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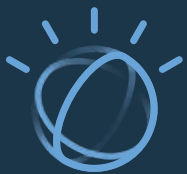


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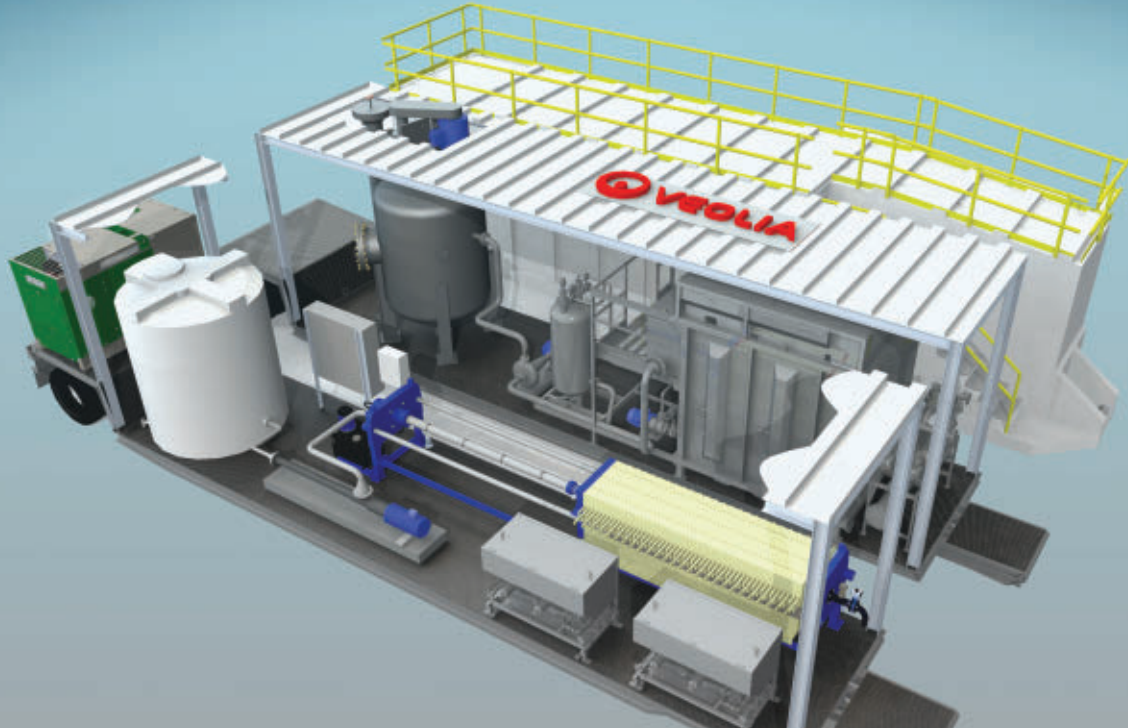
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**EDITORIAL  
NEWSLETTER  
STATISTICS**

**EDITOR'S PERSPECTIVE  
GENERAL INTEREST  
JOURNALLY SPEAKING  
WATCHING GOVERNMENT**



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The global integrated oil and gas business is stabilizing and will likely improve modestly from recent historical lows over the next 12-18 months, says Moody's Investors Service in a recent report.

### 21 Reconfigured LNG markets are creating major uncertainties, book says

Nick Snow

Global LNG markets, which have changed dramatically over the last few years, have created uncertainties that producers and customers will have to address, contend authors of a recent report.

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## COVER

*Bolivia's Incahuasi field was brought into commercial production last month. One of the largest active natural gas and condensate fields in Bolivia, Incahuasi is thought to hold recoverable reserves of 70.8 billion cu m of gas and 4.8 million tons of gas condensate. The field's first production stage involved the drilling of three wells, and the construction of a 6.9 million-cu m/day gas treatment unit, an infield pipeline system, and an integrated production control system. The field, which lies within the Ipati and Aquio licensed blocks, is being developed by a consortium of Total SA (operator), Gazprom, Tecpetrol SA, and YPF. Photo from Gazprom.*



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**GENERAL INTEREST** QUICK TAKES**OPEC agrees to consider production cuts**

Ministers of the Organization of Petroleum Exporting Countries have agreed to consider trimming aggregate member production by as much as 740,000 b/d in response to a halving over the past 2 years in the price of crude oil.

Crude prices jumped more than \$2/bbl in New York on London in response to the news but remained below \$50/bbl.

At an extraordinary meeting in Algiers, they said a group production target of 32.5-33 million b/d would “accelerate the ongoing drawdown of the stock overhang and bring the rebalancing [of the oil market] forward.”

The OPEC Secretariat, customarily citing “secondary sources,” this month reported average total production by group members in August of 33.24 million b/d.

In Algiers, OPEC ministers said a committee of representatives from member countries would recommend production levels of individual members and develop a framework for consultations with oil-producing countries outside OPEC.

The consultations would include “identifying risks and taking proactive measures that would ensure a balanced oil market on a sustained basis, to be considered at the November OPEC conference.” That meeting will be Nov. 30 in Vienna.

**Federal carbon price announced in Canada**

Provincial governments in Canada are resisting the federal government’s plan to impose a carbon price higher than most of them have in place.

Prime Minister Justin Trudeau announced a nationwide floor price on emissions of greenhouse gases while inaugurating debate in the House of Commons over ratification of the Paris agreement on climate change.

The price would start at \$10/tonne of carbon dioxide and rise to \$50/tonne in 2022.

Alberta Premier Rachel Notley said she won’t support the move unless the federal government helps win approval for an oil pipeline linking her province with a Canadian coast. Alberta will impose a carbon tax of \$20/tonne next year, increasing to \$30/tonne in 2018.

The federal proposal meets stiff resistance in neighboring Saskatchewan, where Premier Brad Wall says the tax will

devastate his province’s economy.

Like Alberta, British Columbia has a carbon tax lower than that of the federal plan, but an increase is one of 190 conditions imposed by recent federal approval of a natural gas pipeline crucial to LNG development.

Quebec and Ontario have cap-and-trade plans but will have to ensure their emission cuts meet federal goals. Environment ministers of both provinces voiced approval of the federal plan.

Nova Scotia, which has aggressively cut emissions from power generation, is reported to be concerned about how Trudeau’s initiative will raise prices of gasoline and other fuels.

Other provinces are still formulating climate policies.

**Merger forms Double Eagle Energy Permian**

Double Eagle Energy Permian LLC, Fort Worth, has been formed through the merger of Double Eagle Lone Star LLC and Veritas Energy Partners Holdings LLC, owning more than 63,000 net acres in the Midland basin.

The acreage, of which more than 70% is operated, is mainly in Midland, Martin, Howard, and Glasscock counties, Tex.

Double Eagle Lone Star was a unit of Double Eagle Energy Holdings II LLC, a portfolio firm of Apollo Natural Resources Partners Funds I and II. Veritas was a portfolio of investment partnerships managed by Post Oak Energy Capital LP, Houston.

Cody Campbell and John Sellers are co-chief executive officers of the new company. They held the same positions with Double Eagle Energy Holdings II. Hollis Sullivan, Veritas Energy president, becomes chairman of the new company. **OGJ**

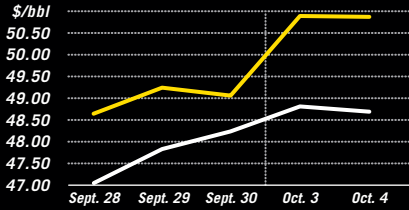
**EXPLORATION & DEVELOPMENT** QUICK TAKES**Alaska’s North Slope yields large light oil find**

Two exploration wells and 126 sq miles of 3D seismic have confirmed 6 billion bbl of light crude in place on Caelus Energy Alaska LLC’s Smith Bay state leases on Alaska’s North Slope, the company reported.

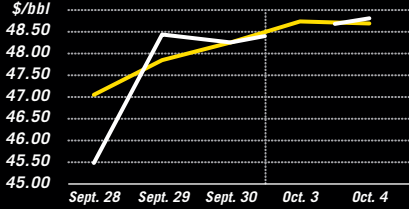
The Caelus-Tulimaniq No. 1 (CT-1) and step-out Caelus-Tulimaniq No. 2 (CT-2) were drilled early this year, targeting a large Brookian submarine fan complex spanning 300 sq miles. Subsidiary Caelus Energy Alaska Smith Bay LLC drilled and logged both wells, encountering an extension of the accumulation 5.25 miles northwest of the CT-1 discovery at the CT-2 lo-



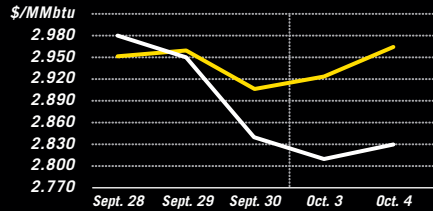
### ICE BRENT / NYMEX LIGHT SWEET CRUDE



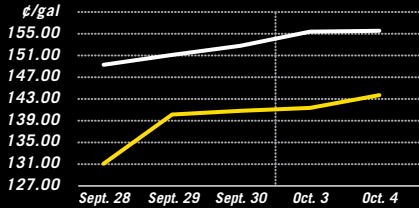
### WTI CUSHING / BRENT SPOT



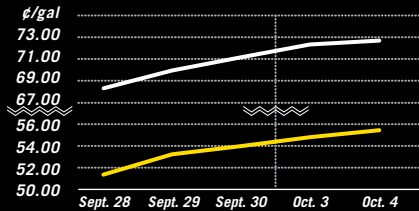
### NYMEX NATURAL GAS / SPOT GAS - HENRY HUB



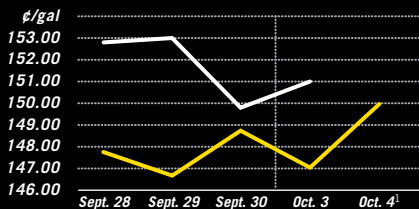
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<sup>1</sup>Not available <sup>2</sup>Reformulated gasoline blendstock for oxygen blending  
<sup>3</sup>Nonoxygenated regular unleaded

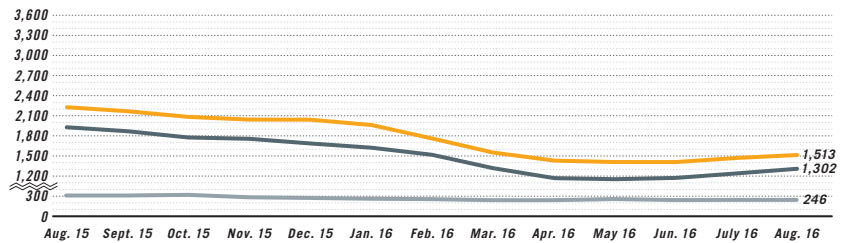
## US INDUSTRY SCOREBOARD — 10/10

Latest week 9/23	4 wk. average	4 wk. avg. year ago <sup>1</sup>	Change, %	YTD average <sup>1</sup>	YTD avg. year ago <sup>1</sup>	Change, %
<i>Product supplied, 1,000 b/d</i>						
Motor gasoline	9,383	9,059	3.6	9,450	9,140	3.4
Distillate	3,542	3,783	(6.4)	3,727	3,922	(5.0)
Jet fuel	1,630	1,616	0.9	1,629	1,570	3.8
Residual	333	181	84.0	302	204	48.0
Other products	5,159	4,879	5.7	4,975	4,876	2.0
TOTAL PRODUCT SUPPLIED	20,047	19,518	2.7	20,083	19,712	1.9
<i>Supply, 1,000 b/d</i>						
Crude production	8,490	9,121	(6.9)	8,805	9,366	(6.0)
NGL production <sup>2</sup>	3,618	3,259	11.0	3,461	3,155	9.7
Crude imports	7,819	7,345	6.5	7,952	7,319	8.6
Product imports	2,103	1,902	10.6	2,172	2,093	3.8
Other supply <sup>2,3</sup>	2,169	2,391	(9.3)	2,207	2,337	(5.6)
TOTAL SUPPLY	24,199	24,018	0.8	24,597	24,270	1.3
Net product imports	(2,261)	(1,878)	—	(1,782)	(1,584)	—
<i>Refining, 1,000 b/d</i>						
Crude runs to stills	16,645	16,263	2.4	16,295	16,180	0.7
Input to crude stills	16,994	16,496	3.0	16,535	16,437	0.6
% utilization	92.2	91.1	—	90.5	91.4	—

Latest week 9/23	Latest week	Previous week <sup>1</sup>	Change	Same week year ago <sup>1</sup>	Change	Change, %
<i>Stocks, 1,000 bbl</i>						
Crude oil	502,716	504,598	(1,882)	457,924	44,792	9.8
Motor gasoline	227,183	225,156	2,027	222,010	5,173	2.3
Distillate	163,077	164,992	(1,915)	151,608	11,469	7.6
Jet fuel-kerosine	43,051	42,648	403	40,096	2,955	7.4
Residual	41,258	40,655	603	39,811	1,447	3.6
<i>Stock cover (days)<sup>4</sup></i>						
			<b>Change, %</b>		<b>Change, %</b>	
Crude	30.2	30.2	-	28.3	6.7	
Motor gasoline	24.2	23.6	2.5	24.5	(1.2)	
Distillate	46.0	46.4	(0.9)	40.1	14.7	
Propane	103.0	106.3	(3.1)	94.6	8.9	
<i>Futures prices<sup>5</sup> 9/30</i>						
			<b>Change</b>		<b>Change</b>	<b>Change, %</b>
Light sweet crude (\$/bbl)	46.74	44.58	2.16	45.52	1.22	2.7
Natural gas, \$/MMBtu	2.96	3.00	(0.03)	2.58	0.39	15.0

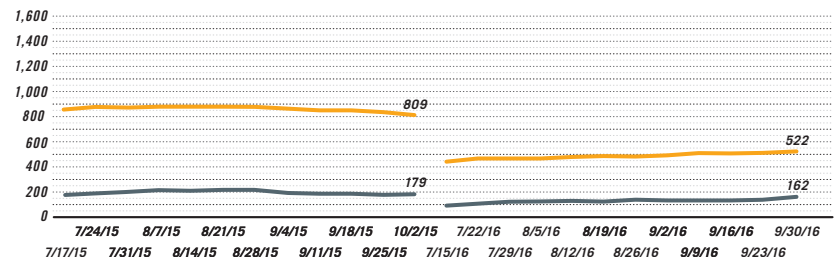
<sup>1</sup>Based on revised figures. <sup>2</sup>OGJ estimates. <sup>3</sup>Includes other liquids, refinery processing gain, and unaccounted for crude oil. <sup>4</sup>Stocks divided by average daily product supplied for the prior 4 weeks. <sup>5</sup>Weekly average of daily closing futures prices.  
Source: Energy Information Administration, Wall Street Journal

### BAKER HUGHES INTERNATIONAL RIG COUNT: TOTAL WORLD / TOTAL ONSHORE / TOTAL OFFSHORE



Note: Monthly average count

### BAKER HUGHES RIG COUNT: US / CANADA



Note: End of week average count

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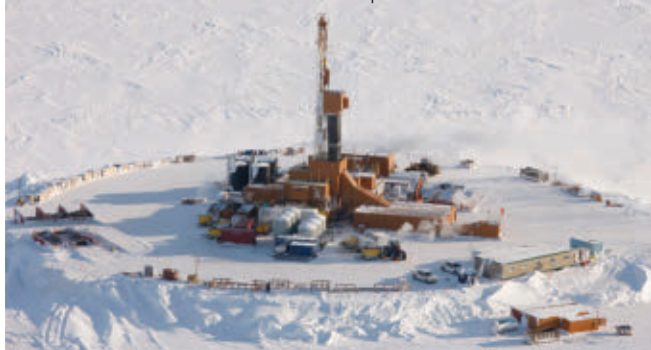
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Two exploration wells have confirmed 6 billion bbl of light crude in place on Caelus Energy Alaska LLC's Smith Bay state leases on Alaska's North Slope. Photo from Caelus.



cation. The operator encountered gross hydrocarbon columns in excess of 1,000 ft in each well. The CT-1 and CT-2 logged 183 and 223 ft of net pay, respectively. The wells were not flow tested due to seasonal time constraints, the company said, but extensive sidewall coring and subsequent lab analyses confirmed the presence of reservoir-quality sandstones containing 40-45° gravity oil.

