IHS Markit™

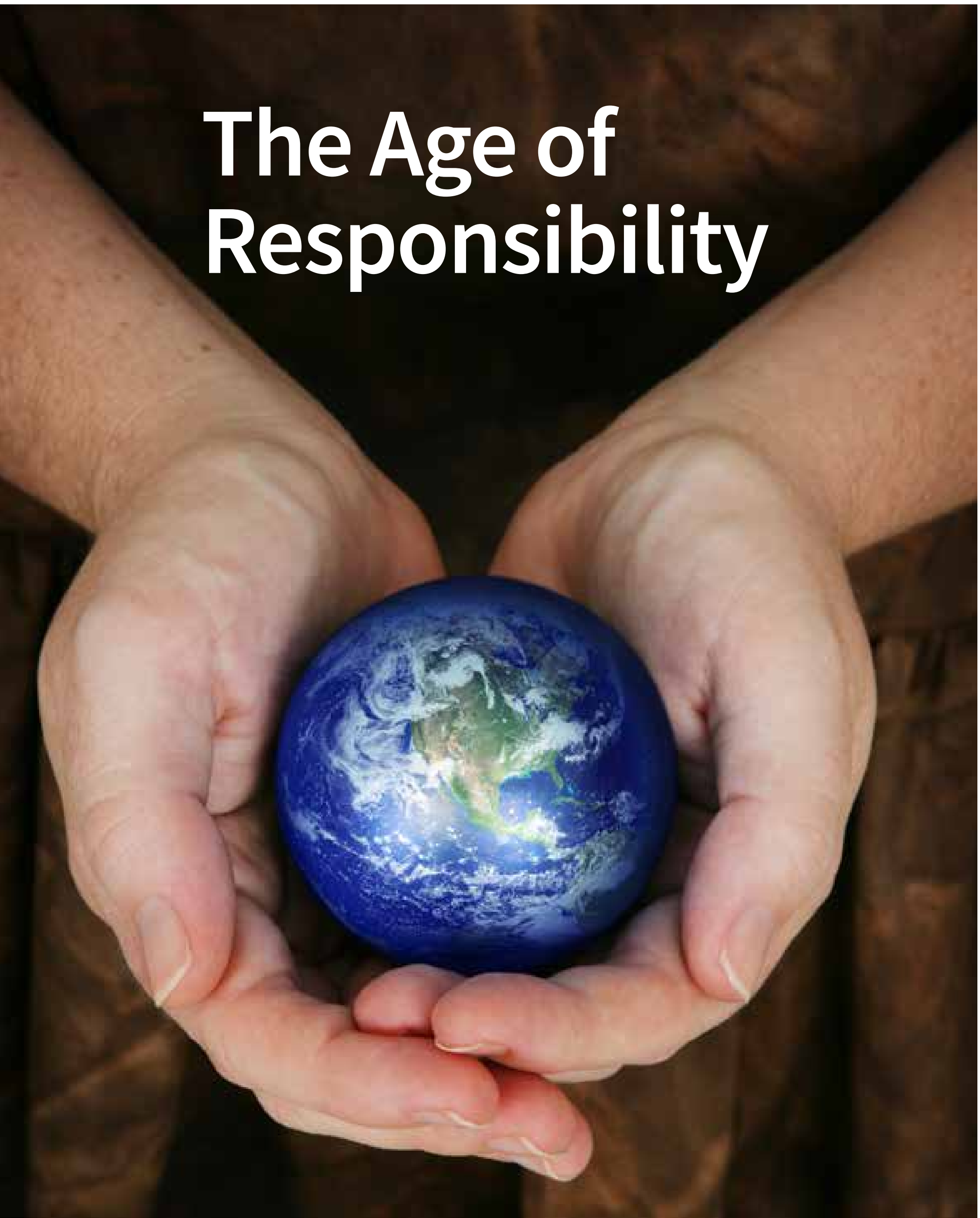
Chemical & Energy

INSIGHTS

2018 **issue 3**

ihsmarkit.com/chemical

Subscribe for free at www.ihsmarkit.com/insights



The age of responsibility

Tony Potter |
Global Vice President, Specialty Chemicals, IHS Markit
E Tony.Potter@ihsmarkit.com
T +49 20118579173
L Essen

Our customers care. Consumers are becoming more discerning and responsible in their choices. They care about their food – from where it is sourced, how it is farmed, and how it is wrapped. They care about the quality of the air they breathe and the purity of the water they drink. They dispose of their waste with more forethought – well, some of them do. Eco-friendly, green, and sustainable are all in.

Plastics are fundamentally good products that have enabled many enhancements to modern living. But media images of the Great Pacific Garbage Patch, consumers' propensity to litter, and the absence of adequate waste collection and management systems in many parts of the world are widely viewed now as the problem of plastic producers. Progress towards a circular economy is in vastly different stages of formulation and implementation throughout the world. These shifts will impact demand for virgin resins, with knock-on effects throughout value chains and into feedstock demand, even changing the future investment requirements for new production capacity.

The chemical industry is experiencing a prolonged and unprecedented peak earnings cycle. Nourished by solid economic growth and under-investment in many value chains, high profitability could be sustained into the early 2020s. It was inevitable that headwinds will emerge, however, and that ultimately there will be an economic slowdown. Some of the largest developed economies, including the United States, are running close to full employment, tempting inflation and higher interest rates. The imposition by the US of 10% import tariffs on USD200 billion of Chinese goods took effect on September 24, with the rate planned to rise to 25% on January 1. Tariffs on another USD267 billion of Chinese imports have been threatened should China retaliate. The evidence is that tariffs are already taking their toll, with Chinese GDP growth in Q3 at its lowest since 2008. International trade has fueled the growth of the chemical industry over the last 20 years, creating competition that benefitted consumers. The new protectionism will force a rebalancing of trade patterns for some chemical products and feedstocks; for others, it will cause an increase in domestic prices that will stymie demand. Trade wars are a risk to both global economic growth and the performance of the chemical industry in particular.

The planning assumptions for your business are changing continuously. IHS Markit is continually assessing how government policies and regulations, consumer preferences, and underlying megatrends such as population growth and the development of the middle class are affecting economic growth, energy prices, and end-use demand for chemicals and polymers – and thus the prospects for your business. We can be sure that the challenges over the next 10 years will not be the same as those during the last decade. Every disruption offers an opportunity somewhere, and IHS Markit is best placed to support you with data, integrated analysis, insight, and long-term forecasts. Reach out to the experts in this issue to start the conversation. And rest assured that our responsibility is to care about your business.

