Future-Fit Materials Playbook

A practical guide to scaling safer, more sustainable, and more circular materials within companies, across value networks, and through markets and policy

VERSION 1.0
MEMBER RELEASE

June 2026

SUSTAINABLE BRANDS

CHANGE | Chemistry

Suggested citation:
Change Chemistry and Sustainable Brands (2026). *Future Fit Materials Playbook v1.0*.

This report was developed by the Scaling Future-Fit Materials Innovation Working Group, which included the following companies as participants and Brand Sponsors: Braskem, Eastman, Estée Lauder, IFF, P&G, and Target.

www.changechemistry.org
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About this Playbook

This playbooks is the first work product of the **Scaling Future-Fit Materials Innovation Working Group**, a collaboration between Sustainable Brands and Sustainable Chemistry that brings together companies working to advance a future in which all chemicals, materials, and products are safe, sustainable, and circular across their full lifecycle from creation through use, reuse, and end of life. The group convenes brand owners, retailers, manufacturers, suppliers, and material innovators to share insights, demonstrate leadership, and define actionable next steps for transforming the materials economy. Its mission is to accelerate wide-scale market adoption of safer, low-carbon, and circular materials and ingredients.

This playbook is designed as a **practical guide to scaling safer, more sustainable, and more circular materials** within companies, across value networks, and through markets and policy.

The playbook is written for **cross-functional leaders** working to scale safer and more sustainable materials within consumer-goods value chains particularly teams in sustainability, innovation and R&D, procurement, finance, marketing and brand, and product stewardship inside brands and retailers. It is equally relevant for **suppliers**, **manufacturers**, and **materials innovators** seeking clearer demand signals and shared evaluation frameworks to accelerate commercialization and adoption.

To maximize relevance of the Playbook across different priorities and operating contexts, we offer an intentionally broad definition of future-fit materials that includes considerations of performance, climate, nature, circularity, transparency, and social equity. However, the Playbook places particular **emphasis on the transition away from hazardous substances** toward safer alternatives. The rationale for this choice is explained in the first section.

Version 1.0 is a **Member Release intended for pilot use** by Change Chemistry and Sustainable Brands members. Future versions will be updated based on member feedback.

Project Leaders

Sustainable Brands® is a purpose-driven platform and community that helps companies integrate sustainability into core business strategy. SB convenes cross-functional leaders across brand, marketing, innovation, and strategy, and provides practical tools, research, case studies, and peer learning.

Change Chemistry is a network of over 100 companies—along the full value chain and across multiple sectors—collaborating to drive market transformation toward safer, more sustainable chemistry through its community learning, value chain collaboration, policy engagement, and market alignment programs.

Sponsors

The following companies have supported the Scaling Future-Fit Materials Innovation Working Group as participants and sponsors: Braskem, Eastman, Estée Lauder, IFF, P&G, and Target.

Preface

The transition to safer, more sustainable materials is no longer a future aspiration; it is a present business imperative. Across industries, leaders are facing converging pressures from customers, investors, regulators, and civil society to rethink the material foundations of the products and services they bring to market. At the same time, scientific advances, new business models, and emerging forms of collaboration are making it increasingly possible to move beyond incremental improvement toward systemic change.

This playbook was developed to help leaders navigate that transition with greater clarity and confidence. It reflects a shared belief that scaling future-fit materials is not only a technical challenge, but also an organizational, financial, and market-shaping one. Progress depends on better alignment within companies, stronger coordination across value chains, and more enabling policy environments. Within organizations that change begins with practitioners championing sustainability. For them, the challenge is not simply understanding why change matters; it is determining how to make that change real within the complexity of existing products, processes, supply chains, performance requirements, and business systems.

Sustainable Brands and Change Chemistry created this resource to support cross-functional decision-makers who are working to turn ambition into action. We hope it helps companies to identify where they are stuck, understand what is required to move forward, and see how collaboration can accelerate progress that no single actor can achieve alone. Version 1.0 is a Member Release intended for pilot use by Change Chemistry and Sustainable Brands members, and we welcome your feedback on how it can be improved.

The path ahead will not be simple. But the opportunity is significant: to build material systems that are safer for people, better for the planet, and more resilient for business. We offer this playbook as a practical guide and an invitation—to learn, to act, and to help shape the next generation of the materials economy together.

KoAnn Vikoren Skrzyniarz
CEO, Sustainable Brands

Jason Pearson
Executive Director, Change Chemistry

Executive Summary

A playbook for engaging in the transition to future-fit materials.

Advanced chemicals and materials are essential to modern life. Modern society, and the products and services that underpin our quality of life, is built on advanced chemicals and materials. From healthcare, food, and housing to mobility, communications, and clean energy, chemistry sits at the foundation of nearly every value chain in the global economy. As the global population grows and emerging economies adopt higher standards of living, demand for these products will only accelerate.

Many legacy chemicals and materials are not fit for continued use. of Today's materials economy is built on more than 350,000 chemicals designed primarily for immediate cost and performance, often without significant focus on the potential broader social, environmental, and economic impacts of their widespread use over time. This model is no longer fit for emerging environmental, health, and regulatory realities.

The transition to future-fit chemicals and materials is already underway. Meeting tomorrow's demand responsibly requires a deliberate shift toward materials that are demonstrably safer and more sustainable across their full life cycles, while continuing to perform reliably and at competitive cost. From a technical perspective, the principles and practices needed to design these future-fit materials are well established, and many solutions have already being invented, tested, and brought to market.

Barriers to the transition are overwhelmingly market-based. The greatest barriers to adoption and use of future-fit materials are commercial, organizational, financial, and regulatory. Across the market, barriers include cost premiums, performance concerns, substitution risk, incumbency lock-in, data gaps, capital constraints, incentive misalignment, and other market distortions. Within companies, barriers exist across functions like R&D, procurement, sustainability, finance, marketing, and executive leadership, with internal misalignment often as limiting as external market constraints.

Companies cannot address these barriers alone. This means the transition cannot be achieved through isolated action or internal optimization. It requires coordinated change across three interconnected domains: within companies, across value networks, and through enabling market and policy conditions. Breaking down internal silos is as critical as aligning incentives across supply chains and engaging constructively with regulators.

The Playbook supports strategic participation in the transition to future-fit materials. It offers practical guidance, frameworks, and real-world examples of how companies are overcoming barriers to innovation and adoption through pre-competitive collaboration, new business and financing models, true-cost and value-based decision-making, and targeted policy engagement. It is built to help organizations move faster — together — toward material systems that are fit for the future, while continuing to deliver the products society depends on.

The following page provides the “Playbook at a Glance.”

Playbook at a Glance Version 1.0 (Member Release)

The table below provides a summary of potential actions included in the playbook. This list of action is **neither comprehensive nor prescriptive**, but rather provides a range of tangible, practical pathways for consideration. Actual actions will necessarily vary by company and context.

1 Measure, Disclose & Set Targets

COMPANY

- Build cross-functional teams; educate stakeholders; articulate the business case
- Adopt a strong chemicals/materials policy and RSL/MRSL
- Inventory and disclose chemical footprint and time-bound phase-out roadmaps

NETWORK

- Align definitions, targets, and metrics across suppliers and customers
- Harmonize RSLs/MRSLs across suppliers and customers
- Empower buyers, sellers, and investors to talk about future-fit materials

POLICY

- Support harmonized global hazard classifications
- Support disclosure mandates, supply-chain transparency, and public registries
- Advocate for targeted chemical phase-out timelines

2 Design & Assess

COMPANY

- Embed Safe and Sustainable by Design (SSbD) into stage-gate processes
- Conduct rigorous alternatives assessments
- Factor externalities into ROI calculations

NETWORK

- Standardize and communicate specs to help suppliers scale
- Share hazard and performance data
- Share assessment, testing, and R&D costs through appropriate collaboration

POLICY

- Advocate for harmonized assessment criteria
- Co-develop standard assessment methodologies and disclosure formats
- Support regulatory recognition and incentivization of safer alternatives

3 Contract & Fund

COMPANY

- Commit to demand through public targets and integrated sourcing plans
- Finance transition costs internally
- Adjust procurement incentives to reward verified safer chemistries

NETWORK

- Participate in offtake agreements; pool demand across industries
- Participate in collaborative market development
- Make shared infrastructure investments

POLICY

- Support and utilize blended finance mechanisms
- Advocate for transition tax credits
- Enable public procurement preferences

4 Collaborate & Shape Markets

COMPANY

- Identify pre-competitive opportunities
- Designate executive sponsors for cross-industry work
- Translate shared learning into internal practice

NETWORK

- Collaborate to address shared challenges (data, assessment, infrastructure)
- Use competitive value-chain partnerships to scale specific materials
- Build cross-industry demand coalitions

POLICY

- Advocate for coordinated public-private market-shaping
- Contribute to and participate in standardized frameworks
- Support international harmonization

1 What Are Future-Fit Materials?

1.1 Definition

Future-fit materials are intentionally designed to deliver required performance while operating within Earth's planetary boundaries:[1] minimizing materials of concern, reducing resource intensity, and enabling reuse, recovery, or regeneration at end of life.[2]

Future-fit materials include both improved existing materials and novel innovations. While most material choices create some negative impacts, future-fit materials are intentionally designed to reduce, avoid, or reverse those impacts wherever possible, while meeting functional, safety, and economic requirements. They are safe, sustainable, and circular by design: strengthening long-term business resilience to regulatory, resource, and reputational risk.

