Monitor
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Future of the chemicals value chain in Europe

What will the European chemicals value chain look like in 2040?

center
for the long view

This study was developed before the COVID-19 crisis hit the chemicals industry as well as their customers in an unprecedented way, resulting in multiple changes and challenges for all industry sectors as well as for the consumer, the full consequences of which are not yet apparent. The approach and methodology of the study focused on the long-term view with the horizon of the next twenty years, analyzing the key market drivers and uncertainties that will influence the chemical value chain in Europe until 2040. It is undisputed that the COVID-19 context will have a significant and serious short- to mid-term impact on the global economy, the developments of the chemical industry as well as their application industries for years to come. However, the authors strongly and firmly believe that the scenarios described for 2040, and the related drivers and uncertainties continue to be valid and are to some extent more important than before. Therefore, the study and its results are in fact even more compelling and relevant for the long-term strategic decisions to be taken by the chemicals industry in Europe.

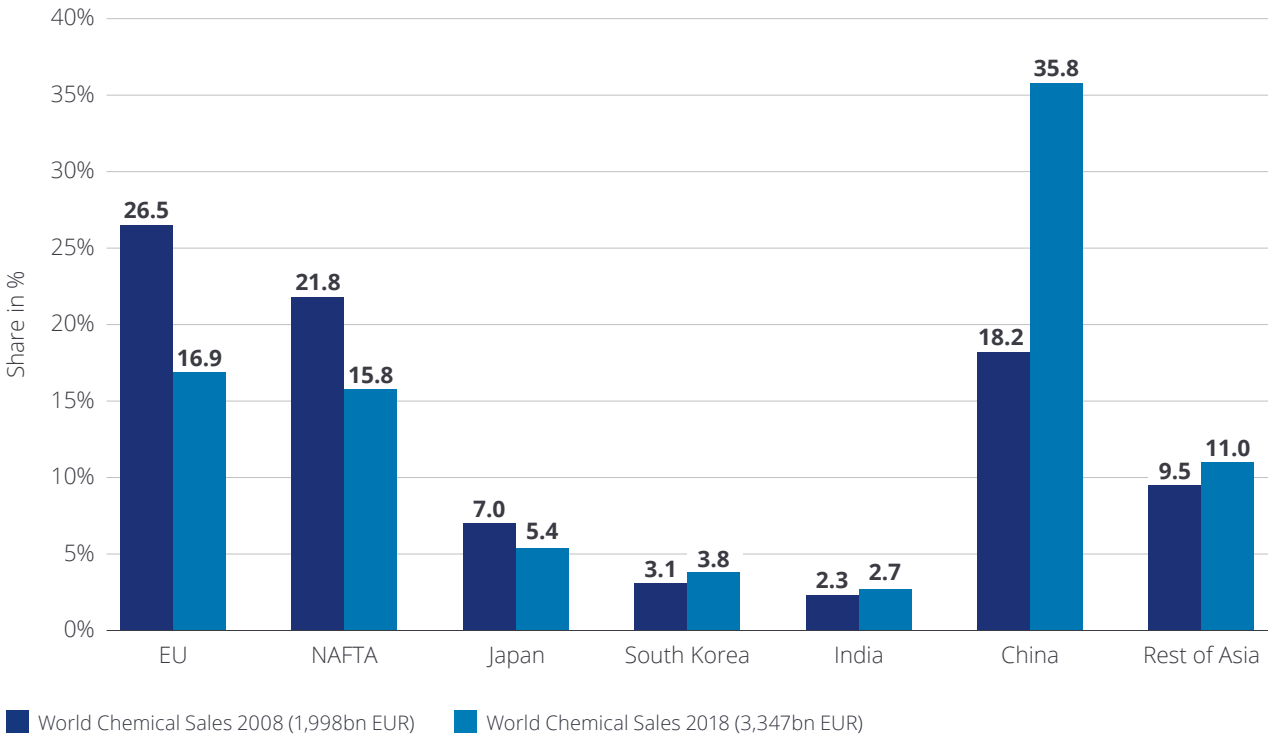
Introduction

Not only are 100 of 184 Nobel laureates for Chemistry European[1], the European chemicals industry has been and remains a cornerstone of the global chemicals industry. With sales of ~565bn EUR, it represents 17 percent of the global chemicals industry of ~3,350bn EUR in 2018.

"The country which is in advance of the rest of the world in chemistry will also be foremost in wealth and in general prosperity."

William Ramsay
Winner of the Nobel Prize in Chemistry, 1904

Fig. 1 – Share of world chemical sales by region



Note: One hundred Nobel laureates for chemistry were born in Europe or hold a European passport.

These impressive numbers and the strong historical foundation might distract from the fact that the industry in Europe will face a number of challenges in the future. It is not only that growth has been as low as <1 percent p.a. in the last decade (CAGR of ~0.6% p.a. from 2008 to 2018), the relevance of home EU markets has been declining continuously (considering home sales and intra-EU exports, with -0.4% p.a. from 2008 to 2018) as well.

However, even with the percentage of exports to regions outside Europe increasing by ~4 percent p.a. in the same period (from 20% to 29% of the chemicals EU sales), strengthening global competition, especially from incumbents of growing economies (such as China and other Asian markets), has resulted in a sharply decreasing global share of the European chemicals industry (originally >25% and currently ~17%).

To add to this context, a challenging market/competitive environment in the EU home markets, disruption of global supply chains, socio-political pressure for sustainability (including carbon neutrality), changing demand from major application industries (such as automotive), and an unfavorable energy and feedstock situation (without the competitive advantage of access to oil, such as from the Middle East or shale gas in the US) shape the framework wherein the chemicals industry in Europe has to compete.

Further, Europe is not only the home of many major chemicals companies; the portion of their sales made in Europe is still significant and still draws large investments. These are mostly not investments into new capacities but, largely and foremost, in modernization and debottlenecking. The chemicals industry has >20bn EUR in capital spending in the European region, and therefore, the future of the industry also has macroeconomic importance.

Fig. 2 – EU chemical sales structure (€ billion)

