MARSH | BRINK *The Edge of Risk*

BRINK Compendium

A Compilation of News Articles Pertinent to the Oil and Gas Industry

INTRODUCTION

The articles contained in this publication have been selected for the ways in which they examine crucial issues for the oil and gas industry. They provide critical insight into the traditional and emerging risks facing companies in the sector, as well as the opportunities available to those companies that best position themselves to take advantage of them.

All articles first appeared on BRINK – a digital platform that informs global decision-makers on critical growth and innovation topics. BRINK is made possible by Marsh & McLennan Companies and managed by Atlantic Media Strategies, the digital consultancy of The Atlantic. It collates knowledge and expertise from the world's leading experts on risk and resilience to provide practical and timely insights to top executives and policy leaders worldwide.

UAE—A CASE STUDY IN MANAGING THE ENERGY TRILEMMA

ENVIRONMENT | DECEMBER 12, 2014

Suhail Mohamed Faraj Al Mazrouei
Minister of Energy for UAE

How to manage the Energy Trilemma—the balance between secure, affordable, and environmentally sustainable energy—is a critical question facing all countries, regardless of their energy resources.

There is no single right solution to this trilemma and each country develops and adapts its approach and policies taking into account energy resources and needs, economic goals, social needs, and opportunities stemming from new technologies.

The United Arab Emirates offers a case study in the evolution of approaches to balancing the energy trilemma. From an initial focus on using its abundant oil reserves, the UAE has widened its view on energy security to include a diversity of energy sources—including nuclear and renewables—as well as energy efficiency and demand side management. This energy security approach provides affordable energy to fuel a diverse economy and improve overall environmental sustainability. Public acceptance of the country's plans for demand-side efficiencies may also require a re-examination of its subsidy system.

Today, planning for energy security and sustainability is on the top of our government's agenda. Energy will continue to be an economic cornerstone of the UAE and will strengthen the country's competitiveness in the future.

EARLY FOCUS ON LEVERAGING AVAILABLE ENERGY RESOURCES

Since the early days of our union, the government used local oil resources to build a reliable energy infrastructure to guarantee the availability of electricity and fuel to its entire population. As our

Our capital, Abu Dhabi, will be an international hub for renewable energy, new energy, and sustainable technologies, thereby balancing its already strong oil-producing position.

population and economy grew, the government realized the need to reduce the use of liquid fuel and replace it with natural gas for environmental and cost factors. That's also when we decided to diversify the natural gas fuel sources and consider importation.

In 2007, Dolphin Energy, a gas company established by the government in 1999, began importing 2 billion cubic feet per day of compressed natural gas via a subsea pipeline from Qatar, which we also supplied to Oman. Today, natural gas from Dolphin Energy supplies almost half of our electricity requirements and allows us to remain almost 100 percent dependent on natural gas for power generation.

In addition to imports, we have also started developing some of the most challenging unconventional sour gas reservoirs in Abu Dhabi. The gas development is part of a broader production capacity enhancement project aiming to set the country at 3.5 million barrels of oil per day by 2017. The production capacity enhancement will ensure the country's position as a long-term oil supplier to the world and keep up with growing local demand. We also upgraded our refinery output to more than 1 million bopd by the end of 2015 from the previous level of 500,000 bopd.

A GROWING FOCUS ON DIVERSITY OF ENERGY SUPPLY

With rapid economic growth and the rise of oil prices, the UAE government again realized the need to cultivate diverse energy sources—that's when we decided to introduce nuclear power and started a journey with the international community to get the endorsement of a state of the art peaceful, safe and secure nuclear program. The Emirates Nuclear Energy Cooperation is constructing four nuclear plants, which will provide 5600 MW-H of emission-free electricity. This will help the UAE reach its clean energy target of 24 percent by 2020.

In the UAE we believe in the future energy evolution and expect that sustainable energy will play a key role in complementing conventional sources. Our capital, Abu Dhabi, will be an international hub for renewable energy, new energy, and sustainable technologies, thereby balancing its already strong oil-producing position. As an expression of this strategy, Abu Dhabi hosts the headquarters of the International Renewable Energy Agency. As part of its commitment to sustainability, and in order to encourage the development of a knowledge-based, export-oriented renewable energy sector, the Abu Dhabi government has made a commitment to renewable power. This decision supports the ongoing diversification of the country's economy and is expected to create a domestic renewable energy market.

Sustainable energy is becoming part of our future energy mix, and we are expecting it to contribute at least 5 percent of the energy mix in the near future. Currently, we have three solar projects feeding the grid, and one of them is Shams-1: One of the world's largest concentrated solar power plants with a capacity of 100 MW-H. The plant is expected to displace 175,000 tons of CO2 every year, equivalent to planting 1.5 million trees or taking approximately 15,000 cars off the road.

MANAGING ENERGY USE TO INCREASE SECURITY AND SUSTAINABILITY

The Ministry of Energy is mandated to structure the National Energy Conservation Law as part of the UAE's energy policy. With multiple initiatives for improving the energy efficiency of buildings, we have a good base to start from. Changing consumption behavior will require some time, and speeding up public acceptance of this plan may require us to reexamine our subsidy system in the UAE.

With the wisdom of our leadership and good planning, we can be an example in the region by building a balanced and sustainable energy policy that ensures security and availability, affordability, and sustainability of resources.

PROGRESS TOWARD BALANCED, SUSTAINABLE ENERGY WORLD REMAINS SLOW

ENVIRONMENT | NOVEMBER 11, 2015

François Austin
Partner and Head of Energy Practice for Oliver Wyman

Energy sustainability is not only an opportunity to transform societies and grow economies, but it is also a necessity—a prerequisite to meet growing energy demand in many parts of the world and to reduce the global carbon footprint. In order to build a strong basis for prosperity and competitiveness, individual countries must balance the three core dimensions of what Oliver Wyman and the World Energy Council have defined as the energy trilemma: affordability and access, energy security and environmental sustainability.

The annual Energy Trilemma Index ranks 130 countries on their performance in meeting the energy trilemma and assesses how well countries are balancing the three dimensions.

As highlighted in the 2015 Index released today, the transition towards balanced and sustainable energy systems is slowly taking place. Over the last five years, positive developments have been recorded in access to energy, share of renewables in the electricity generation mix and rate of energy-efficiency improvements. Global energy intensity has decreased by 4.2 percent and CO2 emissions intensity has fallen by 4.5 percent in that time, while the global electrification rate has risen to 85 percent with an additional 222 million people gaining access to electricity from 2010-2012.

Still, many countries face obstacles to achieving a successful balance across the energy dimensions. This year, only two countries, Switzerland and Sweden, managed to obtain an AAA balance score across all three dimensions. The United Kingdom's score was amended to AAB, as its energy equity performance suffered in comparison to other leading countries.

Several countries, including the UK, Japan and Germany, are identified on the 2015 Watch List as being likely to experience a significant change in Index performance in the near future. These positive or negative changes can be driven by deep transitions in their energy systems—be they of a regulatory nature, concerning the energy supply mix or related to infrastructure changes to improve the resilience of their energy systems. In 2015, South Africa and the U.S. were added to the negative watch list, while the Philippines and Serbia are now on watch for overall positive trends in the coming years.

