Techno-economic viability assessment of the U.S. wood consuming pulp & paper industry

Public report

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Techno-economic viability assessment of the U.S. wood consuming pulp & paper industry

Viability assessment of the U.S. wood-consuming pulp and paper industry – an essential sector for U.S. manufacturing and rural communities

Why pulp & paper mills matters?

Pilar of rural economies

- The U.S. wood-consuming pulp and paper industry is a foundational pillar of rural economies, domestic manufacturing, and forest health. It anchors timber markets, the operating close to 90 pulp & paper mills support roughly 500 direct jobs per mill, and underpin hundreds of sawmills and forestry operations nationwide.
- The sector is facing a wave of mill closures driven not by temporary market cycles, but by aging infrastructure, structural demand shifts, and intensifying global competition—with direct consequences for rural economies.

What is at risk?

20% of U.S. wood consuming pulp & paper mills; 30% of sawmill capacity

- Based on a techno-economic analysis, nearly 20 U.S. pulp & paper mills are assessed to be at elevated or moderate risk of closure in the medium term, with over 7 million tons of pulp capacity and 30 million green tons of annual wood demand.
- Since 2015, the U.S. has already lost about 25% of its pulp capacity, with 42 mills closed—equivalent to 60 million green tons of annual wood demand removed from forest regions. Closure risk is concentrated, not evenly distributed, magnifying impacts on specific regions, product markets, and rural supply chains.

Regional exposure?

U.S. South, Pacific Northwest and Northern regions at highest risk

- The U.S. South—while still the lowest-cost fiber basket—accounts for the majority of mills at risk and over 70% of operating pulp capacity. Recent closures show that low fiber cost alone no longer guarantees survival.
- The Pacific Northwest and Northern regions face elevated risk due to older equipment, higher energy costs, and weaker cost competitiveness, particularly in legacy grades. Nearly 20% of U.S. sawmills are located within the core wood-sourcing radius of pulp mills at elevated or moderate closure risk, exposing ~15–25 million green tons of residual supply to disruption.

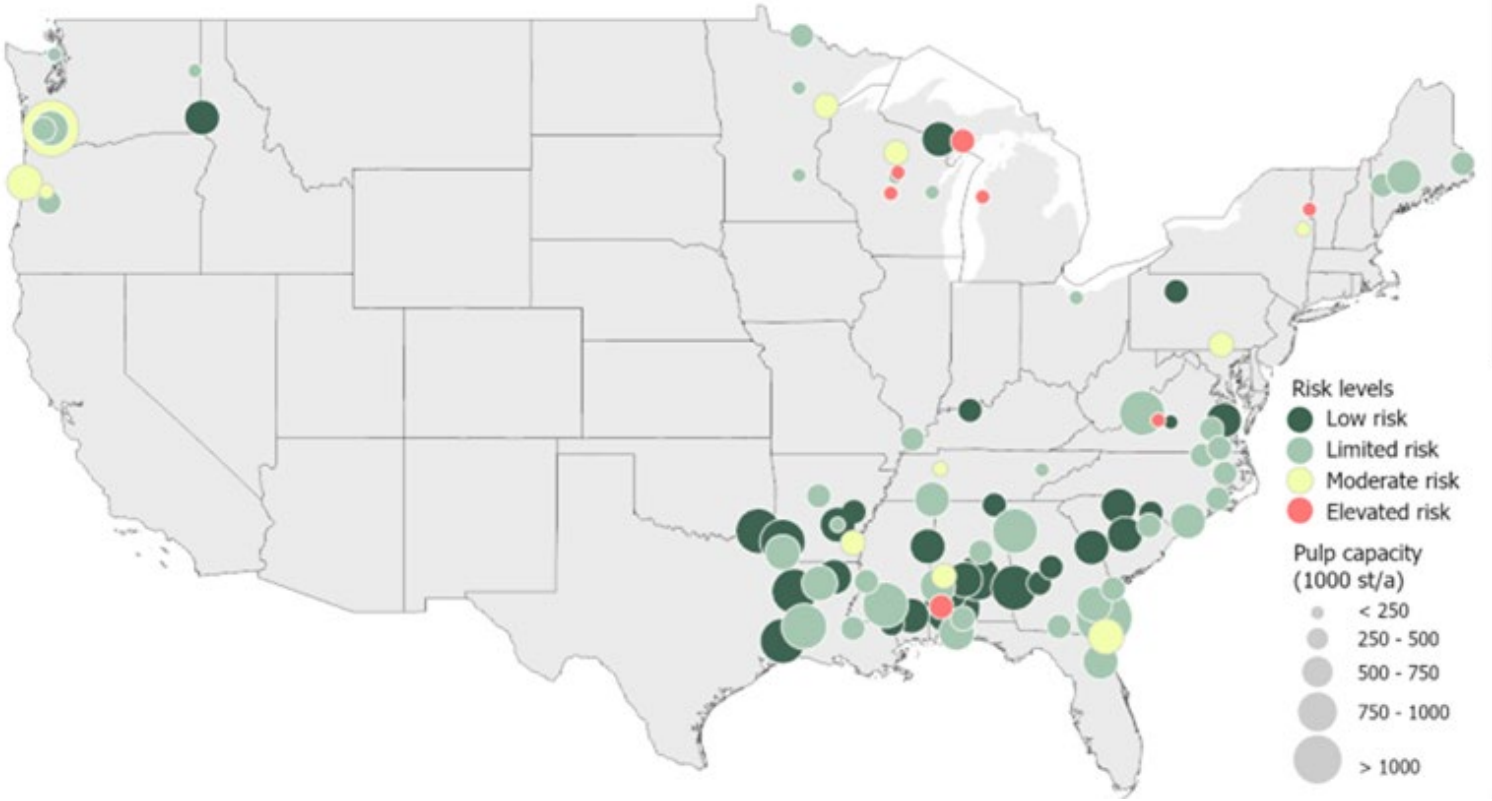
The core drivers?

Aging infrastructure

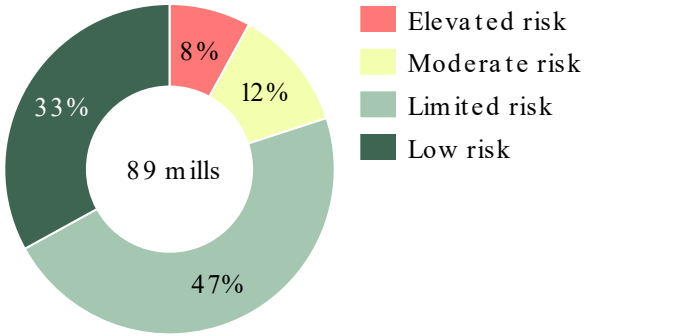
- 41% of U.S. pulp mills operate recovery boilers over 50 years old, triggering $500 million to $1+ billion replacement decisions per site within the next decade.
- Mills with strong cost positions and strategic importance are likely to receive reinvestment. Mills that are small, high-cost, aging, or sub-scale—particularly in structurally declining grades—are most likely to close.

Based on the techno-economic mill assessment, 18 wood consuming pulp & paper mils are at elevated or moderate risk of closure in the medium-term in the U.S.

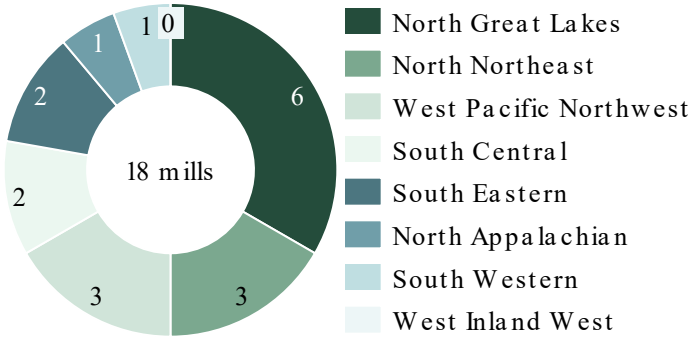
U.S. operating wood consuming pulp mills by risk levels



Mill techno -economic closure risk



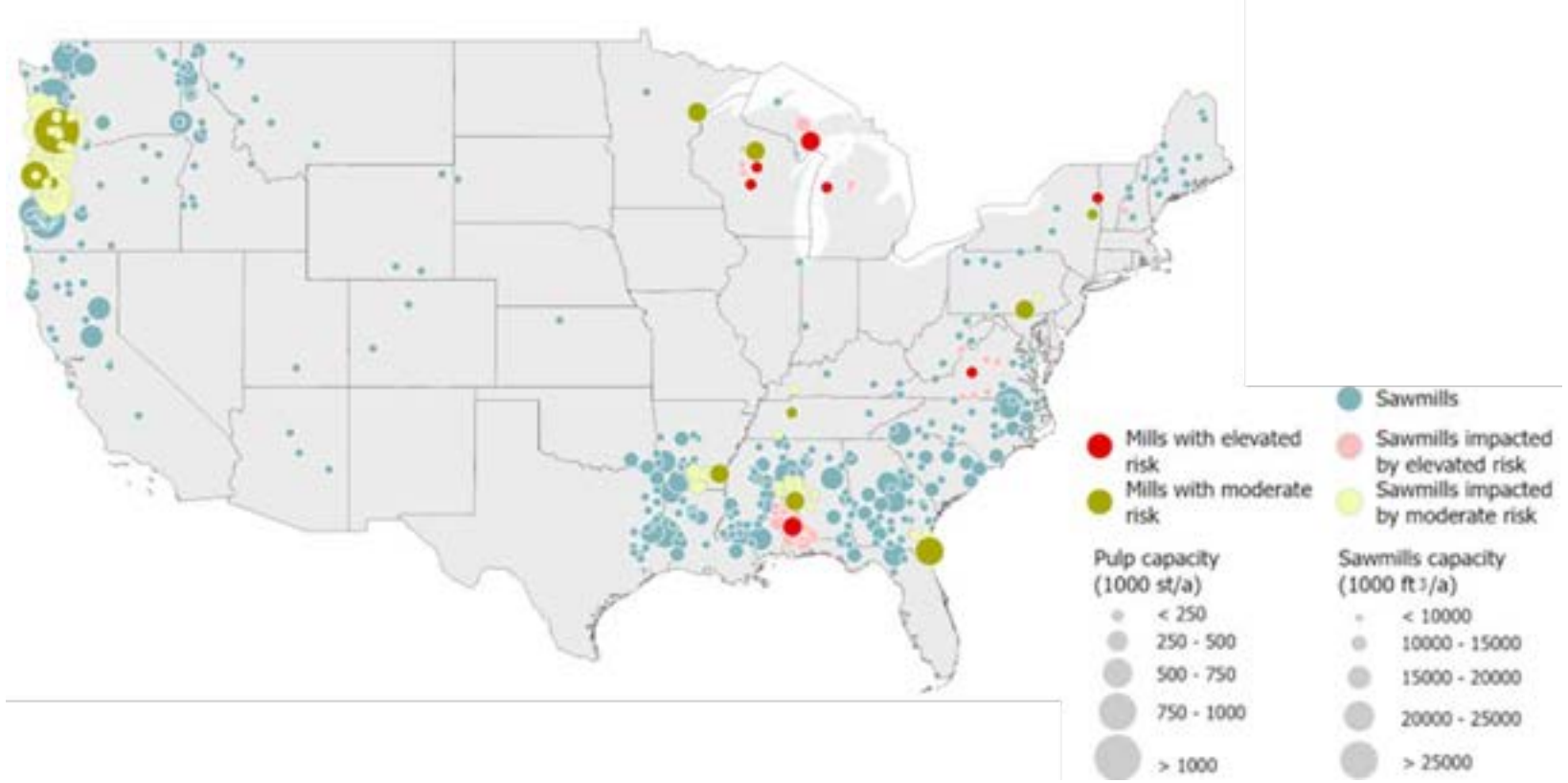
Elevated and moderate risk mills by region