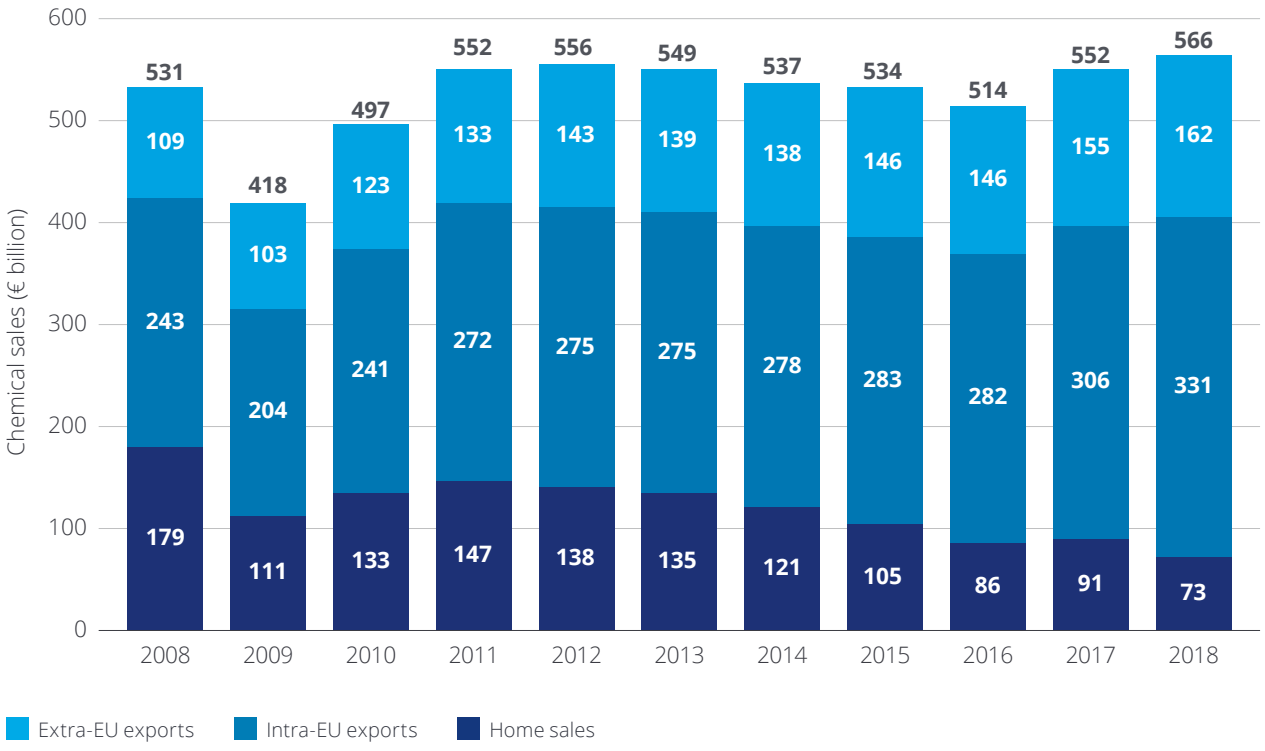
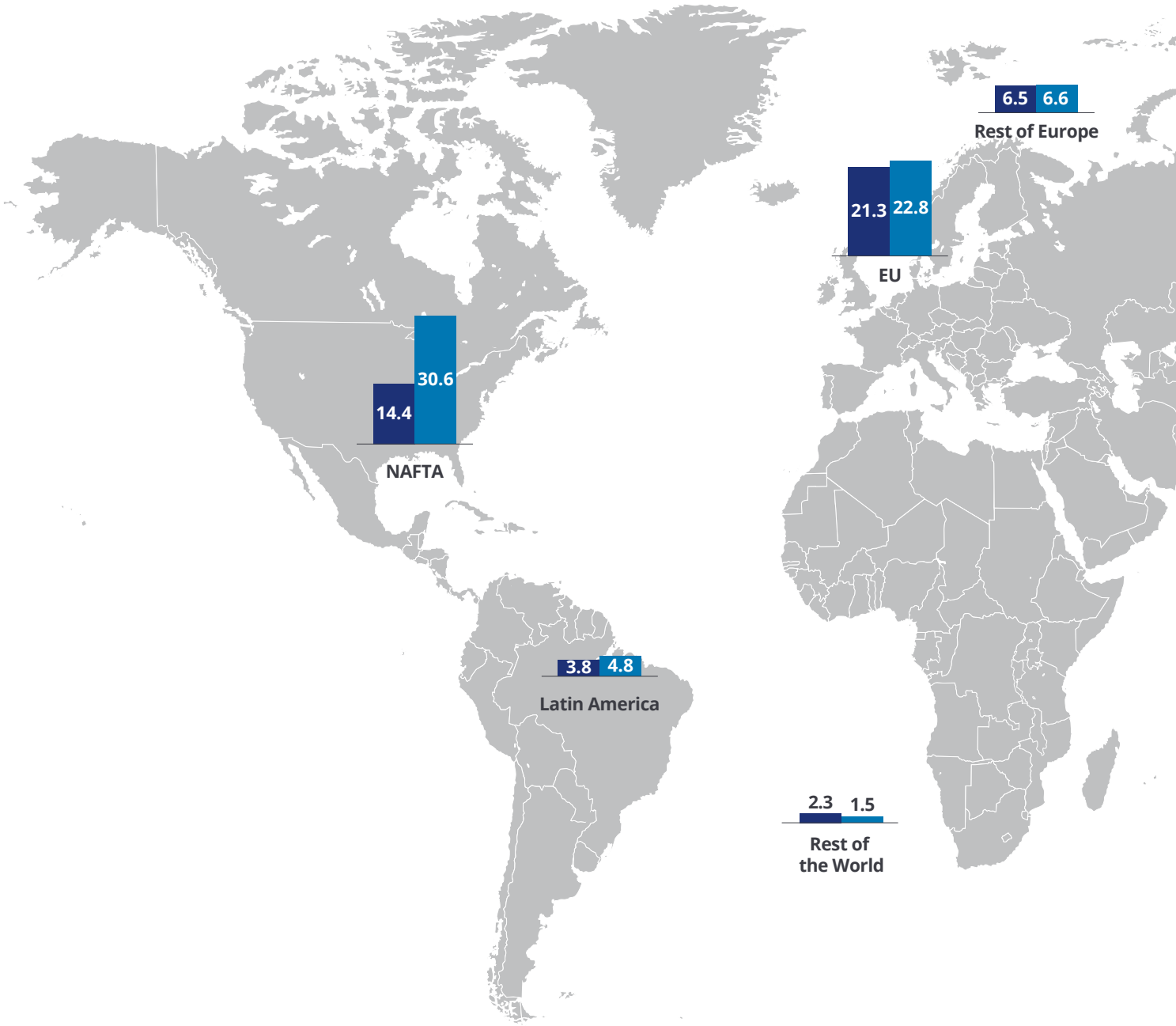
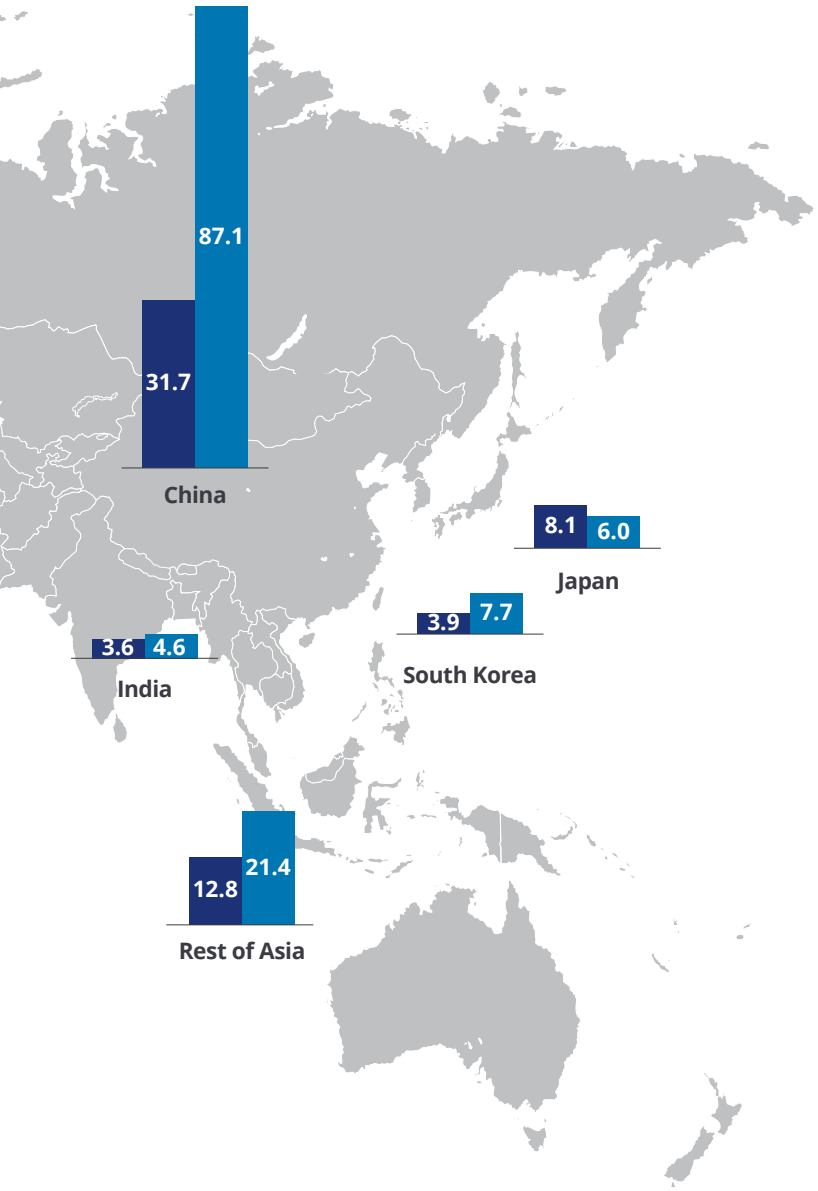


Fig. 3 – Capital spending by region





2008 Chemicals capital spending (€ billion)
2018 Chemicals capital spending (€ billion)

A historically strong presence and commitment and a heavy asset base of the industry in Europe meet an increasingly difficult and challenging environment. This is a sufficient reason for Monitor Deloitte to have a closer look at what the future of the chemicals industry in Europe holds.

To develop a view on the future of the chemicals industry in Europe, Monitor Deloitte combined its propriety scenario approach with its European and global industry expertise, contributions, insights, and perspectives from industry representatives and other stakeholders, such as institutions, associations, and policymakers. The outcome provides a unique, fresh, and unbiased view on the industry and can serve as guidance for industry leaders who do not want to merely react but instead actively shape the future of the chemicals industry in Europe.

What does the future look like? European chemicals companies (most of them acting in the global market) are carefully considering where to invest in new assets and intellectual property, and the shift toward emerging markets with a focus on China/Asia is clear. Moreover, Asia certainly is the significant growth engine of the industry, but is also confronted with challenges, as seen during the last quarter of 2019 and the impact on the global supply chain caused by the Chinese downturn at the beginning of 2020 and the global COVID-19 crisis.

Thinking in scenarios

Scenario planning is a methodology and mindset that offers perspectives beyond the usual corporate planning horizons of three to five years. Scenario planners do not have a crystal ball, and hence, scenario design is not capable of predicting the future per se. Scenario planning helps to take on diverse perspectives and embrace the uncertain future by asking "What-if." Therefore, we have generated a set of scenarios, each describing one plausible extreme future that is distinct from the others. Each scenario is a narrative set of an alternative future environment that might materialize based on driving forces that we can observe today. By making these driving forces visible and experiencing them, scenario planning enables executives, strategic planners, and managers to consider the impact on their strategies and adapt them accordingly. Thereby, strategists can see in detail how their strategic decisions might play out as well as the risks and opportunities of specific strategic options under different extreme conditions. This aids the development of robust responses that help to win in different plausible futures.

Scenario planning combines strategic rigor with creativity in a structured process. Each scenario approach starts with formulating a focal question that describes the strategic challenge. For the underlying approach, we have selected the question, "What will the future of the chemicals value chain look like in Europe in 2040?" This has been the overall guiding question that addresses the strategic core of chemicals companies, imbedding issues such as very long investment cycles (even decades), long-term research and development projects, and locations of intellectual property centers.

"Pursue science because it is knowledge, because it broadens our horizons. There is so much more to be discovered."

