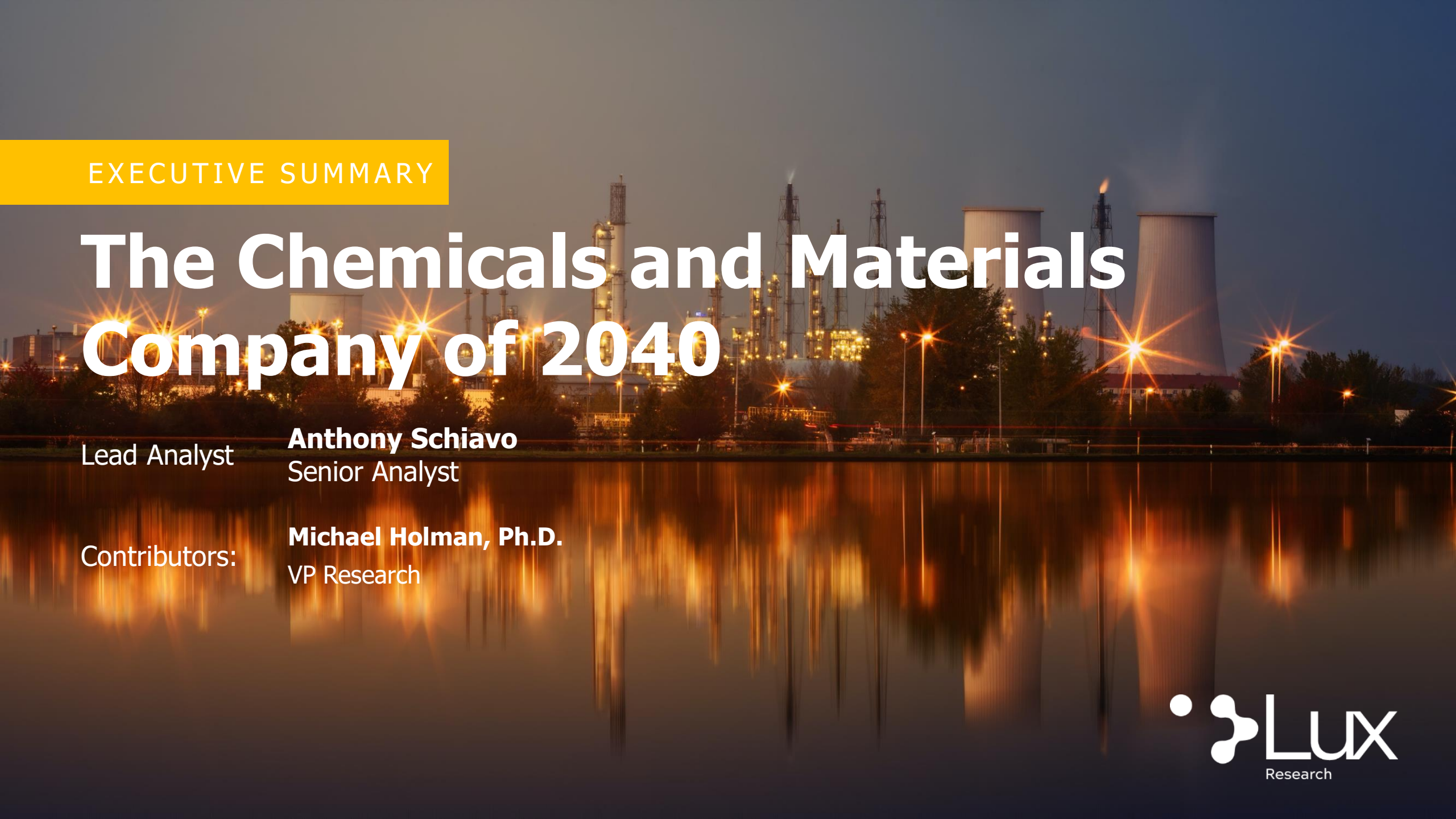

EXECUTIVE SUMMARY

The Chemicals and Materials Company of 2040

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Executive Summary

Global megatrends – changes in feedstock and resources, sustainability, changing consumers, and digital transformation – are challenging the chemicals industry to learn new skills and adopt new goals. The impacts of climate change and digital transformation will be substantial – as the chemicals industry is forced to adopt the circular economy waste plastic will become the most valuable feedstock. This will create a more decentralized industry that relies increasingly on economies of multiples. At the same time, digital sales platforms will commoditize customization, eroding the difference between specialty and commodity businesses. Ultimately the chemicals industry will be forced to shift away from a decision-making framework that prioritizes shareholder value as the only meaningful outcome.