The energy challenges faced by each country are unique and complex, as evidenced by the variability in performance across the trilemma dimensions and contextual factors. Yet the transnational nature of energy markets and environmental issues necessitates a perspective that extends past the country level. Energy leaders have emphasized the need to adopt regionally coordinated approaches to energy resources, infrastructure and regulation.

Accordingly, the Index report includes regional profiles designed to characterize the challenges and opportunities faced by various regions in relation to the energy

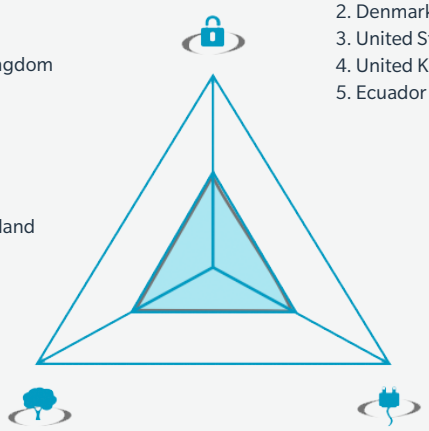
trilemma. The growth in global investment in renewable energy in Asia is noted alongside the rapid growth of greenhouse gas emissions there, while Latin America faces increasing challenges driven by changing weather patterns and concerns related to the energy-water-food nexus.

In the lead-up to the United Nations Climate Change Conference (COP 21) in Paris on November 30 through December 11, energy sector leaders have spoken about the need for a clear international dialogue and a robust, sustainable policy framework to ensure research and investment is targeted at delivering sustainable energy systems. Progress across the dimensions of the energy trilemma remains slow, and can only be sped up by creating such frameworks that give certainty to investors.

FIGURE 1 2015 Energy Trilemma Index Top 10, Top Performers Overall and by Dimension
Source: World Energy Council / Oliver Wyman

2015 Index Top 10

1. Switzerland
2. Sweden
3. Norway
4. United Kingdom
5. Austria
6. Denmark
7. Canada
8. France
9. Finland
10. New Zealand



Energy Security

1. Canada
2. Denmark
3. United States
4. United Kingdom
5. Ecuador
6. Australia
7. Nigeria
8. Gabon
9. Argentina
10. Switzerland

Environmental Sustainability

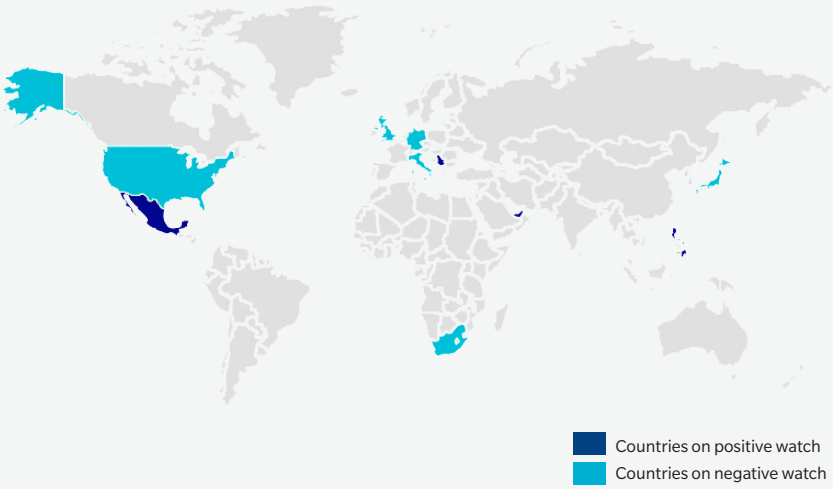
1. Switzerland
2. Costa Rica
3. Columbia
4. Uruguay
5. Albania
6. Norway
7. Paraguay
8. Mauritius
9. Sweden
10. Gabon

Energy Equity

1. United States
2. Canada
3. Luxembourg
4. Qatar
5. Switzerland
6. United Arab Emirates
7. Saudi Arabia
8. Hong Kong, China
9. Austria
10. Gabon

FIGURE 2 2015 World Energy Council Watch List
Source: World Energy Council / Oliver Wyman

2015 Rank	Country	Watch
4	United Kingdom	Negative
12	United States	Negative
13	Germany	Negative
31	Italy	Negative
32	Japan	Negative
38	UAE	Positive
48	Mexico	Positive
50	Phillipines	Positive
84	South Africa	Negative
112	Serbia	Positive



THE LONG BUT NECESSARY ROAD TO ENERGY RESILIENCE

ENVIRONMENT | OCTOBER 15, 2015

Dean Oskvig
President and CEO of Black & Veatch Energy Business

As the world meets in Paris for COP 21, the energy sector needs a clear pathway that ends the uncertainty that has cast a shadow over the energy sector for the last decade. Climate change negotiators have an unprecedented opportunity—and also a responsibility—to put us on a sustainable path that will allow the global economy to continue growing while minimising the impact on the environment.

The world risks failing to meet its energy goals and basic goals of economic development if action is not taken now. In its latest publication, The Road to Resilience – Managing Extreme Weather Risks, the World Energy Council points out that the frequency, severity and exposure of energy systems to extreme weather events are increasing and that the world needs to build more resilient energy systems.

The report highlights the pending crisis that the global economy will face if energy systems are not transformed to handle changing climatic conditions.

The occurrence of extreme weather events has quadrupled over the last 40 years, from 38 events in 1980 to 174 events in 2014. Severe storms' contribution to overall insured losses (last 5 years compared to last 20 years) alone has increased more than 40 percent. Many more events are expected in the future, driven by the increase in global average temperatures.

These climatic conditions are impacting the energy infrastructure and interconnected systems everywhere. As the frequency and severity of extreme weather events increase, the strain on energy supply and demand, production, revenue streams and overall system efficacy is nearing crisis levels. The trends suggest no region is unaffected and

As the frequency and severity of extreme weather events increase, the strain on energy supply and demand, production, revenue streams and overall system efficacy is nearing crisis levels.

no energy system is unthreatened; a global view for energy resiliency is required.

The traditional approach for energy infrastructure resiliency needs to evolve to align with the increasingly extreme weather. In the past, the energy sector has relied on "hard resilience"—an approach focused on building "fail-safe" infrastructure systems. Resilience has been viewed as a way to bring single assets back into operation after an event.

"Hard-resilience" measures are no longer sufficient. Rather than preparing energy assets to resume operations after an event, the energy sector needs to be prepared for an event to occur anytime. Adopting a view of "soft-resilience"—one that focuses on preparing for extreme events—is more proactive and enables better planning.

Furthermore, to ensure the reliability of operations, energy systems need to be viewed holistically as opposed to individual assets. This reduces vulnerabilities that may result from unanticipated events in one part of the value chain and also provides opportunities for different sectors to work together to ensure continuity.

Overall, there needs to be a shift from "fail-safe" systems that look at single assets to "safe-fail" systems that take a systemic approach towards the energy value chain and a more strategic approach towards identifying vulnerabilities.