Gerhard Herzberg
Winner of the Nobel Prize in Chemistry, 1971

Setting the scene – The underlying drivers and the base case

"Humanity stands … before a great problem of finding new raw materials and new sources of energy that shall never become exhausted. In the meantime, we must not waste what we have, but must leave as much as possible for coming generations."

Svante Arrhenius
Winner of the Nobel Prize in Chemistry, 1903

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Step 1 – Identifying relevant trends and drivers

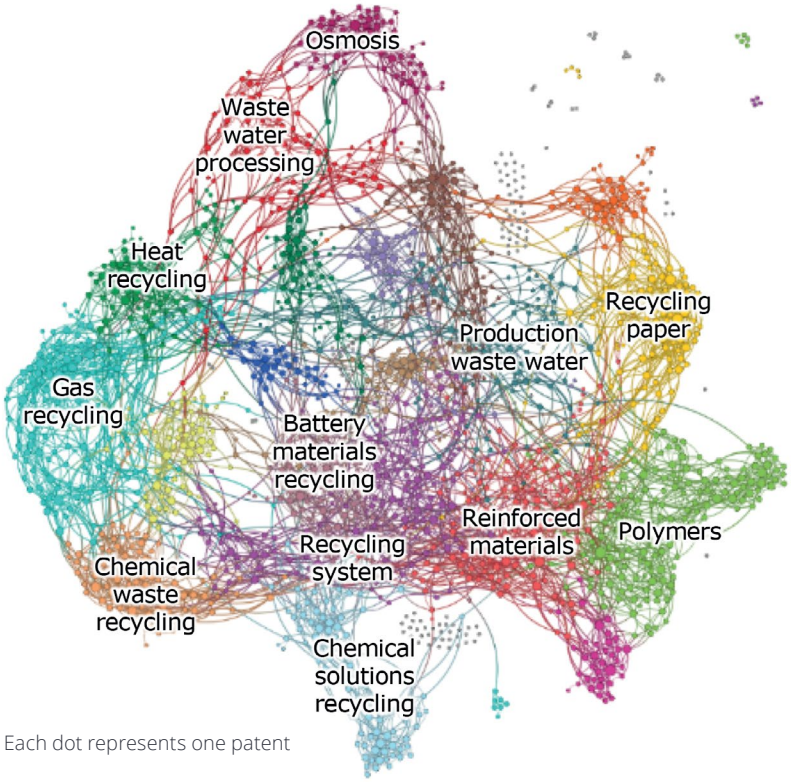
To assess the most impactful trends and forces that affect the chemicals value chain in Europe in the long term, we have combined a variety of research approaches. Drawing on traditional and artificial intelligence-based research, expert interviews, and extensive experience working with major chemicals players, we have identified, analyzed, and clustered the 100 most effective trends and driving forces that will likely continue to affect the chemicals value chain in Europe into the holistic STEEP framework.

- **Social** changes impacting the characteristics of the consumer and consumption patterns
- **Technological** advancements
- **Economic** forces causing industry and market or application shifts
- **Environmenta**l forces
- **Political** dynamics and regulatory changes

Example

A natural language processing assessment showed that "sustainability" generally draws a great deal of investment and focus on innovation in the chemicals industry. However, countries like China, Japan, South Korea, and the United States are between the top original filing locations for patents in this area. This shows that the topic of sustainability in chemicals is very much discussed in Europe as well as in companies, institutes, and universities around the globe, which are taking action in this area, especially in Asia. Additionally, the assessment showed that news and articles on the topics of "chemicals" and "sustainability" are strongly related to the various application industries of the chemical products, e.g., sustainable construction, sustainable retail, sustainable supply chain, and chemical waste reduction, pointing out the important role and high integration of the chemical value chain with the end user and application industries.

Fig. 4 – Deep View patent analysis on Sustainability



Each dot represents one patent

Fig. 5 – Deep View news on Chemicals Sustainability

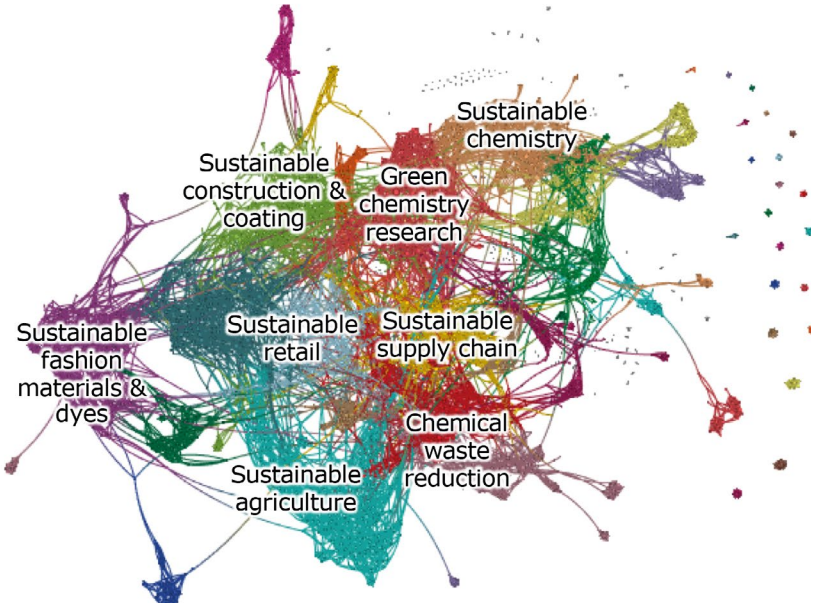
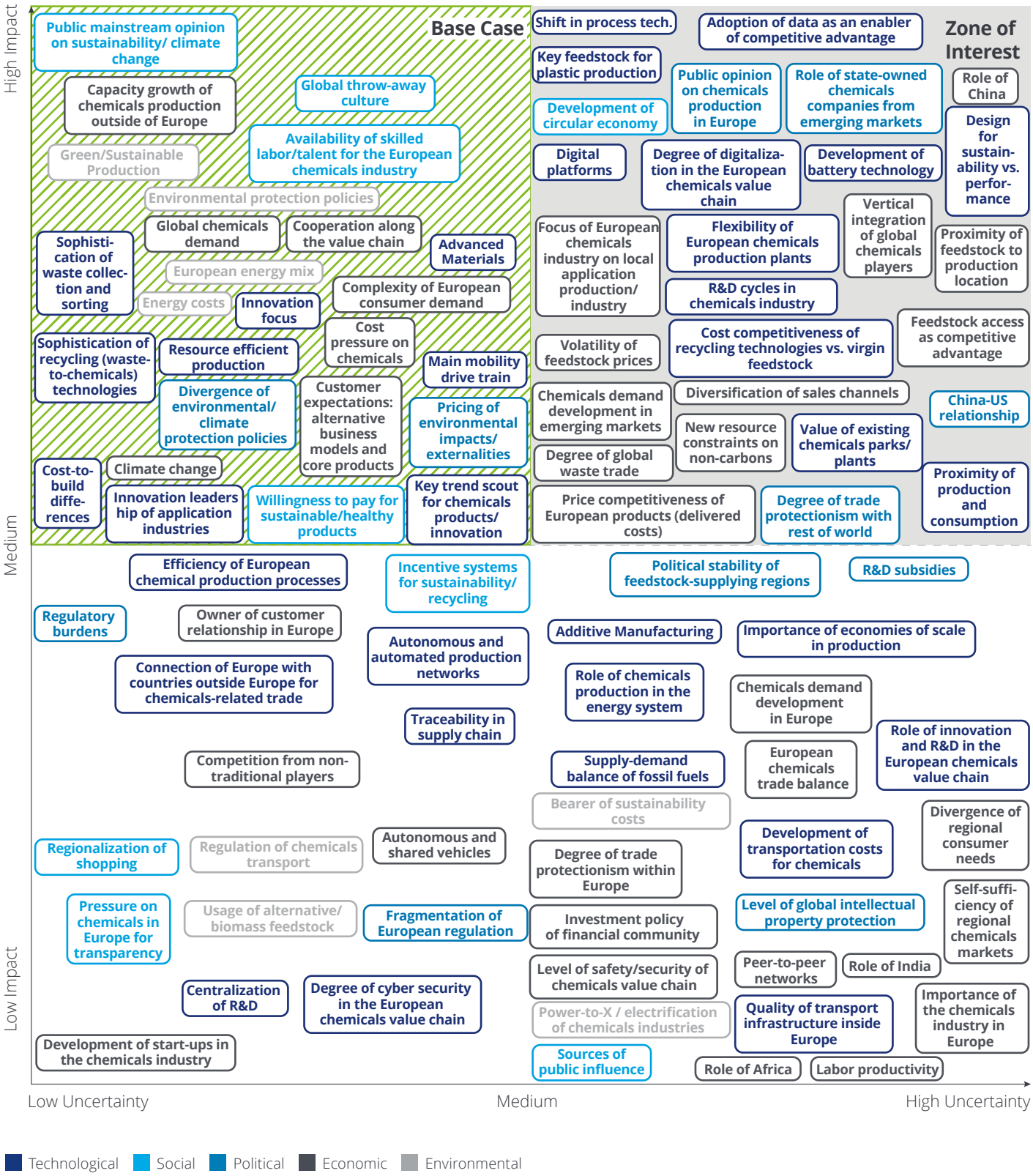


Fig. 6 – Critical uncertainties



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Step 2 – Rating the drivers

After thorough analysis and assessments, the ~100 resulting drivers were rated in terms of their relative uncertainty and impact on the chemicals value chain using the input of Deloitte and external experts. For the drivers in the upper-left quadrant, there is a high level of consensus on how some highly impactful trends will evolve until 2040. As they exhibit low-level uncertainty, these elements form the base case for 2040, a picture of what the chemicals value chain in Europe will most probably look like in 2040.

