ERM
SUSTAINABILITY
INSTITUTE

Time to Transform

CHEMICAL SECTOR TRENDS BRIEFING

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Contents

Executive summary

Whether it is regulatory, consumer, and stakeholder pressure, the industry's unsustainable environmental and social impact, or the surging demand for green chemicals, it is clear that a significant transformation is the only way forward for the chemical sector.

The industry is facing the gargantuan task of rethinking its production process, from the inputs it uses and green product innovation, to community engagement and reducing future and existing waste.

Making progress on sustainability cuts two ways for the chemical sector: it chips away at the industry's often poor environmental and social track record; and, since chemicals are a fundamental building block for almost any product, it also offers the sector a unique chance to play a pivotal role in the sustainable transition the world needs.

Developing sustainable chemicals is paramount to making headway on both the ecological and commercial front. The most significant demand surge for green chemicals comes from consumers and large brands using their purchasing power to reshape the chemical sector. However, the sector faces unique hurdles to a rapid, sustainable switch, such as high costs of green innovation, capital intensity of new production, and enduring dependency on carbon-based feedstock.

Additionally, the volatile global geopolitical landscape continues to impact energy costs and supply chain stability.

The industry needs to bring all hands on deck to overcome these obstacles. It needs to put sustainability front and center to radically innovate product portfolios, phase out controversial products, get serious about community engagement and equity, transition to circular economy practices, and build sustainable, resilient, transparent, and traceable value chains or value systems. These changes will not only take a new

strategic and operational mindset within chemical companies; the sector must also closely collaborate with stakeholders, from suppliers, corporate clients, consumers, investors, and shareholders to regulators, affected communities, universities, and non-governmental organizations (NGOs).

Based on our expertise honed by our continued work with a broad range of leading chemical companies, ERM has identified four sustainability trends that will shape the chemical sector in the coming years, followed by several recommendations on how chemical companies can proactively approach these trends to transition to a cleaner, more just, and commercially resilient future.

Our annual Trends Reports outline ten enduring sustainability trends, how they evolve, and how businesses respond to them. Many trends and developments in those reports affect all industries. However, the intensity of trends or the way they pan out can vary significantly across industries. This third edition of our sector-focused briefing series explores developments specific to the chemical sector.

TREND 1: **Intensifying external pressure demands a strategic answer**	• The regulatory landscape in various geographies is heading towards an unprecedented level of mandatory disclosures and other binding regulations on climate, nature, and equity for chemical companies. • Pressure from stakeholders and investors is also at an all-time high and growing, offsetting the ESG backlash in some geographies. • It will take a complete core business shift of sustainability to satisfy external expectations for the chemical sector.
TREND 2: **Push for more green chemicals and accelerated reduction of harmful waste**	• The demand for sustainable chemicals is outpacing the sectors' speed of developing them, while several environmental issues (plastics, PFAS, and pesticides) are a growing source of public disapproval. • To show it is serious, the sector must accelerate the development and scaling of safe and sustainable chemicals and commit to reducing legacy and future waste that threaten biodiversity and human health.
TREND 3: **ESG demands and geopolitical turmoil force supply chains into a complex overhaul**	• External pressure and regulation demand increasingly strict screening of the chemical supply chain for environmental and equity impacts and swift action in case of issues. • Simultaneously, geopolitical turmoil and geoeconomic rivalries have exposed vulnerabilities in global supply chains, hitting the chemical sector especially hard, increasing both the cost and availability of essential inputs. • Chemical companies have little choice but to embrace this complexity and reconfigure their supply chain to enhance its reliability and resilience and optimize it for environmental and social impact.
TREND 4: **Time to commit to the next phase on the road to Net Zero**	• The chemical sector contributes substantially to greenhouse gas emissions, and fossil fuels are the primary feedstock for most chemical products, creating long-lasting harmful impacts. • Many companies have set long-term decarbonization goals but often skip Scope 3, while nature targets are in their infancy, despite nature's prominent role in mitigating emissions. Intermediate goals are mainly absent. • The sector needs to commit to intermediate decarbonization goals, including Scope 3, and take concrete steps to overcome its dependence on fossil energy and feedstock. It needs to do the same for nature.

TREND 1

Intensifying external pressure demands a strategic answer

The evolving regulatory landscape, combined with shifting stakeholder expectations and pressure from investors, reinforces that sustainability should continue to be at the forefront of business strategy for the chemical sector.

The chemical industry has learned to embrace sustainability, from minimizing impact during production to expanding its portfolio of green chemicals.

There are sound reasons for this embrace, both from a commercial and a climate point of view. Sustainable practices limit natural resource depletion and carbon emissions by the chemical industry but also boost brand reputation, innovation, and green product development to meet market demand.

Despite these advantages, it took considerable external pressure to get the chemical industry moving in a sustainable direction. Ongoing and intensifying external pressure will force it to move much further in the next few years. Since 96 percent of all manufactured goods use chemicals, and the production of these chemicals still leans heavily on fossil fuels, the chemical industry is a prime target for stakeholders seeking sustainable change.[1]

Now and in the foreseeable future, external pressure will remain the biggest driver of change within the chemical sector. Next, we break down the three main components of external pressure chemical companies need to be aware of and respond to.

WHAT TO EXPECT:

In the crosshairs of regulators

Regulators are probably the most impactful of all external stakeholders, pushing chemical companies to be more sustainable. Worldwide climate and environmental regulations are accelerating the adoption of green chemical solutions. Especially in Europe, regulators tighten the thumb screws on the chemical industry by implementing the European Union (EU) Chemicals Strategy for Sustainability, published in 2020 as part of the EU's zero pollution ambition.

In its quest to boost innovation for safe and sustainable chemicals, the EU uses a carrot and the stick. On the one hand, the EU and European governments are pressuring companies to phase out single-use plastics and per- and poly-fluoroalkyl substances (PFAS, or so-called 'forever chemicals') found in many consumer products and chemical pesticides. On the other hand, the EU provides financial incentives to support the development of greener and safer chemicals that are easier to recycle.

Similar to environmental regulation, the EU is ahead of the pack regarding chemicals, but many regions are starting to follow its example. EU regulation is also the de facto world standard for any global chemical company with large EU operations.

