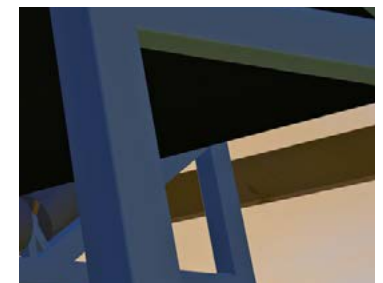
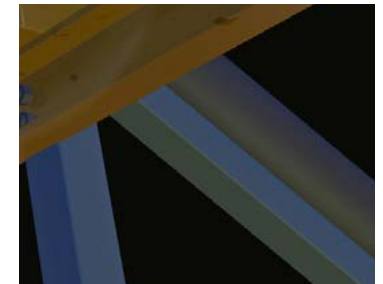


A photograph of two workers in dark uniforms and yellow hard hats standing in a futuristic, brightly lit tunnel. The tunnel's interior is composed of curved, glowing orange and yellow structural elements that create a sense of depth and perspective. The workers are silhouetted against the bright light at the end of the tunnel. The floor is highly reflective, mirroring the workers and the tunnel's structure. The overall atmosphere is one of advanced technology and industrial progress.

ENERGY 2020 VISION: OIL & GAS

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EXECUTIVE SUMMARY



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Ready or not, the global oil & gas industry must contend with an ever-changing 'normal'.

The oil price collapse in late 2014 signified a fundamental change in the energy marketplace. While prices have rebounded from the low of \$26 per barrel in 2016, the supply and demand dynamics that led to the downturn—a supply glut due in large part to U.S. shale and stagnating growth in global demand—are here to stay. Efforts to rebalance the markets have helped inventory levels recover, but those efforts are contingent on key producers limiting output. Gone are the days when success was linked almost exclusively to high production volumes and growing reserves.

It's the confluence of trends—not just the new pricing paradigm, but rapid growth in renewables along with accelerating technology advancements—that is reshaping the industry. The energy company of the future is one that has successfully figured out how to cut costs, enhance operational efficiencies through digital and

technological transformation, and diversify its portfolio to include alternative energy sources.

Reflecting on this period of turmoil and transition, BDO's Global Natural Resources team is looking towards the future to help oil & gas companies anticipate and plan for the challenges and opportunities ahead. We believe that to prepare for success in 2020 and beyond, oil & gas companies must strive to become "Lean, Green, Digital" machines.

The global predictions presented in this report are based on research and collective input from BDO's Natural Resources leaders around the world. In addition, the practice leaders from five countries (Australia, Canada, the United States, the United Kingdom, and the Kingdom of Saudi Arabia) have provided regional predictions for the industry in their markets.

SUMMARIZING BDO'S GLOBAL ENERGY 2020 VISION FOR OIL & GAS:

1. OIL PRICES:

By 2020, low oil prices—expected to remain at or below the \$60 per barrel mark—will spur Gulf Cooperation Council countries to diversify their energy mix within the power sector using auctions to subsidize renewable energy projects.

2. CYBERSECURITY:

By 2020, at least five countries will see foreign hackers take all or part of their national energy grid offline through Permanent Denial of Service attacks.

3. GLOBAL ENERGY TRADE:

By 2020, the growth of LNG imports and solar power will bring electricity to four in five African people.

4. INVESTMENT IN TECH:

While overall spending on R&D may decline, most of the spending that does occur will go towards technologies that enhance exploration and production (E&P) efficiencies.

5. DATA DEMOCRATISATION:

By 2020, the average E&P company will make use of 10 percent of its big data—up significantly from today, but nowhere near full potential.

Agree or disagree with our predictions? We want to know — reach out to us [here](#).

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BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF OIL & GAS *GLOBAL PREDICTIONS*



GULF COUNTRIES DIVERSIFY WITH WIND AND SOLAR

PREDICTION 1

OIL PRICES

BY 2020, LOW OIL PRICES—EXPECTED TO REMAIN AT OR BELOW THE \$60 PER BARREL MARK—WILL SPUR GULF COOPERATION COUNCIL (GCC) COUNTRIES TO DIVERSIFY THEIR ENERGY MIX WITHIN THE POWER SECTOR, USING AUCTIONS TO SUBSIDISE RENEWABLE ENERGY PROJECTS.

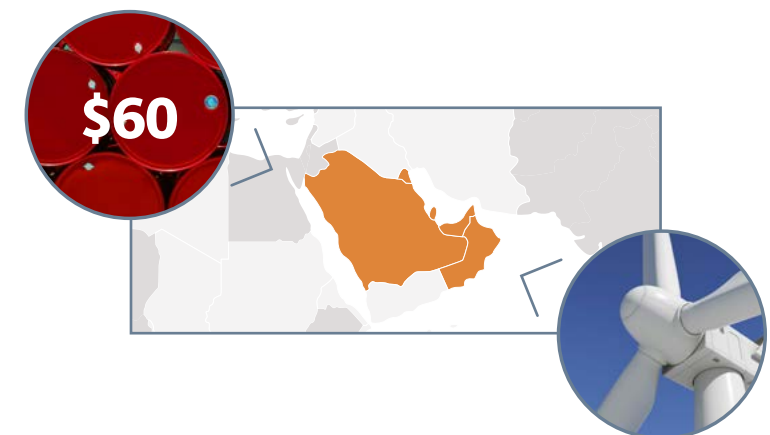
The pressure is on for GCC countries—Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Bahrain, and Oman—to diversify away from oil, especially when it comes to electricity production.

The rising domestic demand for oil, especially in the power sector, is hindering the GCC countries' ability to export oil and causing their economies to contract. In [October 2017](#), the International Monetary Fund (IMF) cut the 2018 GDP forecasts for the GCC states from 2.5 percent to 2.2 percent. Non-oil related economic growth is expected to reach 2.4 percent in 2018—well below the 6.7 percent average seen from 2000-2015. Oil-exporting countries across the broader region saw their fiscal deficits skyrocket from 1.1 percent of GDP in 2014 to 10.6 percent of GDP last year.

