Deepwater Resource Exploitation - A New Frontier For Hydrocarbon Supply

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ABSTRACT

Deepwater resources provide unique opportunities for increased oil and natural gas supplies in Canada, Mexico and the United States. Advances in the exploration and development of the Gulf of Mexico in United States' territorial waters have demonstrated that the potential is very large. Nevertheless, there are underlying uncertainties associated with deepwater resources which could pose huge hurdles to major investments. Technological issues are no longer considered to be the prevalent obstacle to developing deepwater resources. Rather, the commercial frameworks (policy, regulatory and fiscal regimes for investment in the hydrocarbon sector), and how uncertainty and risk impact investment decisions are becoming more important. This paper addresses geological, technical, management issues, risk and uncertainty and the challenges of being in a marine environment, which is periodically more demanding because of external factors such as the weather. Additionally, the main challenge to the future of deepwater exploitation is viewed as a frontier experience where many in industry and government will have to learn on the job because of the pace at which industry is moving to develop deepwater resources.

Keywords: Deepwater, hydrocarbon, ultra deepwater, exploration.

1. INTRODUCTION

Worldwide, offshore oil and gas resources are increasing in importance as companies and governments seek to develop new supplies. Deepwater resources, in particular, represent the frontier of new hydrocarbon supply and are the subject of great efforts worldwide. Deepwater resource endowments also include natural gas, which is also of growing importance to global energy security. While technological issues have long been identified as a key obstacle to developing deepwater resources, the constraints are not just technological in nature but are related to how the resource base is viewed, the willingness to take on risk, and the commercial frameworks that are provided for investment.

Numerous challenges impact deepwater E&P. Increasing water depths with 283 meters (10,000 feet) being the current frontier, test both technology and logistics management. Transportation strategies are part of resource recovery – new offshore pipeline fairways and alternative approaches, such as floating production, storage and offloading facilities (FPSO's) and compressed natural gas (CNG) vessels that can span the distances that are non-economic for gas pipelines. Equally crucial are appropriate commercial frameworks – the combination of policy and regulatory approaches – that facilitate high-risk deepwater investment and provide proper oversight and transparency to deepwater operations. Additionally, the high costs of drilling, production testing, and facilities construction in deepwater field operations require that high-quality fluid and rock data be acquired for appropriate economic decision-making. Specifically, accurate fluid properties must be determined in order to assess oil quality and value (Wenger et. al. 2004).

Ideas covered in this paper on deepwater resource exploitation are based on excerpts derived from the Security and Prosperity Partnership Workshop on "Development of Opportunities in Deepwater Oil and Gas", North American forum, January 23, 2006 Baker Institute, Rice University, Houston, Texas.

2. GLOBAL ENERGY DEMAND

The world's demand for oil has increased sharply in recent years, rising from 78 million barrels per day in 2001 to 87 million barrels per day in 2007. The U.S. Energy Information Administration expects world oil consumption to grow by 1.3 million barrels a day in both 2008 and 2009. Deepwater oil production (2.5 million barrels or 0.4 million cubic meters per day), which is approximately 3 percent of world production, as compared to the world share of total offshore oil production of 30 percent, could more than triple in the near future. Recent increases in crude oil and gasoline prices underscore the need for further development of this resource. According to International Energy Agencies (IEA), it will require a 40 percent increase in the global oil supplies to sustain a 3.6 percent rate of annual growth in the global economy to 2030, which will require an expansion of 33 million barrels per day in the global oil supplies (API Primer March 31, 2008).

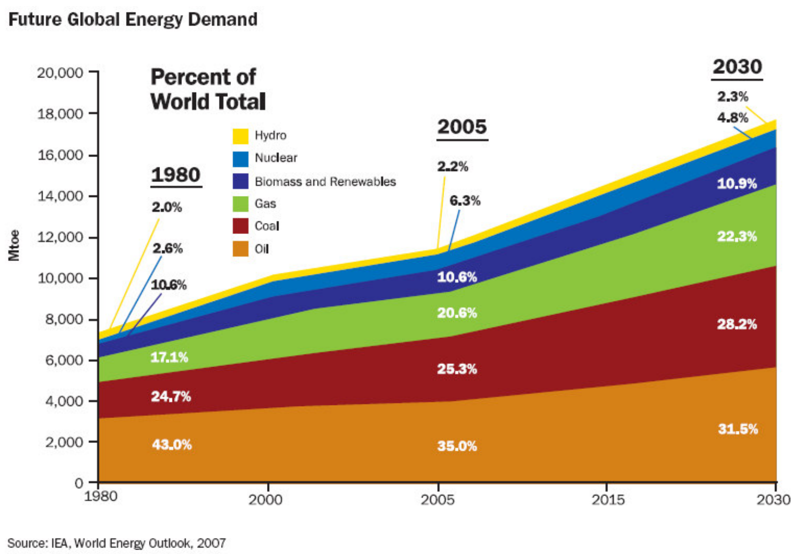

Figure 1: Future Global Energy Demand. (API Primer March 31, 2008)

