APIC 2019

Asia Petrochemical Industry Conference

16-17 May 2019 Taipei Organised by the Petrochemical Industry Association of Taiwan

TRADE TENSIONS WEIGH ON ASIA

Chinese concerns are Asian concerns

Official APIC 2019 publication Prepared on behalf of PIAT by *The Chemical Daily* and *ICIS*

APIC 2019 Asia Petrochemical Industry Conference 16-17 MAY, 2019 / Taipei, Taiwan

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The Chemical Daily
16-8, Nihonbashi Hamacho,
3-chome, Chuo-ku,
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Tel: +813 3663 7934

ICIS

Reed Business Information
Quadrant House,
The Quadrant, Sutton,
Surrey, SM2 5AS, UK
Tel: +44 20 8652 3153

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Chemicals and Petrochemicals Manufacturers' Association, India
Tel: +91 11 4361 2198
http://www.cpmaindia.com

Japan Petrochemical Industry Association
Tel: +813 3297 2011
http://www.jpca.or.jp

Malaysian Petrochemicals Association
Tel: +603 6286 7200
http://www.mpa.org.my

Singapore Chemical Industry Council
Tel: +65 6267 8891
http://www.scic.sg

Korea Petrochemical Industry Association
Tel: +822 3668 6100
http://www.kpia.or.kr

Petrochemical Industry Association of Taiwan
Tel: +8862 2707 3175
http://www.piat.org.tw

Petrochemical Industry Club, Federation of Thai Industries
Tel: +662 345 1005
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APIC 2019
Asia Petrochemical Industry Conference
16-17 MAY, 2019 / Taipei, Taiwan

On behalf of the Petrochemical Industry Association of Taiwan (PIAT), it's my very great pleasure to welcome you to APIC 2019 in Taipei, Taiwan from 16-17 May 2019.

We expect this year's APIC to be an event of great significance; not only enabling us to share the fruits of the technological and industrial development of the petrochemical industry, but also providing an excellent opportunity to exchange information and ideas on our ever-changing economic circumstances.

This is the 40th annual event in the series that started as the East Asia Petrochemical Industry Conference in 1979. As always, it will be an opportunity for attendees to gain a deeper understanding of the regional market trends, chemical regulations, and sustainable solutions involving the petrochemical industry.

After the APIC sessions, we encourage attendees to experience various options for sightseeing, shopping and cuisines. Taipei is the centre of the politics, commerce, art and culture for Taiwan. People in Taiwan are known for their hospitability. A wide variety of food offerings, from our highly rated Xiaolongbao to bubble tea, are available from snack stands in Taipei's lively night markets. Please enjoy!

Lin Fu-Shen
Chairman of PIAT

台灣區石油化學工業同業公會
Petrochemical Industry Association of Taiwan

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Innovative solutions to the challenges of uncertainties in the global economy and a greater awareness of environmental concerns hold the key to growth and survival for Asia's petrochemicals industry, PIAT chairman Lin Fu-Shen told ***Satoshi Kiyokawa*** of *The Chemical Daily*

THE CHEMICAL DAILY

Adapting to the changing tides

In a sharp turnaround from the boom seen through the first half of 2018, the Asian petrochemical industry finds itself in a period of adjustment. The tide changed in the latter half of 2018, with the downward trend in business performance becoming clearer in the fourth quarter of the year. Chemical manufacturers in the region saw profits in their petrochemical businesses take a dive, while suggestions that the so-called super cycle was over began to emerge from the markets.

Coupled with growing momentum in the influx of shale-derived product from the US, increased uncertainties in the global economy and rising awareness of the need for environmental protection, the reversal in market fortunes means the Asian petrochemical industry faces no easy task. Given this tricky situation, Petrochemical Industry Association of Taiwan (PIAT) chairman Lin Fu-Shen stressed that the development of advanced technologies, production of value-added goods and efforts to address environmental issues will hold the key to the Asian petrochemical industry's ongoing growth.

Taiwanese and other Asian petrochemical companies recorded solid results overall in the first three quarters of 2018. However, the fourth quarter brought a sea change, with some firms even recording a loss. Lin cited the trade friction between the US and China, China's economic slowdown and falling crude oil prices as factors behind this about-face, but he noted that the outlook is not as challenging as during the 2008 global financial crisis.

Nonetheless, volatile crude oil prices and uncertainties in the global economy mean that close scrutiny is required, said Lin, adding that a close eye needs to be kept on the impact of US-China trade friction throughout the supply chain.

Given steady economic growth in Asia's emerging markets, with more than 7% forecast in India, Lin anticipated a substantial rise in Asian demand for petrochemical products in the medium to long term as the ranks of the middle class swell. The petrochemical industry must also focus on the worldwide energy situation, with which its fortunes go hand in hand, Lin said.

A survey by the International Energy Agency (IEA) projects that crude oil demand will peak in 2040 and then decline. In response, global oil majors are starting to hammer

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out a range of measures on which they are staking their survival. One such measure is entry into a downstream business – the petrochemical industry. Aiming to produce more petrochemical products with higher added value by increasing the processing level of crude oil, many of these companies have put together plans to integrate petroleum refining with the petrochemical business.

Asia too is seeing more examples of a different set of competitors from those traditionally involved in the petrochemicals sector, for example the entry of three South Korean petroleum refiners into the ethylene production sector. Technological innovation in response to the energy outlook is also making progress and leading to new production and business models, for example the full-scale commercialisation of crude oil-to-chemicals (COTC) technology by oil majors such as ExxonMobil and Saudi Aramco (Saudi Arabian Oil Co).

The growing influx of shale-derived products from the US is the issue that has attracted the greatest attention among industry observers in Asia in recent years. The startup of long-planned large-scale ethylene facilities using moderately priced ethane as feedstock for downstream derivatives plants finally shifted into high gear in 2018 and is continuing to gather pace in 2019. In particular, the export of low-cost ethylene derivatives such as polyethylene is now getting under way in earnest.

The raising of tariffs due to the US-China trade friction has altered trade flows from initial forecasts which anticipated US polyethylene exports would be absorbed by China which has the world's largest demand for chemicals. However, the net effect remains unchanged, with Asia still ultimately the region with the greatest demand, both directly and indirectly.

"The chemical industry needs to better highlight to the public its contributions to the environment"

The development of US shale resources sparked a revolution in the global energy situation, transforming the structure of petrochemical production, but the effects for Asian petrochemical manufacturers have not been entirely negative, Lin said. Increased production of shale gas has capped the rise in crude oil prices. Using reasonably priced naphtha, Asia's many naphtha crackers should therefore, in Lin's view, be able to compete by producing chemicals from C4 and higher fractions that the numerous ethane crackers in the US cannot make.

Addressing environmental issues has – along with US shale-derived products – become one of the key themes for the Asian petrochemical industry in recent years. Ever tighter environmental regulations are, in some countries, restricting production activities and new investment. Accordingly, the need for petrochemical companies to introduce plant management technologies designed with the environment and greater efficiency in mind is now greater than ever.

PIAT

The tide in many countries is also shifting towards a ban on single-use plastic, triggered by the need to tackle the problem of plastic waste in the ocean. Chemical companies in the West are increasingly incorporating the United Nation's Sustainable Development Goals (SDGs) into their business strategy guidelines. Given the way the wind is blowing, companies more than ever have to be aware of environmental responsiveness. As the essential raw materials for many industries, petrochemical products play an ever more integral part in our lives, Lin said.

With 12 of the 17 SDGs closely related to the chemical industry, there are many areas where it can unilaterally propose solutions to the problems, Lin suggested. Given the numerous innovative chemical technologies being introduced for water treatment, energy conservation and carbon dioxide reduction, among others, the industry needs to better highlight to the public its contributions to the environment, he states firmly. The petrochemical industry must respond to growing global awareness of the need for environmental protection by effectively tapping into technologies such as big data, artificial intelligence and the internet of things to create business models that dovetail with these issues, he said.

APIC 2019 marks the 40th anniversary of this gathering, which began life as the East Asia Petrochemical Industry Conference. This year's meeting focuses on the theme *Smart Petrochemical Processes – Sustainable Solutions Enabling a Better World*. Looking at the direction the petrochemical industry should take as it reaches a crucial transitional phase in various respects, Lin hoped APIC will become a forum where participants exchange the latest information and learn about technological trends that will further sustainable development.

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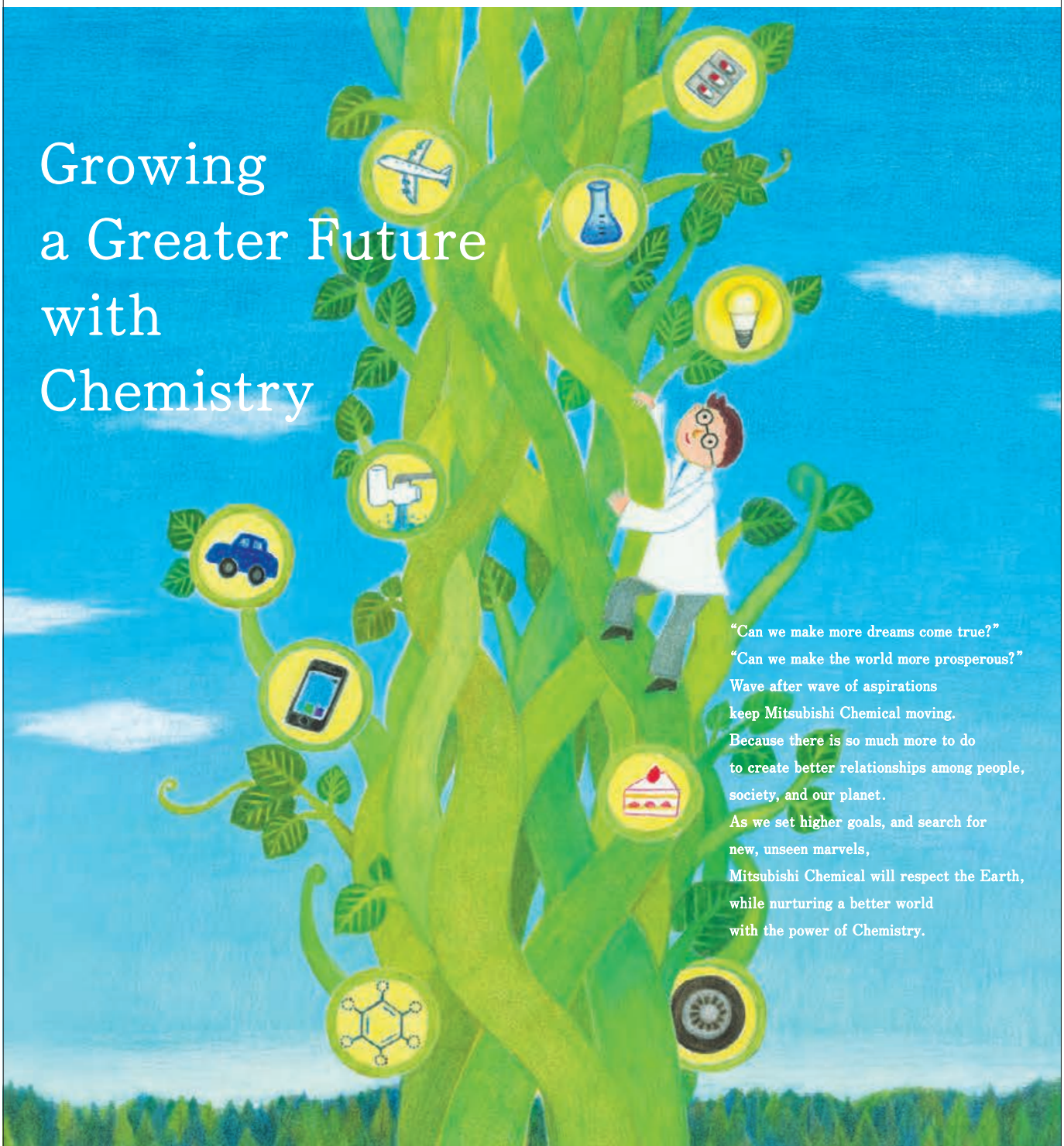

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REVIEW

THE YEAR IN REVIEW

Tariffs, trade tensions, political divides, unlikely alliances, crackdowns and arrests: it has been a year of shocks and uncertainty, testing political and economic limits, while pollution and climate change lurk unchallenged

Kim Jong-un sets out by train for Vietnam, above; Malaysians celebrate a change of government, above right.
Out on bail: Huawei's Meng Wanzhou, left, and Nissan/Renault's Carlos Ghosn, right.
Ready to go: Angela Merkel, below.
All pics from REX FEATURES

2018

27 April North Korean supreme leader Kim Jong-un meets South Korean president Moon Jae-in, the first North Korean leader to cross the demilitarised zone since 1953.

9 May Malaysia's Barisan Nasional (BN) coalition loses power for the first time since independence as former Malaysian prime minister Mahathir Mohamad's Pakatan Harapan coalition is elected. Jailed opposition leader Anwar Ibrahim is pardoned on 16 May, while deposed prime minister Najib Razak is charged with corruption on 20 September.

31 May US tariffs of 25% and 10% come into force on steel and aluminium, respectively, from the EU, Canada and Mexico.

12 June US president Donald Trump and North Korean supreme leader Kim Jong-un hold talks in Singapore in the first-ever meeting between leaders of their two countries.

17 July The EU-Japan Economic Partnership Agreement is signed.

14 August Turkish president Tayyip Erdogan announces a boycott of electronic products from the US in retaliation for US sanctions which help push the Turkish lira to a low of 6.95 to the US$ on 13 August.

2 October *Washington Post* journalist Jamal Khashoggi is murdered inside the Saudi Arabian consulate in Istanbul.

8 October The International Panel on Climate Control (IPCC) warns that 'rapid, far-reaching and unprecedented changes in all aspects of society' are needed to keep global warming below 1.5°C.

19 October The EU and Singapore sign the EU-Singapore Free Trade Agreement.

28 October The far-right Jair Bolsonaro is elected as president of Brazil and takes office on 1 January 2019.

29 October German chancellor Angela Merkel says she will withdraw from politics when her term as chancellor is up in 2021 and will stand down as party leader in December.

6 November The US mid-term elections see the Democrats gain a majority in the House of Representatives while the Republicans expand their majority in the Senate by two seats.

19 November Carlos Ghosn, chairman and ceo of Nissan, Renault and the Renault-Nissan-Mitsubishi Alliance is arrested in Tokyo on allegations of false accounting.

25 November Taiwan's ruling independence-leaning Democratic Progressive Party (DPP) suffers heavy losses in local elections to the opposition Kuomintang (KMT) party.

30 November The US, Mexico and Canada sign the USMCA trade pact at the G20 meeting in Buenos Aires, a replacement for the 1994 North American Free Trade Agreement (Nafta).

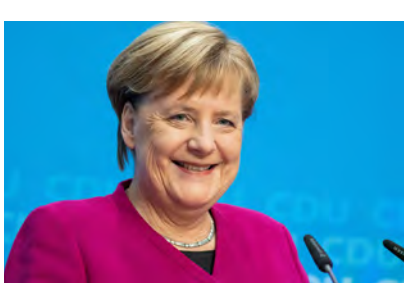
1 December Huawei cfo Meng Wanzhou is arrested in Vancouver, Canada, pending extradition to the US. In January, the US charges Huawei with multiple counts of fraud.

2019

1 January Qatar withdraws from OPEC.

2 January Global stock markets are revealed to have suffered their worst quarterly fall in seven years in Q4 2018.

10 January Venezuela opposition leader Juan Guaidó and the National Assembly declare incumbent president Nicolás Maduro 'illegitimate' and start attempts to remove



US-China trade war

6 July 2018 The US imposes a tariff of 25% on the first US$34bn tranche of US$50bn-worth of Chinese goods, to which China responds with levies on a similar quantity of US imports.

7 August The US re-imposes sanctions on Iran, saying it has not been keeping to the nuclear treaty deal signed by the US, Iran and the EU. They take effect on 5 November.

14 August The US publishes a list of 279 Chinese goods, worth US$16bn, which will be subject to a 25% tariff from 23 August 2018. China imposes 25% tariffs on US$16bn of imports from the US, also from 23 August.

17 September The US announces a 10% tariff on US$200bn-worth of Chinese goods from 24 September, increasing to 25% by the end of the year. It threatens tariffs on a further US$267bn worth of imports if China retaliates, which it does on 18 September with 10% tariffs on US$60bn of US imports.

1 December Planned increases in US tariffs from 10% to 25% on Chinese goods are postponed for 90 days after Chinese president Xi Jinping and US president Donald Trump meet at the G20 summit in Argentina.

24 February US president Donald Trump says he will delay a 1 March increase in tariffs to 25% from 10% on US$200bn worth of Chinese imports because of 'substantial progress' in talks.

29 March 2019 Talks resume in Beijing ahead of an expected April summit meeting in Washington.

him that are continuing at end-March. On 23 January, Maduro severs diplomatic ties with the US following protests in support of Guaidó. In February, the US imposes further sanctions on Venezuelan oil.

1 February US president Donald Trump confirms the US will leave the Intermediate-Range Nuclear Forces Treaty of 1987. The next day, Russia follows suit.

26 February Indian and Pakistan Air Forces launch airstrikes against each other in the disputed Kashmir region.

27-28 February US president Donald Trump and the North Korean chairman Kim Jong-un meet for the second time, in Hanoi, Vietnam.

4 March China premier Li Keqiang announces US$298bn in tax cuts to boost the economy and revises growth forecasts for 2019 to 6.0-6.5% from 6.5% in 2018.

13 March Boeing grounds all 737 MAX planes worldwide after fatal air crashes in Indonesia (29 October) and Ethiopia (10 March).

15 March 50 people are killed and 50 injured in terrorist attacks on two mosques in Christchurch, New Zealand.

22 March Fitch cuts its forecast for GDP growth in India to 6.8%, from 7% in December, for the financial year starting 1 April 2019.

23 March The Islamic State in Iraq and Syria (ISIS) caliphate is declared defeated.

24 March The Mueller report finds no Trump-Russia conspiracy but does not exonerate the president.

24 March The first Thai elections since the 2014 coup are still undecided at end-March, with both the opposition party Pheu Thai (pro-Thaksin Shinwatra) and the pro-army Palang Pracharat claiming enough support to form a government.

Brexit

26 June 2018 The UK parliament passes the European Union (Withdrawal) Act 2018, setting out what will happen after 29 March 2019, the date set for the UK to leave the EU.

20 October Some 700 000 people march through central London, UK, demanding a second referendum on the final Brexit deal.

25 November UK prime minister Theresa May and the EU agree on the terms of Brexit. The agreement still has to be agreed by the UK parliament.

12 December Theresa May survives a no confidence vote within her governing Conservative party.

15 January 2019 Theresa May's government suffers the biggest-ever defeat for a sitting government – by 230 votes – on her Brexit deal.

16 January The UK government survives a vote of no confidence by 325 votes to 306.

13 March The government's Brexit deal is again defeated, by 149 votes.

22 March The EU agrees to a short extension in the Brexit deadline, to 12 April if no deal is reached by 29 March, and to 22 May if a deal is agreed by 29 March. No consensus has been reached at end-March.

23 March One million people march in London demanding a 'people's vote' on a final Brexit deal. A petition calling for Article 50, which set Brexit in motion, to be revoked gets more than 6m signatures.

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US trade-war worries cast shadow over oil recovery

Inflation will hit as Asian economies pass on higher import costs to consumers and fears of a US-China trade war affect market sentiment, reports ***Nurluqman Suratman*** of *ICIS*

The recovery in oil prices is expected to continue in the coming months of 2019, but record-breaking US production and worries about the US-China trade war have cast a shadow over market sentiment.

ICE Brent crude oil has been on a steady rise since the start of the year, with the May contract hovering at US$65.48/bbl in early March, up from US$54.91/bbl on 2 January.

Meanwhile, NYMEX WTI for April was at US$55.94/bbl on 6 March, up from 46.54/bbl on 2 January.

The main stress points in Asia due to higher oil prices will be in India and Indonesia, while sharply higher oil prices will pose macroeconomic challenges across the board in the region.

Inflation will become an issue affecting most Asian economies, whether higher import costs are passed through to the consumer, such as in the Philippines, or suppressed through fiscal subsidies, as is the case in China.

Malaysia will be the only clear winner in the bullish commodity price environment, because it is a net oil-exporting country.