GCC countries' current trajectory is unsustainable. Most have already begun importing LNG because of the shortage in cheap natural gas, further underlining the need for efficient, non-hydrocarbon energy

sources in the area. Countries are starting to make renewables realistic through auction-based approaches to subsidies. Through auctions, countries set a target level of investment in renewables and allocate contracts to the most cost-effective bidders. Almost 50 countries have adopted [this approach](#), and almost 30 additional countries are considering following suit.

Although GCC countries have set targets for deployment of renewables at the national or local level, the region has seen [little deployment](#). By 2020, we predict that relatively low oil prices will spur GCC countries to diversify their energy mix within the [power sector](#). As utility-scale installed solar and wind costs continue to decline, they will use [renewable energy auctions](#) to begin reaching their deployment targets.



ATTACK AGAINST THE GRID: A DRESS REHEARSAL FOR WHAT'S TO COME?

PREDICTION 2

CYBERSECURITY

BY 2020, AT LEAST FIVE COUNTRIES WILL SEE FOREIGN HACKERS TAKE ALL OR PART OF THEIR NATIONAL ENERGY GRID OFFLINE THROUGH PERMANENT DENIAL OF SERVICE (PDOS) ATTACKS.



The advances in technology that allow the energy industry to create new efficiencies and innovations at the same time require connectivity that leaves power grids around the world more vulnerable to cyberattacks.

Several electric grids around the world have already come under threat in recent years, most through Distributed Denial of Service (DDoS) attacks. In 2015, [an attack](#) on a grid in the Ukraine temporarily cut power to more than 200,000 people. A subsequent attack occurred just a year later, reportedly carried out by Russian actors. In May 2017, officials from the Baltic states—which are connected to Russia's power network but plan to move to the European Union's grids—said their power grids were targeted by Russia through a series of DDoS attacks. "On a daily basis there are DDoS attacks designed to probe network architecture, so it could well be possible that something (serious) could take place later on," a NATO official told [Reuters](#).

Any disruption to a country's electric grid would have serious implications for virtually all industries, especially critical ones like healthcare, transportation, security, and financial services. Since 2011, a dedicated and sophisticated group of cyber attackers known as [Dragonfly](#) has been targeting the energy sector in Europe and North America. The group has used Trojanised software, spear phishing emails and watering hole websites to gather intelligence with the potential for sabotage.

While the number of total DDoS attacks decreased by [18 percent year-over-year in Q2 2017](#), there was a 19 percent increase in the average number of attacks per target. This could indicate that the quantity of DDoS attacks may be waning, but the severity of each attack is increasing.

WE PREDICT THAT TODAY'S ATTACKS ON THE GRID ARE A DRESS REHEARSAL FOR A MUCH MORE MALICIOUS TYPE OF ATTACK: PDOS. BY 2020, AT LEAST FIVE COUNTRIES WILL SEE FOREIGN HACKERS TAKE ALL OR PART OF THEIR ENERGY GRID OFFLINE WITH THE INTENT TO DESTROY IT.

LNG & SOLAR: THE PAIR THAT COULD FLIP THE SWITCH IN AFRICA

PREDICTION 3

GLOBAL ENERGY TRADE

BY 2020, THE GROWTH OF LNG IMPORTS AND SOLAR POWER WILL BRING ELECTRICITY TO 4 IN 5 AFRICAN PEOPLE.

Africa represents 16 percent of the world's population but just 32 percent, or 1.5 in 5 African people, have access to electricity. The growth of liquefied natural gas (LNG) could change that.

While [many governments in Africa, especially in sub-Saharan Africa](#), have intensified efforts to invest in domestic energy production, inadequate energy infrastructure has stood in their way. Two out of every three dollars invested into the sub-Saharan energy sector since 2000 have been used to develop energy to be exported rather than for local consumption.

LNG expansion is forecast to help natural gas demand outpace demand for oil and coal [through 2040](#). Africa presents an opportunity for LNG producers to find new sources of demand.

Electricity in Africa has remained expensive—a particularly difficult barrier for its population. However, as noted by the [Africa Energy Outlook](#), “huge renewable resources remain untapped,” with further potential from excellent solar capabilities across all of Africa. Foreign solar companies have taken notice and have [installed solar microgrids](#) or home-based solar systems across sub-Saharan Africa. At the same time, African countries have begun building import facilities for LNG, including a facility in [Ghana](#)—the first import facility in the sub-Saharan market. The continued growth in solar power across Africa could improve the wider energy infrastructure, creating a ripple effect and attracting foreign LNG exporters to invest in pipeline construction, a further boon to their business.

Renewable energy has begun to help more Africans turn and keep the lights on, and LNG exporters—and their investors—will follow this initial track. By 2020, we predict that the growth of LNG imports and solar power within Africa will bring electricity to four in five people on the continent.



INVESTING IN TECH TO KEEP THE LIGHTS ON

PREDICTION 4

INVESTMENT IN TECH

WHILE OVERALL SPENDING ON R&D MAY DECLINE, MOST OF THE SPENDING THAT DOES OCCUR WILL GO TOWARDS TECHNOLOGIES THAT ENHANCE EXPLORATION AND PRODUCTION (E&P) EFFICIENCIES.

As downward pricing pressures rage and with much of the world's [easy-to-reach oil](#) already consumed, oil & gas companies are tasked with producing more with less—or risk shutting their doors. To accomplish this, energy companies, historically slow to do so, are investing in new technologies to increase operational leanness while boosting profit margins.