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Step 3 – Formulating the base case in the STEEP dimensions

Social – Demand for sustainability and circularity will increase

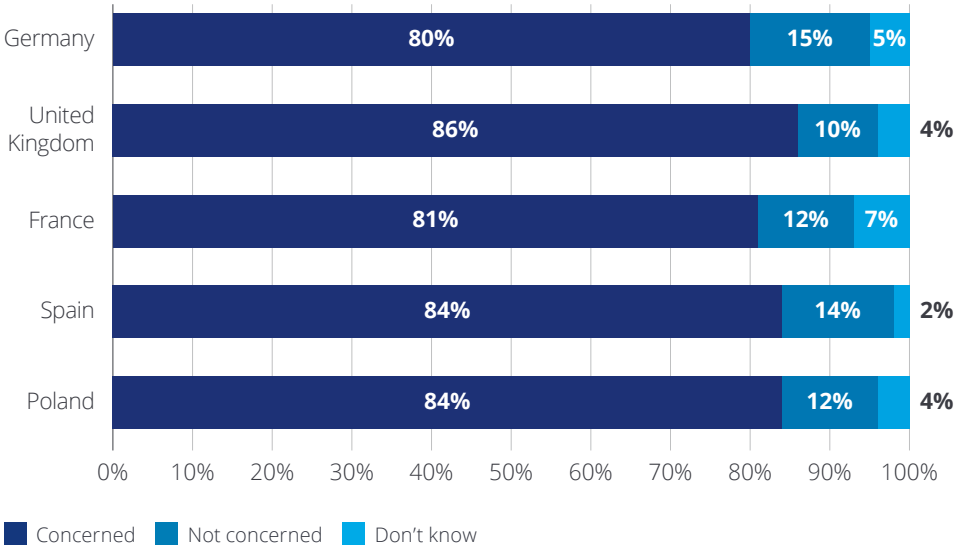
In 2040, public opinion has a stronger sense of the importance of sustainability and climate change than today. The use of single-use products is a key subject of public criticism, not only in Europe but worldwide. This has led to further changes in regulations, and a tendency toward the reuse of products is prevalent. Experts believe that, besides reusing products, consumers in 2040 will also be willing to pay more for sustainable products. The role of Europe as the frontrunner will most probably continue, giving Europe a first-mover advantage toward a "greener" and sustainable future.

These developments and, moreover, the general demographic and labor market-specific trends, will limit the availability of skilled talent and their willingness to work in the chemicals industry – a situation likely to be even more critical than it is today.

Example global throwaway culture: The EU parliament voted to ban single-use plastics in Europe by 2021. Additionally, plastic bottles will have to have at least 25 percent recycled materials by 2025. These changes are also a consequence of the great public concern around the use of disposable, non-recyclable products. A 2019 study from Poland, Germany, Spain, the United Kingdom, and France showed that already >80 percent of the respondents are concerned with this issue, increasing the pressure for new regulations, policies, and actions from governments.

Furthermore, other industries, such as consumer goods and automotive, are adding pressure on the chemicals industry. These industries are responding to the increasing societal pressure on sustainability. For example, IKEA aims to have 100 percent renewable or recycled materials by 2030, Volvo aims for 25 percent of recycled materials by 2025, and Lenovo aims to increase post-consumer recycled plastic resins by 20 percent p.a. (Source: Ikea, Group Volvo, Lenovo, 2020)

Fig. 7 – Level of concern with the use of disposable, non-recyclable products in selected European countries



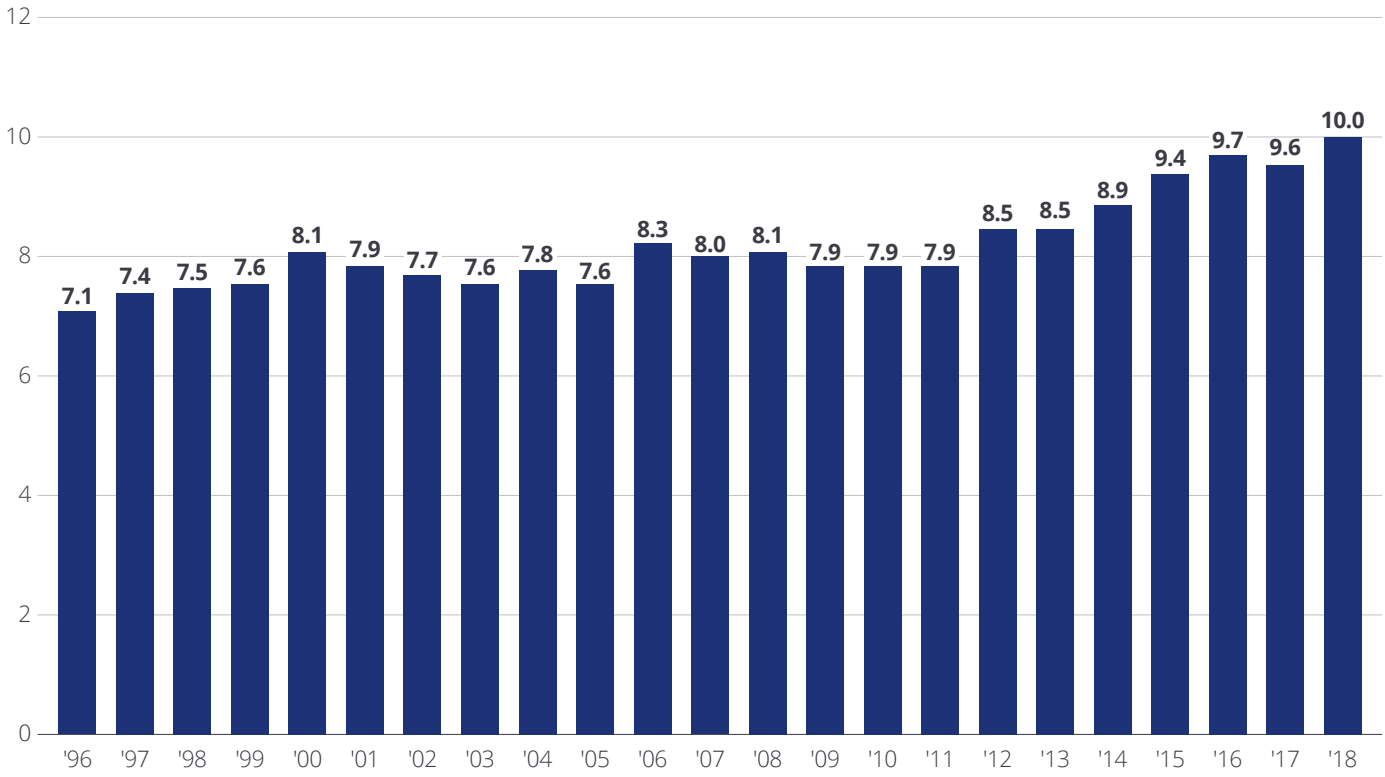
Source: Ipsos, Global Views on the Environment, 2018

Technological – Europe will continue to drive innovation in products and processes, but other regions are catching up quickly

An indisputable dimension for the chemicals value chain is innovation and technology, which consists of three main topics: product innovation (including application technologies), process innovation, and circular technology. The chemicals value chain in Europe is likely to be a frontrunner in all three dimensions, particularly in the specialty and consumer chemicals segment.

Processes to collect, sort, and process waste will be highly sophisticated and automated to enable the circular economy. Recycling technologies will enable the production of chemicals, in particular from mixed recycling material or waste, and open up a new source of feedstock. Experts believe that technologies in Europe will be more sophisticated and efficient than in other regions.

Fig. 8 – Expenditure on research and development in the chemicals industry in the EU from 1996 to 2018 (billion Euro)