Caelus plans to drill an additional appraisal well and acquire 3D seismic data over outboard acreage. The company believes the Smith Bay fan complex may contain 10 billion bbl of oil in place when the adjoining acreage is included. Due to the favorable fluids contained in the reservoir, Caelus expects to achieve recovery factors of 30-40%.

The US Energy Information Agency reported that Alaska's crude production dropped 6.8% month-over-month as of July and 2.6% year-over-year to 438,000 b/d.

Caelus owns a 75% working interest in 26 leases covering 117,000 acres in Smith Bay, about 150 miles west of Prudhoe Bay and 90 miles east of Barrow. The acreage is on state land offshore from the federal National Petroleum Reserve-Alaska.

### Lundin completes Barents Sea appraisal well

Lundin Petroleum AB unit Lundin Norway AS has produced natural gas from Lower Triassic reservoir sections on its PL609 7220/11-3 A (Alta-3) reentry well in the southern Barents Sea. The well lies east of the Alta discovery, which is estimated to contain gross contingent resources of 125-400 MMboe.

The original Alta-3 well was drilled in 2015 and encountered a 120-m gross hydrocarbon column. The reentry well was designed to further assess the quality of the Permo-Carboniferous carbonate reservoir and to conduct injection and production tests, Lundin said. It was the first of three wells in the operator's 2016 drilling campaign on the Loppa High, and it was drilled to a TD of 2,575 m, MD of 2,389 m, and in 400 m of water (OGJ Online, July 21, 2016).

The operator performed three tests—two of which injected 5,000 and 18,200 bbl of seawater below the oil-water contact in the Falk and Orn formations, respectively. The operator produced 21 Mscfd of gas in third test through a 1-in. choke

from the Lower Triassic reservoir.

Pressure data from the Alta-3, Alta-3A, and Alta-3AR indicate good communication with the two previously drilled wells on the Alta discovery (OGJ Online, Sep. 30, 2015). Lundin Petroleum Pres. Alex Schneider said, "Further appraisal over the Alta discovery will be required during 2017 to fully delineate this large structure."

Once the Leiv Eiriksson rig has plugged and abandoned the Alta-3 well, it will move 60 km to the north on PL609 to reenter the suspended well 7220/6-2 to complete the drilling of the Neiden prospect, which is estimated to contain gross unrisks prospective resources of 204 MMboe.

### North Sea well delivers heavier-than-expected oil

Independent Oil & Gas PLC (IOG) says a sample from its first appraisal well on the Skipper oil discovery of the northern North Sea indicates 11° gravity oil, "a significantly higher viscosity than expected."

Skipper lies on Block 9/21a in license P1609, where IOG is sole owner and operator. In July and August, the firm drilled the well to a TVD of 5,578 ft and retrieved oil samples as it moved toward a development plan (OGJ Online, Aug. 22, 2016).

The firm says the measurements do not align with its observations and therefore the remaining samples need to be reviewed and tested. The next steps will then be reservoir modeling to consider potential development options. Determining commerciality may therefore take several months.

"The analysis of the oil retrieved from the appraisal well indicates that Skipper is a heavy oil discovery with similar gravity to other nearby heavy oil fields," explained Mark Routh, IOG chief executive officer. "We have observed that the oil moves in the reservoir and is mobile at surface at ambient conditions."

IOG notes the crest of the Skipper reservoir in the appraisal well was found to be 44 ft shallower than prognosed. As a result, the firm's estimate of the most likely oil in place has increased to 142.6 million bbl from 136.5 million bbl in the 2013 competent persons report.

The quality of the sands, although not cored, suggested permeabilities of more than 10 darcies, which is better than previously assumed, the firm says.

### BP's Bight drilling plan approval delayed again

Australia's offshore oil and gas regulator National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) has asked BP PLC to supply more information about its plans to drill the Stromlo-1 wildcat in the Great Australian Bight offshore South Australia.

NOPSEMA says it needs the data to decide whether the company's environmental plan is acceptable, although it has not said exactly what part of the plan lacked the detail it requires. The regulator merely said the request for more information was a normal part of its assessment of an environmental plan.

BP has already had two environmental plans for drilling in the Bight rejected following NOPSEMA's finding that they did

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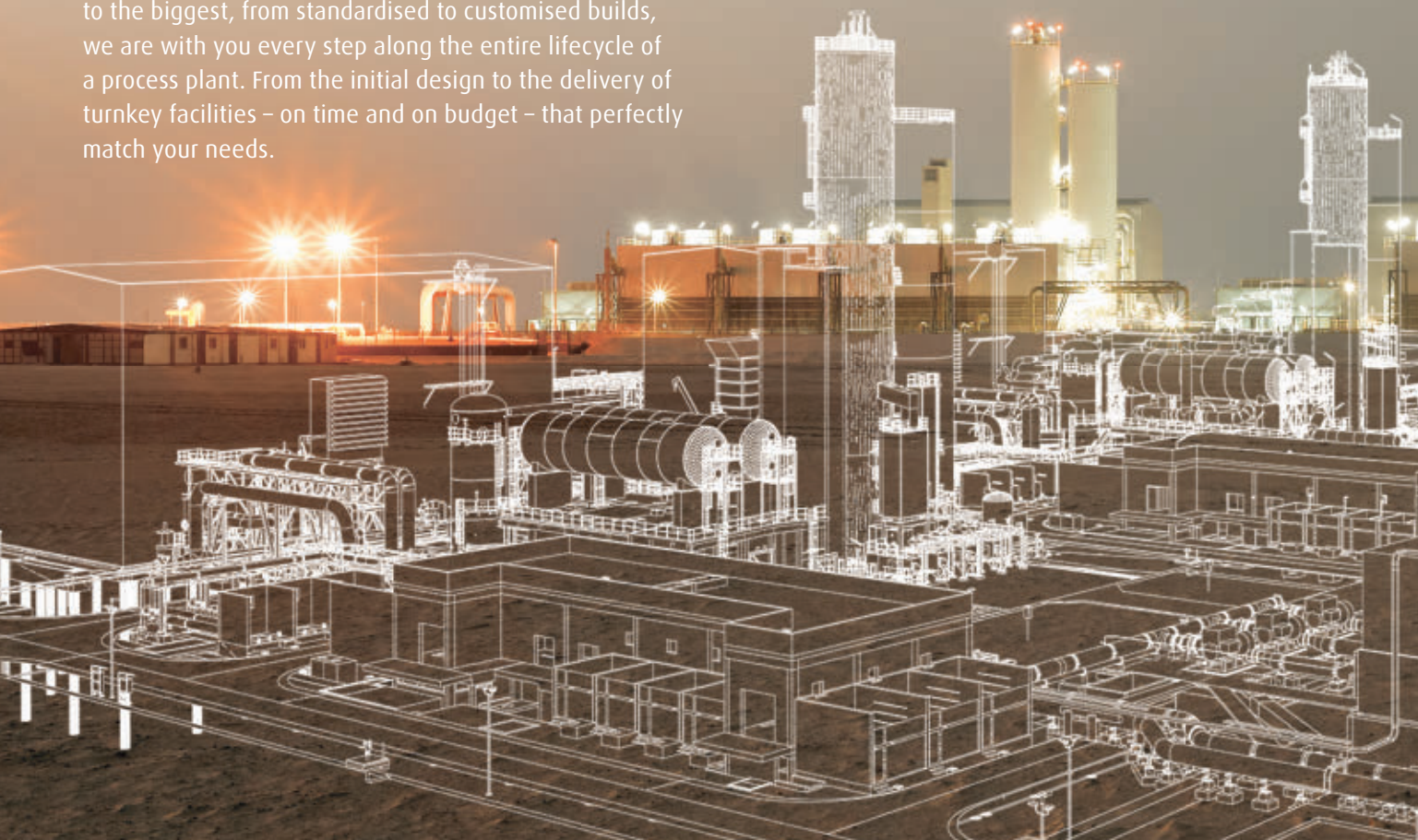
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not meet regulatory requirements.

The request is not an invitation to resubmit the plan or rejection, so the project is still in limbo.

BP says NOPSEMA has neither rejected nor accepted its environmental plan. The latest move is a request to clarify aspects of the company's plan and for BP to supply information that has not been included in the data submitted so far.

NOPSEMA has requested the information by Oct. 28, although it also said BP can request more time if needed.

It now appears that even if acceptance of the plan is forthcoming after this latest request, the timeframe for spudding the well this year will be extremely tight. **OGJ**

## **DRILLING & PRODUCTION** QUICK TAKES

### **DEA submits PDO for Norwegian Sea's Dvalin field**

DEA AG, Hamburg, has submitted the plan for development and operation (PDO) of Dvalin field, previously known as Zidane field, to Norway's Ministry of Petroleum and Energy.

Production is slated to begin in 2020. A total volume of 18.2 billion cu m of natural gas from two reservoirs is expected to be produced from the Dvalin license. Development cost is estimated at €1.1 billion.

Dvalin will be developed with a four-well subsea template connected to the Heidrun platform (OGJ Online, Mar. 18, 2013). Gas will be processed at Heidrun in a new module before being transported in a new export pipeline connected to the 482.4-km Polarled pipeline. It will then move to the Nyhamna onshore gas terminal, where it will be processed and transported to the European market.

"Together with our partners, we have come up with a development solution with sustainable long-term economics in an environment of low market prices," commented Hans-Hermann Andreae, managing director of DEA Norge AS. Dvalin is DEA's first operated field development project in Norway.

The firm cites "creative work in the project team and market developments in the supplier industry" as making the project economically sound. "Over the last few years we have managed to reduce cost by more than 20%," said Andreae. "As a consequence, DEA has got the opportunity to open a new area in the Norwegian Sea for gas production and export."

Dvalin field is on Blocks 6507/7/9 and 6507/8 of PL435 in the Norwegian Sea, 15 km northwest of Heidrun and 290 km from Nyhamna in Norway.

### **DEA lets contracts for Dvalin project**

DEA has let a contract to Aker Solutions for the Dvalin project's subsea production system in the Norwegian Sea. Aker will build a 300-ton subsea template for four wells and also will build the umbilical to be connected with the Heidrun platform.

DEA also let a contract to Aibel to ready the Heidrun platform to receive production from Dvalin. Aibel will build a 400-tonne injection system and a 4,000-tonne module for gas treatment. Aibel said they are to be installed in 2018 and 2019,

respectively. Construction work will be carried out at the Aibel yard in Haugesund, Norway.

Topside modifications for tie-in of Dvalin to Heidrun will be planned and executed by the Heidrun operator, Statoil ASA.

### **BP: Output shut from Clair platform after oil release**

BP PLC reported that the Clair platform, 75 km west of the Shetland Islands, has been taken offline after "a quantity of oil in water" was released into the North Sea early Oct. 2.

The most likely volume of oil to sea has been calculated from platform data as around 95 tonnes, or about 700 bbl, BP said.

The firm said on Oct. 3 the incident resulted from a technical issue with the system designed to separate the mixed production fluids of water, oil, and gas. The release was stopped within an hour once the issue had been identified.

BP will keep output from the platform shut "for the time being" as it investigates the cause of the technical issue.

BP, international industry-funded cooperative Oil Spill Response Ltd., and the UK's newly formed Department for Business, Energy, and Industrial Strategy have been working together to assess any potential environmental impacts and to determine the best response.

BP believes "the most appropriate response is to allow the oil to disperse naturally at sea, but contingencies for other action are being prepared."

Oil has been observed on the sea surface. Both direct observation and oil-spill modelling indicate the oil to be moving in a northerly direction away from land, the firm said. **OGJ**

## **PROCESSING** QUICK TAKES

### **IOC approves projects for Barauni, Panipat refineries**

State-owned Indian Oil Corp. Ltd. (IOC) has reached final investment decision on its previously announced proposal to increase oil processing capacity at the company's 6 million-tonne/year Barauni refinery in Begusarai District, Bihar.

At a Sept. 29 meeting, the company's board approved an investment of 82.87 billion rupees for a project that includes expanding crude processing capacity to 9 million tpy and adding a downstream polypropylene unit at the Barauni refinery, IOC said in a Sept. 30 filing to the National Stock Exchange of India Ltd. and BSE Ltd. (formerly Bombay Stock Exchange).

The board also approved a separate investment of 15.27 billion rupees at the Sept. 29 meeting for projects at the company's 15 million-tpy Panipat refinery and petrochemical complex in Haryana north of New Delhi.

Alongside ongoing implementation of an olefin-recovery project, the Panipat investment will cover an expansion of the complex's existing naphtha cracker, a revamp of the monoethylene glycol (MEG) plant, and modifications to a benzene expansion unit, the company said. Upon first announcing the project in 2015, IOC said it will execute the Barauni expansion project in two phases.

A detailed configuration study and technoeconomic evalu-

ation for Phase 1 of the expansion—which will boost capacity by 1 million tpy to 7 million tpy—remain under way, with the project scheduled for execution in 2016-17, India's Ministry of Petroleum and Natural Gas (MPNG) said.

Phase 2, which will add the remaining capacity increase of 2 million tpy, is due to be completed by 2020-21, MPNG said.

A final timeline for the Panipat olefin-recovery project has yet to be disclosed, but implementation, which began in 2015, remains ongoing, IOC said in its latest annual report.

### Shell commissions unit at Pernis refinery

Royal Dutch Shell PLC has commissioned an aromatics unit and started construction on another at subsidiary Shell Nederland Raffinaderij BV's 404,000-b/d Pernis refinery and integrated petrochemical production site in Rotterdam, the Netherlands.

