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Articles include:

Turning CO_2 into a business opportunity

China's Belt and Road Initiative and the global chemical industry

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Introduction

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Welcome to the 29th edition of REACTION Magazine and the last of this decade! The chemical industry certainly ends the decade in a far better condition than it entered back in 2010. Looking ahead to 2030, with the fundamental changes transforming the world as we know it, it's hard to predict what shape the industry will take in ten years' time, but we'll aim to continue to be there providing insights on the key trends as they arise.

In this issue, we bring you an update on China's Belt and Road Initiative and how that continues to provide opportunities for global chemical producers. We also take a look at the latest trends and initiatives in carbon capture technology and how that may become more important and prevalent over the next decade as we continue to find ways to offset the damage we as humanity are doing to our planet—a topic that's incredibly close to my heart and one that is likely to drive huge amounts of activity in the chemical industry over the next decade.

As ever, our global chemical team remains active in the industry. Over the last quarter it's been great to reconnect with so many of you during visits to China, Japan, and India; you can read reflections on my trips on my KPMG Blog page.

We'll be back with our next edition early in 2020, including articles discussing India and it's circular economy in addition to a follow-up article on cybersecurity within the chemicals industry. If there are any other topics you would like us to cover in future editions of REACTION, please don't hesitate to contact us.

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Turning CO_2 into a business opportunity

By Dr. Martin Gruhlke and Nicolai Kaltwasser

Consumers and public officials are demanding that corporations step up in the battle against climate change by drastically reducing their greenhouse gas emissions, including CO_2. Pressure is only increasing as efforts to date are not enough to hold the average global temperature increase below international goals to prevent irreversible impact on the planet.[1]

In the chemical sector, eliminating fossil-fuel-based feedstocks through carbon capture and utilization (CCU) innovation could go a long way in meeting those goals, but attempts have been hampered by the high cost and immaturity of CCU technologies—until now.

While rising carbon prices cut into the profits and hence the cost advantages that conventional chemical production has enjoyed to date, CCU development is accelerating, with more applications at commercial scale expected to come to market over the next several years. Moreover, as a sustainable process, CCU and its products can draw environmentally conscious customers, command higher prices, attract green investors, and qualify for favorable financial terms to support growth.

As a result, manufacturing CO_2-based chemicals through CCU—once deemed too expensive or even economically risky to pursue—is becoming an increasingly competitive and attractive business prospect.

[1] World Meteorological Association, "Landmark United in Science report informs Climate Action Summit," September 22, 2019.

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Mounting global pressure to reduce carbon emissions

Climate change is now a top if not the leading issue for consumers and governments around the world, and corporate executives and directors have been pursuing more sustainable practices to meet their demands. While the chemical industry like others strives to reduce emissions (and while the products it produces contribute to saving significant amounts of CO_2 further down the value chain), it remains one of the larger producers of CO_2 and other greenhouse gases on a sector basis.

Now growing calls to accelerate emissions reduction by levying carbon taxes at high and increasing rates, combined with elevated carbon pricing as measured by emissions trading systems (ETS), are forcing chemical companies to consider more significant and more urgent efforts to address the problem. In essence, these costs are forcing the chemical sector to expand its quest for carbon reduction beyond the desire for environmental stewardship to include the need to preserve economic viability altogether.

Furthermore, the chemical industry consumes fossil-based carbon both for energy and as feedstock. When the economic, social, and environmental impacts are quantified, the impact can be calculated downstream in other sectors.

Brand owners and other downstream industries simply can't achieve ambitious sustainability goals by modifying their part of the value chain alone. Chemical companies are in a unique position to not only help themselves but also work with their downstream customers and other partners to help them reduce emissions.

The technology available for CO_2 emitters to take significant action has been limited to date, and costs have been prohibitive. But recent developments suggest that's about to change.

