



**FOREST INDUSTRY
RESEARCH PROGRAM**
UNIVERSITY OF MONTANA

Timber Use, Processing Capacity, and Capability Within USDA Forest Service, Region Two Timber- processing Area

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Report Highlights

- The Region Two (R2) study area is comprised of 66 counties with the timberlands of 11 National Forests (excluding the Nebraska NF) located in Colorado, Wyoming and South Dakota. National Forests account for nearly 71 percent (11.6 million acres) of the timberland in the R2 study area.
- Facilities outside of the R2 study area received 5.6 percent of the timber volume harvested in the study area, while about 3 percent of the timber processed in the study area came from outside of R2, suggesting limited interdependence between R2 and neighboring Forest Service regions.
- The Region Two Timber-processing Area (R2-TPA) includes 73 counties in six western states: Colorado, Idaho, Montana, New Mexico, South Dakota and Wyoming.
- A total of 101 primary timber-processing facilities were active in the R2-TPA during 2016. Sawmills, post, pole, and log furniture facilities were the most abundant types of facilities in each state and overall.
- Annual capacity to process timber within the R2-TPA in 2016 was 1,346,430 hundred cubic feet (CCF), or approximately 579,185 thousand board feet (MBF) Scribner, of which 69 percent was utilized.
- Almost 66 percent (on a cubic foot basis) of the timber consumed in the R2-TPA was from trees ≥ 10 inches dbh, and the largest share of timber consumed in each state was in that size class. Consumption of smaller trees varied considerably among the states.
- About 939,211 hundred cubic feet (CCF), approximately 70 percent, of the R2 TPA processing capacity is **not capable** of efficiently using trees < 10 inches dbh.
- About 37 percent of capacity was not utilized in both Colorado (170,658 CCF unused) and Wyoming (97,497 CCF unused), indicating substantially more timber could be used by timber processors, particularly sawmills, in those parts of the Region.
- Approximately 413,000 CCF of unused timber-processing capacity is available in the R2-TPA. However, only about 88,100 CCF of unused capability to process timber < 10 inches dbh exists in the R2-TPA.

Introduction

Insect and disease outbreaks in the central Rocky Mountains reached epidemic levels in the last two decades resulting in large volumes of dead trees across parts of Wyoming, Colorado and South Dakota. Annual mortality from insects and disease on timberland¹ in Region 2 is estimated to be 597.5 million cubic feet (MMCF), 88 percent of all mortality. By comparison, fire mortality accounts for 3.5 percent and logging accounts for 0.5 percent (USDA 2019). Both the states and the Forest Service have increased investments in forest health, hazardous fuels mitigation and safety protection on private and public lands (Wyoming State Forestry Division 2017; State of Colorado 2017; USFS MBRNF 2017). These and other treatments designed to restore ecological condition and function and reduce fire hazard require the removal of a mix of timber valuable enough to offset some of the costs along with smaller trees with limited value and markets (Wagner et al. 2000). The loss of milling infrastructure throughout the West, combined with changing management objectives on federal lands, has raised questions about the industry's ability to purchase and use timber of varying sizes and quality at rates adequate for forest management goals and economically sustainable for the industry (Keegan et al. 2005; Keegan et al. 2006). The expressed need to treat millions of acres in the western United States to meet management objectives has made accurate information on timber-milling capacity and the capability of mills to handle timber of various sizes important considerations for managers.

¹ Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Goals and Objectives

This report was prepared by the Forest Industry Research Program at the University of Montana's Bureau of Business and Economic Research (BBER) as a forest planning support document for Region Two (R2) of the USDA Forest Service. Individual analyses on a forest-by-forest basis have been completed for the Medicine Bow-Routt National Forest (McIver et al. 2017a); Rio Grande National Forest (McIver et al. 2017b); Grand Mesa, Uncompahgre, Gunnison (GMUG) National Forest (McIver et al. 2017c); and Black Hills National Forest (McIver et al. 2017d). As a planning tool for R2 this report seeks to:

1. Examine the harvest of timber from the counties containing R2 non-reserved timberland - the "study area";
2. Analyze the timber flow and identify the location of facilities receiving timber harvested from the study area
3. Describe the types of facilities, and quantify their capacity to process timber, and their capability to use timber of various sizes. The study focuses on facilities that exclusively use timber in round form (i.e., logs)

Definitions and Methods

Data for this analysis are based on 2014 data for Wyoming mills (McIver et al. 2017e) updated through communication with mill operators, and 2016 data for South Dakota, New Mexico and Colorado mills (Hayes et al. 2019). When 2016 data for a mill were not available, prior data were used as a baseline and adjusted to reflect 2016 harvest and market conditions. Using BBER (2017) databases developed from periodic censuses of the primary wood products industry in western states, USFS 2016 cut and sold reports and conversations with mill owners, timber harvest and flow from all ownerships within the study area were analyzed.

To determine the Region Two timber-processing area (R2-TPA), counties containing mills receiving timber from the R2 study area were identified. If historic (2010/2012) data indicated a

substantial flow of R2 study area timber into a county, the county would be included in the TPA even if recent (2014/2016) flows were relatively small or non-existent. Finally, all other counties receiving timber from the study area were included if the volume represented more than 10 percent of the total timber received in that county.

In this report, “capacity” refers to the total volume of timber (a.k.a., roundwood or logs) that existing timber processors could utilize annually. Also known as “timber-processing capacity”, it is a measure of input capacity and generally expressed in board feet Scribner or cubic feet. Input capacity is a useful measure when attempting to express the capacity of multiple types of mills in a common unit of measure because finished products (output and output capacity) are measured in a variety of units: board feet lumber tally (lumber), lineal feet (house logs) and pieces (posts, small poles, and log furniture). Input capacity is a measure of the volume of logs that a mill can process in a given year, given firm market demand and sufficient raw material. Estimates in this report include the capacity of active facilities that exclusively use timber in round form; this includes sawmills and facilities processing timber into house logs, log homes, posts, poles, log furniture, excelsior, fuel pellets, firewood, and landscaping chips.