Another area of pressure where EU laws and regulations lead the way is chemical industry decarbonization. The EU's mandatory carbon-pricing mechanism, the Emissions Trading System (ETS), is a formidable decarbonizing force—for all industries, including chemicals—with carbon permit prices quadrupling in three years. It has inspired many other national and regional carbon trading systems over time.

Europe is also at the forefront of translating the Paris Climate Agreement into additional decarbonization demands, like the decarbonization roadmap for the chemical industry called for by the French government, rules to avoid carbon leakage (companies moving production to areas with lax climate regulations) and import tariffs on products with a high carbon footprint (the Carbon Border Adjustment Mechanism). If history is any guide, chemical companies can also expect similar measures to spread outside Europe.

In Europe, the REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) regulation—which addresses the production and use of chemical substances and their potential impacts on human health and the environment—encourages companies to invest resources in sustainable and safe innovation to support the transition to green chemistry.

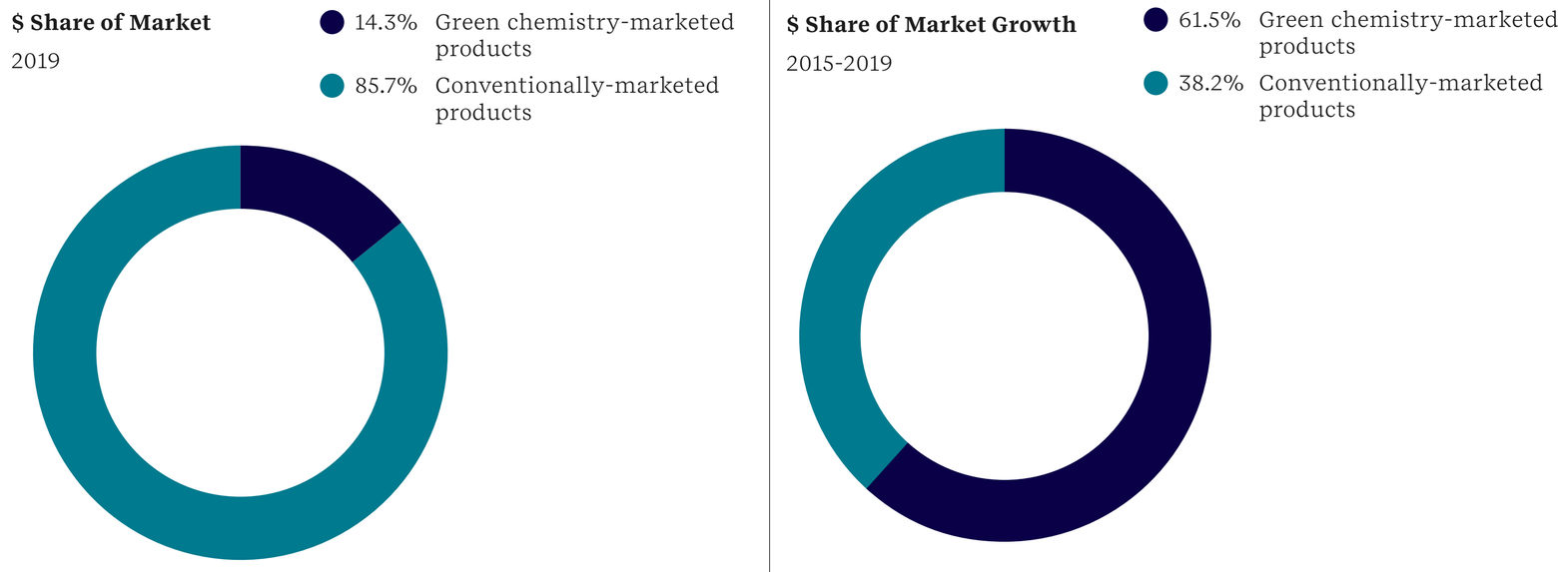
Consumers, corporates, and NGOs push for green chemicals

Regulators are not the only ones applying pressure. Regulators are being pushed themselves by public opinion, often with NGOs putting a topic on the map and consumers responding. The genetically modified organism (GMO) debate in Europe offers a powerful example of this interaction: vocal resistance of NGOs and European consumers led to the strictest GMO regulation in the world.

PFAS chemicals followed a similar path in the EU and increasingly in other areas worldwide. NGOs are calling for the phaseout of PFAS chemicals by making consumers aware that they pose a significant threat to their health, triggering government regulation to phase out PFAS or ban certain individual chemicals. Chemical pesticides and single-use plastics have gone through the same motions.

But these changes have also opened new markets for green chemicals and organic pesticides. The commercial potential of these markets is substantial. Consumer and corporate demand for products containing green chemistry, for example, has created a fast-growing market for green chemistry products. In the U.S., the market for green chemistry grows 12 times faster than conventional chemicals and now makes up 14 percent of the total market.[2]

Figure 1: Market Growth of Green Chemistry Products



Green chemistry-marketed products (10 categories examined) are 14.3% of the market and delivered 62% of the categories market growth (2015-2019)

Figure 1 description: The market share of green chemistry-marketed products has grown rapidly in recent years.

Source: Green Chemistry & Commerce Council

Pressure from NGOs, consumers, and corporate clients also plays a vital role in pressuring chemical companies to better manage their supply chains by embedding high ethical standards, from both climate and social perspectives. This has led to increasing client demand for traceability, meaning detailed information on whether product components are sustainably sourced and produced.

Since all parties involved are highly aware of the financial risks chemical companies face if they do not take ESG factors seriously, clients and NGOs will keep ramping up pressure in the future.

The ESG lens of investors is sharpening

After regulators, external pressure from investors is what chemical companies are driven by the most. From mutual funds to pension funds and private equity companies, investors increasingly look at financial risks and opportunities through an ESG lens. Consumers also reenter the picture here: retail investors are driving the swelling trillion-dollar ESG investment funds market.

A growing number of mutual funds managed by institutional investors are evaluating the ESG performance of companies in which they hold stock. To attract these investors, companies must aspire to set ambitious environmental goals and allocate a significant share of capital spending toward sustainability to make environmental performance a key part of their business strategy. For example, Howard Ungerleider, President and Chief Financial Officer of Dow, one of the three largest chemical producers in the world, noted that Dow received positive investor feedback for major ESG advances, like its clear goals for reaching net zero carbon emissions by 2050.[3] Investors are also looking at the "S" of ESG and evaluating how companies are being socially responsible and contributing to a more equitable society and future.