1.2 Core Criteria

Future-fit materials meet — or make demonstrable progress toward — the following criteria:

Fit-for-purpose performance: Deliver the necessary function for a specific application without over-specifying material requirements beyond what the application demands.

Safe and Sustainable by Design (SSbD): Minimize chemical hazards and maximize sustainability performance across the entire life cycle, including:

> **Elimination of Harmful Substances:** Avoid persistent, bioaccumulative, and toxic substances. Eliminate materials of concern from the design phase rather than managing them downstream.
>
> **Circular inflows:** Incorporate renewable and/or recycled feedstocks where feasible, with the share and sourcing transparently disclosed (including certified chain-of-custody or mass balance where used). Reduce reliance on virgin fossil feedstocks over time.
>
> **Carbon net-zero and nature-positive value chain:** Operate under a verified, SBTi-aligned decarbonization plan with interim targets and demonstrated reductions. Any residual-emission offsets are clearly disclosed and third-party verified.

Transparency: Health, safety, and environmental impacts are traceable, verifiable, and disclosed across the value chain.

Human rights: Produced in ways that protect workers, consumers, and communities and support equity, justice, and fair working conditions. To be equitable and just the externalities cannot be shifted to vulnerable or fenceline communities.

Just transition: Transitions to novel technologies are fair and inclusive, put people at the center, and create decent work opportunities.

1.3 The "Hazard First" Principle

The Playbook places particular emphasis on the transition away from hazardous substances toward safer alternatives.

Our definition of future-fit materials is intentionally broad, including considerations of performance, climate, nature, circularity, transparency, and social equity. However, this first version of the Playbook places particular emphasis on the transition away from hazardous substances toward safer alternatives. Our rationale for this emphasis reflects both the nature of the challenge and the current state of available guidance for companies, as follows.

Chemical hazard is becoming a strategic global priority. The scale and urgency of chemical risk is increasingly recognized as a defining global challenge. Alongside climate change and biodiversity loss, chemical pollution is emerging as a third systemic crisis —one that directly affects human health, ecosystem stability, and long-term economic resilience. (see 2.2 Chemical Pollution) Yet compared to the net-zero and nature-positive transitions, companies have far fewer practical resources, shared frameworks, and coordinated market signals to guide action on hazardous chemicals. This Playbook seeks to help fill that gap.

A future-fit materials transition logically starts with a hazard focus. Leading frameworks for sustainable materials explicitly begin with hazard reduction. The emerging Safe and Sustainable by Design (SSbD) approach—now gaining traction across policy, industry, and finance—prioritizes the elimination of harmful substances as the foundation for all other sustainability objectives. For many companies, the most immediate and actionable entry point into the future-fit materials transition is to identify, prioritize, and phase out substances of concern—particularly those that are persistent, bioaccumulative, toxic, or otherwise high-risk. This reflects a core principle: risks that are designed out at the molecular level do not need to be managed downstream through exposure controls, compliance systems, or remediation.

Hazard reduction delivers on multiple goals. Reducing hazard often enables progress across multiple sustainability goals simultaneously, and it is frequently a gateway to broader system improvements. Materials and products free of substances of concern are often easier to recycle, reuse, or safely return to the environment—unlocking circularity that would otherwise be constrained by contamination risks. They also reduce barriers to transparency and data-sharing across supply chains, as concerns over proprietary or hazardous ingredients diminish. Similarly, eliminating hazardous substances directly advances social equity by reducing occupational risk, lowering community exposure, and helping to ensure that innovations do not shift harm onto vulnerable communities.

Taken together, these dynamics support a "hazard first" emphasis for this Playbook. Over time, leading approaches will integrate hazard, climate, circularity, and equity into unified decision frameworks. However, in this first version of the Playbook, starting with hazard provides a practical foundation. It aligns with emerging regulatory direction, responds directly to growing stakeholder expectations, and offers a clear pathway for early action that can unlock progress across the broader set of sustainability objectives.

2 The Global Materials Transition

2.1 A Materials Economy in Transition

The modern economy is built on chemicals and synthetic materials that have enabled industrialization, innovation, and technological progress. They will continue to underpin healthcare, food systems, mobility, energy infrastructure, and digital and consumer goods as global demand rises. The opportunity now is to ensure that materials underpinning modern life can be produced, used, and cycled in ways that are safe, sustainable, and resilient over the long term.

That opportunity is also urgent. Scientists warn that humanity has now crossed the planetary boundary for "novel entities", the scale and speed of chemical and plastic production exceeds our ability to assess and manage their risks. [3] Approximately 95% of manufactured goods rely on industrial chemical processes.[4] Global chemical production doubled between 2000 and 2017 and is projected to double again by 2030 and triple by 2050, resulting in hundreds of millions of tons of hazardous substances released annually into air, water, and soil. [5] In the European Union, 75% of the nearly 300 million tons of chemicals used each year are considered hazardous to human health or the environment. [6]

To illustrate both the opportunity and the challenge faced, consider plastics. They deliver immense functional benefits across sectors, yet the diversity and complexity of chemical formulations used in plastics has outpaced transparency, data availability, and end-of-life solutions. Of roughly 16,000 chemicals used in plastics, more than 4,000 are known to be hazardous. [7] Nearly half of plastic additive products contain undisclosed components, 25% fall into the highest hazard category, and 11% contain substances with no available hazard data.[8]

2.2 Chemical Pollution as a Global Priority

Chemical pollution joins climate change and biodiversity loss to form what scientists understand as an interlinked "triple planetary crisis."[9] Resource extraction is directly responsible for 90% of global nature and biodiversity loss. [10] More than 11,500 animal species are impacted by pollution.[11]

Pollution is now one of the largest environmental causes of disease and premature death worldwide, responsible for an estimated nine million deaths each year: roughly one in six globally.[13] Deaths from air pollution and toxic chemical pollution have risen by 7% since 2015 and by more than 66% since 2000. [14] The economic burden is equally stark: pollution-related losses are estimated at $4.6 trillion annually (6.2% of global GDP), and the broader disease burden associated with environmental chemical exposures is estimated to

> Pollution, climate change, and biodiversity loss are closely linked. It is increasingly clear that pollution is a planetary threat demanding a global response.
>
> **National Resources Defense Council**[12]

exceed 10% of global GDP. [15] These impacts fall disproportionately on low- and middle-income countries. [16] Within high-income countries, low-income communities and vulnerable populations — including children and pregnant women — disproportionately bear the brunt of toxic exposures.[18]

> If production of hazardous chemicals continues on the expected trajectory, it will threaten the long-term ability of the wider economic system to prosper and generate stable profits.
>
> **ChemSec**[17]

The current system is also economically inefficient. Less than 10% of the more than 90 billion tons of materials extracted annually are cycled back into productive use. [19] Persistent pollutants such as PFAS impose enormous long-term social costs. ChemSec estimates that the annual social costs of PFAS worldwide, from remediation and increased healthcare costs, total €16 trillion, or approximately one-sixth of global GDP. [20] Lack of transparency in supply chains regarding chemical ingredients further prevents consumers and workers from making informed decisions about their exposure.[21]

Together, these trends reveal a materials landscape defined by accelerating production, mounting health burdens, ecological degradation, regulatory strain, and systemic economic loss, underscoring the imperative for businesses to transition toward safer, circular, and sustainable material systems.[22]

2.3 Why This Is a System Problem

In many markets, legacy chemical and material portfolios were optimized for cost, performance, and durability under historical assumptions. As expectations evolve, those same portfolios must now be evaluated through broader lenses. This includes full lifecycle impacts, circularity, and long-term exposure. Investors, regulators, and companies are increasingly focused on identifying materials that deliver performance and durability without transferring hidden costs to society or future generations.

Crucially, these challenges cannot be solved by any single sector or actor. Chemical producers, product manufacturers, brand owners, retailers, policymakers, financiers, and technology providers all shape the material systems from which value is extracted, sharing costs and benefits to varying degrees. Advancing safer, more circular, and more sustainable materials therefore requires coordinated action across value chains that is supported by shared data, aligned incentives, and new models for collaboration.

The barriers of the problem extend beyond science and technology. Commercial risk, capital allocation, procurement practices, regulatory complexity, internal silos, and market perception all influence whether future-fit materials can scale. These barriers exist not only between value-chain partners but within organizations themselves — which is why internal alignment is as critical as external collaboration.

The transition is not defined by failure. It is defined by opportunity: the opportunity to modernize the foundations of the global economy, so they remain compatible with continued growth, societal wellbeing, and environmental resilience. What it requires is collective leadership, systems-thinking, and practical tools that help organizations move from intent to implementation across companies, value chains, and markets.

2.4 Progress

Over the past decade, meaningful progress has been made in addressing many of the structural barriers that once limited the adoption of sustainable chemistry. Regulatory frameworks such as the European Union's REACH and the modernization of the U.S. Toxic Substances Control Act have shifted expectations from reactive risk management to more proactive, data-driven chemical safety, increasing both accountability and transparency across global supply chains. At the same time, advances in green chemistry research, ranging from biocatalysts and low-toxicity solvents to carbon utilization technologies, have expanded the technical feasibility of safer alternatives across sectors.

Complementing these scientific gains, collaborative initiatives have emerged to close persistent data gaps and reduce the transaction costs of substitution: shared hazard data repositories, standardized assessment frameworks, and emerging impact metrics are enabling companies to evaluate and adopt safer chemicals with greater speed and confidence. Together, these developments signal a shift from isolated innovation to more systemic enablement, places where infrastructure for safer chemistry is increasingly built into the market itself.