3.1 DEEPWATER EXPLORATION IN NORTH AMERICA

3.1.1 CANADA

Canada's experience in deepwater exploration is centered specifically along the east coast of Canada. Currently there is one producing gas field in Nova Scotia, and three (Terranova, White Rose and Hibernia) in Newfoundland, which produce about 40 percent of Canada's light oil. There has been increasing interest in other areas where land has been leased for exploration. However, deepwater exploration remains the main interest. Recent discoveries have been made at the Labrador Shelf and Orphan Basin. The potential of the Orphan Basin will be the next area to be assessed by the Canada Newfoundland and Labrador Offshore Petroleum Board, but this could take some time. Labrador Shelf discovered natural gas resources are estimated at about 113 billion cubic meters (4 tcf). At present, there are plans to drill a significant number of exploratory wells in Atlantic Canada between 2006 and 2010. ConocoPhilips announced two exploration wells – one at a depth of 2,300 meters (7546 feet), the other in depths of 750 meters (2461 feet) – in 2008-09 in the Laurentian sub-basin. The Geological Survey estimates the sub-basin contains about 169.9 million cubic meters (6 tcf) of natural gas and 95.39 – 111.29 million cubic meters (600-700 million barrels) of oil.

With 30 and 70 years of shallow and deepwater experience respectively, the Geological Survey of Canada (GSC) marine program promotes energy security through the coordination of exploration activities and the provision of non-competitive seabed information for clients involved in the exploration of offshore hydrocarbons. Clients include industry, regulators, off-shore petroleum boards and federal and provincial agencies. Information is provided at different stages of (a) pre-leasing, (b) pre-drilling, (c) exploration, (d) development and (e) production.

3.1.2 MEXICO

The exploitation of Mexico's hydrocarbon resources has been mainly in shallow waters. Most of Mexico's production comes from fields that are in water depths less than 100 meters (328 feet). The latest field was discovered at a depth of 650 meters (2,133 feet). Only 17 percent of the basin has been explored, which suggests that there is an enormous potential for the exploitation of deepwater hydrocarbon resources. In fact, on the U.S. side of the Gulf of Mexico, potentially large volumes of hydrocarbons have been discovered in the deep and ultra-deep water. These discoveries are also supported by studies in the region.

A business plan for 2002-2010 was developed by PEMEX (Petróleos Mexicanos) to assess the potential of deepwater exploration in the Gulf of Mexico. The main objective was to obtain the necessary subsurface information in order to estimate the hydrocarbon resource distribution, water depths, types of hydrocarbons, distance to facilities, etc. The critical factors to realizing the PEMEX deepwater strategy involved seismic and drilling operations, long-term seismic and drilling contracts, involvement of external consultants, establishment of a monitoring and intelligence group, deepwater applied research consortia and well defined agreements to acquire state of the art technologies from independent players in the Gulf of Mexico.

In order to achieve these goals it was necessary to establish a dedicated center for deepwater processing and interpretation that is responsible for negotiating and managing long-term seismic and drilling contracts and deepwater exploration. It also required the development of core technical skills to enable the performance of conceptual reservoir development studies. PEMEX has acquired 25,558 square kilometers (9,868 square miles) of 3D seismic data and 45,236 square kilometers (17,465 square miles) of 2D seismic data as well as a robust inventory of prospects.

Domestic demands in the oil/gas sector are a major challenge for Mexico. It requires approximately 50 billion dollars (approximately 553 billion pesos) of investment in some areas for Mexico to become self-sufficient in oil by 2014. A greater amount of investment is required for natural gas production. Nevertheless, there are opportunities resulting from energy reform and the corporate governance of PEMEX. The joint development of common trans-border hydrocarbon deposits would require the creation of strategic partnerships for deepwater operations, the granting of concessions for marginal oil fields, and private investment opportunities in refining.