FINANCIAL INVESTMENTS NEEDED TO BOLSTER ENERGY RESILIENCY

There is a significant financial investment required over the next several years to increase the resiliency of energy systems. Current estimates show between $48 trillion and $53 trillion is needed for energy adaptation alone; however this does not include the measures needed to support resilience. Given the magnitude of funding required, the responsibility of resilience is on both the public and private sectors to ensure that costs are managed effectively.

Several challenges currently stand in the way of generating resiliency investment and require the support of various stakeholders to tackle. These include developing goals or metrics to measure adaptation (e.g., sufficient level of resilience) to understand its true costs, and enable governments and companies to track progress; incorporating environmental standards into investment considerations, and designing uniquely tailored financial instruments that create opportunities from extreme weather risk.

Though the road to resilience is long, it is an integral aspect of achieving long-term sustainability. As this report concludes, it calls on various stakeholders to take action and play their part in supporting the future resiliency of energy systems. The report calls on:

- Energy companies and project developers to consider extreme weather in their planning, operations and maintenance, and to implement hard and soft resiliency measures
- Regulators to provide guidance for resilience and market regulations, and to open energy infrastructure to all investors
- The financial services industry to develop models that fully reflect extreme weather risks and include hard and soft resilience measures in their cost benefit analyses
- Insurance companies and banks to create risk transfer options for residual risks
- Long-term and institutional investors to collaborate with other stakeholders to overcome investment barriers

The world is changing. The energy sector is in transition and facing a new world order post-COP, as the global geographic, economic and societal outlook evolves over the next several years, industries and economies need to adapt to survive. There is currently no unaffected region and no economy strong enough to protect its energy assets, nor its citizens; resilience is not an option, it is a must.

U.S. SHALE COULD HERALD REVOLUTION FOR REGIONAL OIL MARKETS

ECONOMY | JULY 2, 2015

Saji Sam
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The striking success of the U.S. shale revolution, could become a global revolution as other areas of the world consider exploiting their untapped shale reserves, looking to the U.S. less as a supplier and more as a harbinger.

The confluence of volatile oil prices, abundant global shale resources, technology to extract these resources, and geopolitics could push companies to produce oil and gas closer to where it is consumed. Such regional markets could upset the political world order in the long term, changing power dynamics between traditional oil producing nations and consumers.

North America, South America, and China are prime candidates for regional markets given the magnitude of technically recoverable unconventional oil and gas these regions hold. Unconventional oil and gas markets have reached maturity in the U.S., providing a blueprint for other basins around the world. Since the U.S. bans oil exports, the market is already somewhat decoupled from the rest of the world. Local oil trades at a discount to global oil markers.

South America has massive reserves; Argentina, Brazil, and Venezuela together hold close to 250 billion barrels of oil equivalent in unconventional resources, 80 percent of which is gas. Argentina alone holds 65 percent of these resources. In China, the total technically recoverable unconventional resources are estimated at 225 billion barrels of oil equivalent, 85 percent of which is gas.

If regions can overcome the politics, environmental concerns, and capital requirements of producing their own resources, they could cut dependence on traditional suppliers, and control their own energy policies.

The U.S. shale revolution will be challenging to replicate. American independent oil companies have enjoyed access to cheap capital in a low-interest-rate environment. The U.S. oil industry was already well-developed when shale production began. Pipelines and rigs were available, more were quickly built, and high-quality roads allowed smooth transportation of equipment. Water is available in the major U.S. shale basins, and mineral rights laws make drilling possible and very attractive in many communities.

Other regions of the world lack some of those factors, and will have to develop the market in their own ways. A lack of surface infrastructure and water in the regions endowed with shale resources could be challenging for China. Argentina must build market confidence to attract the investment needed to develop the ecosystem to enable a shale revolution, driven by the private sector.

But the technology and existing oil reserves offer hope that the political and infrastructure development is worth the effort. If regions can overcome the politics, environmental concerns, and capital requirements of producing their own resources, they could cut dependence on traditional suppliers, and control their own energy policies.

This would mark a historic shift in the long term. Until now, most of the world's oil has been produced in countries with high political risk, including political instability, conflict, and even insurgency. The list of top ten oil exporting countries includes such high-risk nations as Russia, Iraq, Nigeria and Venezuela. In some cases, the cost for an oil company to mitigate that political risk is high enough to prompt executives to scout for shale opportunities in stable regions instead of investing in risky countries with less attractive fiscal regimes.

OPEC may have intended to squeeze North American shale producers as it has maintained production levels in the face of falling oil prices and protected market share. However, the drop in oil prices doesn't necessarily put North American newcomers out of business.

UNCONVENTIONAL SHALE PRODUCTION LEADS THE WAY

Unconventional exploration and development in some of the most productive shale oil fields, such as the Bakken in North Dakota and the Eagle Ford Shale in Texas, is competitive with oil produced by conventional methods. In some areas, unconventional shale production has a break-even price as low as about $40 a barrel, on par with some conventional production. Lower oil prices have prompted producers to cut back on capital projects, tempering demand for oil field services and supplies.

Renegotiating with suppliers will bring that break-even price further down. In addition, many shale companies are focused intently on efficiency and technology improvements, pushing the break-even price low enough to put shale on par with oil fields of many traditional oil producing countries.

Lower oil prices are instead squeezing some of the traditional producers. Our research shows that $50 oil puts some of the politically unstable oil producing countries under considerable stress as they grapple with lower oil revenue in their national budgets. Those most at risk include Nigeria, Venezuela, Iraq, Iran, and Russia. These countries might try to work with other producers to manage supply volumes in hopes of resurrecting oil prices. The Gulf Cooperation Council producers such Saudi Arabia, UAE, Kuwait, and Qatar have amassed considerable wealth during the past decade in their reserves and sovereign wealth funds. While these countries could withstand a few years of $50 oil by depleting their financial reserves, they would come under stress after five to seven years of low oil prices. They are betting on the resurgence of global demand to push prices up.

As OPEC countries and other traditional producers come under pressure from oil prices, the U.S. gains political leverage as it becomes less dependent on those suppliers. U.S. dependency on the Middle East may shape perceptions of the region's vulnerability to security crises, with other countries obliged to play greater roles.

For example, a recent global risk report points out that more widely available liquefied natural gas from the U.S. could undermine the Russian Federation's negotiating leverage with consumers in Europe and Asia. Washington may use LNG exports to achieve foreign policy goals. Other regions might be able to build their own bases of political influence by producing more of their own energy, reducing their historic dependence on other nations. A number of energy companies have already been testing shale production in various European countries, such as Germany, Poland, Romania, and Lithuania. However, in many places, those operators must overcome deep environmental concerns in the community, and have had varying levels of success.

Many governments and national oil companies are growing interested in developing regional supplies as a key path to energy independence and affordable energy. But those countries will have to sort out a slew of issues, from community concerns and zoning issues, to mineral rights ownership and a new relationship with old suppliers. Local oil prices could react, and it could be a wild ride.

