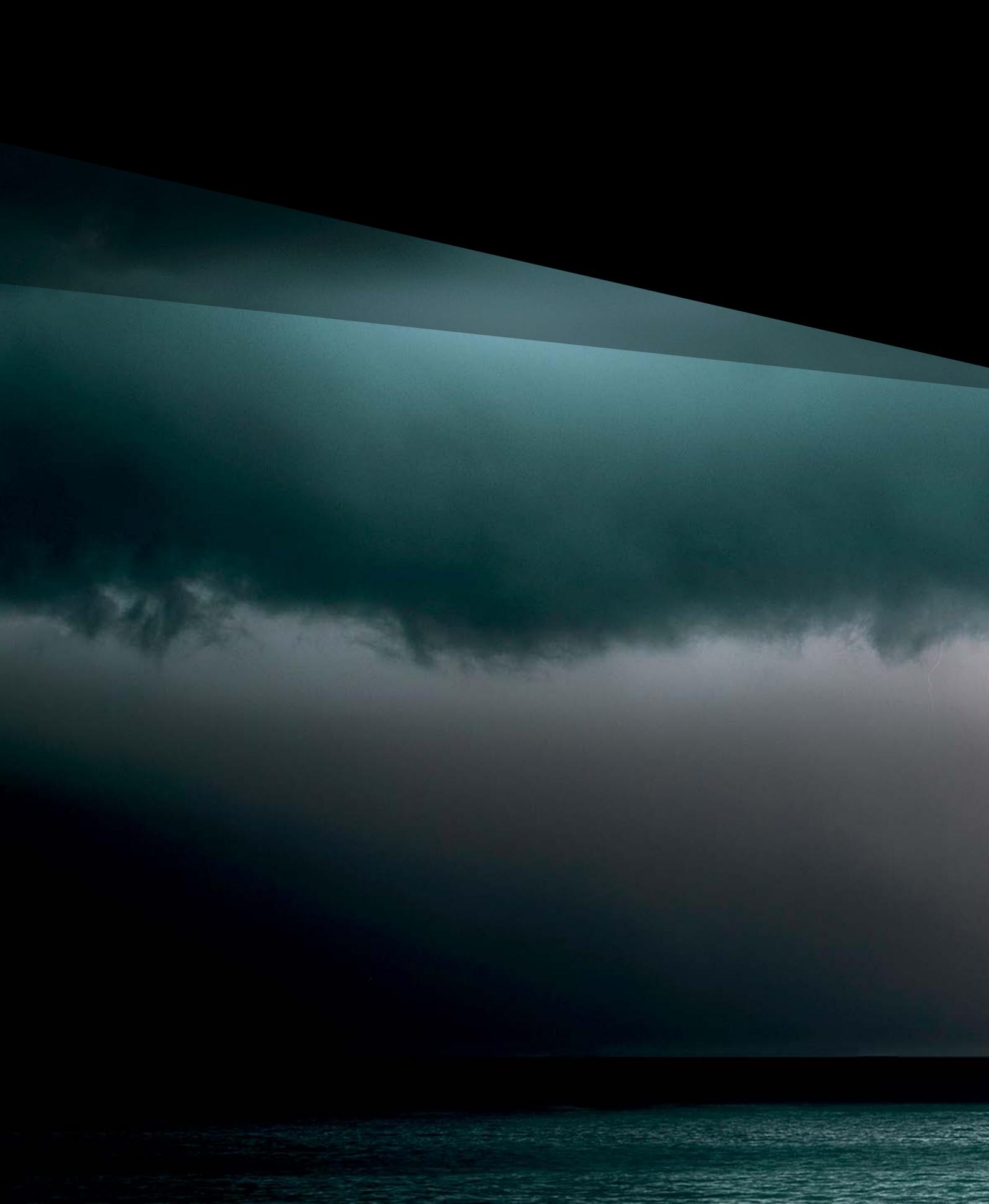


THE OLIVER WYMAN

ENERGY JOURNAL





INTRODUCTION

The global energy industry is in the midst of a perfect storm. Intense competition, persistent economic volatility, and a rapidly evolving political and regulatory landscape are disrupting and transforming almost every aspect of the sector.

The effects are being felt far beyond the industry. From national governments that rely on revenue from energy to finance their economies, to consumers who are being empowered to produce and sell their own electricity, virtually no person, industry, or nation remains unaffected.

Moreover, the pace of change shows no signs of slowing. The transition from fossil fuels to low or no-carbon sources – triggered by a confluence of new technologies, cheaper alternatives, and a raft of new international agreements and rules to reduce greenhouse gas emissions – is proving to be a crucial catalyst for accelerating this transformation.

Innovative and digitally savvy competitors, in many instances unburdened by legacy businesses and costly asset portfolios, are also forcing the pace of change. They bring with them agile strategies and leaner, more flexible ways of working that are upending the traditional business models and operational practices of incumbent oil and gas companies and utilities alike.

But not all incumbents are standing by in the hope that this storm will pass. There is a growing recognition that business as usual is no longer a meaningful, long-term option. Indeed, some forward-thinking organizations are already embracing this new environment's disruption and change in an effort to reinvigorate their businesses. At every level, these oil and gas companies, utilities, and commodity traders are adopting new business models and best practices from other industries to optimize the value of existing operations and assets and, even more importantly, build new and sustainable revenue streams.

Despite the risks and challenges that lie ahead, organizations that are bold, agile, and willing to invest sensibly in innovation and change are likely to be best placed to succeed. The perspectives and insights in this, the third edition of the *Oliver Wyman Energy Journal* represent the latest thinking across our global energy practice on the current and emerging opportunities and risks facing the industry.

I hope you find the *Oliver Wyman Energy Journal* valuable and informative.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Francois Austin', with a horizontal line underneath.

Francois Austin

Head of Energy Practice

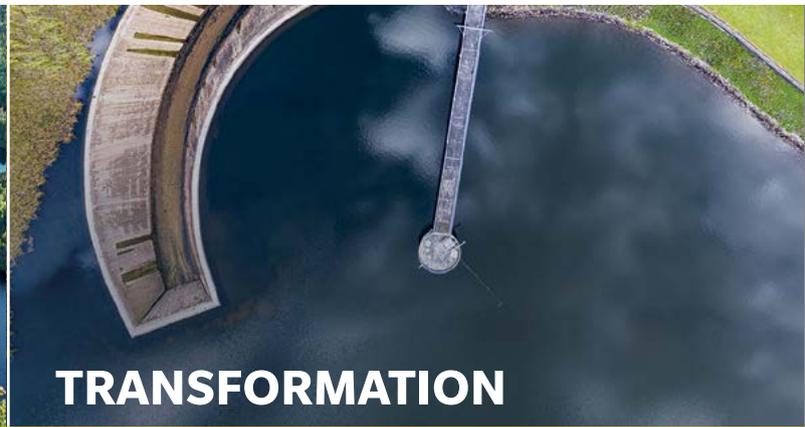


STRATEGY

-  **6 STRIKING A BALANCE IN OIL AND GAS**
How energy players should tackle strategic decisions differently
Bill Heath and Robert Peterson

-  **12 SMART UTILITIES SHOULD DISCOVER SMART HOMES**
Offering smart-home services can be a road to new profits
Sandro Melis, Angelo Rosiello, and Arun Mani

-  **16 UTILITY CUSTOMERS WANT INNOVATION**
In Germany, a survey finds consumers look for utilities with inventive products
Thomas Fritz, Dennis Manteuffel, and Joerg Staeglich



TRANSFORMATION

-  **20 GET CREATIVE ABOUT FLEXIBILITY**
Utilities can no longer afford to take a wait-and-see attitude
Andrew Perry

-  **24 WHAT OIL AND GAS CAN LEARN FROM AVIATION**
A new cyclical reality makes energy companies rethink operations
Bill Heath, Robert Peterson, David Marcontell, and Susie Scott

-  **28 AVIATION FUELS, STAGE TWO**
Renewable jet fuels are the next step in the industry's evolution
Bob Orr, Eric Nelsen, Geoff Murray, and Bjoern Maul

-  **30 ENERGY RECALIBRATED**
Three ways to thrive in the new normal
Alexander Franke, Mark Pellerin, and Tim Thompson

-  **32 WHEN NATIONS NEED TO GO BEYOND OIL**
Gulf states put new emphasis on growing local industries
Bruno Sousa, Volker Weber, Saji Sam, and Bernhard Hartmann

CONTENT KEY

 Oil and Gas

 Utilities



DIGITIZATION

40 THE GAS STATION'S DIGITAL FUTURE IS AROUND THE CORNER

Self-driving autos, mobile apps, and connected vehicles disrupt oil and gas' retail business

Irfan Bidiwala and Eric Nelsen

44 REIMAGINING COMMODITY TRADING

A new breed of commodity-trading titans and digital contenders are about to reorder the industry

Alexander Franke, Christian Lins, Roland Rechtsteiner, and Graham Sharp

52 HOW UTILITIES ARE USING BLOCKCHAIN TO MODERNIZE THE GRID

Welcome to a new era of decentralized power

James Basden and Michael Cottrell

56 DIGITAL ELECTRICITY

German utilities need to digitize – or risk disruption

Thomas Fritz, Matthias Mohr, and Joerg Staeglich



OPERATIONS EXCELLENCE

60 NATIONAL OIL COMPANIES NEED TO UP THEIR GAME

To compete with the majors, NOCs must improve their enterprise risk management

Alexander Franke and Volker Weber

64 THE QUEST FOR FEWER AND SHORTER OUTAGES

Creating a portfolio of small investments and analytics can help even the best utilities improve their record

Alan Feibelman, Curtis Underwood, and Daniel Ludwin

68 OIL RESILIENCE IN ASIA

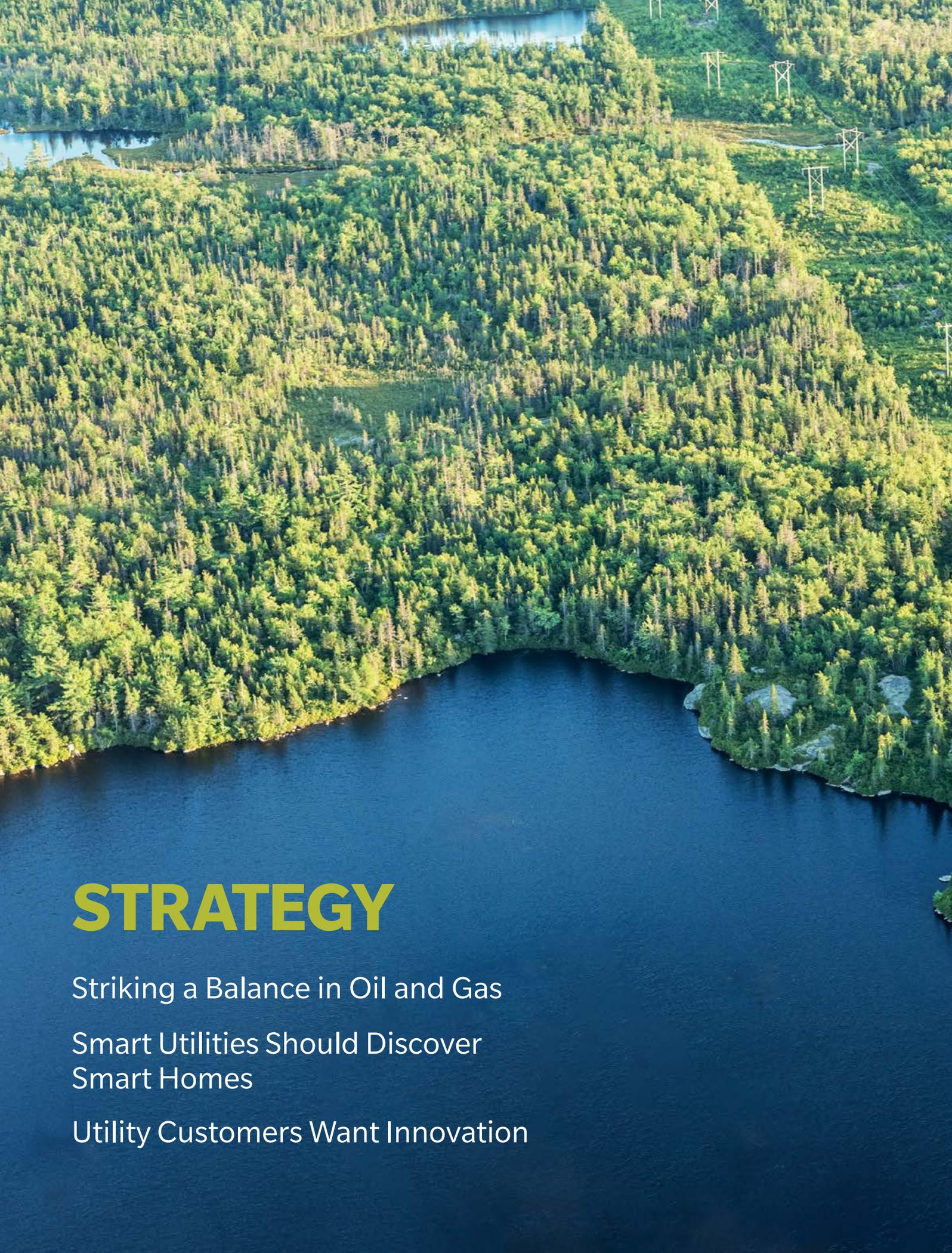
Volatile oil prices have major implications for the region

Blair Chalmers

72 THE WORLD ENERGY TRILEMMA

Ranking the world's top 25 sustainable energy systems

Francois Austin



STRATEGY

Striking a Balance in Oil and Gas

Smart Utilities Should Discover
Smart Homes

Utility Customers Want Innovation





STRIKING A BALANCE IN OIL AND GAS

How energy players should tackle strategic decisions differently

Bill Heath and Robert Peterson

Oil and gas companies are making major strategic moves designed to provide stable cash flows in an era in which oil prices are likely to fluctuate between \$50 and \$60 a barrel. Major European players such as Total and Shell are moving into renewable power generation, while others such as Devon, ConocoPhillips, and BP are focusing on improving the quality and cash flow of their core holdings. Devon and ConocoPhillips are expanding their reach in shale. BP is investing more in deep-water exploration and production. Others like ExxonMobil and Shell are moving more into petrochemical manufacturing and lubricant sales.

Squeezed by smaller capital budgets cut by about 30 percent, or \$200 billion, in the past two years, oil and gas companies are prioritizing investments that provide near-term cash flow over longer-term, technology-enabled plays. Frontier exploration budgets have been slashed, in favor of lower risk, incremental exploration. In North America, budgets are expected to rise by 20 percent per year through 2020, but capital expenditures will go primarily towards low-cost, quick-to-production shale fields, such as Permian and Eagleford. (See Exhibit 1.)

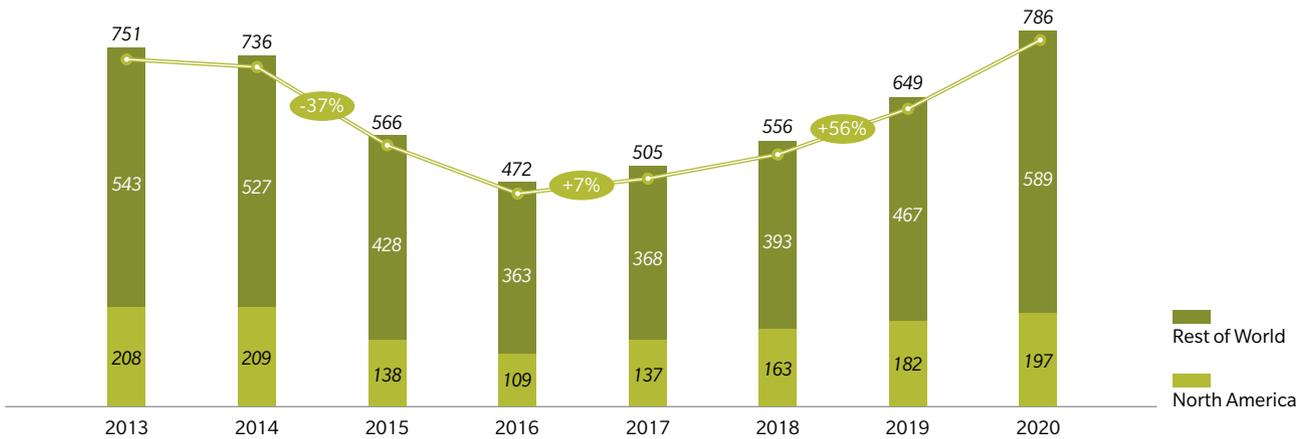
The easy-on, easy-off production of shale has changed the nature of portfolio management in the oil and gas industry in large part because shale drilling is now profitable even if hydrocarbon prices sink to levels as low as around \$45 per barrel. Producers are planning for a tighter price band in the neighborhood of \$50 to \$60 per barrel of oil equivalent, with greater volatility, at the same time that they scout for growth opportunities to steady expected major shifts in future energy consumption and production.

But oil and gas players are struggling to balance both growth and short-term cash flow while properly and swiftly evaluating the trade-offs involved in investment decisions. Capital management processes are just not up to the task of reviewing portfolio choices more frequently and more exhaustively, especially in the current volatile environment. Already, companies are being forced to abandon investment plans made just months earlier because market dynamics have shifted dramatically, invalidating earlier decisions.

EXHIBIT 1: OIL AND GAS INDUSTRY CAPITAL EXPENDITURES

The industry's smaller capital expenditure budgets are on the mend

\$US BILLIONS



Source: SG Cross Asset Research/Equity, Oliver Wyman analysis, all estimates

To keep up with the energy industry's current furious pace of change, oil and gas companies need a new approach. They need to rebalance short-term versus long-term investments, more rapidly stress test the impact of their portfolio. Here's how:

BALANCING SHORT-TERM AND LONG-TERM INVESTMENTS

Oil and gas companies are shifting their mix of investments from long-term to short-term projects in response to the fact that their capital allocation decisions are now scrutinized on the basis of their impact on cash flow, instead of on the traditional measure of reserve additions. With budgets less than half their 2014 size, producers are favoring investments in projects likely to produce oil in three years or less over longer-term, complex deep-water projects. All told, 70 percent of

the investments planned by the oil and gas industry's big five super majors are in shorter-term projects, up from only 30 percent in 2008. (See Exhibit 2.)

The move to shorter-term investments to shore up oil and gas companies' balance sheets could result in longer-term risks for the industry. Smaller production increases could lead to a shortfall in global production by 2020, according to the International Energy Agency. In addition, there's a risk that oil majors may miss out on technological step changes if they focus solely on deploying short-term incremental innovations. For example, they may underinvest in digital innovations such as big data, predictive analytics, geomatics, drones, and robotics that have the potential of significantly lowering oil and gas players' breakeven points and transforming the economics of expensive plays such as deep-water drilling.

