SWST – International Society of Wood Science and Technology

Special Issue: Scaling up Innovation for Sustainable Value Creation

BIOPRODUCTS BUSINESS

Innovation and R&D: Contrasting the US and Nordic Europe forest sectors

Eric Hansen[1]*, Connor Dederich[2], Isobel Read[3], Ivana Zivojinovic[4]

Abstract: Forests and wood products are increasingly recognized as potential contributors to global sustainability goals, and innovation is emphasized as essential for the sector to contribute to sustainability, but questions remain regarding the sector's capacity for innovation and research and development (R&D). This work utilizes content analysis of annual and sustainability reports from the 20 largest (based on sales) publicly-held companies in Nordic Europe and the US to explore differences in their approach to communication regarding innovation, innovativeness, and R&D. We find that Nordic European companies are more likely to emphasize both innovation and R&D than US companies. Overall, firms are most focused on sustainability-oriented narratives when presenting their innovation work. Collaboration with customers and stakeholders for innovation is emphasized, whereas explicit cross-sector collaboration is rarely mentioned. Our findings provide a foundation for future research into the innovation practices of forest sector firms and into how public reporting frames innovation and R&D.

Keywords: Innovation, Research & Development, Forest Sector.

1. Introduction

Recent decades have seen forest sector firms on the defensive, the target of environmental, non-governmental organizations (ENGOs), regulators, and at times, the citizenry. Pressures toward the forest industry began to mount in the 1980s around water pollution, especially dioxin resulting from pulp bleaching operations (Bergquist and Söderholm 2015). In the 1990s, the focus transitioned to sustainable forestry and forest certification, with certification systems proliferating around the globe. Today companies are dealing with issues around carbon, Sustainable Development Goals, and biodiversity impacts. As new issues arise, companies have repeatedly been on the back foot, defending themselves against claims of bad behavior.

Despite its historical battles with external critics, in the last decade, the sector has experienced a renaissance of sorts, as forests and wood products have been recognized as potentially important contributors to climate change mitigation (Nabuurs et al. 2023). While ENGOs tend to be critics of forest sector companies (Šimunović et al. 2018), there are many examples of ongoing collaboration (e.g., Weyerhaeuser and The Nature Conservancy are actively collaborating on ecosystem restoration). And, there is growing interest and recognition among policymakers who are now driving policies that favor the use of wood for

1. Professor and Department Head, Department of Wood Science and Engineering, Oregon State University, Corvallis, OR. Email: eric.hansen@oregonstate.edu

2. Undergraduate student, Oregon State University, Corvallis, OR. Email: dedericc@oregonstate.edu

3. Undergraduate student, University of Washington, Seattle, WA. Email: isobelre@uw.edu

4. Institute of Forest, Environmental and Natural Resources Policy, Centre for Bioeconomy, University of Natural Resources and Life Sciences, Vienna Email: ivana.zivojinovic@boku.ac.at

* Corresponding author

BioProducts Business 11(2), 2026, pp. 21–34. ISSN 2378-1394
https://doi.org/10.22382/bpb-2026-002

energy production and in the built environment (e.g., New European Bauhaus). Many architects embrace wood for building construction, especially mass timber in taller buildings (e.g., Michael Green Architects, Vancouver, BC, Canada). The general atmosphere in the sector is more positive today than at any time in recent decades, despite pushback in places like Finland, where increased harvests in the pursuit of bioeconomy policies are increasingly being criticized (Toivanen 2021).

The literature is replete with calls for increased innovation in the forest sector (FAO 2024), both as a means to embrace societal positivity toward the sector and as a way of renewal, moving away from a commodity and process innovation orientation (Weiss et al. 2020). Given this context, this work explores the innovation and research and development (R&D) context of the top, publicly-held companies in the US and Nordic Europe with a goal of describing differences in the approach taken between the two geographical areas. There is a tendency in the US forest sector to look to Europe, especially Nordic Europe, as the horizon from which trends and significant innovations emerge (Hansen et al. 2007). The literature suggests that European companies in low-tech sectors invest more heavily in R&D than their US counterparts (Moncada-Paternò-Castello and Grassano 2022). Specific to the forest sector, Nordic companies appear to be more innovative and to invest more in R&D than their US counterparts. Are the perceived differences manifest in practice, however, or do they primarily reflect differences in reporting and communication style? While the descriptive approach used in this study, based on content analysis of company annual and sustainability reports, cannot fully answer this question, an analysis of the nature of communication provides important insights into the sectors and sets the stage for future work that can more fully explore why there are differences between how Nordic European and US firms communicate about their innovation and R&D activities. Ultimately, future work can explore the genuine innovation and R&D differences between companies in the two locations. Accordingly, we ask:

(RQ1) How extensively and in what contexts do top US and Nordic forest-sector firms communicate about innovation and R&D in their public reports?

(RQ2) Which thematic frames most commonly accompany reference to innovation and R&D by the sampled firms?

Beyond these questions, we also interpret and position these observed disclosure patterns within the broader innovation literature and suggest how corporate social responsibility (CSR) and financial reports might be refined to better reflect firms' innovation capacities and purpose.

Prior comparative studies have contrasted forest-sector disclosure across regions, documenting cross-national differences in corporate social responsiveness and reporting (Mikkilä and Toppinen 2008; Vidal and Kozak 2008; Li et al. 2011). Our paper builds on that literature by focusing specifically on innovation and R&D language within annual and sustainability reports (rather than CSR reporting in general). We explore the framing of innovation within the immediate contexts in which it appears (e.g., sustainability, collaboration, culture). We also compare the two regional samples cautiously, treating differences in disclosure as suggestive, rather than direct evidence of underlying innovation capacity (Cohen and Levinthal 1990; Teece et al. 1997; O'Reilly and Tushman 2013).

2. Background

The forest sector is an important part of the US and Norwegian economies, but relatively more important in Finland and Sweden. Forests cover 66% of the land base in Finland, followed by 53% in Sweden, 31% in the US, and 20% in Norway (Our World in Data 2025). Total forest area is 310 million hectares in the US, 22 million in Finland, 28.0 million in Sweden, and 12 million hectares in Norway (Our World in Data 2025). Overall employment in the US forest sector, not including those employed by wholesalers, is 956,207, or 0.6% of the workforce (BLS 2025). The equivalent values for Sweden, Finland, and Norway are 72,429/1.5% (Statistics Sweden 2021), 48,182/2.1% (Statistics Finland 2023), and 16,880/0.6% (Statistics Norway 2024).

