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THIS MONTH IN ENERGY ECONOMIST EMERGING MARKETS

Feature: Twilight in Caracas	2
Feature: Oil and the global economy	5
Technology: CO2 stored underground can find escape routes	9
Technology: Huge CSG well boost from microbes	9
News: Oil output freeze looks ineffectual, even if implemented	10
News: Domestic pricing protects Argentinean shale development	11
News: Repsol makes major Bolivian gas discovery	11
News: Anglo American to exit coal, ratings downgraded	12
News: Nuclear restarts to reduce Kansai Electric's LNG demand	13
Data and Markets: Oil producer talks	14

ENERGY ECONOMIST FULL EDITION, MARCH 1, 2016

EDITORIAL	P. 1
FEATURES	P. 3 - 23
Twilight in Caracas	
Oil and the global economy	
The oil market in 2021	
Ancillary services: new solutions, new problems	
European gas demand: signs of recovery	
African risk profile conducive to small-scale RES	
Energy efficiency – an under-utilized brake on demand	
TECHNOLOGY	P. 24 - 27
EVENTS/LETTERS	P. 28 - 32
MARKET NEWS	P. 33 - 44
DATA AND PRICES	P. 45 - 50

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Twilight in Caracas

The days of the Bolivarian revolution are numbered. The collapse in oil prices has taken a heavy toll on Venezuela's economy, and President Nicolás Maduro is unlikely to survive. Debt default looms. A new government could well mean the opening of yet another OPEC giant to foreign investment, but, even without the socialism, Venezuela's heavy oil deposits look expensive in a \$30-\$35/b world. **Neil Ford**

The fate of Venezuela's socialist revolution seems decided. A combination of overdependence on oil revenues, very low oil prices and government mismanagement have pushed the economy into freefall. President Nicolás Maduro has promised to protect the social programs that have delivered real benefits to the poor, but anything other than a rapid recovery in oil prices is likely to see him unseated from power. The opposition Democratic Unity Roundtable (MUD) were drafting plans to remove the president from office as *Energy Economist* went to press and it now just seems a matter of time before Maduro falls.

Chavismo, otherwise known as Bolivarian socialism, will not survive. Hugo Chavez, who died in 2013 after 14 years in power, divided opinion even at the height of his powers. Until relatively recently, the revolution achieved profound improvements in the living standards of many poor Venezuelans. However, its anti-private sector stance has deterred investment and encouraged inefficiency. Moreover, an over-jealous determination to defend the revolution has led to political oppression and an attitude to multi-party politics that is completely against the spirit of democracy.

Chavez was fortunate to be in power during a period of high oil prices. This allowed his government to fund both social projects at home that brought popularity among the poor and aid to other countries that garnered popularity within the region. The oil revenues gave him relative immunity from US enmity and the freedom to colorfully chastise Washington at will. Oil exports allowed Chavez to ignore the inefficiencies of much of the rest of the economy. Maduro, who lacks the charisma of Chavez and his ability to generate semi-religious fervor, has had no such good fortune.

Economic crisis

Oil exports accounted for 96% of the government's income in 2013, but that proportion has fallen as crude prices have nosedived. Government revenues fell by 60% between July 2014 and January 2016. It is difficult to think of a net oil producer that has been harder hit by low prices than Venezuela.

GDP, CONSTANT PRICES (% change)



Source: IMF

The situation has been made worse by oil production flat lining over the past decade at about 2.5 million b/d.

One of the last acts of the outgoing government was to approve a 2016 budget based on an average oil price of \$40/b this year, which seems fairly reasonable, but even this has a massive – although unspecified – inbuilt deficit. Estimates vary, but it is generally thought that an oil price of at least \$150/b is required to balance the budget.

GDP contracted by 10% in 2015 and the IMF predicts a further 6% fall this year. These figures are comparable with the worst years of the Zimbabwean crisis and are experienced only by countries at rock bottom. The only worse performing economy in the world last year was conflict-ridden Syria and it did not publish economic statistics, a trait now copied by the Venezuelan Central Bank.

Inflation stood somewhere between 100% and 200% last year, and the IMF estimates that it will reach 204% next year, although that figure must be taken as an educated guess rather than a precise forecast. Government debt stands at \$122.9 billion, while its foreign currency assets stood at just \$35.5 billion in third-quarter 2015, according to ratings agency Standard and Poor's, which, like Platts, is part of McGraw-Hill Financial.

Long-term mismanagement

The government failed to use its oil revenues to fund diversification programs when it had the chance and most other sectors withered because of the all-encompassing obsession with oil. Venezuela used to export coffee and rice, but now imports both. Even with well-funded state employment schemes, the World Bank expects unemployment will reach 18.1% by end-2016.

Moreover, Caracas failed to set up a proper sovereign wealth fund to cope with downturns in the oil price and is now paying for its short-sightedness. Excess revenues were paid into a special account, but there was no oversight of the funds, and they are believed to have almost entirely disappeared.

S&P currently gives Venezuela a CCC credit rating and a succession of bond repayments this year will test its finances, starting with a \$1.5 billion tranche of debt, due February 26. Alejandro Arreaza, Latin American economist at Barclays, estimates that Venezuela has an 85% chance of defaulting between now and February 2017. The yield on Venezuela's dollar bond that matures in 2020 is 37%.

Venezuela has not worked with the IMF since 2007, which effectively cuts off access to most of the multilaterals. The only likely source of external finance is China, but China has already

lent the country \$50 billion in return for oil and is suffering its own economic slowdown. If Beijing is prepared to lend more money, it is likely to demand physical assets in return.

The economic situation has been further complicated by the use of three official exchange rates that operate in parallel to the black market used by most of the public. The spread of rates is amazing, from 6.3 bolivars to the US dollar as the lowest official rate up to 800 from illegal traders. The currency controls are now into their 13th year, as the government seeks to keep capital in the country, but the effect has been to fuel inflation.

Much of the pressure for change is generated by extreme shortages of basic goods, including flour, sugar and toilet paper. Queuing has long been part of life in Venezuela, but even rumors of a delivery can now produce lines of hundreds of people outside small stores. The government controls the prices of 42 staple items, including cooking oil, rice, milk, coffee and corn flour. Maduro blames foreign “enemy elements” based in Miami, Madrid and Bogota for manipulating the markets to pressurize Caracas, and also private sector companies and political opponents at home for hoarding food and artificially creating shortages.

He insists that welfare schemes and payments cannot be scaled back in response to the government’s financial problems, but the economic crisis is already eroding the achievements of the Chavez government. Poverty levels halved between 2003 and 2011, falling to 27% in 2013, but studies by Venezuelan universities estimate that poverty was higher than ever at end-2015, at 73%.

If this is anywhere near true then the government will lose much of its traditional support among the poor. In addition, although millions of Venezuelans now have access to free healthcare that was previously denied them, doctors and hospitals are running desperately short of medicines and equipment.

Venezuela’s crime rate was high even before the economic crisis, but the situation is now dire. The Venezuelan Violence Observatory calculates the murder rate at 90 per 100,000 residents a year, the second highest in the world after El Salvador. Sustained over the long term that would equate to a 1 in 15 chance of being murdered, a rate that is higher than in some war zones.

To compound the government’s difficulties, El Nino-inspired drought has hit the Venezuelan power sector. Low water

INFLATION, AVERAGE CONSUMER PRICES (% change)



Source: IMF

GENERAL GOVERNMENT REVENUE (% of GDP)



Source: IMF

levels have affected generation at 18 hydroelectric schemes, forcing the government to introduce both power and water rationing, plus restricted opening hours for the country’s many shopping malls.

One area where the government could generate revenue is in fuel price rises because of the cost of its subsidy system. On February 17, Maduro finally backed down and increased the price of high grade petrol for the first time in 20 years, from about \$0.01/liter to \$0.60/liter, a 6,000% increase. Nonetheless, the price of lower grade petrol will still be just \$0.10/liter, so it remains very cheap by international standards.

Political defeat

Last year, opposition parties finally organized themselves sufficiently to form an effective electoral coalition, winning legislative elections December 6 against the ruling United Socialist Party of Venezuela (PSUV). The centre-right MUD coalition took 112 out of 167 seats, giving it a two-thirds majority in the national assembly. The new MPs took their seats a month later, but power remains concentrated in the presidency.

There are a number of ways in which the opposition can put pressure on Maduro, including by using its two-thirds majority to replace judges. It has also pledged to force the Central Bank to resume the publication of precise economic statistics, lift price and currency controls, and seek amnesties for jailed political activists.

Above all else, the opposition could organize a recall referendum once Maduro is halfway into his term of office. A petition containing four million signatures is required to trigger the referendum. The four million threshold was reached in 2014, but Maduro was able to survive because of his personal popularity and the influence of the PSUV.

On February 11, the leader of the house Henry Ramos Allup announced that the MUD would challenge Maduro at the end of February or in March rather than in six months’ time as previously planned. He said: “Nobody doubts now that the six month timeframe is too long. It is not we who impose the timing, it is the needs of the country.”

With the economy crumbling and the single house parliament against him, it seems unlikely that Maduro will survive until his term runs out in 2019. Under the constitution, Maduro can veto laws passed by the National Assembly once, but a second vote in favor cannot be blocked. Only a big rise in

the oil price can save him and his government, and this looks unlikely. Even then, the opposition can expect to win the presidency in 2019, if it can unify behind a single candidate.

The PSUV does hold unfair sway over the media, giving it an advantage in any election, but the MUD's December victory shows that Venezuela is not an authoritarian state, even if Chavez sometimes made it look like one.

Emergency powers

On February 10, the Supreme Court granted Maduro emergency economic powers for 60 days, with the president able to extend them as required. The government now has the ability to introduce new currency controls and Maduro has the right to intervene in the management of private sector companies and increase taxes to foot the bill for food imports and welfare payments.

