



The seventh disruption to the Global Polymer Industry

October 2022

The global polymer industry has historically experienced six disruptions. The seventh disruption is happening today.

Though plastics are everywhere, the global polymer industry is still relatively young. The first fully synthetic plastic, Bakelite, was invented in 1907, and industrial scale expansion of the industry occurred during and after World War II. Due to the combination of product attributes and cost, plastics use expanded greatly for years. Today, all of us interact with polymers nearly constantly – readers of this article are likely wearing plastics in their clothes, are touching plastics with their hands and would find numerous polymers in any direction they look. How many did you see?

Over the past 115 years, we've seen the global polymer industry go through six disruptions, each of which has changed the landscape of competition and created opportunities for value creation. Even more important than the first six disruptions is the seventh – Because we are currently in it.

THE SEVEN GREAT DISRUPTIONS TO THE POLYMER INDUSTRY ARE:



WINNERS

We will discuss who won from each of the seven disruptions.

The first disruption to the global polymer industry was its creation and expansion. The development and commercialization of polymers.

The invention of industrial scale polymerization established the industry.

Large existing chemical manufacturers, such as Dow, expanded from manufacturing assorted chemicals by introducing new polymer products, such as polystyrene.

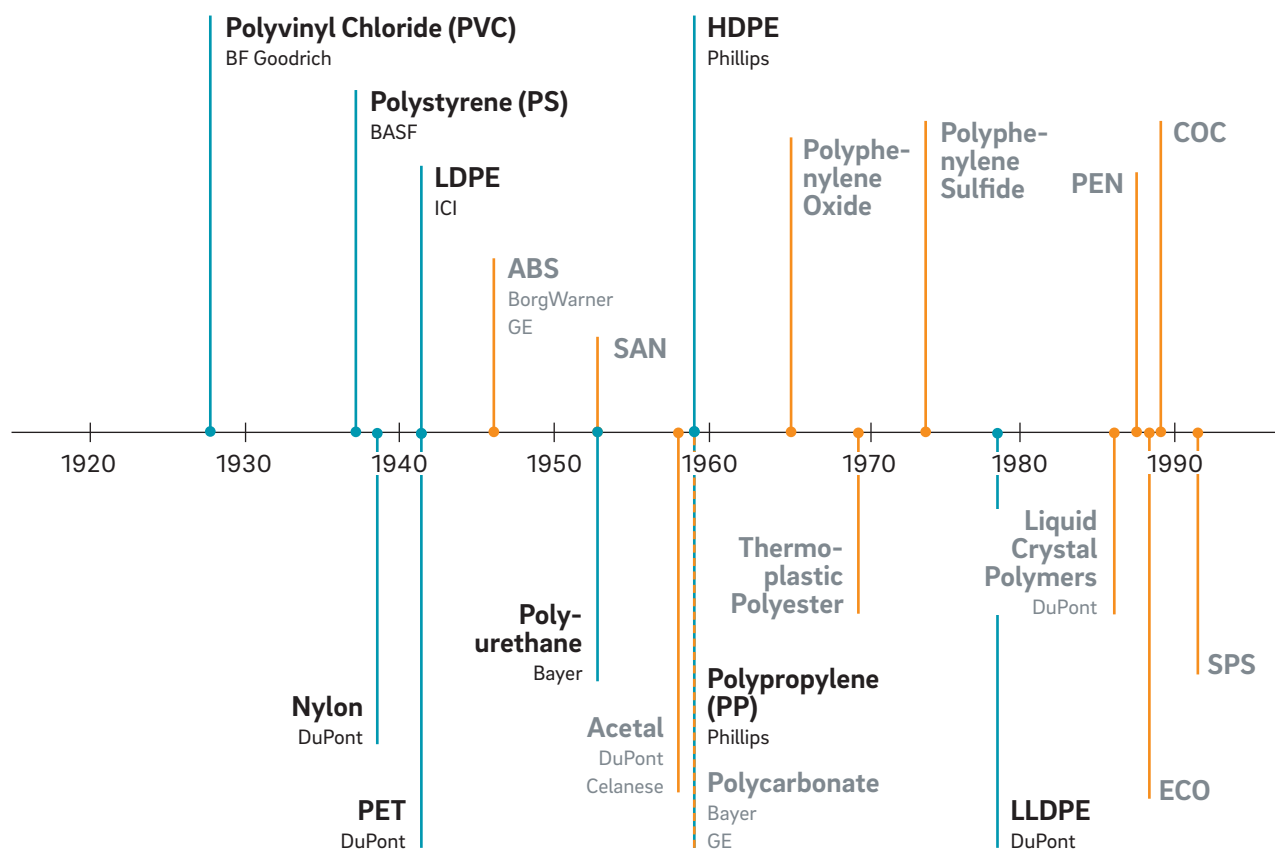
Winners during the period of technology development were companies that could develop and commercialize new molecules and production technologies. This was the era that led to Dustin Hoffman being given the single word of career advice in the 1967 movie, *The Graduate*, "Plastics".

