

Forest sector investment in the United States - trends and implications of capital investment and annual expenditure

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ABSTRACT

Investment is essential to ensure that forests are properly restored, protected, and managed to meet the various needs of society, including a wide range of public and private organizations. This article offers an overview of capital investment and annual expenditures related to forests in the United States, encompassing both the public and private sectors. In 2020, the total capital investment and annual expenditure were \$242 billion (in 2020 dollars). Our findings indicate that private investment is surpassing public investment. However, there were differences in the types of investments made between the private and public sectors and differences in investment and annual expenditure levels can be observed in different geographical contexts. We also elaborated on potential sustainability impacts and identified knowledge gaps that present opportunities for future research.

INTRODUCTION

Consistent investments in forest restoration, protection, and management, as well as forest-related industries and ecosystem services are considered crucial for maintaining and enhancing the benefits provided by forests. Inadequate funding for forest protection, management, and utilization can result in the deterioration or loss of these benefits (Montreal Process Liaison Office 2015). Measuring the level of investment and expenditure in forests, forestry, and forest product markets also helps identify the level of relative importance and development of these sectors within the overall economy, and evaluation of temporal or spatial trends can help identify strengths, challenges, and past or emerging issues (Frey et al. 2022; Skog et al. 2010).

The Montreal Process is an international agreement under which signatory countries with temperate and boreal forests have agreed to track information on various aspects of forests and forestry in order better to assess whether they are sustainable (Montreal Process Liaison Office 2015). This manuscript focuses on capital investment and yearly spending in forest management, as well as the industries reliant on wood and non-wood forest products, ecosystem services, recreation, and tourism in the United States (U.S., a Montreal Process signatory).

The aim of the research is to summarize the value of capital investment and annual expenditure in the forest sector that is allocated to producing, maintaining, and acquiring goods and services from forests. Where possible, we tracked these values over time and by region within the U.S. Our research does not encompass in detail many important aspects related to forest sector that are interlinked and reported under Criterion 6 (Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies, including forest research, education and extension activities (See e.g., McGinley et al. 2019), and 7 (Legal, institutional and economic framework for forest conservation and sustainable management (See e.g., Buttler 2016). Instead, we will compare the investment trends in public and private sector and elaborate on the interlinkages with roundwood consumption and employment trends. Furthermore, we will briefly discuss our findings concerning private-sector investment from the perspective of strategic industrial management and sustainability.

DATA AND METHODS

We make a distinction between annual expenditures and capital investment to align with commonly used accounting methods. Examples of capital investment that are relevant for forest protection, management and utilization include new plants and equipment rebuilds by industrial firms, new forest infrastructure (such as roads, bridges, and buildings), acquisition of additional forest land, and major investments by public agencies in management and protection (Skog et al. 2010). Annual expenditures typically include periodic costs such as rent, utilities and taxes. In this work, we include forest sector related to program costs, including administration expenses and other costs, under the annual expenditures.

To quantify total annual expenditure in protecting and managing forests that provide multiple ecosystem services, we consider both public and private entities. Public entities, such as federal, provincial/state agencies, and local governments, along with private entities, including forest product industrial firms, concessionaires, forest-based recreation and tourism firms, and other non-governmental organizations, all play a role in forest protection, management, and utilization.

This manuscript replicates, updates, and expands upon previous work by Skog et al. (2010). We gathered existing public data from multiple sources to develop the most complete available picture of the U.S. forest-sector (i.e., forests, forestry, and wood products) capital investments and annual expenditures. We have collected data on annual operating expenses and capital investment costs for various entities involved in forest, forestry and wood products. The data are described in Table 1. We aggregate the data into four overarching topics: public annual expenses, public capital investment, private annual expenses, and private capital investment. All time-series are inflation-adjusted year 2020 values using the GDP deflator (World Bank 2023). We report values as they are and refrain from applying, e.g., rolling average annual values that are calculated over a number of years. The investment and expenditure levels are moderately stable and indicative of averages over long term in the forest sector, and as we are recovering from the Covid-19 pandemic, we perceive no need to adjust the variation in the data.

Table 1. Description of data for capital investments and annual operating expenses.

Type of activity/private or public entities	Annual operating expenses	Annual value of capital investments	Geographical and temporal scope
Protecting and managing forests			
USDA Forest Service	Annual operating expenses for the National Forest System, Forest Rangeland research	Capital improvement and maintenance in facilities, roads and trails	Regional, 2006–2022.
State forestry agencies	Annual program costs		All states (with some gaps) for 1998, 2002, 2004, 2012, 2014, 2016, 2018, 2020
Wood product industry Paper product industry, wood furniture industry	Annual costs for payroll and materials	Annual capital investments	Wood and paper product industries: regional. 1997, 2002–2006, 2012–2020. Wood furniture industry: National, 2012–2021
Wood pellet industry		Forisk Consulting (2022) data about commercial scale pellet mill capacity and investment. <i>Data on location and company not reported.</i>	National, announcements in Q3/2022.
Recreation			
**USDA Forest Service		National Forest System appropriations to Recreation, Heritage, and Wilderness	National, 2006 – 2020.
**National Park Service	Expenditures on facility operations and maintenance		National, 2000–2020.
**Concessionaires in national parks	Total revenue obtained by concessionaires, and fees paid to the National Park Service; a portion of fees were used for facilities improvements		National, 2000–2020.
Forest-based environmental services	Not obtained	Some overlap with 6.27	
Non-wood product industries	Not obtained	some overlap with 6.31	

***Due to the inherent challenge of attributing these data points to forest-based recreational activities, thus excluded from the present study. These data are available on request.*

RESULTS

Summary of results

The total capital investment and annual expenditure amounted to a total 242 billion in 2020. The forest sector's public capital investment for the year 2020 (section 3.2) amounted to a total of \$535 million. Additionally, the public annual expenses for the same year amounted to \$7.8 billion (section 3.3).

We found that private capital investment in the forest sector totaled \$13 billion in 2020 (section 3.4). The corresponding private annual expenses for the year amounted to \$220 billion (section 3.5). All investment and expenditure levels have seen an increase since 2012, with the most growth being a 62% increase in private capital investment. For a yearly breakdown, refer to Table 2.

Regarding recreation expenditures, the USDA Forest Service National Forest System allocated \$262 million as annual expenditure on Recreation, Heritage, and Wilderness (Section 3.8).

Table 2. Total private and public capital investment and annual expenditure (million 2020\$)

	Public sector capital investment	Public sector annual expenditure	Private sector capital investment	Private sector annual expenditure	Total
2012	394	5,451	8,229	149,180	163,253
2013	328		8,716	164,004	173,048
2014	331	6,136	11,133	175,606	193,206
2015	355		11,043	183,815	195,214
2016	384	6,930	11,078	188,619	207,011
2017	391		10,920	205,051	216,362
2018	505	7,672	10,415	224,289	242,881
2019	531		13,544	229,272	243,347
2020	535	7,806	13,329	220,749	242,419
<i>2012/2020 % change</i>	<i>36</i>	<i>43</i>	<i>62</i>	<i>48</i>	<i>48</i>

Public sector capital investment

USDA Forest Service—Capital Investment— In 2020, The USDA Forest Service allocated \$535 million capital investment towards managing and protecting forests, up from \$531 million in 2019 and \$505 million in 2018 (2020 dollars). This represents a 70% increase since 2006 (Table 3).

These funds are allocated towards a range of activities, including the development of facilities, roads, and trails, as well as the improvement of infrastructure. Additionally, they support the acquisition and donation of lands, waters, and related interests within the National Forest System, which align with the agency's goals of restoration, outdoor recreation and public access, habitat for wildlife, and protection of water quality.