On the positive side, the focus on multiple, smaller investments could help reduce companies’ potential negative exposure to widely anticipated shifts in the energy landscape that remain uncertain, such as the emergence of the electric car and the rise of renewables. Companies such as Devon, ConocoPhillips, and ExxonMobil that believe in the durability of the hydrocarbon future are placing very different bets than other companies such as Shell that want to create new options for the future by investing more in renewables. It’s unclear which bet is right. But by making more short-term investments, oil and gas players can hedge their bets by taking advantage of the option to delay large investments until the long-term direction of the energy landscape becomes clearer.

REAL-TIME DECISION MAKING

The combination of a shift to more frequent, short-term investments and greater uncertainty means that oil and gas companies need to make investment decisions in a fundamentally different way. In addition to annual deep dives and regular quarterly reviews, companies need to develop the capability to conduct customized real-time portfolio scenario analysis.

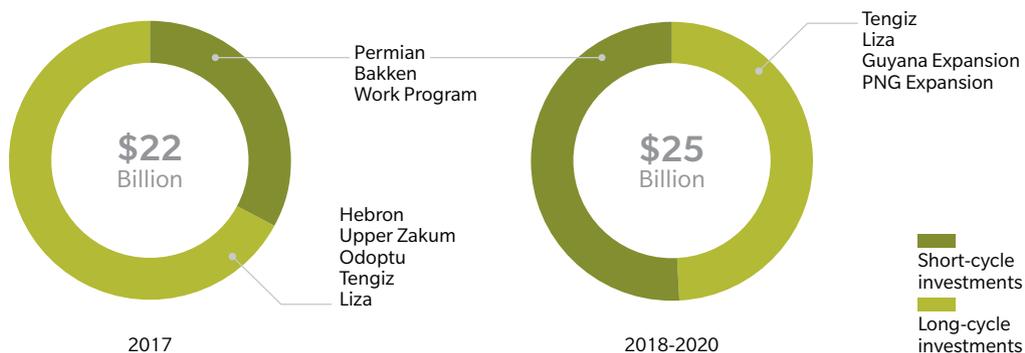
In today’s whipsaw environment, oil and gas players must be able to almost instantly model the question: “What would be the impact on net present value and cash flow if a firm reallocated \$1 billion in incremental development funding from the North Sea to the Permian basin?” One leading player has developed an executive decision-advising portfolio system that enables executives to do

EXHIBIT 2: SHIFTING TO SHORT-TERM INVESTMENTS IN OIL AND GAS

Like other majors, ExxonMobil is shifting most of its planned investment portfolio to short-term investments

EXXONMOBIL CAPITAL EXPENDITURES

\$US



Source: Morgan Stanley Research

just that, in order to nimbly evaluate the impact of an investment on the company's portfolio and quickly reach investment decisions almost on an ad hoc basis.

But developing the capability to answer real-time "what if" questions in a coherent manner requires a higher level of commitment to making rapid investment decisions than has existed in the past. For starters, companies need to identify key risks and focus on the ones in each portfolio element that will have the greatest impact on any given portfolio decision, be it a political risk, safety risk, regulatory risk, technical risk, supply-chain risk, or the potential lack of access to a certain market.

In addition, a more frequent and robust interaction between corporate planning, the executive team, and the regional businesses has to be established to ensure that both the potential positive impact of an investment on the company's portfolio as well as the risks it presents are properly weighed – and what will be required for its practical implementation.

To effectively evaluate these more rapid investments in a more complex context, executives also have to balance both deterministic and probabilistic investment evaluations in an efficient and consistent manner. Oil and gas executives tend to prefer to receive a deterministic "one number" expected value for the value of a project.

They want the probabilistic modeling for key areas, such as exploration and capital project execution, to be rolled into that one number. But by doing so, they miss out on the opportunity to understand the increasingly volatile and complex forces at work, which is critical given energy's fast-changing pace. Firms need to develop a view on when it is appropriate to apply deterministic methods and when an investment merits a more multifaceted, probabilistic approach.

Finally, firms must build the digital infrastructure to knit all the data together in a lucid manner that will support real-time "what-if" evaluations. Like the one leading independent oil company mentioned above that has developed this capability, companies must invest in and integrate software tools that can separately estimate exploration risk, well and reservoir performance, economics, and investment types – preferably all in a single system.

TESTING MORE COMPLEX PORTFOLIO THEMES

At the same time that companies are speeding up their investment evaluations, the nature of their portfolio choices is becoming even more complicated. Oil and gas companies are expanding beyond the areas that they are accustomed to. They are eyeing opportunities in renewable resources, power generation, and drilling – offshore and onshore – in new regions at a time when geopolitical risk in oil producing nations is rising. And when they examine these opportunities, they are interested in participating in the business of not just drilling for oil and gas, but also refining and selling it.

To get the most out of this expanding set of options, it is critical that companies' investment themes be firmly established. Firms must re-examine their core capabilities

The easy-on, easy-off production of shale has changed the nature of portfolio management in the oil and gas industry

Firms must re-examine their core capabilities and ask the question: “What are we really good at? Is it deep-water exploration, shale exploitation, wind energy generation, or petrochemical refining?” Then they must explore where they can create additional value in one of the many other areas that are in flux right now, such as power generation or water management. All the while, companies must bear in mind which investment is the best fit to their culture, core capabilities, and management expertise.

Firms must scout for portfolio elements where their capabilities can result in a competitive advantage. Then they must organize them around themes, such as a geography, resource, skill, or financial flexibility. For example, Shell acquired the BG Group in order to develop a global reach and leadership in liquefied natural gas with the ambition of dominating that business over the next 10 to 20 years. ExxonMobil is now focusing on integrating North American shale production with petrochemical manufacturing in order to lead that business.

To be able to test these options and make choices, firms need to apply a greater range of metrics across a broader swath of themes. Metrics such as the net present value of an asset per barrel or its cash flow as compared to the incremental capital expenditure required should be considered to assess and grade sets of projects that may cover overlapping issues and areas. Then multiple themes such as high-risk exploration, enhanced recovery methods, or shale can be examined as part of a portfolio exercise.

70%

The portion of oil and gas majors’ planned investments tied up in short-term projects

CONCLUSION

Oil and gas companies, whipsawed by plunging oil prices, are now trying to achieve a more stable state of normalcy by shifting to multiple, short-term investments. While this shift is prudent, it will require some adjustments. Energy players must get into the habit of examining their portfolios more rapidly and in greater depth. Otherwise, they run the risk of being confounded by the rapidly expanding set of risks and energy shifts they are becoming exposed to. Companies that invest in developing an integrated and balanced approach to managing their portfolios of investments are likely to succeed in spotting these shifts as they arise, and to respond nimbly to the opportunities they present.

Bill Heath

is a London-based partner in Oliver Wyman’s Energy practice

Robert Peterson

is a Houston-based partner in Oliver Wyman’s Energy practice

This article first appeared in *BRINK*



SMART UTILITIES SHOULD DISCOVER SMART HOMES

Offering smart-home services can be a road to new profits

Sandro Melis, Angelo Rosiello, and Arun Mani

Digital disruptors have rewritten the rules for a broad swath of industries, from transportation to hospitality. Now, it's energy's turn, as utilities struggle with falling demand and lower prices – as well as a push on the part of regulators for new, innovative ideas, such as smart grids, energy efficiency, and home energy production. In Europe and North America, utilities have been cutting costs to maintain profit margins, but there's only so far cost-cutting can go.

To date, tactics to boost utilities' fortunes have included selling home appliances for lighting and temperature control. British Gas was a first mover in this business, launching a separate unit in 2007 and acquiring companies with expertise in solar cells, smart meters, and heat pumps. But most utilities have limited competitive advantage over traditional retailers and digital players in this area. If they cannot ensure product quality and maintenance, the new business could damage their reputation and increase operating costs.

A better move is to branch out into "smart-home" services. Customers are increasingly interested in this kind of proposition, which can include energy management, home security, and entertainment, an Oliver Wyman survey shows. Bundled energy solutions – such as a domestic heating package, intelligent tariffs, and energy consultation – all influence more than 30 percent of respondents in their choice of utility, according to the survey, which was conducted in Germany. (See "Utility Customers Want Innovation" on page 16.). In 2015, the smart-home business sector had a value of \$47 billion globally, and it is expected to grow at 14 percent a year between 2016 and 2022. But utilities need to move fast. New entrants, especially global tech players, are moving into the business with packages that leverage their digital technology.



14%

How much the smart-home business is expected to grow annually

Smart-home services start by helping customers heat and cool their buildings for maximum comfort at minimum cost. Instead of paying for energy use, for example, the customer might pay a monthly flat fee to maintain their home at a constant temperature of 23 degrees Celsius. Southern California Edison (SCE) uses smart thermostats and bill estimation services to help customers use energy more efficiently. SCE even offers \$200 rebates to customers that let it shut down their air conditioning during peak demand periods.

THE SEARCH FOR NEW VALUE

Smartphones and apps are opening the way to an intriguing range of new services. Enel in Italy has launched a product that lets customers know in real time which rooms at home are consuming more energy and which less. The customer can then remotely enable or disable devices connected to smart sockets. The app communicates with motion sensors – in rooms and at doors and windows – that allow people to see what’s going on while they are away: whether their children are sleeping,

for example. In some cities, the app can also order food, as well as providing travel and weather updates.

This array of services also points to a wider range of competitors, who can combine energy services with extras from their own special capabilities. Intel’s Care Innovations unit offers home health monitoring, based on infra-red sensors that track a resident’s movements. Home security company ADT Pulse adds in video and sensor surveillance, which can be monitored online and on a smartphone, and can generate alerts for authorized access (children returning from school) or non-authorized (burglars). Comcast’s Xfinity brand includes TV and internet service in a bundle. (See Exhibit 1.)

MAINTAIN CONTROL

Energy utilities have an advantage over newcomers through their connections to people’s homes and the vast quantities of data they collect on consumer power use. But to offer attractive packages, they will need to team up with firms that provide complementary skillsets, such as telecoms, automated building firms, software designers, and data analytics providers. When they do this, utilities must take care to retain control over the new offerings, by acting as the main orchestrators and first movers. They should offer end-to-end integrated services and examine carefully the customer experience at steps, from product choice, to aftersales. If utilities don’t move quickly, they could lose their relationships with customers, as other players seize the initiative and aggregate various single services into packages.

Preliminary market analyses indicate that smart-home services could increase utilities’ operating margins substantially, anywhere from 11 percent to 18 percent. At the same

EXHIBIT 1: THE NEW SMART-HOME DEVICE BUSINESS MODEL FOR UTILITIES

Some utilities in the US are working with global players to expand their reach into smart-home services

SMART-HOME SERVICES IN THE US MARKET

TELECOM

Comcast Xfinity



- Smart-home services bundled with TV and internet services
- Home security and control devices include central controller, sensor system, cameras, lighting controllers, and thermostats
- \$100-400 installation cost, \$20-50 per month, 24-36 month contract

TECH/SW

Nest, Google



- NEST learning thermostat is able to program itself to monitor home energy usage
- \$250 up-front cost, installation included via some retailers
- GE offers home health monitoring via GE QuietCare
- Infra-red sensors track activity for caregivers

SECURITY

ADT Pulse



- Combines home automation, thermostat and light control, and video surveillance installations, with access to online portal/mobile app
- \$100 installation cost, 36-month contract

RETAILERS

Iris from Lowes



- Smart-home automation kit, which combines home monitoring and energy saving capabilities
- \$180-300 set-up cost, \$0-10 per month, DIY installation and no contract required

UTILITIES

SDGE, Southern California Edison



- Energy efficiency and demand response programs are the focal point of utility-offered smart-home energy management services
 - Home energy adviser
 - Remotely monitor consumption
 - Control heating via mobile
 - Efficiency consulting and education program

Type of service provided



Source: Oliver Wyman analysis

time, customer attrition could fall between 3 to 5 percent. We do not expect a major transformation, but rather incremental changes driven by pilot projects starting in the coming months.

To set the process in motion, utilities should consider creating dedicated units to design and test out new solutions, or try open innovation models. Medium-sized utilities could combine resources if they don't have the scale to compete with tech giants or larger rivals. One thing is certain: Disruption is coming, and utilities need to act. They are about to find that conducting normal business consists of constant innovation.

Sandro Melis

is a Milan-based partner in Oliver Wyman's Energy practice

Angelo Rosiello

is a Milan-based principal in Oliver Wyman's Energy practice

Arun Mani

is a Houston-based partner in Oliver Wyman's Energy practice

UTILITY CUSTOMERS WANT INNOVATION

In Germany, a survey finds consumers look for utilities with inventive products

Thomas Fritz, Dennis Manteuffel, and Joerg Staeglich

Traditional energy suppliers in Germany are under increasing pressure from energy efficiency measures. Unless energy suppliers and municipal utilities take action, their earnings could decline by as much as \$11 billion by 2025, according to our forecast. In order to explore potential new sources of income, Oliver Wyman surveyed 800 households and conducted 100 interviews to learn what new and innovative products energy customers might be interested in buying from utilities. The charts that follow illustrate our findings.

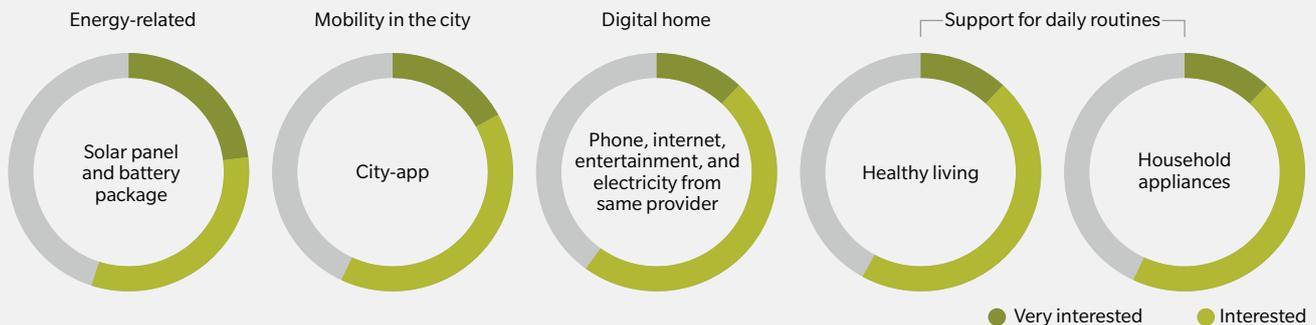
Nearly half of the respondents had a high or very high interest in purchasing half of the 20 products that were discussed. Fifty-two percent of households surveyed were interested in purchasing “Digital Home” products such as telephony, internet, entertainment, and power from a

single source. In addition, many were interested in products and services, such as electronic assistance systems for the elderly, professional advice about healthy living, household devices, aggregated information apps, and in-house solar plant plus battery pack solutions. Customers also indicated they would be willing to switch energy suppliers depending on the innovative products offered.

Energy suppliers have established a high level of credibility and trust with their customers. Those providers that can expand their offerings to include products that offer the latest technology or a way to simplify customers’ lives will be the most likely to continue to be in a position of strength in the future. Customers are open to a wide range of possibilities. Now, it’s up to the utilities to make those innovative products and services available to them.

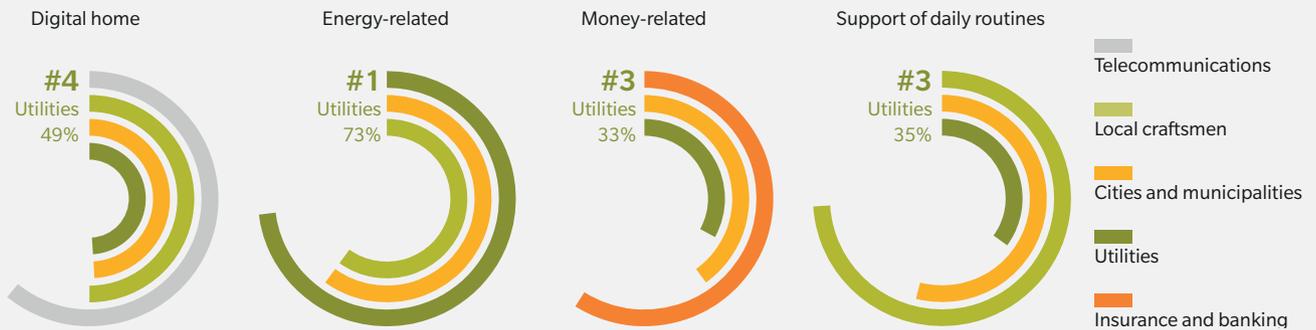
GERMAN CUSTOMERS ARE INTERESTED IN NEW PRODUCT OFFERINGS BY UTILITIES – ESPECIALLY THOSE RELATED TO THE DIGITAL HOME...

Top five products of interest in various areas (share of respondents who are interested in new products)



Source: Oliver Wyman analysis

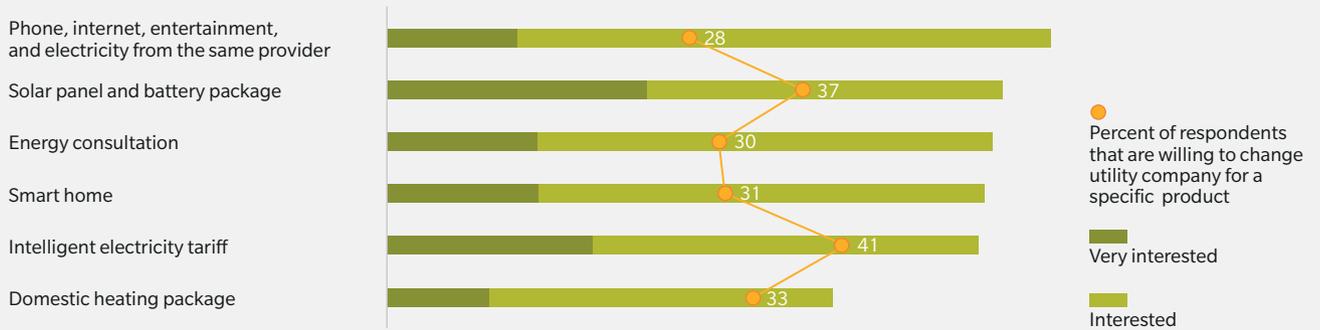
...THAT'S BECAUSE UTILITIES RANK AMONG THE MOST TRUSTED PROVIDERS OF NEW PRODUCTS.
Average credibility rank of a provider for each product category by percent



Source: Oliver Wyman analysis

THESE TOP SIX PRODUCTS AND SERVICES HAVE THE POTENTIAL TO PERSUADE CUSTOMERS TO SWITCH ENERGY SUPPLIERS...