Forest sector companies are typically considered to be "traditional" and focused on low-cost strategies (Hayter and Clapp 2020; Hansen et al. 2015; Näyhä and Pesonen 2014; Rich 1986), lacking a refined market or customer orientation (Han and Hansen

2016; Cohen and Kozak 2002), and evidence points to European companies being more market and customer oriented than their US peers (Hansen et al. 2007). Calls have been made for a transformation in the culture of the sector (Innes 2009), and it is generally recognized that ongoing forest sector innovation is critical to maintain viability (Wise and Parker 2025; Homyack et al. 2022; Näyhä 2019; Binkley 1993). This sentiment is far from new (Hurd 1965). It has been understood for some time, at least in North America, that the sector suffers from under-investment in innovation (Binkley 1995). This is said to be a result of risk aversion, cost, the policy environment, a deficit in training for necessary skills, and a long-term focus on process innovation and cost cutting (Innes 2009). Meanwhile, a host of structural changes are resulting in an increasingly complex operational environment for companies in the sector, necessitating new product development (Weiss et al. 2021; Näyhä 2019).

3. Theoretical background

3.1 Forest sector R&D

While there is no one story of R&D in the forest sector, there are similarities in disinvestment in R&D over recent decades. During the decade beginning in 2000, in western Europe, North America, and Japan, the largest pulp and paper companies invested 1.3% or less of sales in R&D. Personal care and specialty paper companies averaged 1.3%, while packaging and pulp and paper were even lower, at 0.5% of sales. In addition to this, the rate of investment in personal care and specialty paper consistently decreased over that decade (Hujala et al. 2015). Evolution of R&D in Canada has been described in three stages, the first involved federal government efforts focused on processing efficiencies. The second stage saw significant investment in in-house R&D by large corporations. The focus remained on processing, though some new products (e.g., Parallam®) were commercialized. In the third stage, structural changes in the industry, along with a variety of other external forces, drove disinvestment from in-house R&D programs (Hayter and Clapp 2020).

Structural changes drove dramatic disinvestment in R&D programs in US companies (McGinley et al. 2019), starting in the early 1980s (Kellison 2014). Globalization and corporate mergers played a role in the reduction in R&D. As an example, in 1998 International Paper employed 250 R&D personnel. In the following years, the company absorbed 120 R&D employees of Union Camp Corporation and 100 of Champion International. Soon after those acquisitions, the number of R&D personnel had reverted back to 250, by 2005 was reduced to 100, and by the late 2010s was fewer than a dozen (Kellison 2014). Indications are that since 2010, industrial investment in R&D has shrunk further (McGinley et al. 2019). Evidence shows that a tendency toward process innovation remains, even in the context of bioeconomy innovation-related projects (Lovrić et al. 2020). Another structural change in the context of the US is a shift to forestland ownership by timberland investment management organizations and real estate investment trusts (Kellison 2014), neither of which have significant long-term interests in manufacturing or product R&D. The forest sector innovation system in the US has continued to dwindle, as the number of scientists declined by 12% between 2002 and 2016 (Homyack et al. 2022), and the research spending among Sustainable Forestry Initiative companies fell from $102 million to $62 million between 2007 and 2014. If the US invested in R&D at the same rate as Finland, its investment would be 10 times greater (McGinley et al. 2019). Other more developed regions were unable to avoid similar trends, with, for example, Australia experiencing similar disinvestment in forest sector R&D in the 2000s (Pinkard and O'Grady 2016).

Absorptive capacity emphasizes how prior related knowledge and R&D staff shape a firm's ability to recognize, assimilate, and apply external knowledge (Cohen and Levinthal 1990). Dynamic capabilities refer to how firms sense, seize, and transform in turbulent contexts (Teece et al. 1997). Organizational ambidexterity, meanwhile, addresses tensions between improving existing operations and exploring new offerings and markets (O'Reilly and Tushman 2013). In the forest sector literature, these lenses appear in complementary ways: studies of absorptive capacity and knowledge-network linkages show how multinational-local ties and firm-level capability bases condition the ability to create, absorb, and use new knowledge in the forest sector (Korhonen and Niemelä 2005). Work on dynamic capabilities

highlights how bioeconomy transitions in both incumbents and small and medium-sized enterprises (SMEs) are underpinned by sensing-seizing-reconfiguring processes that shape innovation outcomes (Näyhä 2020; Laakkonen et al. 2025). Research on organizational ambidexterity in this sector shows that "hybrid" competitive strategies among forest sector firms link the exploration-exploitation balance to performance (Hansen et al. 2015).

Together, these perspectives connect firm-level capability building to sector-level innovation trajectories and governance (Weiss et al. 2020; Weiss et al. 2021), as well as evidence that cross-sector collaboration is a mechanism through which such capabilities are built and leveraged (Guerrero and Hansen 2021). Debates in the literature also raise concerns that the loss or outsourcing of R&D operations and associated scientific personnel can erode firms' expertise and absorptive capacity, potentially constraining their ability to engage in more science-based forms of innovation (Hayter and Clapp 2020), even as there are growing examples of successful R&D, innovation, and the commercialization of wood-based products ranging from energy to biocomposites to pharmaceuticals (Näyhä 2019).

3.2 Reporting differences, US versus EU

There are meaningful differences in the required financial reporting between the US and EU. In the US, the Financial Accounting Standards Board governs what are known as "generally accepted accounting principles" (GAAP), whereas in Europe, the International Accounting Standards Board creates the International Financial Reporting Standards (IFRS). The two are known to be rules-based versus principles-based (Investopedia 2025). With respect to R&D, IFRS standards require research costs to be expensed, but development expenditures are required to be capitalized when certain criteria are met. Under GAAP rules, both research and development costs are expensed as they occur (Zielhoff and Wojtanek 2025).

In sustainability disclosure, the EU (including Finland and Sweden) is moving on a mandatory, double-materiality footing under the Corporate Sustainability Reporting Directive (CSRD) and European Sustainability Reporting Standards (ESRS), with the first in-scope companies reporting on fiscal year 2024 in 2025 and linking to EU Taxonomy key performance indicators (KPIs), for example, turnover, CapEx, OpEx (European Commission 2025). In the US, the Securities and Exchange Commission has signaled a move away from environmental, social, and governance (ESG) reporting mandates. However, California's climate-related disclosure requirements will drive reporting in this area (Tonello 2025).

Ultimately, regardless of specific reporting requirements, companies considered in this study have considerable freedom in how they communicate their operations and impacts. Internal culture and societal/contextual norms will influence communication strategies.