According to Singapore-based DBS Group Research, 'The macro-headwinds of rising current account deficit (rising import bills) and high inflation as a result of a higher oil price will likely pressure markets on a broad macro-basis, leading to weakened currencies, risk aversion and fund outflows. This is especially applicable for Indonesia, Philippines and India.'

International crude oil prices have rallied this year as Russia and Opec (Organisation of the Petroleum Exporting Countries) curbed production to offset a global supply glut, while US sanctions isolated major suppliers Iran and Venezuela. Militancy problems in Libya and Nigeria have also compounded risks to oil supply.

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Oil accounts for 10% of China's total imports, driven by the surge in oil prices seen in 2018

'These [issues] have mostly remained on the sidelines while the oil market was dragged down by the "risk-off" mode in financial markets and obsessed over world oil demand amid an economic deceleration,' explained oil markets analyst Vandana Hari.

'If one or more of these supply flashpoints erupt while the planned Opec/non-Opec production cuts have tightened supply and removed global oil inventory surpluses, we could see a sustained price surge,' Hari, ceo of Vanda Insights, noted.

'As focus returns to oil market fundamentals and geopolitical risks, the bullish and bearish elements would seem roughly balanced as far as the eye can see, which should rule out major, sustained up or downswings in prices,' she added.

Opec's combined oil output declined by around 890 000 bbl/day in January from December, representing the largest monthly drop since January 2017, according to Spain-based FocusEconomics. This means that the cartel has reached almost three quarters of its target to

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reduce production by 800 000 bbl/day from October's level.

Most Opec members have displayed a strong commitment to the production cuts. But the reduction in output also reflects supply disruptions in Libya, sanctions restraining Iran's oil exports, and the dire state of Venezuela's oil industry, according to the research firm.

Russia, however, is lagging behind its Opec allies and reduced output only marginally. Russian officials, stated that this was due to technical limitations and that its adjustment would be more gradual, according to FocusEconomics.

Countering the cuts, the massive build-up in US crude oil inventories amid surging production has capped prices. In the week ending 1 March, US crude stocks rose by 7.39m bbl, according to the American Petroleum Institute.

It is the biggest weekly build-up since mid-January this year, and there are no signs that output in the US will slow down as the shale revolution continues.

Inventories at Cushing, the delivery point of the NYMEX WTI contract, have more than doubled since early September and swelled by 1.63m bbl in the week to 22 February, despite the plunge in overall crude stocks in the country.

The US Energy Information Administration (EIA) projects domestic crude production will average 12.4m bbl/day this year and 13.2m bbl/day next year.

'My belief is that the world has not yet seen the full impact of [the] shale revolution,' noted International Energy Agency's Fatih Birol at a recent global markets update session at the US Energy Department with US Secretary Rick Perry.

The first phase finished by mainly using shale oil and gas for the US domestically. Now comes the export phase and this will have major, long-lasting implications for global oil and gas markets, Birol added.

As far as the oil market is concerned, there are two main questions to be answered, according to Hari: 'How much more of a positive sentiment from a US-China deal remains to be factored in, and which way will the oil market fundamentals point when they reclaim centre stage?'

Much of the expected boost to global economic momentum from a US-China trade deal has already been priced into crude oil, while oil market fundamentals appear balanced, Hari said.

'Even with the bruising tit-for-tat tariff war out of the way, attention is likely to remain focused on the headwinds to economic growth in China as well as other parts of the world, prompting a moderate view on global oil demand growth in 2019,' she said.

On 5 March, China announced a Rmb2 trillion tax and social contribution cut after an annual report by the country's premier lowered targets for the expansion in gross domestic product to the slowest in almost three decades. This is higher than the Rmb1.3 trillion tax cut last year.

At the annual session of China's parliament, the country's number two leader, Li Keqiang, said that he forecasts slower growth of 6.0-6.5% this year, down from a target of around 6.5% in 2018.

'Despite the slower growth target, China keeps its job market target, such as 11m urban job creation and 5.5% surveyed unemployment rate,

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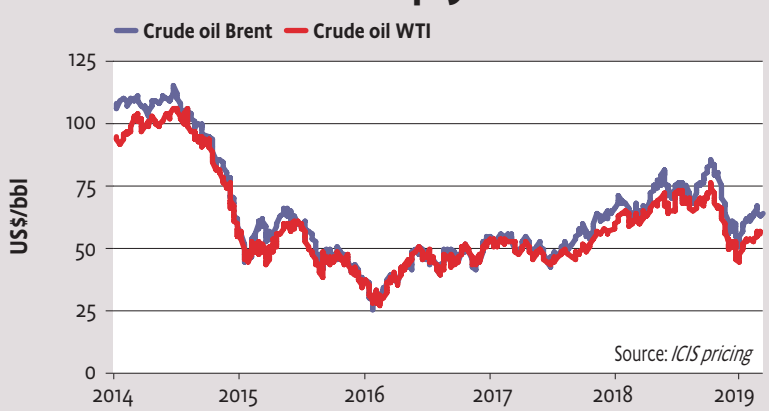
Most Opec members have displayed a strong commitment to the planned oil production cuts

CRUDE OIL SPOT PRICES 2014-19



unchanged. This is the sign of bottom-line thinking,' noted Singapore-based OCBC Treasury Research.

In China, the impact of higher oil prices will be reflected in larger import bills, noted Singapore's DBS Group Research. Given that oil accounts for 10% of China's total imports, the surge in oil prices was the prime driver of import growth in 2018.

The current account balance as a share of GDP, currently standing at 0.5% of GDP, will likely dive into negative territory in 2019, it said.

As for South Korea, higher oil prices will boost inflation, erode real incomes and cut GDP growth for the country, according to DBS.

'The impact will be significant and immediate, given the country's heavy reliance on energy imports and adoption of a floating fuel pricing mechanism,' it said.

High oil prices are a key Achilles heel for the Indian economy, complicating the inflation, current account, fiscal balance and currency outlook, according to DBS. The outlook for external balances, particularly the current account, is negative.

With every US$1 per barrel move in the Brent prices adding about US$2bn to India's oil-imports bill, high oil prices risk widening the net oil deficit as well as the current account gap, it said.

"As focus returns to oil market fundamentals and geopolitical risks, the bullish and bearish elements would seem roughly balanced as far as the eye can see"

However, higher oil prices are in general positive for Malaysia given that it is a net oil exporter. Higher oil prices should reasonably bring about higher production output from the mining industry and contribute directly to overall GDP growth, noted DBS.

Prices of key petrochemical feedstocks benzene, ethylene, paraxylene, styrene monomer and toluene have all been on an uptrend since early January this year.

The hikes seen in the regional naphtha market were underpinned by a combination of firmer upstream crude oil futures and steady demand from Northeast Asian end users.

Spot naphtha prices reached their highest in more than three months in March, with levels not seen since early November, according to *ICIS* data. Spot naphtha prices were at US$549.50/tonne cfr Japan on 1 March, rising sharply from US$468.25/tonne on 4 January this year.

The Asian benzene market has also tracked a similar pattern, with prices on the rise since the start of the year. Spot benzene prices had risen to US$615.0/tonne fob South Korea on 1 March from US$526.50/tonne on 4 January.

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Asian olefins set for less-tight supply this year

Extra capacity, fewer cracker turnarounds and cutbacks in downstream output are good news for Asian ethylene supply, although the outlook for propylene is mixed, report ***Pei Lin Yeow, Joson Ng*** and ***Helen Yan*** of *ICIS*

GETTY IMAGES

Asian ethylene supply should be better in 2019, owing to fewer cracker turnarounds in Japan, regional capacity expansions and possible cutbacks in downstream output.

The outlook for deep-sea supply is mixed, however. European exports are likely to be curtailed by a slew of cracker maintenance shutdowns, but shipments from the US might be boosted by a new export facility in the fourth quarter of the year.

Spot ethylene prices in Northeast Asia ended 2018 on a weak note. Prices fell to a low of US$870/tonne cfr Northeast Asia in December, a level last seen in September 2015.

The weak fourth quarter of last year was due to ample supply from the Middle East and Southeast Asia, on the back of strong cracker run rates, weak polyethylene (PE) sales, and downstream plant shutdowns.

The market turned the corner by mid-January 2019, aided by pre- and post-holiday restocking activities in China and production problems at several sites in Asia.

Arbitrage supply was also limited in the first quarter. Production issues helped balance a previously long market in Europe. Shipments from the Middle East slowed down amid higher downstream operations and cracker turnarounds.

By the end of February, prices had hit a 20-week high at close to US$1180/tonne cfr Northeast Asia.

Sluggish downstream markets in China, resulting from high inventories post-holiday, eventually led prices to come off in early March to settle in the low US$1100s/tonne cfr Northeast Asia.

For the rest of the year, new regional capacities, higher output in Japan and uncertain downstream conditions could outweigh output losses resulting from a heavy cracker shutdown schedule in South Korea, Southeast Asia and Europe.

Producers in South Korea and Malaysia will increase shipments to regional markets in 2019 as they bring capacity expansions onstream. Five projects with a combined capacity of 2.24m tonne/year are due to come onstream between the third quarter of 2018 and mid-2019. Up to 27-28% of that supply, or 610 000-630 000 tonne/year, is potentially available for sale.

"Production activity in some downstream sectors in Asia might weaken, under pressure from rapid capacity expansions in the US and Asia"

South Korea's Hanwha Total Petrochemical will temporarily become a net seller when its additional capacity is onstream in mid-2019. It will return to a net short position at the end of the year when its new 400 000 tonne/year high-density/linear low-density polyethylene (HD/LLDPE) plant starts up.

Exports from South Korea could see a temporary slowdown in March and the second quarter. Four producers will shut their plants for maintenance, with capacity losses totalling around 400 000 tonne.

In Southeast Asia, Malaysia's Petronas/Saudi Aramco Refinery and Petrochemical Integrated Development (RAPID) joint venture will help mitigate production losses from a series of cracker turnarounds in that region during the second half of 2019.

Major suppliers Petronas Chemicals Olefins in Malaysia, Chandra Asri in Indonesia, and Shell and ExxonMobil in Singapore will take their facilities down, contributing to total scheduled capacity losses of over 500 000 tonne/year in Southeast Asia, up from around 270 000 tonne/year in 2018.

Shipments from Japan, the second largest exporter after South Korea, will increase in line with production. Capacity losses from annual mainte-

China experienced its first drop in vehicle sales for 28 years in 2018, hitting butadiene demand

nance shutdowns are expected to be 69% lower this year than in 2018, at around 160 000 tonne/year.

Production activity in some downstream sectors in Asia might weaken, under pressure from rapid capacity expansions in the US and Asia, as well as from the US-China trade war.

The PE supply glut could worsen if shipments from the US increase as producers there resolve their logistics issues progressively. Competition in monoethylene glycol (MEG) and styrene monomer markets is also set to intensify.

Over 4m tonne/year of additional MEG capacity was scheduled to be operational in China, Malaysia and the US between late 2018 and 2019.

Suppliers in the US, which will turn into a net exporter, are likely to circumvent the tariff on imports into China, the leading polyester market, through internal swaps with facilities in other locations.

Chinese styrene makers could see lower margins when Zhejiang Petrochemical enters the fray. The company will have a massive 1.2m tonne/year styrene plant operational in 2019.

On a more upbeat note for suppliers, ethylene import demand in China will continue to draw support from downstream capacity expansions. Four non-integrated plants scheduled to start up between the third quarter of 2018 and 2019 could boost consumption of ethylene by up to 480 000 tonne/year.

Some of the increases in import requirements in 2019 might be offset by new domestic supply from SP Chemicals' cracker, China's first project to use a combination of ethane and propane feed, as well three methanol-to-olefins (MTO) plants.

The cracker is due to come onstream in the second half of 2019, although some market players expect possible delays to 2020.

When operational, SP Chemicals, which currently relies on imports of ethylene for its vinyl chloride monomer and styrene plants, will turn into a net seller. It currently requires around 320 000 tonne/year of ethylene imports when its plants are operating fully.

US exports will increase towards the end of the year if Enterprise Products Partners and Navigator Holdings' new export terminal, with a capacity of 1m tonne/year, starts up in the fourth quarter of 2019.

Shipments from Europe could be crimped by a heavy cracker turnaround schedule in 2019.

Spot propylene prices are expected to peak sometime in the second quarter of the year, as the period coincides with the heaviest production loss in 2019.

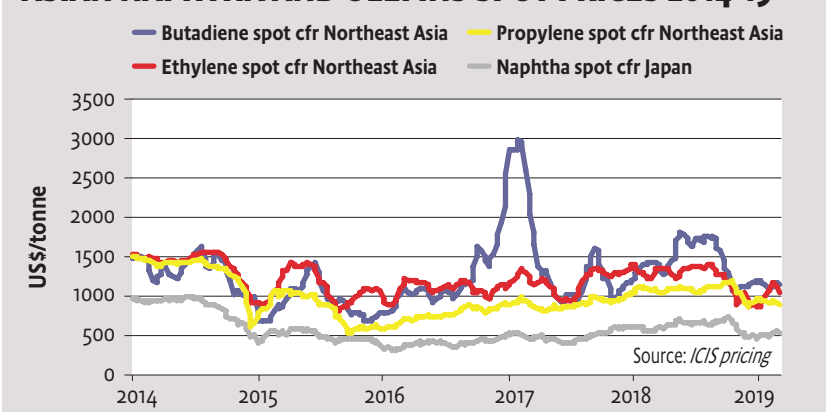
Prices in the cfr Northeast Asia spot markets have been fluctuating within a narrow range this year.

With key downstream derivative polypropylene (PP) set to shake off its post-Lunar New Year lethargy in China, better demand in that country could come at a time of tightening supply in South Korea and Japan as propylene units and crackers start their turnaround season for 2019.

According to *ICIS* estimates, production losses in Northeast Asia (excluding China) are expected to peak in April with March and May also months of significant losses. The second half of the year is relatively quiet in terms of maintenance work but September and October could represent some tightness.

Overall, production losses for

ASIAN NAPHTHA AND OLEFINS SPOT PRICES 2014-19



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Asian ethylene capacity starting up in 2018-2019 ('000s tonne/year)

Company	Location	Facility	Capacity	Start-up
Projects with surplus ethylene				
S-Oil	Onsan, South Korea	Ethylene recovery unit	200	End Aug/early Sep 2018
Lotte Chemical	Yeosu, South Korea	Steam cracker	x200 to 1200	Dec 2018
LG Chem	Daesan, South Korea	Steam cracker	x230 to 1270	Apr 2019
Hanwha Total Petrochemical	Daesan, South Korea	Steam cracker	x310 to 1400	May 2019
Pengerang Refining	Johor, Malaysia	Steam cracker	1300	Mar/early Q2 2019
SP Chemicals	Jiangsu, China	Steam cracker	650	H2 2019-2020
Nanjing Chengzhi Clean Energy	Nanjing, China	MTO	240	Q2-Q3 2019
Liaocheng Meiwu New Materials Technology	Shandong, China	MTO	120	Q2 2019
Jilin Connell Chemical Industry	Jilin, China	MTO	135	H2 2019
Total net ethylene surplus*	1.435m-1.455m tonne/year			
Projects with ethylene for captive use only				
Chandra Asri**	Cilegon, Indonesia	Steam cracker	x40 to 900	End Q3/early Q4 2019
Zhejiang Petrochemical***	Zhejiang, China	Steam cracker	1400	H2 2019-2020
Jiutai Energy***	Inner Mongolia, China	MTO	250	H2 2019
Ningxia Baofeng***	Ningxia, China	MTO	300	H2 2019
Qinghai Damei Coal Industry***	Qinghai, China	CTO	300	H2 2019
Zhong'an Lianhe Coal Chemical***	Anhui, China	CTO	350	H2 2019

*Supply available for merchant sale. Estimates are based on Hanwha Total Petrochemical's balance before it starts up its PE plant at the end of 2019
Chandra Asri's net ethylene surplus will reduce when its PE plant starts up at the end of 2019 * Structurally balanced. MTO = methanol to olefins; CTO = coal to olefins
Source: *ICIS*

planned maintenance work are estimated to be about 6.2% lower compared with 2018. That year, production losses for propylene in the region excluding China were estimated at around 756 000 tonne.

One of the more significant cracker turnarounds is Hanwha Total's unit in Daesan, South Korea, where propylene capacity is about 640 000 tonne/year. The shutdown also includes expansion works that will increase propylene capacity by about 100 000 tonne/year. The shutdown, which started at the end of March, could take about six weeks.

LG Chem also shut its cracker in Daesan for about a month from early March. Other significant propylene shutdowns are JXTG Nippon Oil and Energy's fluid catalytic cracking (FCC) unit in Mizushima, Japan, from the second half of September, and Taekwang's propane dehydrogenation (PDH) unit at the end of September.

Overall demand from China is not expected to change much in 2019. Annual import figures have fluctuated between 2.77m tonne and 3.09m tonne from 2014 to 2018. Imports in 2018 fell some 7.64% compared with 2017, to 2.86m tonne.

For PP, the main downstream outlet, demand in 2019 could be weighed down in Asia due to the US-China trade dispute, although the situation is still fluid. From April to June, demand could improve as buyers from Southeast Asia might be looking to re-stock before the Ramadan fasting month, which begins in early May. Chinese buyers might look to buy before the national Golden Week holiday in October.

In terms of supply this year, PP could possibly lengthen, particularly in the second half as new plants in Malaysia, Vietnam and China are set to start up.

For acrylonitrile, spot prices in Q2 could see some support as there are few planned maintenance stoppages expected in Northeast Asia. Demand during the same period is also believed to be healthy. Supply could lengthen in Q3 as a new plant in China is set to start up in June or July.

Propylene oxide demand in the second quarter of the year could be subdued in Northeast Asia as the trade dispute could potentially affect demand further downstream.

Oxo-alcohols in Northeast Asia could see rather mixed market performances in the second quarter across most grades.

For acrylic acid, demand will experience a traditional lull period in the

C hinese markets but Chinese producers could also take advantage of weak demand to carry out planned maintenance work. Q3 is the traditional period for good demand.

Southeast Asia could see interesting developments. Spot prices there tend to track developments in Northeast Asia, but things might be slightly different in the second half of the year. While the new propylene units in Johor, Malaysia, part of the RAPID project, could, in theory, add length to the regional market, there could be significant production losses during that time as there are two to three cracker turnarounds planned in Singapore and Indonesia.

There is also new demand in Southeast Asia, with Hyosung planning to start up its 300 000 tonne/year PP unit in Vietnam in November or December. The company is expected to import propylene, because its upstream PDH unit is only expected to start up in 2020, most likely in December, along with another PP line.

Asian butadiene (BD) spot prices could face downward pressure in the second half of this year due to lengthened supply from additional capacities, amounting to 550 000 tonne/year, coming onstream in Southeast Asia and China.

The joint venture RAPID project is due to add a new 180 000 tonne/year BD unit in Pengerang, Malaysia, in the second quarter of 2019, while several new BD plants in China, with combined capacities of 370 000 tonne/year, are also slated to start up in 2019.

Jiutai Energy is due to start up a new 70 000 tonne/year BD unit in the second quarter, while Nanjing Chengzhi Energy's 100 000 tonne/year and Zhejiang Petrochemical's 200 000 tonne/year BD units are expected to start up in the second half of the year in China.

The additional capacities are expected to exert downward pressure on the BD price in the second half of 2019, given that there are no concurrent downstream expansions.

Meanwhile, dwindling deep-sea supply from Europe, coupled with expectations of tightened regional supply from a spate of cracker and BD unit shutdowns during the period from March to June, bolstered the Asian BD spot prices in the early part of the year.

"The slump in Chinese automotive sales and production was exacerbated by the US-China trade tensions"

Several crackers and BD plants in South Korea, a major BD exporter, are due to shut in the second quarter, including LG Chem, Hanwha Total and Yeochun Naphtha (YNCC).

BD spot prices fluctuated between US$1100-1200/tonne from late December 2018 to 1 March 2019, largely supported by downstream acrylonitrile-butadiene-styrene (ABS) makers.

Although demand from the ABS sector seasonally strengthens in the second quarter and peaks in the third quarter, support from this sector is not sustainable, given that it accounts for only about 20% of the total consumption of BD.

Major consumers of BD are synthetic rubber makers, primarily styrene butadiene rubber (SBR) and polybutadiene rubber (PBR). SBR and PBR are key raw materials in the production of tyres for the automotive industry.

Spot interest from these purchasers is expected to remain soft for the second half of 2019 amid a slowing global economy.