Products and services in which customers show the most interest



Source: Oliver Wyman analysis

...BECAUSE THEY BELIEVE THE NEW PROVIDER WILL BE STATE OF THE ART AND EASIER TO USE.

Expected benefits that will cause above-average willingness to change their utility (percent share of respondents who perceive the respective criteria as significant or exceptional benefits)



Source: Oliver Wyman analysis

Thomas Fritz is a Düsseldorf-based partner in Oliver Wyman's Energy practice. **Dennis Manteuffel** is a Munich-based engagement manager in Oliver Wyman's Energy practice. **Joerg Staeglich** is a Munich-based partner in Oliver Wyman's Energy practice.



TRANSFORMATION

Get Creative About Flexibility

What Oil and Gas Can Learn from Aviation

Aviation Fuels, Stage Two

Energy Recalibrated

When Nations Need to Go Beyond Oil





GET CREATIVE ABOUT FLEXIBILITY

Utilities can no longer afford to take a wait-and-see attitude

Andrew Perry

The evolution of the United Kingdom's energy system into an innovation-led, decentralized market presents a fundamental challenge to the traditional low-risk, cost-focused approach long favored by established incumbent utilities.

New smart technologies, creative business models, and a gradual updating of the regulatory framework are driving this change. These same forces, however, are also creating a set of strategic complexities, risks, and opportunities for utilities, as well as ushering in a new group of agile startup competitors that are trying to harness these elements to disrupt the utilities market.

The speed and efficiency with which incumbent utilities respond to these challenges may well determine whether they continue to play a leading role in the UK energy market in the long term or cede their position to new market players. And nowhere are these changes more evident than in the area of flexibility.

Flexibility, as broadly defined, involves the management of the generation or consumption of power to ensure system balance. Previously, this balancing act was managed almost exclusively via flexible fossil-fuel generation. But renewable intermittency and nuclear inflexibility pose new challenges to flexibility. In parallel, technology development is opening up opportunities to shift demand so as to match generation and make use of battery storage.

INNOVATION GOES MAINSTREAM

Technology-led commercial innovation is already making its mark on the energy system. Battery storage technology began to come of age as a mainstream system tool in the UK when 1.2 gigawatts of capacity was bid into the enhanced frequency response (EFR) auction in August 2016; and later in December, another 500 megawatts of new-built battery storage projects were awarded 15-year contracts at the capacity market auction.



EXHIBIT 1: NEW BUSINESS MODELS FOR UTILITIES
 Flexibility is a core aspect of new product and service categories



Source: Oliver Wyman analysis

Companies like Stem in the US and Sonnenbatterie (in partnership with Lichtblick) in Germany are developing creative commercial approaches that enable the full value from storage to be captured and the barriers associated with the up-front capital costs to be mitigated. Other projects, like Open Utility’s Piclo marketplace in the UK (in partnership with Good Energy) and MVV’s “Strombank” in Germany, are exploring how peer-to-peer trading and local marketplaces that manage the allocation of demand and generation can become a reality.

With so many companies already in the market, and with many more sure to join, the commercial mettle is being grasped quickly. For example, with the removal of barriers to elective half-hourly settlement due in the early part of this year, Green Energy UK is already offering a business-as-usual, time-of-use tariff for domestic customers.

Energy regulator Ofgem has begun to consider the regulatory implications of such innovations, recently issuing a call for evidence on a smart and flexible energy system. This opens the door to potentially significant changes in

the rules, such as providing greater clarity on how storage is treated from a connection and charging perspective and introducing mandatory half-hourly settlement for all domestic and business customers. Should these changes come about, they could increase the commercial rewards derived from flexibility and help accelerate innovation.

BE BOLD

Flexible use of storage and demand response is fast becoming an integral part of the energy system. Utilities can no longer afford to adopt a wait-and-see policy. They need to focus on developing actionable commercial propositions that use flexibility-related products and services.

There is no playbook for these new business models. They are forming dynamically by way of commercial trial and error in the market. In an increasingly competitive environment, utilities must act with a boldness and creativity that pushes market boundaries. (See Exhibit 1.)

The market for offering flexibility services to relatively sophisticated large industrial and commercial customers is crowded, and margins are tight. A bigger opportunity may center on smaller commercial and domestic users. To take advantage of this, utilities should regard their regulatory obligations, such as the domestic smart meter rollout and mandatory half-hourly settlement of profile classes 5-8, as commercial opportunities. If they do not, others will jump ahead.

Success will call for a commitment on the part of the organization and a focus on a new way of doing things and for allowing new propositions to develop – and fail – quickly. This can be difficult for large incumbent utilities because of their traditional business models and cultural barriers to fast-paced commercial innovation.

CREATE AN INNOVATION ENVIRONMENT

To overcome these types of challenges, utilities must give thought to creating an environment that lets fresh ideas and new cultural approaches flourish, while maintaining a commercial focus.

Acquisition is not necessarily the answer. Many startups lose their way post-acquisition as they are shoehorned into a corporate framework that does not fit them. Moreover, this problem is compounded by the fact that many of the startups that are open to being acquired are often amenable because they find themselves in a position where they have taken their concept as far as it can go.

To mitigate these issues, utilities should consider making strategic investments in smaller businesses while setting out a clear

Changes transforming the UK energy system are creating a wealth of strategic and commercial opportunities for utilities

view of how the utility can offer a comparative advantage to assist in the startup's growth and development.

Alternatively, to develop capabilities organically, utilities should avoid simply setting up another vertical business unit within the organization. To create a fresh culture, the utility should consider establishing a startup under the corporate umbrella. The business should be allowed to hire new people and may benefit from being based in a different location.

The changes transforming the UK energy system are creating new strategic and commercial opportunities for utilities. To be sure, there are no guarantees for success. But the rewards that await those who act quickly and decisively could be great, while the risks and penalties for those utilities that wait and do nothing will likely be much greater.

Andrew Perry

is a London-based engagement manager in Oliver Wyman's Energy practice

This article first appeared in *Utility Week*

An aerial photograph of an airport runway and taxiway system. The runway is dark asphalt with white dashed lines. The taxiway is also dark asphalt with orange dashed lines. The surrounding area is a mix of green grass and brownish soil. In the background, there are large, green mountains under a blue sky with white clouds.

WHAT OIL AND GAS CAN LEARN FROM AVIATION

A new cyclical reality makes energy companies rethink operations

Bill Heath, Robert Peterson, David Marcontell, and Susie Scott

It's a transformative time for the oil and gas industry. OPEC production controls are unable so far to overcome a persistent oversupply. North American shale producers keep a cap on prices as they adjust output to capitalize on market peaks. And then, there are the growing risks to the oil and gas industry from a future less dependent on fossil fuels.

The new economic reality for oil and gas: While the cyclical lows may look the same, the swing back into good times is likely not to see prices exceed past highs or even come close to reaching them. For the foreseeable future, many analysts predict crude oil will not top \$60 a barrel, which means fewer profits and less money to plow back into asset-intensive operations.

Oil and gas executives are reacting appropriately to this new normal, seeking ways to maintain tighter reins on an industry that has always functioned like a federation of very independent states. While some of the larger industry members provide models for improving performance, the oil and gas industry also may want to consider reshaping some of its operations around a historically cyclical and volatile, asset-intensive industry with far tighter profit margins – the aviation industry.

GOING FOR OPERATIONAL TRANSPARENCY

Aviation's strategy has always been to provide its decision makers with optimal transparency into operations, to limit the number of surprises, and maximize the reaction time to problems and opportunities. Single-digit margins make even small mistakes costly, rendering visibility a critical factor in functions up and down the vertical.

To achieve this goal, airlines have three operational imperatives – standardization, centralization, and performance management – and they maintain rigorous

scorecards to ensure they meet and exceed their targets. These are the fundamental components that guide senior-level decision making. By contrast, oil and gas has struggled to implement these concepts across business units with any kind of consistency, and daily decision making is regularly pushed down the management chain where problem solving is based as much on individual style as it is on organizational objectives.

Standardization for airlines involves developing specifically defined processes and protocols that are followed across organizations. For instance, each component on every plane that is categorized as being safety critical requires stringently defined high levels of testing and mandated servicing and replacement schedules. These apply in every region, at every facility.

SETTING ENTERPRISE-WIDE STANDARDS

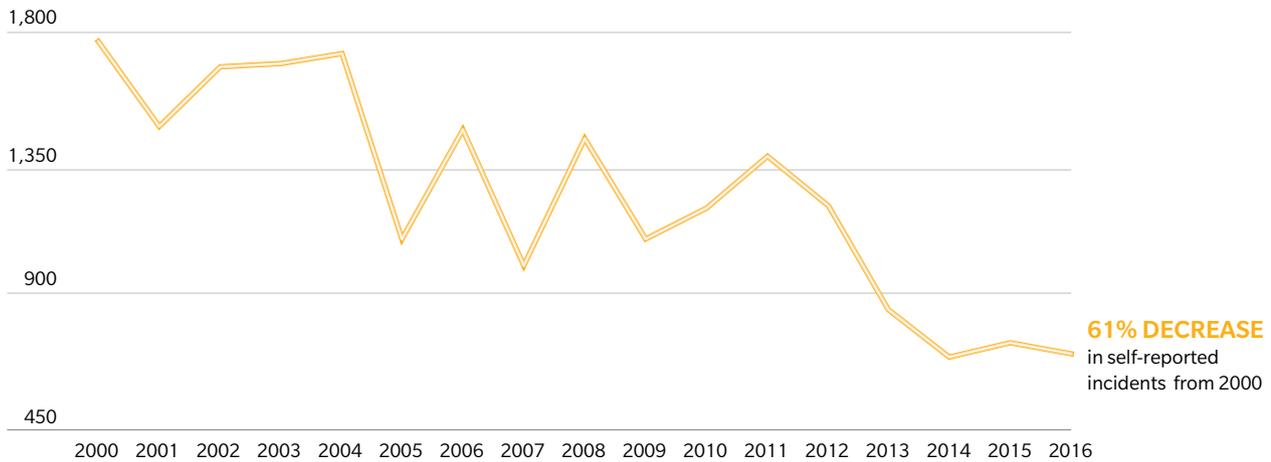
While oil and gas has a similar concern for safety and standards, relatively few industry-wide standards are consistently applied across organizations. Rig operators, for example, often set their own maintenance schedules and protocols. This means when a problem develops, headquarters executives do not always have transparency into the procedure that had been followed.

Standardization is critical, particularly when it comes to the collection of data. In order to construct an accurate view of the organization as a whole, as well as identify the outliers, it requires that information be collected using uniform definitions and similar criteria. Without it, organizations are apt to miss aberrational performance – good or bad.

Centralizing authority and oversight is another priority in aviation. This includes constructing systems that consolidate data. Each airline has a corporate maintenance control team, with access to aircraft data and drawings. These

EXHIBIT 1: AVIATION'S TIGHTER REINS RESULT IN DOWNWARD TREND IN AIRCRAFT INCIDENTS

After a rocky 1990s, airline efforts in standardization and centralization are making a difference in safety

AIRCRAFT INCIDENTS

Note: Based on incidents reported to the Aviation Safety Reporting System (ASRS) between 2000 and 2016 that resulted in aircraft damage, flights cancelled or delayed, maintenance actions, physical injury, or incapacitation, or evacuation

Source: ASRS, Oliver Wyman analysis

teams are tasked with making calls on requests to deviate from standards on maintenance or replacement. The goal here is to ensure that the same rigorous criteria are applied to deferring maintenance as to performing it. In oil and gas, such decisions are typically left to the judgment of local leaders.

ROLE OF THE REGULATORS

The emphasis on standardization and centralization in part is a byproduct of hawk-eyed national regulators, such as the Federal Aviation Administration (FAA) in the United States. These regulators often require a certain degree of transparency into a fleet's operations and mandate responses to certain risk scenarios.

After a rocky decade in the 1990s when airlines saw particularly rapid growth and an increase in the number of accidents, aviation – with encouragement from the FAA – looked

to overhaul its risk mitigation and safety management procedures. The goal was to become proactive rather than reactive, with an emphasis on such elements as maintenance procedures and reviews, and data collection and sharing. To help it develop new templates, aviation turned to the National Aeronautics and Space Administration (NASA) and the nuclear power industry for models – just as oil and gas might look to aviation today. (See Exhibit 1.)

Single-digit profit margins are an equally important motivation for aviation to get risk management right, as even small mistakes eat away at hard-won earnings. While airlines refer to the “safety window” – requirements set by regulators, which cannot be breached – they also maintain an “operations window.”

For instance, one airline may run tight crew scheduling and accept the risk that planes will be delayed; another will brand itself as punctual and invest differently. Even in

these different cost versus operational risk situations, decisions must be made on the basis of standardized principles and centralized decision making.

In the end, a lack of standardization and centralization in any industry can inhibit transparency and obstruct visibility into enterprise-wide functions. This almost always leads to less well-informed decisions and diminished performance.

Compare, for instance, what airline executives hear about their fleet during a day versus information flowing to oil and gas headquarters – and the reactions that information can trigger. If, for example, there have been several similar incidents involving hydraulic landing gear on Boeing 777s in Singapore, Dublin, and Riyadh, the corporate offices of the airline involved will know about all three, and will make sure that landing gear for every 777 in the fleet is checked. The aircraft may even need to be grounded until those checks have been completed, depending on the severity of the problem. Risk detected; risk addressed.

CATCHING SYSTEMIC RISKS

In contrast, an oil and gas company is unlikely to have a collective view on what's happening real-time on its hundreds of offshore wells scattered across the globe. In this case, systemic risks are only detected and addressed with difficulty and often only when events cause catastrophic failures, such as the blowout at the Macondo Prospect well in the Gulf of Mexico.

Operating data is the cornerstone for the strong performance management cultures in airlines. Using a cascading scorecard, leaders analyze the data in detail to understand where performance can be improved. Leaders also feel highly accountable for performance and will do what it takes to address issues.

Airlines maintain rigorous scorecards to make sure they meet or exceed their goals

In oil and gas, little of this attention to detail, centralization, and standardization can be found. Part of the reason for this is an assumption that every site or asset – each usually its own profit center – is unique. This leads to diverging maintenance regimes over time, which means there is no centralized control over how problems are addressed. And in the long run, that focus on individual operating units rather than the whole leads to sub-optimized performance management.

Ultimately, there is no better time to do this kind of review and overhaul than when an industry faces disruption. It is times like these when companies either take the reins on change or let external circumstances dictate their futures.

Bill Heath

is a London-based partner in Oliver Wyman's Energy practice

Robert Peterson

is a Houston-based partner in Oliver Wyman's Energy practice

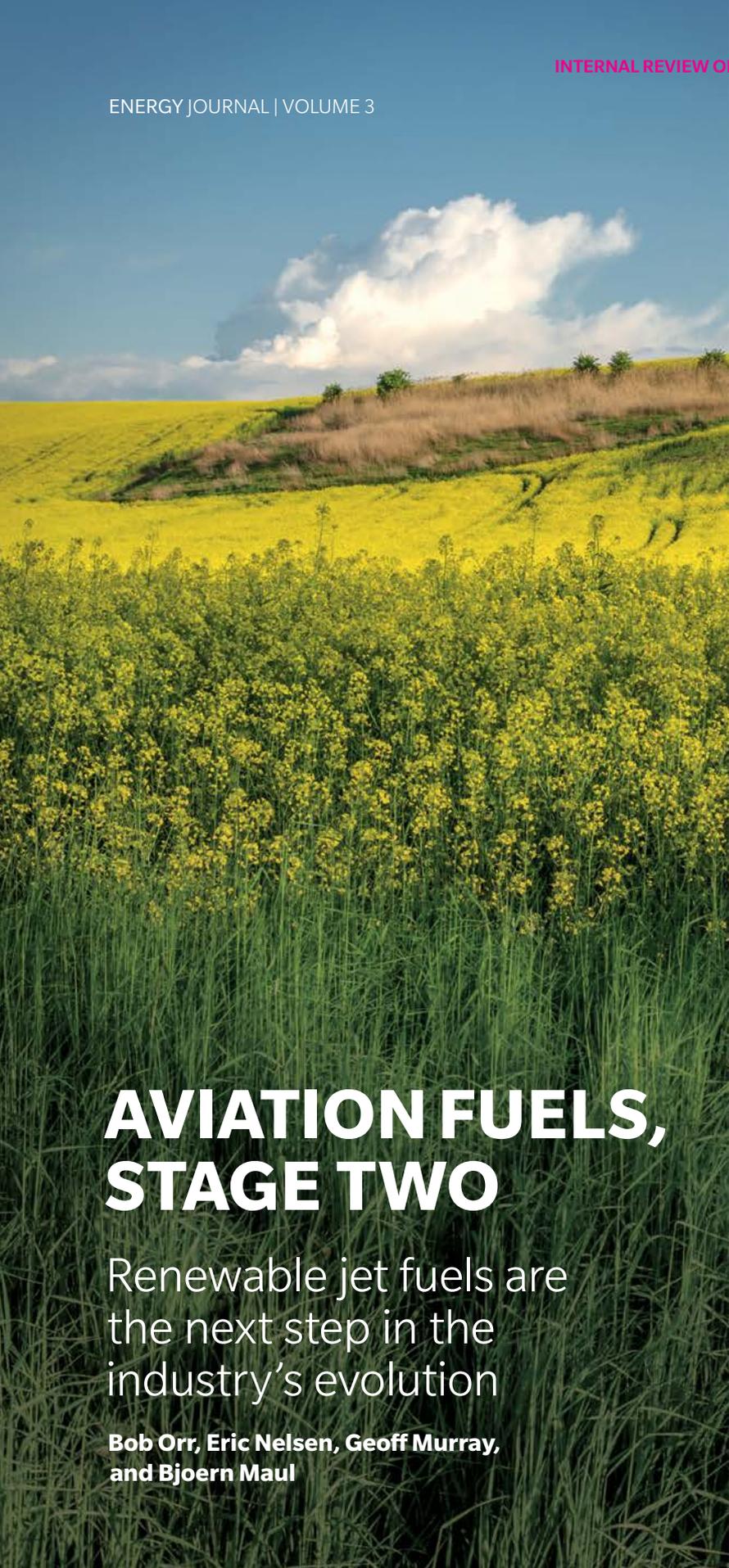
David Marcontell

is an Atlanta-based vice president in Oliver Wyman's Aviation, Aerospace, and Defense practice

Susie Scott

is a Houston-based principal in Oliver Wyman's Energy practice

This article first appeared in *Forbes*



AVIATION FUELS, STAGE TWO

Renewable jet fuels are the next step in the industry's evolution

**Bob Orr, Eric Nelsen, Geoff Murray,
and Bjoern Maul**

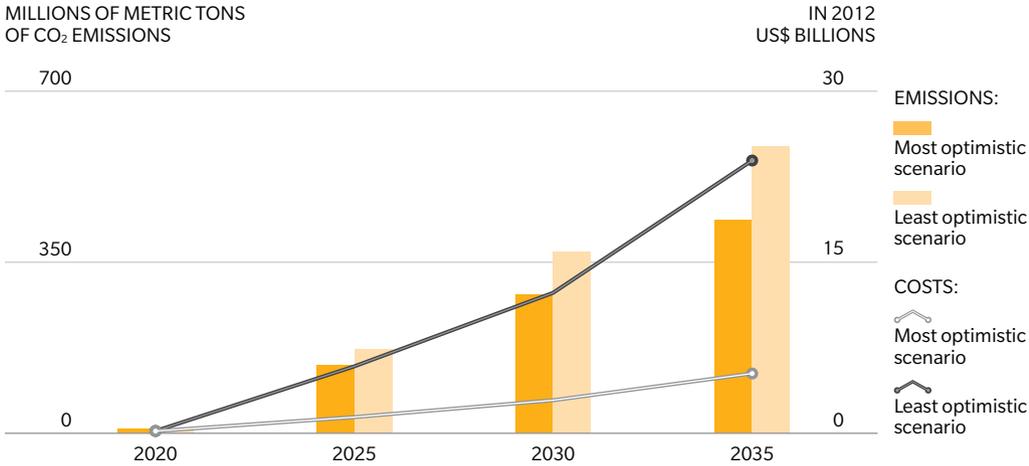
The aviation industry is one of the most advanced in terms of exploring options for reducing greenhouse gas emissions. Aviation contributes only about 2 percent of all human-produced carbon dioxide emissions – but that figure is set to rise, given that demand for air transport is expected to double by 2035. (See Exhibit 1.) To date, the industry has focused mainly on reducing overall fuel usage and improving fuel efficiency, such as through new plane technology and operational improvements. But further reducing greenhouse gas emissions – particularly in the face of new regulations set to come online in the next few years – may require the industry to take the next step: embracing renewable jet fuels.