Source: AFRY SMART

Out of the 414 sawmills in the U.S., ~20% are located within 75 miles of the pulp & paper mills with elevated or moderate risk of closure – roughly 30% of capacity

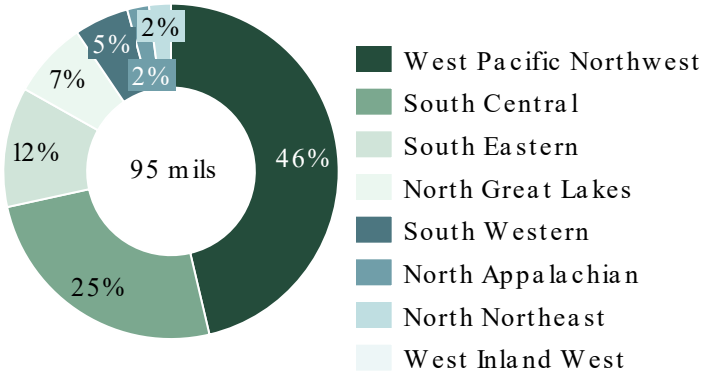
U.S. sawmills and wood consuming pulp & paper mill with elevated risk of closure by 2030



Pulp mill core chip sourcing zone: 50 -75 miles

- There are 95 sawmills with a capacity of 0.7 billion ft³/a in the sourcing zone of pulp & paper mills with elevated or moderate medium-term closure risk based on the techno-economic assessment.
- Pacific Northwest sawmills have the highest exposure – 44 sawmills.

Sawmills exposed to mills with closure risk by # of mills



Source: AFRY SMART. Sawmills with capacity below 1.1 thousand ft³ were excluded

U.S. pulp & paper mill closure risks are regionally concentrated, magnifying impacts on specific regions, markets, and rural supply chains

U.S. south

- 5 pulp & paper mills at elevated or moderate risk (2.1 million st)
- 40 sawmills, with capacity of ~5 million green tons of feedstock, within impact-zone

- U.S. south is the backbone of U.S. pulp and packaging production.
- Pulp & paper mill risks driven by:
  - Despite low fiber costs, capital intensity—not wood supply—drives closure risk
  - Aging recovery boilers at 40% of regional mills
  - Portfolio rationalization by leading producers
  - Oversupply pressure in packaging markets.

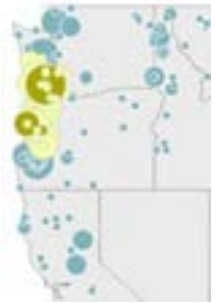
U.S. mid-west & northeast

10 pulp & paper mills at elevated or moderate risk (2.6 million st)

11 sawmills, with capacity of ~2 million green tons of feedstock, within impact zone

- U.S. mid-west & northeast are legacy pulp & paper producing regions with high exposure to declining demand printing & writing paper markets.
- Limited alternative outlets for chips and low-grade fiber increase local economic vulnerability.
- Pulp & paper mill risks driven by:
  - Aging recovery boilers or digesters at >60% of the regional mills
  - Smaller scale, weaker cost competitiveness mills
  - Highest exposure to declining P&W markets.

U.S. west



- 3 pulp & paper mills at elevated or moderate risk (1.9 million st)
- 44 sawmills, with capacity of 10-15 million green tons of feedstock, within impact-zone

- U.S. west has overall moderate volume of pulping capacity at risk, but very high regional dependency on each mill.
- Pulp & paper mill risks driven by:
  - Very old recovery boilers at some mills
  - Higher energy, labor, and environmental compliance costs
  - Exposure to declining product markets – printing & writing paper, virgin fiber corrugated medium and market bleached softwood kraft pulp.

The U.S. pulp and paper sector is not in terminal decline, but it is at an inflection point

How to avoid accelerating loss of domestic pulp & paper manufacturing and forest market instability?

- **Protect competitive regions and grades.** Focus on Southern U.S. packaging, containerboard and fluff pulp assets, where the U.S. remains globally competitive.
- **Enable reinvestment in critical infrastructure.** Recovery boilers and digesters are the single largest determinant of survival; delayed reinvestment sharply increases closure risk.
- **Recognize pulp mills as forest -system infrastructure.** Mill closures ripple outward—into sawmills, logging jobs, and forest health—far beyond the mill gate
- **Anticipate policy -driven capacity loss.** Absent action, the next wave of closures will be structural, not cyclical, with impacts concentrated in rural America.

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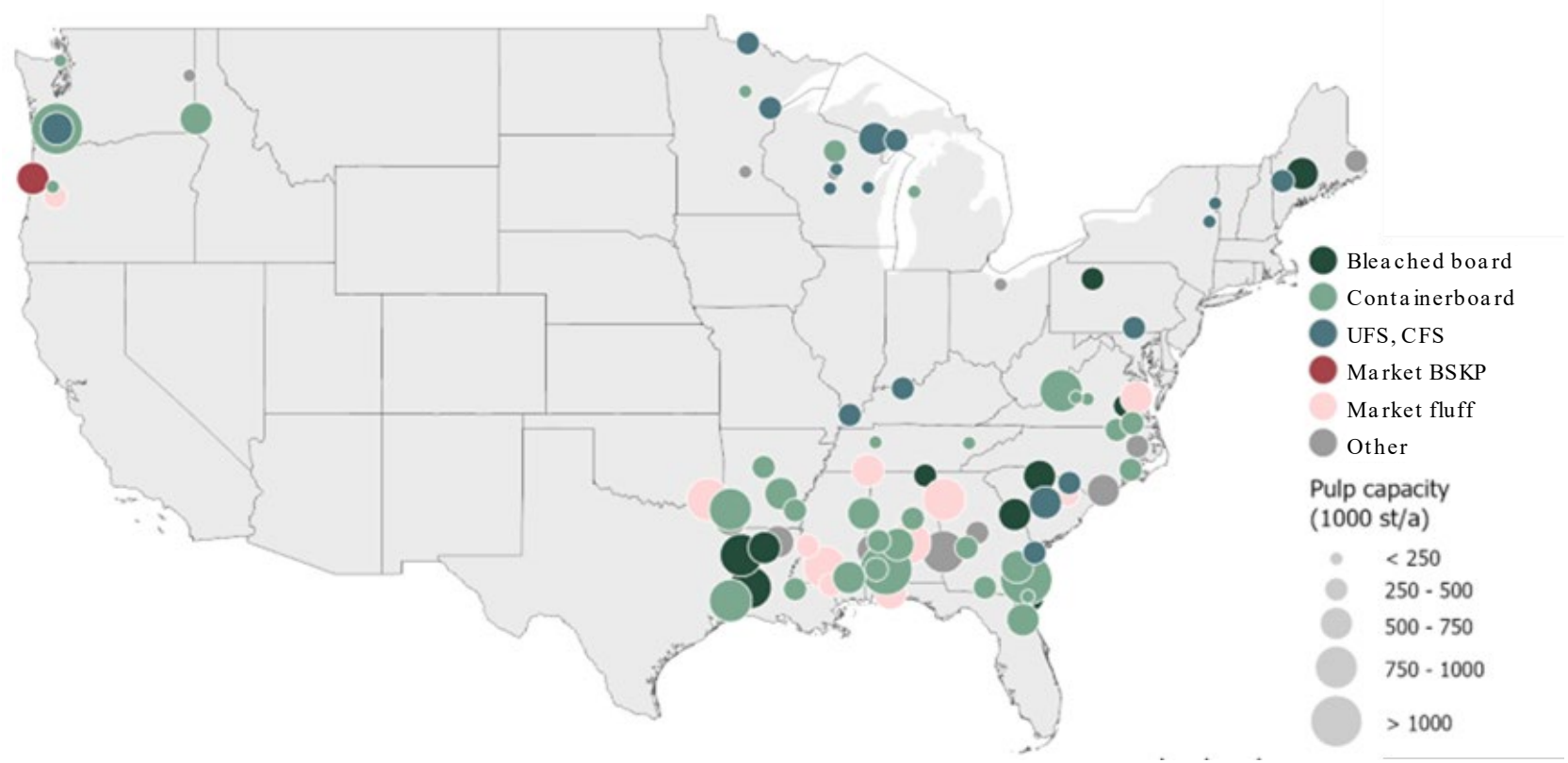
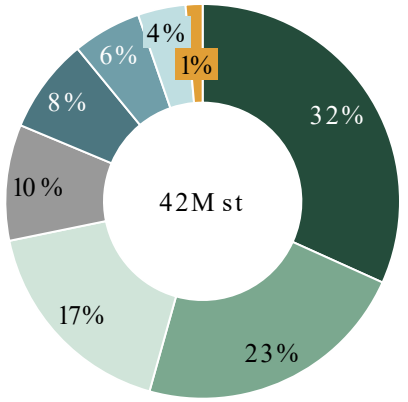
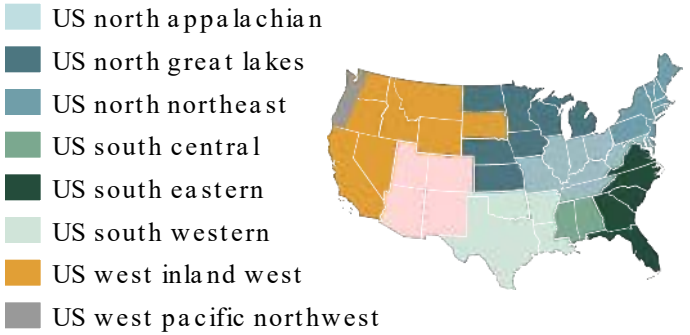
There are 89 operating wood consuming pulp mills in the U.S.- 70% clustered in the U.S. South. On average, a pulp mill consumes 60 million cubic feet of wood per year

Operating wood consuming pulp & paper mills in the U.S.



