
EXPECTATIONS OF CUSTOMER INDUSTRIES FOR THE CHEMICAL INDUSTRY

Excerpt from a SANTIAGO study
for the German Chemical Industry Association



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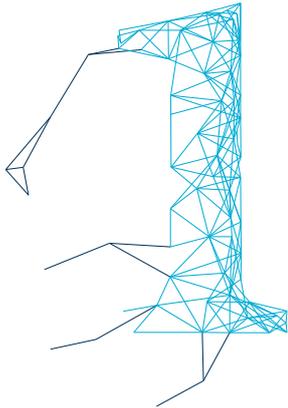
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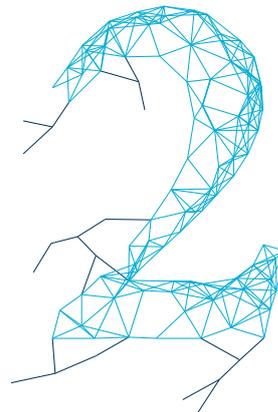
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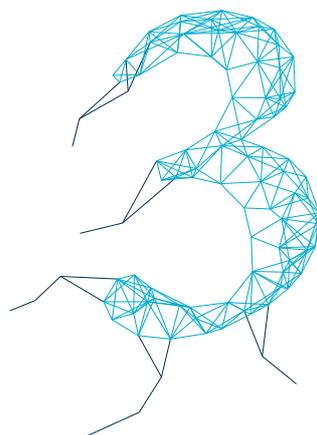
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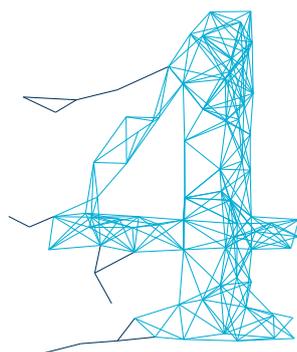
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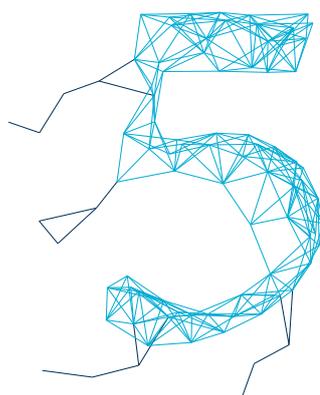
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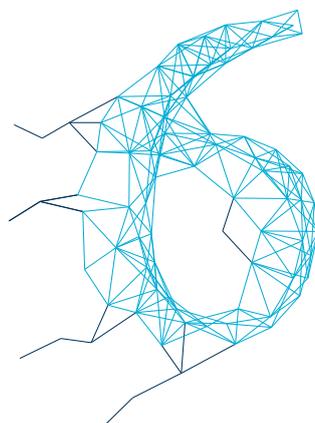
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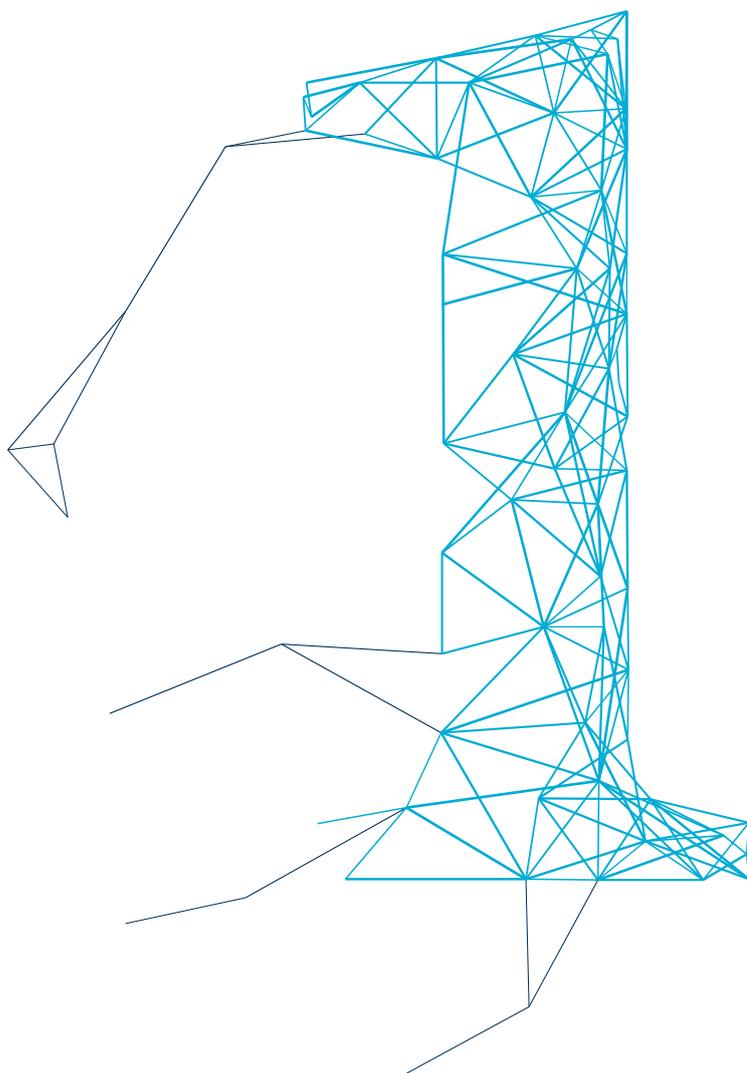


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PREFACE



The chemical industry in Germany is an industry of the future. We make the future possible. With our innovations, we help our customers in a variety of industries to develop better products and services. Progress in medicine and agriculture would also be inconceivable without chemicals. We develop new solutions for tomorrow's challenges – for more resource efficiency, climate protection and sustainability. It is not for nothing that the German chemical industry enjoys an excellent international reputation for its innovative strength and its high standards for quality, safety and sustainability. At the same time, the companies in our industry stand for economic strength and attractive jobs combined with a fair social partnership. We are an industry of the future.

But we also face numerous challenges. Uncertainties and volatilities have increased. The business models in many of our customer industries are in a state of upheaval – not least as a result of ongoing digitalisation. Our customers must adapt to the new needs of their own customers. And they expect support and innovative solutions from us. Added to this are the distortions in global trade relations, which burden the complex supply and production networks of our customers.

In order to remain successful in times of change, the chemical industry must react to these changes appropriately. That is not easy. Especially in our industry, which is characterised by longterm investment and innovation cycles, high capital expenditure and complex regulatory and approval requirements.

In addition: The effects of trends and upheavals in an added value chain are complex. Specific analysis is needed to determine what effects they have on the respective preproduction stages.

The German Chemical Industry Association has therefore commissioned a study to identify the most important changes in our key customer industries of transport, housing, electronics, consumer goods, food and energy. The objective of the study is to identify the requirements that our industry must meet in order to remain successful in the long term, even in a dynamically changing environment, based on these changes.

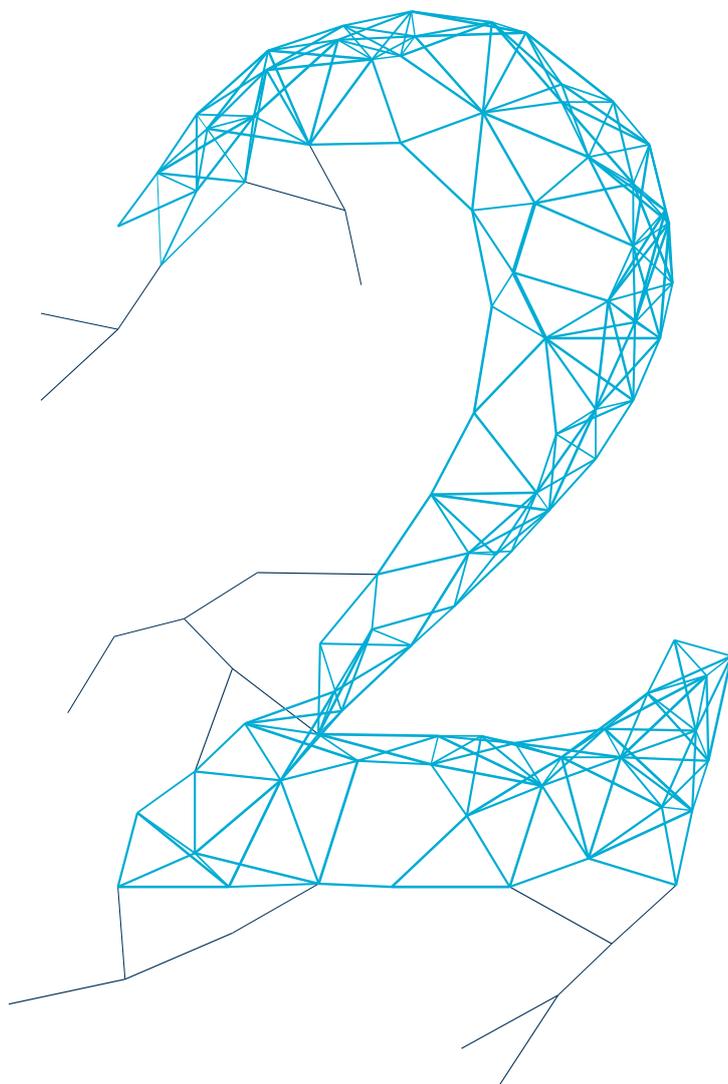
My special thanks go to the experts from the companies who made themselves available for interviews as part of the study, to the members of the Steering Committee of the German Chemical Industry Association (VCI) and to the authors of the study.

The study results do not provide us with reliable future forecasts or specific instructions for action. But I am convinced that the examination of the results can provide important impulses and suggestions. The study is also a request for dialogue – in the companies of our industry, in the association, with our customers and with politicians.

We should jointly seize the opportunities of change courageously so that we can continue to shape the future successfully.

Hans Van Bylen
Chairman of the Board of Henkel AG & Co. KGaA

EXECUTIVE SUMMARY



Innovations – key for success

The German chemical industry is one of the strongest research sectors in Germany. It currently spends around twelve milliard euros a year on research and development (R&D) and generates a fifth of its turnover with products that are under five years old.

The chemical industry is also a driver of innovation: many different industries use innovations from the chemical industry to survive in competition. In the customer sectors of the chemical industry – mainly transport, housing, electronics, consumer goods, food and energy – it is therefore also recognised that the achievements of the German chemical industry are innovative and responsible and have contributed significantly to the current leading competitive position of the individual sectors and companies. The innovative capability of the chemical industry is therefore of key importance for the whole of Germany as a business location.

However, past and current successes do not guarantee future successes. The chemical industry is not only faced with intensifying global competition, which requires new innovations in ever shorter cycles. It is also faced with the challenge that many customer industries, driven by cross sector megatrends, are undergoing radical upheavals, resulting in new requirements for the industry. Successfully meeting these requirements is therefore both an incentive and an obligation for the chemical industry to continue to be perceived by its customers as innovative, digital and responsible.

Ecology and sustainability – dominant megatrend in customer industries

The dominant megatrend that will impact the business of the chemical industry's most important customer industries – and thus also the chemical industry as a supplier – over the next 10–20 years is, according to the interviewed experts, “ecology and sustainability”, followed by compliance with “ethical and social standards” and “digitalisation”.

