

Demand and Forest Productivity in the US South

An Update Report

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PREPARED FOR:

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Executive Summary

In 2017, on behalf of Drax Group, Plc, the National Alliance of Forest Owners, and the US Endowment for Forestry & Communities, Inc., ResourceWise (formerly Forest2Market) published a study entitled *Historical Perspective on the Relationship between Demand and Forest Productivity in the US South*.¹ The study was an in-depth analysis of demand for forest products and the change in the US South's forest landscape², namely tree inventories between 1953 and 2017.

The original report shed light on several key findings. Historical analysis revealed a strong correlation between demand, forest productivity, and inventory. Over the past 75 years, rapid inventory growth aligned with consistent increases in forest products demand through the mid-2000's.

The statistical analysis clearly linked removals and growth, removals and inventory, and removals and acres, suggesting that these factors positively influence changes in forest inventories.

The report concluded that since the 1950s, the South's forests have shown remarkable adaptability to fluctuating demand without experiencing declines in acres and inventory. Forest owners, who are mainly private individuals, families, corporations, and investors, have demonstrated their ability not only to use and maintain the forests but also to replenish and expand them.

Recently, the US Industrial Pellet Association asked ResourceWise for an update of key metrics contained within the original report, using forest products' production data from the Food and Agriculture Organization of the United Nations (FAO) and the most recent forest inventory survey data from the United States Forest Service (USFS), an agency of the U.S. Department of Agriculture.

The principal source of timber inventory information in the United States is the Forest Inventory and Analysis (FIA) database managed by the USFS. The USFS is a Federal agency within the US Department of Agriculture that manages 193 million acres of public lands in national forests and grasslands. It provides technical and financial assistance to state and tribal governments in developing natural resource management and protection plans, primarily for forested areas. The data used is the same as that used for US accounting under the Paris Agreement.

The USFS is mandated to conduct periodic assessments of timber inventories across the US. The latest assessment for most states in the US South occurred in 2022. The purpose of this study is

¹https://www.forest2market.com/hubfs/2016_Website/Documents/20170726_Forest2Market_Historical_Perspective_US_South.pdf

² The US South region in this report includes forestland within the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas and Virginia

to provide additional production and forest inventory metrics from the original report's end year of 2017 to the "recent" survey period, which is generally the period between 2017 and 2022.

This report unveils several critical key findings and underlines the adaptability of Southern forests to demand fluctuations and forest owners' successful efforts to nurture and expand these forests.

Overall, today's forest inventory is the greatest it has been for the last 70 years (Figure 1). Updated data identified a surge in industrial pellet production, triggered by the pivot towards renewable energy. However, since its foundation, the US pellet export industry has had less than 0.1% of impact on the proportion of wood removed compared to inventory. Additionally, the rate of harvested wood per inventory has declined, notably during the period when pellet mills entered the US South market. And while the COVID-19 pandemic had a negative impact on the economy, forest inventory grew regardless, as indicated by the inventory increase from 342 to 353 billion cubic feet.

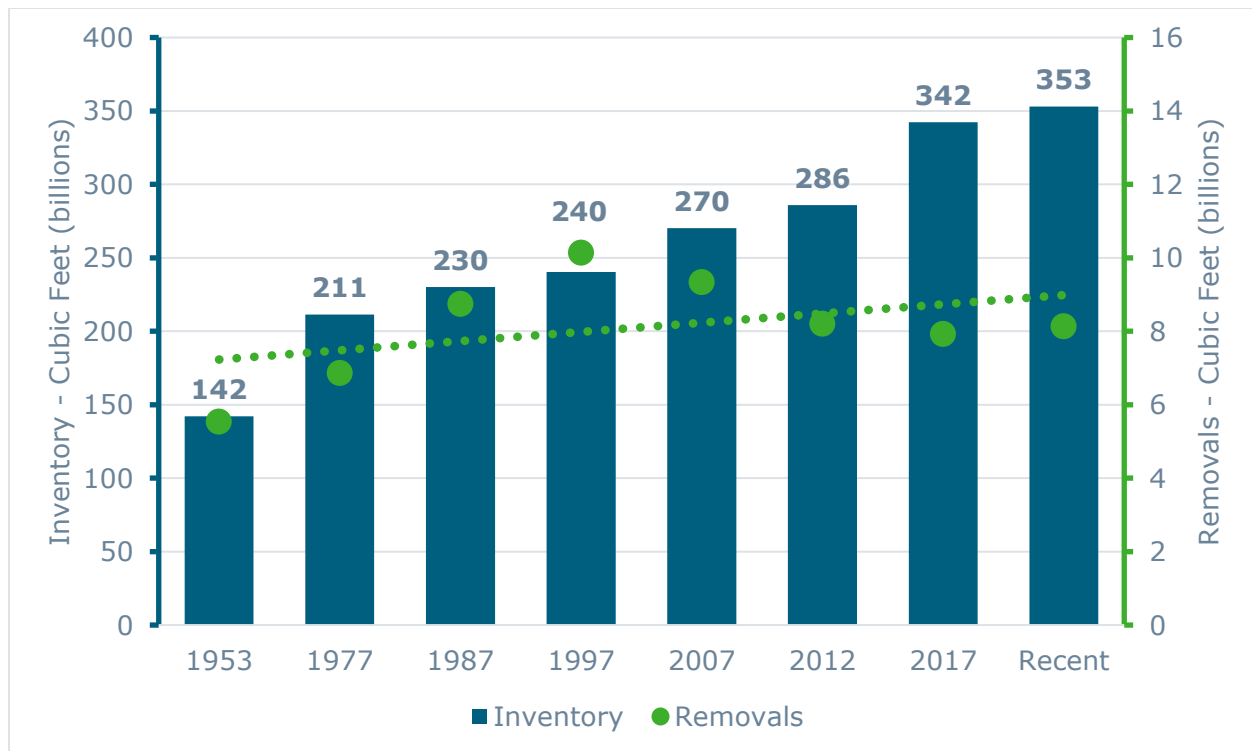


Figure 1 – Trend in US South Forest Inventory and Harvest Removals

As stated earlier, this report underscores the relevance of sustainable forest management and the robustness of Southern forests in accommodating the demand for forest products. The most

recent assessment period continued to reflect the uninterrupted 70-year trend of forests in the US South increasing in every assessment period.

Forest Dynamics in the US South

Forest Ownership

The US South is one of the most productive wood baskets in the world, producing 22% of global industrial roundwood, with China and Russia as the next most productive wood baskets. This productivity is directly linked to the ownership structure in the region and numerous factors that contribute to the productivity of the forestry industry including:

- Various forest owners and their respective management practices.
- Resources generated in the forest throughout its life cycle.
- The products generated as residuals in solid wood production facilities.

Forestland is designated as land with at least 10% stocking of trees of any size (or formerly having such cover that is not currently developed for other, non-forest uses) and covers one third of the US's land base³. Timberland is a subset of forestland that produces or can produce over 20 cubic feet of industrial roundwood per acre per year. Across the United States, two thirds of forestland⁴ or 22% of the total land cover is classified as timberland.

Productive timberland can further be distinguished by the type of regeneration that occurs after a final harvest: planting versus natural regeneration. Planted stands are forest stands where seedlings are planted after a final harvest. In the US South, planted stands are commonly composed of southern yellow pine species. Natural stands are stands where new trees are grown from seeds or sprouts of trees remaining after a final harvest.

Forestland in the US South is owned by several different entities. The first group is government landowners who have varying management practices aligned with its citizens' beliefs and requirements at the federal, state, and local levels. In the US South, government landowners do not contribute significant volumes of industrial roundwood (less than 5%). Across the US South, 15% percent of forestland is publicly owned with 6% as national forest, 4% as other federal lands, and 5% under state and municipality ownership (Figure 2).

³ "State of Forests and Forestry in the United States | US Forest Service." n.d. US Forest Service. <https://www.fs.usda.gov/speeches/state-forests-and-forestry-united-states-1>.

⁴ U.S. Forest Ownership and Management. December 2021. Congressional Research Service. <https://crsreports.congress.gov/product/pdf/IF/IF12001>.

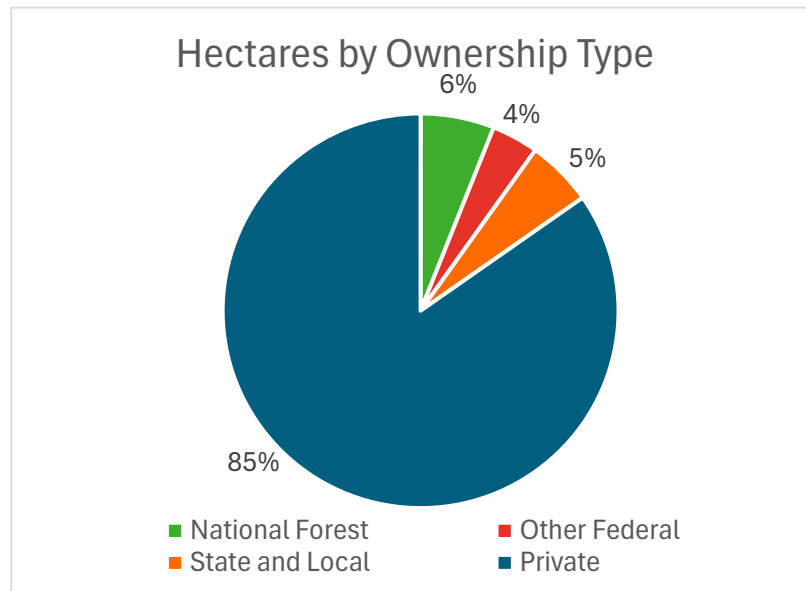


Figure 2 – Hectares by Ownership Type

Most of the forestland in this region, 85%, is privately owned by forest industry organizations, corporate entities, and individual/family properties.

US South forestland owned by the forest industry has decreased since the 1990s and is a smaller component when compared to other types of private landownership today. Most corporate ownership includes real estate investment trusts (REITs) and timberland investment management organizations (TIMOs). These two groups manage timberland resources as their primary business to maximize economic value (asset value, cash flow, and internal rate of return) for their investors. REITs are publicly traded entities that own the timberland they are managing while TIMOs manage timberland on behalf of private investors. This group of forest owners tend to manage their timberland in plantations, where active silvicultural management is sustainably practiced for the production and yield of timber products.

The last type of private owners are non-industrial private forest (NIPF) landowners who may, but likely do not own their timberland as their primary business.

General Management Practices in the US South

Private landowners may have two approaches to their forest management. One is simply to allow trees to naturally regenerate, grow and reach mortality – some landowners may have a portion of this approach but may decide to harvest their timber at some point. The other approach is active management for financial or biological productivity.

Productive timberlands can require significant investment with a lengthy management time horizon. They require active management to monitor the health of the stand and increase the timber yield with the goal of recouping investment through financial return and healthy forests.

Related to understanding management practices, a distinction needs to be made between thinning and final harvests. The purpose of thinning is to remove smaller, unfavorable trees to reduce resource competition for the remaining trees to improve their growing conditions. A thinning focuses growth on the more favorable trees and improves forest health in regard to resistance to disease, pests, and fires. Thinnings also generate biodiversity and intermediate financial return. A final harvest occurs when trees in a stand have reached biological maturity and valued financial worth. Generally, these are ready to be transformed into higher value products such as lumber, plywood and utility poles.