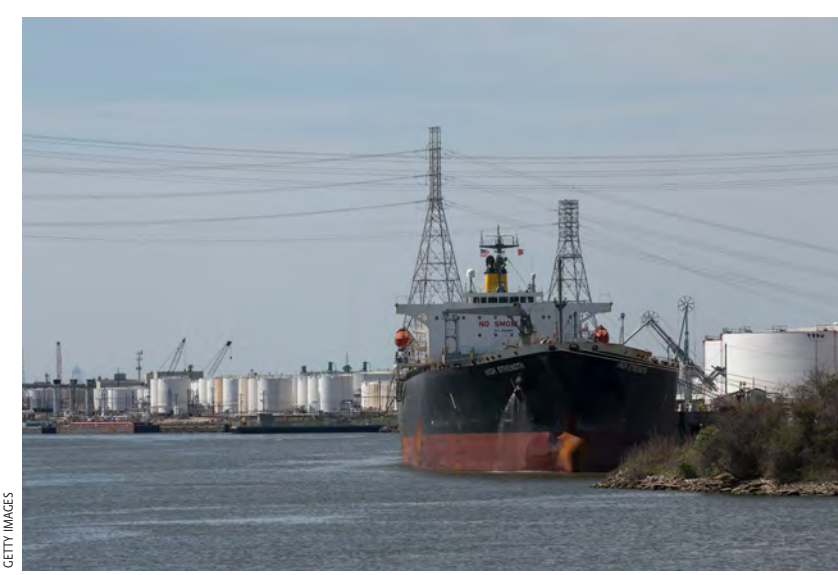
A slowing Chinese economy and declining automotive sector in China, the world's largest automotive market, is expected to weigh on demand for BD from downstream SBR and PBR makers. In 2018, China saw a 2.76% drop in vehicles sales, the first decline in 28 years.

The Chinese vehicle market remained in freefall in January 2019. Vehicle sales in the month slumped 15.76% year on year and were down 11.05% month on month at 2.37m units, according to data from the China Association of Automobile Manufacturers (CAAM). Vehicle production in China also fell. January vehicle output stood at roughly 2.37m units, down 12.05% year on year and 4.71% month on month.

The slump in Chinese automotive sales and production was exacerbated by the US-China trade tensions, which took a toll on business sentiment and demand down the supply chain.

As a result, distributors, traders and end users adopted a cautious stance and reined in their risk appetite, thus dampening sentiment, weighing on demand and suppressing prices down the supply chain.

Port of Houston: US ethylene exports will increase when a new 1m tonne/year ethylene terminal starts up in the fourth quarter



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Rising consumption set to meet polyolefins boost

China remains the world's largest consumer of PE but its trade war with the US significantly changed trade flows in markets around the globe during 2018, reports ***Angie Li*** of *ICIS*

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Trade tensions between the US and China eased during the G20 meeting in Argentina in late 2018

Global polyethylene (PE) consumption continued to rise in 2018, reaching 102m tonne, up 4.2% from 2017. In response to this fairly rapid growth, PE producers are boosting capacity, often with the use of lighter feedstocks for ethylene production. Capacity expansions in 2018-2020 will remain concentrated in North America, Northeast Asia and Southeast and South Asia.

With good availability of low-cost ethane, North America has become the fastest growing area for capacity additions in 2019-2020, with additional production set to hit around 3m tonne/year.

Meanwhile, supply in Northeast and Southeast Asia will, respectively, rise to 25.4m tonne/year and 13.6m tonne/year in 2020 in response to strong demand growth, an increase of 2.8m tonne/year and 1.1m tonne/year compared with 2018.

China remains the world's largest consumer of PE with apparent demand estimated at 30.9m tonne in 2018, while compound growth rates are expected to be at 7-8% in the 2018-2020 period.

The new capacities in China come mostly from privately operated refining and chemical enterprises and coal-based plants, reducing the market shares of Sinopec and PetroChina.

According to *ICIS* data, Sinopec and PetroChina's domestic PE production capacities accounted for 28% of the total in 2018, but might drop to 24% in 2020 once privately operated refining and chemical enterprises and coal-based factories start up plants.

Sinopec and PetroChina have been aggressive in boosting sales of polyolefin products in China, to give them a bigger say in pricing in the market. Sinopec is more active in ramping up sales from third-party suppliers.

So far, Sinopec Chemical Commercial has signed sales agreements with Hengli Petrochemical, Zhong'an Lianhe Coal Chemical and Daqing Lianyi Chemical. This, coupled with its shares in joint ventures, means that around 38% of PE capacity in China will be accounted for by Sinopec in 2020.

Furthermore, Jiutai Energy and Bora Petrochemical are believed to have held negotiations with Sinopec or PetroChina, but this has not been directly confirmed by either side.

According to *ICIS* data, 46% of China's apparent demand was met by imported cargoes in 2018. This situation will extend into 2019, as most new capacities will not be commissioned until the second half of the year.

Europe ranks second in terms of PE consumption. Its compound growth rate for demand is expected to be 2.0% a year during 2018-2020, but growth in supply will stand at 1.1% a year, leaving more local demand to be satisfied by imported cargoes.

Southeast and South Asia take third position in terms of PE consumption. Their compound growth rate for demand is expected to be 6.8%/year during 2018-2020, but that for supply will be 4%/year, despite capacity expansions. Going forward, the supply gap will be filled by imports.

Judging from the global PE supply-demand balance, the Middle East

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A 10% tariff on US$200bn of Chinese exports to the US came into force in September 2018

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and North America will continue to play a net PE export role in the future.

It is estimated that by 2020, nearly 7m tonne of PE will be exported from North America, of which more than 2m tonne will flow to Northeast Asia, and about 1-2m tonne to Southeast and South Asia and Europe.

PE exports from the Middle East will be around 17m tonne in 2020, of which more than 7m tonne will move to Northeast Asia, and about 3.5m tonne to Southeast and South Asia and Europe.

However, the US-China trade dispute significantly changed the global PE market trade flow in 2018. The second round of US and China additional tariffs, at 25% on US$16bn of imports, came in on 23 August 2018.

US-origin high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) flowing into China both saw total tariffs of 31.5% imposed, though low-density polyethylene (LDPE) imports remained at a tariff level of 6.5%.

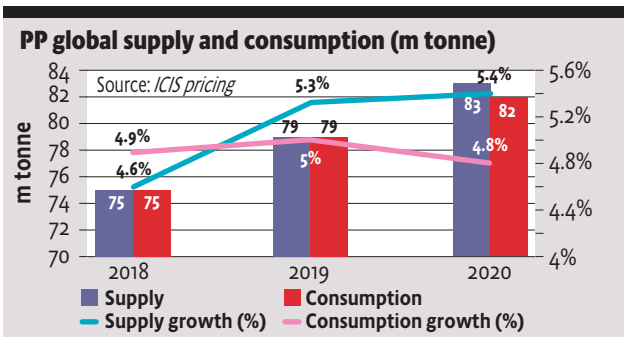
Chinese traders were thus more cautious about buying from the US, including LDPE. Business via general trade from the US to China nearly halted after the implementation of the additional tariffs. Only export-oriented producers could use US-origin products via import processing trade, which is tariff-free.

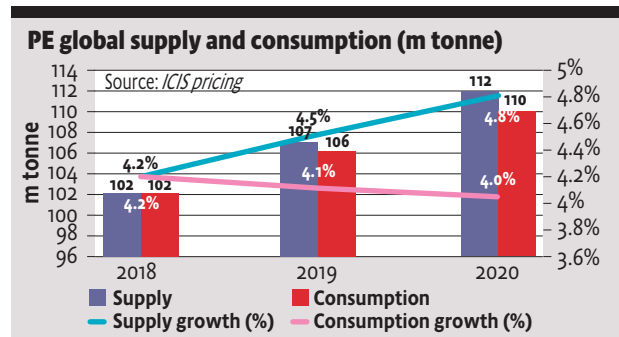
US exports into China under import processing trade accounted for nearly 20% of the total volumes from the US to China in 2018, according to data from China Customs. On that basis, the outflows from the US to China are expected at 200 000-300 000 tonne in 2020, against a backdrop of 25% additional tariffs, while most imports into China will come from the Middle East and Southeast and South Asia regions.

This reflects the fact that large petrochemical suppliers in the US are world-class producers with many polyolefin plants worldwide, not only in the US, but also in the Middle East, Southeast and South Asia and Europe. Multiple overseas suppliers say that it is not difficult for them to allocate or adjust resources in the worldwide range.

During 2018, more US PE cargoes flowed to South America and Europe. Some exports are gradually being transferred to Vietnam and Singapore. The former was due to rapidly rising local demand in Vietnam according to market players, while the latter to Singapore is mainly set to be re-exported.

A 10% tariff on an additional US$200bn of imports from China to the US took effect on 24 September 2018, with the rates set to increase to 25% at some point. This includes a large number of plastics with HS





Global PP capacity expansions 2019-2020 ('000s tonne/year)

Country	Province	Producer	Capacity	Actual/expected start-up
China	Inner Mongolia	Jiutai Energy	350	H1 2019
China	Anhui	Zhong'an Lianhe Coal Chemical	350	H2 2019
China	Qinghai	Qinghai Damei	400	H2 2019
China	Zhejiang	Zhejiang Petrochemical	900	2019-2020
China	Ningxia	Baofeng Energy	300	H2 2019
China	Guangdong	Juzhengyuan	600	H2 2019
China	Liaoning	Hengli PC	880	2019-2020
China	Heilongjiang	Daqing Lianyi Chemical	500	2020
China	Liaoning	Liaoning Bora Petrochemical	600	2020
Vietnam	Nghi Son	Nghi Son Refinery And Petrochemical	400	2018
Malaysia	Pengerang Johor	Petronas RAPID	900	2019
Philippines	Batangas	JG Summit Petrochemical	110	2020
Malaysia	Pasir Gudang	Lotte Chemical Titan	200	2018
Indonesia	Ciwandan, Cilegon	Chandra Asri	80	2019
Russia	Tobolsk	Zapsibneftekhim	500	2019
India	Paradeep	Indian Oil Corp.	680	2019

Source: *ICIS*

codes under Chapter 39, which account for about 25% of the total plastics in value terms, according to market information.

Around 2m tonne of plastic products made from polyolefins are estimated to have been exported to the US in 2018. However, if the tariffs on products exported to the US are finally increased to 25% in 2019, some downstream film processors in the southern part of China will not be able to bear the incremental costs, and thus there are indications that many orders may be redirected to Southeast Asia.

Trade tensions between the US and China eased during the G20 meeting in late 2018 with both countries agreeing not to impose additional tariffs on 1 January 2019. However, market participants believe that this will not prevent Chinese downstream enterprises from moving plants to Southeast Asia.

This is not just because of the trade war, according to a source from PetroChina, but also related to rising costs of land, labour and financing in China, which are forcing domestic low value-added manufacturers to move outside the country, especially for the clothing industry and supporting factories.

For polypropylene (PP), global consumption is estimated at 74.9m tonne in 2018, up 5% from 2017.

Unlike PE, capacity expansions in the PP sector are mostly taking place in Northeast and Southeast Asia, close to the location of consumers. Additional PP supply will exceed 8m tonne/year in 2019-2020, with nearly 4.6m tonne/year, or 60% of global total growth, seen in Northeast Asia, mostly in China, while around 2m tonne/year, or 23% of the global total, will be

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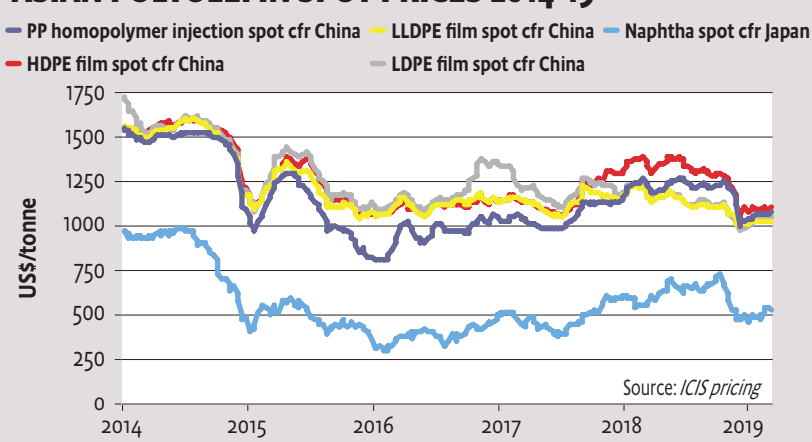
ASIAN POLYOLEFIN SPOT PRICES 2014-19

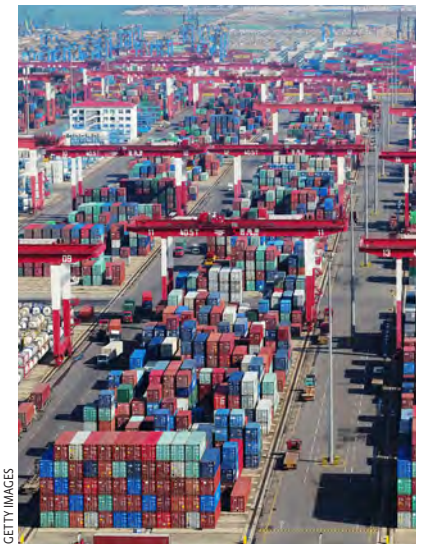


Global PE capacity expansions 2019-2020 ('000s tonne/year)

Country	Province	Producer	Capacity			Actual/expected start-up
			LLDPE	HDPE	LDPE	
China	Inner Mongolia	Jiutai Energy	250			H1 2019
China	Anhui	Zhong'an Lianhe Coal Chemical	350			H2 2019
China	Qinghai	Qinghai Damei	300			H2 2019
China	Zhejiang	Zhejiang Petrochemical	300 HD/LLD	450		2020
China	Ningxia	Baofeng Energy	300			H2 2019
China	Liaoning	Hengli PC		400		2019-2020
China	Liaoning	Liaoning Bora Petrochemical	450 HD/LLD	350		2020
China	Heilongjiang	Daqing Lianyi Chemical		400		2020
China	Ningbo Huatai Chemical	Ningbo	400			2021
US	Lake Charles, Louisiana	Sasol	470		420	LL: Q1 2019/HD: Q3 2019
US	La Porte, Texas	LyondellBasell		500		Q3 2019
US	Point Comfort, Texas	Formosa Plastics		400	400	H2 2019
US	Beaumont, Texas	ExxonMobil Chemical	650			2019
Malaysia	Pengerang Johor	Petronas RAPID	350	400		2019
Philippines	Batangas	JG Summit Petrochemical		250		2020
Indonesia	Ciwandan, Cilegon	Chandra Asri	400			2020
South Korea	Daesan Korea	Hanwha Total		400		2020
Russia	Tobolsk	Zapsibneftekhim	800	700		2020

Source: *ICIS*

China's PP exports are expected to focus on Southeast Asia in the future



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in Southeast and South Asia.

The largest PP capacity expansions are found in China, based on a range of feedstock sources and technologies, including naphtha, propane dehydrogenation (PDH) and methanol to olefins (MTO).

Profits from naphtha- and PDH-based PP were good while oil prices were low. However, margins for outsourced methanol-based suppliers located in eastern China were eroded in 2017-2018 due to volatile methanol prices, with individual MTO plants shut down or running at reduced operating rates. The average operating rate of China's MTO plants was down from around 81% in 2017 to 74% in 2018.

China's granular PP capacity was 22.98m tonne/year in 2018, of which 55% came from the traditional oil-based routes while 41% was from new coal or PDH processes. This latter figure will rise in the next two years, to 44% in 2020.

The Middle East is a traditional net exporter to the global PP market. Northeast Asia is likely to transform into an export region from an import one in the future, in line with rapidly growing capacities in China.

Export volumes of homopolymer PP from China totalled 312 000 tonne in 2018, mostly to Southeast Asia, with 101 000 tonne, or around 32.5%, going to Vietnam.

Indonesia, Thailand and Vietnam are the main consumers of PP in Southeast Asia, according to the *ICIS* Supply-Demand Database, with the consumption growth rate hitting 6.5% a year in Vietnam in 2018-2020, and 5.6% a year and 4.4% a year, respectively, in Indonesia and Thailand. The smaller markets in Cambodia, Myanmar and Laos may grow at high rates in the future.

China's PP exports will focus on Southeast Asia in the future. China's policy to raise export rebates from 1 November 2018, in order to reduce the losses caused by the US-China trade dispute, also increased the competitiveness of Chinese PP.

According to *ICIS* data, raising export rebates for PP offers a competitive edge equal to US$30-50/tonne. However, PP capacity expansions in Southeast Asia might hinder exports from China to the area.

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Domestic benzene production from non-state-owned Chinese refineries rose in 2018

Mixed fortunes for aromatics

New capacity and unexpected surpluses in Europe weighed on benzene and depressed margins for much of H2 2018, but tight supply supported PX and PTA. ***Osamu Yanagisawa*** of *The Chemical Daily* reports

The Asian benzene market has seen significant changes in the last two years. The start of 2017 saw prices temporarily climb above US$1000/tonne and a benzene-naphtha price spread of more than US$500/tonne. By the start of 2019, the spread of benzene over naphtha had fallen to below US$100/tonne.

The exceptional tightness of early 2017 followed US outages for key benzene-derivative styrene in October 2016, which prompted increased styrene production in Asia, tightening benzene supply. The situation was compounded at the end of November 2016 when Opec (The Organisation of the Petroleum Exporting Countries) agreed to cut production, pushing crude oil prices higher.

In 2018, benzene market conditions were generally favourable in Q1 as buyers bought material ahead of scheduled turnarounds. However, the situation reversed in Q2 amid sluggish markets. Inventory levels in the China coastal area grew to a record high of 240 000 tonne and the benzene–naphtha price spread fell to below US$150.

The situation eased in early Q3 as downstream turnarounds were completed, reviving demand for benzene. Inventory levels in the China coastal area eased to 200 000 tonne and the benzene–naphtha price spread increased to around US$250/tonne in early August.

However, the recovery was short-lived. In late August, production problems for benzene derivatives in Europe saw a surplus of European benzene flow to Asia and the US.

At the same time, benzene-derivative plants in the US started turnarounds, increasing benzene surpluses. South Korean benzene producers responded by reducing exports to the US and instead increasing exports to China, which further exacerbated the scale of the surplus in Asia. Domestic benzene production from non-state-owned Chinese refineries reportedly rose by 400 000–500 000 tonne in 2018.

Shipments from Europe to the US and Asia continued into Q4 as low water levels in the River Rhine restricted shipments and production of benzene derivatives in the region.

Inventory levels in the China coastal area had fallen below 150 000 tonne by early Q4, but started to increase again in mid-November, and had climbed above 200 000 tonne by January this year.

Asian benzene supply also increased during 2018 as a series of new plants came onstream. In usual circumstances, these additional capacities would have been absorbed by demand growth, but the additional flow of material from Europe tipped the supply-demand balance into surplus. New capacity included 250 000 tonne/year in Vietnam, 400 000 tonne/year in Saudi Arabia and 120 000 tonne/year in India.

In China, a surge of investment in benzene-derivative plants has led to sharp increases in benzene imports in recent years – from 601 000 tonne in 2014 to 1.21m tonne in 2015, 1.55m tonne in 2016, 2.5m tonne in 2017 and a new record high of 2.57m tonne last year. More than 300 000 tonne was imported in December alone.

In Japan, benzene production fell by 4.7% year on year to 4.17m tonne last year. Despite this, benzene

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exports rose 2.1% to 767 000 tonne. Japanese exports to China fell 25.1% to 300 000 tonne, but rose to both the US and Taiwan, by 32.4% to 285,000 tonne, and by 20.2%to 141 000 tonne respectively. Japan's benzene imports fell 15.7% to 127 000 tonne in 2018, mainly from South Korea. South Korea exported 2.57m tonne of benzene in 2018, down 2.4% year on year. China-bound exports were down 11.6% at 1.27m tonne, but exports to the US rose 20.8% to 650 000 tonne, those to Taiwan were up 4.8% at 520 000 tonne, while those to Japan fell 19.4% to 124 000 tonne.

Global demand for paraxylene (PX) is estimated to have risen by around 7% year on year in 2018 to around 44m tonne. This was driven in part by the Chinese government's July 2017 announcement that China would ban the import of plastic waste with effect from 1 January 2018. China imported some 2m tonne of waste polyethylene terephthalate (PET) in 2017. Replacing this with virgin resin would require at least 1.1m tonne of additional PX.

