

## Change and Challenge in the Petroleum Industry



Oil fuels most of the world's economies. Natural gas, particularly its liquefied form, and coal certainly contribute significantly—and are likely to increase in the future—but among the hydrocarbons, oil remains the linchpin that holds up the modern lifestyles advanced countries enjoy and developing countries emulate.

Energy expert Edward L. Morse says, "Petroleum has proven to be the most versatile fuel source ever discovered, situated at the core of the modern industrial economy."<sup>1</sup> In the U.S. in 2003, petroleum supplied 39.1 quadrillion British thermal units (Btu) of total energy consumed, while natural gas accounted for 22.5 quadrillion Btu and coal 22.7 quadrillion Btu.<sup>2</sup>

While the industry is strong, it is subject to some very considerable stresses:

- Industry consolidation (24 mergers and acquisitions since 1997)
- Global industrial expansion resulting in increased petroleum demand
- Tight supplies of economically extractable oil
- Political instability and terrorism
- High per-barrel price that accelerates development of alternative energies
- Safety and the need to protect workers in "hostile" environments
- Knowledge gap due to the anticipated retirement of engineers and scientists
- Being perceived as a good corporate citizen
- Speed required to establish a presence in new markets
- Need to spread infrastructure risk among competitors

These stressors are causing oil companies to change the way they do business. From their cooperation with competitors to their massive investments in technology, from a renewed focus on safety and the environment to serious investigation of alternative fuels, these firms are reshaping the industry. How they manage these changes also influences how they view their real estate holdings and how they house the scientists and engineers who play a vital role in this transformation.

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## A changing industry facing big challenges

In industrialized nations, oil touches nearly every aspect of a person's daily life. Yet few people, from price-sensitive consumers to preoccupied politicians, understand the extent to which this is the case. In the preface to his book *Oil: Anatomy of an Industry*, Matthew Yeoman describes an experiment: He tries to go one day without oil. Leaving his car parked and walking to work will be easy. He runs into obstacles, however, when he tries to eat breakfast (commercial agriculture depends on oil for fuel, fertilizers, herbicides, and pesticides), clean up (soap, shampoo, shaving cream, deodorant, and toothpaste all contain petroleum-based ingredients), and work (as a journalist he depends on a computer and a phone, both encased in plastics made from petroleum).<sup>3</sup>

Indeed, "petroleum" includes all petroleum-based products, such as gasoline, oil, diesel fuel, kerosene, refined cleaners, and solvents.

Organizations involved in upstream (exploring and extracting) and downstream activities (refining and marketing) for these petroleum products are among some of the most profitable companies in the world.

For example, ExxonMobil led U.S.-based oil companies in 2004 with \$25.3 billion in net income, followed by ChevronTexaco at \$13.3 billion and ConocoPhillips with \$8.1 billion. The top five petroleum companies operating in the U.S. (ExxonMobil, ChevronTexaco, BP, ConocoPhillips, and Shell) now control half of all domestic oil production, half of all domestic refinery capacity, and nearly two-thirds of the retail market.

Internationally, three petroleum companies are among the top five largest and the most profitable corporations worldwide. Shell earned \$18.2 billion in net income in 2004, compared to \$16.2 billion for BP (British) and €9.0 billion for TotalFinaElf (French).

As large as they are, these organizations pale in comparison to state-owned oil companies. The governments of such major producers as Saudi Arabia, Mexico, and Venezuela control about 90 percent of the world's known oil reserves and produce almost 70 percent of the world's oil and gas.<sup>4</sup> One consequence of this is a mutual dependence between developed and less-developed countries. "Cash flow from oil and gas production is vital to the economies of many of the world's less developed nations, and oil produced in those nations is in turn

vital to the economies of America, Japan, Germany, and other fully developed nations, as well as rapidly growing nations such as China, Mexico, Russia and the former Soviet bloc nations, Norway, much of the Middle East, and Africa, along with many other nations, need to generate a steady stream of cash from the sale of oil and gas to stay afloat."<sup>5</sup>

Whether they are involved in upstream or downstream activities, whether they are public corporations or state-owned companies, players in the oil industry must operate within the context of significant issues and major trends that are shaping the long-term outlook for oil.