In 2020, the USDA Forest Service made its largest investments in roads and facilities, which together accounted for approximately 85% of its total investment in Capital Improvement, Maintenance and Land Acquisition. Specifically, the agency allocated \$301 million towards road development and maintenance, and \$154 million towards facilities improvement and construction.

Table 3. U.S. Department of Agriculture Forest Service, Capital Improvement, Maintenance and Land Acquisition 2006-2020 (million 2020\$).

	Facilities	Roads and trails	Land acquisition	Total
2006	91	195	28	314
2007	96	206	29	331
2008	92	215	30	338
2009	94	250	35	379
2010	102	214	47	362
2011	108	246	48	401
2012	112	241	41	394
2013	59	226	43	328
2014	63	231	37	331
2015	65	249	41	355
2016	67	259	58	384
2017	67	272	52	391
2018	148	293	64	505
2019	151	305	75	531
2020	154	301	80	535

Source: USDA Forest Service 2006-2021.

Public sector annual expenditure

In 2020, the USDA Forest Service allocated a total of \$4.96 billion dollars as an annual expenditure towards various programs, with the National Forest System and Wildland Fire Management programs receiving the largest share of funding. Specifically, the National Forest System program received \$2.0 billion dollars, while Wildland Fire Management received \$2.3 billion dollars. State Forestry and Private Forestry received \$347 million dollars, while Forest and Rangeland research received \$305 million dollars (Table 4). Wildland Fire Management program accounted for 47% of the total reported program costs in 2020.

Table 4—U.S. Department of Agriculture, Forest Service annual expenditure program costs by segment, 2008–2021 (million 2020\$).

Year	Forest and Rangeland Research	State and Private Forestry	National Forest System	Wildland Fire Management	Total
2008	202	186	345	2,301	3,035
2009	205	184	342	1,616	2,347
2010	225	222	1,117	1,515	3,079
2011	233	230	1,158	1,571	3,192
2012	230	197	1,209	1,536	3,172
2013	240	205	1,261	1,589	3,294
2014	246	193	1,257	1,816	3,512
2015	258	203	1,302	2,033	3,796
2016	260	212	1,351	2,135	3,958
2017	269	213	1,411	2,642	4,535
2018	292	330	1,890	2,784	5,295
2019	307	345	1,968	2,562	5,182
2020	305	347	1,958	2,351	4,960

Source: USDA Forest Service 2006-2021.

Table 5 shows that in 2020, the total annual expenditures for state forestry agency programs reached nearly \$2.9 billion dollars. The North, South, and Rocky Mountains regions all faced an increase in program expenditures, while the Pacific Coast region showed variability in expenditures from year to year. Specifically, the annual expenditures for the North, South, Pacific Coast, and Rocky Mountains regions were \$468 million, \$531 million, \$497 million, and \$217 million, respectively. Appendix A provides a broader perspective on state-level expenditures for forestry agency programs over time, ranging from \$2 million in Delaware and Rhode Island to \$1.2 billion in California spent on the forest health and wildfire prevention.

Table 5. State forestry program expenditures/costs by region, 1998, 2002, 2004, 2012, 2014, 2016, 2018, 2020 (million 2020\$).

	North	South	Pacific coast	Rocky mountain	Total
1998	156	168	381	62	944
2002	173	238	495	114	1,020
2004	197	259	654	96	1,205
2012	332	457	347	209	2,279
2014	375	427	629	178	2,624
2016	434	517	555	211	2,972
2018	423	513	243	238	2,377
2020	468	531	497	217	2,846

Source: National Association of State Foresters 2022 (years 2012-2020). Years 1998-2004 from Skog et al. 2010.

Private sector capital investment

The total capital investment in the wood product industry was 3.5 billion dollars in 2020, 8.7 billion in the paper product industry, and 0.7 billion dollars in the wood furniture industry. Figure 1 shows the overall trends in the wood products, paper products and wood furniture industries. See Appendix B for specific North American Industry Classification System (NAICS) categories.

Total capital investment in the wood product industry has grown from \$1.4 billion in 1997 to \$3.5 billion in 2020 with some fluctuation over the years. During the global financial crisis, the total capital investments declined by 62% from \$3 billion in 2007 to \$1.1 billion in 2009. After 2009, the total capital investments increased until 2018. Between 2018 and 2020, the total capital investments have declined 11%, from \$4 billion in 2018 to \$3.5 billion in 2020. See Appendix C for more detailed data.

The capital investment in the paper product industry grew by 109% from \$4.2 billion in 1997 to \$8.7 billion in 2020. There has been an upward trend since 2009. During 2018-2020, capital investment in the paper product industry increased from \$5.6 billion to \$8.7 billion, peaking at \$9.0 billion in 2019.

Additionally, the capital investment for wood furniture has consistently increased from \$0.4 billion in 2012 to \$10.6 billion in 2021.

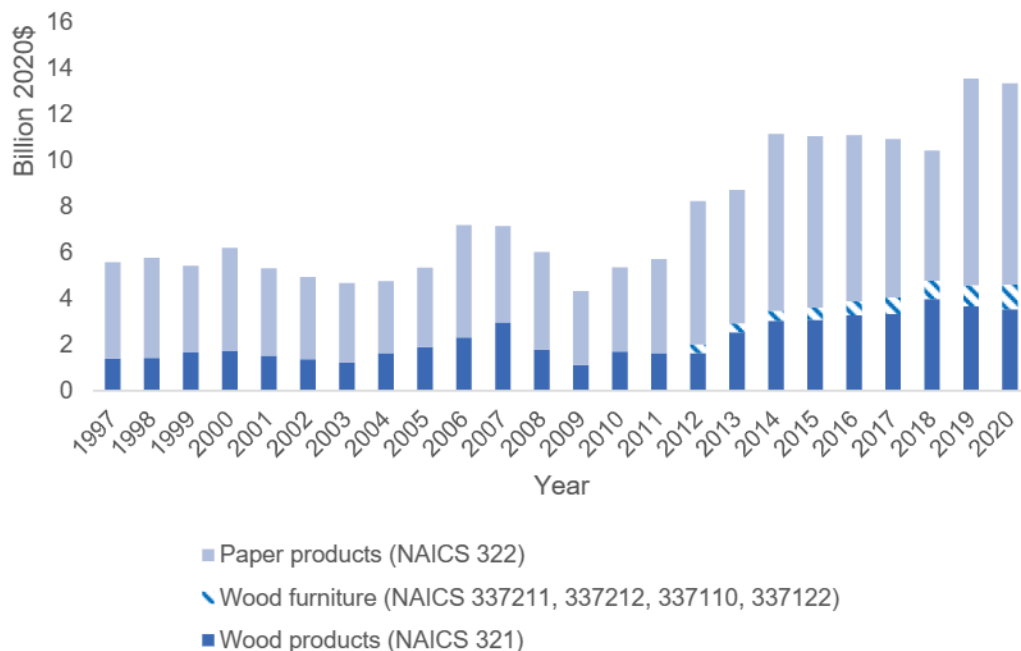


Figure 1. Private sector capital investments in wood products (NAICS 321), paper products (NAICS 322) and wood furniture industries (NAICS 337211, 337212, 337110, 337112) (billion 2020\$). Refer to Appendix C for detail data. Source: Years 1997 - 2006 Skog et al (2010). United States Census Bureau 2023a-d.