As the world's largest producer of polyester, China is rapidly expanding its production capacity for purified terephthalic acid (PTA), a derivative of PX and a raw material for polyester. This has underpinned growth in PX imports, from 11.65m tonne in 2015 to 12.36m tonne in 2016, 14.44m tonne in 2017 and a new record high of 15.9m tonne in 2018.

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Early in 2018, PX prices increased as buyers rebuilt inventories for PTA and polyester as well as PX ahead of a heavy round of scheduled turnarounds. The PX-naphtha spread climbed above US$400/tonne but then slid below US$350/tonne in Q2 because of high stocks and upcoming PX startups.

By July, PX inventories had fallen significantly and prices rose, climbing above US$1300/tonne in late August. The PX-naphtha spread increased to almost US$700/tonne and remained high even as markets calmed. Monthly contract prices for Asian PX were only agreed five times in 2018.

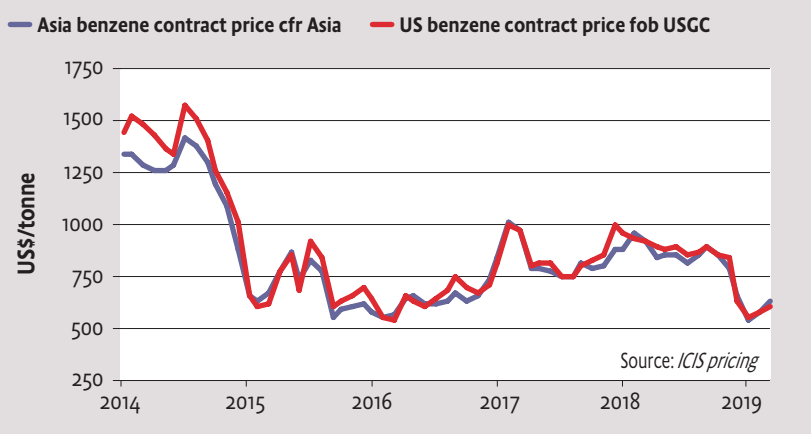
PX plants started up in Saudi Arabia and Vietnam with capacity of 1.35m tonne/year and 700 000 tonne/year, respectively. However, supply remained tight.

In addition, 550 000 tonne/year of PX capacity was restarted in Indonesia in November for the first time in four years, while 800 000 tonne/year of a total 1.6m tonne/year plant in China resumed operations after shutting down in 2015 following an explosion.

Japan's PX production fell 2.7% year on year in 2018 to 3.37m tonne. PX exports fell 3.1% to 3.13m tonne, with shipments to China down 5.5% at 2.45m tonne, but exports to Taiwan were up 9.1% at 662 000 tonne. Japanese imports of PX fell 12.6% to 44 000 tonne in 2018, mainly from South Korea.

PX exports from Japan peaked in

ASIAN & US GULF BENZENE CONTRACT PRICING 2014-19



Low water levels in the River Rhine restricted the shipment of benzene derivatives

2013 at 3.32m tonne, then dipped to 2.4m tonne in 2014 as new Asian plants started operations before recovering to above 3m tonne/year in 2015 and the years since.

According to South Korean trade statistics, South Korean exports of PX rose 1% year on year in 2018 to 7.38m tonne. Exports to China fell 1.9% year on year to 6.53m tonne, but still accounted for around 90% of the total.

South Korean PX exports to Taiwan rose by 75.4% to 660 000 tonne, to the US rose 7.3% to 123 000 tonne, to Indonesia were up 110% to 10 000 tonne and to Singapore increased from zero in 2017 to 10 000 tonne, while those to India fell 84.4% to 10 000 tonne.

South Korean imports of PX were down 1% at 25 000 tonne in 2018. Of this, imports from Japan fell 41.4% to 15 000 tonne while imports from the US increased from zero in 2017 to 10 000 tonne in 2018.

Two new PX plants, each with 4m tonne/year capacity, are due onstream this year in China as part of refinery projects with capacity of 400 000 bbl/day. Both facilities are now optimising production.

In the PTA market, China started up some 20m tonne/year of PTA capacity during the 2012-2014 period, causing a slump in prices due to oversupply.

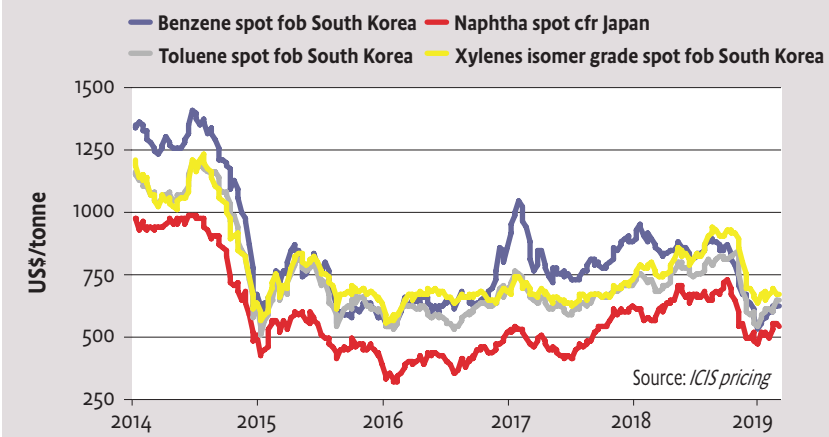
Since then, new plants have come onstream at a slower pace. China's Chengxing Group started up 2.2m tonne/year in 2016, while Taiwan's Oriental Petrochemical (Taiwan) started up 1.5m tonne/year in 2017 and China's Tongkun Group started up 2.2m tonne/year in 2018.

Financial pressure has forced some plants to halt operations for the long term and demand has continued to grow. As a result, the supply-demand balance has tightened. In Q3 2018, PTA prices climbed above those for PX.

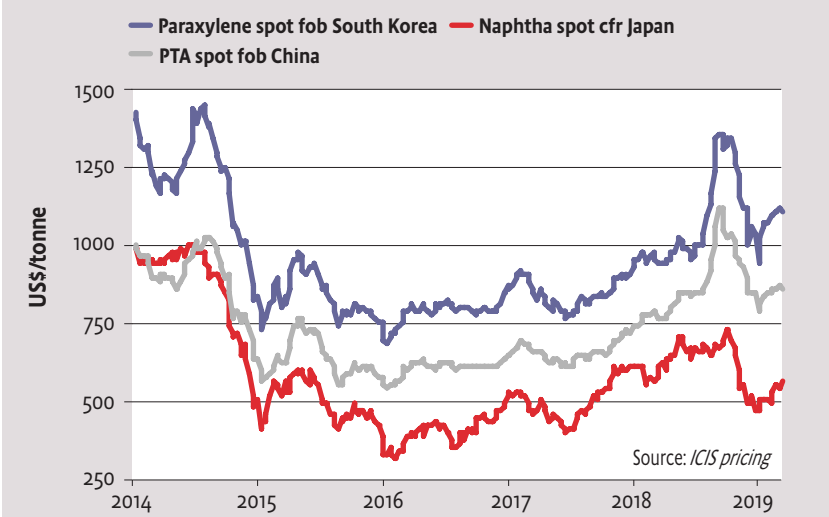
This has already encouraged several plans for further PTA expansions. In 2019, China's Xin Feng Ming Group is planning to start up 2.2m tonne/year of PTA capacity. In 2020 and beyond, these include plans by Billion Industrial Holdings for 2.2m tonne/year; by Hengli Petrochemical for 2.5m tonne/year; and by Zhejiang Yisheng Petrochemical for 5.5m tonne/year.

If demand grows by 5% year on year, it will be sufficient to absorb the output from these new facilities thus keeping supply tight.

ASIAN BTX AND NAPHTHA SPOT PRICES 2014-19



ASIAN PX, PTA AND NAPHTHA SPOT PRICES 2014-19



Styrene supplies still tight despite new capacity

Plant outages and steady global growth in demand for styrene and its key applications have more than offset the startup of new capacity in recent years, as ***Osamu Yanagisawa*** of *The Chemical Daily* reports

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Styrene supply has been consistently tight in recent years as plant closures and steady demand growth have more than offset the startup of new capacity. A large price spread between styrene and feedstocks benzene and ethylene has been maintained even when upstream market conditions have been weak.

In Japan, styrene production capacity was reduced by almost 30% in 2015-2016 and remaining plants have run at full capacity ever since.

Global demand for styrene, the predominant derivative of benzene, is estimated at 30m tonne/year. Key applications include polystyrene (PS), expanded polystyrene (EPS), acrylonitrile–butadiene–styrene (ABS) and styrene–butadiene rubber (SBR).

In China, EPS is the largest consumer of styrene. Traditionally used for insulation and other building materials, more recently EPS has seen significant growth in demand for packaging materials, driven by the surge in online shopping, and it is forecast that this application will in future account for more than half of total consumption.

China's domestic demand for styrene has grown to 10m tonne/year, but the startup of new domestic capacity has steadily eroded imports from their peak of 3.74m tonne in 2015.

In 2018, styrene imports into China dropped to 2.92m tonne, the first time in a decade they have fallen below the 3m tonne mark, as Qingdao Soda Ash Industrial and Anhui Haoyuan Chemical Group started up new plants with capacities of 500 000 tonne/year and 260 000 tonne/year, respectively.

In addition, China's Ministry of Commerce (MoC) last year implemented antidumping duties on styrene originating from South Korea, the US and Taiwan. South Korea exported 1.26m tonne of styrene to China in 2017, but only 840 000 tonne in 2018.

Styrene imports into South Korea also fell, from 790 000 tonne in 2017 to 310 000 tonne in 2018. At the same time, Japan saw year-on-year growth of 120% in its styrene exports to China, to 460 000 tonne in 2018, while its styrene exports to South Korea fell 78% year on year to 90 000 tonne.

"Global annual demand for key styrene derivative ABS resin is estimated at 9m tonne. China accounts for roughly 60% of total consumption"

Plans for new capacity in 2019 are limited, and any production increases are expected to be absorbed by growing demand. However, three new plants will add some 2.6m tonne/year of new capacity in China in late 2020 and during 2021, more or less equalling China's annual import volume of styrene and auguring a major shake-up in the global supply-demand structure.

Global annual demand for key styrene derivative ABS resin is estimated at 9m tonne. China accounts for roughly 60% of total consumption, and imports around 1.7m tonne/year of ABS, of which 80% comes from Taiwan and South Korea.

Asian market conditions for ABS were robust in the first half of 2018. Demand for virgin product was boosted in China by the ban on imports of waste plastics implemented by the Chinese government with effect from 1 January 2018. Boosted by high prices for key feedstocks acrylonitrile, butadiene and styrene, ABS prices surged to peak at around US$2000/tonne in Q2.

The surge in online shopping is driving China's demand for EPS, used for packaging materials

However, prices trended down in the second half of the year as US-China trade tensions dampened the commercial flow of consumer electronics destined for the US market, in turn hitting Chinese domestic demand for ABS, undermining import volumes into China, and forcing Chinese ABS producers to reduce operating rates. Prices ended the year at around US$1400/tonne with margins under pressure.

South Korean exports of ABS to China fell 25% year on year in September while those from Taiwan fell 16%. Exports to the southern China gateway of Hong Kong fell 34% from South Korea and 24% from Taiwan.

Although there was a slight uptick in October in South Korean exports to China, those to Hong Kong fell 11%. In November, exports to China from South Korea dropped 24% year on year, while those to Hong Kong plunged 44%.

Global demand for acrylonitrile has reached 6m tonne/year, with one-third going into ABS resin. The next major application is acrylic fibre, which accounts for close to 30%. Other uses include acrylamide, used in water treatment agents; adiponitrile, an intermediate in polyamide; nitrile rubber; and carbon fibre. Demand for acrylamide is growing in countries such as China where environmental regulations are being strengthened. Use of NBR latex is seeing growth in applications such as surgical gloves.

Acrylonitrile rode an upward Asian market trend in first-half 2018, from around US$1750/tonne to around US$2250/tonne in early Q3. The supply-demand balance was tight due to China's environmental regulations and a concentration of scheduled maintenance turnarounds. Raw material propylene began the year at over US$1000/tonne and rose to around US$1100/tonne by mid-year, with prices then holding largely at above US$1100/tonne through Q3.

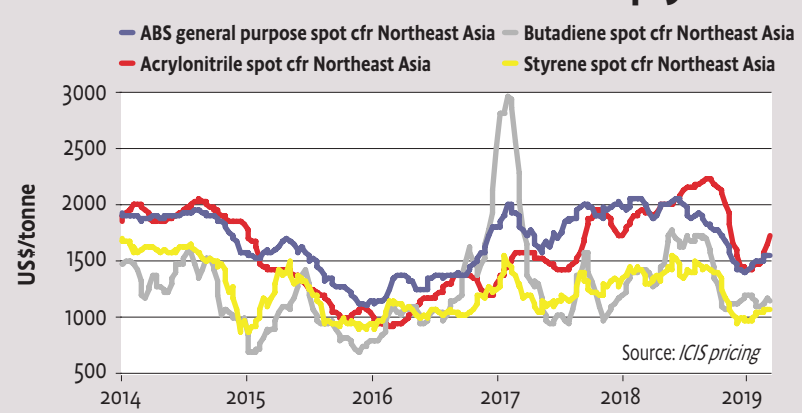
By the end of the year, acrylonitrile markets had weakened due to factors including: an influx of product into Asia due to production cuts by European fibre manufacturers; production adjustments by Asian customers in response to China's slowing economy and its trade war with the US; and hesitation by buyers anticipating lower crude oil prices.

Japan's acrylonitrile exports increased for a third consecutive year in 2018 to 38 000 tonne, up 65% year on year, helped by a rebound in Taiwan-bound volumes to 15 000 tonne after two inactive years. Japan's exports to China rose 72% year on year in 2018 to 12 000 tonne after virtually ceasing in 2016.

Peak Japanese acrylonitrile exports were reported in 2011 at 288 000 tonne, then steadily declined to 5000 tonne in 2015 as China expanded domestic production and Japan reduced domestic capacity.

Chinese acrylonitrile capacity has surged to 2m tonne/year since 2013, with new plants including: 130 000 tonne/year at Sinopec Anqing Petrochemical; 130 000 tonne/year at Shandong Haili Chemical Industry; 260 000 tonne/year at Shanghai Secco Petrochemical. As a result imports into China dropped to 300 000 tonne in 2017, from more than 500 000 tonne annually between 2011 and 2014.

ASIAN STYRENE AND ABS SPOT PRICES 2014-19



光 The hieroglyph in this ad is the origin of the character *hikari* (at left), which in Japanese means to "shine or sparkle" and is also a character in the word "radiance." It is believed to have been inspired by the idea of a person holding a torch above his head, to spread the light in all directions.

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A year of record highs and lows for acetic acid

Following record highs in May 2018, acetic acid prices plunged earlier this year, but they are now expected to bounce back, reports ***Kazuki Kayano*** of *The Chemical Daily*

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EVA markets were hit by China's decision to revise its support for photovoltaic facilities

2018 was a year of dramatic contrasts for acetic acid. Robust demand and tight supply pushed Asian prices to record highs at around US$850/tonne in May, but restored production levels and weakening demand reversed the balance in the second half and prices were pulled down to around US$450/tonne by early 2019.

Nonetheless, expectations at the time of writing in March 2019 were for the balance to once again tighten in Q2 as rebounding demand coincides with a round of turnarounds. Even in the medium term, forecasts anticipate supply will remain tight as there are no standalone acetic acid projects on the books despite steady demand growth. Planned capacity expansions are part of projects with captive downstream derivative facilities.

Asian acetic acid supply steadily tightened in the second half of 2017. Production problems in China and scheduled maintenance turnarounds in June that year were followed in late August by Hurricane Harvey in the US, and in October by an explosion at Eastman Chemical, forcing US exporters of acetic acid derivatives to Europe, South America and elsewhere to supplement acetic acid shortfalls with product from China and other parts of Asia. Some 50 000-60 000 tonne was reported to have moved from Asia to the US in a period of three months.

In late 2017, Chinese acetic acid production took a further hit and export availability was curtailed as coal-based producers of feedstock methanol were impacted by new Chinese environmental regulations intended to reduce coal consumption. Methanol plants based on natural gas were also affected as government efforts to replace coal with natural gas for domestic heating resulted in a shortage of natural gas in northern China.

In February 2018, LyondellBasell Industries declared *force majeure* in the US due to difficulties in procuring raw materials. Asian product was again sought to plug the US shortfall, further tightening supply in Asia.

In April 2018, turnarounds by

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Reduced demand for EVA for solar cell sheets hit VAM demand in China

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small- and medium-sized producers exacerbated supply restrictions from Chang Chun Petrochemical and Celanese in Taiwan and Singapore, respectively, pushing Asian acetic acid prices in May to a record high.

The situation eased in June as operations resumed at plants that had been hit with technical problems, and then saw a sharp reversal with prices falling US$200/tonne in a month in July. Operating problems in China underpinned a US$20/tonne uptick in pricing in August, but it was short-lived. In September, a temporary shutdown by one producer in China of 400 000 tonne/year of acetic acid capacity because of technical issues and a reduction in operating rates from 80% to 50% by another major producer in China had little impact on the market.

Since late October, the market has continued to weaken as demand for acetic acid has softened.

Purified terephthalic acid (PTA) markets have slipped on weaker demand since Q4. Vinyl acetate monomer (VAM) markets have also slowed on the back of reduced demand for derivative ethylene–vinyl acetate (EVA) copolymer. Used in solar cell sheets, EVA was hit by the Chinese government announcement in May 2018 that it had revised its support for photovoltaic facilities. The trade friction between China and the US has also undermined domestic Chinese demand in the last year.

In the short term, scheduled maintenance turnarounds are expected to tighten the supply-demand balance and boost prices in Asia for acetic acid. Turnarounds are scheduled for one Taiwanese and two Chinese acetic acid producers in March-April, a South Korean and a Chinese producer in April-May, and a further Chinese producer in August-September.

In the long term, the Asian market is forecast to be tight, though this could be affected by the recent slowdown in economic growth in China.

Global acetic acid capacity is estimated at around 20m tonne/year. Demand is estimated at 16m tonne/year and will grow at several percent per year as new VAM and PTA facilities come onstream.

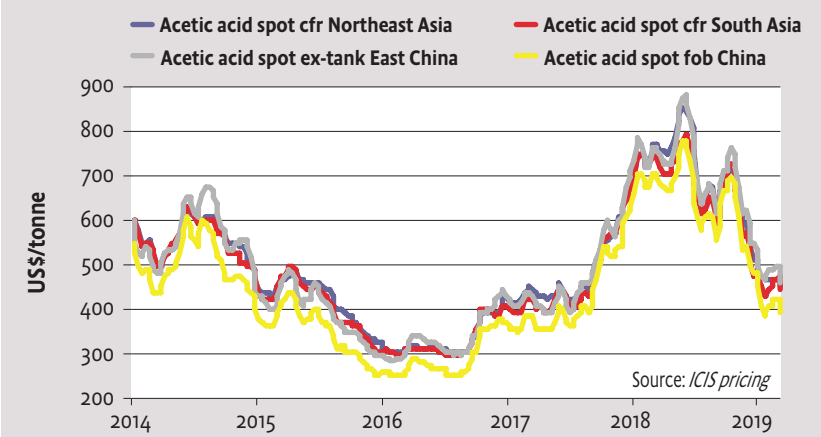
There are few plans in the works for expanding or constructing new acetic acid facilities. South Korea's Lotte BP Chemicals will boost production capacity by 100 000 tonne/year through a debottleneck during scheduled maintenance this April-May, but also has plans to lift VAM production by 200 000 tonne/year by the end of 2020 which would more than utilise the additional acetic acid capacity, leaving it needing to source acetic acid externally.

Elsewhere, reports of plans to increase acetic acid production also involve expansions of downstream derivative capacity.

Celanese plans to lift its US acetic acid capacity to some 700 000 tonne/year by the end of 2021, but is also streamlining its operations in Asia where it has 600 000 tonne/year in Singapore and Nanjing, China.

A gamechanger would be a new 1m tonne/year export-oriented facility being considered in Oman for startup around 2023. An investment on this scale could outweigh forecast demand growth and take the market back into a surplus supply-demand balance.

ASIAN ACETIC ACID SPOT PRICES 2014-19



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Fewer opportunities for deals as M&A pool shrinks

With weak growth and cheap money expected to drive M&A activity, competition to make a deal is intensifying as the number of targets falls, writes ***Nigel Davis*** of *ICIS*

The number of merger and acquisition (M&A) deals reaching completion in the chemical industry has slowed since 2014, signifying perhaps reducing options for consolidation across the sector.