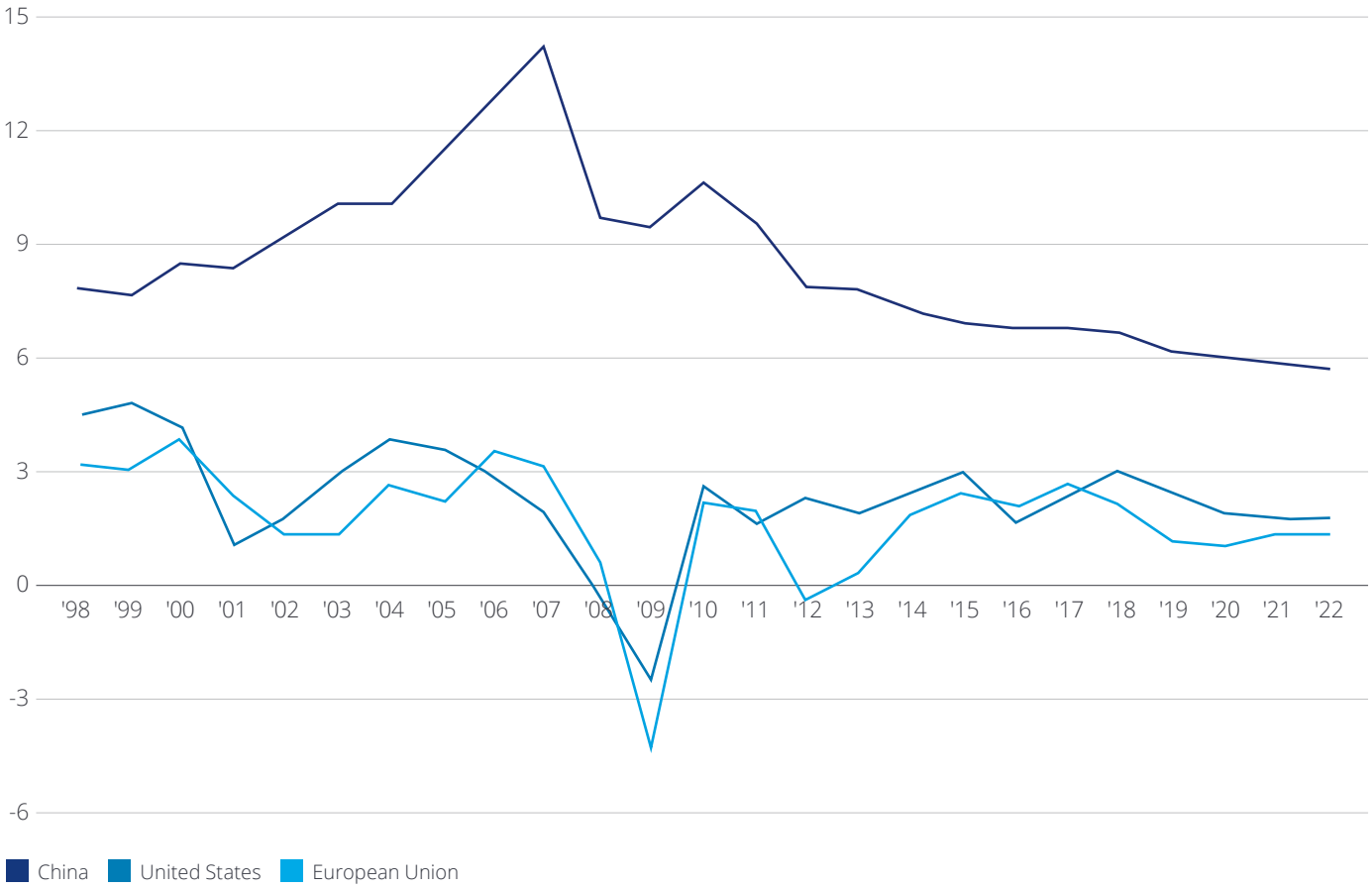
Source: CEFIC Facts & Figures, 2020

Economic – European growth will remain limited and global economy challenging

Overall, an increase in global chemicals demand is expected, and Europe will not be an exception; however, demand will be at a lower level in line with the lower Gross Domestic Product (GDP) growth. Next to volume growth, in Europe we will see a stronger personalization of consumer demand and thus consumer chemicals. Customers of the chemicals industry will ask for other and more advanced service-oriented business models, forcing the industry to reinvent itself and also cooperate to fight new unconventional competitors.

Although there is growth in demand, the competition for the European chemicals industry is not slacking. This is especially important as capacity growth of chemicals production shifts toward other markets. Feedstock prices, costs of new regulations, and energy together play an important role, and cost pressure will rise. The level of cooperation along the European value chain for those reasons will be more important than ever.

Fig. 9 – Growth of gross domestic product (GDP; pre 2020 crisis)



Source: CEFIC Facts & Figures, 2020

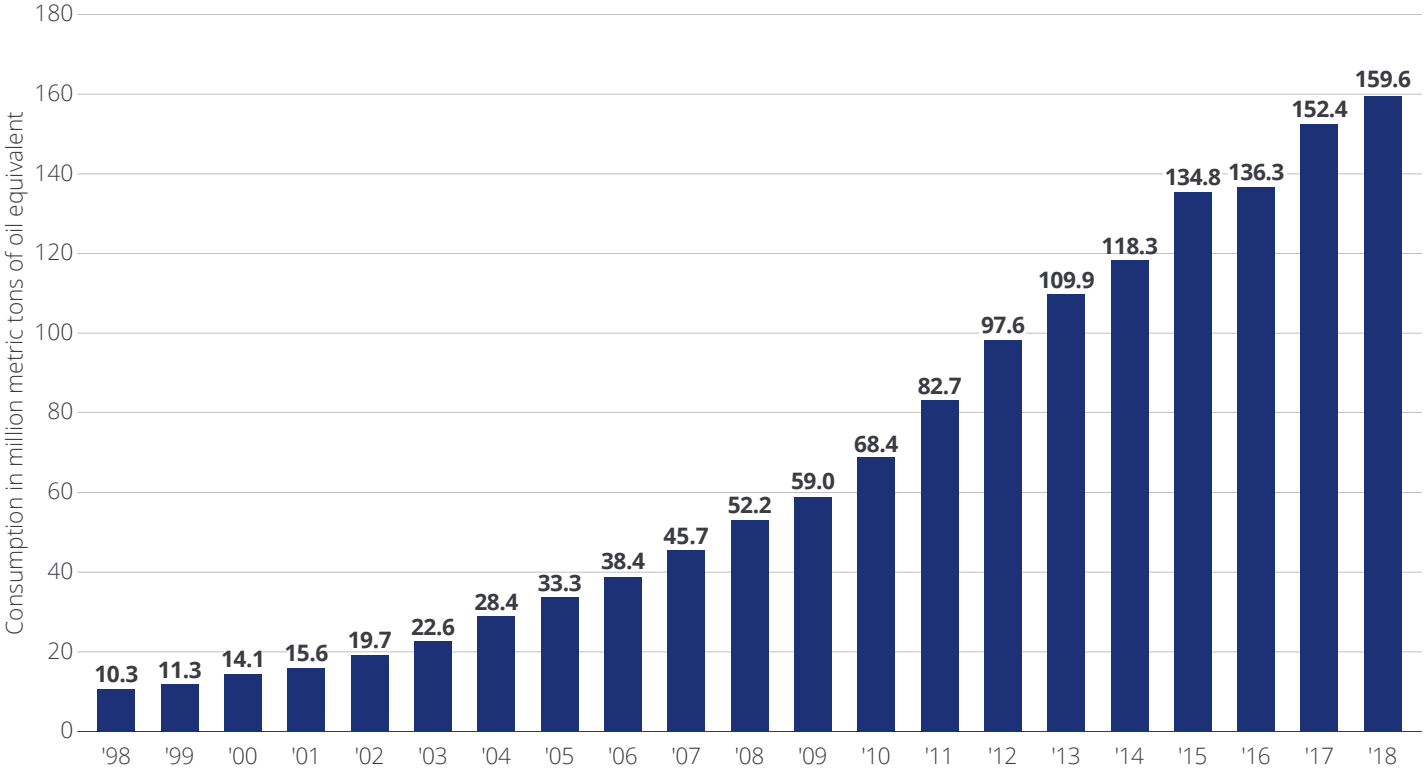
Environmental – Regulations in Europe will become tighter

Incited by global climate change, in this base case, governments around the world have focused on environmental protection policies, and sustainability has moved from the zeitgeist to a proven development. As the average global temperature rises significantly and humanity struggles to achieve the targeted climate threshold of 1.5° C, environmental protection policies in Europe will become more restrictive with requirements of a higher level of sustainability and green production than today.

Simultaneously, energy costs and the European energy mix play a crucial role as they currently contribute greatly to the overall costs faced by chemicals producers.

Example European energy mix: Europe has been increasing diversification of energy sources, especially concerning the inclusion of more renewables. From 2017 to 2018, the power generated from renewables (wind, solar, biomass, and hydro) increased from 152.4 million metric tons (oil equivalent) to 159.6 million metric tons. Moreover, since 2008, it has increased with a CAGR of 11.8 percent.

Fig. 10 – European Union – Renewable energy consumption 1998–2018



Source: BP Statistical Review of World Energy 2019

Political – The political framework and investment climate in Europe are unlikely to change, and inter-European harmonization remains an issue.
Europe has developed some of the world's highest environmental standards, though even emerging markets are now changing from polluters to protectors. In 2040, protection policies and regulations in Europe will be stricter than anywhere else, and the divergence of policies can benefit an industry in one country over another due to cost competitiveness, especially as social and environmental costs will be included in pricing for all products rather than only selected ones. This effect will influence the competitiveness between regions in 2040.

Example divergence of environmental/climate protection policies: In 2019, around 14.9 percent of all greenhouse gas emissions were covered by carbon pricing initiatives. The largest amount from a single region came from the EU, and there are new regulations being implemented (e.g., Germany has announced that, from 2021, a price will be put on greenhouse gas emissions in the transport and building sectors). Furthermore, the survey has shown that pricing of environmental impacts and externalities for products, materials, and social and environmental costs for selected products will continue to grow.

