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The only comprehensive guide to the energy & utilities industry

Jack W. Plunkett

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PLUNKETT'S ENERGY INDUSTRY ALMANAC 2013

Editor and Publisher:
Jack W. Plunkett

Executive Editor and Database Manager:
Martha Burgher Plunkett

Senior Editors and Researchers:
Jeremy Faulk
Jill Steinberg

Editors, Researchers and Assistants:
Kalonji Bobb
Elizabeth Braddock
Alex Grandstaff
Andrew Gustafson
Jillian Claire Lim
Isaac Snider
Suzanne Zarosky

Enterprise Accounts Manager:
Meghan Zarate

Information Technology Managers:
Seifelnaser Hamed
Vin Phung

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Plunkett Research®, Ltd.
P. O. Drawer 541737, Houston, Texas 77254 USA
Phone: 713.932.0000 Fax: 713.932.7080
www.plunkettresearch.com

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P. O. Drawer 541737
Houston, Texas 77254-1737
Phone: 713.932.0000, Fax: 713.932.7080 www.plunkettresearch.com

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PLUNKETT'S ENERGY INDUSTRY ALMANAC 2013

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INTRODUCTION

PLUNKETT'S ENERGY INDUSTRY ALMANAC, the twelfth edition of our guide to the energy field, is designed to be used as a general source for researchers of all types.

The data and areas of interest covered are intentionally broad, from the various types of businesses involved in energy and utilities, to advances in nuclear power and renewable energy sources, to an in-depth look at the major firms (which we call "THE ENERGY 500") within the many industry sectors that make up the energy arena, from upstream and downstream oil and gas companies, to coal producers, oil field services and utilities companies.

This reference book is designed to be a general source for researchers. It is especially intended to assist with market research, strategic planning, employment searches, contact or prospect list creation and financial research, and as a data resource for executives and students of all types.

PLUNKETT'S ENERGY INDUSTRY ALMANAC takes a rounded approach for the general reader. This book presents a complete overview of the energy field (see "How To Use This Book"). For example, advances in oil shale and tar sands production are discussed, as well as the deregulation of the utilities industry, volatility in the price of oil, gas and coal, extremely deep offshore wells and production in Russia.

THE ENERGY 500 is our unique grouping of the biggest, most successful corporations in all segments of the energy industry. Tens of thousands of pieces of information, gathered from a wide variety of sources, have been researched and are presented in a unique form that can be easily understood. This section includes thorough indexes to THE ENERGY 500, by geography, industry, sales, brand names, subsidiary names and many other topics. (See Chapter 4.)

Especially helpful is the way in which PLUNKETT'S ENERGY INDUSTRY ALMANAC enables readers who have no business background to readily compare the financial records and growth plans of energy companies and major industry groups. You'll see the mid-term financial record of each firm, along with the impact of earnings, sales and strategic plans on each company's potential to fuel growth, serve new markets, and provide investment and employment opportunities.

No other source provides this book's easy-to-understand comparisons of growth, expenditures, technologies, corporations and many other items of great importance to people of all types who may be studying this, one of the largest and most complex industries in the world today.

By scanning the data groups and the unique indexes, you can find the best information to fit your personal research needs. The major companies in energy are profiled and then compared using several different groups of specific criteria. Which firms are the biggest employers? Which companies earn the most profits? These things and much more are easy to find.

In addition to individual company profiles, an overview of energy and utility markets and trends is provided. This book's job is to help you sort through easy-to-understand summaries of today's trends in a quick and effective manner.

Whatever your purpose for researching the energy field, you'll find this book to be a valuable guide. Nonetheless, as is true with all resources, this volume has limitations that the reader should be aware of:

- Financial data and other corporate information can change quickly. A book of this type can be no more current than the data that was available as of the time of editing. Consequently, the financial picture, management and ownership of the firm(s) you are studying may have changed since the date of this book. For example, this almanac includes the most up-to-date sales figures and profits available to the editors as of late-2012. That means that we have typically used corporate financial data as of the end of 2011.

- Corporate mergers, acquisitions and downsizing are occurring at a very rapid rate. Such events may have created significant change, subsequent to the publishing of this book, within a company you are studying.

- Some of the companies in THE ENERGY 500 are so large in scope and in variety of business endeavors conducted within a parent organization, that we have been unable to completely list all subsidiaries, affiliations, divisions and activities within a firm's corporate structure.

- This volume is intended to be a general guide to a vast industry. That means that researchers should look to this book for an overview and, when conducting in-depth research, should contact the specific corporations or industry associations in question for the very latest changes and data. Where possible, we have listed contact names, toll-free telephone numbers and Internet site addresses for the companies, government agencies and industry associations involved so that the reader may get further details without unnecessary delay.

- Tables of industry data and statistics used in this book include the latest numbers available at the time of printing, generally through the end of 2011. In a few cases, the only complete data available was for earlier years.

- We have used exhaustive efforts to locate and fairly present accurate and complete data. However, when using this book or any other source for business and industry information, the reader should use caution and diligence by conducting further research where it seems appropriate. We wish you success in your endeavors, and we trust that your experience with this book will be both satisfactory and productive.

Jack W. Plunkett
Houston, Texas
December 2012

HOW TO USE THIS BOOK

The two primary sections of this book are devoted first to the energy industry as a whole and then to the "Individual Data Listings" for THE ENERGY 500. If time permits, you should begin your research in the front chapters of this book. Also, you will find lengthy indexes in Chapter 4 and in the back of the book.

Video Tip
For our brief video introduction to the Energy industry, see www.plunkettresearch.com/video/energy.

THE ENERGY INDUSTRY

Chapter 1: Major Trends Affecting the Energy Industry. This chapter presents an encapsulated view of the major trends that are creating rapid changes in the energy and utilities industry today.

Chapter 2: Energy Industry Statistics. This chapter presents in-depth statistics on production, usage, reserves and more.

Chapter 3: Important Energy Industry Contacts – Addresses, Telephone Numbers and Internet Sites. This chapter covers contacts for important government agencies, energy organizations and trade groups. Included are numerous important Internet sites.

THE ENERGY 500

Chapter 4: THE ENERGY 500: Who They Are and How They Were Chosen. The companies compared in this book (the actual count is 498) were carefully selected from the energy and utilities industry, largely in the United States. 219 of the firms are based outside the U.S. For a complete description, see THE ENERGY 500 indexes in this chapter.

Individual Data Listings:

Look at one of the companies in THE ENERGY 500's Individual Data Listings. You'll find the following information fields:

Company Name:

The company profiles are in alphabetical order by company name. If you don't find the company you are seeking, it may be a subsidiary or division of one of the firms covered in this book. Try looking it up in the Index by Subsidiaries, Brand Names and Selected Affiliations in the back of the book.

Industry Code:

Industry Group Code: An NAIC code used to group companies within like segments. (See Chapter 4 for a list of codes.)

Types of Business:

A listing of the primary types of business specialties conducted by the firm.

Brands/Divisions/Affiliations:

Major brand names, operating divisions or subsidiaries of the firm, as well as major corporate affiliations—such as another firm that owns a

significant portion of the company's stock. A complete Index by Subsidiaries, Brand Names and Selected Affiliations is in the back of the book.

Contacts:

The names and titles up to 27 top officers of the company are listed, including human resources contacts.

Growth Plans/ Special Features:

Listed here are observations regarding the firm's strategy, hiring plans, plans for growth and product development, along with general information regarding a company's business and prospects.

Financial Data:

Revenue (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents consolidated worldwide sales from all operations. These numbers may be estimates.

R&D Expense (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents expenses associated with the research and development of a company's goods or services. These numbers may be estimates.

Operating Income (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents the amount of profit realized from annual operations after deducting operating expenses including costs of goods sold, wages and depreciation. These numbers may be estimates.

Operating Margin % (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure is a ratio derived by dividing operating income by net revenues. It is a measurement of a firm's pricing strategy and operating efficiency. These numbers may be estimates.

SGA Expense (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents the sum of selling, general and administrative expenses of a company, including costs such as warranty, advertising, interest, personnel, utilities, office space rent, etc. These numbers may be estimates.

Net Income (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents consolidated, after-tax net profit from all operations. These numbers may be estimates.

Operating Cash Flow (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure is a measure of the amount of cash generated by a firm's normal business operations. It is calculated as net income before depreciation and after income taxes, adjusted for working capital. It is a prime indicator of a company's ability to generate enough cash to pay its bills. These numbers may be estimates.

Capital Expenditure (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure represents funds used for investment in or improvement of physical assets such as offices, equipment or factories and the purchase or creation of new facilities and/or equipment. These numbers may be estimates.

EBITDA (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure is an acronym for earnings before interest, taxes, depreciation and amortization. It represents a company's financial performance calculated as revenue minus expenses (excluding taxes, depreciation and interest), and is a prime indicator of profitability. These numbers may be estimates.

Return on Assets % (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure is indicator of the profitability of a company relative to total assets. It is calculated by dividing annual net earnings by total assets. These numbers may be estimates.

Return on Equity % (2012 or the latest fiscal year available to the editors, plus up to five previous years): This figure is a measurement of net income as a percentage of shareholders' equity. It is also called the rate of return on the ownership interest. It is a vital indicator of the quality of a company's operations. These numbers may be estimates.

Debt to Equity (2012 or the latest fiscal year available to the editors, plus up to five previous years): A ratio of the company's long-term debt to its shareholders' equity. This is an indicator of the overall financial leverage of the firm. These numbers may be estimates.

Address:

The firm's full headquarters address, the headquarters telephone, plus toll-free and fax numbers where available. Also provided is the World Wide Web site address.

Stock Ticker, Exchange: When available, the unique stock market symbol used to identify this firm's common stock for trading and tracking purposes is indicated. Where appropriate, this field may contain "private" or "subsidiary" rather than a ticker symbol. If the firm is a publicly-held company headquartered outside of the U.S., its international ticker and exchange are given.

Total Number of Employees: The approximate total number of employees, worldwide, as of the end of 2011 (or the latest data available to the editors).

Parent Company: If the firm is a subsidiary, its parent company is listed.

Salaries/Bonuses:

(The following descriptions generally apply to U.S. employers only.)

Highest Executive Salary: The highest executive salary paid, typically a 2011 amount (or the latest year available to the editors) and typically paid to the Chief Executive Officer.

Highest Executive Bonus: The apparent bonus, if any, paid to the above person.

Second Highest Executive Salary: The next-highest executive salary paid, typically a 2011 amount (or the latest year available to the editors) and typically paid to the President or Chief Operating Officer.

Second Highest Executive Bonus: The apparent bonus, if any, paid to the above person.

Other Thoughts:

Estimated Female Officers or Directors: It is difficult to obtain this information on an exact basis, and employers generally do not disclose the data in a public way. However, we have indicated what our best efforts reveal to be the apparent number of women who either are in the posts of corporate officers or sit on the board of directors. There is a wide variance from company to company.

Hot Spot for Advancement for Women/Minorities: A "Y" in appropriate fields indicates "Yes." These are firms that appear either to have posted a substantial number of women and/or minorities to high posts or that appear to have a good record of going out of their way to recruit, train, promote and retain women or minorities. (See the Index of Hot Spots For Women and Minorities in the back of the book.) This information may change frequently and can be difficult to obtain and verify. Consequently, the reader should use caution and conduct further investigation where appropriate.

Glossary: A short list of energy industry terms.

Chapter 1

MAJOR TRENDS AFFECTING THE ENERGY INDUSTRY

Major Trends Affecting the Energy Industry:

1) Energy Industry Introduction
2) Proposals for U.S. Electricity Grid Enhancements Include a "Smart Grid," Regional Transmission Organizations (RTOs) and Technologies such as Flow Cell Batteries
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16) Clean Coal and Coal Gasification Technologies Advance/Carbon Capture (CCS) Proves Costly
17) The Industry Takes a New Look at Nuclear Power
18) Ethanol Production Soared, But U.S. Federal Subsidy Expires
19) New Refineries and Petrochemicals Plants Add to Capacity/Take Advantage of Cheap Natural Gas on the Gulf Coast
20) Energy Intensity Is a Prime Focus in China/U.S. Achieves Dramatic Energy Intensity Results and Lowers Future Energy Needs
21) America on Track to Lead the World in Oil Production by 2017

1) Energy Industry Introduction

Video Tip
For our brief video introduction to the Energy industry, see www.plunkettresearch.com/video/energy.

There is a broad, global focus today on energy as an economic, geopolitical and strategic resource. Some of the world's leading nations, such as Canada and Brazil, are intent on fully developing their oil and gas production. Others, such as China, are focused on purchasing interests in foreign reserves and expertise. Advanced technologies, including 3D seismic, hydraulic fracturing and directional drilling, have opened up exceptional new levels of oil and gas discovery and production around the world.

In addition, there is a greater focus than ever before on the impact of energy production and consumption on the environment. Certain nations, particularly the UK and those in the EU, have very ambitious goals to reduce consumption of fossil fuels. Worldwide, investment in the development and implementation of clean or renewable energy technologies, as well as energy conservation, will be a major priority of many governments and industries. However, this level of interest may be subject to fluctuations in the economy and the price of crude oil and natural gas. The emphasis will vary widely from nation to nation, ranging from cleaner ways to burn the world's immense stores of coal; to the construction of advanced-technology nuclear generating plants that are exponentially safer than older models; to the use of advanced, more cost-effective renewable technologies based on solar, wind and wave power.

Nonetheless, with the exception of hydroelectric power, renewable energy sources remain vastly more costly to implement than fossil fuel-based generators (primarily coal and natural gas). This means that they require significant government subsidies, loan guarantees or incentives in order to cover the costs. As governments in developed economies in Europe, along with the United States, continue to struggle with large deficits and debts, their willingness to back costly renewable energy projects may be dampened significantly. Japan, on the other hand, while facing economic challenges, will maintain a keen interest in alternative energy sources, since it has essentially no fossil fuel supplies of its own and it has changed strategies due to its nuclear disaster of March 2011.

The most important emerging nations are investing heavily in alternative energy sources, while continuing to use growing quantities of fossil fuels. China leads the world in investment in new nuclear plants, and it is installing vast numbers of wind turbines and solar facilities. India is likewise planning multiple new nuclear plants. Brazil continues to be a leader in the low cost production and use of ethanol as a transportation fuel, while developing some of the world's most important new offshore oil and gas fields.

Despite immense demand for energy, supply will remain abundant for the foreseeable future. Better science, technology and engineering are being applied to exploration, production, conservation and distribution alike, with great success. Mature economies such as the United States and leading nations in Europe are benefitting greatly from the world's rapidly growing supplies of natural gas (with the growth in supply coming largely from shale formations) as well as a steady supply of crude oil (with steady growth in shale oil fields, deep offshore wells and Canada's tar sands). Conversely, total energy usage in these mature economies is on a path of decline or slow growth. For example, analysts at BP estimate that American consumption of primary energy sources (such as coal, natural gas and crude oil) declined by a bit more than 1% from 2000 to 2010.

In China, however, the same measure increased by 134%, while the increase was 77% in India. Emerging economies will burn vast amounts of coal and other fossil fuels while their total energy usage continues to soar. This is where the growth in consumption, and related emissions and pollution, is essentially unavoidable for the near future in rapidly rising economies that are adopting modern industrialization, transportation (including millions of new automobiles yearly), business services and housing, with all of the energy consumption that such development demands.

Dramatic shifts in the global energy supply are occurring. Iraq, home to some of the world's largest oil reserves, is expected to begin significant increases in production thanks to increased foreign investment. The International Energy Agency (IEA) forecasts that Iraq's output will grow from 3 million barrels per day in 2012 to 6 million by 2020, and 8 million by 2035.

The IEA forecast in late 2012 that the United States will become almost self-sufficient in energy by 2035, on a net basis accounting for imports and exports. This is due largely to growing oil and gas output, but also to increasing efficiency and

conservation as well as renewables. The IEA further forecast that the U.S. would be the world's leading oil producer by 2017, overtaking Saudi Arabia and Russia. This trend is accelerated by the boom in oil shale fields such as the Eagle Ford in Texas and the Baaken in the North Dakota/Montana area.

Meanwhile, very exciting technologies continue to bolster nearly all facets of the energy sector, from green technologies applied to electricity conservation, to tremendous advances in oil and gas exploration technologies, to highly evolved safer nuclear technologies. At the same time, many renewable energy technologies, such as thin-film solar, concentrated solar and wave power to name but a few, are also making significant advances thanks to substantial improvements in engineering and design. Nanotechnology, an exciting materials science, is about to find broad applications in energy production and consumption with tremendous results.