The ESG funds market did take its first hit in 2022, especially in the U.S. but chemical companies should not draw the wrong conclusion: ESG funds were not the only ones, and they will likely bounce back. At the same time, institutional investors and private equity firms have fully integrated ESG factors into their risk analysis. They will stay on it for one simple reason: companies that do not make sustainability a crucial part of their business strategy will not deliver positive returns in the long run.

RECOMMENDATIONS

Increasing pressure from all stakeholder groups paired with a rapidly evolving regulatory environment makes it clear that companies must make larger strides today if they are to establish long-term resiliency. Chemical companies should work to understand their risk and exposure to PFAS. After this, developing a transformation plan will be critical, and tackling the tasks that are easiest to overcome will be the best place to start.

Push for more green chemicals and accelerated reduction of harmful waste

Many leading chemical companies have set specific, time-bound targets to reduce their harmful impacts. Determining and scaling solutions to address environmental issues, such as waste generation and biodiversity impacts will be a major focus for the industry in the coming years.

The chemical sector has a significant impact on the environment and human health.

While the industry will play a critical role in the transition to a low-carbon economy, it heavily relies on fossil fuels and its processes are carbon-intensive. The industry has also suffered from negative reputational impacts due to the use of forever chemicals and harmful pollution from plastics, fertilizers, and other synthetic chemicals.

While it is possible to minimize the sector's negative impacts, the process is technically challenging. However, innovation is a foundational aspect of the chemical industry and already there are cutting-edge processes being implemented to reduce harmful impacts—from sustainable chemistry principles to plastic alternatives that help reduce waste and move toward a circular economy.

Additionally, chemical and agricultural companies are increasingly forced to confront their significant contribution to biodiversity loss and find ways to reduce their nature-related impacts. A common strategy among chemical companies is to implement nature-based solutions (NbS) portfolios that support offsetting projects in different regions of the world. Some leading firms are already implementing, purchasing, or collaborating with other organizations to implement NbS or develop nature-based tools to transform their business practices, support their path to carbon neutrality, and achieve their sustainability targets.

Next, we highlight four developments for chemical companies to watch, understand, and address.

"The chemical industry holds a unique role in helping drive a sustainable future, not only for our sector but for a broader industrial landscape. To achieve this transformation, we must prioritize transparency at every step, from raw material sourcing to product end of life. This transparency will enable the sector developing new products, by taking a holistic lifecycle approach to sustainability, addressing critical aspects like circularity, biodiversity, climate impact and hazardous waste reduction within the value chain. It will also help identify challenges and the areas where scientific innovations are required to develop products that align within planetary bounds."

Bettina Siggelkow
Clariant
Head of Sustainability Affairs

WHAT TO EXPECT:

Green chemistry to the rescue

The chemical industry can minimize its environmental and health impacts by incorporating green chemistry principles throughout the product lifecycle—from design and manufacturing to use and ultimate disposal. Green chemistry is the design of chemical products and processes that reduce or eliminate the generation of hazardous substances.[4] This results in source reduction by preventing the generation of pollution at the molecular level, reducing the negative impacts of chemical products and processes on human health and the environment, and lessening and sometimes even eliminating hazards from existing products and processes.

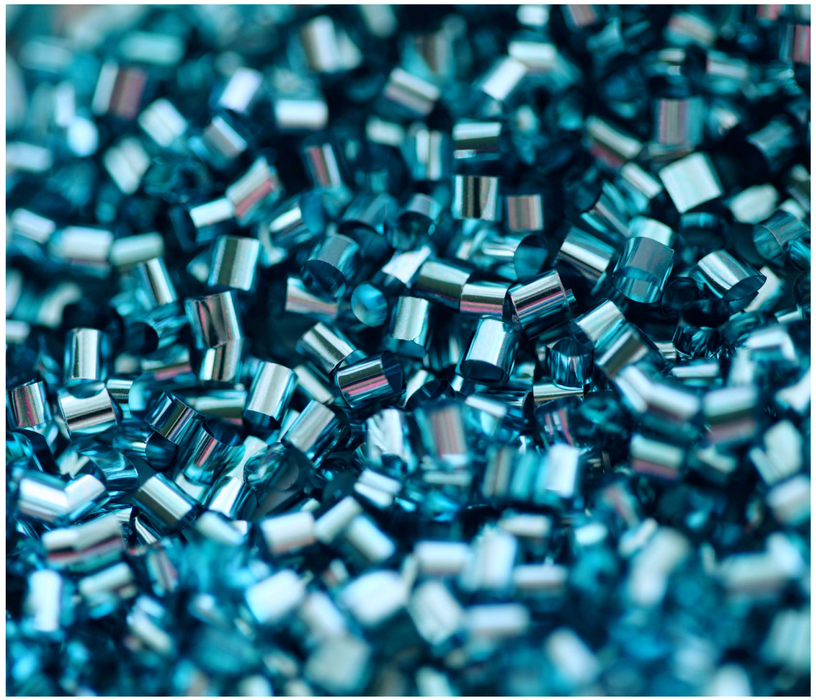
This green chemistry philosophy applies across all areas of chemistry, not just a single discipline. By applying a keen eye toward sustainability and product stewardship, the chemical sector can enhance consumer product safety, prevent and limit waste generation, and reduce the amount of hazardous chemicals that end up in the environment. Green chemistry also boosts the economy and business by enabling higher yields in chemical reactions, reducing costs for remediation and hazardous waste disposal, and increasing sales by earning a safer-product label. Again, we see external regulation as a primary driver in this space (see further information on REACH in Chapter 1).

Going forward, companies will need to proactively invest in research and development (R&D) of less hazardous chemical processes in anticipation of regulatory reforms in other regions. One company moving in the direction of green chemistry is Henkel, a German-based chemical and consumer goods company, which launched Aquence Lam E9500 ECO, the latest innovation in sustainability-focused water-based adhesives and additives for tissue and towel production. Unlike purely fossil-based polymer adhesives, it is made with bio-based raw materials and provides customers with a sustainable solution that helps reduce their Scope 3 CO_2 emissions. As a preservative- and plasticizer-free adhesive, the new product also helps manufacturers ensure a safer working environment.