In contrast, “capability” refers to the volume of trees of a certain size class (measured as diameter at breast height- dbh) that existing timber processors can *efficiently and economically* process annually. Most facilities are designed to operate using trees of a given size class (e.g., log home manufacturers typically use trees ≥ 10 inches dbh, and post manufacturers primarily use trees < 8 inches dbh). Capability at these facilities is readily classified in a single size class. This is true for some sawmills, but sawmills can vary greatly in equipment, configuration, product output, and their ability to process timber of various sizes (Wagner et al. 1998, 2000; Keegan et al. 2004, 2005; Stewart et al. 2004). .

For each mill in the R2-TPA, an estimation of the mill’s capability to process timber of a given size was made based on literature (Wagner et al. 1998, 2000; Keegan et al. 2005, 2006; Stewart et al. 2004), conversations with mill owners and the most recent BBER mill census data, taking into consideration the financial feasibility and physical characteristics of the mill. For this report, three tree size classes were used: < 7 inches dbh, 7-9.9 inches dbh and ≥ 10 inches dbh.

BBER researchers first assigned capability to efficiently process timber <10 inches dbh. Capability to process trees ≥ 10 inches dbh was then calculated as the proportion of total capacity *not* capable of efficiently using trees <10 inches dbh. Total timber-processing capacity and capability by dbh class are presented in both thousand board feet Scribner (MBF) and thousand cubic feet (MCF) to facilitate discussion among forest managers, timber purchasers, and facility operators.

Region 2 Study Area

The Region 2 study area is comprised of 66 counties with National Forest lands located in Colorado, Wyoming and South Dakota (figure 1). Although there are two National Forests in Nebraska, they were not included in this analysis. Region 2 National Forests account for nearly 71 percent (11.6 million acres) of the timberland in the R2 study area (table 1), with Colorado having the largest proportion (63 percent) of the acres under National Forest ownership.

Table 1 – Acres of non-reserved timberland¹ by state and ownership in the Region 2 Study Area.

State	National Forest	Private	Other Federal	Sate	Other public	Total
Colorado	7,341,281	2,132,001	644,543	189,886	99,200	10,406,911
South Dakota	957,943	303,882	23,857	51,911	5,903	1,343,496
Wyoming	3,298,871	849,723	298,368	224,458	0	4,671,420
Total	11,598,095	3,285,606	966,768	466,255	105,103	16,421,827

¹ Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Source: USDA Forest Service, Forest Inventory and Analysis Program, Tue Jan 29 20:47:43 GMT 2019. Forest Inventory EVALIDator web-application Version 1.8.0.00. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station.

[Available only on internet: <http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evaluator.jsp>]

