2019 American Fuel & Petrochemical Manufacturers
OPERATIONS & PROCESS TECHNOLOGY SUMMIT
Conference Daily Published by
HYDROCARBON PROCESSING®
DAY TWO | #AFPMSUMMIT
Tuesday, Oct. 15, 2019

# AFPM President touts industry progress, new Summit 2020

**ADRIENNE BLUME,** Executive Editor, *Hydrocarbon Processing*

The AFPM Operations & Process Technology (OPT) Summit opened on Monday morning with a keynote address by AFPM President and CEO Chet Thompson. Mr. Thompson welcomed attendees to the 72nd—and final—OPT Summit, noting, "The Summit has been a mainstay of the industry for 72 years, and hopefully we'll be talking about the new summit for decades to come."

The "new" summit, Summit 2020, will combine AFPM's OPT Summit, Reliability & Maintenance Conference, and Cat Cracker Seminar into one event. "When you come to these events, you work together to make the industry more efficient, cleaner and safer," the AFPM President said. "This is obvious when you compare where we are today versus where we were 72 years ago."

In 1947, the country's 336 refineries were processing 5.5 million barrels per day (MMbpd) of crude into fuels for 25 million domestic automobiles. "Today, we're meeting the needs of the world as the number-one producer of oil and natural gas," Mr. Thompson said. At present, the U.S. has just 135 operating refineries that process 17.5 MMbpd of crude.

The AFPM head noted that the U.S. political climate is not always friendly toward oil and gas, however. "We need to ensure that consumers know that proposals like the Green New Deal are out of touch with the fact that the fossil fuel and petrochemical industries underpin the world economy and population growth."

"We need to have a seat at the table and engage in rational, balanced conversations about things like climate change," Mr. Thompson continued. "As an industry, doing our part means continuing research and development and public education, providing clean fuels, and investing in carbon capture and sequestration."

At present, AFPM is lobbying for improvements to the revised NAFTA, for meaningful infrastructure reform to expedite project permits, for a rejection of electric vehicle tax subsidies, for improvements to CAFE regulations, and for a resolution to the government's trade conflict with China.

"If we can get these basic things to happen, then we can eliminate the drag on our industry and have refining and petrochemical dominance for many decades to come," Mr. Thompson said. ●

**CHET THOMPSON,** AFPM President and CEO

# The convergence of IT and OT: Making a case for safety and cybersecurity

**ADRIENNE BLUME,** Executive Editor, *Hydrocarbon Processing*

During Monday morning's session on cybersecurity, William Jenkins of PricewaterhouseCoopers spoke about why and how to establish information technology (IT) and operational technology (OT) convergence.

"There is still a thought in the field that, fundamentally, IT and OT are separate," Mr. Jenkins said. "But they're not; they're converging." Worker safety is a major driver of this convergence. Also, organizational complexity is increasing. IT/OT convergence provides process consistency, centralized oversight and control.

**WILLIAM JENKINS** of PricewaterhouseCoopers.

"A commonly observed challenge is that OT often doesn't trust IT to touch their systems," Mr. Jenkins noted. OT systems may be physically robust and capable, but they tend to be logically fragile and limited. "Meanwhile, IT doesn't understand why OT doesn't just fix it," he added. IT methods and tools are often decades ahead of OT, especially in the realm of cybersecurity.

Where does IT stop and OT start? Some OT remains highly specialized, but is increasingly technology-enabled. These OT items tend to be plant-floor or field-deployed front-line systems—i.e., the systems monitoring and controlling actual production processes. Control room systems and servers run on the same operating systems and hardware as enterprise applications, with similar or the same communication infrastructure.

Often, these systems start out as high-end commodity IT hardware and are customized for the environment and/or programmed with OT logic. Hardened control system platforms and devices are becoming more sophisticated and complex, with more processing and communications capabilities.

Cybersecurity for OT presents the majority of the challenges that an organization must address. Varying approaches and solutions can be tailored to the organization. IT can "own" security for OT if the team is dedicated and experienced in OT. However, OT can also "own" security for OT if the team efficiently coordinates with IT. Hybrid models are becoming the norm. Some isolated silos still exist, however—often at the highest-risk areas of an operation, Mr. Jenkins warned. He urged attendees to start a roadmap for addressing the highest-risk cybersecurity items at their plants and companies.

Successful IT/OT collaboration involves organizational change, Mr. Jenkins asserted. A coordinated governance structure is needed that includes a mechanism for communication and collaboration across the organization. Assigned roles, responsibilities, capabilities, functions and services are also required. Numerous organizations have already gone through the selection, implementation and rollout of IT/OT cybersecurity governance frameworks and framework elements, and more will follow. ●

## INSIDE THIS ISSUE

# Process Notes

*Vacuum tower cutpoint delivers profits*

## Cutpoint Concerns

Crude unit vacuum tower performance is often critical to a refiner's bottom line. The vacuum tower bottoms stream is valued far below the gas oil cuts, so most refineries look to minimize it. Many vacuum columns are also designed or revamped to produce a diesel cut, recovering diesel slipped from the atmospheric column that would otherwise be downgraded to VGO product.

Good vacuum column performance can maximize the profitability of downstream units by removing distillate hydrotreater feed (diesel) from FCCU or hydrocracker feed (VGO) and removing VGO from coker feed (resid).

One important measure of vacuum column performance is VGO/resid cutpoint. The cutpoint is the temperature on the crude TBP curve that corresponds to the vacuum tower resid yield.

Vacuum column cutpoint depends on three variables:

1. Flash zone temperature
2. Flash zone pressure
3. Stripping section performance (if present)

Flash zone temperature is driven by vacuum heater coil outlet temperature (COT). Increasing COT increases cutpoint. Vacuum heater outlet temperature is typically maximized against firing or coking limits. When processing relatively stable crudes, vacuum heaters with better designs and optimized coil steam can avoid coking even at very high COT (800˚F+, 425˚C), but poorly designed heaters may experience coking with COT below 700˚F (370˚C).

Flash zone pressure is set by vacuum system performance and column pressure drop. Lower flash zone pressure increases cutpoint until the tower shell C-factor limit is reached, at which point the packed beds begin to flood. Vacuum producing systems are mysterious to many in the industry, so a large number of refiners unnecessarily accept poor vacuum system performance. With technical understanding and a good field survey, the root causes of high tower operating pressure can be identified and remedied.

In columns with stripping trays, stripping steam rate and tray performance are important. Stripping steam rate is limited by vacuum column diameter (C-factor) and vacuum system capacity. Any steam injected into the bottom of the tower will act as load to the vacuum system, so vacuum system size, tower operating pressure, and stripping steam rate must be optimized together. Depending on the design, a stripping section with 6 stripping trays can provide between zero and two theoretical stages of fractionation, which can drive a big improvement in VGO yield.

Although the variables for maximizing vacuum tower cutpoint are simple, manipulating them to maximize cutpoint without sacrificing unit reliability is not. Contact Process Consulting Services, Inc. to learn how to maximize the performance of your vacuum unit.

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# State-based process control begets operational excellence

**ADRIENNE BLUME,** Executive Editor, *Hydrocarbon Processing*

At Monday morning's OPCAT session on operational excellence, presided by Michael Barham of Marathon Petroleum Co., Dustin Beebe of Emerson Automation Solutions gave an introduction about state-based control in the automation of operations.