Rethinking plastics

The chemical and mechanical recycling of plastics is a critical area of concern for the chemical sector—but it is also an area where the industry can have a large impact. By reducing plastic waste, increasing circularity, and replacing fossil feedstocks with secondary raw materials, chemical companies can lower their carbon footprints and minimize their environmental impacts. Again, the EU is ahead of the game, recycling almost 33 percent of its plastic waste in 2021 compared to the U.S., which only recycled five to six percent of the 40 million tons of plastic waste generated.[5,6]

Increased investments in R&D and innovative technologies can provide the solutions necessary to address plastic pollution. For instance, the German-based chemical company, BASF, launched its ChemCycling® project to transform plastic waste into new chemical building blocks through chemical recycling. Using innovative pyrolysis technology, BASF is working to turn plastic waste into a secondary raw material which is then fed into production at the beginning of the value chain, thereby saving fossil resources.



Circular approach to take on waste

To reduce society's negative impact on the environment and with growing public preferences for sustainability, it is critical for companies to transition to alternative economic models. Governments and industries have already begun to shift from the traditional linear model of "take, make, use, and waste" towards the circular economy, where environmentally sustainable recovery of resources from waste plays a crucial role.

It is both a challenge and an opportunity for the chemical sector to apply "circular thinking" to each stage of the product life cycle—from its original conception to ultimate disposal. Circular economy opportunities within the chemical sector include:

- **Avoiding waste through multiple usages:** Many products and components in the chemical industry are disposed of after a single use. Product reuse and recycling could reduce the amount of waste generated by end-consumers.
- **Reducing by-products:** Companies can improve process efficiency using by-products or avoid the generation of by-products through effective synthesis design.
- **Repurposing waste:** Waste can be used as a raw material input in waste-to-chemicals technologies.
- **Design for circularity:** Intentionally designing products and packaging to incorporate circular materials keeps material in use and can position the company with many investors and customers.

Figure 2: Circular Economy Model

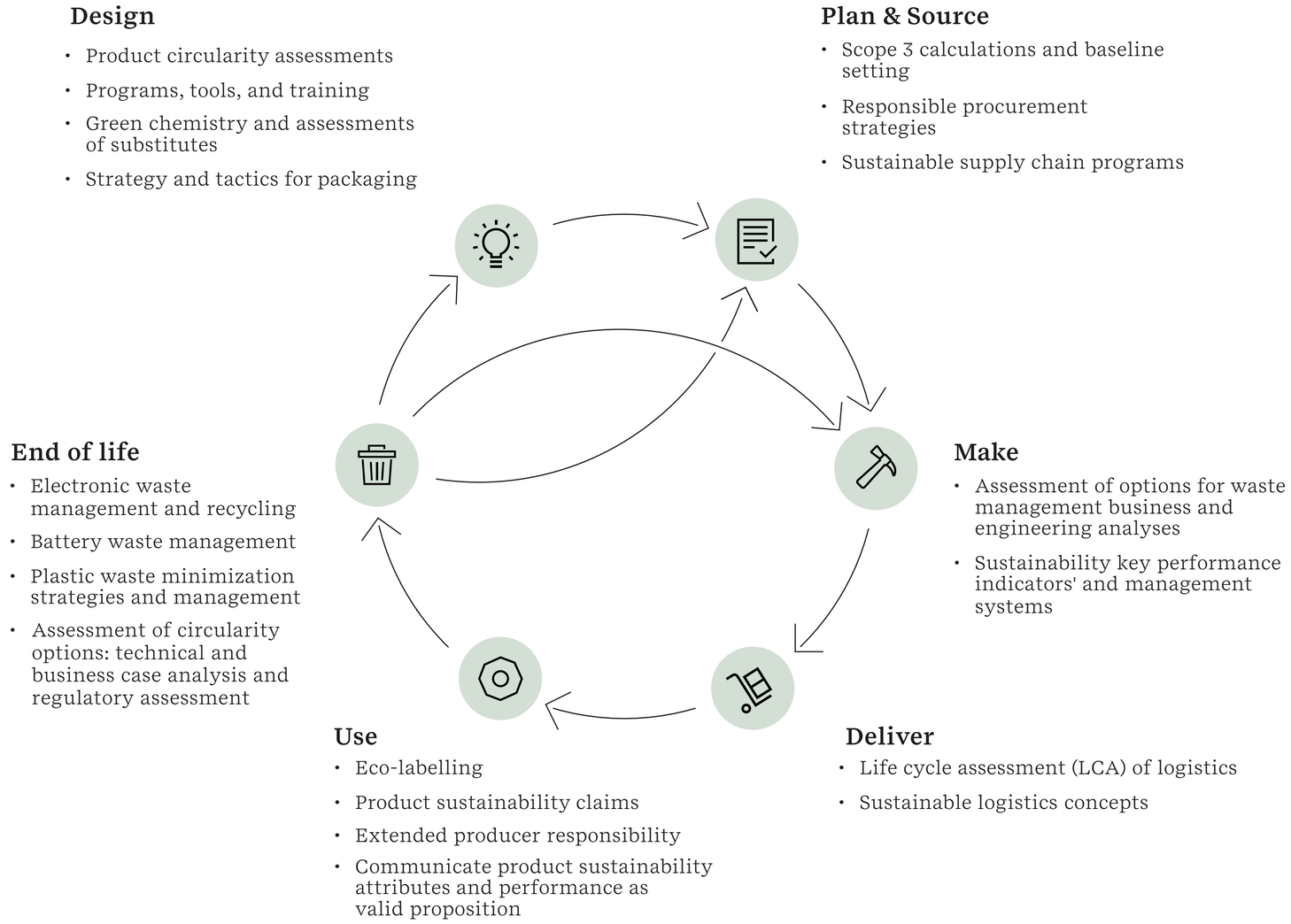


Figure 2 description: A circular model of every stage of the product lifecycle

Source: ERM

To reshape and redesign the economic model to create higher volumes of recycled, reused, and recovered materials, it is critical to close the loop to connect upstream and downstream expertise, through partnerships and collaboration. For example, to ensure plastic products are properly recycled, consumer brands and waste management companies should collaborate to increase waste collection. Further up the value chain, chemical companies processing plastic resins need to work with waste management companies to ensure waste turned into secondary raw materials can re-enter the value chain.

