MARKET BRIEF

SEEING THE FIELD AND THE FOREST

NEXT GEN FIBRE IN CONSUMER PAPERBOARD

This whitepaper explores the business case for consumer goods brands and their paperboard suppliers to transition to using a greater share of Next Gen pulp — pulp produced from low-impact, forest-free alternatives such as agricultural waste and byproducts that would otherwise be discarded or burned. The paper aims to determine the maximum all-in cost of Next Gen pulp required to be competitive with virgin wood inputs on a risk-adjusted basis. The paper is preliminary; Canopy plans to continue validating assumptions regarding technical, economic, and environmental considerations.

As a whitepaper, the results presented herein are preliminary, exploratory, subject to important caveats and limitations, and may be revised by Canopy in the future.

2026

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About the Report

CANOPY

Canopy is a not-for-profit environmental organization dedicated to protecting forests, species, and the climate. Canopy has collaborated with more than 1,000 companies to develop innovative solutions and make their supply chains more sustainable, helping reduce sourcing risk and protect our world's remaining Ancient and Endangered Forests. Canopy's work focuses on the influential relationship between large corporate purchasers and the mills that supply them with pulp, print grade paper, paper packaging, and Man-Made Cellulosic Fibres (MMCF). In helping major purchasers develop and implement forest conservation policies, we leverage forest protection in key regions, improve forestry practices, and develop the market that draws Next Generation alternatives into production. Canopy is funded by philanthropic foundations and individual donors who share our passion for the planet.

ABOUT THIS WHITEPAPER

This is one of two whitepapers released by Canopy as part of a series exploring the business case for brands and their suppliers to transition to Next Gen feedstocks — sustainable alternatives derived from waste or byproducts — for producing viscose textiles and paperboard. These whitepapers will serve as an analytical foundation for Canopy's inaugural **State of Next Generation Markets** report, planned for release in 2027.

The work is preliminary and intended to stimulate discussion rather than forecast market growth, dynamics, or prices. Canopy plans to refine and extend this analysis; we welcome feedback on the analysis approach, modeling, and underlying assumptions.



photo: © Canopy

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photo: © Canopy

At what all-in cost is **Next Gen pulp** competitive with conventional, virgin wood pulp on a risk-adjusted basis for Consumer Paperboard?

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In Brief

Consumer goods brands and their paper packaging suppliers — including converters and pulp and paper producers — are rethinking fibre sourcing as they navigate uncertain market conditions.

Consumer goods brands and their packaging suppliers are operating in a more volatile environment, with swings in energy and input prices, geopolitical and climate change-linked supply disruptions, regulatory pressures, and higher capital costs, while continuing to face pressure to keep consumer prices competitive.[1] In response, customer companies are placing greater emphasis on supply-chain resilience alongside cost, diversifying suppliers, increasing multi-sourcing, and developing more regional and localized supply networks.[2] At the same time, packaging regulations and brand commitments are accelerating a shift away from plastics and channeling new demand into paper-based formats, increasing exposure to virgin fibre price, availability risk, and regulation.

For paper and packaging supply chains, this creates both the pressure and the opportunity to pursue new approaches to fibre sourcing that consider profitability and risk alongside opportunities to diversify fibre types and develop more regional sources of supply, including alternative feedstocks.

Against this backdrop, Canopy developed a financial optimization model to assess the business case for using Next Gen pulp in consumer paperboard, considering both profitability and risk.

Next Gen fibres are defined by Canopy as low-impact alternatives to forest fibre. The Next Gen fibres most relevant to this report are derived from excess agricultural residues and byproducts (e.g., wheat straw and sugarcane bagasse) that remain after accounting for environmental functions and other beneficial uses. Next Gen fibres offer brands and their paper packaging suppliers the opportunity to accelerate progress towards sustainability and resiliency goals: for example, Canopy's latest research finds that replacing virgin softwood from old-growth forests with virgin wood from managed forests alongside 10% agricultural residues could reduce lifecycle greenhouse gas emissions by ~50% in some applications.[3]

Canopy's financial optimization model considers an illustrative commercial relationship between a buyer (e.g., a global, high-volume consumer goods brand or paperboard converter) and a China-based integrated pulp and paperboard mill. It estimates the maximum delivered Next Gen pulp price that supports commercially optimal use of at least 5% Next Gen pulp, and up to allowable quality limits, accounting for mill economics, risk, costs, and operational performance of Next Gen pulp use. It tests how this price changes under varying market conditions, including (i) wood price volatility consistent with historical levels, (ii) higher and more volatile wood prices, and (iii) illustrative EU-style policy mechanisms.

We use high-performance folding boxboard as a conservative test case to inform Next Gen pulp considerations across a broader range of consumer paperboards that currently rely on virgin wood inputs.
Consumer paperboards, including folding boxboard (FBB), are widely used across pharmaceuticals, confectionery, dry foods, personal care, cosmetics, and other consumer goods. Our analysis focuses on a **high-performance FBB grade** with demanding technical specifications: a lightweight, three-layer board with a bright white printable front, a similarly white reverse side, and a strong, lightweight middle layer that provides bulk and stiffness.[4]

In the model's base scenario, we apply a strict technical limit that restricts Next Gen pulp use to 10% of the furnish (the mixture of fibre inputs used to make the paper or board) and to the middle layer, where it has the least impact on product performance. By testing Next Gen pulp use against these relatively demanding requirements, the analysis provides a conservative reference point for other FBB and non-food-contact consumer paperboards, including types and grades with less stringent requirements for strength, stiffness, brightness, whiteness, or print quality, and that continue to rely on virgin wood fibre from high-risk forest sources.

Here is what we found and what companies should consider (see summary in Figure 1):

1 Replacing 5–10% of conventional virgin wood pulp with Next Gen pulp today offers a practical and strategic option to reduce exposure to wood pulp price volatility and prepare for emerging policy requirements.

At a delivered price[5] of **~US$345–380/ADt**, our modeling finds Next Gen pulp would reach ~8% (on average across modeled assumptions) of an optimal high-performance FBB furnish by 2028. Industry reviewers consider this cost range plausible in major paper packaging-producing regions for inputs such as wheat straw residues and sugarcane bagasse. The higher end of this range reflects greater willingness to pay for Next Gen pulp when mills appreciate its ability to diversify exposure to wood price risk or when policy costs emerge; for example:

- The maximum supported Next Gen pulp price rises modestly from ~US$345 to ~355/ADt as mill risk appetite declines, when Next Gen pulp prices have half the variance of hardwood chip prices and do not move too closely with wood prices.
- A 10% upward adjustment to average wood prices further increases willingness to pay up to ~US$380/ADt as the relative savings and stability from Next Gen pulp use increase.
- An illustrative deforestation due-diligence cost, modeled on the EU Deforestation Regulation (EUDR), for virgin wood fibre in board placed on the EU market and in scope, raises the supported Next Gen pulp price to ~US$365/ADt, and up to ~US$380/ADt when the value of hedging against wood price volatility is also considered.

2. **Overcoming technical constraints or adjusting product requirements can substantially increase the value of Next Gen pulp by allowing it to replace more virgin wood pulp, including higher cost inputs.**

At the current 10% technical limit for the high-performance FBB modeled, Next Gen pulp is restricted to the middle layer and replaces relatively low-cost hardwood chips pulped at the mill. If improvements in pulp quality, consistency, or mill processes allow Next Gen pulp to be used in additional layers while maintaining product performance, it can replace higher-cost bleached hardwood kraft pulp (BHKP). **This materially increases the maximum supported Next Gen pulp price from ~US$345-380 to ~US$460–595/ADt, leading to higher adoption that rises from ~10% in 2028 to ~20% by 2030.**[6] Some virgin wood-dependent consumer paperboards may already be able to use up to 30% Next Gen pulp because they have less demanding product specifications than the high-performance FBB modeled. These products may sell at lower prices, but lower input costs could support similar or even higher margins, with additional upside where brands value higher Next Gen fibre content, for example, due to product differentiation or sustainability goals. It is reasonable to expect that as Next Gen receives more investment and commercialization focus, there will be significant improvements in Next Gen processing and performance just as with renewables and other materials and technologies as they've scaled

3. **5–10% Next Gen pulp inclusion also unlocks scaling opportunities, particularly where qualified feedstock, paper and packaging production, and demand intersect.**

Starting with 5–10% inclusion today builds the operating experience needed to increase Next Gen pulp use and identify where product specifications can accommodate higher levels. Put another way, it creates a strategic option to unlock higher inclusion levels of 20% by 2030 and 30+% after 2032, with greater savings and risk diversification benefits. Further scaling its use over time also aligns with the market's broader and continued shift[7] towards more regional and diversified supply chains as companies seek to reduce geo-political, trade, and supply risks.

Scaling opportunities will vary within and across regions, reflecting the type, concentration, and existing uses of locally available agricultural residues, the processing they require, nearby pulp and paper infrastructure, and the end products they can serve. India and China, for example, combine large, diverse residue streams, including cereal straws and sugarcane bagasse, with extensive experience in non-wood papermaking and large-scale paper manufacturing bases. Brazil's highly concentrated sugarcane industry creates a particularly large bagasse opportunity alongside an established pulp and paper sector. Europe and North America offer more geographically specific combinations of cereal and other crop residues,

existing mills, processing innovation and downstream demand. Southeast Asia generates large volumes of rice straw, along with bagasse and oil palm residues already collected at sugar and palm oil mills, and has a fast growing paper packaging industry. These differences will shape where Next Gen pulp capacity is most competitive, which technologies are needed, and which paper and packaging applications are best suited to each location.

Alongside packaging reduction and reuse, use of recycled fibres, and support for forest protections, responsibly sourced Next Gen pulp can help brands, converters, and mills in consumer paperboard supply chains diversify risk while also reducing dependence on high-risk forests.

BOTTOM LINE

Next Gen pulp can play an important risk diversification role in a commercially optimal furnish alongside recycled and FSC-certified wood, even in technically demanding consumer paperboard applications such as high-performance folding boxboard.



photo: © T.J. Watt

FIGURE 1

The business case for transitioning to Next Gen pulp in consumer paperboard

Three sets of market conditions justify ~5–10% use of Next Gen pulp by 2028–2030 at ~$345–$380/ADt in a high-performance, folding boxboard

01
WOOD PRICE VOLATILITY AT HISTORICAL LEVELS

Mills managing risk use Next Gen pulp as a hedge to wood price exposure

02
PERMANENT 5–10% INCREASES IN WOOD PRICES

Higher wood prices raise Next Gen pulp's relative value assuming prices don't move too closely

03
DEFORESTATION POLICIES

Policies that penalize high risk forest inputs raise Next Gen pulp's relative value

If technical limits rise to 30%, willingness to pay increases substantially to ~$460–$595/ADt, with adoption rising from 5% in 2027 to 25% within 5 years

Investing in technical improvements today supports scaling and potentially higher margins as Next Gen pulp replaces higher cost, volatile virgin wood inputs

5% Next Gen pulp by 2027 → ~13% Next Gen pulp by 2029 → ~25% by 2031 → ~30% + thereafter →

What determines whether scale is reached?

WHAT HELPS SCALE

- Early and long-term market commitments
- Thoughtful risk management
- Clear policy value and procurement incentives

WHAT LIMITS SCALE

- Lack of technical improvements and flexibility
- Access to qualified pulp
- Mill qualification and operational readiness

BOTTOM LINE

Next Gen pulp can play an important risk diversification role in a commercially optimal furnish alongside recycled and FSC-dertified wood, even in technically demanding consumer paperboard applications such as high-performance folding boxboard.

Source: Canopy, 2026

Note: Air-dried tonne (ADt): A standard unit for pulp equivalent to one metric tonne at 90% dry matter content.

What Now?

Waiting for Next Gen pulp to reach full performance parity with wood could leave brands and producers without qualified alternatives if market conditions tighten as predicted.

Our findings point to three practical priorities for consumer goods brands, paperboard converters, pulp producers, and mills:

1. **Build an initial market for qualified Next Gen pulp, targeting a 5–10% inclusion rate across consumer paperboard where ample, qualified Next Gen pulp is available.**

   For high-performance FBB, for example, brands and producers should identify and qualify Next Gen pulp for near-term inclusion at 5–10% at competitive rates, which we identify for our illustrative scenarios as ~US$345–380/ADt. At these levels, Next Gen pulp can meet high-performance FBB technical requirements, diversify exposure to wood market risk and future policy, and build the supplier capacity, operating experience, and product qualification needed for future scale. For less stringent paperboards, optimal inclusion rates could be even higher.

2. **Invest in the technical advances needed to expand the use of Next Gen pulp, and rethink technical specifications.**

   The value of Next Gen pulp increases by ~US$100–200+/ADt when it can enter additional board layers and replace higher cost wood pulp. To achieve this potential, brands, producers, and innovators should collaborate on pulp development, mill trials, and product qualification today to raise technical limits and/or adjust brand specifications where appropriate.

3. **Direct Next Gen pulp use towards replacing high-risk virgin wood inputs.**

   Next Gen fibres should form part of a broader fibre strategy that prioritizes packaging reduction and reuse, recycled content and recyclability, and lower-risk forest fibre that avoids Ancient and Endangered Forests and meets credible certification standards (e.g., Forest Stewardship Council (FSC)). Next Gen fibres should be responsibly sourced, used to replace higher-risk wood fibre, and integrated with broader efforts to protect forests.

Brands, converters, and mills should pursue 5–10% inclusion of Next Gen pulp today while building the supply, technical performance, and environmental evidence needed for scaled use.

Context

This whitepaper assesses the business case for consumer goods companies, brands, converters, and their paper packaging suppliers to use Next Gen pulp in consumer paperboard.

