



# GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY



No. 1

December 2009

## ***Research and Development Needs of the U.S. Independent Oil and Gas Producer***

A widely accepted view in the energy sector is that the United States' energy supplies will diversify over the coming decades. New and alternative energy sources will increasingly supplement existing conventional energy sources to meet consumer energy needs at affordable prices. This diversification is useful, because by reducing our reliance on any single energy source it enhances our nation's energy security.

Ensuring that this diversification occurs in a smooth and orderly manner, without economically-damaging disruptions, is fundamentally dependent on advances in science and technology. These advances are necessary to identify new energy sources, reduce generation costs of alternative energy, and to ensure the uninterrupted availability of conventional energy.

This last point is particularly important, because energy is at the heart of the U.S. economy. The new energy future our nation is building rests on a foundation of established, conventional energy sources, including oil and natural gas. These energy sources remain plentiful, even here in the U.S. In fact, as described below, scientific and technological advances have resulted in significant additions to the nation's recognized natural gas and oil resource base.

The role of natural gas in this diversification is growing significantly. In addition to direct use in homes and businesses across America, natural gas is generating electricity when intermittent alternative energy sources are not, is used as a chemical feedstock, and even has potential as a transportation fuel.

Transportation, moving people and goods, is the lifeblood of global commerce. Oil is by far the dominant source of the fuels that power cars, trucks, ships, and planes. It also is a chemical feedstock for many industrial uses. It is a resource that must be used efficiently.

Advanced biofuels, natural gas, and the increasing electrification of the transportation sector are some of the technologies under development for diversifying the fuel mix away from oil. The challenge is making these new energy sources affordable, ensuring they are scalable (i.e., make a significant contribution to the transportation fuel mix), and building the infrastructure necessary to deliver them. This takes scientific and technological advances and time.



## GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

Meanwhile, oil continues to provide the energy that keeps the nation's economic wheels turning.

**Science and technology research and development (R&D) is a critical factor in meeting U.S. energy needs.** Its importance is not restricted to new and alternative energy R&D. In fact, replacing the oil and natural gas consumed today and going forward will require significant technological advancements.

And most of this oil and natural gas will be discovered and developed by a segment of the energy sector that does not have the capacity to conduct its own R&D. This paper focuses on the R&D needs of that group, the U.S. independent oil and natural gas producer.

### **Who is the U.S. independent?**

The U.S. oil and gas industry is composed of two distinct groups of oil and natural gas producers: Vertically integrated majors, which are multinational corporations that not only find and develop oil and gas, but also refine, process, and market petroleum products; and, independent oil and gas producers which find and develop oil and natural gas, but do not engage in refining or marketing activities. Independents are typically classified as small, medium, or large according to number of employees and/or gross revenue.

The U.S. independent community is the backbone of U.S. oil and gas production. According to the Independent Petroleum Association of America (IPAA), a Washington, D.C. based trade association, **independents produce 68% of the nation's oil, 85% of the nation's natural gas, and drill 90% of the nation's oil and natural gas wells.**

The economic value of the independent's operating and production activities are significant in terms of jobs created, tax revenues generated, and domestic oil and natural gas made available to consumers. As IPAA's 2009 Profile of Independent Producers indicates, while independents range from small one-person firms to large corporations, **the median firm is the epitome of American small business:** In business for 26 years with annual gross revenues of nearly \$8 million, and employing 11 full-time and 3 part-time employees. The commercial activities of these firms contribute directly to both U.S. economic health and energy security.

But delivering energy in an efficient and environmentally responsible manner is an increasing technological challenge.

For example, the new emerging shale gas plays, including the Barnett (TX), Fayetteville (OK, AR), Marcellus (NY, PA) and the Haynesville (TX, LA) presently contribute nearly 3 trillion cubic



## **GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY**

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

feet of natural gas annually to U.S. natural gas supply. This is roughly 13% of total U.S. gas consumption. There are other extensive shale bodies across the country currently being explored.

Not long ago natural gas market analysts were concerned the United States would face a natural gas shortage. That scenario looks increasingly unlikely, thanks to geological ingenuity and the application of new technologies. **Science and technology is essential to supplying domestic energy to U.S. consumers, ensuring national energy security and economic well-being.**

The new supply from shale gas has transformed the U.S. natural gas market over the past five years, thanks to the efforts of independent oil and gas producers. It has benefitted consumers by driving down the cost of natural gas, used for home heating and electrical generation. But it was the proper application of new and refined technologies, such as horizontal drilling and hydraulic fracturing, which enabled this success. Optimized and efficient development of these vast resources of natural gas will require continued advances in technology.

### **The U.S. independent business environment**

Science and technology alone are not enough to bring domestic resources to market. It also requires access to land, including public lands, to locate new reserves, and tax and regulatory policies that encourage rather than discourage oil and natural gas production. But as the shale gas plays demonstrate, R&D is a vital component and a source of U.S. competitive advantage.