Addressing impacts on nature and biodiversity

The business world is shifting to nature-positive outcomes and once again regulation is a primary driver. The launch of the first beta version of the Taskforce on Nature-related Financial Disclosures (TNFD) in June 2021 and ratification of the Kunming-Montreal Biodiversity Framework in December 2022 have accelerated the urgency to think holistically about environmental impacts. These disclosures require landscape, agriculture, and chemical companies to disclose and report on their impacts, dependencies, and risks related to nature and set ambitious and wide-ranging targets, including that on forever chemicals, PFAS, and endocrine disrupters, pushing governments to enforce more stringent chemical management and regulation.

One strategy chemical companies are pursuing is including biodiversity targets in sustainability strategies. This is the case for members of Act4nature international, an alliance to accelerate concrete business actions in favor of nature. Solvay received approval from the alliance for its commitment to reduce pressures on biodiversity by 30 percent. Under Syngenta's Good Growth Plan, the agriculture technology company committed to enhance biodiversity and soil health on three million hectares of rural land every year by providing technologies, services, and training to farmers.

Another trending approach is to invest directly in nature-based solutions (NbS) to protect nature and increase the supply of carbon credits. For example, with The Valuing Nature Blueprint, Dow has committed to reducing carbon emissions and adopting "green infrastructure" in their global operations. Bayer, one of the largest pharmaceutical companies in the world, supports nature-based offsets through reforestation, forest protection, and agricultural carbon interventions, among other methods. Similarly, petrochemical companies, Shell and Repsol, directly invest in natural ecosystems to increase the supply of carbon credits or implement their own NbS such as large-scale reforestation.

Spotlight on the TNFD:

The TNFD is a market-led initiative aiming to develop a framework for organizations to report and measure their impacts and dependencies on nature, allowing them to evaluate material risks and opportunities across their value chain. The TNFD, which is set to adopt its recommendations in September 2023, consults with a wide range of market participants to achieve a unified approach to nature-related risk management and disclosure. Currently, many organizations from different industrial sectors are piloting the TNFD as part of their journey to a Nature-Positive strategy, however, the lack of involvement by top agriculture and chemical companies remains a significant gap.

RECOMMENDATIONS

Chemical companies have a massive role to play in the world's shift toward a circular economy. Companies should think about plastics in their business like a carbon footprint. They should first assess what their plastic footprint is and identify all the places this dependence can be reduced. This comes back to the R&D teams and better design—less plastic in the design in the first place will make the biggest difference and most significant positive impact. The World Business Council for Sustainable Development's September 2023 publication, Portfolio Sustainability Assessment v2.0, elaborates on these recommendations and is a critical resource for chemical companies working to build a more sustainable business model.

TREND 3

ESG demands and geopolitical turmoil force supply chains into a complex overhaul

Recent geopolitical events, international crises, and COVID-19 have exposed vulnerabilities in global supply chains. Reconfiguration and optimization of supply chains will be needed to enhance reliability and resiliency.

Chemical sector supply chains are complex, global in scale, and highly fragmented.

The sector's supply chain challenges are further compounded by factors that include persistent supply chain disruptions, labor, raw materials and equipment shortages, increased energy costs, and evolving ESG policy landscapes. Sustained high demand for products is hampered by these challenges. Further, increasing stakeholder pressures continue to act as levers in driving increased transparency, traceability, and diversification in the chemicals supply chain. This in turn is driving innovation in digital transformation for tracking and tracing across the chemicals supply chain. These factors, combined with the unpredictable impacts of extreme and severe weather, caused by a changing climate, present adaptation opportunities and incentives for building resilience into supply chains.

Next, we highlight three developments for chemical companies to watch, understand, and address.

WHAT TO EXPECT:

Geopolitics make everything more complex

Results from the Global Risk Survey, conducted by Oxford Economics, indicate that the ongoing conflict between Ukraine and Russia is expected to result in persistent supply chain disruptions. Specifically for the chemical sector, this has caused added disruptions in the sourcing of basic raw materials such as potash, or fertilizer potassium, which is an essential feedstock material in fertilizer production. Combined, Russia and Ukraine are important sources for a variety of goods as well as raw materials and in 2021, Russia alone produced over 20 percent of global potash.[7] This concentration of raw material production to just a few countries exacerbates existing supply chain vulnerabilities. In order to combat these vulnerabilities, chemical companies can build supply chain resilience through supplier diversification across geographic regions.

Additionally, the spillover effects from the intensifying conflict between Russia and Ukraine continues to impact the availability and cost of energy for the chemical sector. Approximately 70 percent of ammonia production is fueled by natural gas, while natural gas fuels around 60 percent of methanol production. Most synthetic ammonia is used as fertilizer, supporting the global agriculture industry, and methanol is a critical base material used throughout the chemical sector in acrylic plastic; synthetic fabrics and fibers used to make clothing, adhesives, paint, and plywood used in construction; and as a chemical agent in pharmaceuticals and agrichemicals.

Rising energy costs have also led to a spike in the cost of manufacturing chemicals. Between 2021 and 2022, the prices for benzene, nylon, PVC (Polyvinyl chloride), and polypropylene rose 36 percent, 23 percent, 11 percent, and 9 percent, respectively.[8] The Ukraine-Russia war and the resultant energy crisis has caused the EU to import more chemicals than it exports, which creates dependencies. According to the ifo Institute, a research institution based in Munich, production plans in Germany have declined sharply since the beginning of 2021 to their lowest levels since 1991, due to energy price increases, amongst other factors.[9]

Furthermore, the zero-COVID policy and associated lockdowns in China, through December 2022, have led to prolonged disruptions at major chemicals supply chain hubs like Shanghai.

Shortages and high prices are the new normal

Shortages and increased costs in the supply of raw materials such as semiconductors, chlorine, and rare earth elements, among others, have led to persistent supply chain disruptions. A survey undertaken by the National Association of Chemical Distributors (NACD) showed that the production of raw materials needed to make chemical products has yet to reach pre-COVID-19 pandemic levels.[10]

This is driven by roll-on impacts from increased demand, shipping delays, force majeures in the U.S. and Europe as a response to the global pandemic, and a lack of drivers to transport materials and products.