Canopy defines Next Gen fibres as low-impact, forest-free alternatives to wood fibre, derived from feedstocks such as agricultural residues and byproducts, recovered textiles, food and industrial side streams, aquatic biomass, select purpose-grown crops, and microbial cellulose. The Next Gen fibres most available at scale today are derived from agricultural residues and byproducts (e.g., wheat straw and sugarcane bagasse) that remain after accounting for other beneficial uses. These feedstocks are pulped to produce Next Gen pulp, which mills can blend with recycled and virgin wood pulp in their fibre mix.

To assess the business case for Next Gen pulp in consumer paperboard, Canopy developed a financial optimization model that represents a commercial relationship between an illustrative global, high-volume buyer with significant EU sales (this could be a consumer goods company, brand or converter) and a China-based integrated pulp and paperboard mill.

The analysis identifies the maximum "break-even" price at which Next Gen pulp remains a financially optimal part of the mill's fibre mix, starting at 5% inclusion and increasing up to allowable technical limits. It then assesses how this price changes in response to Next Gen pulp price volatility, higher wood prices, and illustrative waste and deforestation policy mechanisms.

The analysis provides a basis for understanding where Next Gen pulp can compete commercially today, what conditions could strengthen its business case, and how its use in consumer paperboard could scale. Canopy advocates using Next Gen pulp alongside paper packaging reduction and reuse, recycled fibres, and lower-risk virgin wood, with appropriate environmental safeguards and investment to support responsible scale.

The exploration comes at an important time as global consumer goods brands and their paper packaging suppliers continue to navigate uncertain market conditions and shift away from plastics.

Price-conscious consumers, volatile raw material and energy costs, tariffs, and geopolitical and climate-related disruptions are putting pressure on margins and increasing the value of resilience in major economic sectors, including paper packaging.[8] Companies are responding by diversifying suppliers, multi-sourcing, and developing more regional and localized supply networks to manage risk alongside cost.[9]

Virgin wood pulp — which dominates many paper packaging applications — faces additional and unique pressures: climate change is increasing forest disruption from wildfire, drought, pests, and disease, while rising wood demand and competition for land add pressure to future wood fibre availability and costs.[10] New deforestation and due diligence requirements are also increasing the importance of avoiding

untraceable, higher-risk wood supply.[11] Additionally, today's credibly certified forest landbase is "oversubscribed" compared to global corporate commitments.

Meanwhile, packaging regulation and brand commitments are accelerating a shift away from plastics and channeling new demand into paper-based formats, increasing exposure to virgin wood fibre price and availability risk. Smithers projects global folding-carton consumption to grow at ~4% annually, from ~52 million tonnes in 2025 to ~63 million tonnes by 2030, driven by the shift from plastic to paper packaging, growing demand in emerging markets in Asia-Pacific and Africa, and growth in select end-use segments.[12]

These conditions strengthen the commercial case for a more diversified and strategic fibre strategy that extends beyond wood and considers cost, risk, and availability across alternative fibre sources and geographies.

We use high-performance folding boxboard (FBB), with a technical limit of 10% Next Gen pulp inclusion, as a conservative test case; the commercial case for Next Gen pulp could be stronger in consumer paperboards with less stringent requirements.

The commercial case for Next Gen fibres will vary across paper packaging depending on product specifications, end use, production systems, geography, and supply chains. Our analysis models a high-performance, non-food-contact, three-ply FBB with demanding requirements for strength, stiffness, brightness, whiteness, and print quality. FBB is primarily made from virgin wood pulp today and is widely used across applications such as pharmaceuticals, confectionery, dry foods, personal care, and cosmetics.

We assume the board has a bright white printable front and reverse and a strong, lightweight middle layer that provides bulk and stiffness. In the base case, these requirements cap today's Next Gen pulp at approximately 10% of the total furnish and confine it to the middle layer, where it has negligible impact on product performance.

This provides a conservative starting point for assessing the economics of Next Gen pulp. Higher inclusion could be achieved in two ways: (1) improvements in Next Gen pulp quality, consistency, or mill processes could allow it to enter additional layers of high-performance FBB while maintaining product performance; (2) consumer paperboards with less demanding requirements for strength, stiffness, brightness, whiteness, or print quality may already accommodate higher Next Gen pulp inclusion. The latter could allow greater use of Next Gen pulp and potentially support attractive margins even where finished-board prices differ, although these product-specific economics are not modeled here.

Next Gen fibres offer strategic optionality for brands and producers seeking to reduce wood system risk exposure.

FBB today remains overwhelmingly dependent on virgin wood fibre. This concentration exposes brands and paperboard producers to pressures across forest and wood fibre supply chains, including cost volatility, supply disruptions, policy and legal exposure, technology substitution, and reputational risk.

While Next Gen fibres come with their own set of risks and technical considerations, including collection, storage, logistics requirements, seasonal variation, exposure to climate change impacts, and operating inefficiencies, they can still serve a strategic role by:

- **Cost resilience:** Reducing exposure to wood-linked input prices and potentially accessing lower-cost residues in locations with concentrated, underutilized supply.
- **Supply resilience:** Creating an additional sourcing option when suitable wood or wood pulp becomes constrained, disrupted, or volatile.
- **Regional sourcing:** Connecting paperboard production with locally or regionally available residues, potentially shortening supply chains and transportation costs where collection and pulping infrastructure are available.
- **Regulatory positioning:** Preparing for packaging, circularity, deforestation, and sourcing requirements that may increase the value of traceable alternatives to virgin wood fibre.
- **Strategic optionality:** Building technical knowledge, supplier relationships, and mill capabilities in an alternative pathway that becomes more competitive over time.
- **Stakeholder value:** Demonstrating progress towards responsible sourcing and reduced pressure on forests, where environmental benefits can be substantiated for the specific residue and sourcing system.

While the analysis is agnostic to Next Gen feedstock, excess agricultural residues and byproducts such as wheat straw and sugarcane bagasse offer promising pathways to commercial scale.

Wheat straw and sugarcane bagasse are promising feedstocks because they combine large potential supply and availability in major paper-producing regions and established use in paper and paperboard production.[13,14] As agricultural residues and byproducts already serve a range of environmental and economic functions, regional Next Gen pulp scaling strategies should focus on residues and byproducts that can be used for pulp without displacing important environmental functions or higher-value existing and potential uses. Notably, an internal Canopy feedstock assessment by Wageningen University (2026) found that even after accounting for these environmental needs and existing beneficial uses, material feedstock volumes remain available, including residues that are currently underused or would otherwise be burned.

Against this backdrop, the following analysis examines the commercial conditions under which Next Gen pulp could partially substitute for virgin wood pulp in FBB, including the price levels, market conditions, and technical limits that shape adoption. For the purposes of the analysis that follows, we assume that any agricultural residue or byproduct pulp used in place of wood delivers a credible environmental benefit in its specific sourcing and production context. We refer to pulp and associated fibre that meet this standard as Next Gen pulp and Next Gen fibres, respectively.

Approach

To assess the case for Next Gen pulp, our model tests what delivered price a mill would be willing to pay under varying market conditions.
The analysis assumes that conventional wood pulp and Next Gen pulp each carry distinct price risks, and that wood currently has a clear incumbency advantage through existing supply chains and mill operations, creating operational costs and constraints to using Next Gen pulp. It tests how different combinations of input price volatility, price pressure, producer risk appetite, and policies would affect willingness to pay and resulting adoption for Next Gen pulp.

The analysis uses a financial model that links a representative high-volume paperboard buyer to a China-based integrated pulp and paperboard mill.
As visualized in Figure 2-A and detailed in Annex 2: Methodology, the model underlying this brief illustrates a commercial relationship between a China-based integrated pulp and paper mill that produces FBB and a global, high-volume consumer goods brand or converter with material retail exposure in the European Union (EU). The model considers:

- Prices and price variability of FBB, conventional wood fibre inputs and Next Gen pulp.
- The value of feedstock diversification across different levels of mill risk appetite.
- Mill feedstock switching costs and operational frictions, including 25% additional operating costs associated with Next Gen pulp use at the paper mill.
- Differences in fibre yield and in the quantity and mix of inputs required to produce FBB.
- The distinct roles of the top, middle and back plies and the technical limits on Next Gen pulp use within each ply.
- Potential policy costs and the option for the buyer to pay mills to use more Next Gen pulp when doing so reduces the buyer's expected costs.
- Limits to year-on-year build rates for deploying Next Gen pulp capacity.

The model's main output is the maximum delivered Next Gen pulp price that supports at least 5% Next Gen pulp use by 2028 and thereafter up to defined technical constraints:
A 5% minimum was selected based on industry input that lower inclusion levels would not justify the operational effort and cost of introducing a new fibre source. The technical constraints are applied as follows:

- In the base technical limitation case ("Tech Limits"), Next Gen pulp can account for no more than ~10% of FBB fibre input by weight. Here, it primarily enters the middle ply, where it replaces hardwood chips processed into mechanical pulp on-site and has a negligible impact on key quality criteria.

- A higher incorporation sensitivity ("Tech Progress") allows Next Gen pulp to account for approximately 30% of total fibre input and enter the top and back plies as well, replacing higher-cost virgin wood inputs. This represents the potential for improved Next Gen pulp quality, greater mill capability, or more flexible product specifications, all without impacting the overall sold board price.

The model uses three sets of tests to represent market conditions: market risk, wood price upward adjustment, and policy support (Figure 2-A):

Test 1 – Market Risk:

This test asks how changes in Next Gen pulp price behaviour and mill risk appetite, represented by lambda ("λ" as defined in Figure 2-B), impact Next Gen pulp breakeven prices. A lower λ means the mill primarily optimizes for expected profits; a higher λ means the producer places greater value on reducing downside exposure to pulp price volatility. These levels of risk aversion are combined with different assumptions about Next Gen pulp price volatility and the correlation between Next Gen pulp and hardwood-chip prices. Our central case assumes that Next Gen pulp prices have half the variance of hardwood chip prices and move only moderately with them (See Annex 2 for more details). These price behaviour assumptions are meant to represent an early market in which Next Gen pulp is secured mainly through longer-term contracts, offtakes, or supplier partnerships, while remaining exposed to some of the same harvest, energy, freight, and other input costs.

Test 2 – Wood Price Upward Adjustment:

This test evaluates the maximum Next Gen pulp price supported after applying a one-time, permanent average price increase to softwood and hardwood pulp, as well as hardwood chips, and tests sensitivities to 5% and 10% increases across varying levels of mill risk appetite. The increase is applied in 2028, and some of it is passed through to the FBB price, consistent with historical relationships between commodity prices and the FBB price. The model is agnostic about the source of the price increases. They could reflect forest system pressures, mill downtime, tariffs or trade restrictions, energy and freight costs, logistics bottlenecks, or stronger competition for wood inputs.

Test 3 – Policy Support:

This test asks how two illustrative policies impact Next Gen pulp break-even price:

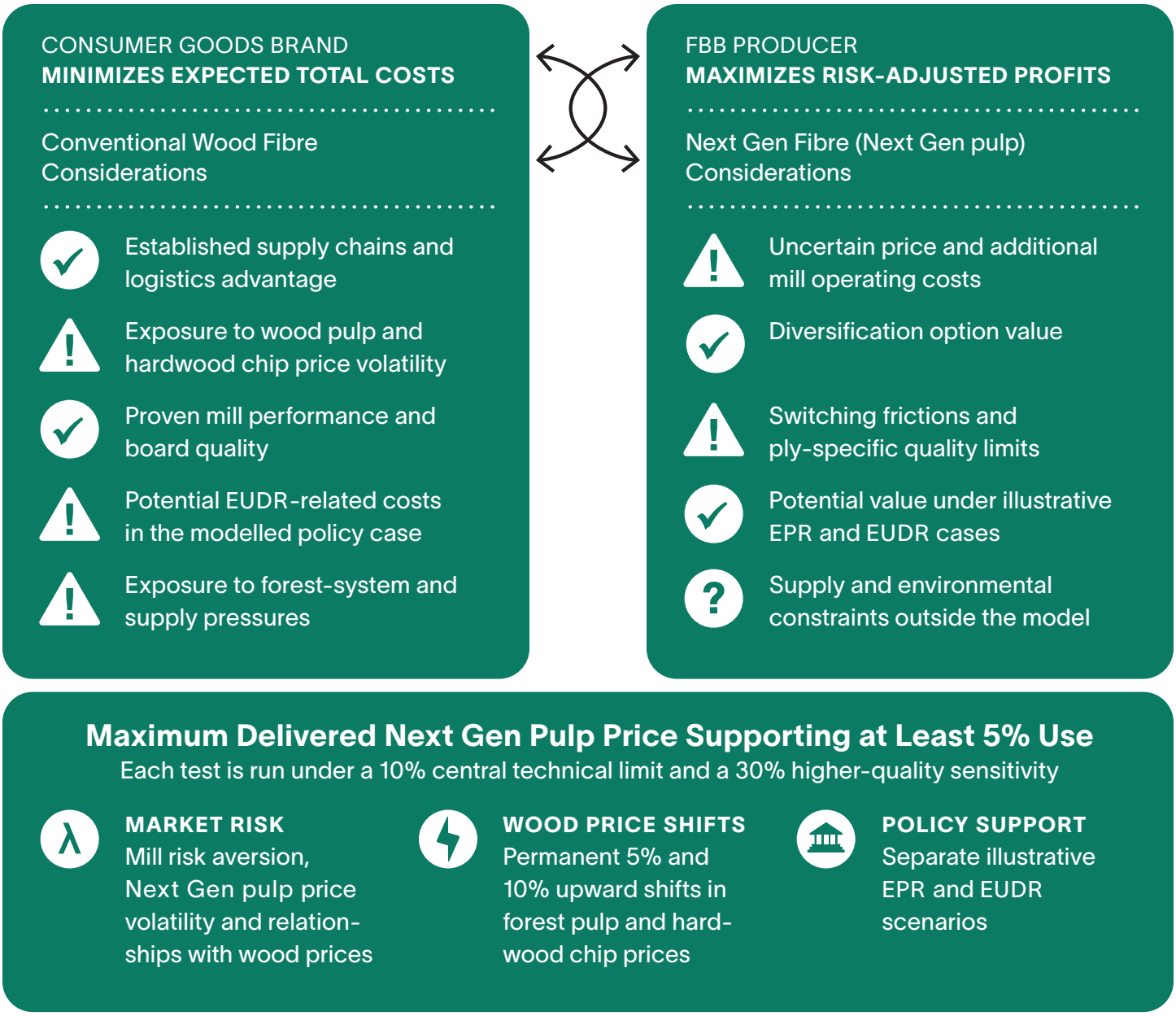
A. **EPR-style policy:** The first policy represents an Extended Producer Responsibility (EPR)-style fee applied to packaging placed on the European market. The model allows the FBB buyer to avoid up to 25% of a €200 per tonne FBB fee on the qualifying share of Next Gen pulp used. The policy start year is uncertain and falls between 2028 and 2032. No current EPR scheme provides this specific fee reduction for Next Gen fibres. The test is exploratory and draws on policy approaches such as the State of Oregon's, which adjusts fees based on lifecycle environmental performance.