4. Methods

Obtaining a list of the largest (based on sales), publicly-held companies in the US and Nordic Europe was surprisingly challenging. We began by utilizing ChatGPT and Microsoft Copilot. Although these tools were somewhat useful, they were consistently inaccurate, for example, by including privately held companies (e.g., Georgia Pacific). A list of the top 100 global pulp and paper companies from Newton Consulting (Newton 2022) was the most useful, published source. Finally, we relied on expert informants to quality check our assembled list of companies: four experts from Finland, two from the US, and one from South America. To keep data analysis manageable, we limited our sample to 10 companies from each region, chosen to be balanced between the regions, despite the obvious size differences. Most of the 20 companies (see Table 1) are primarily focused on business-to-business markets, but several also have strong consumer brands and operate in the business-to-consumer space.

For each of the 20 companies, the most recent annual and sustainability (ESG) reports (English versions) were downloaded in PDF format from each company web site. All but two reports are from 2023, with sustainability reports from US companies Boise Cascade and Sonoco being from 2024. Six companies, all from the Nordic region, combine financial and sustainability reports in one document, resulting in 34 total documents for the 20 companies. Annual and sustainability reports fulfill multiple roles for companies, one being public relations. This aspect of the reporting process and how it influences what

Table 1. Top US and Nordic Europe forest sector companies and their communication around innovation and R&D.

Companies	Country	2023 Sales ($m)	Number of occurrences of term in company reports, Annual+Sustainability[8]			
			Innovation	Innovative	R&D	Research and development
Kimberly Clark	USA	$20.4	12+17	4+13	1+1	5+2
WestRock	USA	$20.3	19+22	4+5	0+0	1+0
International Paper	USA	$18.9	3+21	7+16	0+0	0+2
Graphic Packaging	USA	$9.4	15+71[5]	3+13	1+8	0+1
Packaging Corp. of America	USA	$7.8	3+5	2+5	0+0	0+0
Weyerhaeuser	USA	$7.7	7+8	1+9	0+0	2+0
Sonoco Products	USA	$7.3	4+15	3+4	0+3	6+1
Universal Forest Products	USA	$7.2	4+2	2+1	0+0	2+1
Boise Cascade	USA	$6.8	8+2	2+1	0+0	0+0
Sylvamo	USA	$3.7	1+0	1+0	0+0	0+0
Total		$109.5	239	96	14	23
Total			335		37	
UPM-Kymmene[4]	Finland	$9.2[1]	33	23	42	19
Stora Enso[4]	Finland	$8.2[1]	43[6]	8	7[6]	12
Metsä Group	Finland	$5.3[1]	20+3	2+0	9+0	27+0
Billerud[4]	Sweden	$4.3[2]	15	5	0	0
Södra[4]	Sweden	$3.0[2]	58	4	7	19
Ahlstrom Oy-3	Finland	$2.6[1]	18+66	1+7	8+11	3+1
Holmen[4]	Sweden	$2.4[2]	2	5	0	6
SCA[4]	Sweden	$1.9[2]	17	0	4	4
Moelven	Norway	$1.3[3]	17+6	2+1	0+0	3+1
Norske Skog@	Norway	$1.3[3]	26+[7]	4+[7]	2+[7]	4+[7]
Total		$39.5	324	62	88	99
Total			386		187	

1 0.874 Euro = $1 dollar; converted using xe.com.
2 9.53 Swedish Kronor = $1 dollar; converted using xe.com.
3 10.08 Norwegian Krone = $1 dollar; converted using xe.com.
4 Billerud, Holmen, SCA, Stora Enso, Södra, and UPM-Kymmene: annual and sustainability reports combined.
5 An additional 10 instances appear in table footnotes.
6 An additional 27 instances appear in tables of content.
7 23/3/2/2 instances appear in sustainability report, but the text is completely duplicated between annual and sustainability report.
8 Boise and Sonoco sustainability reports are for 2024.

companies communicate should be kept in mind when considering our results. The analysis process was iterative, beginning with an exploratory reading of 2022 reports to become familiar with the general use of the terms and the foci of the companies. The qualitative analysis software NVivo was used to analyze the content of all reports. Each occurrence of the terms: innovation, innovative, R&D, and research and development was considered to identify the general context of its use. The lead author, as sole coder, assigned a contextual theme to each occurrence of the four terms. The first round of formal coding of the 2023 reports resulted in 28 total themes being created. Careful consideration of these and their frequency of occurrence resulted in a narrowing to six final themes (Table 1). Final selection was based on the frequency of occurrence (greater than 20), consolidation of the categories, "strategy" and "competitiveness", and elimination of categories deemed to be insufficiently related to the study research

Table 2. Study themes, description, and example quotation.

Theme	Our understanding	Example quote
Sustainability focus Coded 123 times	Innovation tied to climate/circular/bioeconomy goals; side-stream valorization, recyclability, lifecycle claims	"Circular bioeconomy is at the core of our operations." [UPM]
Collaboration Coded 71 times	Innovation framed as joint work with customers, suppliers, universities, and NGOs; co-development, pilots, and partnerships	"In close contact with customers and suppliers, SCA is driving structured innovation work based on the company's strategy and sustainability platform." [SCA]
Strategy/competitiveness Coded 48 times	Reference to corporate strategy or the way the firm competes in the marketplace	"The primary basis for competition for most of our packaging products includes quality, service, price, product design, and innovation." [Norske Skog]
Innovative solutions Coded 36 times	Frequent use of "innovative solutions" to frame customer value and market positioning	"The company develops innovative packaging solutions that create better consumer experiences with less environmental impact." [Metsä]
Culture Coded 33 times	Statements on high-performance, inclusion, and innovation culture; R&D as part of ways of working	"Every day we draw on our spirit of innovation, partnerships and collaboration." [WestRock]
Diversity impacts Coded 20 times	Diversity framed as an enabler of innovation, safety, and license to operate	"Finding innovative solutions requires diverse thinking and diverse people and this is at the heart of who we are." [Ahlstrom]

questions (e.g., Awards, R&D Expenditure, and New Offerings).

In many cases, text could have been coded under more than one theme. For example, the following text—"In close contact with customers and suppliers, SCA is driving structured innovation work based on the company's strategy and sustainability platform."—could have been coded under "collaboration", "strategy/competitive advantage", or "sustainability focus", but was ultimately assigned to "strategy/competitive advantage" as being most closely connected. Table 2 provides a general explanation of the six themes along with example quotations.