AMERICAS
CALGARY +1 403 213 4220
HOUSTON +1 281 752 3211
MEXICO +60 4291 921

EUROPE, MIDDLE EAST, AFRICA
LONDON +44 203 253 2330

ASIA PACIFIC
CHINA +86 21 2422 9115
JAPAN +81 3 6262 177
KOREA +82 31 8039 87795

@ihsmarkitchem
linkedin.com/company/ihsmarkit

Navigating Choppy Waters

An IHS Markit Multi-Client Study on Marine Bunker Fuel in a Low Sulfur, Low Carbon World

The study will primarily focus on a deep-dive into 2 key aspects of the IMO 2020 transition:

1. **Regional residue supply and demand modelling:**
   Regional balances of LS and HS fuel supply, demand and trade in the IMO transition period.
2. **Shipping and refining industry scenario analysis:**
   Scenario analysis of the key variables which will define the magnitude and duration of the IMO 2020 impact on the oil markets. Principle scenarios will be compliance level and scrubber uptake, but also refinery project delays and potential regulatory transitional measures intended to smooth the transition. IHS Markit will apply a Monte Carlo style probabilistic analysis to the scenario output, to create probability disruptions for market prices and refinery margins.

Visit **ihsmarkit.com/IMO2020**
to download the proposed table of contents

Sustainability: a critical plastics market driver

Nick Vafiadis |
Vice President, Plastics,
IHS Markit
E Nick.Vafiadis@ihsmarkit.com
T +12817523206
L Houston

Spurred by images of the Great Pacific garbage patch – a growing accumulation of floating ocean plastic waste estimated to be larger than France and weighing more than 593 million pounds – many global consumers have become increasingly outspoken on plastics use and recycling. Some consumers are pushing for bans on plastics, particularly single-use plastics, others choose to substitute products to minimize plastics waste, and still others are doing both.

Data shared by both the Ellen MacArthur Foundation and the World Economic Forum estimate that there will be more plastic than fish in the ocean by 2050. The Ocean Cleanup, an environmental technology organization, estimates that 8 million metric tons of plastic waste are added to the world's oceans annually, much of it from rivers and mismanaged plastic and municipal waste from Asia. The non-profit agency estimates the amount of plastic waste added to the world's oceans will nearly double by 2025.

While recycling is expected to play a central role in resolving the plastics waste issue, initiatives have thus far been largely ineffective. It is estimated that only about 4% of the plastic packaging used globally is ultimately delivered to recycling plants, while a third is left in various ecosystems, and 40% ends up in landfill.

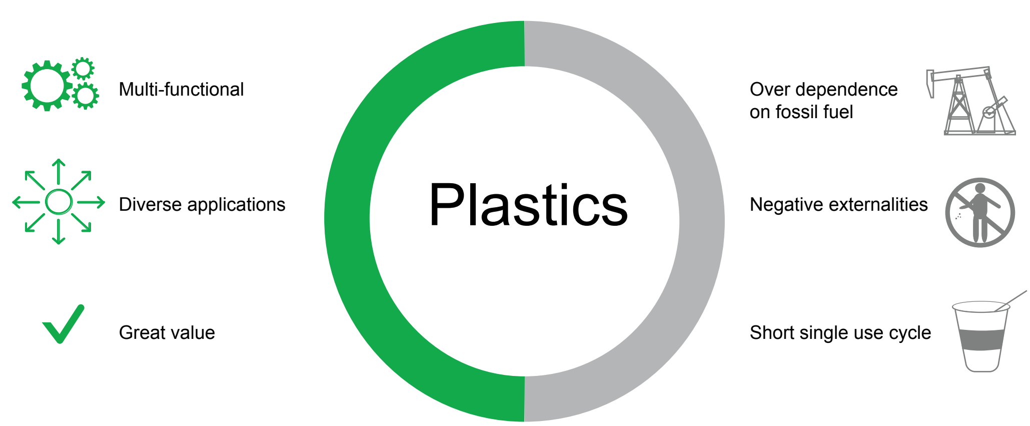
"Only about 4% of the plastic packaging used globally is ultimately delivered to recycling plants, while a third is left in various ecosystems, and 40% ends up in landfill."

Evolving approaches to sustainability

A clear shift is developing in the approach toward sustainability, as the movement transitions from reactive to proactive mode. In the reactive phase, the target was preventing litter and focusing on plastics waste. Thereafter, the focus moved to managed disposal of plastic waste through incineration, landfill, export, and recycling. Now, the emphasis is swinging to circularity, often described as a circular economy, in which the producer becomes a stakeholder in the careful management and reuse of plastic and the reduction of end-waste.

Extended Producer Responsibility (EPR) is a clear example of producer participation in the sustainability movement. EPR essentially levies fees on packaging and certain plastics products that are paid by manufacturers. These fees are used to develop recycling infrastructure and encourage the recycling of content. EPR policies are currently either in effect or targeted for near-term implementation in Europe, North America, China, and India. Presently there are no packaging EPR programs in effect in the US, although we expect to see programs adopted by 2025.

Plastics—Essential to modern living but management of waste critical for industry



Sources: 1) Ocean CleanUp https://www.theoceancleanup.com/
2) Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/

Europe uses a multi-pronged approach to circularity by setting targets for plastic recycling and enabling compliance through EPR. Recent initiatives include a legislative framework to mandate compliance, including taxation, and a certification mechanism for eco-design. A new standard will encourage product designs that are not based solely on functionality, performance, or cost, but on circularity. With this standard, products will be 100% recyclable.

Aggressive policies designed to limit single-use plastic packaging and define specific targets relative to plastics recycling are being implemented globally. For example, the European Union has set a common target for the recycling of 50% of plastic packaging by 2025 and 55% by 2030. In India, the government announced an initiative to eliminate all single-use packaging by 2022. Further, the city of Mumbai implemented an outright ban on single-use plastics. Residents caught using plastic bags, cups, or bottles face penalties of up to 25,000 rupees (£276) and three months in jail.

Impact on today's – and tomorrow's – investments

We expect the trend toward greater sustainability in the industry to continue, which is certainly a positive development. But the pace of change, the prospect of greater regulations, including bans, and consumer deselection of certain plastic end-use products is creating significant investment risk and market uncertainly. This is especially significant for plastics producers, processors, and consumer packaging companies, who must invest now for the future. Additionally, municipalities and governments are also tasked with investing for growth. They must ensure they have a comprehensive recycling infrastructure that is optimal, meets constituent expectations, and is adequately funded. This requires tremendous planning and a multi-layered view.