Maduro has also brought more moderate administrators into some posts and simplified the exchange regime. Unsurprisingly, the MUD oppose the new powers, which Ramos Allup, described as a "national disgrace" and a virtual coup.

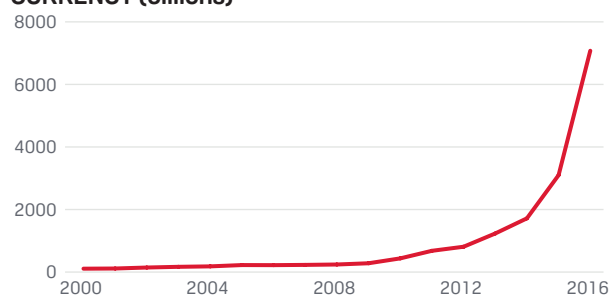
Under the new powers, the military has been given the right to become involved in all oil, gas and mining projects in the country, via a new firm called Cia. Anonima Militar de Industrias Mineras, Petroliferas y de Gas (Camimpeg). This will not prove the answer to any of the country's problems and could make them a great deal worse if people with no expertise in the oil sector are suddenly given the right to intervene. Some observers have suggested that the new firm has been created to shelter national oil assets, if government creditors are able to push for recovery through the assets of the state oil company PDVSA.

PDVSA

PDVSA says that its consolidated debt fell by 4.3% in 2015 to \$43.8 billion, although this figure does not include money owed to service providers. Eulogio del Pino, who is both oil minister and PDVSA president said: "This is a big achievement, considering the unfavorable situation our country went through last year with the fall of oil prices."

However, it seems unlikely that the company's financial position could have actually improved over the course of the year. Elias Matta, an opposition lawmaker and vice president of the energy and oil commission, said: "We want to know the real state of PDVSA's books. The country wants to know how the money from the Chinese funds were

GENERAL GOVERNMENT GROSS DEBT, NATIONAL CURRENCY (billions)



Source: IMF

spent. We also want to investigate what the real cost of production is. And why haven't they implemented the output increases they talked about so much?"

The state oil company has also asked the International Oil Companies with which it works in joint ventures, such as Chevron, ONGC, Statoil and Repsol, to pay for the naphtha imports required to dilute Venezuela's very heavy oil. It has been reported that suppliers have begun asking PDVSA to pre-pay for naphtha deliveries because of the possibility of default. It seems unlikely that the IOCs will comply, given that their contracts specify that PDVSA is responsible for buying the light oil.

They may be keen to remain in a globally important oil producing country for the long haul, but PDVSA management, or at least policy, will change in tandem with the government, so refusal to cooperate now may not greatly affect their prospects in the country. There is a chance that Del Pino could remain in post as he is widely considered to be a reformer, but few others are likely to survive.

New government

It is to be hoped that a peaceful change of government occurs, rather than any violent conflict. Civil wars have not been common occurrences in recent South American history, which has been dominated by more localized insurgencies, coups and military autocracies.

However, Ramos Allup said in January: "There is a movement within the government that is asking for Maduro's resignation as the lesser evil." He added that the government "is doing everything possible to give itself a coup, I don't have any doubt because it's the only justification that we have after this defeat and the monumental errors of 17 years."

These words were provocative in a country that experienced an attempted coup in 2002 and which has had six coups in the past 70 years.

For his part, Maduro has portrayed the opposition as enemies of the state and suggested that 'the people' must resist them. He said: "We cannot forget the threats that we have received, we cannot underestimate them. I call on the people of Venezuela to not underestimate the threats that Ramos Allup has made against the homeland and the Republic."

The implications of a change of government for the energy sector would be huge. Potentially it would open up to foreign investment one of the last few remaining OPEC giants. Restrictions on foreign investment would almost certainly be greatly reduced, encouraging the development of additional production capacity.

Yet the Venezuelan oil sector would still face the problem of attracting investment in the country's mostly heavy oil deposits. Venezuela has the world's biggest oil reserves at 298 billion barrels, but much of that oil is difficult and expensive to produce. The country's political history, the economic wreckage of the last years of the Bolivarian revolution, combined with oil prices of \$30-\$35/b, do not suggest a mad rush for the country's oil wealth.

Oil and the global economy

Falling oil prices are a symptom of wider economic malaise not the cause. It is the malaise that is the real risk, along with the short-term negative feedback effects of low oil prices. Just as there is inertia on the supply side of the market, the demand side also takes time to rebalance, and its recovery is being offset by contraction in the oil and gas sector. **Ross McCracken**

Rising oil prices from 2003 were accompanied by predictions that such a sharp rise in the world's most important energy commodity would bring the global economy to a juddering halt. This would occur at \$40/barrel, then \$60/b, then \$80/b, but, by the time prices breached \$100/b in 2008, the doomsayers were forced to retreat back into their Trojan bars to reconsider their calculations.

It was a reminder that energy economists, and oil analysts in particular, suffer – no differently from anyone else – from a common heuristic, which is to over-estimate the significance of their own subject in the greater scheme of things.

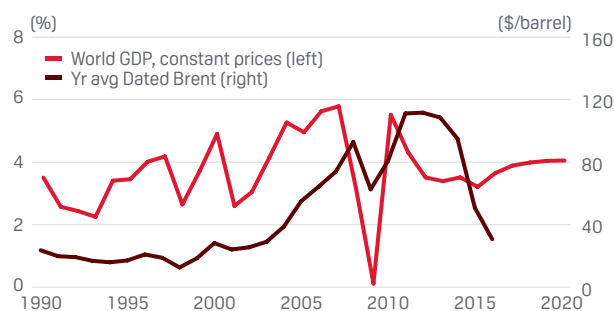
A second equally understandable bias is the association of sharp changes in the oil price with crises. There is good reason for this, owing to the oil crises of the 1970s, the Iran-Iraq war of 1980–88, Iraq's invasion of Kuwait in 1990 and the subsequent invasion of Iraq by US-led forces in 1990–91 and then again later in 2003. Sharp rises in the oil price are associated with bad events, leading on to a tendency to assume that high oil prices cause bad events.

However, the real cataclysm of recent years was the 2008/09 financial crisis, which had its origin in the financial world and had nothing to do with oil. The large-scale bail out of banks exhausted many governments' ability to apply further fiscal stimuli, exposed the weaknesses of the eurozone and left interest rates so low that monetary policy as a means of boosting growth is not currently possible. Central banks resorted to 'quantitative easing', otherwise known as printing money.

Import dependencies

There is a parallel with the general treatment of energy commodity import dependencies. These are seen as bad and for good reasons. They represent a continual outflow of capital from the importing country and a clear security threat, owing to the importing country's dependence on extended supply chains that can stretch back to politically and economically unstable centers of production.

WORLD GDP VS OIL PRICE



Source: Platts

These import dependencies sometimes stem from economic mismanagement, for example Nigeria's dependence on imported oil products. However, for the most part they are a sign of robust economic health. They are a weakness borne of strength.

The largest import dependencies occur in the most economically successful countries, most notably the United States, but also Japan, Germany, Switzerland and more latterly China. These countries are so productive that they suck in base commodities above and beyond their domestic ability to produce them, which varies depending on their own natural resources.

High energy prices

Nor is there any clear association between low energy prices and economic strength. Those countries with the lowest energy prices tend to suffer from some variant of oil curse. Low energy prices encourage wasteful inefficiency and too high a dependence on one sector of the economy, leading to a very vulnerable revenue base for the governments concerned. The real weakness of an energy commodity dependency lies more with the producer than the consumer.

Japan has one of the highest – if not the highest – level of energy import dependency in the world. As a result, it has high domestic energy prices by global comparison. Yet it has been very economically successful, and, despite lackluster growth in recent years, is still the third or fourth largest economy in the world. High domestic energy prices lead to greater efficiency, which is deployed to add value to raw energy imports, which can then be exported as processed higher value-added goods. Again, this is a sign of economic strength not weakness.

There is a definite positive correlation between high energy prices, raw material import dependency and economic health. So there should be little reason to attach a negative association to rising oil prices, or perhaps by extension to the cost of new renewables technologies. Energy importing countries can only sustain energy import dependencies because they have the means to make them affordable.

Reactive pricing

The oil price reacts to rather than leads economic growth; it is a symptom not a cause, although there are feedback effects. The rising and then high level of oil prices from 2003, through the 2008/09 financial crisis, until mid-2014 reflected many factors, but the primary one was rapid, energy-intensive growth in the Chinese economy. This occurred more quickly and relentlessly than the speed with which the supply side of the oil industry could react.

This was in part because of OPEC's cartel behavior and the resource nationalism that kept world class oil and gas resources off limits to the International Oil Companies that might have developed them. But it also reflected the long investment cycle of the oil industry, which is not just rooted in the time it takes to explore and develop new resources, but in the oil services sector that allows that to happen.

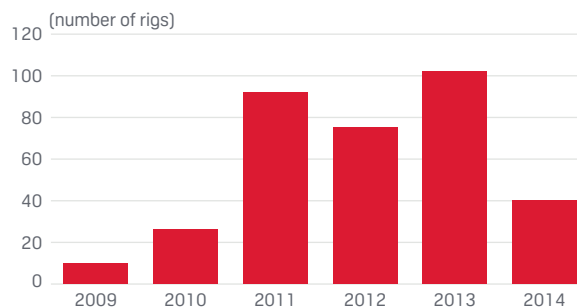
To take an example, in 2003, there was a growing shortage of offshore rigs. Not only that, but there weren't enough shipyards with the capacity to build new rigs. It has taken more than a decade for this key area of oil services to move from scarcity to surplus. This surplus is now being cruelly exposed by the drop in exploration and production activity brought on by the collapse in the oil price.