Technology is present throughout the energy supply chain, from locating oil wells and extracting reserves to refining and transporting the commodity. Oilfield services companies like [Halliburton](#) and [Schlumberger](#) note that their customers already use high-tech equipment and data analytics to determine whether a well will produce enough oil to make it economic—before the drilling begins. Others are using more advanced technologies to “refrack” wells originally drilled using less advanced technologies to extend their shelf life and further capitalise on them. When it comes to new wells, engineers use software and sensor technology to determine the right combinations of chemicals, sand, and water to maximise extraction. When deciding where to drill, E&P companies already rely on a combination of Monte Carlo simulations and 3D seismic surveys to generate 4D seismic imaging and project future physical changes to the oilfield and reservoir. Using current technology, the industry has about an 80 percent overall drilling success rate.

While oil & gas companies have in the past been labelled “[low R&D intensity](#),” investing less than 1 percent of net revenue in R&D, spending on innovation and R&D has increased notably over the last few years.

Investing in innovation is the first step towards global oil & gas companies reducing expenditures while maximising production and maintaining margins. By 2020, while their overall R&D spending may decline, oil & gas companies will put most of their remaining dollars into technologies that boost E&P efficiencies in an effort to do more with less.



A large offshore oil rig stands in the ocean under a sunset sky. The rig's complex metal structure is silhouetted against the orange and blue hues of the twilight. The water in the foreground is dark blue with gentle ripples.

DEMOCRATISATION OF DATA

PREDICTION 5

DIPPING INTO THE DATA

BY 2020, THE AVERAGE E&P COMPANY WILL MAKE USE OF 10 PERCENT OF ITS BIG DATA—UP SIGNIFICANTLY FROM TODAY, BUT NOWHERE NEAR FULL POTENTIAL.

As the adoption of new technologies quickens, the upstream sector's access to data will grow exponentially. Under the pressure of subdued oil prices, the ability to tap into that data becomes a lifeline.

Upstream companies place tens of thousands of data-collecting sensors within wells and surface facilities to monitor assets and environmental conditions in real time. When used correctly, data can create efficiencies across the entire E&P process—from locating and extracting hydrocarbon to arranging for delivery to trucks and pipelines for transport and refinement. In the discovery stage, E&P companies can use [data analytics](#) to analyse year-on-year geological survey data to determine the best places to drill. During the drilling phase, drill bit and

rig technology can track progress continuously and create more accurate and safer drilling processes. When it comes to extraction, data can be analysed to conduct predictive maintenance on wells and determine whether certain wells should be re-fracked.

While most E&P companies have adopted new technologies, they still lack the data analytics capabilities needed to extract the [maximum value of that data](#). Upstream companies are often unable to integrate different sources of data, and information gathered from different datasets is left in silos, unavailable to decision-makers who need it most. Technology companies providing the data infrastructure are often unaware of how to apply the analytics tools to the oil

industry effectively. As a result, most data collected from upstream operations, while it may be used for issue detection and control, is never used for performance optimisation. The average offshore rig has 30,000 data-generating sensors, but [less than 1 percent](#) of that data is analysed and used in decision-making.

As tech companies begin to partner more with the E&P sector, we expect innovation to accelerate and better data integration across organisations to take shape. By 2020, we predict the average E&P company will make significant strides towards data democratisation, making use of 10 percent of its big data—up notably from today, but still nowhere near full potential.

BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF OIL & GAS IN AUSTRALIA



COULD TRUMP RISK TOPPLE US'S ASPIRATION TO BE ON TOP OF THE LNG TOWER?

PREDICTION 1

LNG INVESTMENT

BY 2020, AUSTRALIA WILL TAKE THE TOP SPOT AMONG THE WORLD'S LNG EXPORTERS.

Australia is the world's second-largest LNG exporter behind Qatar. Over the last decade, Australia has made significant investments (more than \$200 billion) in major capital projects. Cost overruns and delayed schedules have caused a plateau in investment by the oil & gas super majors, which will create opportunities for small to mid-sized players and large domestic players to enter the market and build market position. Smaller floating liquefied natural gas (FLNG) technology will be one mechanism to achieve this through commercialisation of stranded gas fields.

Seeing the opportunity, oil & gas majors will maximise the value of existing assets and returns from significant LNG investment. Expansion projects will likely be in the pipeline by 2020, further driving shareholder return. Lessons can be learned from companies that developed Australia's significant LNG projects, including Wheatstone, Gorgon Project, and Ichthys. These will ultimately drive expansion by leveraging the existing base projects and infrastructure, and established regulatory approvals and hubs. This will allow for additional LNG trains and processing off the Western Australian coast.

Whilst the US is currently the world's largest producer of gas, the political risk under the Trump administration will amplify Australia's footprint in the LNG market, appealing strongly to Asian buyers, including Japan, China, and India.



GAS SHORTAGES FUEL UNCONVENTIONAL PROJECTS

PREDICTION 2

MAXIMISING INFRASTRUCTURE

**BY 2020, LNG
INFRASTRUCTURE IN
WESTERN AUSTRALIA
WILL BE THE SOURCE OF
LNG IMPORTS INTO THE
EAST COAST.**

The gas shortages on the east coast of Australia have become a major political issue for the government. The key decision currently under debate surrounding investment in the transcontinental gas pipeline will likely come to fruition. The highly speculative venture will connect Western Australia to the east coast gas hub at Moomba in South Australia, providing an industry-led solution to the east coast gas shortages and catering to large industrial consumers and households.

The Australian Federal Government will support investment in unconventional gas projects on waterways and wind back regulations for development of onshore gas for the domestic market. As part of the solution to address the gas supply shortfall, current LNG infrastructure in Western Australia will be used as the source of LNG imports into the east coast.



An offshore oil rig is shown at sunset, with the sky transitioning from blue to orange and pink. The rig's complex metal structure is silhouetted against the bright horizon. The ocean below is dark blue with white-capped waves.