RISK AND OPPORTUNITY ON THE RISE FOR OIL AND GAS COMPANIES

ECONOMY | JUNE 4, 2015

Philip Tenenbaum
Global Leader of the Energy Vertical for Mercer

John Koob
Partner and Global Oil and Gas Segment Leader for Mercer

Volatile prices have disrupted the oil markets, and the knee-jerk assumption is that layoffs and cutbacks will sweep through the industry. But the future is more complicated.

First, certain segments of the industry, such as companies involved in oil and gas transmission, are not necessarily at risk. For those that are, primarily oil and gas producers and service companies, disruption can be managed and can create significant opportunities for companies to gain competitive advantage.

How? By taking the long view and strengthening the enterprise to compete in what has always been—and always will be—a tumultuous marketplace. Good strategy can reduce the risk of long-term competitive weakness, despite the market's inevitable swings.

Meanwhile, short-term actions are on the table. Recent Mercer surveys of more than 100 oil and gas industry organizations in the U.S., Canada and Mexico looked at the business and human capital responses to the oil price decline. In January 2015, only 44 percent of those surveyed planned to cut back on capital expenditures; however, by April, that figure jumped to 68 percent. Similarly, 38 percent planned to reduce selling, general and administrative operating expenses in January, but by April that figure rose to 61 percent.

As for the human toll, 58 percent planned downsizing or layoffs of permanent employees in the April

In any industry, turning disruption into opportunity calls for a process of best action to meet the near- and long-term requirements of the business, customers, employees and stakeholders.

survey, with 45 percent planning cuts or layoffs of contract workers. Reorganization and restructuring plans soared from 16 percent of surveyed firms in January to 45 percent in April, and the percentage planning to implement broad salary freezes doubled in the same time frame.

The news reflects all this. In April, the Wall Street Journal reported that, since crude prices began tumbling last year, energy companies have announced plans to lay off more than 100,000 workers around the world.

But the rush to pay cuts and staff reductions may prove hazardous over the long term. A better move is a balanced strategy that limits the damage of short-term responses while building capability for tomorrow. Since oil prices are fundamentally rooted in supply and demand, inevitable production cuts will take their toll, demand will outpace supply, and oil and gas organizations will return to growth mode.

They had better be ready for it. Last year, Mercer released a Global Talent Forecast that predicted a shortage of roughly 22,000 petroleum engineers, worldwide, by 2017. Considering that time-to-proficiency for a petroleum engineer can take between seven and 14 years, the likelihood is that the oil and gas industry will be faced with a shortage of critical talent when the markets rebound.

In any industry, turning disruption into opportunity calls for a process of best action to meet the near- and long-term requirements of the business, customers, employees and stakeholders. Sure, companies that require immediate cost savings may have to make workforce reductions, but a farsighted approach to human capital, such as shifting pay to future years or a temporary suspension of some benefits, can produce at least a portion of required savings without impeding the ability to compete once markets rebound. Suspending a 401(k) match for some period of time, for example, instead of canceling the retirement plan, can be an alternative.

Frankly, it takes a framework for action more so than an axe. The process begins with evaluation, asking exactly what is the extent and severity of market conditions? It proceeds through option development (over several time frames), strategic choice (the best options for the short and long terms), and ends in good governance, with the right human capital strategy embedded in the business, aided by a full measure of workforce analytics, monitoring, and reporting.

Just as important as a good process are fundamental actions, and oil and gas companies should take them now. First, they must defend their best assets, those critically important employees who might be ripe for poaching by competitors, by making sure the rewards are sufficient to retain them. Next, they should clarify roles, work and key performance requirements so that employees have a clear view of how to succeed and the skills they need.

And don't think employees aren't paying attention: In Mercer's recent survey of 1,800 North American oil and gas employees, respondents ranked "job security" as their number one preference among a variety of "total rewards" options—even higher than "base pay." This is highly unusual—base pay almost always tops the list—and speaks to how concerned oil and gas employees are about their immediate job prospects. Employers must know what elements of their total reward packages employees value most in order to make the best decisions about what to change.

Companies also should be investing in high-impact training and development programs and have the capability to codify and transfer the knowledge of senior experts to younger employees. But how to engage and retain workers in a volatile market, with so much media focus on the industry? Companies have no choice but to up their own game in terms of corporate communications and transparency.

Most oil and gas companies have already taken the first round of cost cuts—in most cases, the low-hanging fruit of staff cuts and pay freezes. As they plan for rounds two and three, the challenges rise. For example, social media platforms enable laid-off employees to tarnish corporate brands as never before. So it's vital to keep employee perspectives in sight and explore strategies that can preserve both financial and human capital, for example, moving from Defined Benefit to Defined Contribution pension plans.

If anything, change is the challenge. The most competitive companies find ways to adapt to it, improving continuously, putting in place workforce planning tools, creating dashboards based on business conditions that signal when resources need to be brought back on, and honing recruiting efforts to attract the right people at the right time—and at the right cost.

It may take enhanced investment in project management offices and cross-functional teams to ensure that important plans, or mergers and acquisitions, go forward. Amidst so much change, companies often struggle to do what they say they are going to do. Staying true to stated values is vital.

Business conditions may still force the hand of the most committed leadership, requiring the layoffs and cutbacks a given strategy seeks to avoid. If market position is to hold and growth is to rebound, the interests of the enterprise and its stakeholders must come first, and often painfully. It's a tall order, but managing disruption today—rather than simply reacting to and fostering it—is the solution for tomorrow's oil and gas industry.

‘DIGITAL OILFIELD’ VULNERABLE TO CYBER THREATS

TECHNOLOGY | APRIL 7, 2015

Silvio Sperzani
Partner at Oliver Wyman

The potential impact of cyber attacks on utilities and the national grids has been frequently discussed. However, the oil and gas sector is also exposed to significant cyber threats. The rise of the “digital oilfield” has left oil and gas companies increasingly dependent on data to sustain production. As these technologies become widespread, the cyber risk for the oil and gas industry will continue to rise, demanding action and preparedness to protect against these threats.

Digital technologies have already been widely implemented across all segments of energy production, driving improved efficiency and increased production by harnessing the power of connectivity and data. The size of the worldwide digital oil field technology market increased from $18.7 billion in 2011 to $24.6 billion in 2014, for a compound annual growth rate of 9.6 percent between 2011 and 2014. By 2022, the market is expected to be $33.3 billion.

Control rooms, substations and devices used to manage oil and gas plants, refineries and pipelines are now all digital, utilizing video-enabled telepresence and high-speed data links. Upstream, digital technologies are used for reservoir modelling, drilling resource dispatching, computer-aided hydraulic fracturing, production optimization, reliability and preventive maintenance, and supply chain planning analytics.

Downstream, the shift to digital is being realized through supply-demand matching smart grids and new approaches to networking operational systems such as Supervisory Control and Data Acquisition (SCADA). Applications of digital technologies further

FIGURE 3 Digital Oilfield Market Growth, Market in US$ Billions
Made by Brink, MarketsandMarkets

downstream include trading activities, marketing and business insights.