Completed several months ahead of schedule, the new heart-cut splitter at Pernis entered service on Sept. 15, Shell said.

Benzene from the unit will be transported via pipeline 35 km away to Shell's Moerdijk chemical plant between the major ports of Rotterdam and Antwerp, Belgium, where it will serve as feedstock for production of styrene monomer.

The aromatics unit comes as part of the firm's plan to increase flexibility and competitiveness of its operations through further integration of its refining and chemicals businesses.

The use of its own feedstock will allow Shell to continue increasing the profitability of its European chemicals business, Ryerkerk said.

Shell also confirmed on Sept. 15 that it has started official construction on a solvent deasphalting (SDA) unit to be added at the Pernis refinery. Designed to remove heavier fractions from crude oil feedstock to help boost production of lighter, higher-quality products with improved environmental performance, the SDA unit will equip the refinery with more flexibility to change its production slate to a different product mix in response to current market conditions.

The SDA unit remains on schedule to be completed sometime in 2018, Shell said.

### Badlands plans first US Gulf Coast merchant AO plant

Badlands NGLs LLC, Denver, has let a contract to S&B Engineers & Constructors Ltd., Houston, to build the first merchant alpha olefins (AO) plant at the US Gulf Coast for on-purpose manufacturing of polyethylene co-monomers 1-butene and 1-hexane. S&B will provide engineering, procurement, and construction services for the grassroots project, Badlands said.

Configured with production capacities of 93,000 tonnes/year for 1-butene and 141,000 tpy for 1-hexene, the AO plant is scheduled for startup during second-half 2018, Badlands said.

A value of the EPC contract was not disclosed.

Alongside the announcement, Badlands also confirmed that it has signed a 15-year agreement with an unidentified petrochemical and polymers marketer for 100% offtake of the proposed AO plant's output.

Badlands currently is considering two alternative US Gulf

Coast sites for the project, both of which offer close proximity to water transportation routes to enable shipments to US and international customers alike.

The company said it expects to make a final site selection for the AO plant in the next few weeks.

In contrast to the oligomerization process typically used to manufacture polyethylene co-monomer AOs that manufactures a range of up to 14 different products in set ratios—including 1-hexene and 1-butene—the proposed AO plant will use proprietary ethylene metathesis technology processes to produce on-purpose 1-butene and 1-hexene to meet market demand without extraneous output of nonpolyethylene co-monomer AO products, Badlands said.

Already licensed by Badlands from an unidentified provider, the proprietary processing technology will yield 1-butene and 1-hexene products via ethylene dimerization and trimerization, respectively. **OGJ**

## TRANSPORTATION QUICK TAKES

### IEnova closes purchase of Pemex stake in line JV

Infraestructura Energetica Nova SAB de CV (IEnova), a Mexican unit of Sempra Energy, San Diego, has completed its acquisition of Pemex Transformacion Industrial's 50% equity interest in the Gasoductos de Chihuahua joint venture for \$1.14 billion.

IEnova's shares in the JV now increase to 100% from 50%. Pemex will retain 50% shareholder interest in the Ramones II Norte pipeline project through Ductos y Energeticos del Norte S de RL de CV. The assets in the deal comprise three natural gas pipelines, an ethane pipeline, and a LPG pipeline, and associated storage terminal.

IEnova develops, builds, and operates energy infrastructure in Mexico. As of Dec. 31, 2015, the firm had invested more than \$4 billion in operating assets and projects under construction in the country.

### Gazprom gets survey permit for TurkStream pipeline

PJSC Gazprom has received a survey permit for two strings of the 63 billion-cu m TurkStream natural gas pipeline's offshore section in Turkey's territorial waters.

Gazprom and Petroleum Pipeline Corp. (Botas) signed a memorandum of understanding on Dec. 1, 2014, to construct TurkStream.

The pipeline will extend 660 km along the old route of the South Stream gas line and cover 250 km of a new route toward the European portion of Turkey. The first string is planned to exclusively supply gas to the Turkish market.

Gazprom this month also secured TurkStream's first construction permit for its offshore section from Turkish authorities.

The offshore line will consist of four strings with a capacity of 15.75 billion cu m each. **OGJ**

■ Denotes new listing or a change in previously published information.

**OCTOBER 2016**

ICOGPE 2016: 18th International Conference on Oil, Gas & Petrochemical Engineering, Barcelona, web site: [www.waset.org/conference/2016/10/barcelona/ICOGPE](http://www.waset.org/conference/2016/10/barcelona/ICOGPE) **3-4**.

SPE African Health, Safety, Security, Environment & Social Responsibility Conference & Exhibition, Accra, Ghana, web site: [www.spe.org/events/en/2016/conference/16hsea/homepage.html](http://www.spe.org/events/en/2016/conference/16hsea/homepage.html) **4-6**.

Kazakhstan International Oil & Gas Conference (KIOGE) 2016, Almaty, Kazakhstan, web site: [kioge.kz/en/conference/about-conference](http://kioge.kz/en/conference/about-conference) **5-6**.

Society of Petroleum Resources Economists' Second Annual Conference: SPRE 2017 Oil Prices Outlook, Houston, web site: [spreconomists.org/flyers/161006%20Flyer.pdf](http://spreconomists.org/flyers/161006%20Flyer.pdf) **6**.

USEA 9<sup>th</sup> Annual Energy Supply Forum, Washington, DC, web site: <https://www.usea.org/event/usea-9th-annual-energy-supply-forum> **6**.

International Conference on Geosciences, Orlando, web site: [geosciences.conferenceseries.com/](http://geosciences.conferenceseries.com/) **6-7**.

Cyber Security for Critical Assets LATAM, Rio de Janeiro, web site: [www.criticalcybersecurity.com/latam/](http://www.criticalcybersecurity.com/latam/) **6-7**.

23rd World Energy Conference, Istanbul, web site: [www.wec2016istanbul.org.tr/](http://www.wec2016istanbul.org.tr/) **9-13**.

International Conference on Oil Reserves & Energy Management, New York, web Site: [www.waset.org/conference/2016/10/new-york/ICOREM](http://www.waset.org/conference/2016/10/new-york/ICOREM) **10-11**.

The 2016 API Tank, Valves, & Piping Conference & Expo, Las Vegas, web site: [www.api.org/events-and-training/calendar-of-events/2016/tvp](http://www.api.org/events-and-training/calendar-of-events/2016/tvp) **10-13**.

Natural Gas for High Horsepower Summit, Chicago, web site: [www.hhpsummit.com/](http://www.hhpsummit.com/) **11-13**.

OilComm Conference & Exposition, Houston, web site: [www.oil-comm.com/](http://www.oil-comm.com/) **11-13**.

SEG International Exhibition and 86th Annual Meeting, Dallas, web site: [www.seg.org/web/annual-meeting-2016/](http://www.seg.org/web/annual-meeting-2016/) **16-21**.

■ World Class Process Safety Management Forum 2016, Birmingham, UK, web site: [www.tacook.com/processsafety/](http://www.tacook.com/processsafety/) **17-18**.

International Conference on Oil Reserves & Production, London, web site: [www.waset.org/conference/2016/10/london/ICORP](http://www.waset.org/conference/2016/10/london/ICORP) **17-18**.

The 8<sup>th</sup> Saudi Arabia International Oil & Gas

Exhibition (SAOGE), Dammam, web site: [www.saoge.org/](http://www.saoge.org/) **17-19**.

SPE Well Construction Fluids 2025 Forum: Meeting the Challenges, Dubai, web site: [www.spe.org/events/16fmel/](http://www.spe.org/events/16fmel/) **17-19**.

2016 Fall Committee on Petroleum Measurement Standards Meeting, Los Angeles, web site: [www.api.org/Events-and-Training/Calendar-of-Events/2016/fallcopm](http://www.api.org/Events-and-Training/Calendar-of-Events/2016/fallcopm) **17-21**.

Permian Basin International Oil Show, Odessa, Tex., web site: [www.pboilshow.org](http://www.pboilshow.org) **18-20**.

The 37<sup>th</sup> Oil & Money Conference, London, web site: [www.oiland-money.com/](http://www.oiland-money.com/) **18-19**.

Society of Petroleum Engineers (SPE) African Health, Safety, Security, Environment & Social Responsibility Conference & Exhibition, Accra, Ghana, web site: [www.spe.org/events/hsea/2016/](http://www.spe.org/events/hsea/2016/) **18-20**.

IADC Well Control Europe Conference & Exhibition, Copenhagen, web site: [www.iadc.org/event/2016-well-control-europe/](http://www.iadc.org/event/2016-well-control-europe/) **19-20**.

SPE Latin America & Caribbean Heavy Oil & Extra Heavy Oil Conference, Lima, web site: [www.spe.org/events/laho/2016/](http://www.spe.org/events/laho/2016/) **19-20**.

USAEE/IAEE North American Conference, Tulsa, web site: [www.usaee.org/usaee2016/](http://www.usaee.org/usaee2016/) **23-26**.

Arctic Technology Conference (ATC), St. John's, Newfoundland & Labrador, web site: [www.arctictechnology-conference.org/](http://www.arctictechnology-conference.org/) **24-26**.

SPE Russian Petroleum Technology Conference & Exhibition, Moscow, web site: [www.spe.org/events/rpc/2016/](http://www.spe.org/events/rpc/2016/) **24-26**.

SPE North America Artificial Lift Conference & Exhibition, The Woodlands, Tex., web site: [www.spe.org/events/alce/2016/](http://www.spe.org/events/alce/2016/) **25-27**.

SPE Asia Pacific Oil & Gas Conference & Exhibition (APOGCE), Perth, web site: [www.spe.org/events/apogce/2016/](http://www.spe.org/events/apogce/2016/) **25-27**.

The 10th Element Oil-field Engineering with Polymers Conference, London, web site: [oilfieldpolymers.nace.org/](http://oilfieldpolymers.nace.org/) **25-27**.

Produced Water Quality Recycling & Reuse, Denver, web site: [www.produced-water-quality-recycling-reuse-rockies.com/](http://www.produced-water-quality-recycling-reuse-rockies.com/) **26-27**.

Bottom of the Barrel Technology Conference (BBTC) Middle East & Africa 2016, Manama, web site: [www.bbtc-mena.biz](http://www.bbtc-mena.biz) **26-27**.

International Conference & Expo on Oil & Gas, Rome, web site: [oil-gas.conferenceseries.com/](http://oil-gas.conferenceseries.com/) **27-28**.

Gulf Safety Forum (GSF) 2016, Doha, web site: [www.gulfsafetyforum.com/](http://www.gulfsafetyforum.com/) **30-31**.

23rd Africa Oil Week Africa Upstream

Conference 2016, Cape Town, web site: [www.oilgas-events.com/Findan-Event/Africa-Oil-Week/](http://www.oilgas-events.com/Findan-Event/Africa-Oil-Week/) **Oct 31-Nov 04**.

SPE Annual Caspian Technical Conference & Exhibition, Astana, Kazakhstan, web site: [www.spe.org/events/en/2016/conference/16ctce/homepage.html](http://www.spe.org/events/en/2016/conference/16ctce/homepage.html) **1-3**.

4th Iran Europe Oil & Gas Summit, Berlin, web site: [www.iran-summit.com/](http://www.iran-summit.com/) **1-3**.

2<sup>nd</sup> International Conference & Expo on Oil & Gas, Istanbul, web site: [oil-gas.omics-group.com/](http://oil-gas.omics-group.com/) **2-3**.

7th Annual Summit Operational Excellence in Oil & Gas, Houston, web site: [www.opex-inoilandgas.com](http://www.opex-inoilandgas.com) **7-9**.

The Abu Dhabi International Petroleum Exhibition & Conference, (ADIPEC), Abu Dhabi, web site: [www.adipec.com/](http://www.adipec.com/) **7-10**.

RefComm Mumbai 2016, Mumbai, web site: [refiningcommunity.com/refcomm-mumbai-2016/](http://refiningcommunity.com/refcomm-mumbai-2016/) **7-11**.

International Petroleum Technology Conference (IPTC), Bangkok, web site: [www.iptcnet.org/pages/about/future-dates.php](http://www.iptcnet.org/pages/about/future-dates.php) **14-16**.

4th East Africa Oil & Gas Summit & Exhibition, Nairobi, web site: [eaogs.com/](http://eaogs.com/) **15-17**.

International Conference on Oil, Gas

& Petrochemistry, Dubai, web site: [www.waset.org/conference/2016/11/dubai/ICOGP](http://www.waset.org/conference/2016/11/dubai/ICOGP) **16-17**.

21<sup>st</sup> Annual Oil & Gas of Turkmenistan (OGT) Conference 2016, Ashgabat, web site: [ogt.theenergyexchange.co.uk/](http://ogt.theenergyexchange.co.uk/) **16-17**.

Project Financing in Oil & Gas, London, web site: [www.smi-online.co.uk/energy/uk/conference/Project-Financing-in-Oil-and-Gas](http://www.smi-online.co.uk/energy/uk/conference/Project-Financing-in-Oil-and-Gas) **21-22**.

EIC Connect Oil & Gas Conference & Exhibition, Manchester Central, UK, web site: [www.the-eic.com/EIC-Connect/OilGas/About-theEvent.aspx](http://www.the-eic.com/EIC-Connect/OilGas/About-theEvent.aspx) **22-23**.

International Conference on Shale Oil & Gas Engineering, London, web site: [www.waset.org/conference/2016/11/london/ICSOGE](http://www.waset.org/conference/2016/11/london/ICSOGE) **24-25**.

5<sup>th</sup> International Conference on Petroleum Geology & Petroleum Industry, Dubai, web site: [petroleumgeology.conferenceseries.com/](http://petroleumgeology.conferenceseries.com/) **24-25**.

Oil & Gas Safety & Health Conference 2016 OSHA Exploration & Production, Houston, web site: [www.oshasafetyconference.org/Events/ugm/Osha2016/default.aspx](http://www.oshasafetyconference.org/Events/ugm/Osha2016/default.aspx) **29-30**.

OSEA2016 Exhibition & International Conference, Marina Bay Sands, Singapore, web site: [www.osea-asia.com](http://www.osea-asia.com) **Nov. 29-Dec. 2**.