Private sector annual expenditures

In 2020, the wood product industry spent \$81 billion on payroll and materials, while the paper industry spent \$120 billion (Figure 2). The wood product industry maintained relatively stable expenditure levels, with slight increases and decreases during 2018 and 2020. In contrast, the paper industry experienced a decline in expenses. Additionally, the combined payroll and material expenditure for various segments of the wood furniture industry amounted to \$16.4 billion dollars in 2020 (Appendix D).

The annual expenditure in the private sector has increased steadily over time. Between 2012 and 2020, the total annual expenditure increased from \$149 billion in 2012 to \$221 billion in 2020, indicating a 48% increase (Figure 2, Appendix E). In the wood product industry the growth was 76% from \$46 billion to \$81 billion, in paper products 32% from \$91 billion to \$120 billion, and in wood furniture 59% from \$12 billion to \$20 billion between 2012 and 2020.

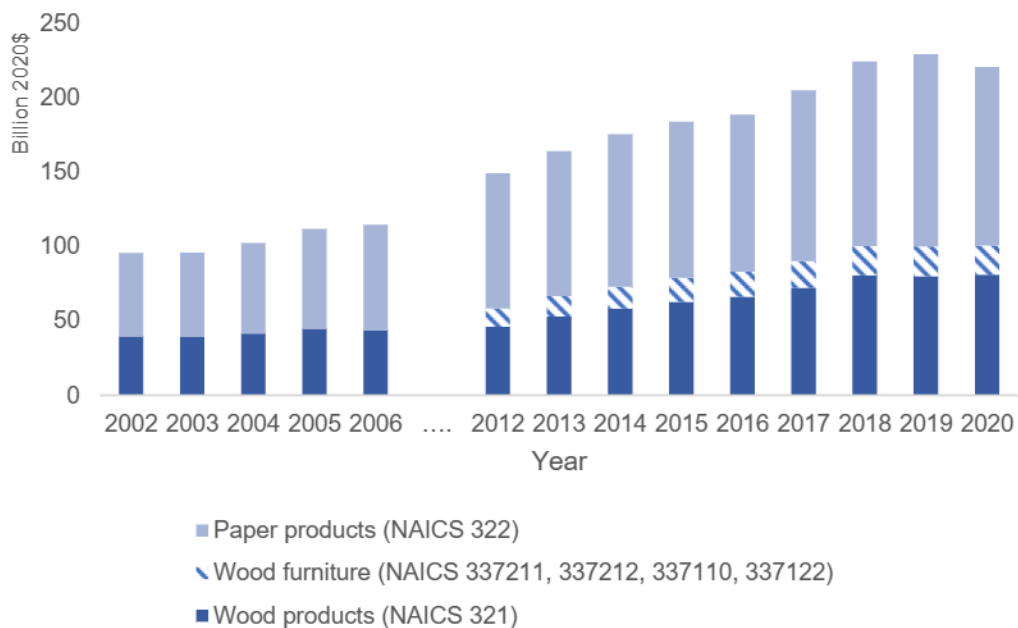


Figure 2. Private sector annual expenditures - payroll and materials expenditure in wood product (NAICS 321), paper product (NAICS 322), and wood furniture (NAICS 337211, 337212, 337110, 337112) industries (billion 2020\$). Refer to Appendix E for detailed data. Source: Skog et al. (2010), United States Census Bureau 2023a-d.

Regional differences in wood and paper product industries' capital investment and annual expenditure

The Southern region claimed the largest share with \$6.7 billion, representing 55% of the total capital investment (Appendix F). The Northern region followed with \$4.1 billion (34%), the Pacific coast with \$1.1 billion (9%), and the Rocky Mountain region with \$0.3 billion (2.2%).

The Southern and Northern regions experienced growth in capital investment since 1997. In the Southern region, investment surged by 148% compared to the \$2.7 billion invested in 1997 (Figure 3). Similarly, the Northern region witnessed 97% growth from its \$2.0 billion investment in 1997. The Pacific coast and the Rocky Mountain regions also experienced considerable growth, with 82% (\$0.6 billion in 1997) and 83% (\$0.1 billion in 1997) increases, respectively.

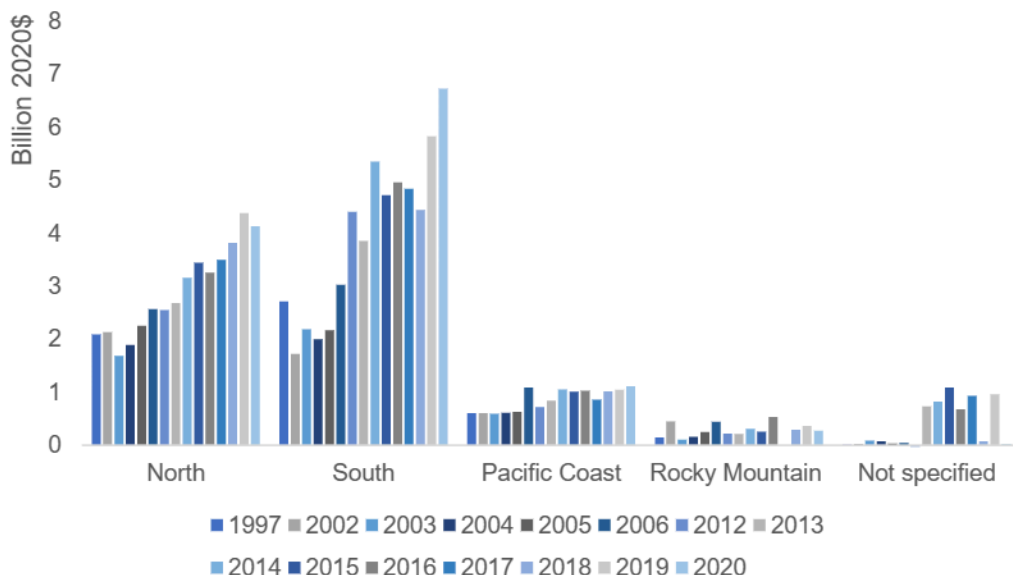


Figure 3. Private Sector Capital investment in wood product (NAICS 321) and paper product industries (NAICS 322) by region (billion 2020\$) 1997-2020. Refer to Appendix F for detailed data. Source: Skog et al. 2010, United States Census Bureau 2023a-d.

In 2020, the North accounted for \$75 billion (39% of the total), South - \$80 billion (40%), Pacific Coast - \$26 billion (13%), and Rocky Mountain - \$8 billion (4%) of the total private sector annual expenditure.

Between 2002 and 2020, the total annual expenditures grew by 110% (Appendix G). During this period, the South experienced the highest growth at 166%, followed by the Pacific Coast at 139%, the North at 85%, and the Rocky Mountains with a decrease of 40% (Figure 4). However, please note that these numbers may be influenced by a relatively large "not specified share," so they should be interpreted with caution.