However, the opportunities that do exist are being grasped by both industry players and private equity, suggesting that the right assets can still attract a high premium at the right time.

The agreed US$6.5bn acquisition of UK packaging company RPC by Berry Plastics of the US under the nose of private equity firm Apollo illustrates the importance of value in the marketplace.

Around the same time, the agreed Euro3bn bid for the methacrylates business of Evonik by private equity firm Advent International was noteworthy for the value placed on the well-established, high technology assets by the buyer. This was calculated by Evonik at 8.5 times enterprise value (EV) to trailing earnings before interest, tax, depreciation and amortisation (EBITDA), and as high as 10 times in a separate analysis.

The valuation appeared to fly in the face of the generally accepted notion of where we are in the commodities cycle. There is currently understandable uncertainty in chemicals M&A, with concerns around global economic growth, China's ongoing appetite for chemicals and plastics, and the outcome of the trade dispute between the US and China.

These factors served to hit M&A

In March, Saudi Aramco (left) agreed a US$69.1bn deal to buy 70% of SABIC; last year, LyondellBasell entered talks with Brazil's Odebrecht to acquire Braskem, below

activity involving China-based firms in the fourth quarter of last year. The environmental crackdown in China also had a negative effect on sentiment.

Latterly, particularly, small-scale chemicals and related-sector M&A activity has been focused (in volume terms) on Chinese companies and it is clear that the uncertainty has put a brake on merger activity.

This is possibly a short-term phenomenon, as the dominance of China in terms of chemicals production growth and sales is expected to be a feature of the sector for years to come. How established chemical companies react strategically depends on many factors but, in the search for growth, China stands out.

The sharp downturn in China's chemicals market in December 2018 came as a shock to the chemical industry. While the tightening of lending in China was a significant factor, US-China tariffs hit sentiment and consumer spending through the fourth quarter. Automotive new builds were down 16% in December and smartphone sales down 20%.

Despite this apparent dampener on M&A activity, some analysts are relatively bullish for 2019, pointing to still-low interest rates and the desire of most companies to continue to fine tune their portfolios. These factors have been driving deal making for most of the decade. Other factors are now coming into play that will underpin chemicals sector M&A in the years to come.

Activist investor pressure has opened up opportunities for further deal-making activity.

The pressure on paints maker AkzoNobel prompted the sale of its speciality chemicals business to private equity investors The Carlyle Group and GIC for Euro10.1bn in 2018. The deal closed in October and was the largest of the year in terms of value.

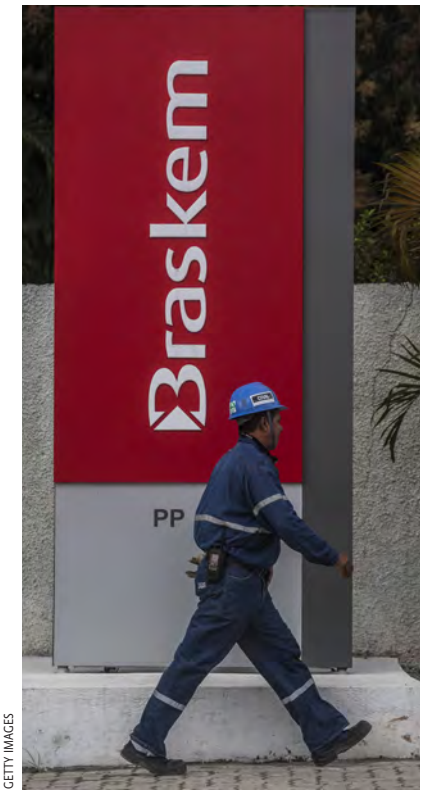
In January, SABIC acquired activist investor White Tale's 24.9% stake in Clariant. Since then, the companies have been working to create a 'high performance materials' joint venture focused on thermoplastics, speciality additives and masterbatches.

This year saw the spin-off in April of Dow from the giant DowDuPont merged entity, to be followed by the release of the new DuPont and eventually the new agricultural company, Corteva Agriscience. DowDuPont was the largest chemical company by sales in 2018.

The shake-up of the major players will continue as the separate entities of that company are spun-out and BASF completes the merger of its oil business with LetterOne.

There was talk last year of a potential merger between China's state-controlled energy, chemicals and fertiliser giant SinoChem and ChemChina. In March, Saudi Aramco agreed a US$69.1bn deal to acquire a 70% stake in SABIC. SABIC is 70% owned by Saudi Arabia's sovereign wealth fund, the Public Investment Fund (PIF), while the remaining 30% is owned by private investors from the six GCC countries.

"The number of completed deals in chemicals in 2018 was down significantly"



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Further consolidation in chemicals can be expected by the major oil companies as they seek to capture oil demand growth and sustain value creation from the barrel.

The state-controlled oil majors are likely to be more active in their search for downstream assets, although increased capital spending will remain the most common route to growth.

Last year Saudi Aramco bought Lanxess' 50% stake in their Arlanxeo joint venture, for Euro1.7bn. State-controlled businesses were also active, with Sipchem's Euro2.3bn acquisition of Sahara Petrochemicals an example.

The much smaller-scale acquisition by SinoChem of Elix Polymers from Sun Capital Partners, completed in January 2019, illustrates also how chemicals assets can change hands over time. Tarragona, Spain-based Elix Polymers is a producer of acrylonitrile-butadiene-styrene (ABS) resins and derivatives. The 40-year-old business has been part of Monsanto, Bayer, Lanxess and Ineos. It was acquired with private equity when Ineos and BASF created the styrenics joint venture Styrolution. Ineos now owns Styrolution outright.

In August 2018, LyondellBasell completed the Euro2.25bn acquisition of plastics compounds supplier A Schulman. In June, the chemicals major entered into exclusive talks with Brazilian conglomerate Odebrecht to acquire that country's leading plastics producer, Braskem, and this could be a major deal for 2019.

In its 2019 global chemicals M&A review and outlook, auditor and financial advisor Deloitte noted how mega-mergers tend to lead to sometimes significant side deals in the divestments that are required by the regulatory authorities.

Notably in 2018, Taiyo Nippon Sanso bought most of industrial gases producer Praxair's business in

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Europe for US$5.8bn. The Japanese industrial gases company is part of Mitsubishi Chemical Holdings. The Praxair-Linde merger also led to the sale of Linde assets in the Americas to Messer and CVC Capital partners Fund VII for US$3.5bn.

The Bayer-Monsanto merger and the Bayer sale to BASF of agrichemical assets for Euro7.6bn fall into this category.

Deloitte says the past demonstrates that chemical industry M&A can flourish in difficult times. It describes activity as 'robust' over the past few years despite recent dips in volumes.

Economic uncertainty may lead some executives to question how aggressively they want to deploy capital in 2019, M&A included. Global trade tensions and protectionism might lead them to pause when considering cross-border M&A activity.

Playing into this mix in the chemicals sector is the clear move towards greater circularity in the material economy. Companies will be keener to acquire technologies and assets that help them deal with the recycling of plastic waste. Some deals along these lines have already been struck.

Weak growth and cheap money will be the two big drivers for M&A activity this year.

Activity is expected to remain brisk in the first half of the year even though valuations remain high. The number of targets, however, is falling, making competition intense.

In specialities, for instance, consolidation among the bigger companies has reduced the number of independent producers with sales revenues of more than US$1bn.

According to the Valence Group, a specialist investment bank, the number of large speciality chemical companies has fallen by about 35% in under a decade from almost 50 to around 30 players. The contraction is even more dramatic if agrochemicals and industrial chemicals producers are included.

Given that few new companies are being formed, the size of the M&A pot is expected to continue to get smaller over the next five years – by

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Dow was spun off in April from merged DowDuPont, which was the world's largest chemical company by sales in 2018

about 25% to around 23. The average enterprise value of those remaining players would average around US$8bn, meaning that available targets with a purchase price of US$1bn–10bn would be extremely limited, according to Valence.

Declining options are helping to drive valuations higher and the suggestion is that this will remain the case with high values benefitting the seller. Speciality chemical valuations are, on average, almost double those for commodity assets. Moreover, the difference is likely to widen as a dip in the petrochemical cycle leads to weaker earnings for commodity players.

Specialities have the chance of holding out against the downturn although some product lines are exposed to weakening downstream industries such as automotive.

According to investment bank Young & Partners, the number of completed deals in chemicals in 2018 was down significantly from 2017: a total of 71 deals of more than US$25m in value compared with 91 in 2017.

The bank focuses on completed deals and transactions can take a number of years to complete because of anti-trust considerations. Most deals were in China and reflected the restructuring and consolidation of the industry there.

That leaves just over half the market available outside China and the gradual decline in the total number of deals even more painful for Western companies trying to do acquisitions, Young & Partners said. This shrinking inventory in the West is, however, a plus for sellers.

Valuations remain high overall but differ from segment to segment within the sector, the broad demarcation being between speciality chemical and commodity chemical assets, although the latter rose sharply between 2017 and 2018.

At the end of 2018, there were 29 deals, worth US$32.7bn, in chemicals announced but not closed, according to the Young & Partners data, but there were no mega-deals valued at more than US$10bn in the pipeline.

By early March 2019, no mega-deals had been announced so it is unlikely that a mega-deal will close during this year. That will have an impact on the data on valuations collected following the year-end but not on the number of transactions, which is expected to remain on a declining trend.

Selected petrochemical M&A deals 2018-19

Buyer	Seller or target	Price	Countries (buyer/target)	Sector
Advent International	Evonik	€3bn	US/Germany	Methylmethacrylate business
Air Products	Shell		US/UK-Netherlands	Coal gasification technology business
Air Products	General Electric		US/US	Gasification business
Aliaxis	Ashirvad Pipes		Belgium/India	Increased stake from 60% to 97% in PVC and chlorinated PVC piping systems
Asahi Kasei	Sage Automotive Interiors	US$700m	Japan/US	Automotive interiors
Borealis	Ecoplast Kunststoffrecycling		Austria/Austria	Plastic recycling
Borealis	DYM Solution		Austria/South Korea	Controlling stake in compounder
Cabot	Nippon Steel Carbon		US/China	NSCC Carbon (Jiangsu) Co carbon black producer
Celanese	Next Polymers		US/India	Engineering thermoplastics compounder
Celanese	Linde		US/Germany	Synthesis gas production unit in Pasadena, Texas
Evonik	Structured Polymers		Germany/US	Specialist in 3D printing materials
Haldor Topsoe	Ferrostaal Topsoe Projects		Denmark/Germany	Ammonia, methanol, gas-to-liquids (GTL) and refining
HIG Capital	Elekeiroz		US/Brazil	Oxo-alcohols and plasticiser producer
Highsun Group	CVC Capital/DSM		China/Netherlands	Fibrant caprolactam and ammonium sulphate manufacturer
Idemitsu Kosan	Showa Shell Sekiyu		Japan/Japan	Merger of oil refiners
Indorama Ventures	M&G USA Corp		Thailand/US	Integrated PTA and PET assets
Indorama Ventures	Custom Polymers PET		Thailand/US	PET recycling facility
Indorama Ventures	M&G Fibras Brasil		Thailand/Brazil	Polyester staple fibre maker
Indorama Ventures	Societe de Recyclage (Sorepla) de Matieres Plastiques		Thailand/France	Plastics recycler
Indorama Ventures	INVISTA Resins & Fibers		Thailand/Germany	PET producer
INEOS Enterprises	Ashland Global Holdings	US$1.1bn	UK/US	Ashland's composites and resins business unit
INEOS Enterprises	Flint Hills Resources		Switzerland/US	Chemical intermediates business
INEOS Styrolution	Total		Germany/France	Polystyrene business in China
Ingevity	Perstorp Holding		US/UK	Capa caprolactone business
Jindal Films	Treofan Europe		India/Germany	Biaxially oriented polypropylene films, controlling stake from M&C
KKR	JBF Group		UK/India	51% stake in the PTA business
KKR	LCY Chemical Corp	US$1.56bn	US/Taiwan	Thermoplastic elastomers and performance plastics
Lenzing Group	NCFC		Austria/China	Lenzing (Nanjing) Fibers (LNF)
Linde	Praxair		US/US	Industrial gases merger to form Linde PLC
LyondellBasell	Braskem		US/Brazil	Proposed polyolefins acquisition
Matheson (Taiyo Nippon Sanso Corp)	Linde		Japan/US	Hydrogen and carbon monoxide (HyCO) business
Messer and investor CVC Capital Partners	Linde	US$3.3bn	Germany/Germany	Gases business in North America, plus certain operations in South America
Mexichem	Pemex	US$179m	Mexico/Mexico	Petroquimica Mexicana de Vinilo (PMV) PVC joint venture, remaining 44.09% stake to 100%
Mitsubishi Chemical	Nippon Synthetic Chemical Industry (NSCI)		Japan/Japan	PVOH
PCC Rokita	IRPC Polyol	US$1.7m	Poland/Thailand	Polyols and polyurethane (PU)
PetroChina	Sinochem		China/China	Transfer of 33.6% stake in WEPEC refinery
PolyOne Corp	Fiber-Line	US$120m	US/US	Customised engineered fibres and composite materials
Ravago	DowDuPont		Belgium/US	European extruded polystyrene (XPS) business
SABIC	Clariant		Saudi Arabia/Switzerland	24.99% in speciality chemicals producer
Sahara Petrochemicals	Saudi International Petrochemical (Sipchem)		Saudi Arabia/Saudi Arabia	Petrochemicals merger
Saudi Aramco	LANXESS		Saudi Arabia/Germany	Full control of synthetic rubber and elastomers jv
Saudi Aramco	SABIC	US$69.1bn	Saudi Arabia/Saudi Arabia	Purchase of 70% stake in petrochemicals producer
Sinochem International	Sun European Partners	€95m	China/Spain	Elix Polymers ABS
Taiyo Nippon Sanso	Praxair	€5bn	Japan/US	European gas business
Taiyo Nippon Sanso	Linde		Japan/Germany	Hydrogen and carbon monoxide (HyCO) assets at five locations in the US
Teijin	Renegade Materials Corp		Japan/US	Thermoset prepregs for the aerospace industry
Teijin	Inapal Plasticos		Japan/Portugal	Automotive composites
Teijin Frontier	JH Ziegler	€125m	Japan/Germany	Automotive interior materials supplier
Toray Industries	TenCate Advanced Composites Holding		Japan/Netherlands	Carbon fibre composite materials producer

Source: *ICIS*

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Challenges on all fronts

Taiwan's petrochemicals industry faces challenges at home and from abroad, including new domestic energy and environmental regulations and an influx of petrochemicals derived from US shale gas. ***Satoshi Kiyokawa*** of *The Chemical Daily* reports

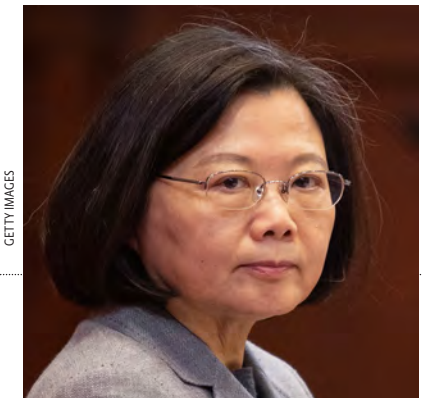
The petrochemical industry in Taiwan enjoyed a boom through 2018 as markets flourished across Asia. However, it is facing headwinds at home and overseas that will pose particular challenges. While the influx into Asia of petrochemicals derived from US shale gas and the future direction of US-China trade tensions are concerns for all Asian countries, Taiwan also faces domestic issues such as environmental regulations and energy policies which some fear could become a drag on industrial development.

The value chain of Taiwan's petrochemical industry is centred on the 3m tonne/year Formosa Plastics Group ethylene complex and the 1m tonne/year CPC cracker complex. The two companies reported utilisation rates of 110% or more in 2018 to October, but this dropped to 100% or less from November. Downstream derivatives also slowed in Q4.

As an importer of feedstock naphtha and an exporter of derivatives, Taiwan's petrochemical industry is directly exposed to the imminent influx into Asia from the US of ethane-based polyethylene (PE) and monoethylene glycol (MEG), products of which Taiwan is a major producer.

PE supply from the US to Asia rose to 1m tonne/year in the last year and is expected to climb to 3-4m tonne/year in the next few years. US MEG exports to Asia are projected to be around 3-4m tonne/year from 2020. Depending on trends in crude oil prices, Taiwan could be forced to adjust production of such C2-related products in response to the resulting disruption to the supply-demand balance in Asia.

Taiwan's president Tsai Ing-wen is aiming to source 20% of energy from renewables by 2025, shifting the emphasis to clean energy



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The impact has so far been limited, with only small volumes of US polymer imported into Taiwan in place of product from Saudi Arabia and other Middle Eastern countries. Two Taiwanese companies, Formosa Plastics Group and USI, have been able to switch production at low-density PE (LDPE)/ethylene-vinyl acetate (EVA) swing plants to favour EVA in response to a rebound in demand for use as an encapsulant in China's solar photovoltaic (PV) market.

At the same time, Formosa Plastics

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Taiwan to build a smart manufacturing industry

By Manabu Katogi, *The Chemical Daily*

Global economic uncertainty has become the hallmark of US-China trade friction, and the effects of this are beginning to play out on the economy of Taiwan.

While the country's gross domestic product (GDP) rose 2.63% in 2018 overall, just 1.78% growth was recorded in Q4, the first time since Q2 2016 that it has dipped below 2%.

Furthermore, although Taiwan achieved record-high exports in terms of value in 2018 with a year-on-year 5.9% increase to US$336.05bn, the outlook for 2019 is uncertain. Crude oil and feedstock prices were becoming more volatile at the time of writing in March. In addition, with growth of high-end smartphones stagnating around the world there was an increasing sense that major export growth would be difficult in Q1 2019.

That said, global trends towards artificial intelligence (AI), the internet of things (IoT) and 5G fit well with efforts by Taiwan's Ministry of Economic Affairs (MoEA) to build on its core semiconductor base and develop a smart manufacturing industry. With smart manufacturing, the first step is applying these leading-edge technologies to achieve digitisation of production data. Major corporations in petrochemicals and electronics have taken the lead, and now small and medium-sized enterprises (SMEs) are following as part of an overall upgrading of Taiwanese industry.

A good example of how this is playing out with SMEs can be found with the Taiwan Environmental Manufacturers Association (TEMA). Comprising more than 80 companies in such areas as water processing and air purification, TEMA's policy is to make full-scale efforts in implementing the IoT to reinforce more robust management setups. It says some companies have already seen improved productivity, and it plans to accelerate the switch to IoT technologies.

The Taiwanese government is also looking to actively encourage the use of renewable energies. Its objective is a nuclear-free Taiwan by 2025, with 20% of its energy mix coming from renewables.

Taiwan's grid-connected photovoltaic (PV) capacity was just below 1 GW in mid-2018. The plan is to increase this to 20 GW by 2025. In response,Taiwan's leading PV manufacturers are developing the capability to manufacture whole panels in-house instead of focusing on supplying cells as in the past. The aim is to increase the market share of panels tailored to the country's environment, for example by offering wind resistance and salinity tolerance. In future, these companies intend to export these value-added products.

Taiwan's renewable energy technologies are anything but lagging behind, said Taiwanese president Tsai Ing-wen. Taiwanese PV manufacturers have maintained their position in the PV cell sector for many years, both while Japan led the field, and since China has become overwhelmingly dominant. Tsai expects this capability will serve Taiwan well as it develops its own sector.

Group has embraced the US shale revolution into its own growth strategy. The company plans to start up a 1.2m tonne/year ethylene cracker and downstream PE and MEG facilities in Texas later this year. The PE will be supplied to the US and other markets in the Americas and Europe, with any surplus expected to be offered in Asia.

China is Asia's largest PE market with demand at 30m tonne/year and growing at 7-8% annually. However, the trade tension between the US and China in the last year has led to the imposition by China of an additional tariff on PE imported from the US. As a result, exports of US-produced PE to China by Formosa Plastics Group would need to take the form of a swap, with the company's Taiwanese product exported to China and its US product exported to Taiwan.

Several petrochemical companies in Taiwan anticipate that the US-China trade dispute could become prolonged. The impact is already being felt, with exports from China that were originally destined for the US being diverted to other Asian markets. As a result, Taiwanese product is facing stiff price competition in export markets including India, South Korea and the Asean (Association of Southeast Asian Nations) region. Consequently, profits from some products are being eroded despite Taiwan's high utilisation rates.

