

# Navigant: Solar plus storage turning variable green power into a dispatchable resource



Storage-plus-renewable energy projects, in particular solar, are expected to play an important role as electric utilities develop their strategies for the grid of the future. The risk and cost associated with battery technology continues to decline, enabling utilities to transition large-scale renewables from intermittent to dispatchable energy resources.

The utility-scale energy storage market has seen a steady growth since 2011, with more than 8.9 GW of non-pumped hydro storage projects coming online over the past seven years, according to Navigant Research, "How Utilities Can Look Beyond Natural Gas with Cost-Effective Solar Plus Storage Strategies."

One of the technologies driving market growth is lithium-ion batteries, the report said. The latest analysis showed that lithium-ion batteries accounted for 29.4% of non-pumped storage capacity and 70% of advanced battery capacity developed since 2011.

Due to the advancements in lithium-ion battery technology, Navigant Research expects that PPA prices for projects combining energy storage and renewable resources will continue to decline as their adoption expands. Storage-plus PPAs are

already less expensive than the LCOE for combined cycle natural gas in the United States, the report found.

“In 2018, storage-plus made its first shift from the validation and first-mover adopters to diffuse adoption led by utilities,” Alex Eller, senior research analyst with Navigant Research, said in a statement. “The accurate valuing and positioning of storage-plus by utilities will continue to drive the market in coming years.”

Regulators and utilities should push for all-resource solicitation to take advantage of the price disruption in the area of storage-plus renewable energy and to meet aggressive renewable portfolio standard targets in the process, the report said.

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## **Trump Doubles Down on Keystone Oil Pipeline With New Permit**



President Donald Trump issued a new permit for TransCanada Corp.'s controversial Keystone XL pipeline Friday, circumventing a court ruling that blocked a previous authorization by his State Department.

The move aims to undercut legal challenges to the \$8 billion project, including a November ruling by a Montana-based district judge that faulted the State Department's previous environmental analysis, according to a person familiar with the matter. It could pave the way for beginning some preliminary work, according to Clearview Energy Partners.

"It looks like the intent is to wipe the slate clean and replace the previous presidential permit with this new one," Height Securities LLC analyst Katie Bays said. Keystone XL doesn't need the changes to the supplemental environmental impact statement "because Trump invalidated that whole process and issued this new president permit."

The pipeline, proposed more than a decade ago, would carry crude from Canada's oil sands to the U.S. Midwest. Trump's State Department approved the project in 2017 after President Barack Obama denied TransCanada a permit on grounds its oil would contribute to global warming.

It's good news for Canada's energy producers after delays to planned expansions of the Trans Mountain pipeline and Enbridge Inc.'s Line 3. The lack of pipelines is partially blamed for a slowdown in oil sands investment and the partial pullback of some international oil companies including Royal Dutch Shell Plc.

Unlike the earlier State Department permit, which was issued after a deep environmental analysis required under the National Environmental Policy Act, the new presidential permit is not directly tied to any such review. And the NEPA statute that generally compels environmental study of energy projects and major agency actions does not apply to the president.

Pipeline developers are generally required to receive presidential permits for border-crossing facilities. The State Department has been tasked with vetting permit applications for oil pipelines since 1968, when an executive order put the agency in charge.

But Trump still retains the authority to issue presidential permits himself, said the person, who asked for anonymity to discuss internal deliberations. And because Trump's permit is not subject to environmental review requirements in federal law, it effectively restarts the process and undercuts the Montana lawsuit.

TransCanada, which is yet to make a final investment decision on the project, applauded the White House's action.

"President Trump has been clear that he wants to create jobs and advance U.S. energy security and the Keystone XL pipeline does both of those things," Russ Girling, president and chief executive officer, said in a statement.

## **November Ruling**

U.S. District Judge Brian Morris's November ruling found that the 2014 environmental assessment by the Obama administration

fell short. Trump had used that review in a March 2017 decision allowing the project to proceed. Morris said the government must consider oil prices, greenhouse-gas emissions and formulate a new spill-response strategy before allowing the pipeline to move forward.