Different parts of the oil industry have different investment cycles, but all display significant levels of inertia once prices fall. New offshore rigs are still being constructed, despite the lack of demand for them; major oil and gas field developments are still coming on-stream, the investment decisions for which were taken when oil was above \$100/b.

Shale has changed this landscape by reducing the time it takes to bring new wells into production, limiting the lag between changes in price and production levels. However, shale still makes up only a small proportion of the global oil industry and has its own inertia. In a low oil price environment, companies have a desperate need to protect cash flow and the only way they can do that in the short term is to maximize production and minimize investment. This accentuates a boom-bust cycle.

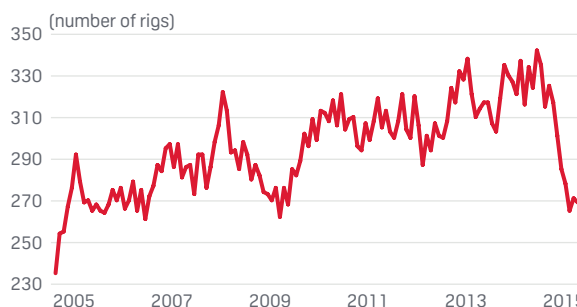
Moreover, OPEC is no longer acting as a cartel, and resource nationalism – already in reverse with the opening of the Iraqi oil patch – is generally weaker in times of low oil

NEWBUILD ORDERS



Source: Platts

INTERNATIONAL ACTIVE OFFSHORE RIGS



Source: Baker Hughes

prices. Although uncertainties remain over Iranian exports, it is possible that, in the next decade, IOCs will have access to Middle Eastern oil resources on a scale unprecedented since before the Iranian revolution of 1979.

Slowing growth

It is demand that drives oil supply. The current drop in oil prices is the result of slower economic growth and a shift in the location of that growth from developing to developed countries. Given also environmental regulation, current and future GDP growth will be less oil intensive than in the preceding decade.

At the same time, the oil industry has caught up and finds itself in surplus across the board, not just in terms of actual oil production, but in terms of the capacity to increase production. This will serve to keep the input costs of exploration and production low for some years in direct contrast to the rapid inflation seen in the oil services sector from 2003-2013.

UK forecasting agency Oxford Economics published its latest global economic forecast in February. At 2.3%, it is the lowest since 2009. The company paints a worrying picture, pointing to signs that weakness in the real economy may be broadening. It sees deep recessions in Russia and Brazil, lower OECD growth and, indicative of the lack of policy levers available to governments, a resort to negative interest rates in Japan and Sweden.

Redistribution

Some observers have suggested that low oil prices are having a negative impact on world GDP, which means that

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OIL

it is possible to argue that rising and falling oil prices are both bad for the world economy. That isn't necessarily as inconsistent as it seems, if it is argued that change itself is bad. But just as oil prices had little discernable impact on global GDP on the way up, the opposite idea that they will have an impact on the way down should be treated with caution.

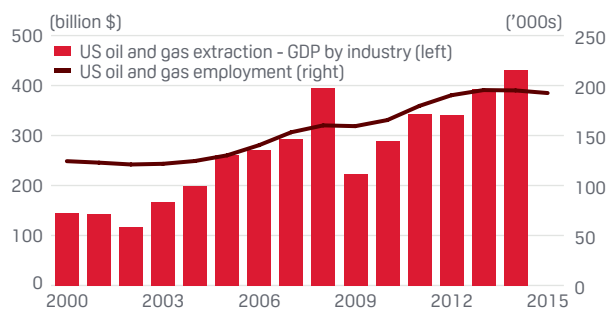
The argument is that the sharp decline in oil and gas sector activity itself will reduce economic growth. There is some truth in this; there is no question that thousands of oil and gas sector workers have and are losing their jobs in the current downturn, while billions of dollars in investment spending has been wiped from oil company investment plans.

The oil and gas sector is suffering recession, and the sector makes up an important part of global GDP. This will be particularly felt in the US, where the shale oil and gas sector has been a major element in national GDP growth over the last decade. It is not just the size of the oil and gas sector that is important, but that it has been a core area of investment spending. Moreover, oil and gas are an important source of state revenue for many countries and reduced oil and gas revenues mean reduced government spending.

However, on a global scale, the oil price is essentially redistributive. Low prices mean more money stays in oil importing countries and less flows to the oil exporters. In turn, they are less able to import the processed goods that the oil importing countries produce. Consider also the downturn in oil and gas investment and social spending and it is certainly possible to paint a picture of downward economic spiral.

But low oil prices are still more symptom than cause. Lower growth exposes the economic weaknesses of countries like China, with its huge debt levels, and those of oil exporters critically dependent on oil revenues. It takes time for the redistribution of what was formerly oil money – from oil exporters to oil importers and from the oil and gas sector to other sectors of the economy – to be redeployed in useful ways. It represents a major reallocation of funds between countries and between economic sectors.

US OIL AND GAS GDP AND EMPLOYMENT



Source: Bureau of Economic Analysis, Bureau of Labor Statistics

CHINA SLOWDOWN

China's apparent oil demand contracted by 0.8% in December 2015 from a year earlier to 11.35 million b/d, according to a Platts report released in February. Refinery throughput in December averaged 10.84 million b/d, a record high volume, according to data from the country's National Bureau of Statistics.

This was a 1.4% increase both year-on-year and month-on-month. However, net imports of key oil products slumped 32.5% from a year earlier to an average 514,000 b/d during the month, driven by significant exports of gasoil, jet fuel and gasoline, according to data from the General Administration of Customs.

For the whole of 2015, apparent oil demand rose by 5.8% to an average 11.11 million b/d, compared with 4.7% in 2014. However, Platts China Oil Analytics expects China's apparent oil demand growth to moderate to just 2.4% in 2016, in line with an expected decline in GDP growth from 6.9% in 2015.

Moreover, apparent oil demand does not measure changes in stocks, data for which is only released intermittently by the Chinese authorities. According to the International Energy Agency, China saw seven consecutive monthly stock builds through end-2015, implying actual consumption was lower than apparent demand.

Demand response

In the classic text book sense, low oil prices should stimulate demand, just as high oil prices encouraged demand destruction and substitution. But in the case of oil, there are mitigating circumstances; countries are keen to reduce oil use for environmental and security of supply reasons. Price is not the only factor.

Moreover, the sharp drop in wind, solar and lithium-ion battery costs might prove the launch pad for the electrification of personal transport. Sales of electric vehicles are still very low, but worldwide their growth curve is beginning to take on an exponential shape, which has been the hallmark of renewable technologies.

It made little sense to move towards the electric car if this meant greater imported fossil fuel use in the electricity sector, but as domestic renewable generation rises, the beginnings of a fully-sustainable domestic transport fuel cycle in the form of electricity is beginning to look more achievable. This raises the broader question of whether the oil industry is in the throes of a cyclical crisis, has a terminal illness, or both.

For OPEC the answer may be moot. OPEC's current strategy, instituted by Saudi Arabia and the other Gulf Kingdoms, is a response not just to the rise of US shale oil, but to the threat of peak demand. It is also – whether OPEC more broadly appreciates it or not, and painful though it may be – the only way that the organization can hope to restore its former power.

Saudi Arabia cannot control the environmental agenda, but it can position itself and OPEC to extract maximum value from a multi-billion dollar industry facing historic decline. So short-term crisis or mortal threat, Riyadh's current strategy still looks like the best that can be done in a difficult situation. The 'freeze' on output growth announced in February by Russia, Saudi Arabia, Qatar and Venezuela

does little to change this and in any case looks unlikely to be implemented.

Recession risks

Changes in the oil price over the medium to long term are essentially neutral for the world economy, and reflective of underlying growth or the lack of it, although they imply large redistributive short-term effects. The focus has been on when the supply-side of the market might rebalance, leading to a recovery in prices. This requires a major contraction in production, which should occur as a result of the drop in oil company exploration and production spend.

But it has been countered by growth in OPEC supply, which delays the time it will take to draw down the record high level of stocks. At the same time, it is causing long-term sectoral recession at the back-end of the oil market, the effects of which will be felt for years. This reduces the input costs for oil production, which makes higher-cost non-OPEC production less high cost and more competitive, which also delays the major contraction in supply required.

However, the supply side of the market also needs time to rebalance. There will be some low price demand response, as shown, for example, by Chinese industrial gas users switching to LPG and South Korean companies shifting from LNG to cheaper Bunker-C fuel oil, but overall demand will be held in check in the short term by the permanent demand destruction of the last decade, further environmental regulation, and by the negative growth

effects of contraction in the upstream oil and gas sector and reduced government spending.

Falling oil prices occur at a time of slowing growth and therefore by definition in a riskier economic environment. Slower growth creates a higher risk of company and sovereign default because they reflect a weaker global economy and expose the fact that dependence on a single export as an oil producer is a greater vulnerability than dependence on oil imports.

With that high risk level comes the possibility of a downward deflationary spiral from which it may prove hard to recover. This is particularly so at a time when interest rates are already so low that governments have lost monetary policy as an economic lever, and at a time when fiscal discipline is necessary because of the expanded level of debt caused by the financial crisis. This, rather than low oil prices *per se*, have stripped governments of the economic levers to stimulate the economy.

The redistribution of what were formerly oil funds to other sectors of the economy will filter through, but it will take time for them to be deployed productively. The real threat is that economies like China are too weak to redeploy that capital effectively because of high debt levels. The feedback effect of falling oil prices is like getting a cold on top of the flu, but it is the weakness caused by the flu that has made the world susceptible to the cold in the first place. And, in a weakened state, a cold can prove a killer.