Eventually polymer discovery and product invention slowed and technological changes became more incremental. The first great disruption passed and the industry moved into a more mature phase.

WINNERS

Companies that developed and commercialized new technologies.

POLYMERIC MATERIAL DEVELOPMENT TIMELINE



Second, polymer demand grew due to physical attributes and attractive production economics. Supply increased to match growing demand.

While the second great disruption overlapped with the invention of some polymers' development, the phenomenon was distinct. The use of plastics allowed product manufacturers to improve the cost-value profile of assorted products, which led to rapidly growing demand. This demand was satisfied by growth of productions. The early stages of growing polymer demand included high-end applications, such as polycarbonate airline windshields. Soon polymers were popularized for common goods (e.g., Tupperware), and eventually spread to single use plastics prevalent today.

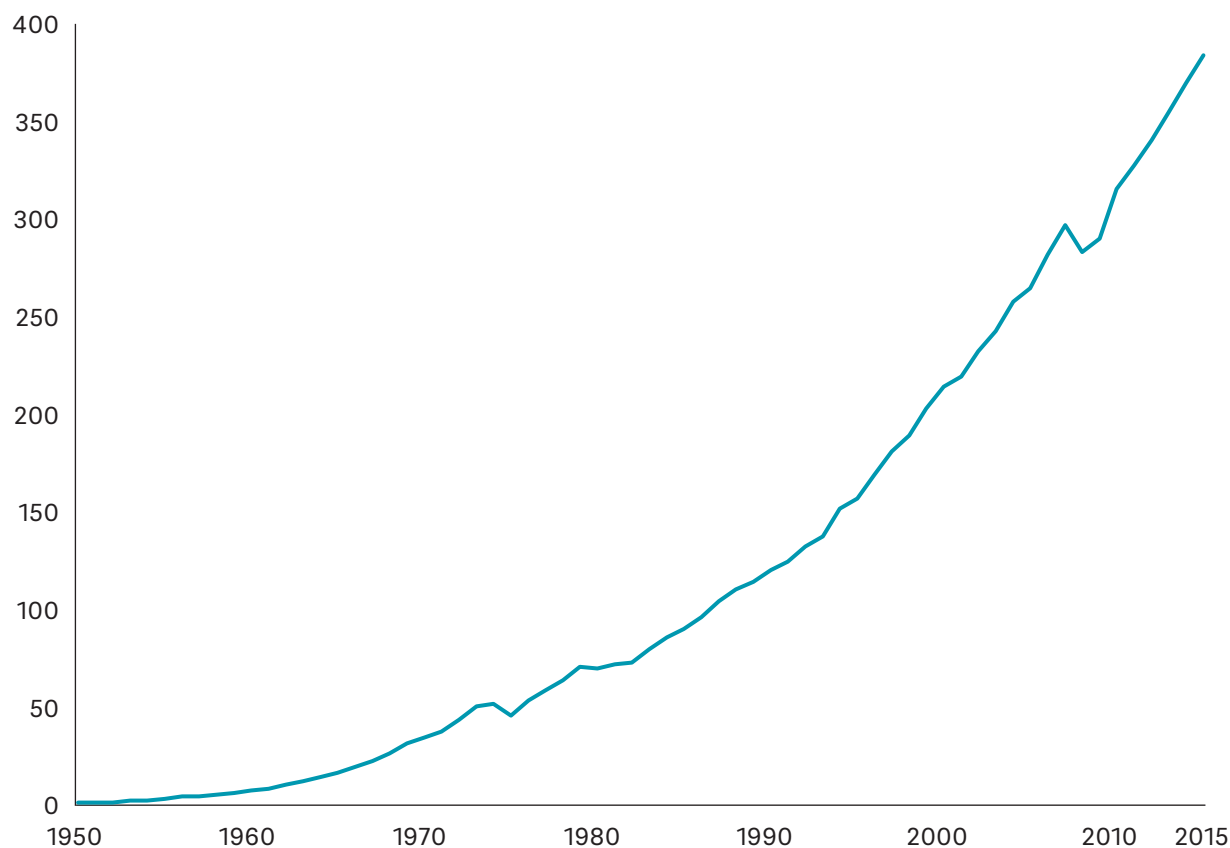
This period of growth led to many winners – a rising tide often raises all ships. Having the ability to meet customer demand was valued.