ATO TRANSFER PRICING SETTLEMENT SHINES A SPOTLIGHT ON OIL & GAS COMPANIES

PREDICTION 3

REGULATORY SPOTLIGHT

**BY 2020, REGULATORS
WILL DEMONSTRATE
GREATER SCRUTINY AND
SURVEILLANCE OF OIL &
GAS COMPANIES.**

The success of the Australian Taxation Office (ATO) in the transfer pricing dispute with multinational oil giant Chevron will be a precedent for Australian authorities to pursue multinational oil & gas companies. Regulators will also have stronger positions in enforcing anti-bribery legislation, such as the US Foreign Corrupt Practices Act (FCPA) and UK Bribery Act, leading to a new revenue source for governments.

The success of the Chevron case will also encourage the ATO to increase surveillance on the debt funding of Australian investments by foreign multinational enterprises in the future. The implications will extend beyond the major players, including smaller and mid-cap organisations and will drive significant revenue back to the Australian government.

By 2020, there will be record fines and settlements being paid by oil & gas companies.

REDEFINED TRADE FLOWS FUEL NEW FINANCING METHODS

PREDICTION 4

REDEFINED TRADE FLOWS

BY 2020, THERE WILL BE A SHIFT IN ECONOMIC ACTIVITY WHICH WILL REDEFINE TRADE FLOWS AND CALL FOR NEW METHODS OF FINANCING NEW PROJECTS.

As Europe, Russia, and Asia become more intertwined, we predict that consumers will push towards shorter-term contracts. There is already widespread speculation that many Asian customers are seeking arbitration and shorter-term contracts to provide flexibility, thus fuelling the desire for “micro” projects. Micro projects require less capex and long-term capital commitment carrying lengthy contracts that underpin the development process.

There will be a proliferation of small and short-lived oil fields, no longer dominated by multinational organisations, which will provide flexibility to customers and to operating companies.





ETHICAL SOURCING WILL LEAD TO MANDATED TESTING

PREDICTION 5

PROOF OF ORIGIN

BY 2020, ALL OILS WILL BE SUBJECT TO PROOF-OF-ORIGIN TESTING.

The heightened focus on ethical sourcing of products, along with the import and export sanctions such as those in place on North Korea and Qatar, will lead to a mandate on "proof-of-origin" testing for oil production.

A secure, complex method of identifying oil and fuel production will be the key enabler, with technologies such as graphene quantum dots already being used to trace shipments that contravene international sanctions. Graphene quantum dots fluoresce and can be configured with a specific spectrum assigned to a particular well or producer. Such technologies may also assist with auditing production sharing contracts.

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BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF OIL & GAS IN CANADA



CLOUD COMPUTING TAKEOVER

PREDICTION 1

SHIFTING ASSETS

BY 2020, TRADITIONAL ACCOUNTING RULES WILL PRESENT NEW CHALLENGES FOR FINANCIAL PLANNING, FORECASTS, AND ASSET MANAGEMENT, AS OIL & GAS COMPANIES INCREASINGLY LEVERAGE INNOVATIVE SOFTWARE SOLUTIONS.

Many oil & gas organizations look to capitalize large capital expenditures through traditional capex and Opex expenditures. With the adoption of cloud technologies, this will continue to present challenges in 2020 as companies shift their large capital expenditures to the cloud.

[Halliburton](#) is an example of a price-conscious cloud user. The company has used cloud technologies most aggressively in new business ventures, where the cost of deploying new on-premise solutions, combined with the risk of over-investing in resources in an unpredictable demand environment, make the cloud's value proposition particularly compelling.

In the quest to be leaner during economic downturns, oil & gas companies in 2020 will be turning many of their operational systems to cloud-based technologies and leveraging the power of connected machinery. Reducing cost and complexity of large capital expenditures that could be traditionally capitalized from an accounting perspective simplified the process. But the cloud and a desire to rent versus buy is changing that.

There are various types of cloud computing arrangements in the marketplace, including:

- **Software as a Service** – This arrangement is a software distribution model where applications are hosted by the service provider and the purchaser has access to the software through a network. The customer maintains all infrastructure and hardware.
- **Platform as a Service** – This arrangement is a model where the cloud provider delivers both hardware and software tools needed for application development. The provider hosts the hardware and software such that the customer does not need to perform installation or purchase in-house hardware and software. This model does not replace the full infrastructure of the customer's needs.
- **Infrastructure as a Service** – This arrangement is a model where virtualized computing resources are provided over the internet. The third-party provider hosts the hardware, software,

servers, storage, and other components on behalf of its users.

With an ever-increasing number of options available to companies transforming their business models, a cloud computing arrangement may not fit into a specific standard and, thus, entities may need to look at the [Conceptual Framework](#) to determine whether there is an asset in the arrangement.

[IFRS 15](#) uses a completely new model for recognizing revenue that is more prescriptive. The changes aren't only for revenue recognition, but also many areas around revenue. In these cloud-based scenarios, there is a risk that the accounting will impact business procurement decisions. By 2020, traditional accounting rules will present new challenges for financial planning, forecasts, and asset management, as oil & gas companies increasingly leverage innovative software solutions.

Greater transparency and monitoring of these cloud software costs in the income statement is recommended to avoid unconscious bias and to provide a clearer basis for decision-making in strategic investments by executives.





THE DEATH OF CONVENTIONAL BUSINESS PLANNING

PREDICTION 2

MODERN BUSINESS PLANNING

BY 2020, CONVENTIONAL APPROACHES TO BUSINESS PLANNING WILL NO LONGER BE SOPHISTICATED ENOUGH TO RESPOND TO DYNAMIC CHANGES IN TODAY'S BUSINESS ENVIRONMENT.

Project success rates are rising. Organizations today are losing an average of US\$97 million for every US\$1 billion invested—a 20 percent decline from last year.