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CO₂ stored underground can find escape routes

Researchers from Penn State University in the US have thrown doubt on the ability to store CO₂ underground in perpetuity, owing to the chemical reactions between CO₂ and the source rock used for storage. Carbon Capture and Storage has been seen as a way of allowing CO₂ intensive technologies, like coal-fired electricity generation, to become more environmentally friendly by storing CO₂ underground. The general assumption has been that depleted oil and gas fields could be used as natural stores because they have held oil and gas over millennia.

However, the researchers found that CO₂ could find multiple escape pathways, owing to the chemical reactions between carbon dioxide, water, rocks and cement from abandoned wells. The team looked at two abundant host rocks, limestone and sandstone.

“We were interested in examining these rocks because they are widely found underground, but there have been concerns that CO₂ may escape once it’s injected,” said Li Li, associate professor of petroleum and natural gas engineering. “Even if it doesn’t escape to the Earth’s surface, there are concerns that it may leak into groundwater drinking aquifers.”

In addition to encountering host rocks, CO₂ stored underground may contact and dissolve into saltwater deposits.

When this happens, the CO₂ increases the acidity of the saltwater. The high-acidity saltwater-CO₂ mixture can dissolve certain types of rocks, such as limestone, as well as cement casings on abandoned oil and gas wells.

“If this plume of CO₂-saturated brine reaches an abandoned well, it will react with the cement,” said associate professor Zuleima Karpyn. “This may open up cracks in the cement depending on the conditions, which would increase the likelihood of CO₂ escaping.”

To recreate natural settings, the researchers conducted an experiment by flowing CO₂-rich saltwater into two different systems -- cement embedded in a sandstone host rock, and cement embedded in limestone. They monitored the chemical reactions that took place and measured changes occurring in the host rocks and cement.

The saltwater-CO₂ solution dissolved parts of the limestone, which lowered the acidity of the solution. In eight days, the limestone lost 3% of its mass and became 24 times more permeable than at the start of the reaction, which means liquids and gases can move through it more easily. The CO₂-saltwater liquid also became less acidic in the dissolution process. As a result, it did not dissolve any of the cement.

“In the limestone interactions, the rock itself becomes the dominant medium

for the dissolution reaction while the cement was the secondary reactant,” said Karpyn. “This means that wellbores are more likely to stay intact if you have limestone. But dissolving the limestone can create leakage pathways, for example, by forming finger-like channels of dissolved rock.”

The researchers found the opposite to be true for the sandstone sample. Rather than dissolving the sandstone, the solution degraded the cement. The sandstone lost very little mass, but the cement lost mass and became more porous.

The findings highlight the complexity of underground carbon sequestration. “The process of assessing whether a site is appropriate for injection has to be system-specific and take into account not only the chemistry and composition of the rocks, but also the ease with which water and carbon dioxide can flow through host rocks,” said Li.

The findings throw new doubt on the viability of CCS as a technology. CO₂ storage would require long-term monitoring. Moreover, if leakage did occur, it is not clear what remedial action could be taken to keep the CO₂ in place, nor who might be responsible for taking that action over the long term.

The research findings are published in the current issue of the *International Journal of Greenhouse Gas Control*.

Huge CSG well boost from microbes

A way of increasing the amount of methane emitted from microbes living in coal seams and on food waste has been discovered by scientists at the University of New South Wales in Australia. This could lengthen the life and productivity of Coal Seam Gas wells and biogas from waste processes with possible applications for woody plant material and the by-products of municipal wastewater treatment.

The technique involves the addition of small amounts of synthetic dye that forms needle-like crystals to help the methane-producing microbes grow faster and produce more methane. “Our research in the lab and in coal boreholes near Lithgow has shown that the crystals can lead to a massive

leap in methane production – a tenfold increase from coal, and an 18-fold increase from food waste,” said associate professor Mike Manefield.

The researchers studied a small synthetic molecule called neutral red that has been used for more than 150 years as a textile dye, or for staining cells under a microscope.

“We knew it was able to shuttle electrons about and we wondered if it could deliver them directly to the microbes that produce methane. Usually these ancient critters get electrons from hydrogen gas. When we added neutral red in the laboratory to a mixture of coal and naturally occurring groundwater

microbes, in the absence of oxygen, we discovered it formed crystals that had never been seen before. The crystals act as electron sponges, harvesting electrons from minerals and bacteria in the mixture and then transferring them with a lot of power to the methane-producing microbes, boosting their growth,” Manefield said.

The patented technology was also tested in a real-life environment in coal boreholes near Lithgow. Small amounts of neutral red were injected 80 meters underground at three sites into the water-saturated coal seam. A fivefold to tenfold increase in methane production was observed during a 12-month period.

Oil output freeze looks ineffectual, even if implemented

Saudi Arabia will not cut its crude production, but will continue to protect its share of world oil markets, foreign minister Adel Jubeir said February 18, two days after the country agreed with leading non-OPEC exporter Russia to freeze output, if other producers did the same. The deal is contingent on Iran, Iraq, Oman, Kazakhstan, Azerbaijan, Mexico and other producers within and outside OPEC joining in.

“If other producers want to limit or agree to a freeze in terms of additional production that may have an impact on the market, but Saudi Arabia is not prepared to cut production,” Jubeir said in an interview with AFP in Riyadh. “The oil issue will be determined by supply and demand and by market forces. The kingdom of Saudi Arabia will protect its market share and we have said so,” he said.

Russia and OPEC members Saudi Arabia, Venezuela and Qatar agreed at talks in the Qatari capital, Doha, February 16 to freeze crude output at January levels, but only if other leading producers within and outside OPEC joined the initiative. Iran, now free of crippling sanctions and planning to boost oil production and exports, welcomed the pact, but did not agree to a freeze.

Iranian oil minister Bijan Zanganeh said Iran would not be deterred from its efforts to recover market share lost during the sanctions period, which reduced its crude exports by more than half. Deputy oil minister and head of the National Iranian Oil Company Rokneddin Javadi said Iran would increase its oil production by 500,000 b/d by March 19, when the current Iranian year ends.

Russia’s conditional assent to the freeze also looks ineffectual. Deputy energy minister Kirill Molodtsov said the possible freeze at January levels implies Russian output could grow by between 1.7% and 1.9% year-on-year in 2016 because “as of mid-January, there was an annual increase of around 1.7% to 1.9% on the year in daily crude

production.” Russia has previously said on many occasions that it does not have the capacity to regulate output nationally for practical reasons.

If implemented, the proposal would keep OPEC and Russian output at 43.1 million b/d, a downward revision of only 115,000 b/d to the 2016 production forecast, investment bank Goldman Sachs said in a research note. On January 20, with no limits on supply and – following the mid-January lifting of sanctions on Iran – international crude benchmark Dated Brent crashed to \$25.985/barrel, the lowest level since November 2003. Prices rebounded above \$30/b in February on talk of the possible output freeze.

Saudi production has been running at record levels in excess of 10 million b/d for almost a year, and official Saudi data published February 18 showed that output climbed to an average 10.19 million b/d in 2015 from 9.71 million b/d in 2014, a year-on-year increase of 480,000 b/d. Exports were up by 290,000 b/d, to 7.39 million b/d last year from 7.1 million b/d in 2014, according to the data, which was released by the Joint Organizations Data Initiative, a transparency initiative linked to the Riyadh-headquartered International Energy Forum.

Platts latest survey put OPEC crude output in January at 32.43 million b/d, 150,000 b/d up on the previous month, owing largely to increases in supply from Saudi Arabia and Iraq. After a dip in December, Saudi Arabia boosted output by 100,000 b/d to 10.2 million b/d, while Iraq, now OPEC’s second biggest producer, saw an 80,000 b/d increase to 4.33 million b/d from 4.25 million b/d in December. Smaller increases came from Indonesia, which rejoined OPEC in January, Iran and Kuwait.

Iran is starting to make inroads into the European markets from which it was excluded for several years, with deals already agreed to supply a total of more than 300,000 b/d to France’s Total, Italian companies Eni and Saras, and Greek refiner Hellenic Petroleum.

COUNTRY-BY-COUNTRY BREAKDOWN OF OPEC PRODUCTION (million b/d)

Country	January	December	November	October	September	August	July	June
Algeria	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.12
Angola	1.74	1.80	1.80	1.78	1.80	1.78	1.80	1.75
Ecuador	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Indonesia*	0.71	0.70	0.70	-	-	-	-	-
Iran	2.91	2.89	2.88	2.88	2.88	2.87	2.87	2.85
Iraq**	4.33	4.25	4.30	3.65	3.72	3.72	3.75	3.75
Kuwait	2.77	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Libya	0.37	0.38	0.38	0.42	0.37	0.36	0.39	0.41
Nigeria	1.85	1.86	1.90	1.95	1.87	1.85	1.85	1.90
Qatar	0.66	0.66	0.66	0.66	0.66	0.66	0.67	0.67
Saudi Arabia	10.20	10.10	10.15	10.10	10.26	10.40	10.45	10.35
UAE	2.90	2.90	2.90	2.90	2.90	2.88	2.88	2.85
Venezuela	2.35	2.35	2.35	2.34	2.34	2.34	2.34	2.34
Total	32.43	32.28	32.41	31.08	31.20	31.26	31.40	31.28

*Indonesia reactivated its membership of OPEC January 1, 2016.

**The estimate for Iraq in December and November now includes all Iraqi crude production, including production in the Kurdistan region of Iraq. Estimates prior to November do not include KRG production.

Source: Platts

Domestic pricing protects Argentinean shale development

Argentina is determined to protect its oil and gas industries in the face of low international prices, passing the cost on to consumers, a policy that could have far-reaching implications for the development of shale oil and gas outside North America.

In January, a sector-wide accord was reached that locked in domestic crude prices at between \$54.90/b and \$67.50/barrel. "The agreement is designed to sustain activity in the sector and avoid what has happened in the biggest markets in the world, where after the decline in prices there have been huge layoffs of workers and cutbacks in investment," energy minister Juan Jose Aranguren said.