**Basics of state-based control.** Fundamentally, the application of state-based control is driven by the desire for operational excellence, Mr. Beebe explained. Operating discipline is a key component of operational excellence, and it requires detection, knowledge and action. Whenever a plant is dependent on a human response, it is more vulnerable to incidents caused by oversight.

Approximately 75% of safety and environmental incidents occur during non-routine operations, such as start-up conditions, Mr. Beebe explained. If an operator does not have state-based alarms to consult, and the control system is optimized only for the running state, then the plant is actually *de-optimized* for the non-running states. This leaves the plant unprepared for a fault during startup or shutdown, when the facility is at the highest risk.

State-based control has been implemented in more than 1 million IO in a variety of processes, Mr. Beebe said. Automation solutions are designed around the process, which is divided into units and then into operating states. Operating discipline and dynamic alarm management are embedded into the automation process for each state.

"It's also important to know what state-based control is *not,*" said Mr. Beebe. State-based control is not basic process control, advanced regulatory control, model predictive control or safety instrumented systems.

However, a human/automation partnership can be created to improve performance and safety. One example is a burner management system that lights fired equipment reliably and safely. "Why don't we do that with other processes?" posited Mr. Beebe. "Why don't we do that with our reactors or our columns?"

State-based control can coordinate a response when, for example, a safety function is activated in a reactor. The reactor would communicate that it has shut down, and the other units would respond to keep themselves in a state of optimal readiness for when normal operations resume.

"It's really about operational discipline," Mr. Beebe said. "Think safety, think reliability, think operability."

**Process automation for vinyl acetate production.**. Following Mr. Beebe's introduction, Jonathan Huggins of The Dow Chemical Co. discussed the implementation of state-based control for a Dow vinyl acetate monomer production plant, in partnership with Emerson Automation Solutions.

Most plants are designed to run at steady state, and operational procedures are typically task oriented, Mr. Huggins explained. Procedure automation automates aspects of operational procedures and coordinates the operations of multiple units.

With procedure automation, a board operator can easily coordinate activities between the control system and field operators. The value of the knowledge captured by procedure automation is that it allows for assessment of operations, improves situational awareness, unifies understanding, retains knowledge, enforces best practices, reduces human error and results in performance gains.

The workflow of procedure automation involves defining and capturing processes, procedures, policies and safety guidelines. This information is then interpreted and translated into design requirements, functionality and structure for the automated procedure. The automation process is built, implemented and tested. Finally, it is put into operation and audited.

During the automation of the vinyl acetate production process, the entire process was broken out into individual unit operations to identify the value in automating different processes. "We asked, are there safety risks? Are there performance or financial risks?" Mr. Huggins said. Based on these evaluations, a list of items was developed to create the greatest value through the implementation of state-based control.

"If there are frequent operator interactions and there's a safety risk, then we're going to automate [a process]," Mr. Huggins explained. "But if it's an infrequent event and the safety risk is low, then we won't automate it. If there are significant impacts on reliability, however, then we'll automate it."

A series of meetings with Dow subject matter experts helped Emerson discern how each unit is started up, the nature of interactions between units, and what problems are typically seen. Agreements were achieved, backed by operational experience and process chemistry.

Twenty-six unit operations across the vinyl acetate plant were examined, and five were selected for implementation, representing 43% of IO coverage at the plant. The observed benefits from automation, Mr. Huggins explained, are faster process startups, more predictable and repeatable plant startups, a 1.5% increase in annual capacity, and reduced operator loading. Additionally, the board operators saw a 50% reduction in alarms and a 60% reduction in operator interactions. The ROI from the automation project was less than two years.

"In conclusion, procedural automation is a viable way of increasing safety and productivity in a plant," said Mr. Huggins. "It helps focus board operator information flow and significantly reduces operator interventions." ●

**DUSTIN BEEBE** of Emerson Automation Solutions.

**JONATHAN HUGGINS** of The Dow Chemical Co.

AFPM

**2019 OPERATIONS & PROCESS TECHNOLOGY SUMMIT**

Published by *Hydrocarbon Processing* as three daily editions, Oct. 13/14, Oct. 15 and as an electronic edition on Oct. 16. If you wish to submit a press release, please contact the editor via email at Mike.Rhodes@HydrocarbonProcessing.com.

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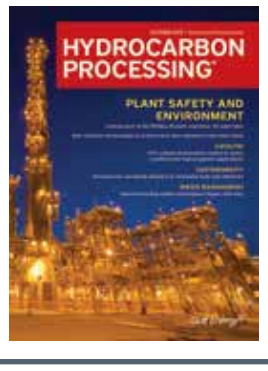


## SCHEDULE OF SESSIONS AND SPECIAL EVENTS

### TUESDAY, OCTOBER 15, 2019

| | |
|---|---|
| 7 a.m.–5 p.m. | Registration |
| 8 a.m.–10 a.m. | **Concurrent Sessions:**<br>• Cybersecurity<br>• Operational Planning, Control & Automation Technologies (OPCAT)<br>• Principles & Practices: Hydroprocessing<br>• Q&A and Discussion Session: Crude |
| 8–12 p.m. | EMpower Session |
| 10–10:15 a.m. | Coffee Break |
| 10:15 a.m.–12 p.m. | **Concurrent Sessions cont.** |
| 12–2 p.m. | Lunch in Exhibit Hall |
| 2–3:30 p.m. | **Concurrent Sessions:**<br>• Operational Planning, Control & Automation Technologies<br>• Principles & Practices: Crude<br>• Q&A and Discussion Session: FCC |
| 3:30–3:45 p.m. | Refreshment Break |
| 3:45–5:15 p.m. | **Concurrent Sessions cont.** |
| 5:30–6:30 p.m. | **Women in Refining Reception***<br>*Reception open to registered women only |

### WEDNESDAY, OCTOBER 16, 2019

| | |
|---|---|
| 7:30–10 a.m. | Registration |
| 8–9:30 a.m. | **Concurrent Sessions:**<br>• Principles & Practices: FCC<br>• Principles & Practices: Fostering Profitability |
| 9:30–9:45 a.m. | Coffee Break |
| 9:45–11 a.m. | **Concurrent Sessions cont.** |

# How the lack of OT visibility can lead to refinery shutdowns

**MILLE GANDELSMAN,** Indegy

As every oil and gas executive knows all too well, a process disruption, even a small one, can be massively expensive. Without the right tools, they can be extremely difficult to identify and mitigate.

To create the desired blends, refineries typically use distributed control systems (DCS), which handle the opening and closing of valves, activate pumps and control tank changes (**FIG. 1**).

Any disruption of these blend optimization systems can produce defective and unsellable batches of oil and gas. Often, if engineering staff discover that a blend has been altered, they cannot immediately pinpoint the exact source of the problem and reset the processes.

The only quick-fix solution is to shut down the blending line, which immediately generates a lake of hazardous waste and heavy financial losses.

**FIG. 1.** Real-time alerts can enable quick identification of potential problems, allowing engineers to prevent disruptions caused by unauthorized changes to critical controllers.

**Finding a needle in a haystack.** In this type of scenario, problems can occur with recipe management, component ratio control, or lend monitoring and tracking.