Administration lawyers could file a motion seeking to dismiss the Montana case, which it has appealed to the 9th Circuit Court of Appeals.

“Rescission of the prior presidential permit appears to render those proceedings moot,” ClearView analysts said in a note. Mooting the Montana case could end delays related to further State Department environmental review of the project and void an injunction blocking pre-construction work, possibly allowing it to begin in August, ClearView said.

Although the move may help resolve concerns in Montana that focused on the State Department’s environmental review, it does little to address a case before Nebraska’s Supreme Court, which is yet to rule on an opposition challenge to the state Public Service Commission’s approval of an alternate route to the path championed by TransCanada. TransCanada also appears to need multiple water quality permits for the project in South Dakota, according to Clearview.

## **Refiner Demand**

U.S. refiners have been seeking alternative supplies of heavy crude oil after sanctions against Venezuela and a political crises in the Latin American country brought imports from the country to zero in recent weeks. At the same time, Canadian oil producers have been desperate to get new export pipelines built after a surge of new production last year caused a glut that depressed prices and prompted Alberta to impose production curtailments.

“The interest in having Keystone completed has never been

higher, from a security standpoint,” Kevin Birn, IHS Markit’s director of North American crude oil markets, said in a phone interview. “The U.S. refiners demand heavy oil in the absence of Venezuelan” crude, he said.

Conservationists blasted the decision, saying it did nothing to address deep environmental problems with the project.

“The Keystone XL tar sands pipeline was a bad idea from day one and it remains a terrible idea,” said Anthony Swift, director of the Canada project at the Natural Resources Defense Council. “If built, it would threaten our land, our drinking water, and our communities from Montana and Nebraska to the Gulf Coast.”

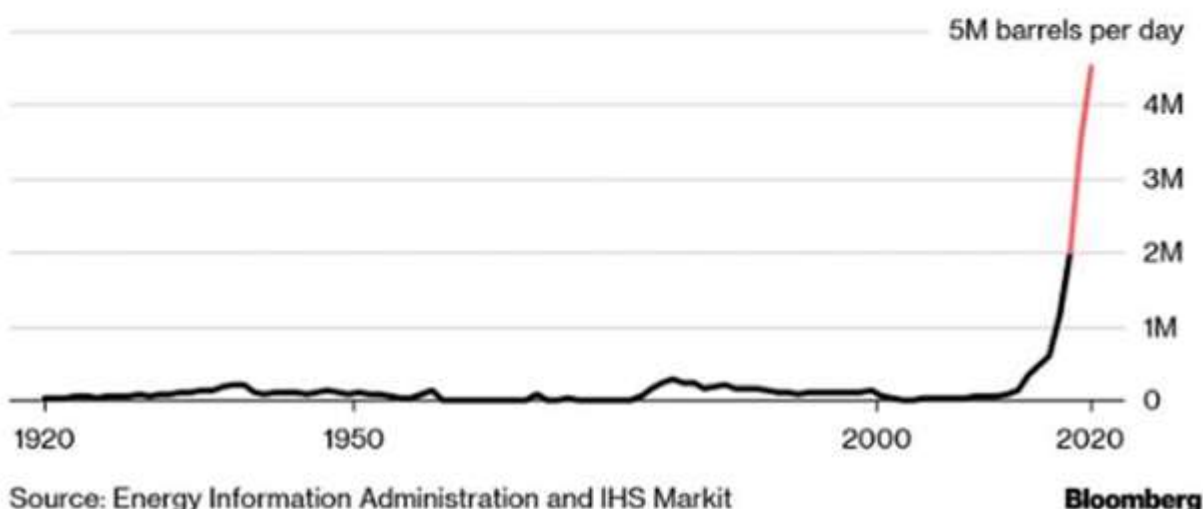
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**From Texas to the world: A flood of US crude oil exports is coming**

## Shale Goes Global

The U.S. export surge started in late 2015 when Washington lifted a 40-year ban on most oil sales overseas, in the process reshaping the world's energy map.