On a volume basis, global plastic production first broke 50 m tons in the 1970's. The next six additional 50 m tons marks, however, were surpassed faster than this first one – global volume experienced exponential growth.

WINNERS

Companies able to scale up production.

GLOBAL PLASTICS PRODUCTION 1950-2015 [MMT]



Source: Roland Berger

Third, polymer production grew worldwide as technology innovators began licensing technology to emerging firms around the globe.

The acceleration of global volume came from the introduction of both new players and new business models, and leveraged the emerging megatrends of globalization and emerging middle classes.

Technology developers, such as LyondellBasell, began to license their technologies to emerging producers. Instead of building new reactors, technology owners instead set up separate divisions to license the technologies and drive earnings from a second source. This was a strategic success for companies like LYB, who were able to drive value creation in a capital-light way, and also for new manufacturers who no longer needed to invest in costly R&D.

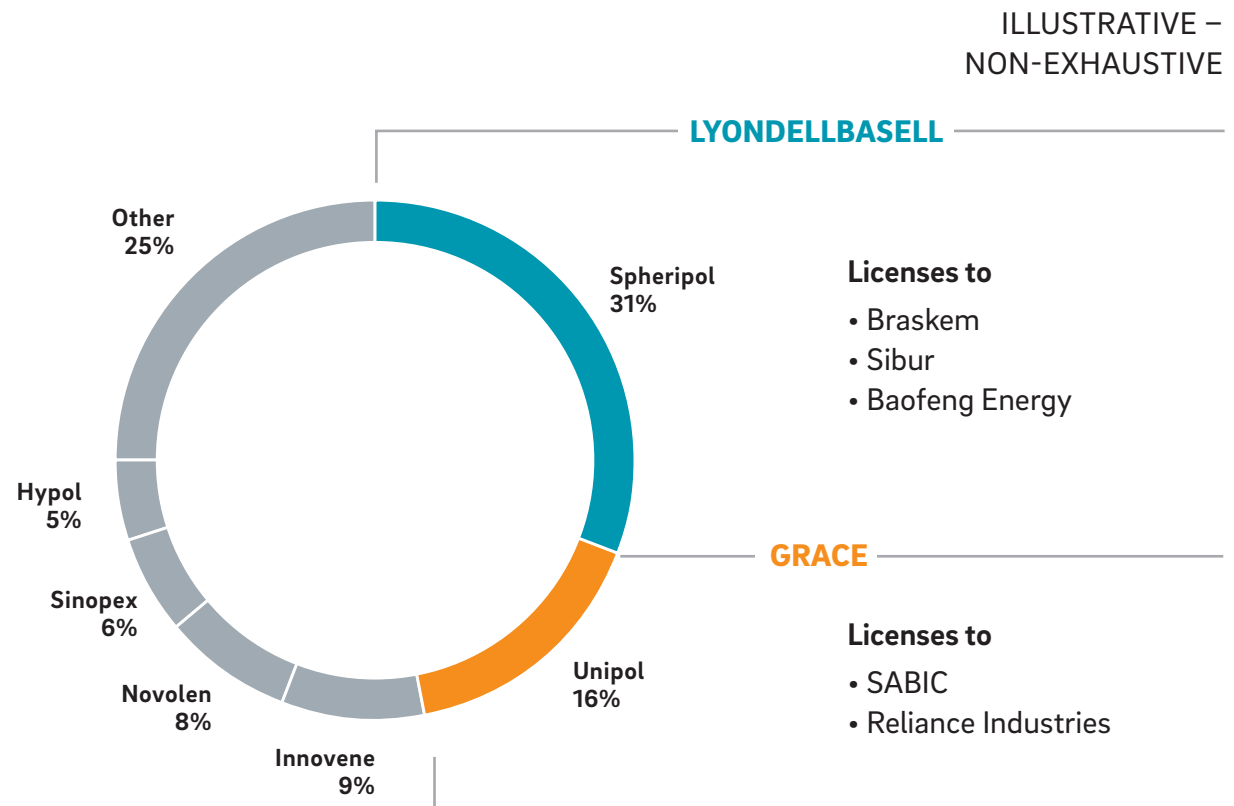
Many licensees were in nations outside of the West. They were able to leverage lower costs and sell resins back to more developed countries, and also develop the polymer industry in their nations as their middle classes, and accompanying purchasing power, emerged.

Today, licensors also are able to aggregate technological advancements from each licensee, effectively outsourcing development costs.