In conclusion, the hydrocarbon potential in the Gulf of Mexico is promising. During the past four years, the experience gained by PEMEX has allowed its technical staff to learn about the nature and risks associated with deepwater exploration systems. The drillable prospect portfolio is promising in the Perdido area, in deep waters in the east coast of Mexico near the border with the United States, as well as in the heavy and light oil province of Coatzacoalcos, Salina Basin. However, the achievements in the past years have been modest in comparison with that of the U.S. Gulf of Mexico. Nevertheless, PEMEX is planning to increase exploration in these areas, in order to develop the potential hydrocarbon resources.

3.1.3 UNITED STATES OF AMERICA

The Gulf of Mexico has been a major supplier of oil and gas to the US for nearly half a century. With declining production from its near-shore, shallow waters, energy companies have focused their attention on oil and gas resources in water depths of 304.8 meters (1,000 feet) and beyond. Deepwater production began in 1979 with Shell's Cognac field, but it took another five years before the next deepwater field (ExxonMobil's Lena field) came online. Both developments relied on extending the limits of platform technology used to develop the Gulf of Mexico shallow-water areas. Deepwater exploration and production grew with tremendous advances in technology since those early days. Progress in developing these resources has made the Gulf of Mexico the focal point of deepwater oil and gas exploration and production in the world. The U.S. Department of the Interior's Minerals Management Service (MMS) estimates that the deepwater regions of the Gulf of Mexico may contain 325 million TJ (56 billion BOE).

From 2005 to the present, there has been a very active leasing pattern as well as exploration and development in the vicinity of the line separating Mexico and the United States. Exploration and production activities near the boundary are of mutual interest and require collaboration between the two countries. Undiscovered conventionally recoverable resources exist at various depths. For example, a reserve of approximately 116 million TJ (20 billion BOE) is estimated at a depth of 1600-2400 meters (5,249 – 7,874 feet), whereas reserves of 7.47 million cubic meters (47 billion barrels) of oil are estimated to occur at a depth of greater than 800 meters (2,625 feet) in the Gulf of Mexico. More recently, a number of exploratory wells have been drilled in the 5,000-7,500 meters (16,404 -24,606 feet) range, which is considered deep and ultra-deep water exploration. Figure 4: depicts the locations and approximate quantities of deepwater crude oil resources in the US. Exploration and development activities on the U.S. side have progressed further along than on the Mexican side and therefore, a number of key decisions must be made concerning the development of potential cross-boundary resources.

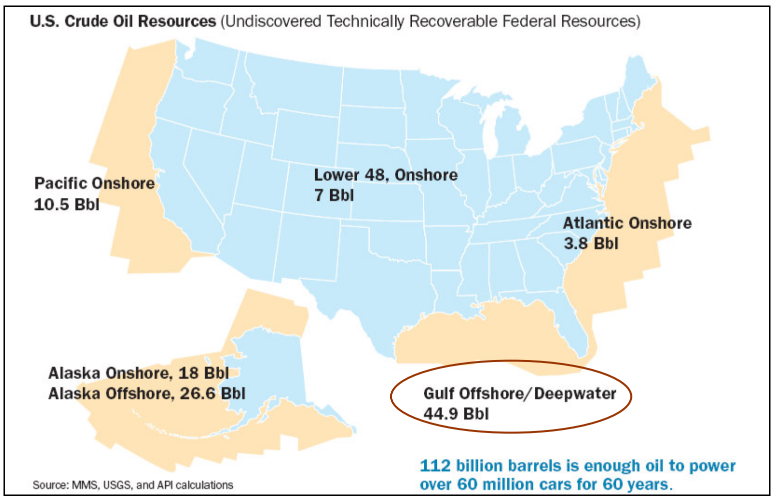

Figure 2: U.S. crude oil resources (API Primer March 31, 2008)

In general, there has been a significant rise in the amount of ongoing activity relative to deepwater oil production during the years 1995 to 2003, but this trend is now leveling off due to the effects of Hurricanes Ivan in 2004, and Rita and Katrina in 2005. Nevertheless, there have been significant discoveries in deepwater exploration during the period 2005-2006, such as Big Foot, Great White (close to the international offshore boundary with Mexico), Silver Tip and Tobago located in the Alaminos Canyon area. Furthermore, two prospects, Cascade drilled by BHP Billiton and Jack drilled by ChevronTexaco are being tested to determine flow rates and reservoir parameters. It should be noted that the development of the Paleogene (e.g. Cascade and Jack) is fraught with technical problems relating to whether oil and/or gas would flow.