Wood pulp mills by region*

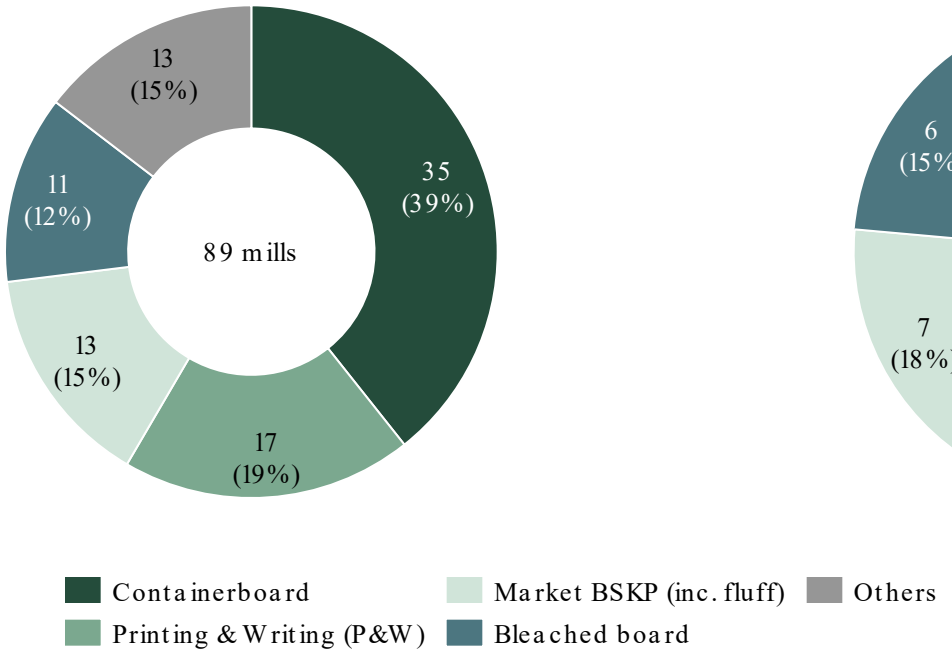




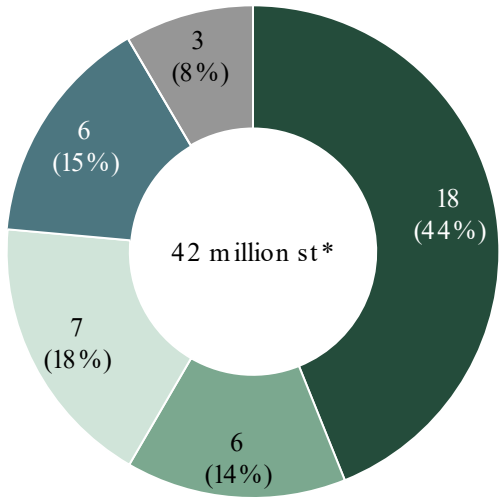
Source: AFRY SMART. *) Total capacity based on total wood pulp capacity. Some manufacturers produce multiple grades.in the same mill, main grade taken for the classification

Majority of the wood consuming pulp & paper mills in the U.S. manufacture containerboard, printing & writing papers, or market pulp

Wood consuming pulp mills by # of mills



Wood consuming pulp mills by capacity



Containerboard
Printing & Writing (P&W)
Market BSKP (inc. fluff)
Bleached board
Others

Source: AFRY SMART. *)mill end product capacity

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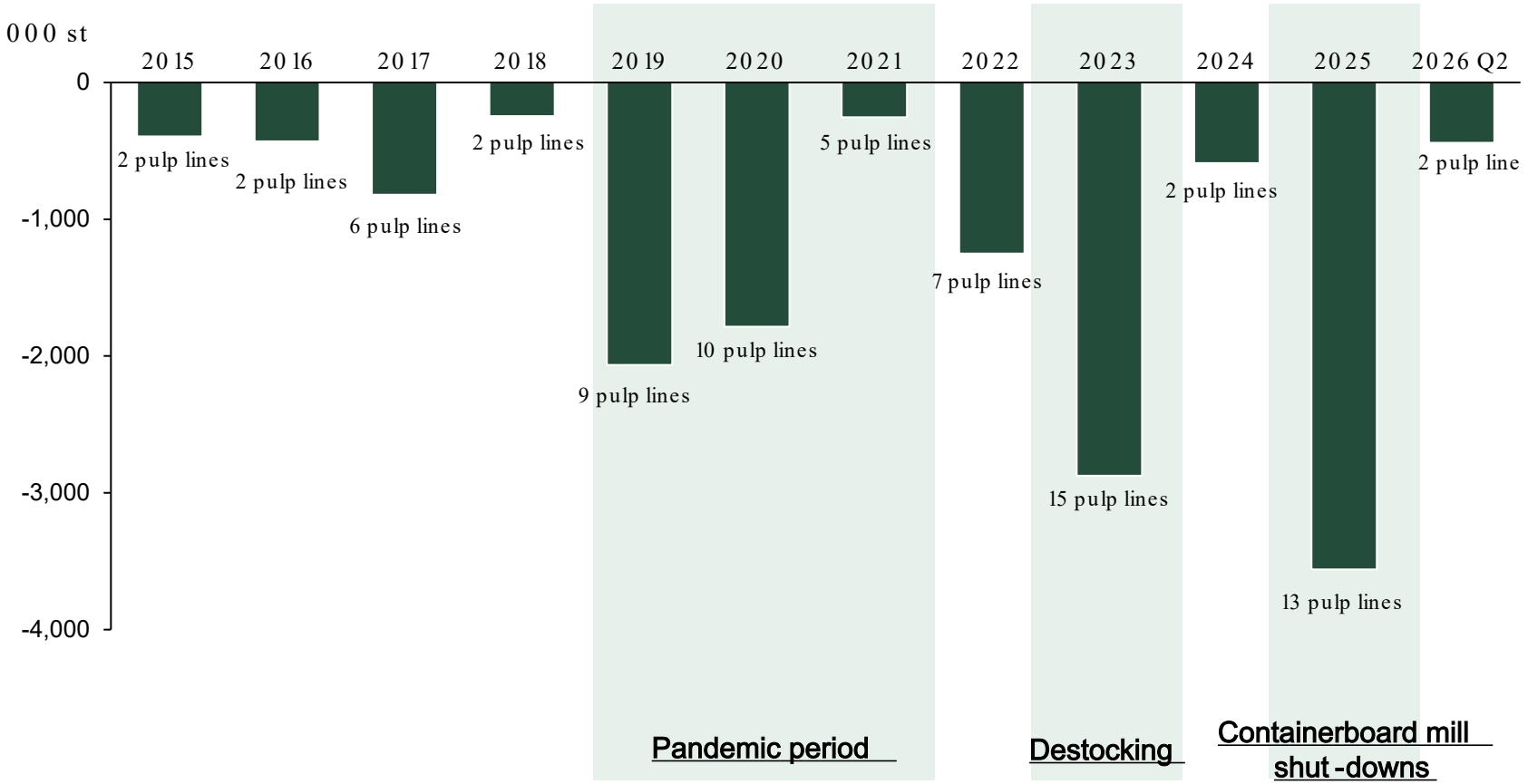
Over the past decade, 43 pulp mills with 15 million tons of wood pulp capacity have closed in the U.S. - equivalent to ~60 million green tons of wood per year

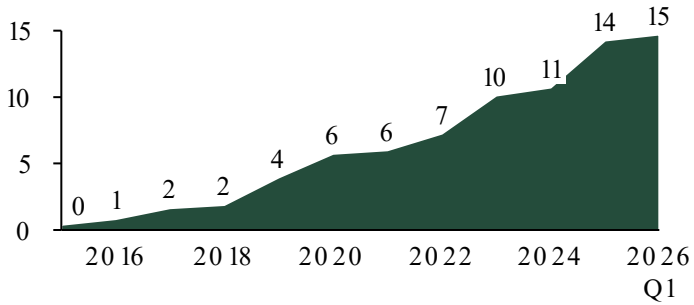
U.S. wood pulp capacity shut -downs 2015 -2026 Q1



- Since 2015, there has been a 25% reduction in pulp capacity in the U.S., while 43 mills, including 70 pulping lines, have closed.
- On average, a pulp mill in the U.S. consumes 1 to 2 million green tons of wood per year, while an integrated pulp & paper mill may directly employ ~500 people.
- Pulp & paper mill closures have created significant stress on forestry and local communities.