These megatrends are giving rise to new requirements from end customers (consumers), who are currently exerting considerable pressure to change in the customer industries of the chemical industry. The pressure is all the greater the closer the industry is to the end customer (food, consumer goods, housing). Some of the changes are so fundamental that the business models of entire industries are at stake (e.g. combustion engines in the course of electromobility). The customer industries pass this pressure for change on to their upstream suppliers, such as the chemical companies, so that these will also face considerable adjustment requirements in the coming years.

In order to continue to be perceived as innovative, digital and responsible with its services and products, the chemical industry would have to meet ten key requirements from the point of view of the customer industries.

10 requirements for the chemical industry

1. “Intensify thinking in solutions”

The customer industries want the chemical industry to pay even more attention to their individual problems and to develop and provide solutions for them. One example is the declining acceptance of plastics. This means an existential danger for many customer industries. Appropriate solutions – from recyclable plastics to high-quality recycle and plastics based on natural raw materials – would have to be increasingly provided. But it is also important to break new ground in the field of recycling technologies.
2. “Think more from the point of view of the consumer as the end customer”

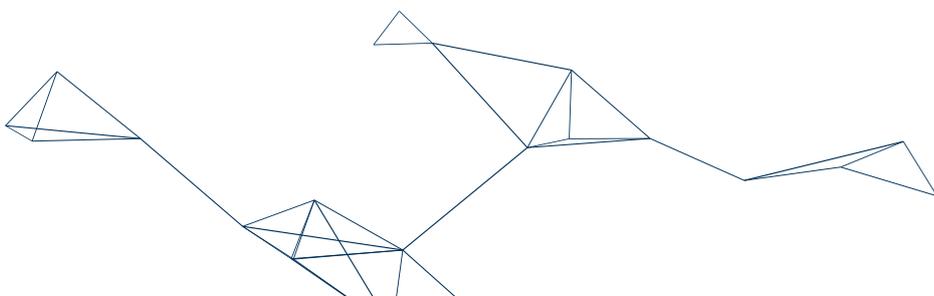
From the point of view of the customer industries, the industry would have been able to recognise earlier that the acceptance of certain products of the chemical industry would have fallen so sharply if it had thought more of the consumer as the end customer. The positioning in the added value chain could be an explanation for the fact that trends relevant to end customers are partly only perceived belatedly by the chemical industry. The customer industries would like to see further development in order to be better prepared for future discussions – from microplastics to solvents to titanium dioxide.
3. “Enable circular economy”

The establishment of a closed circular economy is an important issue for many customer industries. This includes the “technical” dimension – from the collection infrastructure to the reconditioning industry – as well as the “chemical” dimension of the composition of the raw materials. The customer industries would like to see a higher contribution from the chemical industry here. One example is adhesive on demand, which could facilitate the recycling of electronic products and composite materials, e.g. in cars. At the same time, recycling processes must also adapt to modern materials in order to ensure the best possible circular economy.
4. “Establish life cycle perspective”

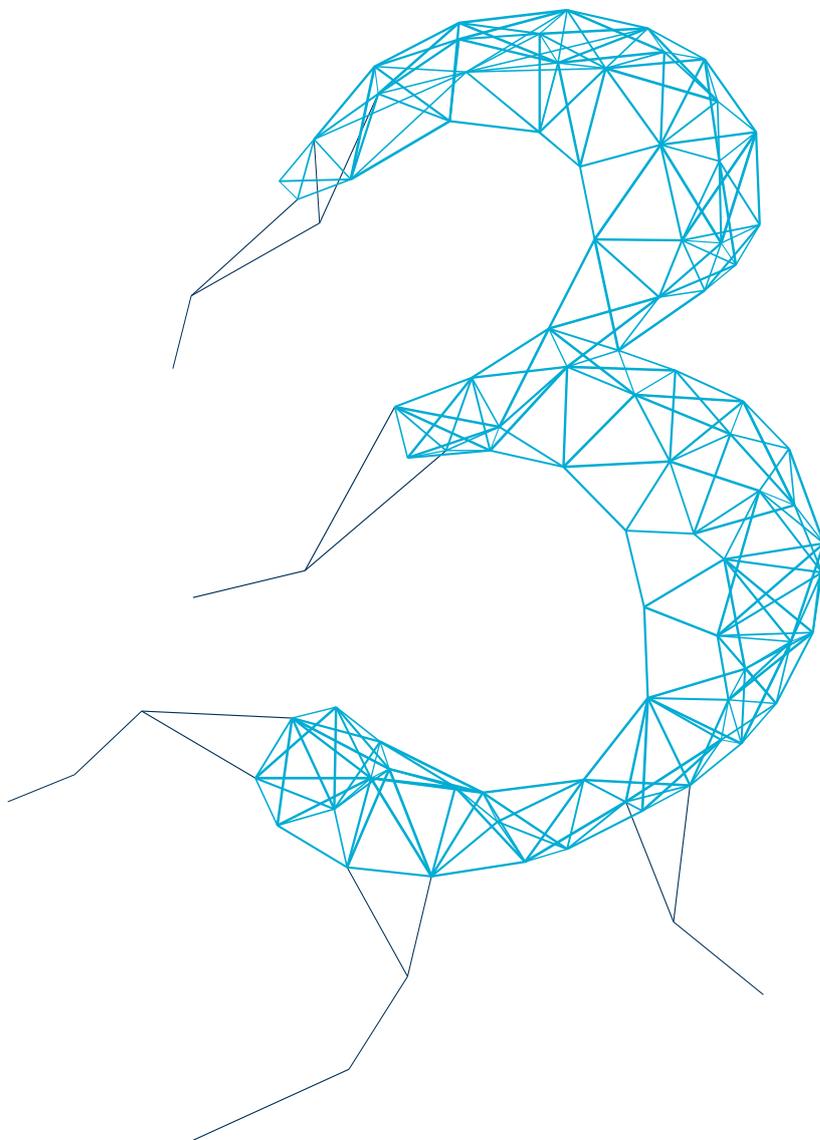
In addition to the establishment of a closed circular economy, many customer industries see significant potentials in ecological optimisation across the added value chains and the life cycle of products. This is already being practised today in some areas of the automotive industry. There are reserves in many other industries. As an important upstream supplier, the chemical industry is requested to interact and cooperate more closely with upstream suppliers and customers and to be more transparent.
5. “Guarantee transparency”

However, transparency is not only a prerequisite for the ecological optimisation of added value chains. Transparency is “the” core requirement of the customer industries in many industries close to end customers. End customers increasingly want to know “what” they are consuming. Companies must meet this demand and request the necessary information from their upstream suppliers. The chemical industry must find a way to meet this requirement without disclosing its know-how in the form of recipes, etc.

6. “Avoid hazardous substances”
- There is a cross-sector requirement to bring economy and nature closer together and to live “toxin-free”. This desire for more naturalness results in the requirement for the chemical industry to avoid or substitute hazardous substances as far as possible. This requirement includes “real hazardous substances” (e.g. certain ingredients) as well as “perceived hazardous substances” (e.g. artificial sweeteners). At the same time, fewer hazardous substances would improve the recyclability of materials within the framework of classical mechanical recycling (see 3).
7. “Comply with ethical and social standards”
- Almost all surveyed companies have sustainability strategies that require compliance with ethical and social standards over the entire supply chain. The chemical industry as an important upstream supplier must guarantee compliance with these standards in its supply chain / production. There is a particular need for action in the extraction / utilisation of critical raw materials.
8. “Produce more flexibly”
- Customer industries increasingly want solutions for their individual problems (see 1). This will result in a more differentiated product landscape – with corresponding impacts on the production architecture. Smaller, more flexible plants will have to supplement large, existing plants. The challenge will be to profitably integrate these smaller plants into the existing process worlds. Medium-sized structures could be superior to large-scale industrial solutions in some cases.
9. “Rethink business models”
- In addition to the need to make production more flexible, there are a number of other aspects from the point of view of the customer industries which suggest that the business model of the chemical industry should be questioned or further developed. For example, at least a partial conversion of the added value chains to natural raw materials is expected. At the same time, the introduction of closed cycles will often only be possible via new business models in the customer industries (e.g. leasing / sharing models), which in turn will reduce the sales volumes of the chemical industry. There is also a need here to look for alternative businesses. Power-to-X could be one of those fields. In this context, the customer industries recommend that the chemical industry cooperates more closely with start-ups.
10. “Improve communication”
- The performance and added value of the products of the chemical industry are undisputed from the point of view of the customer industries. However, they are virtually not perceived by the public (e.g. in the plastics discussion). Here the customer industries see a need for the chemical industry to catch up. They would like to see significantly improved communication within the industry, not only to the public and politicians, but also to customers and suppliers. In essence, the aim is to make the added value of its own products more understandable for the layman.



STUDY DESIGN AND METHODICAL APPROACH



Global megatrends as a starting point

The study examines current megatrends and their impact on six major customer industries of the chemical industry – the transport, housing, electronics, consumer goods, energy and food industries. Based on these changes, the study attempts to identify the future requirements of the customer industries for the chemical industry. The study is based on a method mix of literature analysis and expert interviews both in the customer industries and among member companies of the VCI.

In a first step, potential megatrends and their possible impacts on customer industries were identified on the basis of extensive literature research. These were estimated by the contractors with regard to their relevance for the respective industries and then summarised into subject areas. A distinction was made between cross sector and industry-specific developments.

The objective of the expert survey was to answer three key questions:

- Which megatrends influence or will influence your business in the next 10–20 years?
- Which specific changes result from this for your industry or your company
- What requirements does the chemical industry as an important upstream supplier have to meet in order to support you as best as possible for these changes?

Qualitative expert assessments provide requirements for the chemical industry

The findings and recommendations for action were not derived on the basis of quantitative survey results, but explicitly on the basis of the qualitative evaluations of the surveyed experts and the practical experience of the authors. The findings of this customer survey are therefore based on the subjective assessments of the surveyed experts and not on scientific sources.

As experts from both the customer industries and the chemical industry were interviewed, both perspectives could be incorporated into the interpretation of the results. The survey focused on Germany and Europe. However, the European results were confirmed by the survey of a number of Asian and American experts. This integrative approach (chemical industry versus customer industries, Europe versus world) for the interpretation of the results and the formulation of the requirements is the special feature of the study.

The expert interviews were based on a detailed interview guideline, which was flexibly adapted to the interview partner (guideline for chemical companies, guideline for customer industries) and the respective course of the interview – e.g. by in-depth questions. A total of 58 expert interviews were conducted between the beginning of February and mid-June 2019.

When selecting the companies, care was taken to ensure that the respective sectors were as representative as possible and that companies of different sizes (including start-ups) and fields of activity were taken into account:

- 45 interviews were conducted with experts from German and European companies; seven interviews with experts from Asian companies and six with experts from American companies.

- 15 interviews were conducted with experts from the chemical industry; 43 interviews were conducted with experts from the customer industries (transport: 8, housing: 5, electronics: 5, consumer goods: 12, energy: 8, food: 5). The customer industries were thus approximately equally represented.