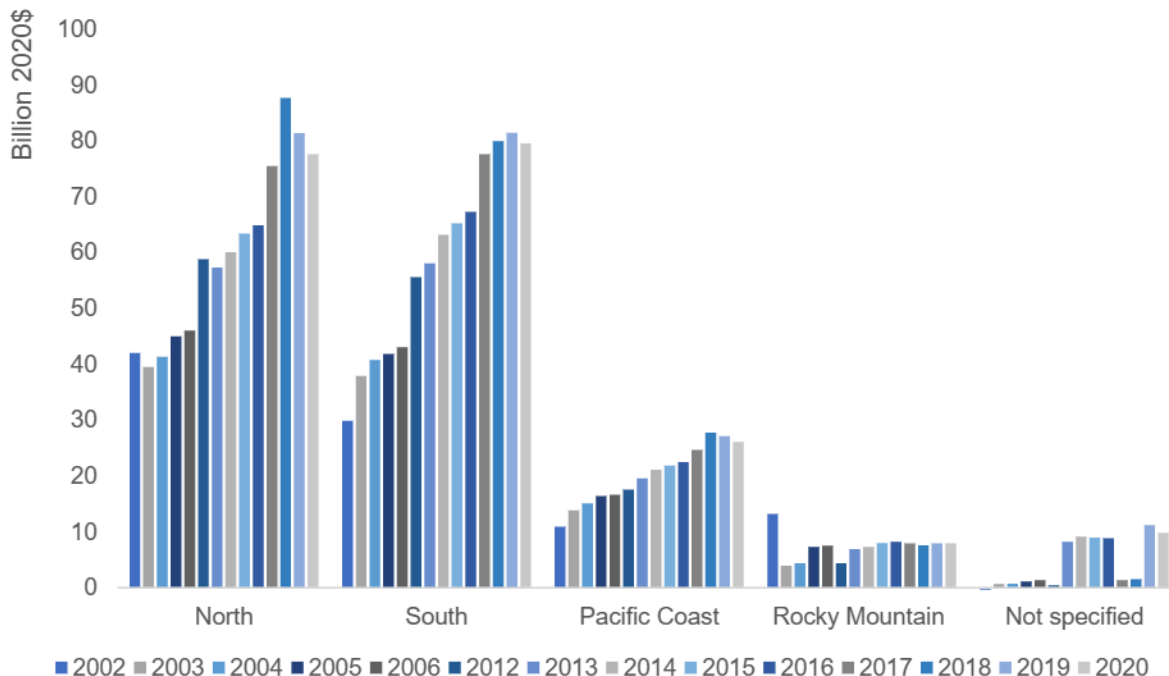


Figure 4. Private Sector Annual Expenditure in wood product (NAICS 321) and paper product industries (NAICS 322) by region 1997-2020(billion 2020\$). Refer to Appendix G for detailed data. Source: Skog et al. 2010, United States Census Bureau 2023a-d.

COVID-19 pandemic impacts on new capital investment

The COVID-19 pandemic affected new capital investments in the wood and paper product industries during 2020. Both sectors experienced declines compared to the preceding year, i.e., 2019. Specifically, the wood product industry saw a 25% decrease, with the capital investment dropping from \$5.2 billion in 2019 to \$3.9 billion in 2020. Similarly, the paper product industry witnessed a 23% decrease, with capital investment falling from \$11 billion in 2019 to \$8.7 billion in 2020 (Figure 5, Appendix H).

In 2021, the wood product industry rebounded with increased new capital investments, amounting to \$6.0 billion. This represented a 16% increase from the pre-pandemic investment levels in 2019. On the other hand, the paper product industry received \$10.2 billion in 2021, which was 10% lower than the investment level in 2019. Between 2019–2020, the total annual expenditure in wood and paper manufacturing experienced a 7% decline (Figure 5).

Despite the challenges posed by the pandemic, the capital investment in the wood furniture sector continued to grow. During the period between 2019 and 2020, capital expenditure in the wood

furniture industry grew by 11.3%, while payroll and materials expenditure increased by 0.8%. Between 2020 and 2021, there was a 13% increase in total capital investment in wood furniture, although detailed data on old and new capital investment and annual expenditure were not available (Figure 1).

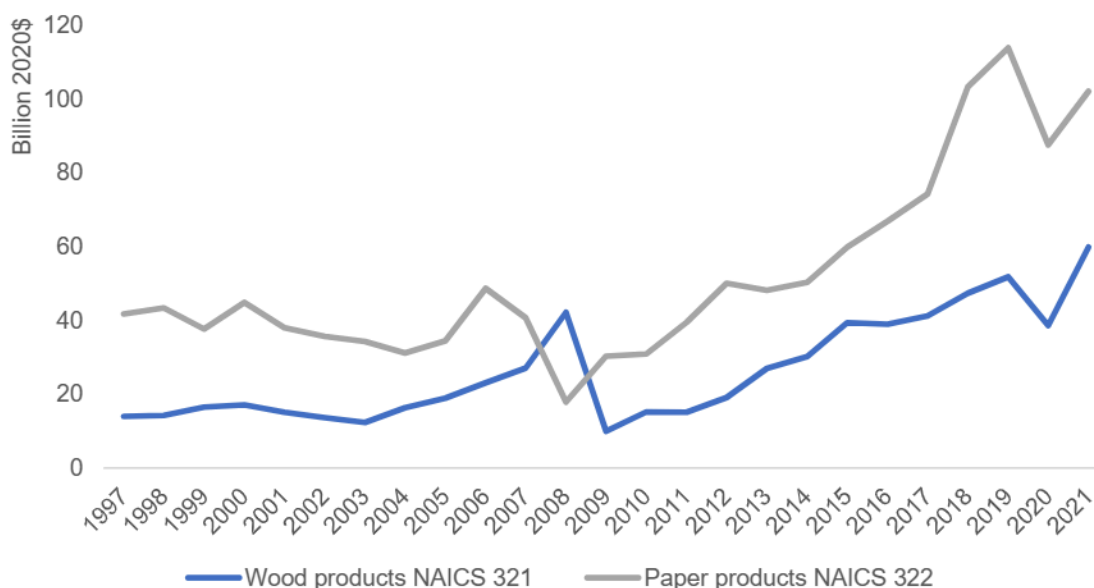


Figure 5. Private Sector New Capital Investment for wood product and paper product industries (NAICS 321 and 322) 1997–2021 (million 2020\$). Refer to Appendix H for detailed data. Source: United States Census Bureau 2023a-d.

Announced new capital investment in wood pellet and lumber industry in 2022

As energy is one of the emerging business areas within the country and internationally, we collected information on the announced new capital investment in wood pellet industry in 2022 based on the data acquired by Forisk Consulting (2022). To complement Forisk Consulting (2022) data on investment capacity, we gathered data pertaining to investment announcements from diverse sources, including media outlets and corporate webpages. Based on these data, we calculated a rough estimation of an average wood demand for every million-dollar investment.

According to data from Forisk Consulting (2022), for the third quarter of that year, there were seven pellet mill announcements within the U.S. (under NAICS 321), which would result in a demand for seven million tons of wood at capacity. We were able to obtain investment announcements for five of these projects, totaling \$760 million dollars based on public data. Figure 6 illustrates the relationship between expected mill investments and wood demand at capacity. On

average, a one million dollar investment in a pellet mill would require annually 8,922 tons of wood (at capacity). However, the impact on total wood demand will depend on other capacity investments and mill closures.

Additionally, as per Forisk Consulting (2022), eight lumber mills are set to be constructed, resulting in a demand of 7,886,000 MMBF¹ (18.3 billion m³) of wood at full capacity. Upon further investigation, we obtained investment announcements for seven of these projects, which were estimated to total \$1.2 billion dollars (as depicted in Figure 7).