B. **EUDR-style policy:** An illustrative deforestation due-diligence cost, modeled on the EU Deforestation Regulation (EUDR), for virgin wood fibre in board placed on the EU market as board or empty packaging. It combines due-diligence operating costs with an expected fine. Certified fibre carries a lower cost — in the model, FSC-certified pulp is assumed to incur none — and Next Gen and recycled fibre are outside its scope. Note: FSC certification supports but does not replace EUDR due diligence.



photo: Canopy

FIGURE 2-A: SUMMARY OF CANOPY NEXT GEN VISCOSE DUAL-OPTIMIZATION MODEL



Source: Canopy, 2026

FIGURE 2-B: INTERPRETATION OF LAMBDA (λ) AS A MEASURE OF RISK APPETITE

λ	How much average profit would the mill sacrifice to avoid $1 of downside loss	In Plain English
0	$0.00	**Risk neutral:** only average profits matter, regardless of how bad the worst scenarios could be.
0.5	$0.50	**Risk tolerant:** willing to buy some insurance, but average profit still drives most decisions.
1.0	$1.00	**Risk averse:** avoiding a dollar of loss is just as good as increasing a dollar of average profit.

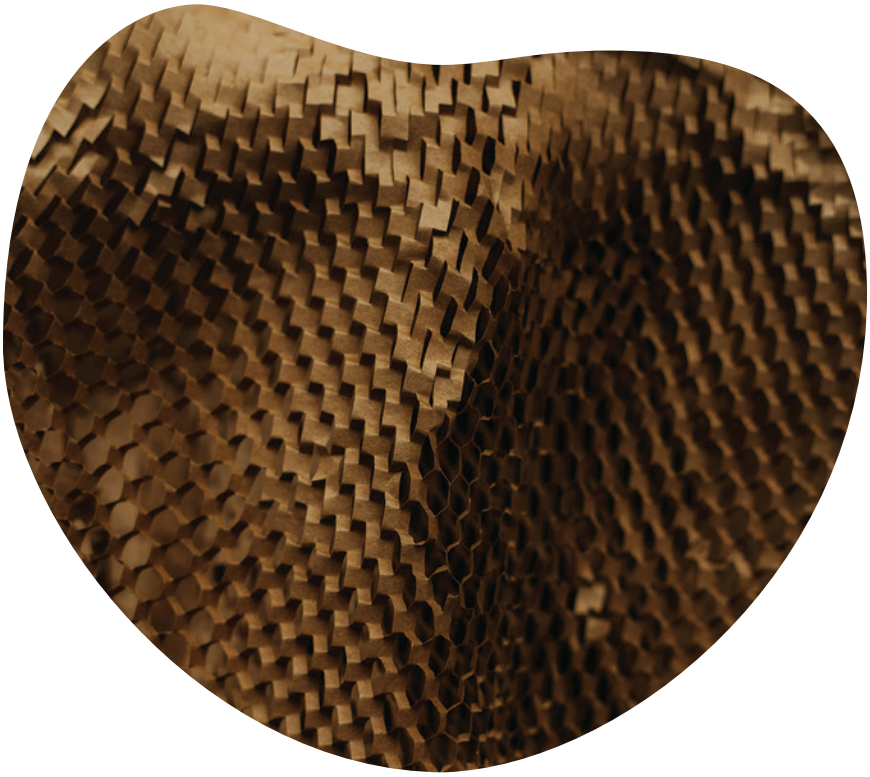


photo: © Annie Sptatt

Key Findings

1. **A maximum delivered Next Gen pulp price of ~US$345-355/ADt supports 5% to 10% use in the near-term as a hedge against wood price volatility alone, not considering policy or potential wood price increases.**

The maximum price the buyer and FBB mill are willing to pay to incorporate at least 5% and up to 10% of Next Gen pulp into FBB depends on a mill's risk appetite and input price behaviour (Figure 3):

- When the mill focuses only on expected profit and places no value on reducing downside risk (λ = 0), the maximum supported Next Gen pulp price in our model is US$345/ADt.
- When a mill is "risk-tolerant," meaning it remains focused on expected profits while placing some value on avoiding large downside losses (λ = 0.5, the central case), the maximum supported price rises to ~US$353/ADt. Here, we assume Next Gen pulp prices have half the variance of hardwood-chip prices and move only moderately with them.[15]
- When a mill is "risk-averse" (λ = 1), the maximum supported price rises to ~US$355/ADt.

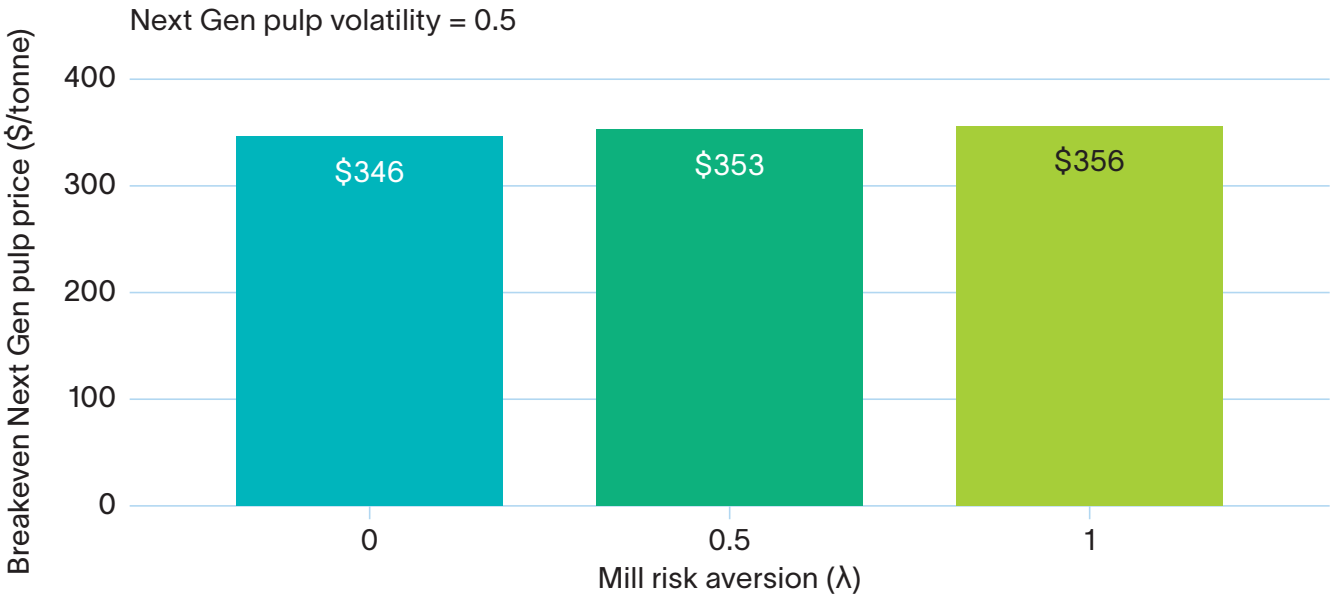
In the real world, the price that a mill can support will vary across applications, geographies, mill configurations, and sourcing arrangements. Industry reviewers considered ~US$345–355/ADt within a reasonably delivered price range for agricultural residues and byproducts, implying that a 5–10% inclusion of Next Gen pulp may already be commercially justified in some markets today as a hedge against wood price volatility alone.



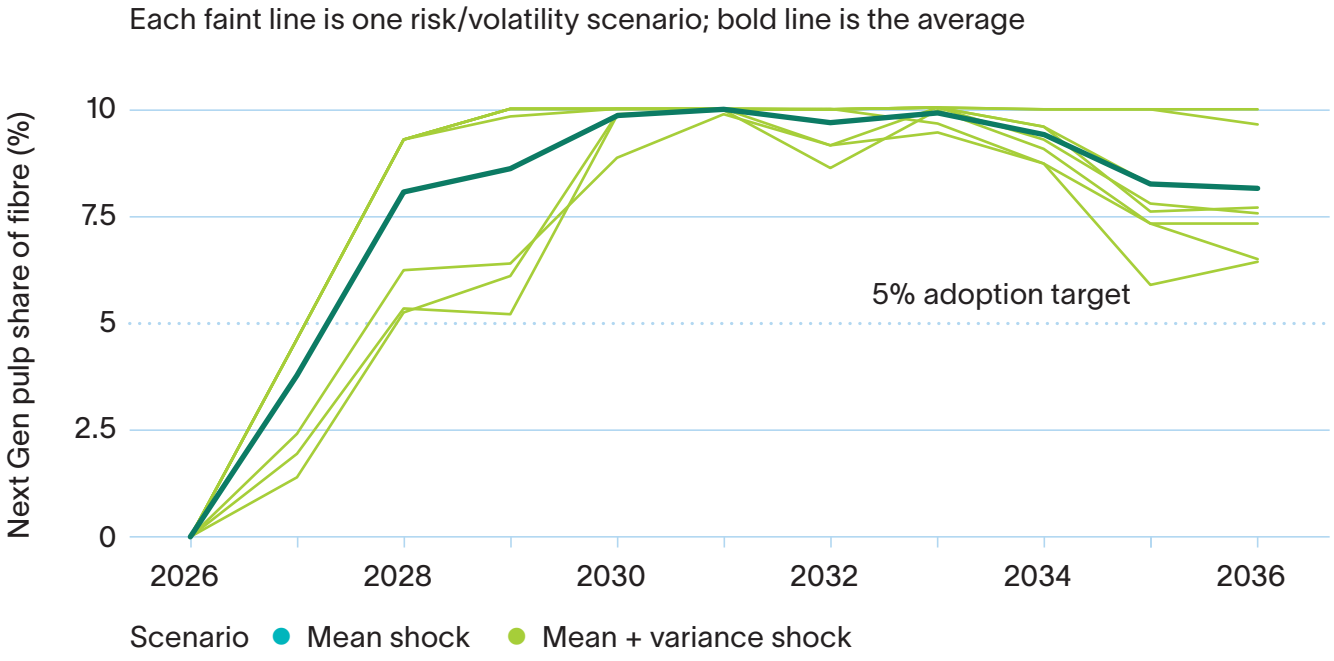
photo: © Adobe

FIGURE 3. WHEN NEXT GEN PULP PRICES ARE MORE STABLE THAN HARDWOOD CHIP PRICES AND MILLS VALUE AVOIDING DOWNSIDE LOSSES, THE MAXIMUM SUPPORTED NEXT GEN PULP PRICE RANGES FROM ~US$345–355/ADT, AND ITS USE CLIMBS TO THE 10% TECHNICAL LIMIT WITHIN 3–4 YEARS.

A. Next Gen pulp breakeven price across mill risk-aversion scenarios



B. Next Gen pulp adoption over time



Source: Canopy model, 2026.