U.S. WOOD PULP CAPACITY REDUCTION

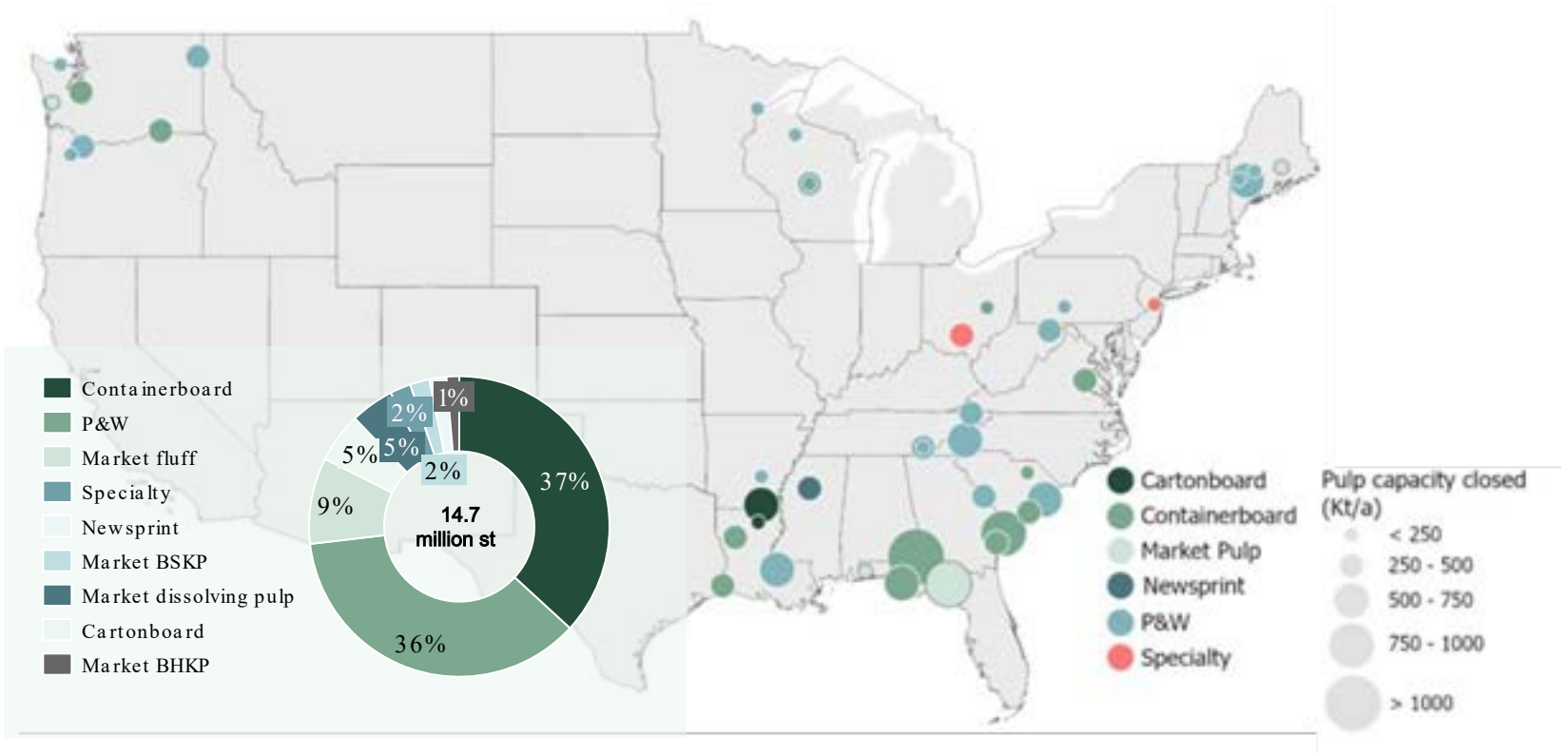
million st



Source: AFRY SMART

Most of the closures were at mill sites producing containerboard or printing & writing papers. The U.S. South has undergone a wave of closures of large-scale containerboard mills

U.S. wood consuming pulping line closures 2015 -2026 Q1

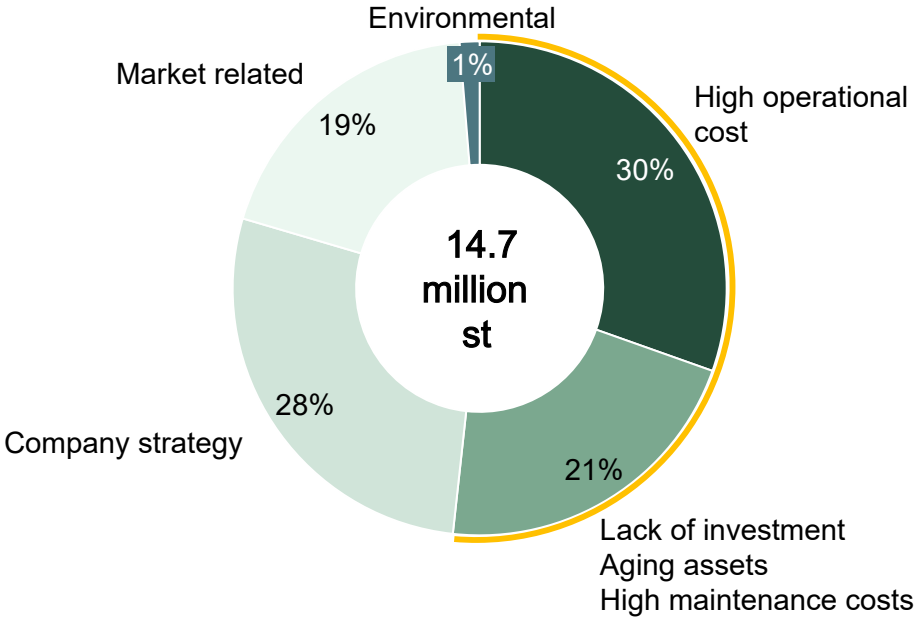


- **13 of the 43 closed pulp mills were integrated to containerboard production**, with average mill size at 400,000 st.
- The 35 million tons containerboard market saw strong pandemic-era growth (+5%/year), followed by slow down in demand in 2022-25.
- Aggressive containerboard capacity investments in 2017-2021 created market oversupply, which drove major shutdowns (-4.5 million st) in 2024–25, in weaker than expected demand growth environment.
- **18 of the 43 closed pulp mills were integrated to Printing & Writing paper production**, with average pulp mill size at 250,000 st.
- The mill closures were driven by the structural decline in Printing & Writing paper consumption. U.S. Printing & Writing paper demand declined by close to 60% from 19 million st in 2015 to 8 million st by 2025.

Source: AFRY SMART

Based on public announcements, high mill operational costs and changes in company strategy drove close to 60% of the U.S. pulp mill closures

Key reasons mentioned for U.S. wood pulp mill closures

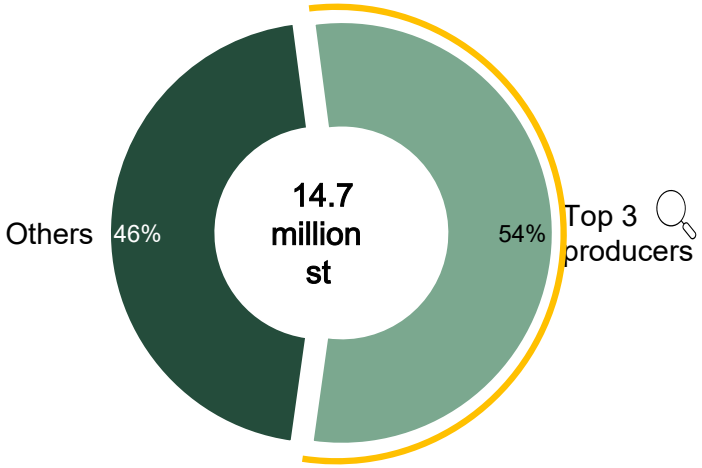


- **High operational cost** typically driven by:
  - Pulp line scale - half of closed mills <250kt
  - Asset quality - most closed mills >40 years
  - Geographic location – regional cost of energy, fiber, labor, etc.
- **Lack of investment, aging assets** can lead to high maintenance costs, eventually large required reinvestments and eventual shutdowns.
- **Company strategy** shifts away form declining P&W markets towards growing consumer and packaging sectors drove retirement of older P&W -linked pulp lines amid structurally declining demand.
- **Market related & balancing** actions caused closures of Printing & Writing paper mills, as well as packaging industry leaders shutting underperforming assets to reduce oversupply and support price stability.

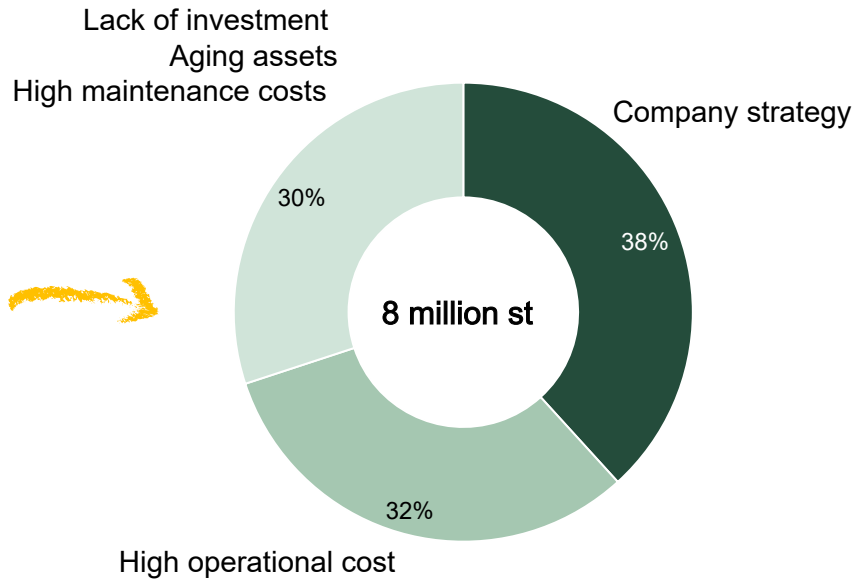
Source: AFRY SMART

Over half of the closed wood consuming pulp mills were owned by the largest pulp & paper producers in the U.S.

Pulp mill closures in the U.S. by producer scale



Reasons for top 3 producers' pulp mill closures



Top 3 p&p companies led the pulp mill closures

- Top 3 producers accounted for 54% of the U.S. pulp mill closures over the past decade.
- Most of the pulp mill closures by the top 3 players were at sites integrated to containerboard, fluff, or P&W paper production.