Fig. 11 – Global Competitiveness Index 4.0 by region

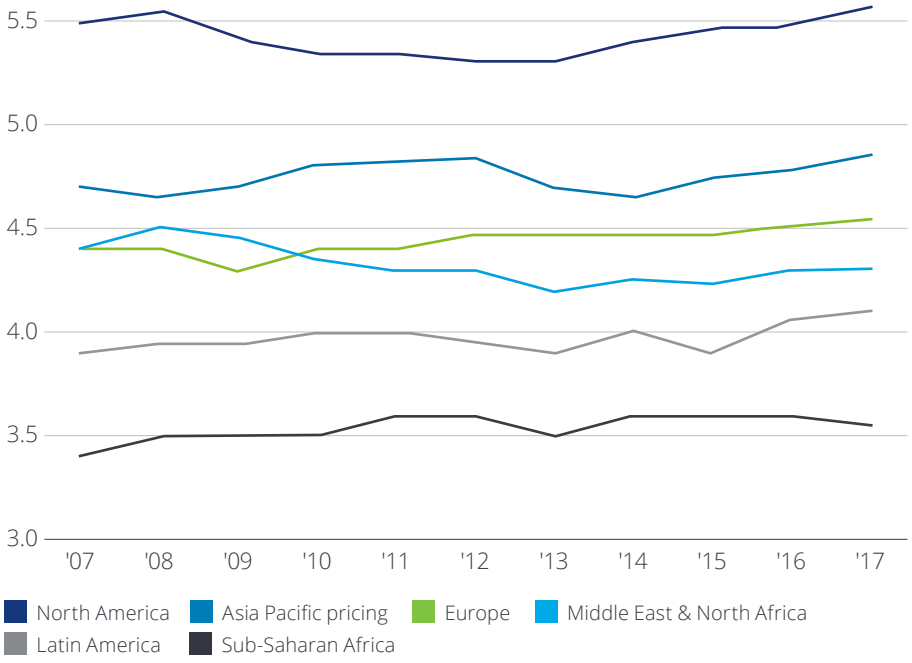
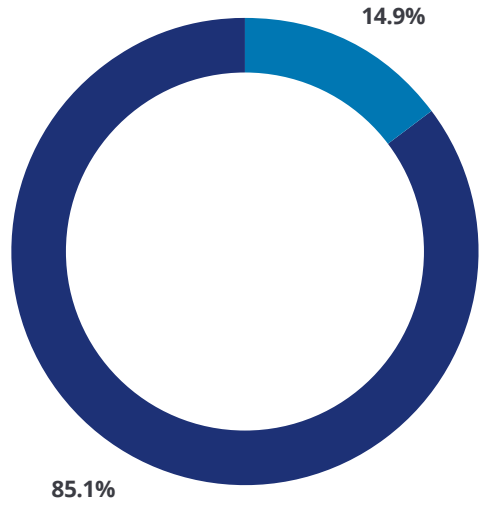


Fig. 12 – Greenhouse gas emissions covered by carbon pricing



Source: The World Bank, 2019

Critical uncertainties and how they shape the scenarios

"The future is uncertain … but this uncertainty is at the very heart of human creativity."

Ilya Prigogine
Winner of the Nobel Prize in Chemistry, 1977

Within scenario development, uncertainty refers to the divergence of opinions regarding the outcome of a driving factor. Therefore, all high impact and uncertain drivers form the "zone of interest" in the driver matrix and are clustered into critical uncertainties. Each critical uncertainty has two extreme endpoints, shaping the future world.

We chose a combination of critical uncertainties that would generate the most challenging, divergent, and relevant scenarios and placed them in a matrix as a basis for scenario analysis using two axes:

- Value creation model of circular economy
- Competitiveness of European chemical assets

Why have we used these two axes? Currently, we see that the value creation model of the chemicals value chain in the circular economy can tip in one of two directions, forming the vertical axis. At one end, chemical companies will be able to have an "open value creation" through further innovation and possibility to increase the product margin through circular economy product flows and sustainable product features in an economically open and competitive environment. On the other end, the value creation might be limited and driven by regulatory restrictions and instructions. This outcome might become reality, e.g., if society's demands for regulation become reality before innovations provide solutions and create a return on investment for the chemical players.

The second axis (horizontal) is related to the competitiveness of European chemical assets. At one end, the current assets (production, R&D, innovation, or labor force) remain the ones available and competitive within the chemicals value chain, for example, with the established players dominating the market with established and existing technologies. On the other end, we would see the structure of the chemicals value chain significantly changing. This is related to the market entrance of new players (such as tech players and start-ups) as well as to the competitiveness of chemical assets that will require a transformational approach. At this end, chemical players will need to direct their investments toward a different and more flexible asset base to maintain or increase the competitiveness of European chemical products (at delivered costs).

Thus, the axes raise two questions: "What will the value creation model of the circular economy be?" and "How will the competitiveness of European chemical assets evolve until 2040?" and define the four scenarios as illustrated in Figure 14.

Fig. 13 – Critical uncertainties with high impact and high uncertainty

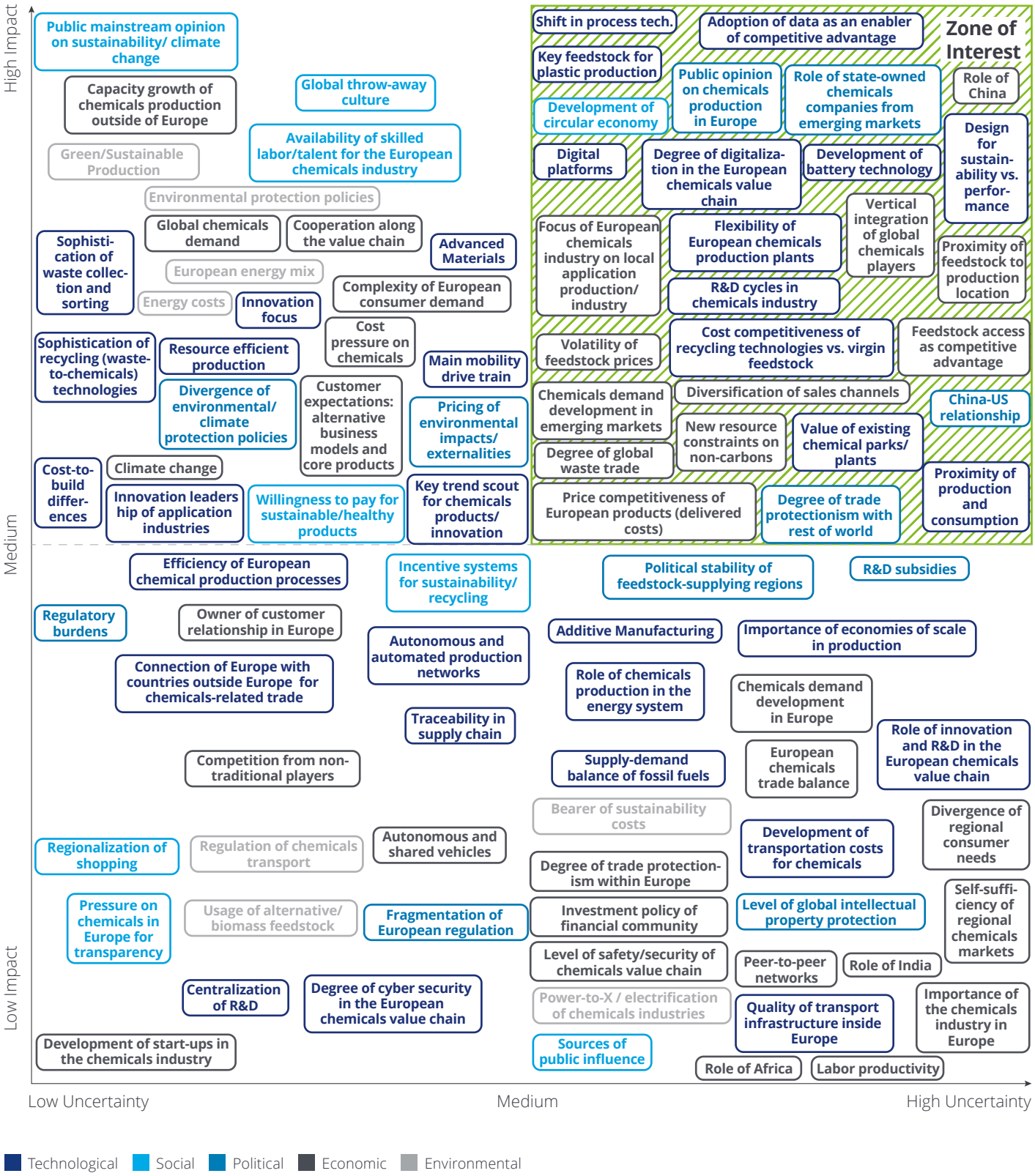


Fig. 14 – Scenario framework

Journey into our four scenarios

Scenario 1: Leading into our sustainable future

A world in which social and technological events drive circularity to become profitable. Thus, creating a thriving, local, collaborative, green-energy-driven market where the chemical industry wants to play and deliver its impact.

In this scenario, the value creation model of the circular economy is based on open value creation, while the competitiveness of chemical assets will require a transformational approach.

The sustainable future is characterized by open markets and strong pressure from society to follow suit on climate change and offer sustainable products. Customers change their expectations and demand personalized products, based on sustainable, recycled materials and produced with green energy. To respond to these needs, the chemicals industry needs to invest in alternative asset structures and production processes and develop new (circular) business models. Simultaneously, consumers have a higher willingness to pay more for sustainable and healthy products, allowing the chemicals industry to pass the additional cost to the end user/application industries. In doing so, prices of carbon-based resources increase tremendously and the circular economy becomes profitable for the chemicals industry, enabling a cycle of open value creation.