The product generated mostly in thinnings, and a product generated in all types of harvests, is pulpwood. It is important to note that pulpwood is an industry term referring to the size or quality of the tree. All roundwood that is not suitable for sawtimber (see product definition below) can be considered pulpwood. The material has many different end uses. It only “becomes” pulpwood when actually consumed by pulping manufacturers. It can more accurately be considered biomass when consumed by bioenergy or biofuel facilities. There are multiple types of trees that can be classified as pulpwood based on size and the presence of defects that make them unsuitable for higher value uses. Tops of larger trees, or topwood, is often collected as pulpwood as well.

Final harvests generally produce both pulpwood and sawtimber. Later thinnings may also generate a mix of pulpwood and smaller diameter sawtimber that is commonly referred to as chip’n’saw logs.

All harvests, both thinnings and final harvests, produce a residual product called slash. Slash, or inwoods biomass, is a byproduct created from the remnants of trees harvested and include the tops, limbs, and leaves that may or may not be collected and chipped in the forest. Markets that do not have a bioenergy producer (purchaser of slash material) generally will result in slash being left in the forest for decomposition or may be burned.

Forest Products and Consumers

Sawtimber, pulpwood, and slash have distinct consumers and markets. Sawtimber and poles are forest products that require the greatest time investment and thus sell for higher prices (Figure 3). Pine poles, generally have the highest average stumpage price (price paid for the live tree “on the stump” in the forest) and are a specific grade of log that is highly valued for its length, strength, and straightness for use as utility poles. Between 2010 and 2022 pine poles have averaged \$45.49 per green short ton (ton).

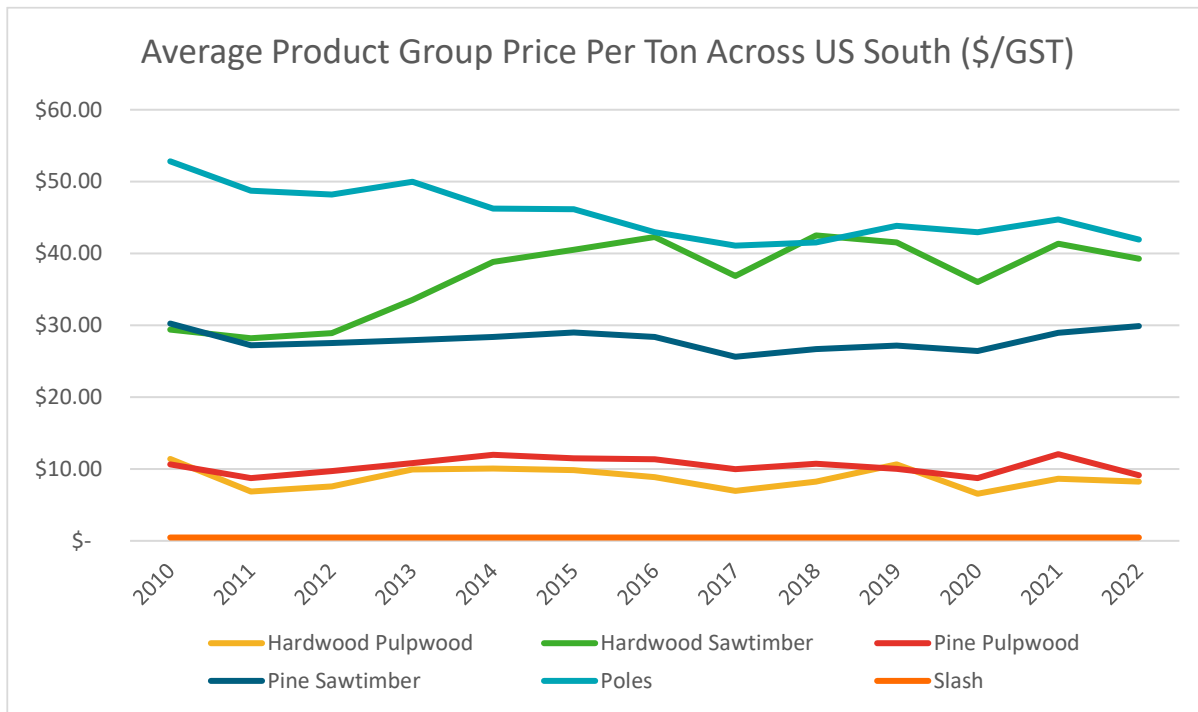


Figure 3 – Average Product Group Price Across US South

Hardwood sawtimber, valued for its strength and beauty (i.e., grade of log), is often used for dimensional lumber, flooring, and veneer. Between 2010 and 2022, stumpage prices for hardwood sawtimber have averaged \$36.87 per ton. Pine sawtimber, used primarily for construction purposes (e.g., dimensional lumber, engineered lumber, and plywood) is generally lower in price than hardwood sawtimber and poles. Over the same period, pine sawtimber has averaged \$27.97 per ton.

The main distinction between hardwood and pine pulpwood in the market is the cellulose fiber length. Hardwood fibers are shorter in length which make them favorable for printed paper products as well as tissue and towel products. The longer fibers found in pine species add strength to paper products such as containerboard and absorption to fluff pulp products such as diapers and napkins. Other consumers of pulpwood products are oriented strand board (OSB) mills, medium density fiber board (MDF) mills, pellet mills and other bioenergy facilities. The average pine pulpwood stumpage price between 2010 and 2022 was \$10.42 per ton while hardwood pulpwood had an average stumpage price of \$8.77 per ton.

Slash is consumed as fuelwood for boilers as well as a key material for pellet producers and other forms of bioenergy. Slash is unique in that the material is only harvested if a bioenergy producer is in the area, otherwise slash will be left on the forest floor for decomposition or may be burned. Further, the cost and time of harvesting and chipping this material may not be economically

viable compared to other feedstock options. As such, the stumpage price paid for slash generally ranges between zero dollars (\$0.00) or \$1.00 per ton.

Changes in the US South Forest Landscape

Forestland and Timberland Acres

Since the middle of the 20th century, forestland within the US South has been relatively stable measuring 229 million acres in 1953 and 233 million acres today.

The USFS classifies the forest landscape into two groups. The first group is forestland while the second group is a subset of forestland called timberland. Forestland is defined as land that is 10% forested by trees of any size. This includes land that may have been naturally or artificially regenerated. Forestland may include areas managed for biodiversity conservation, wildlife habitat, recreation, and other ecosystem services in addition to timber production.

Timberland is forestland that is available to harvest and primarily managed and used for the production of timber or wood products. Timberland is often owned by timber companies, forest management organizations, or private landowners.

Forestland comprises land that is generally greater than 1 acre (0.4 hectares) and has (or had) at least 10 percent of its area covered by tree canopy of any size. Timberland is forestland that is not reserved as a national park or other use and can produce at least 20 cubic feet (0.566 cubic meters) per acre per year of wood from trees. With this distinction in mind, the focus of data in this report is based on timberland.

According to its recent assessment period, forestland acreage has remained stable at 233 million acres since 2017, consistent with the 2012 assessment (Figure 4). This figure is approximately 4 million acres, or 2%, higher than the measurement in 1953. Notably, since its low point in 1997, forestland has increased by 14 million acres, equivalent to a 6% rise.

In 2007, FRAM established the first pellet mill in the South, located in Appling County, Georgia. Since the inception of the pellet industry, an additional 10 million acres have been added, representing a 4.5% increase.

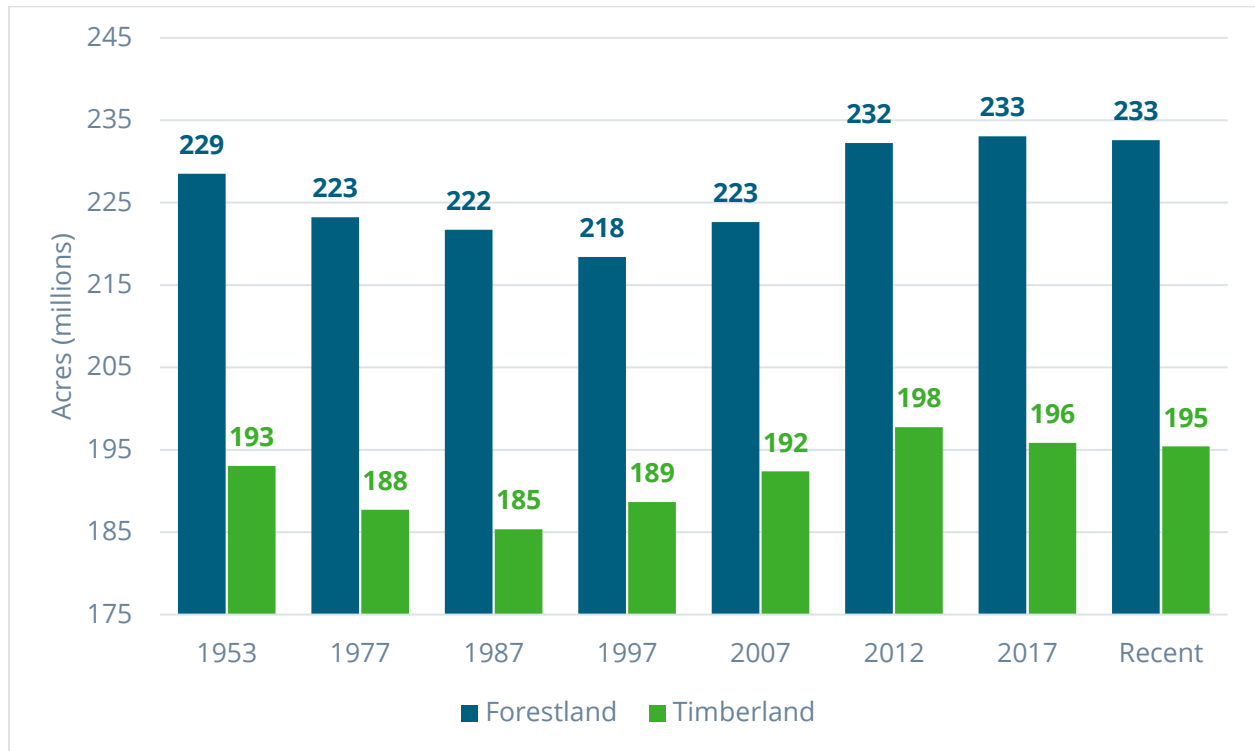


Figure 4 – Forestland and Timberland Acres between 1953 and Recent Assessment

Overall, forestland and timberland acres have remained at historically high levels. According to the latest assessment, there are 195 million acres of productive timberland, a slight decrease of 0.4 million acres,⁵ or 0.2%, from 2017. However, compared to 1953, this figure is 2.0 million acres, or 1%, higher. When compared to the low of 1987, the figure is 10 million acres, or 5% higher.

Forest Inventory Growth

From 1953 to the current assessment period, the growth rate of US forest inventory has increased by 11%, reaching its highest peak during the 2012-2017 period (Figure 5 and Figure 6). Since 1953, forest inventory experienced nearly consistent growth, except for a small decline during 2007-2012 and 2017 to the current period. The average annual growth rate over this duration is 5%. Of this growth, private forests have consistently outpaced public forests. Furthermore, private softwood forests have consistently held the highest volume of cubic feet.