SPE Thermal Well Integrity & Design Sym-

posium, Banff, Alta., web site: [www.spe.org/events/en/2016/symposium/16twid/homepage.html](http://www.spe.org/events/en/2016/symposium/16twid/homepage.html) **Nov. 29-Dec. 1.**

Society of Petroleum Engineers (SPE) Middle East Artificial Lift Conference & Exhibition, Manama, Bahrain, web site: [www.spe.org/events/meal/2016/](http://www.spe.org/events/meal/2016/) **Nov. 30-Dec. 1.**

## DECEMBER 2016

International Conference on Oil Reserves & Power Issues, Hong Kong, web site: [www.waset.org/conference/2016/12/hong-kong/ICORPI](http://www.waset.org/conference/2016/12/hong-kong/ICORPI) **5-6.**

International Conference on Energy Engineering & Oil Reserves, Hong Kong, web site: [www.waset.org/conference/2016/12/hong-kong/ICEEOR](http://www.waset.org/conference/2016/12/hong-kong/ICEEOR) **5-6.**

International Conference on Oil Reserves & Energy Technologies, Hong Kong, web site: [www.waset.org/conference/2016/12/hong-kong/ICORET](http://www.waset.org/conference/2016/12/hong-kong/ICORET) **5-6.**

Kurdistan-Iraq Oil & Gas Conference & Exhibition, London, web site: [www.cwckioj.com/conference/](http://www.cwckioj.com/conference/) **5-7.**

SPE/AAPG Africa Energy & Technology Conference, Nairobi City, Kenya, web site: [www.spe.org/events/en/2016/conference/16afrc/homepage.html](http://www.spe.org/events/en/2016/conference/16afrc/homepage.html) **5-7.**

5th World Congress on Petrochemistry & Chemical Engineering, Phoenix, web site:

[www.petrochemistry.omicsgroup.com/](http://www.petrochemistry.omicsgroup.com/) **5-7.**

Third EAGE Integrated Reservoir Modelling Conference, Kuala Lumpur, web site: [www.eage.org/event/index.php?eventid=1477&Opendivs=3](http://www.eage.org/event/index.php?eventid=1477&Opendivs=3) **5-7.**

OpEx MENA 2016—Operational Excellence in Oil, Gas & Petrochemicals, Abu Dhabi, web site: [www.opex.biz](http://www.opex.biz) **5-7.**

Oil & Gas Supply Chain Procurement, Houston, web site: [energyconference.network.com/oil-gas-supply-chain-procurement-2016/](http://energyconference.network.com/oil-gas-supply-chain-procurement-2016/) **6-7.**

■ CO2/ROZ Conference & EOR Carbon Management Workshop, Midland, Tex., web site: [www.co2conference.net](http://www.co2conference.net) **6-8.**

SPE Heavy Oil Conference & Exhibition, Kuwait City, web site: [www.spe.org/events/hoce/2016/](http://www.spe.org/events/hoce/2016/) **6-8.**

Green Forum: Oil, Gas & Petrochemicals, Abu Dhabi, web site: [www.greenforum.ae](http://www.greenforum.ae) **8.**

■ International Conference on Oil & Gas Non-Metallics 2016, London, web site: [www.amiplastics-na.com/events/Event.aspx?code=C740](http://www.amiplastics-na.com/events/Event.aspx?code=C740) **12-14.**

IADC Critical Issues Middle East Conference & Exhibition, Dubai, web site: [www.iadc.org/event/critical-issues-me-2016/](http://www.iadc.org/event/critical-issues-me-2016/) **13-14.**

ICOGPE 2016: 18th International Conference on Oil, Gas &

Petrochemical Engineering, Dubai, web site: [www.waset.org/conference/2016/12/dubai/ICOGPE/home/](http://www.waset.org/conference/2016/12/dubai/ICOGPE/home/) **26-27.**

## JANUARY 2017

Global Oil & Gas Middle East & North Africa Conference, Cairo, web site: [www.oilgas-events.com/Find-an-Event/Global-Oil-Gas-Middle-East-North-Africa-\(1\)](http://www.oilgas-events.com/Find-an-Event/Global-Oil-Gas-Middle-East-North-Africa-(1)) **24-26.**

SPE Hydraulic Fracturing Technology Conference, The Woodlands, Tex., web site: [www.spe.org/events/hftc/2017/](http://www.spe.org/events/hftc/2017/) **24-26.**

NACE International Pipeline Coating Technology Conference, Houston, web site: [pipelinecoating.nace.org/](http://pipelinecoating.nace.org/) **24-26.**

Offshore West Africa, Lagos, web site: [www.offshorewestafrica.com/index.html](http://www.offshorewestafrica.com/index.html) **24-26.**

■ Oil & Gas IP Summit, London, web site: [www.oilandgasip.com/](http://www.oilandgasip.com/) **25-26.**

2017 API Inspection Summit, Galveston, Tex., web site: [www.api.org/Events-and-Training/Calendar-of-Events/2017/inspection](http://www.api.org/Events-and-Training/Calendar-of-Events/2017/inspection) **Jan. 30-Feb. 2.**

## FEBRUARY 2017

Gulf of Mexico Oil Spill & Ecosystem Science Conference, New Orleans, web site: [web.iagc.org/events/2017-Gulf-of-Mexico-Oil-Spill-and-Ecosystem-Science-Conference-79/details](http://web.iagc.org/events/2017-Gulf-of-Mexico-Oil-Spill-and-Ecosystem-Science-Conference-79/details) **6-9.**

International Conference on Oil & Gas Projects in Common Fields, Bangkok, web site: [www.waset.org/conference/2017/02/bangkok/ICOGPCF](http://www.waset.org/conference/2017/02/bangkok/ICOGPCF) **7-8.**

International Conference on Oil & Gas Projects in Common Fields, Amsterdam, web site: [www.waset.org/conference/2017/02/amsterdam/ICOGPCF](http://www.waset.org/conference/2017/02/amsterdam/ICOGPCF) **7-8.**

Cuba Oil & Gas 2017 Summit, Havana, web site: [www.cubaoilgas-summit.com/](http://www.cubaoilgas-summit.com/) **7-9.**

7th Basra Oil & Gas International Conference & Exhibition, Basra, web site: [www.basraoilgas.com/Conference/](http://www.basraoilgas.com/Conference/) **8-11.**

SPE Canada Unconventional Resources Conference, Calgary, web site: [www.spe.org/events/en/2017/conference/17urc/homepage.html](http://www.spe.org/events/en/2017/conference/17urc/homepage.html) **15-16.**

SPE Canada Heavy Oil Technical Conference, Calgary, web site: [www.spe.org/events/en/2017/conference/17hoc/homepage.html/](http://www.spe.org/events/en/2017/conference/17hoc/homepage.html/) **15-16.**

NAPE Summit, Houston, web site: [napeexpo.com/shows/about-the-show/summit](http://napeexpo.com/shows/about-the-show/summit) **15-17.**

International Conference on Petroleum & Petrochemical Engineering, London, web site: [www.waset.org/conference/2017/02/london/ICPPE](http://www.waset.org/conference/2017/02/london/ICPPE) **16-17.**

19th International Conference on Oil, Gas & Petrochemical Engineering (ICOGPE 2017), Venice, web

site: [www.waset.org/conference/2017/02/venice/ICOGPE](http://www.waset.org/conference/2017/02/venice/ICOGPE) **16-17.**

Society of Petroleum Engineers (SPE) Reservoir Simulation Conference, Montgomery, Tex., web site: [www.spe.org/events/rsc/2017/](http://www.spe.org/events/rsc/2017/) **20-22.**

Australasian Oil & Gas Exhibition & Conference (AOG), Perth, web site: [aogexpo.com.au/](http://aogexpo.com.au/) **22-24.**

LNG Summit, Houston, web site: [lng-usa.com/](http://lng-usa.com/) **23-24.**

Nigeria Oil & Gas Conference & Exhibition, Abuja, web site: [www.cwcnog.com/](http://www.cwcnog.com/) **Feb. 27-Mar. 2.**

Society of Petroleum Engineers (SPE) 20th Middle East Oil & Gas Show & Conference (MEOS), Manama, Bahrain, web site: [meos17.com/](http://meos17.com/) **6-9.**

SPE 20th Middle East Oil & Gas Show & Conference (MEOS), Bahrain, web site: [meos17.com/](http://meos17.com/) **7-9.**

SPE/IADC Drilling Conference & Exhibition, Dublin, web site: [www.spe.org/events/dc/2017/](http://www.spe.org/events/dc/2017/) **7-9.**

SPE Latin American & Caribbean Mature Fields Symposium,

Salvador, Bahia, Brazil, web site: [www.spe.org/events/en/2017/symposium/17lama/homepage.html](http://www.spe.org/events/en/2017/symposium/17lama/homepage.html) **15-16.**

SPE Symposium: Iraq—The Petroleum Potentiality & Future of Energy, Amman, Jordan, web site: [www.spe.org/events/en/2017/symposium/16abas/homepage.html](http://www.spe.org/events/en/2017/symposium/16abas/homepage.html) **15-16.**

15th Global Oil & Gas Turkey, Istanbul, web site: [www.global-oilgas.com/Turkey/Home/](http://www.global-oilgas.com/Turkey/Home/) **15-16.**

SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition, Houston, web site: [www.spe.org/events/ctwi/2017/](http://www.spe.org/events/ctwi/2017/) **21-22.**

Corrosion 2017 Conference & Expo, New Orleans, web site: [nacecorrosion.org/](http://nacecorrosion.org/) **26-30.**

SPE Oklahoma City Oil & Gas Symposium, Oklahoma City, web site: [www.speokcsymposium.org/](http://www.speokcsymposium.org/) **27-31.**

IADC/SPE Managed Pressure Drilling & Underbalanced Operations Conference & Exhibition, Rio de Janeiro, web site: [iadc.org/event/2017-iadcspe-managed-pressure-drilling-underbalanced-operations-conference-exhibition/](http://iadc.org/event/2017-iadcspe-managed-pressure-drilling-underbalanced-operations-conference-exhibition/) **28-29.**

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AAPG 2017 Annual Convention & Exhibition, Houston, web site: [www.aapg.org/events/conferences/ace/](http://www.aapg.org/events/conferences/ace/) **2-5.**



# There's an app for that



**TAYVIS DUNNAHOE**  
Exploration Editor

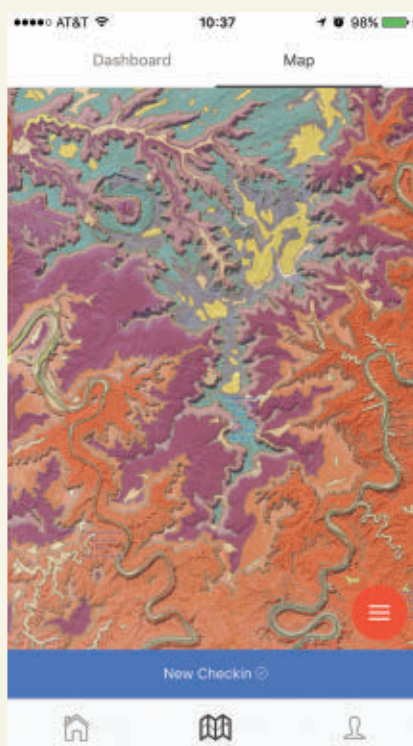
Geologists work where the rocks are, but advancing technology continually lightens the load for those in the field.

A new app developed by University of Wisconsin, Madison, geoscience Prof. Shanan Peters and former geologist for the Wisconsin Geological and Natural History Survey Patrick McLaughlin is putting a portable, GPS-powered field guide in the palm of users' hands.

"The big idea is, 'Tell us what you saw, and I will tell you what I saw,'" Peters said in a press release. Users of the free geology app, known as Rockd, can upload their field observations and photos, and compare those to what other users know about the location.

According to its makers, Rockd overcomes the limitations on geologic maps—their focus on big structures. "Using a map, it can be hard to tell specifically where to go to see a particular rock unit exposed at the surface," he said.

The app provides a virtual map and a method of simple annotation, and it uses information from extensive databases such as Macrostrat, the Paleobiology Database, which was spearheaded by Pe-



A river-dissected plateau near Moab, Utah, shown in the Rockd app, uses colors to display the age of rocks, and two winding rivers cut deeply into the strata. Photo from Rockd.

ters as an accessible interface to large geologic data sets. Rockd also will expand the sum of geologic knowledge as the crowd-sourced data feeds back into the app's data structure.

## New app, not concept

With the iPhone now in its 7th iteration, geology apps have been introduced in recent years, and the functionality of handheld technology has changed the way some geologists gather field data.

In 2015, a group headed by Prof. Christopher Liner at the University of Arkansas, Fayetteville, outlined methods of using an iPhone to conduct geologic field studies. His team located unreported outcrops of the Mississippian Boone limestone formation in northwest Arkansas with a program it coined MARkUP (OGJ Online, Mar. 2, 2015).

The project was carried out using free software at a fraction of the standard cost of a geological field survey.

Modern smart-phone technology and open software have the potential to revolutionize field geology. With more advanced approaches to handheld technology, reconnaissance geology of vast areas may soon come with less time, effort, and cost. **OGJ**

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# A new NEPA bullet

Christy Goldfuss, managing director of the White House Council on Environmental Quality (CEQ), provided scant comfort last month when she assured lawmakers new guidance on greenhouse gas emissions isn't mandatory. To zealous regulators of the Obama administration and their allies in environmental pressure groups, the attachment of climate change to the National Environmental Policy Act (NEPA) confers license to kill.

The CEQ in August sent federal agencies final guidelines on assessing the effects of their decisions on climate change in reviews required by NEPA. Opponents of fossil energy projects often challenge federal permitting and other decisions on the basis of NEPA compliance. And they often succeed. Climate change loads a powerful bullet into a NEPA gun eternally aimed at projects such as pipeline construction and oil and gas leasing of federal land.

## Minuscule effects

Yet linking climate change to NEPA is futile—unless the reason for doing so is to foreclose unwanted activity. NEPA relates to specific federal decisions about well-defined undertakings. It's supposed to address environmental effects of those activities, asking how a specific decision might affect the environment. When the question encompasses global average temperature, the core metric of climate change, the only reasonable answer in relation to any specific project can be that effects will be minuscule. Yes, a federal decision might beget work that emits carbon dioxide, methane, or other GHGs. But that's the extent of measurable climatological effects.

According to current prejudice—supposedly ratified by “science” improperly characterized as “settled”—a decision leading to an increase in the concentration of GHGs in the atmosphere must intensify observed warning. Formulas exist by which to estimate the temperature increase and associated cost. But they're theoretical, wholly dependent on speculative assumptions about poorly understood climate processes. And the theory isn't bearing up well to temperature observations. Even if incremental GHGs warmed the atmosphere as much as they are assumed to do, moreover, those related to any given federal decision would be so

minor in relation to the whole system that specific temperature effects would be inconsequential.

In the hysteria driving climate politics, however, ANY human contribution to GHGs in the atmosphere represents peril necessitating regulatory control—or, increasingly, outright prevention. In their opposition to federal leasing in the Arctic, for example, activists now stress the prospective effect on climate, deemphasizing traditional concerns about oil spills and aquatic life. Spills and damage to marine organisms probably won't happen; GHG emissions from combustion of whatever oil and gas might be found certainly will occur, however negligible the warming effect. Pipelines essential to extracting maximum economic value from newly abundant oil and gas regularly smash against this thickening political wall.