Today's organizations operate in a new working environment. Ongoing economic and political uncertainty, speed of innovation, shifting customer and employee demands, more visibility into organizational activities, and an increasingly diverse set of stakeholders have impacted all oil & gas companies.

By 2020, conventional approaches to business planning will no longer be sophisticated enough to respond to dynamic changes in today's business environment. With such approaches, business plans can end up disconnected from the day-to-day reality of the organization and, ultimately, the business planning process becomes an exercise in playing catch-up rather than a path to desired results.

Common mistakes to avoid?

- Allocating too many irrelevant metrics to the executive scorecards so that executive conversations lose focus on the critical few and the intent is lost
- Not providing context of the metrics or discussing how the executive can influence the metrics
- Insufficient time and effort spent on setting targets for metrics and building action plans to meet or exceed those targets
- Insufficient data transparency to allow executives to measure their ongoing performance
- Not allocating sufficient decision rights to executives to allow them to influence the metrics
- Failure to set an appropriate benchmark for the metric
- Failure to communicate shared ownership of metrics across the organization where more than one department influences the metric

- Not carefully thinking about the behaviors the KPIs will drive towards achieving the strategy
- Not directly linking the metrics and KPIs to the strategy

Oil & gas organizations will need to continue to focus their corporate strategies to avoid these common mistakes and take measures to align operational performance with a strong set of KPIs that are realistically embedded into the corporate culture and back digitally enabled platforms.



ENTERPRISE RESOURCE PLANNING EVALUATIONS WILL RISE PREDICTION 3

RE-EVALUATING ERP PLATFORMS

BY 2020, OIL & GAS ORGANIZATIONS WILL BE FORCED TO RE-EVALUATE THEIR ENTERPRISE RESOURCE PLANNING (ERP) PLATFORMS.

While many assume that the oil & gas sectors look like any other industrial business, when it comes to Enterprise Resource Planning (ERP), operational specific elements will drive organizations to examine their overall approach given the uptick in M&A activity from 2016 to 2017.

By 2020, oil & gas companies will face an existential pressure to achieve a step change in cost and productivity. This typically has hundreds of separate and incompatible systems, and a big ERP investment that is costly to maintain, difficult to change, and unsuitable for a digital world.

Why will oil & gas entities need to re-evaluate their platforms? Four key reasons:

1) Real-time hard and soft asset control

Asset controls in the oil & gas sectors are critical to efficient operations. Because of this nest of requirements, some ERP platforms are unable to deal with these elements efficiently and must ensure that potential vendors are up to scratch in this area.

2) Thin systems integrations

This value point typically applies to the speed of operations. If you find that a particular ERP platform is difficult to integrate with third-party components, you are probably looking at the wrong system. Opportunity costs relating to oil & gas sectors are enormous, so you don't want to find yourself slowed down by one or more difficult affiliate components.

3) Active compliance and policy management

This feature set is where some ERP platforms perform like stars while others don't. The oil & gas sectors are highly regulated, with hosts of federal, state, and tribal rules being applied quarter-over-quarter. Over time, these clusters of regulations and policy sets have sometimes weighed on oil & gas operations.

4) Standardized data processes

In the same way that regulations and levels of process efficiency apply to oil & gas operations, the ability to leverage standardized processes that maintain an ERP datastore becomes equally important.

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BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF US OIL & GAS





LNG: THE US'S FOR THE TAKING?

PREDICTION 1

GLOBAL ENERGY TRADE

BY 2020, 30 PERCENT OF LIQUEFIED NATURAL GAS (LNG) EXPORT CAPACITY WILL BE BUILT IN THE US, MAKING IT ONE OF THE LARGEST GAS EXPORTERS IN THE WORLD.

As the largest global natural gas producer, the US is already a force to be reckoned with in the international energy trade. The nation's market share will continue to accelerate leading [up to 2020](#), buoyed by active shale drilling, and LNG is a pivotal element of our projected growth trajectory. By 2020, the US will be one of the largest gas exporters in the world, accounting for 30 percent of LNG export capacity.

Forecasts from the US Energy Information Administration (EIA) peg LNG exports at [2.8 billion cubic feet per day in 2018](#) – more than five times 2016 quantities when the first LNG shipment left US shores. The marriage of established infrastructure, inexpensive production costs, and regional stability equip the US with a strong foothold in the market.

Qatar and Australia currently hold the titles as the number one and number two LNG exporters, respectively, but the US is uniquely positioned to emerge as another global LNG leader. While well-positioned geographically to reach the Asian market, Australia is at the same time saddled with the costly task of strengthening infrastructure. In Qatar's case, the blockade imposed by Saudi Arabia, the UAE, Egypt, and Bahrain dominated headlines this year. While it is likely that the Qatar-Gulf crisis will reach a resolution ahead of 2020, turmoil is an unfortunate constant in the Middle East, dampening Qatar's long-term potential to be an LNG leader.

Asian markets will be a key source of demand for US LNG in 2020. The European Union and the United Kingdom will also be prime markets for US LNG, as they move to lessen their dependency on Russian gas in favor of a more reliable, consistently priced LNG supplier.

US POWER GRID: A CYBERCRIMINAL'S HOLY GRAIL

PREDICTION 2

CYBERSECURITY

THE US NATIONAL ELECTRIC GRID WILL BE THE TARGET OF A PERMANENT DENIAL OF SERVICE ATTACK (PDOS) BY 2020.

The US national energy grid hasn't fallen victim to a cyberattack yet, but its days are numbered. At the time it was constructed, physical—not cyber—security was the key priority, opening the grid up to vulnerabilities. Ukraine and Finland's power grids were recent targets of Distributed Denial of Service (DDoS) attacks, causing a temporary disruption to services or operations.