5. Results

There is a striking difference between the two regions with respect to communication about innovation and R&D. Table 1 provides an overview of the companies, their size based on total sales, and the frequency with which the terms occur within their respective reports. Nordic companies reference "R&D"/"research and development" about five times as often as US companies (187 vs. 37). In fact, three of the ten US. companies make no mention of R&D within their reports. Billerud is the only Nordic company that fails to mention R&D in their reporting. By contrast, for "innovation"/"innovative" terms the Nordic total is only 15% higher than the US total (386 vs. 335).

While Nordic firms communicate about R&D more frequently than firms in the US, several factors could inflate this gap in disclosure, rather than underlying effort: (i) accounting language, (ii) the prevalence of integrated reports in the Nordic sample, and (iii) communications culture and ESG/regulatory expectations in the EU. These factors likely increase the salience of "development" vocabulary in Nordic reporting, independent of actual lab activity or budgets. We therefore interpret frequency differences as evidence of diverging communication norms and strategic narratives about innovation and NOT as direct measures of innovation input/output.

The plot in Figure 1 contrasts how much each company utilizes innovation (x-axis: innovation + innovative) versus formal R&D language (y-axis: R&D + research & development) in its reporting. Two clear clusters emerge. US firms bunch near the x-axis: they use innovation a lot, but mention R&D far less (typical R&D share ≈ 9% of all mentions). Examples:

- Graphic Packaging (very high innovation, low R&D)
- WestRock and International Paper (innovation-heavy, minimal R&D)

Nordic firms sit higher on the y-axis, pairing innovation talk with substantial R&D framing (average R&D share ≈ 30%). Standouts:

- UPM-Kymmene (high on both; R&D leader)

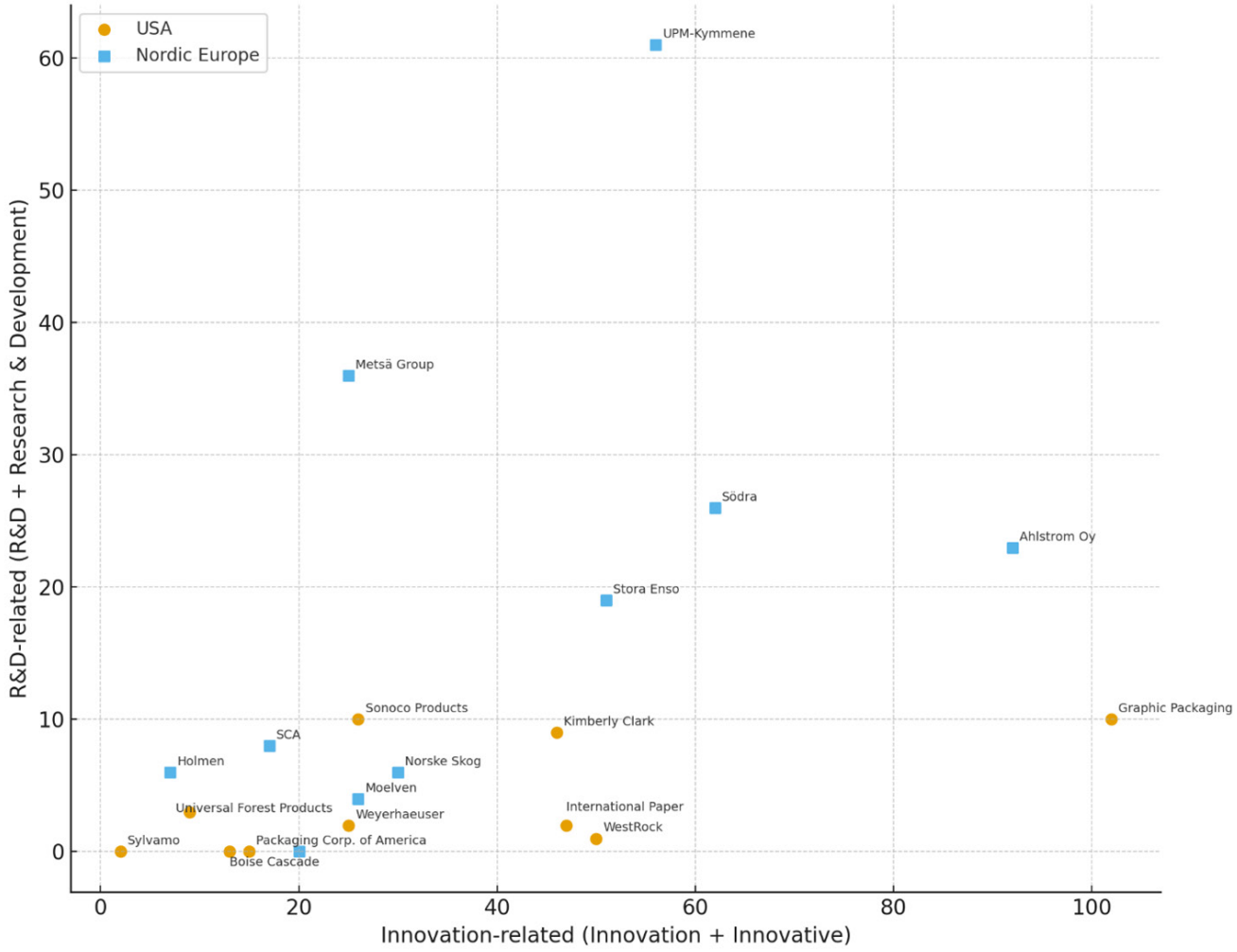

Figure 1. Company use of study terms (innovation, innovative, R&D, and research and development).

- Metsä Group (moderate innovation, high R&D)
- Södra and Ahlstrom (strong innovation with meaningful R&D)

A few exceptions exist. Billerud is innovation-oriented with almost no R&D mentions, while Sonoco is among the few US firms with comparatively more R&D language. Nordic companies systematically anchor innovation messaging in R&D, while US companies emphasize innovation with relatively little explicit R&D framing.