Demand for sustainability, by the numbers

Heat-intensive processes make the chemical sector the largest industrial consumer of energy, accounting for **14 percent** of primary demand for oil and **8 percent** for gas. It is also the **third largest** subsector for direct CO_2 emissions.[2]

The International Monetary Fund suggests that carbon taxes of **$75 per ton** are necessary to accelerate emissions reduction.[3]

CEOs across all industries say climate change is the **No. 1 risk** to growth.[4]

The **majority of citizens** in most countries surveyed view global climate change as a major threat to their nation, and their concerns are growing.[5]

81 percent of global consumers feel strongly that companies should help improve the environment. More than **two-thirds** of them consider sustainability when making a purchase, and more than **one-third** are willing to pay **25 percent** more than the original price for sustainable products.[7]

Investors are looking for sustainable investments, pushing assets under management up **34 percent** in just two years to **$30.7 trillion**.[8]

[2] IEA, Tracking Clean Energy Progress, May 2019.
[3] Reuters, "World urgently needs to quicken steps to reduce global warming: IMF," October 10, 2019.
[4] KPMG, 2019 Global CEO Outlook.
[5] Pew Research Center, "A look at how people around the world view climate change," April 18, 2019.
[6] Nielsen, "Global Consumers Seek Companies That Care About Environmental Issues, September 11, 2018.
[7] CGS, 2019 Retail and Sustainability Survey.
[8] HSBC, Sustainable Financing and Investing Survey 2019.

Accelerating carbon capture and utilization technologies

Several carbon capture and utilization concepts have advanced to the point where they are more likely to reach the commercial market—even within the next few years."

Manufacturers and other large energy users have been looking into carbon capture and storage (CCS) for some time. But more attention is being paid recently to carbon capture and utilization (CCU) for its potential to not only reduce emissions but also provide an alternative, sustainable, and CO_2-neutral feedstock.

Drop-in, CO_2-based chemicals can be substituted for petro-based chemicals across many value chains, and there's been a lot of excitement around the development of chemical synthesis and biotechnology processes that can convert CO_2 into other usable substances.

Mineralization can incorporate CO_2 into building materials, for example. CO_2 also can take the place of other products used in food, water treatment, and other industries, as well as be used to produce basic chemicals and fuels, such as methanol. Meanwhile, advances in biotechnology are creating opportunities to use microorganisms to convert CO_2 to produce fuels like methane or butanol as well as other substances, such as algae oil for biofuels and cosmetics.

Currently, most extended CO_2 processing is for simple applications that incorporate the whole molecule. In order to make a deeper economic and environmental impact, technologies that support further processing are required. Unfortunately, while many different technical pathways for CCU are under exploration, three key issues remain.

First, because many technical processes for CO_2 utilization technologies are still immature, tremendous investment is needed to develop them for commercial scale. Second, in order to implement these technologies, companies need to build new assets, including significant costs for both equipment and experienced personnel.

Finally, as the lowest energy carbon compound, CO_2 needs much higher activation energy to be converted than is required to transform high-energy carbon compounds coming from crude oil, such as propane, ethylene, butadiene, benzene, or toluene.

Despite these challenges, CCU solutions have started to develop more rapidly, and several industries including chemicals are looking at the potential to leverage CO_2 emissions to create brand-new business models.

As CCU innovators get closer to overcoming many of the issues preventing workable applications, and the use of drop-in chemicals grows more compelling, companies with significant CO_2 emissions across all sectors need to be ready when solutions become available at scale.