It's important to note that private forests are forests not owned by municipal authorities, church authorities, or the state. These types of forests provide water, recreational opportunities, timber

⁵ Actual decrease. Rounding error in chart figure has the appearance of 1.0 million acres.

and other forest products, as well as habitats for fish and wildlife. Public forests, on the other hand, are managed by government agencies responsible for balancing multiple uses and interests. Management plans often incorporate public input, environmental considerations, and sustainable practices to ensure long-term ecological health and recreational opportunities.

When compared to the last five-year cycle (2012 to 2017), forest inventory growth⁶ has slowed between 2017 and recent assessments (Figure 5 and Figure 6). However, the comparison is somewhat biased based on US economic conditions during the two business cycles. Between 2012 and 2017, lumber markets saw gradual improvement but remained depressed. During this time, many landowners delayed harvests (i.e., harvest removal supply was low in reaction to low demand and low prices) based on future expectations and their forests continued to grow until the market rebounded and they could recoup the investment they had made in sustainable forest management. As a result, the 2012 to 2017 period was a historic high, growing at 19.4 billion cubic feet annually (6% growth rate).

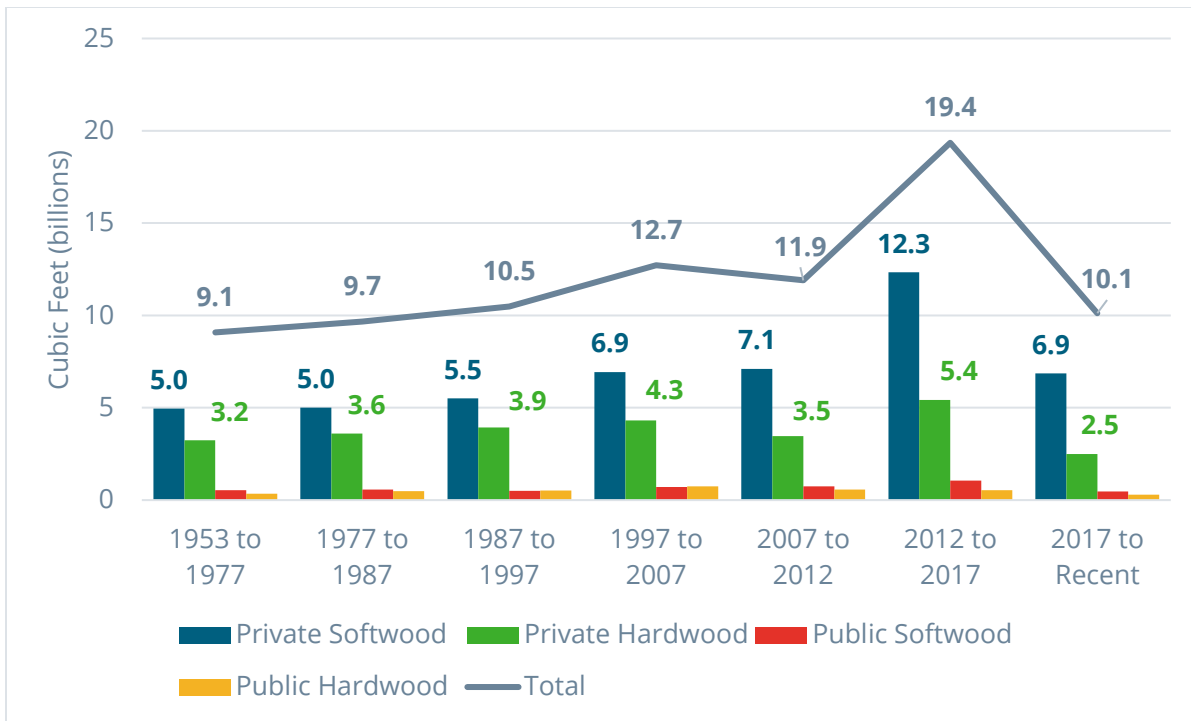


Figure 5 - Annual Forest Growth between 1953 and Recent Assessment

⁶ Growth is equal to the change in inventory plus annual removals

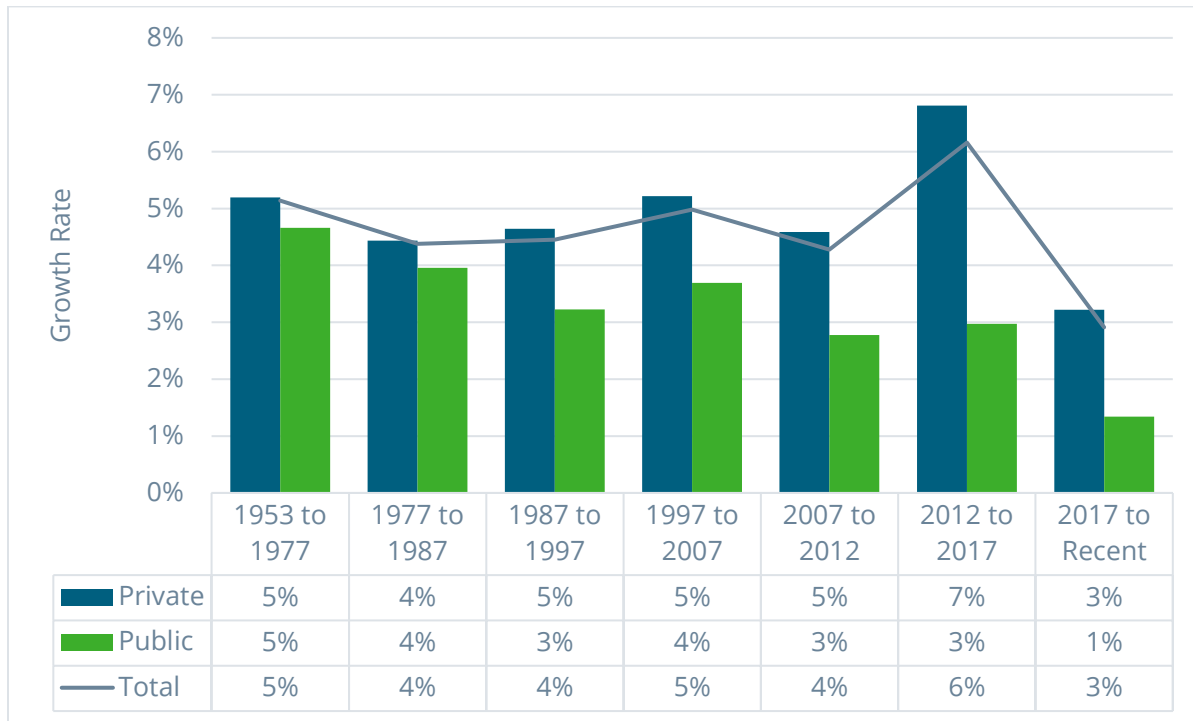


Figure 6 – Growth as a Percent of Inventory (Growth Rate) between 1953 and Recent Assessment

The 2017 to recent assessment cycle reflects the improved conditions in the lumber market. For comparison, southern yellow pine lumber prices between 2012 and 2017 averaged \$365 per thousand board feet while prices between 2017 and 2023 averaged \$515 per thousand board feet (41% higher). Landowners, who had delayed harvests, responded by harvesting more timber and increasing supply in response to greater demand and higher prices. The rate of growth during this period declined to 10.1 billion cubic feet annually (3% growth rate) just below historic growth rate periods between 1977 to 1997 and 2007 to 2012 (4% growth rate). Nevertheless, the most recent assessment period continued the uninterrupted 70-year trend of forests in the US South increasing in every assessment period.

Forest Inventory Removals

Harvest removals increased to 8.1 billion cubic feet in the USFS’s recent assessment, reflecting a 3% increase of over 7.9 billion cubic feet of removals in 2017 (Figure 7). Most of the increase occurred for private landowners’ softwood (pine) trees which reflected 74% of the total harvested volume in the recent assessment. The number reflects an increase of 2% from 2017. Harvests of private hardwood and public timber remained essentially flat.

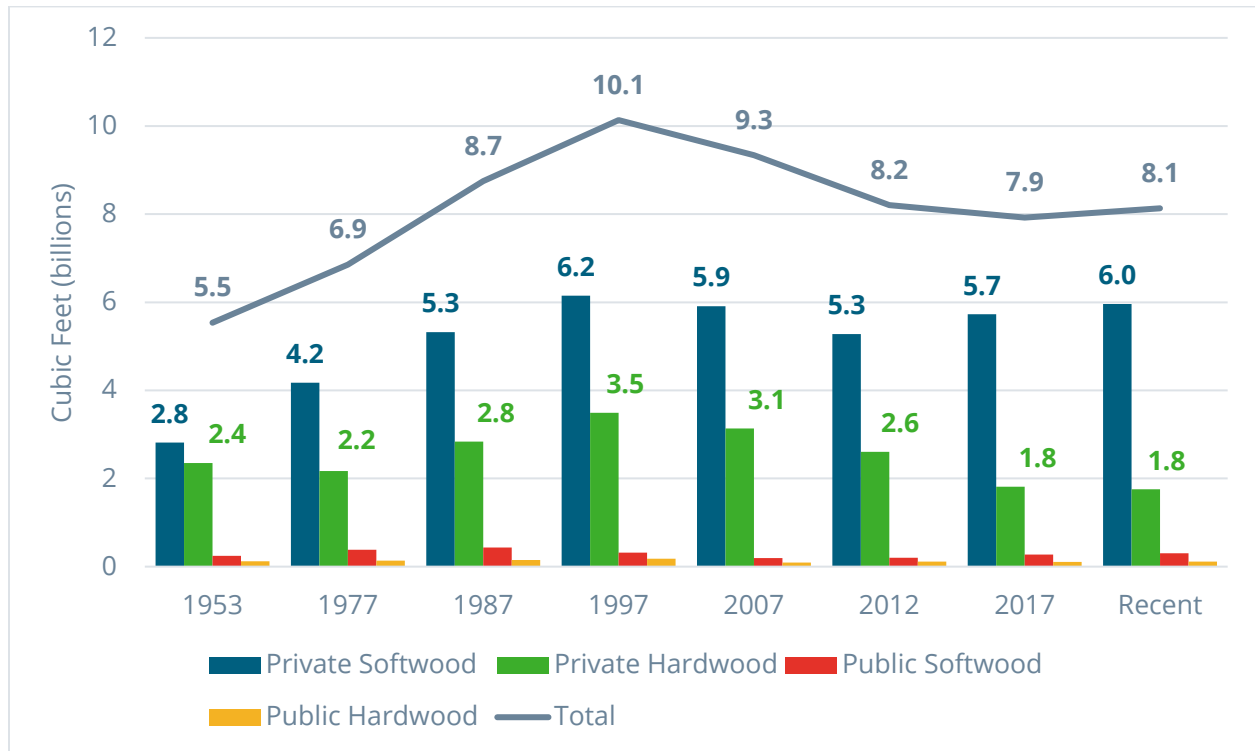


Figure 7 - Annual Forest Removals between 1953 and Recent Assessment

Over the years, harvest volume has remained relatively stable. When considering inventory levels, the percentage of removals relative to inventory is consistent with the 2017 level of 2%, and lower than the historic level of 4% (Figure 8). Since 2012, harvest removals have flattened to around 8.0 billion cubic feet, while inventory increased. Consequently, the rate of harvested wood per inventory has declined, notably during the period when pellet mills entered the US South market.