5.1 Sustainability-focus

Companies in both regions were highly focused on sustainability, but Nordic companies were more likely to use sustainability terminology. For example, Nordic companies used "circular bioeconomy" a total of 341 times compared to 164 for US companies. Nordic companies used "sustainability" a total of 3,137 times compared to 1,768 by US companies. Although there was a similar difference between regions with respect to coded text (Nordic 69; US 54), the difference was less pronounced. The focus on innovation and sustainability can be characterized by the following general company statements describing the intended outcomes of their innovation efforts:

> The goal of our research and development work is to create new products and services, exploit new technologies, and ensure the competitiveness of Metsä Group's current business operations. Research and development operations play an important role in the achievement of Metsä Group's sustainability objectives. [Metsä Group]

> "Skog has partly adapted to these changing market dynamics by investing in sustainable production processes, developing innovative eco-friendly products, and demonstrating its commitment to environmental stewardship." [Norske Skog]

> "Our research and development efforts are focused on improving the recyclability of our products and increasing the sourcing of sustainable materials. In the design process we analyze the entire product lifecycle to ensure that materials selection, production processes, consumer use and end-of-life are appropriately considered." [Sonoco]

The emphasis on innovation addresses reductions of impacts (energy and water savings) and more effective utilization, or innovation that, for example, produces environmentally preferable products:

> "…minimizing the environmental impact of our supply chain, innovatively and efficiently utilizing raw materials, and reducing our energy consumption and water usage. We also focus on decreasing waste and greenhouse gas emissions associated with our manufacturing operations." [Ahlstrom]

> "The company can see further opportunities for positive impact, principally as the company's products facilitate the phasing out of fossil carbon. Innovation and changing consumer behavior are expected to promote increased demand for forest-based products and new uses are being explored." [SCA]

> "UPM Biomedicals is at the forefront of innovation, with a particular focus on sustainable biomaterials for life science and clinical applications." [UPM]

Bioeconomy concepts are tightly connected to the sustainability focus of sampled companies. Examples include the following:

> "Circular bioeconomy is at the core of our operations. We have developed innovative ways to reduce and recover waste and to use side streams, residues and recovered materials." [UPM]

> "A strategic R&D programme for converting side streams for use in the circular economy is underway at Metsä Group". [Metsä Group]

> "100% of WestRock's packaging products will be recyclable, compostable or reusable, driving the transition to a more circular economy through cutting-edge innovation." [West Rock]

Most references focus on environmental sustainability, while addressing social sustainability is not common, some companies emphasize social aspects.

> "Provide product innovation and social and community program investments that increase access to sanitation, help children thrive, and empower women and girls." [Kimberly Clark]

> "We are transforming the world of materials by providing sustainable alternatives to fossil-based products. Sustainable forestry plays a key role here: forests are a source of renewable raw materials for a broad range of products, from everyday necessities to ground-breaking innovations. Growing forests are one of the biggest carbon sinks on the planet, second only to oceans. They are also critical to biodiversity and water systems. In everything we do, we care about the prosperity and wellbeing of people, local communities and the societies around us." [UPM]

5.2 Collaboration

Innovation literature emphasizes the value of and need for collaboration in the process of successful innovation. The companies emphasize collaboration, though collaborations with customers and stakeholders are more commonly mentioned than collaborations with firms from other sectors, even though cross-sector collaboration is often suggested as necessary for the forest sector to realize radical innovations (Näyhä 2020; Guerrero and Hansen 2021). References to collaboration were more common among Nordic companies, including collaboration with universities and sector- or EU-wide research and innovation activities/consortia:

> "We actively collaborate with universities, research centres and key industrial partners in the fields of high-throughput drug screening, personalised medicine, cell therapies, 3D bioprinting, tissue engineering and advanced wound care." [UPM]

> "We are also firmly committed to finding innovative, meaningful ways to continually

improve our practices through ongoing scientific research and cross-functional partnerships." [Weyerhaeuser].

"Södra's partnerships with customers, research and strategic innovation partners along the road to the green transition are extremely important." [Södra]

5.3 Innovative solutions

When companies address their new offerings, they typically refer to "innovative solutions." Most references to innovative solutions are in the context of new products, but some refer to, for example, reduction of waste or reduction of environmental impact:

"Consumer Tissue offers a wide variety of innovative solutions and trusted brands that responsibly improve everyday living for families around the world." [Kimberly Clark]

"…the company develops innovative packaging solutions that create better consumer experiences with less environmental impact." [Metsä]

"Today, Sonoco is a global leader in sustainable metal and paper packaging, providing innovative solutions for some of the best known brands worldwide." [Sonoco]

5.4 Culture

The companies project a culture that is people-centric and performance-driven, positioning inclusion, safety, and talent development as levers of competitiveness. They emphasize customer focus, co-creation, and diversity in their employees that helps fuel innovation:

"By fostering an inclusive and high-performance culture, we ensure Graphic Packaging is a great place to work, an innovative leader for our customers, and a strong partner in the communities where we operate." [Graphic Packaging]

"…to cultivate strong leadership, which is critical to fostering a culture of collaboration, accountability, and agility that supports these goals. We believe that attracting and retaining top talent and building a culture of excellence, innovation, and engagement is essential to our success." [Stora Enso]

"Every day we draw on our spirit of innovation, partnerships with customers and leadership in fiber-based packaging to advance our targets and create a more circular economy." [West Rock]

5.5 Strategy/competitiveness

US-based firms commonly describe the competitive landscape within which they operate. For example, Kimberly Clark states, "The principal methods and elements of competition include brand recognition and loyalty, product innovation, quality and performance, price, and marketing and distribution capabilities." The approach taken to address such issues was not typically called out explicitly in the reports. Innovation and new product development are often mentioned as ways of securing long-term competitiveness. Corporate strategies and approaches to competition were not often mentioned, something that was surprising, given the nature of reporting as one means of signaling the desirability of the company as a target of investment:

"Leadership in Innovation and Sustainability Innovation and sustainability are fundamental to our business, and we strengthened our leadership role in these areas during fiscal 2023." [West Rock]

"At Sonoco, sustainability, innovation and responsible growth are at the core of our business strategy." [Sonoco]

"The primary basis for competition for most of our packaging products includes quality, service, price, product design, and innovation. [Packaging Corp]

5.6 Diversity impacts

Managed well, greater diversity of personnel can create more innovative organizations and can improve company financial performance (Hansen et al. 2016). Companies included in the study clearly recognize this phenomenon and emphasize their aspirations to maintain a diverse workforce. These statements show that diversity is framed not just as a values statement, but as an operating capability that fuels innovation, safety, and license to operate in local communities, and provides an enhanced understanding of the customer base:

> "Finding innovative solutions requires diverse thinking and diverse people and this is at the heart of who we are." [Ahlstrom]

> "In 2023, we added Include and Engage as a new core value because we believe in an inclusive workforce, where employees of diverse backgrounds and perspectives are represented, engaged and empowered to contribute innovative ideas, influence decisions, and bring their authentic selves to work." [International Paper]