US resources have abundant volumes of oil and natural gas resources beneath federal lands and coastal waters, but the bulk of these resources have been placed off-limits to development.

3. GLOBAL ULTRA-DEEPWATER

Figures 3: highlights the locations of deep and ultra-deep water explorations for various hydrocarbon resources.

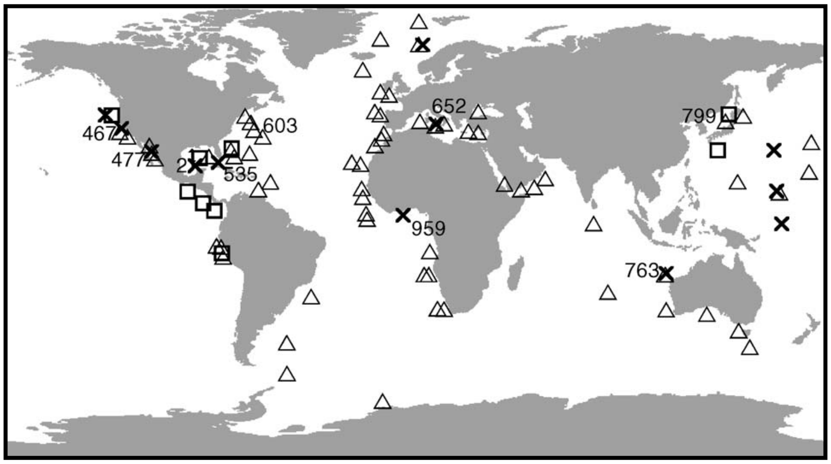

Figure 3: Location of reported black shale occurrences (Δ), hydrocarbon shows (x), and gas hydrates (□) recovered by either the Deep Sea Drilling Project or the Ocean Drilling Program. (Katz, 2003)

3.2 CHALLENGES TO EXECUTING DEEPWATER PROJECTS

3.2.1 LEASE AGREEMENTS AND REGULATION

The time cycle required for each aspect of project development runs on a different and often conflicting time cycle that can result in costly delays. The typical timeframe for a deepwater lease - less than 800 meters (2,625 feet) is a 10-year primary term. This 10-year term can be extended by the granting of a suspension of production (SOP) in cases where a discovery well has been drilled and a commitment to production can be given. The additional time is provided for the operator to complete the necessary activities to place the lease on production (e.g., construction and installation of platforms and pipelines, etc.). The length of time given under the SOP is based on a reasonable activity schedule and the amount of time needed to commence production.

The learning curve associated with deepwater operations is a major issue for regulators, many of whom are presently learning and doing at the same time. A common challenge for regulators and industry is the question of how to implement new technologies. A great deal of coordination and front-end work is required to ensure that everyone understands the risks associated with using a new technology. Regulators are behind on evaluating new technologies and late on integrating consideration of new technologies into the licensing and regulation process, which may be attributed to the timeline required for new regulations to be adopted (5 to 6 years from concept-regulation).

3.2.2 EXPLORATION TIME CYCLE

The estimated period to acquire seismic information is approximately one year, not including delays, which is slow as compared with exploration in other countries. This was partly attributed to the nature of the geology in the Gulf of Mexico. Coming up with a well-formed plan that is both profitable and scientifically sound requires significantly more input from various technical experts than with traditional technologies. In order to shorten the exploration time cycle, the geoscience risk assessment should be integrated with engineering and economic risk in collaboration with regulatory agencies.

3.2.3 TECHNOLOGY MANAGEMENT

Material technology will play a vital role in the development of cost effective and reliable deepwater production systems. Increasing energy demands will continue to push the exploitation of offshore oil and gas reservoirs and the need to reduce cost, improve recovery and increase overall economic performance will drive deepwater production technology. At present, deepwater challenges continue to focus on reservoir performance, fluid characteristics, system flexibility and operation performance. A "strategic inflection point" has been identified wherein conventional systems cannot be used for future deepwater developments. Therefore, new deepwater technologies such as deep-draft semi-submersibles, FDPSOs, ETLPs (new deck designs – for storm events), floating LNG (gravity-based systems, etc), ultra-deepwater tethers and tendon moorings (to extend TLP deep water technology to deeper water), carbon fiber tether (for deeper water TLP applications), high strength-low weight spool/reel installations and multiphase pumps, must become available for deepwater resource exploitation. The risk of using new technologies ultra deep water E&P should be considered in the early stages of concept development before the implementation of the new technology (Development of Opportunities in Deepwater Oil and Gas, January 23, 2006). Significant delays affecting venders and operators can occur if the risks and possible time lags are not anticipated.