Historical oil exports Forecast oil exports 2019-2020



Bloomberg/Houston

Driving his pick-up truck through the heartland of the Permian basin – the vast tract of west Texas scrub where one of history's greatest oil booms means miles-long traffic jams – Vega says there's more crude being pumped than America's refineries can absorb. Today, the primary task of trading houses like his is getting the stuff overseas.

"We buy it, we truck it, we put it on a pipeline, and there it goes to the port – and from there to the world," said Vega, who heads the office of global commodities trader Trafigura Group in Midland, the region's oil industry hub.

What started as an American phenomenon is now being felt around the world as US oil exports surge to levels unthinkable only a few years ago. The flow of crude will keep growing over the next few years with huge consequences for the oil industry, global politics and even whole economies.

Opec, for example, will face challenges keeping oil prices high, while Washington has a new, and potent, diplomatic weapon.

American oil exports stepped up a gear last year, jumping more than 70% to just over 2mn barrels a day, according to government data. Over the past four weeks, US oil exports have

averaged more than 3mn barrels a day.

“This is the new American energy era,” US Energy Secretary Rick Perry told an industry conference in Houston earlier last month.

Oil traders and shale executives believe US crude exports are set reach 5mn barrels a day by late 2020, up another 70% from current levels. If the US hits that target, America will be exporting, on a gross basis, more crude than every country in Opec except Saudi Arabia. (On a net basis, the US remains, just, a net importer, but that’s likely to change in the next few months.)

“The second wave of the US shale revolution is coming,” said Fatih Birol, the head of the International Energy Agency. “This will shake up international oil and gas trade flows, with profound implications for geopolitics.”

The political impact is already being felt. The Trump administration has been able to impose aggressive sanctions on oil exports from Iran and Venezuela knowing the flow of crude from Texas will keep on rising. The economic impact on the US is also evident: In dollar terms, the country’s petroleum trade deficit fell to its lowest in 20 years in 2018.

The US is already a big exporter of refined products such as gasoline and diesel. When combined with rising crude exports, the IEA forecasts American petroleum exports will reach roughly 9mn barrels a day within five years, up from just 1mn in 2012.

In the process, the US will become the world’s second-largest exporter of crude and refined products by 2024, overtaking Russia and nearly topping Saudi Arabia.

Until now, the surge in US oil production from the Permian and other shale basins like the Bakken in North Dakota was absorbed at home, feeding refineries in the US Gulf of Mexico coast. Now, US refiners are finding it increasingly hard to process more of the kind of light crude pumped in the Permian as their plants were built to process denser heavy crude – the type pumped in Venezuela and the Middle East.

“The US is probably close to being able to process as much



light crude as it can," Thomas J Nimbley, the head of US oil refiner PBF Energy Inc, told investors.

As a result, shale executives are travelling the world to seek new customers. Gary Heminger, the head of Marathon Petroleum Corp, for example, was recently in Singapore and South Korea looking for buyers for shale crude.

"All the incremental Permian production needs to be exported," said Raoul LeBlanc at consultant IHS Markit Ltd and a former head of strategy at Anadarko Petroleum Corp. "The Permian needs to find refineries willing to take US light sweet crude as a base-load, most likely in Asia."

Despite a tight oil market due to American sanctions on Venezuela and Iran mixed with Opec production cuts, finding new buyers isn't as easy as it sounds. The crude from the Permian is light, yielding lots of naphtha – used in the petrochemical industry – and gasoline, but comparatively little diesel. And most refineries want to produce diesel.

Until now, US shale producers and oil traders had been selling most of their crude on spot transactions – one at a time. As a result, American oil exports saw wildly different destinations from month to month, from Spain to Thailand to Brazil.

A few stable markets are starting to emerge. Oil refineries in Canada, Italy, the UK, and South Korea are becoming regular buyers. And little by little, oil traders are securing long-term deals with overseas refineries, known as term contracts.