> "A diverse and inclusive work environment is the right thing to do for our people. It is also the right thing to do for our business. Diverse and inclusive teams help us creatively engage with all our stakeholders—our employees, our customers and our communities. Diversity of thought helps us drive innovation, and inclusive teams collaborate effectively to deliver results." [Packaging Corporation of America]

One of the nuances provided by Kimberly Clark is a noted focus on creating a workforce that is reflective of their customer base. Stora Enso operates similarly, aiming to mirror the communities in which they operate:

> "Employing people from disparate backgrounds, cultures, and experiences amplifies our ability to gather insights, foster innovation and understand the culture, context, and mindset of consumers around the world. As a company who serves global consumers and communities, we work to cultivate a workforce comprised of people who look, think, and behave like the people who use our products – now and in the future." [Kimberly Clark]

> "Reflecting the societies where we operate is crucial to our strategy: diversity and inclusion are strong enablers of improved performance, collaboration, and innovation. Increased diversity of thought is needed to develop our products to meet market demand." [Stora Enso]

> "Having a diverse workforce that represents the communities in which we work and the customers we serve is vital to our innovation. We value our diverse workforce from different backgrounds and life experiences who bring different viewpoints to Billerud. Engaged and diverse employees are a key to our continued competitiveness." [Billerud]

6. Discussion

This study examines only publicly held firms, thus the difference in public reporting identified here should be understood as a difference in how listed companies communicate innovation in public reporting, not as a statement about the forest sector as a whole. In summary, among publicly held forest sector firms, the Nordic-US reporting difference aligns with forestry-specific capability patterns, while also reflecting the reporting norms that shape how listed companies communicate innovation. The Nordic and US difference in R&D terminology is consistent with the comparatively higher absorptive capacity observed in parts of the forest sector. This is related to the stronger emphasis on collaboration, pilots, and development in Nordic firms' narratives, where R&D appears to be embedded in university-industry networks and supported by multinational-local knowledge ties. (Aboal et al. 2018; Korhonen and Niemelä 2005). From a dynamic capabilities perspective, Nordic reports more often pair innovation with sensing (bio/circular scanning), seizing (pilots and cross-sector partnerships), and transforming (new biomaterials and side-stream valorization), a pattern documented in bioeconomy transitions among both incumbents and SMEs (Näyhä 2020; Laakkonen et al. 2025; Weiss et al. 2021). By contrast, many US texts emphasize exploitation-process efficiency and customer solutions, with fewer explicit development signals. In terms of organizational ambidexterity, forestry research links "hybrid" competitive strategies to superior performance, indicating that sustaining exploration alongside exploitation is feasible, but unevenly realized across firms and regions (Hansen et al. 2015). Taken together, these findings suggest that regional disclosure styles interact with underlying capabilities: US firms may under-communicate exploration and development even when present, while Nordic firms may foreground sustainability-framed innovation because of institutional reporting expectations (Guerrero and Hansen 2021; Weiss et al. 2020).

These patterns carry several implications. For managers, US firms risk being undervalued by stakeholders if development-stage work is not articulated; Nordic firms risk narrative-substance gaps if "development" talk is not accompanied by verifiable inputs and outputs. A practical remedy in both regions

is to report a small, comparable set of innovation indicators (e.g., R&D-to-sales, TRL milestones and pilot CapEx, counts of active patents) to signal substance behind narrative. For investors and analysts, cross-region comparisons should adjust for report format (integrated vs. standalone) and regime and should weight concrete innovation indicators more than raw word counts. For policy, strengthening university-industry consortia and pre-competitive platforms can raise absorptive capacity, while assurance or guidance on innovation-related disclosures (e.g., linking claims to ESRS metrics in the EU or voluntary innovation KPIs in the US) can reduce interpretive noise. For research, a next step is to test whether "narrative innovation intensity" and the presence of adjacent concrete signals predict subsequent patents, partnerships, and new-product revenues, and to examine CSRD adoption as a natural experiment in disclosure-capability alignment.

6.1 Interpreting innovation and R&D narratives through capability lenses

To deepen our understanding of how innovation and R&D are represented in the analysed reports, we moved beyond looking at frequencies and, after coding, qualitatively interpreted the analysed reports through established concepts in the innovation literature, including absorptive capacity, dynamic capabilities, and organisational ambidexterity. This allows us to consider not only how often firms talk about innovation and R&D, but what kinds of innovation capabilities their narratives implicitly foreground. Interpreted through these lenses, our findings point to several implications for the analyzed companies and their reporting practices. In terms of absorptive capacity, the Nordic producers (e.g., UPM, Metsä Group, Stora Enso, Södra, SCA, Ahlstrom) tend to present a science- and R&D-centered capability story, with references to dedicated R&D units, demo plants, patent portfolios and dense collaboration with universities and customers. By contrast, several US and more downstream firms frame innovation more in terms of commercial responsiveness, supplier platforms and customer solutions than in-house laboratories. Their absorptive capacity is narrated as commercial and relational, anchored in channels, relationships and logistics, rather than scientific. From a dynamic capabilities' perspective, both Nordic and US reports describe sensing around climate, circularity, and plastic substitution, but Nordic texts more often link this to large transformative investments and bioeconomy pilots, while many US firms emphasize seizing opportunities through incremental packaging improvements and process efficiency. With respect to organizational ambidexterity, virtually all companies pair language about cost competitiveness, operational excellence and safety with rhetoric about innovation, sustainability and growth, yet the underlying tensions between exploitation and exploration, such as potential trade-offs between cost-cutting and exploratory R&D, are rarely made explicit[1].

These patterns suggest that CSR and financial reports could, in different ways, more clearly reflect innovation-related aspects and thereby provide richer insight into firms' innovation orientations and capacities. For firms with strong scientific and R&D infrastructures, this might involve linking sustainability and "innovative solutions" narratives more systematically to concrete inputs (e.g., R&D spending, demo investments, collaboration structures) and to how external knowledge is absorbed and translated into new offerings. For firms whose innovation capability is more commercially or relationally based, reports could more explicitly articulate how customer intimacy, supplier networks, and logistics systems function as vehicles for absorbing, recombining, and scaling knowledge, rather than relying on general innovation rhetoric. Across both regions, acknowledging, rather than smoothing over, the organizational tensions between efficiency, risk management, and exploratory work could help stakeholders better assess the credibility of innovation claims and the robustness of firms' capacity to renew themselves over time.