At the same time, implementation has moved from aspiration to demonstration. Cross-sector collaborations, retailer-led chemical management programs, and industry initiatives such as manufacturing restricted substance lists and supply chain transparency platforms are delivering measurable reductions in harmful chemical use while maintaining product performance and competitiveness. Companies across sectors from consumer electronics to textiles to specialty chemical are integrating alternatives assessment, life cycle thinking, and safer material selection into core product development processes, often unlocking cost savings, resilience, and brand value in the process.

While challenges including resource constraints, uneven access to data, and the need for continued workforce upskilling remain, the past decade demonstrates that these barriers are no longer immovable. Instead, they are actively navigated and, in many cases, overcome through practical, scalable solutions. This report will introduce case studies to illustrate how leading organizations are operationalizing these advances. Increasingly companies are translating principles into practice and revealing the pathways by which future-fit materials can move from niche innovation to industry norm.

3 The Business Case

The transition to future-fit materials is a fundamental driver of long-term corporate profitability and resilience, not a cost center, and not a side initiative.

The business case rests on four reinforcing pillars: surging market demand, regulatory pre-emption, liability reduction, and investor pressure. Together, they make the same point from four cardinal directions: doing nothing is a strategic risk, not a neutral position.

> The risks of inadequate chemicals management, particularly regulatory, litigation, and reputational risks, are too costly for companies and investors to ignore.
>
> **Boston Common Asset Management**
> *7th Annual Chemical Footprint Project Report*[23]

By proactively phasing out hazardous substances, companies mitigate severe financial vulnerabilities that include escalating litigation, reputational damage, and the regulatory deselection of core product lines.[24] Beyond risk reduction, adopting safer materials lets businesses capture significant economic value, including an estimated $100–$125 billion market for low-carbon basic materials projected to emerge by 2030.[25] Future-fit chemistries secure lasting competitive advantage by aligning with surging consumer demand, shielding supply chains from resource volatility, and attracting capital from institutional investors who increasingly view chemical accountability as a core indicator of financial stability and management quality.[26]

3.1 Customer Demand and Market Growth

Sustainable materials are increasingly associated with measurable market gains. From 2015 to 2019, products marketed as using green chemistry grew 12.6 times faster than their conventional counterparts and 5.4 times faster than the overall market.[27] The global green chemicals market is projected to reach $270 billion by 2031 at a CAGR of 10.77% (2024–2031),[28] and demand for low-carbon materials including steel, chemicals, and cement could create a $100–125 billion market by 2030.

In B2B markets, sustainability is now a top-three purchasing criterion. Bain's 2024 survey of 500 B2B buyers and sellers found that nearly half of buyers are willing to pay a 5% or greater premium, and many indicate they will leave suppliers that fail to meet sustainability expectations.[29] Companies also increasingly see sustainable materials as a way to build supply chain resilience through dependable access to feedstocks, reliable partnerships, and a diversity of suppliers able to deliver against consistent performance criteria.

Consumer attitudes reinforce the shift. Surveys show that 78% of U.S. consumers consider sustainable lifestyles important, and 71% globally factor sustainability into purchasing decisions.[30] While a value-action gap persists between stated preferences and actual behavior, polling indicates strong public demand for safer products and stronger regulation. A

2025 study of Amazon's Climate Pledge Friendly program found that products carrying the label experienced a 12.5% increase in sales, with related research showing revenue gains of roughly 14–15% after joining the program. [31]

A 2025 Pew Charitable Trusts survey of more than 5,000 U.S. adults found that over 70% are very or somewhat concerned about exposure to harmful chemicals in food and drinking water, with similarly high concern across food packaging, personal care items, and children's products. Roughly five in six respondents say that government and businesses should do more to ensure chemical safety and increase transparency. Concern about chemical exposure is not a niche issue — it is a mainstream consumer expectation increasingly shaping purchasing decisions, brand trust, and the social license to operate.[32]

Commitments from over 2,000 companies under initiatives such as the Science Based Targets indicate that by 2030 the global market for low-carbon steel, chemicals, and cement will reach $100–125 billion USD. [33] Demand for these next-generation materials is projected to significantly outpace supply. [34] Brands that secure access now — through offtake agreements or vertical integration — will capture market share that laggards cannot reach.

While cost parity is the long-term goal, current market dynamics allow for green premiums. [35] Developing markets for recycled plastics, bio-based textiles, and low-carbon metals are seeing premiums ranging from 10% to over 50% for high-quality sustainable alternatives. [36] Products free from chemicals of concern (BPA-free, PFAS-free) command distinct marketing advantages and deeper consumer trust. [37] Recycled plastics often trade 50–100% above virgin benchmarks, and green steel 10–25% higher. [38] Over time, long-term adoption can reduce cost volatility and lower cost of goods sold. [39]

3.2 Reputation and Stakeholder Trust

OECD research finds widespread awareness of chemical hazards, strong concern about chronic health and environmental impacts, and overwhelming support — more than 80% — for stronger government and industry action. [40] Many people already try to limit exposure yet still perceive high residual risk, underscoring the limits of downstream controls and the need for upstream material redesign. Younger populations report higher perceived exposure, suggesting demand for safer materials will intensify. [41]

Large-scale retail data confirms the pattern. A joint McKinsey and NielsenIQ analysis of more than 600,000 products across 44,000 brands found a clear correlation between sustainability-related claims and consumer purchasing behavior. Products making ESG-related claims achieved roughly 28% cumulative growth over five years, compared to 20% for conventional alternatives, and accounted for more than half of total category growth. Consumers are translating sustainability preferences into purchasing decisions at scale — rewarding companies that invest in credible, differentiated sustainability attributes with faster growth, stronger market share gains, and deeper customer loyalty.

A 2022 University of California poll of 1,200 registered U.S. voters found that 92% agree (63% strongly) that the government should require products to be proven safe before they can be sold, and 93% agree (62% strongly) that companies should do a better job of removing harmful chemicals from consumer products. Large majorities support reducing plastics, strengthening chemical laws, and removing harmful substances even if costs increase. [42]

NGO and civil society pressure has become a powerful force shaping corporate chemicals management. Advocacy organizations increasingly target brands over the presence of hazardous substances — PFAS, PVC, formaldehyde, phthalates, toxic additives — using public reporting, retailer scorecards, consumer mobilization, and litigation support. These campaigns elevate chemical risks from technical compliance issues to highly visible reputational concerns, compressing timelines for action, shaping disclosure expectations, and reinforcing the business case for proactive investment in safer, more transparent material systems.

3.3 Regulatory Pre-Emption

The regulatory environment for chemicals and materials is shifting from reactive restriction to proactive prevention. [43] Governments globally, led by the EU's Chemicals Strategy for Sustainability, are implementing frameworks to phase out substances of concern and penalize linear waste. [44]

Cefic estimates that 12–42% of the chemical industry's product portfolio could be restricted as new EU laws phase in between 2023 and 2040. [45] A 2023 American Chemistry Council survey found that chemical manufacturers anticipate growing regulatory challenges and believe themselves to be in an increasingly unfavorable business environment. [46]

Companies relying on hazardous incumbents face deselection risk, where core products may be banned or restricted from key markets. [47] Imminent restrictions on per- and polyfluoroalkyl substances (PFAS) are forcing rapid reformulation in sectors ranging from textiles to electronics.[48, 49] Transitioning to safer alternatives now future-proofs portfolios against these inevitable policy shifts. The 2023 Integrated Report from AGC, one of the world's largest PFAS producers, identifies a risk to its fluorochemical division from the trend toward stricter regulation, and frames the response as a strategic opportunity: to develop products and process technologies in anticipation of environmental regulations and turn them into business opportunities. [50]

3.4 Liability Reduction

Litigation related to hazardous chemicals such as PFAS has cost companies billions, with more than 10,000 PFAS complaints filed across industries. [51] Bayer spent €13 billion on litigation expenses between 2019 and 2023 — more than dividends over the same period — with its CEO citing litigation as a top priority of 2024. [52] Litigation related to PFAS pollution has cost 3M $10.3 billion in the U.S., and the company continues to face legal challenges related to PFAS contamination in multiple jurisdictions, including Europe. [53,54] As regulation tightens globally and policymakers shift toward precautionary approaches, companies reliant on hazardous substances face deselection, reformulation costs, and stranded assets. [55]

Compounding these threats, insurers are increasingly inserting explicit PFAS exclusions into their policies, forcing companies to shoulder these legal and remediation costs directly and raising the risk of sector-wide bankruptcies. [56] Risk modeling firms estimate that U.S. clean-up and bodily injury costs for the largest publicly traded chemical companies could reach up to $248 billion and $66 billion, respectively. [57]

3.5 Investor Pressure

Investors are increasingly attentive. In 2025, 43 investors with over $4 trillion in assets called on chemical companies to phase out highly hazardous chemicals and transition to safer alternatives to protect biodiversity and human health. [58]

"Investors are paying closer attention to how companies manage chemical risks in their supply chains." [59]

— Bill Walsh, Director, Safer Chemistry Impact Fund

Coordinating this pressure, the Investor Initiative on Hazardous Chemicals (IIHC) has rapidly expanded, uniting 80 institutional members representing $23 trillion in assets under management to actively engage with the world's largest chemical producers. [60] Managing and disclosing chemical hazards is no longer a compliance issue or an ESG reporting exercise — it is a strategic imperative reshaping the nature of investor due diligence and portfolio risk management. [61] Sustainable chemistry leadership is associated with stronger total shareholder returns, improved access to capital, and reduced long-term regulatory, reputational, and operational risk. [62]

4 Barriers

Within companies, along value chains, and across the economy, the transition to future-fit materials faces challenges.