WINNERS

Companies that established licensing revenue streams and companies that developed in less established geographies.

POLYPROPYLENE PRODUCTION BY TECHNOLOGY [%]



Fourth, the Middle East began moving downstream from oil, to petrochemicals and into polymers, leveraging its low cost feedstocks.

Although the company that is now Saudi Aramco was founded in 1933, for years the region produced primarily oil, but not a full suite of petrochemicals or polymers. It was not until 1977 that SABIC was founded. The first SABIC annual report shows ~50 engineers, a site plan for Jubail and ambitions for polyethylene and styrene production, as well as several base petrochemicals and intermediates.

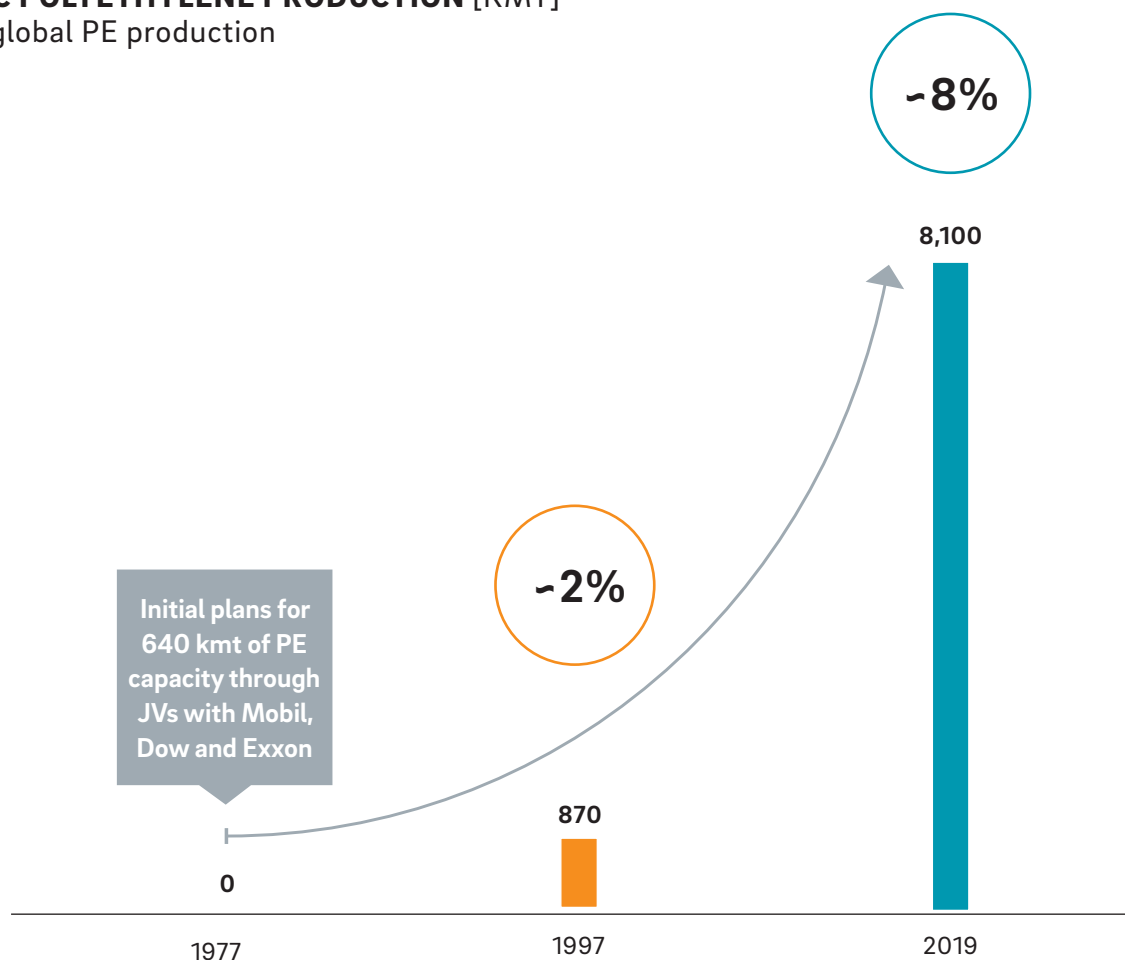
By 2019, SABIC had polyethylene production volume of 8,100 kmt. This development of the Middle East as a downstream producer was enabled by low cost feedstocks, such as ethylene.

The Middle East now serves as a major exporter of polyethylene to the world, accounting for 38% of global HDPE exports in 2020.

WINNERS

Middle Eastern producers and companies participating in development (e.g., Dow, Sadara).