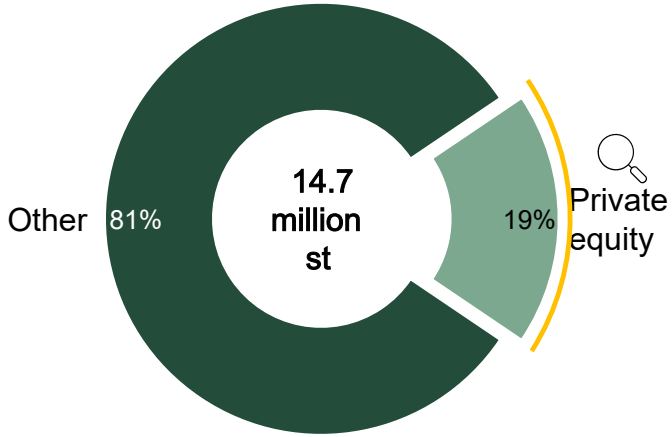
Key reasons for the top 3 pulp mill closures

- Company strategy refocus (e.g. change in business focus, margin management) and high operational costs drove most of the closures.
- The idled mills were generally higher -cost and lower -margin assets within industry leaders' portfolios - but not necessarily the true marginal -cost assets.
- Leading producers tend to close mills with high capital investment needs or rising maintenance costs.

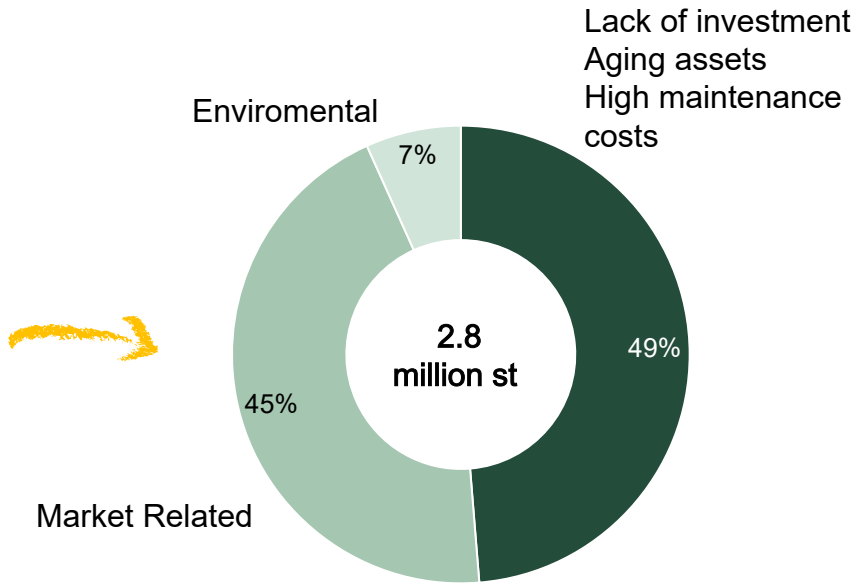
Source: AFRY SMART

About one -fifth of the pulp mills closures were mills owned by Private Equity firms

Pulp mill closures in the U.S. by ownership



Reasons for PE owned pulp mill closures



Closed mills owned by Private Equity firms (PE)

- Private equity owned roughly 20% of the idled pulp lines, mostly in P&W (1.9 million st) and market pulp (0.9 million st) sectors.
- Closures of private equity owned pulp mills were evenly distributed across the U.S.

Key reasons for the PE owned pulp mill closures

- Mills owned by private equity frequently experience minimal investment in asset upgrades and maintenance, which increases mills' risk of closure as assets age and maintenance expenses grow.
- In the last ten years, nearly half of the closures of private equity owned pulp mills can be attributed to aging assets and high maintenance costs.

Source: AFRY SMART

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This report assesses U.S. wood-consuming mills' closure risk based on the mills' techno-economic profiles

Mill techno -economic profile

Major equipment capital expenditures (CAPEX)	**Recovery boiler age**	Recovery boilers are essential for recovering pulping chemicals and generating power. When these boilers reach 50 years of service, substantial investments and replacements are typically necessary within 5 to 10 years. This involves considerable capital expenditures, often between $500 million and over $1 billion, as rising maintenance costs can otherwise threaten the mill's operational efficiency and competitiveness.
	Digester age	A digester "cooks" wood chips with chemicals, heat, and pressure to separate cellulose fibers from lignin, which binds the fibers together. Digesters that have been in use for 50 years typically need significant replacement within the next 5 to 10 years. The usual capital expenditure for this ranges between $100 million and $300 million, varying based on the size and technology involved. Continuous digesters usually incur higher replacement costs compared to batch digesters.
Mill operational quality	**Technical quality**	Asset technical quality measures the technical state of a pulp mill or paper machine. AFRY's mill asset technical quality index combines the benefits of large-scale assets with the asset's technical age, taking into account the mill's CAPEX.
	Cost competitiveness	Cost competitiveness evaluates how an asset's costs compare to those of its peers operating in the same sector and market. AFRY's benchmarking of cost competitiveness relies on modeled costs combining average regional input costs and the specific pulp and paper mill configurations.
Market dynamics & mill competitiveness	**Market supply demand (S/D) balance**	The balance between market supply and demand plays a crucial role in pulp and paper mill closures. The medium-term supply and demand balance for the key market through 2030 is forecast to assess the external market pressures on the U.S. wood consuming pulp and paper mils.
	Marginal supplier analysis	Markets experiencing a structural oversupply are likely to encounter pressure to rationalize, especially affecting high-cost pulp and paper mill assets. Historically, it has often been the leading companies in the sector that have taken the initiative to drive asset rationalization in order to rebalance the market.

Source: AFRY consulting.

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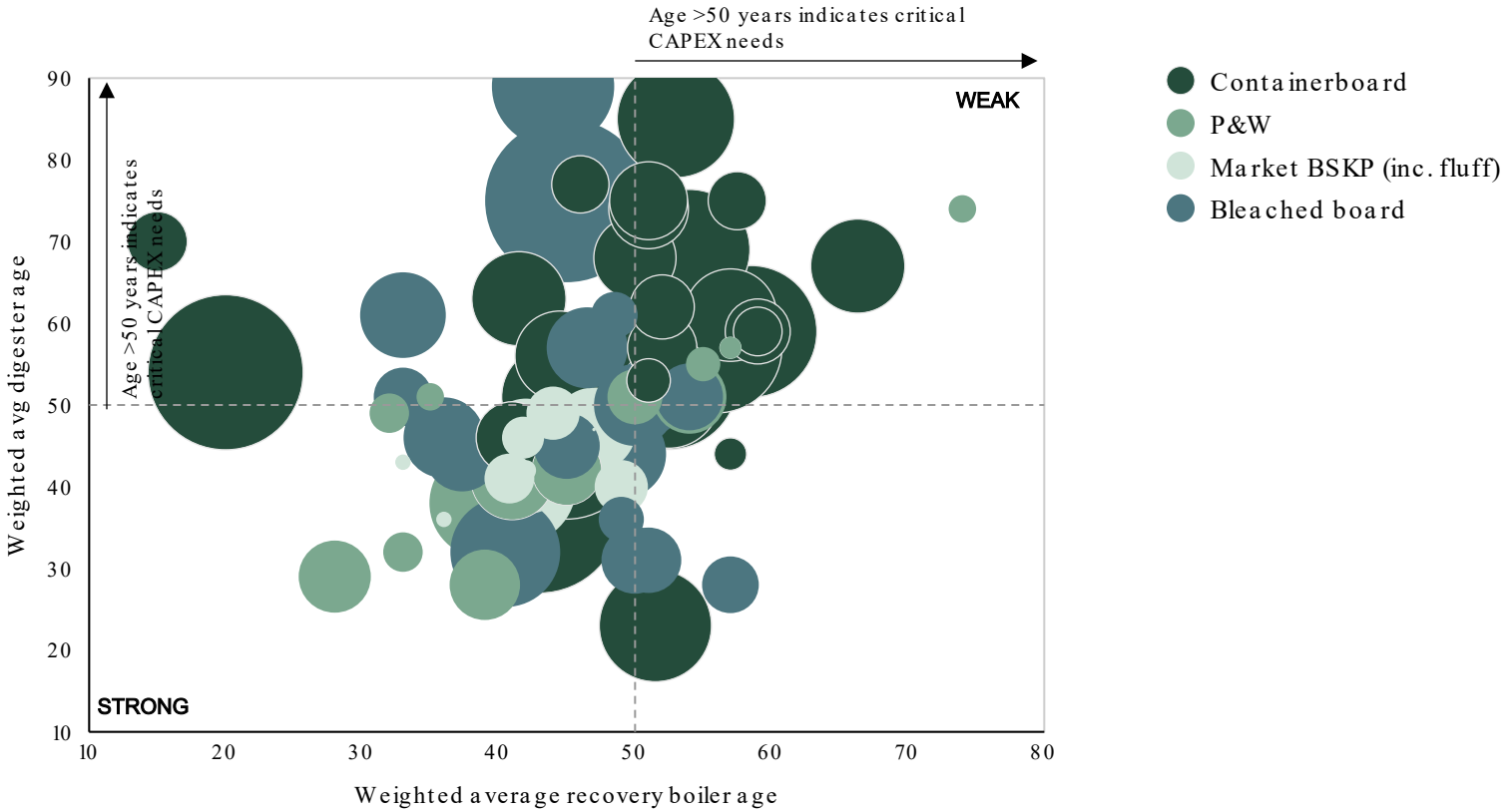
Recovery boilers at U.S. pulp mills are aging and require reinvestment – 50 recovery boilers, representing 41%, have been operational for more than 50 years

Age profile of U.S. pulp mill recovery boiler and digester age



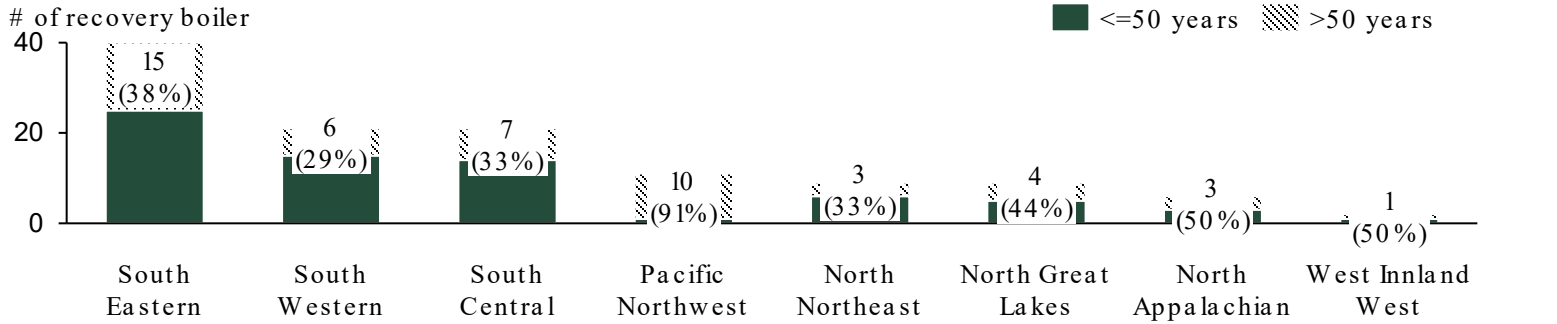
Source: AFRY SMART.