In an effort to improve understanding of this rapidly developing multi-faceted movement, IHS Markit has developed a multi-client study entitled "Plastics Sustainability: A Sea Change – Plastics Pathway to Sustainability." The study offers a base case (trend line) and alternative case (maximum viable threshold) analysis of the plastics demand growth for six key plastics markets. The study provides a granular view of the impact of sustainability on specific end-use segments for key plastic resins as well as analysis of the implications for upstream base chemicals and feedstocks for the years 2018 to 2030.

Also included in the study is a review of current and evolving government regulations, including consumer product companies' policies for plastics sustainability initiatives in major geographies. The study offers an in-depth review of the infrastructure disconnect between post-consumer recycle demand and supply. It also profiles the major technologies for plastics recycling and recovery,

"Aggressive policies designed to limit single-use plastic packaging and define specific targets relative to plastics recycling are being implemented globally"

addressing the gaps in the context of a circular economy. The research includes insight and analysis from two leading sources: More Recycling, a research and consultancy focused on the recycling of post-consumer materials, specifically plastics; and Environmental Packaging International, a consultancy specializing in environmental compliance, product stewardship and sustainability related to packaging and products.

Bioplastics offer a smaller carbon footprint

Marifaith Hackett | Research and Analysis Executive Director, Renewables & Nutrition, IHS Markit
E Marifaith.Hackett@ihsmarkit.com
T +14083434813
L Freemont, California

Bioplastics – polymers that are bio-based, biodegradable (compostable), or both – play a small but significant role in the world thermoplastics market. Currently bioplastics account for less than 1% of global thermoplastics production capacity. Polymers that are wholly or partially derived from renewable feedstocks, including bio polyethylene and bio polyethylene terephthalate (PET), are responsible for 58% of production capacity. Biodegradable (compostable) polymers make up the remainder. Many compostable polymers, including polylactic acid and starch/copolyester compounds, are bio-based (at least in part) in addition to being biodegradable.

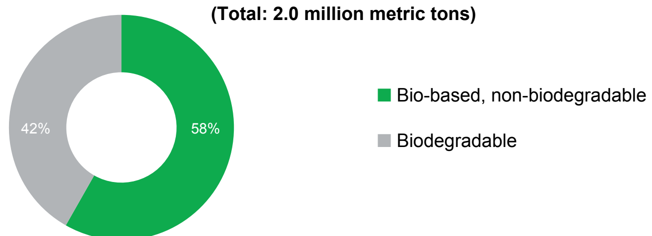
Nondurable applications dominate bioplastics consumption. Important end uses include cold cups, beverage bottles, food containers, disposable utensils, shopping bags, and garbage bags. Durable applications include carpet yarns (in the case of polytrimethylene terephthalate) and air-brake tubing (in the case of polyamide 11).

How do bioplastics contribute to sustainability?

First, because most bioplastics are derived at least in part from corn, sugarcane, or other plants, they have a smaller carbon footprint, with lower cradle-to-plant-gate greenhouse gas emissions than their fossil fuel-based counterparts. At least one bioplastic, polyamide 410, is carbon neutral: its cradle-to-plant-gate-greenhouse gas emissions are zero. The amount of carbon dioxide generated during the manufacture of polyamide 410 – which comes from a combination of renewable feedstocks derived from castor bean oil and petrochemical feedstocks – is offset by the amount of carbon dioxide absorbed during the growth of the castor bean plant.

Global bioplastics production capacity – 2018*

(Total: 2.0 million metric tons)



*Thermoplastics only.
Source: IHS Markit.

Second, bioplastics facilitate composting, thus diverting food remains, yard clippings, and other organic waste from landfill. Diversion of organic waste reduces emissions of methane, a potent greenhouse gas formed as a by-product of waste decomposition in landfills. Clamshells, cups, and single-serve coffee capsules made of biodegradable polylactic acid can be composted along with leftover food in industrial compost facilities. Garbage bags made of biodegradable starch/copolyester compounds reduce the "ick factor" associated with composting food waste.

Third, some (but not all) bioplastics are fully compatible with the existing plastics recycling infrastructure. From a chemical perspective, bio PET and bio high-density polyethylene (HDPE) are identical to their fossil fuel-based counterparts. Soft drink bottles made of bio PET or bio HDPE pose no threat to the quality of PET and HDPE post-consumer recycle streams.

Do bioplastics offer a solution to the highly visible problem of ocean plastic waste?

No. Few commercial bioplastics decompose completely in the environment. Preferred end-of-life options for bioplastics include industrial composting or recycling. Sadly, because of the lack of composting infrastructure and low recycling rates, bioplastics (like conventional plastics) often end up in landfill or incinerators.

Why do bioplastics remain niche products in the global thermoplastics market? Bioplastics can be more expensive than their conventional counterparts. In addition, production volumes are comparatively limited, with only a few sizable manufacturers for each bioplastic. Applications development is ongoing, especially in the case of some new bioplastics, and end users are still learning how to take full advantage of the materials' unique performance attributes.

Could bioplastics play a larger role in sustainability initiatives? Yes, but a major increase in the use of bioplastics seems unlikely in the absence of government mandates. A case in point: French demand for bioplastics increased after the government exempted compostable bio-based plastic bags from its 2017 ban on plastic shopping and produce bags. But bans on conventional plastic shopping bags and other single-use items do not automatically result in increased demand for bioplastics. Consumers have other environment-friendly alternatives, such as reusable shopping bags. Bioplastics will continue to compete for market share as the world grapples with the issue of plastics sustainability.

A Sea Change: Plastics Pathway to Sustainability Special Report

Plastics sustainability is the most critical issue facing the plastics industry and is likely to lead to greater regulation (including bans) and deselection by consumers, retailers & brand owners.

This issue is challenging the entire chemical value chain.

A Sea Change: Plastics Pathway to Sustainability special study helps stake holders move progressively to understand the issues of plastics sustainability with extensive analysis and data quantifying the impacts.

This study will address key questions surrounding plastic sustainability:

- What is the current and future impact on virgin and PCR plastics demand from sustainability initiatives?
- How will various end-use demand segments be impacted by sustainability developments?
- What is the potential impact on petrochemical monomer and feedstock demand resulting from plastics sustainability development?
- How do global and regional regulatory trends impact plastics demand?
- How well is PCR supply positioned to satisfy demand? What are the current and future constraints?
- How do sustainability initiatives affect future plastic prices?
- How much PCR will be available? Where does it end up and why?