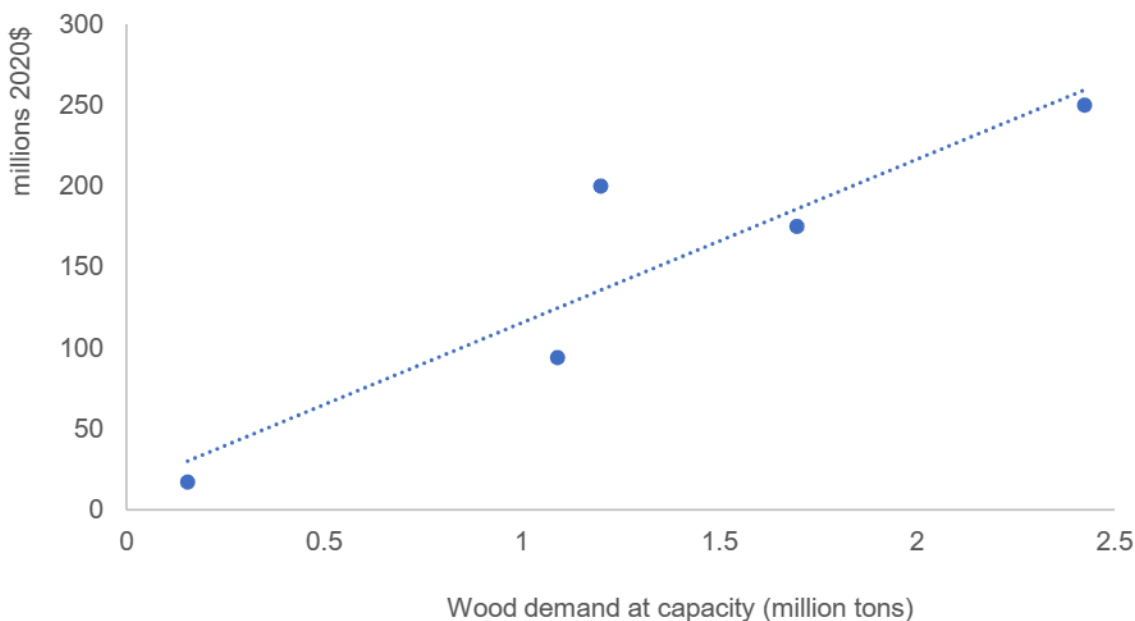


Figure 6. Announced pellet mill investment and wood demand at capacity (Q3/2022). Source Forisk Consulting 2022, public announcements.

¹ MMBF stands for millions of board feet of timber.

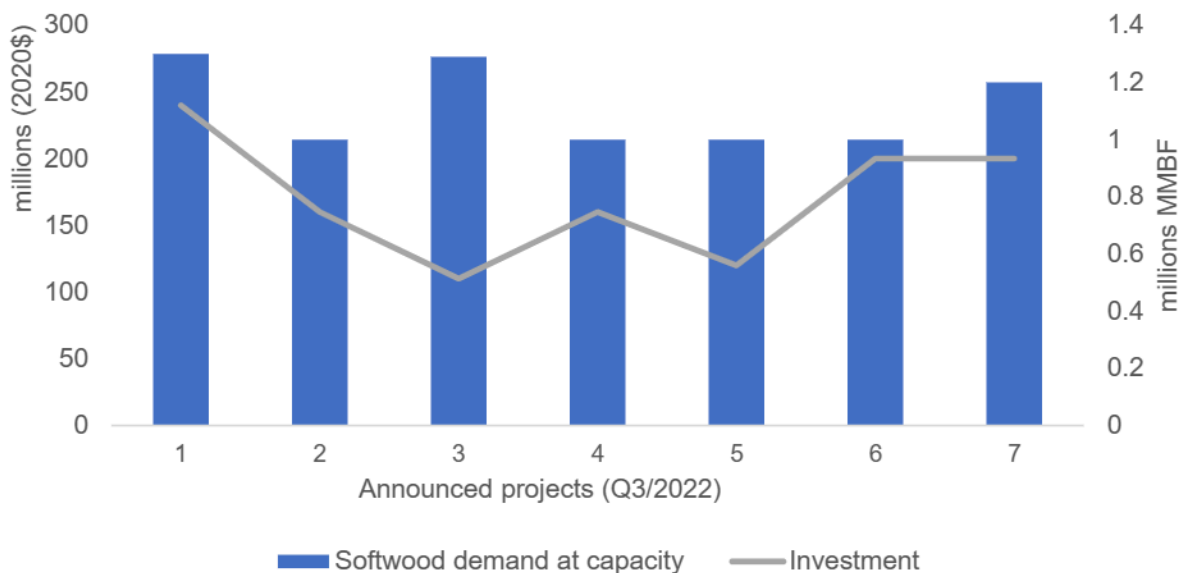


Figure 7. Announced lumber mill investment and wood demand at capacity (Q3/2022). Source Forisk Consulting 2022, public announcements.

DISCUSSION AND CONCLUSIONS

The sustainable benefits of forests, encompassing both wood and non-wood products, recreation, and environmental services, are closely linked to the levels and trends in capital investment and annual operating expenses. These factors also impact the competitiveness of U.S. wood and non-wood product firms relative to foreign firms. Additionally, capital investment levels affect employment rates, wages, and community resilience. This report complements but does not cover capital investment in research, development, education, and extension activities, which are addressed separately as part of the Montreal Process indicator. Additionally, despite the efforts, we were unable to procure comprehensive data for forest-based recreation. Limitations on forest-based recreation data have been previously identified and discussed (e.g., Frey et al. 2021), and information regarding private investments in forest recreation infrastructure in the United States remain missing (Skog et al. 2010). Data were available for the National Forest System appropriations to Recreation, Heritage, and Wilderness by the USDA Forest Service. Data for National Park Service expenditures on facility operations and maintenance as well as

Concessionaires in national parks have been gathered (NPS 2023). These recreation-related data can be made available upon request.

Based on our data and findings, it looks like private investment is outpacing public investment. Both capital investment and annual expenditures in the private sector witnessed a more rapid increase between 2012 and 2020 compared to the public sector. This surge in private investment aligns with simultaneous increases in wood consumption and employment. For instance, during the same period, industrial roundwood consumption rose from 336 million m³ to 363 million m³, reaching a peak of 383 million m³ in 2018 (FAOSTAT 2023). The full-time equivalent workforce in wood and paper product manufacturing increased from 744 thousand to 771 thousand between 2012 and 2020, peaking at 811 thousand in 2019 (USBLS 2023).

There were differences in the types of investments made between the private and public sectors. Capital investment in the private sector outpaced annual expenditure growth, whereas the public sector exhibited the opposite trend. Despite the capital investment numbers lagging in the public sector, the annual expenditure growth in the public sector assimilated the private sector's investment trends. Comparing annual expenditure is particularly meaningful as public sector investments primarily focus on land management for multiple purposes, involving extensive knowledge-based operations and programs. In contrast, private sector investment data tends to emphasize production facilities, as the forest industry heavily relies on capital investments. The private and public sectors have distinct objectives, and unequal investment could jeopardize the long-term production of ecosystem services.

Although specific geographic numbers for federal forest programs were not extracted, trends in state-level programs suggest that similar development patterns exist across different regions. There have been significant increases in public sector programs both nationally and at the state level, with similar trends observed in different regions.

Regarding private sector investment, the North and South regions were approximately at the same level in 2006. However, by 2012, the South region had significantly increased its investments. The South region adopts a more plantation-oriented forest management model and has a high share of private forestry (Oswalt et al. 2019), making it an attractive area for investors. Nevertheless, this growth may exert pressure on forest ecosystem services. In contrast, the Pacific Coast and Rocky Mountain regions have remained relatively stable, with significantly lower private sector

investment levels. The Pacific Coast region is particularly prone to wildfires, and increasing fire treatment may necessitate additional investment in production facilities and innovation capacities in the future.