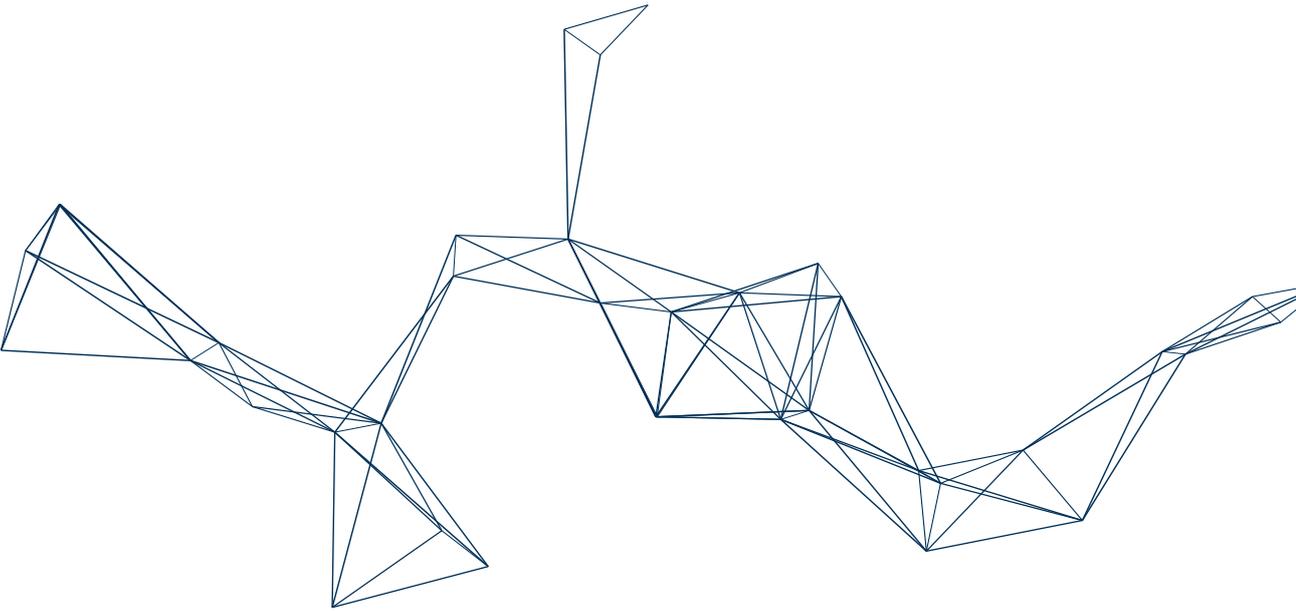
The interviewed experts were distributed in their function across various management levels (company management, divisional management, departmental management, experts). They come from the fields of research and development, marketing and sales, purchasing, IP, regulatory, legal, sustainability and new business development. This ensured that a cross sector, cross-functional evaluation could take place and that a decisionmaker perspective was always taken.

The following chapter first describes the relevant trends and their significance for the individual sectors. Derived from the trends, the resulting developments and changes in the individual sectors are described in chapter 5. Subsequently, it is attempted to derive the resulting requirements for the chemical industry.

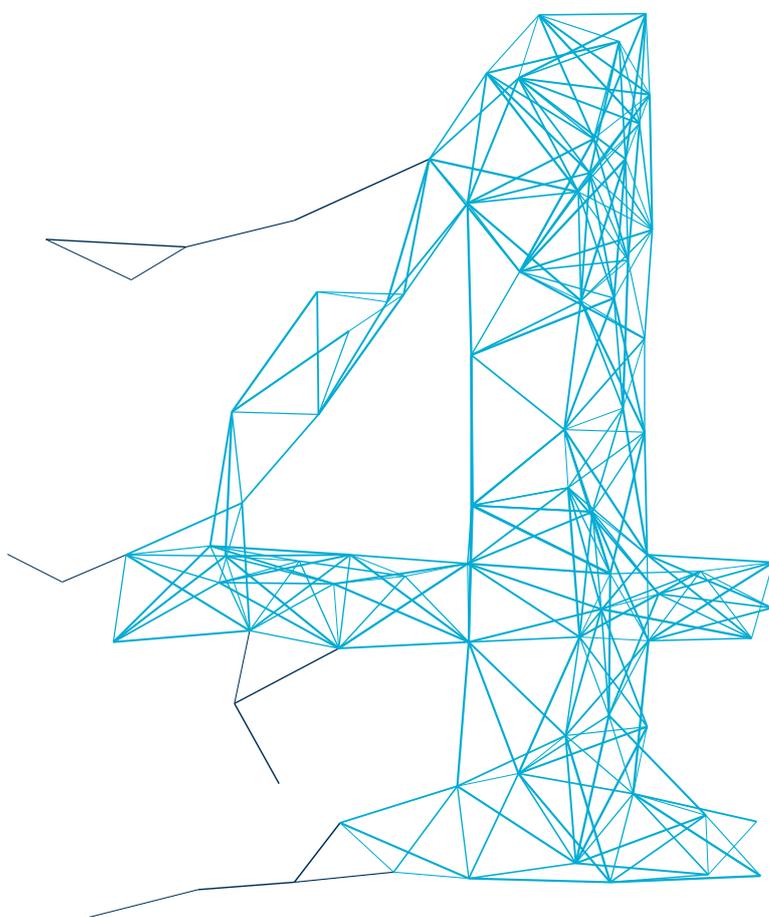
Developments in the individual sectors are very different. Nevertheless, their requirements for the chemical industry are very similar. Therefore, no distinction has been made between industries for the description of requirements for the chemical industry.

Global perspective secures European results

The view to Asia and America shows a similar picture: the perspective of the international experts did not differ significantly from that of the European experts. However, the requirements of the European companies were often “higher” because the starting level is higher due to the far reaching regulation of chemicals here. In this respect, no regional differentiation was made for the description of the requirements. The study results therefore apply unreservedly to Europe and, with lower intensity, to Asia and America.



CROSS-SECTOR MEGATRENDS



Four global megatrends determine the coming years

Ultimately, the (end) customer decides which products are purchased and which are not. These decisions are influenced by (global) trends. The relevance of trends for individual industries is therefore also decisive for the future development lines of the industries and thus also for their requirements for their upstream suppliers.

In addition to the effectiveness of collective trends, the industry has the opportunity to create markets or create individual trends with its own technological innovations (“Tech Push”). Particularly innovative companies (e.g. Apple) succeed in doing this time and again with individual products or product families. However, the significance of these self-created trends is rather low compared with the large collective trends that are built up over many years in the consciousness of customers. The success of planned technological innovations is also difficult to predict.

However, it is more often the case that technological innovations can reinforce existing collective trends at the right time and help them to break through. One example of this is electromobility. Battery-powered vehicles have been in existence for more than 100 years. The technology has also been continuously further developed. The breakthrough still didn’t happen. Not until first Toyota and later Tesla made a further attempt with new, innovative concepts, was it able to serve and strengthen the long-standing trend towards more “ecology and sustainability” and to help the breakthrough of current technology. In Germany, the automotive industry is committed to remaining one of the world’s leaders in electromobility.

The wishes of (end) customers thus also determine what the chemical industry will have to deliver tomorrow. The first section of the expert interviews was therefore devoted to the issue of which global megatrends will have a decisive influence on future developments in the respective industries. Based on an extensive literature analysis (see also chapter 3), four global megatrends were identified in the run-up to the interviews:

- “Ecology and sustainability”
- “Ethical and social standard”
- “Digitalisation, individualisation and acceleration”
- “Demographic change and urbanisation”

These megatrends were discussed with the experts, detailed, supplemented if necessary and prioritised with regard to the impacts on their company / industry.

Expert interviews provide four key results:

- The four trends cover current and expected developments in all sectors over the next few years. Some companies are structured differently, e.g. “ethical and social standards” are partly included under sustainability. Some industries also have different priorities. Urbanisation, for example, is an important and independent trend in the housing industry. The same applies for digitalisation in the transport and electronics industries. However, beyond these specifics, the trends are considered to be comprehensive and complete.
- All four trends are relevant for all industries, although their priority varies considerably in some cases. As a supplier to these industries, the chemical industry must orient itself towards these industry priorities. If only one

industry is supplied, the result is a clear profile. If different industries are supplied, different needs may have to be met. But there is also a clear picture across all industries that will set the agenda for industry as a whole.

- As all trends are relevant for all industries, the resulting requirements for the chemical industry are similar, but differ in their priority. A key requirement that mainly results from “ecology and sustainability” is, for example, the demand for more transparency. This is “the” key requirement for the chemical industry in the food, cosmetics and clothing industries. Transparency is also important for the electronics and energy industries, but here, for example, the demand to “think more strongly in solutions” has a higher priority. If, on the other hand, the perspective of the chemical industry is selected, which wants to be successful in all customer industries, then the priorities level off in the requirements: in order to remain successful in all customer industries, all requirements must be met equally. In this respect, there is no prioritisation in the description of the requirements in chapter 6.
- All trends are relevant for all industries. But not all trends result in specific requirements for the chemical industry. Demographic change mainly affects companies with regard to the recruitment of skilled personnel. This challenge of course also affects the chemical industry, but is not a specific requirement of its customers. Demographic change will also result in new products in some sectors. However, these will be variants of existing products and will not result in new requirements for the chemical industry.

4.1 Ecology and sustainability

Ecology and sustainability are the dominant megatrend across all industries

“Ecology and sustainability” describes as a trend the desire of many people for more naturalness or for a better harmony between nature and economy (“Ecolonomy”). Behind this global trend there is a multitude of topics which also individually determine the current discussion. These include:

- Climate protection (carbon footprint, reduction of energy consumption, etc.)
- More sparing use of global resources (recycling, circular economy, etc.)
- The use of more natural raw materials and production processes (fewer hazardous substances, etc.)

“Ecology and sustainability” is clearly the dominant trend in the food, consumer goods, energy and housing industries. In the electronics and transport industries, “ecology and sustainability” takes second place behind “digitalisation, individualisation and acceleration”. Across all industries, however, it is the trend that will have the greatest impact on customer industries in the next 10–20 years. The trend is not new, but after a prolonged development phase, it has achieved real impact in recent years and will continue to do so over the next few years. The impacts of the trend on the individual industries vary depending on the business. Depending on the business, the focus may also be more on the construction, use or recycling phases or also over the entire life cycle.

Different focal points in the individual customer industries:

- In the automotive industry, the focus to date has been on optimising consumption during the use phase. As the construction of electric vehicles causes substantially higher CO₂ emissions than the construction of ICE vehicles, while at the same time consumption during the use phase is relatively lower, the focus of optimisation is currently shifting to the construction and recycling phases. At the same time, the automotive industry is already more advanced than other industries in its consideration of the entire life cycle of products.
- In plant construction and the energy industry, where capital goods tend to be long-lived, the focus continues unchanged on the reduction of resource consumption during the use phase and on increasing yields. In view of the longevity of products, recycling aspects and circular economy are only gradually gaining in importance.
- Industries that manufacture products that come into direct contact with their users (cosmetics, food, clothing, furniture, toys, etc.) are increasingly shaped by critical consumers' desire to understand "what" they are consuming. Here, the use of natural raw materials and the avoidance of hazardous substances, combined with the necessary transparency, have top priority.
- Industries that mostly use natural raw materials (food, clothing, furniture, etc.) are increasingly paying attention to compliance with ecological standards in production, e.g. the avoidance of monocultures or excessive water consumption. The avoidance of emissions through the transport of products is also playing an increasing role, so that in some sectors regionality is becoming an increasingly important criterion.
- Finally, there are aspects that affect all industries, such as packaging. However, the priorities here also vary depending on the products. The more short-lived the product, the more dominant the packaging topic and the more intensively the respective industries look for solutions or substitutes.

"Ecology and sustainability" is thus the key driver of development in the customer industries in the coming years and thus an important source for the future requirements for the chemical industry.