Despite accelerating pressure from markets, regulators, and investors, scaling future-fit materials is structurally complex.[63] The global chemicals and materials system is highly optimized, capital-intensive, and deeply embedded across horizontal and vertical supply chains.[64] Decades of investment in fossil-based feedstocks, specialized infrastructure, performance standards, and global trade networks have entrenched incumbent chemistries. These systems are efficient, depreciated, and institutionally reinforced.[65] Replacing them requires coordinated transformation across brands, suppliers, manufacturers, financiers, and policymakers — far beyond simple one-for-one substitution.[66, 67]

The challenge is not a single bottleneck. It is a multi-dimensional failure of alignment. Addressing any one barrier in isolation is unlikely to unlock scale; durable transformation requires coordinated intervention across all dimensions of change.

This playbook uses the Lippitt–Knoster Model for Managing Complex Change to organize what is otherwise an overwhelming landscape of obstacles. The model identifies six components required for successful transformation: vision, consensus, skills, motivation and incentives, resources, and a clear action plan. Gaps in any one of these produce friction; gaps across several produce stall.[68] As shown in the overview table below, the model reveals constraints in every area and thereby clarifies where targeted action can unlock progress.

Overview Barriers to the Transition to Future-Fit Materials

Vision	Consensus	Skills	Incentives	Resources	Action Plan
Inconsistent definitions and fragmented standards	Misaligned priorities	Workforce skill gaps	Incumbency advantage	Funding gaps	Approval delays
Inconsistent evaluation metrics	Siloed decision-making	Assessment complexity	Risk aversion	Infrastructure gaps	Policy disconnects
Ambiguous performance expectations	Opaque supply chains	Performance trade-offs	Regulatory uncertainty and fragmentation	Feedstock shortages	Little internal guidance
Few ecosystem roadmaps	Information blocking	Scale-up difficulties	Externalities not priced	Lack of drop-in solutions	Lack of internal roadmaps
				Data scarcity and limited transparency	

4.1 Vision

Transformation requires a shared understanding of the destination. Today's materials transition is hindered by persistent ambiguity in definitions, metrics, and performance expectations.

- **Inconsistent definitions and fragmented standards:** There is no universally accepted definition of "sustainable chemistry," resulting in inconsistent claims about what qualifies as safer or eco-innovative.
- **Inconsistent evaluation metrics:** Companies and industries lack a common language or standardized protocols for critical evaluation methods such as Life Cycle Assessments (LCA) and Techno-Economic Analyses (TEA). This makes it difficult for decision-makers and purchasers to compare the sustainability of one product against another.
- **Ambiguous performance expectations:** Unclear or overly rigid performance standards often evaluate new materials against a single "best in class" metric based on incumbent technologies, failing to recognize alternatives that are sufficiently fit-for-purpose for specific applications. This over-prescription can blind decision-makers to viable, safer innovations and lead them to incorrectly conclude that no functional alternatives exist.

4.2 Consensus

Scaling sustainable materials demands coordinated action across complex global value chains. The current ecosystem is deeply fragmented.

- **Misaligned priorities:** Different actors across the value chain lack alignment on which facets of sustainability to prioritize — carbon footprint reduction versus circularity versus toxicity — leading to disjointed efforts.
- **Patchwork regulatory landscape:** Under federalist systems, differing state and federal chemical policies create a fragmented regulatory patchwork where substances may be restricted, disclosed, or prioritized differently across jurisdictions. This complicates compliance, weakens clear market signals, and makes it difficult to align on consistent material strategies.
- **Fragmented alternatives assessment practices:** The absence of standardized, cross-industry approaches to alternatives assessment creates decision friction across the value chain. Companies may evaluate the same substance using different hazard criteria, data inputs, or performance thresholds — resulting in misalignment, duplicated effort, and delayed transitions.
- **Siloed decision-making:** Without cross-functional collaboration spanning design, sourcing, and finance, sustainable material adoption is treated as an isolated initiative rather than a core business strategy. Different business units possess varying levels of expertise and unique sustainability measurement needs, making it difficult to communicate results and make cohesive, company-wide material selections.

- **Opaque supply chains:** Demand signals from retailers and brands often fail to reach upstream chemical manufacturers due to limited transparency and weak coordination mechanisms.
- **Performance trade-offs:** Adopting new sustainable materials frequently forces difficult compromises between environmental benefits, cost, and functional efficacy. Modifying a material to meet performance specifications may decrease its recyclability or require new additives that present their own challenges. Often the value chain and consumers are not in agreement about the value and disadvantages of choices made in the name of safety and sustainability.

4.3 Skills

Safe and Sustainable by Design (SSbD) innovation requires technical capabilities that remain underdeveloped across industry. The result is institutional anxiety around change — particularly where technical risk intersects with regulatory and reputational exposure.

- **Workforce skill gaps:** There is a documented shortage of chemists and engineers trained in green chemistry and sustainable process design, leaving companies struggling to hire the talent needed to innovate.
- **Upskilling gap creates decision friction:** Many organizations lack structured programs to build workforce capability in sustainable chemistry, leaving employees without the tools to confidently evaluate alternatives or act on sustainability goals. The result is slowed decision-making, risk aversion, and stalled implementation. For innovators, the challenge of moving from the lab to substitution at scale often hinges on determining whether a microscale innovation can address industrial applications.
- **Assessment complexity and cost:** Evaluating alternative materials requires multidisciplinary expertise spanning toxicology, environmental science, and materials engineering. Historically, assessment has been expensive, inconsistent across methods, and siloed within individual companies.[69] Small and medium-sized enterprises (SMEs), in particular, lack the technical capacity to evaluate hazard data, conduct pilot testing, or validate new alternatives, leading to well-founded anxiety over regrettable substitutions.

Reaching meaningfully across deep expertise to collaborate across disciplines is the only way to bring system-wide innovation to fruition.

4.4 Motivation & Incentives

Even when vision and skills are present, change falters without strong economic and strategic drivers. Current market structures favor incumbency.

Incumbency advantage: Fossil-based materials benefit from decades of optimization and fully depreciated infrastructure. Because environmental and health externalities remain largely unpriced, incumbent materials retain a structural cost advantage.

Risk aversion: Reformulation introduces performance uncertainty, supply-chain disruption risk, and potential consumer rejection. Manufacturers default to validated materials.

Regulatory uncertainty, volatility, and fragmentation: Varying regulatory requirements across jurisdictions force companies into costly product customizations to achieve legal compliance. This fragmentation, combined with lengthy and unpredictable environmental permitting processes designed for incremental changes rather than rapid transitions, discourages the massive investments required to realize economies of scale.

Externalities not priced: Making prices reflect true social and environmental costs is essential for incentivizing innovation in green chemistry. [70] The costs of harmful chemicals have been externalized from responsible entities, with the poorest and most vulnerable populations paying the price.

Change management as a hidden barrier: The transition to safer and more sustainable materials requires coordinated organizational change, yet many companies lack structured approaches for building alignment, securing leadership buy-in, and integrating sustainability into core decision-making. This creates internal friction that slows implementation and reinforces reliance on incumbents.

4.5 Resources

Motivation alone is insufficient without capital, infrastructure, and data.

Mismatch between available funding and transition needs: Capital and support mechanisms across the innovation ecosystem are often misaligned with the full cost of transitioning. Significant switching costs — reformulation, validation, certification, supply-chain adaptation — create financial barriers not fully addressed by current funding models. Bridging the gap requires coordinated investment, cost-sharing approaches, and policy incentives to de-risk adoption and enable scale.

Funding gaps ("Valley of Death"): Bringing new materials to industrial scale requires massive capital expenditure — often stretching company balance sheets with investments in the billions. There is a shortage of patient capital to bridge the gap between laboratory research and commercial-scale demonstration.

Infrastructure gaps: There is a severe lack of physical infrastructure, including shared pilot-testing facilities, clean energy grids, and the recycling systems necessary to process circular feedstocks. Securing a dependable, commercial-scale supply of bio-based or recycled raw materials remains volatile.

Information blocking: Legitimate needs for transparency are often blocked by Confidential Business Information (CBI) claims, preventing the sharing of ingredient data necessary to build consensus around safe alternatives.

Feedstock shortages: Manufacturers struggle to secure reliable, commercial-scale supplies of both renewable and circular raw materials. Bio-based feedstocks are constrained by seasonal variability, ethical concerns over land use and biodiversity, and competition from the heavily subsidized bioenergy sector. [71] Recycled, circular feedstocks are bottlenecked by fragmented, inefficient waste collection and sorting systems that fail to aggregate the high-quality streams required for industrial-scale recycling. The inability to guarantee steady, cost-effective feedstock keeps production volumes low, drives up green premiums, and maintains reliance on entrenched fossil-based incumbents.

Lack of drop-in solutions: Many novel sustainable chemicals cannot simply be interchanged with incumbents, frequently requiring costly new equipment, mechanisms, and process modifications. Because these alternatives are rarely direct drop-in replacements, manufacturers face significant technical and financial hurdles to adapt their existing infrastructure.

Data scarcity: A pervasive lack of transparent, high-quality data regarding the toxicity, environmental fate, and performance of new chemical alternatives frustrates innovation and limits confident decision-making. A 2025 report from the Know Better, Do Better Collaborative (an industry-led initiative managed by ChemFORWARD) found that 24% of ingredients remain uncharacterized, representing a significant blind spot for consumer safety, brand risk, and investor liability. Often, data is lost across chains of custody as information moves between industry verticals.