As of October 2012, 3,458 drilling rigs were active worldwide, down significantly from the previous year's total of 3,722. Of that count, 1,834 were in the U.S., down from 2,017 a year earlier. These numbers are from oil field services giant Baker Hughes.

Global Energy Numbers:

Oil: According to the latest data available from analysts at energy giant BP, the world produced 83.5 million barrels of oil daily in 2011, up 1.3% from 2010. This includes unconventional petroleum output from such sources as oil sands, as well as natural gas liquids. However, it does not include alternative sources such as oil from biomass and coal derivatives.

Oil consumption in 2011 averaged 88.0 million barrels per day, up 0.7% from 2010. In the U.S., consumption of oil fell by 1.9% to 18.3 million barrels daily, accounting for 20.5% of global consumption, down from 23.9% in the peak year of 2007. China accounted for 11.4% of global consumption, while India accounted for 4.0%. Proven reserves worldwide totaled 1.652 trillion barrels at the end of 2011, up from 1.622 trillion the previous year.

Natural Gas: According to BP, global production of natural gas was 3,276 billion cubic meters in 2011, up 3.1% from 3,178 billion cubic meters the previous year. This increase in production is due largely to shale gas.

Global natural gas consumption was 3,222.9 billion cubic meters in 2011, up 2.2% over the previous year. (The U.S. consumed 21.5% of that total. Europe and Eurasia consumed 34.1%.)

Proven reserves totaled 208.4 trillion cubic meters, enough to last several decades at today's consumption rates. Massive discoveries of natural gas in shale formations in the U.S. and elsewhere are rapidly altering the gas industry. Likewise, vast investments in LNG infrastructure are enabling international shipment of gas from production areas such as Qatar and offshore Australia to major markets in China, Europe and elsewhere. Contracts for delivery of LNG from U.S. gas fields to be shipped to Europe have recently been signed.

Coal: Analysts at BP estimate that global production of coal was 3,955 million tons of oil equivalents in 2011, up 6.1% over the previous year. Consumption was 3,724 million tons of oil equivalent, up 5.4% over 2010.

The largest emerging nations are hooked on coal. China accounted for 49.4% of the world's consumption in 2011, up from 42.6% in 2008. India accounted for only 7.9% of global consumption, but its usage was up 9.2% over the previous year. The U.S., where much of electric generation is fired by coal, used only 13.5% of world consumption, down from 14.8% the previous year. Europe and Eurasia used 13.4% of total world consumption.

Global coal reserves are massive at 860,938 million tons, or enough to last about 250 years at today's consumption rates. The U.S. holds 27.6% of those reserves; Europe and Eurasia 35.4%; China 13.3%; and Australia 8.9%.

America's Energy Numbers:

Natural gas production in the U.S. increased by 7.7%, to 651.3 billion cubic meters, a 20% share of the world's total. (U.S. proven reserves of natural gas soared by 80.8% from 1991 to 2011, as both shale gas and deepwater offshore discoveries have been very significant.)

The Department of Energy estimates oil production was 5,662 thousand barrels per day, from 536,000 wells, during 2011. (Production was up significantly from 5,476 thousand barrels per day in 2010, and 4,950 thousand barrels per day at the recent low in 2008.)

While production in many of America's largest fields, such as the North Slope in Alaska, is in decline, investments in offshore production, enhanced recovery in older fields and newly drilled shale oil wells have paid off handsomely. Nonetheless, total production is down dramatically from the 1970 peak of 9,630 million barrels of oil.

(Part of the problem is that Alaskan production peaked in 1988.) However, as the nation's natural gas industry has been growing very quickly, and new production has ensued thanks largely to wells in shale, the total production picture of both oil and gas has improved dramatically, especially when natural gas liquids, or oil that is stripped from natural gas during processing, are included. (These gas liquids amounted to 2,183 thousand barrels per day of oil equivalent during 2011, and have been rising very rapidly.)

Historically, America's use of petroleum led to an increase in annual net (after deducting exports) petroleum imports from 3,161 thousand barrels per day in 1970 to a peak of 12,549 thousand barrels daily in 2005. Since then, however, the number has been dropping steadily. In fact, the drop was 1,005 thousand barrels daily from 2010 (9,441) to 2011 (8,436). New American oil production, both onshore and offshore, has been a driver of this dramatic decline in imports. Meanwhile, the source of those imports has changed as well. Thanks to booming output in areas outside of the Persian Gulf, including such areas as Canada, Brazil and the West Coast of Africa, America's reliance on OPEC and Middle Eastern nations for oil has plummeted. By 2011, America received only 49.2% of its oil imports from OPEC members (when measured in dollars), down from 73.1% in 1980. America's imports from Persian Gulf nations such as Saudi Arabia are now significantly less important than they were 30 years ago.

Only 148 refineries operated in America as of 2011, down by about 50% from 1980. However, these remaining refineries have invested heavily in additional capacity to the extent that their total refining output has grown, despite the fall in the total number of refineries. America's substantial new oil and gas production combined with the expansion of existing refiners made the U.S. a net exporter of refined petroleum products in 2011, for the first time since 1949.

Total American consumption of energy of all types was 97,301,269 billion BTUs in 2011, having grown about 50% since 1970. Consumption in 2011 was down slightly from the previous year. More importantly: in terms of BTUs consumed per year per capita, American energy use is in a steady long-term decline. That is, while the number of automobiles and aircraft per capita has grown dramatically; along with vast growth in the percentage of homes and buildings that are air conditioned; combined with tremendous increases in the number of appliances, computers and entertainment devices per person; efficiency has grown to the extent that the energy consumption of an average American declined from a peak in 2000 of 351 million BTUs yearly, to only 312 million in 2011.

By another measure, energy use per unit of economic output has fallen dramatically. On an inflation-adjusted basis, energy consumption per dollar of GDP (gross domestic product) dropped from 17.99 thousand BTUs in 1970 to only 7.28 thousand BTUs in 2009.

According to the U.S. Department of Energy, electric generation in America as of 2011 used the following ratio of fuels: coal 42.2%; nuclear 19.5%; natural gas 25.0%; hydroelectric 7.92%; and non-hydro renewables such wind and solar, at 4.75%.

U.S. consumers have shown a true sea change in their preferences and priorities as a result of higher energy prices, and the era of the gas-guzzling, giant family trucks or SUVs as a standard is over. Meanwhile, consumers and businesses alike are increasingly willing to invest more in the initial cost of green buildings, high-efficiency appliances and equipment and energy-saving transportation equipment, with the promise of lower energy costs for daily operation.

Thanks to the development of advanced technologies for producing gas from America's immense shale formations, available gas reserves are growing at a rapid rate with no end in sight. This trend is revolutionizing the gas and petrochemicals industry, while keeping natural gas prices at very modest levels. Technologies used in shale gas fields, including horizontal drilling and hydraulic fracturing, are now being used in large measure in shale oil fields.

Oil Prices and Total Reserves:

Ever since William Hart dug America's first successful gas well in Fredonia, New York in 1821, and "Colonel" Edwin Drake drilled the first true U.S. oil well in the state of Pennsylvania in 1859, the ability of oil and natural gas to power electric generation plants, transportation, homes and industry has created both immense economic advances and significant controversy. Many times it has been assumed that the world would quickly run out of oil. In 1939, the U.S. Department of the Interior warned that America's oil reserves totaled only enough to fuel the nation for about 13 years. Similar misjudgments were announced on a regular basis in the mid to late 1900s by the federal government and

by a continuing stream of respected reports and books by various authors. In fact, rather than becoming scarcer over time, energy, including oil and gas, became much more plentiful. Energy prices can fluctuate wildly. Nonetheless, over much of history the trend has often been lower prices on an inflation-adjusted basis, when a combination of advancing technologies, determined entrepreneurs and alternative sources exponentially expanded the total amount of energy and reserves available for consumption. The breakthrough in shale gas in recent years is a perfect example.

An estimate of crude oil resources on a global basis, published by Cambridge Energy Research Associates in 2006, was 4.82 trillion barrels—enough to take care of the world's needs for more than 100 years. This number included oil shale and other sources that are relatively difficult to tap. Technologies will continue to be enhanced, enabling the recovery of significant portions of these resources, as long as the market price of energy is high enough to justify necessary investments in technology, exploration, development, production and distribution.

There have long been periods of major fluctuations in price for oil, coal and natural gas. Energy consumers of all types, from residential consumers to transportation firms to industrial plants, have seen oil and gas prices swing wildly, and they have often suffered the economic effects of greatly increased energy costs. Strong global demand for energy combined with political strife in many oil exporting nations could easily lead to a long-term period of relatively high market prices for crude oil. The price of Arabian light crude oil rose from about $1.85 per barrel in 1972 to about $40 in 1981 during an "energy crisis," the peak price for many years to come. Adjusted for inflation, that $40 barrel of oil would have been $100 or so in 2012 dollars.

More recently, during 1986 and again in 1998, the price of a barrel of oil plummeted to about $10 in a short period of time. However, prices generally rose from 2003 through early 2008. In the fall of 2005, the post-Hurricane Katrina price of a barrel of light U.S. crude oil peaked just shy of $70 as the extent of the damage to Gulf Coast production became apparent. The price of natural gas more than doubled from June through October 2005, rising from about $6 to nearly $16 per million BTUs for spot market prices, compared to only about $3.50 during November 2012.

In mid-2006, the price of light U.S. crude peaked at about $80. By late 2007, it had neared $100. By mid-2008 it was over $145, but plummeted quickly into the $60s when the global financial crisis of 2008-09 slowed economies worldwide. Another significant factor in the price of a barrel of oil is the value of the U.S. dollar relative to other currencies. During recent years, the dollar has been in a lengthy slide in value, causing the price of oil (which is priced in U.S. dollars on world markets) to rise when reported in dollar terms. Of course, the value of the dollar is not the sole factor regulating the price of a barrel of oil, but it is a very important contributing factor.

Recent higher prices for oil and gas put a new emphasis on production from alternative (or "unconventional") sources such as tar sands in Canada. These fields are significantly more expensive to produce than conventional fields. Meanwhile, offshore exploration and production will continue to be emphasized in many parts of the world, with sophisticated rigs drilling ever deeper to tap massive reservoirs, using technologies that enable the rigs to go to depths undreamed of 20 years ago. Vast new investments in very deep offshore wells in the Gulf of Mexico brought significant new production to the American market. Outside the U.S., the industry is investing quickly and heavily in deep wells offshore of Africa, Brazil and elsewhere.

Consumers and business organizations alike are attempting to insulate themselves from high energy costs. Many are reacting with new conservation efforts. For example, Toyota's hybrid-powered automobiles have been a huge success. Greatly enhanced building materials and appliances that provide much greater energy efficiency are becoming standard in developed nations. Meanwhile, the growing industrial base and middle class in many parts of the globe, particularly India and China, are putting new strains on energy supplies while energy emissions are creating new environmental concerns.

A significant portion of oil consumption is used as fuel for transportation, including cars, aircraft and trucks. There is no end in sight to the need for power and fuel in developed and emerging economies such as the U.S., the European Union, Japan, India and China. Although the world has made an immense investment in electric supply infrastructure, as much as one-third of the world's population either has no access to, or cannot afford, a steady supply of electricity.

In 1892, Thomas Alva Edison established the Pearl Street Station in New York City—the world's first central electric power station. By the 1920s, electricity was in common use in American buildings

and homes. Fuels for electric generation vary widely around the globe, but coal and natural gas are common sources. In Europe, a large portion of electricity is generated by nuclear plants, especially in France, and massive investments are being made in European solar and wind generation. A looming question is whether America and major nations in Europe will resume significant construction of nuclear generation plants. The fact that several nuclear plants were destroyed by a tsunami at Fukushima, Japan in early 2011 makes significant new development of nuclear sites even more controversial. Meanwhile, advanced generation nuclear technologies have the potential to provide much greater operating efficiencies with vastly increased safety over the plants constructed in earlier years, and the nations of China, India, Saudi Arabia and the UAE are likely to move ahead with massive nuclear plant construction plans that are already in place. China may construct as many as 90 new nuclear plants over the long term.

2) Proposals for U.S. Electricity Grid Enhancements include a "Smart Grid," Regional Transmission Organizations (RTOs) and Technologies such as Flow Cell Batteries

In the U.S., the networks of local electric lines that businesses and consumers depend on every day are connected with and interdependent upon a national network of major lines collectively called "the grid." The grid is divided into three major regions, named East, West and Texas. The regions are also known as "interconnects." In total, the grid consists of about 200,000 miles of high-voltage backbone lines and millions of miles of smaller local lines.

The grid is one of the most reliable electricity delivery platforms in the world, but it is far from perfect, and deregulation of the electricity industry created intense problems. Unfortunately, much of this grid was designed and constructed with technology developed in the 1950s and 1960s, and it was never intended to carry the amazing amount of power that today's electricity-hungry Americans consume. Simply put, the grid is out of date. For example, while electric consumption zoomed ahead by about 35% during the 1990s, the transmission capacity of the grid grew by only about 15%.

When a local utility system needs more power than it is generating, it can draw upon the grid. (In fact, many utility companies in America have no generating capacity at all and draw all of their power from the grid as they resell it to end users.) Conversely, when a generating system is producing more power than is needed locally, it can push power into the grid for other areas to use.

Since electricity cannot be easily stored in large volume for future use, the grid is absolutely vital in smoothing out the fluctuations that occur in supply and demand. Unfortunately, the grid suffers from a long list of inadequacies. For example, about 7% of the energy pushed into the grid is lost during transmission. An even higher amount can be lost when transmission is over great distances. Also, the grid has bottlenecks, or distribution squeezes, particularly in densely populated areas like New York City and San Francisco. This means that utilities cannot always get all of the electricity they need to meet local demand, and blackouts or shortages occur.

In addition to these mounting problems, the grid is suffering from old age. As electricity demand increases, the grid is going to have serious difficulty delivering as needed. Meanwhile, wind and solar plants are being constructed in remote locations and require significant extensions of major power lines in order to get their electricity into the grid for distribution.

Proposed solutions to the U.S. electricity grid's problems range from reorganization to massive investments in advanced computerization to barely proven technologies. Some engineers promote the use of immense, high-capacity batteries called "flow cell batteries" to store enough excess electricity to make the grid much more flexible and reliable. The use of large-scale storage systems scattered around the grid would mean that generating companies could create excess power during periods of slow demand, store that electricity and then sell it through the grid a few hours later when demand picks up. It would also mean that spikes in demand, such as the demand caused by air conditioners turned on during an extremely hot summer afternoon, could be served quickly by drawing on stored power. A few of these large battery energy storage systems are already in place in Japan, Australia, Alaska and Utah. Others are being tested in several locations worldwide.

Battery systems such as these not only add reliability to an electricity grid system, they also lower costs and improve efficiency. For example, wholesale power can be purchased at night, when demand and energy prices are low, and then sold the next day during peak hours for a premium.

New technology may eventually enable batteries to store the high current necessary for utility-scale storage. MIT has developed liquid metal batteries that use a liquid electrolyte made from metals and heated to 700 degrees Celsius (1,292 degrees Fahrenheit) to maintain a molten state. Meanwhile, start-up Seeo, www.seeo.com, is making a solid state battery of a polymer electrolyte material that would last longer than other batteries and store more energy.

SPOTLIGHT: Battery Energy Storage Systems

For more information on battery energy storage systems, check the following company web sites:
Aquion Energy www.aquionenergy.com
Prudent Energy www.pdenergy.com
A123 Systems www.a123systems.com

Other super-capacity storage technologies include flywheels, pumped hydro storage and compressed air energy storage. (A lack of efficient, large-scale storage systems has also been one of the factors holding back the development of solar power.) For additional thoughts along these lines, visit the Electricity Storage Association at www.electricitystorage.org.

Superconductive wires also hold promise over the long-term. (See "Superconductivity Comes of Age.") Meanwhile, shorter-term solutions to the grid's inadequacies are needed. Multiple changes could vastly increase the reliability and efficiency of the grid. Currently, the grid is something of a free-for-all. Thousands of utility companies utilize it, but there is little communication among those companies regarding their real-time operating status. At the same time, regulation of the grid desperately needs to be revamped. Companies that transmit via the grid and that might be interested in investing in grid infrastructure currently must deal with a quagmire of competing interests. The grid's three interconnects are broken down into about 120 control areas, but operators of those control areas have very little authority beyond making requests (but not demands) of utilities participating within those areas.