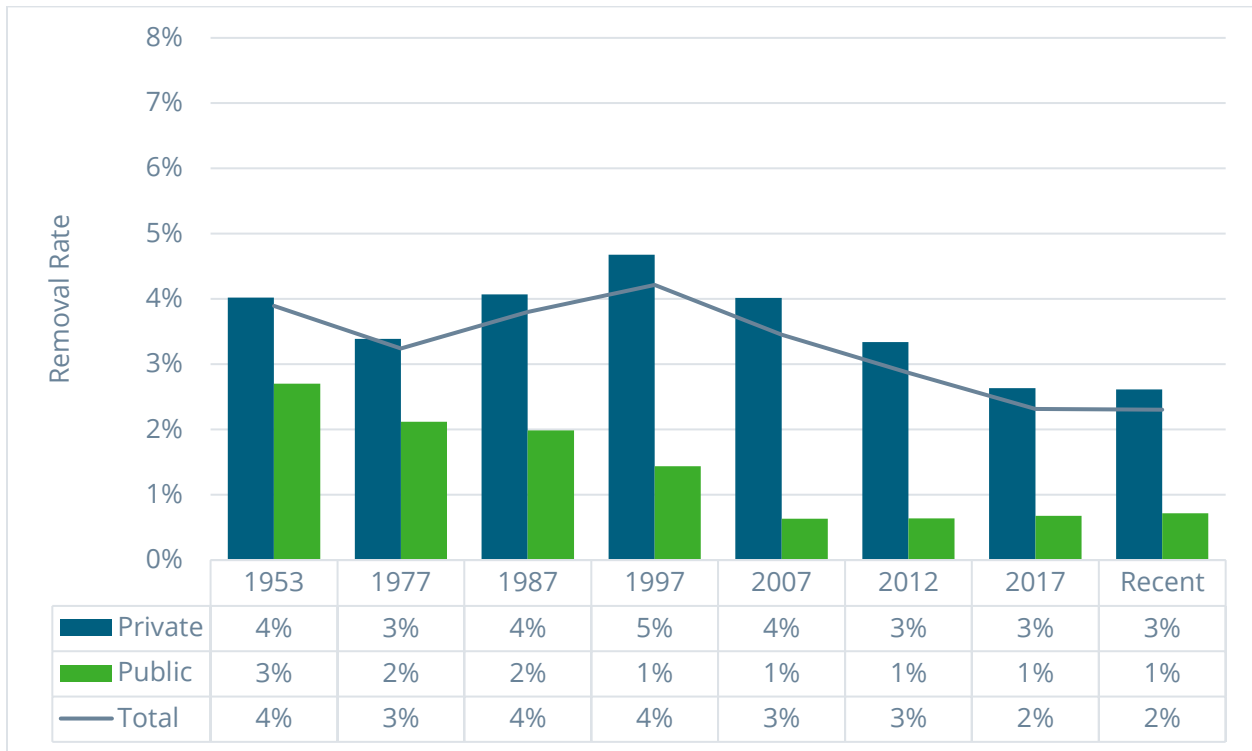


Figure 8 - Removals as a Percent of Inventory (Removal Rate) between 1953 and Recent Assessment

Forest Inventory Growth-to-Removal Ratios

A simple measurement to determine whether inventory is increasing or decreasing, in addition to the rate of increase or decrease, is growth-to-removal ratios (GRR). If the ratio is greater than 1.0 then growth is outpacing removals and volume is added to the inventory. If the ratio is less than 1.0, removals are outpacing growth, and the inventory will decline. If the rate of change in the ratios is small, then the change in inventory is occurring slowly. Conversely, if the change in the ratio is large, then the change in inventory is large.

Since 1953, growth has been greater than removals ranging between 1.11 and 2.40 (Figure 9). The historic high of 2.40 occurred during the downturn in lumber markets between 2012 and 2017. Comparatively, between 2017 and the recent assessment, GRR was 1.26 and higher than the lower rates between 1977 and 1987.

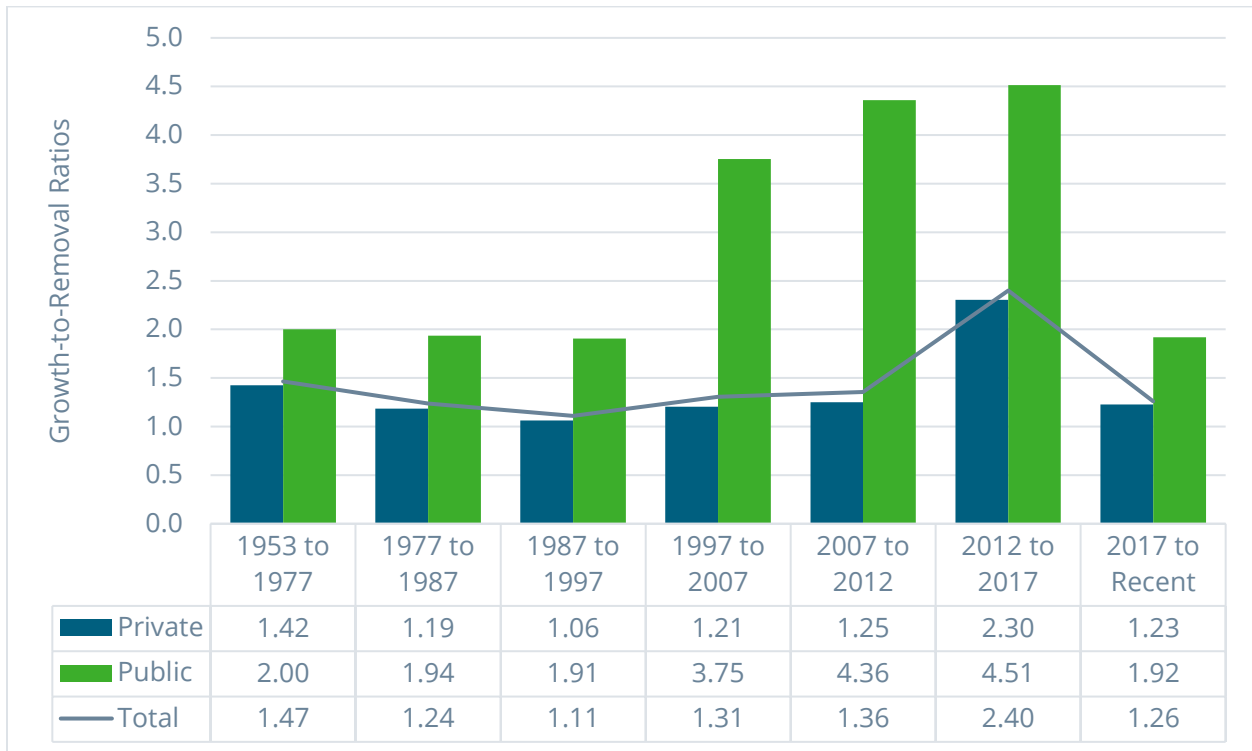


Figure 9 – Growth-to-Removal Ratios between 1953 and Recent Assessment

As GRRs have remained above 1.0, forest inventory in the US has continued to increase. However, the sharp decline between the 2.40 historic high and the most recent assessment reflects a slowing down of the inventory’s rate of increase (see next section).

Forest Inventory

As stated previously, with GRRs over 1.0 where growth has outpaced harvest removals, the forest inventory in the US has increased. Much of the increase occurred between 2012 and 2017 (Figure 10 and Figure 11).