Finding the root cause of these disruptions can sometimes take days. One common culprit is unintended changes made to DCS controllers involved in the blending process. Without the proper tools and audit trail to identify and track when, by whom and what modifications were made to the DCS controllers, it is difficult—if not impossible—to pinpoint with complete certainty the source of the changes.

Simply put: Most refiners lack visibility into their core systems.

In one incident, it took engineers a week to narrow down the timeframe of a disruption in the days following an upgrade to a different (unaffected) part of the refining system. Since the upgrade was not supposed to impact the fuel blending DCS controllers, the engineers guessed that the controllers were modified by mistake.

**Without logs, manual reset is required.** Since DCS controllers do not track changes in event logs or issue alerts when intended or unintended changes are made, it is usually difficult to back up a hypothesis on the cause of disruption. These devices also lack basic security controls, including authentication, access control and encrypted communications. As a result, it is impossible to restrict access to them.

Without any record or documentation on the known "good state" and configuration of control devices before a disruption, the only solution usually is to shut down the process and manually reconfigure all controllers.

**ICS monitoring can track changes to OT devices.** New technologies, like the Indegy platform, provide a comprehensive audit log detailing all access and changes made to devices, even those performed directly on the controller and not over the network. By capturing the who, what, when, where and how, the audit trail enables staff to quickly pinpoint problems and identify their source.

Meanwhile, real-time alerts can enable quick identification of potential problems. These allow engineers to prevent disruptions caused by unauthorized changes to critical controllers. The detailed information contained in these alerts allows staff to block unauthorized changes to DCS controllers in seconds.

In addition, some ICS security platforms can capture vital historical information about each controller's configuration, code and settings. This asset data shortens mitigation and recovery time, while reducing the costs associated with downtime.

Finally, a platform like the one provided by Indegy enables engineers to customize security policies that govern change management. These granular policies are deterministic in nature and based on real-time activities, and not on statistical calculations. This results in zero false positives and enables highly effective incident management.

In addition to helping protect refinery operations against disruptions, ICS security platforms can reduce asset management costs by providing new levels of visibility and control. ●

**MILLE GANDELSON** is CTO of Indegy and has 15 years of experience in ICS and cybersecurity. He leads the company's technology research and product development. Prior to Indegy, he led engineering efforts for Stratoscale and spent several years managing cybersecurity research for the elite 8200 intelligence unit of the Israel Defense Forces.

## ENERGY EFFICIENCY LEADS ENERGY SECTOR JOB GROWTH

Energy efficiency is the fastest-growing segment of U.S. energy-sector employment, now employing more than 2.3 MM Americans, according to a new analysis from E4TheFuture and the national, nonpartisan business group E2 (Environmental Entrepreneurs). Energy efficiency workers now account for 28% of all U.S. energy jobs.

The new report, "Energy Efficiency Jobs in America," finds that energy efficiency jobs grew 3.4% in 2018—more than double the rate of growth for overall jobs nationwide—with 7.8% growth projected for 2019. Among the states, California leads energy-efficiency employment with 318,500 jobs, followed by Texas (162,800), New York (123,300), Florida (118,400) and Illinois (89,400). Thirteen states saw efficiency jobs increase by more than 5% in 2018, led by New Mexico (11.6%), Nevada (8.1%), Oklahoma (7.2%), Colorado (7.2%), and New Jersey (7.1%). Not a single state saw declines in energy-efficiency employment in 2018.

The report, released at the annual meeting of the National Association of State Energy Officials (NASEO), highlights energy efficiency's continued economic importance.

"While politicians argue over the direction of our energy transition, the economic benefits of improving energy efficiency continue to unite America's business and environmental interests," said Pat Stanton, Director of Policy at E4TheFuture. "Not only is expanding America's energy efficiency key to solving multiple climate policy goals, it is now integral to business expansion plans, saving money and creating local jobs that cannot be outsourced."

Efficiency businesses added 76,000 net new jobs in 2018, accounting for half of all net jobs added by America's energy sector (151,700). The sector also employed twice the number of workers in 2018 as all fossil fuel industries combined (1.18 MM). There are now more than 360,000 energy efficiency businesses operating across the U.S.

"We all know energy efficiency saves consumers and businesses money with every month's power bill," said Bob Keefe, executive director of E2. "We should also remember that energy efficiency is creating jobs and driving economic growth in every state—and doing so while also helping our environment, not hurting it."

Energy efficiency jobs are not limited by geography, geology or political persuasion. Energy efficiency workers are in every state and in virtually every U.S. county, the report shows. More than 317,000 energy efficiency jobs are located in rural areas, while 928,000 jobs are found in the nation's top 25 metro areas. In 41 states and the District of Columbia, more Americans now work in energy efficiency than fossil fuels.

"State energy officials understand that energy efficiency and the jobs that come with it are an integral and important part of the overall economy," said David Terry, Executive Director at NASEO, which provides research support for the underlying data behind the report.

Other key findings include:

- 10% of energy efficiency jobs are held by veterans, nearly double the national average of 6%
- Construction and manufacturing make up more than 70% of U.S. energy efficiency jobs
- More than one-sixth of U.S. construction workers spend 50% or more of their time on energy efficiency (1.3 MM workers)
- 321,000 energy efficiency jobs are in manufacturing
- More than 1.1 MM energy efficiency jobs are in HVAC technologies
- Energy efficiency employers are projecting 7.8% job growth in 2019. ●


## Axens continues its development and takes on a new identity

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*"This acquisition constitutes an amazing opportunity enabling our Group to pursue its growth and provide our customers with inventive, integrated and sustainable solutions for cleaner mobility, chemical intermediate production, natural gas and effluent treatment, and support their environmental and energy transition challenges."* - Jean Sentenac, CEO of Axens

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# Global refining: Profiting in a downstream downturn

**EMILY BILLING** and **TIM FITZGIBBON,** McKinsey & Company

Refiners have been able to count on steady growth in oil demand for years, but not for much longer. Over the past decade, rising incomes in developing countries and the popularity of vehicles with high fuel consumption in developed countries have buoyed oil demand by about 1.2%/year. However, some oil-fueled transportation is now being displaced by improvements in fuel efficiency, the rise of alternative fuels and electric vehicles, and the emergence of other transport options, such as lift sharing.

Between now and 2035, growth in global oil demand will slow to 0.5%/year, with demand for road transport peaking by 2026 and overall demand for oil peaking by 2032. The few sectors with continuing demand growth will be those with poor fuel substitutes, such as aviation, or nonfuel end uses, such as petrochemicals (FIG. 1).

The pace of change will vary by region. Europe and North America (NA) will see demand for liquids falling by 0.3%/year from 2018–2035, particularly in road transport, as the adoption of electric vehicles accelerates. Developing regions, such as Asia, Africa and Latin America, will continue to see some growth across most fuels, with the strongest in light ends [liquefied petroleum gas (LPG) and naphtha] and transport fuels. Africa and Southeast Asia will see the fastest growth, with liquids demand growing at 1.9%/year and 2%/year, respectively, to 2035.