These technologies are now so crucial to oil and gas operations that, according to the Journal of Petroleum Technology, a large offshore field could deliver more than 0.75 terabytes of data each week, while a large refinery will produce 1 terabyte of raw data per day.

As oil reserves become scarcer and companies scramble to stay ahead of their competitors the industry's dependency on data will continue to increase.

By harnessing people, information and processes, digital technologies enable companies to achieve crucial efficiencies and cost savings. For example, by establishing links between operational technology and IT networks (such as linking SCADA operational technology to IT business and desktop applications), companies achieve benefits including remote monitoring and administration. Meanwhile, production data from the field can be matched with demand to maximise earnings.

According to IHS-CERA, digital oilfield-related implementation may result in up to 8 percent higher production rates, as well as up to 25 percent in operating cost savings and 2 to 4 percent lower project costs. This production boost will prove indispensable as oil reserves are depleted and companies find themselves turning to more complex and remote sources. The resulting increased demand for real-time data, distributed sensors, high-speed communications, and data-mining techniques will hasten the adoption and innovation of digital technology.

Given this significant and increasing reliance on data and interconnected systems, the oil and gas industry finds itself vulnerable to cyber attacks, whether conducted by hostile governments, militant groups or private citizens wishing to make political statements or mischief. Numerous such attacks against oil and gas companies have already taken place. Malware and phishing are two common types of cyber threats that have targeted digital oil.

- Malware: Malware includes viruses and other malicious software that targets IT data assets. In July 2014, the Energetic Bear virus was released by a Russian hacking group and targeted oil, gas, power, and energy investment companies. Prior to its discovery by a cyber security firm, the virus covertly enabled the hackers to monitor energy consumption in real time and disable physical systems.

- Phishing: Phishing is a form of social engineering that uses deception and manipulation to target data assets. Spear phishing uses emails that appear to be from a known individual to target employees and steal data. This technique was used in 2011 by Chinese hackers in a series of cyber attacks targeting oil and energy companies known as "Night Dragon."

Other types of attacks include insider threats and denial of service attacks. By 2018, an ABI Research study predicts that cyber attacks against oil and gas infrastructure will drive $1.87 billion in cybersecurity spending by the oil and gas sector.

It is crucial that the oil and gas industry develops the necessary capabilities to defend against cyber risk. Taking cues from the utility industry, oil and gas companies should prioritize investment in cybersecurity measures. Furthermore, the industry must seek to implement wide-ranging information sharing and threat intelligence programs to maximize knowledge regarding advanced persistent threats and related solutions.

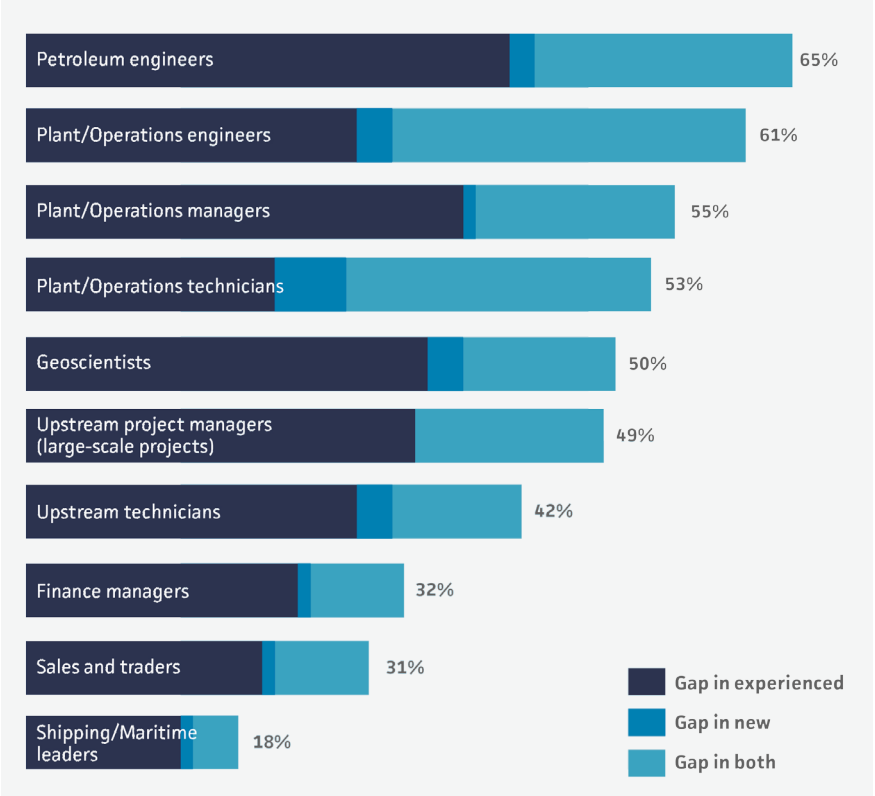
With necessary resources dedicated to effective risk management, the innovations of the digital oilfield will continue to bring the oil and gas industry into an era of increased efficiency and production, while managing the cyber risk associated with increased digital connectivity.

THE OIL AND GAS TALENT GAP

ECONOMY | NOVEMBER 18, 2014

BRINK Editorial Staff

FIGURE 4 Percentage of Companies Anticipating a Talent Gap, Industry Perception of Pending Talent Gaps Across Occupational Groups
Source: Mercer Global Oil and Gas Talent Outlook and Workforce Practices Survey



Oil and gas executives won't be prepared to meet tomorrow's production demand if they don't quickly address the one asset about which they know the least: their people. The industry is confronting a chronic, global talent shortfall, according to the results from a study of the talent outlook and workforce practices in the oil and gas industry recently conducted by Mercer.

Addressing the talent gap will require industrywide solutions that start with companies understanding the internal and external market forces at work. As the chart below shows, the talent mismatch is especially acute among more experienced workers. Mercer surveyed 126 participants from 112 organizations with more than one million employees, representing a cross-section of company types in 50 countries.

To fill the gap, many companies plan to recruit workers from their competitors. Not only is this strategy unsustainable, it will most likely be insufficient to meet future demand. In addition, oil and gas firms are competing with companies in other industries for the same pool of talent. Instead, human resource executives need to step up and provide clarity about both the talent gaps that are developing and the creative workforce-building techniques that can solve them.

WHAT EVER HAPPENED TO BIG OIL?

ECONOMY | NOVEMBER 10, 2014

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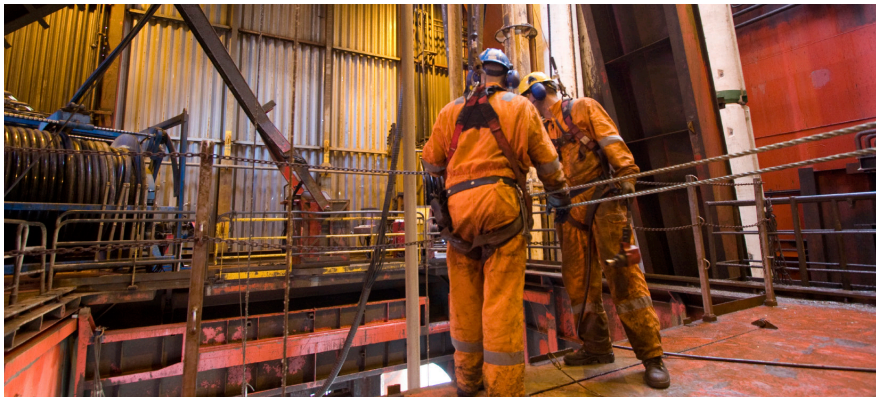


Big oil is feeling the brunt of tumbling oil prices. Across the board, earnings are gapping lower, causing the sector to re-think mitigation strategies in order to take the sting out of falling profits. The possibility of sustained lower oil prices has the entire sector considering its options and reevaluating future investments.