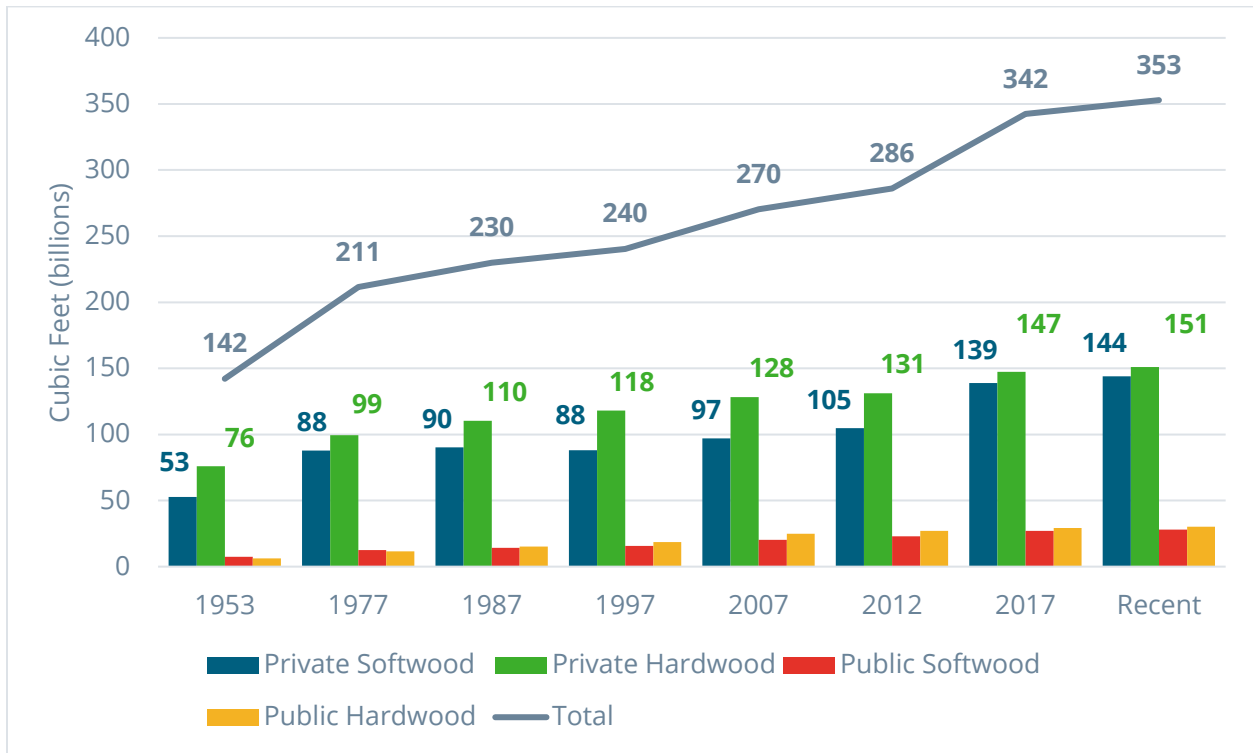


Figure 10 - US Forest Inventory between 1953 and Recent Assessment

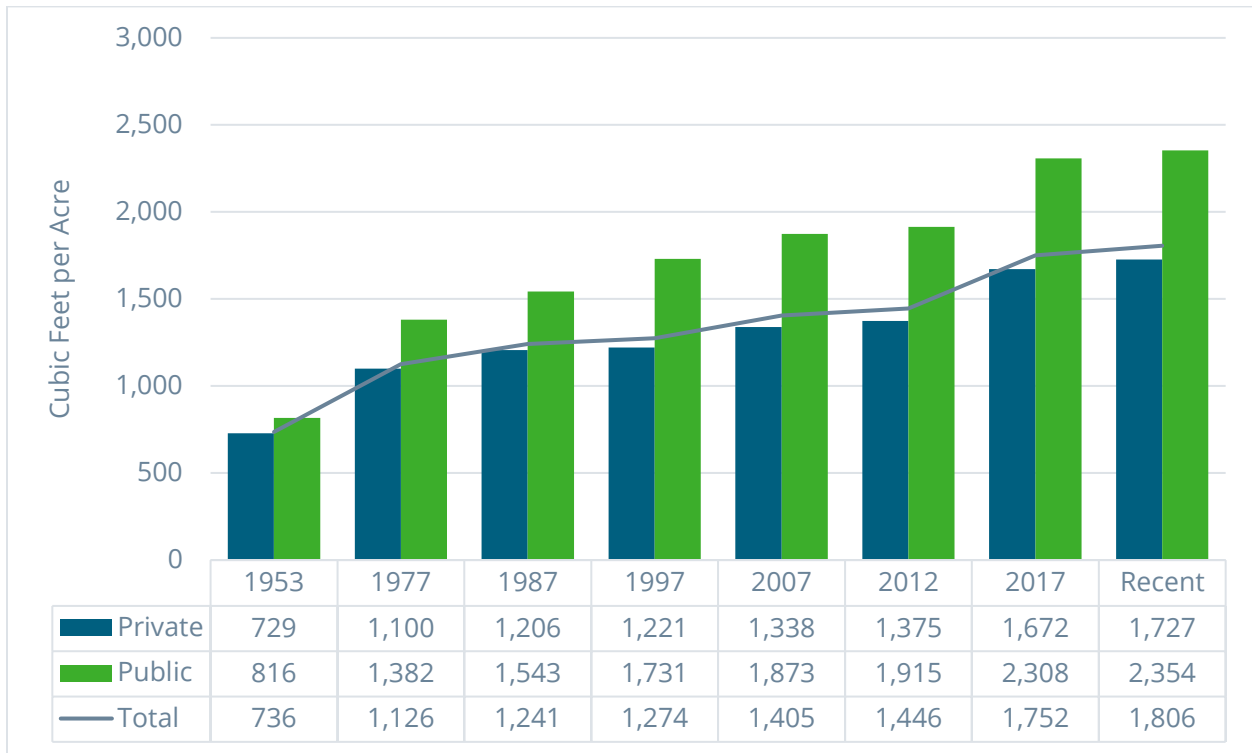


Figure 11 – US Forest Inventory per Acre between 1953 and Recent Assessment

According to its recent assessment, the USFS measured the US South inventory at 353 billion cubic feet of volume. This reflects an increase of 11 billion cubic feet, or 3% over the 2017 measurement of 342 billion cubic feet. Since 1953, US forest inventory has increased at a rate of 1.3% annually. For the softwood resource, the rate of increase has been 1.5% annually and for hardwood 1.2% annually. For private ownership, the rate of increase has been 1.2% annually and public ownership has been 2.1% annually.

Overall, today’s forest inventory is the greatest it has been for the last 70 years.

Changes in the US Economy and Forest Products Demand

Gross Domestic Product and Housing Starts

Perhaps the two best measures describing the influence of demand for forest products are gross domestic product and housing starts (Figure 12).

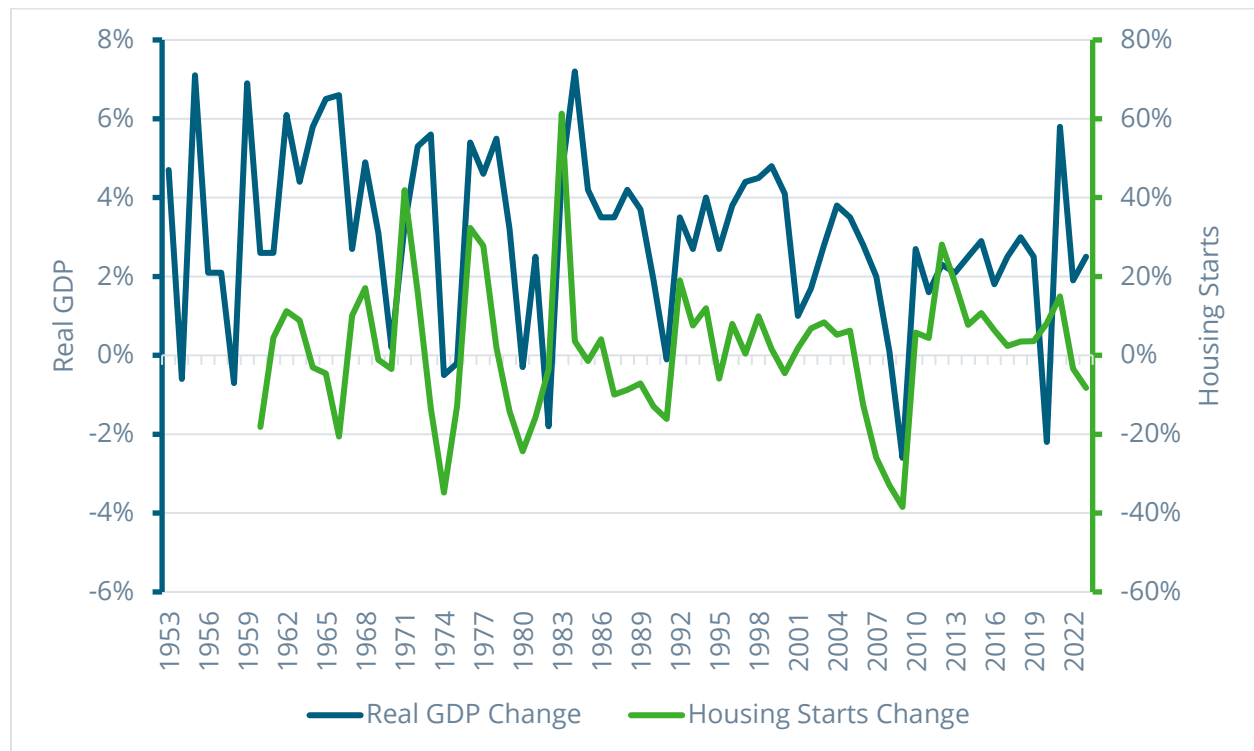


Figure 12 – US Annual Percent Change in Real GDP and Housing Starts between 1953 and 2023

The change in real gross domestic product (GDP) measures a country's value of goods and services that are produced within a given period adjusted for inflation. Real GDP is a general barometer of whether a country's economy is growing or shrinking and is a general measure of how the forest products industry's demand may have been affected within a given year. As economic growth accelerates, resulting in higher real GDP, the demand for forest products tends to increase, as there is higher consumption and industrial activity occurring in the market.

The change in housing starts is also a measure of the forest products industry's demand as the housing market is directly related to demand for forest resources to produce building materials.

Between 2017 and 2023, the US economy was significantly affected by the Coronavirus disease (COVID-19). Between 2017 and 2019, the economy grew at a real rate of 2.7% annually. But in 2020, the economy entered a recession, shrinking by 2.2% before recovering 5.8% in 2021 and growing an average of 2.2% between 2022 and 2023. Overall, between 2017 and 2023, the US economy's real GDP averaged a growth rate of 2.3% annually.

Forest Products Production

Solid Wood Products

US consumption of solid wood products, such as lumber and plywood, continued to increase between 2017 and 2022 as the housing market strengthened (Figure 13).

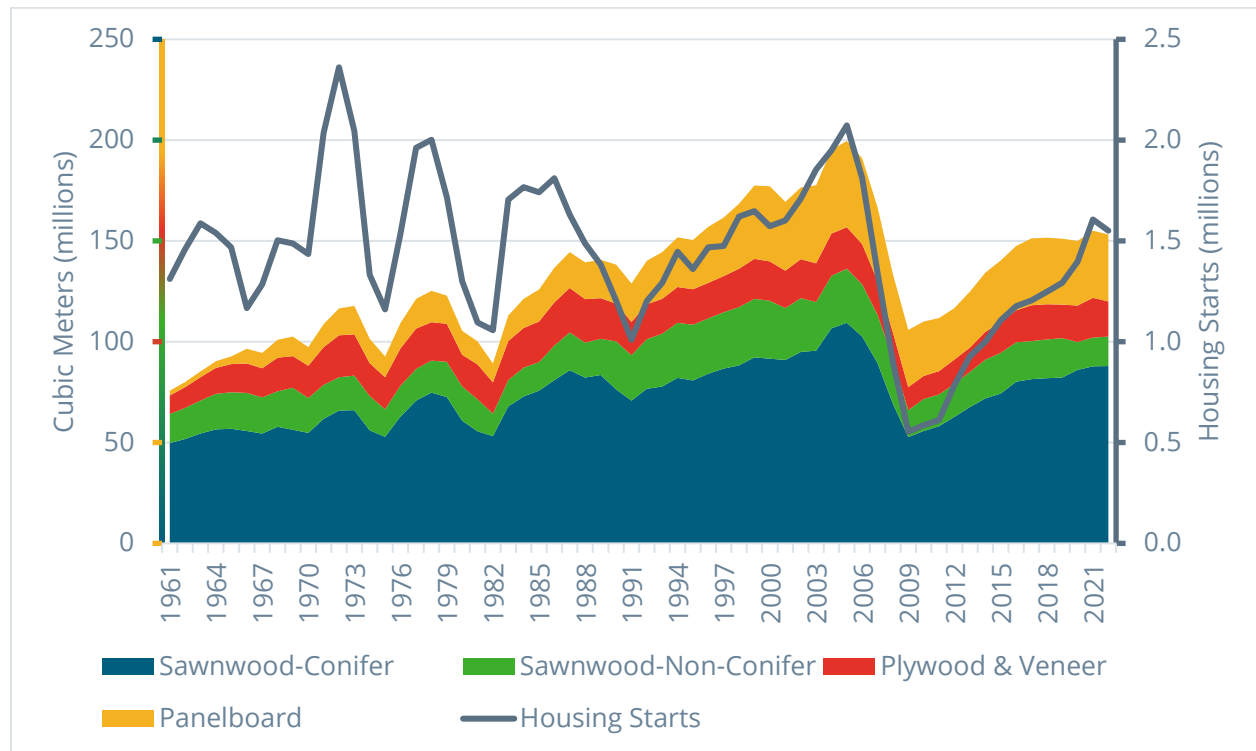


Figure 13 – US Apparent Consumption of Solid Wood Products between 1961 and 2022

According to FAO, apparent consumption⁷ of conifer sawnwood in the US was 81 million cubic meters in 2017 and increased to 88 million cubic meters by 2022 (+1.6% annually). Domestic

⁷ Apparent Consumption = Production + Imports - Exports

production increased 2.1% annually (Figure 14) while exports and imports decreased 4.3% and 0.4% annually respectively. For hardwood sawnwood, apparent consumption declined from 19 million cubic meters to 15 million cubic meters (-5.1% annually). Domestic production and exports declined 5.0% and 3.4% annually, while imports increased 2.0% annually. Apparent consumption for plywood and panelboard was generally flat over this period.