Region 2 Capacity & Capability Study Area

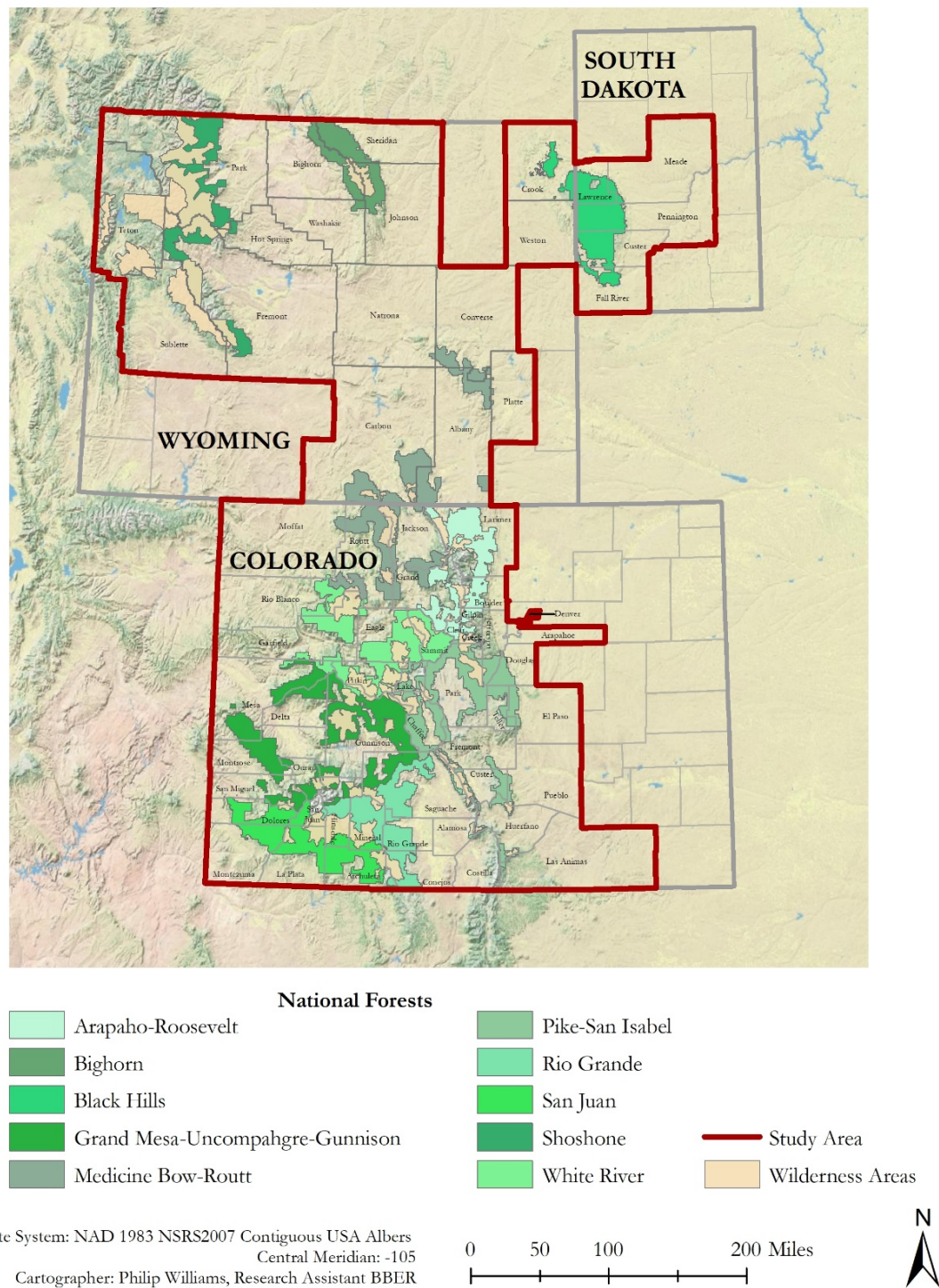


Figure 1 – Region Two (R2) study area – Counties with R2 Timberlands.

Timber harvest

Timber harvested from the study area totaled nearly 285,500 MBF (table 2), approximately 674,867 hundred cubic feet (CCF) (McIver et. al. 2017e; Hayes et. al. 2019). National forests accounted for the largest proportion (66 percent) of harvest in the study area. South Dakota had the largest proportion of harvest from National forest (72 percent) and Wyoming the smallest (57 percent). Private timberlands were the second largest provider of timber in each state in the study area. The timber harvested in the study area was estimated to be comprised of ponderosa pine (43 percent), lodgepole pine (30 percent), and spruce (12 percent). Douglas-fir accounted for 5 percent, aspen 3 percent and undifferentiated softwoods 7 percent (McIver et. al. 2017e; Hayes et. al. 2019).

Table 2 — Region 2 Study Area Timber Harvest by State and Ownership, 2016.

State	National Forest	Private	State	BLM	Other public	Total
	----- MBF Scribner -----					
Colorado Total	79,072	34,283	3,492	1,854	915	119,616
South Dakota Total	77,755	30,607	98			108,460
Wyoming Total	32,446	16,424	7,598	925		57,393
Grand Total	189,273	81,314	11,188	2,779	915	285,469

Region 2 Timber-Processing area (TPA)

The Region Two Timber-processing Area (R2-TPA) establishes the geographic region *potentially* influenced by timber harvested from R2 by analyzing the flow of timber harvested from all ownerships in the R2 study area. The analysis also describes the extent to which timber processors are dependent upon the timber harvested in these counties, and National Forest timber more specifically. The R2-TPA includes 73 counties in six western states (table 3).

Table 3 — Region Two Timber-processing Area (R2-TPA), 2016.

Colorado	Hinsdale*	San Juan*	Natrona*
Alamosa	Huerfano*	San Miguel*	Park*
Arapahoe	Jackson	Summit*	Platte*
Archuleta	Jefferson	Teller	Sheridan*
Boulder	La Plata		Sublette
Chaffee*	Lake*	South Dakota	Teton*
Clear Creek*	Larimer	Custer*	Washakie*
Conejos	Las Animas*	Fall River	Weston*
Costilla*	Mesa	Lawrence	
Custer	Mineral	Meade*	Out of Region
Delores*	Moffat*	Pennington	Idaho
Delta	Montezuma		Jefferson
Denver	Montrose	Wyoming	Montana
Douglas*	Ouray*	Albany	Broadwater
Eagle	Park	Bighorn*	Mineral
El Paso	Pitkin*	Carbon	Park
Fremont	Pueblo	Converse	New Mexico
Garfield	Rio Blanco*	Crook	Colfax
Gilpin*	Rio Grande	Fremont	Rio Arriba
Grand	Routt*	Hot Springs*	Taos
Gunnison*	Saguache	Johnson	

* = Counties with R2 national forest land but no timber processors.

Industry structure

A total of 101 primary timber-processing facilities were active in the R2-TPA during 2016 (figure 2), with Colorado having the majority of the facilities and the most diverse range of wood products (table 4). Sawmills, post, pole, and log furniture facilities were the most abundant types of facilities in each state and overall. An understanding of the structure of the industry can add insight into which facilities have the capability to use timber of various sizes as well as other characteristics (e.g., log quality) that may be important to potential timber sale

bidders and timber processors. Generally speaking, capability to utilize larger diameter timber is concentrated in sawmills and houselog producers while capability to use smaller diameter timber resides with post, pole, log furniture and firewood producers. Sawmills can process a limited percentage of their inputs from smaller trees or trees that have been killed by insect or disease as long as the material is sound. Houselog facilities need the larger trees but prefer standing recently dead trees, particularly lodgepole pine or spruce. Post, pole, firewood, and other facilities can use smaller and lower quality timber for their products.

Table 4 — R2-TPA Number of Facilities by Type and State, 2016.

Facility type	Colorado	South Dakota	Wyoming	Out of region^a	Total
Sawmills	33	7	10	6	56
Post, pole & log furniture	11	2	8	1	22
Houselog/log home	10	1	3	1	15
Firewood/energy products	3	—	1	—	4
Other facilities ^b	3	—	—	1	4
Total	60	10	22	9	101

^a Out of region states: Idaho, Montana, New Mexico.

^b Other facilities include producers of pellets, shavings, excelsior, vigas, mulch and playground chips.