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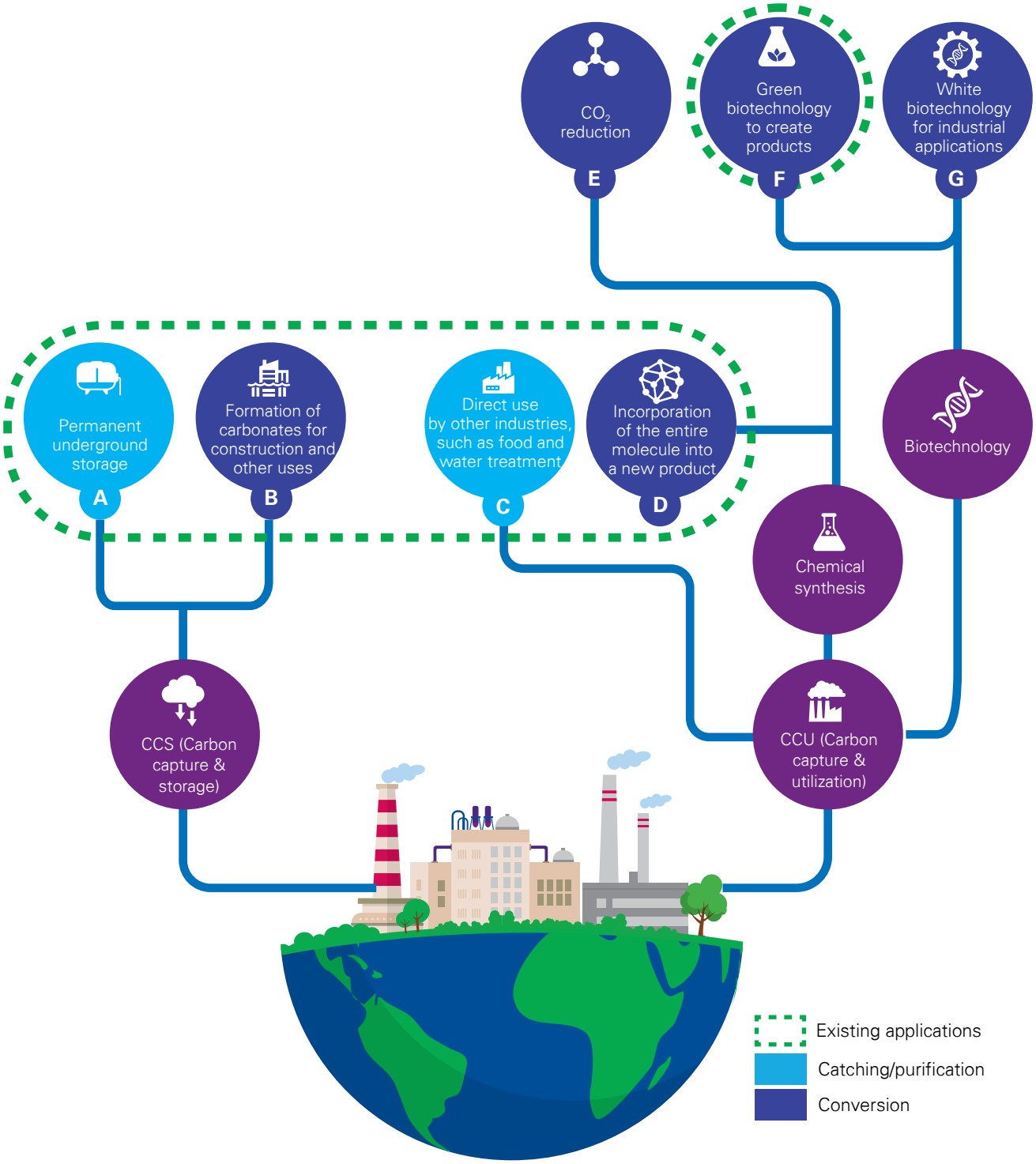
Companies demonstrating CCU applications at a larger scale

Carbon8 Systems treats industrial waste and byproducts with CO_2 from power plant emissions—mimicking natural processes but at a rapid pace—to produce a variety of mineralized products for the construction industry.

Electrochaea exposes coal power plant exhaust and other waste gases to microorganisms that convert CO_2 into methane, which serves as fuel.

Source: Company websites

Existing and developing CO_2 applications



Source: KPMG, CHEManager, May 2019.

Emerging economic opportunity

Several factors make the business reasons for pursuing CCU hard for chemical companies to dismiss.

The rising cost of emitting CO_2 is making conventional chemical manufacturing more expensive.
The higher cost of CO_2-based drop-in chemical production eats into profit margins, making it difficult to produce products that can compete in the market against conventionally produced chemicals. (A)

However, the new and higher carbon pricing will make conventional chemical production less lucrative. The cost of manufacturing processes that continue to emit large quantities of CO_2 will only increase, while a CO_2-neutral producer can avoid the carbon penalty and help cover higher CCU production costs. (B)

Sustainable production creates opportunities for new revenues, premium pricing, and preferred financing terms, as well as attracts investors.
As global attention to climate change increases, sustainably produced products are drawing more consumers who often are willing to pay a higher price to be green. Meanwhile, demand is growing from downstream customers for sustainably produced products to meet their own company's environmental goals.