U.S. state and federal agencies are making efforts to increase the grid's efficiency and enforce compliance to regulatory standards. After the massive blackout of August 2003, a joint U.S.-Canadian taskforce was created that stipulated 46 recommendations for improvement to the monitoring of transmission lines and for use of the grid. Each recommendation has since been implemented. These recommendations included the establishment of Independent System Operators (ISOs), which are independent, nonprofit organizations. ISOs ensure that electric generating companies have equal access to the power grid. They are gradually being replaced by larger Regional Transmission Organizations (RTOs), each of which cover a major area of the U.S. (as of mid-2011, about 60% of the U.S. electric power supply was managed by RTOs, according to the ISO/RTO Council). The North American Electric Reliability Corporation (NERC), www.nerc.com, is now responsible for enforcing mandatory reliability standards on utilities. NERC fines are levied when performance falls below those standards.

The utilities industry is pushing its own vision of the grid's future, via the respected Electric Power Research Institute (EPRI, www.epri.com), an organization of members representing more than 90% of the electricity generated and delivered in the U.S. EPRI envisions creating an environment in which utilities are encouraged to invest heavily in new transmission technologies. Part of its plan is aimed at developing constant communication among the systems pushing power to, and pulling power from, the grid. EPRI hopes the grid will become a self-repairing, intelligent, digital electricity delivery system. As a result, a systems breakdown in one area might be compensated for by users or producers elsewhere, aborting potential blackout situations. The total investment required would be more than $100 billion.

Another part of its technology platform is based on making the grid "smarter," by using state of the art digital switches and sensors to monitor and manage the grid—a vast improvement over today's equipment. This smart grid would incorporate sensors throughout the entire delivery system, employ instant communications and computing power and use solid-state power electronics to sense and, where needed, control power flows and resolve disturbances instantly. The upgraded system would have the ability to read and diagnose problems. It would be self-repairing, by automatically isolating affected areas and re-routing power to keep the rest of the system running. Another advantage of this smart grid is that it would be able to seamlessly integrate an array of locally installed, distributed power sources, such as fuel cells and solar power, with traditional central-station power generation.

Internet Research Tip:

The GridWise Alliance, www.gridwise.org, is a consortium of public and private utility and energy companies that supports a stronger electricity grid. Members include General Electric (GE), IBM, Duke Energy and Cisco Systems.

In 2009, a new transmission "interconnect" was proposed that would connect the Eastern, Western and Texas grids. Called the Tres Amigas superstation, the project will be located in Clovis, New Mexico, and will use superconducting cable to convert different kinds of current from each region into a common direct current for transmission. (Superconductivity is created by cooling transmission cable to as low as minus 418 degrees Fahrenheit, thus enabling the system to transmit electricity with almost none of the power loss associated with standard cables.) The current would be converted again to the necessary type to match the destination grid. The interconnect theory behind the project means that electricity can be seamlessly moved from one grid to the next as needed in a more efficient and cost-effective manner.

Tres Amigas is spearheaded by Tres Amigas LLC, run by Phil Harris, the former CEO of PJM Interconnection LLC, a major grid-operations concern. American Superconductor Corporation will provide planning services as well as the superconducting cable. The Clovis location is less than 100 miles from substations in each of the existing grids, and would be especially useful in transmitting power generated from the massive wind power farms in West Texas. The greater connectivity afforded by the superstation could promote the development of new energy sources. Despite the $1 billion cost for the venture, Tres Amigas had moved ahead with construction planning and had been granted approval from the Federal Energy Regulatory Commission (FERC) to offer transmission services at negotiated rates. Groundbreaking for the Tres Amigas SuperStation was originally scheduled for July 2012 but was delayed pending further funding.

An additional technology advantage to the Tres Amigas project is that it will run on DC (direct current) rather than traditional AC (alternative current), which is much more efficient and will result in less electricity being lost during transmission. Furthermore, Tres Amigas plans to utilize compressed air energy storage technology. This means that wind farms could produce power even when there is low demand, and that power could be stored for later use as needed.

New smart utility meters are beginning to be installed at consumers' locations in major U.S. markets that transmit usage data to utilities, display price fluctuations and alert utilities to service interruptions instantaneously. The meters save utilities the cost of employing meter readers and promote conservation since homeowners can plan activities such as washing clothes or charging plug-in devices at night when prices are lower. Homes with solar panels can use the smart meters to measure and sell excess power back to the utility. There's even the ability, for homeowners willing to participate, for utilities to remotely adjust air conditioning and heating systems to cheaper settings when demand is high. Homeowners might adjust settings remotely as well. The use of smart meters can have dramatic benefits for electric utilities in two ways. First, such meters can promote conservation, thus delaying the need to invest in expensive new generating capacity. Second, the utilities can use a dynamic pricing method that enables them to charge considerably higher rates during times of peak demand.

Internet Research Tip: Smart Meters

For an excellent explanation of smart meters, how they work and how they save energy, see CenterPoint Energy's Energy InSight web page: www.centerpointenergy.com/services/electricity/residential/smartmeters

In October 2009, U.S. President Obama announced grants totaling $3.4 billion (part of the $862 billion economic stimulus package) to be provided to 100 companies including utilities, manufacturers, cities and other agencies in 49 states. The funds, which are being matched by grant money from private sources totaling an additional $4.7 billion, would be used to pay for approximately 18 million smart meters, 700 automated substations and 200,000 smart transformers. Working together, they are intended to result in higher efficiency, reliability and sustainability. (China has invested substantially in this sector, pumping $7.32 billion into grid projects in 2010 according to market research firm Zpyrme.)

Since state regulators must okay new initiatives undertaken by utilities, a number of roadblocks have slowed the process, in some cases leaving utilities with precious little time to lock in funds promised by the government. For example, Baltimore Gas & Electric, a subsidiary of Constellation Energy Group, was rejected by the Maryland Public Service Commission when it proposed smart grid

improvements in June 2010. The DOE responded by extending its deadline for state approval which was eventually granted.

By early 2012, the Institute of Electric Efficiency reported that 27 million smart meters had been installed in the U.S., and projected that 65 million will be installed by 2015. Bloomberg New Energy Finance stated that power companies throughout the U.S. had invested more than $15 billion in smart grid projects by 2012, and planned to spend another $13 billion through 2015.

Proponents of smart meters claim that their efficiencies will offset the high installation costs. Pacific Gas & Electric Company (PG&E) estimated that about 70% of its initial investment will be recouped due to savings in maintenance crew costs. Widespread use of the meters creates a smarter network, as their powerful technology allows communication to flow from utilities to consumers and back again.

The meters also have detractors. Power companies have received complaints from customers claiming that their bills are vastly higher due to the meters showing falsely high readings. In several states, class action lawsuits have been filed. In some cases, manufacturers are blaming a lack of consumer education with regard to reading and using the meters. In others, a fast rollout of the new meters caused problems when old billing systems incurred erroneous charges when interfacing with the new equipment.

A number of state regulators (including those in California, Oregon, Nevada and Vermont) are allowing utilities to bill customers who opt out of smart meters a surcharge for keeping their traditional meters. In California, for example, PG&E is charging $75 as an initial fee, followed by $10 per month, citing the costs of hiring workers to travel to individual homes to read the old meters. PG&E reported in early 2012 that about 90% of its 5.4 million customers had smart meters, while 26,800 opted out.

Technology firms are hoping to cash in on the federal funds-supported smart meter initiative. Companies including ABB, Cisco Systems, Ambient Corp., IBM and Microsoft have promoted products that support smart grid needs. ABB, for example, specializes in high-voltage direct current links (HVDC) that are ideally suited for transmitting power over long distances. Likewise, appliance manufacturers such as General Electric, Whirlpool and LG are developing new, smart products that turn themselves off when electricity demand is high (and most expensive) and back on when demand falls.

SPOTLIGHT: Ray Bell's Smart Meter

Silicon Valley entrepreneur Ray Bell has a serious entry in the smart meter market with his advanced technology concept. In addition to measuring power usage, the Bell meter acts as an Internet router, monitoring energy usage remotely and noting problems instantaneously. Better yet, the meters communicate via WiMAX for extra-long range wireless transmission. Bell signed a deal with General Electric to license his wireless interface and network software, which GE uses in manufacturing the meters and marketing them to utilities. Intel Capital (the capital arm of Intel, which is a manufacturer of WiMAX chip sets) is another investor in Bell's startup company, Grid Net, www.grid-net.com. The global market opportunity is vast. New smart units cost between $125 and $300 each. Bell and GE face competition from Washington state-based Itron, among others, but Grid Net's GE and Intel-backed credentials place it in the forefront of the smart meter market.

3) Superconductivity Comes of Age

Superconductivity is based on the concept of using super-cooled cable to distribute electricity over distance, with little of the significant loss of electric power incurred during traditional transmission over copper wires. It is one of the most promising technologies for upgrading the ailing electricity grid.

Superconductivity dates back to 1911, when a Dutch physicist determined that the element mercury, when cooled to minus 452 degrees Fahrenheit, has virtually no electrical resistance. That is, it lost zero electric power when used as a means to distribute electricity from one spot to another. Two decades later, in 1933, a German physicist named Walther Meissner discovered that superconductors have no interior magnetic field. This property enabled superconductivity to be put to commercial use by 1984, when magnetic resonance imaging machines (MRIs) were commercialized for medical imaging.

In 1986, IBM researchers K. Alex Muller and Georg Bednorz paved the path to superconductivity at slightly higher temperatures using a ceramic alloy as a medium. Shortly thereafter, a team led by University of Houston physicist Paul Chu created a ceramic capable of superconductivity at temperatures high enough to encourage true commercialization.

In May 2001, the Danish city of Copenhagen established a first when it implemented a 30-meter-

long "high temperature" superconductivity (HTS) cable in its own energy grids. Other small but successful implementations have occurred in the U.S.

Internet Research Tip:
For an easy-to-understand overview of superconductivity and its many current and future applications, visit the Superconductivity Technology Center of the Los Alamos National Labs: www.lanl.gov/orgs/mpa/mpastc.shtml

Today, the Holy Grail for researchers is a quest for materials that will permit superconductivity at temperatures above the freezing point, even at room temperature. There are two types of super-conductivity: "low-temperature" superconductivity (LTS), which requires temperatures lower than minus 328 degrees Fahrenheit; and "high-temperature" superconductivity (HTS), which operates at any temperature higher than that. The former type requires the use of liquid helium to maintain these excessively cold temperatures, while the latter type can reach the required temperatures with much cheaper liquid nitrogen. Liquid nitrogen is pumped through HTS cable assemblies, chilling thin strands of ceramic material that can carry electricity with no loss of power as it travels through the super-cooled cable. HTS wires are capable of carrying more than 130 times the electrical current of conventional copper wire of the same dimension. Consequently, the weight of such cable assemblies can be one-tenth the weight of old-fashioned copper wire.

While cable for superconductivity is both exotic and expensive, the cost is plummeting as production ramps up, and the advantages can be exceptional. Increasing production to commercial levels at an economic cost, as well as producing lengths suitable for transmission purposes remain among the largest hurdles for the superconductor industry. Applications that are currently being implemented include use in electric transmission bottlenecks and in expensive engine systems such as those found in submarines.

Another major player in HTS components is Sumitomo Electric Industries, the largest cable and wire manufacturer in Japan. The firm has begun commercial production of HTS wire at a facility in Osaka. In addition, Sumitomo has developed electric motors based on HTS coil. The superconducting motors are much smaller and lighter than conventional electric motors, at about 90% less volume and 80% less weight.

Another leading firm, AMSC, formerly American Superconductor (www.amsc.com), sells technology to wind turbine makers, enabling them to design full 10 megawatt class superconductor wind turbines that will operate with higher efficiency than traditional models. It is also participating in advanced-technology electric transmission projects. For example, in 2012, two of its D-VAR STATCOM products were selected to increase grid reliability in the UK.

Advanced-generation HTS cable has been developed at American Superconductor, utilizing multiple coatings on top of a 100-millimeter substrate, a significant improvement over its earlier 40-millimeter technology. The goal is to achieve the highest level of alignment of the atoms in the superconductor material resulting in higher electrical current transmission capacity. This will increase manufacturing output while increasing efficiency. This is a convergence of nanotechnology with superconductivity, since it deals with materials at the atomic level. The company is well set up to increase production as demand increases.

Leading Firms in Superconductivity Technology:
Sumitomo Electric Industries, http://global-sei.com
AMSC, www.amsc.com
Nexans, www.nexans.com
SuperPower, Inc., www.superpower-inc.com

4) Global Shale Gas Resources Revolutionize the Energy Industry

Natural gas supplies a significant portion of America's energy needs by heating buildings, running factories and providing energy to power plants that generate about 25% of the electricity used in the U.S. Environmental concerns about burning coal to generate electricity, even when using the latest clean technologies, have made it difficult to gain a license for the construction of new coal-fired power plants. Gas, on the other hand, burns in a considerably cleaner manner. Consequently, a reliable and reasonably priced supply of natural gas is absolutely vital to the U.S. economy. In addition, natural gas is used heavily by industry, as raw material in the manufacture of fertilizers, plastics and many other items, and to a small but growing extent, natural gas is used as a fuel for fleets of commercial trucks, cars and buses.

From the 1980s through the early 1990s, natural gas prices in the range of $1.50 to $2.00 per MMBTU (million Btu) were common. Lately, however, prices are much higher. The Henry Hub

price per MMBTU is considered the base price for natural gas in the U.S. (The Henry Hub is a major gas-gathering site located in Louisiana.) In 2003, the average Henry Hub price was up to $5.80. Prices in 2007 through 2010 have varied widely, often running $3.50 to $7.00. As of November 2012, prices were about $3.50, which was below the price needed by some operators in order to earn good profits on new wells, which tend to be in shale. New gas wells in shale require an investment of $5 to $10 million each. However, the vast new quantities of gas being discovered and brought into production are depressing market prices.

The industry has known for decades that shale holds high quantities of gas, but it was previously too difficult or too expensive to produce. First of all, the shale tends to lie deep in the ground, typically around 5,000 to 7,000 feet, where the gas permeates rock in a tight formation. In the 1990s, a technique was perfected that drills long, horizontal holes reaching out from the drilling site, and then uses high-pressure water streams to fracture the shale, thus releasing gas. Drilling can extend from the site for a significant distance in any direction after making a horizontal turn from the initial vertical hole. After drilling is completed, a process called hydrofracturing is performed in which millions of gallons of water (along with chemicals) are forced down the well into the shale. This process, also called "fracking," creates fractures in the shale, making the gas flow freely. The process includes the injection of grains of sand or tiny ceramic particles ("proppants') to hold open the newly cracked rock formations. When the water is pumped back out, the gas that was trapped in the shale is released into the pipe. By 2003 or so, these advanced technologies were so well proven that a frenzy of new drilling activity burst forth in the United States and Canada.

Although it has been produced in substantial quantity for only a few years, shale gas, now produced in numerous important fields across America, Canada and other nations, already accounted for about 25% of America's natural gas supply by 2011 (up from only 1% in 2000). By some estimates, including an analysis by the International Energy Agency, shale gas could account for 50% by 2035. There are multiple reasons why this is important: First, this shale gas is a domestic supply, not at all reliant on imports. Next, natural gas is easy to distribute. A massive pipeline and urban supply system is already in place in much of the U.S. Finally, natural gas burns with much lower emissions than coal, and it is relatively easy and inexpensive for electric power plants to switch from relying on coal as a fuel to using gas. This new production in shale is generating tens of thousands of jobs and billions of dollars in revenues for energy companies and state tax collectors.

Numerous shale gas areas are widespread across America. For example, there is the massive Marcellus shale field and the adjacent Utica and Devonian, running from New York southwest through several states to Kentucky and Tennessee. The New Albany is being actively explored in Illinois and Indiana; and the Fayetteville is in Arkansas, to name just a few of the known fields. Tax revenues from shale gas production will help to bail out the budgets of many state governments. Depending on whom you ask, shale gas may have boosted U.S. proven and unproven reserves to between 2,000 and 3,000 trillion cubic feet (TCF), much more than a 100-year supply. (Meanwhile, even more gas is on the way. Massive fields lie beneath the prolific Gulf of Mexico basin. Also, coalbed methane production and improved techniques for getting more gas from "tight" fields that were previously unprofitable are boosting the total amount of gas available.)