4.6 Action Plan

Transformation requires coordinated execution across policy, industry, and finance. Yet roadmaps are often incomplete or misaligned. Without integrated planning, progress emerges in bursts followed by stalls.

Approval delays: Permitting and regulatory frameworks were designed for incremental upgrades, not rapid deployment of breakthrough technologies. Approval processes are frequently lengthy, costly, and unpredictable.

Policy disconnect: There is a persistent lack of connection between regulatory priorities (e.g., banning a chemical) and the research and innovation funding required to actually develop a viable replacement, leading to frantic, uncoordinated scrambles for alternatives.

Lack of internal roadmaps: Many brands lack centralized transition strategies, internal carbon pricing, or dedicated financing mechanisms to systematically integrate next-generation materials. Sector- and system-wide action plans would create clearer alignment across the value chain on priorities to transform markets.

4.7 Additional Considerations

In addition to the six categories of barriers revealed by the Lippitt–Knoster Model, two additional cross-cutting lenses can help to position barriers in a specific context and therefore help companies to identify which playbook interventions may be most relevant to that context.

Internal vs. Value-Chain Barriers

Some barriers live inside a single company: cross-functional silos between R&D, procurement, sustainability, finance, and marketing; absent internal carbon pricing; procurement KPIs that reward unit-cost reduction over total-cost or risk-adjusted value. Others sit between value-chain actors: misaligned definitions, inconsistent restricted substance lists (RSLs), opaque supplier data, fragmented demand signals. Both need to be addressed, but they require different interventions. Internal misalignment is often as limiting as external constraints and is usually faster to fix.

Availability of Preferable Alternatives

Companies seeking to replace existing materials with future-fit materials are necessarily constrained by the market availability of preferable alternatives. Even if so-called “drop-in” replacements have been commercialized, they may face barriers of qualification, supplier capacity, and unit economics. And new—or yet-to-be-invented—materials may additionally lack production infrastructure, offtake agreements, and the willingness of multiple actors to invest ahead of a market. These barriers will vary based the specific materials, product categories, or application contexts prioritized by a company.

For companies navigating these challenges of availability for a specific material, product, application, or category, one of three action pathways will typically be considered: 1) product-level **substitution**; 2) **scaling** of existing alternatives; and 3) **innovation** of new alternatives. The steps and actions described in this playbook provide an enterprise-level context for such action. Change Chemistry is currently working with its members to develop a more detailed parallel playbooks for each of the action pathways themselves.

5 The Playbook

The playbook offers a transformation model with **four steps** applied across the **three domains** of change. , The steps are sequential in logic but iterative in practice; most organizations will be at different points across different materials and product categories simultaneously.

5.1 Three Domains

Companies cannot scale future-fit materials alone. Scaling requires coordinated change within companies, across value networks, and in the regulatory environment. Progress in one domain without the others results in stalled adoption, persistent cost premiums, or stranded innovation. Companies committed to the transition to future-fit materials work across three domains.

COMPANY	**Company.** Internal alignment, governance, and capability — chemicals policy, footprint measurement, cross-functional teams, internal financing mechanisms, and decision frameworks that integrate environmental and health considerations into core business strategy.
NETWORK	**Value network.** Coordinated action across suppliers, customers, investors, and adjacent industries — harmonized definitions and standards, shared assessment infrastructure, pooled demand, offtake agreements, and shared R&D.
POLICY	**Ecosystem / Policy.** Engagement with the broader ecosystem and regulatory and policy environment — supporting harmonized hazard classifications, advocating for transparency mandates, public procurement preferences, transition tax credits, and blended finance mechanisms.

Each domain reinforces the others. Companies cannot decarbonize alone; value chains cannot align without consistent policy signals; policy is most effective when it codifies practices that leading companies and coalitions have already proven viable.

5.2 Four Steps

A company's strategic transition to future-fit materials ideally follows an iterative cycle of four steps: 1) measure, dislose, and set targets; 2) design and assess options; 3) contract and fund solutions; and 4) collaborate to shape markets. For each step, the Playbook itemizes, by domain, potential actions that could be taken. The list of actions presented is intended to be **neither comprehensive nor prescriptive**. Rather, the Playbook section provides a range of tangible, practical pathways for consideration. Actual action plans will necessarily be informed by company-specific priorities and operating context.

Playbook at a Glance Version 1.0 (Member Release)

The table below provides a summary of potential actions included in the playbook. This list of action is **neither comprehensive nor prescriptive**, but rather provides a range of tangible, practical pathways for consideration. Actual actions will necessarily vary by company and context.

1 **Measure, Disclose & Set Targets**	COMPANY	• Build cross-functional teams; educate stakeholders; articulate the business case • Adopt a strong chemicals/materials policy and RSL/MRSL • Inventory and disclose chemical footprint and time-bound phase-out roadmaps
	NETWORK	• Align definitions, targets, and metrics across suppliers and customers • Harmonize RSLs/MRSLs across suppliers and customers • Empower buyers, sellers, and investors to talk about future-fit materials
	POLICY	• Support harmonized global hazard classifications • Support disclosure mandates, supply-chain transparency, and public registries • Advocate for targeted chemical phase-out timelines
2 **Design & Assess**	COMPANY	• Embed Safe and Sustainable by Design (SSbD) into stage-gate processes • Conduct rigorous alternatives assessments • Factor externalities into ROI calculations
	NETWORK	• Standardize and communicate specs to help suppliers scale • Share hazard and performance data • Share assessment, testing, and R&D costs through appropriate collaboration
	POLICY	• Advocate for harmonized assessment criteria • Co-develop standard assessment methodologies and disclosure formats • Support regulatory recognition and incentivization of safer alternatives
3 **Contract & Fund**	COMPANY	• Commit to demand through public targets and integrated sourcing plans • Finance transition costs internally • Adjust procurement incentives to reward verified safer chemistries
	NETWORK	• Participate in offtake agreements; pool demand across industries • Participate in collaborative market development • Make shared infrastructure investments
	POLICY	• Support and utilize blended finance mechanisms • Advocate for transition tax credits • Enable public procurement preferences
4 **Collaborate & Shape Markets**	COMPANY	• Identify pre-competitive opportunities • Designate executive sponsors for cross-industry work • Translate shared learning into internal practice
	NETWORK	• Collaborate to address shared challenges (data, assessment, infrastructure) • Use competitive value-chain partnerships to scale specific materials • Build cross-industry demand coalitions
	POLICY	• Advocate for coordinated public-private market-shaping • Contribute to and participate in standardized frameworks • Support international harmonization

Step 1: Measure, Disclose & Set Targets

The first step of any credible material transition is to **make visible** the current state, to set **targets** against it, and **commit** so that internal teams and external partners can act.

COMPANY

Build cross-functional teams, educate stakeholders, and articulate the business case: Help colleagues to understand what to prioritize and why. Successful implementation requires deep internal alignment across procurement, product design, R&D, finance, and sustainability. Educate suppliers and articulate the financial business case, highlighting long-term benefits like reduced liability and enhanced competitive advantage.

Inventory and disclose chemical footprint: Companies should quantitatively measure their chemical footprint to track hazardous chemicals present in their products and operations. Frameworks like the Chemical Footprint Project and the Investor Initiative on Hazardous Chemicals (IIHC) can help businesses to set time-bound reduction goals and publicly report progress, signaling leadership to investors and stakeholders alike.

Adopt a strong chemicals or materials policy: Policies should go beyond regulatory compliance to include a Restricted Substances List (RSL) for hazardous chemicals in finished products and a Manufacturing Restricted Substances List (MRSL) to govern chemical inputs and protect workers during production.

Publish a time-bound phase-out roadmap: Develop actionable, time-bound plans to phase out products containing highly hazardous or persistent chemicals such as PFAS. [72] Publishing these roadmaps ensures accountability while proactively mitigating risk.

NETWORK

Align definitions, targets, and hazard and sustainability metrics across suppliers and customers: Fragmented understanding of sustainability criteria frequently stifles progress across the value network. [73] Collaboratively establishing standardized definitions, shared hazard criteria, and uniform sustainability metrics ensures that upstream suppliers and downstream customers evaluate materials using a common, science-based language. [74]

Harmonize RSLs/MRSLs across suppliers and customers: The proliferation of individual, brand-specific restricted substance lists creates an overwhelming compliance and reporting burden for suppliers. [75] Industry-wide initiatives such as ZDHC and AFIRM allow value chains to send consistent demand signals and simplify the phase-out of hazardous chemistries.

Empower buyers, sellers, and investors to talk about future-fit materials: Bridging the communication gap between buyers and sellers is essential. A 2024 Bain survey showed that while 85% of B2B sellers report embedding some degree of sustainability in their products and services, only 27% consider themselves very knowledgeable about their customers' sustainability needs. [76] Providing shared platforms, training, and standardized data enables all stakeholders — including the financial community — to confidently discuss, evaluate, and prioritize future-fit chemistry in their purchasing and investment decisions. [77]

POLICY

Support harmonized global hazard classifications: Inconsistent hazard classifications create market confusion and hinder the global transition to safer chemistry. [78] Industry leaders should advocate for and support widespread adoption of standardized systems such as the UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS). [79]

Support disclosure mandates, supply-chain transparency requirements, and public chemical registries: The lack of transparency across complex, multi-tiered supply chains is a critical barrier to identifying and substituting hazardous substances. Advocating for full material disclosure and publicly accessible chemical registries empowers downstream users to make informed decisions. [80]

Advocate for targeted chemical phase-out timelines: Voluntary actions are often insufficient to drive rapid, sector-wide transformation. Companies should support regulatory frameworks that establish clear, legally binding timelines for phase-out of specific chemicals of concern, ensuring a level playing field and providing the certainty needed to justify investment in safer alternatives. [81]

Step 2: Design & Assess

This step ensures that future-fit principles are embedded into how new molecules and products are designed and that the alternatives are evaluated to avoid regrettable substitutions.