6.2 Limitations

This study has four main limitations. First, the frequency with which reports mention "innovation" or "R&D" is an imperfect proxy for actual innovation

1 Building on the conceptual background, we qualitatively interpreted the analyzed reports with the support of an AI language model that systematically searched all documents for references to absorptive capacity, dynamic capabilities, and organizational ambidexterity, using the definitions developed in the Background section as prompts. The model's outputs were treated as grounded interpretive suggestions and were then critically reviewed and refined by the authors, who had previously conducted detailed reading and coding of the material.

inputs or outputs; differences in accounting and reporting regimes may change terminology independently of actual R&D spending. At the same time, the integrated-reporting and CSRD context in the Nordic countries may elevate the use of development language independently of actual lab budgets or other R&D inputs. We therefore interpret these word counts as reflecting disclosure norms—that is, what firms normally report and how they report it—rather than as direct measures of innovation investment. Second, because we analyzed English-language versions of Nordic reports, the sample may be biased toward investor-facing, professionally edited documents that emphasize innovation more than native-language materials. Third, our content-analysis design, especially the chosen keyword set and the size of the context window used for coding, may miss euphemistic, brand-led, or highly technical references to innovation that avoid our target terms. Finally, only a single coder was used for data analysis. Future work should triangulate disclosure-based measures with independent indicators of innovation such as R&D intensity (sales-based), patent counts/citations, pilot announcements and technology readiness levels (TRLs), and formal collaboration or licensing agreements.

Our approach yields a comparable measure across reports and shows that institutional and reporting regimes systematically shape the public story companies tell about innovation. Using this lens helps distinguish communicative norms from underlying capability signals, highlighting when US firms may under-communicate development-stage work and when Nordic firms may emphasize sustainability-framed innovation because of CSRD and integrated reporting expectations.

7. Literature cited

Aboal, D., Rovira, F., Veneri, F. (2018). Knowledge networks for innovation in the forestry sector: Multinational companies in Uruguay. *Forest Policy and Economics* 97, 9–20. https://doi.org/10.1016/j.forpol.2018.08.013

BLS. (2025). Quarterly Census of Employment and Wages. Bureau of Labor Statistics. https://data.bls.gov/cew/apps/bls_naics/v3/bls_naics_app.htm#tab=hierarchy&naics=2022&hier=4233_32_11 Last Accessed on September 3, 2025.

Bergquist, A. K., Söderholm, K. (2015). Transition to greener pulp: regulation, industry responses and path dependency. *Business History* 57(6), 862–884. https://doi.org/10.1080/00076791.2014.986105

Binkley, C. S. (1995). Designing an effective forest sector research strategy for Canada. *The Forestry Chronicle* 71(5), 589–595. https://www.doi.org/10.5558/tfc71589-5

Binkley, C. S. (1993). Creating a knowledge-based forest sector. *The Forestry Chronicle* 69(3), 294–299. https://doi.org/10.5558/tfc69294-3

Cohen, W. M., Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly* 35(1), 128–152. https://doi.org/10.2307/2393553

Cohen, D. H., Kozak, R. A. (2002). Research and technology: market-driven innovation in the twenty-first century. *The Forestry Chronicle* 78(1), 108–111. https://doi.org/10.5558/tfc78108-1

European Commission. (2025). *Corporate Sustainability Reporting*. https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en. Last accessed on October 26, 2025.

FAO. (2024). *State of the World's Forests: Forest-sector Innovations Towards a More Sustainable Future*. Food and Agriculture Organization of the United Nations. Rome, Italy. 104 pp. https://doi.org/10.4060/cd1211en

Guerrero, J. E., Hansen, E. (2021). Company-level cross-sector collaborations in transition to the bioeconomy: A multicase study. *Forest Policy and Economics* 123, 102355. https://www.doi.org/10.1016/j.forpol.2020.102355

Han, X., Hansen, E. (2016). Marketing sophistication in private sawmilling companies in the United States. *Canadian Journal of Forest Research* 46(2), 181–189. https://www.doi.org/10.1139/cjfr-2015-0242

Hansen, E., Conroy, K., Toppinen, A., Bull, L., Kutnar, A., Panwar, R. (2016). Does gender diversity in forest sector companies matter? *Canadian Journal of Forest Research* 46(11), 1255–1263. https://doi.org/10.1139/cjfr-2016-0040

Hansen, E., Nybakk, E., Panwar, R. (2015). Pure versus hybrid competitive strategies in the forest sector: Performance implications. *Forest Policy and Economics* 54, 51–57. https://www.doi.org/10.1016/j.forpol.2015.02.001

Hansen, E., Juslin, H., Knowles, C. (2007). Innovativeness in the global forest products industry: exploring new insights. *Canadian Journal of Forest Research* 37(8), 1324–1335. https://doi.org/10.1139/X06-323

Hayter, R., Clapp, A. (2020). Towards a collaborative (public-private partnership) approach to research and development in Canada's forest sector: an innovation system perspective. *Forest Policy and Economics* 113, 102119. https://doi.org/10.1016/j.forpol.2020.102119

Homyack, J., Sucre, E., Magalska, L., Fox, T. (2022). Research and innovation in the private forestry sector: past successes and future opportunities. *Journal of Forestry* 120(1), 106–120. https://doi.org/10.1093/jofore/fvab039

Hujala, M., Tuppura, A., Jantunen, A., Arminen, H. (2015). Structural changes and effects of R&D investments in the pulp and paper industry. *International Wood Products Journal* 6(4),181–188. https://doi.org/10.1179/2042645315Y.0000000015

Hurd, E. S. (1965). Implications of New Product Development for Forest Management. *Journal of Forestry* 63(9), 687–690. https://doi.org/10.1093/jof/63.9.687

Innes, J. L. (2009). The promotion of 'innovation' in forestry: a role for government or others? *Environmental Sciences* 6(3), 201–215. https://doi.org/10.1080/19438150903090517

Investopedia. (2025). U.S. vs. International Accounting: GAAP vs. IFRS Differences. https://www.investopedia.com/ask/answers/041715/how-accounting-united-states-different-international-accounting.asp. Last accessed on June 9, 2025.