Recovery boilers

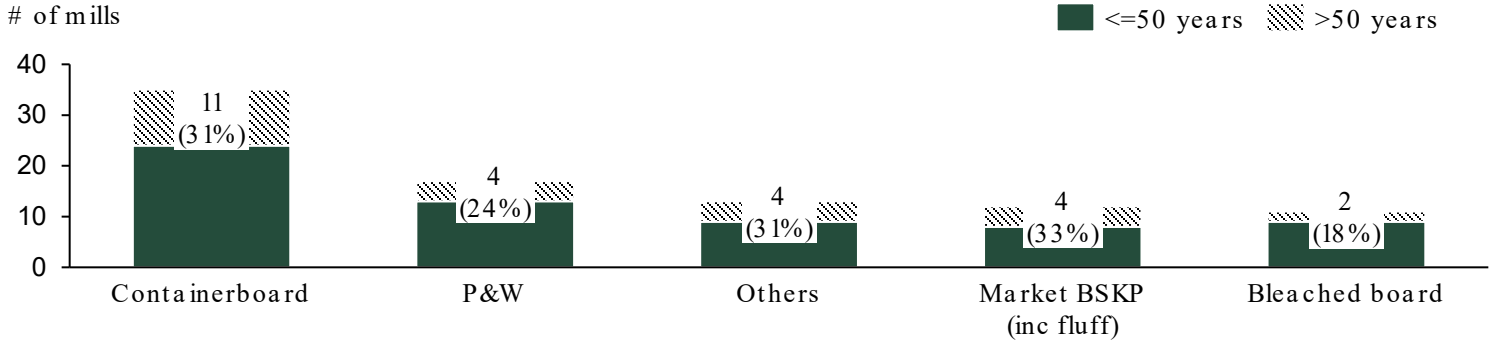
- There are 121 recovery boilers at the 89 pulp mills in the U.S. 41% of the mills have recovery boiler age >50 years
- When recovery boilers reach 50 years of service, substantial investments and replacements are typically needed within 5 to 10 years. Capex between $500 million and over $1 billion may be needed, or rising maintenance costs and needs can disrupt the mill's operations, efficiency and competitiveness.
- Average recovery boiler age by region:
  - U.S.: 45 years
  - Europe: 31 years
  - Latin America: 20 years
  - China: 10 years

Recovery boilers are aging at mills across the U.S., with many of the containerboard mills operating boilers that have been in use for more than 50 years

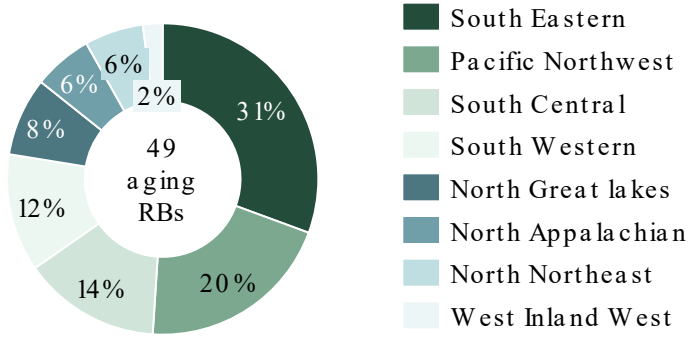
U.S. recovery boiler age by region



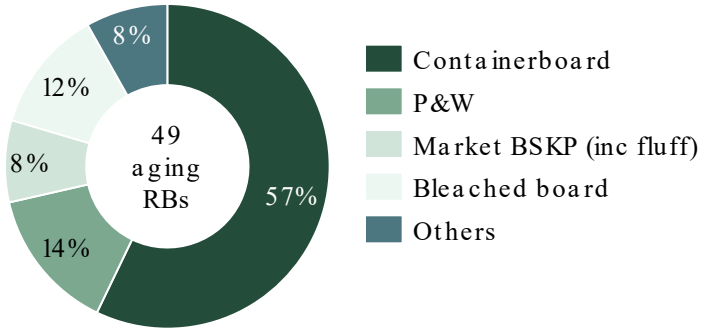
U.S. recovery boiler age by mill main product market



Recovery boiler age > 50 yr by region



Recovery boiler age >50 yr by grade



Source: AFRY SMART.

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Techno-economic mill risk profiles point to continued mill rationalization risk particularly among mills producing Printing & Writing papers and virgin fiber fluting

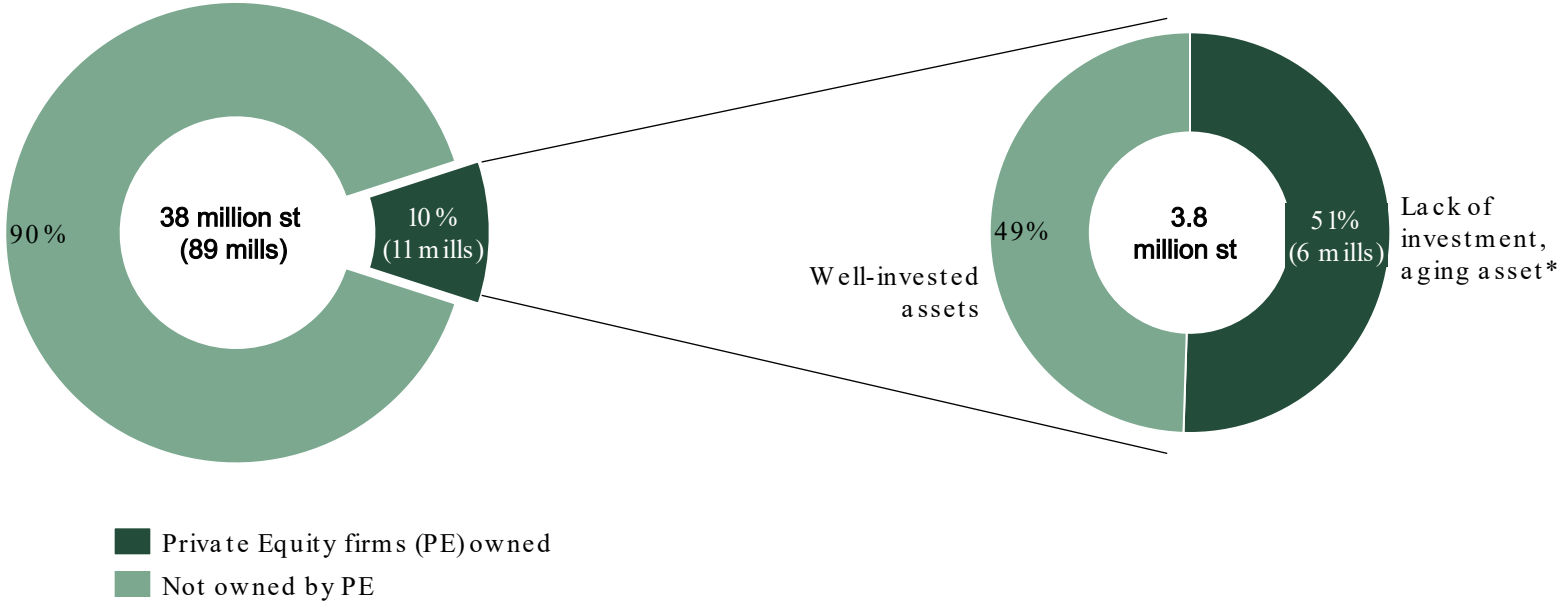
Risk levels: Low risk | Limited risk | Moderate risk | Elevated risk

Key grades	Pulp capacity (million st) | number of mills	Mill techno-economic profile scoring: Mills with major CAPEX needs	Mill techno-economic profile scoring: Mill operational quality	Mill techno-economic profile scoring: Market supply demand balance	Risk level by pulp capacity	Sawmill risk exposed capacity (000 ft ^{3})*
Containerboard (Including white-top liner)	18 | 31				37% / 45% / 15% / 2%	440
Virgin fiber fluting (NSSC)	6 | 12				49% / 37% / 14%	460
Printing & Writing Papers	7 | 19				46% / 29% / 12% / 13%	26
Bleached cartonboard	7 | 13				42% / 42% / 10% / 7%	110
Market Bleached Softwood Kraft Pulp	8 | 13				60% / 12% / 21% / 6%	410
Market Fluff Pulp	7 | 12				48% / 52%	0

Source: AFRY Smart. Some manufacturers produce multiple key grades.in the same mill. Some sawmills might be impacted by more than one mill closure. *) Sawmills within 75 miles of moderate/elevated risk mills

Roughly 10% of theoperating wood-consuming pulp mills in the U.S. are owned by private equity – half of them have pending major capex

Operating wood pulp consuming mills in the U.S. by ownership



Limited PE ownership among the operating mills

- Private equity owns only about 10% of operating pulp & paper mill capacity – mainly in fluff (2.5 million st) and Printing & Writing (1.0 million st).
- Most of PE-owned mills are owned by American Industrial Partners (AIP) following its late-2025 acquisition of International Paper's market pulp business.