Yet, the rapid rise in oil exports is challenging. Not even Saudi Arabia in the 1960s and 1970s saw exports grow so quickly.

"The US export market needs to transition from infancy to adulthood far more rapidly than any major exporter ever has," said Roger Diwan, another oil analyst at IHS Markit.

Key for US oil exports is China, mired in a trade war with Washington. Until this year, Chinese refiners were buying large chunks of American shale exports. But the flows all but dried up in August. If US oil exports are going to increase at the pace that executives and traders anticipate, the shale industry needs the White House to strike a trade deal with the

Chinese.

“If the China demand pull fails to materialise, for political reasons, quality mismatch or otherwise, US exports will likely have to muscle their way into the global refining system, likely via price discounts,” Diwan said.

US shale crude is already selling at a big discount to Brent, the international oil benchmark. West Texas Intermediate sells nearly \$10 under Brent. And some of the lighter grades from the Permian, including a new stream called West Texas Light, are seeing even wider discounts.

Finding buyers for the light Permian crude isn't the only obstacle. Pipelines and ports have become the biggest bottleneck in US oil exports, with traders engineering logistically complex chains combining railways, trucks, pipelines, barges, and ship-to-ship transfers to get crude out of the country. Several ventures are aiming to build new facilities to allow exports via supertankers, which need deepwater ports.

Although the Permian isn't growing as fast as last year, oil traders and executives still anticipate that America will add another million barrels a day this year to its production, with the bulk coming in the second half. The current slowdown, which some executives jokingly call a “fracking holiday,” is the direct result of shareholder demands for higher returns and less growth, and lower oil prices in late 2018 and early 2019. But the Permian is likely to re-accelerate in the second half of this year when new pipelines open.

If the forecast proves correct, US crude production will surpass 13mn barrels a day by December, up from 11.8mn barrels a day at the end of last year and well above the previous all-time high set in 1970.

“It's going to be less than if people were able to spend unconstrained, but there's going to be growth, lots of it,” said Osmar Abib, chairman of global energy at Credit Suisse Group AG.

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# Ocean LNG to offtake and market Golden Pass LNG volumes



Doha

Qatar Petroleum announced Sunday that Ocean LNG will be responsible for the “offtake and marketing” of all LNG volumes to be produced and exported from the Golden Pass LNG Export Project located in Sabine Pass, Texas, US.

Ocean LNG is an international joint venture marketing company, owned by affiliates of QP (70%) and ExxonMobil (30%).

Earlier this year, Ocean LNG entered into a binding LNG sales and purchase agreement with Golden Pass Products LLC to purchase and offtake all the LNG volumes to be produced by Golden Pass LNG.

Since its establishment, Ocean LNG has been active mainly in South America and Europe. Following a successful Final Investment Decision (FID) of Golden Pass LNG on February 5, 2019, Ocean LNG will now focus its efforts on marketing its US

LNG volumes in the Asia Pacific region through further extensive engagements.

It will also expand its relations and networks with both established customers as well as emerging and prospective LNG buyers, while at the same time maintaining a strong footprint across South America and Europe.

HE the Minister of State for Energy Affairs, Saad bin Sherida al-Kaabi, also president & CEO of QP, said, "The FID of Golden Pass LNG earlier this year underpins Ocean LNG's marketing efforts to deliver US LNG to customers across the globe. This is a further testament of Qatar Petroleum's position as a global LNG leader with a large portfolio capable of offering tailored LNG supply structures and commercial terms in an evolving global LNG environment."

Ocean LNG will be prominently featured for the first time as part of the QP pavilion at the upcoming global industry event, LNG 19, which will be held in Shanghai from April 1-5.

Golden Pass LNG is situated in a prime location with well-established connectivity to extensive natural gas resources in the US, and has shipping access to both the Atlantic and Pacific basin markets.

Golden Pass LNG, which received all necessary regulatory approvals for the export of LNG from the US Federal Energy Regulatory Commission and the US Department of Energy, was sanctioned in early February of this year by its shareholders, and construction activities at its site are expected to commence imminently.