As a part of the accord, refiners were allowed to increase diesel and gasoline prices by 6% in January and will add another 6% in March. These hikes are designed to help refiners contend with the impact of a 40% currency devaluation in December on their dollar-based costs.

The government has also rolled out a \$10/b subsidy for oil exporters in the south of the country and plans to raise gas pricing at the wellhead to encourage more investment. Electricity pricing has also been increased by up to 500%.

These incentives are encouraging oil companies to continue with shale development at a time when other

countries are seeing a sharp drop in investment. "So far the companies that are exploring [Vaca Muerta] are continuing their pilot plans, and they are continuing to make advances," Aranguren said.

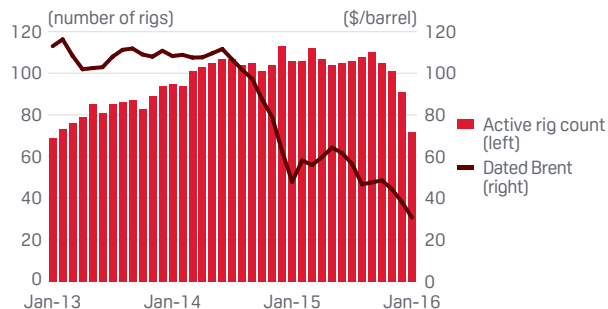
Companies are also seeing success in other shale plays. Madalena Energy announced promising results in February from drilling on the Lower Agrio shale formation. No reserves have yet been assigned to the company's Curamhuele Block, but the company last November released independent third party best estimates (P50) – prior to recent drilling – of unrisks prospective resources of 365 million barrels of oil equivalent, or 99.4 MMboe of risked prospective resources. The company also believes it has risked prospective resources of 92.6 MMBoe on the Vaca Muerta shale.

However, Vaca Muerta remains the main focus. Argentina's state-run YPF and Chevron were the first to enter into production, reaching 54,000 b/d of oil equivalent at end-2015 as part of a \$16 billion long-term development project. Dow Chemical and YPF have agreed to begin a \$2.5 billion shale gas project in 2016, while ExxonMobil has launched a \$14 billion shale project. Total, Shell and Malaysia's Petronas are following suit in the pilot phase, while Russia's Gazprom is looking at opportunities.

The country is trying to rebuild its oil and gas production, which declined by 20% between 2004 and 2014. Oil output stabilized at 532,000 b/d in 2015 and gas rose 3% to 120 MMcm/d, thanks in part to the rise in unconventional output. However, to sustain the production growth, \$20 billion must be invested annually in the oil sector, according to the Argentine Oil and Gas Institute, an industry group.

The number of rigs active in Argentina declined in December and January, falling to 72, down from 110 in September. This is the first sharp drop in the country's rig count since oil prices started falling in the summer of 2014. The agreement on domestic crude pricing is likely to stabilize the drop and sustain activity on Argentina's prospective shales.

ARGENTINA RIG COUNT VS INTERNATIONAL OIL PRICE



Source: Platts, Baker Hughes

Repsol makes major Bolivian gas discovery

Spain's Repsol has discovered a potential 4 Tcf of natural gas at its Caipipendi Block in Bolivia. Repsol has identified the Boyuy (2.6 Tcf), Boicobio (1 Tcf) and Ipaguazu (269,000 Mcf) fields, which could produce 18 million cu m/d (6.6 Bcm/year) by 2019, and help underpin Bolivia's gas supply contracts to neighboring Brazil and Argentina, Repsol company manager Diego Diaz said.

The structures are larger than Repsol's Margarita Field and could bring in \$1.3 billion in annual sales, Hydrocarbons Minister Luis Alberto Sanchez said. The discovery may boost the country's total natural gas reserves by 40%, Bolivian President Evo Morales added. "We had projected reserves at 17 Tcf by 2020, but this new information from Repsol wasn't in our plans," Morales said. "This came as a complete surprise."

Bolivia's reserves currently total 10.5 Tcf (297 Bcm) of natural gas and 211 million barrels of crude, according to a

study by GLJ Petroleum Consultants. They have fallen since Morales came to power in 2006 from 700 Bcm. The finds by Repsol will thus be a welcome relief for the government, which has been criticized for a lack of investment in exploration and poor reserves replacement.

The country produced 61.33 MMcm/d of natural gas and 61,870 b/d of crude and gas liquids through first-half 2015, the latest available figures from state oil and gas company YPFB show. The company aims to boost the country's natural gas output to 77.4 MMcm/d by 2020.

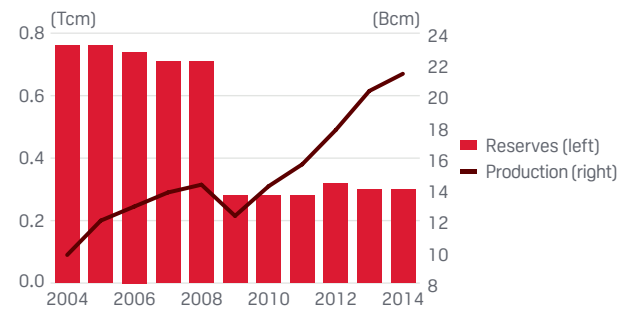
Bolivia, where Morales has seized oil and gas fields and refineries from companies including Repsol, Petrobras and BG, saw oil and gas exports drop 39.8% in value terms to \$3.97 billion in 2015. However, according to BP data, Bolivia's gas production by volume has been rising since 2009, reaching 21.4 Bcm/yr in 2015, up from 20.3 Bcm in

2014 and 12.3 Bcm in 2009. YPF has also started work on a \$57 million exploration program in the northern Andes, aiming to drill a first oil well in the Pando department near the Brazilian border within 16 months after carrying out 2-D seismic work, Morales said.

The government has broader gas-based industrialization plans that total \$30 billion in investment spending over 10 years. The country is seeking to position itself as a key energy provider within the region, with plans to step up both natural gas and electricity supplies to Argentina and to start supplying gas to Paraguay, Uruguay and possibly even Chile, despite historical enmities between the two countries.

Sanchez said in February that his Argentine counterpart, Juan Jose Aranguren, had agreed to raise power purchases to 1 GW from Bolivia by 2018 from 500 MW this year. As part of its strategy of deriving more value from its natural gas resources, Bolivia is building more gas-fired generating capacity to support power exports. The country currently has surplus generating capacity of 400 MW, according to Sanchez. The two ministers were due to meet again February 26. Sanchez said a deal on stepping up gas deliveries to Argentina could include arranging for Argentina's state-run YPF to explore for gas in Bolivia.

BOLIVIAN NATURAL GAS RESERVES AND PRODUCTION



Source: BP Statistical Review of World Energy

Argentina has a contract with Bolivia gradually to increase gas imports to 27.7 MMcm/d in 2017 from an average of 17 MMcm/d in 2015, but Aranguren has said more supplies are needed to meet a spike in demand during the May to September cold season. Argentina also imports about 15 MMcm/d through two floating LNG regasification terminals and, in January, arranged to import 5.5 MMcm/d of gas supplies from two LNG regasification terminals in Chile from May to September.

Anglo American to exit coal, ratings downgraded

Diverse global miner Anglo American plans to divest a number of non-core Australian coal mines in 2016 as well as its South African thermal operations in the long term, choosing to focus on its diamond, platinum group metals and copper assets, it said in its results for 2015 released in February.

"We will continue to evaluate options for all our coal assets across all the geographies and until any decision is made, all assets will be actively managed with a continued focus on safety, performance and delivering value in line with the 2016-17 business plans," an Anglo spokesman said.

Anglo said had already announced its decision to sell its Callide, Dartbrook, Dawson and Foxleigh mines in Australia and its remaining coal assets were being evaluated for buyer interest. "We will follow the usual sale process and it is our aim to sell the assets as going concerns to have minimal impact on our workforce," the company said.

In South Africa, the spokesman said there was already a process in place to reduce its stake in the state-owned utility Eskom-tied mines, with the miner announcing in 2015 it was aiming to sell the New Largo, New Vaal, New Denmark, Kriel and Isibonelo mines. "Our other domestic and export thermal operations in South Africa will be sold. These assets will be actively managed to further improve performance in the short-term and to increase value for the sale of these assets," he said.

Other plans for divestment in Australia include the Bowen Basin metallurgical coal mines, Moranbah North, Grosvenor and Moranbah South, which will be sold as a package. Anglo said it had already started engaging with

potential buyers for the mines that have a combined resource base of over 500 million mt. Anglo said its New South Wales mines, Drayton and Drayton South, would also be divested, with operations at Drayton to be halted this year.

Elsewhere in Australia, Anglo said the Grasree underground and Capcoal open cut mines in Middlemount, Queensland would be managed to improve performance and be considered for sale at an appropriate time. Anglo also operates the Goedehoop, Greenside, Zibulo, Kleinkopje, Landau and Mafube thermal coal mines in South Africa, while it owns a 33.3% share in the Cerrejon thermal coal mine in Colombia.

In 2015, Anglo produced 33.8 million mt of export thermal coal, with 17.4 million mt from South Africa, 11.1 million mt from Colombia and 5.3 million mt from Australia.

Fitch Ratings has downgraded Anglo American as a result of the plans. "The downgrade follows the release of additional information on the group's operational restructuring, which includes the sale of approximately 25 assets, and if completed will result in Anglo American becoming a materially smaller mining company focused on diamonds, copper and platinum," Fitch said in a statement.

"We believe the reduced scale of the group together with the current weak credit metrics and uncertainty related to the timing and execution of the restructuring plan/asset sales are more commensurate with a 'BB' category rating," Fitch said. The agency has downgraded Anglo's long-term Issuer Default Rating and senior unsecured rating to BB+ from BBB-; the

outlook on the long-term IDR is negative. The company's short-term IDR has also been downgraded to B from F3.