4.2 Ethical and social standards

In addition to the "what", the "how" will also be of key importance for customers in the future

"Ethical and social standards" describes as a trend the desire of many people not only to better understand "what" they are consuming (see also 4.1), but also "how" the products are manufactured. Behind this global trend there is also a multitude of topics which individually determine the current discussion. These include:

- Compliance with environmental standards (e.g. for the extraction of raw materials, but also for the recycling of waste)
- Compliance with occupational health and safety standards
- Assurance of reasonable remuneration

While the driver for "ecology and sustainability" was the desire for a better balance between nature and economy, "ethical and social standards" is the desire for a better balance between society and economy. People no longer want to consume

and live “at the expense of others”. Similar to “ecology and sustainability”, there are different focal points in the different sectors.

- Companies that, for example, use semi-finished products made from critical raw materials pay particular attention to ensuring appropriate extraction conditions (labour and mainly environmental standards) when extracting these raw materials. One example is the extraction of cobalt and nickel, which are used for the production of batteries, which in turn are used in automotive manufacturing, the energy industry or mobile telephone production. The objective is to ensure that raw materials come from controlled and certified industrial mining and not from uncontrolled private mining. The companies are making a significant and growing effort here to certify and audit their suppliers.
- In highly labour-intensive manufacturing processes with many added value steps along global supply chains (e.g. in the garment industry), occupational health and safety aspects are often at the forefront, which are also controlled by certification and auditing of suppliers.
- In industries that use locally produced raw materials such as wood, meat, fruit or other foodstuffs, it is often a question of ensuring that producers are appropriately remunerated. The certification is also mainly used here by wholesalers and intermediaries. In some cases, own production capacities are also established on-site to ensure compliance with the standards.

Growing transparency requirements
for the chemical industry

The chemical industry, as one of many upstream suppliers of the industries in focus, is facing this trend with all its force as they must ensure global compliance with these standards in their own production and supply chain.

The global megatrend “ethical and social standards” shares second place after “ecology and sustainability” with “digitalisation, individualisation and acceleration” in the prioritisation by the interviewed experts.

4.3 Digitalisation, individualisation and acceleration

Digitalisation is fundamentally
changing many industries

“Digitalisation, individualisation and acceleration” deals with the possibilities and consequences of digitalisation, whereby individualisation and acceleration are partly only made possible by digitalisation and partly form a trend in individual industries independent of digitalisation.

The range of changes caused by digitalisation is far-reaching:

- Some completely new markets are emerging and require new strategies and business models (e.g. sharing models), some traditional business models are about to be replaced
- New sales channels enable the development of new potentials, established sales channels lose importance

- New production processes (e.g. 3D printing) enable decentralised, flexible production architectures and last but not least individualisation down to batch sizes of one – production on demand
- Digitalisation also enables a general acceleration of business processes, from R&D to maintenance, and thus a shortening of innovation/ delivery cycles

Not all industries are equally affected by all digitalisation options. The resulting consequences for the business models are decisive for the extent of the change. For example, one development direction in the automotive industry is to further develop from a traditional vehicle manufacturer towards a mobility service provider. The energy industry is on its way from traditional power generation in large power plants with central grid control to intelligent management of small producers in decentralised grids. Completely new business models are emerging in both industries. In other industries, such as the food industry, new sales channels and markets are emerging (e.g. online delivery business). Essential parts of the business model, the production of food, will become faster and more efficient, but the core will initially remain unchanged. The same applies, for example, to plant construction.

The chemical industry in digital change

The chemical industry itself also has many options that are actively used:

- The digitalisation of research makes it possible to increase innovation performance and contributes to shortening innovation cycles
- Digitalised processes, from maintenance to production, help to further improve quality and efficiency in the industry
- Digital interaction with customers, from sales to exchange of product data, enables faster response to customer requests

In this respect, the chemical industry itself is undergoing a digital transformation process. The reaction to the new requirements resulting from the “digital” changes in the customer industries represents an additional challenge.

Individualisation and acceleration as an independent trend

Digitalisation enables individualisation and acceleration. However, individualisation and acceleration are also independent of digitalisation developments that influence many industries. For example, there used to be two clothing collections a year, but new products are now being launched on the market every month. Customers are increasingly demanding individual solutions for their problems or wishes, down to a batch size of one. The product cycles, and thus also the innovation cycles, are sometimes considerably shorter in some industries. They pass on these requirements to their upstream suppliers, which poses major challenges for the chemical industry, mainly in research, development and production, in view of the established industrial high-volume production.

The global megatrend “digitalisation, individualisation and acceleration” shares second place after “ecology and sustainability” with “ethical and social standards” in the prioritisation by the interviewed experts.

4.4 Demographic change and urbanisation

Skills shortage: Central impact of demographic change

All industries, including the chemical industry, are equally affected by demographic change, especially in the recruitment of suitable specialists, and compete with each other in this field. All industries face the same challenges and must respond to them, including the chemical industry. However, in the context of this study, these requirements are not customer requirements in the narrower sense and should therefore not be further explored here.

In this context, however, the operation of the global megatrends described above is of great importance. Companies that credibly act “ecologically and sustainably” and convincingly advocate compliance with “ethical and social standards” will enjoy an advantage in the competition for scarce skilled workers.

This makes it an “indirect must” for the chemical industry to meet the requirements of the customer industries resulting from the described trends (see chapter 6). It will only be able to credibly address the described trends in the future and remain successful in the competition for young talent if it meets the requirements.

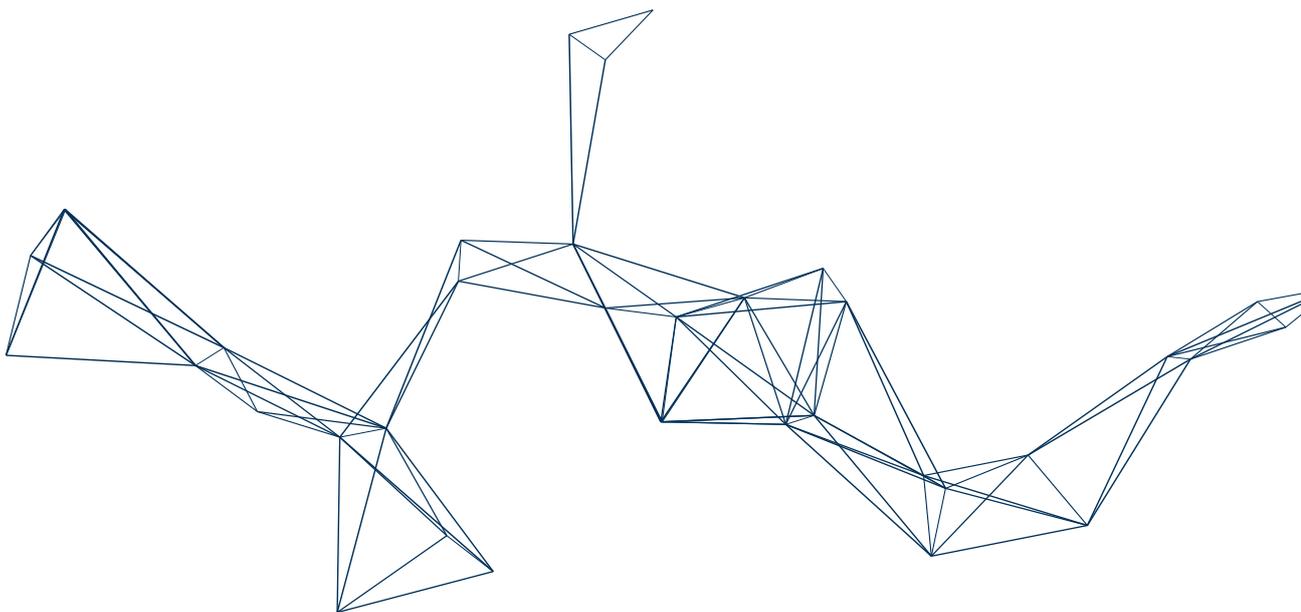
Urbanisation as source of new challenges

In addition to the ageing population in developed countries, there is a clear trend that more and more people will live in cities in the future. New mega cities will arise, mainly in emerging countries in Asia, Africa and South America. In connection with the consequences of climate change, completely new challenges are emerging – from insulation and cooling to communication and traffic – as more and more people live together in increasingly confined spaces as temperatures rise. In the housing industry and also in parts of the electronics industry (Smart Cities / Smart Homes), urbanisation is therefore a central trend in its own right.

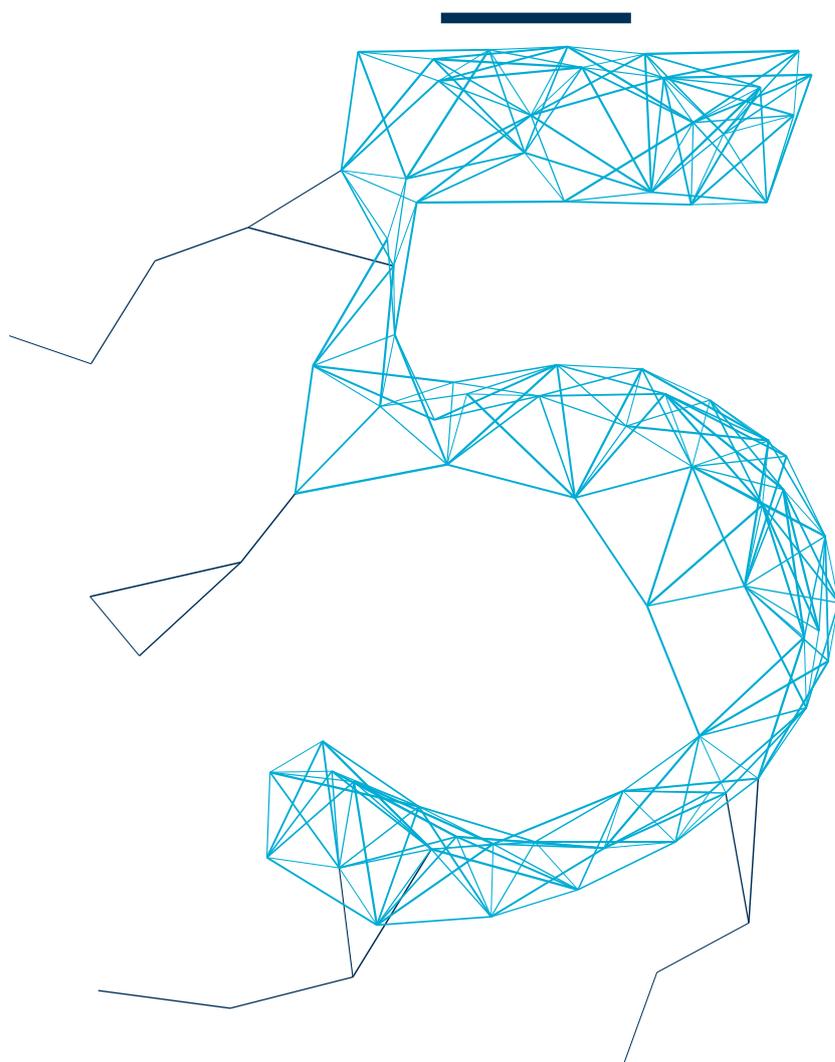
4.5 Conclusion: Five findings from the analysis of megatrends

- Specific customer requirements for the chemical industry arise primarily from “ecology and sustainability”, “ethical and social standards” and “digitalisation, individualisation and acceleration”.
- These trends are not new, but have not become fully effective for various reasons until now. Successful industries and companies have had to address these trends in the past, albeit with fewer requirements than in the future.
- Success in the area of “ecology and sustainability” requires innovations. Credibility in the area of “ethical and social standards” requires a sense of responsibility. Mastery of “digitalisation, individualisation and acceleration” requires digital thinking.
- The successful development of the chemical industry in line with the successful development of its customer industries in recent years shows that the industry has obviously succeeded in handling the described trends in the past and has been regarded as innovative, responsible and digital.
- However, success in the past is no guarantee for success in the future. The trends have now become fully effective, combined with new customer requirements. The ability to meet these requirements in the future is a prerequisite for future success.