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## **US oil drillers ease off as services companies forecast major cutbacks**



Crude explorers cut activity in the US oil patch for the sixth straight week as major oilfield services companies painted a gloomy picture for activity in 2019. Working oil rigs fell by eight this week to 816, according to data released Friday by oilfield-services provider Baker Hughes. The weekly rig count has only risen three times in 2019. The persistent decline in activity comes despite gradual recovery in the price of oil, with West Texas Intermediate touching \$60 per barrel this week. Schlumberger Ltd and Halliburton Co, two of the largest providers of oil services, said on Monday there'll be a double-digit drop in spending from customers in the US and Canada this year, a deeper cut than they had previously forecast. US shale is facing increasing technical challenges, Schlumberger chief executive officer Pal Kibsgaard said at a conference in New Orleans. "Interference" between so-called parent and child oil wells, as well as decline in investment, indicate that shale activity growth will slow in the coming years, he said. Despite a pullback in drilling, producers are working through a sizeable backlog in drilled-but-uncompleted wells. That has kept US crude production at a record 12.1mn for much of March, according to data from the Energy Information Administration.

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# Texas Oil Production Falls for the First Time in a Year



Texas, home to the largest U.S. shale play, saw oil production slip in January for the first time in a year, as pipeline bottlenecks in the Lone Star state prompted drillers to cut back.

The decline pushed overall U.S. production lower by 90,000 barrels a day, marking the first national drop since May, according to revised data from the Energy Information Administration. January production clocked in at 11.87 million barrels a day.

Explorers curbed drilling in January, after crude prices collapsed at the end of 2018 and amid investor calls to reduce spending. A dearth of pipeline capacity from the Permian Basin

of West Texas to the Gulf of Mexico has also hemmed in production.

“People are holding off and waiting until the capacity comes in – they can get a much better price,” said Michael Lynch, president of Strategic Energy and Economic Research in Winchester, Massachusetts. “This is why you’ve seen a lot of the drilled but uncompleted wells.”

A cold snap in parts of the Permian at the start of the year, which caused production to be curtailed, may also have played a part.

“It just slows down things enough,” Lynch said. “You get some wells that don’t get hooked up.”

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## Investors pile into decade’s best oil price rally



Hedge funds are leaning into crude’s biggest rally in a

decade. Their wagers on rising benchmark oil prices in New York and London have jumped to the highest levels since October, according to data released on Friday for the week ended March 26. That put them on track to benefit from gains that capped the best quarter for crude since 2009 as fresh evidence of tightening global supplies emerged. West Texas Intermediate has advanced 32% this year, and global Brent crude is up 27%. Among the reasons supporting the optimism, Opec orchestrated global production cuts and drilling slowed in America's shale patch. "Risk-on seems like it's back in vogue," said Stewart Glickman, an energy equity analyst at CFRA Research. "People are looking at those things and what seems like a pretty steadfast position by the Saudis and thinking, 'why can't oil go to \$70 or \$75?'" The net-long WTI position – the difference between bets on higher prices and wagers on a decline – climbed 12% to 238,205 futures and options contracts, according to US Commodity Futures Trading Commission data. Longs increased by almost 7%, while shorts slid 16%. Glickman himself is cautious about oil's future, noting an increase in permitting in the Permian shale basin that could portend another big acceleration in production. Still, he said, "if you want to be a bull in energy, there's enough data points to support the argument." Money managers increased bets on Brent crude by 13,429 net-long positions, or 4.4%, to 322,035, according to ICE Futures Europe data.

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**Russian Arctic LNG firm joins majors for foray into**



# power



Novatek PJSC is looking at power generation to unlock demand for liquefied natural gas from its massive projects in Russia's Arctic.

The developer of the Yamal LNG plant in Siberia is seeking to be on a par with global majors Royal Dutch Shell Plc and Total SA in a global push to expand into electricity. Novatek will in the long run consider joint ventures to take the next step from gas to power and help nations such as India clean their air, according to chief financial officer Mark Gyetvay.