The negative outlook "primarily reflects the high level of uncertainty regarding the ultimate success of the group's restructuring plan," the company said. "In part this comes from the large number of mining assets currently available for purchase, creating a buyers' market." With several of the company's available assets being marginally profitable or

loss making, "this raises the question of whether they will attract a purchase multiple that is acceptable to Anglo's management," Fitch said.

Moody's ratings agency had downgraded Anglo American ahead of the restructuring announcement. It said the downgrade "reflects Moody's view that the current environment is not a normal cyclical downturn, but a fundamental shift in the operating environment for the global mining sector."

Nuclear restarts to reduce Kansai Electric's LNG demand

The restart of two 870 MW Takahama nuclear reactors could reduce Japanese utility Kansai Electric Power Co.'s LNG consumption by up to three cargoes a month, with the impact felt most during off-peak months, Platts analytics unit Eclipse Energy said in February. Kansai Electric restarted the 870 MW No. 3 nuclear reactor at the Takahama nuclear plant January 29 and has been running at full capacity since February 4.

The utility is also preparing the 870 MW No. 4 nuclear reactor for restart in late February, but reported a contaminated water leak from the primary coolant desalination tower February 20, according to Japan's Nuclear Regulation Authority. The leak occurred when the primary coolant's temperature and pressure had been increased to commercial operation levels on the final day of planned four-day coolant system leak tests.

These and one-day valve checking tests were scheduled prior to eight-day restart tests, including lifting control rods and synchronization of the reactor to the electricity grid, as part of NRA's fifth and final round of pre-operational inspections prior to Takahama 4's restart, which may now be delayed. Takahama-4 would be the fourth reactor to restart in Japan after nearly all

the units were closed following the March 2011 Fukushima disaster.

Once the two nuclear units are fully operational, Kansai Electric is expected to turn down its oil-fired power plants first as long as LNG spot prices low. The trigger point for choosing oil over gas to generate electricity is about \$6/MMBtu for March 2016, while the Platts JKM for cargoes delivered in March was assessed at \$5.30/MMBtu February 22.

However, the nuclear restarts could still impact Kansai's LNG demand. "A reduction of LNG demand is likely to come in off-peak seasons in the form of a turn-down in the less efficient gas-fired plants, namely [the] 1.8 GW Nanko gas-fired units," said Nayem Chowdhury, quantitative analyst for Eclipse. New gas-fired plants such as the 2.2 GW Himeji Daini combined-cycle units will continue to run as baseload, he said.

A market source close to Kansai Electric said the impact from the restart of the Takahama reactors may be limited, but the effect could be significant once Kansai Electric restarts two 1.18 GW reactors at the Ohi nuclear plant. The source added that growing competition in the retail electricity market, which is expected to be fully deregulated from April, could depress demand.

Chowdhury also questioned whether Kansai Electric would lift LNG from the US Sabine Pass project, from which it plans to buy three to four cargoes between 2016 and mid-2017. "I won't be surprised if they look to not lift or find sellers for the volume," he said.

Kansai Electric consumed 6.08 million mt of LNG over April-December, down 6.5% from 6.5 million mt in the same period a year earlier. The impact of the restart of the nuclear reactors has been apparent for another Japanese utility, Kyushu Electric Power Co., which restarted two 890 MW reactors at its Sendai plant in August and October. Since November, Kyushu Electric has been receiving two to three fewer LNG cargoes a month, according to cFlow, Platts trade flow software.

Japan's LNG imports fell to 85 million mt for 2015, down 4% from 88.5 million mt in 2014, according to the Ministry of Finance. Chowdhury expects demand to fall further in 2016 to 80 million mt. Against this, Japan's contracted volume under long-term commitments is 71 million mt, leaving a gap of 9 million mt, which could offer opportunity for spot deals.



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OIL 

MARKET INDICATORS

Oil producer talks

International crude prices were buffeted in February by discussions between major producers concerning a potential freeze in production levels at January levels. Russia, Saudi Arabia, Qatar and Venezuela agreed to the conditional freeze, if other producers also joined.

Crude marker Dated Brent was assessed at \$32.74/barrel February 1, fell to \$28.66/b February 11 and then rose to \$34.35/b February 22 before dropping back to \$32.385/b February 23. The conditional freeze agreement is significant because of Russia's involvement, but even if it were implemented, it falls far short of an actual cut in output volumes.

Moreover, Iran said that it would not take part as it wants to rebuild its share of the market now that international sanctions on the country's oil exports have been lifted. Iraq has also been ambivalent about participation as it also hopes to increase its crude export levels. Furthermore, if Russia froze output at January levels, it would be doing so at record volumes that incorporate a gain in production this year over 2015.

The drop in the Dated Brent price February 23 was attributed to comments by Saudi Arabia's oil minister Ali Naimi which appeared to dismiss the possibility of a

coordinated production cut, which he called a "waste of time." The pursuit of a production cut by OPEC would be pointless because there was "less trust" that other members would comply with it, Naimi said at the IHS CERAWEEK conference in Houston.

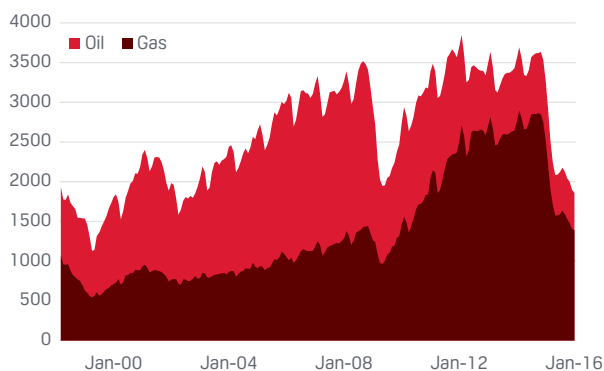
Naimi referred to the freeze agreement as the "beginning of process," lending some support to the argument that a coordinated cut could be next. The process so far though represents mainly an attempt to talk the market up with limited genuine action behind it.

It suggests that Saudi Arabia's policy is to continue with its strategy of high output to build market share until one of two objectives are met; either non-OPEC production shrinks far enough to see prices rise, or a wide group of producers is formed that is able to agree some form of output control. With Russia's commitment so far minimal in volumes terms and neither Iran nor Iraq showing willing, the low price squeeze on non-OPEC production looks likely to continue.

Gas markets

Prices for spot LNG sales in the Asia-Pacific market rose in the first half of the month from \$5.05/MMBtu February 1 to \$5.80/MMBtu February 8, before then falling to \$4.50/MMBtu February 23, the lowest level since July 2009. The

GLOBAL RIG COUNT (monthly average)



Source: Baker Hughes

DATED BRENT (\$/barrel)



Source: Platts Global Alert

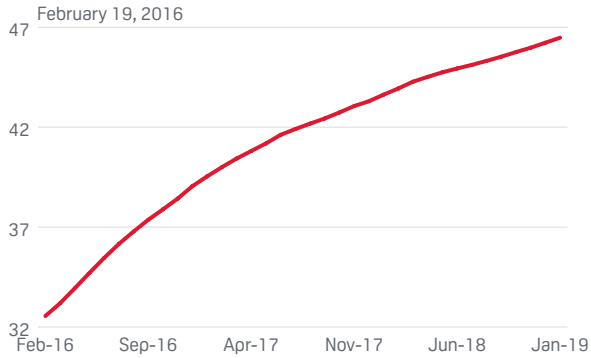
OIL FORECASTS (million b/d)

	Call on OPEC	Change in non-OPEC supply	OPEC NGLs	Total world oil demand	Change in demand	Supply/demand balance
February 2016 estimates for 2015 (million b/d)						
EIA	31.60	1.37	0.12	93.78	1.36	0.13
IEA	30.10	1.40	0.20	94.40	1.60	0.00
OPEC	29.80	1.30	0.10	93.00	1.60	-0.20
February 2016 forecasts for 2016 (million b/d)						
EIA	32.30	-0.56	0.31	95.02	1.24	-1.49
IEA	31.70	-0.60	0.20	95.60	1.20	-1.60
OPEC	31.60	-0.70	0.20	94.20	1.20	-1.70

Supply/demand balance is the change in non-OPEC supply plus change in OPEC NGLs minus change in demand, a positive number implying greater supply than demand. OPEC provides data that combines OPEC NGLs and global biofuels, both appearing as one figure under 'Change in OPEC NGLs'. The EIA and IEA include global biofuels in their 'Change in non-OPEC supply' data.