In order to better classify and understand these requirements, the developments in the individual industries resulting from the described megatrends will be described in more detail in the next chapter.



CURRENT DEVELOPMENTS IN THE MOST IMPORTANT CUSTOMER INDUSTRIES OF THE CHEMICAL INDUSTRY



The six selected key customer industries of the chemical industry differ considerably. In this respect, the megatrends described above result in different effects and priorities in the individual industries.

The following explanations are based on a limited number of expert interviews in the respective industries and therefore do not claim to fully describe “all” relevant and expected developments for the industry. The analysis is limited to those developments that could have impacts on the chemical industry.

5.1 Transport

Electromobility as technology that will determine the coming years

In the transport industry (experts from the automotive and aircraft industries were interviewed), “ecology and sustainability” and “digitalisation, individualisation and acceleration” are equally ranked first as megatrends. The direct impacts, the search for new drive technologies and fuels to reduce emissions and resource consumption as well as the digitalisation of transport, partly overlap because, for example, networked driving and digitally controlled traffic flows promise additional energy savings. The development of new drive technologies in particular, such as electromobility, presents the transport industry with major challenges and will cause a fundamental upheaval. The pressure to change is considerable and results in specific requirements for the chemical industry as an important upstream supplier.

The focus is on innovations. The development of new technologies requires breaking new ground. For example, electric flying requires a new dimension in lightweight construction (e.g. based on “spinning threads”). The acceptance of electromobility depends crucially on the storage capacity of the batteries and the resulting range. With these new developments, the transport industry wants the chemical industry to continue to support it with innovative solutions and to address the individual challenges of the companies even more intensively.

Recycling and circular economy as part of the business model

The production of batteries requires the use of scarce raw materials such as cobalt and nickel. A full-scale change to electromobility could therefore quickly result in resource bottlenecks. Functioning recycling and a closed circular economy will therefore have to become an integral part of the business model. The already very well developed recycling in the automotive industry will have to be enhanced again. The requirement for the chemical industry in this context is to enable circular economy by appropriate composition of the primary products (“design-to-recycle”). This includes the desire to avoid hazardous substances in products as far as possible and, where possible, to use natural raw materials.

But “design-to-recycle” is not an end in itself. In addition to enabling mechanical recycling and circular economy, the ecological optimisation of the product (e.g. with regard to CO₂ emissions over the entire life cycle) also requires a perspective over the entire life cycle. This is already well developed in the transport industry as compared with other industries. However, the focus will change. On the one hand, it is necessary to optimise the consumption of resources in the utilisation phase (“design-to-performance”) and on the other hand not to lose sight of the recycling phase (“design-to-recycle”). Success in this optimisation requires, among other things, that all suppliers are closely integrated and follow the same logic. The transport industry therefore wants the chemical industry to continue working on establishing a comparable “life cycle perspective”. Ideally, “design-to-sustainability” should then result from a balanced consideration of the product use phase and waste recycling phase.

Mandatory compliance with ethical and social standards

Compliance with ethical and social standards in the manufacture of their products is of great importance for companies in the transport industry. The greatest challenge for the future lies in the procurement of critical raw materials, e.g. for battery production. The effort that companies invest in the certification and auditing of their suppliers or in comparable measures and projects is correspondingly high. The chemical industry must ensure that these standards are complied with in its production and supply chain and document this transparently.

Intensive communication between customer and supplier as prerequisite for success

“Design-to-sustainability” and the ecological optimisation of products over their entire life cycle require a holistic perspective and the ability to think about the consequences. However, companies in the transport industry cannot do this alone. Even more intensive interaction with all important upstream suppliers is a prerequisite. Here, the industry would like the chemical industry to further intensify its communication with its customers.

5.2 Housing

More naturalness,
fewer hazardous substances

Similar to the transport industry, the dominant trends in the housing industry are “ecology and sustainability” and “digitalisation, individualisation and acceleration”. A third trend that strongly impacts the industry is “urbanisation”.

The most significant impact of the “ecology and sustainability” trend in the housing industry is the desire for more naturalness and health protection. The constituents of building materials are playing an increasingly important role. People want to understand “in what” they are living and what effects the materials used could have. This desire presents the construction industry with major challenges. On the one hand, many ingredients perceived as harmful to health create important product characteristics such as flame retardation. On the other hand, many ingredients also guarantee important quality characteristics, such as durability. Here, the housing industry has a clear requirement for the chemical industry to search even more for innovative solutions and to provide natural alternatives that guarantee comparable product characteristics.

However, the desire for more innovation is also supported by “digitalisation, individualisation and acceleration” and “urbanisation”. Digitalisation (including Building Information Modelling) will not only enable many further developments – from simulation options in the planning and construction phase to networking of the subsections and fault analysis and management – but also a completely new form of building with new types of building products – from 3D printing products to Smart Homes. Urbanisation will result in more and more people living together in confined spaces with rising temperatures in cities. For example, this presents new requirements for the possibilities for energy recovery and insulation. Among other things, all these developments require innovative chemical solutions.

Clearly increasing
transparency requirements

The desire for more naturalness and health protection in building materials goes hand in hand with the requirement to document the ingredients of these materials much more transparently in the future than today. The housing industry passes on this requirement to its upstream suppliers. In its opinion, the chemical industry can become even better in this area. The information currently provided by the chemical industry certainly meets all legal requirements, but is not sufficient to meet future transparency needs.

However, the housing industry would also like to see more cooperation elsewhere: regarding the impacts of chemicals regulation in Europe. If substances are declared as hazardous, this has considerable impacts on the construction industry. Early coordination between the chemical industry and key customer industries could help to limit the impacts of new regulations on customer industries or make it possible to research alternatives at an early stage. Communication from both sides must be expanded.

Recycling and circular economy as the coming challenge

Recycling and circular economy are not yet very pronounced in the housing industry. This is partly due to the fact that certain ingredients classified as hazardous make the recycling of building materials more difficult or even impossible. The ability to recycle is therefore an important requirement for future building products, and the housing construction industry would like the chemical industry to make the circular economy possible even more effectively than before with its future products.

In addition, new recycling technologies, such as the chemical recycling of plastics, must be further developed so that complex waste materials, regardless of their contents, can also be recycled. More natural raw materials and the use of fewer hazardous substances would be a first step. As in the transport industry, however, this would have to be supplemented by elements such as “design-to-sustainability” and life cycle perspectives. However, the housing industry has not yet progressed as far as the transport industry. An upstream supplier who has established a corresponding “life cycle perspective” could therefore make an important contribution to the development of the housing industry.

Smaller production units as prerequisite

The desire for the described innovations is combined with the desire for more flexibility in the chemical industry. Many new developments are initially sold in small quantities. If the product is also based on new technologies, appropriate investments in the production infrastructure are required. The chemical industry has followed a “large-scale industrial” approach up to now. Smaller and more flexible production units could help to provide more individual solutions for customers in the housing industry.

5.3 Electronics

Innovations along the entire added value chain

Unlike the transport and housing industries, the dominant trend in the electronics industry is “digitalisation”. “Ecology and sustainability” follows in second place. In many cases, “digitalisation” is the driver of development. Autonomous driving would not be possible without appropriate products from the electronics industry. However, these products must also be ecological and sustainable at the same time. In view of the diversity of the electronics industry – with companies along the entire added value chain (from chip manufacturers to mobile telephone manufacturers) – the developments in the individual market segments differ. However, the resulting requirements for the chemical industry are very similar. Thereby, the focus is on innovations.

For example, if future generations of chips and processors must be faster, smaller and more flexible (combined with more powerful analytics) for chip manufacturers, it is a matter of improving recyclability by using other plastics or intelligent adhesives for mobile telephone manufacturers. In all cases, from the electronics industry’s point of view, the chemical industry must make even more innovative products to meet the individual challenges of companies.

Increased recycling of expensive
and scarce raw materials

Similar to the transport industry, the electronics industry uses many expensive (e.g. gold) or scarce (e.g. cobalt, nickel, rare earths) raw materials and therefore has a high interest, not only for ecological reasons, in increasing recycling and developing in the direction of circular economy. In this context, the chemical industry can help to increase the recyclability of products and simplify the circular economy. For example, intelligent adhesives could help to make it easier to recycle batteries and raw materials from mobile telephones.

In view of the need for critical raw materials, compliance with ethical and social standards in their extraction is just as important as in the transport industry.

Increasing joint development
of new products

In order to make faster progress in the development of new products that meet the described requirements, it would be desirable from the point of view of the electronics industry to cooperate much more closely and ultimately even to coordinate joint research priorities. This could ensure that the chemical industry, as an upstream supplier, can provide timely solutions. Here, however, the electronics industry still senses a certain reluctance on the part of the chemical industry and would like to see further development accordingly. Deepened interaction would also be a prerequisite for finding ecological optima for the entire added value chain and the life cycle of individual products. The electronics industry would therefore like to see improved communication and the widespread establishment of a “life cycle perspective” in the chemical industry.

Permanently provide small quantities

Some chemicals are only required in small quantities by the electronics industry (e.g. in chip production). The companies must commit themselves to their customers to provide these products with the same specifications in the long term and are therefore dependent on comparable supply security from their upstream suppliers. This is not always the case. In many cases, the small quantities fall victim to portfolio optimisations and cause significant problems in the customer industries. Here, the electronics industry wants a stronger customer perspective and more flexibility from the chemical industry.

5.4 Consumer Goods

Transparency and traceability as key requirements

The segments of the consumer goods industry are diverse and range from clothing and toys to furniture. As different as the segments and their individual developments are, they are united by the fact that “ecology and sustainability” is the dominant megatrend of the coming years. The key requirement arising from this megatrend is people’s desire to understand “what” they are consuming better than in the past. Therefore, transparency and traceability are the most important requirements for the companies’ upstream suppliers. From the point of view of the consumer goods industry, the chemical industry still has a lot of catching up to do in this respect. The information provided today about the constituents of the primary products (e.g. product safety data sheets) fulfils all legal requirements, but in many cases is not sufficient to meet future transparency requirements.

More naturalness is a must

The desire to better understand “what” one is consuming ultimately results from the need for more naturalness and health protection. People would like as little exposure as possible to hazardous substances and would like assurance that the consumer goods industry provides them with appropriate products. Whether these substances are actual hazardous substances or perceived hazardous substances is irrelevant. Companies in the consumer goods industry are responding to this need with individual sustainability strategies in which either certain additives are not permitted for their products (e.g. biocides) or the chemicals that will still be permitted in future are defined via positive lists. Both variants give rise to a clear requirement for the chemical industry to develop more natural as well as nonhazardous alternatives and to respond individually to the needs of the customer companies. The chemical industry should think even harder about solutions than it already does.

Regulation as possible asset

The better and more reliable the transparency of the substances used, the more suitable chemical primary products are for the consumer goods industry. European chemicals regulation, which is often perceived as burdensome and complex, can be an advantage in global competition as it can ensure this safety in comparison with products from unregulated countries. The horizontal and sectoral regulations for chemicals in Europe can thus become a competitive advantage, provided that companies in the chemical industry pass on the results transparently to their customers.