"There are still billions of people on this planet that don't have access to power, so we may need eventually to look further downstream, we may need in the future to partner up with other potential projects to bring power, so take it from gas to power," Gyetvay said in an interview in London. "That may be one of the options for Novatek to pursue in the future."

The world's biggest energy companies will gather at the LNG2019 conference in Shanghai next week amid increasing pressure from investors to protect their business from a shift to lower-emission fuels. While many nations favour renewables

as they seek to combat air pollution, gas is a cleaner alternative to coal to address the intermittent nature of power from solar and wind.

As a first step, Novatek has already teamed up with Siemens AG to explore co-operation in areas including LNG supply and power generation.

For LNG producers, investments in gas and power infrastructure in regions that offer significant demand potential helps secure an outlet for the supply from their multibillion-dollar liquefaction projects.

At a time of fierce competition among global LNG producers, having a customer secured through mechanisms such as an integrated gas-to-power project is a boon. Many nations in Asia and Africa lack infrastructure and need outside investment.

China's unprecedented drive to switch from coal to gas and become the world's second-biggest LNG importer demonstrates that "the push to clean air has already begun," Gyetvay said.

India and markets in southeast Asia are expected to follow.

"The exciting element is what potentially the Indian market has to offer," Gyetvay said. "It is still 40% to 45% coal, it offers tremendous opportunities, Africa is a continent that is developing and needs gas. A lot of these former export countries, like the Middle East, are now moving toward gas."

Spot LNG has crashed almost 50% since the start of the year to \$4.60 a million British thermal units, and lower prices are seen as a trigger for demand in nations that would otherwise opt for dirtier coal or oil.

"LNG companies with a significant amount of spot exposure have the most to lose from weak spot prices in 2019," Sanford C Bernstein & Co analyst Neil Beveridge said on March 26 in a note. The New York-based researcher sees prices returning to \$8 a million Btu by the next northern hemisphere winter.

Gyetvay is unfazed by what he sees as a "very, very short window of lower prices" due to the multi-decade nature of LNG projects. While on a short-term basis, there will be impact on profitability, most of Yamal LNG's contracts are linked to

crude, diluting the impact of spot price dynamics, he said. "If the prices stay lower for a period of time, that may open up the market for us," Novatek's Gyetvay said. "We are not really worried about it."

Yamal LNG's first production line, or train, has now switched to supplies under its long-term, oil-linked contracts, and Train 2 is starting to, Gyetvay said. Train 3 started a year ahead of schedule, and its early volumes are sold on a spot basis, as is typical for new LNG plants.

That flow of uncommitted volumes is spilling into European markets, making Russia the biggest supplier of LNG into northwest European markets this year. That dynamic is helped by the plunging economics of sending a cargo from the Atlantic region to Asia after the typical premium nations such as Japan, South Korea and China pay for spot LNG disappeared.

"Europe has been a stronger market, so we are able to deliver cargoes to the European market," Gyetvay said. "Another thing we can do is look at early nominations for contracted volumes so we are asking the buyers to step up on early nominations on their particular long-term contracts."

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**Natural gas prices falling across the globe as supplies rise**



Natural gas prices are falling across the globe as supplies from the US to Australia flood the market, sparking concern some exporters will have to curtail output and raising questions about new investments. While prices typically ease at this time of year as mild weather in the northern hemisphere crimps demand, a boom in output of the heating and power-plant fuel is exacerbating the slump. The crash comes as the world's biggest energy companies are set to gather at the LNG2019 conference in Shanghai next week, with many considering whether to move forward with a wave of massive, multibillion-dollar liquefied natural gas export projects. Global trade is already shifting as lower prices wipe out the economics of sending US gas to Asia and boost Europe's appeal as a market. New LNG production from Australia, Russia and the US has helped to push prices in Asia more than 50% lower this year after a warmer-than-normal winter. Even as concern about climate change drives a shift to cleaner-burning gas from coal, demand isn't growing fast enough to absorb the supply surge. "The gas market obviously is undergoing a winter" fallout after warm weather curbed demand, said Francisco Blanch, head of global commodities and derivatives research at Bank of America Corp in New York. "We are getting a glut

across the board and we don't see that changing all that much."