By 2020, we expect the US critical infrastructure will be the victim of an even nastier strain of cyberattacks—permanent denial of service (PDOS). True to its name, PDOS attacks aim for permanent destruction and can manifest in three key ways: Destroying physical equipment and structures, disabling services and/or wiping out data.

With increasing success since 2011, a sophisticated group of cyber hackers called Dragonfly have used Trojan-horse software, ransomware, and targeted spear-phishing attacks on energy facilities and executives to gain access to critical information systems and operational databases, potentially laying the groundwork for

a larger-scale attack like PDOS.

As one of the largest and most sophisticated economies, an attack to the US's power grid is the holy grail for cybercriminals. Cyberwarfare is a worsening national security threat, and the US energy industry is a likely battleground for early attacks.

The power sector isn't the only slice of the energy industry with a target on its back. A cyberattack to the nation's pipelines—targeting a key junction so fuel can't flow through—could disrupt oil exports and domestic supply. Cyber vulnerabilities extend throughout the oil & gas supply chain, impacting all companies from exploration and production (E&P) to oilfield services (OFS).





TO DRILL OR NOT TO DRILL: TECH ELIMINATES THE QUESTION

PREDICTION 3

TECHNOLOGY

DIGITIZATION AND TECHNOLOGICAL ADVANCEMENTS—THE NEXT GENERATION OF SEISMIC IMAGING AND PREDICTIVE ANALYTICS—WILL NEARLY ELIMINATE EXPLORATION RISK FOR OIL & GAS DRILLING AND WILL PROPEL THE US INDUSTRY TO ACHIEVE A DRILLING SUCCESS RATE BETWEEN 95 TO 100 PERCENT.

The energy industry may power the world, but technology is the force fueling the oil & gas sector behind the scenes. Technology is present throughout the energy supply chain, from locating oil wells and extracting reserves to refining and transporting the commodity. With the acute understanding that advanced technology increases operational leanness and profit margins, energy companies have always been early-adopters of technology.

A recent [partnership](#) forged between oilfield service company (OFS) Halliburton and Microsoft offers a preview of the digital transformation ahead for oil & gas. The pair teamed up to collaborate on bringing

machine learning, augmented and virtual reality, cloud software solutions, and the Industrial Internet of Things (IIoT) to the oilfield.

Which stages of exploration and production are on the verge of a digital revolution? Continued innovation will lead to greater precision and accuracy during crucial decision-making junctures, including the first core decision: to drill, or not to drill. Today, E&P companies rely on a combination of Monte Carlo simulations and 3D seismic surveys to generate 4D seismic imaging and project future physical changes to the oilfield and reservoir. Using current technology, the industry has about an 80 percent overall

drilling success rate. By 2020, US oil & gas companies will have achieved a success rate between 95 to 100 percent for locating and assessing oil reserves, eliminating a key risk in the exploration process.

Oil & gas companies have worked tirelessly to [harness technology](#) in recent years, but today's cutting-edge advancements are only the beginning. Technology is an untapped oilfield, primed for exploration.

UP FOR DEBATE: US PIPELINE TO CENTRAL AMERICA

PREDICTION 4

ENERGY INFRASTRUCTURE:

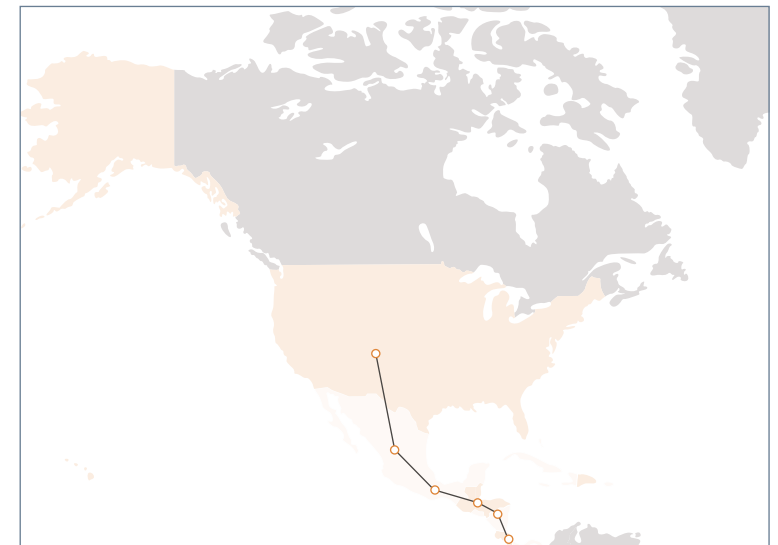
IN 2020—A US PRESIDENTIAL ELECTION YEAR—THERE WILL BE DISCUSSIONS ABOUT CONSTRUCTING A NATURAL GAS PIPELINE FROM THE US TO CENTRAL AMERICA, USING MEXICO AS THE ROUTE.

The year is 2020, and the next US presidential election is upon us. Candidates take the stage and are posed with the following topic for debate: expansion of US energy trade with Central America.

Central America—and Latin America, more broadly—is experiencing an [energy transformation](#), and the region's growth shows no signs of slowing. The question of how the US can best tap into that emerging market will continue to persist well into 2020, particularly as it relates to the demand for natural gas in the region. While nations around the world embrace natural gas as an alternative, more environmentally-friendly energy source, this option is largely inaccessible to Central American countries. That reality is shifting, as Panama breaks ground on the construction of the region's first LNG export terminal, the Costa Norte LNG Terminal. In the meantime, countries like [Guatemala](#) lack a consistent and reliable supply of natural gas, creating a natural opportunity for the US.

Central to the debate about strengthening trade with the region is developing the necessary infrastructure. Constructing a new pipeline through Mexico into Central America, or extending one of the nearly 20 US-Mexican gas pipelines, has been proposed as the conduit for natural gas trade in the region.