Packaging: milestone on the road to the future

In the segments of the consumer goods industry, consumers regularly face the topic of packaging because they usually dispose of it themselves and because products tend to be short-lived, which is why they are continually exposed to the issue. The desire described at the beginning for more naturalness and health protection also comes into play here. The dominant packaging material today, plastic, is increasingly met with rejection by many consumers. Consumer rejection is supported and reinforced by the media by the activities of numerous NGOs. In some cases, the first regulatory interventions are taking place. Companies in the consumer goods industry are reacting to this requirement and intensifying their search for alternatives. In addition to transparency and

traceability, the second key requirement of the consumer goods industry for the chemical industry is therefore to rapidly develop alternatives in the packaging field.

From the point of view of many companies in the consumer goods industry, a first important step would be the use of recycled plastics. However, this is only available to a limited extent in high quality. Other production processes (e.g. recyclable packaging) could be starting points. In addition, new recycling technologies, such as chemical recycling, must be further developed so that complex waste materials, regardless of their contents, can also be recycled. The further development of traditional oil-based added value chains towards added value chains based more strongly on natural raw materials is also proposed. The chemical industry could make an important contribution here to enabling circular economy.

In addition to “What”,
“How” is decisive

In addition to the desire for more naturalness and health protection, the question of “how” a product is produced is increasingly becoming a decisive purchasing factor. In addition to the question of the production of raw materials (e.g. wood in the furniture industry), the focus is on topics such as the environment, occupational health and safety, remuneration, etc. The companies in the consumer goods industry guarantee compliance with relevant ethical and social standards by means of their sustainability strategies and invest in the certification and regular auditing of their suppliers. As an important supplier, the chemical industry must also ensure and transparently document compliance with these standards for its own production and its upstream suppliers.

In addition to production, the recycling of products and, primarily, packaging are becoming increasingly important. The companies are partly investing in the development of waste collection infrastructure in Africa or Asia or in their own recycling projects (e.g. for nappies). Also in this context, there is the desire of the consumer goods industry for the chemical industry to facilitate circular economy by the composition of the primary products as well as by the development of new innovative recycling technologies.

More end customer perspective

Many companies in the consumer goods industry are under significant pressure to change against the background of the customer requirements described above. However, the development of trends, primarily “ecology and sustainability” here, and of the resulting requirements is not new and could have been better anticipated. The prerequisite for this anticipation is proximity to the consumer as the end customer. The companies in the consumer goods industry have this proximity due to their business model. Companies in the chemical industry have only partially limited this proximity due to their position in the added value chain. In the past, these different perspectives have contributed to the fact that customers and upstream suppliers have not always fully understood each other, with the consequence that alternatives are lacking today in critical areas such as packaging.

The consumer goods industry would therefore like the chemical industry to make even greater efforts in the future to look at an end-customer perspective in order to anticipate developments earlier and gain time to develop appropriate alternatives.

5.5 Foods

Parallels to the consumer goods industry

The food industry as a classic “end customer industry” is similar to that of the consumer goods industry with its requirements for the chemical industry in many areas. In this respect, the above remarks largely apply analogously. Against this background, transparency regarding the substances used and their traceability back to the raw material is also the most important requirement in the food industry. This requirement is closely linked to the desire for more naturalness and health protection. The topic of packaging enjoys even greater attention than in the consumer goods industry because the products of the food industry are used practically every day (e.g. beverage cups) and are therefore even more visible to consumers and the public. Overall, the food industry would like the chemical industry to provide even better solutions for its individual problems and to advance appropriate innovations. Compliance with ethical and social standards enjoys the same importance as in the consumer goods industry, but is supplemented by industry-specific aspects (e.g. animal welfare).

Better communication as prerequisite for success

The positive characteristics of plastic as food packaging are undisputed from the point of view of the food industry. However, these advantages are hardly noticed in the public discussion and the food industry is under similar pressure as the consumer goods industry to change in this respect. The use of more high-quality recycled material, but also the development of new, innovative recycling technologies, such as chemical recycling, could help. As suitable recycled material is currently scarcely available, alternatives such as glass or paper are sometimes discussed, although their environmental balance is worse than that of plastic. From the point of view of the food industry, this would have been avoidable if the advantages of plastic had been communicated more comprehensively and proactively. The food industry would therefore like to see the chemical industry’s communication further developed in the future, in which it positions the advantages of its products more actively in public and politics.

But communication also remains a challenge elsewhere. From the point of view of the food industry (this applies similarly in the consumer goods industry), the chemical industry must communicate the advantages of its products more effectively not only to politicians, NGOs and the public, but also in many cases to its own customers. The chemical industry has a strong scientific focus. However, end customer-oriented industries such as consumer goods and food are often also strongly influenced by marketing aspects. The professional backgrounds of the people who meet in customer/supplier meetings can therefore be very different. As a result, both parties do not always completely “understand” each other. This leaves opportunities and options unused. From the point of view of the customer industries, the chemical industry should continue to work to convey the added value of its products even more generally comprehensible.

Rethink Supply Chain

In addition to the parallels with the consumer goods industry, there are a number of specific characteristics:

- For example, the shelf life of food is becoming an increasingly important issue. Consumers want less preserved food (which is of course less durable). This can reduce or change the need for additives.
- However, the shelf life can also have an impact on the packaging because it only has to guarantee its characteristics for a shorter period than in the past (e.g. UV protection). New options can also arise from this.
- Regionality is increasingly becoming a purchase criterion – also with impacts on the necessary shelf life and packaging.
- Packaging that can be used several times is also becoming a trend, even if it will not be suitable for all products.

The described changes show that ultimately the entire supply chain of the industry could be affected. Many companies in the consumer goods industry are therefore working on concepts to restructure the entire supply chain. The requirement for the chemical industry is that it supports this development by establishing a corresponding perspective across the entire added value chain and life cycle.

The end customer as trendsetter

Ultimately the customer decides. This study has impressively confirmed this ancient wisdom. Even if the dominant megatrend across all sectors is “ecology and sustainability”, the resulting requirements are all the more dominant the closer the respective company is to the end customer. The current pressure for change, e.g. in the packaging field, is therefore also most intense there. Companies that act as suppliers do not yet feel many requirements with the same intensity, but have to adapt to the relevant requirements. This also applies for the chemical industry. As a classic supplier industry, it has first noticed many trends with a time lag and now has to react quickly to the resulting pressure for change from its customer industries.

5.6 Energy

Management of the energy transition as a key task

“Ecology and sustainability” is also the dominant trend in the energy industry. The most direct impact for the energy industry is the gradual transition to renewable energies. This development has also been going on for many years, but only achieved its full effectiveness by banning nuclear energy and coal energy in the future. The energy industry is facing a fundamental transformation, which is partly linked to the realignment of business models. Further innovations are required in order to quickly complete the changeover. For example, the efficiency of solar modules and wind turbine rotors must be further increased. Power-to-X and comparable technologies must be further developed in a targeted manner. The various storage technologies required to buffer the peaks of renewable energies are also becoming increasingly important. The energy industry would like further innovative support from the chemical industry here.

Recycling as coming challenge

As many first-generation wind and solar plants are only gradually reaching the end of their useful life, recycling the materials is not yet a key challenge. Expiring modules are kept on the market, amongst other things, by second-use concepts. However, in view of the growing volumes in the market, the recycling of components will be the next challenge and companies in the energy industry are increasingly urging their upstream suppliers to develop technologies and materials that will enable circular economy in the future.

In addition, the expansion of renewable energy is associated with a strongly growing demand for scarce raw materials. As in the transport and electronics industries, the development in the direction of a circular economy is thus becoming an elementary element of the new business models. This makes it all the more necessary to optimise the products in accordance with a suitable balance between “Design-to-Performance” and “Design-to-Recycle” over the entire life cycle. This requires closer cooperation between operating companies and producers. The energy industry invites the chemical industry to participate even more actively than to date in this intensified relationship.

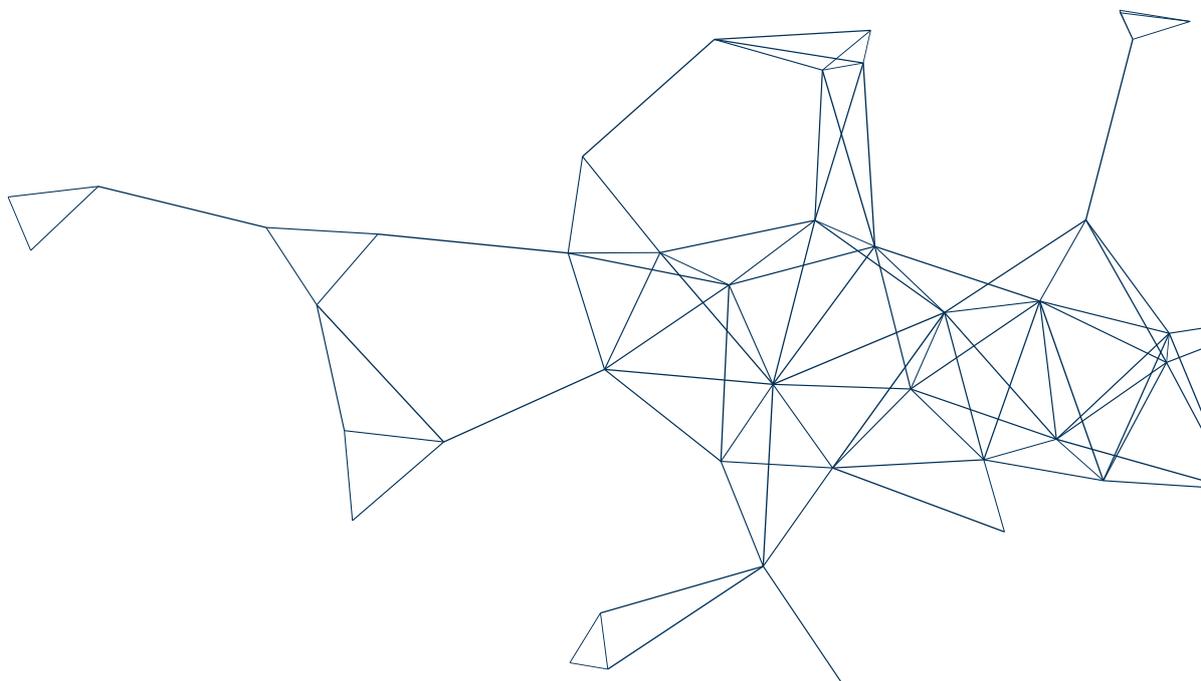
The increased demand for these critical raw materials is also causing the energy industry to attach great importance to compliance with ethical and social standards.