## Coping with growing demand everywhere

Oil companies—public corporations and state- and non-state-owned enterprises—are faced with increasing demand for petroleum products due to global industrial expansion.

According to the Energy Information Administration, "World oil consumption rose in 2003 by about 1.4 million barrels per day, with the industrialized nations accounting for about 55 percent of the increase. Demand in the developing nations rose by 0.7 million barrels per day, and developing Asia accounted for 81 percent of the increase. In 2004, world oil demand is expected to grow by about 1.7 million barrels per day."<sup>6</sup>

In fact, world oil consumption in 2004 jumped by 2.7 million barrels per day, with China and India accounting for much of the increased demand for oil.<sup>7</sup> For example, China more than doubled its use of oil between 1992 and 2002. "Its demand for oil is booming, due both to a rise in its industrial base and to rapidly growing middle and upper classes that are clamoring for automobiles, larger houses, and other energy-guzzling items such as TVs and home computers."<sup>8</sup> India is not far behind. Its use of oil increased 61 percent over the same period.

## Dealing with volatility aboveground

About 63 percent, or 717.9 billion barrels, of the world's known oil reserves are found in six Persian Gulf countries: Saudi Arabia, Iran, Iraq, United Arab Emirates, Kuwait, and Qatar. Russia, Venezuela, Libya, and Nigeria account for another 19 percent, or 217.4 billion barrels. By contrast, two industrialized nations with known reserves,



the U.S. and Canada, claim 47.6 billion barrels, or about 4 percent, while the developing nations of China and Mexico contain 39.7 billion barrels, or about 3.5 percent.<sup>9</sup>

Already, American producers import about 44 percent of the crude oil they refine.<sup>10</sup> In describing America's, and much of the developed world's, predicament, Professor Michael T. Klare notes, "Only the Middle East and other regions that have long suffered from instability and civil unrest have sufficient untapped reserves to satisfy...rising petroleum demand in the years ahead. Like it or not, for as long as we continue to rely on petroleum as a major source of energy, our security and our economic well-being will be tied to social and political developments in these unpredictable and often unfriendly producers."<sup>11</sup>

In some hydrocarbon-rich provinces, changeable fiscal regimes and political risks can derail the best-laid plans and undermine confidence among international oil companies. HIS Energy ranks the political risk in oil-producing countries using a process that rates and weights 11 risk variables under the broad categories of political, socio-economic, and commercial risks, with a specific focus on the upstream oil and gas industry in each country. A recent ranking found these 10 countries, in descending order, at the bottom of the scale: Myanmar (Burma), Israel, Nepal, Sudan, Bolivia, Pakistan, Venezuela, Nigeria, Iraq, and Democratic Republic of Congo.<sup>12</sup>

Unfortunately, many of these same countries pose added security risks for the international oil companies doing business there. While four major attacks on Saudi Arabian compounds and office buildings since May 2003 have not disrupted the flow of oil from the world's largest producer, they demonstrate that terrorists have the oil industry and its infrastructure in their sights.

As militants in the Saudi Arabia look for targets, they have increasingly turned their attention to foreign workers primarily because authorities have tightened security so effectively at critical infrastructure sites the *ihadis* find it's easier to attack employees. "Many people watching the news since May believe the attacks in Riyadh, Khobar, and Yanbu are something new," states Paul Hueper, a U.S.-based expert on global energy-infrastructure security. "There have been fairly continuous and, in fact, an escalating series of attacks against Western interests since late 2000."<sup>13</sup>

### Facing uncertainty underground

Searching for oil is an imprecise science. It has been since the beginning of the oil industry in 1857, when a group of New Haven, Connecticut, investors founded the Pennsylvania Rock Oil Company and hired Edwin Drake to drill for a flammable substance that seeped from the ground.

After more than six months of drilling deep and finding nothing, Drake "had exhausted all the funds of the investors when, out of desperation, they mailed him instructions to abandon the operation. But the letter didn't reach Drake until after he had tried one final well."<sup>14</sup> Sixty-nine feet six inches later, Drake struck oil.