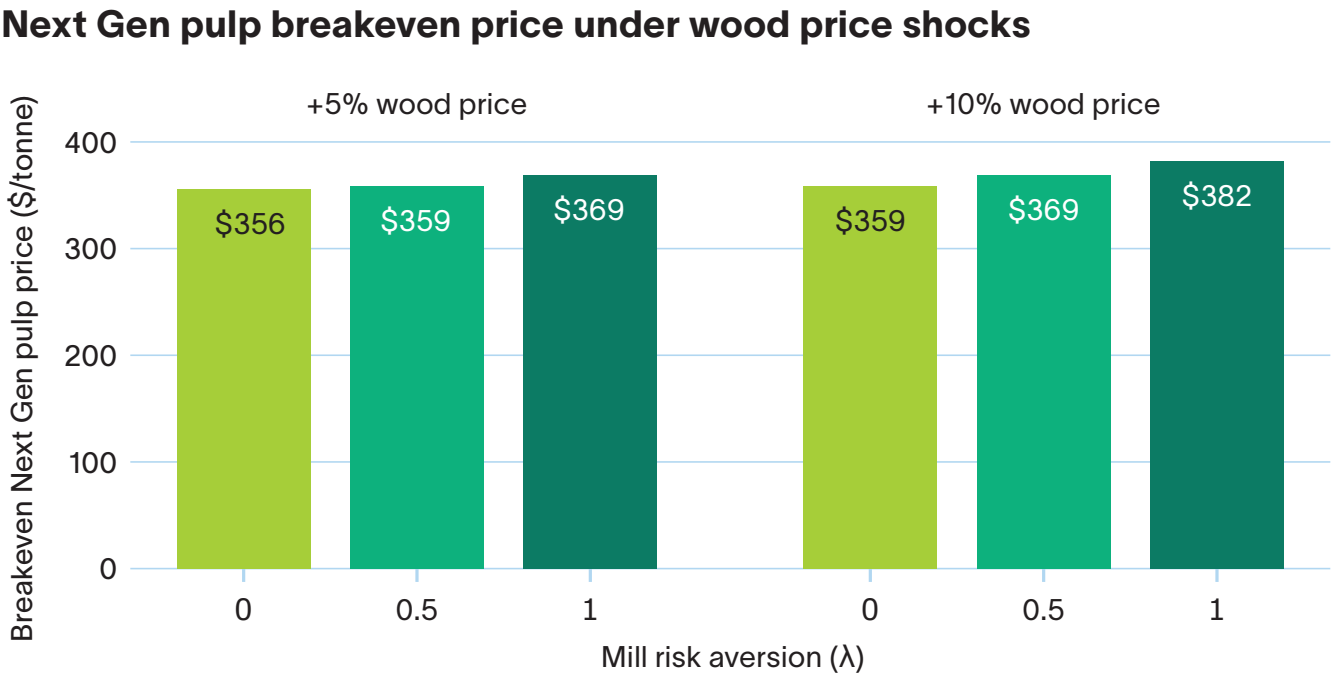
2. A modest 10% upward shift in average wood prices further increases willingness to pay up to US$380/ADt when mills aim to manage risk.

Higher wood prices can strengthen the case for Next Gen pulp because it can replace wood inputs that have become more expensive and reduce the mill's exposure to wood price volatility, even as some of the increase in wood costs will likely be passed through to FBB prices.

The value of Next Gen pulp depends on a balance between (i) the higher cost of wood, (ii) the resulting increase in FBB prices, and (iii) the value the mill places on managing risk related to wood price volatility.

A 10% upward shift in wood prices raises the maximum supported price as high as ~US$380/ADt, ~4-7% above the corresponding Test 1 results (Figure 4, right most bar). The results of the 5% test are somewhat muted, but still relevant to risk-averse mills where the maximum price rises to ~US$370/ADt.

FIGURE 4. PERMANENT UPWARD SHIFTS IN WOOD PRICES BY 10% RAISES THE MAXIMUM SUPPORTED NEXT GEN PULP PRICE BY 4–7% (ASSUMING A 10% TECHNICAL LIMIT).



Source: Canopy model, 2026.

Note: *Policy scenarios are illustrative and do not represent forecasts of actual fees, eligibility, coverage, or enforcement.*

Note: Assumes Next Gen pulp prices have half the variance of hardwood chip prices and only move moderately with them. See Annex 2 for more details.

3. Illustrative policy incentives also increase willingness to pay up to US$380/ADt when mills aim to manage risk.

The maximum price that the mill and brand are willing to pay for at least 5% and up to 10% Next Gen pulp depends on the policy mechanism and range, depending on mill risk appetite and input price behaviour (Figure 5):

- When an EPR-style policy allows the FBB buyer to reduce its fees by using Next Gen pulp, the maximum supported Next Gen pulp price rises by ~US$10–15/ADt, to ~US$360–365/ADt.
- When an EUDR-type policy increases the mill's cost of sourcing and demonstrating compliance for non-FSC forest fibre, the maximum supported Next Gen pulp price rises by US$20–25/ADt to ~US$365–380/ADt.

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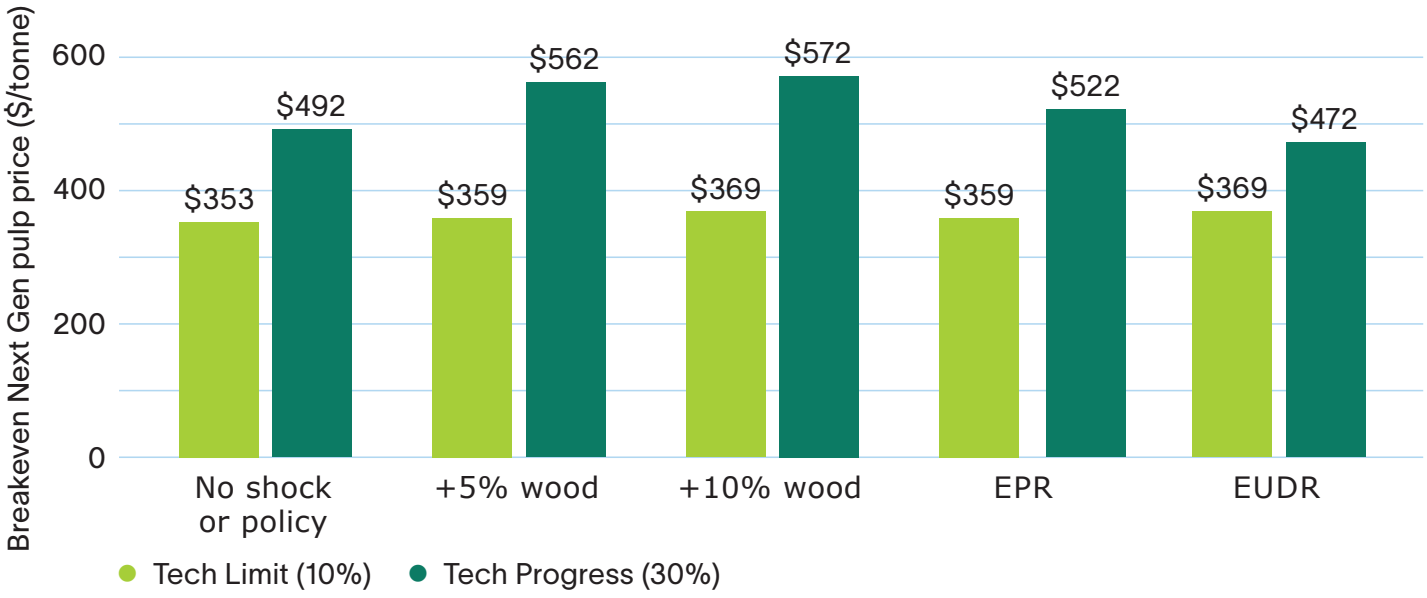


photo: © A.S. Wright

FIGURE 5. THE ILLUSTRATIVE EPR AND EUDR-TYPE SCENARIOS RAISE THE MAXIMUM SUPPORTED NEXT GEN PULP PRICE TO ~US$360–$365/ADT AND ~US$365–380/ADT, RESPECTIVELY.

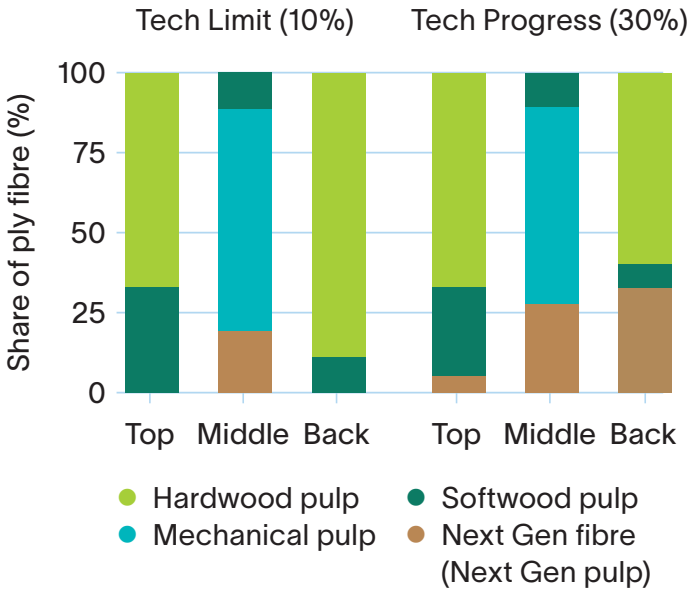
A. Next Gen pulp break-even price by scenario • Tech Limit (10%) vs Tech Progress (30%)

Moderate mill risk aversion (λ = 0.5); moderate Next Gen pulp price voltility (ρ = 0.3)



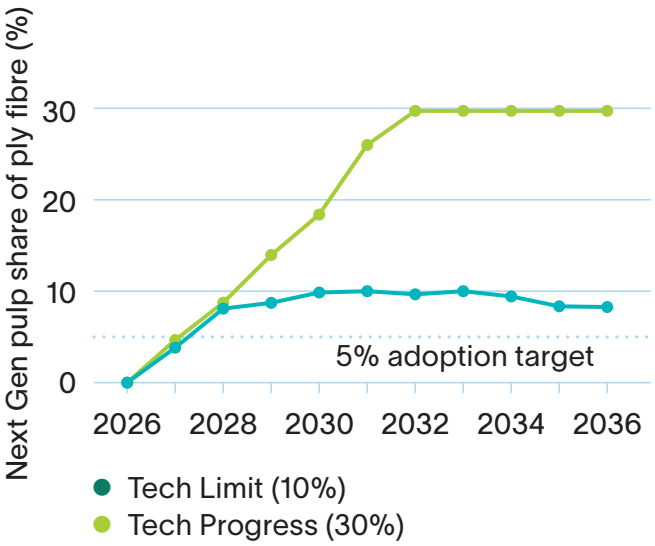
B. Average fibre mix by ply

Fibre share within each ply (average across all years)



C. Next Gen pulp adoption over time • Tech Limit (10%) vs Tech Progress (30%)

Average across risk/volatility scenarios



Source: Canopy model, 2026.

Note: *Policy scenarios are illustrative and do not represent forecasts of actual fees, eligibility, coverage, or enforcement.*

Note: Assumes Next Gen pulp prices have half the variance of hardwood chip prices and only move moderately with them. See Annex 2 for more details.

4. Raising Next Gen pulp technical limits to 30% inclusion supports significantly higher delivered prices of ~US$460–595/ADt.

The preceding findings indicate a viable starting market for Next Gen pulp at a modest 5–10% inclusion across a range of market and policy conditions.

When Next Gen pulp's technical limit rises from 10% to 30% of the furnish, the maximum supported price increases from ~US$345–380/ADt to ~US$460–595/ADt across the corresponding tests.

The higher price reflects a change in what Next Gen pulp can replace and its greater value as a protection against wood market risk. At current quality limits, Next Gen pulp primarily displaces hardwood chips processed into relatively low-cost mechanical pulp in the middle ply. In the 30% configuration, Next Gen pulp can also replace some of the more expensive pulp used in the outer plies. The mill can consequently support a higher Next Gen pulp price while maintaining or reducing its overall furnish costs. The test assumes that the resulting FBB continues to meet the required product specifications and that the FBB price is not impacted by higher Next Gen pulp use.

Under the assumptions tested, optimal Next Gen pulp use reaches approximately 19% of the furnish in 2030, 25% in 2031, and the 30% ceiling in 2032, remaining near that level through 2036.

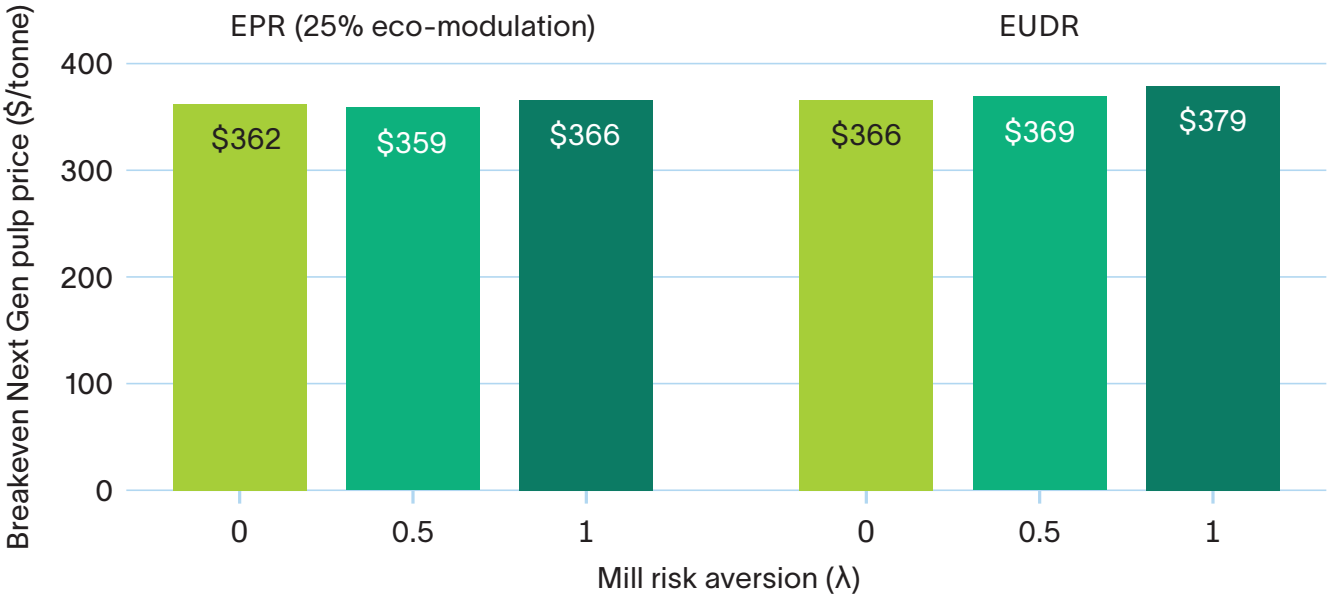
In practice, higher Next Gen pulp inclusion can be achieved through two complementary pathways: mills and innovators can improve pulp quality, consistency, processing, and mill integration to meet existing product specifications, while buyers can adjust product specifications to accommodate more Next Gen pulp. As described in the next section, the second pathway was not modeled here but could enable higher Next Gen fibre content where differences in characteristics such as colour or finish are acceptable.



photo: © A.S. Wright

FIGURE 6. IF NEXT GEN PULP PERFORMANCE AND PRODUCT SPECIFICATIONS ALLOW ITS USE TO EXPAND FROM ~10% TO 30% OF THE FURNISH, THE MAXIMUM SUPPORTED DELIVERED PRICE RISES FROM ~US$345–380/ADT TO US ~$460–595/ADT AND INCLUSION RISES TO 30% BY 2032.