The Global Impact of Shale Gas:

While the U.S. already has more than 20 known shale areas of significance, shale zones also exist in many other nations worldwide. This is making shale gas into a global energy revolution of massive proportion. Technologies will continue to advance, while growing production may keep market prices low throughout much of the world.

Leading oil and gas companies are seeking to lease shale production acreage around the world while they study the latest drilling and production techniques already in widespread use in the United States and Canada. Several fields are already being produced in Canada. ExxonMobil is actively drilling on acreage it has leased in British Columbia, Canada in an area known as the Horn River Basin. In the U.S., ExxonMobil acquired a leading shale gas producer, XTO Energy, for $31 billion. In 2010, CNOOC, the Chinese National Offshore Oil Corp., agreed to pay $2.2 billion for a one-third interest in a South Texas shale project owned by Chesapeake Energy. In 2011, Australian mining firm BHP Billiton Ltd. acquired American oil shale producer Petrohawk Energy Corp. for $12.1 billion.

European firms are extremely interested in shale production. Norway's StatOilHydro bought a significant interest in leases owned by U.S. leader Chesapeake Energy in 2009. Engineers from other

countries such as Italy and Norway are studying American gas extraction techniques to expand their own proven natural gas reserves. Greater reliance on low-cost natural gas from shale is profoundly impacting global energy markets. To a large extent, Europe currently relies on gas imported from Russia—development of new European gas fields would create a major energy paradigm shift.

Major Shale Gas Reserves Worldwide:

Continent/Nation	Trillion Cubic Feet of Recoverable Shale Gas Resources:
Europe:	
Poland	187
France	180
Norway	83
Ukraine	42
Sweden	41
Asia/Pacific	
China	1,275
Australia	396
North America	
U.S.	862
Mexico	681
Canada	388
Africa	
South Africa	485
Libya	290
Algeria	231
South America	
Argentina	774
Brazil	226

Note: these are very conservative 2009 estimates based on U.S. Energy Information Administration studies. Total reserve counts are likely to continue to grow rapidly.

However, few regions outside of the U.S. and Canada have the right circumstances in place to encourage the development of their shale gas fields. Generally, the following challenges are holding back shale development in Europe and Asia: 1) A lack of firms and personnel with experience and technical expertise in shale; 2) A lack of pipeline infrastructure in shale areas; 3) Higher costs of drilling and operating wells compared to costs in the U.S.; 4) A lack of sufficient water supplies for fracking and 5) A shortage of independent oil and gas companies. Last, but not least, is the fact that U.S. mineral rights below ground follow the ownership of the land at the surface. When individual landowners allow drilling, they are well compensated. In many nations outside the U.S., however, governments control sub-surface mineral rights. This means that homes, business and other interested parties who must live with the disruption of drilling probably will not receive any money from the production.

While many oil companies have expressed interest in producing shale gas in Europe, the governments of major European nations have different ideas. The French government banned hydraulic fracturing, essential to shale gas production. However, a March 2012 publication, "Shale Hydrocarbons in France," leaned toward encouraging the production of shale gas, particularly in the Paris Basin, and France may eventually allow this practice. Many other nations have announced or considered moratoriums on fracking, including the Czech Republic and Romania.

The European region faces a conundrum. Green parties have significant influence in the region, as evidenced by the strong opposition to the development or operation of nuclear power plants in many nations. At the same time, the European region has aggressive goals for cutting greenhouse gas emissions, and switching to relatively clean-burning gas could be of some help in this regard. Likewise, this part of the world continues to rely on huge quantities of natural gas for much of its heating and industrial needs. Another issue is the fact that most European governments have a significant need to boost tax revenues, and a boom in shale production could have a very positive effect on government coffers.

The end result will likely be cautious, highly regulated exploration and production in Europe's bounteous shale gas fields, in the face of stiff opposition from Green parties. Chevron has acquired potential drilling sites in such nations as Lithuania, Romania and Poland that it believes to be very promising. Russia also appears to have significant potential in producing gas from shale.

Environmental and Logistical Questions:

While shale gas reserves (and shale oil for that matter) clearly exist in massive quantities, significant environmental and logistical questions loom. While consumers in the U.S. are enjoying a tremendous economic gift in the form of low energy prices thanks to shale gas, many environmentalists have raised alarms about the methods used to produce this gas. State regulators are beginning to place more stringent

demands on shale production firms in three areas: 1) providing the public with information about the chemicals used downhole during fracking, 2) proper recycling and/or disposal of water used during fracking, and 3) protection of water tables and drinking water supplies when they are penetrated by drilling operations.

Many environmental activists have been extremely critical of the impact of shale gas drilling. In the U.S., some state governments, most notably New York, are reluctant to let shale gas drilling move forward. In Europe, some nations, most notably France, are reluctant to approve drilling operations. Over the long term, the result is likely to be an industry that is much more tightly regulated. Meanwhile, logistical considerations and impediments must be dealt with. Some areas that have vast shale gas production potential lack sufficient pipelines to transport the new gas.

Another side effect of the boom in shale gas production, and resulting low market prices for gas, is a bust in the American LNG business. During the early to mid 2000s, a handful of firms invested billions of dollars in new LNG (liquefied natural gas) processing plants in America, intended to offload imported gas from foreign fields for U.S. markets. They were encouraged by high demand for this relatively clean fuel, and spot prices that reached nearly $16 in 2005. However, the bounty of new shale gas production has devastated LNG prospects in America. By 2010, without the new shale gas wells, there would have been a constant stream of LNG ships offloading needed gas into American markets at high prices. This would have made America's energy bill vastly higher, while making its balance of trade look even worse.

In 2011, LNG offloading facilities were being retrofitted to export gas instead of import it due to the huge finds in oil shale.

5) Crude Oil from Shale Booms in North Dakota's Bakken and Texas' Eagle Ford

State of the art technologies used to successfully get natural gas from shale are also being used to develop new crude oil production in the U.S. In the Eagle Ford Shale in South Texas, for example, thousands of new oil wells are underway or in production. In California, oil from the Monterey shale is creating excitement. However, the biggest drilling frenzy is in the North Dakota field known as the Bakken Shale, which lies throughout much of North Dakota and extends into Eastern Montana and the Canadian territories of Saskatchewan and Manitoba.

Many of the wells in the Bakken Shale are stupendous producers, bringing in two thousand barrels of oil per day per well in some cases. Wells can cost upwards of $10 million each to drill and complete. Official estimates of recoverable reserves there are 4.3 billion barrels, but some observers place the total at 10 billion or even 20 billion barrels. While the total amount of oil is not yet clear, it is indisputable that multiple layers or "zones" of oil exist (the Three-Forks formation lies below the Bakken, and other promising formations are known). In fact, the Bakken is one of the largest continuous oil accumulations in the world.

Production in the Bakken is found about 10,000 below the surface, where bounteous light-sweet crude oil is trapped. While many companies are in operation here, the most noted is Continental Resources, headquartered in Enid, Oklahoma.

The Eagle Ford production zone lies between 4,000 and 14,000 feet underground. Approximately 30 counties in South and Central Texas are the focus of this play. (In addition, the Eagle Ford clearly extends across the border into Mexico. Developing that resource is a stated focus of the new President of Mexico, Enrique Pena Nieto, elected in 2012.) As of the end of November 2012, 267 rigs were operating in the Eagle Ford, more than 15% of all rigs working in the U.S. For the month of July 2012, official Texas Railroad Commission (the state agency responsible for regulating oil and gas wells) records showed that 310,000 barrels of oil per day were produced, up from only 120,532 barrels per day in July 2011. In addition, the region produced 1.21 billion cubic feet of natural gas per day in July 2012, and 51,676 barrels of condensate per day. As a result of this activity, Texas oil production reached its highest level since April 1991.

6) Coalbed Methane Production Soars, Boosts U.S. Gas Production

A booming alternative natural gas source is coalbed methane, or CBM. (Traditional natural gas consists of about 80% methane.) CBM is a natural methane gas that is found in coal seams, while traditional natural gas deposits are trapped in porous rock formations. Since coal is found in abundance throughout much of the world, CBM could eventually be an important energy source. Technology for the production of CBM has advanced to the point that its production soared from 1,780

billion cubic feet in 2007 to 4,350 billion cubic feet in 2010 (the latest data available).

A small amount of CBM is already produced successfully in the Rocky Mountain region and other sections of the U.S. While more than one-half of current production is from the Rocky Mountain area, the U.S. also has at least 12 other major CBM basins, including the Black Warrior Basin in Alabama and Mississippi, the San Juan Basin in Southern Colorado and Northern New Mexico, the Piceance Basin in Colorado, the Powder River Basin in Wyoming and Montana and the Uintah Basin in Utah. Meanwhile, Canada is producing small amounts as well, and it is seriously studying the potential of producing a large amount of CBM in coal areas of Alberta. U.S. coalbed methane resources could total 100 trillion cubic feet of economically recoverable CBM out of an estimated total of 700 trillion cubic feet in place. However, future technology developments may boost the industry's ability to use these vast reserves.

CBM exploration costs are relatively low, and this resource may eventually be widely developed in other coal-rich areas of the world. For example, China holds vast coal reserves, and the government has stated plans to develop coalbed methane as a significant source for future gas consumption.

7) New Pipelines are Needed to Handle Growing Production, But They Create Controversy

Several large oil or gas pipelines are under planning or construction in the U.S. and Canada, and several recent projects have made news in the Eurasian area. A major Canada-based company, TransCanada, proposes a new $13 billion, 48-inch diameter, 1,700-mile crude oil pipeline that would run from Hardisty, Alberta south through six U.S. states, ending in Houston and Port Arthur, Texas on the Gulf of Mexico. ExxonMobil is participating in the project, called the Keystone XL pipeline, with TransCanada. As of late 2012, the project was waiting from approval from the U.S. government following the re-election of President Barack Obama. Meanwhile, TransCanada began construction on the section of the proposed pipeline that runs between Cushing, Oklahoma and the Gulf of Mexico in August 2012.

A major concern to many environmentalists is the fact that the pipeline is intended to carry oil from Canada's tar sands region. Producing usable oil from tar sands creates potential environmental costs that are unacceptable to some. Nonetheless, Canada's oil production has grown very rapidly, and it must have a way to market. The Canadian government is considering alternative transport, if the Keystone project becomes politically untenable, that would send the crude to Canada's west coast so that it could be sold to Asian markets such as China, completely bypassing the U.S.

Elsewhere, in November 2011, Canadian oil transmission firm Enbridge, Inc. entered into an agreement to acquire ConocoPhillips' 50% interest in the Seaway Crude Pipeline System for $1.15 billion. The Seaway pipeline originally moved oil from the Gulf of Mexico to the Cushing, Oklahoma hub. Enbridge reversed the flow, anticipating up to 400,000 barrels per day (bpd) in activity. This strategy was developed in response to rising crude inventories at the Cushing hub.

Meanwhile, a pipeline planned by Enterprise Products Partners, LP of Houston, Texas may compete with the Keystone project. Enterprise proposes to construct the Flanagan South pipeline, which would run from Flanagan, Illinois to Cushing, Oklahoma. It would connect with the Seaway (which now runs from Cushing to Freeport, Texas). Together they might transport as much as 850,000 barrels of crude oil per day by mid-2014.

Various entities have been attempting to gain financing and support for proposed new Alaskan natural gas pipelines for several years, including the massive "Denali" pipeline project which has been shelved by its sponsors, BP and ConocoPhillips. Denali was estimated to cost $35 billion. These proposals faced numerous engineering, regulatory and financial hurdles. Battles over environmental impact are particularly onerous, and financing is difficult.

However, a newer project may be underway in the near- to mid-term to build a natural gas pipeline in Alaska, thanks to the early 2012 settlement of a dispute between energy companies including Exxon Mobil, BP and ConocoPhillips and the state of Alaska. The settlement allows the energy companies to maintain leases in the Point Thomson field (located to the east of the enormous Prudhoe Bay field) in exchange for the assurance that production will begin by May 2016 at the latest. The Point Thomson field holds some of Alaska's largest and most easily accessible gas reserves, which are planned for export to overseas markets. Initial output from the field will be 10,000 barrels of natural gas condensate and 200 million cubic feet of natural gas per day. An additional 35 trillion cubic feet of natural gas is estimated to lie in Alaska's adjacent North Slope.

The proposed project could cost between $45 billion and $65 billion, require up to 1.7 million tons of steel and provide employment for up to 15,000 people during construction and more than 1,000 permanently. Capacity is targeted at 3 billion to 3.5 billion cubic feet per day. The goal is to terminate the pipeline at a site where a future processing plant would convert the natural gas into LNG for export to gas-hungry Asian markets.

Meanwhile, the Canadian Government is considering a plan to encourage the development of a $7 billion (Canadian dollars) MacKenzie Pipeline to carry natural gas produced in the Northwest Territories. It could be a major supply of energy to the tar sands operations of Alberta, which utilize vast amounts of gas in order to generate steam for extracting crude from the tar sands. However, the project hit numerous snags, including environmental issues, high construction costs and low market prices for natural gas. If it finally gets underway, the $16.2 billion project would run from the Mackenzie Delta on the Beaufort Sea to Canadian and U.S. markets. Partners in the 1,220-kilometer pipeline include Imperial Oil, Aboriginal Pipeline, ConocoPhillips and ExxonMobil, however, Royal Dutch Shell pulled out of the project in mid-2011.

Outside the U.S., additional pipeline projects are in the planning stages. Turkey, Austria, Hungary, Romania and Bulgaria are working together on the $11.8 billion Nabucco project which would run 2,051 miles from Austria southeast to Turkey and then east to the Caspian Sea. The pipeline would have an annual capacity of 8 billion cubic meters and a maximum of 31 billion cubic meters, or 5% of the EU's consumption. The start date was pushed back to 2013 with completion in 2017.

Russia's proposed South Stream pipeline would stretch more than 1,500 miles from the Russian port of Novorossiysk to Varna in Bulgaria. South Stream would transport 63 billion cubic meters per year of natural gas from the Black Sea to Bulgaria, where it would branch off in two directions, one towards southern Italy and the other through Hungary into Austria. South Stream AG, a joint venture between Italy's Eni SpA and Russia's OAO Gazprom, Electricite de France and another joint venture between Gazprom and Bulgargaz of Bulgaria are among the companies that are slated to build and operate the pipeline. In 2011, EDF of France and Wintershall of Germany joined the project. It is expected to be completed by as early as 2015.

Another project called Nord Stream, commenced operations in November 2011. The first of Nord Stream's parallel 760-mile pipelines delivers natural gas from Russia to Germany under the Baltic Sea, bypassing Ukraine, which has historically been the site of major pipelines and currently delivers most of the Russian natural gas used in the EU. The second pipeline was completed in October 2012. The project comes at a fortuitous time, since there have been disruptions in supply from Russia due to pricing disputes between Moscow and the Ukraine, as well as Ukraine's difficulties in paying for the gas it obtains from Russia. Nord Stream is backed by a consortium primarily led by OAO Gazprom, Russia's state-owned gas supplier. Other partners in the project are German-based BASF/Wintershall AG and E.On Rhurgas AG and the Netherlands' NV Nederlandse Gasunie.

8) LNG Projects Offer Increased Supply/Floating LNG Plants May Change the Industry

One way to distribute natural gas to high-demand markets like China and Japan is through LNG (liquefied natural gas). However, due to the necessity of special handling, bringing that supply to market in major quantities requires advanced technology and huge capital outlays. First, the natural gas must be chilled to minus 259 degrees Fahrenheit, in order for it to change into a liquid state. Next, the LNG is put on specially designed ships where extensive insulation and refrigeration maintain the cold temperature. Finally, it is offloaded at special receiving facilities where it is warmed and converted back into a gaseous state ("gasification") suitable for distribution via pipelines.

Offshore gasification facilities, far from onshore residences, sometimes have a better chance at regulatory approval. These plants can receive LNG, heat it to the extent that it resumes gaseous form and then pipe it to an onshore terminal. One such project in the U.S., called Energy Bridge, is located 116 miles off the coast of Louisiana and uses adapted oil technology to send the product back to shore.

LNG facilities are immense engineering projects that take many years and serious financial commitments to complete. For example, Chevron is spending $29.7 billion on its Wheatstone LNG project in Australia, which will have a capacity of 38.4 billion cubic feet per year. Initial shipments from the facility are planned for 2015.