Today, the technology and equipment oil companies use is beyond anything Drake, who borrowed a salt-well drill, could have imagined. ChevronTexaco provides one example of the tremendous investment the major oil companies are making in exploration and production. Using a special ship called the *Discoverer Deep Seas* equipped with powerful 15-foot-diameter propellers that can rotate 360 degrees to keep the ship steady even in 95-mile-per-hour winds, drillers recently went four miles deep in the Gulf of Mexico's Alaminos Canyon area searching for what scientists believed was 200 million barrels of oil. After spending \$50 million, they had nothing but a dry hole, illustrating that even in these days of space-age 3-D seismic studies, wildcatting is still a risky business.<sup>15</sup>

On the one hand, efforts to get at "conventional" oil (produced from underground hydrocarbon reservoirs by means of production wells) have prompted oil companies to invest ever more heavily in technology and equipment. On the other, these firms have increased investments in producing "unconventional" oil, including oil sands, shale oil, and extra heavy crude oil, some of which require additional processing to produce synthetic crude.

To spread the risk of investing in costly technology, equipment, and processes firms are entering into joint-venture relationships designed to spread infrastructure risk among competitors in order for the entire industry to remain healthy. In some cases, firms have sought mergers or acquisitions in order to expand resources for highly technical exploration and advanced production. Since May 1997, there have been over 24 mergers and acquisitions in this industry, including

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ConocoPhillips (November 2001), ChevronTexaco (October 2000), BPAmoco/ARCO (May 1999), and ExxonMobil (December 1998).<sup>16</sup>

Beyond the need for more resources to fund exploration and production, the tendency toward joint ventures, mergers, and acquisitions, particularly in the U.S., isn't surprising given the monopolistic past of the industry. It's as if a group of college friends who spent nearly every waking minute together drifted apart after graduation. Now, years later, their children are dating, and in some cases, getting married. ExxonMobil, for example, can trace its lineage back to companies that operated as part of the original Standard Oil Trust, including the two largest—Standard Oil of New Jersey and Standard Oil of New York. Another five corporations from that era—Atlantic Refining, Waters Pierce, Standard Oil of Indiana, Standard Oil of Nebraska, and Standard Oil of Ohio—constituted most of what by 1998 had become Amoco, and which has since merged with BP.<sup>17</sup>

### Expanding business opportunities

Today, many companies that evolved from the search for oil and the quest to process it into a usable fuel that began in the late 1800s also have significant natural gas operations. The intertwining occurred for the simple reason that their exploration for one often uncovered the other.

Companies involved in both oil and gas—two key sources of energy in industrialized regions and Eastern Europe and the former Soviet Union (EE/FSU)—are in a strong position to take advantage of what the U.S. Department of Energy calls “the fastest growing source of primary energy. Over the 2001-2025 forecast period, consumption of natural gas is projected to increase by 67 percent in the reference case, to 151 trillion cubic feet in 2025.”<sup>18</sup>

As a result, the U.S., China, and Japan are becoming key markets for liquefied natural gas (LNG). “Approximately \$30 billion in new LNG-related projects were underway worldwide as of 2003, with another \$100 billion under consideration. For example, ExxonMobil is participating in a \$10-billion project to develop two LNG facilities in Qatar.”<sup>19</sup>

Other changes on the energy scene, particularly increasing prices for both oil and gas, are prompting several companies to take a broader view of their business. They are transforming themselves through

investments in alternative energy sources, including solar, wind, biomass, geothermal energy, and fuel cell technology.

For example, BP Solar, a subsidiary of BP, is the world's largest maker of solar panels. The company's technological advances have helped reduce the cost of its solar panels by more than 90 percent since 1980 and, with the introduction of new thin-film panels, the company expects its solar operations to become a \$1 billion-a-year business by 2007.