Global megatrends will challenge the core operating principles of the chemicals industry over the next 20 years

The modern materials and chemicals industry began to emerge around 150 years ago, with many companies starting in the 19th century with a single or few products and steadily broadening activities through research and acquisition to encompass a diverse range of chemicals. Throughout this history, chemicals companies have continuously honed a handful of core skills (R&D, operations, sales, and acquisition) to achieve two basic goals – increase sales volumes and increase profits. The industry has gotten quite skilled both at moving and transforming materials, and at marshaling the necessary information to successful manage vast global operations, to achieve these goals – leading both its suppliers and customers on total shareholder returns for much of the 21st century so far.

However, **megatrends that are now confronting the chemicals industry are not just forcing it to adopt new skills but also to develop new goals, both beyond and in tension with volume growth and profits.** Concerns about, and the impacts of, climate change and other environmental issues like plastic waste are forcing the industry to rethink the *flows of materials,* while consumer attitudes and the rising economic importance of digital technologies are changing how it needs to approach *flows of information.* In this report we break down the forces pushing change in the chemicals industry, and provide guidance in terms of how specific subsectors will need to respond – and consider how these forces will challenge the core goals and philosophies of the industry.

Four megatrends are driving changes for chemicals and materials companies through 2040

The pressures forcing fundamental change in the chemicals and materials industry are coming from these megatrends, two each impacting mainly the flows of materials and flows of information.

Flows of materials

Feedstock and resources

The chemicals and materials industry will be transformed as external pressures, and changes in adjacent industries like oil & gas, shift the nature of the feedstocks and processes it will use, and as resources like water and energy present new challenges.

Sustainability

The chemicals and materials industry must solve key end-of-life issues such as plastic waste while addressing CO_2 emissions & feedstock sustainability. Firms need to implement sustainability-driven changes in their own operations and deliver products that enable sustainability for their customers.

Flows of information

Changing consumers

Rising demand from consumers for products with greater personalization, cleaner ingredients, more functionality, and better sustainability drives material innovations. Firms with consumer facing brands and those supplying them must be ready to meet these fast-changing demands.

Digital transformation

Digital design and manufacturing tools can accelerate commercialization timelines and create new digital business models for materials. Successful firms will use these digital technologies to improve their operations, business models, and markets.

Sustainability needs will force the chemicals industry to decouple consumption and revenue growth

DRIVERS

Government regulations, consumer sentiment, investor pressure, and simple physical limitations are converging to force chemicals firms to focus on improving sustainability. The spotlight will fall on CO_2 emissions, plastic (or other) waste, impacts from use of water use and natural resources, as well as pollution. What's more, the most sustainable option for many customers is to use less, and as digital technologies and other innovations that enable lower consumption come to market many materials could see volumes fall.

IMPACTS

Chemicals companies will need to invest in more sustainable production approaches that consume fewer resources, like CO_2 to chemicals, 3D printing, and recycling. To grow despite headwinds against consumption they will need to either align to markets that will be resistant to the trend (such as production of food ingredients) or find business models like outcome-based selling that decouple revenue growth from sales volumes.

KEY TECHNOLOGIES

3D Printing

Digital Transformation

CO_2 to Chemicals

Recycling

Digital transformation creates more transparency and new business models for the chemicals industry

DRIVERS

The explosion of digital technologies has made it possible to collect more data on the physical operations of the chemicals industry than ever before. At the same time, digital sales platforms are enabling far more transparency into the flows of goods and money, as well as the buying behaviors for customers in the industry.