Almost all chemical sector respondents in an American Chemistry Council (ACC) survey indicated that they have modified their operations in response to these challenges by, for example, increasing raw material inventories (92 percent of respondents) and increasing inventories of finished products (62 percent).[11]

The respondents also claimed that to better manage the production of raw materials, they are focusing on inventory optimization, supply chain analysis (59 percent), and supplier base optimization (53 percent).

Additionally, the COVID-19 pandemic impacted labor supply, in turn, affecting wages. Although the most severe impacts of the pandemic have dissipated, turbulence in the labor market is expected to continue. Labor projections from the American Trucking Association (ATA) show that the trucking industry could be short by over 140,000 drivers by 2026, increasing the driver shortage to over 160,000 drivers by 2030.[12]

This indicates that even if raw material production can get back to normal, the chemical industry may still face challenges and delays in transporting materials and finished products to their final destination.

Evolving to transparent and traceable supply chains

Beyond the emerging and evolving legislative landscape, companies face pressure from stakeholders to embed high ethical standards in their supply chains. Stakeholders are increasingly aware of ESG risks and opportunities in the chemical sector supply chain and voicing concerns about forced labor, child labor, and the exploitation of Indigenous peoples. These factors are influencing chemical companies to improve supply chain transparency and traceability and enhance due diligence practices across their supply chain. Chemical companies are also driving ESG performance improvements upstream into their value chain by setting ESG standards for suppliers, a trend that is expected to continue. For example, in 2022, Chemours, a U.S.-based chemicals company, achieved their goal of 15 percent of suppliers showing an improvement in sustainability performance.[13] Chemours measures supplier sustainability performance in partnership with EcoVadis through its Supplier Corporate Responsibility Assessment (SCRA) which evaluates ethical business practices, social performance, environmental performance, and sustainable supply chain.[14]

As the drivers to build more sustainable and resilient chemical supply chains compound, companies are re-evaluating their supply chain risks and opportunities, particularly around uncertainties in raw material supplies. Creating truly sustainable supply chains requires collaboration and transparency between chemical companies, suppliers, customers, and consumers.

RECOMMENDATIONS

Companies with relatively more complex supply chains, like those in the chemical sector, should own their supply chains or at the minimum become a part of a joint venture. Removing the aspect of being a customer to a supplier who is selling base chemicals or minerals, for example, will significantly reduce stress on the business. Companies should also take frequent account of geopolitical forecasts and diversify their supply chains when possible. They will have to think more carefully and critically in terms of designing supply chains, which will also give companies an opportunity for a larger impact by bringing this assessment back to the fundamentals of the design stage.

Time to commit to the next phase on the road to Net Zero

The chemical sector must overcome obstacles, such as dependence on fossil fuels for energy and feedstock, to meet decarbonization targets and the demand for sustainable products.

Many governments have implemented policies and targets to reduce carbon emissions, all in support of the net zero transition.

It is vital for the chemical industry to align with these initiatives. According to the International Energy Agency, chemical sector emissions need to peak in the next few years and decline towards 2030 to be on track with Net Zero emissions. In 2022 the Science Based Targets initiative (SBTi) launched a project to develop guidance and Sectoral Decarbonization Approach methods for chemical companies to set ambitious decarbonization targets and to establish 1.5°C-aligned emissions reduction pathways for high-impact subsectors in the industry, to be completed by 2024.[15]

Many chemical companies are already setting net zero plans. For example, Dow set a goal of reaching net zero carbon emissions by 2050 and plans to spend $1 billion per year, about a third of its capital budget, on decarbonization. This level of spending could become the norm for the petrochemical industry and according to BloombergNEF, the sector will need to invest a total of $759 billion by 2050 to nearly eliminate carbon emissions.[16]

One of the key challenges of the chemical sector is represented by the energy transition. Securing renewable energy sources will be crucial to align with a net zero world. Additionally, the industry's net zero pathway will require increased investment in the research, development, and deployment of low-carbon technologies to meet market demand.

Next, we highlight three developments for chemical companies to watch, understand, and address.

"With the fast increasing environmental, social, and societal pressures, business leaders in the chemical industry are faced with an increasingly complex decision to make. Among the few certainties in this throe of change: industry transformation is inevitable. Our members increasingly acknowledge the deep interconnection between the three imperatives for this transformation - decarbonization, help halt nature and biodiversity loss, and tackling inequality. Assessing challenges and their solutions requires, therefore this trifocal lens, a system approach to look at value chains holistically, from feedstock, to business models, product end of life and resource regeneration. Circular economy and collective actions are key levers that we seek to move forward."

Anne-Laure Brison
World Business Council for Sustainable Development
Senior Manager, Chemicals Group

WHAT TO EXPECT:

The slow but steady turn to decarbonized feedstocks

The chemical industry strongly relies on carbon-based feedstocks, which are raw material inputs that contain carbon. Ideally, fossil fuels and carbon-based feedstocks can be substituted with sustainably produced biomass from agricultural and forestry waste and by-products. However, considering today's production volumes, there will not be enough biomass feedstock for many of the most-produced commodity chemicals, such as

In addition to electrification, investments in low-carbon or carbon-free fuels such as hydrogen are required to decarbonize the chemical sector. Today, most hydrogen used is grey hydrogen, which is obtained from fossil fuels through steam reforming. However, increasingly, blue and green hydrogen, produced through lower-carbon inputs such as natural gas and renewable energy, are becoming viable alternatives. The chemical sector can act as a producer and a consumer in the hydrogen economy by, for example coupling Carbon Capture, Utilization and Storage (CCUS) technologies with blue hydrogen production. This would enable companies to turn methanol and other precursors useful in a chemical into a sustainable feedstock. Additionally, chemical companies could provide liquid Organic Hydrogen Carriers (LOHCs), or chemicals featuring similar physical properties as gasoline. These synthetic fuels are becoming the most promising long-term energy and hydrogen source, especially in long-distance transportation where electrification is less feasible.

ethane, propane, benzene, and toluene. This is because of competition between the chemical and energy sectors for biomass supply, complex supply chains for biomass with diverse feedstock, and competition with the food and agriculture sector for land use.