Texaco has created a subsidiary—Texaco Energy Systems—to develop fuel cells as an alternative source of clean power for use in everything from cars to industrial generators. Shell and ExxonMobil also are pursuing fuel-cell technologies. In considering how to “kick the oil habit,” Nicholas Varchaver writes in *FORTUNE* that a \$3.5-billion-dollar-a-year investment in hydrogen fuel cells and biomass fuels “could within two decades replace 20 percent or more of our current oil use. The lion's share of that spending (\$3 billion) should be devoted to a long-term but crucial goal: developing hydrogen technology for cars and electricity generation.”<sup>20</sup>

Many experts agree that hydrogen could eventually eliminate the need for fossil fuels for automobiles and do so without producing greenhouse gases. It may eventually have even more potential as a source of electric power in homes. But, as the American Physical Society recently noted, the leap to fuel cells won't occur without major scientific breakthroughs in at least two areas—developing an efficient, economical, and clean means of producing hydrogen and then finding a cheap, lightweight material that can store hydrogen safely in a car.<sup>21</sup>

Coal gasification to separate hydrogen is currently the most feasible production method, but it has its problems: It uses a lot of energy, and it produces hydrogen that contains contaminants so the fuel must be purified before using it in hydrogen fuel-cell engines. Electrolysis—using electricity to separate hydrogen out of water—is a promising alternative, although it is currently only about 75 percent efficient because a more effective catalyst to facilitate electrolysis doesn't exist.

The realization that alternative fuels and renewable-energy technologies will play an increasingly important role as a bridge between the current focus on hydrocarbons and the clean, cheap promise of hydrogen has prompted many oil companies to invest

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heavily in these areas. To date, Shell has spent \$500 million on renewable energy resources, including solar and wind power. On the other end of the spectrum, Shell is supporting the Canadian company Iogen, which is producing cellulosic ethanol. Made from switchgrass, poplar trees, and straw, cellulosic ethanol yields more energy than corn-based ethanol, yet it can be blended into gasoline and would require minimal modifications to current engines and gas stations.<sup>22</sup>

### Doing more with less faster

The speed required to establish a presence in new markets, which often entails overcoming barriers to doing business, is placing increased pressure on oil companies and their workers to perform. The industry has seen modest gains in productivity, but not to the level that others have attained, according to industry analyst Allen Mesch. "Since 1987, U.S. Oil and Gas Extraction has achieved a 20.6 percent (1987-1999 statistics) improvement in output per employee. The Bureau of Labor Statistics data reveals that the industry was able to provide the same level of output with a decreasing number of employees." Petroleum Refining fared better with an output-per-employee improvement of 65 percent. However, these gains are much less than those for the Computer and Office Equipment (1,718 percent) and Electronic Components and Accessories (992 percent) categories. Even Coal Mining managed an improvement of 104 percent.<sup>23</sup>

That the oil industry has achieved these gains is noteworthy given its shrinking workforce. As Allen Mesch notes, "Since 1981, the U.S. oil and gas industry has lost around 455,900 jobs. From a high of 930,400 employees in 1982, oil and gas employment has declined to 474,500 in 2002.... Eighty-two percent of the job loss occurred in oil and gas extraction. In this classification, oil and gas field services absorbed 60 percent. The primary causes of the loss in jobs are 1) lower oil prices, 2) productivity improvements, 3) corporate mergers and restructuring, and 4) outsourcing."<sup>24</sup>

A bigger challenge to maintaining productivity levels may well come from a knowledge gap due to the retirement of geoscientists and petroleum engineers, particularly in the U.S. Seventy percent of the technical staff involved in oil exploration and production in the United States is between the ages of 41 and 65, while about 20 percent is less than 36 years old. At a recent symposium on the issue hosted

by the University of Houston's Global Energy Management Institute, or GEMI, Tim Holt, vice president of BP onshore operations, said "There's a problem brewing" unless the industry takes steps to bring new talent aboard.<sup>25</sup>

Two factors make the problem worse. First, enrollment in petroleum engineering programs at U.S. colleges and universities now averages 1,500 students, down 85 percent from its peak in 1982. Second, those who graduate are choosing other industries to work in, even though petroleum engineers lead their counterparts in other architectural and engineering disciplines with an annual salary 45 percent above the category average. And, compared to other scientists, geoscientists have an annual salary 29 percent higher than the category average.<sup>26</sup>