Overcoming the sector boundary as an opportunity

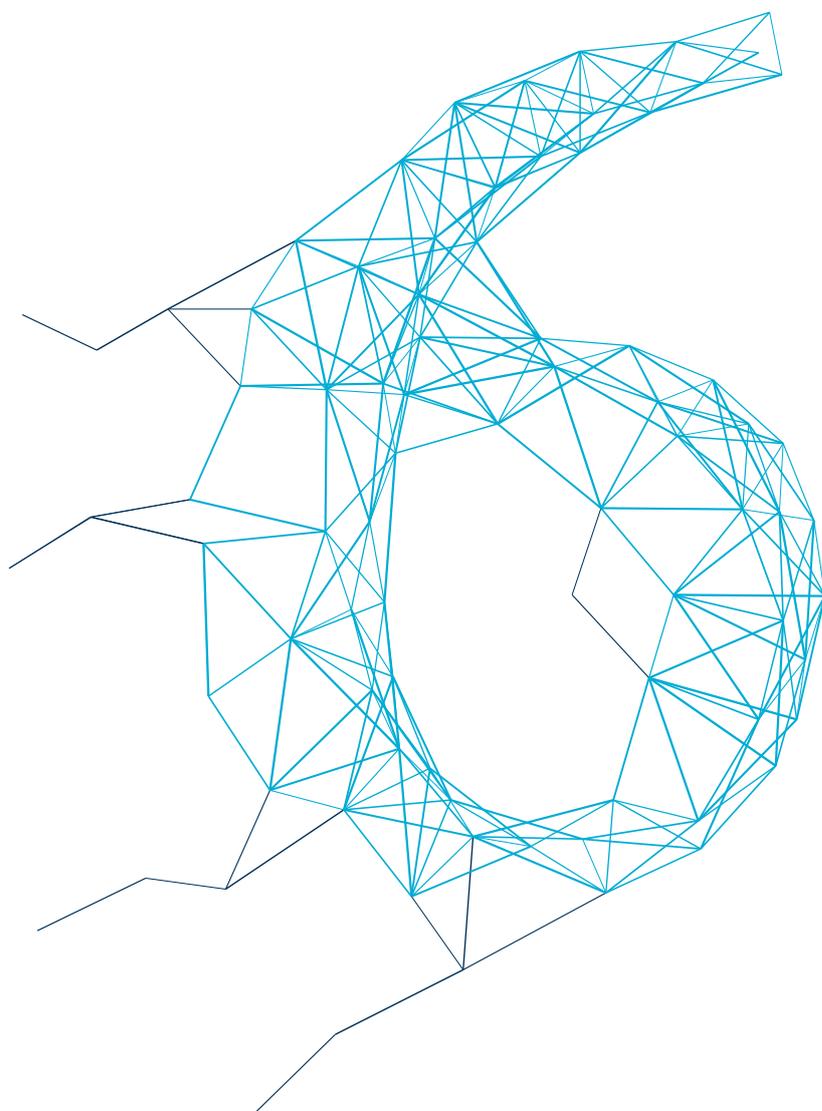
There are close links between the energy and chemical industries. For example, many of the perspective energy generation and storage processes (e.g. Power-to-X) use substances that are available in the chemical industry (sometimes as by-products or waste products). On the other hand, many – at least on a smaller scale – already in principle technically functioning processes, such as “chemical recycling” (thermochemical or solvolytic processes for recycling plastics), would be supported in their further development if electricity from renewable sources were provided at lower prices. This could result in options to expand the business models in both directions. Also in this context, the energy industry would like greater cooperation with the chemical industry along the added value chain in order to better understand each other and jointly look for optimisation approaches. Ultimately, from the point of view of the energy industry as well as the chemical industry, it is a question of rethinking business models.

Produce more flexibly

The desire of the energy industry for more individual solutions will result in a further differentiation of the portfolio for the chemical industry with smaller volumes per product line. This can result in further development of the current production architecture. More than before, new products will be tested on the market in small quantities and will be produced if successful. The development will thus develop to a certain extent from the classic “Scaling Up” to “Numbering Up”. A prerequisite for meeting the various customer requirements is therefore also at least partial further development of the business model of the chemical industry (new added value chains based on natural raw materials, smaller, more flexible production units, etc.).



TEN REQUIREMENTS FOR THE CHEMICAL INDUSTRY FROM THE POINT OF VIEW OF THE CUSTOMER INDUSTRIES



The analysis of the interviews with the experts from the six most important customer industries of the chemical industry showed that the developments expected by the customer industries are essentially based on the same megatrends – primarily “ecology and sustainability” – but differ in intensity in their impacts on the respective businesses. For example, the desire for more transparency and traceability for the consumer goods and food industry, driven by the requirements of consumers, NGOs and regulation, is by far the top priority. This desire also exists in the other industries; however with lower intensity. The automotive industry, on the other hand, is facing a change in the entire business model with the change in drive technologies and the development towards mobility services. The rapid development of new technologies here (from more efficient battery technology to new lightweight materials), combined with better cooperation along the added value chain, therefore has a higher priority than, for example, in the consumer goods and food industry.

The results show that, despite the differences in priorities, the surveyed industries have similar requirements for the chemical industry. An industry like the chemical industry, which would also like to be successful in all its customer industries in the future, must therefore meet all these requirements equally. The following summary of these requirements therefore also deliberately dispenses with prioritisation.

6.1 Intensify thinking in solutions

“Individual” innovations as
match winners of the future

The performance and innovative strength of the chemical industry in the past is undisputed. However, the developments in the customer industries described above are currently – and even more so in the future – significantly changing the requirements of customers for the chemical industry. The ability to innovate will remain the decisive success factor. The most important change, however, is that more “individual” innovations are now required. The customer industries want the chemical industry to search even more for solutions to their individual challenges. The drivers for these challenges can have very different sources (customers, regulation, own sustainability strategies, NGOs, public opinion, etc.). The results are varied, ranging from other ingredients in food packaging (e.g. because shorter UV protection will suffice in the future) to more natural sweeteners in the beverage industry and the substitution of hazardous substances used in the housing industry.

As the needs of the customer industries become more individual, the product portfolio of the chemical industry will become even more diverse and differentiated and the resulting volumes per product line smaller. This will pose new challenges for the industry’s entire business model – from innovation to production processes.

“Experimental thinking”
as prerequisite

The development of these individual solutions will primarily require other innovation processes. The willingness to experiment, test at an early stage and, if necessary, develop prototypes to the end together with the customer will have a different importance than today. Not everything will be predictable and some experiments will fail. Overall, the complexity of research and development will increase significantly. The implementation of these requirements will partly require a further development of thinking towards a stronger willingness to experiment with more entrepreneurship and more “medium-sized” thinking. However, the implementation could also, if the impacts on the supply chain and production are considered (see also 6.9 “Rethinking business models”), mean the entry into further development of the industry’s business model.

6.2 Think more from the end customer’s point of view

With the right product at the
right time at the right place

Developing individual innovations requires time. Having the right innovation ready for the market at the right time is therefore the voluntary exercise of entrepreneurship. This is all the more true as trends go through a life cycle and are often weak for years before “becoming hurricanes” in a relatively short time. It is therefore crucial to recognise in good time “when the hurricane is imminent”. Prominent examples from other sectors are the nuclear exit and the diesel/electromobility discussion. Both trends had been around for a long time, but ran in the background only to “become hurricanes” in the relatively short term on the basis of singular events. Many interviewees see the growing rejection of plastic products by many end customers as a comparable development to which the chemical industry could have reacted earlier.

With a few exceptions, the chemical industry does not supply directly to end customers. As ultimately the end customer and his behaviour define the trends, the positioning in the added value chain carries the risk of recognising market-determining trends too late or not at all. As ultimately also the customer industries do not benefit if the products demanded by the market are not in the right place at the right time, the customer companies of the chemical industry wish to think even more from the end customer’s point of view in order to be able to react earlier in other current or upcoming discussions (from solvents to titanium dioxide to biocides and fluorine).

Thinking more from the end customer’s point of view requires increased investments in trend and market research, an even more intensive discussion with customers and suppliers, more intensive development cooperation along the added value chain and, as already explained in 6.1, an even greater willingness to try out solutions based on uncertain information.

New perspective required

The chemical industry has a scientific focus. The scientific facts decide whether solutions are ultimately realised. Thinking more strongly from the end customer's point of view therefore sometimes also requires a change of perspective, because the end customer does not always act on the basis of facts, but partly or perhaps even predominantly on the basis of individual assessments and emotions. A purely factor-oriented approach can therefore only partially identify developments triggered by assessments and emotions.

The consistent implementation of this change of perspective could be a building block on the way to a further developed business model for the industry.

6.3 Enable circular economy

The chemical industry as an enabler on the way to the circular economy

The dominant megatrend of “ecology and sustainability” results in the desire to use resources more sparingly and ideally (at least in part) to recycle them. The drivers vary from industry to industry. If, for example, the automotive and electronics industries are concerned with the scarcity of raw materials for battery production, the focus in the consumer goods and food industries is on the reduction / avoidance of packaging waste. The closer to the end customer and the more short-lived the product, the more dominant this requirement becomes.

In order to meet this requirement, a variety of parameters are required – from the further development of the collection infrastructure to the technology-open further development of the recycling processes (mechanical and chemical) to the technology-open design of the (legal) general conditions. The chemical industry as a stakeholder can influence these general conditions to a certain extent.

In addition to these “technical” parameters of the circular economy, however, ensuring or facilitating the “material” recycling of waste in the product sector is of key importance. The chemical industry, often the most important upstream supplier, plays a key role in this. The chemical industry has always had relevant products in its portfolio. However, some of these were more complex to produce and therefore more expensive. In the market environment of many industries to date, there has been a lack of willingness to pay on the part of customers. Here the weights are currently shifting from “can” to “must”. The materials / products of the chemical industry “must” be better recyclable, otherwise they can be sold less or not at all from the perspective of the future. In addition, recycling processes, such as “chemical recycling”, must be further developed to ensure the recovery of complex waste materials. In this context, the chemical industry can make an important contribution to enabling circular economy and the customer industries explicitly want the industry to significantly expand this contribution in the future.

More intensive interaction
along the added value chain

Recycling and circular economy require more than innovative materials. It is crucial that the recycling aspect is already taken into account in the design of the end product (design-to-recycle). This must also always be done from the point of view of “design-to-performance”, so that the products can also be marketed with regard to the requirements of the market for other product characteristics. This requires more intensive cooperation and coordination between all companies in an added value chain than is often the case today. For the chemical industry, this necessity will also make the business model more complex and at the same time increase the pressure to disclose the compositions of materials (see also 6.5 Guarantee Transparency).

6.4 Establish life cycle perspective

Implement optimisation
across added value chains

The implementation of ecology and sustainability requires more than the assurance of functioning circular economy. In principle, this involves ecological optimisation along the entire added value chain or the entire life cycle of the respective products with regard to clearly defined targets (e.g. CO₂ consumption). This optimisation is taking place to some extent today, for example in the automotive industry. The ongoing discussion about the CO₂ consumption of electric versus petrol vehicles from production through use to recycling highlights these approaches. In many other industries, manufacturers at every stage of the added value chain, including the chemical industry, are optimising their operations, often without taking into account the consequences for subsequent stages. However, the sum of the individual optima does not necessarily represent the overall optimum. In this respect, there are still large reserves with regard to the ecological optimisation of added value chains, also beyond the recycling aspect.

Many companies in the customer industries are planning to make further progress on the path of holistic optimisation. The chemical industry, often the most important upstream supplier, plays an important role in this. The requirement for the chemical industry resulting from this plan is to open itself even more to a life cycle perspective that spans all added value chains. Comparable approaches are already in use in the automotive industry and are being developed in the housing industry.

As already mentioned in 6.3, the prerequisite for implementation is not only the creation of comprehensive transparency, but also a more intensive exchange with upstream suppliers and customers of the company’s own products.

Define clear objectives

In addition, the definition of a clear objective is a key prerequisite for ecological optimisation across the added value chain and life cycle. This objective is usually set by the end customer and/or by the state, thus also defining the priority objectives for manufacturers active in the respective chain.

