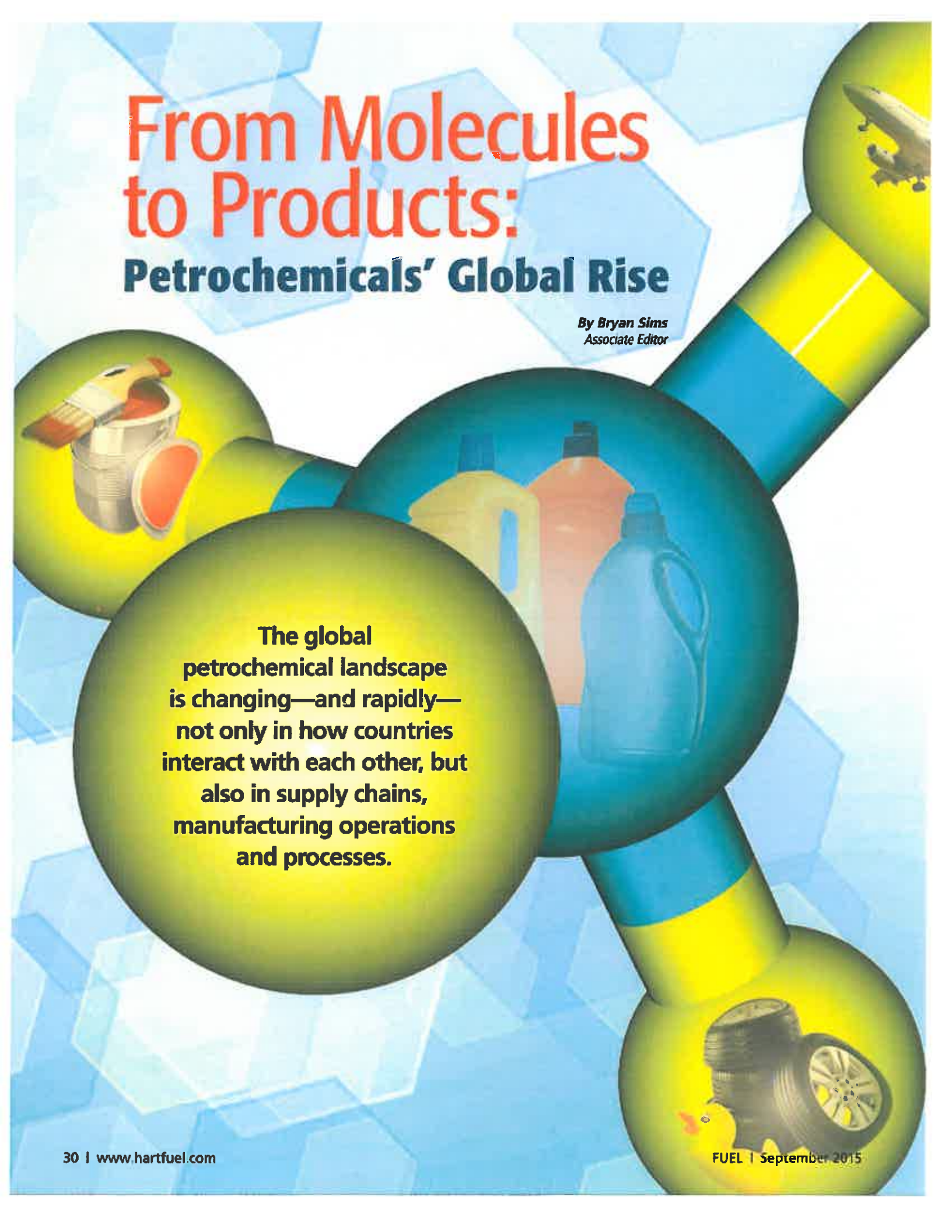


From Molecules to Products:

Petrochemicals' Global Rise

*By Bryan Sims
Associate Editor*



**The global
petrochemical landscape
is changing—and rapidly—
not only in how countries
interact with each other, but
also in supply chains,
manufacturing operations
and processes.**



It's a good time to be in the petrochemical business. The oil-price plunge of mid-2014 triggered a wave of petrochemical-supply reduction, and the industry is cautiously optimistic for better economic conditions, along with lower prices to improve global demand. While the U.S. is taking the lead with distinct resource advantages, other countries and regions are experiencing growth in the petrochemical sector as well.

U.S. outlook

The U.S. is widely viewed as an ideal location for domestic and foreign petrochemical companies to invest and take advantage of abundant and cheap natural gas and NGL, such as ethane and propane, brought on by new horizontal fracking technology in shale formations spawning a resurgence of domestic chemical manufacturing. Plentiful shale gas has catapulted the U.S. to being the lowest-cost chemical producer in the world behind the Middle East, attracting billions of dollars in investments and transforming the country from being an energy importer to an emerging net energy exporter.

As a result, the U.S. shale gas "revolution" has literally turned the global petrochemical industry on its head.

According to the American Chemistry Council's (ACC) "Mid-Year 2015 Chemical Industry Situation and Outlook" report, U.S. basic chemicals (which include inorganic chemicals, petrochemicals, plastic resins, synthetic rubber and manufactured fibers) output is anticipated to grow 3.1% this year and 3.7% in 2016.

With new capacity expected to come online, basic chemical production volume growth is forecast to exceed 5% per year during 2017 to 2019, moderating to a still robust 4% gain in 2020.

Even with the strength in the U.S. dollar, because of renewed global competitiveness, basic chemicals exports are also expected to play a large role in driving expanding production, led by bulk petrochemicals and organics, as well as plastic resins, according to the Washington, D.C.-based trade group.