The growing demand for forest and other biobased products is transforming the investment landscape, potentially accounting for the uptick in investments in the forest sector. In the United States, there has been a rapid surge in sustainable investing in recent decades (Hale 2021), and the trajectory of the forest sector hinges on its alignment and involvement in this form of investment. Within the ubiquitous sphere of sustainable investing, the Environmental, Social, and Governance (ESG) criteria stands out as one of the most contemporary approaches (Townsend 2020). ESG criteria are applied to minimize material risks associated with environmental, social, and governance issues. In the forest sector, substantial changes in tangible assets, such as production facilities, machinery upgrades, and greenfield investments, necessitate substantial capital investment in the multimillion-dollar range. Consequently, investors' perception of material risks within the sector may impact future capital availability.

Considerable uncertainty pervades the landscape of forest investment, encompassing variations in perceptions of risk versus opportunities and preferences for public versus private governance and investment (Begemann et al. 2023). Investments in the U.S. forest sector are influenced by both domestic and international markets and policies. However, a comprehensive examination of regional future strategic orientations and their intersections and divergences is uncommon in this context (Cubbage et al. 2022).

Forest sector benefits from preparing for multitude future scenarios (Zhang et al. 2023, Duden et al. 2023, West et al. 2021), that are closely tied to the risk and reward profiles of investments. The unexpectedly high demand and disruptions in supply chains during the COVID-19 pandemic created an excessive demand for lumber, leading to a surge in prices in late 2020 and Early 2021 (Riddle 2021). As Bruck et al. (under review) have reported, although the COVID-19 pandemic posed challenges for landowners, loggers, and wood mill workers, the concurrent surge in lumber prices potentially improved the industry's investment capacity. This can be observed in new capital investment data (Figure 5). After a decline in 2020, the investment began to recover in 2021. Overall, private sector capital investments have trended upwards since 2012 (Figure 1), with particularly significant increases in the U.S. South (Figure 3).

The difference in public and private investment amount and growth rates may appear larger than they are. Public restoration and ecosystem management programs, such as Bipartisan Infrastructure Law (2021), have a substantial impact on forests, and these activities are carried out through various public organization, including the Bureau of Land Management, and Bureau of Fish and Wildlife, which fall out of scope of this report. For example, private forest landowners in the U.S. can receive direct payments for ecosystem services payments through markets, subsidies, and hybrid approaches, from both governmental and non-governmental sources (Frey et al. 2021). Nevertheless, we opted not to estimate the share of such forest-related investment of public organizations, as well as investment in environmental services due to inadequate precision under current capital investment and annual expenditure classification systems. Frey et al. (2021) provide estimates on the revenues from ecosystem service, which serves complementary information to ours. The increased orientation to restoration and conservation, coupled with the incorporation of the value of carbon (Mei 2023) and biodiversity (Panwar et al. 2021), may translate into renewed forest sector business models in the future that will continue to blur the traditional organizational and sectoral boundaries (Hurmekoski et al. 2018). Globally, increasing investor attention is being geared toward non-wood forest products and ecosystem services such as carbon payments, conservation easements, hunting licenses or other non-wood forest products (Chudy and Cabbage 2020), which may further shape the outlook of the forestry sector in the long-term.

In the section on announced new capital investment in wood pellet and lumber industry in 2022, we combined data from media outlets and company reports for investment amounts and wood use at capacity of announced investments in energy and lumber sector based on data by Forisk Consulting (2022). Consequently, the wood use at the capacity cannot be interpreted as an additional wood demand, and the broader evaluation of the industrial wood demand is beyond the scope of this study. These encompass an interplay of factors, encompassing structural realignments within the industry itself and the nuanced dynamics of market forces, including the introduction of novel product categories (Hurmekoski et al. 2018). While we are unable to break down the data geographically due to privacy agreements, prior research has emphasized the significant role of the U.S. South in the energy sector, as this region supplies a substantial quantity of pellets worldwide (Visser et al. 2022). Diverse perceptions regarding the sustainability of wood use especially for energy purposes persist, and potential regulatory changes related to wood sustainability classifications and carbon policies in importing regions may impact the outlook of

the U.S. forest sector. However, given the multiple ongoing crises affecting the energy markets globally, major shifts are unlikely to occur soon, and bioenergy is likely to remain a sector with investment potential.

Similar to Skog et al. (2010), data are not available for certain entities responsible for forest protection and management, including family forest owners, local governments, NGOs, and some corporate landowners such as conservation organizations, Timber Investment Management Organizations (TIMOs), and Real Estate Investment Trusts (REITs). Moreover, information on businesses dealing with non-wood products or forest-related recreation remain unavailable. Additionally, accurate data on entities providing "environmental services from forests" are lacking, as we currently do not have sufficient information at the organizational level regarding capital investment and annual expenditure. Such data may be limited in scope, covering specific regions, and time periods. Similarly, there are not sufficient data on the non-wood forest product industry.

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DISCLAIMERS

The findings and conclusions in this publication are those of the authors and should not be construed to represent any official USDA or U.S. Government determination or policy.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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APPENDIX A. STATE FORESTRY ANNUAL EXPENDITURES 1998, 2002, 2004, 2012, 2014, 2016, 2018, 2020 (MILLION 2020\$).

	1998	2002	2004	2012	2014	2016	2018	2020
Alabama	11	17	14	13	17	7	7	8
Alaska		7	19	31	55	85	49	25

Arizona	1	2		6	6	12	11	
Arkansas	6	11		13	16	22	18	23
California	194	336	477	638	712	1,025	962	1,167
Colorado	9	14	19	28	10	14	12	16
Connecticut	1	1	2	2	2	3	3	3
Delaware	1	1	1	1	2	2	2	2
District of Columbia	1	3	4	0	0	0	13	13
Florida	24	47	51	64	75	102	105	111
Georgia	18	25	20	33	37	55	60	55
Hawaii	1	9		7	9	13	5	23
Idaho	9	41	13	22	46	52	55	59
Illinois	3	4		3	4	4	6	8
Indiana	4	4	9	10	12	10	9	11
Iowa	1	2	3	0	5	5	4	5
Kansas	1	1	1	1	2	2	3	4
Kentucky	5	8	11	12	13	16	15	20
Louisiana	6	10	13	10	10	15	13	3
Maine	5	11		10	11	17	11	13
Maryland	3	6	5	6	9	11	10	12
Massachusetts	2	2	2	10	12	11	10	12
Michigan	20	22	22	36	30	43	39	50
Minnesota	19	28	29	39	51	68	69	79
Mississippi	13	21	17	18	24	36	33	26
Missouri	6	3	2	7	12	12	16	20
Montana	5	10	8	25	27	39	77	42
Nebraska	2	2	3	2	5	5	4	6
Nevada	2		4	13	20	23	28	26
New Hampshire		5	18	4	5	6	5	7
New Jersey	3			10	10	13	9	13
New Mexico	2	18	20	14	11	16	12	22
New York	8	9	12	14	18	22	20	26
North Carolina	22	26	37	34	46	57	47	60
North Dakota	1	2	3	4	5	6	5	6
Ohio	5	7		9	10	16	10	16
Oklahoma	5	9	8	10	14	15	11	16
Oregon	84	66	73	143	275	262	146	207
Pennsylvania	18			47	62	87	89	84
Rhode Island	1	2	2	1	1	2	1	2
South Carolina	10	13	12	13	23	28	22	35
South Dakota	1	1	3	5	4	3	1	2
Tennessee	8	14	15	15	21	25	20	29
Texas	5	4	25	102	51	79	93	111
Utah	16	8	9	21	23	25	26	37
Vermont	2	3	3	3	5	6	6	12
Virginia	10	12	15	17	22	29	23	35
Washington	35	37	57	157	288	214	59	291
West Virginia	2	4		2	5	3	2	3
Wisconsin	12	16	25	32	47	49	36	58
Wyoming	5	2	8	35	10	15	12	16

Source: Years 1998, 2002, 2004 from Skog et al. (2010) (Skog et al. (2010) values were divided by 1000 due an apparent mistake in reporting). Years 2012, 2014, 2016, 2018, 2020 are obtained

from Association of State Foresters 2023. Empty cells indicate a lack of data for a particular category or time period.