Since 2009, five renewable jet fuels have been approved for use in aircraft. These are known as “drop-in” fuels: Much like the ethanol-gasoline mix used by cars, they are blended into conventional fuels for use in today's aircraft engines. A number of major airlines have tested renewable fuels, but high costs and commercial-scale availability are holding back widespread adoption. It's something of a chicken-and-egg problem: Biorefineries can't reduce costs and increase scale without a commitment from the airlines to buy the fuel.

What may finally get renewable jet fuels over the hump is regulation. In October 2016, the 191 member states of the International Civil Aviation Organization (ICAO) agreed to a new global market-based measure to support the twin goals of near-term carbon-neutral growth and long-term reduced carbon emissions. Sixty-six member states (including the US and China), representing nearly 87 percent of international aviation activity, will participate in the pilot phase of the program, beginning in 2021. Without renewable jet fuels, it is unlikely that airlines will be able to reduce emissions sufficiently to meet the requirements of this and other emissions regulation schemes that are set to go into effect.

EXHIBIT 1: THE GREENING OF AVIATION

Estimated aviation emissions to be offset, and the cost to achieve carbon-neutral growth from 2020



Note: The impact on aviation of offsetting costs for a global MBM scheme are expected to be much lower than fuel price volatility. The estimated offsetting cost for 2030 equals an extra US\$2.6 in jet fuel price per barrel, versus a standard deviation in jet fuel prices annually of nearly US\$40 per barrel over the past decade

Source: ICAO, Committee on Aviation Environmental Protection (CEAP)

Renewable jet fuels represent an opportunity for airlines to invest in their future. There are several ways they can get out ahead as regulation kickstarts demand: First, by starting now and gradually expanding renewable fuel commitments with biorefineries, they can rapidly drive improvements in fuel cost and availability. Second, they will need to work with airports and with planemakers to develop efficient fuel delivery mechanisms on the one hand and ensure engine requirements are met on the other. And finally, the industry should participate in and strongly encourage government funding of ongoing fuel research and development, with a focus on scalable low-cost feedstocks and increased refinery efficiency.

Airports also could realize an opportunity through the early adoption of renewable fuels. Developing airport-wide plans for sustainability

that include renewable fuel usage would allow an airport to differentiate itself from others as a “sustainable airport” and further local community sustainability goals.

Bob Orr

is a Houston-based partner in Oliver Wyman’s Energy practice

Eric Nelsen

is a Chicago-based partner in Oliver Wyman’s Energy practice

Geoff Murray

is a Chicago-based partner in Oliver Wyman’s Aviation practice

Bjoern Maul

is a Zurich-based partner in Oliver Wyman’s Aviation practice

This article first appeared in *Forbes*

ENERGY RECALIBRATED

Three ways to thrive in the new normal

Alexander Franke, Mark Pellerin, and Tim Thompson

Energy company economics are under attack. Companies are spending beyond their means, piling up excessive debt, and destroying shareholder value. Many have swung from operating with surplus cash, to making due with shortfalls. Balance sheets that once served as shock absorbers have been wiped out, risking the ability of many companies to perform for years to come.

Energy companies have come out on top of volatile boom-and-bust commodity cycles before by raising new capital, tearing up and renegotiating supplier contracts, reducing permanent headcounts, and temporarily cutting capital budgets and dividend programs. But this rout is different. It's been more than 24 months since West Texas Intermediate oil prices tumbled from a high of \$106 to a low of \$27 in the first quarter of 2016. And it's unlikely that prices will bounce back any time soon, even if OPEC pulls back on production.

So energy company executives need to go beyond their comfort zones to build up resilience in the extraordinary times they now operate in. The industry has been recalibrated. Now companies need to revamp in order to continue to thrive in it. Here are three ideas for steps to start with:

Stop throwing good money after bad projects. Find creative ways to free up capital. Reexamine strategic and financial plans. Tighten working capital and shed non-core assets that can be operated without needing to be owned.

Swap financial for operational risks. Focus on becoming efficient, reliable, and profitable operations. Don't grow your oil reserves to provide shareholders exposure to the underlying commodity when it is no longer valued by banks and rating agencies. Explore physical and financial ways to

optimize your supply chain, and take advantage of the fact that the forward price of oil is now higher than the spot price to boost returns.

Reconsider hedging. Stable performance is especially valuable now that most energy companies are operating with razor-thin margins for error. When capital buffers are depleted, use hedges to survive, recover, sustain, and grow long term. Use proprietary information to both dampen the downside (similar to buying insurance), and tap into the asymmetric upside that could result with an unexpected oil price rally.

Volatility doesn't always need to imply vulnerability. But it will for those companies that remain high-cost producers stuck in the past. Instead, energy companies owe it to themselves to manage risk more proactively, take action, and embrace tough decisions – as well as to the industries and consumers that count on them.

Alexander Franke

is a Zurich-based partner in Oliver Wyman's Energy practice

Mark Pellerin

is New York-based partner in Oliver Wyman's Energy practice

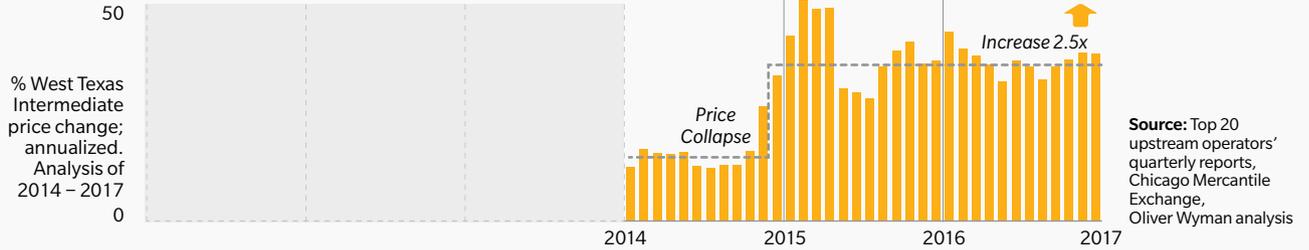
Tim Thompson

is a Calgary-based principal in Oliver Wyman's Energy practice

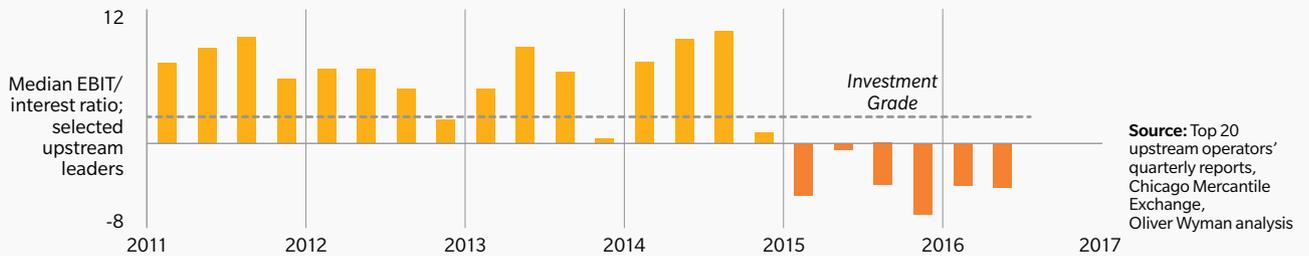
This article first appeared in *BRINK*

ENERGY'S NEW NORMAL

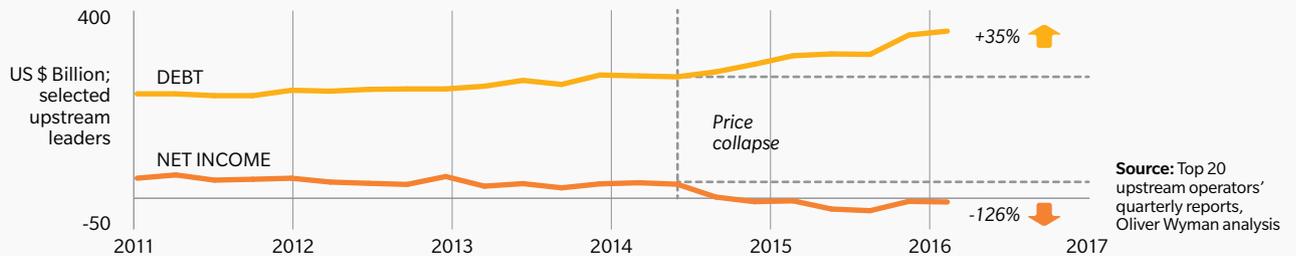
VOLATILITY IS HERE TO STAY...



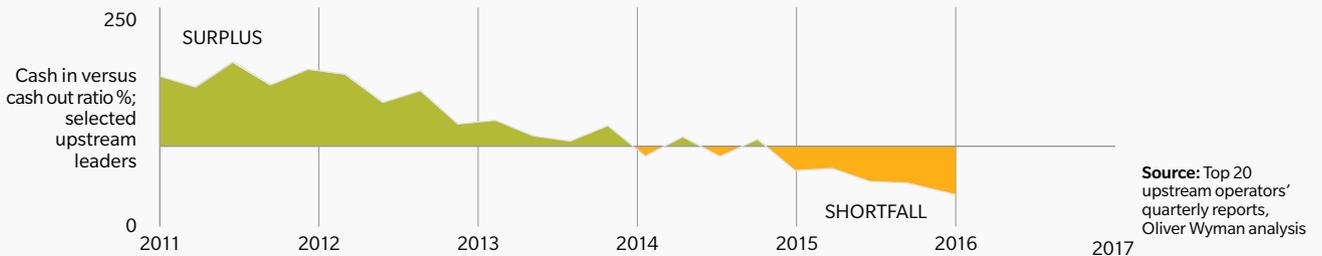
...BUT EVEN THE ENERGY INDUSTRY'S LEADERS CAN'T AFFORD IT.



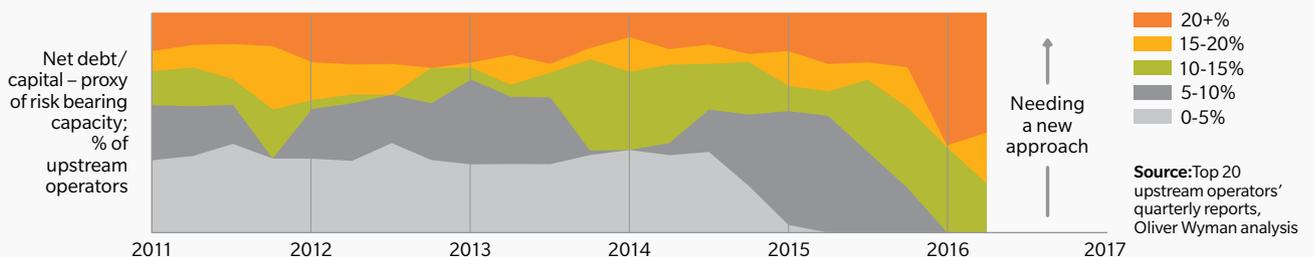
COMPANIES ARE PILING UP DEBT EVEN AS THEIR EARNINGS DECLINE...



...AND THEY CONTINUE TO SPEND BEYOND THEIR MEANS...



...HARMING THE BALANCE SHEETS OF EVERY ENERGY INDUSTRY PLAYER.







WHEN NATIONS NEED TO GO BEYOND OIL

Gulf states put new emphasis on growing local industries

Bruno Sousa, Volker Weber, Saji Sam, and Bernhard Hartmann

There's a certain symbolism in the role South Korea has taken on in helping the United Arab Emirates launch its nuclear power industry. South Korea – a relative newcomer to nuclear power compared to bigger rivals like the United States, Japan, or France – grew its own industry from the ground up in order to cut energy costs, create new jobs at home, and boost domestic growth.

Today, a Korean consortium led by state-owned electric utility Korea Electric Power Company (KEPCO), is working with the UAE and its Emirates Nuclear Energy Corporation (ENEC) to do the same thing. The joint Korean and ENEC team is building four facilities in western Abu Dhabi with the help of local labor and companies, part of the Emirates own localization efforts to increase its industrial base and employment and generate more electricity to power the nation's economic growth moving forward. The first reactor in Barakah is scheduled to be completed in 2017; the other three are slated for 2020.

THE PRESSING NECESSITY TO LOCALIZE

The need has never been greater for Gulf region nations like the UAE to decrease their dependence on oil and gas as commodities and broaden the industrial base of their economies. With the decline in crude oil prices over the past two years, some of the richest Gulf nations are experiencing budget deficits and unemployment for the first time in decades. But almost all major oil producing nations – from Venezuela, to Indonesia – are under pressure from their constituents to expand their manufacturing sectors, create more good-paying jobs, and increase local content across their oil and gas value chain.

But, it's not easy. In the past, well-intentioned efforts to increase local production often have been fraught with problems and disappointments, as economies overreach to score big results over a short period or fail to take into consideration the skill level and readiness of their workforce and local supply chain. In the Middle East, governments have built massive state-of-the-art manufacturing facilities, only to find they had to import workers to staff them – undermining both their security and the goal of providing jobs to their own citizens.

EXHIBIT 1: TRYING FOR A BIGGER ECONOMIC PAYBACK FROM ENERGY:
Nations globally are pushing producers for more local content and jobs

EUROPE	AFRICA	MIDDLE EAST	ASIA	AMERICAS
<p>NORWAY</p> <p>50% of research and development in oil and gas has to be done in Norway</p> <p>80% achieved local content through procurement policies</p> <p>Considered among the best localization efforts, Norway developed into a major export center for oil and gas equipment.</p>	<p>NIGERIA</p> <p>95 to 100% local talent, as required by Nigerian Oil and Gas Industry Content Development Act</p> <p>In 2010, Nigeria passed a law giving preference to local businesses and workers and allowing the government to consider local content when evaluating bids.</p>	<p>SAUDI ARABIA</p> <p>75% local content by 2030 in oil and gas industry</p> <p>As part of a broader Saudi initiative, Saudi Aramco is using procurement policies to encourage suppliers to increase local content sustainability.</p>	<p>SOUTH KOREA</p> <p>80 to 95% local content for new construction in the country's nuclear industry</p> <p>70% the amount Korea plans to increase its nuclear capacity by 2029</p> <p>Nuclear power is a strategic priority for Korea because it imports so much of its energy needs.</p>	<p>BRAZIL</p> <p>70% local content in oil exploration phase required</p> <p>75% in production phase</p> <p>90% production aimed for in 2020</p> <p>Foreign investors must invest one percent of each oil field's revenue into energy research and development.</p>
<p>POLAND</p> <p>30% local content target for new nuclear construction</p> <p>Poland is trying to move away from coal and build a nuclear reactor, but the first project has been delayed.</p>	<p>SOUTH AFRICA</p> <p>61% local content for national energy utility</p> <p>52% for new builds</p> <p>South Africa through Eskom promotes local content creation, using it as one of the key procurement criteria for new projects and regular spend.</p>	<p>OMAN</p> <p>90% of workforce should be Omani in oil and gas industry</p> <p>32% the amount the government wants to increase the oil and gas sector's contribution to the Omani economy by 2020.</p>	<p>INDONESIA</p> <p>45% for offshore oil and gas operations; 70% for oil and gas production on land</p> <p>30% on nuclear construction</p> <p>Indonesia's local content law says preference must be given to citizens for jobs, and oil and gas companies are required to prioritize local goods, which are given price preferences.</p>	

Source: Oliver Wyman analysis, Saudi Vision 2030, ANP, PROMINP, Eskom, IPIECA, Global Local Content Council, World Nuclear Association, and published reports

Even localization projects considered success stories, such as the one undertaken by the Norwegians after the discovery of offshore oil deposits in 1969, can and do take decades to achieve their goals. Norway's effort, which took more than 15 years, is not even typical, as that nation's economy was already relatively prosperous before it started developing its oil and gas resources. Most oil-producing economies are more dependent on oil and gas revenue than Norway ever has been. (See Exhibit 1.)

USING OIL AND GAS PROCUREMENT AS A LEVER

Still, Norway serves as a model for helping nations ensure that the development of oil and gas leads to an expansion of local industry and employment. In Norway's case, the focus was on working with international oil companies (IOCs) to develop the oil and gas value chain and guarantee the transfer of knowledge and technology through agreements. The Norwegians achieved import substitution by requiring IOCs to use 50 percent local content to supply their operations, and the nation mandated that research and development should be conducted in Norwegian facilities.

Norway's approach also was based on developing local companies in fields that supported the oil and gas industry. For instance, the Norwegians focused on their upstream oil and gas sector by developing enterprises that made offshore oilfield drilling equipment and other related equipment. Eventually, the nation became a major export center for these upstream capabilities.

Saudi Aramco, Saudi Arabia's national oil company, is following the Norwegian example to a certain degree by using its massive clout as a

Norway developed local companies in fields that supported the oil and gas industry

purchaser of oil and gas equipment and support services. Aramco is incentivizing its suppliers to increase the amount of local content by making it one of the procurement criteria by which it assesses bids. The company provides a 10 percent premium for local content.