Mandatory or not, CEQ's merger of NEPA and climate anxiety will be, in the hands of incumbent regulators, deadly for oil and gas work. With proportionality vanishing from climate regulation, the rapidly developing and altogether dangerous tendency is to reject any activity that emits GHGs or that leads to activities that will. This needs more attention than it receives in discussions about why the US can't sustain economic growth above 2%/year.

## Declining emissions

Declining US emissions of GHGs make sacrificial regulation all the more questionable. The Environmental Protection Agency reports emissions from large industrial sources in 2015 were down 4.9% from 2014 and down 8.2% from 2011. The biggest improvement came from the biggest emission source: electric power plants. It reflected increases in power from renewable sources and substitution of coal by natural gas. Emissions from upstream oil and gas activity were down slightly from 2014 but above 2011 levels and from refineries, up slightly from 2014 but below 2011.

EPA's report shows the US can moderate emissions without letting precaution become paralysis. Yet federal regulators act with growing urgency about preventing GHG emissions wherever possible and with decreasing concern about consequences for projects and jobs. The CEQ move opens a new phase in a regrettable expansion of government already too large. **OGJ**

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# Moody's: Global integrated oil, gas business stabilizing

The global integrated oil and gas business is stabilizing and will likely improve modestly from recent historical lows over the next 12-18 months, says Moody's Investors Service in a recent report. The report—"Integrated Oil & Gas: Global Oil Price Uptick, Accelerated Cost Cuts Put Upstream Activities on Road to Recovery"—says higher oil prices and lower operating costs are driving a steady improvement in companies' earnings.

"Over the last year, integrated oil and gas companies have accelerated reductions in their operating costs to adjust to earlier oil-price declines. As a result, most companies' upstream operations returned to positive net income generation in the second quarter of 2016, while also benefiting from an uptick in the price of crude," said Elena Nadtochi, a Moody's vice-president, senior credit officer, and author of the report.

Moody's expects recent capital investments should support a flat production profile by the industry in the next 3-5 years. A stronger recovery in oil prices beyond their estimates of an average Brent price of \$45/bbl next year would be the main driver of a faster improvement in earnings and cash flows.

"Nevertheless, in the longer term, we think the sector will continue to face multiple challenges as we expect oil prices to remain in the range of \$40-60/bbl. These include improving returns on capital and delivering long-term growth in production beyond 2020, as well as finding ways to enhance the replacement of reserves," the report said.

Moody's estimates that the industry will generate about \$65 billion in negative-free cash flow in 2016-17, although several companies are expected to generate positive-free cash flow next year. Moody's also expects to see integrated companies continue to fund deficits through assets sales, new debt issuances, and cash balances over the next 12-18 months.

### **Drag factors**

According to the report, the pace of upstream cost reduction is expected to slow after the industry delivered a 26% cut in average production costs per barrel of oil equivalent in 2015.

"We think the sector is likely to be approaching the limit of

production cost reductions and the pace of improvement in cost positions is likely to slow in 2016 and 2017. Because we expect the sector's production to be flat over the next 12-18 months, improvements in upstream cash margins and cash flow generation are likely to be driven mainly by the pace of the recovery in oil prices during this period."

The business' earnings recovery also will be slowed by weaker downstream performance in 2016 due to the oversupply of refined products in Europe and North America, weaker growth in gasoline demand, and sustained high operating rates. However, the decline is likely to be cushioned by contributions from most stable chemicals and marketing operations.

Most companies are still reducing capital spending to support dividend payments. Moody's expects that the sector's capex is likely to decline by 20% on aggregate in 2016 and by 10-15% in 2017, given the persistent low oil-price environment. However, Eni SPA, Chevron Corp., and Statoil ASA will buck this trend in 2016-17, as they pursue large-scale projects to bring on additional production volumes in 2018-19.

"While oil revenues and operating cash flows declined in 2015-16, the sector maintained a high level of dividend payments, even as European peers have opted for scrip dividend payouts as a temporary measure," the report said.

Nevertheless, Moody's still expects the industry's cash flow to remain too low to fund dividends. This is based on Moody's current price estimates of \$40/bbl in 2016 and \$45/bbl in 2017 and assumes current dividend policies.

"We expect that dividend payments will remain the key driver behind the projected negative free cash flow generation by the sector in 2016 and 2017," Moody's said.

"The high level of investment in 2008-15 and sustained, relatively high levels of shareholder payments have left the industry with a higher level of debt than in 2008-09, even as [earnings] and operating cash flows declined below the levels seen during the last trough. These more levered positions were reflected in the recent downgrade of the ratings of the integrated companies during the industry-wide credit review that we concluded in April 2016," the report said.

Companies' credit profiles will only recover gradually,

the report said. The industry's rising net debt load should stabilize as companies use the proceeds from targeted divestments to fund operations and to reduce debt after acquisitions.

"The industry's balance sheet remains solid, with about \$150 billion in cash balances, which is equivalent to almost 25% of the sector's adjusted debt. Cash balances continue to provide an additional level of support to investment plans and dividend payments in 2016-17. Given the direct impact of higher oil prices on cash flow generation, a markedly higher oil-price environment with oil prices sustained at above \$45/bbl would result in a sooner return to free cash flow generation than we currently anticipate." **OGJ**

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## Reconfigured LNG markets are creating major uncertainties, book says

**Nick Snow**

Washington Editor

Global LNG markets, which have changed dramatically over the last few years, have created uncertainties that producers and customers will have to address, contend authors of a recent report.

Long-term contracts are giving way to spot purchases amid excess supplies, evolving price dynamics, and competition from pipelines, the authors said during the US launch of "LNG Markets in Transition: The Great Configuration" at the Center for Strategic and International Studies on Sept. 28.

"Why do we call it a reconfiguration? First, because the supply-demand balance will be very different from what we anticipated," said Anne-Sophie Corbeau, a research fellow at the King Abdullah Petroleum Studies Center who previously was senior gas expert at the International Energy Agency and co-edited the report.

"There will be increasing pressure on how LNG is traded. The key word will be adaptation in providing LNG to new customers at affordable prices," she predicted. "Is such a thing possible? That's something I think we could know and understand in the next 2-3 years."

Her co-editor, David Ledesma, said, "I think it's fair to say the global LNG market has been shaken up." Ledesma is a research fellow at the Oxford Institute for Energy Studies, which published the report, and a former specialist in developing complex integrated energy projects at Royal Dutch Shell PLC and other companies.

"Change is happening. It's uncomfortable. There are new players and new alliances. Evolving market structures are

driving the change. No one can say for certain where it is headed," Ledesma said.

### **Export capacity surged**

When Corbeau and Ledesma began to produce the report in mid-2014, only 100 million tonnes/year of LNG export capacity was under construction, including a single US project, Ledesma noted. When they finished it in May, 150 million tpy of capacity, including 64 million tpy in the US, which were scheduled to come on line in 2015-20, was being built, he said.

"We have uncertain regional demand outlooks," Ledesma said. "Asia will remain the market with the biggest demand, but it won't be homogenous. Europe could be a swing element because Russia wants to keep its market share through its pipelines. Norway and North Africa should not be dismissed as pipeline competitors to LNG there either."

Supplies also have surged on expectation that more LNG will be needed starting in 2020, Corbeau said. Australia is poised to become a major player with some delays, but possibly will overtake Qatar as the world's top supplier by 2020, she told her CSIS audience. The US could benefit not only from its growing gas production but also from having several former LNG import projects that can be reconfigured for exports with relative ease, Corbeau said.

"I think the consensus is that the market will be rebalanced between 2020 and 2025," she stated. "But if there's not demand to absorb this new LNG in Asia, Africa, and Latin America, there could be a major price war in Europe. Buyers also face a dilemma. Future demand in the next 10-20 years is uncertain. Many long-term contracts are expiring, and buyers are being pushed to spot or short-term purchases. But many export projects were built assuming there would be long-term contracts."

### **Overly optimistic expectations**

An expectation 5 years ago that there would be a golden age of gas presumed that unconventional production opportunities would be similar worldwide, according to Jonathan Stern, who founded the OEIS energy research program in 2003 and was its director until October 2011 when he became its chairman and a senior research fellow. "That hasn't occurred, especially in Europe where anyone thinking of drilling a well that requires hydraulic fracturing can expect to encounter a rent-a-mob who's against it," he said.

"Clean energy studies have replaced fossil-fuel programs in most European universities," said Stern, who contributed to the report. "The UK is the single bright spot because it looks as if its carbon pricing is beginning to work—finally. But I think we'll need to write Europe off as a significant unconventional fossil energy producer because the idea is so politically unpopular."

Christopher Caswell, KBR Inc.'s gas monetization director who prepared the report's technical appendix, noted that export project developers can reduce costs by picking

the best possible sites for projects that don't require special treatments to make high-quality LNG. "We've seen both small and huge modular projects, but haven't found the matrix in between. Repeatability is the key to modular projects, and it's not there yet," Caswell said.

CSIS Energy and National Security Program Senior Fellow Jane Nakano, who moderated the discussion, asked how countries with lower credit ratings will be engaged if they express interest in importing LNG. "It will be a problem for places like Thailand [and Tobago] and Pakistan, which already have domestic production that is declining. No government is good at facing up to this," said Howard Rogers, Stern's successor as OEIS energy research program director.

"I think traditional gas exporters like Egypt are going to have to rethink using middle men, which they have done for years," Ledesma said. Many African countries have low, but increasing, wholesale gas prices, but significant regulatory uncertain and payment issues, he said.

Corbeau noted, "We don't know where all of this is heading. It could be a very messy transition." **OGJ**

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## BOEM issues draft PEIS with stronger G&G protective measures for gulf

**Nick Snow**

Washington Editor

The US Bureau of Ocean Energy Management released a draft programmatic environmental impact statement (PEIS), which recommends stronger protections for marine mammals and environments in the Gulf of Mexico from potential impacts from oil and gas geophysical surveys.

The draft PEIS was a condition of a federal court settlement between BOEM and the Natural Resources Defense Council and other plaintiffs earlier this year, the agency said on Sept. 28. Comments will be accepted for 60 days following its scheduled Federal Register publication on Sept. 30. BOEM also scheduled five public meetings on the draft PEIS along the Gulf Coast beginning Nov. 9 in New Orleans.

Officials from oil and gas organizations quickly responded. "Seismic testing has been safely used in the US and around the world for decades to locate potential new sources of energy, and we will be reviewing the PEIS in the coming weeks," American Petroleum Institute Upstream Director Erik Milito said on Sept. 28.

"Marine life and commercial fishing have thrived in the Gulf of Mexico for more than 30 years while scientists and industry experts have used safe technology without a single case of harm to animals," Milito said.

The International Association of Geophysical Contractors also is evaluating the draft PEIS "to ensure BOEM's framework for permitting seismic exploration and suggested mitigation measures are proportionate to the level of risk of potential impacts to marine life, based on sound science and within [the US Department of the Interior agency's] existing legal framework," IAGC Pres. Nikki Martin said on Sept. 29.

IAGC supports science- and risk-based regulations that are consistent with existing practices that are proven to be effective and operationally feasible, she noted in an e-mail to OGJ. "We also appreciate the agencies moving forward with implementing a regulatory structure so G&G activities may continue uninterrupted in the future," Martin said.

A National Ocean Industries Association spokeswoman observed that the gulf is the primary source of the nation's offshore energy production, and seismic testing is crucial to locating oil and gas resources there.

"Seismic testing has been safely conducted for decades around the world and in the Gulf of Mexico where rich tourism and fishing industries coexist with and thrive alongside offshore oil and natural gas development," she said on Sept. 29. "We are currently reviewing the draft programmatic EIS and look forward to providing BOEM with constructive feedback."

BOEM said the draft PEIS evaluates potential environmental impacts of G&G surveys on marine mammals, fish, corals, and other environmentally sensitive species in the seabed and water column of the GOM's Outer Continental Shelf.

G&G activities addressed by the draft include deep-penetration and high-resolution seismic surveys, electromagnetic surveys, magnetic surveys, gravity surveys, remote-sensing surveys, and geological and geochemical sampling, it said.

BOEM said it is the lead agency on this draft PEIS, with the US Bureau of Safety and Environmental Enforcement and the National Marine Fisheries Service (NMFS) as cooperating agencies. The PEIS, which the agency hopes to complete by September 2017, will support both BOEM's G&G permitting and NMFS's Marine Mammal Protection Act decision-making for oil- and gas-related G&G activities.

In addition to the one in New Orleans on Nov. 9, BOEM will hold public meetings about the draft on Nov. 10 in Gulfport, Miss.; Nov. 14 in Fort Walton Beach, Fla.; Nov. 15 in Mobile, Ala.; and Nov. 17 in Houston. **OGJ**

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## Regulators urged to move faster on Pennsylvania pipeline projects

**Nick Snow**

Washington Editor

Three Pennsylvania trade associations called on federal and state regulators to move more quickly on their reviews of proposed natural gas pipelines in the commonwealth. Pro-



**NICK  
SNOW**

Washington Editor | Blog at [www.ogj.com](http://www.ogj.com)

longed delays of decisions could hurt not only producers unable to get their gas and gas liquids to markets, but also local communities that need impact fee revenue to help meet growing demand for basic services, they warned in a Sept. 28 teleconference with reporters.

“Today, the greatest challenge we have in Pennsylvania’s natural gas industry is the lack of necessary pipeline infrastructure to connect our gas production with other markets across America,” said Stephanie Catarino Wissman, executive director of the Associated Petroleum Industries of Pennsylvania (API-PA), a division of the American Petroleum Institute. “It is estimated that 25-30% of the wells drilled to date still do not have pipeline takeaway capacity.”

Many proposed pipelines across Pennsylvania could help relieve this problem, Wissman said. “For example, the Atlantic Sunrise and PennEast projects will deliver much-needed natural gas to millions of American homes by connecting producing regions in northeastern Pennsylvania to markets both here and in other states,” she said. “The Mariner East II will transport NGLs such as ethane and butane from eastern Ohio and southwestern Pennsylvania to the Marcus Hook industrial complex outside of Philadelphia.”

Gas liquids also can heat homes in the winter, power homes and businesses, and help provide a feedstock for Pennsylvania’s agricultural and manufacturing industries, Wissman said. “Recently, UGI received approval to build the Sunbury Pipeline from Lycoming County to the gas-fired power plant at Hummel station in Shamokin Dam. This project has been hailed by local and state elected leaders, regulators, and the business community as the answer to bringing more electricity to local users and also helping to meet clean power goals by using natural gas,” she said.

Pennsylvania has more than 60,000 miles of pipelines already, but more capacity is needed, Pennsylvania In-

## Mexico’s ASEA moves ahead

Mexico continues to make significant energy policy reforms. Some of its most important are taking place in its new National Agency for Safety, Energy, and Environment (ASEA). Much work has been done already, but significant challenges remain, according to ASEA Executive Director Carlos de Regules.