Notably, U.S. chemical production is projected to grow across all regions of the U.S. this year. Over the next five years, the most dynamic growth is predicted to occur in the U.S. Gulf Coast region followed by the Ohio Valley.

"Our outlook is for improving activity and improving production, largely because this industry is so supply-driven," Kevin Swift, chief economist for the ACC, told *FUEL*.

Access to plentiful and affordable natural gas supplies is allowing the U.S. to capture an increasing share of global

chemical investment. This trend is expected to continue as the U.S. becomes an ideal destination for capital investment.

With competitiveness aided by the shale gas revolution, U.S. chemical industry capital spending is forecast to rise 9% this year, 8.5% in 2016, 8.3% in 2017, and the gains won't fall below 6% until 2020, according to the ACC.

By 2020, U.S. capital spending by the chemical industry is projected to exceed \$52 billion—more than double the level of spending in 2010 when new chemical-industry capital spending revived shortly after the Great Recession, according to the ACC.

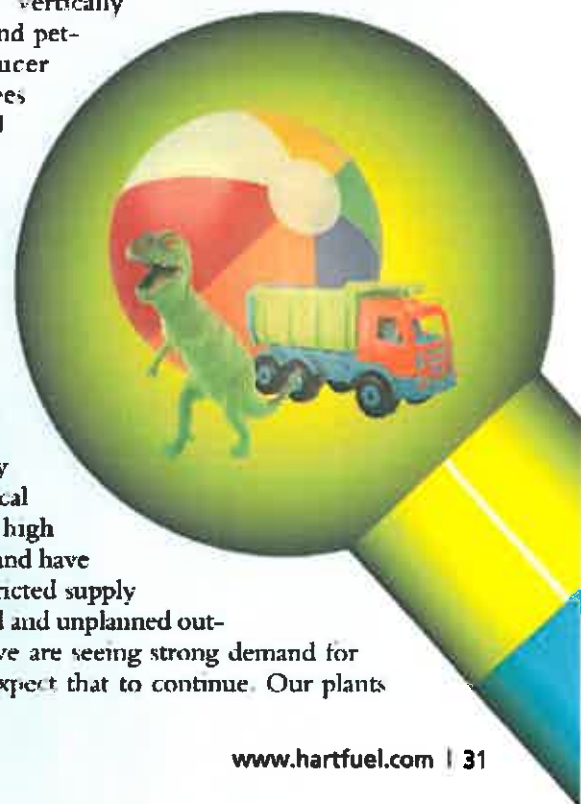
The ACC tracked over 230 new chemical production projects (valued at over \$142 billion altogether, up from \$90 billion in announced projects as of mid-2014) that have been announced through mid-May and the dynamics for sustained capital investment appear to be in place. About 61% of those new chemical projects are direct foreign investments. Peak spending for the projects are anticipated to occur in 2017, the ACC noted, with only 5% of that figure representing delayed projects.

U.S. companies such as DuPont, Dow Chemical Co., Eastman Chemical Co., Westlake Chemical Corp., Celanese Corp. and LyondellBasell are a few of the companies spending big to ramp up production. Major oil companies such as ExxonMobil Corp. are also boosting their chemicals capacity.

"[U.S.] capacity is going to start slowly coming onstream in the second half of this year, however, it's really going to start taking off in 2016 and 2017, and that's going to coincide with stronger activity worldwide," Swift said.

Bob Patel, CEO and chairman of Netherlands-based vertically integrated refiner and petrochemical producer LyondellBasell, sees better days ahead for his company as it looks to expand existing capacity and production flexibility to take full advantage of low-cost U.S. natural gas and NGL feedstocks.

"Our overall outlook is healthy for the petrochemical industry. We see high industry utilization and have seen periods of restricted supply as a result of planned and unplanned outages. In addition, we are seeing strong demand for our products and expect that to continue. Our plants



are currently running at or near capacity and earnings have been robust as we have seen lower prices for many of our natural gas and NGL feedstocks, which are helping to offset lower prices on crude oil-based products," Patel told *FUEL*.

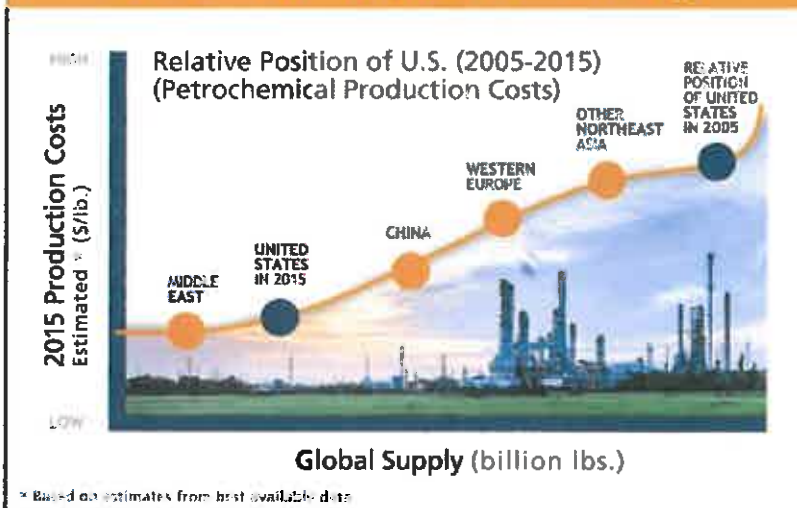
Despite fervent investment activity in the U.S. taking advantage of low-cost NGL feedstock for petrochemicals and an eye for exports, it's still unclear if the industry will see a rebalancing in the market once all chemical molecules come into the supply chain.