HELPING SUPPLIERS MEET LOCAL CONTENT GOALS

Aramco has set clear objectives and targets for major projects. It even provided its planned spend per category for the next five years to help suppliers justify the investment necessary to localize production and services. The Norwegian initiative eventually was able to increase local content in the oil and gas industry to 80 percent – a goal the Saudis hope to replicate.

Over the next several years, the goal of the Saudi Aramco program is to double the percentage of local content to 70 percent. It also hopes to create 500,000 jobs and raise the export contribution from the initiative to 30 percent.

Saudi Arabia is working to tighten connections between training and job creation and develop key performance indicators to measure success

500,000

The number of jobs that Saudi Aramco hopes to create

through a program called the In-Kingdom Total Value Add program (IKTVA). The IKTVA program is designed to measure and monitor the “added-value” to the Kingdom from a supplier, reviewing such items as the value of local goods and services used, salaries paid to local citizens, and the amount spent on training and development.

PRODUCING SUSTAINABLE GAINS

As in the case of Norway, the use of procurement as a lever is producing immediate and sustainable results for Saudi Arabia. Siemens recently completed the first “Made in the KSA” gas turbine at the company’s Dammam Energy Hub, the first gas turbine plant in the Kingdom and the largest in the Gulf Cooperation Council (GCC). Additionally, Siemens committed to help develop a vocational education and training program, working with the Saudi Colleges of Excellence. The program may prove particularly useful, given the results of a recent survey of oil and gas country and project managers that identified the lack of competent labor as a key barrier to effective localization programs.

Currently, the agreement with Siemens focuses on the development of technicians and business administration graduates. These types of positions are likely to be attractive to locals and were identified by the industry survey as critical needs.

Eventually, the government may want to consider extending this agreement or establishing another with a different supplier to develop the kind of blue-collar skills, such as welding, needed in manufacturing and construction. This would further align talent development initiatives with creating sufficient, sustainable jobs, as these skilled blue-collar jobs tend to be more plentiful in most projects than managerial positions.

INVESTING IN MODERNIZATION

Saudi Arabia and Siemens also negotiated research and development agreements to collaborate on the expansion of renewable energy and the digitization of the oil and gas industry. The investment here helps Saudi Arabia diversify beyond fossil fuels and will allow its dominant industry to compete more effectively, by bringing in cloud technology and advanced analytics.

The Saudi Aramco effort is backed by a larger KSA localization campaign detailed in the Kingdom’s ambitious Vision 2030 economic initiative. Among its broader goals: to create a \$2 trillion investment fund to finance economic diversification; transform Aramco into a global

industrial conglomerate; and establish the Kingdom as a trade hub connecting Asia, Europe, and Africa.

Another pledge is to expand the country's military industrial complex, so that half of its future defense industry purchases will be fulfilled with Saudi domestic production. Similar to the more targeted Aramco project, Saudi Arabia's goal in Vision 2030 is to increase the localization of oil and gas sectors from 40 percent, to 75 percent by 2030.

ATTRIBUTES OF A SUCCESSFUL INITIATIVE

So what are the characteristics of a successful localization campaign? While every country has its own spin on localization initiatives, there are a few attributes that distinguish the ones most likely to produce results. First, it's important that localization plans are centralized and coordinated on both the country level and the operator level. They also must be staged over time to ensure successful technology transfer and adequate preparedness of the workforce and local supply chain.

Localization efforts must be sustainable and reflective of the current state of the national industry and the economy. Initiatives are not free, usually requiring a large investment by the government or foreign investors in such items as the purchase of technology rights.

Embedding localization mandates into procurement and human resources provides mechanisms for implementation. To be successful, they also require strong

government commitment, and they must be standardized and able to be replicated.

Finally, everything must be measurable. To ensure sustainability, governments and companies must be able to demonstrate progress to its citizens and customers.

At the end of the day, economic development is never easy, particularly when it involves reducing an addiction to a resource once considered to be a limitless source of wealth and growth. But gradually, various countries are developing the best practices that will eventually allow the Gulf region nations and others to realize localization goals.

Bruno Sousa

is a Dubai-based principal in Oliver Wyman's Energy practice

Volker Weber

is a Dubai-based partner in Oliver Wyman's Energy practice

Saji Sam

is a Dubai-based partner in Oliver Wyman's Energy practice

Bernhard Hartmann

is a Dubai-based partner in Oliver Wyman's Energy practice

This article first appeared in the *Middle East Economic Survey*



DIGITIZATION

The Gas Station's Digital Future
Is Around the Corner

Reimagining Commodity Trading

How Utilities Are Using Blockchain
to Modernize the Grid

Digital Electricity





THE GAS STATION'S DIGITAL FUTURE IS AROUND THE CORNER

Self-driving autos, mobile apps, and connected vehicles disrupt oil and gas' retail business

Irfan Bidiwala and Eric Nelsen

Can you picture a day when you never have to pump gasoline at all at the service station? You won't even have to get out of the car. It's not because they've hired more gas station attendants. It's because the pump and the car can communicate with each other, work together to select your preferred fuel, and fill the tank without the driver being involved. Like gliding through E-ZPass, you'd be paying with a cloud-connected app that, by then, may be standard on most autos.

If your vehicle is self-driving, you should be able to be happily ensconced in your bed or at your computer while your car buys the gas without you even being there.

A NEW RELATIONSHIP WITH THE AUTOMOBILE

This is the future for service stations and gasoline consumers. Today, comparison apps may seem high-tech for your neighborhood favorite, but within the next decade or two, the gas station around the corner will likely be serving everything from hybrids, to autonomous cars, to electric vehicles, to car shares – and selling them a lot more than just regular and premium.

Like so many industries disrupted and transformed by technology, the iconic gas station will soon undergo what will be a pretty substantial digital makeover that connects it not just to the consumer but the car itself. It's not one trend pushing the change; it's a multitude of disruptions that are overhauling our relationship with the auto and the way gasoline is sold. And with all these things in transition, the business model for the service station must ultimately begin to reflect the new reality.

Gasoline demand has begun to decline in more mature economies and will probably continue to, as a growing number of people don't dream of owning a car the way previous generations did. According to the US Census, the number of no-car households increased slightly in 2015, perhaps in part because more people want to live in cities, and of course the well-documented lack of interest in car ownership among millennials.



APP-ENABLED ON-DEMAND FUELING

The gas station that comes to you at your house or wherever



EVOLVING CONSUMER SEGMENTS

The digital evolution of the auto influenced by new technology and a sharing economy



MODERNIZED STATIONS WITH UNIQUE SERVICES

Making a digitally enabled gas station into your personal concierge



CONNECTED CARS

“Smart” next-generation autos with constant connection to the cloud



SELF-DRIVING AUTOS

Cars that take themselves to the gas station and fuel up



DIVERSITY IN THE FUEL OFFERING

The challenge serving conventional cars, electric cars, driverless cars, and people with no cars



PERSONALIZED FUEL MIX

Ability to custom-mix additives to create your own fuel



MOBILE AND SMART-CAR APPS

Enhanced selection and seamless interaction between customer and site



ANALYTICS AND ON-SITE MARKETING

Developing customized promotions for individual customers



AUTOMATED FUELING AND PAYMENT

No need to leave the vehicle with connected, self-driving cars

Source: Oliver Wyman analysis

COOL SERVICES, A VARIETY OF FUELS

The gas station of, say, 2030 will not only have to do things differently; it will have to do different things to be profitable. For instance, one futuristic vision is to have short-distance drones deliver pre-ordered snacks or packages while the driver waits in the car.

The gas station of the future is going to have to mirror the diversity of its clientele. Given the rising popularity of hybrids and electric cars like Tesla, perhaps the gas station will have to consider having charging stations, as some now do in Europe. Or perhaps the demand is for compressed natural gas or liquefied petroleum gas. Already, gasoline and diesel generate less than 30 percent of the profits at the average gas station, and that figure may continue to decline, not necessarily from low demand but because the gas station is selling so many other services and products.

Of course, we're used to the convenience store aspect of gas stations, changing them into personal fueling stations – and that service is expected to become more ubiquitous and more sophisticated over time. But the gas station also will likely be a place where you can pick up your order from Amazon after it was delivered to the station by drone. Or maybe you pick up groceries that you ordered or your dry cleaning. In essence, your gas station becomes a giant post office box or a personal concierge – a convenient one-stop shop for the sharing economy as it blossoms.

2 A.M. GASOLINE CALLS

The change may go beyond the services the station offers; it may involve when it offers them. The busiest time for the gas station of 2035 may be at 2 a.m., when autonomous driving cars are programmed to take themselves to the station to fill up for the next morning's drive to the office.

The transactions may not even take place at the service station as on-demand fuel services begin to pop up. With an app, consumers can type in their order and have it delivered to their office parking lot or their driveway.

Stations also will deal with more wholesale purchasers, as car-sharing services like Lyft and Uber grow. Rather than

sell to individual drivers, service-station franchises may only maintain long-term contracts with the companies that employ drivers. Manufacturers of autonomous autos also may decide to develop long-term fuel programs for their buyers.

ANTICIPATING THE FUTURE

While the potentially painful disruption is not entirely welcome news for the legions of independent gas stations and their owners, it represents an opportunity for early adopters, ready to embrace and anticipate change. Already, we're seeing service stations experiment with predictive analytics and other technology-driven innovations like mobile payment. For instance, one US convenience store-gas station chain is cutting gas prices by up to 10 cents per gallon for customers paying via app-enabled direct debit.

By 2022, cars are expected to have enough internet connectivity to allow drivers to simply ask their cars for recommendations on where to go for gas and then rely on the car to seamlessly pay for it. In the United Kingdom, Jaguar and Shell are piloting advanced capabilities for site interaction with such web-enabled vehicles.

The digital revolution has already compressed product cycles and brought disruptive innovation to a range of industries. Like it or not, the traditionally conservative gasoline industry appears to be among its next targets. What's not clear is which enterprises will be early movers and which will go the way of the drive-in movie.

Irfan Bidiwala

is a Houston-based partner in Oliver Wyman's Energy practice

Eric Nelsen

is a Chicago-based partner in Oliver Wyman's Energy practice

Alex Kirov, Tom Shyr, and Bryan Yamhure Sepúlveda contributed to this article and the research it's based on

This article first appeared in *Forbes*



REIMAGINING COMMODITY TRADING

A new breed of commodity-trading titans and digital contenders are about to reorder the industry

**Alexander Franke, Christian Lins,
Roland Rechtsteiner, and Graham Sharp**

Over the past year, the gulf between high-performing commodity traders and weaker players has been widening. Big oil traders such as Trafigura, Glencore, BP, and Shell Trading racked up record trading results. At the same time, smaller oil traders and players in other weaker-performing commodity classes stagnated or declined. Meanwhile, new digital entrants in the power sector signaled sweeping change in the next decade, as legacy commodity traders began to rethink the impact of digitization and a greater degree of electrification on their vaunted trading operations. Apple and Google, for instance, have subsidiaries that are registered energy wholesalers in the United States. The German tech firm United Internet has also launched a new business, aiming to trade and market energy and energy services.

The commodity trading industry is about to be reordered – again. The market is sending a powerful message that the industry will be divided into three divergent camps – a core of sophisticated, competitive global traders versus smaller traders and new digital contenders. The number of traders will shrink, and survivors will need to proactively rethink traders’ roles as digitization radically reshapes the industry.

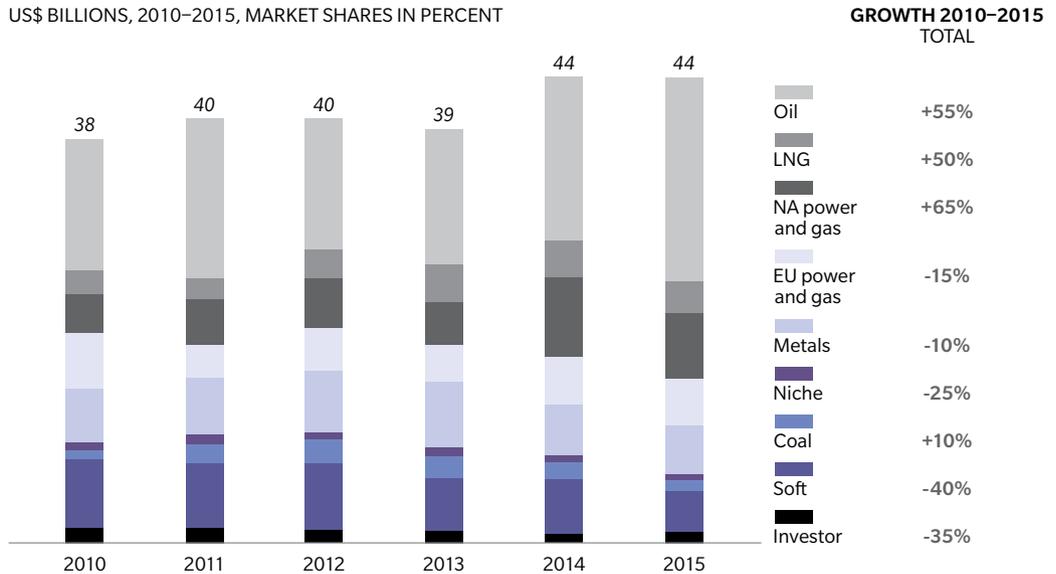
What has set the consolidation of commodity trading on fast-forward is the fact that the industry’s gross margin growth is flat-lining around \$44 billion. (See Exhibit 1.) While oil traders stormed ahead, thanks to low, volatile spot prices that created cash-and-carry trading opportunities, traders in other asset classes, such as European power and gas, were hurt as renewable power gained ground and changed the market structure unfavorably.



EXHIBIT 1: COMMODITY TRADING MARGINS BY THE NUMBERS

The gross margins of traders in oil, natural gas, and North American power and gas are improving, but traders in other asset classes are struggling

US\$ BILLIONS, 2010–2015, MARKET SHARES IN PERCENT



Notes: Sum of products may not equal to total due to rounding; significance of shift overstated in graphic due to rounding; niche consists of emissions, Asia power, and gas and exotics (weather)

Source: Oliver Wyman proprietary data and analysis

As a result, as we predicted in last year’s report (“The Industrialization of Commodity Trading”) it’s the large commodity traders who are thriving in the current lower-margin environment. By streamlining middle- and back-office operations, integrating trading and origination capabilities closely, and taking advantage of analytics provided by artificial intelligence systems, a core set of traders are now world class in speed and flexibility.

With these gains accelerating, the leaders of the commodity trading pack are raising the bar for the industry. They are setting a new world standard for commodity trading efficiency that

will force even the largest players to further expand their trading networks in order to harvest volatility better, while squeezing more efficiency from their operations. At the same time, these trading giants are deepening their relationships with existing customers and rounding out their portfolios by winning over new ones, including the growing number of customers starting to produce electricity. Consider:

QUEST FOR SCALE

The stakes for trading hydrocarbons are rapidly rising. The trading volume of oil and refined products handled by leading independent commodity traders is catching up to the asset-backed majors. Major asset-backed traders trade 5 million to 10 million barrels of oil per

\$44 billion

The commodity trading industry's total gross margins

day. In 2015, independent commodity traders traded more than 4 million barrels per day on average, about 30 percent more than they traded in 2010. Independent traders are also trading much more liquefied natural gas.

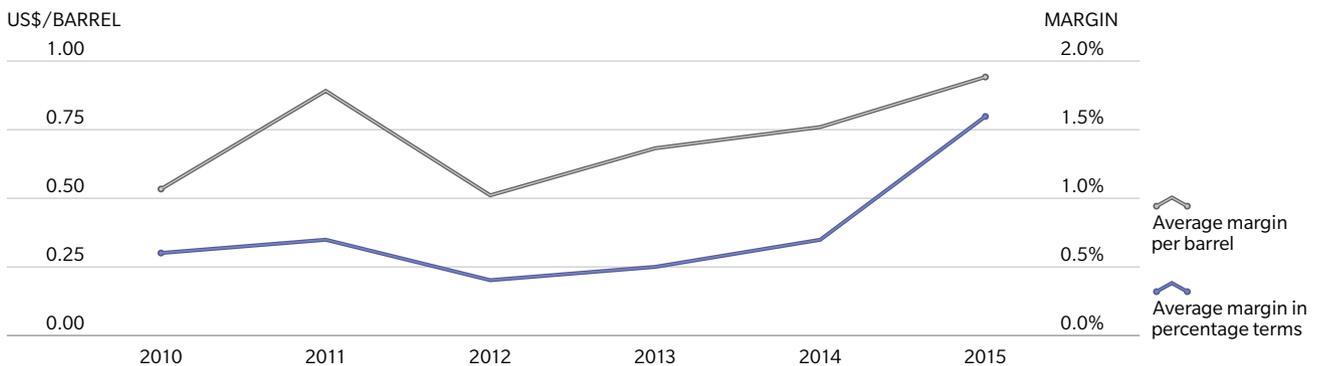
Thanks to their current rate of expansion, large independent traders are racking up gross margins comparable to those of large asset-backed majors. To some degree, these greater margins reflect windfall gains, as oil's forward price has been higher than its spot price. But the bigger reason is that large independent traders have built up massive portfolios, which let them take advantage of volatility across interconnected commodity

markets and move into new commodities and geographies. (See Exhibit 2.)

The big players will likely only become bigger. In the past, large independent traders had to increase their reach by leasing more tanks and monetizing market volatility with minimal material working constraints. But in 2015, they derived most of their profitability from strategic deals struck with commodity producers that expanded their global reach and diversified their customer base. This development along with new forms of financing – backed by

EXHIBIT 2: DRIVEN BY LOWER OIL PRICES AND FAVORABLE MARKET CONDITIONS, OIL PRICES ARE DOWN, BUT GROSS TRADING MARGINS ARE UP

Gross margins per barrel of large physical oil and refined products have tripled over the past two years, reaching higher absolute levels than at their 2011 peak



Source: Oliver Wyman analysis based on publicly available data

external sponsors, such as private equity or sovereign wealth funds, for both independent traders and their counterparties – gives independent commodity trading leaders the financial might to move into even more new businesses.

COMMERCIAL EFFECTIVENESS

Leading commodity traders are moving toward metamorphosing into leaner, nimbler organizations. Many traders have gone through multiple rounds of workflow streamlining. Now, the industry's leaders want to respond even faster to opportunities and changing market conditions by automating processes and shortening reporting lines. As in banking, commodity traders are exploring the use of automation to reduce repetitive and time-consuming workloads.

At the same time, retiring senior staff and trading veterans are being replaced by junior staff trained in-house, instead of expensive rainmakers recruited externally. At this point, many junior staff members have gone through in-house graduate and mid-entry level programs for traders and support functions. So commodity traders are increasingly only hiring externally when knowledge of a specific asset class or region is required.