**Continuing refining capacity growth.** Despite the weakening outlook for global demand, refining capacity continues to grow. Global distillation capacity is expected to expand by 1.3%/year between 2019 and 2023, mostly as a result of greenfield additions in Asia (> 2.4 MMbpd) and the Middle East (> 1.8 MMbpd), shown in FIG. 2. **Note:** These figures include a 0.25% "creep factor" to account for debottlenecking up to 2030, except in Australia, Europe and Japan, where market dynamics are expected to eliminate creep by 2023.

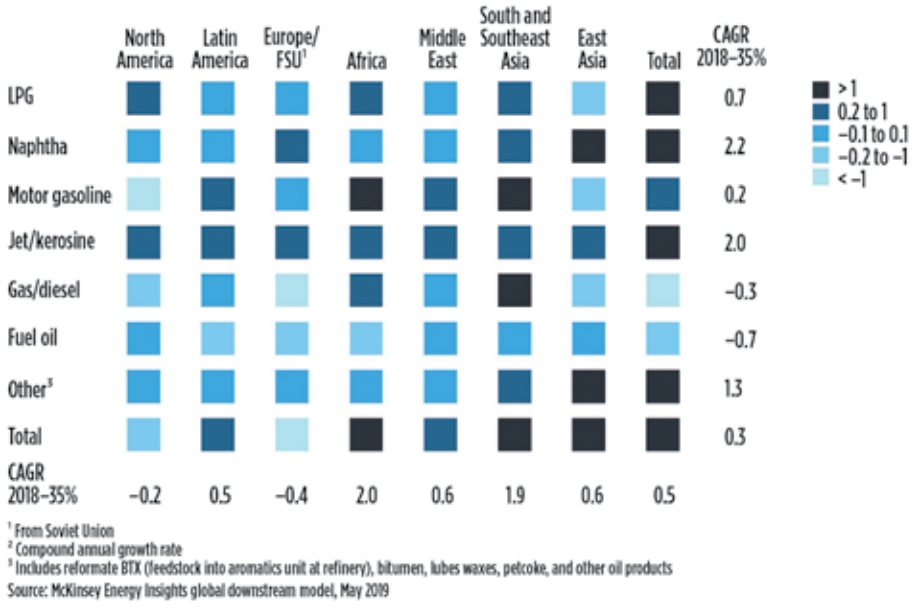



**FIG. 1.** Change in petroleum product demand (MMbpd), 2018–2035.

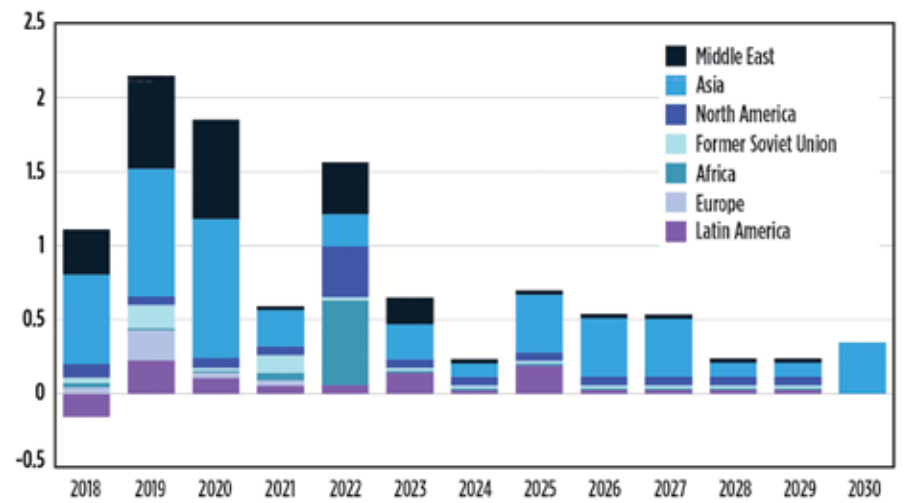



**FIG. 2.** Change in refining distillation capacity, MMbpd of stream capacity.

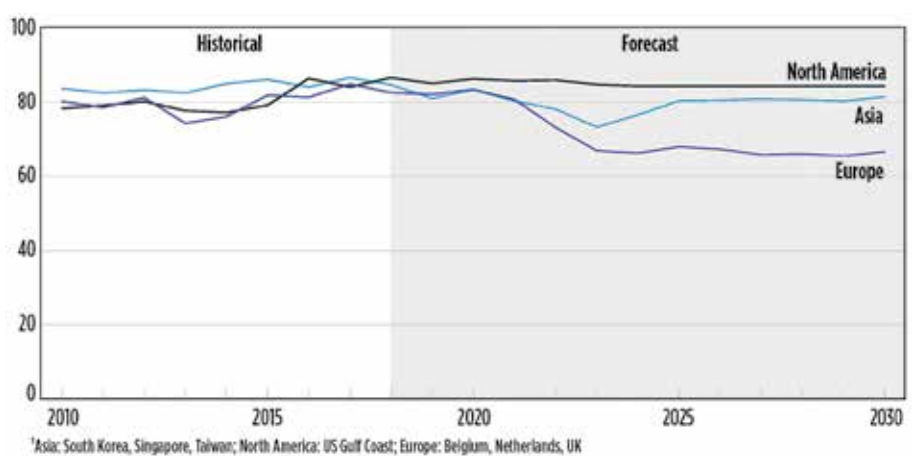



**FIG. 3.** Regional hub[1] refining utilization, % of stream day distillation capacity.

To capitalize on Asia's strong oil demand, refiners are investing in large new refineries and expanding existing ones, particularly in China and Southeast Asia. Capacity growth in Asia during 2019 is set to be the highest in recent times, with even more additions expected in 2020. Beyond 2025, 600,000 bpd of distillation capacity and an equal amount of condensate splitters will be added to meet the region's continuing growth in demand for light product and naphtha.

A few projects are expected to be added in other regions too, but not on the same scale. In Africa, the 500,000-bpd Dangote refinery is intended to alleviate persistent product shortages in oil-rich Nigeria. Even so, Africa will still rely heavily on imports of light products to meet still-growing demand.

**A mixed outlook for utilization.** The combination of slowing growth in global demand and continuing expansion of refineries will cause global overcapacity to increase and utilization to decline. The implementation of IMO 2020—the agreement by the International Maritime Organization to limit the sulfur content in marine fuels to 0.5%—should temporarily boost utilization, with refineries running harder to supply low-sulfur diesel to replace higher-sulfur residual fuel oil in bunker markets. However, by 2022 this effect should be offset by refiners' efforts to increase the supply of low-sulfur residual fuel oil, along with shippers' investments in installing scrubbers to allow more high-sulfur residual use. The market is expected to shift quickly toward overcapacity and lower utilization, with different regions feeling the impact in different ways (FIG. 3).

Europe will see the greatest downside, with light product demand starting to fall in 2021 and with utilization hit by a strong wave of capacity additions in Africa, Asia and the Middle East. After a sharp fall from 83% in 2020 to 67% in 2023, utilization remains level through to 2030. These levels of utilization are likely to prove unsustainable for some refiners, triggering a wave of capacity rationalization.

By contrast, the Asian hub should see only a temporary reduction in throughput before growing regional demand pushes utilization back up again, with regional refiners showing restraint in adding more capacity. This brings Asia hub utilization beyond 80% by 2025, and up to 85% by the early 2030s.