The cost of doing business also will increase for those companies that continue to emit high levels of CO_2 as more lenders offer attractive financing options (such as lower-interest loans) to companies with sustainable practices and products and as socially conscious asset managers and other investors seek "green" investments. (C)

CO_2-based drop-in chemicals are on track to compete on profitability with conventional chemicals.
As carbon pricing increasingly impacts the profitability of conventional chemical production and drop-in chemicals begin to gain the advantage in the marketplace, companies leveraging CCU have the additional funds necessary to invest in CCU applications while remaining margin-neutral. (D) Over the long term, the advantage for companies applying CCU only grows as costs associated with conventional manufacturing continue to climb and costs for innovative processes decline due to scale and learning.

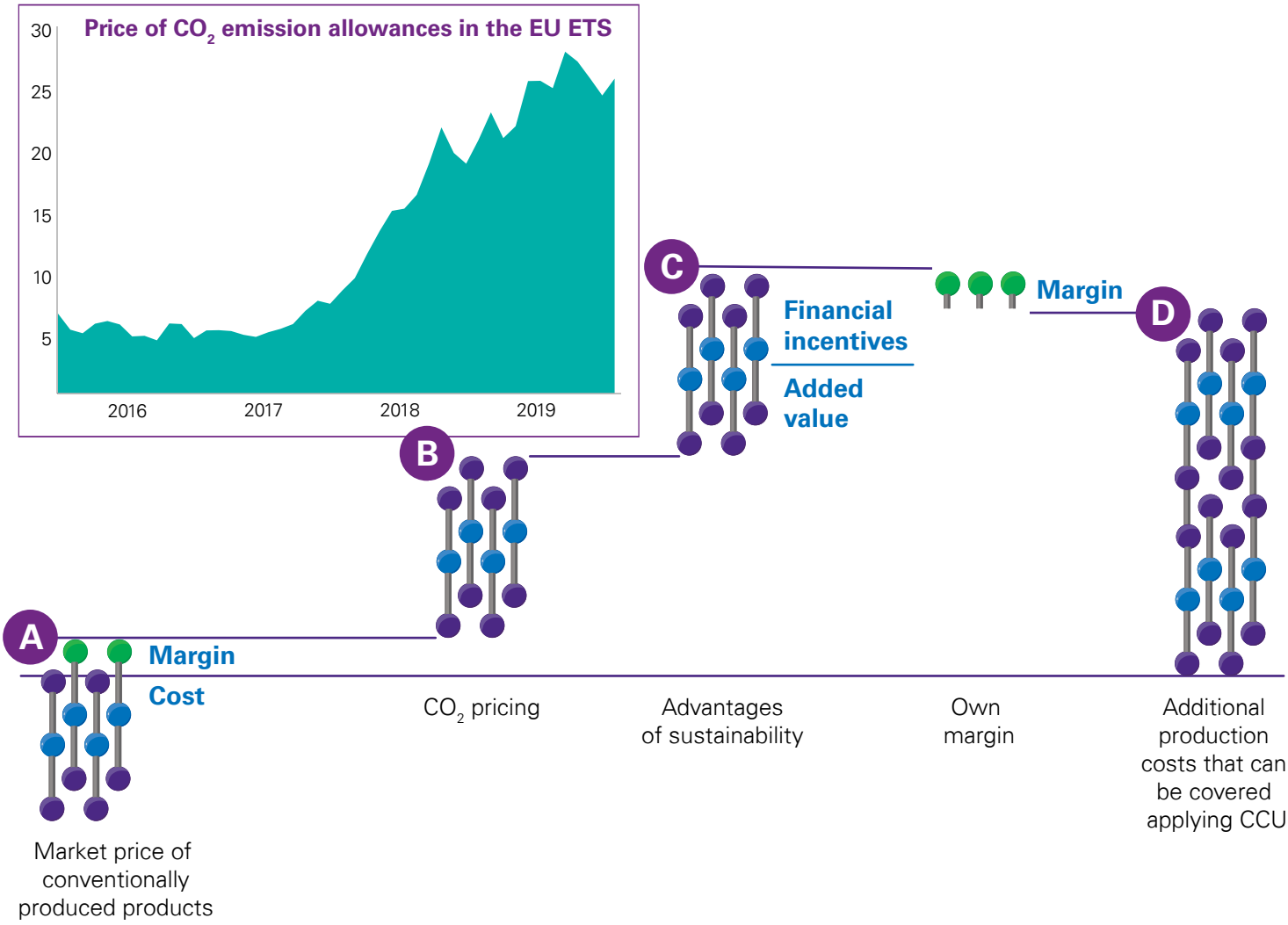
This opportunity to decrease exposure to carbon pricing, protect margins, and find new markets and investors lies not only with the traditional chemical manufacturers but also with their customers and potential partners, for example, energy providers and producers of construction materials.