"Everybody's trying to build plants, but is that going to bring us back to the cyclicity that we had here in North America 15 or 20 years ago?" asked Michael Shannon, global head of chemicals and performance technologies at KPMG.

"We've been thoroughly lucky in North America because over that time period the China boom occurred and most of the investment dollars that would drive cyclicity with supply and demand all went to Asia," Shannon told *FUEL*.

"It's been kind of a growing and expanding industry and now with all the money being invested back here in North America to take advantage of shale, I think we run the risk of having a lot more cyclicity. Companies need to think about further developing out their supply chain because we're going to have to export chemical molecules in one shape or form," he said.

U.S. Chemical Industry Global Cost Advantage



Source: American Chemistry Council

Oversupply issue

U.S. companies are currently enjoying a favorable advantage over their foreign competitors that use oil-derived naphtha as feedstock, which is still expensive relative to NGL.

Oversupply in the marketplace is running at about 700,000 barrels (bbl) ahead of global demand of about 92 million barrels per day, according to the U.S. Energy Information Administration (EIA). This overhang, the EIA noted, will persist through 2015, putting downward pressure on prices.

That's good news for chemical companies in Asia and Europe, which make ethylene, a key petrochemical building block for making a host of products such as high-density polyethylene and ethyl glycol, to name a few, primarily from oil-based naphtha.

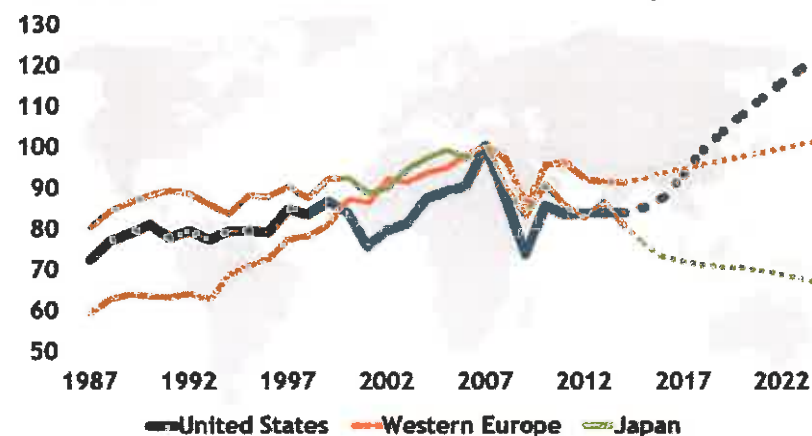
Lyondell's European operations are benefiting from North American shale development, Patel said.

"We have restructured our European business to more effectively utilize advantaged NGL feedstocks coming either from North America or from other regions. As a result of this effort, about half of our European ethylene was produced from cost-advantaged raw materials such as propane, butane and condensates during 2014," he said.

Additionally, Patel said that he sees increased demand for his company's products as low-cost produc-

U.S. Captures Market Share Away From Western Europe...

Basic Chemicals - Volume Index of Production (2007=100)



Sources: Eurostat, Federal Reserve, American Chemistry Council analysis, Japan's Minister of Economy, Trade and Industry

tion of chemical molecules will make them from the U.S. more competitive.

"We also have a competitive advantage with our fuel-blending components. Through our proprietary propylene oxide (PO)/tertiary butyl alcohol (TBA) process, we can upgrade lower-priced butane to high-octane blending components," Patel explained.

Effect of lower oil prices

Most U.S. chemical makers crack natural gas-derived ethane, which has been cheap since the shale gas boom began late last decade. However, the oil-price decline is pinching their cost advantage, according to Mark Eramo, vice president, Chemical Market Insights for Houston-based IHS Chemical.

"If I'm the low-cost guy, guess what? My cost structure hasn't changed at all, but my price just fell. All of a sudden, I'm coming into 2015 and I have a lot less profitability than I thought I was going to have because crude oil prices fell," Eramo told *FUEL*.

For example, high-cost Asian producers set global prices for petrochemical derivatives such as polyethylene, he explained.

"Lower oil prices are starting to push those prices down. Low-cost producers sell lower prices because the guys who set the prices on the high end of the cost curve are seeing lower costs because crude fell and, therefore, naphtha fell, and so prices have come down. In other words, the high-cost guys just got some breathing room," Eramo said.

The significance of this dynamic, Eramo pointed out, is that low-cost chemical producers such as those in North America will need to manage compressed margins closely; however, margins should still be favorable over international competitors due to healthy domestic demand, he noted.

According to IHS' scenario analysis, Eramo said that the differential between oil- and gas-based feedstock prices in the various regions of the world (Europe, Middle East and the Americas) divides cost-advantaged from cost-disadvantaged chemical producers in a very competitive market.