Region 2 Timber Processing Area - Forest Products Facilities -

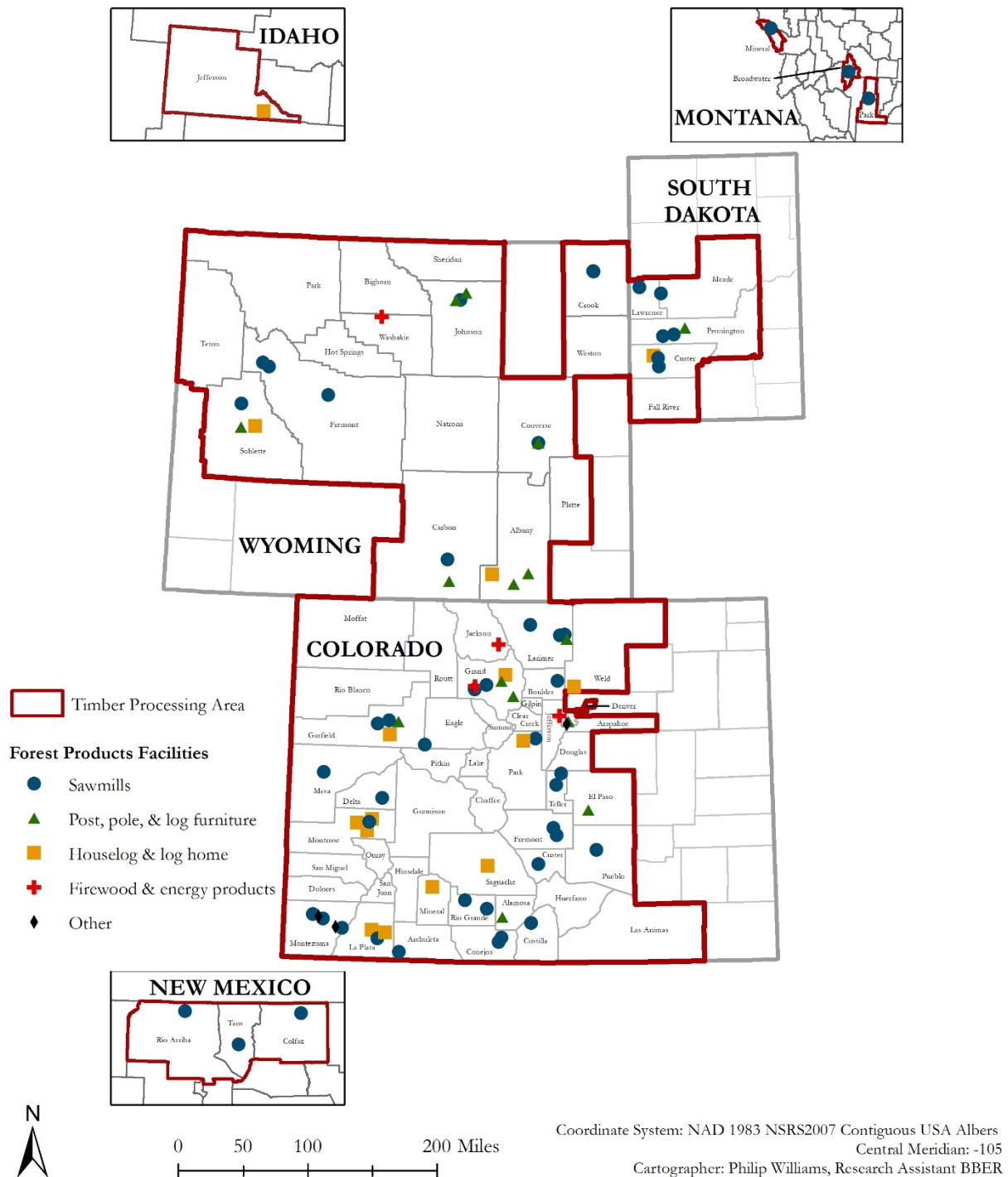


Figure 2 – Timber-processing Facilities in R2-TPA, 2016.

Timber flow

Nearly 285,500 MBF Scribner of timber flowed from the R2 study area to processors throughout the R2-TPA in 2016 (table 5) of which approximately 30 percent was dead at the time of harvest. Forestland in Colorado provided the largest share (42 percent) of the timber harvested in the study area, and facilities in Colorado and South Dakota together processed about 69 percent of the timber harvested in the study area. Colorado had the highest (84 percent) in-state retention of timber; followed by South Dakota, with 78 percent. About 24,895 MBF (43 percent) of the timber harvested in the Wyoming portion of the study area was processed out-of-state, with over 12,100 MBF going to out-of-region facilities (i.e., facilities within the R2-TPA, but not in Colorado, South Dakota, or Wyoming). Out-of-region facilities received 5.6 percent of the total timber volume harvested in the R2 study area, the majority of which was harvested in Wyoming. About 3 percent of all the timber processed in the R2 study area came from out of region with approximately two-thirds (6,271 MBF) coming from various ownerships in Region 4, suggesting limited interdependence between R2 and the other Forest Service regions (McIver et. al. 2017e; Hayes et. al. 2019).

Table 5 — Region Two Study Area Timber Flow by State^a, 2016.

Destination	Origin			Total
	Colorado	South Dakota	Wyoming	
	----- Thousand board feet Scribner -----			
Colorado	100,529		896	101,425
South Dakota		84,745	11,873	96,618
Wyoming	15,160	23,715	32,503	71,377
Out of region	3,928		12,121	16,049
Total*	119,616	108,460	57,393	285,469

^a Does not include timber received from outside of the R2 study area.

* Values may not sum due to rounding.

Capacity, Capability, Consumption and Utilization in the R2-TPA

Capacity and Capability

Annual capacity to process timber within the R2-TPA in 2016 was 1,346,430 CCF, or approximately 579,185 MBF Scribner (figure 3). Colorado had the largest share (35 percent - on a cubic foot basis) of the overall capacity (table 6), with South Dakota and Wyoming each having around 20 percent. Approximately 27 percent of R2-TPA timber-processing capacity resided in a few larger sawmills in Idaho, Montana, and New Mexico – outside of Region 2. The quantity of timber from the R2 study area flowing to these more distant facilities can be highly variable from year-to-year and are strongly influenced by national lumber markets, availability of timber from lands near those mills, as well as transportation costs (e.g., diesel fuel prices). The majority (205,580 CCF) of capability to process trees < 10" dbh was also concentrated in Colorado, while larger tree (≥10" dbh) capability was more evenly distributed among the states within and outside the region. Seventy-five (75) percent of the out-of-region capacity was concentrated in the ≥ 10" dbh size class, which reflects the greater economic value of larger-diameter logs and their ability to be transported longer distances to mills.