The problem reaches across all types of workers who bring knowledge and skill to the industry, not just the petroleum engineers and geophysicists but also the technologists in drilling, reservoir management, production, and exploration who work with them. In 2004, 69 percent of these technologists reported that they have more than 20 years of experience.<sup>27</sup> Allen Mesch says that while "the first half of the 21st century will contain many challenges for the oil and gas industry, one of the major problems will be how to maintain the necessary skills to continue to find and produce oil and gas."<sup>28</sup>

### Workplace Implications

The challenges oil and gas companies face are having a significant impact on how they view their real estate holdings and what kind of workplaces they provide their employees. These are important issues since many companies in this sector have vast real estate holdings. More and more these companies are managing these holdings from an enterprise-wide perspective, running their facilities like any other part of the business. They are realizing that facilities and furnishings can be a strategic tool for achieving the organization's business goals. That focus has several implications for the workplace.

### Achieving a global look for the brand

Several business drivers have prompted major oil companies to work toward a consistent brand appearance, including the need to

- Accommodate mergers and acquisitions,
- Give employees a similar workplace experience,
- Embrace a culturally diverse workforce.

At BP, for example, senior management seized on the occasion of the merger with Amoco to reposition the BP brand. One component of the repositioning was to become an employer of choice. The BP management team established several programs to address this and other areas. Realizing that offices can help change people's behavior, the BP Property Team undertook an initiative called the Blue Chalk protocol. It brought together a broad team of people from human resources, information technology, marketing, and real estate to consider the office of the future at BP and then identify a model that could be used worldwide.

The BP Property Team now uses the Blue Chalk protocol as the basis for discussions with employees who will be involved in a move. Team members supplement the protocol with questions about specific needs regarding privacy, collaboration, and storage. About 80 percent of the time, the Property Team is able to stay very close to the protocol, which means that BP facilities around the world are slowly taking on a similar look that reflects the brand identity.

Architecture and design firms, such as Gensler, report that the global oil companies they work with favor open-plan offices as a way to create equity among global locations. This becomes particularly important in dispelling perceived inequities that can arise as, for example, a European-based employee used to 130 to 150 square feet per person (total rentable area divided by number of people) is reassigned to work for a year in the U.S., where standards can be as much as 450 square feet per person.

While all industries will have more culturally diverse workforces in the coming years, the oil industry is likely to feel this shift sooner. With a significant proportion of their technical workforces due to retire over the next 15 years, oil companies are hiring their replacements all over the world. Unfortunately, petroleum engineers, geophysicists, and MBA graduates, particularly in the U.S. and Europe, tend to perceive petroleum as an aging, "dirty" industry with questionable long-term prospects when compared to working in other industries, such as information technology.

To combat this image, Shell is working hard to provide exciting, well-

designed, motivating places to work. Modeling its approach on new ways of working and flexible work styles similar to a university campus, Shell is introducing a uniform look and feel to its offices around the world through a common design theme, as well as common color schemes, equipment, and furniture. This effort is part of an industry-wide trend that lets regional offices reflect the local culture while adhering to basic global standards.

### Moving from private to open offices

The oil industry as a whole tends to be conservative and take a traditional approach to the workplace, particularly in the U.S. where it reflects the strong organizational hierarchy under which most of the oil companies continue to operate. Individual workstations remain the predominant type, although there are some instances of a shift to more open, collaborative spaces, as well as those that are unassigned, casual, and designed to support a range of communication activities in the work environment.

Depending on the company, where its offices are located, and the type of work being done, offices can be nearly anywhere on a spectrum from private spaces (with four walls, a door, and a window) to very open, highly collaborative environments. At ConocoPhillips, for example, nearly all of the people in the upstream and corporate functions of the business work in private offices, whereas on the downstream side of the business about three-quarters occupy open-plan offices. The Property Management team at ConocoPhillips believes the first group will move into more open offices but only as process and business requirements and cultural issues allow.

At TXU Corporation, a Dallas-based energy company, employees who do most of their work in offices (as compared to field personnel) rely on face-to-face interactions to develop ideas and think through their implementation. As a result, about 60 percent of people work in open-plan environments. TXU senior management thinks this percentage will stay the same for the near future.