For more information www.ihsmarkit.com/plastics

270895966-VL-0918

Global plastics recycling

1

Over the past few years, the Chinese authorities have been more aggressive at setting up targets and implementing regulations to address environmental concerns domestically. This has been the case for plastic waste with an initial temporary measure in 2013 with the Operation Green Fence, followed by a more stringent regulation with the National Sword Act in 2017, Blue Sky Policy in 2018, and a ban on plastics scraps and waste to the WTO in 2018.

2

Compared to 2013, the impact of the recent measures on the market for plastic bales and scraps and to a lower extent virgin material has been more important. This could be at least partially explained by the fact that the National Sword and import ban are more strictly implemented by the Chinese authorities with measures expected to remain in place over the medium to long term.

3

Export volumes of plastic scraps from most countries and regions – including the US, Mexico, West Europe, and Japan – to China have declined significantly over 2017 and particularly towards the end of the year to become virtually nothing in early 2018 due to the ban implemented at the WTO level.

4

This ban has been relatively well-implemented on PE (Polyethylene) while some very minor volumes of PET (Polyethylene Terephthalate) and potentially PP (Polypropylene) are still reported to find their way to China.

Source: IHS Markit

Case study

Ban on plastic scrap imports in China and potential opportunities for plastic recycling in the West

Initial situation

The client, a waste management company with global operations, hired IHS Markit to understand the current regulation and changes in policies (such as Operation Green Fence, National Sword Act, and Blue Sky Policy…) regarding plastic scrap imports in China and its impact on the wider recycling industry.

Impact

IHS Markit assisted the client with an understanding of the legislation in China and the changes implemented over the past 18 months.

An analysis highlighted the potential impact of the plastic scrap import ban on the Chinese industry but also on large exporters of plastic waste, namely the US and West Europe, as well as third-party countries indirectly impacted by the situation.

What IHS Markit did

IHS Markit reviewed the mechanism in place for plastic scrap imports in China and specificities by polymer types (PP, PE, PET) where relevant.

The team analyzed previous regulatory changes and the consequences on plastic scrap imports to China in the past several years. A review of the recent implementation of the National Sword Act and announced Blue Sky Policy was carried out.

A detailed study describing global tradeflows for plastic scrap was completed looking at the evolution of Chinese imports as well as exports from North America and West Europe in the past five years. A more granular analysis focusing on monthly trade volume in the past year helped identify, confirm and quantify the impact of the changing regulation in China on a large number of countries with consequences on the wider plastic recycling industry.

IHS Markit discussed the changes observed on the market. A scenario analysis was then completed to understand the impact of such a policy in China as well as potential consequences in other parts of the world.

5

These measures have led to a number of consequences. For the China recycling industry, limiting the amount of scrap raw materials available is therefore putting businesses, often small and medium companies, at risk of bankruptcy. A number of companies are reported to have shut down or relocated some of their capacity in other countries.

6

Consequences have also been felt in the exporting countries, with a significant decline in plastic waste export volumes and new destinations for these waste materials.

7

Finally, there have been a number of unintended consequences. Countries, mainly in Southeast Asia, face a surge in scrap plastic imports. They also have difficulty coping with materials due to the lack of infrastructure available to sort, clean, and recycle them. The decline in recycled resins also resulted in a boost to the domestic demand for virgin material in China since the end of 2017.

8

Despite the significant changes regarding PE/PP and PET scraps, trade flows in volume and destination. The impact on prices is reported to be relatively minimal in a global environment of rising prices for recycled and virgin resins.

Climate change regulations: coming soon to an industry near you?

Kurt Barrow |
Vice President, Oil Markets, Midstream and Downstream Insights, IHS Markit
E Kurt.Barrow@ihsmarkit.com
T +18326797238
L Houston

Steven Knell |
Research and Analysis Director Energy-Wide Perspectives, IHS Markit
E Steven.Knell@ihsmarkit.com
T +442031593360
L London

Just over 25 years ago, governments around the world began using different policies and regulatory measures to slow the growth of greenhouse gas (GHG) emissions linked to global warming and climate change. Over that period, the focus of climate change policy expanded to include more sectors of the economy and additional forms of energy production and consumption. In 2015, 195 countries signed the Paris Agreement, the most wide-ranging and ambitious deal on climate action yet. As the first deadline of that accord draws near, climate policy programs are expanding to include sectors of the economy previously not targeted for GHG emission reductions.

There are two key trends at work here. First, more governments have made unprecedented commitments by signing the Paris Agreement. Before 2015, approximately 70 countries had climate policies of one sort or another in place. Now, there are more than 160 national policy programs, called intended nationally determined contributions (INDCs), in support of the Paris Agreement (see Figure 1).

Second, this latest phase of climate policy development is driven by higher levels of ambition. The GHG emissions reduction targets in the Paris Agreement are challenging, to say the least. To realize the goal of only a 2-degree Celsius increase in the global average temperature this century, emissions of carbon dioxide, methane, and other GHG would need to peak by 2020. Then they must decline in absolute terms from close to 50 billion metric tons of carbon dioxide equivalent (CO2e) today to around 30 billion tons of CO2e by 2030. This is a drop of about 40%, depending on the exact pathway assumed. To deliver those outcomes, IHS Markit estimates the global economy would need to improve its emissions intensity by more than 4% each year. Historically, the most effective climate change policy has delivered an average annual emissions intensity improvement of less than 2%.

Setting aside the U.S. for a moment, all major nations that signed onto the Paris Agreement are developing policies to deliver GHG reduction targets. Will all nations meet these targets? Probably not. But, as nations take steps to fulfil their pledges, major shifts in energy markets are expected. Refining and chemicals operators should brace themselves for new types of regulations across their value chains, with plant-level emissions set to become a higher priority.

To date, climate policy has had a more direct impact on the downstream energy industries through on-road fuel efficiency standards, which are directly related to carbon emissions regulation. Some governments, such as those of the European Union, India, and the United States, formulated additional CO_2e- or GHG-specific targets for tailpipe emissions of light-duty vehicles. These fuel efficiency standards are the primary policy mechanism that governments use to reduce carbon in their transportation sectors.