IMPACTS

The growing volume of data both about internal operations and external customers presents a tremendous opportunity for firms in the industry – but also a frightening threat of losing competitive position for any company that is slower to exploit it than existing or emerging competitors. The most notable impacts of digital transformation will be in the business models, where new tools and data will be crucial to enabling service-based and outcome driven business models to help the chemicals industry maintain growth in the face of lowered consumption, and to deliver customized products to smaller and smaller market niches.

KEY TECHNOLOGIES

Digital Sales Platforms

Industrial IoT / Industry 4.0

Materials Informatics

Lab Automation

These technologies will impact the business models of chemicals industry segments

The force of these megatrends will be felt differently by different types of chemicals and materials firms, so we've divided the industry into the segments below, considering the resources used to produce the materials, the level of commoditization in their markets, and the final use of the materials. While the breakdown is not exhaustive – and while many firms have businesses in multiple segments – the goal is to provide a representative framing that helps to think through the effects on different businesses. In the following slides we highlight how these businesses will change as a result of the megatrends.

Industry segment	Example products
Commodity inorganic chemicals	Ammonia, chlorine, phosphates, etc.
Commodity organic chemicals	Propylene, ethylene oxides, methanol, xylenes, etc.
Commodity polymers	Polypropylene, polyethylene terephthalate, etc.
Specialty organic chemicals	Surfactants, coatings additives cosmetics, food additives, paper additives, etc.
Specialty polymers	Engineering polymers, coatings, adhesives, etc.
Consumable chemicals	Agrochemicals, water chemicals, process chemicals, cleaning chemicals, etc.

SEGMENT ANALYSIS: Specialty polymers

Informatics, digital sales, and 3D printing alter landscape

Flows of materials

Sustainability concerns – while nontrivial – will not drive major changes in material flows in this sector as volumes are smaller, and recycling is much more challenging. Moreover, there are fewer opportunities for bio-based polymers relative to the commodity sector both due to the relatively low number of performance biopolymers as well as the lack of alignment between biopolymer's advantages – such as biodegradability – and the needs of the specialty polymer segment. A more notable shift will come from the rise of 3D printing, which has the potential to compress the supply chain: With the rise of online selling, chemical companies can sell printable materials directly to manufacturers instead of distributors.

Flows of information

Specialty polymers will be the most impacted by changes in flows of information. Materials informatics will enable faster and easier development of customized formulations, dovetailing with growth in digital sales platforms, which will enable high performance and customized materials to be sold online with a minimum of human intervention. At the same time, digital design tools and 3D printing will more tightly tie the process of materials selection with product design. Materials will be designed to meet specific product needs; the growth of MI and DSPs will enable this to occur for increasingly smaller volume products.

OUTLOOK: Specialty polymers

Shifting value chains as leading players move downstream

Level of disruption: High

Key megatrends: Feedstock & resources | Sustainability | Changing consumers | Digital transformation

The specialty polymer space will be pulled in multiple competing directions by the forces of business model transformation. On one hand, the combined capabilities of MI and DSPs will make it easier to provide its usual services, such as formulation customization and technical support, through low-touch, low-cost online channels. A growing number of end users will seek out these new channels to secure the lowest cost polymers for themselves.

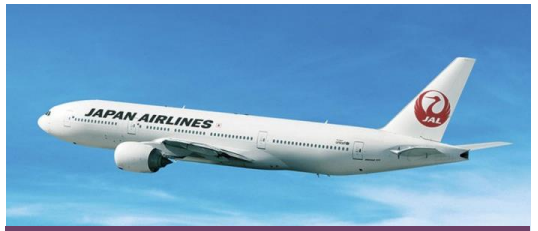
Specialty polymers companies, like specialty chemicals companies, can respond to this by positioning themselves as premium providers by offering more intensive in-person support combined with digital tools. But unlike specialty chemicals, polymers players have another option: move downstream and become manufacturers themselves. This move makes the most sense where material properties and manufacturing methods are closely tied, as access to proprietary materials translates into novel manufacturing capabilities and products. There are already examples of this strategy – BASF acquiring Sculpteo in 3D printing, or Teijin acquiring Benet Automotive. While not as catastrophic as some the changes in other areas, specialty polymers players will nonetheless be forced to evolve their business models to survive.