“We came up with some important definitions to provide what might be called our ‘lighthouse’ during our initial operations,” he said during an Oct. 3 discussion at the Woodrow Wilson International Center for Scholars. “We thought having a defined mission was important. We wanted to make sure that people got home safely from work each day, and that environmental protection remained paramount.”

ASEA is similar to its counterparts in other countries in some ways, and different in others. Its authority extends along Mexico’s entire oil and gas value chain from wellhead through transportation to the gasoline pump and burner tip. Hydrocarbons are largely unregulated in the country’s states and communities. Several federal nonenergy ministries have issued rules.

“When we started operations, we inherited 85,000 directives that we were able to bring down to a manageable 5,000,” Regules said. “Many had nothing to do with corrective enforcement, but were standard operations. We changed that.”

The agency’s core values emphasize professionalism, accessible transparency, impartiality, and timely decisions, he said. “You can produce very interesting regulation and authorization

processes, but if you don’t do it in a timely matter, it’s not worth much,” Regules observed.

ASEA has had to take some distinctive approaches to developing its regulatory model. It began by discussing safety and environmental approaches used by the US Bureau of Safety and Environmental Enforcement and other countries’ similar agencies. Then it decided to make its regulations goal-oriented instead of prescriptive, and adopt a risk management approach for regulators as well as operators.

It also worked with the companies it would be regulating. “We got together with each industry association to learn their best practices to produce relevant and pertinent regulations,” Regules said.

### *‘Right level of risk’*

“We’re trying to establish the right level of risk, and goal-oriented regulations allow the industry to apply its existing safety and environmental expertise,” he said. “By the end of 2016, we expect to issue 33 new environmental and safety regulations across the entire value stream.”

“One of the most refreshing aspects of Mexico’s energy reforms is that people are so open to talking about these things,” said the discussion’s moderator, Duncan Wood, who directs the Wilson Center’s Mexico Institute. “It’s the result of some very hard work, and it’s not like other parts of Mexico’s government. They have said they still have a lot to learn, which also is refreshing.” **OGJ**



dependent Oil & Gas Association Pres. Dan Weaver stated. Depressed gas prices have reduced the number of rigs drilling exploratory wells in the state to 22, but there are many completed wells that are increasing demand for more pipeline capacity, he said.

“New pipelines are essential to safely transport this abundant energy to underserved US markets, especially cities in the Northeast Corridor and New England where the demand for more affordable natural gas far exceeds the capacity of the present infrastructure,” Weaver said.

“Pennsylvania’s manufacturers need new in-state infrastructure to deliver energy and natural-gas feedstocks outside the Marcellus shale formation,” said Pennsylvania Manufacturers Association Pres. David Taylor. “There is a new petrochemical manufacturing industry waiting to be born that will create even more wealth than the drilling has, but only if we build new pipelines to connect Pennsylvania natural gas production with the industrial consumers who are waiting for it.”

The US Federal Energy Regulatory Commission is reviewing at least 14 proposed Northeast US pipelines, all originating from the Marcellus and Utica shale plays, the officials said. These projects have the potential to supply huge amounts of affordable gas and NGLs to support manufacturing as far away as Canada and the New England states to the north and North Carolina to the south, they said.

“If these projects are encouraged, Pennsylvania will encourage a generation of economic growth,” Taylor said. “It all depends on maximizing production and getting the infrastructure to move [the gas and liquids] to waiting customers.” **OGJ**

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## Saudis more intent on downstream assets than oil prices, speaker says

**Nick Snow**

Washington Editor

Saudi Arabia’s national oil company appears more intent on continuing to secure refining and petrochemical assets worldwide for its crude oil than on cutting production to stabilize or increase oil prices, observed Jean-Francois Seznec, a Middle East studies adjunct professor at Johns Hopkins University’s School of Advanced International Studies (SAIS).

“There’s a strategy here to make sure it has a base of users for the crude it produces,” he said during a Sept. 28 discussion at SAIS after citing Saudi Aramco’s recent and pending downstream acquisitions and new projects in the US, Yemen, Japan, South Korea, and elsewhere. “It looks as if 60-70% of its production will go to itself so it

can depend less on crude markets and [the Organization of Petroleum Exporting Countries].”

Seznec spoke soon after OPEC ministers at a special meeting in Algiers agreed to consider trimming member countries’ aggregate production by as much as 740,000 b/d in response to global crude prices falling by more than half in the last two years (OGJ Online, Sept. 29, 2016).

“As usual with OPEC production agreements, the devil will be in the details,” Seznec said. “It’s not clear if Russia—as the world’s largest producer at 11.4 million b/d—had a role.” Saudi Arabia has increased its production by 400,000 b/d since January to 10.6 million b/d, “which made a lot of people unhappy,” he said.

The kingdom’s new energy minister, Khalid Al-Falih, wields more influence than his predecessor because he also controls the electricity and other ministries, Seznec said. He noted that a Saudi prince now controls an oversight committee at Aramco, but added, “Not one Saudi Aramco board member or senior manager is a royal family member. The engineers who control the oil there also are starting to control the general economy.”

He said he expects Aramco to have only limited success in going public because the country’s reserves and inventories are so opaque. “In terms of day-to-day operations, it probably is more transparent than Exxon-Mobil. It’s less so when it comes to ownership and who has access to the money,” Seznec said. “Other state oil companies have to turn their revenue over to finance ministries and then ask for some of it back for their operations. Saudi Aramco keeps its money and has complete access.” **OGJ**

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## EIA: US petroleum product exports rose in first half

The US exported 4.7 million b/d of petroleum products in this year’s first half, an increase of 500,000 b/d over first-half 2015 and almost 10 times the crude export volume, according to data from the US Energy Information Administration.

Propane exports increased by more than 230,000 b/d in this year’s first half compared with the same period in 2015, surpassing motor gasoline to become the second-largest US petroleum product export, after distillate, EIA said. US exports of distillate and gasoline increased 50,000 b/d and nearly 140,000 b/d, respectively, in the first half of this year.

Mexico, Canada, and the Netherlands remain the major export destinations of US petroleum product exports in this year’s first half, importing a respective 775,000 b/d, 579,000 b/d, and 271,000 b/d.

“US petroleum products tend to stay in the Western Hemisphere. In 2015, approximately 60% of total petroleum

product exports remained within the Western Hemisphere, down slightly from 65% in 2005,” EIA said.

Distillate exports averaged 1.2 million b/d in this year’s first half, an increase of 50,000 b/d from the same period in 2015. Central and South America accounted for the largest share of US distillate exports, averaging more than 620,000 b/d in this year’s first half, an increase of more than 30,000 b/d from the same period in 2015. The largest single destination overall for US distillate exports was Mexico, which averaged 147,000 b/d in this year’s first half.

US propane exports increased from 562,000 b/d in first-half 2015 to 793,000 b/d in the same period of 2016, with exports to Asia and Oceania accounting for 94% of this growth. Japan imported the most US propane at 159,000 b/d in this year’s first half, an increase of 111,000 b/d from the same period of 2015, while US exports of propane to Panama, however, fell from 41,000 b/d in the first half of 2015 to 7,000 b/d in this year’s first half.

“The large increases in propane exports to Japan and decreases in propane exports to Panama could be a result of reduced ship-to-ship transfer activity. Some of the propane exports from the United States that undergo ship-to-ship transfers will cite the location of the transfer and not the final destination of the propane. This often results in larger-than-actual export numbers for the countries where the ship-to-ship transfers take place and in less-than-actual numbers for some final destinations,” EIA said.

Gasoline exports increased 138,000 b/d in this year’s first half compared with first-half 2015. North America (Canada and Mexico) accounted for most of the growth, with an increase of 92,000 b/d. Mexico represented the largest single recipient of US gasoline exports at 363,000 b/d in this year’s first half, up from 283,000 b/d in first-half 2015.

In January, as part of the liberalization process, Mexico began to allow companies besides Petroleos Mexicanos to import fuels, resulting in increased exports from nearby refineries along the US Gulf Coast. **OGJ**

## NGSA: Record winter gas demand will be matched by enough supply

Colder weather forecasts and greater demand for natural gas than last winter are expected to place upward pressure on gas prices this winter compared with last winter’s unusually low prices, the Natural Gas Supply Association said in its 2016-17 Winter Outlook assessment of the wholesale gas market.

Combined demand from all the major customer segments—residential and commercial, industrial, electric, and exports—will reach a record level of 92.3 bcf/d this winter, primarily due to the forecast 12% colder winter, NGSA said.

The association also underscored that gas supplies are

ample to meet winter demand, and that reliability is further enhanced by an anticipated near-record amount of gas in underground storage.

“The picture that emerged for the upcoming winter is one of a flexible natural gas market that is able to respond to changes in weather and customer demand with ample supply and full storage facilities. Because of colder weather and growth in demand for natural gas, NGSA anticipates upward pressure on prices compared to last winter,” said Bill Green, NGSA chairman and vice-president, downstream marketing, for Devon Energy Corp.

“We’d like consumers to keep in mind that wholesale natural gas prices were unusually low last winter due to record warm winter weather,” Green said. “Last winter, wholesale prices averaged less than \$2/MMbtu, the lowest since the ’90s and that’s not just because the winter was so mild. It’s also because of abundant gas from shale, with even more gas on tap from storage and a flexible and responsive pipeline infrastructure system.”

### Key demand factors

The forecast colder winter is expected to increase gas demand from the residential and commercial segments by a combined average of 4 bcf/d, according to Energy Ventures Analysis (EVA).

Industrial segment demand this winter is projected to set a new record, although it will increase only 0.7 bcf/d compared with last winter. New builds and capacity expansions in the gas-intensive petrochemical and fertilizer industries continue to drive demand. NGSA said 71 capacity expansions and newbuild projects in these industries are planned over 2015-21, consuming an estimated 3.7 bcf/d more of gas by 2021.

Growth in exports to Mexico as well as exports of LNG contribute to the increased demand, winter-over-winter. EVA projects Mexican exports to rise 0.8 bcf/d and LNG exports to average an additional 0.8 bcf/d. “While LNG exports are growing, they remain a very small slice of overall demand,” Green said.

Electric sector demand is expected to decline 3.3 bcf/d this winter, attributable to less fuel switching. EVA forecasts significantly less short-term fuel switching to gas than last winter because of expected higher gas prices.

“NGSA anticipates temporary fuel-switching to natural gas to continue this winter, but at about half the volumes that took place during last winter’s record-setting fuel switching,” said Green. In fact, the US Energy Information Administration credits the power sector’s increased use of gas in 2015 to reducing carbon dioxide emissions to the lowest levels since 1993.

### Key supply factors

Turning to this winter’s gas supply fundamentals, the outlook projects a winter of robust production, although production will drop slightly by 0.5 bcf/d from last year’s record

high. There is potential for record inventory of gas in storage, similar to last winter. About 16% of winter supply comes from storage on average.

Green said, “The shale revolution has ushered in a remarkable era, as evidenced by dramatic growth in production over the last 9 years. Despite the low rig count, this winter’s supply is expected to remain robust because of drilling efficiencies and new infrastructure coming online to move natural gas to customers.”

Green said, “The important takeaway is the strength and responsiveness of natural gas supply. When you take into account the expectation for record storage and the strength and flexibility of the natural gas pipeline system, the industry is well-positioned to meet record demand from consumers.” **OGJ**

## Teamsters, unions question Dakota Access reconsideration

**Nick Snow**

Washington Editor

The Obama administration’s decision to withdraw and reconsider permits it issued for the proposed Dakota Access crude oil pipeline raises serious questions about the future of building US systems and the livelihoods of the project’s construction workers, general presidents of the International Brotherhood of Teamsters and four other labor unions said (OGJ Online, Sept. 12, 2016).

“The project is being built with an all-union workforce and workers are earning family-sustaining wages, with family health care and retirement contributions,” they said in an Oct. 3 letter to US President Barack Obama. “However, the project delays are already putting members out of work and causing hardships for thousands of families.”

The Sept. 9 decision to withdraw a US Army Corps of Engineers permit for a portion of the proposed 1,172-mile, 30-in. pipeline—that would connect the Bakken and Three Forks production areas in North Dakota to Patoka, Ill.—came months after the project won final state and federal approvals after more than 4 years of state and federal reviews, the letter said.

It said the withdrawal and reconsideration decision also came hours after Judge James F. Boasberg of US District Court for the District of Columbia denied a request for a preliminary injunction by the Standing Rock Sioux Indian tribe and other opponents who argued that consultations had not been adequate.

Boasberg concluded that “not only had the US Army Corps likely met its National Environmental Policy Act and National Historic Preservation Act consultation obligations, it appeared to have exceeded the requirements in most cases,” the letter said. “In fact, the [Corps] held 389 meetings

with 55 tribes on the Dakota Access project.”

The union leaders warned that the precedent created by “this extraordinary intervention following the conclusion of the regulatory process is chilling for future investment in necessary US systems—from highways and bridges to ports and factories.

“Our members make careers out of jobs created by projects like Dakota Access, and our jobs depend on the investments of conscientious employers,” they said. “If companies like Energy Transfer Partners cannot trust that the regulatory process outlined in federal law will be upheld, who will continue to invest in America? The family-sustaining jobs and benefits that this project provides are in jeopardy.”

General presidents of the International Union of Operating Engineers; Laborers International Union of North America; United Association of Plumbers, Fitters, Welders & Service Techs; and International Brotherhood of Electrical Workers joined Teamsters GP James P. Hoffa in signing the letter.

A sixth organized labor leader—North American Building Trades Unions Pres. Sean McGarvey—expressed similar concerns during a teleconference with reporters that also included American Petroleum Institute Pres. Jack N. Gerard (OGJ Online, Sept. 13, 2016). **OGJ**

## Chevron’s Salt Lake City refinery plans alkylation unit revamp

**Robert Brelsford**

Downstream Technology Editor

Chevron Corp. is planning to convert the existing 4,500-b/d hydrofluoric acid (HF) alkylation unit at its 53,000-b/d refinery in Salt Lake City, Utah, into the first-ever alkylation unit in the US based on ionic liquids (IL) alkylation technology.

Chevron will convert the existing 4,500-b/d HF alkylation unit at Salt Lake City to ISOALKY, a proprietary alkylation technology developed by Chevron USA Inc. and now licensed by Honeywell International Inc.’s UOP LLC, that uses ionic liquids instead of HF or sulfuric acids as a liquid alkylation catalyst for production of high-octane fuels, UOP said.

Alongside increasing C<sub>3</sub>-C<sub>5</sub> olefin feed flexibility and lower handling risks vs. HF and sulfuric acid, ISOALKY enables catalyst regeneration to occur within the unit itself, lowering catalyst consumption by 400 times vs. sulfuric acid, according to the technology licensor.

Pending permit approvals, construction on the conversion project is scheduled to begin in 2017, with the ISO-ALKY unit due for startup in 2020.

Once the unit is fully commissioned, Chevron will permanently remove the refinery's HF-specific equipment as well as inventory of HF acid, UOP said.