Consider the world's two biggest economies, the U.S. and China. In the U.S., the Corporate Average Fuel Economy (CAFE) program was enacted in 1975. The original miles-per-gallon (mpg) target on auto manufacturers became a dual standard that now includes an Environmental Protection Agency (EPA) regulation for CO_2e emissions. The 2016 target for light-duty vehicle sales – 250 grams of CO_2 per mile (gCO_2/mi), equivalent to 34.1 mpg – was changed by the Obama administration to 163 gCO_2/mi, an equivalent of 54.5 mpg, in 2025. However, the actual 2017 emissions were estimated to be 275 gCO_2/mi – 10% above the 2016 target. The current U.S. administration has proposed relaxing the targets, although the outcome is uncertain at this writing. IHS Markit's base case view is for only a slight reduction in the standard, given automotive manufacturers' model development plans and the lawsuit and discussions regarding California's continued participation in a national standard.

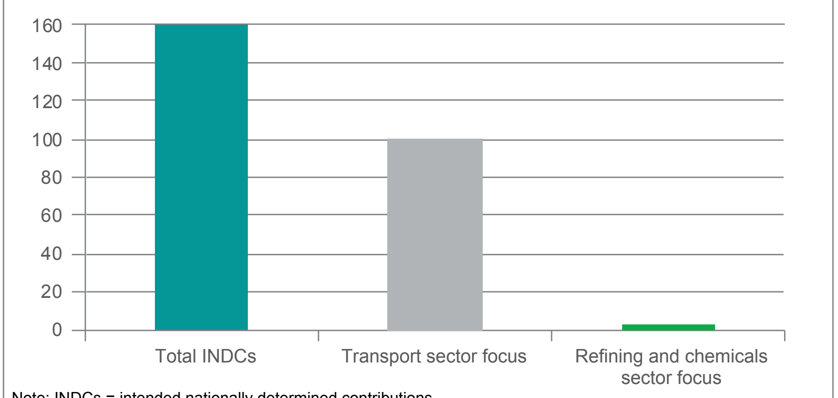
While the U.S. is relaxing emissions standards, China is tightening them further. By adding a new energy vehicle (NEV) standard, China is essentially mandating that an increasing portion of new auto sales will be electric vehicles (EVs). In fact, about half of global 2017 EV sales were in China. The NEV is a dual standard applied alongside an already stringent corporate average fuel consumption (CAFC) standard. China's CAFC improves fuel economy from about 34 mpg in 2015 to 47 mpg in 2020 and over 58 mpg (proposed) in 2025.

How do regulations affect other sectors beyond light-duty cars?

Japan was the first to adopt a heavy-duty vehicle fuel efficiency standard, followed by the U.S., China, and the European Union. More nations are expected to follow their lead, given the increasing road transport demand and benefits of technology advances in truck powertrains and transport supply chains.

Policymakers are also looking to the sea-borne shipping and aviation sectors to contribute to emissions reduction efforts, but these changes may affect the refining and chemicals businesses. In response, those industries have taken it upon themselves to organize collective responses befitting their international character. Most of these responses emphasize the need to give operators the chance to contribute to lower emissions outcomes in a flexible manner that keeps costs down.

Figure 1 Paris Agreement commitments and downstream sector specific provisions



Note: INDCs = intended nationally determined contributions
Source: IHS Markit.

So, what is the future of refining in a world of flat or declining demand?

Virtually all projections that measure progress toward the objectives of the Paris Agreement include an eventual contraction of oil demand. Even an energy transition that does not completely align with a 2-degree emissions pathway will mark a departure for many downstream businesses, whose strategies have been predicated upon growth. Lower demand growth will certainly mean a weaker business environment for refineries. But, the reality might not be as dire as it first appears. It is true that fewer refining projects will be needed to process crude oil into product. And, yes, once peak demand is reached, total crude runs will decrease and asset rationalization will take place.

However, rationalization in the refining industry has been occurring for a long time. The industry has shuttered nearly 1 million barrels per day (B/D) per year of refining capacity in mature markets over the past decade. During this time, the industry has also added about 2 million B/D of new capacity, mostly in growing markets. IHS Markit expects this same expansion in growing markets and decline in contracting markets will continue for many years, even as the global total demand begins to shrink.

What will change at the plant level?

Plant-level process emissions have been less important to the achievement of environmental goals, at least to date. Asset owners have been required to make moderate adjustments and trade-offs in plant designs to stay compliant on new projects. However, in the few countries where policies have been put in place to reduce refinery plant-level emissions, like the European Union Emissions Trading System, markets are not yet being impacted significantly in either margin or price.

Nor are petrochemical producers being strongly influenced by plant-level or supply chain emission requirements. In fact, conversations about environmental outcomes in the petrochemical industries have focused on the sustainability of plastics and the opportunities to recycle petrochemical products (see prior article). As petrochemical operations expand to meet growing end-use demand, and as the oil product slate shifts further towards petrochemical feedstocks, social and regulatory scrutiny of industry GHG emissions from both products and plants is likely to increase.

Most governments focused somewhat on the transport sector in the initial policy outlines created to deliver on their Paris pledges. But petrochemical and refining has not been called out by many administrations. IHS Markit expects this situation to change as governments increasingly grasp the need for GHG cuts across all large emitting sectors. Striking the right balance between such national environmental goals and the competitiveness of global refining and chemicals businesses will be important.

Climate policy is expected to target additional emissions reductions from refining and chemicals operations. The focus to date has been on products and fuels, and that is likely to intensify. At the same time, plant-level emissions will come under greater pressure as governments seek to hit ever-more-ambitious targets. As companies make critical investment and business decisions – which often have multi-decade payouts and are based on international trade – it is important that they have an integrated view of the climate policy, energy, and petrochemical landscape.

Global trade wars: implications for refined products and chemicals

Dewey Johnson |
Vice President, Base Chemicals, IHS Markit
E Dewey.Johnson@ihsmarkit.com
T +1 281 752 3213
L Houston

Daniel Evans |
Vice President - Head of Global Refining and Marketing Research
E Daniel.Evans@ihsmarkit.com
T +33 14 770 7852
L Paris

The escalating trade war between the US and China has had a limited direct impact on the refining and chemical industries. So far only liquefied petroleum gas (LPG) and polyethylene have been materially impacted by the imposition of new tariffs. Both countries realigned their trade practices slightly, with Chinese importers of LPG, chemicals, and plastics swapping out US-sourced cargo and US exporters seeking other markets *(see Figure 1)*.