SABIC POLYETHYLENE PRODUCTION [KMT] % of global PE production



Source: SABIC investor relations, Roland Berger

Fifth, the United States experienced the shale revolution, which enabled the US to become a low-cost producer.

The fifth disruption to the global polymer industry turned expected trends of globalization on their head – instead of industry being moved to lower cost countries from the US, the United States suddenly had a cost advantage. Shale gas lowered the production cost of ethylene from ~800 USD/mt in 2008 to ~400 USD/mt 5 years later, which was particularly impactful for polymers that use a significant proportion of ethylene, such as Polyethylene, as well as others, such as PVC. US HDPE developed a ~280 USD/mt cash cost advantage vs. other regions and US exports grew from ~900 kmt to ~4,000 kmt from 2000 to 2020.

During this period, US production costs became lower than W Europe and Asia, allowing the US to take a growing share of global trade. Foreign direct investment also increased, with additional capacity being developed across polymers in the United States.

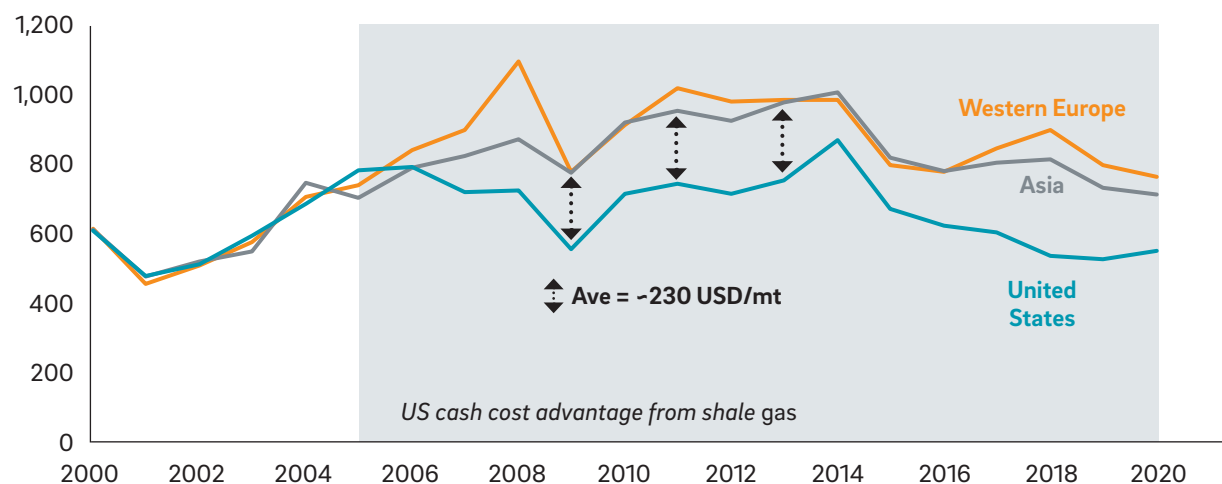
Non-US companies with US PVC

- Shin-Etsu
- Formosa Plastics
- Orbia

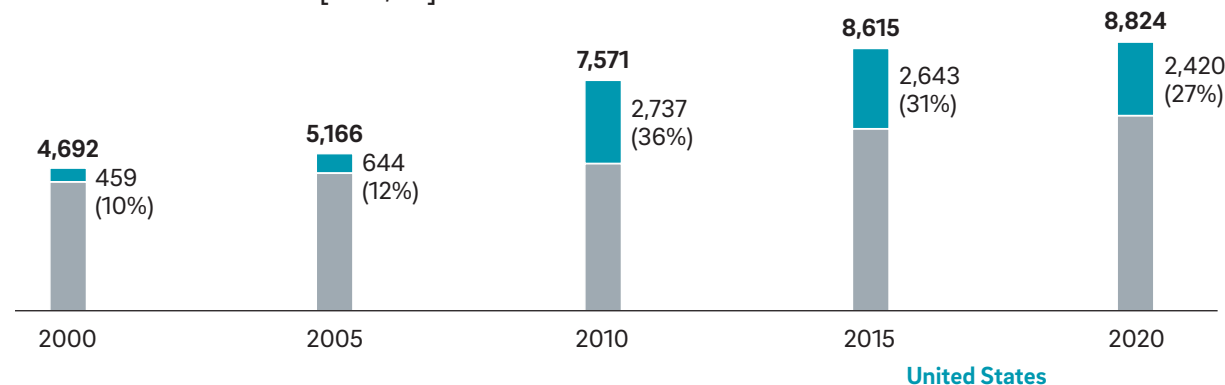
WINNERS

US-based producers that became cost leaders and foreign investment in US production.