Conventional chemical manufacturing has a competitive advantage due to cheaper fossil-fuels-based feedstocks. However, the advantage is starting to tip toward chemicals produced with CCU technologies."

The business case for CCU

Carbon tax savings and sustainable business and financing opportunities can offset the higher expense of CCU technology investment and manufacturing

Benchmark cost comparison of manufacturing conventional versus CO_2-based drop-in chemicals



Details of benchmark cost comparison

A Conventional products have, until recently, cost less to produce than drop-in chemicals and allowed higher profit margins.

B The cost of CO_2 emissions has risen sharply in recent months and will climb further with the introduction of general CO_2 pricing.

C Downstream customers need sustainably produced products to meet their climate protection goals, and these products can command higher prices for the additional benefit. Sustainable production also can attract additional funding opportunities.

D The cost of manufacturing CO_2-based products can become higher by this difference compared to the cost of manufacturing a conventionally produced product. Money can then be used to develop new technologies and run more expensive processes.

Source: KPMG, EEX Group

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Chemical companies can take steps now to explore the benefits and opportunities of scalable CCU technologies coming to market over the next few years."

Getting ready for CCU adoption

The implementation of CCU solutions will be more complex than "plug and play." With their experience and knowledge, chemical companies can play a pivotal role in helping other sectors realize the benefits of CCU even as they transform their own operations.

In order to leverage CCU to gain an early competitive advantage, companies can prepare their organizations now by taking the following actions:

1. **Establish guiding principles for pursuing carbon capture and utilization.**

This first step helps companies develop a framework and criteria for finding the most suitable applications for their business models. Define the company's ultimate goals for CCU, including a time horizon for completing implementation and metrics for success. Overall, CCU plans should fit well into the company's topline business strategy.

2. **Compile a list of potential technologies.**

Based on the guiding principles, research and preselect the possible applications. Be sure to include an assessment of their maturity using technology readiness levels (TRL). Narrow down the list to approximately five potential applications that best fit the organization.

3. **Target the top ideas based on market and partnership opportunities.**

Conduct a detailed value chain analysis, including identifying byproducts and assessing the market for the applications. Next, select the final one or two applications and define the most logical partnership model to execute the plan, from joint ventures or acquisitions, to licensing or long-term supply agreements.

4. **Develop a business plan and identify the best partners.**

Establish the target business model for the selected application(s) based on market, customers, and products, and define the value proposition. Identify potential partners that meet the requirements as well as physical considerations, such as proximity to a CO_2 emitter. Once again, use the original guiding principles to evaluate and finalize the candidates and develop and execute a strong, compelling outreach plan.

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Case study: One CO_2 emitter's disciplined approach to defining a CCU strategy

Challenge
As the goals for international CO_2 emission reduction have grown increasingly aggressive, the management team of a major industrial company concluded that conventional production involving high CO_2 emissions would eventually be eliminated and that it should consider transformation to mitigate the impact.

The company's leaders take a long-term view and are willing to put in the time to invest in scientific research, find partners, and build a true competitive advantage. The company established an initiative to develop growth opportunities in carbon capture and utilization based on the available CO_2 from its own production, with the potential to expand its CCU capabilities in the future.

Approach
With KPMG's assistance, the company drew up a long list of chemicals they would consider producing based on their own specific criteria, including a focus on non-drop-in chemicals for industrial applications produced by white biotechnology.

KPMG then evaluated each chemical according to a set of research-based insights, such as the market volume and value, regional characteristics, product grades, competitive environment, product applications and end uses, and production chains and costs. Each element received a score.

Outcome
With KPMG assistance, the company received extensive insight into potential chemicals, which they did not have the resources to collect and analyze on their own. The scoring approach provided the transparency needed to make a decision on how to move forward, and the shortlisting exercise helped focus resources on investigations into potential business models for CCU.

This effort was the first step for this industrial company to expand into the chemical sector. In the long run, the company may then transform from using CCU from its own CO_2 emissions to direct air capture as a source of CO_2.