Next Gen pulp breakeven price under policy



Source: Canopy model, 2026.

The higher-incorporation case is a technical sensitivity. It assumes higher-quality Next Gen pulp, greater substitution flexibility, and a constant FBB selling price.



photo: © Canopy

Next Steps

Our analysis suggests that the market does not need to wait for Next Gen pulp to reach higher technical qualification before commercialisation begins. Even against the demanding specifications of the modeled high-performance FBB, qualified Next Gen pulp can support a commercially plausible starting market at 5–10% inclusion when delivered at ~US$345–380/ADt. This initial market matters because it can create the demand, operational experience, and investment needed to improve Next Gen pulp performance and expand supply. If Next Gen pulp can ultimately reach 30% of the furnish and substitute for higher-cost virgin wood pulp, its supported price rises substantially to ~US$460–595/ADt, demonstrating its strategic and risk diversification value.

Why, then, has the market not scaled faster? Industry conversations point to three related constraints: (i) the time, cost and operational risk involved in qualifying a new fibre source; (ii) technical limits on how much Next Gen pulp can be incorporated into demanding paperboard applications today; and (iii) commercial inertia, including concerns about its historical environmental performance despite today's modern options. These constraints can reinforce one another. Innovators need committed demand to finance capacity and improve pulp performance; mills need reliable supply before investing in qualification and process changes; and buyers need qualified products before making larger procurement commitments. In contrast, conventional wood-pulp supply chains are mature, standardized, and deeply integrated into mill operations.

But business as usual is becoming less attractive. Tightening margins leave little room to absorb higher input costs, while volatility, supply disruptions, geopolitical and climate change-related risks, and changing regulations are increasing the risks of relying on established wood-based sourcing models. Companies are already responding by diversifying suppliers and building more regional supply chains. Next Gen fibres provide another opportunity to rethink fibre sourcing, starting with a commercially viable 5–10% market that can build the supply, operating experience, and investment needed to support higher inclusion over time. [16,17]

There are two routes to scale: improve Next Gen pulp's ability to meet a higher technical bar or adjust product specifications so that more Next Gen pulp can be used while maintaining the performance actually required for the application. The first pathway requires suppliers and mills to improve pulp quality, consistency, and processing performance and determine where Next Gen pulp can substitute for higher-value virgin wood pulp. Given the efficiency and performance improvements from renewable energy systems like solar once they are deployed at scale, one can assume similar improvements for Next Gen fibres as they move from niche to commercial adoption. This is the pathway represented by the 30% scenario in our model. At that level, Next Gen pulp can enter additional board layers and replace the higher-cost BHKP, thereby substantially increasing its maximum supported price.

The second pathway may be available sooner for some products. Consumer paperboards with less demanding requirements for brightness, colour, finish, strength, or print quality may be able to accommodate higher Next Gen fibre content without waiting for Next Gen pulp to meet the specifications of high-performance FBB. This pathway was not modeled, but brands and converters can identify applications where specifications can change without compromising required performance. These products may command different prices, but greater use of lower-cost fibre could maintain or increase margins, particularly where higher Next Gen fibre content supports product differentiation, sustainability commitments or reduced forest-related sourcing risk.

Scale will depend as much on building regional supply systems that generate qualified, responsibly sourced pulp as on improving the pulp.

The most strategic areas for Next Gen pulp scale are likely to emerge where sufficient sustainably available residues, preprocessing, or pulping capacity, paper and paperboard production, and committed demand can be connected within regional supply systems.

As discussed, wheat straw and sugarcane bagasse stand out because they combine large potential supply and availability in major paper-producing regions and established use in paper and paperboard production.[18,19] Asia, for example, accounts for more than half of global paper and board production and many regions such as India and China boast large wheat and sugarcane sectors; Europe combines another major paper and paperboard manufacturing base with extensive cereal production.[20,21] Brazil similarly combines one of the world's largest sugarcane sectors with a major pulp industry, accounting for around 13% of global pulp for paper production.[22]

Notably, agricultural residues and byproducts already serve a range of environmental and economic functions, from maintaining soil health to providing animal feed (e.g., wheat straw), supporting energy production (e.g., sugarcane bagasse), and producing other products, so not all generated material is suitable or available for pulp production. *Regional Next Gen pulp scaling strategies should focus on residues and byproducts that can be used for pulp without displacing important environmental functions or higher-value existing and potential uses*.

But even after accounting for these environmental needs and existing beneficial uses, substantial volumes remain available in many regions, including material that is currently underused or burned. For example, the UN Food and Agriculture Organisation (FAO) estimates that around 450 million tonnes of crop residues are burned each year globally, while Canopy's recent work in Punjab and Haryana in India found that the two states alone generate approximately 35 million tonnes of crop residue annually, much of which remains underused or is burned in fields.[23] Similarly, analysis in Brazil has estimated that more than 30 million dry tonnes of bagasse are available annually after existing heat and power uses,[24] though growing demand for biofuels could compete for this supply.

Paperboard buyers can accelerate the scaling process through clear demand signals and market commitments, while mills start with 5–10% inclusion. Current policy provides limited direct support for Next Gen use. Packaging EPR regimes are expanding, but most focus primarily on recyclability, recycled content, waste reduction, and the costs of managing packaging at end of life, without explicitly recognizing Next Gen fibres. The EU's packaging framework similarly places strong emphasis on prevention, recyclability and recycled content, but does not create a specific Next Gen incentive. The EUDR increases traceability and due diligence requirements for covered virgin wood and wood-derived products, potentially changing their relative costs and risks, but does not directly reward substitution with Next Gen pulp.[25] As a result, many of the potential benefits of Next Gen fibres are not yet reflected in the economics facing brands, converters, and mills.

Our modeling suggests that policy recognition can help, but designing it well is important. Next Gen fibres should not receive preferential treatment simply because they are non-wood; impacts vary by feedstock, sourcing, processing, transport, and the material displaced. Oregon's EPR system provides a useful model for a more flexible approach. Rather than prescribing a preferred material, the Recycling Modernization Act allows producers to seek eco-modulated fee discounts through lifecycle evaluation, with larger incentives when an evaluation demonstrates substantial reductions in environmental impact from actions such as packaging redesign. The mechanism is already being implemented: the first life-cycle evaluation bonus applied to the 2026 fee year, with larger bonuses for demonstrated impact reductions applying from the 2027 fee year.[26] This type of performance-based approach could allow qualifying Next Gen pulp to receive greater policy value where it demonstrably improves environmental outcomes, without assuming that every alternative fibre is preferable.

But stronger policy recognition of Next Gen pulp is unlikely to be sufficient on its own to scale the market in the near-term. Policymakers should consider two complementary roles: creating clearer market value for demonstrably lower-impact fibres and investing in the technical and supply infrastructure needed for those alternatives to reach commercial scale. In our illustrative 10% technical-limit scenarios, EPR- and EUDR-type mechanisms increase the maximum supported Next Gen pulp price only modestly by ~US$10–25/ADt. The larger barriers to scale are technical and commercial: developing consistent pulp, completing mill trials and qualification, financing first commercial facilities, and connecting regional feedstock supply with mills and committed buyers. Public funding can address these barriers directly through funding and other incentives for R&D, shared testing and qualification infrastructure, mill trials, demonstration facilities, and early commercial capacity.

Responsible sourcing can preserve the diversification and forest benefits of Next Gen fibres — and ensure long-term access — as the market scales. Companies should consider Next Gen fibres within a hierarchy that first reduces unnecessary packaging and expands reuse, then maximizes recycled fibre, and deploys Next Gen pulp where it can replace higher-risk virgin wood and is sourced responsibly from sustainably available supply, and uses responsibly sourced virgin

fibre where needed. This approach can diversify fibre supply while maintaining incentives to protect natural forests and improve the management of forests and plantations that continue to supply the sector.

For Next Gen fibres, companies evaluating suppliers and projects should consider both the environmental impacts of the pulp itself and the consequences of scaling the feedstock in a particular region. LCA can inform this assessment, but it should be complemented by regional analysis of feedstock availability, competing uses, and land and forest impacts. For example, companies need to understand whether residue removal could affect soil health, whether bagasse would otherwise supply renewable energy or biofuels, and whether Next Gen pulp actually displaces higher-risk wood or another relatively low-impact fibre such as recycled content. Building these considerations into supplier qualification and procurement criteria early can help companies capture the diversification, resiliency, and forest benefits of Next Gen fibres while avoiding unintended impacts as the market scales.

In short, Next Gen pulp can create value at modest 5–10% inclusion levels today, giving buyers, mills, and suppliers a viable starting point to diversify fibre supply, build regional supply chains, and invest in the technical and commercial improvements and environmental qualification needed to unlock higher inclusion and greater value over time.



Analysis and Limitations

This analysis is illustrative and intended for exploratory purposes; its results are preliminary, may be refined in the future, and may not be applicable to all brands, producers, and other supply chain actors within consumer paperboard and consumer brand value chains. Factors simplified or not yet considered in this model could also mute or amplify the results, including the availability and sustainability of qualified non-forest-derived alternative fibres, market power and pricing dynamics, and consumer cost pass-through.

See Annex 2 for methodological details.

This work is intentionally preliminary; Canopy hopes to extend this work to explore or validate the following questions in the future:

1. **Technical Feasibility and Innovation.** How do the technically feasible ranges for Next Gen pulp inclusion vary by layer and grade of paperboard, type of input, product, and end use beyond the high-performance folding boxboard considered in this analysis — and how may this evolve in the future given current investment levels and innovations?
2. **Relative Risk Evaluation.** How may different Next Gen pulp prices and associated risks be impacted by macroeconomic, environmental, and geopolitical factors, similarly and differently from forest-driven systems, and how can this sourcing be optimized?
3. **Environmental screens.** What are the most critical sets of environmental risks, sensitivities, and directional trade-offs to consider by agricultural residue, the type of forest product being displaced, and the product?
4. **Location-specific considerations.** How sensitive are assumptions and results to location-specific considerations, and where are the priority areas to pursue Next Gen agricultural residue transition, considering cost, risk, consistency of access, and availability and aggregation of agricultural residues, transport distance, seasonality, counterfactual wood fibre sourcing, and other competing local uses?
5. **All-in cost.** Considering the answers above, what is a reasonable range of all-in, risk-adjusted cost estimates for Next Gen pulp from priority feedstocks such as wheat straw, rice straw and sugarcane bagasse, sourced from different locations?

Suggested Citation

Canopy. 2026. *Seeing the Field and the Forest: Next Gen Fibre in Consumer Paperboard*. Whitepaper (Market Brief). October 2026.

Annex 1: Glossary and Abbreviations

FIBRE AND FEEDSTOCKS

Agricultural residues and byproducts	Materials remaining from agricultural production or processing, such as wheat straw and sugarcane bagasse. Some of this material already serves environmental functions (e.g., soil health) or other beneficial uses, including animal feed, bedding, and energy production.
Air dry tonne/ADt	A standard unit for pricing and comparing market pulp. One air-dry tonne represents one tonne of pulp with approximately 90% dry matter and 10% moisture.
Ancient and Endangered Forests	Canopy's term for forests of high conservation, biodiversity, and carbon value, including intact and old-growth forests. Canopy works to keep these forests out of pulp, paper, and packaging supply chains.
Bleached hardwood kraft pulp/BHKP	Chemical pulp produced from hardwood species. Its relatively short fibres contribute smoothness, formation, and print quality. In the FBB modeled, it is used in the top and back plies.
Bleached softwood kraft pulp/BSKP	Chemical pulp produced from softwood species. Its longer fibres provide strength and reinforcement. In the FBB modeled, it is used in all three plies.
Chemical pulp	Pulp produced by chemically separating cellulose fibres from wood or other plant material. Chemical pulp generally provides stronger fibres than mechanical pulp but has a lower yield from the original feedstock.
Fibre furnish or furnish	The combination and proportion of fibre inputs used to produce paper or paperboard. A commercially optimal furnish is the technically feasible combination of fibre types that meets product-performance requirements while maximising the mill's risk-adjusted profitability.
Forest fibre	Fibre produced from wood sourced from natural, semi-natural, or plantation forests. Its environmental performance depends on factors including forest type, management practices, traceability, and the ecological value of the source landscape.