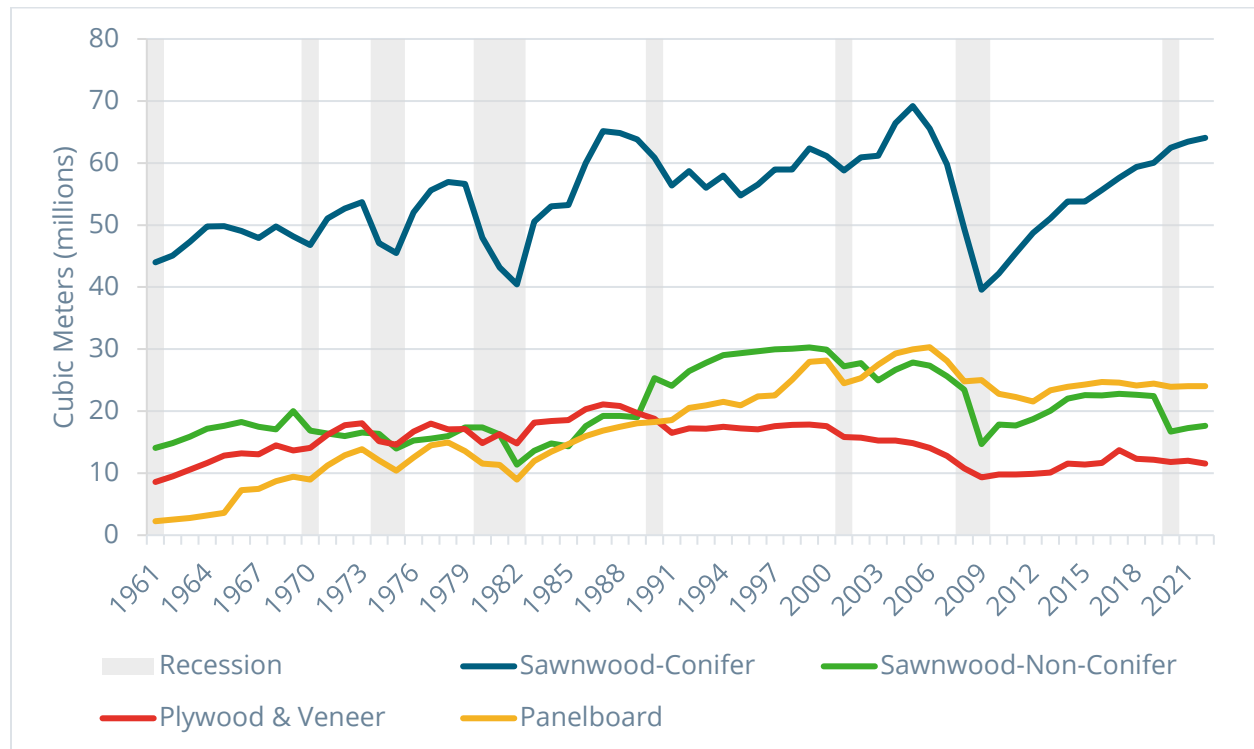


Figure 14 – US Production of Solid Wood Products between 1961 and 2022

Apparent consumption is an equation used as an indicator to understand the total demand within a market as it provides insights into how much of a product is being consumed within the country or region, regardless of whether the product was produced domestically or imported.

It should also be noted that the US South experienced significant capacity additions for pine sawmills from 2017 to 2023. Markets for conifer logs in the Pacific Northwest, particularly in British Columbia Canada, declined during this period. In response, Canadian lumber companies have expanded capacity in the US South. Production in the Pacific Northwest regions declined by roughly 15 million cubic meters over the period, while the US South increased 9 million cubic meters. As a result, demand in the US South for larger diameter roundwood of conifers⁸ increased while demand for hardwoods were generally flat to declining.

⁸ Also referred to as “softwood(s)”, “southern yellow pine” or “pine”

Pulp and Paper Products

US pulp production increased between 2017 and 2019 but subsequently declined during and after the COVID period, ending 2022 at almost the same level as 2017. Overall, pulp production remains below its peak period in 1995 (Figure 15).

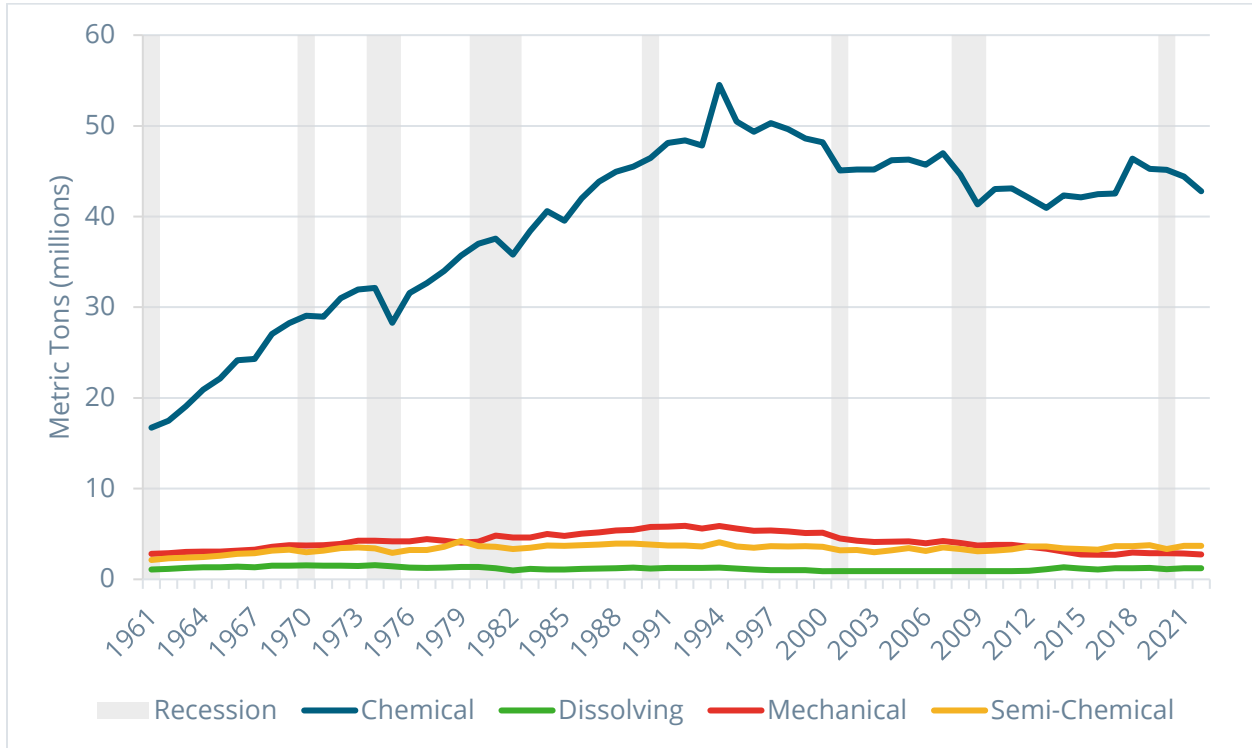


Figure 15 - US Production of Pulp between 1961 and 2022

As for paper, the same trend occurred with increases between 2017 and 2019, followed by a decline during and after COVID. However, the growth trend in packaging, household sanitary products, and recovered paper and fiber generally held up when compared to communication papers (printing and writing) and newsprint. These former segments continued to decline annually by 10.3% and 22.3%, respectively (Figure 16).

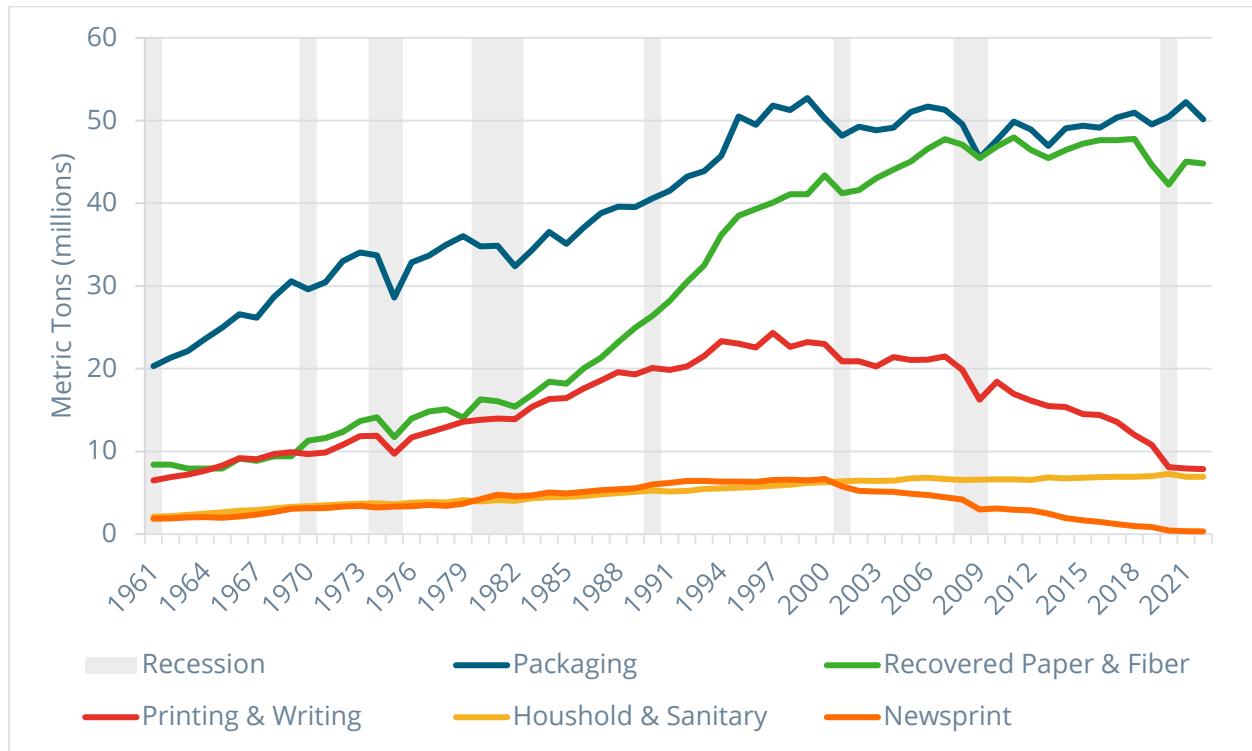


Figure 16 – US Production of Paper Products between 1961 and 2022

It's important to note that the packaging category encompasses various grades, such as containerboard and paperboard/boxboard. Since 1997, the packaging sector has remained relatively stagnant, largely due to several reasons. While containerboard has seen an increase over the years, the other grades in the packaging sector have been more affected by globalization in supply, particularly in China and Europe, leading to flat or declining trends in the US. Additionally, economic factors play a crucial role. Economic cycles and fluctuations can impact consumer spending patterns and demand for packaged goods. Therefore, during times of a recession, demand for packaging dropped.

The COVID period and the challenging economy, both domestically and globally, have significantly affected the landscape of pulping and paper mills in the US South over the last few years with several closures, including:

- Georgia-Pacific Corporation (communication papers) – Zachary, Louisiana – 2019
- Georgia-Pacific Corporation (bleached boxboard) – Crossett, Arkansas – 2019
- White Birch Paper (newsprint) – Ashland, Virginia – 2019
- Pactiv Evergreen (cartonboard) – Canton, North Carolina – 2023
- WestRock Company (kraft papers) – Charleston, South Carolina 2023

As a result, demand for pulpwood has been variable since 2017.