Table 6 — R2-TPA Annual Timber-processing Capacity and Size Class Capability by State, 2016.

State	<i>Total capacity and capability by size class MCF^a</i>				<i>Total capacity and capability by size class MBF^b</i>			
	Total	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh
Colorado	46,531	9,273	11,285	25,973	176,780	19,320	39,985	117,475
South Dakota	26,197	500	7,956	17,741	109,654	1,000	26,497	82,157
Wyoming	25,371	638	1,611	23,122	115,065	1,742	6,607	106,717
Out of region ^c	36,543	259	9,199	27,084	177,685	399	43,149	134,137
Total*	134,642	10,669	30,052	93,921	579,185	22,461	116,238	440,485

^a MCF = One thousand cubic feet.

^b MBF = One thousand board feet Scribner.

^c Out of region states: Idaho, Montana, New Mexico.

* Values may not sum due to rounding.

Region 2 National Forests Timber Processing Area - Mill Capacity -

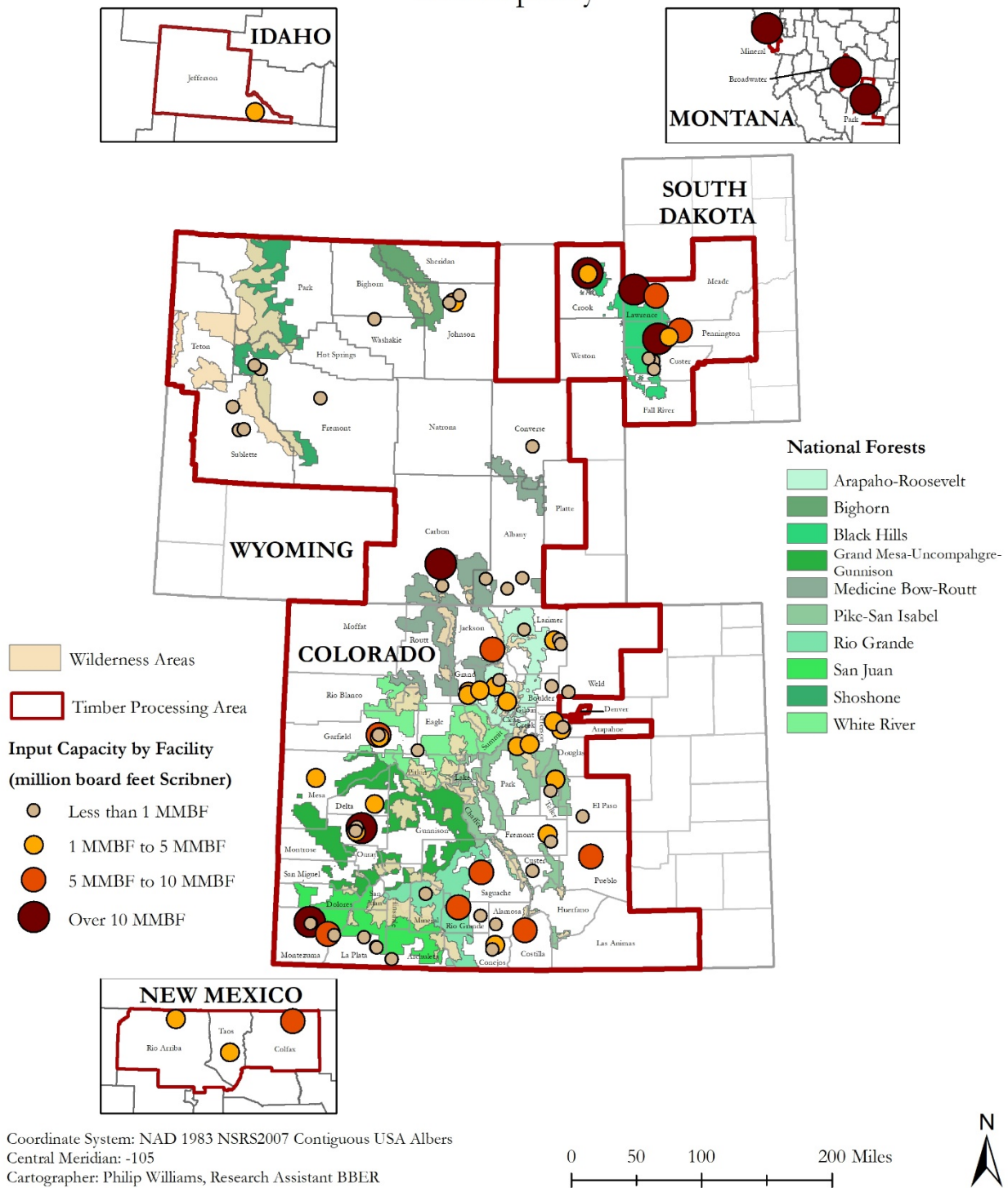


Figure 3 – Region Two Timber-processing Area (R2-TPA), 2016.

Sawlogs (i.e., logs sawn into lumber) accounted for 80 percent of total (cubic) capacity to process timber by product type (table 7). Almost 82 percent of sawlog capability was in the $\geq 10''$ dbh class. Post, pole and log furniture products together with firewood and energy products represented the vast majority (88 percent on a cubic basis) of the capability to process trees <7 inches dbh. There was no capability to process houselogs <7 inches dbh, which limits opportunities to market small lodgepole pine to other mill types, although there is more than 25,270 CCF of larger (dbh ≥ 10 inches) houselog capability. Several facilities in the R2-TPA produced firewood from log ends or took in smaller logs to produce firewood as an ancillary product, contributing substantially to total capacity in firewood products.