In Taiwan itself, industry is facing a challenge from new energy and

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Taiwan's government has vowed to shut all the country's nuclear power plants by 2025

environmental policies. The government has vowed to shut all nuclear power plants by 2025. It plans to shift the emphasis to clean energy by reducing the share of coal-fired thermal power generation in the energy mix to 30% from the current 40% and is also targeting 50% LNG-fired thermal power and 20% renewable energy.

Concerns over the proposed changes have been voiced from all manufacturing sectors, including the petrochemical industry. The fear is that higher energy charges could damage competitiveness if the share of renewable energy – dependent on wind, sunlight and other parts of the natural environment – is increased, while thermal power generation – fired by the cheaper raw material coal – is reduced.

The power plant operated by Formosa Plastics Group in Mailiao has already come up against the clean energy policy. It has three coal-fired power generators, each with an output of 600 000 kW, and accounts for 11% of the total power generated in Taiwan. Surplus power is supplied to external buyers, supporting overall Taiwan supply.

"Profits from some products are being eroded despite Taiwan's high utilisation rates"

It is reported that the plant is under pressure from the government to switch from coal- to LNG-fired thermal power generation to alleviate air pollution. According to Formosa, this will require a major investment in power plant facilities and carry a high price tag for essential LNG receiving facilities and associated auxiliary plant. The scale of the investment required is expected to lead to an increase in electricity costs of 20–30% in real terms, Formosa said.

Taiwan's petrochemical manufacturers are clear that they have a duty to demonstrate consideration for the environment, but some are concerned that in this case the regulations go too far, reflecting a lack of understanding of the industry. Environmental regulations have long been a bone of contention for the petrochemical industry, with both CPC and Formosa Plastics scrapping plans for major projects in the past.

In recent years, the Taiwanese petrochemical industry has been described by senior chemical industry figures as suffering from five shortages: energy, water, land, workforce and high-calibre talent. Furthermore, they say, limited domestic demand means that the industry is dependent on exports, but the limited number of Taiwan's free trade agreements makes this a challenge against the backdrop of a global economy. An industrial development policy that brings the government and the private sector together will be required to overcome these issues, they say.

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A year of opportunities

Having benefitted from China's strict environmental regulation, Japan's chemical industry now has new opportunities at home, writes ***Yasuhiro Watanabe*** of *The Chemical Daily*

For Japan's chemical industry, 2019 is seen as an important year as forecasts point to mid-range growth. With the country seeing population decline as a result of low birth rates and an ageing society, the time has come for robotics and artificial intelligence (AI) to support a shift to a more advanced workforce. At the same time, the global population is rising, resulting in increasingly severe issues that include food shortages, water shortages and environmental damage.

All this presents an opportunity for the chemical industry to contribute to solutions for these issues. Japanese companies see themselves as public institutions and have long promoted the ideal of helping to solve social issues, giving them experience in tackling such problems.

With the aim of balancing economic value with social value as society changes, chemical companies are seeking to reinvest profits in the relevant growth sectors. They also see it as an opportunity to increase their global presence.

Driven partly by the 2008 global financial crisis, but also to meet growing competition from China, Japan's chemical industry has carried out a major restructuring in the last decade. China invested Rmb4 trillion into industry following the 2008 crisis, resulting in large-scale capacity expansions and greater self-sufficiency in its chemical industry.

Even before 2008, Japanese companies had been shifting toward high value-added products such as speciality chemicals. After 2008, moves to reduce the industry's reliance on cyclical bulk chemical markets took on greater importance.

The effects of this can be seen in the results of 10 major Japanese chemical companies: Mitsubishi Chemical Holdings, Sumitomo Chemical, Mitsui Chemicals, Asahi Kasei, Toray Industries, Shin-Etsu Chemical, Sekisui Chemical, Showa Denko, Tosoh and Ube Industries. Before the 2008 crash, these companies generated a combined operating profit of Yen978.1bn in fiscal year 2007, ending 31 March 2008. In fiscal 2017, they generated nearly Yen1.76 trillion, almost 80% higher.

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The presidents of Showa Shell Sekiyu and Idemitsu Kosan confirm their companies' merger

In recent years, Japan's chemical industry has also benefitted from the knock-on effect as China has strengthened environmental regulations. Only a handful of Chinese manufacturers have so far been able to implement the required measures governing emissions, effluent and waste. The result has been reduced output in China and tighter global supply for chemicals such as methyl methacrylate (MMA) monomer, acrylonitrile and caprolactam, and a widening price spread between these and their raw materials.

"There appears to be growing momentum for oil and chemical companies to work together"

As a result, Japanese companies have seen record-breaking financial results. For example, Mitsubishi Chemical Holdings, which controls about 40% of the global MMA market, generated Yen109.6bn in core operating income from its MMA business, around 30% of the total.

However, there has been a profound change in sentiment since mid-2018 as Chinese growth has slowed. The trade war between the US and China, which together account for about 40% of nominal global GPD, has caused demand to slump for many products, including chemicals. The Chinese automotive sector saw vehicle shipments fall for the first time in 28 years in 2018, while smartphone shipments dropped 15% to 390m units.

Growth is expected to continue slowing in China and will impact Japanese results for fiscal 2020. Japanese manufacturers make more than 50% of smartphone components globally and Japan's chemical companies supply them with film and other materials.

Results for Japanese chemical

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Financial results for leading Japanese chemical companies in Apr-Dec 2018 and forecast for fiscal 2018 (Yen 100m)

		Sales	% change	Operating Income	% change	Ordinary Income	% change	Net Income	% change
Shin-Etsu Chemical	Apr-Dec 2018	12 068	13.7	3246	33.4	3294	31.6	2421	39.7
	Forecast fiscal 2018	15 600	8.2	3900	15.8	4000	17.5	2900	8.9
Mitsubishi Chemical HD*	Apr-Dec 2018	29 318	6.1	2669	(12.5)	na	na	1659	(1.8)
	Forecast fiscal 2018	40 400	8.5	3680	(3.3)	na	na	2130	0.6
Asahi Kasei	Apr-Dec 2018	15 867	6.9	1567	5.0	1652	2.9	1154	(17.7)
	Forecast fiscal 2018	21 710	6.3	2010	1.3	2090	(1.7)	1450	(14.8)
Sumitomo Chemical*	Apr-Dec 2018	17 141	6.7	1549	(22.1)	na	na	889	(18.1)
	Forecast fiscal 2018	24 100	10.0	2200	(16.2)	na	na	1200	(10.2)
Toray	Apr-Dec 2018	18 083	9.7	1123	(8.9)	1114	(8.3)	813	4.8
	Forecast fiscal 2018	24 000	8.9	1400	(10.5)	1350	(11.4)	900	(6.2)
Tosoh	Apr-Dec 2018	6457	7.3	796	(15.6)	831	(16.6)	563	(18.3)
	Forecast fiscal 2018	8800	6.9	1000	(23.4)	1050	(20.6)	710	(20.0)
Mitsui Chemicals	Apr-Dec 2018	11 147	16.1	746	(1.5)	862	9.3	579	(4.9)
	Forecast fiscal 2018	14 950	12.5	1000	(3.4)	1100	(0.2)	800	11.8
Sekisui Chemical	Apr-Dec 2018	8290	4.7	595	(4.6)	593	(7.7)	419	(5.2)
	Forecast fiscal 2018	11 610	4.8	1000	0.8	980	4.3	670	5.6
Teijin	Apr-Dec 2018	6596	7.3	481	(14.5)	513	(9.7)	407	2.6
	Forecast fiscal 2018	8900	6.6	600	(14.1)	620	(8.6)	460	1.0
Ube Industries	Apr-Dec 2018	5404	6.6	300	(20.1)	334	(14.4)	228	(14.3)
	Forecast fiscal 2018	7400	6.4	440	(12.4)	455	(10.3)	305	(3.7)

* Mitsubishi Chemical HD and Sumitomo Chemical have adopted international financial reporting standards (IFRS) and report core operating income which excludes special items

Source: *The Chemical Daily, company results*

companies first stalled in the second half of fiscal 2018. With the exception of companies such as Shin-Etsu Chemical, which saw increased revenue and profits, most players saw profits decline, with Sumitomo Chemical, Mitsui Chemicals, Asahi Kasei, Toray, Teijin and Sekisui Chemical making mid-year downward adjustments to their full-year earnings forecasts.

Restructuring and integration in oil refining have also moved forward in recent years, though more slowly than anticipated due to the strong economy. The rapid decline in demand for fuel oil in recent years tipped the balance.

JXTG Nippon Oil & Energy, formed in 2017 through the merger of JX Holdings and TonenGeneral Sekiyu, holds a market share of more than 50% for fuel oil. Idemitsu Kosan and Showa Shell Sekiyu were due to complete their merger in April.

As a result, Japan's refining sector has been consolidated into what is basically a three-player market with Cosmo Energy Holdings. As such, the sector is seen as having completed a first phase of restructuring. Now the question is whether these players will also undertake restructuring of complexes integrated with downstream petrochemical operations.

In the petrochemical industry, Mitsubishi Chemical Holdings, Sumitomo Chemical and Asahi Kasei have each permanently shut down a naphtha cracker since 2015, helping domestic production match weaker demand. To further strengthen cost competitiveness, however, it is becoming increasingly clear these players must improve integration with feedstock suppliers.

Delays to the merger plan between Idemitsu Kosan and Showa Shell Sekiyu have put things on hold as far as the next steps in restructuring are concerned. There has been a sense of indecision around issues such as where oil refinery operations stop and petrochemical operations start

At the same time, oil companies have focused on restructuring their core businesses, which faced a now-or-never situation, and associated downstream petrochemicals operations have been left on one side.

Now there appears to be growing momentum for oil and chemical companies to work together to target greater integration and restructuring extending to the petrochemicals sector, particularly in areas such as Chiba and Kawasaki where companies control bases across both industries.

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President Xi Jinping's belief that humans must live in harmony with nature has resulted in mixed fortunes for China's petrochemicals companies facing the country's new environmental rules, with gains for some and closures for others reports ***Fanny Zhang*** of *ICIS*

China is enthusiastically pursuing a 'green earth and blue sky' policy for sustainable growth.

President Xi Jinping has affirmed his intention to use the full weight of the state to resolve long-standing environment problems and says there should be 'zero tolerance' of environmental crimes.

Xi is more focused on conservation than any of his predecessors, holding a firm belief that humans must live in harmony with nature.

He has made conservation a key part of officials' appraisals and last year named it as one of the three 'battles' – along with political and financial risks, and poverty alleviation – that the country has to fight.

This determination for a better environment comes despite slowing economic growth in China. It has been a problem particularly for the country's petrochemical industry, and especially those units that are older or smaller, or not equipped with the latest technologies.

As chemicals is among the most polluting of industries, the sector has been hit hard by the tightening environment rules. The immediate impacts include forced shutdowns and closures, reshuffling of chemical parks and an overall increase in the cost of doing business to meet strict environmental standards.

First, the closures. In the north-eastern province of Shandong, China's largest manufacturing base for chemicals, 620 chemical companies were closed or switched to produce non-toxic products in 2017. Another 2614 were shut for rectification.

The province's authorities have vowed to eliminate around 20% of its 6150 chemical companies from 2018 to keep the number below 5000.

Each year, from the start of October to the end of March, when the northern regions usually encounter bad weather and smog, there are regularly orders to cut plant operating rates, not only in chemicals, but in steel and cement as well.

Production interruptions also happen if violations are discovered by the environmental authorities during random inspections.

Such shutdowns or closures of noncompliant producers play a role in capacity elimination and in making production more centralised. Compliant companies are the beneficiaries.

For products such as polyvinyl chloride that have excess capacities, the green drive helps to accelerate industry consolidation, because compliant players will continue to operate while the uncompetitive ones will be eliminated.

Second, chemical companies are now being strongly encouraged to move into chemical industry parks to better contain pollution. Most provinces now only allow new chemical plants to locate in such parks.

The chemical industry parks themselves are being rationalised. Those located in environmentally sensitive regions are being cancelled.

A major battlefield is the Yangtze River Economic Belt, which covers 11 provinces and cities including Shanghai, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan, Yunnan and Guizhou. This has become a major chemical corridor, producing around 46% of China's chemicals.

Many chemical raw materials, such as crude oil, naphtha and paraxylene are transported by ocean shipment, so companies prefer to set up production facilities in parks near to a port. But along the corridor

China is working to improve air quality and cut pollution in key cities and municipalities

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sewage and waste are being dumped directly into the river without treatment.

To protect drinking water and marine ecologies, the Chinese government has ordered the closure of chemical parks located within 1km of the Yangtze River by 2020. Those beyond this distance will have to meet emission standards and pass annual environment assessments. New chemical parks and plants are not allowed to be set up within the 1km zone.

According to the China Petroleum and Chemical Industry Federation (CPCIF), there were 601 chemical parks nationwide at the end of 2017. The number is estimated to have dropped to 480 in 2018.

Along the Yangtze River, there are 76 major chemical parks, with 37 in Jiangsu, 21 in Hubei, seven in Anhui, four in Jiangxi, three in Sichuan, three in Chongqing and one in Hunan.

Tougher environment requirements push up the overall operating cost for chemical producers, because they have to install and run waste treatment facilities and pay environmental taxes. Also, new projects face difficulties in selecting a favourable location.

As local officials' performances are linked to emission targets, they are unwilling to invite new chemical factories that could have a deleterious impact on the local environment. Also, local residents now have a say on whether new plants are allowed to set up shop or not.

"Clearly, China is determined to continue its green drive in coming years"

Due to increasing public awareness of pollution and its harm to health, residents' protests and vetoes of new projects are now happening more frequently. For example, Guangdong Guohan Energy stopped its proposed 1.8m tonne/year propane dehydrogenation (PDH) project at Chaozhou in Guangdong province because the proposal was rejected by local residents. PetroChina's proposed 500 000 tonne/year paraxylene plant at Yunnan province was also cancelled due to strong protests from local residents. Meanwhile, Shandong government has called off a planned 800 000 bbl/day refining project at Yantai that would have involved around US$30bn of investment by Nanshan Group and Singapore Jurong amid objections by residents.

Looking ahead, China's emission standards will become even tougher, driving further consolidation of the chemical industry. To guarantee effective implementation of its move to cut pollution, Beijing has stepped up legitimisation of its green policies and will allow use of police and judicial authorities to ensure enforcement.

There are three focus areas in China's ongoing campaign on pollution: air, water and soil.

Prevention and control of pollutants contributing to any of these three focus areas are written into separate laws – the Air Pollution Control Act (an amended version took effect on 1 January 2016); the Water Pollution Control Act (an amended version became effective on 1 January 2018); and the Soil Pollution Control Act, a new law enacted on 1 January 2019.

On 1 January 2018, the Law on Environment Protection Tax came into effect, under which companies or business operators are required to pay a tax for their direct emission of pollutants to air, water or soil.

With these laws, environment violations are defined as a crime and subject to criminal penalties.

Enforcement has been tightened over the years with China seeing more and more cases against polluters and officials penalised for failing to comply with environment restrictions.

According to official data, in 2018 some 186 000 cases of environment offences were punished and fines totalling Rmb15.28bn levied, 32% more than in the previous year and about 4.8 times that in 2014. The country arrested 15 095 people for environmental crimes, up by 51.5% year on year, while 42 195 people were prosecuted, 21% higher than in 2017.

Environmental crimes and violations cover a range of misdoings, such as illegal deforestation and land occupation, as well as unlawful mining and fishing activities.

In 2018, the Ministry of Ecology and Environment (MEE), the top environment watchdog, received 96 755 tip-offs and resolved a majority of them. The central and local authorities ordered 43 486 enterprises to rectify their violations and fined another 11 286 companies a combined Rmb1.02bn. Meanwhile,

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722 people were detained.

The efforts have brought positive results. In 2018, average concentrations of small, hazardous particles known as PM2.5 in 338 cities across the country declined to 39 microgram/cubic metre (μg/m^3), 9.3% lower than the previous year.

The average PM2.5 level in key cities such as Beijing and Shanghai dropped to 51 μg/m^3 and 36 μg/m^3 respectively in 2018. Shanghai is now very close to meeting the official air quality standard of 35 μg/m^3. The World Health Organisation recommends an annual average of no more than 10 μg/m^3.

Clearly, China is determined to continue its green drive in coming years. In mid-January, the MEE held a two-day meeting to summarise its 2018 achievements and outline 2019 objectives. Li Ganjie, the environment minister, said at the meeting that 'Blue Sky, Green Water and Pure Land' would still be this year's highlights.

To win the battle on blue sky, MEE will continue to implement storm action plans in key regions during autumn and winter; actively and steadily promote the control of bulk coal; and promote ultra-low emissions in industries such as iron and steel. There will be comprehensive treatment of polluting firms as well as control of volatile organic compounds (VOCs) in key industries.

"The focus will be the restoration of the Yangtze River and treatment of the Bohai Sea"

On improving water, the focus will be the restoration of the Yangtze River and treatment of the Bohai Sea. In addition, actions will be taken to tackle polluted water in cities and villages. MEE will also carry out investigations and assessments on drinking water in major rural areas.

To rectify soil degradation, the ministry will strengthen the reform of solid waste imports and further cut the category and quantity of such imports.

Meanwhile, it will launch pilot projects for the construction of 'waste-free cities' and prevention of pollution from scrap lead batteries. It will also formulate an action plan on prevention and control of groundwater pollution.

In addition, there will be another round of 'looking back' this year to review grassroots enforcements of environment requirements. To this end, MEE will send inspection teams to selected provinces and cities to carry out onsite checks to see whether violations have been appropriately rectified.

At times, local officials have turned a blind eye to offences because of concerns over the impact on local economies. The central government has described such local officials as 'fraudulent', 'superficial' or 'perfunctory' in meeting green goals.

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"If we can complete this effort, and again I say if... we might be able to have an agreement that helps us turn the corner in our economic relationship"

US trade representative Robert Lighthizer in February 2019

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China's international trade representative and vice minister of commerce Fu Ziying in August 2018

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"Trade talks are impossible while Washington imposes tariffs that are like 'holding a knife' to someone's throat"

US and China lock horns

Asia's exporting countries are feeling the effects of the ongoing trade war between the US and China, with no solution in sight. By ***Pearl Bantillo*** of *ICIS*

High-level negotiations to end the trade war between China and the US have been under way since the start of this year. They have stopped a further escalation of the 2018 tensions that were triggered in July and have started to affect Asia's export-oriented economies.

At the start of December, US president Donald Trump decided to offer a 90-day trade war truce, which he extended on 24 February, thus postponing his threat to hike tariffs from 10% to 25% on US$200bn worth of imports from China by 1 March, citing good progress in the discussions.

Months into the negotiations, no clear indications have emerged on whether or not the trade war – which currently affects US$360bn worth of goods between the two countries – will be resolved.

'The extension will provide both sides with additional time to come to an agreement on more difficult issues, chief among which are enforcement mechanisms that the US wants to include in any deal to ensure China upholds its end of any trade bargain that may eventually be struck,' research firm Fitch Solutions said in a note.

'However, we believe that any deal will largely be short-term in nature and will likely involve China buying more US products, but it will not fully resolve some of the major issues at hand,' it added.

Of the two, China appears to be feeling the brunt of the adverse impact, given its much larger export exposure to the US market. Its economy is expected to show a slower growth rate this year of 6.0-6.5%, compared to 6.6% in 2018. Its manufacturing sector is in contraction, with the purchasing managers' index (PMI) posting readings of below 50 since December.

Most end products made in China are shipped out of the country, making its economy vulnerable to the trade war waged by the US.

In 2017, China's exports to the US were valued at US$522.9bn, while total US shipments to China stood at US$187.5bn. The wide deficit of more than US$300bn with China was what prompted the US to wage the trade war, according to Trump.

As the two sides decided to return to the negotiating table late last year, the trade war has not escalated but risks to the global economy remain due to the tariffs that have already been imposed.

Compounding the global economic slowdown is weakness in the European economy, prompting the Organisation for Economic Co-operation and Development to lower its global growth projection for 2019 to 3.3% and for 2020 to 3.4%, from the previous forecast of a 3.5% expansion for each year.

Fitch Solutions believes it is unlikely that the Trump administration will cancel the existing additional tariffs of 25% imposed on US$50bn of goods and 10% on another US$200bn.