APPENDIX B: NAICS CODES UNDER 321 – WOOD PRODUCT MANUFACTURING AND 322 – PAPER MANUFACTURING

Codes	Titles	US Business Entities
321	Wood Product Manufacturing	31,379
3211	Sawmills and Wood Preservation	3,102
321113	Sawmills	2,472
321114	Wood Preservation	630
3212	Veneer, Plywood, and Engineered Wood Product Manufacturing	1,629
321211	Hardwood Veneer and Plywood Manufacturing	298
321212	Softwood Veneer and Plywood Manufacturing	82
321213	Engineered Wood Member (except Truss) Manufacturing	62
321214	Truss Manufacturing	871
321219	Reconstituted Wood Product Manufacturing	316
3219	Other Wood Product Manufacturing	26,648
321911	Wood Window and Door Manufacturing	1,243
321912	Cut Stock, Resawing Lumber, and Planning	1,242
321918	Other Millwork (including Flooring)	14,547
321920	Wood Container and Pallet Manufacturing	3,439
321991	Manufactured Home (Mobile Home) Manufacturing	515
321992	Prefabricated Wood Building Manufacturing	1,116
321999	All Other Miscellaneous Wood Product Manufacturing	4,546
322	Paper Manufacturing	9,149
3221	Pulp, Paper, and Paperboard Mills	3,069
322110	Pulp Mills	352
322121	Paper (except Newsprint) Mills	2,019
322122	Newsprint Mills	31
322130	Paperboard Mills	667
3222	Converted Paper Product Manufacturing	6,080
322211	Corrugated and Solid Fiber Box Manufacturing	1,829
322212	Folding Paperboard Box Manufacturing	154
322219	Other Paperboard Container Manufacturing	652
322220	Paper Bag and Coated and Treated Paper Manufacturing	1,463
322230	Stationery Product Manufacturing	429
322291	Sanitary Paper Product Manufacturing	423
322299	All Other Converted Paper Product Manufacturing	1,130

Source: NAICS Association webpage, 2023

APPENDIX C— CAPITAL INVESTMENT IN PRIVATE SECTOR*Wood product industry (NAICS 321) by region 1997–2020 (million 2020\$).*

	North	South	Pacific Coast	Rocky Mountain	Not specified	Total
1997	392	670	271	61	1	1,395
1998						1,422
1999						1,655
2000						1,709
2001						1,516
2002	526	302	173	369		1,363
2003	434	525	207	61	3	1,230
2004	554	712	267	94	6	1,633
2005	622	832	326	105	9	1,893
2006	707	978	464	159	7	2,314
2007						2,964
2008						1,788
2009						1,114
2010						1,699
2011						1,630
2012	568	808	228	89	-60	1,633
2013	724	996	380	116	309	2,526
2014	725	1,232	449	182	441	3,029
2015	657	1,341	467	125	489	3,080
2016	877	1,392	470	378	148	3,266
2017	917	1,614	488	69	237	3,325
2018	1,240	1,913	557	123	143	3,975
2019	1,299	1,675	438	141	97	3,651
2020	1,204	1,581	543	132	72	3,532

Paper product industry (NAICS 322) by region 1997–2020 (million 2020\$).

	North	South	Pacific coast	Rocky mountain	Not specified	Total
1997	1,702	2,042	338	89	7	4,179
1998						4,342
1999						3,769
2000						4,491
2001						3,799
2002	1,609	1,422	432	83	27	3,573
2003	1,256	1,665	386	42	83	3,432
2004	1,337	1,292	344	68	71	3,113
2005	1,636	1,337	303	144	26	3,446

Table continues

2006	1,861	2,052	628	288	39	4,867
2007						4,170
2008						4,222
2009						3,214
2010						3,649
2011						4,082
2012	1,982	3,596	491	132	24	6,225
2013	1,960	2,858	460	95	426	5,799
2014	2,433	4,119	605	128	382	7,667
2015	2,786	3,379	547	128	598	7,439
2016	2,382	3,571	562	153	534	7,201
2017	2,584	3,225	375		697	6,881
2018	2,351	2,529	459	167	138	5,644
2019	2,969	4,155	611	225	1,009	8,969
2020	2,822	5,146	568	141	56	8,733

Wood furniture 2012-2021 (million 2020\$).

	Wood office furniture manufacturing (NAICS 337211)	Custom architectural woodwork and millwork manufacturing (337212)	Wood kitchen cabinet and countertop manufacturing (NAICS 337110)	Nonupholstered wood household furniture manufacturing (NAICS 337122)	Total (NAICS 337211, 337212, 337110, 337122)
2012	40	105	160	66	371
2013	46	118	179	48	391
2014	41	117	201	77	436
2015	59	117	233	116	525
2016	58	259	217	77	611
2017	43	210	384	77	714
2018	45	247	428	76	796
2019	55	254	527	89	925
2020	86	315	557	105	1,063
2021	98	312	627	119	1,156

Source: Years 1997 - 2006 Skog et al (2010). United States Census Bureau Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries (2013-2016, 2018-2020), Years 2012 and 2017 from Economic Census statistics. Annual Survey of Manufactures: annual Survey of Manufactures: Geographic Area Statistics: Statistics for All Manufacturing by State 2013-2016. Empty cells indicate a lack of data for a particular category or time period.

APPENDIX D— PRIVATE SECTOR ANNUAL EXPENDITURE: PAYROLL AND MATERIALS EXPENDITURE

Wood product industry (NAICS 321) by region 2002-2020 (million 2020\$).

	North	South	Pacific Coast	Rocky Mountains	Not specified	Total
2002	15,436	8,388	4,551	11,380	-235	39,520
2003	13,052	15,841	7,664	2,354	185	39,095
2004	13,560	16,530	8,556	2,748	189	41,582
2005	14,364	18,136	8,905	3,196	197	44,798
2006	13,869	17,810	8,617	3,249	177	43,722
2007						
2008						
2009						
2010						
2011						
2012	15,927	19,112	8,241	2,232	443	45,955
2013	15,802	21,046	9,731	3,678	2,602	52,860
2014	16,908	23,383	10,744	3,740	3,507	58,282
2015	18,523	25,539	11,071	4,361	3,245	62,740
2016	19,937	27,154	11,437	4,602	3,192	66,322
2017	24,366	30,801	12,929	3,722	438	72,256
2018	28,423	32,111	15,018	4,322	682	80,556
2019	28,303	31,973	14,469	4,245	1,044	80,035
2020	28,029	33,297	14,367	4,472	902	81,067

Paper product industry (NAICS 322) by region 2002-2020 (million 2020\$).