Historically, the U.S. was importing modest amounts of LNG. In 2007, it received 770 billion cubic feet. Imports in 2008 fell to 350 billion cubic feet, according to the EIA. Prices in the U.S. for

natural gas have been very low, due to abundant supply, largely from new shale gas fields; however, the U.S. maintains some of the world's largest storage capacity for LNG, making it a "market of last resort" for LNG shippers. At one time, LNG looked like it would become an important source for America's gas needs, but abundant domestic gas from shale, beginning around 2004-2005, has changed the picture dramatically.

The vast majority of all liquid natural gas exports to the United States came from a single LNG processing plant in Trinidad and Tobago, a Caribbean island nation near the coast of Venezuela. This facility, Atlantic LNG, was built with investments from BP, BG Group and Repsol.

On the receiving side, the special terminals in the U.S. dedicated to LNG were previously limited to four on the mainland and one in Puerto Rico (a paltry number when compared to the 25 terminals in Japan). Many of these plants have been expanded in recent years.

Optimistic forecasts of demand brought about significant investment in new terminals in Louisiana and Texas. A small company called Cheniere Energy (www.cheniere.com), with assistance from ExxonMobil and Sempra Energy, completed three new LNG terminals. Two of the completed terminals are in Louisiana and one is in Texas. The Sabine Pass facility, on the Texas/Louisiana border, completed construction and began operation in mid-2009, at a total cost of $1.55 billion. Cheniere is now working on a completely reversed strategy. It has signed long-term contracts with two major customers whereby it plans to export LNG from its Sabine Pass plants, hopefully to start in 2015, with an initial capacity of 9 million tons per year. Implementation of the plan requires final government approval, financing and plant configuration.

Other U.S. firms are interested in exporting LNG as well. Longer term, a massive, $65 billion pipeline has been proposed to carry natural gas from Alaskan fields to a yet-to-be-determined spot on the West Coast where an LNG facility would convert it for shipment to Japan and other Asian markets.

However, the prospect of exporting large quantities of America's natural gas, particularly from the lower 48 states, is creating significant controversy. While it might create large numbers of jobs and improve America's balance of trade, the increased demand would likely drive up domestic prices. This means that end users ranging from households to the booming petrochemicals industry could see their natural gas costs rise. In November 2012, the Department of Energy released a long-awaited report, conducted by economic consultants at NERA, encouraging the export of U.S. natural gas. Many observers feel that U.S. exports could have a significant impact on global energy markets. The Energy Information Administration (EIA) expects U.S. production of natural gas to grow by about 50% through 2040, to a total of 33.1 trillion cubic feet yearly from 23.0 trillion in 2011. The EIA estimates that the U.S. could export 4 billion cubic feet of gas daily by 2027, about 6.6% of consumption levels as of 2012.

Much of the world's LNG is shipped to Asia, where market prices are significantly higher than in the rest of the world. Major exporters of LNG included Qatar, Malaysia and Indonesia, with Additional sources include Australia, Nigeria, Oman, and Russia.

The global LNG market is partly dominated by two firms in Qatar; Qatargas and RasGas. This is partly due to Qatar's ownership of one of the world's largest conventional natural gas reservoirs, the offshore North Field. Qatar also welcomes foreign oil and gas firms, especially ExxonMobil, which owns the RasGas gas liquification facility there in partnership with Qatar Petroleum. At a cost of $20 billion, RasGas added 31.2 million tons of LNG to annual capacity. Qatar exported 337.8 billion cubic feet in 2011.

A revolutionary new floating gas plant concept is underway off the northwestern coast of Australia. Royal Dutch Shell, working with a consortium comprised of Korea's Samsung Heavy Industries Co. and France's Technip SA to build a $5 billion floating facility called Prelude that will be 488 yards long and 82 yards wide (its weight will be 600,000 tons when fully equipped and loaded, about six times that of an aircraft carrier). By processing LNG offshore, previously stranded reserves that were too remote to be feasible can be tapped. When complete, the facility can produce up to 3.7 million tons of LNG per year. Once an underwater field is exhausted, the floating plant can be deployed elsewhere. Other floating plant projects are on the drawing board or under construction, including Japan's Inpex Holdings, Inc.'s plant in the Timor Sea in Indonesia and Australia's Santos Ltd. received approval from the Australian government in 2012 for a plant in a joint venture with French-based company GDF Suez SA.

ExxonMobil is also extremely active in gas/LNG production in the Australia area. China has a multi-year contract with ExxonMobil, valued at $41 billion,

for the delivery of LNG from the Gorgon project, a vast natural gas and LNG facility jointly owned by ExxonMobil, Chevron and Royal Dutch Shell.

With demand from the U.S. not meeting expectations, where will new LNG production go? Markets in Japan, China and India continue to grow. Japan is already a huge importer of LNG, there being few alternatives for the transport of gas to the island nation. Japan's appetite for LNG was enhanced by the March 2011 tsunami that led to the meltdown of several of its nuclear power plants. Europe is also a potential customer for large amounts of LNG. Depending on how quickly export facilities can be constructed in the U.S., the Department of Energy expects domestic gas prices to rise between 14% and 36% between 2012 and 2022. ExxonMobil plans to invest $10 billion with partner Qatar Petroleum in an LNG export facility in Port Arthur, Texas.

China plans to become a major importer of LNG and has completed several terminals along the Chinese coast. Total Chinese consumption of gas is expected to grow threefold from 2010 through 2020, and LNG will be a major component.

SPOTLIGHT: BG Group plc

2011 Revenues:	$21.3 billion
2011 Profits:	$4.3 billion
Employees:	6,625

BG Group plc, headquartered in the U.K. but operating in over 20 countries, is engaged in the exploration, development, production, transmission, distribution and supply of natural gas. The company is divided into three business segments: exploration & production, liquefied natural gas (LNG) and transmission & distribution. The company's exploration & production division develops, produces and markets gas and oil in 11 countries. In 2011, the firm produced nearly 2.3 million barrels of oil equivalent and increased its reserves and resources to approximately 3.24 billion barrels of oil equivalent. BG Group's LNG division develops and operates infrastructure for the procurement, transport and sale of LNG as well as LNG liquefaction and regasification facilities. The company's transmission & distribution division aims to develop new markets, transport gas to them and distribute that gas to power generating, industrial, commercial and residential customers. BG Group owns interests in distribution companies in Brazil (Comgas) and India (Gujarat Gas Company Limited and Mahanagar Gas Limited), Argentina and Uruguay (MetroGas) and a pipeline in Kazakhstan.

In April 2012, the firm sold its 40% equity in GNL Quintero SA's LNG terminal to Enagas S.A. In May of the same year, BG sold its 40% stake in two gas-fired power generation plants in the Philippines to First Gen Corporation.

9) Russia and West Africa Have Massive Production/Israel Develops Major Gas Fields

OPEC (the Organization of Petroleum Exporting Countries) nations are slowly losing some of their dominance in oil production, as output of crude oil in Russia, Brazil and Africa has become very significant. Russia's crude output reached a record 10.28 million barrels daily in 2011, up from 10.27 million barrels in 2010 and 9.97 million barrels in 2009 according to BP (following a downturn in 2008 during which output fell for the first time in a decade). Russia has become a powerhouse in crude production, second only to Saudi Arabia. Production costs remain relatively low in many Russian fields.

Russia holds among the world's largest reserves of conventional oil and natural gas. Geographically speaking, Russia is perfectly located to feed increasing demand in China for oil and gas and quite capable of supplying Japan, which has no major petroleum sources of its own. Meanwhile, Russia is a vital supplier of natural gas to European nations, via an extensive network of pipelines. At one time, Western companies were clamoring to cooperate with their Russian peers in exploration and in constructing vast new pipelines to deliver Russian oil and gas to thirsty markets. However, in 2006 the Russian government became much less accommodating to the investment interests of foreign oil firms, and forced some companies out of their positions in major Russian projects.

The west coast of Africa is another of the world's fastest growing petroleum producers. Wells offshore Nigeria and Angola are already spouting immense quantities of oil and gas. New activity is promising offshore Senegal, the Ivory Coast, Equatorial Guinea, Ghana, Gabon and Namibia. Deepwater wells are also being drilled off South Africa. Deepwater tracts offshore of Africa now account for a significant portion of the world's oil production, primarily in Libya, Nigeria, Algeria and Angola. This can be good news for the Unites States and Europe for two reasons. First, major American and European oil firms have been able to invest in African exploration and production in a big way. Second, that production is finding its way to American and EU consumers, reducing the need to rely on OPEC.

By 2011, Nigeria was producing 2.5 million barrels daily, up from 2.4 million barrels in 2010 and 2.06 million barrels in 2009. Its output is highly desirable light crude that is low in sulfur content. Unfortunately, Nigeria's politics are in a volatile state, with rebel troops often fighting the government for control. Nigeria was the biggest oil producer in Africa in 2011, followed by Algeria at 1.89 million, Angola at 1.84 million, and Libya at 501.5 thousand.

Off the African coast, companies like ExxonMobil, Royal Dutch/Shell and Chevron are drilling deep, technologically advanced wells. Total depth of new wells is frequently in the 12,000- to 15,000-foot range, including 4,000 to 6,000 feet of water. Oil corporation Total has signed important agreements to operate offshore of Nigeria.

Seismic surveys of the Leviathan prospect, located about 84 miles offshore of the northern coast of Israel, may hold 16 trillion cubic feet of natural gas, making it one of the world's most promising offshore fields. Should the surveys prove true (analysts estimate a 50% chance of success), the find would position Israel as an exporter of natural gas for the first time, in addition to supplying the country's domestic needs for 100 years. Noble Energy, Inc. of Texas is leading the drilling activity there. Leviathan lies next to the Tamar, a field discovered in 2009 which has the potential of holding 8 trillion cubic feet of gas. Noble Energy announced another significant discovery in late 2011 offshore of Cyprus with gross mean resources of 7 trillion cubic feet, while in 2012 it expanded its activity in the Tanin field.

10) Companies Use New Technologies for Enhanced Oil and Gas Recovery

Even as demand decreased during the global economic recession of 2008-09, oil companies continued to look for ways to expand their production capabilities. The problem is that extraction and development costs can be extremely high. The direct cost of extraction (sometimes referred to as "lifting costs") varies widely around the world's oil fields. For example, Pemex in Mexico was spending $4.30 per barrel in 2006, which rose to $10.60 per barrel by mid-2010. "Finding costs" are a separate expense. This represents the cost of exploring for and developing fields prior to production.

Today, sophisticated methods are used to enhance and prolong oil field production. However, such methods can be expensive. "Tertiary recovery" methods may include the injection of CO_2, steam injection, or the use of special chemicals. Other recovery stages are defined as "primary recovery," which is a field that flows normally with little additional effort, and "secondary recovery," a term which often is used to describe enhanced recovery via waterflooding.

By the 1970s, drillers began mixing water with carbon dioxide (CO_2) and injecting it into wells. The CO_2 dissolves in oil and causes it to expand, making it easier to force out of the ground. It also makes oil less viscous and easier to pump. Houston-based oil pipeline company Kinder Morgan, Inc. has used the process with remarkable success. The firm acquired an oil field in Texas' long-established Permian Basin in 2000. Production in the field had dropped to 8,500 barrels per day. With the use of CO_2, Kinder Morgan produced as much as 31,000 barrels per day from that field.

Likewise, Anadarko is investing $684 million for long-term operations at its Salt Creek oil field in Casper, Wyoming. CO_2 injection boosted Salt Creek's production from about 5,000 barrels per day initially to more than 10,000 barrels in 2010.

A related technology, called MEOR (microbial enhanced oil recovery), creates microbes that biologically generate CO_2 and chemicals with cleaning agents that help flush oil out of rock. It is hoped that the microbes, which multiply very quickly, will penetrate into rock and naturally transform heavy oil into easily obtained sweet crude. The U.S. Department of Energy is funding a number of MEOR research products. MEOR is already used to treat heavy oil deposits in Venezuela, China, Indonesia and the U.S.

Another new technology is the use of steam injection which heats rock and thins viscous liquids including crude oil. Steam injection is expensive, so geologists are using sensors to detect temperatures far below ground at likely drilling sites. The sensors detect where the steam is most needed, saving drilling effort and costs with better targeting. Chevron is using the technology to pump more oil from its prolific Kern River field in southern California. The company drilled 660 observation wells equipped with the sensors in 2009, and Chevron officials believe the process has saved the firm $300 million in drilling costs while prolonging the life of the field. While most fields drilled around the world often yield about 30% of the oil contained there, Chevron hopes to tap 80% of Kern River's oil.

Nanotechnology is now assisting geologists and producers via tiny carbon clusters called nanoreporters. Roughly 30,000 times smaller than a human hair, the nanoclusters can react to materials that they encounter, including crude oil. By injecting

nanoreporters into oil reservoirs and measuring their changes, geologists may have better indications of where they can find remaining oil for enhanced recovery. Research on the technology is currently underway at Rice University, funded by Marathon Oil, ConocoPhillips, Royal Dutch Shell and BP. Researchers at Rice began field tests in 2011.

11) Advances in Technology Lead to New Gains in Exploration and Production/Electromagnetic Technology Looks Promising

In the same way that the InfoTech revolution has increased productivity everywhere from the factory floor to the supermarket to the business office, leading-edge technology is shaking up the energy industry. Both onshore and offshore, the use of advanced seismic technologies and horizontal drilling with pinpoint accuracy are drastically improving drilling results. Offshore, subsea templates that allow both drilling and production of dozens of wells, as much as 15 miles apart, from one underwater structure provide finding and lifting efficiencies undreamed of a few years ago. Pipeline and transport systems are advancing at the same time. For example, it is now common to deliver oil from a subsea well straight to a pipeline system without ever bringing it to the ocean's surface.

Geophysicists are using high-powered computer workstations to analyze seismic data in three-dimensional, color-coded views that show oil- and gas-producing structures never seen before. Drilling success rates are up substantially. An enhanced 4-D system adds the dimension of time to geologists' seismic view of evolving underground formations. Exploration companies utilizing 3-D and 4-D seismic data typically find productive wells more than 70% of the time, compared to 40% with conventional methods.

Many of these technologies, however, are only refinements of techniques that were discovered many years ago. One very promising technology uses electromagnetic waves (instead of sound) to map features of the earth far below the surface. Instead of mapping density and solidity, as sound does, electromagnetic waves map resistance to electricity. Because oil has a fairly unique electromagnetic signature, maps made with these waves can be incredibly accurate. Electromagnetic exploration is currently in a period of rapid commercialization. This technology works well in salt water, so it is appearing in deep-sea explorations. However, some firms are performing airborne electromagnetic surveys aboard aircraft. ExxonMobil is one of the first innovators of this technology, calling it Remote Reservoir Resistivity Mapping, or R3M. Another, much smaller company, ElectroMagnetic GeoServices AS (www.emgs.com), has developed its own version of electromagnetic exploration called marine EM that promises to make this new field very competitive. The Norway-based firm was awarded a $90 million contract in 2011 to perform a range of electromagnetic surveys for Petrobras.

Spending on global exploration and production increased four-fold between 2002 and 2012, although oil production during that period was up by only 12% according to McKinsey & Company. Oil field services companies, which grossed about $750 billion in 2011, are responsible for the greatest investment in new technology. These companies include FMC and Cameron on the supply side; Transocean and Noble Energy for drill rig lease-out services; and Schlumberger, Halliburton, Baker Hughes and Weatherford International which dominate production and extraction services.

12) Extension of Offshore Drilling into Extreme Water Depths Continues/Brazil Is a Leading Producer Offshore

Since the first offshore well was drilled in shallow water 10 miles off the Louisiana coastline in 1947, offshore oil and gas production has been of rapidly growing importance in the U.S. and many other nations worldwide. Today, the average oil well in the Gulf of Mexico flows over 30,000 barrels of oil daily—100 times the rate of flow of an average onshore U.S. well. Newer, extremely deep-water wells flow at even greater rates. The Gulf of Mexico already produces from approximately 4,000 American platforms, with 35,000 wells and 30,000 miles of pipelines.

In the aftermath of the April 2010 explosion of BP's Deepwater Horizon well in the Gulf of Mexico, the Obama Administration placed a moratorium on deepwater drilling off the U.S. coast that lasted for several months. The federal government also placed stringent new requirements on offshore drillers. The result was a significant slowdown in exploration through 2010.

New legislation regarding offshore drilling requires stricter environmental reviews, greater federal involvement in rig operations and drilling company CEOs to personally certify compliance. Oil and gas companies must also hire outside auditors to certify the reliability of blowout preventers. The

preventers must be equipped with two sets of blind shear rams, which are pincer-like clamps that cut through drill pipe to shut off the flow of oil. Refitting or replacing them will be expensive and some rig platforms are not large enough to hold them.