COMPANY

Embed future-fit principles into stage-gate processes: To avoid creating new toxic legacies, innovators must integrate future-fit criteria and frameworks—e.g., Safe and Sustainable by Design (SSbD)—directly into research and development stage gates. This ensures that human health, environmental safety, and circularity are prioritized alongside cost and performance from the inception of a new molecule or product. [82]

Conduct alternatives assessments: When substituting a hazardous chemical, companies must rigorously evaluate potential replacements to avoid regrettable substitutions. Robust chemical alternatives assessment protocols help systematically compare hazard profiles, cost, and functional performance before a final selection is made. For a useful case study, see IFF Innovation for Sustainability (I4S) Methodology.[83]

Factor externalities into ROI calculations: Traditional ROI calculations often fail to account for the hidden, externalized costs of hazardous chemicals — worker exposure, environmental remediation, future litigation. Forward-thinking companies redefine economic value creation by internalizing these externalities into their financial models, making the business case for safer alternatives substantially clearer. [84]

NETWORK

Standardize and communicate specs to help suppliers scale: Suppliers face significant challenges scaling sustainable materials when buyers continually demand highly customized formulations or blends. By standardizing material specifications and consistently communicating these needs, brands can guarantee the predictable order volumes suppliers require to optimize production and achieve economies of scale.

Co-develop assessment methodologies: Evaluating complex trade-offs in sustainable chemistry requires multi-disciplinary expertise few individual companies possess. Value-network actors should collaborate to co-develop robust, science-based assessment methodologies that evaluate full lifecycle impacts, ensuring industry-wide trust and alignment. For a useful case study, see BASF Eco-Efficiency Analysis.[85]

Share assessment costs and invest in shared testing infrastructure: The financial burden of toxicological screening and performance testing often stalls the adoption of new chemistries. Public-private incubators or pre-competitive consortia allow companies to share assessment costs and jointly invest in open-access piloting and demonstration facilities.

Share hazard and performance data: Data scarcity bottlenecks innovation. Secure data-sharing platforms and chemical hazard data trusts enable value chains to quickly identify safer alternatives and close knowledge gaps without repeatedly funding redundant safety testing. For a useful case study, see ChemFORWARD Chemical Hazard Data Trust.[86]

Share R&D costs through pre-competitive and competitive collaboration: Developing breakthrough sustainable chemistries is capital-intensive and technically challenging.

Companies can accelerate progress by forming pre-competitive R&D consortia to pool resources, tackle shared functional challenges, and share the financial risks of early-stage innovation. For a useful case study, see Eastman, Sealed Air, and Ahold Delhaize: compostable protein trays.[87]

POLICY

Advocate for harmonized assessment criteria: A proliferation of varying sustainability metrics makes it difficult to accurately compare new materials and assess their environmental benefits. Stakeholders should advocate for government and industry bodies to establish consistent, universally accepted criteria for defining and assessing what constitutes safe and sustainable chemistry.

Support regulatory recognition and incentivization of safer alternatives: Entrenched fossil-based incumbents often maintain a significant cost advantage over novel sustainable materials. Companies should advocate for policies that formally recognize verified safer alternatives and provide targeted regulatory incentives — such as expedited permitting — to accelerate market entry. For a useful case study, see Renewable Carbon Initiative.[88]

Step 3: Contract & Fund

Design and assessment identify what to scale. Contracting and funding determine whether scaling actually happens. This step addresses the most persistent gap in the materials transition — the funding Valley of Death — and the commercial mechanisms required to give innovators and producers the certainty they need to invest.

COMPANY

Commit to demand: Securing reliable, long-term market demand is crucial for scaling novel materials out of the laboratory. Brands can demonstrate commitment by setting public targets for sustainable material inclusion and integrating these goals directly into core business strategies and sourcing plans. [89]

Finance transition costs: Implementing safer chemistry often entails significant capital expenditure for facility upgrades and product reformulations. Companies can support the shift by establishing internal transition financing mechanisms, ensuring that product teams have the capital needed to absorb the initial green premiums of novel materials. [90]

Adjust procurement incentives: Procurement teams are traditionally incentivized strictly on cost reduction, which penalizes the adoption of innovative but initially more expensive sustainable materials. Realign procurement incentives and KPIs to actively reward the sourcing of verified safer and circular chemistries.

NETWORK

Participate in offtake agreements: Innovators require financial certainty to secure the capital needed to build commercial-scale production. Buyers help bridge this gap by signing binding offtake agreements or letters of intent, effectively guaranteeing a future market for the sustainable chemicals once produced. [91]

Pool demand across industries: Individual companies rarely generate enough demand volume to justify a supplier's transition to a new sustainable chemical. By participating in cross-industry consortia to pool demand, multiple brands aggregate their purchasing power to signal a unified market need that accelerates commercial production.

Participate in collaborative market development: Engaging in collaborative market development connects startups with established supply chains. Companies can work together to give emerging technologies entry via niche, high-margin, low-volume applications and then map a scalable growth strategy that incrementally addresses larger market segments. For a useful case study, see L'Oréal Sustainable Innovation Accelerator (L'AcceleratOR).[92]

Make shared infrastructure investments: The lack of specialized physical infrastructure — commercial-scale biorefineries, advanced recycling facilities — restricts supply. Value-chain actors should collaborate to finance shared, decentralized production infrastructure or jointly fund the repurposing of existing legacy chemical plants.

POLICY

Support and utilize blended finance mechanisms: The high risk and extended timelines of scaling physical chemical technologies deter conventional private equity. Blended finance — combining public grants, philanthropic capital, and private investment — can effectively de-risk these projects, bridging the funding gap across technology readiness levels. For a useful case study, see BASF Horizon Europe Projects.[93]

Advocate for transition tax credits: To overcome the capital requirements of industrial transformation, businesses should advocate for targeted fiscal policies. Transition tax credits and government loan guarantees provide essential financial relief for companies investing in the R&D and scaling of sustainable chemistry solutions.

Enable public procurement preferences: Government purchasing commands market power that can instantly legitimize and scale new technologies. Advocating for public procurement policies that prioritize or mandate sustainable and safer chemicals creates a guaranteed baseline market, helping innovators drive down costs for the broader economy.

Step 4: Collaborate & Shape Markets

The first three steps build the foundation: visibility, design, and commercial mechanisms. The fourth step is where the system actually shifts. Scaling future-fit materials at the speed the science demands is not achievable by any individual firm, no matter how committed. It is built through coordinated action across value networks and through markets, and it requires a clear-eyed understanding of which kinds of collaboration solve which kinds of problems.

Two kinds of collaboration

Pre-competitive collaboration. Companies pool resources to solve shared bottlenecks that none can solve alone and where the solution does not confer individual competitive advantage. Pre-competitive work is appropriate for: building shared hazard and performance data (e.g., chemical hazard data trusts); developing harmonized assessment methodologies; investing in shared pilot or demonstration infrastructure; aligning on common definitions, metrics, and supplier requirements; and articulating shared advocacy positions on policy. The risk it solves is duplication, fragmented standards, and the inability of any single firm to justify the cost of foundational infrastructure. Organizations such as Change Chemistry play a bridging role across these domains convening pre-competitive initiatives that address shared system barriers. Change Chemistry's members convene to align definitions, policies, frameworks, and priorities to reduce duplication of effort and accelerate the identification and adoption of safer, more sustainable materials.

Competitive value-chain partnerships. Companies form bilateral or small-group commercial arrangements to bring specific materials to scale. Competitive partnerships are appropriate for: offtake agreements with specific innovators; joint product development between brand, converter, and retailer; vertical integration or equity investment in supply; and proprietary specifications that confer market differentiation. The risk these solve is the funding Valley of Death and the absence of demand certainty for a specific commercial-scale facility.

Most material transitions need both, often simultaneously. Confusing the two is a common failure mode: companies sometimes try to negotiate competitive deals in pre-competitive forums (slowing them down with IP and exclusivity concerns) or attempt to solve through pre-competitive groups what only a binding offtake will solve.

Cross-cutting enablers

Three enablers cut across every step of this playbook. They are not separate plays so much as conditions that determine whether the plays succeed.

Factor externalities into return calculations: True-cost accounting and impact-weighted accounting allow companies to make decisions on the basis of total economic value created, not just internalized cost. The longer externalities remain unpriced, the longer incumbent materials retain a structural advantage they have not earned on their environmental and health performance.

Build workforce capability: The transition runs on people. Investing in upskilling — green chemistry curricula, alternatives-assessment training, cross-functional fluency between procurement, R&D, and sustainability teams — is among the highest-leverage long-term investments a company can make. Workforce capability is also where just-transition principles operate in practice: the question is not only what materials are scaled, but who is supported through the transition and who builds the next generation of the industry.

Share data; reduce information asymmetry: From hazard data to performance specifications to supplier disclosure, data sharing reduces the cost and risk of every other action in this playbook. It is also the area where Confidential Business Information frequently blocks progress on legitimate transparency needs. Industry initiatives, data trusts, and policy mandates for disclosure each have a role.