Table 7 — R2-TPA Annual Timber-processing Capacity and Size Class Capability by Timber Product, 2016.

Timber product	Total capacity and capability by size class MCF ^a				Total capacity and capability by size class MBF ^b			
	Total	$<7''$ dbh	7-9.9" dbh	$\geq 10''$ dbh	Total	$<7''$ dbh	7-9.9" dbh	$\geq 10''$ dbh
Sawlogs	108,133	702	18,946	88,485	516,541	3,320	91,189	422,032
Post, pole & furniture logs	12,195	4,716	6,753	726	17,937	5,844	11,331	762
Firewood/energy logs	6,805	4,692	1,388	724	16,969	11,730	3,455	1,785
Houselogs	3,560	—	1,033	2,527	16,306	—	4,743	11,563
Other product logs ^c	3,949	560	1,932	1,458	11,432	1,567	5,521	4,344
Grand Total *	134,642	10,669	30,052	93,921	579,185	22,461	116,238	440,485

^a MCF = One thousand cubic feet.

^b MBF = One thousand board feet Scribner.

^c Other products include pellets, shavings, excelsior, vigas, mulch and playground chips.

* Values may not sum due to rounding.

Timber Consumption

Almost 66 percent (on a cubic foot basis) of the total timber consumed in the R2-TPA was from trees ≥ 10 inches dbh, and the largest share of timber consumed in each state was in that size class (table 8). Wyoming had the greatest proportional (93 percent) consumption of trees ≥ 10 inches dbh although consumption volume (144,910 CCF) was the smallest. Consumption of smaller trees varied considerably among the states. For trees 7 to 9.9 inches dbh, consumption was around 30 percent overall and similar for Colorado and South Dakota; while in Wyoming, this size class represented just 6 percent of consumption. Out-of-region facilities had a slightly higher proportional consumption of trees in the 7 to 9.9 inch class (37 percent) and the smallest use (1,850 CCF) of trees <7 inches dbh. The economic feasibility of using smaller trees diminishes considerably as hauling distances increase because the products

(e.g., firewood, posts) that are made from small material are generally lower-value, and hauling costs are higher per unit volume with small logs. Colorado had the highest volume (50,860 CCF) and proportion (17 percent) of timber consumption in the <7 inches dbh class likely due to timber availability, shorter hauling distances, and more diverse timber products than the other R2 states (McIver et al. 2017e; Hayes et al. 2019).

Table 8 — R2-TPA Annual Timber Consumption by Size Class and State, 2016.

State	<i>Consumption by size class MCF^a</i>				<i>Consumption by size class MBF^b</i>			
	Total	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh
Colorado	29,466	5,086	8,551	15,829	105,511	9,175	25,990	70,346
South Dakota	23,485	475	7,345	15,665	97,598	950	24,111	72,538
Wyoming	15,621	271	859	14,491	71,420	653	3,796	66,971
Out of region ^c	24,775	185	9,137	15,453	120,204	285	43,675	76,244
Total MCF *	93,348	6,017	25,892	61,439	394,733	11,063	97,571	286,099

^a MCF = One thousand cubic feet.

^b MBF = One thousand board feet Scribner.

^c Out of region states: Idaho, Montana, New Mexico.

* Values may not sum due to rounding.

Sawlogs played a major role in the R2-TPA; they accounted for 80 percent of the timber consumed in the R2-TPA, and 78 percent of sawlog consumption was in the ≥ 10 inches dbh class (table 9). Sawlogs also accounted for 94 percent of the volume processed in the ≥ 10 inch dbh class. Post, pole, log furniture and firewood accounted for slightly less than 16 percent of the total timber volume processed in the R2-TPA. The majority of the timber used for these products was in the <10 inches dbh classes and combined accounted for nearly 43 percent of the volume consumed in these size classes. Nearly 87 percent of the timber used for houselog production came from trees ≥10 inches dbh.

Table 9 — R2-TPA Annual Timber Consumption by Size Class and Timber Product, 2016.

Timber product	Consumption by size class MCF ^a				Consumption by size class MBF ^b			
	Total	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh
Sawlogs	74,541	657	15,902	57,982	355,309	3,146	76,828	275,335
Post, pole & furniture logs	10,935	4,266	6,055	615	15,879	5,103	10,141	635
Firewood/energy logs	3,765	838	2,446	481	9,332	2,095	6,086	1,151
Houselogs	1,415	—	187	1,228	6,484	—	852	5,632
Other product logs ^c	2,692	256	1,302	1,134	7,729	718	3,665	3,347
Grand Total *	93,348	6,017	25,892	61,439	394,733	11,063	97,571	286,099

^a MCF = One thousand cubic feet.^b MBF = One thousand board feet Scribner.^c Other products include pellets, shavings, excelsior, vigas, mulch and playground chips.

* Values may not sum due to rounding.

Utilization

Total capacity utilization in the R2-TPA was 69 percent, and South Dakota had the highest (90 percent) proportional utilization (table 10). About 37 percent of capacity was not utilized in both Colorado (170,658 CCFF unused) and Wyoming (97,497 CCF unused), indicating substantially more timber could be used by timber processors, particularly sawmills, in those parts of the Region. Capacity utilization at out-of-region facilities was 69 percent and in line with the associated state-level utilization levels reported by BBER (Hayes and Morgan, 2017; Hayes et al 2019; Simmons and Morgan, 2017). Again, it is important to note that the capacity and consumption data for out-of-region facilities included all the timber received by the facilities, and R2 timber was generally a small fraction of the total volume consumed among those facilities.

Table 10 — R2-TPA Timber-processing Capacity, Consumption, and Utilization by State, 2016.