PVC CASH COST [USD/mt]



GLOBAL PVC EXPORTS [kmt, %]



Source: IHS, Roland Berger

Sixth, China invested at an unprecedented scale in polymer capacity to become self sufficient, which changed the global balance of trade.

Through China's rapid growth and development in the late 90s early 2000's, a significant proportion of global polymer trade was headed to China. China, however, began to invest strategically into growing its capacity across multiple industries, including polymers. One example of this can be seen in PVC, where China had 3,500 kmt capacity in 2000 and 27,000 kmt capacity in 2020. During this time, China's imports as a proportion of total PVC consumption decreased from 48% to 1%.

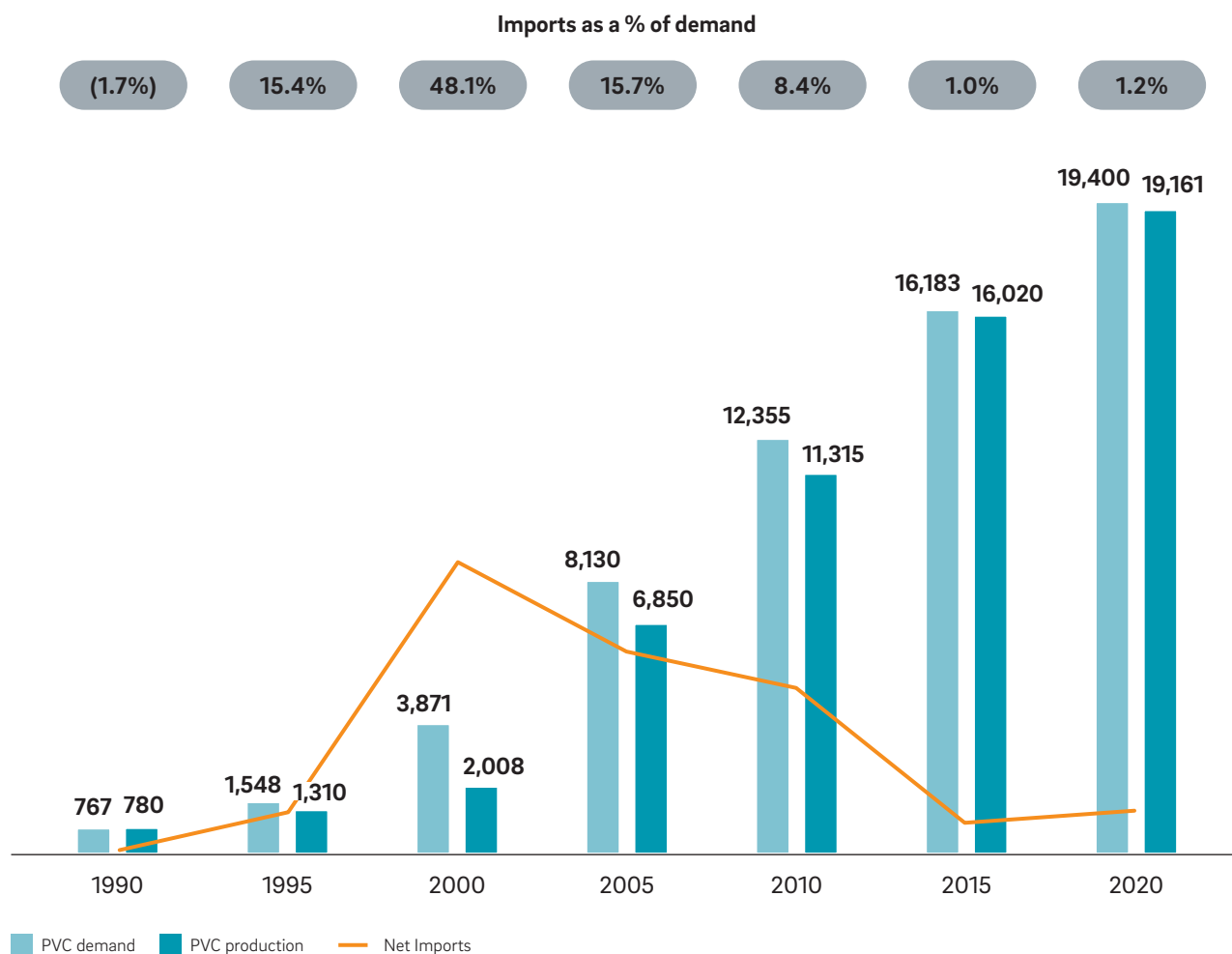
In addition to PVC, China has also developed self sufficiency in other polymers and materials, such as PET, polycarbonate and epoxy.