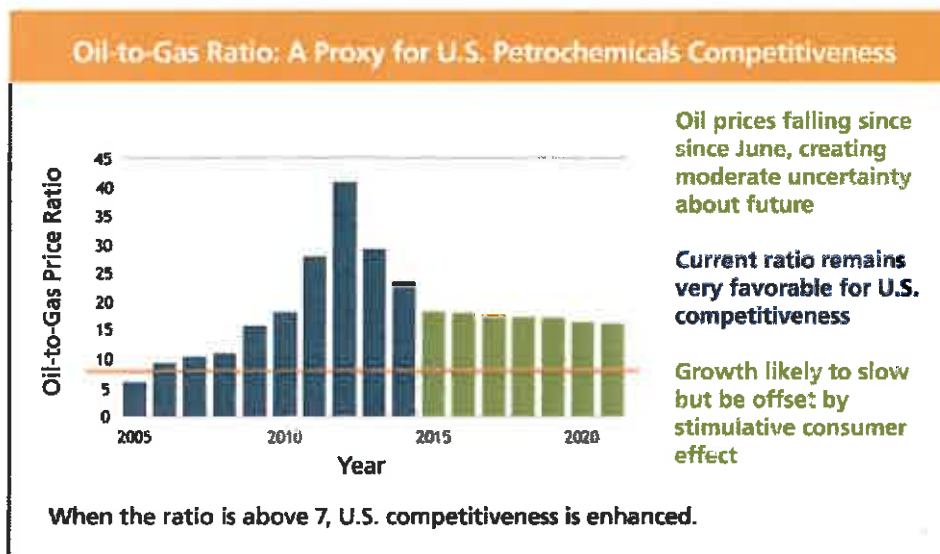
Whether the analysis focuses on the elementary feedstock choices (naphtha, ethane or propane), power costs, alternative values for use in crude oil refinery products or heating markets, successful producers must find means to create a competitive advantage at the level of relative oil-to-natural gas price.

Advantaged producers, and even their customers, according to Eramo, will need to capitalize on these advantages through investments in new multibillion-dollar production facilities.

However, Houston-based consultancy McKinsey & Co. concluded in a report earlier this year advising chemical companies on how to adjust to volatile oil-price movements. "Chemical companies need not necessarily fear oil-price volatility; in fact, the best ones will savor the opportunities it presents."

Trade dynamics

According to the ACC, a recovery in Europe will partially offset a slowdown in China and other emerging nations affected by global chemical volumes. The global chemical industry is forecast to expand 3% this year, strengthening to a 3.9% gain in 2016 and in 2017.



Sources: American Chemistry Council analysis, U.S. Energy Information Administration, NYMEX and Intercontinental Exchange

In the long-term, developing nations will outpace developed nations, but due to competitive advantages from shale gas, growth will be strong in North America as well, the ACC noted. With long-term structural and competitiveness challenges, Western Europe and Japan are expected to lag, although lower oil prices have provided a new lease on life.

With strengthening production volumes, global capacity utilization will improve in the years to come, the ACC noted.

While strength in American manufacturing, improvement in labor markets and growth in key end-use markets have translated to solid domestic demand for chemicals, weakness in external markets has limited U.S. chemical export sales, according to the ACC.

The effect of a high U.S. dollar and failure of external markets to strengthen "will persist slightly longer than



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— Kerin Swift, chief economist,
American Chemistry Council

expected,” the ACC report explained. The growth trend of U.S. chemical exports over the rest of the forecast period has softened slightly as a result of a more moderate growth trajectory in emerging market partners.

In the meantime, American consumption of imported goods is expected to remain strong with more exaggerated strength over the short term due to the effect of the high U.S. dollar. As a result, it will take a year longer

than previously thought for the industry to return to a net exporter position, according to the ACC.

The ACC further noted that, despite the competitive position that the American chemical industry owes to a comparably favorable oil-to-gas ratio, trouble in the economics of major trading partners means that the industry likely will not post a trade surplus until 2018, with the industry positioned as a net exporter over the longer term.

Considering chemicals trade, excluding pharmaceuticals, the U.S. is already a net exporter. As new investments in the chemical industry come online, basic chemicals export growth will accelerate.

“[The U.S.] will be exporting quite a bit of the new capacity due to increased production of petrochemicals and resins,” Swift said.

According to Shannon, the global petrochemical economy would benefit more by exporting finished goods over exporting chemical molecules as it’s typically an indicator of healthy manufacturing and gross domestic product (GDP) contributing to demand. But, much of this will be determined when global supply chains come online in the next few years.

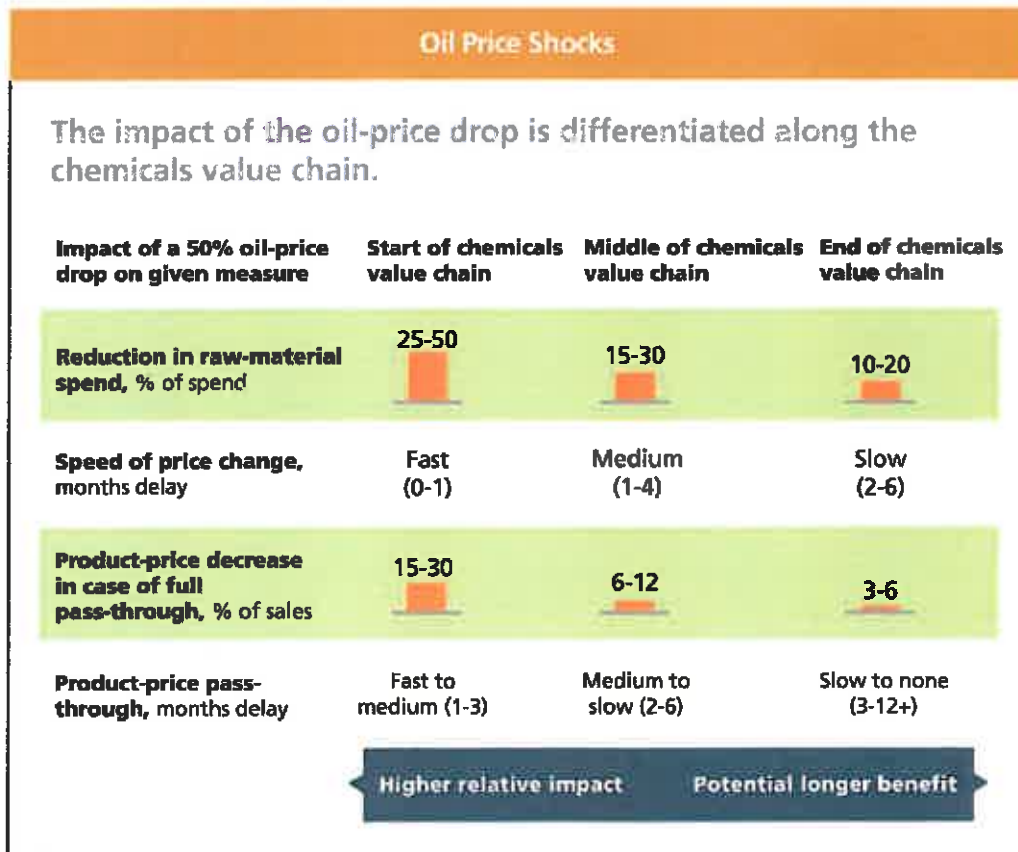
“It’s kind of like a chess match where you have to think five steps ahead and there’s multiple alternatives that can happen in those five steps,” he said.