Hardwood chips	Wood chips from hardwood species used to produce pulp. In the illustrative integrated mill, hardwood chips are processed onsite into high-yield mechanical pulp (bleached chemi-thermomechanical pulp) used in the FBB middle layer.
Mechanical pulp	Pulp produced primarily through mechanical separation of fibres, sometimes combined with heat and mild chemical treatment (chemi-thermomechanical pulp). It retains more of the original wood and provides high yield, bulk, and stiffness, making it useful in the middle layer of FBB.
Next Generation feedstock/ Next Gen feedstock	Low-impact, forest-free raw material from which Next Gen fibres are derived, as defined by Canopy. Next Gen feedstocks include agricultural residues and byproducts, recovered textiles, food and industrial side streams, aquatic biomass, and select purpose-grown crops. They must be responsibly sourced and exclude material needed for environmental functions (e.g., soil health), animal feed, energy production, or other beneficial uses.
Next Generation fibre/Next Gen fibre	The cellulose fibres derived from Next Gen feedstocks, either separated from the feedstock itself or produced by microorganisms grown on it (microbial cellulose). Next Gen fibres serve as alternatives to wood fibre in paper and board.
Next Generation pulp/Next Gen pulp	The processed mass of Next Gen fibres that a mill uses to make paper and board, produced by pulping Next Gen feedstocks or processing microbial cellulose. Mills can use it on its own or blend it with recycled and virgin wood pulp in their furnish. In this whitepaper, Next Gen pulp refers to pulp that delivers a credible environmental benefit relative to the wood it replaces in its specific sourcing and production context.
Recycled fibre	Fibre recovered from used paper and paperboard and processed for use in new products. Its suitability depends on factors including fibre quality, contamination, collection systems, and product performance requirements.

PAPERBOARD PRODUCTION

Converter	A company that turns paperboard into finished packaging, such as folding cartons, by printing, cutting, folding, and gluing it. Converters sit between paperboard mills and consumer goods brands.
FBB buyer	The consumer goods brand, packaging converter, or other company that purchases FBB or packaging made from it. In the model, the buyer is a global, high-volume purchaser with significant EU sales and may make incentive payments to the mill to use Next Gen pulp when doing so reduces its own expected costs.
Folding boxboard/FBB	A lightweight, multilayer paperboard commonly used for consumer packaging. It typically combines bleached chemical pulp in the outer layers with a bulkier mechanical pulp middle layer. The high-performance grade modeled here is a three-ply, non-food-contact board with a bright white printable front, a similarly white reverse side, and demanding requirements for strength, stiffness, brightness, whiteness, and print quality.
Integrated pulp and paper mill	A facility that produces pulp and uses it onsite to manufacture paper or paperboard. The illustrative mill in this analysis produces part of its wood pulp internally and purchases other pulp inputs to produce folding boxboard.
Layer or ply	One of the fibre layers that together form multilayer paperboard. Each layer serves a different function, such as surface quality, stiffness, bulk, or strength.
Non-food-contact packaging	Packaging that is not intended to come into direct contact with food. This whitepaper focuses on non-food-contact applications.
Qualification/ qualified Next Gen pulp	The process of testing and approving a new fibre source for regular use in a given product, including mill trials and confirming that the finished board meets product specifications. Qualified Next Gen pulp has completed this process and is responsibly sourced.

Technical limit	The maximum share of Next Gen pulp that can be used under a model configuration while maintaining the assumed product quality and production requirements. The base case ("Tech Limits") caps Next Gen pulp at about 10% of the furnish, in the middle ply only. The higher-incorporation sensitivity ("Tech Progress") raises the cap to about 30% and allows Next Gen pulp in all three plies.

POLICY AND REGULATION

Eco-modulation	A fee structure within an Extended Producer Responsibility (EPR) programme that adjusts producer fees according to product or material characteristics. It can reward the use of qualified, lower-impact materials without mandating a specific material choice.
EPR-style policy	An illustrative Extended Producer Responsibility policy mechanism tested in the model. It allows the FBB buyer to avoid up to 25% of an assumed €200 per tonne packaging fee on the share of Next Gen pulp used, once that share reaches 10%. The policy start year is uncertain and falls between 2028 and 2032. No current EPR scheme provides this specific fee reduction for Next Gen fibres.
EU Deforestation Regulation/EUDR	An EU regulation requiring covered commodities and products, including wood pulp, paper, and paperboard, placed on or exported from the EU market to meet deforestation, forest degradation, and due diligence requirements. Since September 2026, packaging used only to support, protect, or carry another product is excluded.
EUDR-style policy	An illustrative deforestation due-diligence cost tested in the model, modeled on the EUDR. It combines due-diligence operating costs with an expected fine on virgin wood fibre in board placed on the EU market as board or empty packaging. FSC-certified pulp is assumed to incur no cost, and Next Gen and recycled fibre are outside its scope.
Extended Producer Responsibility/EPR	A policy approach that makes producers financially or operationally responsible for managing packaging after use, including collection, sorting, and recycling.

Forest Stewardship Council/FSC	A certification system covering forest management and chain of custody practices. FSC certification supports, but does not replace, EUDR due diligence.
Life cycle assessment/LCA	A method for estimating the environmental impacts of a product or material across its life cycle, from raw material sourcing through production, use, and end of life.
Policy support	Regulation or public policy that improves the economics or encourages the use of qualified Next Gen pulp. The model tests two illustrative mechanisms: an EPR-style policy and an EUDR-style policy.

ECONOMICS AND MARKET

All-in delivered Next Gen pulp price	The total price of Next Gen pulp delivered to the mill, including the pulp price and relevant pre-processing, transport, or logistics costs. It excludes the additional mill operating costs of running Next Gen pulp, which the model accounts for separately.
Commercial adoption or scale	Use of a material at a meaningful level in regular production, beyond trials, pilots, or limited product lines.
Correlation/ρ/rho	The degree to which Next Gen pulp and wood input prices move together. Lower correlation can increase the diversification value of Next Gen pulp. The central case assumes Next Gen pulp prices move only moderately with hardwood chip prices ($\rho = 0.3$).
Downside risk	The risk of unfavourable cost, supply, policy, or market outcomes that reduce profitability. In the model, it is measured as the average financial result across the worst 5% of simulated market outcomes.
Hedge	A sourcing strategy in which one input reduces exposure to changes in the price or supply of another.

Maximum supported Next Gen pulp price	The highest delivered Next Gen pulp price at which the model still selects at least 5% Next Gen pulp use by 2028, and use up to the applicable technical limit thereafter, after accounting for the costs and potential inefficiencies associated with its use. It represents a commercial threshold under the model assumptions, not a forecast of the market price of Next Gen pulp. This report also refers to it as the breakeven price, the maximum delivered price, or willingness to pay.
Mill risk aversion/risk appetite/λ/lambda	The degree to which the mill values protection against adverse financial outcomes in addition to expected profit. A higher λ means greater risk aversion, or lower risk appetite. The model tests three levels: a risk-neutral mill (λ = 0) cares only about average profit; a risk-tolerant mill (λ = 0.5, the central case) places some value on avoiding large losses; and a risk-averse mill (λ = 1) values avoiding a dollar of downside loss as much as gaining a dollar of average profit.
Price volatility	How much the price of a commodity or production input fluctuates over time, typically measured as the standard deviation of price changes (variance is that measure squared).
Willingness to pay	The maximum price that can be supported for Next Gen pulp under the model assumptions (see Maximum supported Next Gen pulp price). In this report, the term refers to the combined commercial decision of the mill and FBB buyer and does not necessarily represent the price either party would pay independently.
Wood price upward adjustment	A one-time, permanent increase in average softwood and hardwood pulp and hardwood chip prices, applied from 2028 and partly passed through to the FBB price. The model tests increases of 5% and 10%.

Annex 2: Methods

This appendix describes the methods used to produce the results presented in this Market Brief. The objective of the analysis is to assess the conditions under which Next Gen pulp could become economically attractive as a partial substitute for virgin wood-derived pulp.

The analysis uses the Folding Boxboard Supply Chain Optimization Model ("the model") developed by Canopy specifically for this report, with support from consultants Blue Lotus Strategies and Glynmoran. It evaluates how market prices, producer risk preferences, and policy incentives could affect the future adoption of Next Gen pulp derived from waste and byproducts such as wheat straw or sugarcane bagasse. The analysis is agnostic with respect to which Next Gen pulp is used and assumes that this pulp would be responsibly sourced, with a better environmental footprint relative to the virgin wood inputs it replaces.

In this analysis, we use the model to find the maximum price at which a profit-maximizing, risk-averse pulp and paper mill (tested against risk appetite and other conditions) still chooses to transition at least 5% of its total input mix to Next Gen pulp. In each model year, an illustrative FBB producer chooses among four pulp inputs to produce a three-ply board:

- Bleached hardwood kraft (BHKP) that provides short, fine fibres, which give a smooth, well-formed, printable front and reverse surface.
- Bleached softwood kraft (BSKP) that provides long-fibre reinforcement and strength in the top-coated layer and reverse face as well as in the middle ply.
- Bleached chemi-thermomechanical pulp (BCTMP), a high-yield mechanical pulp made in-house from hardwood chips for the middle ply.
- Short fibre Next Gen pulp substitutes provide similar physical properties to hardwood fibres and can potentially be used in any of the three layers, subject to quality constraint caps.

The model starts in 2026 and covers a ten-year period from 2027 to 2036. The model makes an important simplifying assumption that both producers and brands are price takers. The model's purpose is not to forecast reality but rather to test what combinations of price changes, policy incentives, and risk preferences, would make Next Gen pulp in paper products economically attractive.

A. ANALYTICAL FRAMEWORK AND MODEL STRUCTURE

The analysis combines four components:

1. A Stackelberg game model representing interactions between an FBB buyer (e.g., consumer goods brand, packaging converter) and an FBB-producing pulp and paper mill
2. A nested constant elasticity of substitution model representing FBB production
3. A historical commodity price vector autoregression (VAR) model
4. Scenario and sensitivity analysis

Together, these components represent a commercial relationship in which brands and converters influence producer economics, FBB mills determine their commercially optimal fibre mix, and changing market and policy conditions alter the relative attractiveness of conventional wood fibre and Next Gen pulp, referred to here as alternative fibre.

Each part of the analysis and related economic modeling is described below:

1. Stackelberg Game

A Stackelberg game is a situation in which one actor chooses their optimal decision based on another actor's optimal response. The model represents the commercial relationship between an FBB buyer and producer.

The brand first determines whether to provide incentive payments to encourage greater use of Next Gen pulp. The mill then chooses its production levels and aims to maximize its own risk-adjusted profitability.

The FBB buyer is exposed to policy and FBB costs, and has the option to reduce them by incentivizing the FBB mill to use Next Gen pulp. Total buyer-side costs, therefore, include incentive payments, FBB costs, and policy compliance costs. The model allows the brand to provide two forms of support:

- an incentive payment linked to Next Gen pulp use; and
- an incentive payment linked to total board production, irrespective of input mix.

The brand selects the combination that minimizes its own expected costs, subject to a minimum board quantity. The buyer is risk-neutral and minimizes expected total discounted cost over the 10-year timeframe by optimally choosing the schedule of incentive payments.

In the Stackelberg game:

- The brand evaluates a range of possible incentive payments;
- For each possibility, the FBB producer chooses its optimal fibre inputs, considering its own costs and risk exposure, as relevant;
- The brand then selects the incentive level that minimizes its own expected cost, given the producer's response.

This reflects commercial reality: brands influence demand and purchasing conditions, while mills ultimately determine the composition of the board they manufacture.

2. FBB Producer Decision Model

The producer's decision is modeled as a risk-adjusted profit-optimisation problem over 10 years. The producer simultaneously chooses all annual Next Gen pulp shares and FBB output levels for the years 2027 through 2036, based on the 2026 market and policy outlooks.

The producer's objective is to maximize *expected net present value minus a penalty for downside risk*. The risk measure is Conditional Value-at-Risk, or CVaR. CVaR measures the average outcome in the worst tail of simulated results. In plain terms, it captures the average financial result in the most unfavourable market conditions.

This formulation recognizes that commercial sourcing decisions depend not only on average profitability but also on exposure to adverse market outcomes. Said another way, the model captures the commercial value of diversification when alternative fibres exhibit different price behaviour from conventional wood.

We test different levels of mill risk aversion, represented through the parameter λ ("lambda"), because we lack data-driven estimates of paper sector risk preferences and want to evaluate possible diversity across the industry.

A producer with low risk aversion cares more about average outcomes and less about the worst-possible outcomes. A producer with high risk aversion places greater weight on avoiding adverse outcomes stemming from price shocks or margin volatility. This feature is important because we want to represent the potential for Next Gen pulp to provide value as a diversification option, even if it is more expensive on average.

The mill's production decisions are represented using a nested Constant Elasticity of Substitution (CES) production function, reflecting the structure of commercial folding boxboard.

The model represents the different functional roles of the three plies:

- **Top ply**, providing printability and appearance.
- **Middle ply**, providing bulk and stiffness.
- **Back ply**, providing structural support and reverse-face properties, including printability for higher grades.

Each ply has a different "recipe" or mix of hardwood kraft pulp (BHKP), softwood kraft pulp (BSKP), bleached chemi-thermomechanical pulp (BCTMP), and Next Gen pulp. Substitution across fibres within a ply is possible but heavily constrained by commercial product requirements.

The model assumes that Next Gen pulp initially replaces virgin wood fibre only within the middle ply, where it has least potential for impacting quality criteria. Under the central scenario, this limits incorporation to approximately 10% of total fibre input by weight.

An alternative scenario allows Next Gen pulp to also replace part of the hardwood kraft layer in the back and front plies, increasing total incorporation ceiling to approximately 30% while holding all other market assumptions (FBB price, FBB quantity demanded) constant. This scenario is intended to test a sensitivity where Next Gen pulp reaches a quality level and commercial scale that allows for larger displacement of virgin wood while maintaining FBB quality criteria.