This led to a negative impact on producers dependent upon China trade, but benefitted local Chinese producers that were able to participate in the domestic market. Winners included growing Chinese manufacturers, as well as Chinese end users, which had expansive domestic capacity as well as imports.

WINNERS

Chinese producers and end users and non-Chinese firms investing in China production.

CHINA PVC PRODUCTION, CONSUMPTION, AND NET IMPORTS [kmt]



Source: IHS, Roland Berger

Lessons learned from each of the past disruptions are still critical for polymer producers today.

Each of the past six disruptions of the polymers industry has provided lessons that are still valid today. Producers that want to establish or maintain their position as a winner need to utilize multiple approaches to ensure lasting success.

That said, not all of these lessons can be used by all producers – companies must use the opportunities they have available, whether they are technological, scale-driven, or related to access feedstock and end markets. Companies that are unable to secure a competitive advantage are likely to find themselves in a position of deteriorating market position.

While these lessons and drivers of success are still valid today and important going forward, the world has become more complex.

There are new requirements for winning that are emerging in today's seventh disruption. The factors in the seventh disruption have the potential to turn the polymer industry on its head and new winners will emerge.

LESSONS LEARNED

	Disruption	Lesson
1	Technology development	Development of new technologies is a pathway to leadership
2	Scale	Scale is a pathway to success and requires process excellence and capital
3	Licensing	Exploit technology leadership globally to sustain position
4 5	Middle East & US Shale revolution	Understand and leverage inherent feedstock advantages to drive growth
6	China self sufficiency	Establish/secure position in growth markets to avoid being squeezed out

Today the polymer industry is at a critical strategic juncture – the seventh disruption. Those that successfully navigate today's challenges will win.

Today's disruption appears to be amongst the most significant in the history of the polymer industry. Instead of just one factor, the industry faces many at the same time.

ESG policies have impacts ranging from potential CO₂ taxes on production and shipment to even more existential concerns related to circularity, such as which polymers should be used.

Energy price volatility is driving shifts in cost curves across regions and creating uncertainty for both supply and demand.

Supply chain disruptions are causing shortages of raw materials, delays in shipments and is causing customers to, at times, reconsider the materials specified into their products.

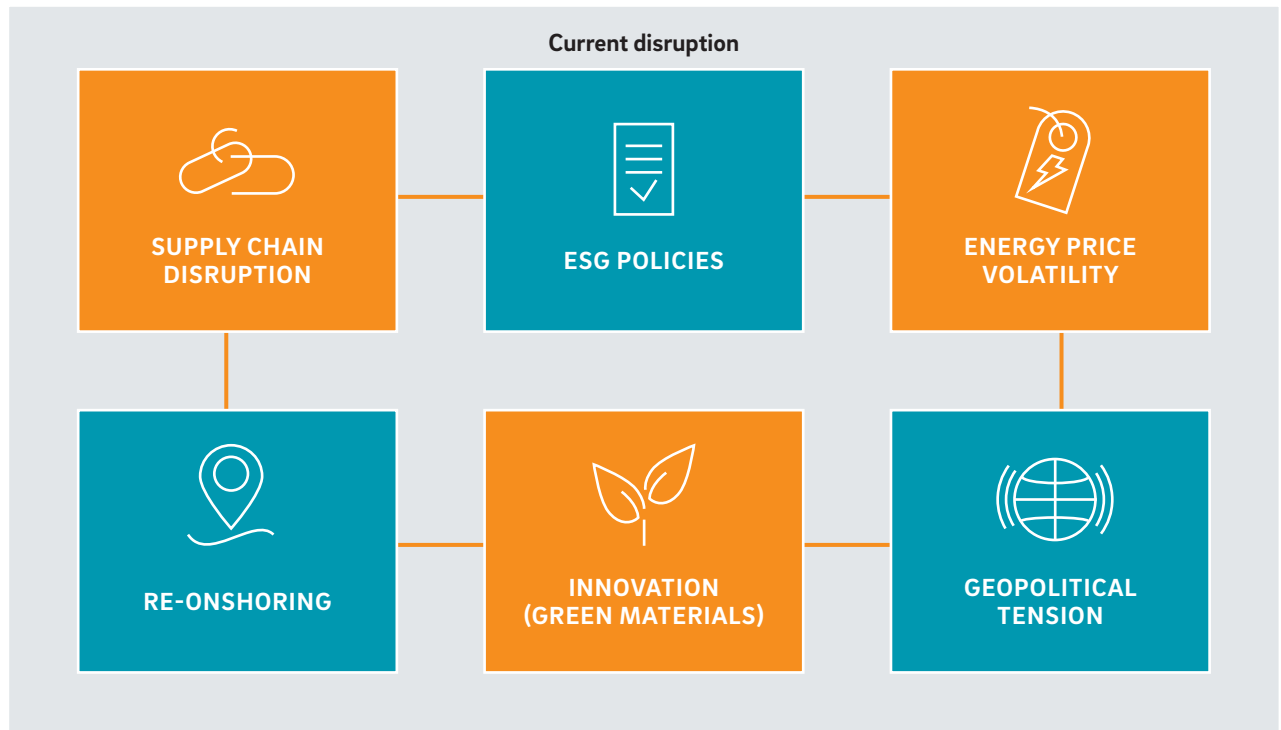
Geopolitical tension is rising, which has led to introduction of higher tariffs, changing trade routes and overall uncertainty.