Tracking olefin activity

The largest volume and perhaps the most market-indicative petrochemical is ethylene. Improved demand for consumer products from higher GDP eventually translates into higher ethylene demand as much of the resulting plastics production ends up in consumer products.

Yet, market observers suggest that low oil prices will initially lead to destocking as producers wait for signs of a price bottom even as demand growth accelerates.

“LyondellBasell has taken a different approach to growth than many of our peers, choosing our investments through the expansion of existing ethylene production facilities, rather than through the construction of large, new assets,” Patel told FUEL.



Source: McKinsey & Co.



LyondellBasell's Maasvlakte, Netherlands, plant is one of three facilities that the company operates in the Rotterdam port area. It is the largest propylene oxide (PO)/styrene monomer (SM) plant in the world where PO and SM are produced based on the company's unique PO/SM technology. *Source: LyondellBasell*

"This approach has allowed us to add incremental ethylene capacity ahead of our peers. We are also developing a project to build a greenfield PO/TBA [tertiary butyl alcohol] plant along the U.S. Gulf Coast.

"This proposed facility would leverage both our proprietary technology, as well as the advantages of U.S. NGL raw materials. The availability of NGL has also allowed us to re-start an idled methanol plant in Channelview, Texas," Patel noted.

On the supply side, lower crude oil prices are expected to change ethylene production costs over time, impacting the global ethylene market. In 2015, according to IHS Chemical, current global ethylene operating rates will still remain below 90%, and the positive effect on global demand will amount to less than 1 million metric tons (MMmt) this year.

However, by 2016, depleted inventories, together with faster consumption growth, is anticipated to generate additional global ethylene demand that is more than 1 MMmt above the previous higher crude oil price-based forecast. The greater demand growth could add up to 3.5 MMmt by 2020, according to IHS.

"Ethylene today is about a 140-MMmt market, and if it's growing at 3.5% year-on-year, that's a lot of incremental ethylene demand," Framo told *FUEL*.

"With a loyalty on a cracker being between 1 to 1.5 tons [MMmt per year] and if the global market demand is growing at a rate of 3%, 3.5% or 4% annually on that 140 MMmt, you've got to be building new steam crackers every year," he noted.

Ethane and propane prices have been extremely favorable in the U.S. Over the past two years, ethane prices have fallen by 60% or more, leading to a huge opportunity for ethylene producers. Ethane prices are down to the equivalent of about 25 cents per gallon (gal), according to a report by North Carolina-based consultancy FMI Corp.

Propane, the other key feedstock in ethylene production, has had a similar drop in pricing in the U.S., and although it's pricing is more seasonally dependent than ethane, it, too, is attractive as a feedstock in the U.S., where it's selling at the equivalent of around 48 cents per gal, the report noted.

"One would anticipate that overseas producers would see similar, if not as significant, improvements in their cost structures as well, but this is not the case. Saudi Arabian and Iranian ethylene production, which, like U.S. production, is heavily tilted toward ethane and propane feedstocks, had been as much as 50% cheaper than U.S. production," Mike Clancy, author of the FMI report, was quoted as saying.

"However, the changing price structure of U.S. petrochemical producers has come at exactly the wrong time for Middle Eastern producers. Because of OPEC limits on oil production, many of the region's producers have severely curtailed production of natural gas (produced as a byproduct of oil production in much of the region), with significant accompanying repercussions for petrochemical producers," Clancy noted.

In both Saudi Arabia and Iran, ethylene production capacity has come online much faster than the natural gas needed to keep the feedstock supply chain fully engaged. This led to the Saudis declaring a moratorium on supplying new ethylene production facilities in 2006. As a result, undersupply issues at current facilities have been rampant the past five years.

Meanwhile, European producers have struggled as well. European petrochemical production tends to be oil-based rather than natural gas-based, and ethylene is no exception. There, most ethylene is produced from oil-based naphtha, which is already more expensive than ethane or propane produced from natural gas, Clancy explained.

"And, despite a period of low oil prices, it is reasonable to believe that trend will reverse itself in the not too distant future, and oil prices in the \$75 per bbl to \$85 per bbl range will become the new normal. Should that be the case, European ethylene manufacturers will be oper-

ating with a greater than 100% price disadvantage with respect to their U.S. counterparts," according to Clancy in the report.

FMI further noted that while Asian production has been a significant player, it is also largely dependent on naphtha feedstocks.

"China is currently undergoing its own shale extraction efforts, but it seems likely it will find something more urgent to do with its natural gas and NGL than ethylene, especially as China will likely need to replace coal as its primary power generation fuel to improve air quality and international standing," according to FMI's Clancy.