Pellet Products

US industrial pellet production increased from 5.1 million metric tons in 2017 to 9.5 million metric tons in 2023, an increase of 10.8% annually.⁹ The US South accounted for 72% of total US industrial pellets in 2017 at 3.7 million metric tons. In 2023, the percentage increased to 85% of total US industrial pellets at 8.1 million metric tons, an increase of 14.1% annually.

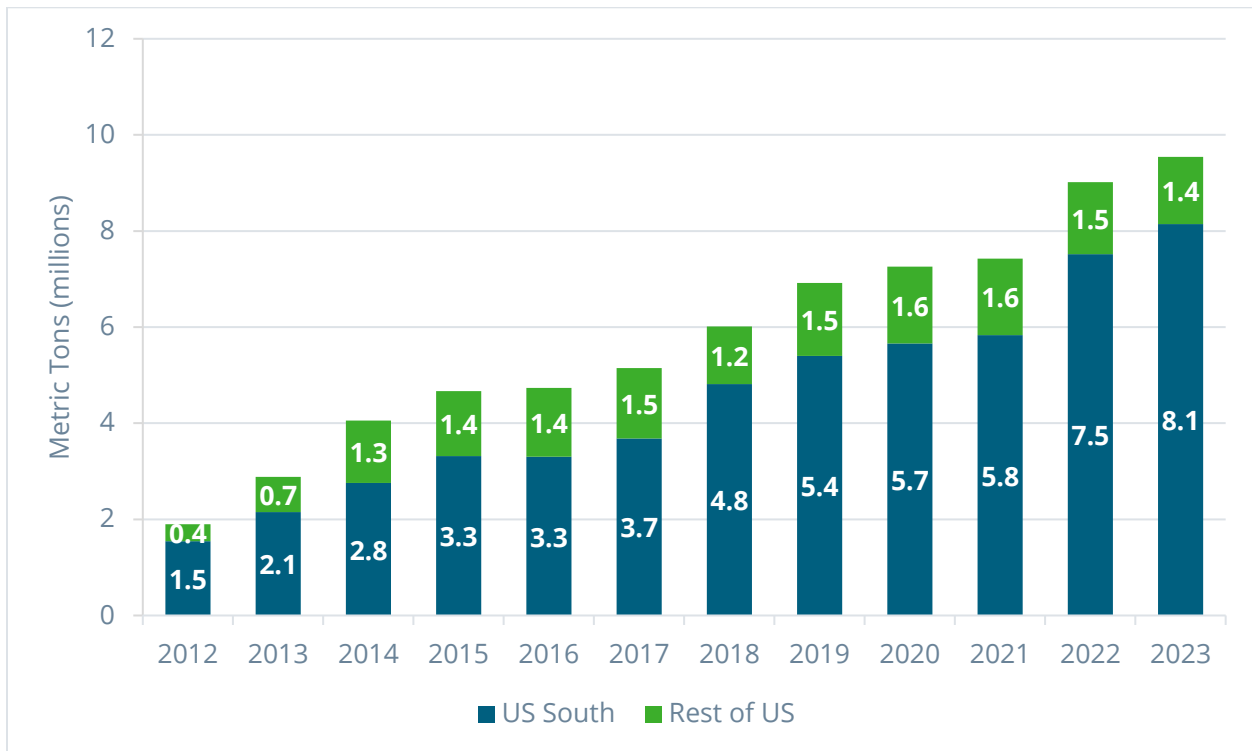


Figure 17 – US Production of Industrial Wood Pellets between 2012 and 2023

The rise in pellet production can be attributed to several key factors. However, the significant driver of this recent growth is the shift from fossil fuels to renewable energy sources, such as pellets. As energy producers and regulators worldwide recognize the value of woody biomass for power, heat, industry, aviation and maritime fuel and negative emissions, the demand for renewable sources has surged, leading to a subsequent increase in wood pellet production.

Given the decline of pulp and paper production and simultaneous increase in wood pellet production, the latter’s market share amongst industries that use pulpwood and byproduct wood residuals has risen from 1.3% in 2012 to 3.4% in 2017 and to 6.1% in 2022. For context, 6.1%

⁹ Calculated using export data from the United States International Trade Commission

represents approximately 9 million tons out of the total 148 million metric tons of total production in 2022 (Figure 18).

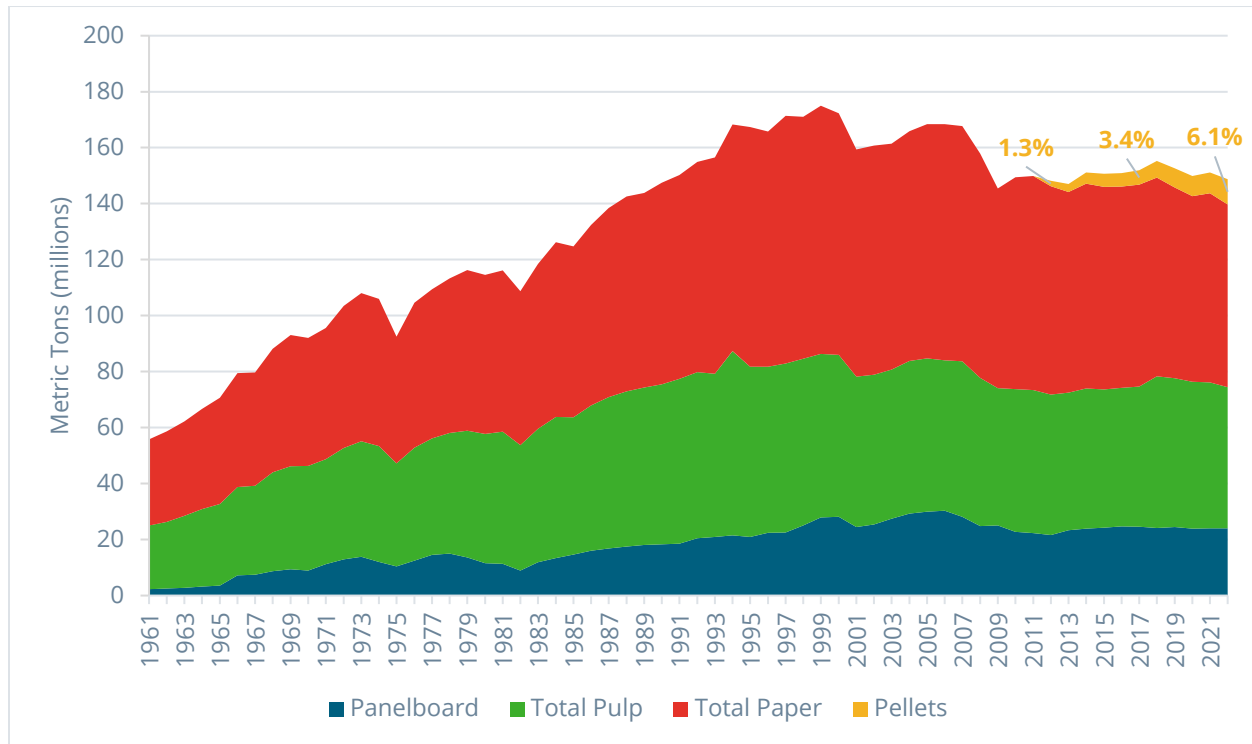


Figure 18 – US Industrial Wood Pellets Market Share of Wood Fiber Producers

Private Forest Owners Response to Market Demand

In our 2017 report, it was concluded that a strong relationship between demand, forest productivity and, ultimately, inventory exists in the US South market. A clear link between removals, growth and inventory exists. High demand promotes investment in and management of timberland acres, improvements in growth and the building of timber inventories.

Since the 1950s, the South's forests have demonstrated their resiliency, and forest owners, who are predominantly private individuals, families, corporations and investors, have demonstrated their ability not only to use and maintain, but also to replenish and grow, the forest. Updated data identified a surge in industrial pellet production, triggered by the pivot towards renewable energy. While the COVID-19 pandemic had a negative impact on the economy, forest inventory grew regardless, as indicated by the inventory increase from 342 to 353 billion cubic feet (Figure 19), underscoring the relevance of sustainable forest management and the robustness of Southern forests in accommodating the demand for forest products.

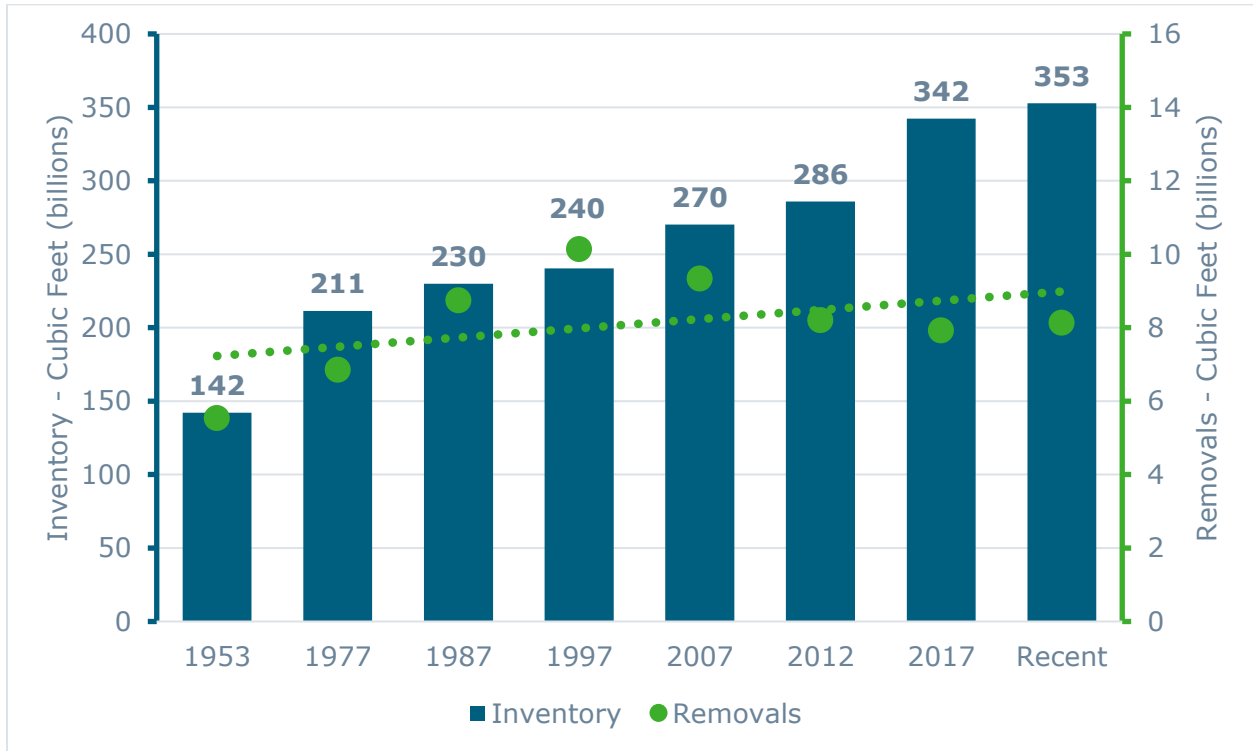


Figure 19 – Trend in US South Forest Inventory and Harvest Removals

Pellet Mills in Relation to Wider Forestry Sector

In 2022, pellet mill removals accounted for 0.08% of the inventory, while non-pellet removals accounted for 2.05% (Figure 20). Pellet mills’ share of total removals climbed to 4%, marking a relatively small yet noticeable leap from just 1% in 2012.