DIGITIZATION

Farther down the road, traders foresee a world in which artificially intelligent automation within defined systems will become the norm and make more of the routine decisions. Determining delta-hedging positions, managing fleets of vessels, optimizing credit risk, aggregating internal and external intelligence on cash flows, and even making freight decisions accounting for cargo flows in relation to the market, weather, congestion,

and other factors will soon all be assisted by machines as often as by man.

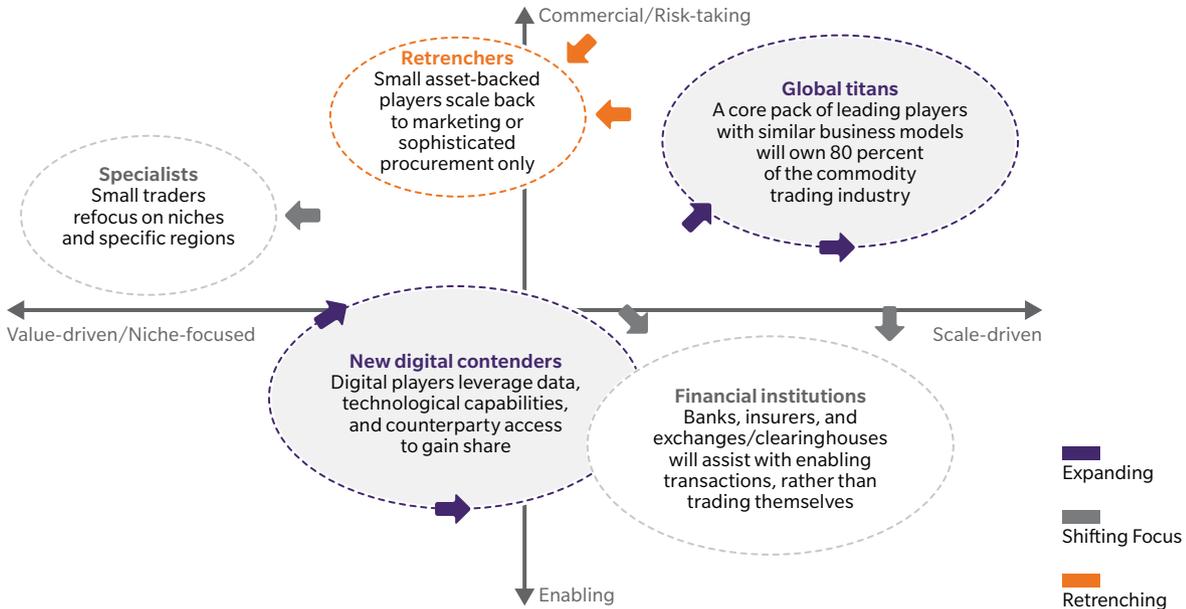
They will also likely experiment with distributed ledger and smart contract technologies to redraw their middle- and back-office operations, following in the footsteps of financial institutions. In spite of the physical nature of commodity trading, a new wave of productivity gains will come from applying intelligent algorithms to tasks such as processing letters of credit, determining warehousing, and chartering vessels.

CUSTOMER CENTRICITY

Major trading houses are refining their approach to customer service so as to capture recurring business from a fragmented base of customers. Commodity traders have focused on offering tailored services, such as supplying commodities, managing projects, financing, and operating facilities to companies. In electricity markets, they are beginning to need to figure out new ways to service customers that both produce and consume energy.

To succeed, major traders will have to discover new efficient ways to service a bigger and more fragmented customer base. Traders recognize the need to move beyond arm's-length transactions arranged on Instant Messenger in order to obtain structural positions that will yield stable margins and tradable market intelligence on a regular basis. But offering the same level of service to consumers as they do to companies with larger bulk businesses on a 24/7 basis is very costly. So major traders have begun to deploy new technologies in addition to investing in customer servicing arms.

EXHIBIT 3: THE COMMODITY TRADING MARKET BEYOND 2025
 The commodity trading industry will fall into three divergent camps: global titans, new digital contenders, and a range of smaller players



Source: Oliver Wyman analysis

COMMODITY TRADING BEYOND 2025

As major asset-backed and independent trading houses continue to charge ahead, these global titans will forge a new market structure alongside new digital contenders who will seize electrification and data-driven opportunities to act as catalysts for even more change. (See Exhibit 3.)

The revamping of the industry’s incumbents combined with the entrance of these new market participants will force other players to rethink their future in the commodity trading space. Financial institutions, such as banks, insurance companies, and clearinghouses will need to focus first and foremost on servicing commodity traders. Other traders

will also have to specialize and focus on niche segments where they can sustain a competitive advantage or adopt entirely different strategies.

GLOBAL TITANS

The new breed of a commodity-trading titan will manage both wholly and partly owned assets around the world. And it will deploy digital solutions as much as possible, leading to a bifurcation of human capital in the front office, as artificial intelligence assumes a greater role and middle- and back-office operations become much leaner.

A new wave of productivity gains will come from applying intelligent algorithms to tasks

Vastly fewer people will be required, compared to today's standards, because artificially intelligent systems will manage the bulk of volume. People will oversee, stress test, and maintain automated risk management systems and physical operations. Even proprietary-trading strategies – both financial and physical – will be semi-automated, with a small team of traders, analysts, and data scientists steering, approving, managing, and programming underlying algorithms. As a result, employees will focus more on structuring non-vanilla deals and managing a multitude of relationships with stakeholders.

Global titans will continue to focus on securing outlets, such as refineries for crude and retail chains for fossil fuels in developing economies such as India and Indonesia. But over time, these giants' asset-backed trading portfolios will expand to become a global energy ecosystem with a multitude of private and public sector stakeholders. Trading and recycling plastics will also play a bigger role in their portfolios as the importance of hydrocarbons in transportation fuels declines in the developed world and more liquid spot and forward markets for olefins and polymers develop.

As they expand into more commodities, these global titans will also begin to look more alike. Services related to renewable generation will contribute materially to revenue. Even players with a non-utility background will sooner or later strike new deals or partnerships to optimize the renewable energy produced by utilities and from rooftops.

They will also begin to manage and originate trades like technology-backed ventures that will involve greater complexity. Bread-and-butter bulk-trading strategies will take a back seat to higher-margin customized businesses. Simpler trading operations and interactions with customers, such as fuel-only retail outlets in emerging markets, will become a lower priority.

THE NEW NIMBLE DIGITAL CONTENDERS

At the other end of the spectrum, an army of new low-cost digital contenders will own a greater share of the industry's traditional commodity trades. As commodity trading becomes more automated and energy consumption more homogeneous and electric, global online platform providers like Amazon and Alibaba, transportation providers like Uber, information aggregators like Google and Baidu, and even telecom service providers and technology conglomerates will all leverage their own energy consumption.

In an energy-abundant, more electrified world in which market intelligence is at least as important as capital, these players run by a younger generation will outmaneuver many commodity trading veterans unwilling to change. By subsidizing energy with revenue from their many other services and charging subscription fees, these new digital contenders will sell power for much less. They will also monetize valuable proprietary intelligence from customers ranging from households to electric vehicles to companies. By offering

reliable power in emerging markets, they will also quickly roll out a large portfolio of digital services, such as advertisement payment services.

SMALLER TRADERS AND BANKS

Other market participants' roles will need to be redefined. Smaller independent traders will need to specialize – and dominate – niche markets such as petrochemicals and renewables.

Meanwhile, banks and other financial institutions will need to refocus on assisting commodity traders. The combination of highly efficient commodity trading goliaths and rising regulatory pressures have raised the stakes to the point that it is close to impossible for banks to return back to physical trading. Instead, they should help existing players by showing the way for them to digitize the financial aspects of their businesses. By pioneering blockchain technologies for commodity finance purposes and smart contracts to facilitate inspections and warehousing, experienced financial institutions can build a partnering platform with existing market participants.

CONCLUSION

As trading margins in developed markets stagnate, it remains unclear which type of player will determine the energy landscape of the future. Traders that can tailor service offerings to specific markets at vastly different stages of development are the mostly likely to succeed in a new energy ecosystem, especially in new frontier markets. But global titans will have to cope with a greater degree of service complexity than ever before, extending from

arranging financing packages from third parties such as private equity, sovereign, and international development funds, to cash-flow-based lending, to waste management services for feedstock for biogas facilities.

It is no longer a question of whether large commodity traders will have to digitize and transform into players within a greater cross-industry, cross-commodity energy ecosystem, but rather when and who the winners and losers will be. The broad outline for how the commodity trading industry will evolve over the next decade or so is apparent. Now, it's up to commodity trading titans to proactively embrace change and for new digital contenders to discover ways to fit into and profit in an industry with well-established players as it goes through what is likely to be the most profound transition in its history.

Alexander Franke

is a Zürich-based partner in Oliver Wyman's Energy practice

Christian Lins

is a Zürich-based principal in Oliver Wyman's Energy practice

Roland Rechsteiner

is a Zürich-based partner in Oliver Wyman's Energy practice

Graham Sharp

is a senior advisor to Oliver Wyman

Ernst Frankl, a Frankfurt-based partner, and **Adam Perkins**, a London-based engagement manager in Oliver Wyman's Energy practice, contributed to this article





HOW UTILITIES ARE USING BLOCKCHAIN TO MODERNIZE THE GRID

Welcome to a new era of decentralized power

James Basden and Michael Cottrell

In New York state, neighbors are testing their ability to sell solar energy to one another using blockchain technology. In Austria, the country's largest utility conglomerate, Wien Energie, is taking part in a blockchain trial focused on energy trading with two other utilities. Meanwhile in Germany, the power company Innogy is running a pilot to see if blockchain technology can authenticate and manage the billing process for autonomous electric-vehicle charging stations.

Blockchain has grabbed the attention of the heavily regulated power industry as it braces for an energy revolution in which both utilities and consumers will produce and sell electricity. Blockchain could offer a reliable, low-cost way for financial or operational transactions to be recorded and validated across a distributed network with no central point of authority. As in the financial services industry, this capability has prompted some people to explore whether blockchain may one day replace a portion of utilities' businesses by doing away with the need for intermediaries altogether. But that view is too extreme and simplistic.

What is more likely to happen is that blockchain will become part of the answer to updating and improving centralized, legacy systems with a distributed hybrid system made up of a patchwork of both large power plants and microgrids powered by distributed energy resources such as solar power. Such a decentralized energy system would be capable of delivering efficient, reliable, and, in many cases, renewable energy.

This coming shift is prompting the industry to focus on blockchain's potential to make peer-to-peer energy trading a reality, though it's unclear how soon the nascent technology can be scalable. For example, in a blockchain microgrid project in Brooklyn, N.Y., each participant trading electricity had to invest in a computer with a blockchain "node" in order for their homes with solar panels to be able to sell power to neighbors. The blockchain network manages and records the transactions with little human

Blockchain technology may ultimately accelerate the transition to what the energy industry calls a “distributed world” made up of both large and smaller power-generation systems

interaction. The “nodes” in the computers are needed to validate and share the information to minimize the possibility of downtime or interference with the data. The more data that needs to be bundled into “blocks” and passed along, the more computing power they need.

But it’s possible that blockchain may one day enable the development of an integrated trading system that would permit businesses to trade their option to use electricity during a given time frame. For example, a factory could sell five minutes of unused power during a down time to a different factory that needs the additional power. Trading grid flexibility in this way could provide large efficiency benefits for grid operators.

Another area where blockchain could take hold is in enabling customers to switch power suppliers more quickly. Companies are conducting pilots to explore blockchain’s potential to make existing processes, such as meter registration, more efficient and less costly. British startup Electron is developing a blockchain platform that could allow British customers to switch power suppliers reliably

within a day, and are working with the Data Communications Company, the UK’s new centralized meter data agency. Previously, a switchover could take much longer.

Finally, blockchain may make existing electric industry processes more efficient by serving as the backbone for utilities’ “smart grid” management systems that automatically diagnose network emergencies and problems and reconfigure in reaction to them. Austrian startup Grid Singularity is using blockchain technology to develop a decentralized energy exchange platform that can host applications ranging from validating electricity trades to monitoring grid equipment, in part because such a platform has the potential to prolong the life of equipment, improving both large and small power-generation system operators’ earnings.

To be sure, as with any new technology, blockchain remains largely unproven, and significant barriers remain. Use cases will need to be more highly developed to convince government-backed programs and regulators that there will not be multiple program delays and possible cost overruns if they agree to adopt the new technology. Common industry standards will also need to be established.

EXHIBIT 1: A DISTRIBUTED WORLD

Blockchain technology is applicable to a wide range of distributed energy resources



Source: Oliver Wyman analysis

Nevertheless, if it proves reliable and scalable, blockchain technology may ultimately accelerate the transition to what the energy industry calls a “distributed world” made up of both large and smaller power-generation systems for homes, businesses, and communities. To succeed in maximizing the potential of distributed generation and managing less predictable and more volatile renewable power sources, the industry’s infrastructure first must become nimbler and less centralized. (See Exhibit 1.)

So while blockchain may at first appear to be a form of technological disruption that the power industry should avoid, it could prove to be exactly what is required to keep up with evolving demand for electricity in smaller, lower value blocks and at higher frequency. While there’s always room for startups to move

in and disrupt this industry, established utilities are best placed to evaluate and make strategic bets on blockchain technology’s potential applications. If they can seize the moment, centralized incumbents may turn out to be the true disruptors, ushering in a new era of decentralized power.

James Basden

is a London-based partner and head of utilities in Oliver Wyman’s Energy practice

Michael Cottrell

is a London-based engagement manager in Oliver Wyman’s Energy practice

This article first appeared in *Harvard Business Review*

DIGITAL ELECTRICITY

German utilities need to digitize – or risk disruption

Thomas Fritz, Matthias Mohr, and Joerg Staeglich

Germany's Kaiswerwetter Energy Asset Management manages 51 solar and wind parks using cloud-based tools. Blockchain startup Powerpeers runs a digital interactive peer-to-peer market for self-produced energy, while Bankymoon offers a blockchain smart metering solution. Dutch operator Stedin monitors real-time "self-healing" power grids that can restore power to customers within a minute of a power outage.

On almost every front, digital technology advances are challenging the traditional ways utilities have managed their operations. To better understand the potential likelihood and impact of digitization on utilities, Oliver Wyman examined the level of digitization of eight German utilities' generation, trading, network, and sales, and ranked them based on a questionnaire in comparison to cross-industry best practices.

To date, German utilities have implemented only a very basic level of digitization. On a scale of zero to 100, utilities ranked 31, a clear sign that they are at risk of losing ground to emerging digitized competitors. German utilities' grids are the furthest along in adopting digital capabilities, such as in the area of workforce management, though they have barely begun to introduce machine-learning tools designed to run grids more securely and reliably through predictive maintenance and real-time monitoring. Utilities' trading capabilities are at a similar level, in large part because of their high levels of data handling.

But the German energy industry's digital tools for power generation and sales remain rudimentary. Utilities have yet to take advantage of big data in conducting maintenance. Meanwhile, on the sales side, utilities have their work cut out for them: They must improve the customer experience,

which at the moment is a poor and costly one, by offering more digital client-oriented services to businesses and customized real-time offers and virtual care agents to consumers.

As has already been demonstrated in other industries, companies cannot afford to be complacent. If German utilities continue to digitize at their current rate, they face certain disruption by emerging digitized competitors. Utilities must embrace digitization, rather than ignore it. Those that do invest in digitization have the potential to realize enormous efficiency improvements, advances that can serve as natural barriers to new upstarts entering the market. It's time for utilities to digitally speed up.

Thomas Fritz

is a Düsseldorf-based partner in Oliver Wyman's Energy practice

Matthias Mohr

is a Munich-based engagement manager in Oliver Wyman's Energy practice

Joerg Staeglich

is a Munich-based partner in Oliver Wyman's Energy practice

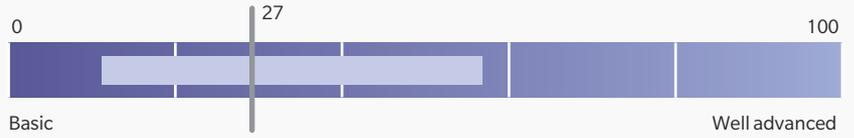
DIGITIZING ELECTRICITY IN GERMANY

German utilities have only begun to tap the potential of digitization, with an average overall utilization rate of 31 on a scale of zero to 100

SURVEY RESULTS



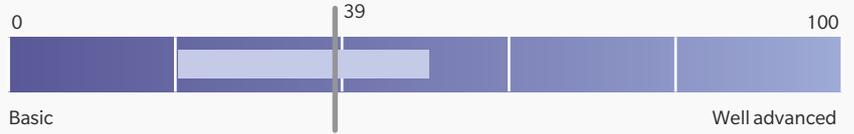
CENTRALIZED GENERATION



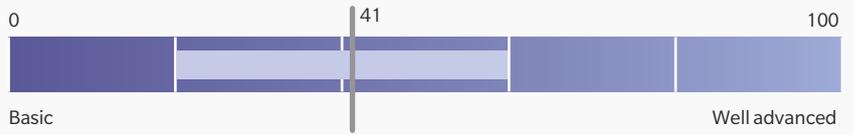
DECENTRALIZED GENERATION



TRADING



GRID



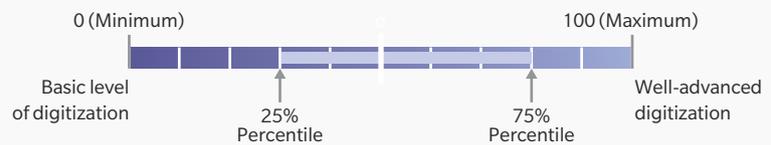
B2B SALES



B2C SALES



LEGEND



Source: Oliver Wyman analysis



OPERATIONS EXCELLENCE

National Oil Companies Need to Up Their Game

The Quest for Fewer and Shorter Outages

Oil Resilience in Asia

The World Energy Trilemma







NATIONAL OIL COMPANIES NEED TO UP THEIR GAME

To compete with the majors, NOCs must improve their enterprise risk management

Alexander Franke and Volker Weber

National Oil Companies (NOCs) and their governments – just three years ago riding a wave of \$100 oil – today face unusually trying times. Thanks to a plunge in oil prices, at one point to below \$30 a barrel, NOCs are earning about \$170 billion less than they did a decade ago, even as their sponsor governments are being asked to spend more on defense, social programs, and infrastructure.

The result: Many parent governments are confronting daunting budget deficits for the first time. In 2016, Qatar reported its first budget deficit in 15 years, while Saudi Arabia reported its largest shortfall ever the year before. Cumulative government net lending and borrowing by members of the Organization of the Petroleum Exporting Countries (OPEC) went from a net positive \$188.12 billion in 2012, to negative \$312.79 billion by the end of 2016, based on data and 2016 estimates from the International Monetary Fund’s World Economic Outlook. (The calculation excludes Indonesia, which was suspended from OPEC in November 2016.) Between 2014 – the year oil prices took a nosedive – and 2016 alone, OPEC borrowing grew by more than eight times.