Kellison, R. (2014). A new model for forest sector research and development in the United States. US Endowment for Forestry and Communities. 14 pp. https://www.usendowment.org/a-new-model-for-forest-sector-research-and-development-in-the-united-states/

Korhonen, S., Niemelä, J. S. (2005). A conceptual analysis of capabilities: Identifying and classifying sources of competitive advantage in the wood industry. *The Finnish Journal of Business Economics* 54(1), 11–47. https://researchportal.helsinki.fi/en/publications/a-conceptual-analysis-of-capabilities-identifying-and-classifying/

Laakkonen, A., Heiskanen, A., Näyhä, A., Toppinen, A., Hurmekoski, E. (2025). Foresight-related dynamic capabilities in Finnish forest-based bioeconomy SMEs. *Futures & Foresight Science* 7(1), e70007. https://doi.org/10.1002/ffo2.70007

Li, N., Toppinen, A., Tuppura, A., Puumalainen, K., Hujala, M. (2011). Determinants of sustainability disclosure in the global forest industry. *EJBO-Electronic Journal of Business Ethics and Organization Studies* (1): 33–40. https://urn.fi/URN:NBN:fi:jyu-201201271084

Lovrić, N., Lovrić, M., Mavsar, R. (2020). Factors behind development of innovations in European forest-based bioeconomy. *Forest Policy and Economics* 111, 102079. https://doi.org/10.1016/j.forpol.2019.102079

McGinley, K. A., Guldin, R. W., Cubbage, F. W. (2019). Forest sector research and development capacity. *Journal of Forestry* 117(5), 443–461. https://doi.org/10.1093/jofore/fvz030

Mikkilä, M., Toppinen, A. (2008). Corporate responsibility reporting by large pulp and paper companies. *Forest Policy and Economics* 10(7–8), 500–506. https://doi.org/10.1016/j.forpol.2008.05.002

Moncada-Paternò-Castello, P., Grassano, N. (2022). The EU vs US corporate R&D intensity gap: investigating key sectors and firms. *Industrial and Corporate Change* 31(1), 19–38. https://doi.org/10.1093/icc/dtab043

Nabuurs, G-J., Mrabet, R., Abu Hatab, A., Bustamante, M., Clark, H., Havlík, P., House, J., Mbow, C., Ninan, K. N., Popp, A., Roe, S., Sohngen, B., Towprayoon, S., Steinfeld, J. P. (2023). Agriculture, Forestry and Other Land Uses (AFOLU). In: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC),* pp. 747–860. Cambridge University Press. https://doi.org/10.1017/9781009157926.009

Newton. (2022). 100 Top Companies in the Global Pulp & Paper Market. https://www.newtonconsultingpartners.com/post/100-top-companies-in-the-global-pulp-paper-market. Last accessed June 6, 2025.

Näyhä, A. (2020). Finnish forest-based companies in transition to the circular bioeconomy-drivers, organizational resources and innovations. *Forest Policy and Economics* 110, 101936. https://doi.org/10.1016/j.forpol.2019.05.022

Näyhä, A. (2019). Transition in the Finnish forest-based sector: Company perspectives on the bioeconomy, circular economy and sustainability. *Journal of Cleaner Production* 209, 1294–1306. https://doi.org/10.1016/j.jclepro.2018.10.260

Näyhä, A., Pesonen, H. L. (2014). Strategic change in the forest industry towards the biorefining business. *Technological Forecasting and Social Change* 81, 259–271. https://doi.org/10.1016/j.techfore.2013.04.014

O'Reilly III, C. A., Tushman, M. L. (2013). Organizational ambidexterity: Past, present, and future. *Academy of Management Perspectives* 27(4), 324–338. https://doi.org/10.5465/amp.2013.0025

Our World In Data. (2025). Forest Area. https://ourworldindata.org/forest-area. Last accessed on October 26, 2025.

Pinkard, E. A., O'Grady, A. P. (2016). Innovation in the Forestry Industry: Ready or Not! *Australian Forestry* 79(3),153–156. https://doi.org/10.1080/00049158.2016.1213622

Rich, S.U. (1986). Recent Shifts in Competitive Strategies in the U.S. Forest Products Industry and the Increased Importance of Key Marketing Functions. *Forest Products Journal* 36(7/8), 34–44.

Šimunović, N., Hesser, F., Stern, T. (2018). Frame analysis of ENGO conceptualization of sustainable forest management: Environmental justice and neoliberalism at the core of sustainability. *Sustainability* 10(9), 3165. https://www.doi.org/10.3390/su10093165

Statistics Finland. (2023). Employed by Area, Industry, Sex, Year and Information. PxWeb. https://pxdata.stat.fi/PxWeb/pxweb/en/StatFin/StatFin__tyokay/statfin_tyokay_pxt_115i.px/table/tableViewLayout1/. Last Accessed on September 3, 2025.

Statistics Norway. (2024). 13926: Employees and jobs, by sector, industry (SIC2007), contents, quarter and region. Statbank Norway. SSB. https://www.ssb.no/en/statbank/table/13926. Last Accessed on September 3, 2025.

Statistics Sweden. (2021). Number of employees according to Structural Business Statistics by industrial classification (NACE Rev. 2) and year. PxWeb. https://www.statistikdatabasen.scb.se/sq/165277. Last Accessed on September 3, 2025.

Teece, D. J., Pisano, G., Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal* 18(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Toivanen, T. (2021). A Player Bigger Than Its Size: Finnish Bioeconomy and Forest Policy in the Era of Global Climate Politics. In: *Backhouse, M., et al. Bioeconomy and Global Inequalities*. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-68944-5_7

Tonello, M. (2025). *Regulatory Shifts in ESG: What Comes Next for Companies?* Harvard Law School Forum on Corporate Governance. https://corpgov.law.harvard.edu/2025/04/12/regulatory-shifts-in-esg-what-comes-next-for-companies/. Last accessed on November 28, 2025.

Vidal, N. G., Kozak, R. A. (2008). The recent evolution of corporate responsibility practices in the forestry sector. *International Forestry Review* 10(1), 1–13. https://www.jstor.org/stable/43739695

Weiss, G., Hansen, E., Ludvig, A., Nybakk, E., Toppinen, A. (2021). Innovation governance in the forest sector: Reviewing concepts, trends and gaps. *Forest Policy and Economics* 130, 102506. https://doi.org/10.1016/j.forpol.2021.102506

Weiss, G; Ludvig, A; Živojinović, I. (2020) Four decades of innovation research in forestry and the forest-based industries - A systematic literature review. *Forest Policy and Economics* 120, 102288. https://doi.org/10.1016/j.forpol.2020.102288

Wise, A., Parker, H. (2025). Innovation in global forestry: Evolution towards a diversified industry. *Journal of Business Research* 189, 115140. https://doi.org/10.1016/j.jbusres.2024.115140

Zielhoff, I., Wojtanek, K. (2025). R&D Costs: IFRS® Accounting Standards vs. US GAAP. https://kpmg.com/us/en/articles/2025/rd-costs-ifrs-accounting-standards-us-gaap.html. Last accessed on June 9, 2025.