Summary

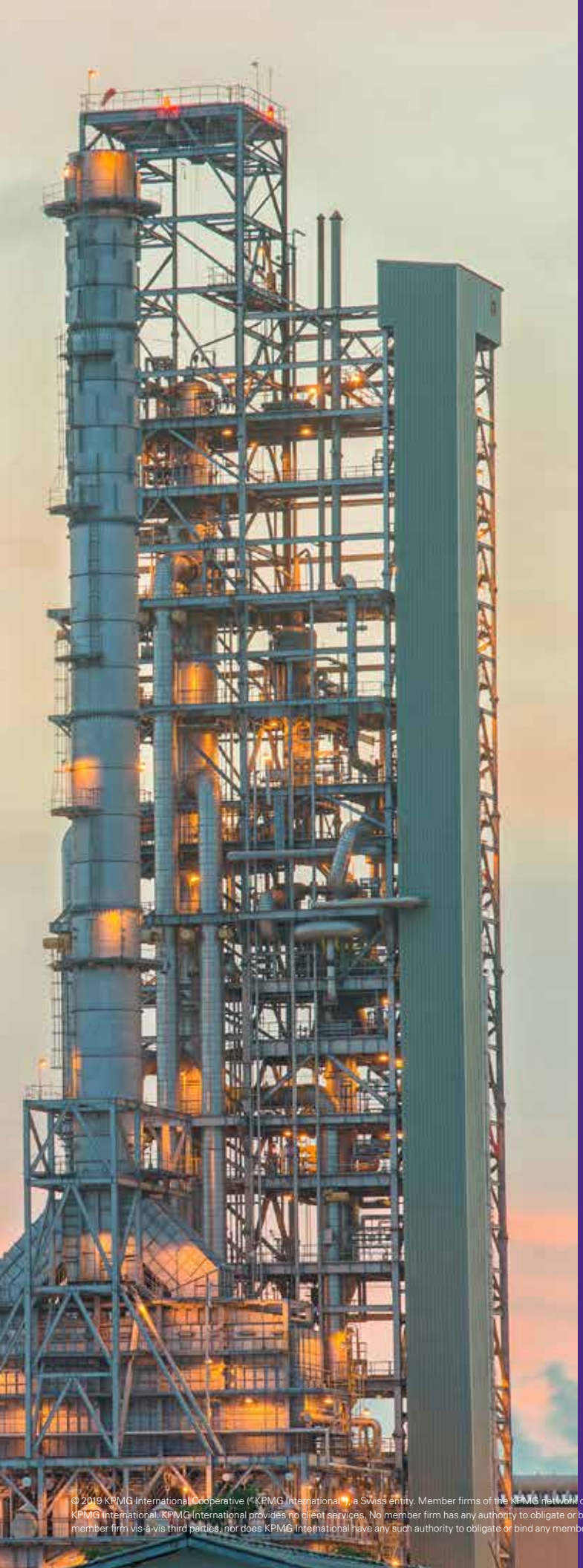
The combination of rising carbon prices, global sustainability demands, and rapidly developing carbon capture and utilization technologies has changed the outlook for chemical companies considering CO_2-based products. Beyond reducing emissions, CCU represents an opportunity to reinvest in innovation and introduce new offerings to help them remain relevant as the market shifts toward sustainably produced products and away from conventional manufacturing.

CCU is a boon not only to chemical companies but also to their downstream customers and to other industries. Sectors may begin to converge as large CO_2 emitters such as energy providers consider manufacturing chemicals from their own emissions, reducing their carbon footprint while at the same time opening new markets.

With new CCU applications expected to reach maturity within a few years, companies need a strategy and partners in mind to act quickly when the economics fully tip toward CCU.

ENRich 2019: Navigating energy transition

During ENRich, Paul Harnick, KPMG's Global Chair, Chemicals & Performance Technologies, was on the Circular Economy In Energy and Resources panel. The panel discussed, how circularity using modern technologies will shape the future of conventional energy sources. To view the panel discussion, please click here. You can also read his article, ***Opportunities abound for Indian chemical companies,*** which is featured in **VOICES: Navigating energy transition** (page 10) and can be downloaded here.