LOOKING FOR A BOOST IN NEW PLACES

The pressure is rising, not just on governments, but also on the NOCs, especially those that supply oil-dependent nations with the overwhelming majority of their revenue. To overcome the volatile economics of the oil market and buy access to new, expanding markets, the NOCs have been actively investing for more than a decade in operations outside their home countries.

The most recent example of this strategy is Saudi Aramco’s \$7 billion deal for a 50 percent stake in a massive oil refinery project being developed by Petronas, Malaysia’s NOC, in the southern state of Johor, near Singapore. The investment, which officials say will make Aramco the biggest foreign investor in Malaysia, is expected to help the Saudi NOC increase business in the burgeoning Southeast Asian market.

\$170 billion

How much less NOCs are earning than a decade ago

But despite the sizable outlays often involved, the tactic has not produced the kind of results that the NOCs had hoped to achieve. (See Exhibit 1.) While NOC profit margins have plunged by roughly 8 percentage points since oil prices recently hit \$50, the decline actually started in 2006, not long after they began to expand their operations globally. The reason? While international expansion promises benefits, it also has increased the NOCs' exposure to risks ranging from delivery delays, cost overruns, and partner disputes on international projects, to a globally diverse menu of regulatory requirements. With more of their operations stretched across continents, there is a danger that the timelines and budgets for even domestic projects may be affected. Expanding their international footprint also put them at greater risk of "black swan" events, such as sophisticated cyberattacks, that could trigger global operational meltdowns – risks that few, if any, NOCs had even recognized in the past, let alone prepared for.

PUTTING A PRICE TAG ON RISK

If NOCs are to compete globally with international oil majors and match their performance, they will need to bolster their

financial resilience and dramatically improve the quantity, quality, and timeliness of their data. A first step would be the development of enterprise risk management (ERM) infrastructures that go beyond recognizing and assessing risks, to putting price tags on the potential threat that each risk presents.

For many years, NOCs were moneymaking machines for their governments, with little incentive to diversify or build advanced data collection capabilities. But with their new role as international players comes a requirement for greater transparency into their systems and information. NOCs need to put ERM to use not just for mitigating risk, but also as a way to drive business.

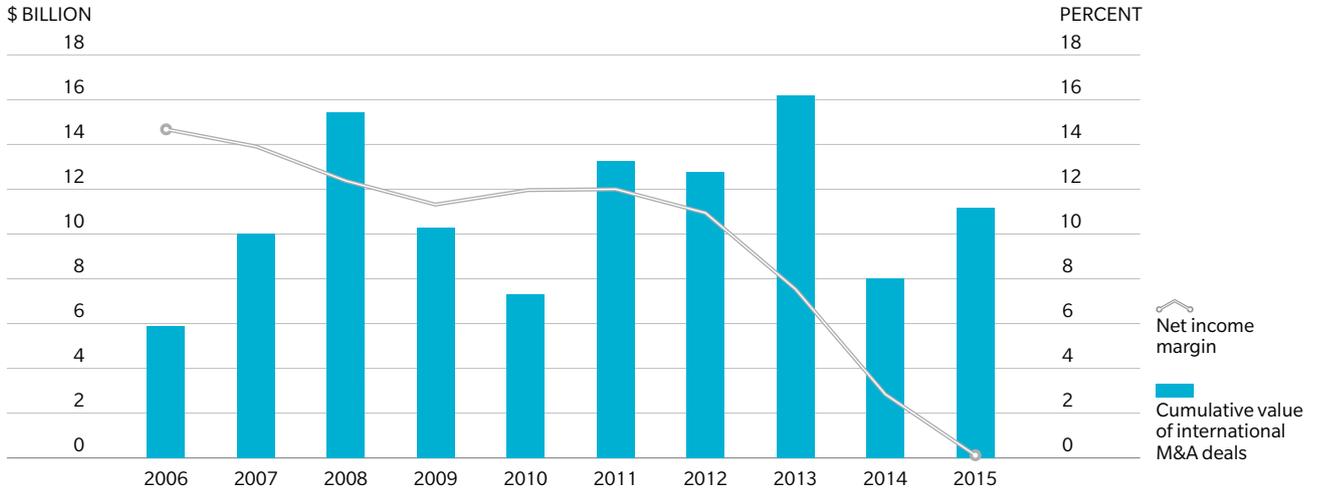
First, NOCs should develop the kind of enterprise-wide, risk-management systems that embed risk assessment and mitigation into all of their key decision-making processes, such as strategic planning, investments, and business planning and budgeting. This ensures NOC managers timely access to risk-related intelligence and insights that can then be used to navigate through uncertainty and inform decisions on proposed expansions and new projects, as well as active operations.

NECESSITIES OF A RISK CULTURE

That said, senior managers must understand and know how to apply data and insights as they emerge. This will require that NOCs professionalize and formalize ERM by adopting standardized and consistent definitions of risk management concepts and processes, as well as delineating the roles and responsibilities of those who manage risk. It all boils down to one thing: establishing a risk culture.

EXHIBIT 1: WAITING FOR A RETURN ON INVESTMENT

National oil companies’ diversification overseas has failed to live up to expectations



Sources: EBITDA margin: Sinopec, Petrobras, PDVSA, PetroChina, Pemex, Petronas, Pertamina, Statoil, Gazprom, Rosneft, Socar, Ecopetrol SA, QP (standalone), KPC M&A deals: Petrobras, PDVSA, PetroChina, Pemex, Petronas, Pertamina, Statoil, Gazprom, Socar, Ecopetrol SA, Sonatrach, Saudi Aramco, ADNOC, QP, KPC

Note: Cumulative value of M&A deals from 2006 onwards

Additionally, NOCs will need to invest in the kind of state-of-the-art automated solutions – typically in use at the major oil companies – that streamline and upgrade internal data flows. Such a framework empowers the entire workforce to protect the enterprise from downside scenarios, increasing a company’s organizational resilience and establishing a consistency in how ERM is applied.

As international players operating in a much more public space than many of them are accustomed to, NOCs are taking on new reputational and regulatory risks as they contend with greater scrutiny from foreign entities. Outside their home countries, they lack the clout and control they enjoy on their own turf, thus elevating their risk exposure. One key element of ERM for NOCs will be the need to recognize the vastly different regulatory environments that exist across their enterprises,

and develop risk management processes that address the variety of standards and politics.

Ultimately, NOCs will have to analyze their own risk appetites and develop a global agreement among major stakeholders on the amount and type of risk that is acceptable. Without that baseline assessment, NOCs will find it difficult to create the kind of cross-functional cooperation and perspective that will allow them to not only improve their financial performance, but also take advantage of offshore opportunities that allow them to grow over the long run.

Alexander Franke

is a Zurich-based partner in Oliver Wyman’s Energy practice

Volker Weber

is a Dubai-based partner in Oliver Wyman’s Energy practice

This article first appeared in *Arabian Oil and Gas*

THE QUEST FOR FEWER AND SHORTER OUTAGES

Creating a portfolio of small investments and analytics can help even the best utilities improve their record

Alan Feibelman, Curtis Underwood, and Daniel Ludwin

Thanks to digitization, utility customers have so many more reasons to demand the best reliability possible from their electric utilities – from checking a home camera, to remotely controlling the home thermostat, to charging the vast array of electronics consumers maintain, including even their automobiles.

The good news for electric utilities in the United States is that, as a group, they have done remarkably well over the past decade delivering and improving service reliability in terms of the overall frequency of outages, which has been declining. The annual median number of non-storm service interruptions dropped 11 percent between 2010 and 2015, after falling 16 percent for the five years before. These calculations are based on IEEE 2.5 beta System Average Interruption Frequency Index (SAIFI) data, which excludes major storms. (See Exhibit 1.)

But not every utility has been able to achieve this result. A considerable number of utilities have seen a falloff in reliability (outage frequency), while others are finding further gains increasingly difficult to eke out.

Additionally, reducing the average duration of outages has proven a tougher nut to crack. The Customer Average Interruption Duration Index (CAIDI) increased by nearly 5 percent since 2010. So while lights go out less frequently today than five or 10 years ago, the average interruption to service is somewhat longer.

That said, some utilities are demonstrating that it is possible to “move the needle” on both fronts of reliability: Nine of the companies benchmarked have improved both SAIFI and CAIDI by more than 10 percent over the past decade.

THE NEED FOR ANALYTICS

Utilities – even those that have shown improvement – want to do better. Unfortunately, they’re not always looking in the right places and not always supporting decisions with the right analytics.

There’s surprisingly more bang for the buck to be found in small, targeted investments, according to an Oliver Wyman analysis. Getting maximum reliability improvement from a fixed amount of capital spending or operations & maintenance expense requires utilities to “up their analytic game” to identify and target the specific root causes of the outages, rather than just completely rebuilding a poorly performing circuit.

To identify true cause-and-effect patterns and select the discrete actions to optimize reliability improvement and spending, analytics must separate signals from the noise generated by the volumes of outage and interruption data. The focus of the analysis must be on data directly attributable to relevant assets and preventable outages – rather than simply sweeping all outage data into the probe.

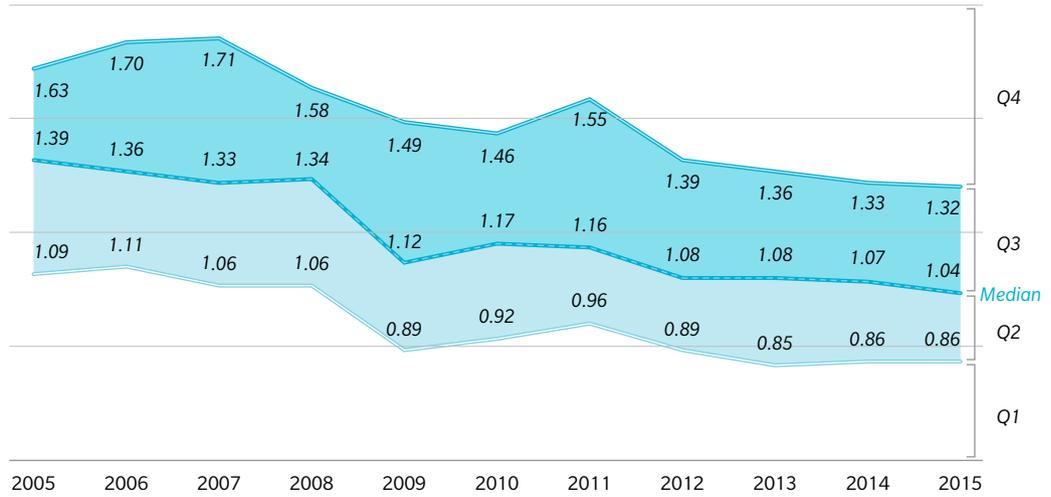
CHANGING THE NETWORK DESIGN

To lower the number of service interruptions, top utilities often start by enhancing the design of their networks. By dividing them up into more sections that can be disconnected from each other, they can reduce the number of customers involved when outages do occur. While this sectionalization approach is relatively straightforward, many utilities fail to maximize the impact of the investment because they don’t use advanced analytics to answer some basic questions like which outages to consider, where to draw the line on how many

EXHIBIT 1: A SNAPSHOT OF US UTILITY RELIABILITY

Utilities have increased reliability by reducing the frequency of service outages ...

**SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIFI) BY QUARTILE
ANNUAL INTERRUPTIONS PER CUSTOMER, IEEE STANDARD MAJOR EVENT DAYS (MED) REMOVED**



...but while there are fewer outages, they tend to be longer.

**CUSTOMER AVERAGE INTERRUPTION DURATION INDEX (CAIDI) BY QUARTILE
AVERAGE MINUTES PER INTERRUPTION, IEEE STANDARD MAJOR EVENT DAYS (MED) REMOVED**



Sources: IEEE Distribution Reliability Working Group Benchmark Results 2005 to 2015, Oliver Wyman analysis

reclosers to install, and the optimum number of customers to be included per section.

Every problem (and network) has unique aspects, so a one-size-fits-all approach rarely works. While it requires more effort to do a granular analysis of the various data available, it almost always leads to a more accurate diagnosis of problems and ultimately to the optimization of investments and solutions. Fortunately for utilities, there is a bevy of data sets and technologies available to boost reliability within most budgets.

To tackle the problem of duration, utilities should construct an “anatomy of an outage” to understand what they can do to speed up power restoration. These anatomies involve tying each increment of time to a step in the utility’s restoration process, from outage notification to full restoration. By constructing such analyses, utilities can identify outlier performance and then drill down to examine individual regions, shifts, outage types, or even the performance of particular dispatchers and crews in the quest to shave minutes from the restoration process. Some leading utilities make use of monthly “anatomy of an outage” reports that are distributed to various field and dispatch work groups.

GOING BEYOND SAIFI AND CAIDI

Regardless of their progress with reliability, all utilities have the potential to go beyond SAIFI and CAIDI and pursue a more customer-centric perspective on reliability performance. Customers do not fully differentiate between momentary and sustained outages. No matter the outage duration – 30 seconds, 30 minutes, or 30 hours – customers feel inconvenienced if they must reset an alarm clock or operate in the dark for any period of time. Leading utilities are beginning to examine a permutation of the Customers Experiencing Multiple Interruptions (CEMI) metric, which includes both sustained

A granular analysis of the data almost always leads to a more accurate diagnosis and optimization of investments

and momentary interruptions, to identify customers and circuits that have experienced abnormally high levels of outages as a means of further improving customer satisfaction.

Ultimately, customer expectations for highly reliable and uninterrupted electric service will continue to rise, challenging every utility – whether leading or lagging – to improve their performance and the effectiveness of their reliability-related efforts.

Alan Feibelman

is a Boston-based partner in Oliver Wyman’s Energy practice

Curtis Underwood

is a Boston-based partner in Oliver Wyman’s Energy practice

Daniel Ludwin

is a Toronto-based principal in Oliver Wyman’s Energy practice



OIL RESILIENCE IN ASIA

Volatile oil prices have major implications for the region

Blair Chalmers

Perception is relative. Entering 2017, oil prices are hovering around \$50 per barrel, down from their peak – above \$100 – in 2014. Compared to where prices stood 12 months ago, however, the current price of oil is 50 percent higher. Choosing to see the glass as half-empty or half-full depends on whether one stands to gain or lose from lower prices.

Asia's top 10 oil-importing countries accounted for 44 percent of global imports in 2015. (See Exhibit 1.) As a region, it is the world's largest importer of oil. So it's easy to see why the World Economic Forum's recent annual Executive Opinion Survey finds "energy price shock" to be a key concern for business executives in the region.

A sustained period of lower oil prices would seem beneficial for the region. However, to understand the economic impact of this in a meaningful way requires deeper consideration.

The industry is positioned within a much broader economic ecosystem impacted by price shifts. Stakeholders in this ecosystem include governments, energy-intensive industries, the financial sector, and end users, areas worth exploring in more depth.

WINNERS AND LOSERS ACROSS ASIA

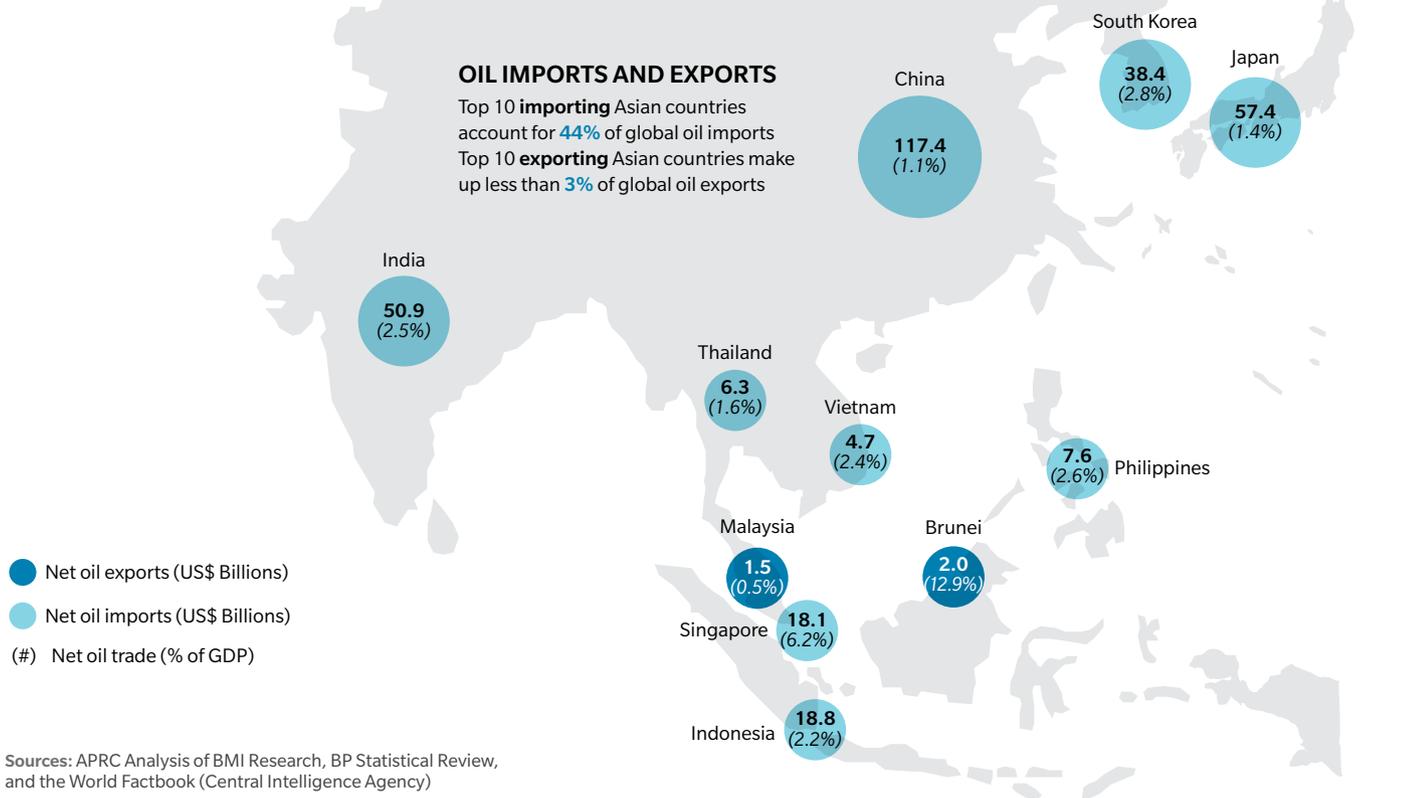
The two net oil exporters in Asia – Brunei and Malaysia – have been hit hard by the price collapse, given their reliance on oil income to balance their budgets. But slumping oil commodity prices also afforded opportunity, providing Indonesia and Malaysia the option to remove expensive fuel-subsidy schemes. Indonesia's fossil-fuel subsidies accounted for more than 4 percent of GDP in recent years, which weighed on the national budget.