3. Vector Autoregression and Monte Carlo Simulation

The model uses vector autoregression (VAR) using annual data to simulate future prices for:

- folding boxboard;
- bleached hardwood kraft pulp;
- hardwood chips;
- Brent crude oil.

A VAR is a statistical model that identifies historical relationships among price series. In this case, it captures to what extent these data have moved together over the past 20 years.

We then use Monte Carlo simulation to generate 1,000 possible future price paths over the ten-year period. Each simulated path represents one possible market future.

Because a transparent price history for Next Gen pulp does not yet exist, Next Gen pulp price volatility and relationship to wood prices are modeled separately. The central case assumes that Next Gen pulp prices remain partially linked to hardwood-chip markets while exhibiting substantially lower year-to-year volatility, reflecting the expectation that early commercial supply will rely primarily on term-based commercial agreements rather than highly liquid spot markets.

Sensitivity analysis explores alternative assumptions regarding both Next Gen pulp price correlation and volatility before selecting the central specification presented in the report.

4. Scenario and Sensitivity Analysis

The analysis uses scenario testing and sensitivity analysis to assess a range of market and policy conditions as well as producer risk aversion to evaluate the maximum willingness to pay for Next Gen pulp.

The scenarios vary in producers' risk appetite, price volatility, wood pulp price shocks, and policy.

The analysis considers three groups of scenarios (Test 1 – Market Risk, Test 2 – Wood Price Upward Adjustment, and Test 3 – Policy Support).

Each scenario is evaluated under two product configurations:

- Next Gen pulp can displace no more than 10% of FBB fibre input by weight while maintaining current commercial specifications;
- a 30% incorporation limit representing increasing Next Gen pulp quality and paper mill capability.

TEST 1 – MARKET RISK

The first scenario group examines how the commercial value of Next Gen fibres changes under different assumptions regarding:

- mill risk appetite (λ);
- Next Gen pulp price volatility;
- correlation between Next Gen pulp and conventional wood market prices.

Sensitivity analysis was first undertaken across a wider range of plausible assumptions. Unless otherwise stated, reported results use the central specification identified through that process, in which Next Gen pulp prices are assumed to move only moderately with hardwood-chip prices and exhibit substantially lower price volatility.

TEST 2 – WOOD PRICE UPWARD ADJUSTMENT

The second scenario group examines the commercial implications of a persistent 5% or 10% shift, starting in 2028, to wood pulp and wood chip prices. The price shocks are assumed to flow through markets modeled in the VAR, but all other market dynamics are assumed constant.

TEST 3 – POLICY SUPPORT

The third group evaluates how an illustrative EPR eco-modulation incentive for Next Gen pulp and EUDR-related costs influence commercially optimal fibre sourcing.

The analysis evaluates two illustrative policy mechanisms.

1. Extended Producer Responsibility (EPR)-Style

The model represents EPR-style policy through eco-modulated fees applied to packaging placed on the European market. FBB buyers can reduce up to 25% of these costs by incorporating sufficient quantities of qualifying Next Gen pulp. Currently, there is no EPR scheme that provides fee reductions for the use of Next Gen fibres excluding recycled fibres. This policy test is exploratory and approximates Oregon's EPR scheme, which allows producers to reduce base fees by 10%

for evaluating and disclosing life-cycle impacts, and by 20–30%, subject to per-product dollar caps, where an evaluation demonstrates a substantial reduction in environmental impact. The model's 25% discount approximates the middle tier.

2. EU Deforestation Regulation (EUDR)-Style
The model also considers an illustrative deforestation due-diligence cost, modeled on the EUDR, for virgin wood fibre in board placed on the EU market as board or empty packaging (packaging used only to carry other products is excluded under Commission Delegated Regulation (EU) 2026/2102); certified fibre carries a lower cost (modeled as zero for FSC-certified pulp, although certification supports rather than replaces EUDR due diligence), and Next Gen and recycled fibre are outside its scope. These policy representations are illustrative and are intended to explore potential commercial impacts rather than predict future regulatory implementation.

5. Model Outputs

For each scenario the model estimates:

- commercially optimal fibre mix;
- annual board production;
- annual Next Gen pulp use;
- break-even delivered price for Next Gen pulp;
- brand incentive payments;
- expected producer profitability;
- downside-risk measures;
- policy costs;
- fibre adoption over time;
- layer-by-layer furnish composition.

The metric of interest reported throughout this paper is the **maximum delivered price** that responsibly sourced Next Gen pulp can command while achieving at least 5% of the fibre input mix under each scenario.



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B. ASSUMPTIONS BY MODEL COMPONENT

1. CORE MODEL

All assumptions in this section are either expert judgement, sourced from personal communications with internal and external experts, or drawn from cited public data sources.

Category	Assumption
Model period	2027–2036
Initialization year	2026
Discount rate	8% per year
Inflation	1% per year applied to deterministic operating, distribution, and bleaching costs
Currency	US$, with EUR-denominated policy costs converted at 1.08 US$/EUR
Units	Pulp quantities: Air dry metric tonnes Fibre quantities: Bone dry metric tonnes Prices: nominal US$ specific to each model year
Producer scale	Three representative mills
Mill capacity	500,000 tonnes of FBB board per mill per year
Total capacity	1,500,000 tonnes of FBB board per year
Output grade	Premium coated folding boxboard
Fibres	Bleached hardwood kraft pulp (BHKP), bleached softwood kraft pulp (BSKP), bleached chemi-thermomechanical pulp (BCTMP) produced on site from hardwood chips, and Next Gen pulp; recycled fibre from old corrugated containers (OCC) optional (off in the base case)
Production structure	Nested CES — three plies (top, middle, back); each ply a two-input CES of a residual pulp and BSKP, with NG displacing virgin fibre linearly
Ply fibre shares (GC1, the premium, white-backed grade of FBB)	Top 0.32, middle 0.43, back 0.25 of total furnish

Category	Assumption
Next Gen substitution	Linear displacement within each ply, allocated middle → back → top up to per-ply caps
Next Gen efficiency	0.88 tonne effective fibre per tonne Next Gen pulp
FSC-certified share	Fixed at 40 percent of forest fibre input
Producer objective	Maximize expected net present value adjusted for downside risk
Brand objective	Minimize expected total discounted cost per tonne of finished packaging
Producer risk measure	Conditional Value at Risk (CVaR) using the worst 5% of simulated outcomes
Number of price simulations	1,000 price paths
Producer decision timing	The producer chooses a ten-year fibre and output schedule under uncertainty
Brand demand floor	Average board consumption must be at least 75 percent of total nameplate capacity across the three mills
Board-to-packaging conversion	1.05 tonnes board per tonne finished packaging (converting/sheeting waste)

2. FEEDSTOCK AND PRODUCTION COSTS

The producer's annual profit is calculated from folding boxboard (FBB) revenue, brand incentive payments, fibre costs (purchased bleached hardwood and softwood kraft pulp, on-site BCTMP produced from hardwood chips, and Next Gen pulp), electricity and bleaching chemicals for the on-site BCTMP line, transportation costs, other board-machine operating costs, and policy-related cost adjustments.

Forest-pulp prices (bleached hardwood kraft, or BHKP), hardwood chip prices, and the FBB board output price are sourced from the VAR Monte Carlo. Bleached softwood kraft (BSKP) is priced at a fixed premium over hardwood kraft. FSC-certified forest pulp can receive an assumed price premium when the EUDR-type policy scenario is active.

Next Gen pulp — agricultural-residue pulp such as straw or bagasse — has its own price treatment (see the price section). Next Gen pulp is purchased at the mill gate, and the model applies an operating-cost uplift to the Next Gen pulp share of

the furnish, reflecting the incremental board-machine cost of running non-wood fibre. Next Gen pulp displaces virgin fibre ply by ply, subject to per-ply recipe limits.

Category	Assumption	Source (accessed)
Initial BHKP (hardwood kraft) price	US$575/t CIF (cost, insurance, and freight) China	Price Watch / Price-Watch.ai, "Bleached Eucalyptus Kraft Pulp Prices", https://www.price-watch.ai/bleached-eucalyptus-kraft-pulp-prices/ (accessed Jul 2026): CIF Shanghai BEKP assessed US$560–590/t, Sept 2025; midpoint → 575. Cross-check: Fastmarkets, "Prices for NBSK, BHK imports in China begin to tumble", https://www.fastmarkets.com/insights/prices-for-nbsk-bhk-i mports-in-china-begin-to-tumble/ (accessed Jul 2026).
Initial BSKP (softwood kraft) price	US$719/t CIF China (fixed premium over BHKP)	Assumption: set at +25% over BHKP (719 = 1.25 × 575), expert judgement (Jul 2026).
Initial hardwood chip price	US$172 per bone-dry metric tonne (BDMT) CFR (cost and freight) China (feeds the on-site BCTMP line)	Salon Paper, "China Wood Chips Weekly Report", https://www.salonpaper.com/blog/china-wood-chips-weekly-report-june-2026 (accessed Jul 2026): Beihai grade-A eucalyptus ~1,210 CNY/t ~= US$168 domestic at 7.19 CNY/US$; + freight → ~US$180 CFR; 172 taken as a domestic-floor/CFR proxy. Benchmarks: eucalyptus FOB ~US$157–161/BDMt (Mason, Bruce & Girard, GCA Forest Sector Outlook 2024 Q2, https://www.masonbruce.com); Forest & Wood Products Australia, https://www.fwpa.com.au (both accessed Jul 2026).
Initial FBB board price (GC1)	US$1,050/t FOB (free on board)	We anchor to IndexBox China FBB export US$980/t (2024). Model GC1 is a premium export grade, so we apply a calibrated 7% premium above the FBB export average which is enough to ensure the FBB mill is profitable.

Category	Assumption	Source (accessed)
On-site BCTMP marginal cost	US$411/t at base prices (chips at 0.87 yield + electricity + bleaching)	Derived (not directly sourced): chips 172/0.87 yield (per bone-dry tonne of pulp; about US$178 per air-dry tonne) + electricity (2 MWh/t × ~US$0.10/kWh) + bleaching (40 kg/t × US$0.34/kg) = 198 + 200 + 14 = 411. Electricity: GlobalPetrolPrices China, https://www.globalpetrolprices.com/China/electricity_prices/; China Briefing, https://www.china-briefing.com/news/chinas-industrial-power-rates-category-electricity-usage-region-classification/ (both accessed Jul 2026). Make-or-buy ceiling: traded BCTMP ~US$500-730/t CIF China (Fastmarkets FP-PLP-0060; Mercer International Q4 2024, https://www.mercerint.com, accessed Jul 2026).
Next Gen pulp operating-cost uplift	+25% on non-fibre board-machine cost, charged on the Next Gen pulp furnish share	Expert/user-specified (Jul 2026); no external benchmark for Next Gen pulp-specific board-machine operating cost.
Transportation cost	Inland port-to-mill leg only (ocean freight already embedded in CIF/CFR prices), inflated at 1% per year	Model assumption: only the inland port → mill leg is added (ocean freight already embedded in the CIF/CFR pulp and chip prices); inflated at 1%/yr.
FSC premium	0% in the base case; an assumed premium can be activated under the EUDR scenario	Model assumption: 0% in the base case; an assumed premium can be activated under the EUDR-style scenario. No FSC paperboard-pulp premium series was sourced.

Category	Assumption	Source (accessed)
Other operating costs	Electricity, steam, bleaching chemicals, biocide/ defoamer, labour, depreciation, and interest	Standard board-mill cost items (expert judgement); not individually price-sourced in this table.
Due-diligence and traceability operating cost	Applied to non-FSC forest-fibre output where the EUDR policy is active	See Policy Representation (EUDR-type): due-diligence opex cost equal to 10% of its deterministic non-fibre operating costs, scaled by the share of its fibre furnish that is non-FSC forest fibre. The 10% figure is expert assumption.

3. PRICE AND MARKET UNCERTAINTY

Historical annual price data from 2005 to 2024 are used to train the VAR model for four series: bleached hardwood kraft (BHKP) wood pulp, FBB paperboard, hardwood chips, and Brent crude oil. Pulp, board, and chip prices are based on UN Comtrade trade-weighted unit values. Brent crude oil is included because movements in energy markets can affect broader commodity and pulp price dynamics.

The VAR model is fitted to annual log changes in:

- bleached hardwood kraft (BHKP) wood-pulp prices;
- FBB paperboard (output) prices;
- hardwood chip prices;
- Brent crude oil prices.

The model uses those historical relationships to generate correlated future price paths. Board and chip price paths are mean-corrected to a one percent nominal annual drift, and the board innovation variance is scaled to the calmer post-2011 period. The simulated prices are then re-anchored to the model's assumed 2026 starting prices.

Alternative fibre is treated separately from the VAR. Because there is no mature, well-measured historical market for agricultural residue and byproduct pulp, the model holds Next Gen pulp at a constant real mean price and overlays volatility whose scale is anchored to hardwood chip innovations — correlated with wood-pulp and chip price shocks (a competing fibre channel) but uncorrelated with the finished board price.