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Nicolai works in deal advisory and strategy as part of KPMG's team serving the life sciences and chemicals sector. His recent projects include helping an energy supplier to explore sustainable chemical products based on CO_2 raw material and a specialty chemicals company to assess a carve-out.

China's Belt and Road Initiative and the global chemical industry

By Norbert Meyring

China's Belt and Road Initiative (BRI) represents one of the largest infrastructure, trade, and economic agendas in history, which against a background of ongoing global subpar growth and escalated trade tensions demands the utmost attention. Indeed, the positive economic impact that the initiative can potentially deliver has become a matter of considerable discussion, with a number of studies by the World Bank estimating it can lead to a 4.1 percent increase in trade flows in 71 participating countries,[9] cut the costs of global trade by 1.1 percent to 2.2 percent,[10] and increase the GDP of East Asian and Pacific developing countries by 2.6 to 3.9 percent on average.[11]

For MNCs, the increased connectivity that BRI will bring, coupled with China's position as one of the most important nodes in the global value chain and its ongoing industrial upgrading process, can provide unique advantages to support their global and regional operations and enable them to capture new business opportunities. And while much of the discussion on the benefits that companies can reap from the initiative has been focused on infrastructure and other sectors, BRI has the potential of becoming a game-changer for chemical companies.

[9] Suprabha Baniya, Nadia Rocha & Michele Ruta, Trade Effects of the New Silk Road: A Gravity Analysis, World Bank Policy Research Working Paper 8694, January 2019.

[10] World Bank gives credit to Belt and Road Construction, People's Daily, 22 April 2019.

[11] François de Soyres, The Growth and Welfare Effects of the Belt and Road Initiative on East Asia Pacific Countries, World Bank Group, October 2018 Number 4.

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A silk road around the world

The original Silk Road spanned 4,000 miles across Asia and consisted of not just one road but several routes and connected branches between China and the West.

Today's "New Silk Road"—as the BRI is also called—supports trade across both land and sea, stretching from Asia to Europe and touching areas in Africa, Latin America, and the South Pacific. The initiative comprises the Silk Road Economic Belt and the 21st Century Maritime Silk Road. While the former comprises roads, railways, and other types of infrastructure, the 21st Century Maritime Silk Road is a sea-based network of shipping lanes and port facilities across the South China Sea, the Indian Ocean, the Arabian Sea, the Mediterranean Sea, and the Pacific Ocean. Other routes have been proposed in this evolving map of trade and influence, including a polar route.

The objective of the BRI is to connect economies and cultures across large portions of the world. China plans to invest approximately USD900 billion in BRI projects and import USD8 trillion in commodities and services.[12] As of March 2019, the Chinese government had signed cooperation agreements with 125 countries and 29 international organizations. The initiative could touch the lives of 4.4 billion people and impact at least 40 percent of the global GDP.[13] While these numbers may fluctuate over time, the magnitude of the BRI's possible coverage is extensive.

Key rationales and drivers in China for the BRI

Several key motivators can be cited to explain China's support for the BRI.[14] The Initiative will boost the nation's economy, helping to bolster its GDP growth, now targeted at 6 to 6.5 percent[15] after several decades of double-digit growth rates.[16] The BRI is poised to strengthen trade and investment flows between China and countries along the "Belt and Road" by increasing and improving infrastructure connectivity, enhancing the financing capacity in these countries, and streamlining administrative procedures at customs. At the same time, the BRI is designed to promote cross-continental cooperation between China and Eurasian nations.[17]

[12] What's in it for the Belt-and-Road countries? The Economist, 19 April 2018. See also: Navigating the Belt and Road Initiative, The Asia Society.

[13] Ibid.

[14] Drivers of the Belt and Road initiative, National Bureau of Asian Research, 2017.

[15] China lowers 2019 GDP growth target to 6-6.5 per cent range, South China Morning Post, 5 March 2019.

[16] China annual GDP growth rate, Trading Economics. See also: China's Economic Rise: History, Trends, Challenges, and Implications for the United States, Congressional Research Service.

[17] Belt and Road Initiative to bring win-win results: Malaysian official, Xinhua, 16 May 2017.

Impact on China's chemicals market

In general, the impact of the BRI on the Chinese chemical industry can be measured in three ways.