Despite the relative success of this LPG trade realignment, it has not come without a cost. As Chinese importers turn more to Middle East supply, Saudi Arabian contract prices have increased, making the Middle East the main beneficiary of the tariffs. The knock-on impact for other importers of Middle East LPG has been higher import prices, resulting in a rising Far East Index (FEI), a price benchmark for the general Northeast Asia region.

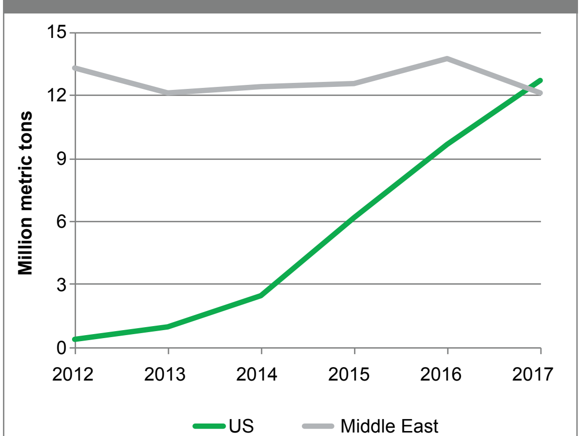
A different realignment has been observed in polyethylene, the largest chemical product export to China. While trade routes have changed, with U.S. exports redirected from China to other countries, China prices have remained capped despite the 25% trade tariffs. This is due to the relative supply excess in this global market, which includes sources in multiple geographies. However, North America polyethylene exports will grow from 3 million metric tons (MMT) in 2017 to 9 MMT in 2020. With China representing nearly 50% of the annual demand growth, competitive access to this market will become increasingly important.

These test cases demonstrate room to mitigate the direct impact of tariffs. However, there is a growing expectation that the wide-ranging economic ramifications of newly imposed tariffs will exert downward pressure on demand growth for both chemicals and refined products.

Since January 2018, when the US imposed a 30% tariff on imported solar panels – the majority of which come from China – a raft of new measures have been announced by the Trump administration. Roughly USD 250 billion worth of Chinese imported goods are now being targeted under Section 301 of the Trade Act of 1974. After the first wave of measures targeting USD 50 billion, an additional USD 200 billion are subject to a 10% tariff since September 24. What's more, the tariff rate is due to rise to 25% in January 2019. A third package of tariffs, targeting another USD 260 billion, has been threatened if China retaliates. Tariffs as high as 25% on European and other foreign-made automobiles are also being discussed. US trade partners have retaliated in kind, imposing their own tariffs on US exports.

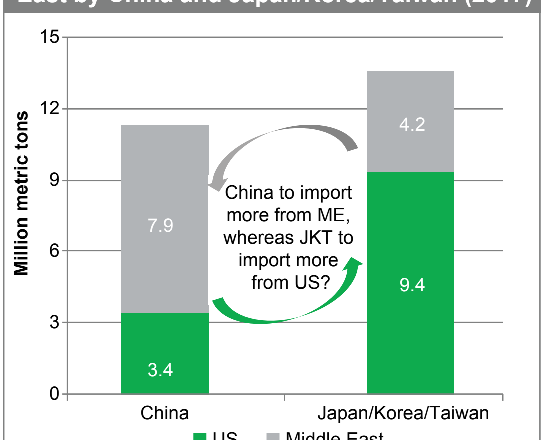
While there may be short-term benefits for the US, IHS Markit's view is that tit-for-tat trade tariffs will benefit nobody in the long run. IHS Markit has already revised the global GDP growth forecast for 2019, from 3.2% in January 2018 to 3.0% in October 2018. In

Figure 1. Flexibility of Propane Import Sources



Source: IHS Markit. © 2018 IHS Markit

Propane imports from US and the Middle East by China and Japan/Korea/Taiwan (2017)



Source: IHS Markit. © 2018 IHS Markit

addition, IHS Markit has downgraded growth projections for 2020, from 3.0% in January 2018 to 2.9% in October 2018. IHS Markit expects the pass-through effect of tariffs to domestic prices in the US will be high, eroding purchasing power. Ultimately, IHS Markit believes that the inflationary effects of a trade war will exceed the benefits for the US and that this will be exacerbated by retaliation. The impact on China will be twofold. First, Chinese exports to its largest trading partner will be directly impacted. Second, reduced inward foreign direct investment will hamper growth. In addition, the spill-over effects will undermine confidence and asset prices globally, further reducing global GDP growth in 2019 and 2020 and impacting the chemical and refined product markets.

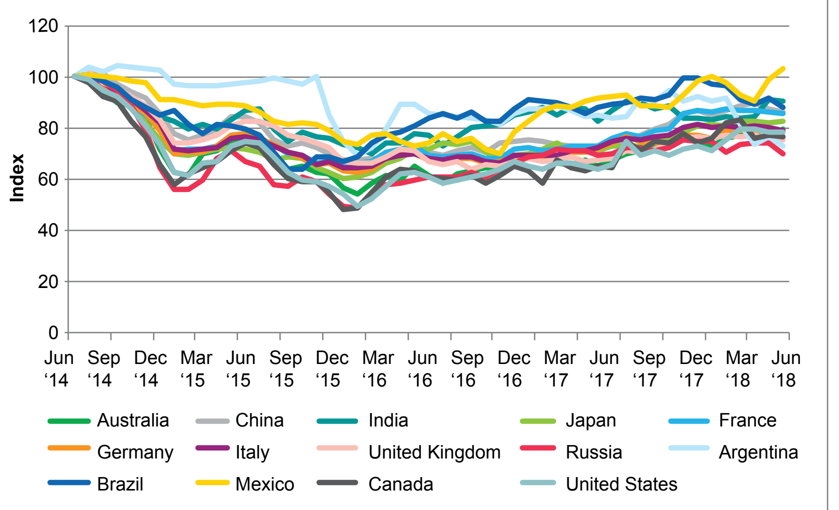
Refined product markets are likely to be affected by the downward pressure a weaker economic outlook could impose on demand. IHS Markit has revised 2019 GDP forecasts downwards by 0.2% for China (from 6.3% in January 2018 to 6.1% in October 2018) and upwards by 0.1% for the US (from 2.6% in January 2018 to 2.7% in October 2018). Global GDP is projected to grow 3.0% in 2019 versus a previous prediction of 3.2%. Based on historical GDP growth trends, IHS Markit would expect to revise 2019 demand growth downward by up to 250,000 barrels per day (b/d). However, these projected changes downplay the impact on demand. A secondary effect of the trade tariffs is rising US interest rates and an appreciating dollar, which in turn have contributed to emerging market currency devaluation. While the impact has not been as significant in some markets as it has been in Argentina and Turkey, the net impact is that refined products are becoming more expensive in local currency *(see Figure 2)*.