On the U.S. Gulf Coast (USGC), utilization is projected to fall only slightly, from 86% in 2020 to 84% in 2023, before continuing at this level. This higher utilization is supported by cheap crude from an excess of local supply coming from booming unconventional (shale oil) production. USGC refiners should continue to benefit from their installed base of highly complex and efficient capacity and their proximity to Latin America, a structurally short market.

**Rationalization is likely.** This outlook for refinery utilization will lead to a new wave of rationalization, particularly in Europe. With structural disadvantages, including weak local demand, inefficient refining capacity and declining local crude supply, Europe is the most susceptible to closures. Indeed, roughly 900,000 bpd of distillation capacity would need to be closed to bring European hub utilization up to 80% in 2035.

Marginal assets in other mature markets also look likely to close. Australia, Northeast Asia and the U.S. East and West coasts share similar characteristics: demand that is flat or falling; an installed refining base that includes plants with low complexity, high costs or both; and locations that lack advantages in crude supply or attractive nearby opportunities for product export.

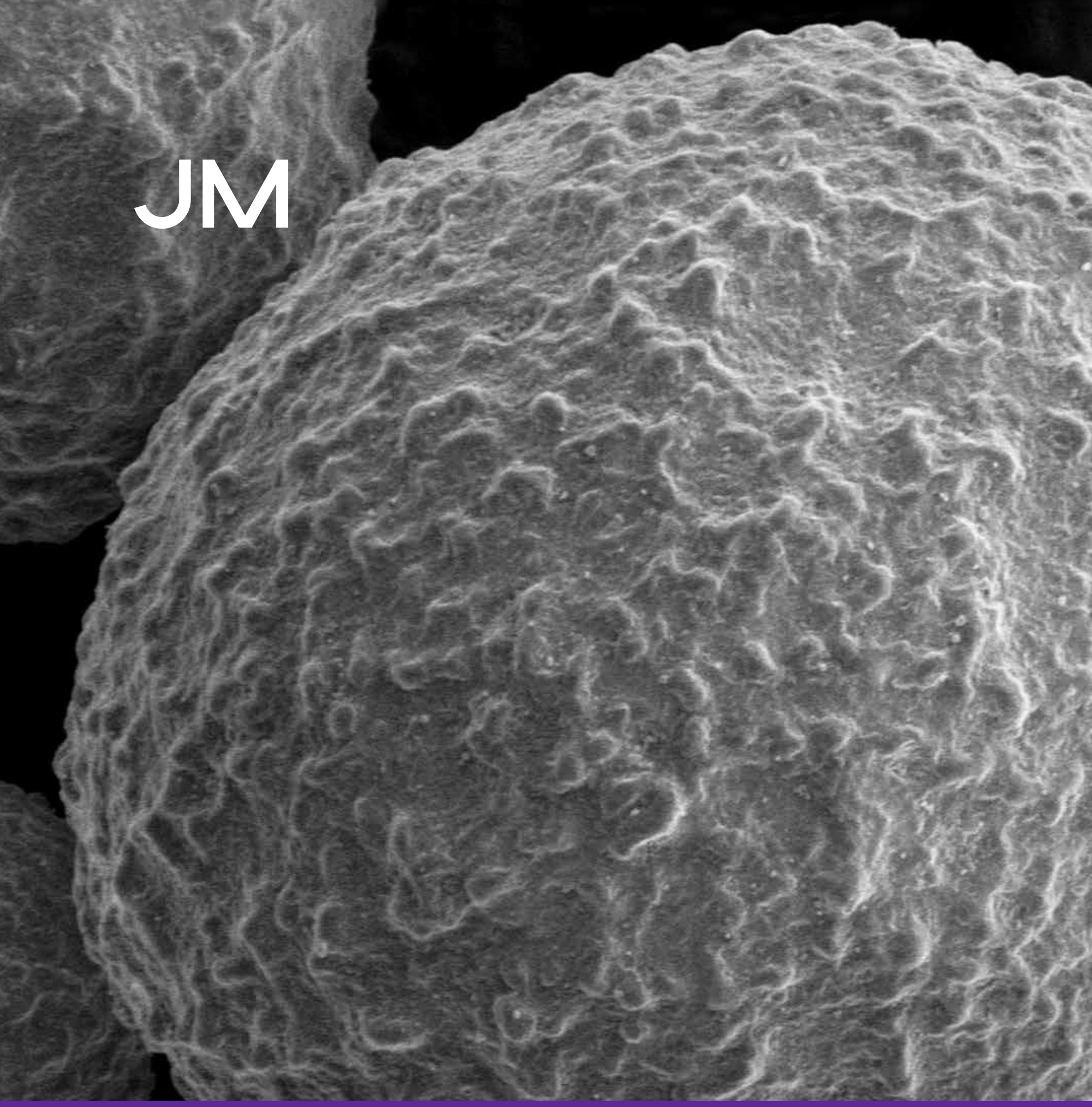
History suggests that the path to rationalization will be slow and inefficient, with the least-efficient plants (those with a simple configuration and high costs) not necessarily being the first to close.

**Creating value in the downturn.** Despite this challenging outlook for refining, there is some good news. Even with rationalization, the industry should remain sizable for decades to come, with significant pockets of profitability in some regions at some points in the cycle.

Refiners should act now to reposition their portfolios strategically for the challenging decade ahead. The approach they take will vary depending on their nature, asset focus and financial position. Even so, a few themes are likely to be central to any successful long-term strategy.

First, more efficient assets can be restructured to shift refiners to the left-hand side of the cost curve. Refiners with marginal assets should be looking out for the best approach and timing for exit. Any new projects should be evaluated based on realistic views on short- and long-term market conditions and project economics. As lengthening supply chains create a need for investment in logistics capacity, some players may see opportunities to diversify their assets or offerings. Finally, investors should be looking for opportunities in the margin cycle to acquire assets at a bargain price. ●

EMILY BILLING is a Consultant for McKinsey & Company, and TIM FITZGIBBON is a Senior Expert for McKinsey & Company. Both work out of the company's Houston, Texas office.

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# Risk-based asset management and the aging U.S. refinery infrastructure

**JIM STUART,** Lloyd's Register

**FIG. 1.** To realize the benefits of a risk-based approach to asset management, operators are leveraging new approaches and analyzing their vast inspection and maintenance data to deliver actionable insights that pinpoint risk and enhance asset/plant performance and reliability.

While the U.S. is enjoying record crude oil output, the aging midstream (pipelines and terminals) and downstream (refineries) infrastructures are placing additional uncertainty on prices, safety and environmental protection. According to the U.S. Energy Information Administration (EIA), as of January 1, 2018, there are 135 operable petroleum refineries in the U.S. These aging but critical assets produce gasoline, diesel, jet fuel and a host of other petroleum-based products, including asphalt and lubricants. However, recent, unexpected refinery outages and fires highlight the risk to prices, people and the environment.

In his April 2019 article, "Oil refinery breakdowns spike gasoline prices," *Forbes* magazine energy writer James Conca noted, "The problem is, America's refineries are old and at full capacity, so any problems with them spike gasoline prices." Conca added that "the U.S. does not have sufficient refinery capacity to make the gasoline and diesel we need. And the refineries we have are old and keep shutting down. Or blowing up."