The global chemicals demand and capacity increases in volume (especially outside Europe), but driven by the high degree of personalization and demand for local products, economies of scale become less important. The focus of the European chemicals value chain on specialty chemicals increases, and some incumbent chemical players might close down or significantly scale back existing large-scale assets due to the diverse market structure, ending or reducing the scale-driven "Verbund" domination in Europe. On the other hand, it is arguable that the "Verbund" is at the heart of circularity, and that in this scenario the entire industry in Europe becomes a "Verbund," managed not by a single company but by many players.

Changing customer expectations require alternative business models — more recycled materials and an increasing focus on sustainability. In order to fulfill these increasingly diverse customer needs and requirements, the European chemicals industry ought to beat the global competition through high investment in innovation, adjustment of production assets (which would require a new round of investments in production assets) toward flexibility of raw materials (including recycled feedstock), and more efficient assets (digitalized and autonomous systems enabled by artificial intelligence).

Through technological breakthroughs, the technical viability and profitability of circularity support a value-creating circular economy for European chemical players. Furthermore, it will also drive the transformation of the European energy mix toward greener energy sources and more efficient production. Investments of European chemical players into innovation and R&D pay off significant dividends, and R&D cycles will shorten. To achieve this, the European chemicals industry not only invests in innovation, but also increases partnerships between chemical players along the value chain ecosystem and with external players (e.g., large tech companies, start-ups). Consequently, chemicals start-ups begin to thrive, new players enter the market and European chemical players succeed in leveraging data and know-how, fulfilling the transformation of chemical assets in Europe and ensuring competitiveness in the global context.

Due to the open market context and the attractiveness of the high quality of European life, Europe is able to further develop and attract academically and geographically diverse top talent. With the willingness to follow sustainable consumer demands, the European chemicals industry will be well perceived socially and politically, which, in turn, attracts further talent and (financial) resources that need to come into play for the industry to lead the way into a sustainable future.

The "Leading into our sustainable future" scenario in a nutshell

- **Social:** Strong pressure from society to follow suit on climate change and sustainable products.
- **Technological:** High (attractive) investments in innovation and (more) flexible production assets.
- **Economic:** Strong value creation and growth by existing and new players adapting to the "new normal" even beyond European home markets.
- **Environmental:** Regulations are becoming stricter; Europe still leads, but other regions follow closely.
- **Political:** Despite ongoing differences in local regulations and policies, overall trend to sustainability and "level playing field" for the industry.

Scenario 2: Cracking under pressure

In this world, green governments and social pressure force the chemicals industry to comply with higher environmental standards, and also create a more regulated market.

In this scenario, the value creation model of the circular economy is based on regulated value creation, while the competitiveness of chemical assets will also require a transformational approach.

Stronger governmental regulation of the chemical industry (and its downstream application industries) induces its transformation to comply with new standards. Lobbying attempts from the European chemicals industry are reactive and do not show significant impact. Green governments come into power in multiple European countries, more quickly enforcing new regulations that are more disruptive and stricter. Simultaneously, China and the United States begin to follow different business and regulatory models, which are less strict than in Europe and provide a competitive edge in the global market. Motivated by the public and through green governments, strong regulations, and an EU that is stronger than ever, the entire chemicals industry landscape in Europe is forced to change. The efforts in a circular economy are driven by these new regulations, and as the financial viability of the investments is not met, the cost pressure on the chemicals industry in Europe continues to increase.

Nevertheless, regulations require a significant change in the asset base, with more regional, flexible, and fragmented assets. However, the resulting investments do not show a high rate of return. To minimize the impact, autonomous, intelligent systems come into play in order to make the European chemical industry more efficient and greener. This enables the industry to comply with the strict regulations and to partially cope with the financial burden.

While Europe is driving European self-sufficiency across the value chain, the focus on the global playing field is lost. Innovation is focusing on complying with regulation and less on achieving a competitive advantage. The global market share of the European chemicals industry declines due to its domestic (European) focus and lack of global cost competitiveness. In particular, as profit margins in Europe are pressured by regulations, there is a lower overall value pool.

Ultimately, the European business environment is unsuitable for attractive investments (e.g. production plants), especially for non-European multinationals. Further, the highly regulated European market environment leads to a reduction in market creativity, in overall investments and innovation. This strengthens the need for partnerships between chemical players, with external players bridging the talent gap.

As a result, the European chemicals value chain consolidates and the "EU competition agency" tries to avoid consolidation, but needs to accept that this is the only way toward sustainable chemical production.

The "Cracking under pressure" scenario in a nutshell

- **Social:** Society drives stronger governmental regulation of the chemicals industry.
- **Technological:** Transformation of the asset base with autonomous, intelligent systems are coming into play to make the industry more efficient and greener.
- **Economic:** Global market share of the European chemical industry declines due to its European focus and lack of cost competitiveness.
- **Environmental:** The transformation in the European chemicals industry induces new environmental standards.
- **Political:** Green governments come into power, enforcing new regulations that are faster, more disruptive, and stricter.

Scenario 3: Managing decline

This is a world in which heavy lobbying leads to a shielded market for European chemicals players, thus, protecting them from outside competition and regulations but also making them progressively less competitive.

In this scenario, the value creation model of the circular economy is based on regulated value creation, while the competitiveness of European chemical assets remains based on the status quo.

Besides the current societal pressure to drive stronger regulations toward a circular economy and continuing to be the center of attention, the chemical players have focused on an active lobbying approach. European players are able to predict and actively shape environmental regulations. At the same time, public opinion is changing, and generations Y and Z lose their drive for sustainability. Import barriers are put into place by lawmakers to protect the European chemicals industry. The less severe environmental regulations favor the domestic (European) players, providing more predictable margins but in turn making margins highly dependent on regulators. Regulator dependent margins lead to a lower value pool and an overall lower incentive to innovate within the European chemicals industry. Due to European economic downcycles, the majority of large innovations and trends stem from outside of Europe. Price competitiveness of European products, in comparison to the rest of the world, declines. It becomes more difficult for Europe to keep its role as a net exporter due to a lack of international competitiveness, and the market begins to consolidate, as it is not able to compete on costs, innovation- and compliance standards internationally.

For the remaining companies in the post-consolidation European chemicals industry, the market is relatively "cozy" with predictable demand and low overall competition due to the protective regulations. But the European market as a whole suffers from lower efficiency and ultimately higher prices for consumers. Hence, European chemical players have a pure European business focus and are highly dependent on their own management of the local market.

The "Managing decline" scenario in a nutshell

- **Social:** Younger generations are losing their appetite for sustainability.
- **Technological:** Innovation focusing on supporting the existing asset base, lack of incentives, breakthrough innovations stem from outside of Europe.
- **Economic:** Losing its role as net exporter leads to a European industry consolidation with high predictability of demand and low competition.
- **Environmental:** The focus on environmental protections and standards are lost, and global environmental agreements are abandoned.
- **Political:** To protect the European chemicals industry, import barriers are put into place.

Scenario 4: Managing circularity

In this world, circularity becomes profitable, supported by limited changes from the chemicals industry and public opinion; this leads to targeted innovations and collaboration across the industry to produce the best new products.

In this scenario, the value creation model of the circular economy is based on open value creation, while the competitiveness of the European chemical assets remains based on the status quo.

There are deep discussions on environmental frameworks as awareness of climate change and sustainability issues increases within and outside of Europe. Europe, however, is steamrolling to stricter environmental regulations, driving the expansion of green, clean energy across Europe, and thus production in Europe has geographical advantages. Therefore, the European chemicals industry is able to achieve the environmental targets, as well as to set even higher standards of their own, beating expectations. In this sense, the lobbying of the chemicals industry for a circular economy leveraging existing structures and value chains pays off.

The public perceives the general sustainability targets to be reasonable, increasing trust in the industry and the regulations. Consumers are, firstly, willing to pay a higher price for sustainable products, and secondly, the chemicals industry is taking advantage of society's trust and environmental consciousness with self-promotion and is reaping the benefits of becoming an attractive employer.

The availability of inexpensive, green energy fuels established processes and existing assets and technologies. The chemicals industry and its application industries do become more sustainable and circular, with technologies and processes favoring existing asset bases and value chains, such as chemical recycling rather than advanced sorting and separation to foster mechanical recycling.

The need to adjust current assets is consequently limited, but not everything is prosperous to the same extent. For example, innovation is rather narrow and focused and technological breakthroughs are more likely to be seen downstream, closer to the application industries.

Due to the developments in circularity, based on inexpensive green energy and recycled inputs, the European chemicals industry no longer has feedstock disadvantage compared to other regions. Moreover, the chemicals industry can continue to focus on further optimizing the existing asset base while managing investments with the profitable circular economy.

The "Managing circularity" scenario in a nutshell

- **Social:** The public perceives sustainability targets to be reasonable, increasing trust in the European chemicals industry.
- **Technological:** Advancement of green energy and recycling accelerates development along established processes, assets, and technologies.
- **Economic:** To successfully manage circularity, investments take place, further optimizing the existing asset base, eventually resulting in higher margins.
- **Environmental:** Industry regulators actively shape environmental regulations, e.g., enabling expansion of green, clean energy.
- **Political:** Local, national and European authorities are lobbying for greater environmental regulations to beat the environmental targets.

Taking the long view by industry subsegment

"One never notices what has been done; one can only see what remains to be done."