Asia's LNG benchmark, the Japan-Korea Marker, has more than halved since the start of the year to \$4.375 per million British thermal units as of March 26. It's fallen to a rare discount to European prices, as UK National Balancing Point futures traded at around \$4.50 on Friday, down 44% this year in their worst quarter in a decade. US gas futures are down more than 8% this year, heading for the worst quarterly loss in two years. The gas crash stands in stark contrast to oil prices, which are heading for their best quarter since 2002 as Opec and its partners curtail production amid a decline in output from Iran and Venezuela. Since gas is produced as a by-product of crude drilling in places like West Texas's Permian Basin, the oil rally threatens to exacerbate the gas glut. European gas prices are also dropping relative to the US, and if the spread narrows further, American exporters may be forced to cut output, according to Societe Generale SA. The market is collapsing just as more Gulf Coast terminals designed to send LNG overseas are poised to start up, creating the first real test of buyers' appetite for US cargoes. "Prices could keep falling and stay low for weeks, perhaps until sometime closer to the middle of the year, after the market has adjusted and overcome frictions on the supply, demand and shipping sides," Citigroup Inc analysts including Anthony Yuen wrote in a March 28 note to clients. European prices may need to fall more than 15% to make US LNG into the region uneconomic and help rebalance an oversupplied system this summer, BloombergNEF analysts said in a report this week.

So much production is flooding the market that prices may not begin a sustained rebound until heating demand starts to pick up during the northern hemisphere winter, said Meg Gentle, chief executive officer of Tellurian Inc, which is planning a \$28bn export terminal in Louisiana. The short-term pain may seem at odds with expectations that several developers are now

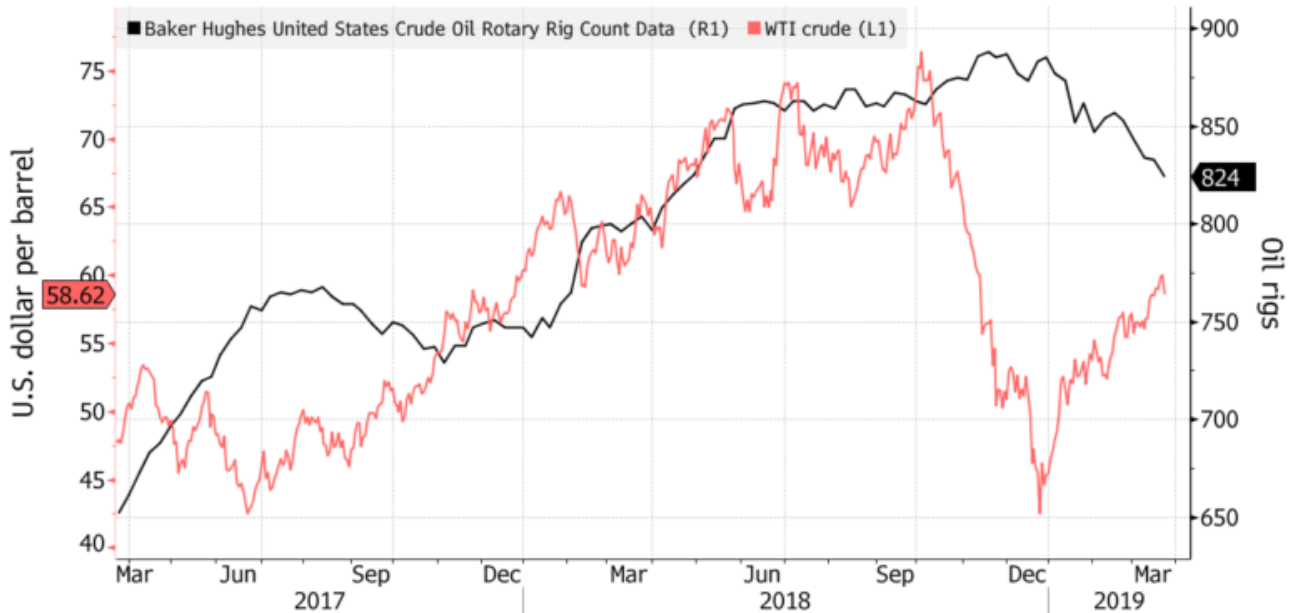
set to announce billions of dollars in investments for new export facilities. That's because the medium-term outlook calls for the current surplus to shift into a deficit early next decade, which can only be avoided if projects are sanctioned now. The impacts of this situation on US projects "might raise questions at LNG2019 for the US developers trying to sell LNG export capacity," Citigroup analysts wrote in the note. "Ultimately, customers are likely to look past this nearterm dynamic." Global consumption is forecast to grow 1.6% over the next five years, with China accounting for a third of global demand growth to 2022, according to the International Energy Agency. Gas is expected to surpass coal as the world's second-largest energy source, after oil, by 2030 amid a push to cut emissions.