The EIA website notes that the newest refinery with significant downstream unit capacity is Marathon's facility in Garyville, Louisiana. That facility came online in 1977 with an initial atmospheric distillation unit capacity of 200,000 bpd and, as of January 2018, had a capacity of 556,000 bpd.

The upstream sector of the oil and gas industry has deployed technological innovations that have modernized drilling and exploration, resulting in huge increases in production. Downstream operators are working to deploy new technologies to ensure asset integrity and provide a holistic, 360° understanding of their operating assets to optimize production and maintenance, improve asset reliability and minimize risk.

A risk-based approach enables operators to:

- Optimize business operations while lowering the risk profile
- Prioritize inspection and maintenance work orders based on risk
- Eliminate unnecessary inspection and maintenance activities
- Enable more accurate risk mitigation
- Calculate cumulative risks of aging equipment
- Focus limited resources on critical assets
- Extend maintenance and turnaround intervals
- Safely extend equipment life.

To realize the benefits of this risk-based approach to asset management, operators are leveraging new approaches in mining and analyzing their vast inspection and maintenance data to deliver actionable insights that pinpoint risk and enhance asset/plant performance and reliability (**FIG. 1**). Lloyd's Register has shown that some operators have realized up to 20% gains in overall production while reducing failure risk by 80% and achieving cost savings of up to 50%.

Just as new technologies have enabled this huge growth in crude output in North America, oil refineries and chemical plants are working hard to leverage a new era in digital intelligence of their assets, driving improved maintenance and reliability programs that remove unnecessary pressure on operations and budgets.

**Three pillars of risk-based asset management.** The three foundational pillars of this risk-based approach to managing asset performance are: engineering expertise, actionable data, and a digital platform with the analytical tools to bring these elements together for analysis and resulting updates to asset strategies and maintenance plans.

Capturing engineering expertise in a digital format (often referred to as organizational memory) has been a priority for the process industries for years with the looming retirement of a significant percentage of the workforce. At a November 2017 conference called the "Meeting of the Minds," industry leaders explored how the mechanical integrity and reliability fields will need to prepare for the impending loss of knowledge resulting from the retirement of the baby-boomer generation—a national event known as the "great crew change." According to some reports, this represents as much as 50% of the current experienced workforce.

An article on that November 2017 conference also reported, "Knowledge transfer is a vital requirement to reduce the risk of increased errors, missed opportunities for safety advancements, or (worst-case scenario) catastrophic events."

**Enabling knowledge capture.** While significant focus by technology providers has been placed on advancing predictive analytics and Industry 4.0 wireless device connectivity to drive advanced maintenance and reliability programs, asset management platforms must also enable knowledge capture before half the experienced engineers, inspectors, maintenance technicians and reliability pros retire. The term "digital transformation" has become an overused buzz word; however, the consequences of not having a methodology for capturing and digitizing the collective knowledge of the retiring workforce is unacceptable and is, therefore, compulsory for any asset performance management (APM) platform.

Actionable data begins with the basics, application programming interfaces (APIs) for easy connectivity to enterprise asset management (EAM) systems or computerized maintenance management systems (CMMS) to access maintenance history, as well as failure mode and effects analysis (FMEA) data. Recent advances in big data, Industrial Internet of Things (IIoT) machine connectivity and cloud technology have created new opportunities to access actionable data from all types industrial/plant assets. Condition monitoring technology delivers real-time asset health information from sensors and a vast new array of IIoT devices that feed this data stream through secure wireless networks back to APM systems for analysis.

A comprehensive APM platform brings together advanced analytical tools and relevant data (historical and real time), as well as maintenance and reliability methodologies for all equipment types to deliver on the predictive/prescriptive asset performance vision. With the right APM platform, operators can optimize maintenance and clearly identify the risk of failure from a single component to global manufacturing/production enterprise systems. With greater asset reliability comes extended time between turnarounds, longer asset life and greater lifetime return on investment (ROI).

With these pillars in place, operators are equipped with the technology and knowledge base to safely and reliably increase production beyond previous expectations. Additionally, maintenance and reliability teams can use this predictive/prescriptive insight to schedule required maintenance for the least impact on production schedules.

If downstream operators are going to process this new supply of U.S. crude oil, let alone keep the nation's refineries running at full capacity, safe and reliable operations are business and moral imperatives. Unplanned downtime or—in the worst-case scenario—a containment incident that harms people and/or the environment, can instantly set back production gains. ●

**JIM STUART** is Senior Vice President for digital products and software for Lloyd's Register. He has been leading technology companies for more than 20 yr, with experience that covers software product innovation, digital strategy development and implementation, business transformation and operational excellence. For more information on the Lloyd's Register AllAssets APM platform, visit https://www.lr.org/en/allassets/.

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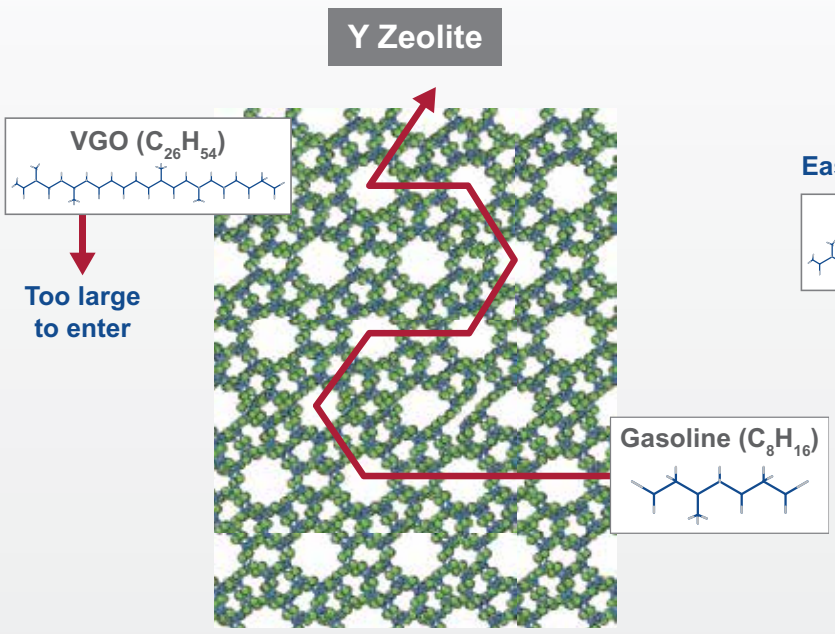
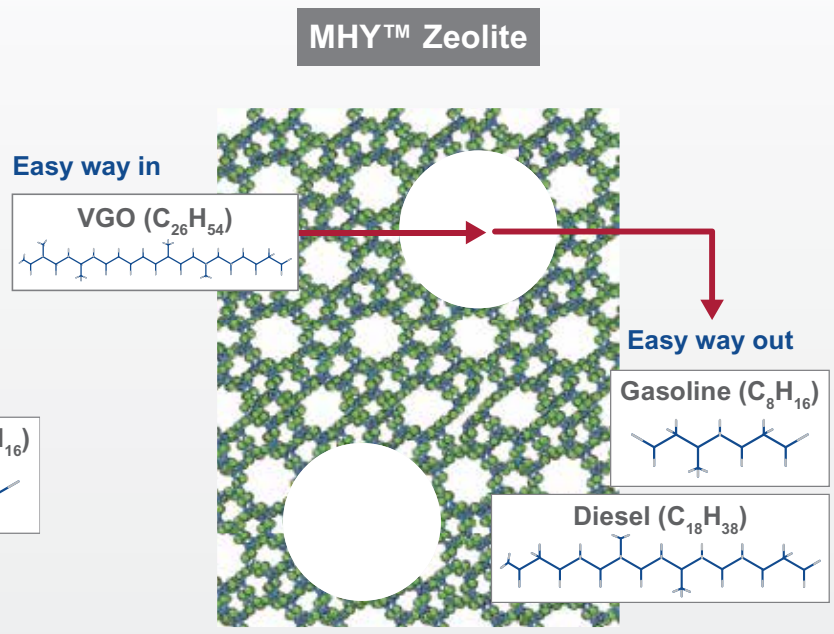



Small pores in conventional Y zeolites work well with molecules that boil up to 950ºF (510ºC).