Independents need advancements in scientific knowledge, technology developments, and policies that improve their ability to do two critical things: (1) extract more oil from old reservoirs that have become uneconomic for large companies, and (2) explore for and produce new petroleum pools, many of which will be too small to interest major companies.

Low production wells and small fields are not interesting to large companies, which typically will not consider an exploration prospect that, if successful, will produce less than ten million barrels. In contrast, independents produce from reservoirs that might only contain 10,000 barrels or less.

For example, oil fields in southeast Kansas, many more than 80 years old, still produce. But many of the producing wells are “stripper wells,” yielding only 1-2 barrels of oil per day, along with large volumes of produced water. Large companies cannot make economic returns on their investment at that scale; many smaller independents can and do.



## **GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY**

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

Similarly, three-dimensional seismic has enabled independents to identify very small petroleum accumulations, which can be produced through a single well. Being able to better delineate the feature using technology enables independents to be more efficient in their drilling, saving the costs of drilling additional unnecessary development wells.

Conversely, if a small independent discovers a large new resource, requiring significant capital investment to develop, they typically sell that to a larger company. Such is the case with the horizontal Bakken play in North Dakota.

**But the same characteristics that enable independents to successfully operate in a low-margin environment by necessity limit their investments in internal research.** As a result, the group responsible for providing the majority of domestic oil and natural gas to U.S. markets is dependent on others for new scientific knowledge and technology.

### **Oil and gas R&D investment**

The trajectory of federal R&D spending on oil and natural gas technologies over the past decade has been one of inexorable decline. The rationale for these funding decreases was that the nation's oil and natural gas producers had access and resources to procure necessary technology for their operations. But while majors typically do have the ability to conduct research and develop new technologies or obtain them from service companies, independents do not.

The goal of a robust federal R&D program in oil and natural gas technologies is to enable and encourage the environmentally-responsible development of the nation's petroleum resources on behalf of the American people.

The need for such a program could not be greater. Exploration and production is changing in three fundamental ways, especially onshore U.S.: (1) exploration targets are typically smaller and more subtle, making them more difficult to find, (2) the emergence of non-traditional resources, such as shale gas, which is transforming the nation's gas markets but requires new scientific understanding, approaches, and tools to realize its full potential, and (3) large capital requirements to conduct successful drilling programs (e.g., a single horizontal well in North Dakota's Bakken play costs about \$8 million).

The Bakken, a buried rock formation found in North Dakota and Montana, provides an illustrative example. In 1995 the U.S. Geological Survey (USGS) estimated that the Bakken formation contained 151 million barrels of oil that could be extracted using currently available technologies. **The USGS updated its estimate in 2006 to 3,650 million barrels of recoverable**



## **GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY**

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

**oil, a 25-fold increase. The difference was improved scientific understanding and technological improvements.**

And yet the State of North Dakota has estimated that using current technologies, oil producers are only recovering an average of 1.4% of the oil actually contained in the Bakken. Recovery factors vary both in the Bakken (0.7% to 3.7%) and from geologic basin to basin, because they are dependent on the geology and other physical conditions in the oil reservoir. We will never produce all of the oil in a particular reservoir. However, even small, incremental gains in recovery can significantly affect the nation's available petroleum reserves. Science and technology are the key.

**Why can't the private independent sector perform the R&D necessary to provide the scientific and technical know-how needed by these smaller operators?** Research requires substantial long-term investment in highly educated and creative people and their technical support, with no assurance of payout.

The capital structure of these smaller companies is such that they can make an adequate return on smaller discoveries, whereas larger firms cannot. Ironically, though, finding these smaller exploration targets requires better technology—technology that may be financially out of reach for these operators. Major oil companies and service companies allocate their research dollars on technology R&D that will produce the largest return (those that will help them find and develop large fields). As a result, many of the topics of interest to independents do not receive R&D investment.

What follows are several domestic independent R&D needs identified by the AAPG Government Affairs Committee R&D Workgroup, based on the input and experience of the workgroup members and AAPG members invited to provide their perspective.

### **R&D needs for the U.S. small independent**

#### *Regional geology*

A small independent oil and gas producer typically employs a small staff of geoscientists and engineers (often one or two) to develop and drill exploration targets. As a result, all effort is focused on the specific lease where the well is drilled. What is often lacking is regional geological context. This includes:

- Geologic mapping.
- Structure and tectonics.
- Stratigraphy and sedimentology.



## GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

- Geochemistry and petroleum systems.
- Basin modeling.

Improved regional-scale understanding of the geology enables independents to develop new exploration concepts and find more subtle oil and gas traps.

Such regional context can be provided by state geological surveys, university faculty and students, and other scientists.

### *Technology R&D*

Independents will target both conventional oil and natural gas deposits and non-traditional oil and natural gas resources, depending on the geology. Both demand technologies that fall in two broad categories: (1) locating the resource, and (2) producing the resource.