Category	Assumption	Source (accessed)
Historical VAR window	2005–2024	Estimation sample for all four series. UN Comtrade unit values, https://comtradeplus.un.org (accessed Jul 2026).
Commodity price method	Four-variable vector autoregression of BHKP wood pulp, FBB board, hardwood chips, and Brent crude oil, with Monte Carlo simulation	Series: BHKP HS 470329, FBB board HS 481092, hardwood chips HS 440122 (UN Comtrade, https://comtradeplus.un.org, accessed Jul 2026); Brent crude oil (spot).
Number of Monte Carlo iterations	1,000	Model setting for the production run (Jul 2026); raised from 500 to 1,000 for Monte-Carlo fidelity.
Board drift/ variance	1% nominal annual drift; innovation variance scaled to the post-2011 period	Estimated from UN Comtrade HS 481092 FOB, 2005–2024: drift ~1%/yr; post-2011 SD ~4.25%/yr vs full-sample ~12.4%/yr → variance scale 0.12. https://comtradeplus.un.org.
Chip drift	1% nominal annual drift	Estimated from UN Comtrade HS 440122, 2005–2024 (post-2011 approximately flat). Analysis 21 Jul 2026, https://comtradeplus.un.org.
Next Gen pulp volatility anchor	Central case assumes Next Gen pulp price variance is half that of hardwood chips	Next Gen pulp is anchored to the closest incumbent fibre type, hardwood chips. We assume 0.5 to reflect potential for longterm offtakes and tested sensitivities UN Comtrade China-import unit-value annual log-change SD: straw HS 1213 0.150, maize HS 1005 0.133, chips HS 440122 0.126–0.150, vsBHKP HSS 470329 0.198. https://comtradeplus.un.org (accessed 21 Jul 2026);

Category	Assumption	Source (accessed)
Next Gen pulp-wood-pulp correlation	0.30 (competing-fibre channel; expert judgement / UN Comtrade proxies)	Straw HS 121300 and bagasse HS 230320 vs BHKP HS 470329, 2005–2024; AR(1)-innovation basis straw +0.23/bagasse +0.35 (avg ~0.29 → 0.30). https://comtradeplus.un.org (accessed 18 Jul 2026).
Next Gen pulp-chip correlation	central (swept/ 0.30/0.50)	Same straw/bagasse series vs chips HS 440122; AR(1)-innovation basis straw +0.51/bagasse +0.64 (data central ~0.5; 0.30 used, swept 0.15/0.30/0.50). https://comtradeplus.un.org (accessed 21 Jul 2026).
Next Gen pulp-board correlation	0 (agricultural residues have no cost channel to the board price)	Straw HS 121300 and bagasse HS 230320 vs board HS 481092; raw and AR(1)-innovation correlations indistinguishable from zero (n ~ 14-16 annual obs). https://comtradeplus.un.org (accessed 18 Jul 2026).

4. ALTERNATIVE FIBRE: RECIPE LIMITS AND COSTS

Rather than a learning curve, the FBB model constrains Next Gen fibre use through per-ply recipe limits and charges an operating-cost premium on the Next Gen fibre furnish share. Next Gen pulp substitutes for virgin fibre linearly within each of the three plies, up to a maximum blend share for that ply.

NGF is allocated across plies in a fixed waterfall — middle ply first, then back, then top — each ply filled to its per-ply cap before Next Gen fibre spills into the next. Under the base recipe only the middle ply admits Next Gen fibre, giving a funish-wide Next Gen fibre ceiling of 10 percent; a higher-cap sensitivity opens all three plies (roughly 10/30/50 percent for top/middle/back), raising the furnish-wide ceiling to 30 percent.

An operating-cost uplift of 25 percent is applied to the non-fibre board-machine cost attributable to the Next Gen fibre share of the furnish, reflecting the incremental energy, chemical, and maintenance cost of running non-wood fibre.

All assumptions used here are based on expert judgment and consultation with internal and external experts.

Category	Assumption	Source (accessed)
Next Gen pulp allocation	Waterfall middle → back → top; each ply filled to its cap before Next Gen pulp spills to the next	Model design (internal); expert-informed (Jul 2026).
Base per-ply Next Gen pulp caps (GC1)	Middle 22%; top and back 0 (Next Gen pulp in the middle ply only)	Expert-informed recipe limits (Jul 2026): GC1 max Next Gen pulp blend share middle 0.221, top and back 0. No public mill-furnish source;
Base furnish-wide Next Gen pulp ceiling	About 10%	Derived: = 0.108
High-cap sensitivity per-ply caps	Top 10%, middle 30%, back 50%	Sensitivity design (Jul 2026): all three plies opened, top/middle/back = 0.10/0.30/0.50.
High-cap furnish-wide ceiling	About 30%	Derived: 0.10 × 0.32/0.88 + 0.30 × 0.43/0.88 + 0.50 × 0.25/0.88 = 0.325.
Next Gen pulp operating-cost uplift	+25% on non-fibre board-machine cost, on the Next Gen pulp furnish share	Expert/user-specified (Jul 2026); see the Feedstock table.
Year-on-year Next Gen pulp change limit	Capped at 5–10% of mill board output per year (ramp schedule)	Model constraint: 5% of mill board output in years 1–4, 7% years 5–6, 10% years 7–10. Scenario-design assumption.

5. POLICY REPRESENTATION

The model evaluates two policy categories:

1. An EU packaging Extended Producer Responsibility (EPR) fee with eco-modulation;
2. An EU Deforestation Regulation (EUDR) due-diligence and fine mechanism applied to forest fibre, with Next Gen pulp and recycled OCC outside its scope.

In the model, policies can affect brand compliance costs, producer input prices, producer operating costs, and the relative cost of Next Gen pulp compared with forest pulp.

EPR is represented as a per-tonne packaging fee with eco-modulation: the fee is discounted on the share of Next Gen pulp, provided the modeled qualifying share reaches a constant 10 percent Next Gen pulp threshold.

EUDR is represented as a fine on the non-FSC forest fibre share of board placed on the EU market as board or empty packaging, plus a due-diligence and traceability operating cost applied to the same non-FSC forest share. Certified fibre carries a lower cost, modeled as zero for FSC-certified pulp, and Next Gen and recycled fibre are outside its scope. The fine base is the CFR value of the board itself as placed on the EU market.

The EUDR start year is fixed in the model (2027, as the regulation covers wood pulp, paper and paperboard from 30 December 2026 (excluding, since September 2026, packaging used only to carry other products) for large and medium operators and 30 June 2027 for micro and small). The EPR start year is drawn stochastically within a window (2028–2032), so the producer and brand face uncertainty over when the packaging fee begins.

All assumptions used here are based on expert judgement and consultation with internal and external experts.

Policy category	Timing assumption	Brand-side effect	Producer-side effect
EPR	Stochastic start 2028–2032	Per-tonne packaging fee (assumed €200), eco-modulated for the qualifying (Next Gen pulp/OCC) share (eco-modulation rate assumed 25%)	Next Gen pulp price bump and forest-pulp price adjustment (both set to 0 in this analysis)

Policy category	Timing assumption	Brand-side effect	Producer-side effect
EPR threshold schedule	10%	Eco-modulation discount applies only once the qualifying share reaches the threshold	Affects the value of Next Gen pulp adoption
EUDR	Fixed start 2027	Fine on non-FSC forest-fibre board volume; Next Gen pulp, OCC, and FSC pulp exempt	Forest-pulp price bump (set to 0) and due diligence and traceability operating cost (about 10 percent on the non-FSC forest share)
EUDR fine base	Applied to board placed on the EU market as board or empty packaging	Fine = fine rate × CFR board value × non-FSC forest share (rate band 0.10/0.25/0.50%; base about US$1,000/t)	

6. BRAND INCENTIVES AND BRAND COST ACCOUNTING

The brand can offer two incentive payments to the FBB producer:

- Next Gen pulp-specific incentive: paid per tonne of Next Gen pulp used by the producer;
- Board-output incentive: paid per tonne of finished packaging, regardless of fibre mix.

The brand sets a single optimal level for each incentive, held constant across all years.

The brand's objective includes:

- Total discounted incentive payments;
- Total discounted EPR compliance costs;
- Total discounted EUDR compliance costs (fine plus due diligence and traceability operating cost).

The brand's cost measure is total discounted cost, or TDC, expressed per tonne of finished packaging in the base case.

7. SCENARIO DESIGN

The analysis uses three main scenario blocks. Each block is run twice — once under the base per-ply Next Gen pulp recipe caps and once under the higher-cap sensitivity — for 42 model cells in total.

Block A (Test 1 – Market Risk)
This block evaluates whether Next Gen pulp adoption occurs under market conditions alone, based on historical price relationships. No policy instruments are active. The block crosses producer risk aversion with the Next Gen pulp price-volatility scale and the Next Gen pulp-chip price correlation.

Block B (Test 2 – Wood Price Upward Adjustment)
This block estimates Next Gen pulp adoption under a persistent step increase in forest pulp and hardwood chip prices, applied from 2028 onward and passed through to the board price.

The block tests two shock magnitudes, each crossed with three producer risk-aversion levels:

- B1: a persistent +10 percent price step;
- B2: a persistent +5 percent price step.

Block C (Test 3 – Policy Support)
This block estimates Next Gen pulp adoption under policy support: an EPR-only scenario (packaging fee with eco-modulation) and, separately, an EUDR scenario, each crossed with three risk-aversion levels.

For each policy the model solves the full brand-mill interaction and reports the resulting Next Gen pulp adoption, incentive schedule, and brand cost.

8. KEY LIMITATIONS AND CAVEATS

The results reflect conditional, scenario-based estimates of the market and policy conditions under which Next Gen pulp is adopted in FBB furnish. They should not be read as forecasts of future market share.

Representative supply chain. The model uses one representative brand and one representative FBB producer scaled to three identical mills. It does not represent the full diversity of producers, brands, geographies, contract structures, technologies, or sourcing strategies.

No full market-equilibrium feedback. The model does not solve for global supply, demand, and price equilibrium. Prices are simulated externally and then used in the producer and brand decision model.

Next Gen pulp price path is assumption-based. Mature historical market data for agricultural-residue pulp do not exist. The Next Gen pulp price level, volatility, and correlations rely on assumptions and public proxy series and should be treated as uncertain.

Next Gen pulp supply is outside the model. The model assumes that qualifying feedstock is available when Next Gen pulp use expands. Real-world adoption may be constrained by collection, sorting, silica and ash content, contamination, logistics, and pulping capacity.

Recipe limits are expert-set. Next Gen pulp use is capped ply by ply at expert-informed blend shares rather than derived from fibre mechanics. Actual mill limits may be higher or lower and may depend on grade, machine, and product specification.

Nested-CES production with linear Next Gen pulp displacement. Each ply is modeled as a two-input CES of a residual pulp and softwood kraft, with Next Gen pulp displacing virgin fibre linearly up to the per-ply cap. Actual mill performance may depend on fibre quality, refining, blending constraints, and interactions the CES form does not capture.

FSC share is fixed. FSC-certified forest pulp is fixed at 40 percent of forest-fibre input. The model does not independently optimize the FSC versus non-FSC mix.

Producer decisions are open-loop. The producer chooses a ten-year fibre and output schedule under uncertainty. The model does not allow the producer to re-optimize every year after observing actual market conditions.

Policy design is notional. EPR- and EUDR-style policies are represented through economic costs, incentives, timing assumptions, and price effects. Actual policy design, enforcement, exemptions, reporting rules, and industry responses may differ.

Brand cost accounting is incremental. Brand total discounted cost includes incentive payments and policy compliance costs. It excludes market-price packaging procurement, assuming fixed downstream demand and exogenous market prices. Reported brand cost values should be interpreted as incremental sourcing and compliance costs, expressed per tonne of finished packaging.

Future market relationships may diverge from historical patterns. The price model uses annual data from 2005 to 2024. The estimated relationships reflect that period and may not capture future structural changes in pulp, board, energy, or agricultural-residue markets.

Footnotes

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2 PwC Middle East and MIT Data Science Lab, Localizing supply chains and its impact on performance, December 15, 2024. Available at: https://www.pwc.com/m1/en/publications/localising-supply-chains-and-its-impact-on-performance.html. For global evidence, see McKinsey & Company's 2024 supply chain risk survey, in which about 60% of respondents reported acting to regionalize supply chains (note 7).

3 Preliminary results. Dataset and methodology were produced by independent life cycle assessment (LCA) practitioners as part of a multi-year collaborative research project commissioned by Canopy to assess and compare the sustainability profile and impact of Next Gen fibres. An International Organization for Standardization (ISO)-compliant public report is under development, pending critical review.

4 The FBB used in this analysis has three plies: (1) a top coated layer comprised of bleached hardwood kraft and bleached softwood kraft; (2) a middle core consisting of high-yield mechanical pulp, made in-house from hardwood chips; and bleached softwood kraft; and (3) a reverse face comprised of bleached hardwood kraft and bleached softwood kraft. We further assume that Next Gen pulp is first used in the middle ply before the reverse, and finally, the top coated layer, given that inclusion of alternative fibres such as agricultural residues and byproducts can have an impact on the brightness, whiteness, and printability of FBB.

5 Maximum delivered Next Gen pulp price refers to the highest price a mill could pay for Next Gen pulp delivered to the mill while its use remains commercially optimal, after accounting for the costs and potential inefficiencies associated with its use.

6 Assumes in both scenarios that Next Gen pulp price variance is 0.5 times hardwood-chip price variance and its correlation with hardwood-chip prices at 0.3.

7 McKinsey's 2024 global survey found that ~60% of supply chain leaders were already taking action to regionalize their supply chains. McKinsey & Company, *Supply chains: Still vulnerable*, McKinsey Global Supply Chain Leader Survey 2024, October 14, 2024. https://www.mckinsey.com/capabilities/operations/our-insights/supply-chain-risk-survey-2024

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11 Karla Mendes, "Brazil Paper and Pulp Industry Invests in Blockchain to Comply with EUDR," Mongabay, December 2024, https://news.mongabay.com/2024/12/brazil-paper-and-pulp-industry-invests-in-blockchain-to-comply-with-eudr/.

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15 See Annex 2; in the model this is specified as NGFvar = 0.5 and ρ = 0.3.

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