5.3 Balancing the Premium Paradox

To successfully shift the market, organizations must navigate a fundamental structural paradox regarding "green premiums"—the price differential between sustainable alternatives and entrenched fossil-based incumbents. The paradox rests on a fundamental difference in perspective between sellers and buyers.

- **Seller's Perspective (Capturing Early Margin):** For material innovators and early-stage chemical developers, an initial green premium is a vital economic lifeline. It allows pioneering companies to capture early margins, recover immense R&D capital expenditures, and prove commercial viability at smaller production volumes. High-value, low-volume applications provide the initial runway required to keep innovation alive.
- **Buyer's Perspective (Barriers to Mass Adoption):** Conversely, from a procurement and corporate finance perspective, high green premiums act as a severe bottleneck. While a brand may willingly absorb a 50% to 100% premium for a limited-edition, niche product line to meet short-term marketing or sustainability goals, premiums of this scale completely stall mass-market adoption. Procurement professionals cannot achieve systemic portfolio transformation if doing so permanently compromises long-term margin health.

The ultimate goal of a future-fit materials strategy is not to accept these premiums as a permanent cost of doing business, but to systematically compress them over time until cost parity is achieved.

Compressing Premiums Through Strategic Contracting

The commercial mechanisms detailed in this playbook—specifically **demand pooling** and **long-term volume commitments**—are designed explicitly to bridge this gap. By aggregating multi-year demand across fragmented value chains, corporate buyers provide innovators with the predictable volume required to scale up manufacturing facilities. As production moves from pilot plants to commercial-scale output, economies of scale inherently drive production costs down, compressing the green premium and opening the floodgates for mass-market integration.

6 Getting Started

6.1 General Guidance

This playbook is designed for cross-functional leaders, not single-function teams. The actions described here cannot be executed by sustainability teams in isolation; they require integrated effort across R&D, procurement, finance, marketing, legal, and executive leadership. Several practical principles apply:

- **Use it diagnostically first.** Start by identifying which domains and which steps are weakest for the specific material transition you are pursuing. Different materials will require emphasis in different places.

- **Treat the steps as a cycle, not a march.** Real transitions revisit measurement and disclosure as data improves, return to design and assessment when alternatives emerge, and adjust contracting and policy engagement as markets evolve.

- **Match the play to the pathway.** Drop-in replacements and system-change materials demand different combinations of these actions. Drop-ins lean harder on procurement, qualification, and harmonized specifications. Novel materials lean harder on offtake, demand pooling, blended finance, and infrastructure.

- **Build the business case first; the rest follows.** Internally, articulating value creation — not just risk mitigation — is what moves capital, headcount, and decision rights.

6.2 Where to Begin

There is no single right entry point. The most productive starting place depends on which barriers are most binding for a given company and material category. For most cross-functional leaders reading this playbook, three questions are worth answering first:

- **What is our current chemical footprint, and what is our target?** Without this, no other action can be properly scoped or measured. If a public footprint, RSL/MRSL, and time-bound plan of action are not yet in place, that is Step 1.

- **Where are we losing alignment internally?** If R&D, procurement, sustainability, finance, and marketing are not making decisions from a shared framework, external collaboration will not stick. Cross-functional alignment is the highest-return early investment.

- **Which one material transition could we anchor a coalition around?** Pre-competitive collaboration tends to start with one well-scoped shared problem — a specific substance class, a specific functional use, a specific supply bottleneck — rather than with a general intent to collaborate.

6.3 Cross-Functional Alignment & Accountability

The transition to future-fit materials cannot be executed by sustainability teams in isolation. Scaling safer, low-carbon, and circular chemistry requires deep integration across corporate silos, shifting primary leadership as a material moves from initial assessment to commercial contracting. To ensure clear ownership, the matrix below maps the primary roles for key corporate functions across the core execution steps of this playbook, utilizing the RACI framework.

Cross-Functional RACI Matrix

Responsible .... *Who does the work?* Accountable .... *Who decides / approves?* Consulted .... *Who provides input(s)?* Informed .... *Who is kept up to date?*	**Sustainability**	**Research & Development**	**Procurement & Sourcing**	**Corporate Finance**
Step 1: Measure & Assess Baseline mapping, hazard screening, and hotspot identification	A / R	C	C	I
Step 2: Define & Target Setting performance specs, circular inflows, and net-zero goals	R	A / R	C	I
Step 3: Contract & Fund Demand pooling, long-term agreements, off-take commitments	C	C	R	A
Step 4: Scale & Iterate Continuous hazard reduction, value-chain tracing, market expansion	A	R	R	C

6.4 Navigating Operational Hand-Off

A critical point of failure for many corporate material transitions occurs at the boundary between assessment and execution. To unlock systemic change, organizations must recognize and manage a fundamental shift in leadership:

- **During Step 1 (Measure & Assess):** The **Sustainability** team rightfully holds the steering wheel. They possess the specialized expertise to baseline Scope 3 emissions, evaluate chemical hazard profiles (such as Full Chemical Hazard Assessments), and flag supply chain vulnerabilities. R&D and Procurement act as vital consultants, supplying data on current formulations and supplier relationships.

- **The Critical Pivot at Step 3 (Contract & Fund):** When moving into commercialization, **Procurement and Finance must take the steering wheel from Sustainability.** A material strategy cannot scale if it remains a sustainability pet-project. Step 3 introduces complex financial risk-sharing, demand pooling across business units, and multi-year off-take commitments. Because these plays directly impact gross margins, working capital, and legal risk, **Finance** becomes the final Accountable authority, and **Procurement** becomes the primary execution driver (Responsible).

In this mature operational phase, Sustainability transitions into a trusted advisory and consulting role, ensuring that the final commercial contracts strictly preserve the integrity of the original Safe & Sustainable by Design (SSbD) criteria.

7 Looking Forward

7.1 What Success Looks Like

Five years from now, an industry meaningfully along the future-fit materials transition will look measurably different from today's:

- Shared, science-based definitions of safer and more sustainable materials, used consistently across brands, suppliers, and regulators.
- Harmonized restricted substance lists across major value chains, replacing today's patchwork of brand-specific RSLs.
- Functional, well-funded chemical hazard data trusts that eliminate duplicative testing and reduce regrettable substitutions.
- Material commercial deployment of next-generation chemistries enabled by offtake agreements, pooled demand, and blended finance.
- Internal carbon and externality pricing inside major brands, reshaping ROI calculations to reflect total economic value.
- Regulatory frameworks that recognize and reward verified safer alternatives, with clear and credible phase-out timelines for substances of concern.
- Workforce capability — scientists, engineers, procurement professionals, and finance leaders — trained to operate fluently across green chemistry, alternatives assessment, and value-chain collaboration.

7.2 An Invitation

This playbook is a working document. It will improve as more companies share what works, where they have hit obstacles, and how cross-sector coalitions can be built. Sustainable Brands and Change Chemistry invite practitioners across industries to use it, test it, push back on it, and contribute to its next iteration.

The scale of the materials economy means that no single company, sector, or country can complete this transition alone. It also means that even modest coordination unlocks disproportionate value. The opportunity is to modernize the foundations of the global economy together while continuing to deliver the products and services on which society depends.

Appendix A: Glossary of Terms

Hazard Classification

Aquatic Toxicity: The potential of a substance to cause adverse effects in aquatic organisms, typically measured by its impact on species such as fish, algae, or invertebrates over short- or long-term exposure.

CMR: Substances that are Carcinogenic, Mutagenic, or Reproductive toxicants, posing serious long-term risks to human health.

Developmental Toxicant: A substance that interferes with normal development, potentially causing birth defects, impaired growth, or developmental delays.

EDC (Endocrine Disrupting Chemical): Chemicals that interfere with the endocrine (hormone) system, potentially causing adverse effects in organisms, their offspring, or populations.

Genotoxic: A substance capable of damaging genetic material (DNA), potentially leading to mutations and cancer.

GRAS (Generally Recognized as Safe): A designation used by the U.S. FDA indicating that a substance is considered safe for its intended use based on scientific evidence or long history of use in food.

Immunotoxicant: A substance that adversely affects the immune system, reducing its ability to respond to infections or increasing susceptibility to disease.

Neurotoxicant: A substance that disrupts the structure or function of the nervous system, potentially affecting cognition, behavior, or motor function.

PMT (Persistent, Mobile, and Toxic): Substances that remain in the environment, can travel long distances (including through water systems), and pose toxic risks.

Reproductive Toxicant: A substance that adversely affects fertility, reproductive capability, or the development of offspring.

Respiratory Sensitizer: A substance that can induce allergic reactions or hypersensitivity in the respiratory system following inhalation.

Skin Sensitizer: A substance that causes allergic skin reactions following repeated exposure.

Teratogen: A substance that specifically causes structural abnormalities or birth defects during fetal development.

Toxic: A substance that can cause harm to living organisms through chemical interaction, depending on exposure level and duration.

vPvB (very Persistent, very Bioaccumulative): Substances that remain in the environment for long periods and accumulate significantly in living organisms, posing long-term risks.

Material Types

Plasticizers: Substances added to materials (especially plastics) to increase flexibility, softness, or durability.

Polymers: Large molecules made of repeating subunits, forming the basis of plastics and many synthetic materials.

Sealants: Materials used to block the passage of fluids through surfaces, joints, or openings.

Stabilizers: Additives used to maintain the chemical or physical stability of materials under heat, light, or environmental conditions.