State	Capacity MCF ^a	Consumption MCF ^a	Percent utilized	Capacity MBF ^b	Consumption MBF ^b	Percent utilized
Colorado	46,531	29,466	63	176,780	105,511	60
South Dakota	26,197	23,485	90	109,654	97,598	89
Wyoming	25,371	15,621	62	115,065	71,420	62
Out of region ^c	36,543	24,775	68	177,685	120,204	68
Total*	134,642	93,348	69	579,185	394,733	68

^a MCF = One thousand cubic feet.^b MBF = One thousand board feet Scribner.^c Out of region states: Idaho, Montana, New Mexico.

* Values may not sum due to rounding.

About 109,351 CCF (90 percent) of post, pole, and log furniture timber-processing capacity in the R2-TPA was utilized, whereas only 69 percent (745,409 CCF) of sawlog capacity was utilized (table 11). Sawlog processing capacity is currently high enough for mills to accommodate an additional 335,923 CCF (161,232 MBF) of timber annually, mostly for trees \geq 10 inches dbh. Houselog capacity (35,602 CCF), consumption (14,151 CCF) and capacity utilization (40 percent) were the lowest among the timber products in the R2-TPA. Currently, markets for house logs are constrained by the log home industry's recovery from the housing crisis caused by the Great Recession (Simmons and Morgan, 2017). Additionally, the need to use timber \geq 10 inches dbh to produce houselogs create an additional challenge to that portion of the industry.

Table 11 — R2-TPA Timber-processing Capacity, Consumption, and Utilization by Timber Product, 2016.

Timber product	Capacity MCF ^a	Consumption MCF ^a	Percent utilized	Capacity MBF ^b	Consumption MBF ^b	Percent utilized
Sawlogs	108,133	74,541	69	516,541	355,309	69
Post, pole & furniture logs	12,195	10,935	90	17,937	15,879	89
Firewood/energy logs	6,805	3,765	55	16,969	9,332	55
Houselogs	3,560	1,415	40	16,306	6,484	40
Other product logs ^c	3,949	2,692	68	11,432	7,729	68
Total *	134,642	93,348	69	579,185	394,733	68

^a MCF = One thousand cubic feet.

^b MBF = One thousand board feet Scribner.

^c Other products include pellets, shavings, excelsior, vigas, mulch and playground chips.

* Values may not sum due to rounding.

Discussion

This discussion section focuses on the facilities operating in Colorado, South Dakota, and Wyoming – the study area states. Out-of-region timber processors have been excluded to focus on more local timber use and capacity. Also, a closer look at timber size capabilities will be discussed. Overall capacity utilization within the study area states (70 percent) is very similar to the entire R2-TPA (69 percent), although total capacity (980,996 CCF) and consumption (685,724 CCF) are lower. Total unutilized timber-processing capacity in the three study area states combined is 295,272 CCF almost evenly split between \geq 10 inches and $<$ 10

inches dbh.

Overall capacity utilization (90 percent) and utilization within each size class are highest in South Dakota (table 12). Notably, utilization of trees <7 inches dbh is 95 percent, indicating very limited opportunity to immediately increase the use of small-diameter material without structural changes in South Dakota's timber-using industry. Colorado and Wyoming have lower overall utilization, and Colorado, in particular has about 41,865 CCF of unused capability for trees <7 inches dbh, and about 27,345 CCF of unused capability to use trees 7-9.9 inches dbh. Because of the fire and subsequent closure of Western Excelsior (Durango Herald, 2017) unused capability in these size classes can be expected to be diminished.

Table 12 — Timber-processing Capacity, Capability, Consumption, and Utilization by Size Class and State within Region Two (R2), 2016.

R2 State	Capability by size class MCF ^a				Consumption by size class MCF ^a				Percent utilized by size class			
	Total capacity	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh
Colorado	46,531	9,273	11,285	25,973	29,466	5,086	8,551	15,829	63	55	76	61
South Dakota	26,197	500	7,956	17,741	23,485	475	7,345	15,665	90	95	92	88
Wyoming	25,371	638	1,611	23,122	15,621	271	859	14,491	62	42	53	63
Grand Total	98,100	10,410	20,853	66,837	68,572	5,832	16,755	45,985	70	56	80	69

^a MCF = One thousand cubic feet.

* Values may not sum due to rounding.

By timber product, sawlogs are still the largest component of capacity (735,096 CCF), consumption (507,019 CCF), and unused/available capacity (228,077 CCF). Sawlog capacity utilization of 69 percent (table 13) for Region Two was similar to Idaho (68 percent) and slightly more than in Montana (62 percent), based on recent studies (Hayes and Morgan 2017; Simmons and Morgan 2017). Most sawmill operators reported that capability to process trees in the 7-9.9 inch dbh class was weighted to trees ≥ 9 inches dbh. They also stipulated that trees in this size class needed to be completely sound in the butt log to make them economically viable to process, reinforcing the notion that not only is tree size an important consideration when evaluating timber sale feasibility, but log quality should be considered as well (Fahey et al. 1986; Loeffler et. al. 2018).

Taken together, post, pole, log furniture, firewood, and fuelwood account for about 18 percent of total capacity and 40,527 CCF of available (unused) capacity in the study area. About 30 percent of the facilities producing posts, poles, or log furniture make these

products ancillary to their main product – often lumber. For many of these facilities, stated capacities were nearly equal to consumption, causing unusual utilization rates in the smallest size classes. Firewood/energy products had a similar dynamic, with 8 of 11 facilities producing firewood as an ancillary product. A substantial proportion of the “overutilization” of capability in the 7-9.9 inch dbh class can be attributed to *sawmills* that produced firewood (as an ancillary product). Since post, pole and firewood production is generally less capital intensive than lumber-production, capacity in these small-timber using sectors could increase within a short period of time. However, these ancillary products are generally not high value, high volume, or the major components of the study area’s industry. Caution should be taken, so as not to over-rely on these sectors to handle large volumes of smaller-diameter material.

