefore, a total of 109.8 million board feet of timber were cut in Colorado in 1999. This is approximately 8% of the amount wood used in Colorado for board foot products (includes firewood and roundwood) and for panels (measured in square feet, but converted to board feet for this analysis). However, given the limited capacity for production and the location of processing facilities in Colorado, some of the cut went to Wyoming and New Mexico for processing. These data appear to further support estimates that out-of-state wood imports amounted to 90% to 100% of the wood used in 1999.

Sources:

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Schwolert, P. 2000. Personal communication. Fort Collins, CO: Colorado State Forest Service.

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Wilderness Society. 2000. Web site: http://www.wilderness.org/

Conclusion

Colorado uses tremendous amounts of wood products, but it depends on imports from other states and countries to meet its needs. As a result, significant amounts of money from Colorado's economy are transferred elsewhere to purchase and transport wood. Despite the presence of abundant forests capable of providing many types of wood products and serious concerns about forest health and catastrophic fires, Colorado continues to import 90% to 100% of the wood it uses. In many cases, the wood being used is transported great distances from forests that are similar in nature to Colorado's and even less capable of producing wood fiber. Thus, there appear to be excellent opportunities for using trees thinned from Colorado forests in this market. In particular, small diameter trees removed to improve forest health and reduce fire hazard could be utilized for some products. Additionally, there are policy and management questions related to Colorado's use of imported wood that should be addressed. Small diameter opportunities and policy and management implications are discussed in subsequent papers.

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