3.3 TECHNOLOGY DEVELOPMENT – OUTSOURCING, FINANCING, AND REGULATION

The development of deepwater technology is expensive in absolute costs for a number of reasons and a considerable amount of time is required for commercial deployment. Outsourcing is therefore seen as a viable solution to commercialize the above-mentioned technologies. Also, the adoption of technologies that have been utilized outside of the petroleum industry (e.g. robotics and military applications) and the combination of oilfield hardware technology and information systems technology are viewed as possible options.

The major technology issue facing the industry is financing and the role of the changing roles of the operator and vendor communities. In the past, the operator financed and promoted new technologies but now the vendor community conducts much of the R&D and promotes new technologies to the operators. Some majors still conduct their own research and technology development. For example, ExxonMobil conducts a significant amount of research and development in house, as do Shell and BP, one support feature that drives this activity being the price of oil at $114 a barrel.

This type of outsourcing can result in 30-70 percent cost savings in labor and 15-30 percent overall and could lead to a reduction in cycle times for product development and market deployment. Outsourcing has been around since the 1950's and it is expected to increase in the future in various activities, from drilling rig operations to facilities design, etc.

In the aftermath of Katrina and Rita, one prevalent question facing the industry is how much of that technology is still considered proven? Much of the equipment destroyed in the hurricanes was relatively new. Interestingly enough, a relatively high number of the offshore rigs destroyed in the hurricane were built in the last ten years. With environmental concerns at the helm, one needs to know very soon where the technology stands in order to improve the management of and deal with issues of remote management of subsea systems. To minimize water-related risk and not trade off performance would require some time - learning by doing – since all technologies and knowledge of the seafloor are arising very rapidly. As such, it will be necessary to develop FPSO and smart well technologies. However, the main issue is when will the industry have the comfort level to pay for that technology?

It appears there is a role for government to play in technology development. In 1999-2000 the U.S. Department of Energy initiated the Offshore Technology Roadmap (OSTR) with the task of developing a roadmap of actions that will enable companies to better access the ultra-deepwater energy resources of the U.S. Gulf of Mexico (Development of Opportunities in Deepwater Oil and Gas, January 23, 2006). On the U.S. side, this will require the development of a public-private partnership in the U.S. – similar to Brazil's Procap 3000, or Norway Demo 2000 or UK's ITF and Canada's ACPI, etc. In addition, the U.S Energy Policy Act of 2005 provides the framework for actions that will lead to the commercialization of exploration and production of new technologies. A substantial part of the Energy Policy Act has been the allocation of $1.5 billion over the next 10 years as matching funds to assist developers of technology. The commercialization of technology first requires its demonstration and usage. In this regard, much can be learned from the Norwegians who are deploying cutting-edge technology.

A general argument is that regulation inhibits innovation. Therefore, there have been attempts to amend regulations to make them more performance based and incorporate more flexibility for new technologies. However, there must be some accountability on the part of industry. Nevertheless, the concept of gathering experts and assessing risks should be adopted by regulators facing new technologies.

3.3.1 PROJECT FINANCING

Capital availability is not considered to be a significant obstacle to deepwater operations, as internal cash flows could be utilized for E&P activities in the Gulf. Also, with the current oil and gas prices, there is no shortage of outside capital for investment, whether it originates from conventional sources such as banks, domestic and international, or from unconventional sources such as hedge funds.

The issue of project financing has more to do with project opportunity than with availability of capital. The key to attracting investment is visibility (i.e. knowing what you are investing in). Therefore, information on reservoir characteristics, contracts structure, solidity of contract structure, legal recourses etc. will help accomplish this feat. Visibility attracts capital, but clarity is a key. Thus, capital availability is not an issue. The issue is in what kind of a project one should invest, since there is a great desire to be involved in the oil business.