In addition to upgrading equipment, drilling companies must have a cleanup plan ready in the event of another disaster. To that end, ExxonMobil, Chevron, Royal Dutch Shell and ConocoPhillips announced a $1 billion joint venture to create a rapid-response system capable of containing up to 100,000 barrels per day (the Deepwater Horizon spilled up to 60,000 barrels per day). The nonprofit venture, to be called the Marine Well Containment Co., and will be available to any drilling company with the assets to afford the billions necessary to pay for use of the system and the crews necessary to man it. Exxon estimates the system could be ready by 2012.

The new post-Deepwater Horizon regulations add to the time it takes to receive federal permits. Development plans were taking about 150 days as of 2012, compared to 54 days prior to the Deepwater Horizon explosion, while permits were taking about twice as long to be approved. Despite these difficulties, the number of permits approved rose to 105 in the first eight months of 2012, compared to 79 for all of 2011.

By late 2011, drilling in the Gulf had resumed to almost normal levels. As of September 2012, there were 52 total platform rigs, 28 of which were contracted. Offshore Gulf oil and gas production fell slightly by the end of 2011 and into 2012, and were expected to bottom out at 1.3 million barrels daily. The future looks brighter, since according to Bentek energy, production from the Gulf will grow by almost 27% by 2022 to reach 1.8 million barrels per day from fields such as Exxon Mobil's Hadrian and Chevron's Jack.

The growth will be fueled by a number of major discoveries in the area. BHP Billiton plc and Chevron Corp. announced new discoveries, both more than 100 miles off the Gulf Coast and in more than 4,000 feet of water. Together the finds represent the potential for billions of barrels of oil.

ExxonMobil also made significant finds in the Gulf in 2011. The company previously had limited activity in deepwater Gulf drilling, but will likely become a major player thanks to three discoveries. Together they likely contain 700 million barrels of oil equivalent, making them the fourth largest in the Gulf behind BP's Atlantis and Thunder Horse and Royal Dutch Shell's Mars. In 2012, Mexico's Pemex made two significant deepwater discoveries, which together could amount to between 475 million and 525 million barrels of crude reserves.

SPOTLIGHT: The Mars Platform

Mars, a floating platform off the coast of Louisiana, is one of the major production sites in the Gulf. (Production is from up to 24 wells that are attached to the platform for gathering purposes and maintenance.) It was jointly developed by Shell (71.5%) and BP Amoco (28.5%). Shell Deepwater Production, Inc. is the operator. Mars is an excellent example of modern offshore technology. It utilizes a Tension Leg Platform (TLP) that weighs about 36,500 tons. The platform is over 3,250 feet tall from the seabed to the top of the drilling rig. It is designed to stand up to hurricane force winds of 140 mph or more, and waves of 70 feet. Over 100 workers can live onboard at any one time, coming and going via helicopter, while supply ships keep a stream of necessary materials on hand. Oil production is sent via an underwater pipeline to Louisiana in a 116 mile trip. Gas production is sent 55 miles to a separate facility.

Mars is so big that it represented about 5% of all U.S. Gulf of Mexico production when Hurricane Katrina slammed into it in 2005. The hurricane caused extensive damage topside; aerial photos of Mars showed something that looked like a giant collapsed factory, with broken cranes and a collapsed rig tower. Shell quickly repaired Mars, improved the platform's safety precautions and restored production ahead of schedule.

Technological advances have further extended possible well depths to more than seven miles. One example of these wells is the Tonga #1 well in the Gulf of Mexico. Completed in December 2003 by Schlumberger and ChevronTexaco, the well reaches an astounding depth of 31,825 feet, or slightly less than six miles. Another well, Unocal's St. Malo, found oil by drilling through water and rock to a depth of 35,966 feet. In August 2012, Exxon Neftegas Ltd. drilled even deeper, completing its Z-44 Chayvo well with a measured total depth of 40,604 ft. as part of its Sakhalin-1 Consortium, near an island off eastern Russia, seven miles offshore.

Deep water hubs for natural gas are also reaching new depths. For example, the Independence Hub off the coast of Louisiana in the Gulf of Mexico, regulates gas flow from wells on the Gulf floor, two miles below. Attached to the wells by cables called umbilicals, the hub sends data, electricity and chemicals such as antifreeze to keep droplets of water

from freezing and slowing the flow of natural gas to the wells below. The wells are capped by heads that regulate flow and pressure. Flow lines transport gas from the wells back to the hub for transmission via the Independence Trail pipeline to the mainland. Ten different gas fields feed the Independence Hub, collectively extracting 1 billion cubic feet of natural gas per day.

Prior to the Deepwater Horizon debacle, a shortage of rigs capable of drilling at such extreme depths was a serious problem. Entering into a long-term contract for a rig was extremely difficult and costly. Because of the shortage, rental rates had been prohibitive, and waiting times were lengthy. As of late 2012, drilling costs for deepwater rigs in the Gulf of Mexico reached approximately $413,000 to $463,000 per day, down from 2009's record $500,000 to $600,000 per day, but significantly more expensive than the $150,000 per day charged in 2002. More rigs are being constructed and entering the market, but many of them are already under contract for several years of drilling.

In total, offshore reserves near America's Atlantic, Pacific and Gulf Coasts might reach 86 billion barrels or more, if widespread exploration was allowed, but state and federal restrictions make it impossible to drill in many promising fields. Meanwhile, Mexico, Cuba and the Bahamas all hope for new offshore drilling in waters adjacent to the United States.

Many of the world's poorest countries are in Africa, and they have an opportunity to benefit hugely from this new oil production, in both royalties and fees earned by their governments and in jobs created for their people. However, there is great concern that newfound wealth will be misused. Consequently, major oil firms and agencies such as the World Bank and the United Nations are cooperating in unique ways in an attempt to ensure that the billions of dollars of economic activity to be created will clearly benefit local populations. For example, the São Tomé measure, which was signed into law in 2004 by an island nation off the east coast of Africa, requires transparent accounting of oil revenue and creates an investment fund that will kick in when the oil is tapped out. Meanwhile, political strife in Nigeria and other oil-producing African nations can lead to production interruptions and may cause foreign firms to think twice about further investments here.

Brazil has become a leader in oil production. Already a global leader in the production and use of ethanol (for fuel in cars and trucks), Brazil has proven to have immense oil reserves offshore in deep water. While the potential for production is excellent, costs of producing from Brazil's offshore fields is very high. This cost structure creates long-term challenges. By 2011, Brazil was producing a very significant 2.19 million barrels of oil per day, compared to Venezuela's 2.72 million.

Petrobras, Brazil's government-controlled oil company, recently announced the discovery of several mega oilfields offshore, including a major gas deposit named Jupiter, off the coast of the state of Rio de Janeiro, and an immense new oil discovery about 155 miles offshore of the state of Sao Paulo in the Santos Basin. This is close to the major offshore oil field once known as Tupi, but renamed "Lula" in 2010, which was discovered in 2006 in the Santos Basin. Combined, these finds turned Brazil into an offshore oil and gas giant almost overnight. Lula ranks as one of the biggest discoveries in the Western Hemisphere in the past 30 years. The Santos Basin is a vast area in very deep water. There, oil reservoirs lie under a thick layer of salt, which creates technical challenges due to heat, pressure and potential movement of the salt structure. Lula may hold 8 billion barrels of oil, and the latest Santos Basin discovery may hold as much as 33 billion barrels. Drilling a single well in the Santos Basin requires an investment of about $250 million. These wells have an average depth of about 22,000 feet, including 7,000 feet of water. Under the water is the 6,500-foot-thick, corrosive layer of salt. When a drill bit finally penetrates the salt, it can access a pool of oil estimated to run from 250 to 400 feet thick. The total Santos Basin covers about 1,000 square miles. The exploration and production challenges here are similar to those faced on a regular basis in the Gulf of Mexico.

Oil and gas fields in Brazil are so promising that Petrobras has set a stunning $224.7 billion investment budget for the 2010-2014 period. The investment is already paying off, since Petrobras announced two new finds in the Espirito Basin in 2011 and another in its Caracara prospect in 2012.

As a nation, Brazil was a net importer of oil until recent years, which led it to be a successful pioneer in the commercialization of ethanol, made on a very cost-effective basis from local sugar cane. Now, Brazil has leased up many of the world's rigs that are capable of deep water operation. Petrobras is among the world's largest producers of oil drilled in waters deeper than 1,000 feet. It could easily become the world's fourth-largest oil producer (behind Russia,

Saudi Arabia and the U.S.), if it can manage exploration and production costs effectively.

SPOTLIGHT: Petroleo Brasileiro SA

Petroleo Brasileiro SA, known as Petrobras, is owned primarily by the Brazilian government and is one of the world's largest energy companies. It refines, produces and distributes oil and oil-based products both nationally and internationally. The firm divides company activities into six business sectors: exploration and production; refining, transportation and marketing; distribution; gas and power; international; and corporate. Petrobas' exploration and production unit researches, identifies, develops, produces and incorporates oil and natural gas reserves in Brazil. It currently produces roughly 2.17 million barrels of oil per day. The company's refining, transportation and marketing business includes 12 oil refineries that operate approximately 90% of Brazil's total refining capacity.

The distribution business, operated through subsidiary Petrobras Distribuidora SA, distributes approximately 38.8% of the demand for petroleum byproducts in Brazil through roughly 7,306 service stations. The gas and power segment markets domestic and imported natural gas and implements projects with the private sector to guarantee fuel throughout Brazil. This division also develops and invests in alternative energy sources, including wind, solar and biofuel energy. Internationally, Petrobras operates in over 20 countries, maintaining international operations such as exploration and petroleum procurement. Operations not covered by the other segments are classified under the corporate sector. The firm sells fuels and lubricants for the auto, aviation, marine and railroad industries, among others. It is investing up to $224.7 billion through 2014 for improvements and new fields, concentrating on finds in deep offshore waters, including the new Lula field, which may contain as many as 8 billion barrels of oil. In July 2011, Petrobras announced two new oil and gas finds in the Espirito Basin offshore of Brazil.

The Brazilian government is so committed to controlling its domestic oil industry that it requires that Petrobras operate as the only sub-salt driller in the offshore area. Government regulations also require that Petrobras comprise at least 30% of any offshore oil exploration or production consortium and that offshore wells source the bulk of their necessary goods and services from within Brazil. At the same time, the government hopes to turn Brazil into a leader in the oilfield services business.

Petrobras' first floating production, storage and offloading facility in the Gulf of Mexico is the Cidade de Angra dos Rios. Called an FPSO, these facilities resemble oil tankers in appearance and have been in use for a number of years in other parts of the world including the North Sea, the North Atlantic, the Mediterranean and the Indian Ocean. Each FPSO can process up to 150,000 barrels of oil per day and 6 million cubic meters of gas per day. The Petrobras vessel was built in Singapore and arrived in the Gulf in early 2010 where it serves the Cascade and Chinook fields. In late 2010, Petrobras and several partner companies signed contracts worth $3.46 billion with Engevix Engenharia SA, a Brazilian shipbuilder. The contract is for the construction of eight FPSO hulls for delivery between 2013 and 2015. Petrobras hopes to eventually buy as many as 45 FPSOs.

In addition to the challenges posed by deep water activity, which cover everything from shifting pressure zones, extreme temperatures and drills required to pass quickly from water to sand to rock, oil and gas companies face a scarcity of deep water drilling rigs. The October 2012 international offshore rig count was 306, down from October 2011's 312, up from the 305 counted in October 2010 according to Baker Hughes. (Most of the offshore rigs are not capable of working in extreme depths.) Natural gas activity in the South China Sea and off Malaysia, Indonesia and Vietnam will further stress the demand for equipment and know-how.

13) Energy Demand Climbs in India and China/Nuclear, Hydro and Gas Projects Grow

In 2009, China became the world's biggest energy consumer by some estimates, surpassing the U.S. For 2010, global energy research firm Enerdata reported that China consumed 2.49 billion tons of oil equivalent (which represents crude oil, nuclear power, coal, natural gas and renewable sources) in 2010, or 4% more than America's 2.24 billion tons. There is little doubt that China's total energy consumption has grown at a staggering rate over recent years.

For 2011, when measuring energy consumption by British thermal units (Btus), China was slightly behind the U.S. with 96.66 thousand trillion units consumed, compared to 97.88 thousand trillion units in the U.S., according to the U.S. Energy Information Administration (EIA). When consumption was

measured on the basis of metric tons of standard coal equivalent, China's consumption in 2011 rose 7% to 3.48 billion metric tons over the previous year, according to China's National Bureau of Statistics. As of 2011, China continued to rely on coal for the majority of its energy needs, but it is investing heavily in other resources.

China is industrializing and modernizing at a very rapid rate. As a result, its demand for energy 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.

Growing electricity consumption means a greater need for an infrastructure system to handle transmission and distribution. As of late 2012, China's State Grid Corp. was calling for government approval of a $250 billion upgrade to the power grid. Analysts estimate that the grid needs to expand capacity to 1,500 gigawatts (GW) by 2020, from 1,060 GW at the end of 2011. The plan includes up to 20 ultra-high voltage power lines (called corridors) which would connect far flung regional grids. Most of China's coal, natural gas and renewable energy resources are located far from major cities, creating major logistical problems. By some estimates, up to 60% of China's rail capacity is required to move coal to generating stations. The corridors, which would lessen energy loss during transmission, would help alleviate multiple problems. Power plants could be built closer to coal sources. Whether or not the state will approve the plan's $250 billion price tag remains to be seen.

China has a modest amount of oil production of its own, including its largest area, the 40-year-old Daqing Field, where production has fallen since its peak in 1997. By 1993, China's rapid industrial growth forced it to become a net importer of oil, and it now depends highly on foreign oil. In late 2009, ExxonMobil completed construction in China of a $4.5 billion refinery and petrochemical plant, one of the largest facilities in the firm's global operations.

Today, China's imports oil from sources all over the world. Like many other nations, it is working hard to improve its oil security and move away from reliance on OPEC. As a result, China is investing heavily in oil fields and projects from South America to Indonesia to Kazakhstan to Russia. China National Offshore Oil Corp. International Limited (CNOOC), for example, has properties in production or under development in Indonesia, Australia and Nigeria.

China is also importing heavily from Canada and investing in Canadian ventures. China's state-controlled CNOOC owns 17% of Canadian oil sands company MEG Energy.

By 2009 China had become the world's largest automobile market, surpassing the U.S. in terms of units purchased each year. China's government is trying to head off growing automobile pollution and gasoline consumption problems. It has imposed strict new mileage standards for automobiles, stricter than those in place in the U.S. Electric vehicles may quickly become popular in China. Now is definitely the time to plan ahead for China's energy future and lay the groundwork for widespread alternative and renewable power sources, as the country continues to rapidly grow its economy. The Chinese government has called for 15% of all its energy needs to be supplied by renewable sources by 2020, up from about 7.5% in 2007. It remains to be seen whether it can meet this goal. However, China has become a global leader in the manufacture of both wind turbines and solar cells. Its firms produce large quantities of renewable energy equipment both for export and for domestic installation.

Also, one of China's prime renewable sources is hydroelectric power. Already one of the world's largest producers of such power, China plans to dramatically boost its output by 2020, to 300 gigawatts, taking advantage of massive rivers that flow through the center of the nation. China is also investing heavily in solar, wind and biomass projects.

China's economic development has been more rapid than India's. Its reliance on manufacturing industries creates large and rapidly growing demands on electric production. In addition, its population is about 300 million larger than India's. As of mid-2012, China had 15 nuclear reactors in operation with 11.9 gigawatts of capacity and at least 26 under construction, with many more on the drawing board. However, after the damage suffered by Japan's Fukushima reactors, China may rethink its emphasis on nuclear power. Before the Fukushima disaster, China's goal was to increase nuclear power generation capacity to 80 gigawatts by 2020. A host of international energy and construction companies are involved in Chinese projects, including Westinghouse and General Electric.

Meanwhile, China will continue to rely very heavily on coal for generation. Unfortunately, its coal-fired plants are very heavy polluters, adding to China's already great dilemma with industrial pollution. China's burning of coal is one of the world's largest sources of carbon dioxide emissions.

Adoption of clean coal technologies, such as relatively easy to install scrubbers, would be an immense help. As of 2011, as much as 77% of China's electricity was supplied by domestic coal, and China holds massive coal reserves.