	North	South	Pacific Coast	Rocky Mountains	Not specified	Total
2002	26,627	21,520	6,364	1,861	-260	56,111
2003	26,465	22,107	6,188	1,583	482	56,825
2004	27,797	24,241	6,573	1,672	535	60,818
2005	30,653	23,732	7,541	4,128	946	66,999
2006	32,213	25,250	8,033	4,295	1,167	70,958
2007						
2008						
2009						
2010						
2011						
2012	42,930	36,528	9,324	2,177	-19	90,940
2013	41,534	37,047	9,858	3,263	5,632	97,335
2014	43,193	39,804	10,407	3,582	5,661	102,647
2015	44,899	39,713	10,804	3,666	5,739	104,822
2016	45,003	40,178	11,095	3,629	5,655	105,559
2017	51,155	46,826	11,770	4,229	950	114,931
2018	57,440	47,849	12,749	3,315	2,709	124,062
2019	51,165	49,512	12,708	3,719	12,165	129,270
2020	47,649	46,302	11,754	3,507	10,915	120,127

Table continues

	Wood office furniture manufacturing (NAICS 337211)	Custom architectural woodwork and millwork manufacturing (337212)	Wood kitchen cabinet and countertop manufacturing (NAICS 337110)	Nonupholstered wood household furniture manufacturing (337122)	Total
2012	1,181	3,248	5,519	2,338	12,286
2013	1,226	3,576	6,578	2,430	13,810
2014	1,239	3,835	7,155	2,449	14,678
2015	1,376	4,245	8,086	2,546	16,253
2016	1,375	4,443	8,388	2,532	16,738
2017	1,350	5,222	8,795	2,497	17,864
2018	1,577	5,945	9,588	2,560	19,670
2019	1,677	6,126	9,695	2,470	19,968
2020	2,058	5,601	9,776	2,121	19,556
2021	2,036	6,482	11,865	2,526	22,909

Source: Years 2002–2006 Skog et al. (2010), United States Census Bureau. Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries in the U.S.: 2018 - 2020, Annual Survey of Manufactures: annual Survey of Manufactures: Geographic Area Statistics: Statistics for All Manufacturing by State 2013–2016. 2012 and 2017 from Economic Census statistics. Empty cells indicate a lack of data for a particular category or time period.

APPENDIX E. PRIVATE SECTOR TOTAL ANNUAL EXPENITURE: PAYROLL AND MATERIALS EXPENDITURE IN WOOD PRODUCT (NAICS 321), PAPER PRODUCT (NAICS 322), AND WOOD FURNITURE (NAICS 337211, 337110, 337122) INDUSTRIES (MILLION 2020\$).

Year	Wood products (NAICS 321)	Paper products (NAICS 322)	Wood furniture (NAICS 337110, 337122)	Total
2002	39,520	56,111		95,631
2003	39,095	56,825		95,920
2004	41,582	60,818		102,400
2005	44,798	66,999		111,797
2006	43,722	70,958		114,680
....				
2012	45,955	90,940	12,285	149,180
2013	52,860	97,335	13,809	164,004
2014	58,282	102,647	14,677	175,606
2015	62,740	104,822	16,253	183,815
2016	66,322	105,559	16,738	188,618
2017	72,256	114,931	17,864	205,051
2018	80,556	124,062	19,670	224,289
2019	80,035	129,270	19,967	229,272
2020	81,067	120,127	19,556	220,749

APPENDIX F— PRIVATE SECTOR TOTAL CAPITAL INVESTMENT: WOOD PRODUCT (NAICS 321) AND PAPER PRODUCT INDUSTRIES (NAICS 322) BY REGION 1997–2020 (MILLION 2020\$).

Year	North	South	Pacific Coast	Rocky Mountain	Not specified	Total NAICS 321 and 322
1997	2,094	2,713	609	149	8	5,574
1998						5,765
1999						5,424
2000						6,200
2001						5,315
2002	2,135	1,725	604	452	27	4,935
2003	1,690	2,190	593	103	86	4,663
2004	1,892	2,003	611	162	77	4,746
2005	2,258	2,169	629	249	35	5,339
2006	2,568	3,030	1,091	446	46	7,180
2007						7,135
2008						6,010
2009						4,328
2010						5,348
2011						5,712
2012	2,550	4,404	719	221	-36	7,858
2013	2,684	3,854	840	211	735	8,325
2014	3,158	5,352	1,054	310	823	10,697
2015	3,443	4,721	1,014	254	1,088	10,518
2016	3,259	4,963	1,032	532	681	10,467
2017	3,501	4,839	863		934	10,206
2018	3,820	4,442	1,015	293	78	9,619
2019	4,382	5,830	1,049	363	960	12,619
2020	4,134	6,727	1,111	273	20	12,266

Source: Skog et al. 2010, United States Census Bureau. Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries in the U.S.: 2018 - 2020, Annual Survey of Manufactures: annual Survey of Manufactures: Geographic Area Statistics: Statistics for All Manufacturing by State 2013-2016. 2012 and 2017 from Economic Census statistics. Empty cells indicate a lack of data for a particular category or time period.

APPENDIX G—PRIVATE SECTOR TOTAL ANNUAL EXPENDITURE: PAYROLL AND MATERIALS EXPENDITURE IN WOOD PRODUCT (NAISCS 321) AND PAPER PRODUCT INDUSTRIES (NAICS 322) BY REGION 2020–2021 (MILLION 2020\$) IN TOTAL.

Year	North	South	Pacific Coast	Rocky Mountain	Not specified	Total
2002	42,063	29,907	10,915	13,241	-495	95,631
2003	39,517	37,949	13,851	3,937	667	95,920
2004	41,358	40,770	15,128	4,419	724	102,400
2005	45,017	41,868	16,446	7,324	1,143	111,797
2006	46,082	43,060	16,649	7,544	1,344	114,680
2007						
2008						
2009						
2010						
2011						
2012	58,857	55,640	17,565	4,409	424	136,895
2013	57,336	58,093	19,589	6,942	8,234	150,195
2014	60,101	63,187	21,150	7,322	9,168	160,929
2015	63,423	65,252	21,876	8,027	8,984	167,562
2016	64,939	67,332	22,532	8,230	8,847	171,881
2017	75,521	77,627	24,699	7,951	1,388	187,187
2018	85,864	79,960	27,767	7,637	3,391	204,618
2019	79,468	81,485	27,178	7,964	13,210	209,305
2020	75,677	79,599	26,122	7,979	11,816	201,194

Source: Years 2002–2006 Skog et al. 2010, United States Census Bureau. Annual Survey of Manufactures: Summary Statistics for Industry Groups and Industries in the U.S.: 2018–2020, Annual Survey of Manufactures: annual Survey of Manufactures: Geographic Area Statistics: Statistics for All Manufacturing by State 2013–2016. 2012 and 2017 from Economic Census statistics. Empty cells indicate a lack of data for a particular category or time period.

APPENDIX H—NEW CAPITAL INVESTMENT FOR WOOD PRODUCT AND PAPER PRODUCT INDUSTRIES (NAICS 321 and 322) 1997–2021 (MILLION \$2020).

	Wood products NAICS 321	Paper products NAICS 322
1997	1,395	4,179
1998	1,422	4,342
1999	1,655	3,769
2000	1,709	4,491
2001	1,516	3,799
2002	1,363	3,573
2003	1,230	3,432
2004	1,633	3,113
2005	1,893	3,446
2006	2,314	4,867
2007	2,707	4,072
2008	4,222	1,788
2009	996	3,032
2010	1,523	3,095
2011	1,515	3,953
2012	1,914	5,007
2013	2,700	4,814
2014	3,020	5,037
2015	3,943	5,992
2016	3,899	6,696
2017	4,125	7,426
2018	4,739	10,333
2019	5,178	11,392
2020	3,861	8,770
2021	5,988	10,216

Source: United States Census Bureau. Annual Capital Expenditure Survey (ACES) (1996–2021). See Skog et al. 2010 for past data.