Through 2013, oil prices quadrupled since 2001. But many of the world's largest international oil companies have not kept pace. Instead, their operating cash flow has only doubled over the same period. And most of their stock market valuations have trailed even further behind, underperforming the broader stock market as a group by about 65 percent. (See Exhibit 1.)

There's an important lesson for oil and gas firms here—but it may not be what you think. The recent downturn in the oil market aside, most international oil companies had already stopped capturing the value of rising commodity prices for shareholders, especially oil prices. That new development alone should set off alarms in the executive suites of international oil majors, since it potentially undermines the reason why most investors want to own stakes in them.

But the bigger lesson is that oil and gas firms urgently need either to break apart or become more vertically integrated. Those are two key ways they can deliver value to their shareholders commensurate with rising commodity prices, and remain the leaders of their industry going forward. Business models that straddle the middle ground don't seem to be working.

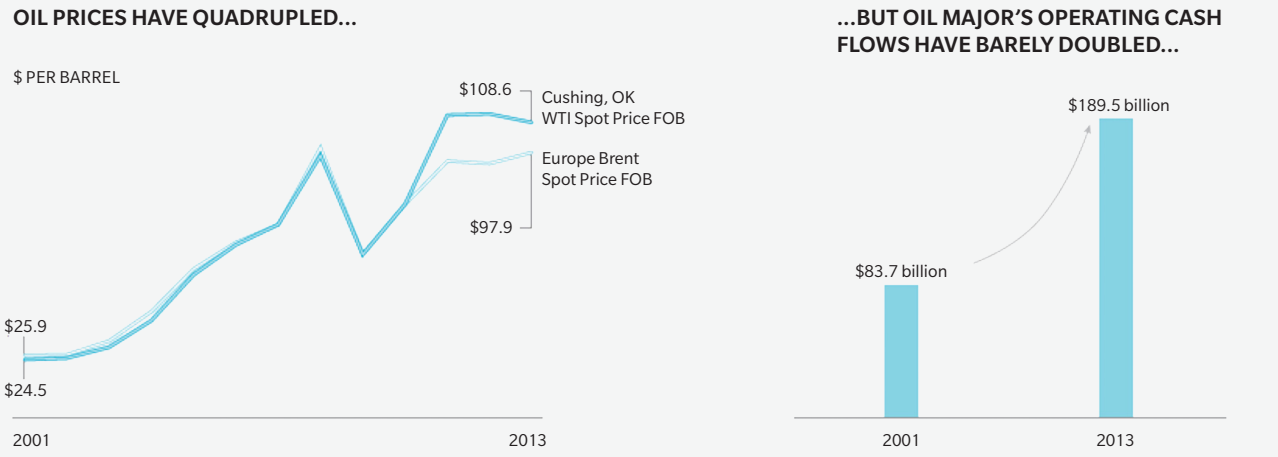
MIGRATING VALUE

The value created from oil field development is migrating to oil field services companies. At the same time, volume, which has been the favorite measure of growth for international oil companies, is becoming an unreliable indicator of growth in value for shareholders. The traditional correlation between the market valuations of most of the international oil companies and volume is breaking down as more natural gas is traded at a discount to oil prices, fewer petroleum supply agreements are structured around oil prices, and the amount of capital required to renew a unit of production continues to expand.

The relationship between depreciation and capital expenditures is also fundamentally changing, making historic earnings almost meaningless. Until 2000, international oil companies expended roughly as much capital as their assets depreciated. But since then, their capital expenditures have increased by five times, while depreciation has risen by only half as much.

Sooner or later, all that extra capital will have to be depreciated, a factor that is creating a potential new moral hazard for an industry that has been issuing distributions to

FIGURE 5 The Oil Major's Dilemma
Source: Thomson Reuters: Datastream, Oliver Wyman Analysis. Calculations Reflect the World's Six Largest International Oil Companies



shareholders based on historic earnings. Many oil majors have paid dividends to shareholders that have met or exceeded their combined cash flow remaining after capital spending—or free cash flow.

So what steps should the supermajors take?

INTEGRATE...

First, they should divert cash flow from capital spending and direct it back to shareholders. Due to the false signal of rising oil prices, capital spending is spinning out of control. More capital is being committed to high-stakes projects. But the hurdle rates to achieve returns on these megaprojects are higher than is generally recognized when adjusted for their greater inherent risks (including cost overruns and delivery delays), especially in today's increasingly fractured geopolitical environment. These projects may also suffer from a higher failure rate than in the past, in part because the chronic hollowing out of experienced workers and managers has made it more difficult for oil and gas firms to oversee contractors.

Supermajors should also seriously consider investing in a wide range of assets from which they can create value, ranging from oil exploration projects to oil field services. Doing so will require oil majors to forge new paths to make intra-business investment decisions now that oil exploration projects may no longer deliver the highest returns. In the past, an oil exploration investment would not be compared to other types of investments. But in the future, they may need to be.

...OR DISINTEGRATE

Finally, international oil companies could divide up their business portfolios and put some of their assets up for sale. As more oil and gas firms attempt to expand their reach into more types of businesses, they are driving up the valuations of everything from gasoline stations to oil field service equipment. It may make sense for some supermajors to unlock value by selling some assets that do not work together or that could realize greater value by being combined with others to achieve economies of scale. There is a historical precedent for following such a strategy. Seventeen years after the Standard Oil Company was dissolved in 1911, the total market value of the 30 surviving companies of the 33 that were divested had market valuations that were more than five times higher than the original company.

As the business landscape for oil and gas firms radically shifts, supermajors face difficult choices. But they are not impossible, and many companies are already taking action. The industry is in the throes of extreme change—and that calls for extreme measures. The sooner the Big Six can make the profound strategic and operational changes that will enable them to create greater value in a higher-stakes world, the better.

This article also appears in the Oliver Wyman Energy Journal.

NO 'NEW NORMAL' FOR U.S. ENERGY MARKETS; VOLATILITY IS ORDER OF THE DAY

ECONOMY | NOVEMBER 10, 2015

Blu Putnam
Chief Economist of CME Group

Energy markets are entering their second year of a low-price environment and that may bring yet more changes in market dynamics, with the major development of 2016 being a slowing of North American production.

This production cutback comes with a significant lag after the price drops, but the lack of new investment in 2015 and few prospects for investment in 2016 and beyond suggest the time has arrived to observe supply adjustments.