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## **Shale Suffers Growing Pains That Could Slow U.S. Oil Production**

## Rig Reversal

U.S. drilling activity is still feeling the effects of last year's price collapse



Source: Baker Hughes

The dramatic ramp-up in U.S. shale production is running into a combination of issues – technical and financial – that threaten to slow the pace of expansion, according to some of the industry's biggest companies.

Schlumberger Ltd. and Halliburton Co., two of the largest providers of oil services, said Monday there will be a double-digit drop in spending from customers in the U.S. and Canada this year, a gloomier outlook than they had previously given.

American frackers are tightening their belts following a plunge in crude prices in late 2018 and as investors urge drillers to do more with less. An explosive surge in output from shale formations has pushed U.S. oil production past Russia and Saudi Arabia to become the world's largest. There are warning signs that growth cannot continue indefinitely.

That's leading one of those producers, Devon Energy Corp., to slash its workforce by about a third amid pressure on spending, Chief Executive Officer Dave Hager said Monday at the Scotia Howard Weil energy conference in New Orleans. The Oklahoma-based driller has already whittled down its headcount by 200 people this year, he said, and is planning to get its total down to 1,700, from about 2,500 now.

In addition to financial limits, technical difficulties are sparking concern that some oil production forecasts won't materialize. Schlumberger Chief Executive Officer Paal Kibsgaard became the latest voice in the U.S. energy industry to warn of the problems caused by "interference" between newer oil prospects – called child wells – and their so-called parent.

Too close, and the child wells can turn out to be less prolific than their parent. But too far apart, and drillers can end up leaving oil in the ground.

"Is there a parent-child relationship? Absolutely. Has it been there since time immemorial? Absolutely," Diamondback Energy Inc. CEO Travis Stice said at the conference. "It's our responsibility to account for the economics of the degradation between a parent and child well, and it's our responsibility to dial that into our forecast."

Stice said Diamondback hasn't had to cut back its activity in response to those issues, like some of its peers who have had to widen spacing after production failed to live up to expectations.

"I think what you're seeing is reserve reports coming out at the end of last year with a lot of negative performance revisions in there," he said. "That's really the first tell as an industry that you've overcapitalized your assets."

It's not just budget constraints or technological challenges that may slow growth. Concho Resources Inc. President Jack Harper said the industry will have to throw more money at the Permian Basin's stretched schools and roads for the hot shale play to handle the level of activity expected over the next several years.

In another sign that the shale boom might be slowing down, explorers have reduced the number of oil rigs operating in the U.S. to the lowest in about a year, a report by Baker Hughes showed on Friday. There's also a backlog of thousands of wells



that have already been drilled but haven't yet been fracked, the most costly part of the process of bringing a well into producing.

So far, U.S. oil output is holding at a record 12.1 million barrels a day after jumping about 30 percent in just two years. But shale wells have a short life span, with yields sometimes declining in just a few months. More have to be drilled and fracked frequently just to keep up the pace of production.