Half of the PE owned assets need critical CAPEX

- 6 out of the 11 PE-owned mills have recovery boilers or digesters more than 50 years in service.
- The mills mainly produce market fluff and UFS and are located in the north northeast and south eastern regions

Source: AFRY SMART; Note: Total capacity based on total wood pulp capacity. *) major CAPEX needed for either recovery boilers or digesters are considered as lack of investment, aging assets

Current policy efforts are directionally supportive of the U.S. forest products sector, but their ability to prevent mill closures - particularly in the near term - is constrained

Key policy wins

Land access and permitting reforms	Trade protection: section 232	Renewable Fuel Standard (RFS) expansion	Timber Production Expansion Program (TPEP) / SAWMILL Act	Supply predictability: Fix Our Forests Act (FOFA)

Recent federal policy actions—spanning forest access, trade, biofuels, and industry support—represent a shift in the U.S. wood products landscape. However, while these measures collectively demonstrate strong policy momentum, their **near-term impact on mill viability is often limited.**

"Disconnect" between federal policy wins and actual mill activity because:

- **Land -access/permitting reforms** help federal-land softwood systems, but limited support on hardwood mills;
- **Trade protection** does not mitigate the demand-side drivers behind wood pulp mill closures;
- **Renewable Fuel Standard (RFS) expansion** may help wood-derived feedstocks, but only slowly;
- **Timber Production Expansion Program (TPEP) / SAWMILL Act** are more directly targeted to mill capital constraints - but available funding remains modest relative to the scale of mill attrition;
- **The pending Fix Our Forests Act (FOFA)** improves supply predictability with some caveats that could potentially weaken county fiscal benefits tied to timber revenues

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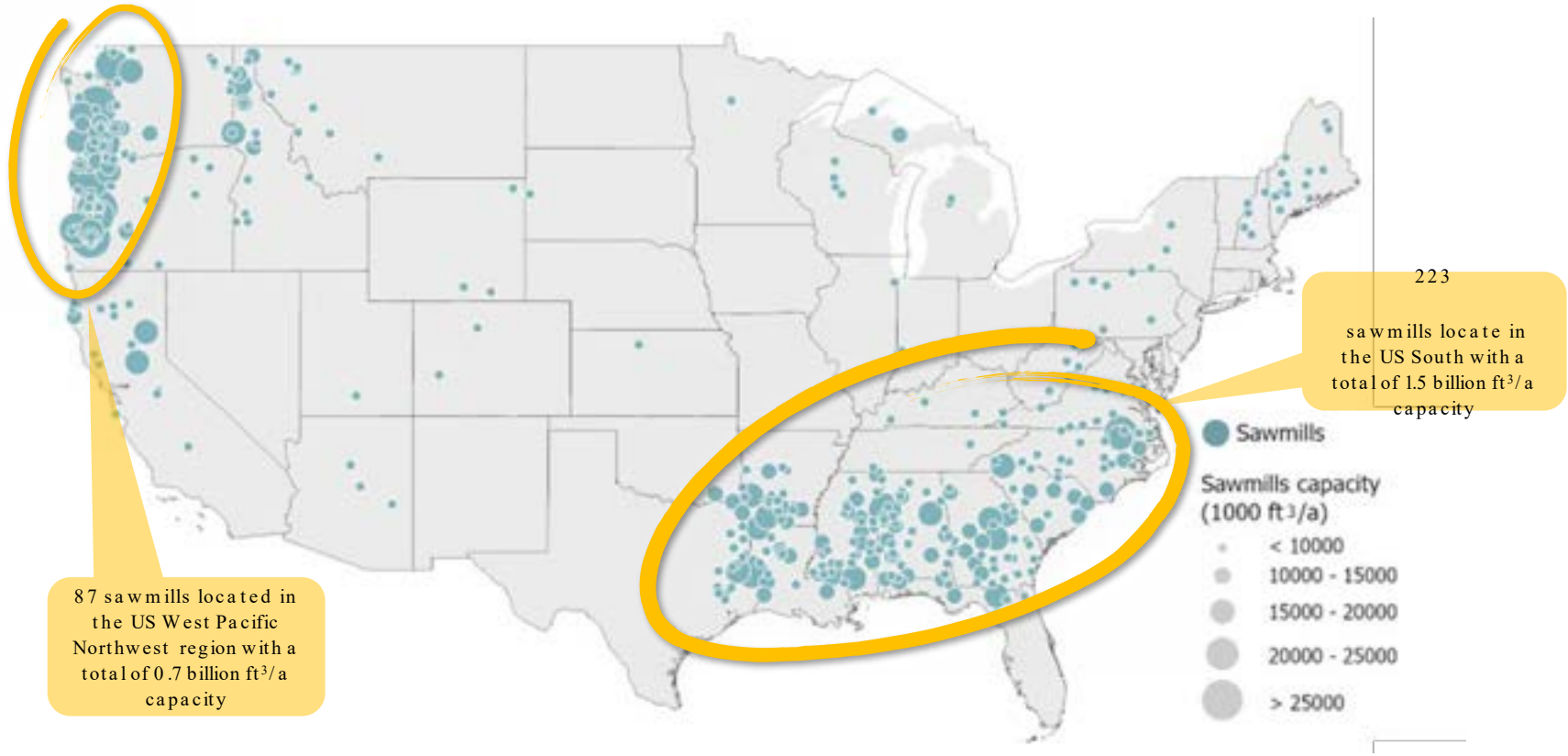
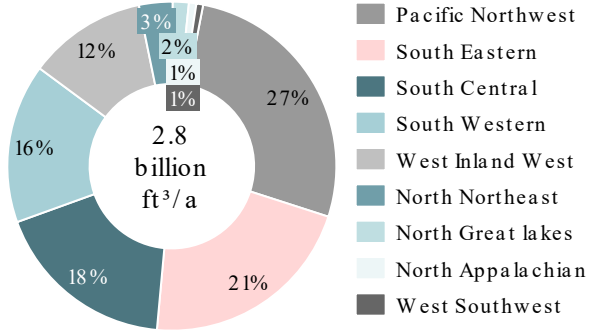
Out of the approximately 414 sawmills in the U.S., more than 70% are located in the Pacific Northwest or in the U.S. South

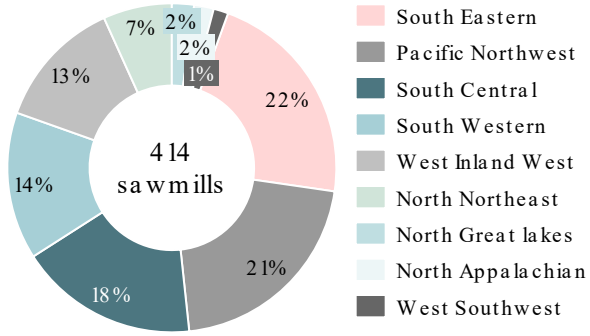
U.S. operating sawmills



Sawmill regional split by capacity



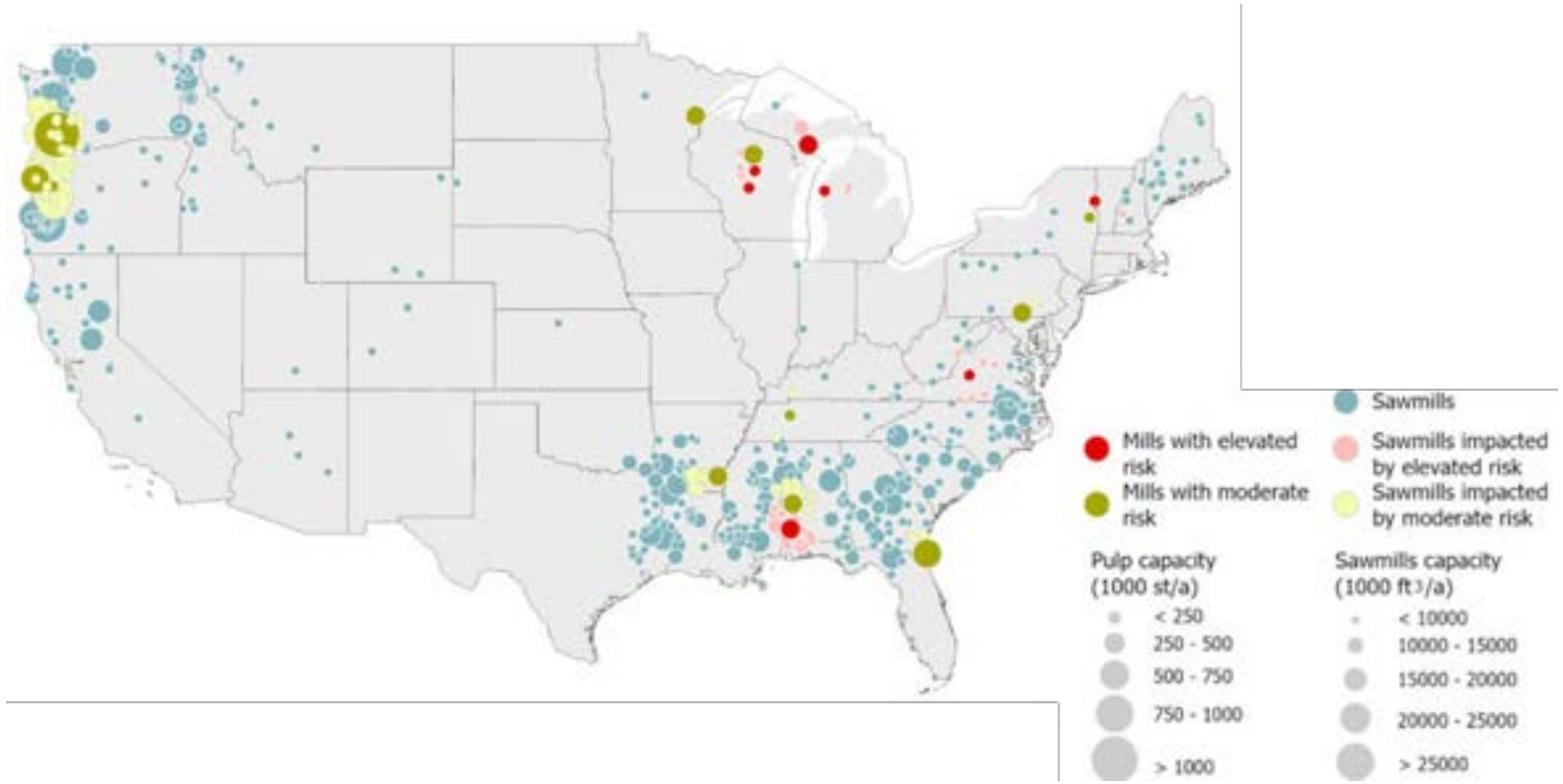
Sawmill regional split by # of mills



Source: AFRY SMART. Sawmills with capacity below 1.1 thousand ft³ were excluded

Almost 30% of the U.S. sawmills capacity is located within 75 miles of the pulp & paper mills with elevated or moderate medium-term risk of closure due to mill techno-economics