China's role, impact

The supply of ethylene in the global market will likely be driven by conventional steam naphtha-cracking output despite the rapid emergence of new feedstock sources, IHS' Eramo explained. However, the fastest growth in ethylene production other than from steam cracking is expected to come from the methanol-to-olefin/coal-to-olefin (MTO/CTO) route in China.

"There is a massive wave of investment occurring in China that will increase their ability to produce ethylene and propylene and methanol from a coal source. In other words, coal in China today is equivalent to what natural gas is to North America," Eramo said.

Green Chemicals Press Ahead

While it's a very small part of the global chemical industry, there is still a fair amount of work by companies to mass produce chemicals derived from renewable sources such as starches, oils and cellulosic plant-based materials rather than from shale gas or coal-based inputs.

"We have still seen a heavy focus in terms of companies using first-generation feedstocks—things like vegetable oils and commodity sugars. That's not to say our space doesn't have interest in cellulosic feedstocks. It's just not nearly as strong as you see with in terms of market adoption as you see with cellulosic ethanol," Julia Allen, analyst at Lux Research, told *FUEL*.

"Most of the scale-up is more toward focusing on fermentation on down, and they're basically going to prove out that section of their process before taking on that next step and showing additional feedstock capabilities for cellulosic sugars and other next-generation feedstocks," Allen said.

While the downturn in oil prices may have slowed their scale-up efforts, Allen explained that bio-based chemical developers have since toggled their respective processes to produce certain chemicals that may

be lacking in the market, while taking advantage of deviations in cost curves.

"We've seen a pretty interesting change in the industry. When the shale gas boom first happened, oil prices were so relatively high and natural gas prices dropped. This affected what the different companies were putting into their crackers and led to kind of a glut in C₂ [two-carbon molecules, like ethylene] and C₃ [three-carbon molecules, like propylene] with a lower availability of the C₄ area," Allen said.

"Our companies looked at that and the high prices for things like butadiene and saw an opportunity," she noted, citing companies like Genomatica that are actively involved in this area.

"We see the [bio-based chemical] market responding to changes to the incumbent market prices," Allen continued. "Now that both oil and natural gas prices are low, what we're seeing is that companies are certainly starting to be aware of it. It's not a one-month, two-month or three-month blip." ■

—Bryan Sims



“LyondellBasell has taken a different approach to growth than many of our peers, choosing our investments through the expansion of existing ethylene production facilities, rather than through the construction of large, new assets. This approach has allowed us to add incremental ethylene capacity ahead of our peers.”

— Bob Patel, CEO and chairman, LyondellBasell

He noted that the surge in ethane and propane feedstocks from North America is expected to dramatically reduce production costs of ethylene and propylene. These products could likely overtake the market of naphtha-based ones in Asia. However, the decision to shift feedstocks will be a difficult one for producers to make heading into 2016.

Meanwhile, Houston-based energy research firm Wood Mackenzie sees lower oil prices translating to lower naphtha prices at levels that will allow it to be competitive against coal and ethane-based supply. Although the CTO route will still bring a new wave of supply by 2020, this will be delayed due to the near-term slowdown of some projects.

Ethylene demand growth is expected to remain despite China's economic transition. Therefore, with decelerated CTO supply growth and resilient demand, a longer window of opportunity for improved profitability has emerged for Asia's naphtha-based producers, according to the firm.

“Wood Mackenzie does not expect oil prices to remain at current levels for the long term. However, while [CTO] supply was previously expected to account for 27% of China's ethylene production by 2020—growing from a proportion of only 5% in 2014—this time frame has a greater degree of uncertainty,” Stephen Zinger, vice president of chemicals at Wood Mackenzie, was quoted as saying earlier this year.

“The longer the delay due to issues with project financing related to the low-oil price environment, the later production would come online,” Zinger said, noting that naphtha is priced in direct relation to crude oil; therefore, oil prices have made it more competitive for olefin production vs. coal in the near term.

Like the U.S., China is also committed to investments in building out on-purpose propylene production units. Instead of utilizing propane like U.S. producers to make propylene, China producers seek to use coal and/or methanol as their primary feedstocks.

“They [China] is going to be almost 90% self-sufficient by 2018 or 2019, and that's coming from a position of maybe being less than 50% self-sufficient,” Eramio said.

“We [the U.S.] are going to swing the balance of trade in propylene around the world because China is making massive investments in on-purpose propylene technology because of their growing consumption in the country,” he noted.

KPMG's Shannon agrees with Eramio's assessment of China's prospects for being an emerging olefin producer and consumer, which could potentially trigger broader market impacts on the petrochemical landscape.

“I'm very bullish on China,” he said. “I think the big question is: where's the next growth and expansion from a market perspective?”

Other global markets

Petrochemical outlooks from other established and emerging regions and countries examined for this report are experiencing growth and competition despite lower commodity prices and unique challenges.

Europe

The European chemical industry is expected to take relative benefit from the positive development in EU manufacturing, but the improvement in 2015 is still relatively modest because of higher energy and feedstock prices in the 28-member bloc, according to Dorothee Arns, executive director of petrochemicals and plastic additives for the European Chemical Industry Council (Cefic).

“It is wrong to conclude that the lower oil prices of the past couple of months have solved the competitiveness issue of the petrochemical and chemical industry in Europe,” Arns told *FUEL*.

“The structural issues facing the European industry remain: high feedstock costs, high energy costs, high regulatory costs and complexity. Even after the recent decline in oil prices the production costs of the basic chemical building block ethylene remains twice as high in Europe as in the U.S., and this competitiveness gap is well



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— Mark Eramo, vice president, Chemical Market Insights, IHS Chemical

reflected by trade data on petrochemicals, which underline that Europe is experiencing a significant decrease in exports to the rest of the world," Arns said.