With the US barricading itself with a tariff wall against China, the former's massive polyethylene capacity expansion in recent years will have to seek other markets across the Pacific.

Since the start of 2019, Southeast Asian markets, which are likely to be on the receiving end of US shipments, have been feeling downward pressure due to the ready availability of cargoes.

Overall sentiment across Asia's petrochemical markets is being overshadowed by uncertainties over

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REX FEATURES

The newly named CPTPP was formed by 11 countries after the US withdrew from the TPP

the US-China trade negotiations.

To prevent a sharp slowdown in China, intermittent cash injections by the central bank to the domestic financial system are being made to boost domestic consumption, with some fiscal stimulus measures in the form of tax cuts.

At the 13th National People's Congress in Beijing, Chinese premier Li Keqiang announced further cuts on taxes, including a reduction in the value-added tax (VAT) rate for manufacturing, to 13% from 16%.

China's economic weakness, partly attributable to the ongoing trade war, is hitting shipments from neighbouring countries, including South Korea and Japan.

South Korea's petrochemical exports posted declines for three consecutive months starting December 2018 as shipments to China slowed. China accounted for about a quarter of South Korea's total exports in 2018. In January 2019, South Korea's shipments to China slumped 19.2% year on year to US$10.8bn, according to the Korea International Trade Association.

Japan, the world's third-largest economy, saw an 8.4% year-on-year decline in January exports, as shipments to China fell by 17.4%.

The US now appears to be setting its sights on India, with a plan to strip the huge emerging market economy of its preferred trading status under the GSP (Generalised System of Preferences) programme, via a presidential decree. GSP is the largest and oldest US trade preference programme.

A GSP eligibility review for India was launched in April 2018 as the South Asian country 'has implemented a wide array of trade barriers that create serious negative effects on United States commerce. Despite intensive engagement, India has failed to take the necessary steps to meet the GSP criterion', the US Trade Representative (USTR) said on 4 March. Total US goods and services trade with India is estimated at US$126.2bn

Amid the protectionist policy being adopted by the US since Trump assumed the presidency in 2017, which started with the US withdrawal from the Trans-Pacific Partnership (TPP), other nations have been forging ahead with multilateral, as well as bilateral, pacts to counter any adverse impact of rising US tariffs on global trade.

Eleven countries led by Japan proceeded with the TPP, renamed the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), without the US. The pact came into force on 30 December 2018 in Australia, Canada, Japan, Mexico, New Zealand and Singapore, 60 days after the sixth country ratified the pact.

In Vietnam, it took effect on 14 January 2019, while Brunei Darussalam, Chile, Malaysia and Peru have yet to ratify the deal.

At the first meeting of the CPTPP Commission in Tokyo on 19 January, a ministerial statement was issued expressing a commitment to implement the deal, 'which sends a strong signal in support of free trade'.

'Amid growing concerns over recent trends toward protectionism, ministers shared the view that it is of paramount importance to maintain and further strengthen the principles of an effective, open, inclusive and rules-based trading system,' it stated.

Malaysia continues to have reservations about the CPTPP, and is evaluating the agreement.

The CPTPP member nations have a combined GDP of US$10.3 trillion, accounting for 13.5% of the world economy, and have a combined 15.3% share of world trade.

The larger Regional Comprehensive Economic Partnership comprises 16 countries, including the 10 Asean (Association of Southeast Asian Nations) member countries – Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam – and their six Asean free trade agreement partners, namely Australia, China, India, Japan, South Korea and New Zealand.

It is gunning to be the biggest trade agreement, with member countries having a combined GDP of US$25.4trillion and population of 3.55bn.

At an early March meeting in Siem Reap, Cambodia, parties reiterated a consensus that the negotiations should be concluded this year. The group will convene again in August, in Beijing, China.

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Stretching the oil dollar

Middle East gas and oil players have their eyes fixed on the future with plans to move downstream that will shake up the petrochemicals landscape from 2025 and beyond with a number of mega-deals across the world. ***Joseph Chang*** of *ICIS* reports

While the US cracker wave on the back of the shale gas boom is getting much of the attention, big oil and gas players in the Middle East are lining up mega-projects that could shift the landscape of global petrochemicals from 2025 and beyond.

Driving this push from oil companies is the growing realisation that oil demand for transportation fuel will plateau with the electrification of vehicles and improving fuel efficiency.

Thus, the future for hydrocarbons is not in gasoline and diesel, but in chemicals, where demand should continue to climb alongside GDP growth. And it is clear that 'Big Oil' is no longer satisfied simply providing feedstock for the downstream chemical sector.

Abu Dhabi National Oil Company (ADNOC) wants to 'stretch the dollar' from the barrel of oil to the maximum by producing chemicals, said ceo Sultan Ahmed Al Jaber.

ADNOC is embarking on a US$45bn investment to more than triple petrochemicals capacity at its Ruwais site from a 2016 base of 4.5m tonne/year to 14.4m tonne/year by 2025, and adding new downstream product chains in construction chemicals, oilfield chemicals, surfactants and detergents.

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Aramco, above, and ADNOC ceo Sultan Ahmed Al Jaber, below, have ambitious plans to develop downstream chemical positions

In February 2019, its 50:50 joint venture company Borouge awarded front-end engineering and design contracts for the fourth phase of its expansion in Ruwais, which will include a 1.8m tonne/year mixed-feed cracker and add a total of 3.3m tonne/year of olefins and aromatics capacity.

The cracker will be the first in the country to use mixed feeds. The feedstock slate will be ethane, butane and naphtha.

'The Middle East is running out of cheap natural gas. All new projects are mixed feed, with a typical mix of about 35% ethane, and 65% propane, butane and naphtha which is not as advantaged as ethane,' said Hassan Ahmed, analyst at US-based investment research firm Alembic Global Advisors.

While ADNOC and joint venture partner Borealis plan to finalise the downstream configuration within three months of the recent contract awards, it should include polyethylene (PE) and polypropylene (PP).

'Having the new plants onstream will enable Borouge to meet the increasing demand for polyolefins in our key markets in the Middle East, Asia and Africa,' said Wim Roels, ceo of Borouge's marketing arm Borouge Pte.

In late 2018, Borouge began construction of a 480 000 tonne/year PP unit in Ruwais, which will be integrated with the existing Borouge 3 facility. The new plant is expected onstream in Q3 2021 and will increase Borouge's PP capacity by 25% to 2.24m tonne/year.

Saudi Aramco's planned crude-oil-to-chemicals (COTC) complex with SABIC in Yanbu, Saudi Arabia, is perhaps the most watched project on the planet because it could have stunning implications for the petrochemicals sector.

Featuring a budget of around US$30bn and a process to convert 400 000 bbl/day of crude oil to 9m tonne/year of chemicals and base oils, the mega-complex is expected to start operations in 2025.

Middle East company mega-projects overseas ('000s tonne/year)

Company	Type	Products	Capacity	Location	Cost	Start-up
SABIC/ExxonMobil	Petrochemicals	Ethylene, PE, MEG	1800 (ethylene)	San Patricio County, Texas, US	n/a	2022
Saudi Aramco/ NORINCO/Panjin Sincen	Refinery petrochemicals	Olefins, aromatics	1500 (ethylene), 1300 (paraxylene)	Liaoning, China	US$10bn+	2024
Saudi Aramco/ ADNOC/India consortium	Refinery petrochemicals	Petrochemicals	18 000 total	Raigad, India	US$44bn	2025
SABIC/Fuhaichuang Petrochemical	Petrochemicals	Olefins	1800 (ethylene), 600 (propylene via PDH)	Zhangzhou, China	n/a	n/a

Source: *ICIS*

Middle East mega-projects ('000s tonne/year)

Company	Type	Products	Capacity	Location	Cost	Start-up
Saudi Aramco/Total	Mixed-feed cracker	Ethylene and derivatives	1500 (ethylene)	Jubail, Saudi Arabia	US$5bn	2024
Saudi Aramco/SABIC	Crude-oil-to-chemicals	Petrochemicals, base oils	9000 total*	Yanbu, Saudi Arabia	US$30bn	2025
ADNOC	Mixed-feed cracker, other	Olefins, aromatics, polyolefins, surfactants, speciality chemicals	9900 total**	Ruwais, Abu Dhabi	US$45bn	2025

* May be much higher, depending on crude oil conversion rate ** Planned capacity to achieve its goal of 14.4m tonne/year of petrochemicals capacity by 2025. Includes a Borouge mixed feed cracker of 1.8m tonne/year and a total of 3.3m tonne/year of olefins and aromatics
Source: *ICIS*

The initial plan was to convert 45% of each oil barrel to petrochemicals. However, Aramco aims to boost that figure significantly.

In January 2018, Aramco signed a joint development agreement with CB&I and Chevron Lummus Global to scale up and commercialise Aramco's proprietary Thermal Crude to Chemicals (TC2C) technology to directly convert crude oil to chemicals at higher yields.

Then in January 2019, it signed another joint development and collaboration agreement with Axens and TechnipFMC to accelerate the commercialisation of its Catalytic Crude to Chemicals (CC2C) technology with a goal to achieve commercial readiness by 2021.

Aramco believes it can convert 60-70% of the oil barrel into petrochemicals using its proprietary process technology.

Petrochemicals are averaging about 10-15% of global refinery output, with wide differences between integrated complexes.

"ADNOC wants to 'stretch the dollar' from the barrel of oil to the maximum"

'In recent years, refiners have increasingly raised their share of petrochemical output at the expense of traditional fuels. Some of the new refineries in China can convert up to 40%,' according to Stefano Zehnder, vice president of consulting at *ICIS*.

'In Saudi Arabia the original base concept is rapidly evolving. It's clear Aramco is looking to scale up to commercial size its crude-to-chemicals technologies,' said Zehnder.

'With the potential for further increase from the base 45% yield, this points to even higher petrochemicals and base oils capacities than the 9m tonne/year base. The final configuration will be a function of the desired balance between petrochemicals, base oil and fuel products,' he added.

Ahmed from Alembic Global Advisors notes that COTC is all about 'integration and trying to be more efficient both upstream and downstream'.

That is because 'every new facility in the Middle East puts them higher on the cost curve', a function of the mixed feedstock slate.

Aramco plans to invest an eye-popping US$100bn in petrochemicals over the next 10 years, ceo Amin Nasser said at the Gulf Petrochemicals & Chemicals Association (GPCA) annual meeting in Dubai in November 2018.

In October 2018, Aramco and France-based Total signed a joint development agreement for the front-end engineering and design of their planned joint-venture petrochemicals complex in Jubail, Saudi Arabia.

The US$5bn project, slated for start-up in 2024, will comprise a mixed-feed (50% ethane, 50% refin-

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ery off-gases) cracker with 1.5m tonne/year of ethylene capacity and downstream units.

The petrochemical complex will be downstream of Aramco and Total's joint venture SATORP refinery and the companies expect an additional US$4bn in investments in petrochemicals and speciality chemicals capacity from third-party investors.

Aramco is also in the process of merging with Saudi Arabia-based petrochemicals and polymers giant SABIC (see page 35).

Saudi Arabia will clearly make great waves in the global petrochemical industry as it actively pursues diversification away from oil and invests to create greater value downstream from the oil barrel.

Aramco aims to convert between 2m and 3m bbl/day of its oil into petrochemicals, representing 20%-30% of its current production, ceo Nasser said at the GPCA meeting.

Globally, petrochemicals will add nearly 7m bbl/day of oil demand by 2050, reaching a total of about 20m bbl/day, according to Aramco.

Aramco and Abu Dhabi's ADNOC are not only ploughing investment dollars in their backyards but also setting up mega-complexes around the world.

The most ambitious of these plans is the memorandum of understanding (MoU) signed in June 2018 between Aramco, ADNOC and a consortium of Indian oil companies (Indian Oil, Hindustan Petroleum, Bharat Petroleum) to build a US$44bn refining and petrochemicals complex in India with 18m tonne/year of petrochemicals capacity.

Aramco and ADNOC would jointly own 50% of the project, with the Indian consortium owning the other half. The refinery would be capable of processing 1.2m bbl/day of crude oil and provide feedstock for the integrated petrochemical complex.

While the project was originally planned in Ratnagiri, India, the Indian government announced in March its relocation further north along the western coast to Raigad following opposition from farmers in Ratnagiri. The government expects construction to start in 2020 with completion by 2025.

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Aramco will put US$100 bn in petrochemicals over the next 10 years, said ceo Amin Nasser

Alembic Global Advisors' Ahmed cautions on raising expectations from MoUs. 'The Crown Prince of Saudi Arabia went on a tour across Asia and many MoUs were signed. But MoUs sometimes don't materialise. Until we see steel in the ground, we typically don't take them too seriously,' said Ahmed.

China is another target for Middle East oil companies. In February 2019, Aramco signed an agreement with China's NORINCO Group and Panjin Sincen to develop a US$10bn-plus fully integrated refining and petrochemical complex in Liaoning, China with startup expected in 2024.

"However, it remains to be seen what projects actually start up and in what timeframe"

The partners will create a new company, Huajin Aramco Petrochemical (Aramco 35%, NORINCO 36%, Panjin Sincen 29%), as part of a project that will include a 300 000 bbl/day refinery with a 1.5m tonne/year cracker and a 1.3 tonne/year paraxylene unit. Aramco will supply up to 70% of the crude oil feedstock for the complex.

Aramco will inherit two additional mega-projects when its planned merger with SABIC goes through. SABIC and China's Fuhaichuang Petrochemical are planning to jointly build a petrochemical complex in Fujian, China, a source from Fuhaichuang said in late February.

In September 2018 SABIC signed an MoU with the Fujian provincial government to build a world-scale petrochemical complex in the south-eastern province of China.

The project, to be located at Gulei in Zhangzhou, would include a 1.8m tonne/year cracker, a 600 000 tonne/year propane dehydrogenation unit and derivatives units, according to the Fuhaichuang source. An official deal has yet to be finalised.

However, one SABIC mega-project is already under way. On the US Gulf Coast, SABIC and ExxonMobil are building a 1.8m tonne/year ethane cracker in San Patricio County, Texas, with a monoethylene glycol (MEG) plant and two PE units downstream. Project completion is expected by the fourth quarter of 2021 and start-up in the first half of 2022.

Beyond the potential merger between Aramco and SABIC, Middle East oil companies could seek to acquire Western petrochemical assets.

Aramco acquired Germany-based Lanxess' synthetic rubber business by buying out the latter's 50% stake in their Arlanxeo joint venture in December 2018, while SABIC took a nearly 25% stake in Switzerland-based speciality chemicals and catalysts company Clariant in September 2018.

Earlier major deals included SABIC's acquisition of US-based GE Plastics in 2007 and Abu Dhabi's IPIC (now Mubadala) acquisition of Canada's NOVA Chemicals in 2009.

'They would be still be interested but we would not expect them to go too far from their comfort zone in olefins and polyolefins, and possibly in polyurethanes. We think they would look to the US rather than Europe,' said Ahmed from Alembic Global Advisors.

It is clear Middle East oil companies have giant ambitions in petrochemicals, with plans to bring on massive amounts of capacity in 2025. However, it remains to be seen what projects actually start up and in what timeframe.

'The devil's in the details in terms of what gets built, delayed and cancelled. We all know the game of companies throwing down big numbers to prevent competitors from overbuilding,' said Ahmed.

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A fast track to new investment

China's One Belt, One Road and Greater Bay Area schemes are likely to attract petrochemicals companies to South China with their promise of growth and access to Asian markets, writes ***Yohei Tada*** of *The Chemical Daily*

South China is attracting attention as a destination for investment by petrochemical companies. In 2018, ExxonMobil and BASF each unveiled plans to build major complexes in Guangdong province, while SABIC (Saudi Basic Industries Corp) signed a memorandum of understanding (MoU) with Fujian province to build a large petrochemical complex. The region is forecast to see steady demand growth. Its status as the starting point of the Chinese government's One Belt, One Road cross-border economic zone initiative also offers companies the prospect of access to markets elsewhere in Asia.

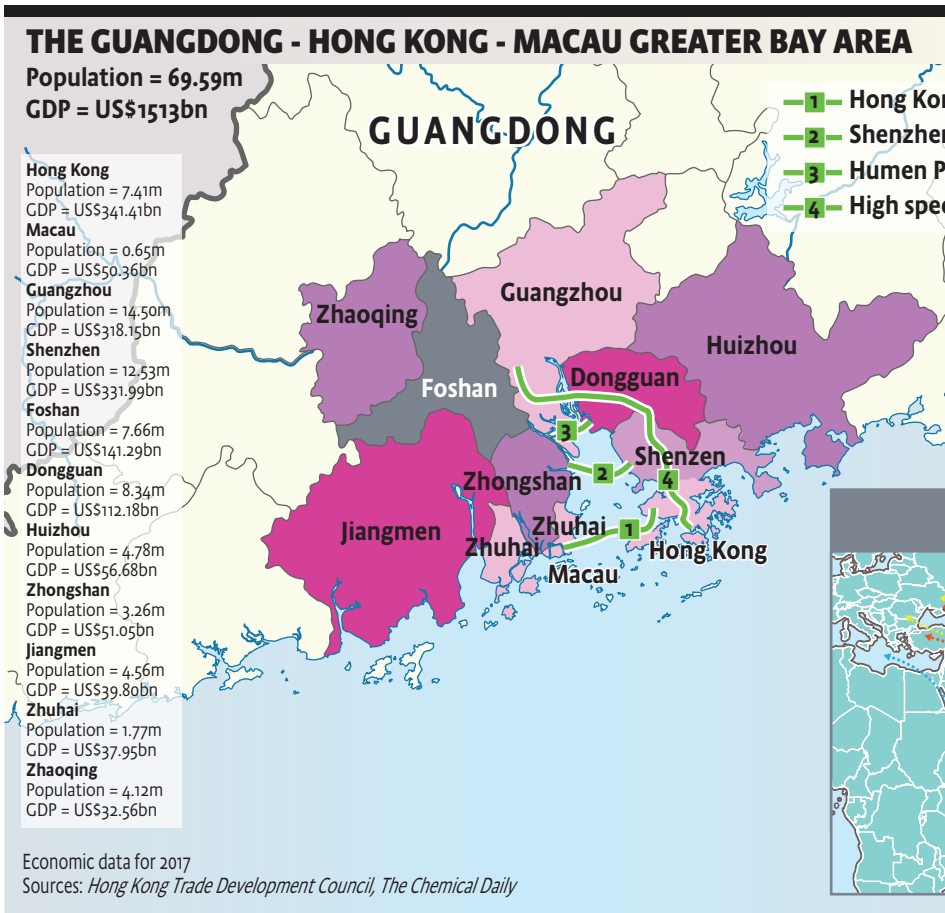
BASF announced in July 2018 it would invest up to US$10bn in Guangdong. It signed a framework agreement with the provincial government in January this year to establish a *Verbund*, or highly integrated, production complex in Zhanjiang city. Due to be entirely German financed, the Zhanjiang complex will be BASF's second *Verbund* site in China after Nanjing and its third-largest site worldwide after its Ludwigshafen, Germany headquarters and its complex in Antwerp, Belgium.

The project will mainly produce C2-C4 chemicals from a 1m tonne/year steam cracker. The derivatives slate will include ethylene glycol, superabsorbent polymer, acrylates and functional resins. The first plant is due to start up by 2026, with the whole complex due for completion by 2030. As well as using waste products and byproducts as raw materials, the *Verbund* site will maximise energy efficiency, thereby contributing to the circular economy, the company says.

ExxonMobil signed a framework agreement in September 2018 with the Guangdong government to build an integrated refining and petrochemical complex in Huizhou Dayawan Petrochemical Industrial Park, one of China's seven major petrochemical hubs. The investment, expected to be several billion dollars, will include a 1.2m tonne/year cracker and polyethylene and polypropylene lines. A feasibility study is now under way, with startup expected in 2023 pending a final investment decision.

Gross domestic product (GDP) in Guangdong province rivals that of South Korea and is forecast to see annual growth at around 6-7%. Home to the cities of Shenzhen and Dongguan, the province's demand for chemicals is seeing growth from sectors such as automotive, daily necessities and electronics.

The One Belt, One Road initiative is expected to further bolster growth in South China as infrastructure links are developed to the markets in Asean (Association of Southeast



Economic data for 2017
Sources: *Hong Kong Trade Development Council, The Chemical Daily*

Asian Nations) and the rest of Asia.