Combined with a relatively high crude price environment, these factors may create the perfect recipe for price-sensitive demand. Considering that demand growth has been slowing following several years of very strong growth, additional downward pressure on demand is likely to reduce both crude prices and refining margins. That projection assumes there are no major supply disruptions, which is still a serious risk.

Chemical markets continue to grow at multiples of GDP, ranging from 1 to 1.5X. Yet this amplification works in both directions. Thus, changes in economic growth are magnified in chemical market demand *(see Figure 3)*. Economic simulation scenarios of a full trade war outbreak reflect potentially severe short-term effects on the Chinese economy, with a 30% to 40% decline in GDP growth from more than 6% to 3.5% GDP). With China representing the epicenter of chemical demand growth, this creates a potential for significant disruption of chemical markets

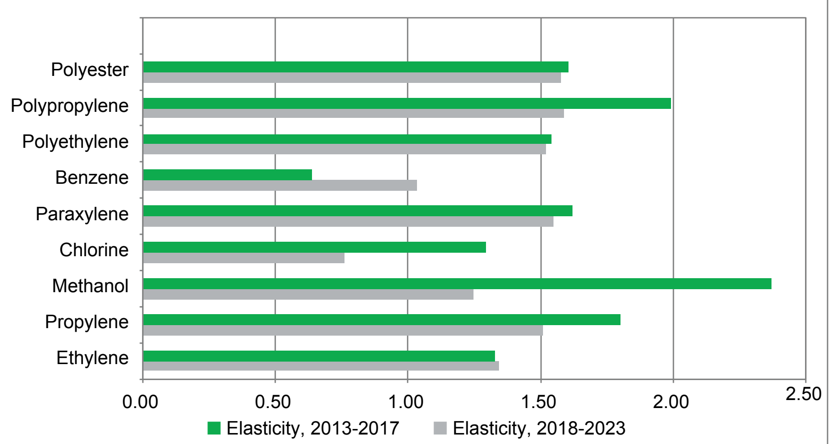
Early trade skirmishes are having minimal impact on refining and chemical industries, as these efficient commodity products reroute for optimal lowest delivered cost. The more disruptive potential occurs in the event of escalation to a full trade war, which could exert potentially damaging blows to regional and global economies. Lost demand and immediate excess supply situations could follow, creating falling margins for industry participants.

Figure 2. Retail gasoline prices in local currency terms (indexed to June 2014)



Source: IHS Markit. © 2018 IHS Markit

Figure 3. Elasticity Versus Demand



Source: IHS Markit. © 2018 IHS Markit

China's ethanol push: Implications for the refining and petrochemical markets

Harry Liu |
Associate Director,
Consulting, IHS Markit
E Harry.Liu@ihsmarkit.com
T +861065334643
L Beijing, China

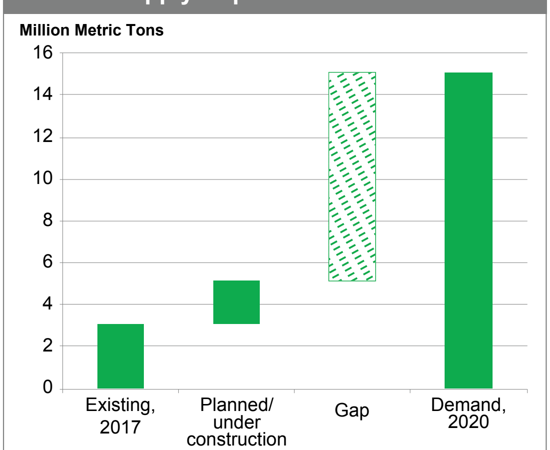
William Chen |
Principal Research Analyst,
IHS Markit
E William.Chen@ihsmarkit.com
T +861065334529
L Beijing, China

In 2001, China initiated an ethanol fuel program to consume aged grains no longer suitable for use as food. The program was confined to six provinces and select cities in four additional provinces to avoid jeopardizing the food supply to China's population of 1.3 billion people. IHS Markit estimates that China produced about 52,000 barrels per day (b/d) of E10, a 10% concentration of ethanol-based gasoline blend, in 2017. This blend was largely derived from grain, as non-grain-based ethanol technology remains commercially unproven, even with the support of government subsidies.

Given China's concern for food security, ethanol (which comes mainly from grain) has never been considered a strategic fuel target for the government. That changed in September 2017, when the Chinese government announced legislation proposing the use of ethanol in fuel for all of China by 2020. This move is perceived as the government's reassurance it will abide by the Paris Accord to reduce fossil fuel consumption and alleviate global warming. But it also enhances energy security by reining in the country's dependence on oil imports. On a more practical level, the initiative promises to reduce the huge corn inventory that has been building up for years, resulting from government farming subsidies.

The ethanol push faces tricky supply options: bioethanol, fossil-fuel-based ethanol, or US imports?

Ethanol Supply Gap



Source: IHS Markit. © 2018 IHS Markit

With a minimum of 10% ethanol blend in the gasoline pool, which is expected to reach 3.4 million barrels per day (MMb/d) in 2020, China would need to source 15 million tons of ethanol per year. That total is almost seven times the volume consumed today. This volume will increase year-over-year to the mid-2030s, when gasoline demand is expected to peak. Currently China imposes significant tariffs of 30% on ethanol imports, both denatured (mostly for fuel) and natured ethanol, to inhibit imports. This policy is likely to remain. This year's US-China trade friction, which is commanding a 25% higher tariff on imported ethanol from the US into China, further pressures import economics.

That leaves domestic sources as the most likely solution to the huge supply gap. Yet China is not likely to encourage the development of fossil-fuel-based ethanol capacity, such as syngas, coke oven gas, or coal-based ethanol, or even natural-gas-based ethanol, due to its significant carbon and environmental footprint.

The current corn inventory is enough to sustain ethanol production for nationwide E10 use (which requires more than 15 million tons per year) for about five years. Fuel-ethanol production capacity stands at around three million tons per year. It will be years before ethanol capacity grows to the level required. Therefore, ethanol supply is unlikely to catch up with demand in the medium term.