In order to successfully transition, chemical companies that rely on fossil fuels and carbon-based feedstocks must explore alternatives to ensure the continuity of their feedstock supply. The winning solution will be a combination of bio-based and recycling-based inputs.

However, considering the technical and financial challenges that need to be overcome to deploy low carbon technologies, innovation-supporting policies, and strong collaboration among industry players across the whole value chain will be key enablers for the decarbonization of the industry.

From fossil fuel hog to renewable energy trailblazer

The chemical industry plays a key role in the decarbonization roadmap. According to the International Energy Agency (IEA), the chemical sector is the largest industrial energy consumer and the third largest industry subsector in terms of direct CO2 emissions. Around half of the chemical industry's energy input is consumed as feedstock. In 2021, direct CO_2 emissions from primary chemical production amounted to 925 metric tons, a 5 percent increase with respect to the previous year, resulting from production increases to levels above those in 2019. This is in tandem with a relatively stable primary chemicals CO_2 intensity over recent years, at around 1.3 metric tons of CO_2 per ton of primary chemicals.[17] Today the entire sector accounts for 5-6 percent of global Scope 1 and 2 GHG emissions.[18]

As part of one of the world's largest and most diversified industries, chemical companies can play a catalytic role in the deployment of renewables to reduce GHG emissions. Chemical companies are increasingly rethinking their energy needs and turning more and more toward renewable energy. As renewable energy is on its way to becoming more competitive and readily available, corporate sourcing of renewable electricity is an increasingly attractive solution for many chemical companies. For example, BASF committed to powering its U.S. sites with renewable energy and has entered into virtual power purchase agreements (VPPAs) for wind and solar power, totaling 250 megawatts (MW). By offsetting carbon-intensive grid-supplied electricity, BASF is taking a critical step toward reaching its goal of net zero emissions by 2050.

Successful Green Alternatives:

- NatureWorks, a bioplastics and biomaterials company, converts plants to capture and sequester CO_2 transforming it into a portfolio of polylactic acid performance materials called Ingeo. The Ingeo Technology forms a resin as strong as the rigid petroleum-based plastics currently used for food containers. NatureWorks is also working to source raw material for its products from agricultural waste.[20]
- BASF, the largest chemical producer in the world, developed fully biodegradable bags called "Ecovio®," made of a compostable polyester film called "Ecoflex®" they developed as well as cassava starch and calcium carbonate. The bags are certified by the Biodegradable Products Institute and disintegrate into water, CO_2, and biomass in composting systems.
- Procter & Gamble and Cook Composites and Polymers replaced fossil-fuel derived paint resins and solvents by creating a mixture of soya oil and sugar.[21]
- Athletic footwear company Nike designed a sneaker that uses a pigment derived from algae to replace petroleum-based ink.[22]

Figure 3: Percent GHG Emissions for the Chemical Sector

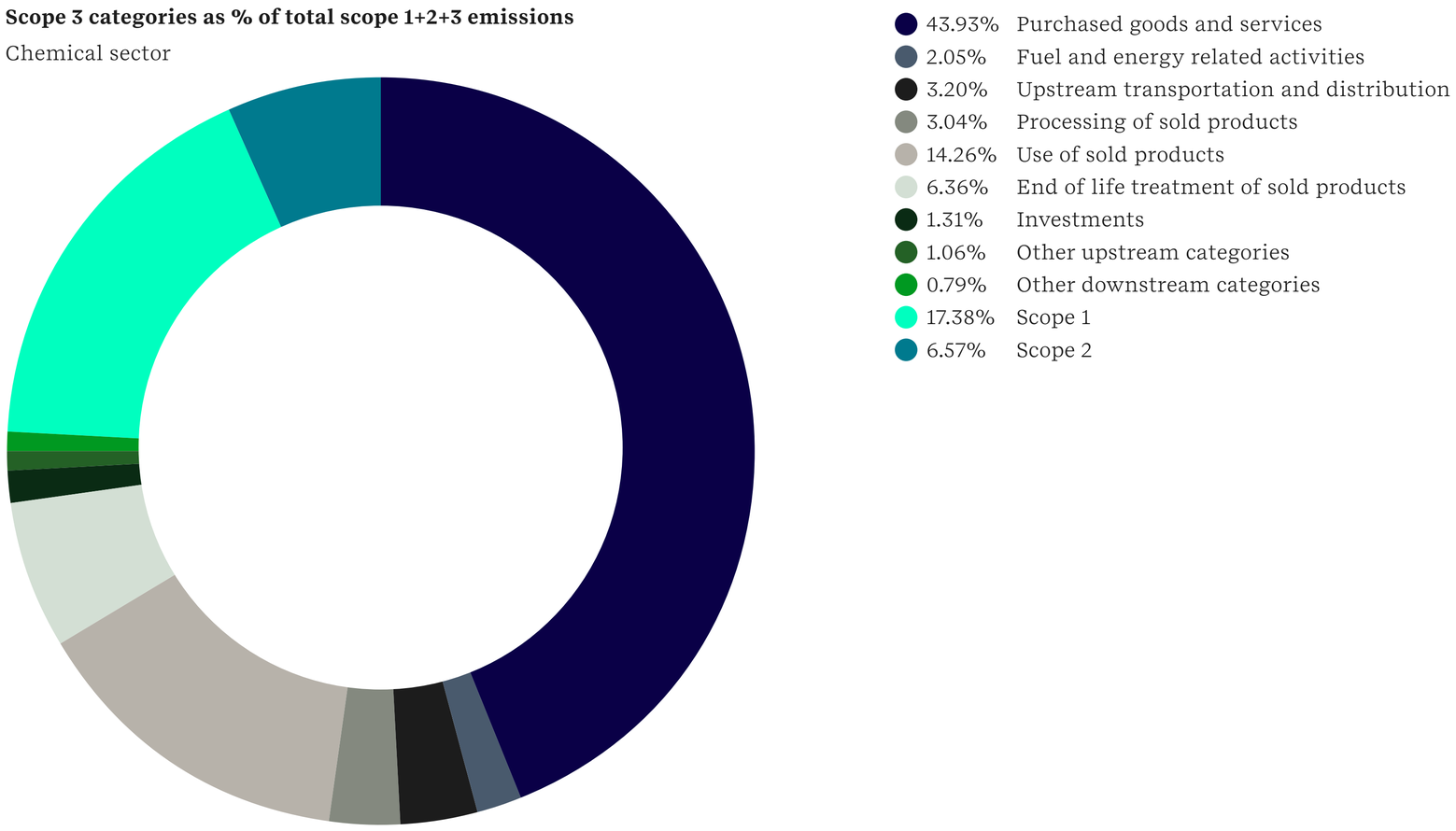


Figure 3 description: GHG emissions as a percentage of overall emissions for the chemical sector.
Source: CDP