In addition, the Chinese government is moving forward with its Greater Bay Area scheme, a national project to develop an economic zone encompassing Guangdong province, Hong Kong and Macau, which is expected to attract a further influx of industry clusters. GDP for the combined region exceeds that of both Australia and South Korea. China's goal is to form a huge market of around 70m people to rival the international bay areas of Tokyo and San Francisco. The Greater Bay Area's GDP is understood to have grown by about 7% in 2018, making its economy larger than that of Tokyo Bay.

Infrastructure investments underpinning the scheme include the 55km Hong Kong–Zhuhai–Macau Bridge, which opened in October 2018, and a high-speed railway connecting Hong Kong to Guangzhou which started operations in September 2018. The bridge-opening ceremony was attended by president Xi Jinping, indicating the importance that China attaches to the project. The bridge has cut travel times in the area to under an hour.

This year, Shenzhen will start work on reforms to permit mutual recognition of qualifications with Hong Kong and Macau as part of regulatory and human-resource initiatives under the Greater Bay Area scheme.

In Q4 last year, semiconductor industry groups in Guangzhou, Shenzhen and Zhuhai, together with counterparts in Hong Kong and Macau, formed the Greater Bay Area Semiconductor Industrial Alliance to offer a collaborative forum for relevant organisations and companies in the technically complex sector. The goal is to maximise synergies through closer information exchange and technology development on a South China regional basis, in line with the central government aim of increasing the national scale of semiconductor manufacturing in China.

Semiconductor production by companies in Guangdong province reached 25bn chips in 2018, while the area around Guangzhou has become China's largest centre for the assembly and application of integrated circuits. In 2017, four of China's top 10 integrated circuit design firms came from Shenzhen.

"The One Belt, One Road initiative is expected to further bolster growth in South China"

In Fujian province, SABIC signed an MoU with the provincial government last year for construction of a world-scale petrochemical complex and is now undertaking a feasibility study. The company has also regarded Guangdong province as a possible location for investment for some time and hopes to tap into rapidly growing demand in China and the wider Asian region by setting up a key hub in South China.

Germany's Merck signed an agreement last November with Guangzhou Development District and will start operations at a new innovation hub in Guangzhou this September. It will partner research institutes, universities, startups and other local companies with outstanding technologies. It aims to support the creation of new technologies by publicising research activities and encouraging collaborations on projects involving the latest innovations and technologies of its healthcare, life-sciences and performance materials businesses.

A high speed rail link between Hong Kong and Guangzhou is part of the Greater Bay Area plan

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Adding value to increase core profitabilities

Diversification is the name of the game in South Korea with oil refiners investing in petrochemicals and cracker operators moving away from a reliance on naphtha feedstock, as ***Satoshi Kiyokawa*** of *The Chemical Daily* reports

Major petrochemical investments due for completion in South Korea in 2023 will boost the country's ethylene capacity by 4-5m tonne/year to around 14m tonne/year if implemented in full, close behind the world's third largest producer Saudi Arabia. Most of the extra output will be used to make polyolefins, most of which will be exported to China and elsewhere in Asia, in competition with product from the Middle East and the US.

Two main trends characterise the current round of petrochemical investments. The first is the move by oil refiners to invest in petrochemicals with the intention of exporting derivatives. The second is the effort by cracker operators to diversify their feedstock slate away from a reliance on naphtha.

Three major South Korean oil refiners – GS Caltex, Hyundai Oilbank and S-Oil – are moving into ethylene production. They share a common concern about the forecast peak and subsequent decline in demand for refined products in a couple of decades. Each company is integrating its oil refining with petrochemical facilities, and will use surplus fuel oil and off-gas as feedstocks in addition to naphtha to add value and increase the profitability of their core refining operations.

GS Caltex is investing in an ethylene and polyethylene complex in Yeosu, while Hyundai Oilbank is partnering Lotte Chemical for an ethylene and polyethylene joint-venture complex in Daesan.

S-Oil is furthest forward with plans for a 1.5m tonne/year cracker at Ulsan. Representing a total investment of Won4 trillion (US$3.55bn), the project will also boost propylene capacity with a residue fluid catalytic cracking (RFCC) facility to provide 700 000 tonne/year of propylene for derivatives including polypropylene (PP) and propylene oxide. The project is part of a wider strategy by S-Oil's majority owner Saudi Aramco (Saudi Arabian Oil Co) which has also taken stakes in projects in the Middle East, the US and other parts of Asia that integrate oil refining with petrochemicals.

South Korean oil refiners are moving into petrochemicals ahead of lower petrol demand

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Among established South Korean petrochemical players, Hanwha Group (in Daesan), LG Chem (in Daesan) and Lotte Chemical (in Yeosu) are taking a lead in terms of diversifying their cracker feedstock slates to use propane for the production of ethylene. Each company is planning to increase ethylene capacity by 200 000-300 000 tonne/year this year. The goal is also to increase feedstock flexibility and improve the resilience of their businesses to shifting market conditions.

LG Chem is also planning an 800 000 tonne/year cracker expansion in Yeosu, while Hanwha-Daelim joint venture Yeochun NCC is planning a 335 000 tonne/year capacity increase at existing naphtha cracking facilities in 2020.

As noted, most of the new olefins capacity planned in South Korea will be used to make polyolefins for export to China and the rest of Asia. However, business conditions in target Asian markets are facing uncertainty. Apart from the influx of US shale-derived and Middle Eastern polyethylene, concerns are growing over tougher regulatory regimes regarding single-use plastics as well

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S-Oil is furthest ahead with plans for a 1.5m tonne/year cracker, situated at Ulsan

as signs of slower economic growth in China.

Furthermore, most expansion plans in South Korea emerged during 2017 and in early 2018. Now that markets have weakened and profitability has fallen, there is growing speculation that these players could rethink their investment strategies if the situation does not improve.

In recent years, various South Korean companies in the sector have touted a goal of moving away from petrochemicals to instead pursue growth sectors such as life sciences, electronics-related business and speciality products. But the reality for now is that these companies are still finding the bulk of their profits from petrochemical operations. To continue with future investments into high-growth businesses, these companies have judged it necessary to first reinvest in the petrochemical operations that are generating their profits in the short term.

However, since the second half of last year the profitability of petrochemicals such as olefins and general-purpose resins has dropped, while in parallel the macroeconomic environment has become increasingly uncertain. Prices came under pressure in 2018 as the Asian market felt the full impact of the influx of cost-advantaged polyolefin imports from shale-based US producers. At the same time, business conditions slowed in key consuming markets, most notably China. Stock building in the second half of the year also contributed to the weaker results.

As a result, South Korea's ethylene producers reported weaker financial results for 2018 compared with 2017, particularly in the fourth quarter. Double-digit drops in operating profit were common despite an overall upward trend in sales.

LG Chem saw the operating profit ratio of its olefins-related business fall from 14.7% to 5.6% in Q4 2018, while Lotte Chemical's dropped from 22.2% to 4.8%. Hanwha Chemical's basic chemicals business came off a strong second quarter, with an operating profit of Won148bn and an operating profit ratio of around 16%, but these figures dropped to Won88bn and 7.8% in the third quarter, then to a loss of Won51bn in the fourth quarter.

Efforts to develop higher added value downstream businesses are making some progress, for example in lithium-ion batteries (LiBs).

LG Chem's energy solutions business, for example, increased its operating profit roughly seven-fold year on year for 2018, to Won209bn. While this is still only a small proportion of the company's overall operating profit, it represents a second consecutive year of profit. The business was in the red in 2016.

"There is growing speculation that these players could rethink their investment strategies"

SK Innovation's battery business ended 2018 at Won317.5bn in the red, due in part to earlier investments to scale up production. The business's sales revenue performed strongly and was reported at Won348.2bn, almost 2.5 times that recorded in 2017.

Both companies are investing actively in LiBs. LG Chem's capital investment budget for 2018 saw Won1.5trillion set aside for basic materials and chemicals including petrochemicals, but an even larger investment of Won1.9trillion went to its energy solutions business. The company has earmarked Won3.1trillion for the energy solutions business this year, while SK Innovation is looking to set up new plants in China and Hungary this year, roughly quadrupling its production capacity.

Although the LiB-related operations for both companies currently contribute less to overall results than their conventional petrochemical operations, they are expected to see good growth as the electric vehicle market develops.

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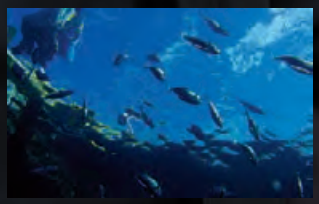

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Creating hydrogen fuel from sewage sludge

Enabling geothermal power generation

Spate of projects near completion

The next four years will see several new petrochemical complexes come online in Southeast Asia with investment in other projects in the region continuing, report ***Kogaku Nakamura*** and ***Junichi Iwasaki*** of *The Chemical Daily*

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Cracker investments are coming from Chandra Asri, above, and RAPID, below

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Several major petrochemical complexes are due online in Southeast Asia between 2019 and 2023, with projects in Malaysia, Indonesia, Vietnam and Thailand making notable progress.

In the Malaysian state of Johor, an operational start is due this year for the RAPID (refinery and petrochemical integrated development) project involving state-owned Petronas Chemicals Group (PCG) and Saudi Aramco. The refinery started trial operations at the beginning of the year and is expected to begin commercial operation by June. The naphtha cracker and residue fluidised catalytic cracking (RFCC) unit for producing basic chemicals should begin trial operation in the first half of the year, with production of derivatives including polyethylene and polypropylene expected to start before the end of 2019.

PCG says total investment in RAPID will amount to US$27bn. Although a downturn in the economy forced the company to scale back its plan for derivatives, it has been able to bring the project to fruition after parent company Petronas (Petroliam Nasional) secured an injection of capital from Saudi Aramco in 2018.

Saudi Aramco will supply up to 70% of the crude oil for the RAPID refinery. This has the advantage of securing a stable customer for the Middle Eastern company's crude oil while adding value to Saudi Arabian resources through the manufacture of petrochemical products. The investment is consistent with the Saudi Arabian government's Saudi Vision 2030 economic structural reform plan.

Indonesia's largest chemical company Chandra Asri Petrochemical has firmed up the plan for its second ethylene centre CAP2, expected to come online in 2023. The naphtha cracker in Cilegon, western Java, will have capacity to produce 1.1m tonne/year of ethylene and 600 000 tonne/year of propylene as well as butadiene and polyolefin facilities. A final decision will be made in early 2020. The investment is expected to reach US$5bn.

With Indonesian demand for synthetic resin growing faster than GDP, about half the country's polyolefin supply is imported. According to Chandra Asri, Indonesia imports 500 000 tonne/year of polyethylene and 750 000 tonne/year of polypropylene. CAP2 will help plug the gap with a planned 750 000 tonne/year of polyethylene and 450 000 tonne/year of polypropylene.

Chandra Asri is also boosting capacity at its existing ethylene centre to meet demand growth ahead of the CAP2 completion. The capacity of its butadiene extraction facility was increased by 30% in July 2018. At the end of last year, the company started Indonesia's first commercial facility for solution-polymerised styrene-butadiene rubber (S-SBR) in a joint venture with French tyre giant Michelin which will use the product for energy-efficient tyres.

Also in Indonesia, Lotte Chemical

Titan Holding began developing the site for its US$3.5bn petrochemical complex in late 2018. The company, a subsidiary of South Korea's Lotte Chemical, expects to start commercial production in 2023. Also located in the province of Banten in western Java, the complex will include a 1m tonne/year naphtha cracker and facilities for polyolefins and other derivatives. A second Lotte Chemical subsidiary, Lotte Advanced Materials, is planning to build a 300 000 tonne/year ABS polymer facility at the same site following its purchase in 2018 of the two existing Indonesian ABS producers.

In Vietnam's Thanh Hoa province, full-scale operations were started in November 2018 at the US$9.2bn Nghi Son project by joint-venture partners Idemitsu Kosan, Mitsui Chemicals, Kuwait Petroleum International. and Petrovietnam (Vietnam Oil and Gas Group).

"Chandra Asri is also boosting capacity at its existing ethylene centre to meet demand growth ahead of the CAP2 completion"

The Nghi Son refinery has capacity to process 200 000 bbl/day of crude oil by atmospheric distillation, 105 000 bbl/day of heavy oil by direct desulphurisation and 80 000 bbl/day of heavy oil by fluid catalytic cracking. The petrochemical complex has capacity for 700 000 tonne/year of paraxylene, 240 000 tonne/year of benzene and 370 000 tonne/year of polypropylene. It will reduce Vietnam's dependence on imports.

Also in Vietnam, Thailand's Siam Cement Group (SCG) will start up a 1m tonne/year naphtha cracker complex in 2023 in Long Son in the south of the country. The derivatives slate will include high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE) and polypropylene (PP). The cracker is designed to take a feed of up to 70% propane, with feedstocks tailored to market conditions. SCG has signed a long-term supply contract with Qatar Petroleum for a combined total of 2m tonne/year of propane and naphtha.

The Long Son project was originally planned as a joint venture between SCG, PetroVietnam, Vinachem (the Vietnam National Chemical Group) and state-owned Qatar Petroleum. However, Vinachem and Qatar Petroleum withdrew and SCG bought out PetroVietnam's stake in June 2018.

In Thailand, the biggest ethylene producer in Southeast Asia, the focus is on expansion.

PTT Global Chemical (PTTGC) will start up a naphtha cracker with capacity for 500 000 tonne/year of ethylene and 250 000 tonne/year of propylene in 2020 under its Olefins Reconfiguration Project (ORP). Its focus downstream is on improving integration in order to add value.

In 2018, PTTGC entered two new sectors with the acquisition of purified terephthalic acid (PTA) and polyethylene terephthalate (PET) businesses, integrating production from raw materials paraxylene and monoethylene glycol. The company is also building its presence in engineering plastics. Initiatives include a polyol venture with Sanyo Chemical Industries and Toyota Tsusho and a polyamide 9T (PA9T) resin project with Kuraray and Sumitomo Corp.

SCG group company SCG Chemicals, Thailand's second largest cracker operator with joint-venture partner Dow Chemical, is increasing ethylene capacity by 20% to 1.25m tonne/year by 2021. In addition, PTT Group petroleum refining and petrochemical major IRPC is considering expanding its naphtha cracker to lift ethylene capacity by 50% to 540 000 tonne/year.

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Return to expansion trail

Buoyed by a rapidly growing economy and their need for greater integration, India's refining and petrochemical majors are once again drawing up expansion plans, reports ***Malini Hariharan*** of *ICIS*

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A strong economy and stable demand growth are driving new investments by Indian majors

After a lull in capacity planning Indian refining and petrochemicals majors have returned to the drawing board, lining up major expansion plans. A rapidly expanding economy, stable demand growth outlook, rising deficits and the need for greater refinery–petrochemical integration are the key drivers for new investments.

State-owned refiners are leading the charge in formulating plans. The government's move to support electric vehicles as well as higher fuel efficiency standards have made petrochemicals an attractive investment proposition for these refiners.

The first, and probably the easiest, route that is being explored is value addition to the propylene stream from fluid catalytic cracking (FCC) units at refineries. If all plans materialise, India's propylene capacity could almost double by 2025.

A number of refiners have lined up polypropylene (PP) investments downstream rather than other derivatives. India currently uses around 95% of its propylene production for making PP and this figure is likely to fall by only a few percentage points in the future.

The various projects for PP (see page 66) should leave the country well supplied. India's PP demand is running at a little over 5m tonne/year and growing at 8-9%/year. The country imported 850 000 tonne and exported 710 000 tonne in 2018.

Only a few companies are looking at other propylene derivatives. Bharat Petroleum Corp Ltd (BPCL) is due to complete an acrylates and oxo-alcohol complex at Kochi, Kerala, in 2019-20. The company has also planned a propylene oxide and polyols facility in the second phase.

These new facilities would utilise 500 000 tonne/year of the propylene the company will be producing at its refinery on the same site.

Acrylates and oxo-alcohols have attracted interest from others as well. Indian Oil Corp (IOC) has also identified an investment at its refinery in Koyali, Gujarat. Recently, BASF inked a memorandum of understanding with Indian infrastructure major Adani for a joint-venture investment in a propane dehydrogenation and oxo-alcohols and acrylates project at Mundra on the west coast of India. BASF will make a final decision after completing a study by the end of 2019.

BASF is looking at making the proposed site fully carbon neutral, relying entirely on renewable energy by taking a minority stake in a wind and solar park at the same location.

Turning to ethylene, the pace of investments in new cracking capacity has yet to pick up. Only one new cracker is likely to come up by 2023-24, the 1.2m tonne/year project by HPCL-Mittal Energy Ltd (HMEL) in Bhatinda, Punjab. The derivative slate includes polyethylene (PE) as well as monoethylene glycol (MEG).

India has a surplus of PE and MEG which should be digested by the time HMEL starts up. Indian producers exported a little over 1m tonne of PE in 2018 following the commissioning of more than 1m tonne/year of new capacity during 2017-18.

While most upcoming projects will be around existing chemical hubs in western and northern parts of India, government efforts are under way to boost investments in other regions.

The eastern part of India will see new investments in PP, MEG, paraxylene (PX) and purified terephthalic acid (PTA) by IOC at Paradeep, Orissa. The company is also mulling a small PP unit downstream of its refinery at Barauni, Bihar.

This region's sole cracker operator Haldia Petrochemicals Corp Ltd (HPCL) is reportedly studying a new petrochemical complex in the state of Orissa.

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Major Indian petrochemical projects ('000s tonne/year)

Company	Location	Product	Capacity	Status	Planned start-up
Bharat Petroleum Corp Ltd	Kochi	Acrylic acid	47	Under construction	2019-20
		Acrylates	190	Under construction	2019-20
		Oxo alcohols	92	Under construction	2019-20
		Propylene oxide	290 est	Planned	
		Propylene glycol	100	Planned	
		Polyols	250	Planned	
	Rasayanee	Polypropylene	450	Planned	2024
Chennai Petroleum Corp Ltd	Manali	Polypropylene	475	Planned	
GAIL	Pata	Polypropylene	60	Planned	2023
	Uran	Polypropylene	500	Planned	2024
Hindustan Petroleum Corp Ltd	Pachpadra	Ethylene	897	Planned	
		Propylene	965	Planned	
HPCL Mittal Energy	Bhatinda	Ethylene	1200	Under construction	2022-23
		LLDPE/HDPE	800	Under construction	2022-23
		HDPE	450	Under construction	2022-23
		Polypropylene	550	Under construction	2022-23
Indian Oil Corp Ltd	Paradeep	Polypropylene	700	Commissioning	2019
		Monoethylene glycol	357		
		Paraxylene	800		
		PTA	1200		
	Barauni	Polypropylene	200	Planned	
	Koyali	Polypropylene	400	Planned	
		Acrylic acid	90	Planned	
		Acrylates	150	Planned	
		Oxo alcohols	148	Planned	
	Panipat	Polypropylene	450	Planned	
Nayara Energy	Vadinar	Polypropylene	450	Planned	

Source: *ICIS*

The two companies are also looking to attract downstream companies in the textiles and plastics industries.

In the south, Chennai Petroleum Corp Ltd (CPCL) is considering a PP plant as part of a larger refinery expansion.

A few large projects are showing slow progress. Not surprisingly, the ambitious mega-refinery on the west coast of India is one of them. Land acquisition has become a major headache for Ratnagiri Refinery and Petrochemicals Ltd (RRPL), a joint venture between IOC, BPCL and Hindustan Petroleum Corp Ltd (HPCL).

RRPL has planned a 1.2m bbl/day refinery and integrated petrochemical project that has attracted interest from Saudi Aramco and ADNOC, which would like to secure future oil supplies by investing in the refinery. However, the project faces an uncertain future unless the local government is successful in finding an alternative site. In March it announced it would relocate the project to Raigad district to the north of Ratnagiri (see page 54).

India is well positioned to meet its growing demand through these new investments, but given the excessive focus on a few derivatives, it also runs the risk of being reliant on imports for some products, which include intermediates that are needed by the wider chemicals industry.

Take the case of styrene or acrylonitrile, where India is fully reliant on imports. Import dependence is also quite high for products like methanol, acetic acid and polyvinyl chloride.

Companies are continuing to evaluate these import-substitution opportunities. However, a combination of factors including availability of feedstocks, access to technologies and weak project economics has constrained interest. With no new capacities on the horizon, the country will continue to rely heavily on imports at least for the next few years.

"A number of refiners have lined up PP investments downstream rather than other derivatives"

"Bear" by Conor Allenby (age 5) of the United Kingdom ©KIDS EARTH FUND 2019

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