While the ultimate outcome of that discussion is largely dependent upon the resolution of the North American Free Trade Agreement (NAFTA) renegotiations and the winner of the 2020 election, we can predict one thing for certain: The possibility of constructing a pipeline between the US and Central America will be revisited during the next presidential debate.



OH, OH, WE'RE HALF WAY THERE: RENEWABLES & ENERGY INDEPENDENCE

PREDICTION 5

RENEWABLES

THE US RENEWABLE ENERGY MARKET WILL PROVIDE 20 PERCENT OF THE NATION'S ELECTRICITY BY 2020.

Renewables accounted for [12 percent](#) of domestically-produced energy overall and [nearly 15 percent](#) of the US's total electricity generation in 2016, and alternative energy investments are set to accelerate. Central to the question of bolstering US renewables is strengthening the necessary infrastructure and expanding the nation's electric grid. By 2020, renewable energy will provide 20 percent of the US's electricity.

The US's recent departure from the 2015 Paris Agreement changes the perception of the nation as a global leader on renewables, but investment will by no means halt. Large US oil companies—among them BP, Chevron, and Total—are all invested in the renewable energy space, a move suggesting Big Oil factors renewables into the energy mix of the future.

Renewable energy is a critical factor compelling the US toward energy independence. This milestone is twofold, referring to self-sufficiency in both electrical and oil supplies. The US has already achieved partial energy independence, from an electrical supply standpoint, which relies on coal, natural gas, and hydro-renewables.

True energy independence—eliminating US dependency on foreign oil and gasoline—will remain beyond our grasp in 2020, however. Oil prices are likely to remain in the \$50 to \$60 per barrel range through 2020, effectively removing the incentive for production in higher-cost regions like oil sands in Canada and deep water offshore regions in the Gulf of Mexico. Seventy-five percent of US-consumed petroleum was produced in the US in 2016, according to the [EIA](#). While the US will continue to strengthen its energy security, the scale won't tip to 100 percent by 2020.

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BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF OIL & GAS IN THE KINGDOM OF SAUDI ARABIA





SAUDISATION: THE NEW BUZZ WORD

PREDICTION 1

LOCALISATION

SAUDI ARAMCO WILL STEP UP ITS DRIVE TO INCREASE THE USE OF LOCAL GOODS, SERVICES, AND LABOUR, REACHING 70 PERCENT LOCALISATION BY THE END OF 2020.

The In-Kingdom Total Value Add Program (IKTVA) was launched at the end of 2015. This Saudi Aramco initiative aims to change the behaviour of its suppliers—with a goal to increase the use of local goods, services, and labour, and boost local employment and exports. The program is gathering momentum; many suppliers have already established an IKTVA baseline score, measured against key metrics for local value creation, and are already working to develop action plans to increase their IKTVA score.

Going forward, Saudi Aramco will pay close attention to IKTVA scores and, by 2020, the scores will become a deciding factor in how contracts are awarded. We foresee other energy companies following Saudi Aramco's lead and introducing their own version of the IKTVA program.

ALTERNATIVE ENERGIES TO FUEL A SUNNY SAUDI

PREDICTION 2

ALTERNATIVES

SAUDI ARABIA IS TAKING STEPS TO REDUCE THE DOMINANCE OF OIL & GAS IN THE ENERGY SECTOR, AND WE PREDICT INVESTMENTS IN ALTERNATIVE ENERGY SOURCES WILL REACH US\$50 BILLION BY 2020.

Renewable energy today accounts for less than 1 percent of the energy produced in Saudi Arabia. That may be about to change as the country steps up its investment in alternative sources of energy. There is no shortage of solar power to tap into, and wind and nuclear power are also likely to enter the mix. Local energy needs are growing by more than 8 percent each year, and the aim is for alternative sources of energy to cover this rising demand for energy, leaving more oil for the export market.

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BDO'S ENERGY 2020 VISION: THE NEAR FUTURE OF OIL & GAS IN THE UK



A tall industrial drilling rig, likely for shale gas, stands against a sunset sky. The rig is a complex structure of metal towers and ladders, with various pipes and equipment attached. The sky transitions from a deep blue at the top to a bright orange and yellow at the bottom. In the foreground, there are several large, cylindrical storage tanks or components of the rig.

THE UK'S ENERGY FUTURE WILL BE A SELF-SUFFICIENT ONE

PREDICTION 1

SHALE RESERVES

BY 2020, THE UK WILL HAVE COMMERCIALISED ITS SUBSTANTIAL SHALE GAS RESERVES AND WILL BE ENERGY SELF-SUFFICIENT.

For a country reliant upon imported energy, the discovery of substantial quantities of domestic shale gas has provided the UK with an opportunity to become energy self-sufficient. The UK government recognises this potential and has offered favourable tax breaks to shale-gas producers and initiated fast track planning procedures to kickstart production.

Today UK energy security is in flux and worryingly uncertain. Last year, Prime Minister Theresa May halted a deal with China and France to develop a new nuclear power facility at Hinkley Point. In addition, the

more traditional forms of energy production in the UK, like energy from coal-fired power stations, are unsustainable in the long term if the UK is to meet its carbon reduction obligations. The UK's dependence on natural gas imports can be eliminated if it embraces shale gas production.

However, there are wildly differing estimates of how much shale gas there is in the UK. In 2013, the British Geological Survey suggested that within the Bowland Shale of central Britain there could be between 822 trillion cubic feet (Tcf) and 2281 Tcf.

How much of this is recoverable is unknown, and this is only one relatively small region. When you consider the potential in other areas of the UK and the potential for offshore reserves, the opportunity is huge and could transform the UK's energy market significantly.

THE UK: FUTURE FRACKING CAPITAL OF THE WORLD?

PREDICTION 2

FRACKING

BY 2020, THE UK WILL HAVE DEVELOPED THE MOST ROBUST PLANNING, LICENSING, AND OPERATING REGIME FOR FRACKING IN THE WORLD.