While neither Chevron nor UOP disclosed further details surrounding the project, UOP did confirm Chevron's decision to move forward with the proposed unit revamp follows results of ISOALKY's performance in a 5-year pilot study carried out in a small demonstration unit at the Salt Lake City refinery.

### Existing IL technologies

Announcement of Chevron's proposed HF-to-IL unit conversion follows the South Coast Air Quality Management District (SCAQMD) of California's release of an alkylation technology study by Norton Engineering Inc., Montville, NJ, that recommends sulfuric acid alkylation and solid acid alkylation as the most commercially available and potentially feasible technology for replacing HF alkylation units at refineries in SCAQMD's region.

SCAQMD is air pollution-control agency responsible for all of Orange County as well as urban portions of Los Angeles, Riverside, and San Bernardino counties.

Commissioned by SCAQMD, the independent study concludes commercialization of IL alkylation technology requires additional optimization and testing to be considered viable as a replacement technology for existing HF units in the district.

IL alkylation technology, however, already has been successfully employed on both pilot and commercial-scale bases in China in a retrofit of a sulfuric acid alkylation unit as well as construction of a grassroots unit.

Following 8 months of extensive bench-scale laboratory testing and a subsequent 60 days of operation in a continuous-flow pilot unit, PetroChina Co. Ltd., a unit of China National Petroleum Corp., retrofitted an existing 65,000-tonne/year sulfuric acid alkylation unit at one of its refineries

with Beijing-based China University of Petroleum's (CUP) Ionikylation process, which uses a more highly selective, composite IL catalyst vs. other IL alkylation processes (OGJ, Oct. 23, 2006, p. 52).

While the SCAQMD-commissioned study contends the industrial-scale test was limited to 5 days, the unit in fact continued to run cyclically for about 3 years until changes in C4-feedstock pricing made ongoing operation economically unappealing, an individual familiar with the project told OGJ.

Chinese independent refiner Deyang Chemical Co. Ltd. subsequently selected Ionikylation for construction of grassroots alkylation unit in its manufacturing operations in Dongying Economic Development Zone, Dongying City, Shandong Province.

Intended to help meet increased demand for cleaner motor fuels both in China and abroad, the 2,000-b/d Ionikylation unit was commissioned in 2013 and remains in operation today, according to descriptions on Deyang Chemical and CUP's web sites. **OGJ**

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## THE EDITOR'S PERSPECTIVE

# OPEC will find production quotas hard to reinstate

by **Bob Tippee**, Editor

*Country-by-country coordination of oil supply is more difficult now than it was in past efforts by the Organization of Petroleum Exporting Countries to make it work.*

*The strategy nevertheless lies at the core of a vague plan OPEC ministers described in Algiers on Sept. 28.*

*With supply coordination, OPEC has been fairly successful. The average price of crude oil since the 1970s is higher than it would have been if the group hadn't restrained production.*

*But it's a clumsy project.*

*OPEC confronts the classic hazard of cartels: Price elevation born of supply restraint tempts participants with spare capacity to cheat—and they do.*

*Compounding the challenge are conflicting interests and outright antagonisms among OPEC members.*

*OPEC has muddled through with pragmatic flexibility, adapting policy to economic and political imperatives—such as by abandoning country quotas when the tactic proved inconvenient or unnecessary. And while OPEC held low-cost production idle, rising crude prices summoned high-cost supply to market.*

*The consequent surplus, aggravated by surging production from unconventional resources, crushed prices. The market is shedding high-cost supply mercilessly.*

*OPEC said that at a Nov. 30 meeting in Vienna it will repropose country quotas targeting group output of 32.5-33 million b/d.*

*For at least three reasons, cooperative production cuts of as much as 740,000 b/d will be elusive:*

- *Unprecedented hostility between Saudi Arabia and Iran amplifies the geopolitical dimension of OPEC decision-making.*

- *The group now competes against supply quickly available from tight-oil plays; formerly, it controlled all prompt supply and didn't face immediate loss of market share.*

- *An implied condition, cooperation of non-OPEC producers—mainly Russia—has not worked before and remains problematic. State domination of Russian oil companies notwithstanding, Moscow doesn't directly control production.*

*The only force able to rally producers to effective production restraint is shared pain intense enough to make all participating producers ignore other interests. No reason exists to think pain has reached that level among the crucial parties—especially when some of them want others to hurt.*

**(From the subscription area of [www.ogj.com](http://www.ogj.com), posted Sept. 30, 2016; author's e-mail: [bobt@ogjonline.com](mailto:bobt@ogjonline.com))**

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## IMPORTS OF CRUDE AND PRODUCTS

	— Districts 1-4 —		— District 5 —		— Total US —		
	9-23 2016	9-16 2016	9-23 2016	9-16 2016	9-23 2016	9-16 2016	9-25* 2015
	1,000 b/d						
Total motor gasoline.....	750	544	28	25	778	569	989
Mo. gas. blending comp.....	717	535	13	13	730	548	908
Distillate.....	98	72	46	5	144	77	55
Residual.....	98	88	79	61	177	149	185
Jet fuel-kerosine.....	14	117	73	30	87	147	27
Propane-propylene.....	65	64	19	19	84	83	55
Other.....	875	949	(2)	60	873	1,009	780
<b>Total products.....</b>	<b>1,900</b>	<b>1,834</b>	<b>243</b>	<b>200</b>	<b>2,143</b>	<b>2,034</b>	<b>2,091</b>
<b>Total crude.....</b>	<b>6,637</b>	<b>6,789</b>	<b>1,197</b>	<b>1,520</b>	<b>7,834</b>	<b>8,309</b>	<b>7,554</b>
<b>Total imports.....</b>	<b>8,537</b>	<b>8,623</b>	<b>1,440</b>	<b>1,720</b>	<b>9,977</b>	<b>10,343</b>	<b>9,645</b>

\*Revised.  
Source: US Energy Information Administration  
Data available at PennEnergy Research Center.

## EXPORTS OF CRUDE AND PRODUCTS

	9-23-16	Total US 9-16-16	*9-25-15
	1,000 b/d		
Finished motor gasoline	547	606	513
Jet fuel-kerosine	229	187	143
Distillate	1,355	1,303	1,342
Residual	394	193	418
Propane/propylene	578	1,075	589
Other oils	1,854	1,784	1,030
<b>Total products</b>	<b>4,957</b>	<b>5,148</b>	<b>4,035</b>
<b>Total crude</b>	<b>507</b>	<b>588</b>	<b>526</b>
<b>Total exports</b>	<b>5,464</b>	<b>5,736</b>	<b>4,561</b>
<b>NET IMPORTS</b>			
Total	4,514	4,607	5,084
Products	(2,814)	(3,114)	(1,944)
Crude	7,328	7,721	7,028

\*Revised.  
Source: Oil & Gas Journal  
Data available at PennEnergy Research Center.

## CRUDE AND PRODUCT STOCKS

District	Crude oil	— Motor gasoline —			— Fuel oils —		Propane-propylene
		Total	Blending comp.	Jet fuel, kerosine 1,000 bbl	Distillate	Residual	
PADD 1.....	14,239	56,250	51,899	9,237	66,055	11,715	7,691
PADD 2.....	146,639	50,569	44,209	7,271	33,444	1,371	28,994
PADD 3.....	264,694	84,995	74,335	16,310	44,508	23,458	62,778
PADD 4.....	25,227	6,753	4,995	898	3,813	136	<sup>1</sup> 3,801
PADD 5.....	51,916	28,615	26,329	9,335	15,257	4,578	—
<b>Sept. 23, 2016.....</b>	<b>502,715</b>	<b>227,182</b>	<b>201,767</b>	<b>43,051</b>	<b>163,077</b>	<b>41,258</b>	<b>103,264</b>
<b>Sept. 16, 2016.....</b>	<b>504,598</b>	<b>225,156</b>	<b>200,976</b>	<b>42,647</b>	<b>164,993</b>	<b>40,656</b>	<b>101,749</b>
<b>Sept. 25, 2015<sup>2</sup>.....</b>	<b>457,925</b>	<b>222,010</b>	<b>193,751</b>	<b>40,095</b>	<b>151,608</b>	<b>39,810</b>	<b>98,741</b>

<sup>1</sup>Includes PADD 5. <sup>2</sup>Revised.  
Source: US Energy Information Administration  
Data available at PennEnergy Research Center.

## REFINERY REPORT—SEPT. 23, 2016

District	REFINERY OPERATIONS		REFINERY OUTPUT				
	Gross inputs	Crude oil inputs	Total motor gasoline	Jet fuel, kerosine	Fuel oils		Propane-propylene
	1,000 b/d		1,000 b/d		1,000 b/d		
PADD 1.....	1,064	1,073	3,179	75	320	46	145
PADD 2.....	3,586	3,585	2,594	249	1,026	53	399
PADD 3.....	8,682	8,577	2,240	838	2,633	198	959
PADD 4.....	648	646	333	40	224	11	<sup>1</sup> 179
PADD 5.....	2,627	2,453	1,627	503	506	80	—
<b>Sept. 23, 2016.....</b>	<b>16,607</b>	<b>16,334</b>	<b>9,973</b>	<b>1,705</b>	<b>4,709</b>	<b>388</b>	<b>1,682</b>
<b>Sept. 16, 2016.....</b>	<b>16,963</b>	<b>16,588</b>	<b>9,888</b>	<b>1,714</b>	<b>4,978</b>	<b>464</b>	<b>1,761</b>
<b>Sept. 25, 2015<sup>2</sup>.....</b>	<b>16,182</b>	<b>15,963</b>	<b>9,599</b>	<b>1,534</b>	<b>5,011</b>	<b>421</b>	<b>1,564</b>
	<b>18,436 Operable capacity</b>		<b>90.1 utilization rate</b>				

<sup>1</sup>Includes PADD 5. <sup>2</sup>Revised.  
Source: US Energy Information Administration  
Data available at PennEnergy Research Center.

## OGJ CRACK SPREAD

	9-30-16*	10-2-15*	Change	Change,
	\$/bbl			%
<b>SPOT PRICES</b>				
Product value	60.96	59.53	1.43	2.40
Brent crude	46.74	46.99	(0.24)	(0.52)
Crack spread	14.22	12.55	1.67	13.34

## FUTURES MARKET PRICES

<b>One month</b>				
Product value	61.09	59.61	1.48	2.48
Light sweet crude	46.66	45.01	1.65	3.67
Crack spread	14.43	14.61	(0.18)	(1.22)
<b>Six month</b>				
Product value	61.37	63.28	(1.91)	(3.01)
Light sweet crude	49.38	47.73	1.65	3.46
Crack spread	11.99	15.55	(3.55)	(22.85)

\*Average for week ending.  
Source: Oil & Gas Journal  
Data available at PennEnergy Research Center.

# STATISTICS

## OGJ GASOLINE PRICES

	Price ex tax 9-28-16	Pump price* 9-28-16 ¢/gal	Pump price 9-30-15
(Approx. prices for self-service unleaded gasoline)			
Atlanta	158.5	207.9	212.8
Baltimore	164.9	215.9	216.8
Boston	161.0	205.9	215.1
Buffalo	155.6	216.7	222.1
Miami	150.7	205.7	224.0
Newark	171.1	204.0	209.8
New York	178.9	239.9	227.4
Norfolk	193.8	234.5	205.8
Philadelphia	146.5	215.3	227.0
Pittsburgh	162.9	231.7	226.0
Wash., DC	187.0	228.9	224.9
PAD I avg	166.4	218.8	219.3
Chicago	220.6	269.2	276.5
Cleveland	171.8	218.2	225.7
Des Moines	164.8	215.2	254.4
Detroit	166.3	215.2	243.5
Indianapolis	167.9	216.2	227.7
Kansas City	162.5	198.2	220.3
Louisville	170.8	215.2	247.2
Memphis	178.4	218.2	206.6
Milwaukee	156.9	208.2	257.9
Minn.-St. Paul	164.2	211.2	244.5
Oklahoma City	155.3	190.7	224.2
Omaha	160.1	206.2	232.5
St. Louis	165.5	201.2	204.8
Tulsa	158.4	193.8	215.5
Wichita	163.8	206.2	222.0
PAD II avg	168.5	212.2	233.5
Albuquerque	152.8	190.1	204.8
Birmingham	164.3	203.6	201.7
Dallas-Fort Worth	160.3	198.7	198.8
Houston	160.2	198.6	198.8
Little Rock	158.5	198.7	205.9
New Orleans	161.7	200.2	203.6
San Antonio	159.1	197.5	204.0
PAD III avg	159.6	198.2	202.5
Cheyenne	173.4	215.8	251.4
Denver	186.6	227.0	257.9
Salt Lake City	181.8	229.6	253.9
PAD IV avg	180.6	224.1	254.4
Los Angeles	245.8	304.8	318.7
Phoenix	183.3	220.7	228.2
Portland	179.7	229.2	262.6
San Diego	220.2	279.2	314.6
San Francisco	225.8	284.8	305.6
Seattle	199.3	262.2	281.6
PAD V avg	209.0	263.5	285.2
<b>Week's avg.</b>	<b>173.1</b>	<b>219.8</b>	<b>233.5</b>
<b>Sept. avg.</b>	<b>174.3</b>	<b>221.0</b>	<b>242.3</b>
<b>Aug. avg.</b>	<b>170.1</b>	<b>216.7</b>	<b>264.7</b>
<b>2016 to date</b>	<b>162.8</b>	<b>209.5</b>	—
<b>2015 to date</b>	<b>203.1</b>	<b>250.4</b>	—

\*Includes state and federal motor fuel taxes and state sales tax. Local governments may impose additional taxes. Source: Oil & Gas Journal. Data available at PennEnergy Research Center.

## BAKER HUGHES RIG COUNT

	9-30-16	10-2-15
Alabama	2	3
Alaska	7	11
Arkansas	1	4
California	6	13
Land	6	12
Offshore	0	1
Colorado	20	30
Florida	0	0
Illinois	2	3
Indiana	0	0
Kansas	0	10
Kentucky	1	0
Louisiana	41	66
N. Land	14	27
S. Land	3	2
S. Land waters	4	8
Offshore	20	29
Maryland	0	0
Michigan	0	0
Mississippi	3	5
Montana	0	1
Nebraska	0	1
New Mexico	30	46
New York	0	0
North Dakota	30	65
Ohio	14	20
Oklahoma	68	97
Pennsylvania	23	30
South Dakota	0	0
Texas	245	357
Offshore	1	0
Inland waters	0	1
Dist. 1	21	40
Dist. 2	11	37
Dist. 3	7	24
Dist. 4	7	14
Dist. 5	7	7
Dist. 6	8	16
Dist. 7B	6	4
Dist. 7C	20	33
Dist. 8	135	153
Dist. 8A	13	13
Dist. 9	1	3
Dist. 10	8	12
Utah	5	5
West Virginia	10	18
Wyoming	13	24
Others NV-1	1	0
<b>Total US</b>	<b>522</b>	<b>809</b>
<b>Total Canada</b>	<b>162</b>	<b>179</b>
<b>Grand total</b>	<b>684</b>	<b>988</b>
US oil rigs	425	614
US gas rigs	96	195
Total US offshore	22	30
<b>Total US cum. avg. YTD</b>	<b>487</b>	<b>1,052</b>

Rotary rigs from spudding in to total depth. Definitions, see OGJ Sept. 18, 2006, p. 46. Source: Baker Hughes Inc. Data available at PennEnergy Research Center.