Marie Curie
Winner of the Nobel Prize in Chemistry, 1911

Irrespective of which scenario will become the reality of tomorrow, it is clear that the future will require different strategies, business models, and the fulfillment of different success factors by the chemical industry in Europe. It is equally clear that there is no single, homogeneous chemicals industry. Despite some communalities, every sub-sector, such as building blocks, plastics, and specialty/consumer chemicals, will face different implications from the different scenarios.

In the first breakdown, Monitor Deloitte outlined major implications for three main clusters of the chemicals industry. Each is characterized by a distinctive set of success factors, market/competitive frameworks and, hence, they are impacted differently to the four scenarios.

Building blocks

Among others, the building blocks sector contains petrochemicals and basic inorganics. Today, these account for 13.7 percent, ~77bn EUR, of the European chemicals industry. The sector is mostly represented by large, globally operating chemical companies, which in turn have dedicated assets and are very scale driven with specification-based, exchangeable products. Many of these products are globally traded and therefore see strong competitive pressure from world-scale facilities in other regions. Feedstock and energy costs are a driver of this segment and thereby see pressure on sustainable feedstock and sustainable energy.

Given the high importance of feedstock and the dependency on the installed, immobile production assets, this asset-heavy industry will be most impacted by scenarios that demand a change in these structures.

The crucial question for this industry sub-sector is whether we are moving right or left. Scenarios on the left hand that rely on existing asset structures and provide protection from international competition, such as "Managing circularity," allow the building blocks industry to maintain and profitably operate their asset structure. However, this still requires a number of changes, such as adapting to different feedstock and energy sources, cooperation with other players along the value chain, and some rationalization/consolidation. Overall, they are still manageable as subsequent value chains remain intact. Scenarios like "Leading into our sustainable future," however, would represent a serious threat for the industry as the demand for new, small, and flexible assets will increase in the building blocks segment and existing structures are no longer likely to be competitive.

In any scenario, the organic building blocks will have to additionally substitute fossil hydrocarbon feedstock by waste or bio-based raw materials or CO_2 using (green) H_2 based power-to-products routes, while inorganic building blocks will have to explore the ability to use electrolysis, or ammonia production as chemical storage to buffer the volatile renewable energy generation.

Synthetic materials

Currently, the synthetic materials sector is a main focus of the public debate on sustainability, circular economy, and waste. It includes polymers, plastics, and synthetic rubbers, accounting for 21.3 percent of the total European chemicals industry (~120bn EUR). Volume-wise, characterized

by polyolefins and single-use/packaging plastics, the sector is overall distinguished by a broad variety of materials, ranging from commodities with standard qualities (e.g. HDPE) to very special high-end materials (e.g. PSU). There is a broad variety of applications and there is a strong impact of application developments. Although there is a significant shift happening, there is a comparably small number of players. Next to developing materials with superior properties for resource-efficient applications, the importance to avoid waste, reuse, and recycle requires (re)design for circular material flows (reuse, mechanical, or chemical recycling).

The main question for this industry sub-sector is "up or down?" Scenarios that allow and support an open value creation in connection with the circular economy, like "Leading into our sustainable future," provide the most opportunities but require large changes. Circularity will require the players to develop new business models and technologies, form new alliances, and reposition the industry in the eyes of the consumer. This offers the opportunity to change the "rules of the game" and become sustainably competitive even against players that currently enjoy superior scale and feedstock positions – and the industry segment players are best positioned to benefit from that development. The "Cracking under pressure" and "Managing decline" scenarios provide a more secure, predictable future in the short- to mid-term; however, the competitiveness will likely erode, and the synthetic materials value chains in Europe will see a creeping decline in the long run.

Specialty/consumer chemicals

Specialty and consumer chemicals compose a diverse and heterogeneous sub-sector, e.g., with personal care, plastic and coating additives, construction chemicals, adhesives, and many more. Combined, they account for 39.6 percent of the total European chemicals industry, an enormous 223bn EUR market. Due to its proximity to end customers, it receives public attention regarding the health and environmental aspects of ingredients in end products, and comparatively little regarding the production itself, and thus requires technical understanding and application know-how. The common ground within the sector is mostly that performance/properties in the end product are the dominating factor. Players range from large global companies to specialized local competitors, and production is often smaller scale using multipurpose assets with less focus on utilization and economies of scale.

Given the complexity of the sub-sector, the impact and consequences of the different scenarios are diverse as well. Given less dependence on feedstock and an asset base that is in general more flexible and fragmented, specialty/consumer chemical players will see the largest impact on the customer side. Requests, both from B2B and B2C, require a "new way of thinking" considering the impact and value of these chemicals in their respective applications and in the eyes of the consumer in all scenarios. Products should be safe for people to handle and have limited harm on the environment, thus, re(designing) for performance in applications as well as sustainability. It will be crucial, having in mind that it is all about applications, so keeping pace or, better, being ahead of the application industries' changing needs with innovative products, services, and business models in Europe and globally is the path to success.

"Open" scenarios such as "Leading into our sustainable future" offer the framework to do so and provide more opportunities and growth potential within and outside of Europe. "Closed" scenarios like "Managing decline" and "Cracking under pressure" threaten the developments of these value chains in Europe as the regional markets will become more "ring-fenced" and European production will be more and more restricted to European markets. Consequently, this can mean the end of many export businesses.

To conclude and to further assess the potential impact of each scenario on the different sub-sectors and chemical players, as well as the corresponding risks and opportunities, it is useful to answer the following key questions:

- What is the future of my product/service portfolio in the base case, and what are the future key success factors, and where do I need to adapt?
- What does each scenario mean for the supply side of my business, and what are the potential changes I have to manage?
- What does each scenario mean for the demand side of my business, and what will the future requirements be?
- What are my established and potential competitors doing?
- What are the consequences for my European assets in terms of localization, global competition in Europe, and opportunities outside Europe?
- Which scenarios play to my own strengths, or what are the competencies/capacities that must be added for the future?
- What are the key drivers that push that scenario in my business context, and how do I monitor them?

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Abbreviations

AI	Artificial Intelligence
CAGR	Compound annual growth rate
CEFIC	European Chemical Industry Council
CLV	Center for the Long View
GDP	Gross Domestic Product

Methodology

"I feel a little bit like the Wright-brothers who were flying for the first time and people were asking why do we need a flying machine!"

Bernard Feringa
Winner of the Nobel Prize in Chemistry, 2016

The methodology of this study is based on the proven scenario approach first employed by Shell and perfected by Monitor Deloitte. A seven-step scenario development approach applies the guiding scientific principles of objectivity, reliability, and validity. The study is the outcome of a series of interviews, questionnaires, and workshops involving experts from Deloitte's global chemicals practice and industry professionals as well as experienced scenario practitioners from Monitor Deloitte's Center for the Long View (CLV). Scenario planning starts by identifying the focal question of the underlying issue. Since we could tell an infinite number of different stories about the future of the chemicals value chain, we first had to agree on the issue or strategic challenge we wanted to address. This enabled us to appropriately support decision-making for our clients. Scenarios are tools for shedding light on strategic challenges, while the focal question sets the scope of the scenarios. In the present case, we focused on the question, "What will the future of the chemicals value chain look like?" Scenarios are a way of understanding the dynamics that shape the future. Therefore, in a second step, we pinpointed the forces that drive the focal question.

Driving forces are fundamental sources of future change. They shape the course of events and history, and dramatically enhance our ability to imagine future scenarios. These drivers can be grouped into five categories, known as STEEP forces, as they consist of social, technological, economic, environmental, and political factors. Since most issues involve more than one of these categories, they are only labels. In order to derive our driver list, we also conducted expert workshops using Deep View, an artificial intelligence (AI)-based trend-sensing and analysis machine. Deep View helps to avoid the bias of the traditional approach, which often has a built-in tendency based on the character, mood, or preferences of the scenarists. As part of the workshop series, in a third step, we identified the critical uncertainties for the focal question. Not all driving forces are uncertain; some may be predetermined. These are the trends already in the pipeline, unlikely to vary significantly in any of the scenarios. Critical uncertainties are driving forces with the potential to tip the future in one direction or another. They have two fundamental characteristics – they have an unusually high impact and are uncommonly uncertain or volatile. Initially, all uncertainties appear unique, but by stepping back, we can reduce uncertainties to clusters that serve as the building blocks for creating our scenario sets. The scenario framework was developed in the next step by focusing the entire list of related uncertainties into two orthogonal axes. We then defined a matrix consisting of crossing and independent axes that allowed us to define four very different quadrants of uncertainty. In the underlying study, we used the relevance of creativity and the relevance of mass marketing as critical uncertainties and developed four distinct yet plausible future scenarios. The CLV scenario approach includes two further steps that help enterprises make use of the defined scenarios: developing strategic options and monitoring the scenarios. We use the scenarios to derive consequences for market stakeholders, in this case creative agencies and media companies, for example. Existing strategies are tested against each scenario and adjusted where necessary. Here, we apply proven Monitor Deloitte methodologies to identify, dissect, and analyze businesses' strategies. At the same time, new strategic options are formulated that are suitable for all or for individual scenarios. As it is important to provide long-term scenario monitoring in order to ensure the validity of defined strategic options, we have developed CLV Gnosis. This is an AI-based modular tool that tracks movements toward individual scenarios in real time and indicates the direction the future is heading

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