At Shell, part of the push toward a global aesthetic that allows a regionally appropriate look involves a move from predominantly single-cell offices to open-plan spaces where groups of people work in a single area without dividers or partitions and sometimes without desks in traditional sizes or shapes. The goal at Shell is to get the majority of its workforce into these open-plan environments with only

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the minority in offices that are largely determined by the function of the job, such as personnel managers and lawyers who require certain levels of visual and acoustical privacy to do their work.

### **Balancing collaboration with density**

According to Gensler, which provides architecture, design, and planning for many of the major oil companies, promoting collaboration is the driving force behind the move from private to open-plan offices. However, as organizations slowly migrate to more open spaces they are requiring high densities that balance the need for collaboration against the cost of facilities. Open-plan offices take up less space per person than single-cell, private offices, which can result in significant cost savings.

With many of their people traveling frequently and working at numerous sites, some organizations are achieving density through desk sharing (“hoteling” or “hot desking”). At Shell, for example, this translates into a ratio of 1.2 people per workstation. At BP, many employees at the company’s UK headquarters stay at home for concentrated, individual work and go into the office to collaborate with others and meet with team members. The company supplies free-access workstations with adjustable furniture and chairs, lockable storage units, and universal connections to phone and data networks to accommodate these drop-in workers. BP also provides meeting rooms, coffee areas, and public spaces designed to foster collaboration.

### **Using technology to boost productivity**

The technology that oil companies provide their employees is leading edge, especially where operational efficiencies can be obtained. Management requires solid benchmark metrics in order to justify investing in technology, but when the numbers are good, the dollars are there to invest.

In particular, mobile employees receive the technology tools they need to work anywhere, including cell phones, personal digital assistants, and laptop computers. An integral part of this support is a common technology infrastructure across the entire organization. To varying degrees at Shell, BP, and ConocoPhillips, for example, an employee can log on and access a common information technology platform to communicate with colleagues and tap into the

corporation’s extensive database of knowledge and best practices.

TXU Corporation, typical of many energy companies, is making large investments in technology to increase productivity and decrease time to market for new products and services. Part of the corporation’s commitment includes appointing a technology officer, independent of the information technology group, whose responsibility is to focus on keeping TXU on the leading edge of technology.

### **Addressing safety in its broadest sense**

Safety continues to be of critical importance at oil and energy companies. This focus affects workplace practices as many organizations think of safety in its broadest sense. With an emphasis on desk sharing and a diverse workforce, companies are providing their employees with furnishings and chairs they can easily adjust to user sizes and preferences, as well as the education they need to use them correctly.

ConocoPhillips, for example, incorporates ergonomic furniture and training into all its facilities. An ambassador program in each location ensures that as new people join a group they receive training. At Shell, managers conduct ergonomics clinics to train employees every time they move to a new workspace.

### **Providing for security of people and places**

Security is a fundamental component of doing business for oil companies. While the events of September 11 brought this issue into starker focus, security has been a concern for some time given the volatile places where these organizations operate. The relatively high profile required for both upstream and downstream operations means that these companies will continue to support extensive security needs in the physical workplace.

### **Becoming a good corporate and environmental citizen**

Bad press, deserved or not, has given major oil companies the impetus to invest heavily in projects that improve the areas where they do business. In some cases, this leads to cooperation among competitors, as when Shell and ExxonMobil jointly built an airport and a school on Sakhalin Island in Russia.

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Most companies have embraced environmental responsibility in the facilities they build and operate. They are incorporating sustainable materials and following guidelines for building and operating environmentally friendly buildings, such as those from the Rocky Mountain Institute and Leadership in Energy and Environmental Design (LEED) from the U.S. Green Buildings Council.

Whatever the stresses the petroleum industry will encounter it is certain that they will translate into changes for the places where employees work. Those changes are likely to occur over a long time, just as oil is likely to retain its importance as the primary fuel of modern economies for the foreseeable future.