Several initiatives are in place to partner Chinese coal mines with international energy companies to create synthetic gas from coal. Royal Dutch Shell and South Africa's Sasol are working on projects with China's Shenhua Group that were planned for completion in 2013. Shenhua Group also completed a $1.5 billion coal-to-oil facility in 2008, which can convert coal into as much as 22,000 barrels of crude-oil-type fuel per day. Moreover, Shenhua Group is part of a consortium of power and coal companies called GreenGen, which plans to build an even cleaner-burning integrated gasification combined cycle (IGCC) plant that will include carbon capture and storage technology by 2015.

The Chinese are also rapidly building more efficient coal plants that utilize steam heated to extreme temperatures. The most efficient new plants convert up to 44% of the energy in coal into electricity. China's commitment to building more plants with high-specification emission control systems, despite the higher cost, is making it one of the world's top markets for advanced coal-fired plants, according to the IEA.

While China's total energy usage has been growing, it has also been improving its "energy intensity," the amount energy required to create one unit of gross domestic product (GDP). China's five-year plan through 2015 calls for a 16% improvement in this regard.

India's federal government has promised to invest in its electrical capacity in order to provide access to all residents. The government is seeking private sector investment and promoting competition for lucrative power plant contracts. It is actively promoting construction of coal-fired plants, nuclear plants and renewable energy.

India has long been plagued by power shortages. In 2012, the power supply deficit rose to 7.5%, up from 6.5% in 2011, according to the Indian Ministry of Power. Recently, about 50% of the population was without any kind of reliable electricity. Low-income, rural areas often rely on burning wood or dung for fuel, and small solar cells for recharging of cellphones.

Indian power utility Reliance Energy Ltd. announced an $11-billion coal-based power plant in the state of Orissa. (India is one of the world's major coal producers.) Another project, a $2.53-billion, 3,500 megawatt natural gas plant in the state of Uttar Pradesh, has also been announced. It would capitalize on the 2002 discovery of sizeable deposits of natural gas off India's east coast. Both of these plants would be among the largest of their types in the world.

A primary focus for India's development will be nuclear power generation. The U.S.-India Nuclear Energy Accord, passed by the U.S. Congress in late 2006, affords India access to U.S. civil nuclear technology. India has a stated goal of producing 20,000 megawatts of nuclear power by 2020. In September 2008, India signed an agreement similar to the U.S.-India Accord with France, opening the door for industry leader AREVA Group. India's lower and upper houses of parliament both passed a civilian nuclear bill in late 2010 which is expected to green light the agreement into operation. As of 2012, India had 20 nuclear power reactors in operation, according to the World Nuclear Association. After the 2011 Fukushima nuclear disaster, mass protests in India by people living near proposed sites for new reactors threatened to slow development. However, as of 2012, seven additional reactors were under construction.

14) Canada's Oil Sands Production Reaches 1.7 Million Barrels per Day, But Operating Costs Are High

The oil sands (also referred to as "tar sands") found in Canada, Venezuela and other locations throughout the world were historically regarded as unrecoverable assets by many members of the energy industry. However, through a combination of decades of work, evolving technologies and a rise in oil prices, the process of turning oil sands into usable crude oil has become a viable business. According to the EIA, Canada is the largest single exporter of oil to the U.S. In 2011, Canada sent crude to America equal to U.S. imports from all of the Persian Gulf nations combined, in terms of dollar value. Including tar sands, it has 175 billion barrels of recoverable oil reserves, ranking third in the world behind Venezuela and Saudi Arabia, according to 2011 estimates by BP.

In the Athabasca field in the province of Alberta, Canada (due north of Montana on the U.S./Canada border), huge cranes reap massive scoops of oil sands from open pit mines of vast proportion. These scoops dump the sands into monstrous trucks nearly as tall as three-story buildings. Each truck burns 50 gallons of diesel per hour as it lumbers along, hauling 360-ton loads of tar-coated sand and clay to giant

tumblers and superheated cookers. Oil sands are coated with bitumen, a substance with the consistency of cold molasses that can be processed and refined into a synthetic crude oil. This labor-intensive work is turning the black dirt of Athabasca into one of the greatest sources of oil in the world. Additional Alberta fields include the Peace River and Cold Lake regions.

The technology used in mining oil sands has been under development for many years. Canada's first strip mines in the oil sands opened in the 1960s with expansion into the 1970s. In the 1990s, the industry was further encouraged by very high market prices for crude oil. By 2003, a collection of startups and joint ventures, including major oil company partners, managed to streamline the process of mining, transportation and processing these oil sands so that the cost of turning two tons of tar sand into a barrel of crude oil was about $25. The cost was high, but acceptable. Strip mining, pulling the oil sands from open pits, remained the primary method of extraction.

Billions of dollars were poured into new facilities to mine and convert the sands to usable crude. Thousands of people were hired and moved to remote areas where workers were scarce, and housing and other services were even scarcer. Costs soared quickly, to the extent that the business may not be profitable for many producers when oil market prices are below $60 to $70 per barrel.

How much of this mineral-rich black dirt is there? In Canada alone, where most of the oil sands projects are located, there may be as much as 1.8 trillion barrels of oil equivalent by some estimates.

For 2012, the Canadian Association of Petroleum Producers (CAPP) reported 1.70 million barrels output per day. Production is expected to reach as high as 3.7 million barrels per day by 2025.

Future growth in production will depend to a large extent on market prices along with the industry's ability to control production costs as well as environmental damage. Meanwhile, significant changes in oils sands technology are in store. Massive oil sands reserves also exist in Venezuela.

SPOTLIGHT: Oil Sands Operations at Suncor Energy

Suncor Energy, www.suncor.com, has a history of production in the Alberta, Canada oil sands since 1967. Today, it has about 13,000 employees, and a wide variety of energy activities including natural gas, wind power, ethanol production and downstream operations. In 2012, it estimated oil sands production at between 319,000 and 330,000 barrels per day. Capital spending for 2012 on oil sands was projected to be about $4.5 billion, with $7.5 billion total to be spent on all its businesses. Long term, the firm plans a $20.6 billion expansion to oil sands capacity, in a project called "Voyageur." When fully implemented, the Voyageur project will give Suncor an oil sands capacity of 550,000 barrels per day.

Oil sands production is evolving away from strip mining, with "*in situ*" (which is Latin for "in its original place") production, as opposed to strip mining, beginning to account for a growing portion of the industry. With this method, pairs of perforated well holes are drilled to a depth of a few hundred meters below the surface. The two bores are then drilled horizontally for another 800 meters or so, one a few feet below the other. Above ground, massive steam generators burn natural gas to create steam that is injected into the top bore hole. This has the effect of melting the bitumen out of the sand. The bitumen settles downward. The liquefied bitumen is then pumped out through the bottom bore, along with a quantity of water. The water is recycled to the steam generator. The bitumen is mixed with a petrochemical that dilutes it, and is then sent via pipelines to a refinery. The process is referred to as "steam-assisted gravity drainage," or SAGD. As of 2012, the cost of SAGD production was around $55 to $65 per barrel.

From an environmental standpoint, this method eliminates the need for ugly surface mines. However, it requires the burning of immense quantities of natural gas by the steam generators. Any way it is done, production from oil sands leaves a considerable carbon footprint.

Several new techniques are being tested that may result in much more efficient production at lower cost and with fewer emissions. In one theory, butane is used downhole as a solvent to dissolve the bitumen. Canadian firm N-Solv hopes to be able to use solvents to enable the production of bitumen at a cost savings of $9 to $15 per barrel over SAGD. Other firms adapting SAGD technology include Laricina

Energy, Royal Dutch Shell, Athabasca Oil and Husky Energy.

In an attempt to lessen the carbon footprint left by oil sands production, Royal Dutch Shell announced plans in 2012 to spend $1.36 billion on a plant in Canada that is intended to capture and store underground more than 1 million tons of carbon dioxide per year. The plant is scheduled to begin operations by 2015.

15) Production of Synthetic Crude from Kerogen Trapped in Shale Advances Through New Technologies

While the U.S. has much smaller oil sands deposits than those of Canada, it is rich in a different unconventional oil formation: kerogen-rich oil shale. This is found as a rock formation containing the oil precursor kerogen, which can be processed into synthetic oil of very high quality, similar to sweet crude. Kerogen-bearing shales are younger, in geologic terms, than formations that contain crude oil. Natural forces have not yet converted the sedimentary kerogen deposits into crude. (This type of field is not to be confused with production of actual crude oil from shale in the Bakken Shale and other fields.) Oil shale yields between 10 and 60 gallons of kerogen-based oil equivalent per ton of rock. Vast reserves are in the Green River Formation in the Western U.S., including parts of Colorado, Wyoming and Utah. The richest U.S. fields (those that contain at least 15 gallons per ton) are thought to hold a total of 1.8 trillion barrels of oil equivalent.

During the 1970s, after the oil embargo crisis, the federal government strongly encouraged both energy conservation and alternative production. In 1979, it established the U.S. Synthetic Fuels Corp., endowing it with billions of dollars for research and development of new fuels. As a result, major oil companies attempted to commercialize oil shale, but those efforts were largely abandoned by the 1980s as oil prices fell. There were also concerns about environmental damage from shale mining, and there were many technical hurdles to face. Commercial production seemed impossible. By 1985, Congress killed the Synthetic Fuels Corp.

Today, producing oil from shale remains a major challenge, but the immense oil needs of Americans combined with higher prices for petroleum means that oil shale will receive a new look by the industry. As long as the price of crude oil remains above $50 or $60, oil shale production may become attractive. For example, Shell Exploration & Production has a well-advanced test site in Colorado where it is attempting to perfect a technology that warms the kerogen while in the ground, by using heated rods that are sunk into layers of shale and then pumping out the resulting liquid. The system is called the In Situ Conversion Process (ICP). (See www.shell.us/home/content/usa/aboutshell/projects_locations/mahogany/technology for details.) ExxonMobil is researching similar technology called Electrofrac which cracks shale deposits with hydraulic pumps and then pours in electrolytic fluid to separate the kerogen from the rock. Shale deposits can be deep—up to hundreds of feet below the surface. Shell's technology is moving ahead rapidly, with more than 200 oil shale development patents filed, it is the firm's biggest R&D investment. Shell has even announced that it will work with the government of China to develop shale deposits there.

Other firms seek to "mine" the rock and then process the oil from the shale using high heat in furnaces. There are vast ecological problems with this method, however, as the process is very similar to strip mining.

16) Clean Coal and Coal Gasification Technologies Advance/Carbon Capture (CCS) Proves Costly

In 2011, global production of coal was 3.96 billion tons of oil equivalent, up from 3.73 billion tons in 2010, according to BP plc. While coal is an abundant resource in many parts of the world, it is generally burned in a manner that creates significant amounts of air pollution. On a global scale, the burning of coal produces more carbon dioxide than any other fossil fuel source. "Clean coal" technologies have been developed, but such technologies are enormously expensive.

In the U.S., coal comes from several different regions. The Northern Appalachian area of the Eastern U.S. and the Illinois Basin in the Midwest produce coal that is high in sulfur, which emits more pollutants. In contrast are the enormous stores of coal in Wyoming and Montana, which burn at lower temperatures and produce less energy than high-sulfur coal, but create less pollution. In existing mines, the U.S. has about 237 billion tons of recoverable coal.

According to BP, coal accounted for 30.3% of global energy consumption in 2011, compared to 29.6% in 2010, and 25.6% in 2000. World consumption grew 5.4% in 2011 and coal production grew by 6.1%. China's coal consumption was up by 9.7% in 2011 over 2010, and India's increased 9.2%.

China accounted for 49.4% of the world's coal consumption in 2011.

In recent years, a large number of U.S. utilities are turning away from coal in favor of less-polluting natural gas. Texas-based Calpine acquired 19 power plants from Pepco Holdings, Inc. for $1.63 billion. The bulk of the plants burn natural gas, and Calpine is planning to convert its coal burning concerns in New Jersey and Delaware to gas also. North Carolina utility Progress Energy plans to close 11 coal burning plants by 2017.

In 2011, the Environmental Protection Agency (EPA) attempted to establish the Cross-State Air Pollution Rule, to cover about 1,000 power plants in 27 U.S. states. Originally, the Rule stated that plants must cut emissions of sulfur dioxide by 73% and nitrogen oxide by 54%, from 2005 levels, by 2012.

The Rule created an immediate uproar. A number of analysts stated major concerns about its impact on the reliability and stability of the U.S. power grid. Others consider the total costs to the economy to be much too high. The Federal Energy Regulatory Commission (FERC) announced in August 2011 that 81 gigawatts of generating capacity is likely to be lost by 2018 as coal plants are restricted or closed. That amounts to approximately 8% of all U.S. generating capacity, which could easily result in blackouts and rolling brownouts in addition to substantial raises in electricity rates.

The EPA subsequently softened the requirements with a proposal in October 2011 to offer 10 U.S. states more flexibility in meeting the rule and all 27 states would have until 2014 to comply instead of 2012. Even after these changes, this is still a daunting regulation with the potential for massive economic consequences. On August 21, 2012, the U.S. Court of Appeals in Washington struck down the rule, stating that the EPA overstepped its legal authority and imposed standards that were unreasonably strict. The court further ordered that the EPA continue to enforce the 2005 Clean Air Interstate Rule instead. As of October 2012, the EPA was seeking a rehearing over the legality of the Rule.

Meanwhile, as a result of the regulatory environment and cheap natural gas, thanks to abundant supply from shale, U.S. consumption of coal was falling as of 2012. The EIA reported a drop of 6.5% in consumption in 2012 compared to 2008. The EIA forecasted that 8.5% of the U.S.'s coal-fired fleet will retire by 2016, and 17% by 2020. The EIA also forecasted net electric generation from coal would fall to 32% in 2012, compared to 48% in 2009.

High-sulfur coal is now easier to sell in some markets, since advanced filtering units called scrubbers are in use by a growing number of electric generating companies. Scrubbers are multistory facilities that are built adjacent to smokestacks. They capture sulfur as the coal exhaust billows through the smokestack and sequester it for storage before it can be cleaned. Unfortunately, scrubbers are extremely expensive. Costs of $400 million and more for a single scrubber are common. For example, Progress Energy budgeted $1 billion on the technology for three of its newer coal-burning plants, which generate enough revenue to justify the expense. Constellation Energy spent $885 million on a scrubber installation that has significantly reduced emissions from two of its coal-burning units at its Brandon Shores plant in Maryland. The installation included the replacement of two 700-foot smokestacks with a new, shorter one that emits clouds of steam produced in the scrubbing process.

Multiple clean coal technologies are in development. Scientists at the University of Texas are developing a new technology that blasts sound waves into the flue ducts of coal-fired power plants. The noise, which registers at more than 150 decibels (about as loud as a jet engine at takeoff) causes tiny ash particles in the emission stream to vibrate and stick to larger ones, thereby making larger particles that are easier to capture by pollution control equipment like scrubbers.

Yet another technology to reduce emissions is the use of photosynthesis to capture exhaust gases, such as CO_2, from power plants. A company called GS CleanTech (now a part of GreenShift Corporation, www.greenshift.com) developed a CO_2 Bioreactor that converts a concentrated supply of carbon dioxide into oxygen and biomass in the form of algae, which can then be converted into fuel. Competitor GreenFuel Technologies used a different method of recycling carbon dioxide from flue gases, achieving the same end result: algae. An early test of GreenFuel's reactor at the Massachusetts Institute of Technology promised the removal of 75% of the carbon dioxide in the exhaust sampled. Unfortunately, the process proved too expensive.

Coal-gasification plants could conceivably become a trend for electric generation plant construction over the long term. However, costs remain a significant obstacle. Such plants use a process that first converts coal into a synthetic gas, later burning that gas to power the electric generators. The steam produced in the process is further used to generate electricity. The process is called Integrated

Gasification Combined Cycle (IGCC). While these plants are much more expensive to construct than traditional coal-burning plants, they produce much less pollution. Since the coal isn't actually burnt, these plants can use lower-cost coal that is high in sulfur. In addition, such plants reduce the amount of mercury emitted from the use of coal by as much as 95%. Several demonstration plants have been constructed using IGCC technology, typically with government funding. U.S. plants include those in Mulbery, Florida and West Terre Haute, Indiana. Japan has constructed a demonstration plant, the Nakoso Power Station at Iwaki City. Other demonstration plants are in operation or under consideration in Europe, Asia and Australia. However, high costs and the difficulty of funding continue to create challenges. Siemens, a leading global firm in the power equipment industry, has been involved in multiple projects.