Surfactants: Substances that reduce surface tension, enabling mixing of liquids (e.g., oil and water), commonly used in cleaning products.

Assessment

Comparative Chemical Hazard Assessment (CCHA): A method for comparing the hazard profiles of chemicals to identify safer alternatives based on human health and environmental endpoints.

Exposure Assessment: The evaluation of the extent to which humans or the environment come into contact with a chemical, including frequency, duration, and pathways.

Functional Use Analysis: The process of identifying the role a chemical plays in a product to determine whether safer alternatives can fulfill the same function.

Life Cycle Assessment (LCA): A systematic approach to evaluating the environmental impacts of a product, process, or material across its entire life cycle — from raw material extraction to end of life.

Multi-Criteria Decision Analysis (MCDA): A structured decision-making process that evaluates multiple factors (e.g., cost, performance, hazard) to compare alternatives.

Quantitative Structure-Activity Relationship (QSAR): A computational method used to predict the properties or hazards of chemicals based on molecular structure.

Risk Assessment: The process of evaluating the likelihood and severity of harm resulting from exposure to a hazard.

Safety Assessment: A broader evaluation of whether a substance or product can be used without unacceptable risk under intended conditions.

Sustainable Assessment: An evaluation that integrates environmental, health, social, and economic impacts to determine overall sustainability performance.

Substitution & Design

Atom Economy: A principle of green chemistry that measures how efficiently raw materials are incorporated into the final product, minimizing waste.

Benign by Design: The intentional design of chemicals and materials to be inherently non-toxic and environmentally safe.

Biomimetic Chemistry: The design of chemical processes or materials inspired by biological systems.

Catalysis (as a sustainability lever): The use of catalysts to increase reaction efficiency, reducing energy use and waste.

Chemical Substitution: The replacement of a hazardous chemical with a safer alternative.

Circular: A system in which materials are reused, recycled, or regenerated, minimizing waste and resource extraction.

Cradle to Cradle: A design philosophy that ensures materials can be perpetually cycled without loss of quality or safety.

Design for Degradation: Designing materials so they safely break down into non-toxic components after use.

Feedstock: Raw materials used as inputs in chemical processes.

Functional Substitution: Replacing a chemical based on the function it performs, rather than direct chemical replacement.

Future-Fit Materials: Materials intentionally designed to meet performance needs while operating within planetary boundaries and minimizing human and environmental harm.

Informed Substitution: A systematic approach to replacing hazardous chemicals using robust hazard, performance, and economic data.

Inherently Safer Design: Designing processes and products to eliminate hazards rather than controlling them.

Low Carbon: Materials or processes associated with reduced greenhouse gas emissions.

Net Zero: Achieving a balance between greenhouse gas emissions produced and removed from the atmosphere.

Process Intensification: Redesigning processes to make them more efficient, using less energy, materials, or space.

Regrettable Substitution: Replacing a hazardous chemical with an alternative that later proves to also be harmful.

Renewable Feedstocks: Raw materials derived from renewable biological sources rather than fossil fuels.

Safer Solvents and Auxiliaries: Substances used in chemical processes that are selected to minimize toxicity and environmental impact.

SSbD (Safe and Sustainable by Design): A framework that integrates safety, sustainability, and performance considerations into the design phase of chemicals and materials.

Equity & Justice

Cumulative Burden: The combined impact of multiple environmental, social, and economic stressors on communities.

Environmental Justice: The fair treatment and meaningful involvement of all people in environmental decision-making, regardless of race, income, or location.

Externalities: Costs or benefits resulting from an activity that are not reflected in market prices, often borne by society or the environment.

Fenceline Communities: Communities located near industrial facilities that are disproportionately exposed to pollution and environmental hazards.

Free, Prior and Informed Consent (FPIC): The right of communities, particularly Indigenous peoples, to give or withhold consent to projects affecting their lands or resources.

Toxic Hotspots: Geographic areas with high concentrations of hazardous pollution and associated health risks.

Finance & Market Shaping

Blended Finance: The use of public or philanthropic funds to mobilize private investment in high-risk or high-impact projects.

Business Value Creation: The generation of economic, environmental, and social value that enhances long-term organizational performance.

Data Trust: A mechanism for sharing data securely among stakeholders while maintaining ownership and confidentiality protections.

Impact-Weighted Accounting: A method that integrates environmental and social impacts into financial accounting.

Offtake Agreement: A contract in which a buyer commits to purchasing a future output from a supplier, often used to de-risk investments.

Pooled Demand / Demand Aggregation: Combining demand across multiple buyers to create scalable market signals.

Pre-Competitive Collaboration: Cooperation between companies on shared challenges before competing in the marketplace.

True Cost Accounting: Incorporating environmental and social costs into economic decision-making.

Scaling

Cost Parity: The point at which sustainable alternatives cost the same as conventional options.

Drop-In Replacement: A substitute that can be used without changes to processes or infrastructure.

Economies of Scale: Cost advantages achieved through increased production volume.

First-Of-A-Kind (FOAK) Plant: The first commercial-scale facility using a new technology, typically higher cost and risk.

Incumbent Advantage: The benefit existing technologies or materials have due to established infrastructure and market position.

Infrastructure Compatibility: The ability of a material to integrate into existing production or distribution systems.

Lock-In Effect: The persistence of existing technologies due to past investments and system dependencies.

Path Dependency: The influence of historical decisions on current and future options.

Performance Parity: When a sustainable alternative matches or exceeds the performance of the incumbent.

Technology Readiness Level (TRL): A scale used to assess the maturity of a technology from research to commercialization.

Valley of Death (Innovation Finance Gap): The stage where innovations struggle to secure funding to move from development to commercialization.

Policy

Direct Regulation: Government rules that mandate or restrict specific activities or substances.

Extended Producer Responsibility (EPR): Policies requiring producers to manage the lifecycle impacts of their products, including disposal.

Information-Based Policy: Policies that influence behavior through disclosure, labeling, or transparency requirements.

Polluter Pays Principle: The concept that those responsible for pollution should bear the costs of managing it.

Price-Based Policy: Economic instruments such as taxes or incentives used to influence behavior.

Rights-Based Policy: Policy approaches grounded in the protection and promotion of human rights, including the right to a healthy environment.

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Notes

1 Planetary boundaries refer to the nine scientifically defined limits that regulate Earth-system stability according to the Stockhom Resilience Centre, including: climate change; biosphere integrity; land system change; freshwater change; biogeochemical flows; novel entities; ocean acidification; stratospheric ozone depletion; atmospheric aerosol loading. For the purposes of this first version of the Playbook, the "novel entities" boundary is particularly relevant, since it refers to "the introduction of synthetic chemicals, plastics, and other human-made materials into Earth's systems."

2 This definition builds on previous work by Change Chemistry, the Expert Committee on Sustainable Chemistry, Cefic, ISC3, the UMass Lowell Center for Sustainable Production, SUCCeSS, UNEP, and WBCSD.

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[82] Safer Chemistry Impact Fund. (2025). Addressing the Portfolio Risks of Chemical Hazards: Guidance for Investors.

[83] see IFF Innovation for Sustainability (I4S) Methodology is an example of integrating sustainability assessment into the core innovation process — applying structured screening of human health, environmental, and circularity dimensions at multiple decision points to inform product and ingredient development.

[84] World Business Council for Sustainable Development (WBCSD), ERM. (2024). Towards Planet Positive Chemicals: A Chemical Transformation Roadmap.

[85] BASF Eco-Efficiency Analysis provides a structured, data-driven approach to comparing alternative materials and processes by integrating environmental and economic performance across the full product life cycle. BASF has applied this framework across hundreds of products and value chains — from packaging materials to automotive.

[86] ChemFORWARD Chemical Hazard Data Trust enables companies across industries to access standardized, expert-verified hazard assessments. By pooling assessment data, the trust reduces duplicative testing costs, accelerates identification of safer alternatives, and creates the consistent hazard signal that downstream value chains need to act.

[87] Eastman, Sealed Air, and Ahold Delhaize: collaborated across the value chain — from material innovator to converter to retailer — to launch compostable protein trays. The partnership shows how aligned demand, technical capability, and retail commitment can together solve a problem that none of the partners could solve alone.

[88] Renewable Carbon Initiative organizes industry advocacy for EU policy that recognizes and incentivizes renewable carbon sources — bio-based, recycled, and CO_2-based — as substitutes for fossil carbon. It demonstrates how coordinated industry voice on a specific policy lever can shift the regulatory landscape in favor of future-fit materials.

[89] Boston Consulting Group (BCG), Fashion for Good. (2025). Scaling Next-Gen Materials in Fashion: An Executive Guide.

[90] University of Massachusetts Lowell - Lowell Center for Sustainable Production. (2022, October). Analyzing Success Factors to Accelerate Commercialization of New Technologies that Replace Incumbents: Lessons for Green Chemistry Commercialization.

[91] Sustainable Chemistry Finance Coalition. (2023). Strategic approach to transition finance for sustainable chemicals and materials: A blueprint for the finance community.

[92] L'Oréal Sustainable Innovation Accelerator (L'AcceleratOR). L'Oréal's €100 million sustainable innovation accelerator selects and supports early-stage materials and chemistry innovators with funding, technical partnership, and access to commercial channels, illustrating how brand-led market-development programs can shorten the journey from lab to scale.

[93] BASF Horizon Europe Projects. BASF's participation in Horizon Europe demonstrates how public R&D funding programs can de-risk early-stage development of safer, more sustainable chemistries, and how multinational producers can use those frameworks to bring breakthrough materials closer to commercial scale.