- 1 Edward L. Morse, "A New Political Economy of Oil?" *Journal of International Affairs* 53, No. 1 (Fall 1999), p. 2.
- 2 Energy Information Administration, *Annual Energy Outlook 2005 with Projections to 2025* (Washington, D.C.: U.S. Department of Energy, February 2005), Report DOE/EIA-0383(2005).
- 3 Matthew Yeoman, *Oil: Anatomy of an Industry* (New York: The New Press, 2004), xi-xiii.
- 4 Jack W. Plunkett, *Plunkett's Energy Industry Almanac 2004* (Houston: Plunkett Research, Ltd., 2004), Chapter 1, Part 6.
- 5 Jack W. Plunkett, *Plunkett's Energy Industry Almanac 2004*, Chapter 1, Part 6.
- 6 Energy Information Administration, *Short-Term Energy Outlook*, March 2004 on-line version, web site [www.eia.doe.gov/emeu/steo/pub/contents.html](http://www.eia.doe.gov/emeu/steo/pub/contents.html)
- 7 CBC News, "Supply and Demand: World oil markets under pressure," (CBC News Online, April 28, 2005) Available at [http://www.cbc.ca/news/background/oil/supply\\_demand.html](http://www.cbc.ca/news/background/oil/supply_demand.html) (accessed June 6, 2005).
- 8 Jack W. Plunkett, *Plunkett's Energy Industry Almanac 2004*, Chapter 1, Part 17.
- 9 BP, *Energy in Focus: Statistical Review of World Energy* (London: BP, June 2004), p. 4.
- 10 Department of Energy, "Estimated Crude and Products Imports to the U.S. from Leading Supplier Countries," *Petroleum Supply Monthly*, August 2004.
- 11 Michael T. Klare, *Blood and Oil: The Dangers and Consequences of America's Growing Petroleum Dependency* (New York: Metropolitan Books, 2004), p. 20.
- 12 Martin Clarke, "Call the lawyers," *Petroleum Economist*, September 2004.
- 13 James Gavin, "Saudi oil comes under threat," *Petroleum Economist*, July 2004.
- 14 Matthew Yeoman, *Oil: Anatomy of an Industry*, xvi.
- 15 Christopher Helman, "ChevronTexaco takes the big plunge: Oil giant goes to great depths to find new supplies," *Forbes*, October 18, 2004.
- 16 [www.eia.doe.gov/emeu/finance/mergers.html](http://www.eia.doe.gov/emeu/finance/mergers.html) (5/21/2004).
- 17 Matthew Yeoman, *Oil: Anatomy of an Industry*, p. 4, 71.
- 18 Energy Information Administration, "International Energy Outlook 2004," (Washington, D.C.: U.S. Department of Energy, April 2004), Report DOE/EIA-0484(2004), p. 3.
- 19 Jack W. Plunkett, *Plunkett's Energy Industry Almanac 2004*, Chapter 1, Part 5.
- 20 Nicholas Varchaver with Reporter Associates Abraham Lustgarten and Jenny Mero, "How to Kick the Oil Habit," *FORTUNE*, 23 August 2004, p.
- 21 Panel on Public Affairs, "The Hydrogen Initiative," *American Physical Society*, March 2004; available at [http://www.aps.org/public\\_affairs/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=49633](http://www.aps.org/public_affairs/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=49633) (accessed November 22, 2004).
- 22 Nicholas Varchaver with Reporter Associates Abraham Lustgarten and Jenny Mero, "How to Kick the Oil Habit."
- 23 Allen Mesch, "Petrochemicals: The Real Scarce Resource," (Plano, Texas: PetroStrategies, Inc., May 2003), pp. 15-17.
- 24 *Ibid.*
- 25 Marianne Lavelle, "Opportunity Gushed," *U.S. News & World Report*, March 8, 2004.
- 26 Allen Mesch, "Petrochemicals: The Real Scarce Resource," p. 62.
- 27 Monica Perin, "Labor Shortage: Technologists in Short Supply as Industry Continues to Morph," *Houston Business Journal*, June 18, 2004.
- 28 Allen Mesch, "Petrochemicals: The Real Scarce Resource," pp. 66-74.