It's not all doom and gloom for Europe, Arns said, noting opportunities for a high level of production integration, large domestic markets with strong nearby industry clusters, an established infrastructure and a skilled workforce will remain the backbone for the continent's growth prospects ahead.

"Additionally, a huge part of our [chemical] output is based on base chemicals other than ethylene, such as propylene, benzene and four-carbon streams [such as butadiene], which is not the case elsewhere," according to Arns.

"This wider portfolio range, together with the traditionally strong innovation efforts in Europe, will certainly help to generate new growth clusters to solve the upcom-

ing societal megachallenges, such as energy-efficient uses or new materials," Arns noted.

Cefic's latest "Chemicals Trends Report" noted that European chemical output grew just 0.1% during the first two months of 2015 compared to the same period in 2014, while producer prices fell 6.8% year-on-year.

Meanwhile, Europe's GDP is forecast to grow by 1.65% in 2015, up from 1.3% in 2014, according to Cefic's report.

"This implies that the European economy is even doing better than expected," Arns told *FUEL*.

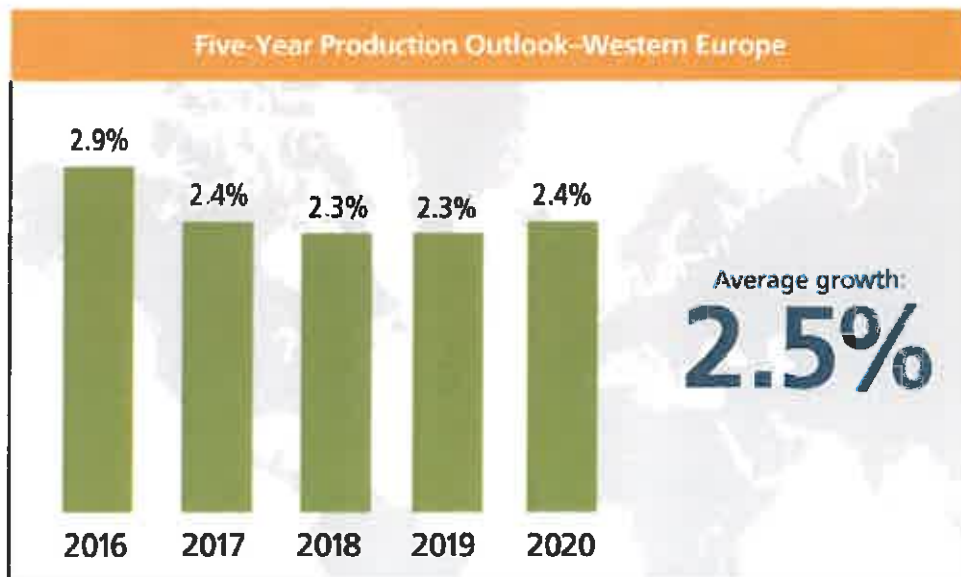
"The lower oil prices are supporting people's purchasing power and consumption in major economies and, hence, GDP growth. From today's point-of-view, GDP growth in EU-28 is estimated to be 1.8% in 2016," she said.

The U.S.-based ACC is more optimistic than Cefic on the outlook for Europe's chemical production in 2015. It forecasts overall output growth for Western Europe of 1.9% this year, rising to 2.1% in 2016.

With respect to individual countries in the 28-member bloc, some envision improved production and demand prospects this year heading into 2016.

For example, most companies in the U.K.'s £50-billion (US\$77.9 billion) chemical industry predict they will increase sales and exports this year, according to a survey conducted in April by the U.K.'s Chemical Industries Association (CIA).

The trade body found that nearly 60% of companies expect sales and export growth, while nearly 50% of businesses intend to increase capital expenditure and grow employment numbers.



Source: American Chemistry Council

Not as many U.K.-based chemical businesses expect their margins to increase as a result of higher sales, 25% of respondents expect margins to increase whereas 18% expect margins to fall. The majority expect their profit margins to stay the same, the CIA found.

In Germany, chemical production is forecast to increase 1.5% this year, according to the German Chemical Industry Association; however, margins are forecast to remain compressed in the short term with prices for chemical products expected to fall by 2%.

Canada

In Canada, producers of industrial chemicals are projecting sales volumes and profits to slightly decline in 2015, according to a survey of members by the Chemistry Industry Association of Canada (CIAC).

CIAC's members expect overall sales to drop 7% this year, to CA\$23.7 billion (US\$20.1 billion), mainly on lower global commodity prices. They also forecast small declines in exports, profits and employment.

Profitability will remain strong by historical terms; however, operating profits are expected to reach CA\$3.86 billion (US\$2.9 billion), nearly flat with 2014 levels, while capital investment is expected to increase 30% to CA\$3.4 billion (US\$2.7 billion) in 2015, which, if achieved, would be the second-most profitable year on record.

Meanwhile, the Bank of Canada projects GDP growth of 2.4% in 2015.

"This bullish outlook reinforces the message that companies in Canada are ready to take advantage of the attractive investment climate that currently exists," according to the CIAC.

Middle East

The Middle East region's petrochemical industry is facing a host of challenges, including a dwindling supply of advantaged gas feedstock, competition from many shale gas-based projects in the U.S. and the explosive growth of China's coal-to-chemicals industry.