First, China intends to support the upgrading and relocation of basic chemical manufacturing closer to the BRI route in the nation's western provinces, predominantly located in chemical parks with high production and environmental standards. Increasingly stringent environmental regulations are already affecting existing chemical manufacturers located in eastern China. Shanghai Kingfa Science and Technology, a plastics compounder, has announced plans to build a new plant in Chengdu, Sichuan.[18] Investments into new chemical production facilities in western China that reach high environmental standards and align themselves with the Belt and Road may find financing more readily available and more support from local authorities.

Second, China can enhance its energy security through closer geopolitical and trading ties with Middle Eastern countries. With an ever-increasing demand for energy, China maintains a diverse supply to avoid shortfalls. China intends to procure lower-priced crude oil and natural gas from Middle Eastern countries and support the region's economic development through investment initiatives. PetroChina has announced its intentions to invest in areas covered by the BRI initiative. The company recently won a bid for 10 percent stakes in two projects off the coast of Abu Dhabi, worth an investment of more than USD1 billion.[19] In March 2017, Sinopec entered into a strategic agreement with Saudi Arabia's SABIC to develop petrochemical projects, just one part of deals worth a total of USD65 billion.[20] "SABIC is committed to growing together with our customers, business partners and all stakeholders for mutual success," stated Yousef Al-Benyan, SABIC vice chairman and CEO, at the 2018 China International Import Expo, "especially in China, which is one of the key engines driving the economic growth of Asia Pacific and the world as a whole".[21]

Third, China can increase its domestic chemical processing capacity to reduce its dependence on imports, further upgrade domestic manufacturing capabilities of higher performance materials, and act as a chief supplier for exports along the Belt and Road or for use in finished goods for export along the route.

In terms of specific sectors, the BRI will have a significant impact on Chinese petrochemicals. Increased connectivity, better access to petrochemical plants, and the availability of a lower-cost workforce along the BRI route are driving growth in consumption and capacity. In addition, producers in the BRI region may prove to be significant competitors for petrochemicals producers in the US and Europe. Also, BRI projects are expected to drive continued petrochemical demand in China, Central Asia, the Middle East, and Europe.

The BRI will also have a strong affect on Chinese construction chemicals, a high-growth sector with an expected global CAGR of 5.7 percent, from 2016 to 2022.[22] Demand is driven by construction in the commercial sector, growth in residential complexes, government initiatives for green-building construction, megaprojects for public infrastructure, and rapid population growth, all influenced by the westward push of the BRI.

[18] One Belt, One Road: The Impact of China´s Belt and Road Initiative on the Chemical Industry, Chemanager International, 30 November 2018.

[19] One Belt, One Road: The Impact of China´s Belt and Road Initiative on the Chemical Industry, Chemanager International, 30 November 2018.

[20] SABIC and Sinopec Support Saudi Vision 2030 and China's One Belt, One Road Initiative by Signing a Strategic Cooperation Agreement, press release, 16 March 2017. See also China, Saudi Arabia eye $65 billion in deals as king visits, Reuters, 16 March 2017.

[21] SABIC AT CIIE: Grow Together for Success Now and in the Shared Future SABIC.com, 5 November 2018.

[22] Global $41.7 Billion Construction Chemicals Market 2017-2022—Research and Markets, PRNewswire, 15 March 2017.

Steps to consider for chemical players

In addressing the potential opportunities and risks related to the BRI, global chemical companies can consider the following actions:

1. Get up to speed on the structure, agenda, and potential impact of the BRI, and closely monitor new developments as they occur. Progress in different corridors is proceeding at different rates, but existing infrastructure and resources in some regions are already being used to advance BRI projects.

2. Develop both immediate and longer-term strategies for involvement with the BRI, whether as a supplier for current projects or involvement in new markets. Service companies or engineering arms of chemicals companies may have opportunities to work in JVs with existing or new Chinese partners. Multinational players should also monitor closely some of the BRI-related plans, such as the companies and purchasers represented at the China International Import Expo.

3. Put together a dedicated team to raise your company's understanding of the BRI from a commercial, economic, and political point of view as new information and projects are announced. Although costs and benefits will differ for every company, the magnitude of the BRI requires a thoroughly strategic approach in addressing risks and realizing opportunities. In the current economic and political context, filtering truth from noise requires in-depth analysis.

4. Consider the BRI as another reason to expand into new global markets, especially in Asia.

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