Net importers have been clear beneficiaries, with India realizing cost savings that have helped narrow its current account deficit and reduce inflation from 10.9 percent in 2013, to 5.9 percent in 2015. Healthy macroeconomic fundamentals have also allowed the Indian government to manage its fiscal deficit better by cutting subsidies on petroleum products while raising energy taxes.

The oil and gas industry and its direct suppliers have been the most adversely affected. Record losses have led to significant restructuring and divestments, with many companies struggling to stay afloat. South Korea's three largest shipbuilders are all expected to

EXHIBIT 1: ASIA'S OIL DEPENDENCE

A net oil trade map of Asia



continue with job cuts and asset sales in 2017, with at least one of the three requiring employees to take rotations of unpaid leave.

Meanwhile, energy-intensive industries, such as transportation and farming, have benefited significantly. Globally, operating profit margins for airlines are estimated to be 8.8 percent in 2016, up from 3.5 percent in 2013. Singapore Airlines recorded full-year operating profits of S\$485 million (US\$342 million) in financial year 2015/16, up S\$145 million from the previous year, due largely to lower net fuel costs.

PLANNING FOR AN UNCERTAIN FUTURE

Two major drivers of the oil price fall surprised many in the industry. The reduction in Chinese oil demand growth came sooner than many had expected, and few predicted the ability of US shale production to reach the heights that it has. It is hard enough to predict the future trajectory of oil prices in times of apparent global stability; doing so in times of significant global uncertainty is harder still.

This leaves the stakeholders in the oil price economic ecosystem with decisions to make about how to build resilience. For the oil and gas industry, the past few years have been about cutting costs. The president of Halliburton, the oil industry services provider, described new contract negotiations with oil producers

as a “barroom brawl.” The exploration and production firms may have won in recent negotiations; however, getting tough on suppliers can backfire when oil prices rise again and service providers hold the power. That’s why producers, as successfully shown by many North American shale companies, need to focus on true efficiency gains that will have a lasting impact beyond the current downturn.

Following the recent agreement between members of the Organization of the Petroleum Exporting Countries (OPEC) and other producers to cut production in 2017, prices have edged higher, and there is renewed confidence among some in the industry that significant investment will be signed off on this year for new projects. However, this confidence does not seem to extend to Asian exploration and production firms, as the mature oil fields in the region require expensive technology investment just to maintain existing production levels. China alone is expected to see production fall by seven percent for the second year running.

This fall stands in stark contrast to the region’s growing energy demand and ensures that governments in Asia have hard decisions to make about how to manage their individual energy trilemmas, ensuring the balance between energy security, environmental sustainability, and energy equity. The most recent Energy Trilemma Index suggests that Asia can improve across all three dimensions by increasing the use of renewable energy sources, and decreasing its import dependence by fostering reliable trade relationships and improving infrastructure.

Investment from Asian countries in renewables has been mixed. Some believe that a fall in oil prices may reduce the competitiveness of renewable investments. Others calculate this effect would be offset by ongoing technological advancements that have ensured renewables remain at least as competitive as they were a few years ago. Broad ratification of the Paris Agreement by major Asian economies should

\$100 billion

How much China invested in renewables in 2015

contribute to ensuring that investment in renewables remains a policy priority, as it already is in China, where a \$100 billion renewables investment in 2015 accounted for a third of global expenditure.

Amidst the uncertain global economic outlook, Asia is generally seen as a bright spot for growth. The trouble with dealing in unknowns, however, is that a period of volatility for the region is just as possible. Given the political, economic, and environmental events over the past year, ongoing volatility would surprise few. As a result, the concept of building resilience has never been more applicable to stakeholders across the oil price economic ecosystem, both to protect against further downturns and to enable organizations to take advantage of any unforeseen opportunities that may arise.

Blair Chalmers

is a director at
Marsh and McLennan Companies’
Asia Pacific Risk Center

Oliver Wyman is a division of
Marsh and McLennan Companies

This article first appeared in *BRINK Asia*

THE WORLD ENERGY TRILEMMA

Ranking the world's top 25 sustainable energy systems

Francois Austin

Europe leads the world in the provision of sustainable energy systems, with 21 European countries appearing in the top 25 ranking of the 2016 World Energy Council/Oliver Wyman Energy Trilemma Index. The index ranks 125 countries on their performance in meeting and balancing the energy trilemma: delivering secure, affordable, and environmentally sustainable energy. Denmark, Switzerland, Sweden, the Netherlands, and Germany hold the top five positions in the 2016 rankings. The highest ranked non-European country is New Zealand, which came in ninth in the index. The United States, Canada, and Singapore are the only other non-European countries in the top 25.

The index highlights the unique energy profile of each of the leading countries and the challenges they face in meeting the goals of the energy trilemma. Some countries, such as the US and Canada, rank lower in the environmental sustainability category due to higher emissions per capita. Other countries, such as Ireland, are ranked lower on energy security. To continue to move forward on the energy trilemma rankings, each country must craft policies that will ensure secure, affordable, and environmentally sustainable energy as they make the transition to a low-carbon economy.



 Leader in each of three dimensions

 Leader across two dimensions

 Top 25

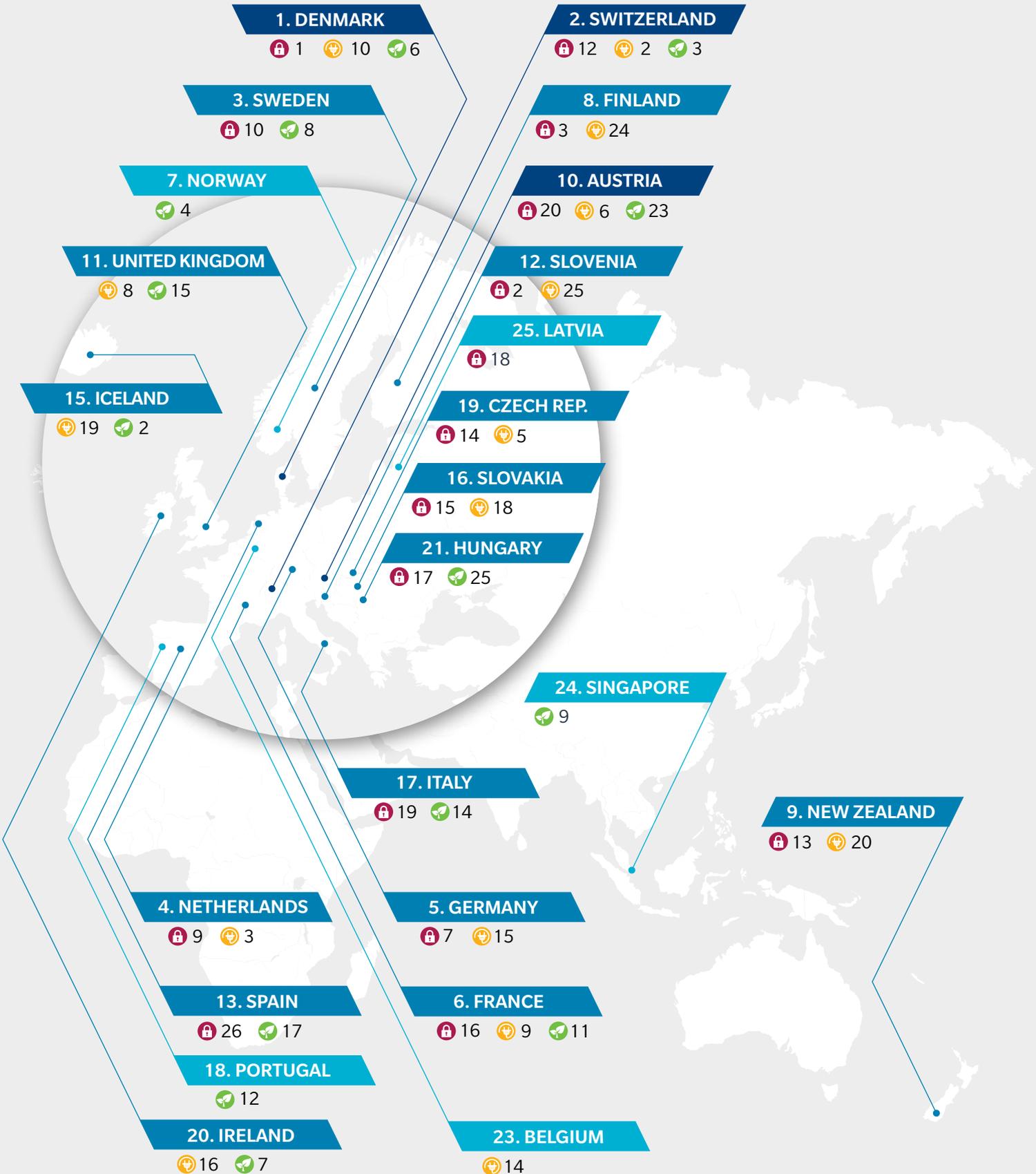
* Dimensional score is below 25, but overall balance score is high

 **Top 25: Energy Security**
The effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of participating energy companies to meet current and future demand

 **Top 25: Energy Equity**
The accessibility and affordability of energy supply across the population

 **Top 25: Environmental Sustainability**
The achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources

Francois Austin is a London-based partner and head of Oliver Wyman's Energy practice



Sources: World Energy Council and Oliver Wyman

RECENT PUBLICATIONS FROM OLIVER WYMAN

For these publications and other inquiries, please email energyjournal@oliverwyman.com or visit www.oliverwyman.com.



AIRLINE ECONOMIC ANALYSIS

How carriers should approach 2017.



INCUMBENTS IN THE DIGITAL WORLD

How incumbent organizations can ultimately win in a marketplace transformed by digital disruptors.



THE MARKETPLACE REVOLUTION

Shattering the foundation of the \$3 trillion sick-care marketplace.



TEN DIGITAL IDEAS FROM OLIVER WYMAN

In this collection of articles, we showcase ten digital ideas from across our firm for how business leaders can improve and grow their businesses.



MRO SURVEY 2016

Innovation and adoption in the aviation maintenance, repair, and overhaul sector.



PERSPECTIVES ON MANUFACTURING INDUSTRIES

A collection of viewpoints on industrial companies' challenges and trends, as well as their opportunities and potential courses of action.



THE STATE OF FINANCIAL SERVICES 2017

Financial services firms need to adapt to a broadly reordered marketplace.



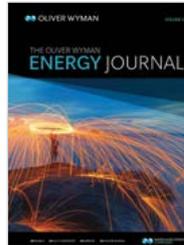
THE OLIVER WYMAN AUTOMOTIVE MANAGER

Perspectives on the latest trends and issues in the automotive industry.



THE OLIVER WYMAN CMT JOURNAL, VOL. 3

Our latest thinking on the opportunities and challenges in communications, media, and telecommunications.



THE OLIVER WYMAN ENERGY JOURNAL, VOL. 2

The latest thinking from across Oliver Wyman's Energy practice on how shifts underway will create new risks and opportunities not just for the energy sector, but also for every company and person that depends on it.



THE OLIVER WYMAN RETAIL JOURNAL, VOL. 5

Retail is an industry in transition. In this journal, we focus on the future to help us understand where the next upheaval is likely to come from and how retailers can be prepared.



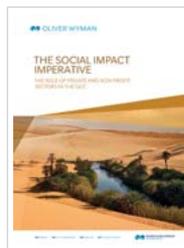
THE OLIVER WYMAN RISK JOURNAL, VOL. 6

A collection of perspectives on the complex risks that are determining many companies' futures.



THE OLIVER WYMAN TRANSPORT & LOGISTICS JOURNAL 2016

Perspectives on the issues facing the global transportation and logistics industries.



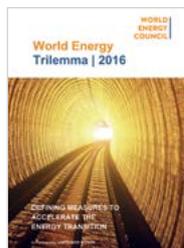
THE SOCIAL IMPACT IMPERATIVE

The role of private and non-profit sectors in the GCC.



WHOLESALE BANKS AND ASSET MANAGERS

The world turned upside down.



WORLD ENERGY TRILEMMA

Defining measures to accelerate the energy transition.

OLIVER WYMAN ENERGY JOURNAL

AUTHORS

FRANCOIS AUSTIN

Partner

Email: francois.austin@oliverwyman.com

JAMES BASDEN

Partner

Email: james.basden@oliverwyman.com

IRFAN BIDIWALA

Partner

Email: irfan.bidiwala@oliverwyman.com

BLAIR CHALMERS

Director, MMC Asia Pacific Risk Center

Email: blair.chalmers@oliverwyman.com

MICHAEL COTTRELL

Engagement manager

Email: michael.cottrell@oliverwyman.com

ALAN FEIBELMAN

Partner

Email: alan.feibelman@oliverwyman.com

ALEXANDER FRANKE

Partner

Email: alexander.franke@oliverwyman.com

ERNST FRANKL

Partner

Email: ernst.frankl@oliverwyman.com

THOMAS FRITZ

Partner

Email: thomas.fritz@oliverwyman.com

BERNHARD HARTMANN

Partner

Email: bernhard.hartmann@oliverwyman.com

BILL HEATH

Partner

Email: bill.heath@oliverwyman.com

ALEX KIROV

Principal

Email: alexander.kirov@oliverwyman.com

CHRISTIAN LINS

Principal

Email: christian.lins@oliverwyman.com

DANIEL LUDWIN

Principal

Email: daniel.ludwin@oliverwyman.com

ARUN MANI

Partner

Email: arun.mani@oliverwyman.com

DENNIS MANTEUFFEL

Engagement manager

Email: dennis.manteuffel@oliverwyman.com

AUTHORS

DAVID MARCONTELL

Vice president

Email: david.marcontell@oliverwyman.com

SANDRO MELIS

Partner

Email: sandro.melis@oliverwyman.com

GEOFF MURRAY

Partner

Email: geoff.murray@oliverwyman.com

BOB ORR

Partner

Email: bob.orr@oliverwyman.com

ADAM PERKINS

Engagement manager

Email: adam.perkins@oliverwyman.com

ROBERT PETERSON

Partner

Email: robert.peterson@oliverwyman.com

ANGELO ROSIELLO

Principal

Email: angelo.rosiello@oliverwyman.com

SUSIE SCOTT

Principal

Email: susie.scott@oliverwyman.com

BJOERN MAUL

Partner

Email: bjoern.maul@oliverwyman.com

MATTHIAS MOHR

Engagement manager

Email: Matthias.mohr@oliverwyman.com

ERIC NELSEN

Partner

Email: eric.nelsen@oliverwyman.com

MARK PELLERIN

Partner

Email: mark.pellerin@oliverwyman.com

ANDREW PERRY

Engagement manager

Email: andrew.perry@oliverwyman.com

ROLAND RECHTSTEINER

Partner

Email: roland.rechtsteiner@oliverwyman.com

SAJI SAM

Partner

Email: saji.sam@oliverwyman.com

GRAHAM SHARP

Senior advisor

Email: manuela.leuenberger@oliverwyman.com

AUTHORS

THOMAS SHYR

Engagement manager
Email: thomas.shyr@oliverwyman.com

BRUNO SOUSA

Principal
Email: bruno.sousa@oliverwyman.com

JOERG STAEGELICH

Partner
Email: joerg.staeglich@oliverwyman.com

TIM THOMPSON

Principal
Email: tim.thompson@oliverwyman.com

CURTIS UNDERWOOD

Partner
Email: curtis.underwood@oliverwyman.com

VOLKER WEBER

Partner
Email: volker.weber@oliverwyman.com

BRYAN YAMHURE SEPULVEDA

Senior consultant
Email: bryan.yamhure@oliverwyman.com

EDITORIAL BOARD

FRANCOIS AUSTIN

Partner
Email: francois.austin@oliverwyman.com

JAMES BASDEN

Partner
Email: james.basden@oliverwyman.com

HOOMAN BASSIRIAN

Global energy marketing manager
Email: hooman.bassirian@oliverwyman.com

ROLAND RECHTSTEINER

Partner
Email: roland.rechtsteiner@oliverwyman.com

VEIT SCHWINKENDORF

Partner
Email: veit.schwinkendorf@oliverwyman.com

EMILY THORNTON

Director of research
Email: emily.thornton@oliverwyman.com

PAT WECHSLER

Marketing manager
Email: pat.wechsler@oliverwyman.com

DESIGN

MIKE TVESKOV

Designer

Email: michael.tveskov@oliverwyman.com

MELISSA UREKSOY

Designer

Email: melissa.ureksoy@oliverwyman.com

KATHARINA VAUBEL

Picture researcher

Email: katharina.vaubel@oliverwyman.com

DIGITAL PRODUCTION

KARLA BORALLO

Designer

Email: karla.borallo@oliverwyman.com

TOM GROPE

Director of Digital Marketing

Email: tom.groppe@oliverwyman.com

LUIS HURTADO DE MENDOZA

Designer

Email: luis.hurtadodemendoz@oliverwyman.com

AGNIESZKA LASINKIEWICZ

Digital Production Specialist

E-mail: agnieszka.lasinkiewicz@oliverwyman.com

ANNA PISKORZ

Digital Production Specialist

E-mail: anna.piskorz@oliverwyman.com



ABOUT OLIVER WYMAN

Oliver Wyman is a global leader in management consulting. With offices in 50+ cities across nearly 30 countries, Oliver Wyman combines deep industry knowledge with specialized expertise in strategy, operations, risk management, and organization transformation. The firm has more than 4,500 professionals around the world who help clients optimize their business, improve their operations and risk profile, and accelerate their organizational performance to seize the most attractive opportunities. Oliver Wyman is a wholly owned subsidiary of Marsh & McLennan Companies [NYSE: MMC], a global professional services firm offering clients advice and solutions in the areas of risk, strategy and people. Marsh is a leader in insurance broking and risk management; Guy Carpenter is a leader in providing risk and reinsurance intermediary services; Mercer is a leader in health, wealth and career consulting; and Oliver Wyman is a leader in management consulting. With annual revenue of more than \$13 billion and more than 60,000 colleagues worldwide, Marsh & McLennan Companies provides analysis, advice and transactional capabilities to clients in more than 130 countries. The Company is committed to being a responsible corporate citizen and making a positive impact in the communities in which it operates. Visit www.mmc.com for more information and follow us on LinkedIn and Twitter @MMC_Global.

Copyright © 2017 Oliver Wyman. All rights reserved. This report may not be reproduced or redistributed, in whole or in part, without the written permission of Oliver Wyman and Oliver Wyman accepts no liability whatsoever for the actions of third parties in this respect. The information and opinions in this report were prepared by Oliver Wyman. This report may not be sold without the written consent of Oliver Wyman.