The UK has large potential reserves of shale gas. Shale gas or oil is trapped within impermeable shale rock. In contrast, conventional natural gas deposits, such as those under the North Sea, are trapped below impermeable rock. Therefore, simply drilling down to shale gas is not enough to extract it. The rock must be fractured at high pressure to get the gas or oil out. This process is known as fracking.

The biggest barrier to fracking in the UK is public opposition. A [2017 survey](#) by the UK Department for Business, Energy & Industrial Strategy showed just 16 percent of people support the process of shale gas extraction, down from 21 percent in 2016 and the lowest since the study was launched five years ago.

Almost half of the survey participants admitted to knowing little about fracking. There remains a widely-held belief amongst the public that the UK does not need to access the energy potential in shale to protect its national energy security.

To help alleviate some of the concerns raised by the public, the UK government proposed a series of wealth funds to support local community projects in areas where fracking was used in shale gas production. More recently, the government announced its intention to make the distribution of the gains from shale gas production simpler by making direct payments

to individual households. However, these initiatives do not appear to be enough to gain majority support from the UK populace.

The current process for obtaining permissions to drill for shale gas is established, but the UK population needs education on the robustness of the licencing process and the process of fracking itself. Only then will the UK's planning, licencing, and operating regime be world class. The UK people need education and knowledge to encourage the general population to support fracking, and the UK government needs to be clear that shale gas reserves are crucial to the UK's energy security.





THE NATIONAL GRID WILL TUMBLE

PREDICTION 3

SECURITY

THE UK NATIONAL GRID WILL BE THE TARGET OF A MAJOR CYBERATTACK BY 2020.

There is growing concern in the UK around the threat posed by cyberattacks on power stations and electricity grids. The UK has already seen the devastation and confusion that a large-scale cyberattack can have on its infrastructure when the [WannaCry ransomware attack](#) hit the National Health Service in May 2017. Commentators have highlighted that the danger to UK energy infrastructure is heightened because of the trend away from well-protected, centralised large power stations and towards decentralised power, such as small, flexible gas power plants and solar panels on homes.

There are also a growing number of web-based devices that help us control our personal technology, including the national roll out of smart meters to our homes and the use of connected home technologies to control everything from our lights to our heating to our home security.

It therefore is easy to predict that determined cyber criminals could target the UK at both a national energy level and a localised community, household level. The implications and potential effects of such attacks are huge—they could limit or cut off hospital services, street lighting, household heating, and communication. The list of potential liabilities is endless.

Cybersecurity in the energy sector has been high on the agenda for many of the big energy companies for years and has been a focus of governmental debates. It is clear this is one area no one can afford to ignore and where we all must remain vigilant.

SMALL OPPORTUNITIES: THE BEGINNING OF GREAT ENTERPRISES

PREDICTION 4

INVESTMENT

BY 2020, INVESTORS WILL HAVE DIVERSIFIED THEIR INVESTMENT PORTFOLIOS IN THE OIL & GAS SECTOR.

It was an ancient Greek statesman who said that small opportunities are often the beginning of great enterprises. The same can be said about the oil & gas sector today.

Following the dramatic fall in oil prices in 2014, there has been a slow but steady recovery in prices to its current level of around \$60 per barrel. Statistically, this is a huge increase over the last few years but still falls significantly shy of the high of \$115 per barrel seen in March 2011.

In *Drilling Down 2017*, we noted that the proceeds from secondary fundraisings more than doubled in 2016. Other notable findings include: Alternative Investment Market (AIM) oil & gas shares outperformed the FTSE AIM 100 index and 31 companies raised an average of \$21.1 million in 2016, compared to 33 companies raising an average of \$12.8 million in 2015. However, the number of AIM-listed oil & gas companies fell again. There are more positives in these stats than in recent years.

To survive during the oil price crash, companies slashed their capital expenditure programmes and sought efficiencies in every corner of their business. With rebased costs and oil prices creeping back up slowly, companies are now beginning to view new investments in resource development as more attractive. We have already seen the green shoots in the market place. Now that there is more interest from the capital markets in projects, companies are finding it (relatively) easier to raise funds where the payback can be demonstrated. Margins, meanwhile, look more sustainable for the longer term and consolidation is seen as a positive. Investors seem to have learnt what "good" looks like. These small steps will create the opportunity for the great enterprises in the sector that are yet to come.





THE UK: A BEACON FOR DIGITAL INNOVATION IN THE GLOBAL MARKET

PREDICTION 5

DIGITAL DEVELOPMENTS

BY 2020, ROBOTS AND OTHER TECHNOLOGIES WILL REPLACE SOME OF THE ENERGY LABOUR FORCE.

Oil & gas companies ruthlessly cut costs and sharpened their investment filters to survive the low oil price environment. That drive for efficiency now needs to focus on innovation to create long-term productivity improvements. This is therefore the right time for the industry to grasp the benefits of digital innovation: Companies are working off a lean cost base with a \$60bbl oil price that offers improved margins without bringing the super profits that breed complacency.

The use of big data, algorithms, machine learning, and artificial intelligence (AI) are having a powerful impact on other sectors

of the economy. By 2020, the UK oil & gas sector will have embraced a digital mindset as it seeks out productivity gains. We have already seen tangible progress, such as predictive maintenance sensor systems and AI being deployed to analyse historical well data and help select optimum drilling locations. By 2020, innovators will be deploying AI to manage drilling in real time and remove costly human error. The use of predictive analytics to anticipate equipment failure will be the norm and robotics will have started to replace humans for repetitive tasks such as replacing damaged equipment.

The need to drive efficiency in its mature UK Continental Shelf assets, leading oil services capabilities built around Aberdeen, and a thriving technology sector in the UK, will come together to deliver innovative solutions for the global oil & gas industry. Companies that embrace the change will thrive.

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