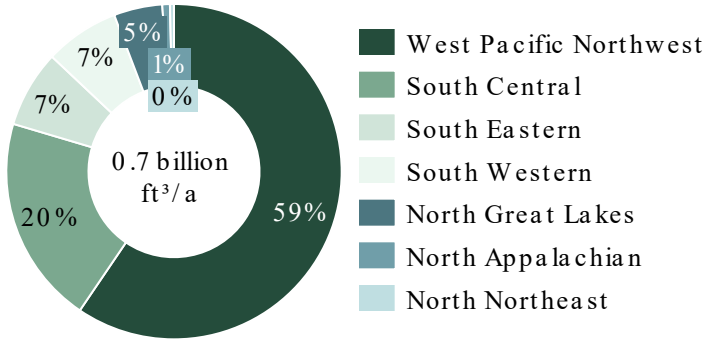
U.S. sawmills and wood consuming pulp & paper mill with elevated risk of closure by 2030



Pulp mill core chip sourcing zone: 50 -75 miles

- Most pulp mills source wood within 50-150 miles - 50-75 miles being the sweet spot.
- There are 95 sawmills with a capacity of 0.7 billion ft³/a in the sourcing zone of pulp & paper mills with elevated or moderate medium-term closure risk – Pacific Northwest region sawmills have the highest exposure (0.4 billion ft³/a).

Sawmills exposed to mills with closure risk by capacity



Source: AFRY SMART. Sawmills with capacity below 1.1 thousand ft³ were excluded

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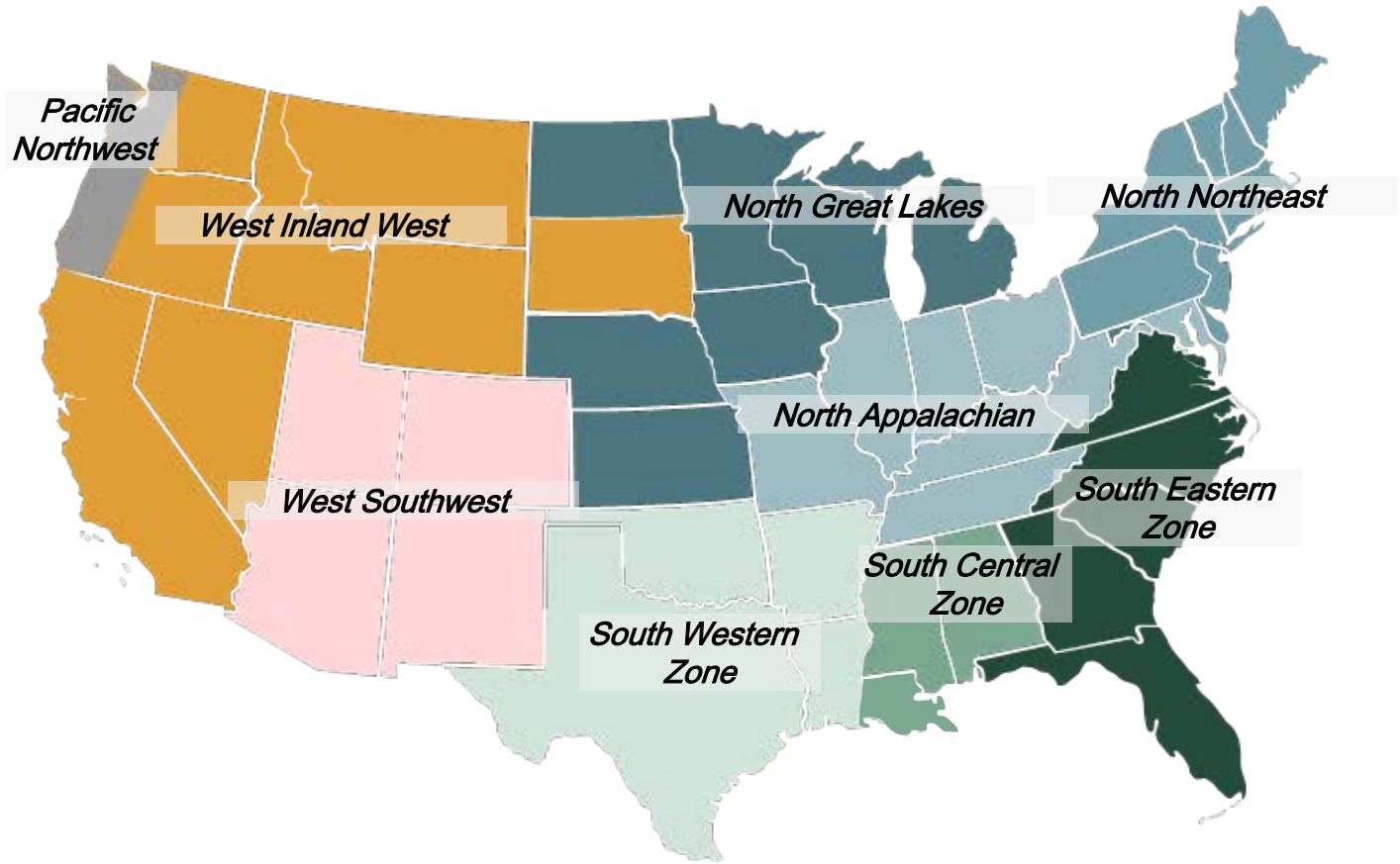
Techno-economic viability assessment of the U.S. wood consuming pulp & paper industry

Pulp and paper grade definitions

Market sectors	Key subgrades	Examples of products
Virgin containerboard	• Unbleached (Unbl.) kraftliner • White top liner (WTL) is a linerboard grade with a white top ply (made from bleached pulp or coated), combined with a brown base. • NSSC: neutral sulphite semi-chemical fluting/corrugating medium	  
P&W (Printing & Writing paper)	• UFS (uncoated free sheet) is an uncoated P&W paper made from chemical pulp (free of mechanical pulp). Commonly used for copy paper, office paper, books, and manuals, valued for good printability. • CFS (coated free sheet) is a coated P&W paper made from chemical pulp, with a coating layer to enhance brightness and smoothness. Used mainly for magazines, catalogs, direct mail, and high-quality books.	 
Market BSKP	• Market BSKP refers to bleached softwood kraft pulp sold on the open market. It is produced mainly from softwood species and is valued for its long fibers, high tensile strength, and reinforcement properties. It's widely used in printing & writing papers, tissue, specialty paper	
Market fluff	• Market fluff pulp is a grade of bleached chemical softwood pulp sold on the open market and engineered for high absorbency, bulk, and softness. It is primarily used in absorbent hygiene products such as baby diapers, adult incontinence products, and feminine hygiene items.	 
Bleached board	• Bleached board is a paperboard grade produced primarily from bleached chemical pulp, resulting in a white or light-colored surface with good strength and printability. It is used in packaging applications where appearance, hygiene, and brand presentation are critical.	 

U.S. regional definitions



Region	States
Pacific Northeast	OR (Pacific coast region), WA (Pacific coast region)
West Inland West	CA, ID, MT, NV, OR (interior region), SD, WA (interior region), WY
West Southwest	AZ, CO, NM, UT
North Great Lakes	IA, KS, MI, MN, ND, NE, WI
North Appalachian	IL, IN, KY, MD, MO, OH, TN, WV
North Northeast	CT, DE, MA, ME, NH, NJ , NY, PA, RI
South Western Zone	AR, LA (West), OK, TX
South Central Zone	LA (East), MS
South Eastern Zone	FL, GA, NC, SC, VA

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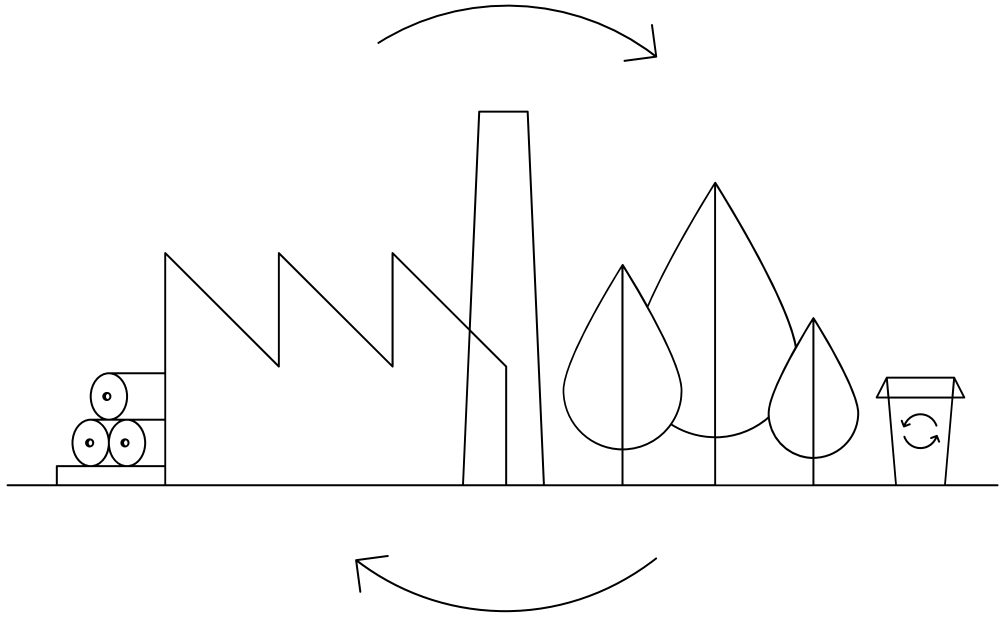


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