However, on the downside, escalating costs of drilling rigs and shortages, particularly those capable of deepwater drilling can pose a problem. The long term forecast price of oil, is another reason not to be overly optimistic. In a world where there are only 6 rigs capable of drilling to depth of 5000 feet (with 20 on order and scheduled to be operational by 2009), it is no surprise that it is expensive right now to drill in deepwater (Development of Opportunities in Deepwater Oil and Gas, January 23, 2006). Once the exploration risks are overcome, good return rates can be anticipated but could be potentially more lucrative if gas is also discovered.

3.3.2 UNITIZATION

Unitization is one of several methods which address the joint development of a common hydrocarbon-bearing area sitting astride one or more leases or bisecting an international offshore boundary. It is a new concept that is practiced in countries such as Brazil, which has not experienced the division of resources among companies or states in the past, it is a familiar and regularly practiced process in the United States in places like Texas, Oklahoma, California, and Louisiana (Development of Opportunities in Deepwater Oil and Gas, January 23, 2006).

The purpose of unitization is to: (a) conserve the natural resources; (b) prevent waste; and/or (c) protect correlative rights, including Federal royalty interests. The unitization of leases for exploration, development, and production purposes may be initially approved without the necessity of having a successful exploration well drilled when geophysical data reasonably supports the inclusion of such a lease within a unit. In fact, all leases overlying a common geologic structure should be included in the unit if each has the potential for a well to be drilled to explore and develop all potential hydrocarbon accumulations within the unit area. The appropriate allocation is given after wells are drilled and production is established. Therefore, in accordance with relevant laws and regulations, both nations should be encouraged to pursue the cooperative development of a common area for the mutual benefit of both.

4. TRANS-BOUNDARY RESOURCES IN THE GULF OF MEXICO

The 1978 Treaty between the Government of the United States of America and the Government of the United Mexican States on the Delimitation of a Maritime Boundary in the Western Gulf of Mexico that was signed in 2000. The latter represents a major milestone in territorial sea negotiations, because it not only relies on international law precepts, but on direct political recourses between two States, where it is not clear to whom the resources belong. Moreover, Mexico and the United States shall not claim or exercise for any purpose sovereign rights or jurisdiction over the continental shelf or over its natural resources; and even goes further in limiting the exploitation of natural resources in a band of 10 nautical miles from the boundary set.

Although Mexico does not have experience in the joint development of common hydrocarbon-bearing areas with the United States, it has established the legal framework to address the shared resource issues. Mexico has held two trans-boundary negotiations one with the United States and one with Honduras. The Treaty between the Government of the United States and the United Mexican States on Maritime Boundaries of 1978, based on the principle of equidistance, established the geographic limits of the countries and the sovereign power over the resources contained in that region.

An underlying principle of unitization and/or joint development is the sharing of available technical data across the international offshore boundary. By utilizing this principle the United States and Mexico could establish a framework with which to overcome the hurdles on how to properly develop and allocate common hydrocarbon resources in the Gulf of Mexico. It behooves both the United States and Mexico to move forward on negotiations that could one day lead to joint development of shared resources in the Gulf of Mexico. However, there is some uncertainty as to how the U.S. legal authorities will view the sharing of this information. Nevertheless, the sharing or utilization of data from both sides of the border will be beneficial to both countries.

5. CONCLUSION

Compared to conventional offshore exploration and production activity, deepwater development is frontier territory, but the potential is very large. In the world of risk-reward relationships for upstream investment there is attraction to deepwater areas. There are other advantages to being offshore, among which are acquiring mineral rights, data, etc. However, the trade-off is size of scale of projects, the risk of failure and high costs, and the challenges of being in a marine environment, which is periodically more demanding because of external factors such as the weather. The main challenge to the future of deepwater exploitation is viewed not as a technology issue, but more of a management issue, particularly management of skills. In a frontier experience, industry and government will have to learn by doing because of the pace at which industry is moving to develop deepwater resources. There will have to be a certain amount of flexibility with regard to problem solving, building, and implementing regulatory frameworks, deploying technology and many other activities.

The future of deepwater development of hydrocarbons in the Gulf of Mexico appears to be promising. However, it would require companies, regulators and the research community to develop and refine models of collaboration as the dollar investment in R&D increases. There are tremendous opportunities for many stakeholders once people are mobilized to share information in building a knowledge base that is widely accessible. The benefits to be derived from those activities could lead to a stable and accelerated investment climate and greater opportunity for those willing to take the risk necessary to develop these potential resources.

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