MHY™ zeolite technology creates larger pores, allowing zeolites to crack larger molecules that boil in the 950-1100ºF (510-593ºC) range.

# Q&A: Addressing IMO 2020 challenges, opportunities

**MATT FLANAGAN,** Opportune LLP

In just a few months, on January 1, 2020, a new, sweeping global regulation is scheduled to go into effect that caps the amount of allowable sulfur content in all marine fuels used by ocean-going vessels from the current level of 3.5% m/m (mass/mass) to 0.5% m/m. Enacted in 2016 and set to be enforced by the International Maritime Organization (IMO), the new regulation is expected to have wide-ranging implications to the downstream energy sector, including oil refiners, traders, marketers and the shipping industry. The rule will also force dramatic changes in demand for certain bunker fuels.

Matt Flanagan, a Partner who leads Opportune's downstream sector and process and technology practice, shared his thoughts with *Hydrocarbon Processing* and AFPM on prevailing concerns swirling within the industry about how the IMO 2020 regulation offers both short- and long-term challenges and opportunities for all stakeholders.

***HP*/AFPM: What are the main challenges awaiting the shipping and refining industries as IMO 2020 approaches?**

**Flanagan:** The main concerns we are hearing across the industry are supply availability and price impacts. For example, will there be enough supply overall and will it be readily available at fueling ports? Several new ventures in place are coming online to try and meet the demand for lower-sulfur fuels, but none of those are a short-term solution. In the near term, it is expected that supplies will be tight and prices will be elevated for at least a year. Bunker fuel demand in 2018 was 3.5 MMbpd, representing approximately 5% of total global fuel demand, and the market likely will not quickly shift to cover that demand.

The international shipping community has two options when it comes to meeting the new IMO 2020 standard: implement fuel scrubbers on their fleet or purchase the low-sulfur fuel from refiners globally. Shipping companies have realized that, for the most part, scrubbers are not the answer as they do not adequately address the new low-sulfur fuel standard, and many shippers were simply dumping the sulfur byproduct into the world's waterways—clearly a violation of global shipping laws.

For refiners, we expect to see margin uplift into 2020–2021 as a result of the IMO 2020 regulation coming into effect as demand far outstrips supply in the near term. The real questions are: How long will that "bull" market last, and which refiners are best prepared to capitalize on this opportunity?

***HP*/AFPM: Is there an emerging market for technology to help solve these upcoming challenges, or is the industry looking at other solutions (e.g., LNG)?**

**Flanagan:** We have seen a few new technologies entering the marketplace. For instance, Rigby Refining has taken a unique approach with their technology of hyrdoprocessing finished high-sulfur marine fuel to produce compliant very-low-sulfur fuel oil. While not technically a new technology, scrubbers are seeing resurgent demand due to the expected price spread between high- and low-sulfur fuels. With the new requirements to have bunker delivery notes (BDN) certify ISO 8271 compliant, companies are discussing how to move the BDN from a straight paper system to a more technical solution.

Additionally, as part of the new fuel change and the reporting requirements associated with it, software is changing. One of the primary integrated maritime software companies, Veson Nautical, has invested in new features related to the reporting and tracking of compliant fuels. Several companies are investing to improve their optimization tools. Most of this work appears to be custom development.

***HP*/AFPM: In a broad sense, does the downstream industry seem prepared at this point to comply with the IMO 2020 regulation?**

**Flanagan:** It will not be perfect, but the industry will weather the storm. Most shipowners will fully comply and, while there will be increased shipping costs, the market will find a way to fill the demand. There will be increased prices the first year or two as the market adjusts to the increased demand, but as supply and new technologies come into play the market will eventually find balance. ●

MATT FLANAGAN is a Partner in Opportune's energy consulting practice and leads its downstream industry sector. He has 25 years of experience in global refining and marketing, midstream pipelines and transportation (liquids and gas), exploration and production, petrochemicals and mining. He can be contacted at mflanagan@opportune.com.

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# The codes and standards component of selecting an engineering contractor

**EDDIE GUIDRY,** Fluor

You have a project at one of your facilities. Maybe it is a large capital venture, or it could be a substantial revamp. Either way, you have a budget and, as a responsible decision maker, you consider many factors, with engineering costs being a key component of your analysis. You know your large operating company has top-notch corporate specs, frame agreements, etc., in place.

As such, you feel you will have minimum risk exposure from a technical standpoint since all engineering firms are fairly equal in expertise. If imbalances exist between prospective engineering firms, surely your company specifications and the manufacturer frame agreements will level the playing field, right? You may want to reconsider this line of thought.

For the sake of this article, two contractors are bidding for the engineering: Contractor A (CA) and Contractor B (CB). CA has a solid reputation with a *better-than-satisfactory* safety record, performance history, financials, etc. CB is almost in the same league as CA but is only *satisfactory* by comparison. Both engineering firms employ licensed, professional engineers. CB presents a much lower bid. This decision should be easy. Not so fast.

**Codes and standards knowledge is the difference.** Within every specification there is usually an obscure pitfall: the part containing a list of applicable codes and standards. From the perspective of the corporate discipline expert, all the bases are usually covered with these lists. Typically, all relevant code-making organizations and document numbers are cited. The specs probably contain broad language such as "… the (insert your favorite discipline) work/equipment shall comply with the latest American or International code(s) or standard(s)." This is where the stark differences between contractor CA and CB may become apparent. The consequences of ignorance regarding codes and standards can be devastating. Knowing and considering the "code-savvy component" of the engineering contractor is critical.

As with all professions, there are great engineers, good and mediocre engineers and (shall we say) the rest of the pack. In our example, CA attracts the great engineers because they are a leading engineering firm. CB attracts many of the good ones. What difference does it make? Great engineers stay up on their skills. This includes attending regular training on the latest technologies, new equipment offerings, better engineering methods and techniques, and (last but certainly not least) the latest codes/standards developments. Good engineers usually have a general knowledge of applicable standards but may not have the desire to be leaders in their field.

Why pay more for great engineers, when good ones can get the job done?

**You get what you pay for.** Contrary to commonly held beliefs, all engineers are not created equal, nor is engineering a commodity. The adage of "getting what you pay for" usually rings true with engineering. Great engineers will be aware of industry changes and advances in safety. If they do not have the needed expertise in an area, they usually have established professional networks and contacts with the right knowledge.