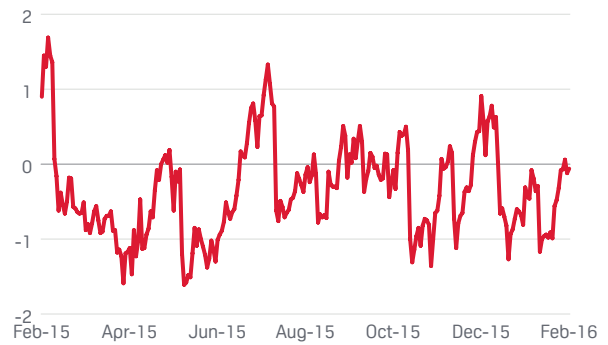
Sources: EIA, IEA, OPEC

PLATTS FORWARD CURVE FOR DATED BRENT (\$/barrel)



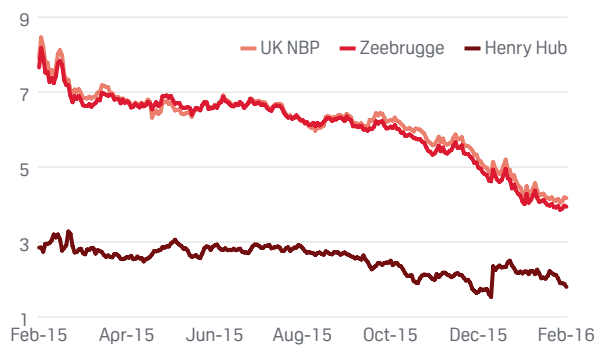
Source: Platts Forward Curve - Oil

MARKET STRUCTURE: DTD BRENT VS 1SR MO (\$/barrel)



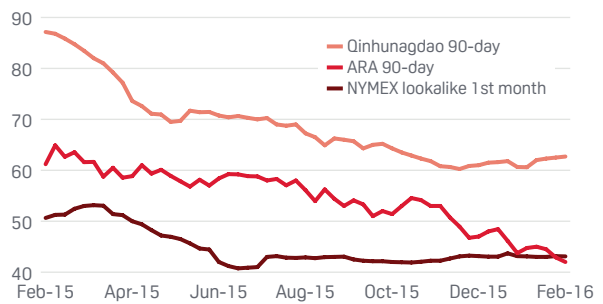
Source: Platts Global Alert

NATURAL GAS MONTH-AHEAD (\$/MMBtu)



Source: Platts Gas Daily, European Gas Daily

COAL (\$/mt)



Based on energy values of CIF ARA 6,000 Kcal/kg, FOB Qinhuangdao 6,200 Kcal/kg, Nymex lookalike 6,668 Kcal/kg

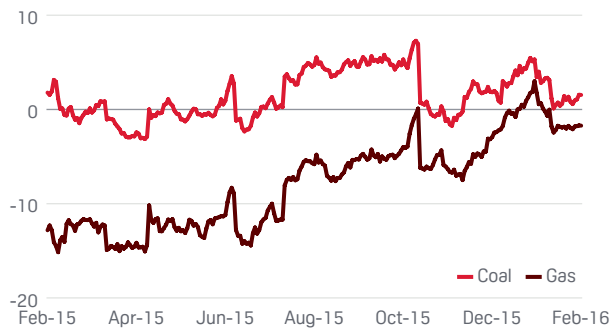
Source: Platts Coal Trader, Coal Trader International

OIL PRODUCT COMPARISONS: FEBRUARY 19, 2016 (\$/barrel)

WTI Cushing Front month: 29.84		Brent front month: 32.20		Dubai front month: 30.21	
CIF NY					
Unleaded 93 0.3% Barge	44.30	FOB Rotterdam Barges			
No.2 Barge	38.20	Premium Gasoline 10 ppm	38.68		
Jet Barge	41.85	Gasoil 0.1%	39.51		
No.6 3.0% NY Spot cargo	20.76	Jet	41.20		
		Fuel Oil 3.5%	20.35		
FOB Singapore					
Gasoline 92 unleaded 40.10					
Gasoil Reg 0.5% sulfur 40.28					
Kerosene 42.91					
HSFO 180 CST 23.52					
FOB Gulf Coast					
Unleaded 93 (waterborne) 46.94					
No.2 (waterborne) 36.86					
Jet 54 (waterborne) 39.46					
No.6 3.5% 21.19					

Source: Platts Global Alert

NWE NEXT MONTH GENERATING COST COMPARISONS, PROFIT/LOSS (\$/MWh)



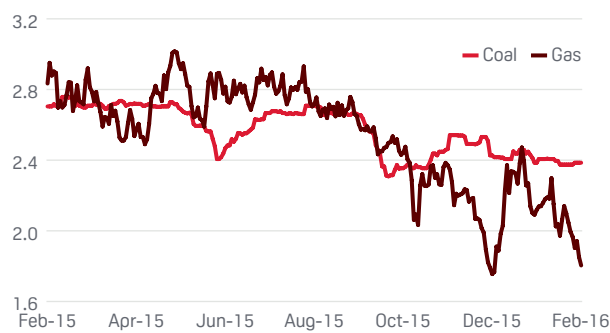
Source: Platts European Power Daily

NWE NEXT QUARTER GENERATING COST COMPARISONS, PROFIT/LOSS (\$/MWh)



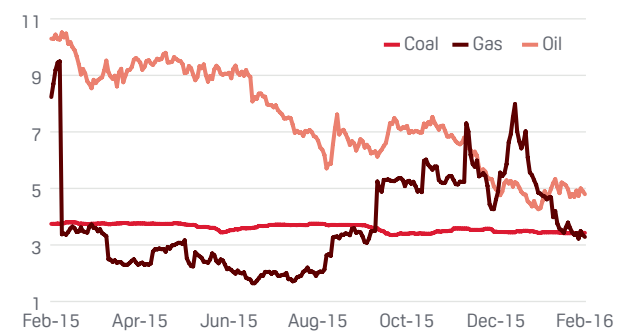
Source: Platts European Power Daily

US SOUTHEAST FUEL COST COMPARISON (\$/MMBtu)



Source: Platts

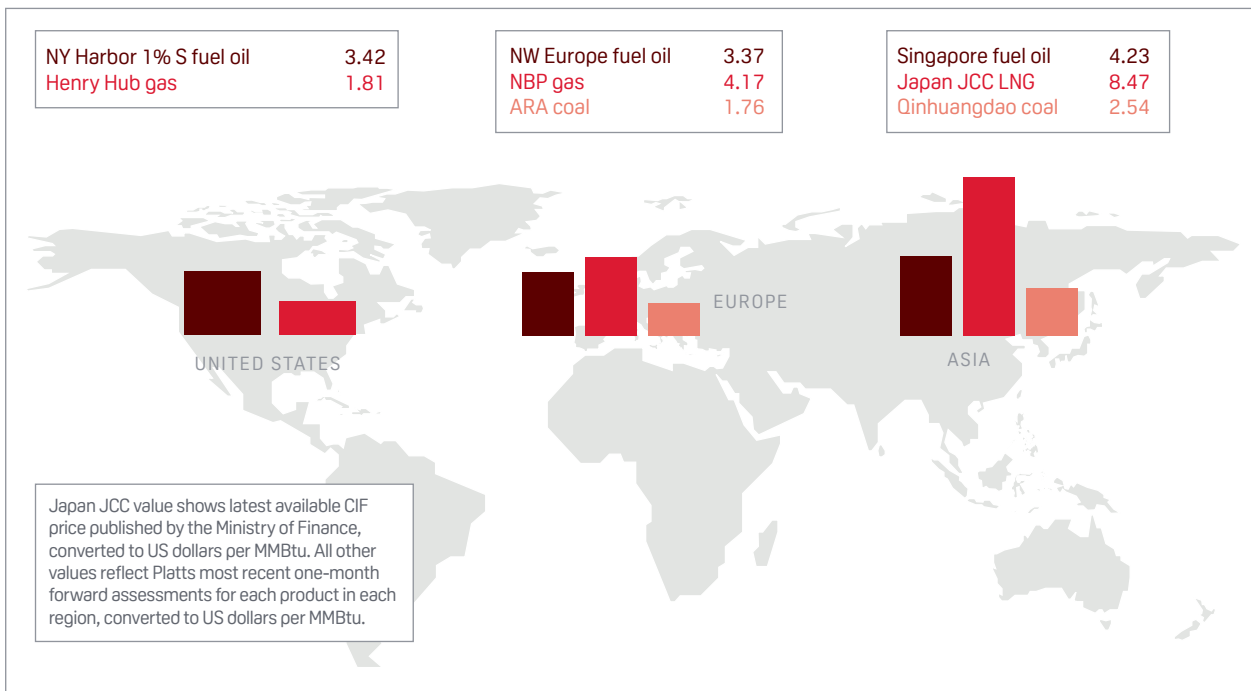
US ISONE FUEL COST COMPARISON (\$/MMBtu)



Source: Platts

NWE Note: Based on typical kg CO₂/mmBtu rates of 101.5 for coal, 55 for natural gas; and on generating efficiencies of 49% for UK gas plant, 54% for western Europe gas plant, 34% for all coal plant. Benchmark coal priced at ARA. Details of methodology at www.platts.com.
US Note: Based on typical heat rates of 9,800 Btu/kWh for coal generation and 7,800 Btu/kWh for natural gas generation; no NO_x controls on coal stations resulting in 0.6 lb/mmBtu NO_x; benchmark coals meeting specifications for NYMEX look-alike and CSX-Big Sandy/Kanawha Central Appalachian coals, barged to Cincinnati and railed to Atlanta, respectively. For details, see methodology at platts.com.

COMPARATIVE POWER FEEDSTOCKS: FEBRUARY 19, 2016 (\$/MMBtu)



Source: Platts LNG Daily

Platts JKM for March delivery averaged \$5.339/MMBtu over the January 18 to February 15 assessment period, down 20.5% from a month earlier, owing to weak demand from North Asian end-buyers, and limited interest from traders in a backwardated market. March is the last late-winter month for North Asia, with demand for heating from buyers in Japan, Korea, China and Taiwan expected to contract as temperatures start warming up in April.

Expectations that supply will emerge from new projects such as Australia's Gorgon also weighed on the market. In addition, although Russia's Sakhalin Energy again postponed the deadline of a sell tender offering one to two cargoes a month over April 2016-March 2017, this time to March 1, both the 4.45 million mt/year Peru LNG export plant and the 3.7 million mt/year Equatorial Guinea LNG plant in West Africa resumed normal operations after a month of scheduled maintenance.

First LNG production from Train 1 at Chevron's Gorgon project in Western Australia is imminent, according to remarks made by chairman and CEO John Watson end-January. He said then that Train 1 would start up within weeks and that modules had been delivered to site and construction was progressing for Trains 2 and 3. Each train has capacity of 5.2 million mt/year.