Re-onshoring is becoming a theme across the industry due to other factors, but the ramifications of decisions today last decades given asset life.

WINNERS

Those who understand risk and opportunities, think clearly and strategically holistically and move decisively.

TODAY'S CHALLENGES



**All factors must be solved for together –
EACH ALONE IS NOT SUFFICIENT**

Roland Berger is uniquely prepared to support clients, with a depth of industry knowledge and functional expertise throughout multiple cycles.

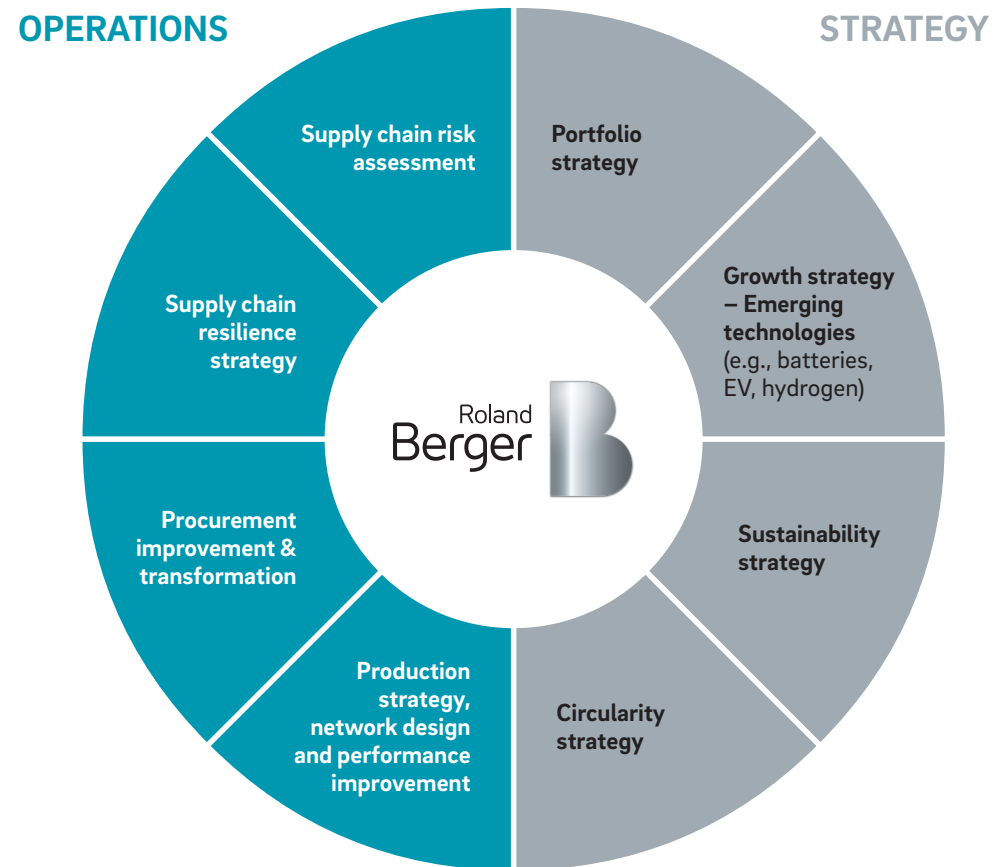
Roland Berger couples depth of industry knowledge up and down the polymers and chemicals value chain with a full product suite, including both strategic expertise, as well as operations knowledge.

As our clients think through the emerging risks of this seventh, current disruption to the industry, two types of work stand out as most urgent.

First, developing an understanding of Operational risks and establishing resiliency.

Second, understanding strategic ramifications of emerging factors today and how impacts will echo throughout upcoming cycles.

HOW ROLAND BERGER CAN SUPPORT



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