## OGJ PRODUCTION REPORT

	9-30-16 1,000 b/d	210-2-15
(Crude oil and lease condensate)		
Alabama	18	27
Alaska	450	457
California	530	571
Colorado	305	348
Florida	6	7
Illinois	22	26
Kansas	96	132
Louisiana	1,275	1,327
Michigan	16	18
Mississippi	52	69
Montana	60	77
New Mexico	355	410
North Dakota	1,030	1,196
Ohio	60	73
Oklahoma	300	428
Pennsylvania	15	19
Texas	3,540	3,738
Utah	78	101
West Virginia	20	23
Wyoming	185	235
Other states	49	44
<b>Total</b>	<b>8,462</b>	<b>9,326</b>

<sup>1</sup>OGJ estimate. <sup>2</sup>Revised. Source: Oil & Gas Journal. Data available at PennEnergy Research Center.

## US CRUDE PRICES

	9-30-16 \$/bbl*
Alaska-North Slope 27°	37.05
Light Louisiana Sweet	43.61
California-Midway Sunset 13°	39.05
California Buena Vista Hills 26°	49.20
Wyoming Sweet	44.49
East Texas Sweet	42.50
West Texas Sour 34°	40.00
West Texas Intermediate	45.00
Oklahoma Sweet	45.00
Texas Upper Gulf Coast	38.75
Michigan Sour	37.00
Kansas Common	43.75
North Dakota Sweet	36.25

\*Current major refiner's posted prices except N. Slope lags 2 months. 40° gravity crude unless differing gravity is shown. Source: Oil & Gas Journal. Data available at PennEnergy Research Center.

## WORLD CRUDE PRICES

OEPC reference basket	Wkly. avg.	9-30-16	\$/bbl
		Mo. avg.,	43.13
		July-16	Aug.-16
OEPC reference basket			
Arab light-Saudi Arabia	42.68	43.10	43.10
Basrah light-Iraq	43.14	43.47	43.47
Bonny light 37°-Nigeria	41.37	42.01	42.01
Es Sider-Libya	45.30	46.35	46.35
Girassol-Angola	44.00	44.85	44.85
Iran heavy-Iran	45.09	46.06	46.06
Kuwait export-Kuwait	41.59	42.17	42.17
Marine-Qatar	41.37	41.88	41.88
Mery-Venezuela	43.53	43.44	43.44
Minas 34°-Indonesia	36.71	36.46	36.46
Murban-UAE	41.84	41.26	41.26
Oriente-Ecuador	46.54	46.25	46.25
Saharan blend 44°-Algeria	40.72	40.84	40.84
Other crudes	45.30	46.35	46.35
Fateh 32°-Dubai	42.64	43.58	43.58
Isthmus 33°-Mexico	45.07	44.22	44.22
Brent 38°-UK	45.00	45.85	45.85
Urals-Russia	43.76	44.06	44.06
Differentials			
WTI/Brent	(0.10)	(1.10)	(1.10)
Brent/Dubai	2.36	2.27	2.27

Source: OPEC Monthly Oil Market Report. Data available at PennEnergy Research Center.

## US NATURAL GAS STORAGE<sup>1</sup>

	9-23-16	9-16-16	9-23-15	Change, %
	bcf	bcf	bcf	
East	874	851	830	5.3
Midwest	1,014	985	942	7.6
Mountain	233	230	200	16.5
Pacific	318	318	354	(10.2)
South Central	1,161	1,167	1,183	(1.9)
Salt	275	278	318	(13.5)
Nonsalt	885	889	864	2.4
<b>Total US</b>	<b>3,600</b>	<b>3,551</b>	<b>3,509</b>	<b>2.6</b>
	<b>July-16</b>	<b>July-15</b>	<b>Change,</b>	<b>%</b>
<b>Total US<sup>2</sup></b>	<b>3,329</b>	<b>2,933</b>	<b>13.5</b>	

<sup>1</sup>Working gas. <sup>2</sup>At end of period. Source: Energy Information Administration. Data available at PennEnergy Research Center.

## REFINED PRODUCT PRICES

	9-23-16 ¢/gal	9-23-16 ¢/gal
<b>Spot market product prices</b>		
Motor gasoline	No. 2 Distillate	
(Conventional-regular)	Low sulfur diesel fuel	
New York Harbor	New York Harbor	139.90
Gulf Coast	Gulf Coast	138.40
	Los Angeles	144.90
Motor gasoline	Kerosine jet fuel	
(RBOB-regular)	Gulf Coast	129.90
New York Harbor		
No. 2 heating oil	Propane	
New York Harbor	Mont Belvieu	52.50

Source: EIA Weekly Petroleum Status Report. Data available at PennEnergy Research Center.

## IHS PETRODATA RIG COUNT

	SEPT. 30, 2016			
	Total supply of rigs	Marketed supply of rigs	Marketed contracted	Marketed utilization rate (%)
US Gulf of Mexico	103	48	34	70.8
South America	50	43	37	86.1
Northwest Europe	108	86	63	73.3
West Africa	70	53	27	50.9
Middle East	170	159	121	76.1
Southeast Asia	94	79	40	50.6
Worldwide	834	681	480	70.5

Source: IHS Petrodata. Data available at PennEnergy Research Center.

## WORLDWIDE CRUDE OIL AND GAS PRODUCTION

	July 2016	June 2016	7 month average production		Change vs. previous year		July 2016	June 2016	Cum. 2016
			2016	2015	Volume	%			
			Crude, 1,000 b/d						
Argentina.....	512	500	516	533	(17)	(3.2)	112.3	108.1	749.28
Bolivia.....	50	50	50	50	—	—	65.0	65.0	455.00
Brazil.....	2,586	2,564	2,415	2,429	(14)	(0.6)	84.0	83.5	615.14
Canada.....	3,100	3,109	3,432	3,662	(231)	(6.3)	455.0	454.5	3,248.16
Colombia.....	850	890	927	987	(60)	(6.1)	30.0	30.0	210.00
Ecuador <sup>1</sup> .....	550	550	546	544	1	0.3	1.0	1.0	7.00
Mexico.....	2,157	2,178	2,197	2,265	(69)	(3.0)	179.3	176.4	1,282.20
Peru.....	42	37	43	60	(17)	(28.1)	46.9	39.8	272.92
Trinidad.....	66	69	72	81	(9)	(11.1)	99.0	100.2	730.80
United States.....	8,685	8,701	8,961	9,421	(460)	(4.9)	2,372.0	2,309.0	16,677.66
Venezuela <sup>1</sup> .....	2,150	2,160	2,270	2,414	(144)	(6.0)	68.0	68.0	476.00
Other Latin America.....	86	86	86	89	(3)	(3.1)	4.5	4.5	32.00
<b>Western Hemisphere.....</b>	<b>20,834</b>	<b>20,894</b>	<b>21,514</b>	<b>22,535</b>	<b>(1,022)</b>	<b>(4.5)</b>	<b>3,517.1</b>	<b>3,440.0</b>	<b>24,756.16</b>
Austria.....	14	19	14	17	(3)	(17.8)	3.6	2.9	24.19
Denmark.....	141	153	140	158	(18)	(11.3)	13.5	14.7	90.69
France.....	17	16	17	17	—	1.7	0.1	0.1	0.76
Germany.....	46	46	46	46	1	1.2	21.0	21.2	156.89
Italy.....	23	28	55	98	(44)	(44.3)	14.7	14.3	113.71
Netherlands.....	10	10	18	28	(10)	(36.2)	105.8	103.0	1,099.05
Norway.....	1,754	1,474	1,628	1,599	29	1.8	372.0	370.8	2,646.42
Turkey.....	49	51	49	48	1	1.8	1.1	1.1	8.12
United Kingdom.....	977	927	997	876	121	13.8	118.1	100.5	793.66
Other Western Europe.....	5	5	5	7	(2)	(27.1)	3.2	3.2	22.24
<b>Western Europe.....</b>	<b>3,036</b>	<b>2,729</b>	<b>2,969</b>	<b>2,893</b>	<b>76</b>	<b>2.6</b>	<b>653.0</b>	<b>631.9</b>	<b>4,955.72</b>
Azerbaijan.....	844	800	802	868	(66)	(7.6)	54.0	54.4	386.72
Croatia.....	14	14	14	12	2	14.3	5.4	5.2	37.50
Hungary.....	14	14	14	12	2	19.8	5.3	5.3	37.75
Kazakhstan.....	1,308	1,303	1,331	1,336	(4)	(0.3)	137.7	137.7	946.42
Romania.....	76	76	76	80	(4)	(4.6)	27.7	26.2	213.08
Russia.....	10,268	10,226	10,332	10,118	214	2.1	1,564.4	1,529.1	12,439.26
Other FSU.....	441	480	410	420	(10)	(2.4)	649.1	561.1	3,526.81
Other Eastern Europe.....	61	61	61	57	5	8.0	25.7	25.6	182.13
<b>Eastern Europe and FSU.....</b>	<b>13,026</b>	<b>12,974</b>	<b>13,040</b>	<b>12,903</b>	<b>138</b>	<b>1.1</b>	<b>2,469.3</b>	<b>2,344.7</b>	<b>17,769.67</b>
Algeria <sup>1</sup> .....	1,110	1,100	1,100	1,109	(9)	(0.8)	230.0	230.0	1,610.00
Angola <sup>1</sup> .....	1,760	1,740	1,754	1,771	(17)	(1.0)	4.0	4.0	28.00
Cameroon.....	82	82	82	82	—	—	2.0	2.0	14.00
Congo (former Zaire).....	28	28	28	28	—	—	0.0	0.0	0.00
Congo (Brazzaville).....	290	290	290	290	—	—	0.0	0.0	0.00
Egypt.....	684	684	684	688	(4)	(0.5)	127.0	127.0	889.00
Equatorial Guinea.....	248	248	248	248	—	—	0.1	0.1	0.42
Gabon.....	260	260	260	260	—	—	0.3	0.3	2.10
Libya <sup>1</sup> .....	300	320	334	409	(74)	(18.2)	45.0	45.0	315.00
Nigeria <sup>1</sup> .....	1,460	1,510	1,620	1,801	(181)	(10.1)	70.0	70.0	490.00
Sudan.....	258	258	258	258	—	—	0.0	0.0	0.00
Tunisia.....	47	47	47	51	(4)	(8.1)	7.5	7.5	52.52
Other Africa.....	285	285	285	285	—	—	7.8	7.8	54.41
<b>Africa.....</b>	<b>6,812</b>	<b>6,852</b>	<b>6,991</b>	<b>7,280</b>	<b>(289)</b>	<b>(4.0)</b>	<b>493.6</b>	<b>493.6</b>	<b>3,455.45</b>
Bahrain.....	48	50	49	51	(1)	(2.5)	32.0	32.0	224.00
Iran <sup>1</sup> .....	3,630	3,620	3,414	2,839	576	20.3	465.0	465.0	3,255.00
Iraq <sup>1</sup> .....	4,320	4,250	4,290	3,781	509	13.4	87.4	82.0	584.69
Kuwait <sup>1,2</sup> .....	2,870	2,870	2,827	2,777	50	1.8	48.1	48.1	341.87
Oman.....	1,030	1,020	1,016	980	36	3.7	86.0	86.0	602.00
Qatar <sup>1</sup> .....	660	660	660	661	(1)	(0.2)	550.0	550.0	3,850.00
Saudi Arabia <sup>1,2</sup> .....	10,650	10,500	10,314	10,133	181	1.8	250.0	250.0	1,750.00
Syria.....	30	30	30	30	—	—	14.0	14.0	98.00
United Arab Emirates <sup>1</sup> .....	3,030	3,010	2,887	2,864	23	0.8	165.0	165.0	1,155.00
Yemen.....	10	5	17	67	(49)	(74.0)	0.0	0.0	0.00
Other Middle East.....	1	1	1	1	0	0.0	26.5	26.5	185.50
<b>Middle East.....</b>	<b>26,279</b>	<b>26,016</b>	<b>25,506</b>	<b>24,184</b>	<b>1,322</b>	<b>5.5</b>	<b>1,724.0</b>	<b>1,718.6</b>	<b>12,046.07</b>
Australia.....	306	280	290	306	(16)	(5.2)	181.7	167.3	1,116.59
Brunei.....	100	105	110	120	(10)	(8.2)	37.0	37.0	263.30
China.....	3,949	4,046	4,104	4,287	(183)	(4.3)	364.0	358.9	2,797.54
India.....	738	736	736	764	(28)	(3.7)	95.5	91.8	635.63
Indonesia.....	740	740	741	795	(55)	(6.9)	213.0	213.0	1,491.00
Japan.....	11	11	11	11	—	—	11.1	11.1	89.80
Malaysia.....	725	742	728	594	134	22.6	186.5	202.9	1,330.05
New Zealand.....	36	36	36	40	(4)	(10.5)	15.8	15.7	106.13
Pakistan.....	78	83	84	93	(9)	(9.7)	124.5	122.5	849.18
Papua New Guinea.....	30	30	30	30	—	—	0.5	0.5	3.50
Thailand.....	259	253	262	239	23	9.4	103.1	90.6	761.26
Vietnam.....	300	300	300	300	—	—	33.0	33.0	231.00
Other Asia-Pacific.....	27	27	27	33	(5)	(16.6)	114.4	114.4	798.07
<b>Asia-Pacific.....</b>	<b>7,299</b>	<b>7,389</b>	<b>7,459</b>	<b>7,613</b>	<b>(154)</b>	<b>(2.0)</b>	<b>1,480.0</b>	<b>1,458.6</b>	<b>10,473.06</b>
<b>TOTAL WORLD.....</b>	<b>77,286</b>	<b>76,854</b>	<b>77,479</b>	<b>77,408</b>	<b>71</b>	<b>0.1</b>	<b>10,337.1</b>	<b>10,087.4</b>	<b>73,456.13</b>
OPEC.....	33,230	33,030	32,758	31,899	858	2.7	1,983.5	1,978.1	13,862.57
Offshore Europe.....	2,899	2,581	2,792	2,659	133	5.0	503.4	517.6	3,799.37

<sup>1</sup>OPEC member. <sup>2</sup>Kuwait and Saudi Arabia production each include half of Neutral Zone. Totals may not add due to rounding.  
Source: Oil & Gas Journal. Data available at PennEnergy Research Center.



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