Natural gas is more likely to dance to the tunes played by evolving weather patterns. El Niño is strong, and typically there will be some serious droughts, most likely in Indonesia, Malaysia, possibly Australia and India, with a warmer-than-usual winter in the United States that may support low natural gas prices. Strong El Niños, however, are often followed in short order by a strong La Niña, cooler waters in the equatorial Pacific, which might include a very cold 2016-17 winter in the U.S. and reverse the current course of natural gas prices.

And then, there is the BTU pricing gap in the U.S., where $1 spent on natural gas buys considerably more energy content compared to refined petroleum products, suggesting long-term upward price pressure on natural gas and/or downward pressure on crude oil.

MARKET REACTIONS TO LOWER OIL PRICES

When commodity prices fell in 2008, it was mostly related to a sharp drop-off in demand from the mature industrial countries that were experiencing a financial panic. In late 2014, when oil prices fell by half, the challenge for commodities in general, and oil specifically,

The new development in 2016 may be, at long last, evidence of a supply response in North America to lower oil prices.

was excess supply complicated by weakening demand from China and many emerging market countries.

To the amazement of many analysts, there was not a quick supply response to lower oil prices. Many oil companies have considerable debt, and many oil-producing countries have significant income requirements. Hence, when oil prices dropped, there was a need to keep the cash flowing. Certainly, many of the high-maintenance and expensive wells were shut down; however, increased production was obtained from the more cost-efficient wells. Production overall held up very well.

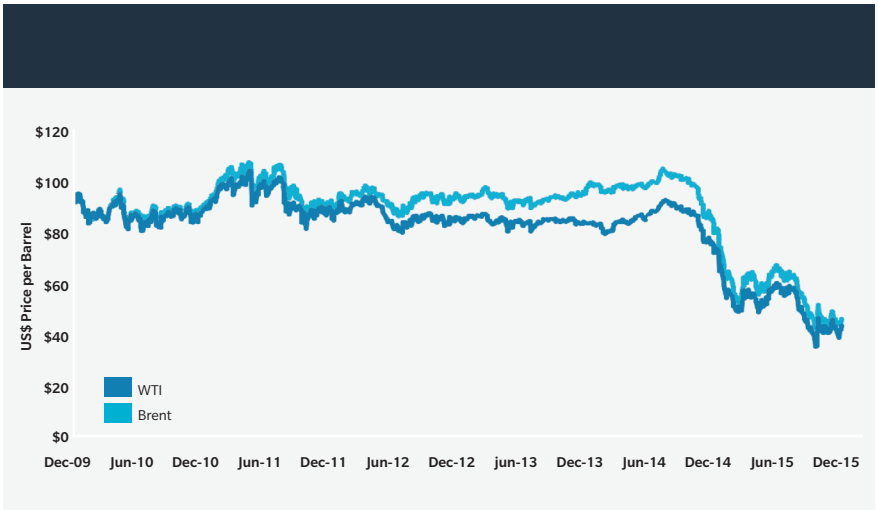
The new development in 2016 may be, at long last, evidence of a supply response in North America to lower oil prices. During 2015, many new investment projects in the energy sector were canceled or delayed indefinitely. A year later, though, the lagged impact of the lack of capital investment in energy projects could start to be reflected in oil production in 2016 and well beyond.

While there is certainly a possibility of oil prices revisiting previous market lows, or going to $20 as some analysts have suggested, the probability is declining sharply. The market impact of slower growing demand from China and more Middle Eastern supply, particularly from Iran, is fully incorporated into prices. These factors are old news. Hence, as argued here, the surprise of 2016 may involve less supply.

The probability of sharply higher prices—a return to $100/barrel oil—is also very low. To get back to $100 oil, either China or other emerging market countries have to start growing rapidly again (not likely) or a major supply disruption occurs in the Middle East (possible, just not very likely). This means crude oil prices may be range-bound again in 2016, although perhaps heading into the upper half of the range instead of the lower half, as the pendulum of less oil flowing starts to counterbalance slow demand growth.

volatility in the basis risk between Brent and other oil types, which will make Brent less useful for hedging and risk management relative to WTI.

There is also likely to be movement in the price for natural gas in different regions of the world over the next few years. The U.S, as a low-cost producer, has the potential to export liquefied natural gas to Asia, especially Japan. While it takes years and billions of dollars to build the liquefaction plants and port facilities, it is all in progress, and over time, this will put upward pressure on U.S. natural gas prices and downward pressure on natural gas prices in Europe and Asia.



NUANCES WITHIN THE ENERGY SECTOR

Within the energy sector, there are some important differences in market dynamics. U.S. crude oil, represented by West Texas Intermediate (WTI), is now gaining favor over North Sea oil (i.e., Brent) in terms of its potential to reassert itself as the global benchmark for oil prices. Brent has been in a production decline for over a decade. Moreover, Brent has been hit harder by lower prices, since the North Sea is a high-maintenance region from which to extract oil. Also, European natural gas long-term contracts were once priced off Brent, but that is happening less and less as natural gas prices dance to their own tune, even in Europe. We expect more

Weather matters, too. A strong warming of the Pacific Ocean near the equator approaching South America represents an El Niño weather pattern that has built steadily since March 2015. Warmer waters lead to more evaporation, and that means more precipitation depending on where the winds blow. El Niños, however, also shift wind patterns and raise the potential for a

warmer-than-average winter in the U.S.

Looking further ahead, however, the energy markets need to be thinking about La Niña. The forces that created El Niño can dissipate with amazing speed. Indeed, a strong El Niño is often followed in short order by a strong La Niña, meaning much cooler-than-normal waters along the equatorial Pacific. Put another way, a warmer-than-usual U.S. winter of 2015-16 might be followed by a much colder one in the winter of 2016-17, reversing the weather-related influences on U.S. natural gas prices.

And finally, for the very long-term outlook, one has to consider the BTU pricing gap in the United States. One dollar spent on natural gas in late 2015 buys almost a half-million BTUs of energy, while the same dollar spent on refined petroleum products (i.e., crude oil-derived products) yields less than 150,000 BTU; that's a threefold-plus ratio in favor of natural gas. Over time, and we mean a long time, this will drive more residential and industrial demand for natural gas relative to crude oil.

The bottom line for energy markets is that a "new normal" is highly unlikely. Instead, markets will adapt to the changing dynamics, driven by everything from economic growth patterns and current global pricing disparities to shifting ocean temperatures. Volatility is the order of the day.

All examples in this report are hypothetical interpretations of situations and are used for explanation purposes only. The views in this report reflect solely those of the author and not necessarily those of CME Group or its affiliated institutions. This report and the information herein should not be considered investment advice or the results of actual market experience.

TOP COMMODITY TRADERS REVAMP STRATEGY AS INDUSTRY MATURES

ECONOMY | OCTOBER 16, 2015

Roland Rechtsteiner
Partner and Global Head of the Oil & Gas Practice at Oliver Wyman

Ever since the financial crisis, a group of traditionally slow-moving asset-backed trading giants have been pushing to meld their operational expertise with the entrepreneurial style and culture of independent traders. They are being rewarded handsomely by the new trading model that they have pioneered with rock-solid trading results at a time when the market is stuck at rock-bottom prices for everything from copper to crude oil.