OUTLOOK

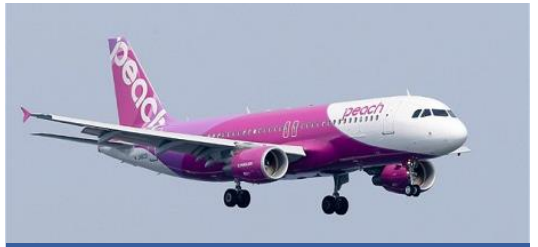
The chemicals industry will split into high-touch and low-touch business models

The commodity and specialty business are mostly distinguished by standardization vs customization. **Digital sales platforms will erode these differences by *commoditizing customization,*** making it easier to bring a degree of customization even to commodity materials, while lowering the cost (and differentiation) of customization in specialties – leading to new shades of gray between the two models.

There will be an airline-like split between premium chemical companies and budget chemicals companies. Premium and budget airlines will both carry you from Bangkok to Tokyo, but there is a huge difference in comfort, reliability, and price. Similarly, there will be budget chemicals companies that will sell high purity specialized materials, but customers will have to rely on automated tools for materials selection, product development, and post-sale support in return for rock-bottom prices. At the same time, chemicals companies will offer premium services in which they will take on not just traditional specialty chemical services such as formulation development and manufacturing assistance but become deeply involved in product development with their customers. This privileged support will help end users stay on the cutting edge of materials and product development, while reducing their risk and needing less internal expertise.



Flag carrier



Low-cost carrier

Lux Research

OUTLOOK

Sustainability, climate change, and the digital economy are direct challenges to chemicals' profitability

The most "sustainable" material is one that is never produced, as it consumes no water, feedstock, or energy and creates no waste. This fact is in direct tension with materials and chemicals businesses today, which must sell more materials in order to make more money. Users materials in every industry – from automotive to packaging – will be looking to consume less. At the same time, the value of products and the economy as a whole is shifting away from the physical and towards the digital, leaving a smaller slice for materials. **The materials and chemicals industry will be forced to find to decouple revenue growth from increasing sales volumes in order to navigate this change.** This shift may mean adopting business models with lower revenues but higher margins, and or even sacrificing near-term profits and cannibalizing one's own business in order to protect future opportunity.

Even if CO_2 emissions and pollution were halted overnight, **the chemicals industry will still have to deal with this profit issue as digital transformation is a subversive threat to revenue growth and profitability.** Services and capabilities that once required human labor – such as R&D or sales – will increasingly require less labor as they are automated. The chemicals industry will, as a result of these changes and greater transparency in the markets, be able to charge less for these services. This automation of services that once added value will only accelerate commoditization and erode the margins of higher service business models. Combined with challenges to existing advantaged feedstocks, the change will make profitability even more challenging.

OUTLOOK

What steps can we take now to avoid more pain down the line?

The chemicals industry needs to get ahead of changes in its relationship with stakeholders, most notably it's shareholders, to avoid being caught off guard. These changes can be externally motived – by governments or by public opinion – or internally, by shareholders and employees.

External:

- Consumer-facing companies can use their purchasing power to motivate change in the chemicals industry by only buying from companies who meet aggressive climate goals.
- Governments can levy punitive taxes on climate change. The frameworks for this exist – carbon taxes and penalties for pollution – but the prices are too low to motivate real change.
- Nationalization of industry – already common in the energy space - or other forms of asset seizure.

Internal:

- Adopt a legal framework that demands and prioritizes outcomes other than profit. The most notable example here is the B Corporation, which includes climate and social goals.
- Pressure from institutional investors to meet climate goals, even at the cost of reduced profitability.
- Elimination of dividends, stock buybacks, and other forms of shareholder payouts to invest in and subsidize sustainable technologies.

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