Ultimately E10 could materialize in China, but it will take longer than the government expects

Despite the immense supply challenge, E10 may support China's fuel and food initiatives eventually, as the government increasingly commits to decarbonize energy consumption, improve energy security, and alleviate poverty. Three steps will help China reach is goals:

- China's crude oil imports dependency reached about 68% in 2017. Bio-ethanol for gasoline can curb the growth of crude oil imports dependency.
- China promises to reach peak carbon emissions by around 2030. To meet this goal, the country will need to shift energy consumption patterns from coal to gas and renewables. A move to bio-ethanol to displace petroleum-derived gasoline will help honor this commitment.
- A need to create demand for base agricultural

production will protect farmers' interests at home. This demand could help narrow the ever-increasing disparity between rich and poor, as well as urban and rural populations.

IHS Markit acknowledges the challenges of transporting ethanol from plants to blending facilities and gas stations. This difficulty results from the potential for water contamination during transport, which adds complexity to compliance mandates across the supply chain. With these caveats, we expect the E10 policy to be adopted after some delay, although it will not be realized uniformly or simultaneously across the country.

What are the implications for refining and petrochemical operations?

The use of ethanol will impact oxygenate blends in gasoline such as methyl tert-butyl ether (MTBE), tert-amyl methyl ether (TAME), and even methanol. These liquids are to be excluded from ethanol-blended gasoline due to the restriction of oxygen content in the gasoline specification, which is required to minimize nitrogen oxide emissions from gasoline engines.

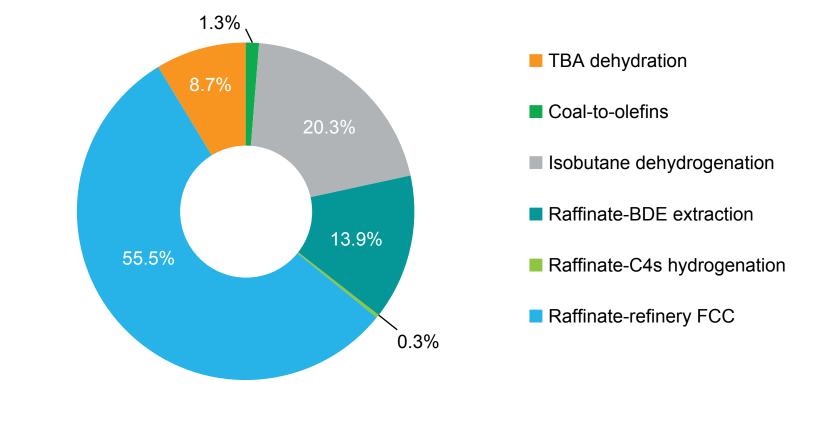
However, the phase-out of oxygenate blends from the gasoline pool is not the end of the story. Refiners and traders will need to redesign the gasoline pool in a cost-efficient manner while meeting the country's fast-evolving gasoline specifications. In addition, refiners and chemical companies must adjust their operations to deal with issues related to fluidized catalytic cracker (FCC) operation, C4 olefins, and methanol used as the feedstock for producing gasoline oxygenates.

TAME technology is widely adopted in Chinese refining systems. It addresses refiners' challenges, including lower olefins in the new gasoline specifications and increasingly higher demand for octane. If TAME is out of the gasoline pool, refiners will have to desulphurize FCC light naphtha, which is used as TAME feedstock, to meet the 10 parts-per-million sulphur requirement at the cost of a lower octane rating. To make up for the octane loss, refiners may need to invest in alkylation and isomerization units.

MTBE is primarily used as a blendstock in the gasoline pool, which accounted for 95% of total MTBE demand in 2017. In addition to its use as an octane improver, a small portion of MTBE is consumed in the production of high-purity isobutylene (HPIB). This end-use segment is expected to grow at 7.6% annually during 2020-2028, but the relative proportion of MTBE for HPIB will steadily rise to 24.5% in 2028, assuming the total MTBE demand in China decreases. MTBE exports are expected to slightly increase, which will release, to some extent, the pressure from domestic oversupply. However, it is unlikely that China will become a major MTBE exporter in the future. Some of the volumes will be exported as a blending component along with gasoline exports, which are expected to rise in the long run.

It will be interesting to see which MTBE producer will shut down first because of this ethanol push. State-owned enterprises are much more competitive than private players because of better integration along the value chain, from feedstock supply to gasoline disposal. Hence, private and small players will be under immense pressure. Also squeezed will be some of the butylene isomerization-based MTBE units with feedstocks of raffinate-2. The alternative way to weather this ethanol storm is to repurpose MTBE units into production of ethyl tert-butyl ether (ETBE), which uses the same C4 feedstock but in reaction with ethanol instead of methanol. However, no policy support is yet in place. In fact, ETBE is considered a better way for ethanol to make inroads into gasoline, due to better stability and vapor pressure performance.

China: 2017 MTBE Capacity by Feedstock



Source: IHS Markit.

IHS Markit®

North America Propylene Supply Study

An In-depth Analysis of the Eleven North American Propylene Trade Areas (PTAs)

Structural shifts in North America's propylene supply and market dynamics have occurred during recent years and factors influencing these changes are continuing to have a significant impact. The North America Propylene Supply Study from IHS Markit will highlight and address these changes and key strategic issues facing the propylene industry.

Strategic Issues

- Shale Gas/Tight Oil Impact on Olefins
- On-Purpose Capacity
- Expansion of Propylene Export Capability
- Changes to Pipeline Infrastructure
- Propylene Derivative Additions
- Impact of Changes in the Refining Sector
- Massive Chinese Propylene Investment

North America Producer Profiles

Prices

- Mechanisms
- Energy Forecast through 2027
- Propylene Price Forecast through 2027

Propylene Technology Review

- Description of Major Technologies Including Process Flow Diagrams
- Economic Snapshots all Major Technologies for Propylene Production

Distribution

- Definition of Propylene Trade Areas (PTA)
- Inter-PTA trade grids, PTA production and consumption, PTA supply and demand
- Polymer-Grade, Chemical-Grade, and Refinery-Grade propylene integration by PTA
- Steam Cracker and PDH Propylene Producers' Capacity and Logistics Capabilities
- Refinery Propylene Producers' Capacity and Logistics Capabilities
- Propylene Export Terminals

Trade

- Discussion of Propylene Trade
- Tables of Net Equivalent Trade, Imports, Exports
- North America, Canada, Mexico, United States

Appendices

- Production Location Maps
- Capacity Tables
- PG/CG Integration Tables
- RGP Integration Tables

For full study scope and deliverables, visit: www.ihsmarkit.com/napss

273358620-VL-0918