Table 13 — Timber-processing Capacity, Capability, Consumption, and Utilization by Size Class and Timber Product within Region Two (R2), 2016.

Timber product	Capability by size class MCF ^a				Consumption by size class MCF ^a				Percent utilized by size class			
	Total capacity	<7" dbh	7-9.9" dbh	≥10" dbh	Total	<7" dbh	7-9" dbh	≥10" dbh	Total	<7" dbh	7-9.9" dbh	≥10" dbh
Sawlogs	73,510	702	11,256	61,551	50,702	657	7,251	42,794	69	94	64	70
Post, pole & furniture logs	11,330	4,456	6,147	726	10,318	4,080	5,623	615	91	92	91	85
Firewood/energy logs	6,805	4,692	1,388	724	3,765	838	2,446	481	55	18	176	66
Houselogs	2,720	—	193	2,527	1,206	—	145	1,061	44	—	75	42
Other product logs ^b	3,735	560	1,867	1,308	2,582	256	1,291	1,035	69	46	69	79
Total *	98,100	10,410	20,853	66,837	68,572	5,832	16,755	45,985	70	56	80	69

^a MCF = One thousand cubic feet.

^b Other products include pellets, shavings, excelsior, vigas, mulch and playground chips.

* Values may not sum due to rounding.

The majority of Region 2 mills’ unused capability to process trees < 7 inches dbh (table 14) is in Jackson and Larimer counties in Colorado (32,265 CCF). This same area shows the highest volume processed in excess of capability for trees 7 – 9.9 inches dbh, which suggests some facilities processed trees larger than they would prefer. Facilities in Grand County Colorado report processing more volume in both size classes for trees < 10 inches dbh than what is considered economically optimal. In South Dakota Custer and Pennington counties have the highest proportion (64 percent) of unused capability for trees < 10 inches dbh (4,120 CCF). Unused capacity in Albany, Carbon, Converse counties Wyoming for trees < 10 is nearly 5,700 CCF, about 51 percent of all the capacity for trees this size in the state.

Table 14 – Unused capability to process trees by state and county group within Region Two.

State & County Group	County Name	Unused capability < 7 inches dbh	Unused capability 7- 9.9 inches dbh	Unused capability ≥ 10 inches dbh
COLORADO		<i>CCF (hundred cubic feet)</i>		
Group A	Jackson, Larimer	32,265	(9,819) *	4,007
Group B	Grand	(1,088)	(388)	1,565
Group C	Eagle, Garfield	1,977	2,332	22,620
Group D	Arapahoe, Boulder, Denver, Jefferson	4,680	7,192	6,496
Group E	Delta, Mesa, Montrose	1,331	14,718	16,392
Group F	Custer, El Paso, Fremont, Park, Pueblo, Teller	167	4,644	11,600
Group G	Archuleta, La Plata, Mineral, Montezuma	1,822	5,688	13,243
Group H	Alamosa, Conejos, Costilla, Rio Grande, Saguache	710	2,979	25,524
SOUTH DAKOTA				
Group I	Custer, Pennington	249	3,871	10,658
Group J	Lawrence, Meade	0	2,238	10,102
WYOMING				
Group K	Albany, Carbon, Converse	531	5,162	67,192
Group L	Fremont, Sublette	1,220	789	943
Group M	Crook, Johnson, Washakie	1,917	1,568	18,174
Grand Total		45,783	40,973	208,516

* Values in parentheses are volumes of trees processed in excess of size-class capability.

Conclusions

As land managers in Region Two continue to implement fuels reduction and ecosystem restoration treatments, an understanding of the current industry composition, capacity and constraints associated with processing trees of various sizes will be essential. Approximately 412,948 CCF of unused timber-processing capacity is available in the R2-TPA. However, only about 88,122 CCF of unused capability to process timber < 10 inches dbh exists in the R2-TPA. Already, some facilities have reported using greater volumes of small-diameter timber than they felt they were capable of efficiently and economically processing. This is likely a reflection of the fact the national forests comprise the majority of timberland and are offering substantial quantities of small trees in efforts to reduce wildfire hazard and mitigate the impacts of

widespread tree mortality.

Throughout the R2-TPA and study area, sawmills have the largest capacity to process timber and, with the exception of South Dakota, have approximately 30 to 40 percent of that capacity unused. Virtually all of the 335,923 CCF of unused sawlog timber-processing capacity is in the in the > 7 inches dbh classes, with 305,039 CCF available in the ≥ 10 inches dbh class. Most facilities, but sawmills in particular, prefer and often process trees that are larger than the smallest tree sizes they are capable of processing due to higher recovery rates (i.e., more output per unit of input) and greater profitability (Stewart et al. 2004). Increasing small-tree timber-processing capabilities for sawmills is capital intensive, requiring investments typically in the millions of dollars and, without secure timber supplies, can be quite risky.

The R2-TPA has 77,023 CCF of unused timber-processing capacity for products other than sawlogs. Capability to process trees < 10 inches dbh tends to be concentrated in products other than sawlogs or in smaller sawmills which make other ancillary products (e.g., firewood, posts, or pellets). Some of the operators of these facilities we spoke with, particularly in Colorado, voiced concerns that many projects being proposed and offered for sale were simply too large and therefore not feasible for them to bid on. They were not critical of the Forest Service personnel they work with but were frustrated with a process perceived to encourage planning larger projects in order to get the most accomplished for the planning dollars spent. In short, when planning forest management activities that involve removing trees from the landscape, land managers should balance their need to remove small and/or dead trees with the local industry's ability to profitably use that material. Offering larger quantities of small and/or dead trees than the industry can profitably use will lead to unsold sales and fewer acres being treated. It seems imperative that regional and forest-level planners engage with their local industry stakeholders to understand where there is under-utilized capacity and room for industry expansion to meet National Forest management needs.

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