Engineering firms should be scrutinized and evaluated on their culture of supporting participation in the development of industry codes and standards. The economic benefits to the project will be realized in three important areas: 1) engineers with a high degree of code knowledge—in addition to their experience—usually possess the ability to avoid costly mistakes, particularly during the early stages of a project; 2) as the project progresses and vendor documents are received, these same folks can typically spot items that may not be code compliant; and 3) allowing these same experts to inspect the equipment at the factory and during construction is vital.

Please remember this when analyzing your next project engineering contractor's bids. Don't just look at the bottom-line numbers and assume all engineers and engineering firms are equal—they are not. Always ask the bidders about their firm's codes and standards development. Ask the bidders how many widely recognized industry experts they employ and what their accessibility will be on your project. The hidden economic dividends reaped will be enormous, even if not easily quantified. ●

**EDDIE GUIDRY** is a Fluor Corp. Senior Engineering Fellow specializing in electrical codes and standards.

# Digitally transforming plant shutdowns, turnarounds and outages (STOs)

**COURTNEY BREWER,** Sphera

Turnarounds are the cornerstone of any plant's maintenance strategy, but getting them right is challenging. A turnaround is defined as a scheduled event where an entire process unit of an industrial plant (**FIG. 1**) is taken offline for an extended period for a revamp and/or renewal.

The numbers paint a vivid picture of the complexity: tens of thousands of separate jobs, durations that can last 20–60 days for process plants, and thousands of contractors. It can be unnerving to complete a large portfolio of maintenance tasks with potentially new contractors, planned downtime and the subsequent loss of production in a tight timeframe.

According to industry research organization TA Cook, 82% of turnarounds do not satisfy performance expectations, with about half experiencing delays and 80% going over budget. Even more daunting, studies show that about half of all work-related accidents at manufacturing plants occur during planned maintenance outages.

**Leveraging the right tools and insights.** While it is tempting to see the solution as solely an exercise in planning, scope creep (uncontrolled growth in a project's scope) is one of the main reasons that turnarounds fail to meet performance expectations. For staff and contractors, problems occur when the plan meets dynamic execution in real time. Even the most sophisticated maintenance plan has gaps; without the right tools, making dynamic adjustments to a turnaround plan to satisfy emerging work can result in increased risk, unexpected delays, prolonged downtime and costly overruns that can run into millions of dollars per day in lost production from asset downtime.

On the other hand, effectively managing a turnaround can lead to tremendous savings. For example, deferring work until the next turnaround could save hundreds (if not thousands) of staff hours and dramatically reduce asset downtime. Eliminating the need to order and ship new parts could further reduce costs. However, it is difficult to make those decisions without the right tools and insights.

Where digitalization and the adoption of automation technologies based on the Industrial Internet of Things (IIoT) have allowed oil and gas and petrochemical manufacturers to make strides in improving operational performance, Industry 4.0 developments are also changing the way operators plan and execute major turnarounds. By connecting disparate data and business processes, digitalization can provide teams with a complete view of the risks and activities involved in the turnaround scope, so the trade-offs can be clearly understood and managed to ensure that turnarounds come in safely, on time and on budget.

Digital can transform shutdowns, turnarounds and outages in numerous ways, but a comprehensive list can include a top five:

1. Achieve scope assurance with predictive analytics, enabling managers to do the right work on the right assets at the right time.
2. Ensure adherence to schedules, operational effectiveness and safety by leveraging connected industrial worker mobility, as well as location awareness technology.
3. Perform digital walkthroughs with data analytics prior to each turnaround to correctly prioritize the scope of work and to create an up-to-date electronic record.
4. Standardize processes and procedures to help streamline work and increase the efficiency of critical workflows.
5. Safely manage the transition to and from daily operations.

Sphera is at the forefront of this transformation with the release of its new Digital Turnaround software solution and services that provide turnaround managers and work teams with a radically different, far more effective way to visualize and manage activities and risks associated with major plant shutdowns, turnarounds and outages. The software delivers insights to encourage better, more informed decisions to help ensure that turnarounds come in safely, on time and on budget.

To learn more about Sphera's digital turnaround solution, visit https://sphera.com/news. ●

**COURTNEY BREWER** is Sphera's Product Marketing Manager for operational risk management. She is responsible for developing and delivering the global go-to-market strategy for the company's operational risk management portfolio. Brewer joined Petrotechnics, which was acquired by Sphera, in 2014. She has more than 12 years of experience creating top-of-mind awareness for global technology solution providers supporting the oil and gas, chemical and manufacturing industries.

# SCENES FROM THE 2019 AFPM SUMMIT


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1 Howdy, partner! AFPM Summit attendees enjoyed the chance to don western wear and pose for pictures.

2 The Gasoline Processes Q & A session on Monday morning featured a panel that included (left to right) **Abigail Slater,** HollyFrontier Corporation; **Davinder Mittal,** HPCL – Mittal Energy Ltd.; **Thomas Porritt,** Chevron U.S.A. Inc.; **Bill Kostka,** Axens North America; and **Peter Eckels,** Honeywell UOP.

3 **Rob Ewing,** Innovations and Technology Manager for DuPont Clean Technologies – Refining, addressed a capacity crowd at the company's pre-conference workshop.

4 *Hydrocarbon Processing's* Executive Editor **Adrienne Blume** and Honeywell UOP's **Steve Skillen** met at the company's hospitality suite. Last week, Ms. Blume moderated a Honeywell UOP webcast that garnered more than 600 leads for the company.

5 At Sunday night's opening reception, **Rainer Racoczy** (left), **Karen Buckman** and **Ralf Weishaupt** from Clariant Corporation look forward to the key learnings of the AFPM Summit.

6 The theme of Sunday night's opening reception was "The Last Rodeo," and featured an excellent country and western guitar duo.

7 **Frederic Jardin** of Eurecat U.S. (left) and Axens North America's **Christian Vaute** catch up at the opening reception.

8 Every break in the Summit schedule provides an opportunity for new business connections and the sharing of ideas.

9 At Monday morning's general session, **Bill Cates** of Hunt Refining awarded **Ken Chlapik** from Johnson Matthey (right) the Lifetime Service Award in recognition of his significant and long-lasting contributions to the value and quality of the AFPM Summit.

10 At Monday morning's Emerging Leaders Town Hall, the next generation of innovators gathered together for teambuilding exercises and valuable insight into career paths, transforming cultures, mentoring and transitioning from peer to leader.

AFPM

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**International Base Oils & Waxes Conference**
March 29 – 31
New Orleans Marriott
New Orleans, LA

**Security Conference**
April 13 – 15
Westin Riverwalk Hotel
San Antonio, TX

**Labor Relations / Human Resources Conference**
April 16 – 17
Westin Riverwalk Hotel
San Antonio, TX

**National Occupational & Process Safety Conference**
May 13 – 14
Grand Hyatt San Antonio
San Antonio, TX

**The Summit: Excellence in Plant Performance**
August 25 – 27
Grand Hyatt San Antonio
San Antonio, TX

**Board of Directors Meeting**
September 13 – 15
The Meritage
Napa, CA

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