In the US, front-month Henry Hub gas for March delivery closed at \$1.782/MMBtu February 23, compared with \$2.152/MMBtu February 1. The price fell despite US Energy Information Administration saying February 18 that US natural gas in storage had dropped by 158 Bcf to 2.706 Tcf in the week ended February 12, with the net fall greater than analysts' expectations of a withdrawal of between 149 and 153 Bcf.

In the corresponding week of 2015 the EIA had reported a lower withdrawal of 117 Bcf, although the figure was below the five-year average of a 170-Bcf decrease. But even after the higher on-year withdrawal, stocks were still 532 Bcf, or 24.5%, higher than the year-ago level of 2.174 Tcf. Stocks were also 555 Bcf, or 25.8%, higher than the five-year average of 2.151 Tcf.

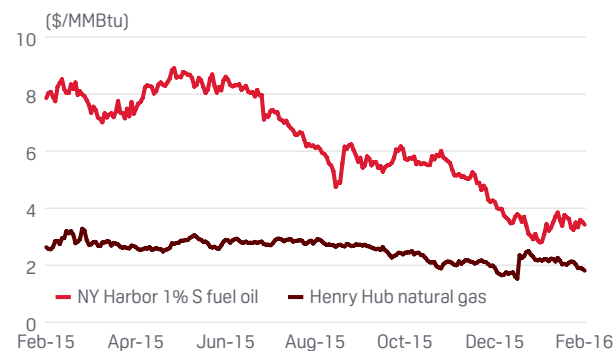
Nor did weather forecasts offer any support, with Citi Futures Perspective energy futures specialist Tim Evans saying: "the natural gas market is back on the defensive, with the latest temperature forecast running slightly warmer."

In the UK, month-ahead gas prices at the NBP started the month at \$4.241/MMBtu, dropped to \$4.09/MMBtu February 15, before rising again to \$4.225/MMBtu February 23 as temperatures dropped, boosting demand. Storage withdrawals increased to help meet the increase in demand, and stock levels stood at 2.001 Bcm February 16, down from 2.602 Bcm at the beginning of February.

CIF ARA coal falls to record lows

The Europe-delivered CIF ARA thermal coal market fell \$1.95/mt during February to the lowest level since Platts started assessing spot prices in March 2007, owing to low

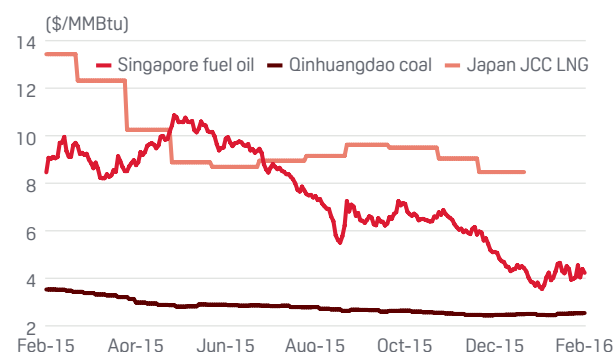
COMPARATIVE POWER FEEDSTOCK PRICES: US



Values reflect Platts most recent one-month forward assessments for each product in each region, converted to \$/MMBtu.

Source: Platts LNG Daily

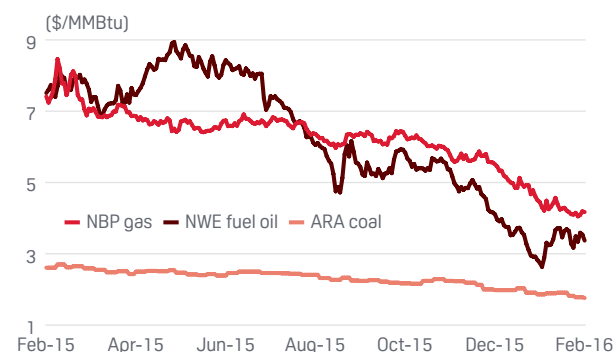
COMPARATIVE POWER FEEDSTOCK PRICES: ASIA



Japan JCC value shows latest available CIF price published by the Ministry of Finance, converted to \$/MMBtu. All other values reflect Platts most recent one-month forward assessments for each product in each region, converted to \$/MMBtu.

Source: Platts LNG Daily

COMPARATIVE POWER FEEDSTOCK PRICES: NWE



Values reflect Platts most recent one-month forward assessments for each product in each region, converted to \$/MMBtu.

Source: Platts LNG Daily

demand after a mild winter. Platts assessed CIF ARA 6,000 kcal/kg NAR prices at \$41.85/mt February 19. Weakening crude oil prices have also helped weigh on thermal coal prices, with turbulent global financial markets also pressuring commodity prices.

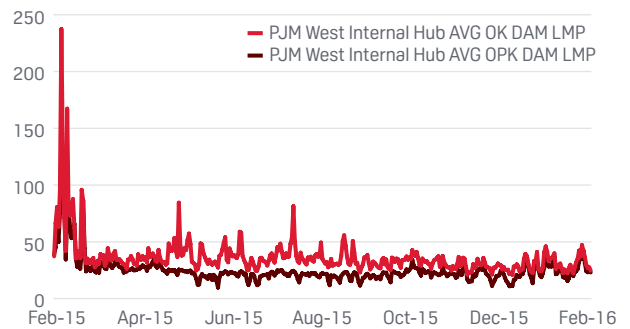
However, there may be some upside, with 40 days of wage negotiations between mineworkers union Sintracarbon and Colombia's largest thermal coal miner

UK BASELOAD MONTH AHEAD (£/MWh)



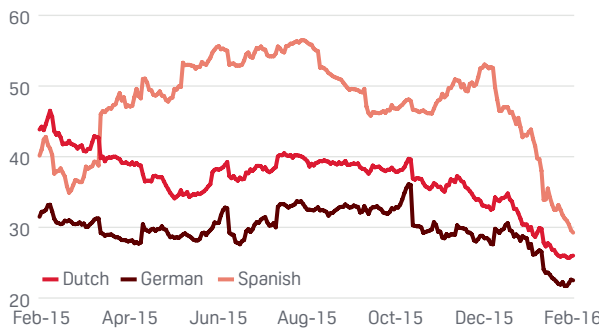
Source: Platts European Power Alert

PJM WEST AVG OK/OPK DAM LMP (\$/MWh)



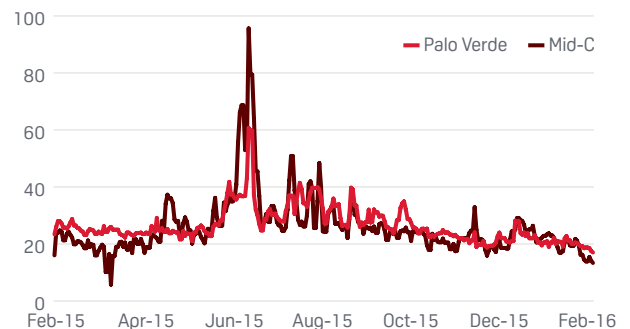
Source: Platts

EUROPEAN BASELOAD MONTH AHEAD (€/MWh)



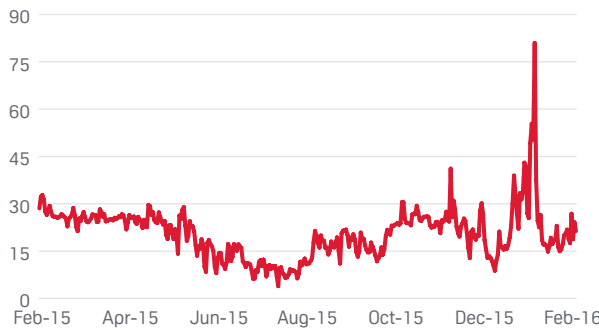
Source: Platts European Power Alert

US DAY AHEAD (\$/MWh)



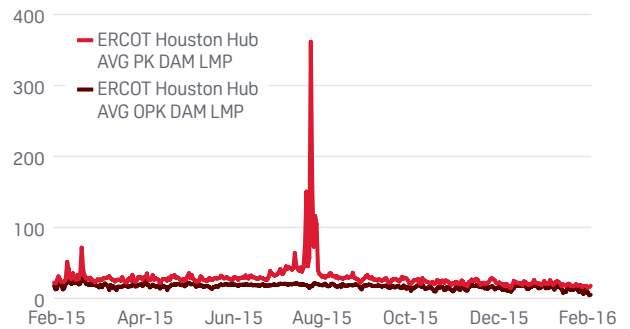
Source: Platts

NORD POOL SYSTEM DAY AHEAD (€/MWh)



Source: Platts European Power Alert

ERCOT (HOUSTON) AVG PK/OPK DAM LMP (\$/MWh)



Source: Platts

Cerrejon having yielded no agreement and workers expected to vote to strike imminently.

In South Africa, Richards Bay FOB 6,000 kcal/kg NAR spot prices continued to move in the opposite direction to their European counterparts, rising over \$4 during the month. Platts assessed FOB Richards Bay 6,000 kcal/kg NAR at \$54/mt February 19, gaining \$4.25 month-on-month. Sources attribute the strength to strong bidding from one large produce/trader, with most market participants unsure where South African material would price into at these price levels.

A factor that is expected to put downward pressure on prices is the opening arbitrage for Colombian and Russian coals to

India, the primary buyer of South African thermal coal. However, so far, despite the competition from other coals, South African spot prices have failed to slip to lower levels, although stocks at the Richards Bay Coal Terminal have risen from 2 million mt earlier in February to around 2.75 million mt.

In the Asia-Pacific market, most of the month was quiet due to the Lunar New Year week-long holiday in China. Sources said, although Colombian coal was being sold to India, it was unlikely it would find buyers in China, owing to China's limits of several trace chemical elements in imported thermal coal. Platts assessed the Australian Newcastle 5,500 kcal/kg NAR with 20% ash content at \$40.10/mt February 19, climbing 80 cents on the month.