Technologies useful for finding the resource are:

- Access to affordable seismic and other geophysical data (esp. 3D data) to develop better exploration targets.
- New techniques for the direct detection of hydrocarbons in the subsurface and seepage at the surface.
- Improved, cost-effective geo-steering and directional drilling tools.
- Next generation low cost, ultra-mobile drill rigs, with a small footprint.

Once a discovery is made, they need:

- Better tools to design and monitor stimulation efforts (e.g., fracturing) to enhance production.
- Cost-effective tools and best practices for enhanced oil recovery (EOR; e.g. water floods, CO<sub>2</sub>-based EOR, which delivers incremental oil and sequesters carbon, new techniques).
- Low emission production technologies to lower well site emissions (e.g., VOCs).

New technologies to enhance safety of exploration and production activities are vital. **A principal consideration with all technology R&D is to ensure the technology is available at a price the target market can afford.**

### *Water management*

Much of the nation's oil and gas resource, especially on federal lands, is in arid parts of the country. Employing best practices for water management at each stage of exploration and production is an important part of responsibly developing his resource. It should include all aspects of managing water:



## **GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY**

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

- Dealing with storm runoff.
- Fugitive waters associated with drilling and other operations.
- Water needed for site operations, fracturing, and water floods.
- Handling produced water.

It should provide planning guidance for designing and building pads and wells. Conserving water during operations and properly disposing of produced waters is a high cost part of a drilling and production budget, an area where enhanced R&D would be useful.

### *Technology transfer*

Getting technology and scientific knowledge from originators into the hands of the small independent is essential. Such transfer can occur through state geological surveys, universities, community colleges, and national organizations such as the Petroleum Technology Transfer Council (PTTC). Small independents are swift adopters of new concepts and technologies once proven effective, but they need access to affordable technology transfer to learn these skills and techniques. The PTTC has been extremely successful delivering such programs. Many independents rely on it to remain abreast of science and technology breakthroughs.

### *Data access and preservation*

The public records contain large amounts of geologic and other data that are essential to successful exploration and development of the nation's petroleum resources. Most of the data still exists only in hard copy format, which requires travel and laborious processing to be useful. Enabling public agencies owning relevant data to make them available in digital form at low cost to operators is necessary. The North Dakota Industrial Commission, the oil and gas regulatory agency of North Dakota has created such a program. It can serve as a model for other states.

Major oil companies can afford to digitize and catalog this data themselves. Independents do not have the means to do this. Yet access to this data is vital to encourage new exploration.

Equally important to find and develop the nation's oil and natural gas is the ongoing preservation and accessibility of cores and cuttings from oil and gas wells. In many states these are warehoused and cataloged by the local geological survey or other local geological or petroleum association. The U.S. Geological Survey (USGS) also maintains large sample repositories. The cost of maintaining and archiving these collections of cores and samples is significant. Existing programs at the USGS, such as the National Geological and Geophysical Data Preservation, are significantly underfunded. They are critical resources, however, for developing new exploration ideas. There are numerous examples where access to stored core



## **GOVERNMENT AFFAIRS COMMITTEE ISSUE ADVISORY**

*Research and Development Needs of the U.S. Independent Oil and Gas Producer*

---

and other samples that had previously not been studied led to significant production increases in older fields.

The objective is making public data available to users in the form they can best use it.

### **Conclusion**

This paper has identified five technical areas essential to enabling the nation's independent oil and natural gas producers to deliver the petroleum resources that U.S. consumers require for everyday living. These areas include:

1. Regional geology.
2. Technology R&D.
3. Water management.
4. Technology transfer.
5. Data access and preservation.

Oil and natural gas exploration and production is a sophisticated and “high-tech” endeavor.

Twenty years ago it would have been unimaginable to remotely steer a drill bit along a particular layer of rock within a foot or two tolerance at a distance of 12,000 feet, two-and-a-half miles below the surface of the earth. Today this type of technology is commonplace, and in fact necessary, to meet the nation's energy needs. Similar advances are necessary to deliver tomorrow's energy.

**Technology continues to drive our nation's search for energy, and entrepreneurial independent oil and natural gas operators will lead the way if we make the necessary R&D investment.**

This issue advisory has been prepared by the DPA Government Affairs Committee as a reference document for the use of the AAPG Geoscience & Energy Office in Washington, D.C. as it communicates with policy makers. The advisory benefitted greatly from the input of the following energy professionals: C. Clark, J. Eppink, L. Gerhard, A. Green, R. Green, W. Lawson, P. Link, P. Methany, V. Rigatti, J. Rogers, R. Sellars, D. Smith, C. Stanley, M. R. Thomasson, L. Watney.

**Carl J. Smith**, Chair  
Government Affairs Cmte

**Lee Gerhard**, Vice Chair  
Government Affairs Cmte

**Paul W. Britt**, President  
Division of Professional Affairs

Issued: December 2009