Meeting market demand for green alternatives

There are increasingly more climate policies and emissions reduction commitments across all the chemical industry's value chain. Considering over 95 percent of all manufactured goods rely on some form of industrial chemical process, there will be an increasing demand for net zero products to successfully meet net zero targets.[19] By responding to climate policy pressures and investing in sustainable technologies, chemical companies will be pioneers in the sector and pull the global economy toward low-carbon and sustainable solutions. This will translate to a competitive advantage in global markets.

Moreover, the market is starting to show that people are readily accepting more environmentally capable substitutes, even if they cost slightly more or function less effectively. Therefore, chemical companies should see sustainability as a critical component of their core business and invest in the development of more sustainable products to capitalize on the growth of the green product market.

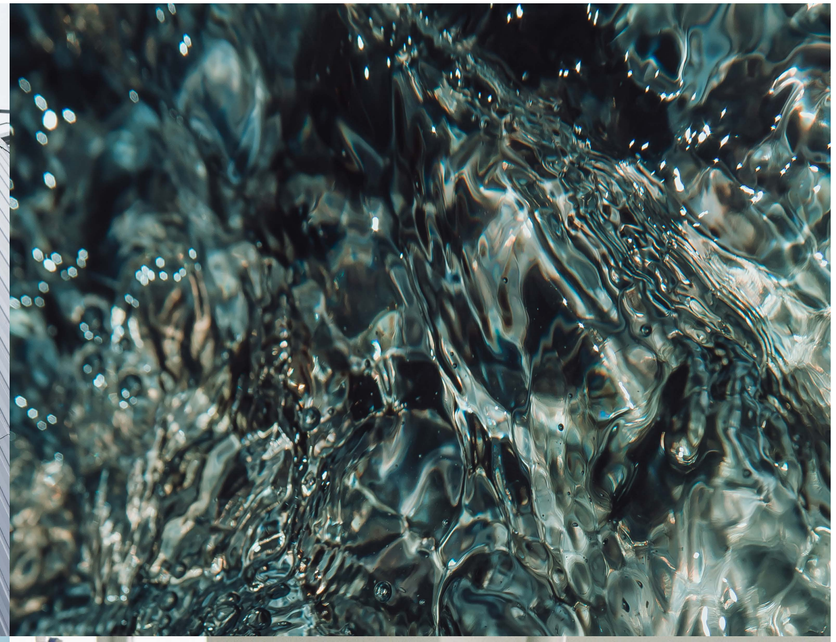
RECOMMENDATIONS

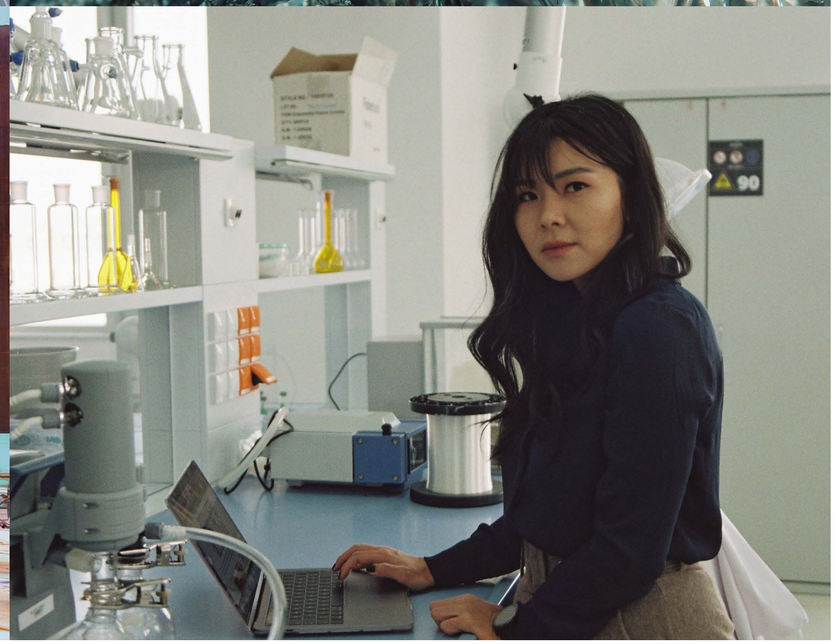
There is no single golden bullet which will bring chemical companies further along the road to Net Zero. But optimizing processes by reducing Scope 3 footprints, which are massive for chemical companies, will have a huge impact on renewables and climate action in general. Also, companies will need to accept strategic change is a must and that there will be some products they will no longer be able to make.

Conclusion

The chemical sector is at a critical juncture to fundamentally transform to support the development of products that help solve the world's sustainability challenges. The largest growth in demand for sustainable chemicals is occurring at the consumer level, and large brands are using their purchasing power to reshape the sector. However, the sector faces unique hurdles, such as capital-intensive projects and dependence on carbon-based feedstock. Additionally, long-lasting, broader impacts from a volatile global socioeconomic and political landscape continue to impact the availability and cost of energy and the effectiveness of supply chains.

The chemical sector can work to overcome these obstacles by refining product portfolios, phasing out challenged products, transitioning to a circular economy, and building sustainable, resilient, transparent, and traceable value chains. The sector cannot make these changes without close collaboration and support from various stakeholders such as suppliers, customers, consumers, investors, shareholders, universities, regulators, and NGOs. The industry will need to actively adapt to market demands, track regulatory and market adaptation measures, collaborate with stakeholders, and leverage existing opportunities that will drive it to be more sustainable.





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