Growth in the petrochemical industry in the six Gulf Cooperation Council (GCC) countries is projected to slow to 7.1% year-over-year (y-o-y) through 2020 compared with 11% y-o-y in the last 10 years, according to the Gulf Petrochemical and Chemical Association (GPCA), which represents the downstream hydrocarbon industry in the Arabian Gulf.

In 2014, petrochemical production in the GCC rose by 4.5%, the second-highest growth region in the world, the GPCA noted.

Regional growth in chemicals production was largely attributed to a surge in plastic production, which grew by 6% in 2014, nearly twice the worldwide average. Meanwhile, global production of chemicals rose by 2.8% last year, a similar figure seen in 2013, according to the GPCA.

New US Chemical Production Projects Thanks To Shale Gas

More than 215 new chemical production projects valued at more than \$135 billion have been announced for development through 2015 due to advantaged shale gas feedstock:

- BASF is planning its most expensive plant ever, a propylene facility on the U.S. Gulf Coast. In addition to the U.S. Gulf Coast propylene plant, BASF expanded a Texas ethylene facility it owns with France-based Total SA.
- Chevron Phillips Chemical has announced the construction of a petrochemical facility in Baytown, Texas. The U.S. Gulf Coast project includes a 1.5-million-metric-ton-per-year (MMmt/y) ethane cracker and two 500,000 mt/y capacity polyethylene facilities.
- ExxonMobil Corp. is planning an ethane cracker in Baytown, 25 miles east of Houston. The facility will have an annual capacity of up to 1.5 million tons of ethylene feedstock from ethane. Its two polyethylene processing units, now under construction near Houston, are capable of producing 650,000 tons per year of the plastics components. This is the chemical company's largest U.S. investment.
- Formosa Plastics is developing a 1.2-MMmt/y ethylene plant in Point Comfort, Texas. The facility is expected to cost around \$3 billion and include units producing 1.2 MMmt/y of ethylene, 600,000 mt/y of propylene and 400,000 mt/y of high-density polyethylene and is estimated to become fully operational in 2017.
- South Africa-based Sasol approved construction of an \$8.1-billion plant in the U.S. that will convert natural gas into plastics and other products from shale gas. The plant converts ethane into ethylene, which is used to make chemicals such as glycol and ethylene oxide. The cracker will have a capacity of 1.5 MMmt/y.
- Total Petrochemicals & Refining USA filed environmental permit applications to build an ethane cracker on the U.S. Gulf Coast. The plant will have a maximum capacity of 1 MMmt/y of ethylene. ■

Source: KPMG

"This development is a testament to the ambitious growth plans of the Arabian Gulf's chemicals industry is based on solid fundamentals," Abdulwahab Al-Sadoun, secretary general of the GPCA, was quoted as saying.

"The region has grown nearly 60% over the global average, an achievement that is made all the more significant when you consider that this progress was made despite continuing economic uncertainty in Europe and a recent slowdown in China," Al-Sadoun said.

Saudi Arabia continues to be the GCC's most dynamic petrochemicals market, with new fertilizer and plastic projects coming online, as well as innovative research centers being launched by companies like Saudi Basic Industries Corp. (SABIC), Rabigh Refining and Petrochemical Co., Sadara Chemical Co., Saudi International Petrochemical Co. and Tasnee.



"It's been kind of a growing and expanding industry and now with all the money being invested back here in North America to take advantage of shale I think we run the risk of having a lot more cyclicality. Companies need to think about further developing out their supply chain because we're going to have to export chemical molecules in one shape or form."

— Michael Shannon, global head of chemicals and performance technologies, KPMG

"While production growth is certainly a positive development, GCC chemicals producers must not rest on their laurels. The petrochemicals sector is tied into global economic trends and demographic demand, meaning that we in the Arabian Gulf could be affected by developments from around the world," Al-Sadoun said.

"However, what we are seeing in the GCC is that local producers are not only expanding capacities, but also capturing value-added opportunities—Safco's new fertilizer plant, for example, is capable of capturing 850,000 million tons of carbon dioxide per year, enabling this SABIC affiliate to be the operator of one of the largest carbon capture and utilization facilities in the world.

"Moving forward, the picture looks positive," Al-Sadoun continued. "As Sadara [joint venture between Dow Chemical Co. and Saudi Aramco] formally comes onstream this year, 14 of the 26 units operated by the company will manufacture products that have never been produced in the Arabian Gulf, signaling that an era of diversification is imminent."

India

Growing at a compounded annual growth rate (CAGR) of about 14%, the petrochemicals industry in India is forecast to reach 100 billion (US\$1.58 billion) by 2020 from the current size of around 40 billion (US\$630.6 million), according to an April study released by the Associated Chambers of Commerce and Industry of India (ASSOCHAM).

"Petrochemicals currently contribute about 30% to India's 120 billion [US\$1.9 billion] chemical industry, which is likely to grow at a CAGR of 11% over the next few years and touch 250 billion [US\$3.94 billion] by 2020," according to the study.

"The petrochemicals sector is one of the fastest-growing segments with a growth rate of 13%, which is more than twice the growth of India's gross domestic prod-

uct and also the global growth rate in the petrochemical space, which is stagnant at 6%."

Securing feedstock, the right product mix and mergers and acquisition opportunities are key imperatives for India's petrochemical industry, ASSOCHAM pointed out in the study.

Compared to the U.S. and China, ASSOCHAM indicated that India's per-capita consumption of polymers is still relatively nascent; however, opportunity exists to reach out to a large population and sustain current economic growth, which would drive the country's polymer consumption.

The organization further highlighted lucrative opportunities in segments like specialty chemicals and specialty polymers, as well as an emerging manufacturing hub, as key factors for advancing the sector ahead. ■

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