The five top asset-backed traders have been growing their gross margins more than three times as fast as independent traders since the financial crisis. As a result, they have grown their gross margins as a group by more than 15 percent every year since 2010. By contrast, the gross margins of the top five independent traders have expanded annually by only 5 percent.

This revolutionary shift is the outcome of an evolutionary transition of nonconformist commodity trading into a mature industry. The commodity traders that have come closest to achieving established, institutionalized global machines designed to generate earnings reliably in spite of market conditions are now at the head of the pack.

In short, they are industrializing.

The "new normal" of commodity trading no longer only hinges on superstar, siloed individuals.

THE NEW NORMAL OF COMMODITY TRADING

The "new normal" of commodity trading no longer only hinges on superstar, siloed individuals living off their ingenuity, agility and speed. Instead, today's standout results are systematically driven by transforming market and competitor intelligence gathered from personal networks into tradable institutional knowledge, offering structured customer solutions and monetizing "optionality," defined as the options available to run, manage and extract the most value from their portfolios globally. Leading players are becoming one-stop shops able to finance, store, transport, refine and distribute commodities globally with machine-like efficiency, avoiding operational or financial strain.

Leading energy companies are now reaping the rewards of refining their ability to incorporate their longstanding operational expertise into their trading divisions' cultures. Over the past several years, they have cut costs by standardizing, automating, and outsourcing processes. They have also improved their ability to act nimbly by educating all of their stakeholders and breaking down the barriers between logistics operations and their supply and trading divisions.

As a whole, these efforts are having a significant impact. For example, in the first three months of 2015, BP's profit fell only 20 percent compared to the same period in the previous year, even though crude oil prices were cut in half. Similarly, the trading arms of Total and Shell helped to support their overall group results by taking advantage of favorable forward market conditions and storage capacity along their logistics chains. One leading asset-backed player was able to reduce the ratio of costs to trading income by more than 10 percent simply by standardizing and outsourcing more work.

INDUSTRIALIZED CULTURE SHIFT

So now, other asset-backed traders and maverick independent traders, too, are attempting to institutionalize their operations without sacrificing nimbleness and entrepreneurial drive. At the same time, they are shifting toward a more rules-based management-run model, with explicitly defined delegations of authority and institutionalized processes around investment decision making and capital allocation. Many are also building out their corporate functions such as corporate finance, strategy and external communications.

Traditionally, private independent commodity traders are starting to involve their compliance and legal departments more in complex issues such as customer relationships. Some are going so far as to outsource and offshore routine administrative work and to publish comprehensive annual reports.

Successful strategists are designing large systems and industrialized platforms that can maintain the high degree of entrepreneurship and individual talent required for them to act swiftly on monetizing opportunities.

Hence, the question becomes: Will all commodity traders be able to industrialize to the degree required to reach the next level? And if independent commodity traders improve their resilience, will the top asset-backed traders be able to go on building out their capabilities and gaining market share at the same pace?

THE NEXT FIVE YEARS

The commodity-trading industry is moving from its roots as a fragmented band of maverick traders stepping in to smooth out the vast global supply and demand imbalances and information asymmetries to an industrialized group of nimble, global one-stop-shops for multiple commodities, also providing financing, risk management and logistics.

Within five years, we predict that commodity traders will morph into organizations with all the benefits and challenges of other mature industries. And as commodity traders' business models become increasingly homogeneous, they will be under even more intense pressure to distinguish themselves from the pack.

The recent transformation of top asset-backed traders underscores what leading independent traders and other asset-backed traders need to do in order to grow and become more resilient. If the past is an indicator for the future, independent players will find nimble and swift ways to adapt and lead again.

Conversely, even those asset-backed traders that are presently the industry's front-runners will need to continue to push the envelope in professionalizing the industry and strive to be more agile by exploring new, innovative ways to inexpensively optimize all of the options available in their massive global operations. No one can afford to sit still.

THE SECRET LIFE OF RAILROADS

ECONOMY | DECEMBER 11, 2014

BRINK Editorial Staff

Railroads in the U.S. have quietly become the de facto alternative pipeline for the oil and gas industry, moving as much as 1.5 million barrels of oil a day.

Oil by rail increased from 10,000 carloads in 2008 to 408,000 in 2013; shipments are up 9 percent over last year through the first seven months of 2014, according to the Energy Information Administration. This growth is tied to the recent boom in U.S. oil production and insufficient pipeline capacity.

But the increased rail traffic carries great risk. The worst disaster happened last year when a train derailed in Lac-Mégantic, Quebec, just north of Maine. Forty-seven people died and 30 buildings were destroyed. In the U.S., rail car accidents increased from 8 incidents in 2008 to 119 in 2013; most of these were small, but enough serious accidents have taken place to move federal regulators and the railroad industry to call for improved safety requirements.

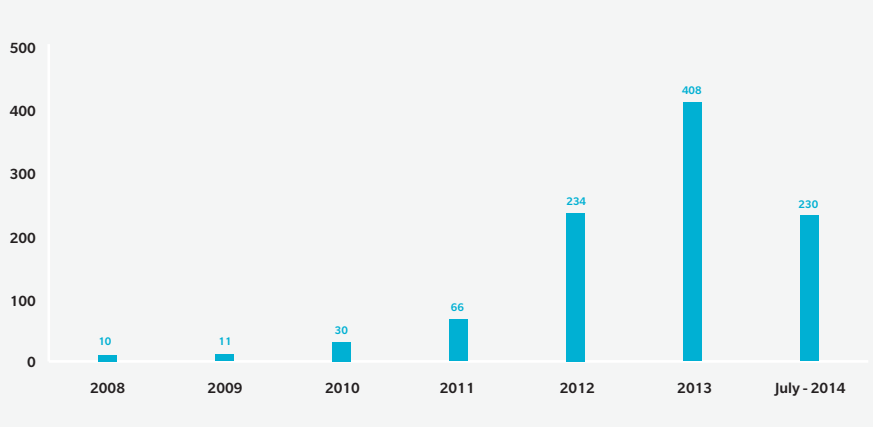
In January the National Safety Transportation Board said they were "concerned that major loss of life, property damage and environmental consequences can occur when large volumes of crude oil or other flammable liquids are transported on a single train involved in an accident."

The NTSB's concern was underscored in an August GAO report that said despite "generally good safety records, the increased transportation of these flammable hazardous materials creates potential for serious incidents."

The Department of Transportation has a rulemaking in progress to address many of these safety concerns including:

- A new definition identifying a train as a "high-hazard flammable train" when carrying 20 or more tank cars of flammable liquid
- Risk assessments for rail routing
- Notification to State Emergency Response Commissions when transporting 1 million gallons or more through their state
- New standards for rail car construction

FIGURE 7 Growth of Crude by Rail Carloads, Originated Carloads on Class 1 Railroads
Made by Brink, Data: Energy Information Administration



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