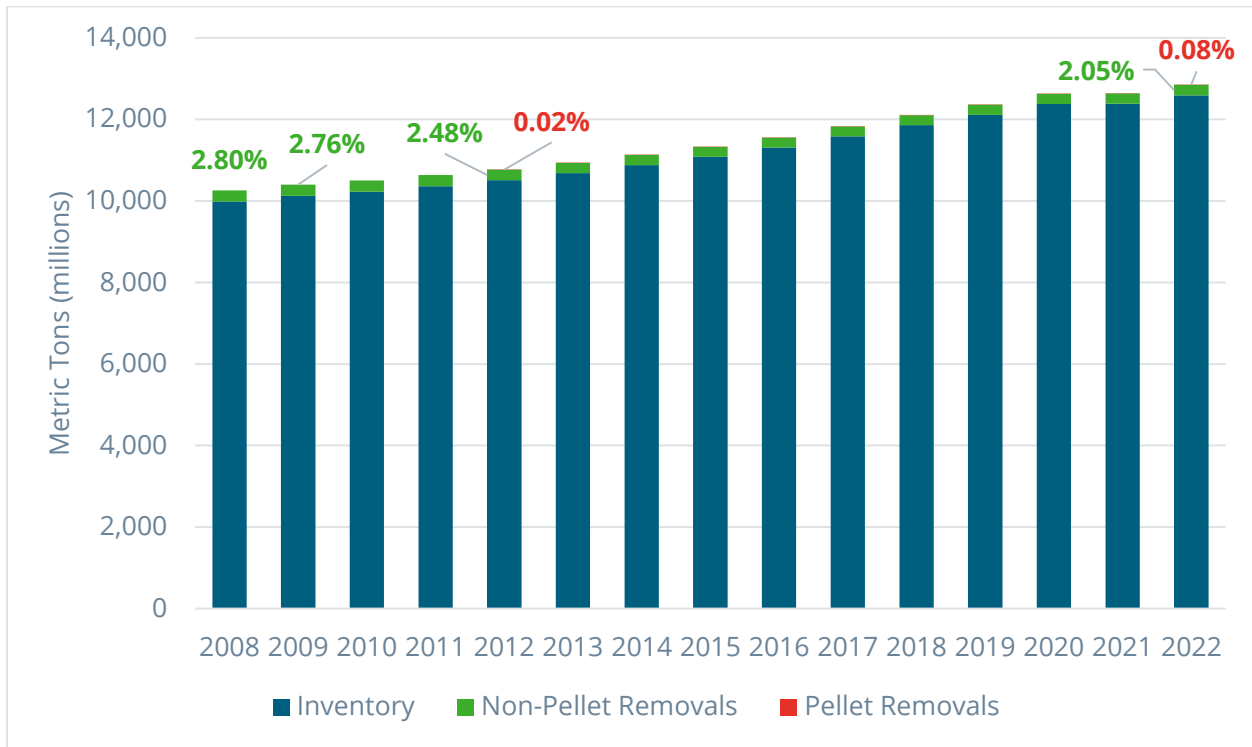


Figure 20 – Harvest Removals in Relation to Forest Inventory between 2008 and 2022

Looking back at previous years, in 2012, pellet mills removed 0.02% of the inventory. In comparison, non-pellet removals accounted for 2.48% of the inventory. Combined removals were 263 million metric tons, representing 16 million metric tons less than the level observed in 2008 and 2009 and 2.50% of the forest inventory compared to 2.78%.

By 2022, pellet mill removals had increased to 10 million metric tons, or 0.08% of the inventory. In comparison, non-pellet removals were 258 million metric tons, 2.05% of the inventory. While pellet mills’ share of total removals increased from 1% in 2012 to 4% by 2022, the combined removals of 268 million metric tons represented 11 million metric tons less than the level observed in 2008 and 2009 and 2.13% of the inventory compared to 2.78%. Forest owners in the US South are increasingly growing more wood than they are removing.

Since its foundation, the US pellet export industry has had less than 0.1% of impact on the proportion of wood removed compared to inventory.

Conclusion

Since 2017, the US economy and the forest products industry has experienced significant variability, mostly affected by the COVID period during 2020 and 2021. Despite the ups and downs and the increased and decreased demand for resources, forest inventory in the US has remained resilient. It increased to its highest level over the last 70 years at 353 billion cubic feet.

New developments are currently occurring for bioenergy, biofuels and carbon mitigation facilities. In relation, early pellet mills are now exiting their adolescent years and becoming teenagers within the forest products industry, allowing for at least a 10-year analysis of pellet mills' demand on the forest inventory.

Based on this analysis, while pellet mills' market share of harvest removals has increased from 1% to 4% in the forest products industry, the growth in forest inventory and the change in non-pellet mill removals from 2008 to 2009 has offset the increase in pellet mill removals. Before pellet mills entered the market, harvest removals were at a rate of 2.78% of forest inventory. By 2022, harvest removals were at a rate of 2.13%. Pellet mills have increased from 0.02% of the inventory to 0.08%, a relatively small percentage across the US forest landscape when compared to the remaining industry but providing an additional demand and revenue source for landowners, helping to encourage forest growth (Figure 21).

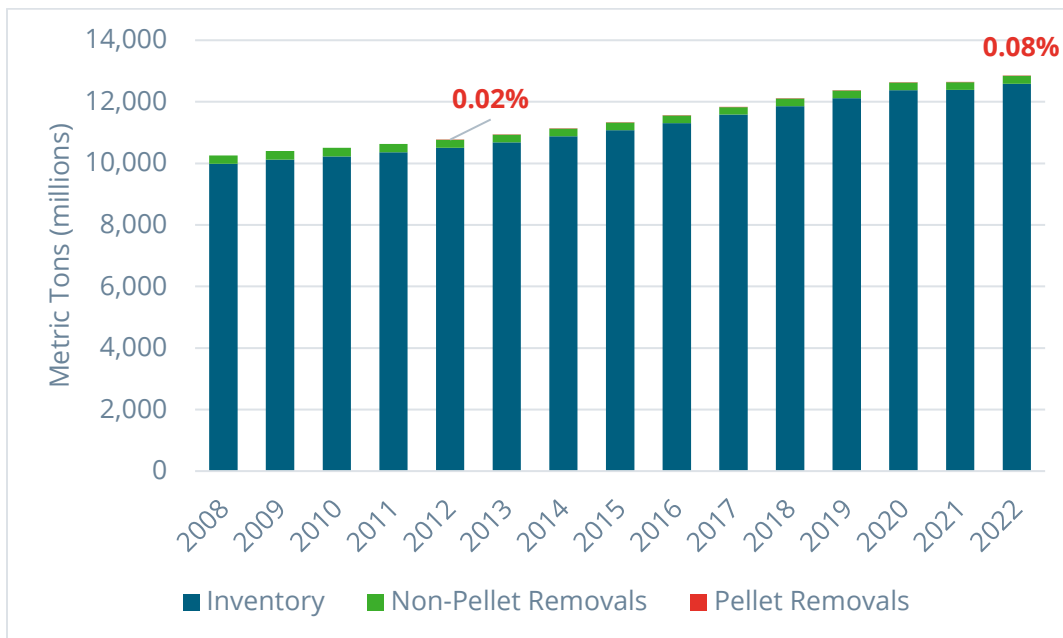


Figure 21 – Pellet Removals as a Percent of Forest Inventory

Appendix – Glossary

Annual Growth and Annual Removals – A comparison of the rate at which wood is produced in the forest and the rates at which it reaches mortality by natural causes and removed by harvesting activities. This comparison is one of the most important features of any forest inventory. It may show that the forests are being harvested too heavily or that the wood they grow is not being fully utilized. If overexploitation persists, destruction of the forest and loss of future production will follow. On the other hand, under-exploitation indicates failure to make full use of the productive power of the forest. (See Growth-to-Removal Ratio.)

Bark – See Wood Fuel. The tough exterior covering of a woody stem that is removed prior to manufacturing the solid wood that remains into a product such as wood fiber, lumber or plywood.

Byproduct – Additional wood products generated from the manufacturing process of turning round logs into lumber. Includes residual chips, bark, sawdust, and shavings.

DBH – Diameter at Breast Height – Used to determine a log's classification as pulpwood or sawtimber. The DBH of a standing tree is measured 4-1/2 feet off the ground (the breast height of a forester taking a forest inventory).

Forestland (or Timberland Type) – A classification of forested land based on the species forming a plurality of live-tree inventory (stock).

- **Hardwood** – Usually a natural stand of primarily deciduous broad-leaved species of trees without a predominate species.
- **Lowland Hardwood** – Forested land found in areas that hold water at least some part of the year and located near creeks, rivers and other water bodies.
- **Upland Hardwood** – Forested land containing well-developed, closed-canopied trees dominated by deciduous hardwood species.
- **Mixed Pine/Hardwood** – A forest composed of a mix of hardwood and pine species.
- **Natural Pine** – A forest of pine that predominantly grew from a natural re-seeding process.
- **Planted Pine** – A human-created forest stand that was regenerated artificially either by sowing or planting.

Green Short Tons (GST) – See Ton.

Growth-to-Removal Ratio (GRR) – The annual growth in forest inventory divided by the annual tons removed is the growth-to-removal ratio. A ratio above 1.0 may indicate opportunities for

additional harvests. When below 1.0, it indicates timber is removed from production faster than it is replaced by growth.

Metric Ton - Commonly used unit of measure of weight of wood fiber outside the United States. A metric ton is 2,204.62 pounds or 1,000 kilograms.

Oriented Strand Board (OSB) - A type of engineered lumber like particle board formed by adding adhesives and compressing layers of wood strands (flakes) in specific orientations.

Pulpwood - Any stemwood that is generally 5" to 9" in DBH. Includes low quality trees and topwood stemwood not suitable for veneer or lumber. Used by chipmills, OSB mills and pulp and paper mills and may require debarking and chipping.

Residual Chips - Wood fiber generated from the edge cuts necessary to turn round logs into lumber or veneer/plywood. The material size is generally consistent and free from contaminants.

Roundwood - A length of cut stemwood generally having a round cross-section, such as a log. Logs and other round timber generated from harvesting trees for industrial or consumer use.

Sawtimber - Large stemwood trees harvested to produce lumber. The term can also be generically used for stemwood trees harvested to produce plywood and poles.

Southern Yellow Pine (SYP) - Trees of the Pinus genus in the US South primarily include the species loblolly (Pinus taeda), longleaf (Pinus palustris), shortleaf (Pinus echinata) and slash (Pinus elliottii). The wood has a yellow tint.

Stemwood - Wood from the main part of a tree and not including the branches, stump or roots.

Timberland Investment Management Organization (TIMO) - Acts as a broker for institutional clients. These organizations find, evaluate and purchase timberland properties that would best suit their clients' investment objectives. They actively manage the timberland to achieve adequate returns for investors.

Ton (or Green Short Ton) - Commonly used unit of measure of weight of wood fiber in the United States. Frequently referred to as a short ton when compared to a metric ton because it is equivalent to 2,000 pounds compared to 2,204.62 pounds. Green refers to the content of wood, including moisture.