However, the analysis of developments in the customer industries has shown that the priorities in the industries are different. While in some industries the avoidance of hazardous substances is the top priority, in others it is the reduction of

CO₂ consumption over the product life cycle or the improvement of recyclability as well as the further development of recycling technologies. As a result, many companies in the chemical industry that supply different customer industries now have to meet different priorities. Companies must learn to deal with these different priorities and define their individual ecological target hierarchy based on their customer portfolio. In extreme cases, this could result in similar materials/ products having to be manufactured for different customer industries using different production processes (e.g. CO₂-optimised for some and pollutant-optimised for others). There are also clear indications here that more flexible production, possibly in smaller units, could become one of the future match winners (see also 6.8 “Produce more flexibly”).

The state and/ or the EU also define ecological targets (e.g. via limit values or the volumes of CO₂ certificates). The hierarchy of objectives is not always clear even with these requirements, which can become a challenge, particularly in the case of conflicting objectives. According to the view of the customer industries, it would be desirable if the chemical industry were to make even greater efforts to harmonise/ prioritise environmental requirements on the part of the state.

6.5 Guarantee Transparency

Growing transparency requirements from various sources

The industry analysis has shown that transparency requirements will increase significantly in the future. In some industries (e.g. food), transparency is even the most important requirement for the chemical industry. At the same time, new standards are being defined and demanded by politicians and NGOs. The desire for transparency includes various dimensions. On the one hand, this means understanding “what” the respective product contains (see also 6.6 “Avoid hazardous substances”). In many cases the driver is the protection of health (Does the wall paint contain solvents? Have biocides been used in the production of the pullover? etc.). It also means understanding “how” the product has been produced (see also 6.7 “Comply with social/ ethical standards”). For example, this involves whether environmental standards have been complied with, etc. In some industries, the question of “where” the product has been manufactured or “where from” the raw materials used in its manufacture come from is also playing an increasingly important role. For example, chemical companies that use natural raw materials in their production processes are experiencing increasing demand for the use of regional products.

In addition to these requirements, the desired optimisation of the circular economy and improved ecological optimisation along the added value chain also require more transparency in the cooperation between manufacturers at the various stages of a product’s added value chain.

Today, the chemical industry complies with all statutory transparency regulations (e.g. safety data sheets). However, the described future transparency requirements of the customer industries go far beyond the legal scope defined today.

Paradigm shift towards disclosure of recipes

The customer industries are aware that the demand for more transparency collides with the legitimate interest of the industry in protecting its know-how (e.g. recipes). Nevertheless, the demand is “non-negotiable”. Some companies in the customer industries already operate with positive or negative lists and arrange for the provided chemical products to be checked by external service providers. The chemical industry must therefore quickly look for solutions that are equitable for both parties.

On the other hand, it is argued that the restraint of recipes is no longer up to date, as ultimately any composition can be deciphered on the basis of modern analytical methods. The restraint of recipes therefore only guarantees apparent protection and could therefore also be abandoned altogether. In many companies in the chemical industry, the discussion has not yet been concluded, as disclosure would represent a fundamental paradigm shift.

Managing transparency – the technical dimension

The willingness to provide data is an important requirement for transparency. The second is to also be able to provide these data. The variety of products in many companies today is already so high that the provision of product safety data sheets and other product documents becomes a challenge. The analysis has shown that product diversity will continue to increase in the future (see 6.1 “Intensify thinking in solutions”). At the same time, the volume of required data per product will increase significantly. The efficient management of master data will thus perspective become a differentiating element in competition and companies in the chemical industry should invest in a corresponding increase in the performance of their processes and systems.

6.6 Avoid hazardous substances

“Ecolonomy” as maxim

The desire for more naturalness is an important trend in many industries. It is even the dominant development in some industries. The desire for more naturalness goes hand in hand with the desire for the use of fewer hazardous substances. Whether these substances are actual hazardous substances or perceived hazardous substances is irrelevant. Companies in the customer industries are responding to this need of the end consumers with individual sustainability strategies in which either certain additives are prohibited for their products or the chemicals that will still be permitted in future are defined via positive lists. Politicians are also reacting with further regulatory interventions. Many chemical additives that are still accepted today – from certain ingredients in plastics and artificial sweeteners in beverages to titanium dioxide as a food additive – may no longer be accepted. The chemical industry must adapt to meet this desire for more naturalness. It means creating a better harmony between nature and economy (“Ecolonomy”).

Starting the changeover

A new phase of differentiation in the chemical industry begins when the described trends take effect. Proven technologies and product ranges will lose some of their importance. The individual innovative strength of the companies will decide who can provide the required substitutes the quickest. The beginning of the changeover begins with an open exit.

Similar to the automotive industry, the change of technologies could be accompanied by a phase of uncertainty. Initially, high investments are required, the return on which is uncertain as long as “the” future technology has not yet been found. One example is the discussion of future drive technologies in the automotive industry (battery-powered cars versus those with hydrogen fuel cells), which also has impacts on the research and investment strategy of chemical companies. At the same time, volumes in traditional technologies and product lines will decline. Falling volumes in the core business coupled with simultaneous high start-up investments in new technologies also mean that the industry could be facing a phase of declining returns. This phase will enter a new phase of growth as soon as the new technologies are stable.

6.7 Comply with ethical and social standards

“Higher level responsibility”
as driver of development

Compliance with ethical and social standards (from occupational health and safety standards and equitable remuneration to environmental standards in cultivation and the mining of raw materials) is very important in all customer industries. The closer the products are to the end customer (e.g. clothing, food), the higher the priority. Many companies have already set up their own certification and auditing processes in order to monitor their respective suppliers accordingly. Partly this is done with inhouse resources, partly by using specialised service providers. Overall, there is a development towards a “higher level of responsibility” that goes beyond one’s own product.

As an important upstream supplier to most industries, the chemical industry must ensure compliance with these standards in its own production and also at its upstream suppliers. An important example is the mining of critical raw materials such as cobalt, nickel, etc., which are needed, for example, to manufacture batteries. The objective here is to ensure that the raw materials originate as far as possible from industrial production that complies with the relevant standards. The chemical industry must therefore also continue to invest in the certification and auditing of suppliers beyond the already established processes and make the results available to its customers in a transparent manner.

6.8 Produce more flexibly

“Numbering Up” instead
of “Scaling Up”

The customer industries are demanding more innovations to solve their individual challenges. The development of these individual solutions will primarily require other innovation processes. The willingness to experiment, test at an early stage and, if necessary, develop prototypes to the end together with the customer will have a different importance than today. But the new products not only have to be developed, they must also be produced – initially in small quantities. The decisive factor will therefore be the ability to control risks with new products via more flexible and smaller production units. Many companies in the chemical industry today do not have this capability, or only have it to a limited extent, in view of the existing processes and production architecture (“world-scale philosophy”).

Meeting the future requirements of customer industries therefore also requires a rethink in production up to the further development of business models. Smaller, more flexible plants will have to supplement large, existing plants. The challenge will be to profitably integrate these smaller plants into the existing process worlds. In some cases this will be mutually exclusive and may require the establishment of new companies on greenfield sites. “Medium-sized/flexible structures” will be partially superior to large-scale industrial solutions in this area. At the same time, the entry into such structures means the entry into the restructuring of the business model. If new products prove to be successful, the smaller plants could be supplemented by further plants. In the future, the “Numbering Up” could at least partially complement the traditional “Scaling Up”.

Make greater use of start-ups

In many industries, start-ups are systematically used as input providers to question and optimise in-house processes and business models. However, according to the surveyed experts, start-ups in the chemical industry have so far only been used to a limited extent for this purpose. On the one hand, this can be due to the fact that the necessity of acquiring knowledge from outside and producing more flexibly is not yet perceived as a key requirement for the future. On the other hand, the “small” solutions of many start-ups do not fit into the current process worlds of many companies in the industry.

In the opinion of the interviewed experts, the chemical industry should cooperate more closely with start-ups, because they can provide impulses for meeting the described requirements better and faster. Therefore, making greater use of start-ups is not a classic requirement of the customer industries, but a recommendation from the chemical industry itself.

6.9 Rethink business models

New requirements for the industry business model

In many areas, the described requirements of the customer industries could provide impulses for further development of the business model of the chemical industry:

- Developing more individual solutions requires not only new approaches in research and development, but mainly also more flexible and smaller production units (see 6.1 and 6.8).
- A strengthening of the end customer perspective could be associated with a change of perspective from a pure “fact orientation” to a stronger “demand orientation” (see 6.2).
- Further optimisation of the circular economy requires even more intensive communication and interaction with customers and suppliers than is often the case today (see 6.3). This interaction must be mapped in sales and development processes.
- Meeting different priorities in different customer industries (see 6.4) could result in further differentiation in the product portfolio and production structure as well as in recycling technology beyond the scope described in 6.1 and 6.8.
- The growing transparency requirements could cause a fundamental paradigm shift, the disclosure of recipes (see 6.5).
- The reduction of hazardous substances could require the introduction of completely new technologies and production processes (see 6.6), e.g. the introduction of new added value chains based more strongly on natural raw materials.
- Compliance with ethical and social standards in own supply chain will partly require additional certifications and audits of suppliers (see 6.7).

Industry-specific developments with further impacts

In addition to these impulses, which can be derived directly from the requirements of the customer industries, there are a number of other expected developments in the customer industries that could have an impact on the positioning of companies in the chemical industry:

- The establishment of an effective circular economy will not be feasible without “leasing” or “product as a service” solutions. This means that the business models in the customer industries will continue to change in some cases.
- The creation of an efficient circular economy could also result in an increase in the service life of some products, with a corresponding impact on the volumes of upstream suppliers.
- The creation of an effective circular economy will additionally result in “round stream chains” with completely new requirements from today’s added value chains.
- Furthermore, an effective circular economy will require suitable recycling technologies, particularly for complex waste materials. Chemical recycling can make an important contribution by complementing traditional mechanical recycling processes in an appropriate way.

Conclusion: Start search for new business areas

Overall, the chemical industry faces major challenges. Many proven technologies and products will lose their importance. New technologies and products must be developed. However, the solutions must be more individual than in the past. The range of the product portfolio will continue to increase and the volumes per line will reduce. Costs and complexity will increase for a transition period.

The chemical industry thus faces similar challenges to those currently facing the automotive and energy industries. The issue is how the business model can be further developed against the background of these developments in order to make the industry fit for the future.

6.10 Improve communication

More active marketing of added value of own products

The performance and added value of products from the chemical industry are undisputed from the point of view of customer industries (e.g. plastics for food packaging). However, these positive product characteristics are often not perceived in the public discussion and are partly overshadowed by negative associations. These negative associations are partly responsible for the pressure to change that many customer industries are exposed to. They would therefore like to see significantly improved communication of the industry, not only to the public and politicians, but also to customers and suppliers. In essence, the aim is to make the added value of its own products more understandable for the layman and the public. As already described in 6.2, a change of perspective from a purely “factororiented” approach to one that also takes more account of “emotional” aspects could help here.

Intensify communication with customers, suppliers and other partners

In addition to the content dimension of communication, the customer industries also want the chemical industry to increase the intensity of its communication. Meeting the future requirements of the customer industries (e.g. in order to further optimise the circular economy) requires an intensive exchange between all stakeholders along the added value chain. According to the customer industries, today’s communication performance of the industry is often not sufficient for this.

Growing transparency requirements are also forcing a reassessment of communication. Today, the chemical industry provides all the information required by law. However, some customers would like further information. The industry is therefore partially perceived as not transparent. As transparency will become an indispensable prerequisite for competitive success in the future, the customer industries also recommend a rethink here.