American Electric Power (AEP), a Columbus, Ohio electric utility, shelved plans to build an IGCC carbon-capture plant in West Virginia due to the company's concerns that state regulators would not allow it to be reimbursed for $668 million cost above through raises in customer utility rates. Without substantial government support on the federal and state levels, power companies are unlikely to be able to afford IGCC efforts.

An additional step that can be added to IGCC plants is the capture or "sequestration" (CCS) of carbon dioxide. The technology to do so already exists. For example, Norway's Statoil has used it for years at its natural-gas wells in the North Sea. The sequestered carbon dioxide can be pumped underground. Fortunately, carbon dioxide can be used in oil and gas wells to enhance recovery in a process known as CO_2 flooding. These floods sit near large, natural reservoirs of CO_2.

Internet Research Tip: Carbon Capture and Sequestration (CCS)

For an excellent discussion of carbon capture and sequestration technologies, research and demonstration projects, see the U.S. Department of Energy's web site for the NETL (National Energy Technology Laboratory) www.netl.doe.gov/technologies/carbon_seq/index.html.

South African fuel company Sasol Ltd. has had success in making liquid fuel from coal that powers gasoline, diesel and jet engines. Germany first used the technology, which is called Fischer-Tropsch after the scientists who developed it, during World War II. In the decades since then, the technology has been refined and improved to the point that Sasol provides a significant portion of South Africa's fuel needs and is expanding with gas-to-liquids plants in Qatar and Nigeria.

In the U.S., recent federal stimulus funding includes money for carbon capture and sequestration research and demonstration. FutureGen Alliance, www.futuregenalliance.org, a project involving a utilities consortium funded by subsidies from the U.S. government, hopes to build a plant in Mattoon, Illinois to test cutting-edge techniques for converting coal to gas, capturing and storing pollutants and burning gas for power. FutureGen Alliance signed an agreement with the DOE to build the FutureGen 2.0 CO_2 pipeline network and CO_2 storage site to be built in Morgan County, Illinois.

In 2012, the EPA proposed new limits on U.S. utilities' greenhouse gas emissions of less than 1,000 pounds of carbon dioxide per megawatt hour (about half of the emissions produced at that time). A number of companies are testing carbon capture technologies to meet this goal. For example, NRG Energy, in partnership with the National Energy Technology Laboratory to capture carbon dioxide at a rate of up to 90% of emissions from 240 megawatts of capacity by 2015. The DOE has a goal of a commercial demonstration of such as project by 2020.

17) The Industry Takes a New Look at Nuclear Power

The first man-made nuclear fission was achieved in 1938, unlocking atomic power both for destructive and creative purposes. In 1951, usable electricity was created via a nuclear reactor for the first time, thanks largely to research conducted at the Manhattan Project that developed the first atomic weapons during World War II.

By the 1970s, nuclear power was in widespread use, in the U.S. and abroad, as a source of electricity. As of 2011, nuclear power provided about 19.25% of the electricity generated in the U.S., created by 104 licensed nuclear reactors, according to the Nuclear Energy Institute.

Significant, long-term construction of new nuclear plants is in jeopardy due to the post-earthquake disaster at the Fukushima nuclear power plant in Japan that occurred in March 2011. Even before the Japanese crisis, by late 2010, as many as seven proposed American reactor projects had been deferred due to funding problems. Obtaining

financing for these extremely expensive projects is a main issue. Exelon suspended plans to build a twin reactor in Texas, while Constellation Energy abandoned a new project in Maryland after the federal government refused to reduce an $880 million fee that it proposed to charge in return for guaranteeing a $7.6 billion loan necessary to build the plant.

The potential for accidents, meltdowns and other disasters has never been far from the minds of many consumers (after all, for many of us the first image that comes to mind upon hearing the word "nuclear" is a nuclear bomb). The 1979 Three Mile Island nuclear power plant accident in the U.S. led to the cancellation of scores of nuclear projects across the nation. This trend was later reinforced by the disaster at Chernobyl in what was then the Soviet Union.

As of 2012 in the U.S., a new reactor was under construction, the Watts Bar Unit 2 in Tennessee. Engineering giant Bechtel was selected to complete this project, which had been sitting in an incomplete state for years. The project will cost $4 billion to $4.5 billion and be online as early as September 2015, with generating capacity to serve 650,000 homes.

At the Alvin W. Vogtle nuclear site in Georgia, two additional reactors are under construction, to be owned and operated by Georgia Power, a part of the Southern Company, at an estimated cost of $14 billion. In February, 2012, the Nuclear Regulatory Commission voted to grant a license to the proposed new units, which will utilize the highly advanced Westinghouse AP1000 technology. Two new units are also under construction at the V.C. Summer nuclear site in South Carolina, scheduled to begin operation in 2017 and 2018.

The Tennessee Valley Authority (TVA) approved, in August 2011, construction of a nuclear plant near Scottsboro, Alabama, at the Bellefonte site. As of late 2012, the project had not yet cleared Nuclear Regulatory Commission approval. Construction may begin in 2013 or 2014.

However, nuclear power plants in many other parts of the world are in jeopardy as popular opinion turned against the technology in the wake of Fukushima, despite the fact that nuclear power can dramatically reduce a nation's carbon emissions. In 2011, German Chancellor Angela Merkel announced plans to shut down all 17 of its nuclear reactors by 2022. In 2010, these nuclear plants generated 23% of Germany's electricity. The government hopes to have renewable sources make up the difference, as it had already made plans to increase renewable energy's role from 13% in 2010 to 35% by 2020. In ensuing years, German power costs will likely rise significantly as it scrambles to build new sources to take up the slack in power demand. It remains to be seen whether Germany can actually bear the economic costs of closing the plants. Switzerland also announced plans to abandon new nuclear projects and phase out existing reactors as they reach the end of their usability. Italy, also, announced a one-year freeze in March 2011 on plans to re-launch nuclear projects. It cancelled all plans to revive its nuclear program in June 2011 after a landslide vote against it.

The nation of France was an early adopter of nuclear power. The French approved a single, very cost-effective nuclear plant design and built it over and over again around the nation. France currently gets nearly 80% of its electricity from nuclear sources. The decisions by several countries to abandon new plants will be a significant blow to French companies such as AREVA SA and Electricite de France SA which build reactors and provide expertise in the technology on a global basis.

As for China, it had 15 nuclear reactors in operation in 2012 with a generating capacity of about 11.9 gigawatts, according to the World Nuclear Association. Before the Fukushima disaster, China was on track to reach a goal of 80 gigawatts of capacity by 2020 (which would still be less than 5% of its electricity). In comparison, China hopes to generate 200 gigawatts from wind and an extra 100 gigawatts of hydropower by 2020 as well. Post Fukushima, China was expected to shift nuclear regulation from the National Development and Reform Commission to the Ministry of Environmental Protection. China had several plants under construction as of 2012, and a long-term interest in developing as many as 90 new plants in total. In addition, in November 2012, China resumed the approval of new nuclear projects, after putting them on hold following the Fukushima disaster.

SPOTLIGHT: AREVA Group
2011 Sales: $11.8 billion
2011 Profits: -$3.2 billion
Employees: 47,541
Headquarters: Paris, France

AREVA Group was created through the merger of AREVA T&D, COGEMA and FRAMATOME ANP, which combined the French Government's interests in several nuclear power and information technology businesses. The Commissariat a l'Energie Atomique (CEA), the French atomic energy commission, owns a major interest in the company. AREVA operates in five divisions: mining, front-end, reactors and services, back-end and renewable energy. The mining division handles the uranium ore exploration, mining and processing operations of the company in 15 countries. Through the front-end division, and wholly-owned subsidiary AREVA NC, the company manages concentration, conversion and enrichment of uranium ore as well as nuclear fuel design and fabrication. The reactors and services division offers design and construction services for nuclear reactors and other non-carbon dioxide emitting power generation systems. Through AREVA NP, the firm designs and constructs nuclear power plants and research reactors and offers instrumentation and control, modernization and maintenance services, components manufacture and the supply of nuclear fuel. The back-end division provides treatment and recycling of used fuel, as well as cleanup of nuclear facilities. The renewable energy division invests in and develops sites for wind energy, bioenergy, solar power and hydrogen power as well as energy storage. In 2012, the firm entered into final negotiations for the sale of its nuclear measurements subsidiary Canberra to private equity manager, Astorg Partners; the firm also divested its stakes in La Mancha Resources, Inc., Eramet and Sofradir.

Estimates of final costs for a new, 1,000-megawatt unit in the United States range from $6 to $12 billion, depending on whom you ask. Another way of measuring the cost of a reactor is to calculate the overnight cost, which factors the material and labor that goes into a plant as if simultaneously purchased. Measured that way, costs for reactors range between $1,700 per kilowatt of capacity to $9,000 per kilowatt, depending on the kind of reactor. However, the history of nuclear reactor construction is littered with cost overruns, delays and complications. A focus on standardized, advanced-technology designs that can be built over and over again can streamline the regulatory process, reduce financial risks and encourage investment. Meanwhile, costs are so high that new construction is unlikely anywhere in the world without substantial government guarantees and assistance. The fact that nuclear power can dramatically reduce a nation's carbon emissions is a big plus.

The U.S. government offers incentives, primarily in the form of loan guarantees, for the construction of reactors. However, the process and cost of actually getting those guarantees issued can be daunting.

Nuclear Waste and Uranium Reprocessing: The controversial Yucca Mountain nuclear waste repository project in Nevada was intended to create a permanent location for America's nuclear waste. It was designed to store waste 1,000 feet underground above another 1,000 feet of solid rock. Supporters maintained that one central depository is far safer than the current method of storing waste underwater near each reactor site. Waste would be transported to a central repository by truck and rail, and it would be sealed in armored casks designed to withstand puncturing and exposure to fire or water. However, the Obama Administration vowed to end development of the site, which has sucked up $13 billion in federal funds to date, and little further construction is expected for the near term. The 2011 federal budget called for the elimination of funding for the project.

Meanwhile, the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico began accepting shipments in 1999. It stores nuclear waste in rooms mined out of a salt formation 2,150 feet below ground. As of 2012, WIPP continued its operations, winning recognition by the DOE for improvements in energy, water and fleet efficiency while reducing pollution and waste. However, this site is primarily for the disposal of nuclear waste from research, medical and military uses.

TECHNOLOGY SPOTLIGHT: TerraPower

A unique, private technology research firm based in Bellevue, Washington, Intellectual Ventures www.intellectualventures.com, has proposed a revolutionary nuclear reactor concept it calls TerraPower. This technology would use a new class of reactor called TWR or traveling-wave reactor that would solve the current nuclear waste problem. TWRs would use today's stockpiles of depleted uranium from power plants as its primary fuel source. The TWR would essentially be a reactor-reprocessor. Traditional reactors rely on uranium-235, and their operation leaves a more common uranium-238 as waste. Every year or two, traditional reactors must be opened and refueled, and the "spent" uranium-238 waste is stockpiled. Millions of pounds of it are now in storage. A TWR could be fed that uranium-238, which it would convert into a desirable fuel, plutonium-239. Similar conversion of U-238 has already been proven, but present technologies for reprocessing into plutonium are expensive and complicated. TWR could represent a significant step forward while reducing the potential of diverting plutonium to use in atomic weapons. With substantial investment from Bill Gates, TerraPower may see a demonstration reactor as early as 2022.

Another underground disposal project is in Finland at the Olkiluoto Nuclear Power Plant. The proposed site will store spent fuel rods in iron canisters sealed in copper shells to resist corrosion. The canisters will be placed in holes surrounded by clay far below ground. The project is slated for completion in 2020.

The alternative to the storage of nuclear waste is reprocessing, in which spent fuel is dissolved in nitric acid. The resulting substance is then separated into uranium, plutonium and unusable waste. The positive side of reprocessing is the recycling of uranium for further nuclear power generation. Surplus plutonium can be mixed with uranium to fabricate MOX (mixed oxide fuel) for use in a commercial nuclear power plant. MOX fuel contains 5% plutonium. Commercial MOX-fueled light water reactors are used in France, the United Kingdom, Germany, Switzerland and Belgium. In the U.S., MOX fuel was fabricated and used in several commercial reactors in the 1970s as part of a development program. The negative side of reprocessing is that the resulting plutonium may be used for nuclear weapons and the financial costs are prohibitively high. Additionally, environmentalists are extremely concerned about the potentially high levels of radioactivity produced during reprocessing, as well as the transportation of reprocessed waste.

Safer New Nuclear Power Technologies: New technologies may eventually enable construction of nuclear generating plants that are less expensive to build and much safer to operate than those of previous generations.

PBMR, Ltd. (www.pbmr.co.za), is a pioneer in "pebble-bed modular reactor" (PBMR) technology. It is based in South Africa, where at one point the firm hoped to build a working reactor. However, funding was never definite and the company is attempting to regroup. Earlier, scientists in Germany operated a 15-megawatt prototype PBMR from 1967 to 1988. Pebble-bed technology utilizes tiny silicon carbide-coated uranium oxide granules sealed in "pebbles" about the size of oranges, made of graphite. Helium is used as the coolant and energy transfer medium. This containment of the radioactive material in small quantities has the potential to achieve an unprecedented level of safety. However, multiple challenges remain, partly stemming from the fact that PBMRs operate at very high temperatures. For several years, various efforts around the world have attempted to create viable high-temperature, gas-cooled reactors similar to this.

In 2008, PBMR, Ltd. said that it created its first enriched uranium-coated particles, 14,000 of which are contained in one of its "pebbles." In September 2009, the firm announced that it had manufactured its first complete pebbles, each containing 9.6% enriched uranium. Sixteen pebbles were shipped to Russia for two years of irradiation tests to demonstrate the fuel's integrity under reactor conditions. Successful tests would mean that the fuel is ready to be used in a demonstration reactor. PBMR Ltd. had a setback in 2010 when Westinghouse withdrew from a consortium formed to build a pebble bed reactor in South Africa. The withdrawal, coupled with significant cost overruns and delays, caused the cancellation of the South African project and most of PBMR Ltd's hopes for success.

The world's most promising pebble bed project is being carried out at the Tsinghua Institute of Nuclear and New Energy Technology in China. China actually has a working model that was completed, tested and brought on line in 2000-04. Even though this test prototype generates a relatively minute 10 megawatts, it is theoretically only a matter of scaling up the design to create a commercially viable project. The best part of the Chinese design is modularity. Future, full-size sites will consist of small 100-

megawatt reactors that can be grouped and chained into a single plant, making a more distributed energy model possible, where capacity can be upscaled as needed. The Chinese appear to be solving the high temperature problem by operating the reactors at a relatively low 750 degrees Celsius. Cooling is being considered using steam cycle technology as an alternative to helium. Two pebble bed plants are planned in China. The test site, in Shidao, could eventually house up to 18 reactors. It remains to be seen whether the Chinese can create a commercially-viable reactor in this manner, but this is a serious effort that looks promising. Success could have a great impact on global nuclear development.

Other nuclear technologies will be used elsewhere in China. As of 2012, Westinghouse, a major maker of nuclear power plants (and owned by Toshiba in Japan), was building four new nuclear plants, using its AP1000 model, in China. The project includes work performed by U.S. engineering giant Shaw Group, Inc. AREVA Group also has a deal with China for two reactors and approximately 20 years worth of atomic fuel.

Westinghouse, like competitor GE, is focusing on an advanced, water-cooled reactor technology. The world's first AP1000 plant began construction in March 2009 at Sanmen, in the Shejiang province of China. The AP1000 is considered a generation 3+ reactor technology. Advanced generation reactors feature higher operating efficiency, greater safety and design that uses fewer pumps and other moving parts in order to simplify construction and operation, and make emergency responses more dependable. "Passive" safety systems are built-in that require no outside support, such as external electric power and human action, to kick in. For example, the AP1000 features systems for passive core cooling, passive leak containment cooling and leak containment isolation. Passive systems rely on the use of gravity, natural circulation and/or compressed gas in order to react to emergencies.

The long term future of nuclear plant design may be exemplified by the work of Babcock & Wilcox. This company was founded decades ago as a manufacturer of boilers and it has a lengthy history of making components, such as pressure vessels, for the energy industry. It has adapted its technology base in order to design an innovative nuclear generation concept, the mPower modular reactor. It is a low cost, high efficiency design of compact size. The engineers leading the project were focused on one concept: to create a reactor pressure vessel, the core of the unit, that can be built at a factory and be small enough to fit on a railroad car for delivery to the final site. This overcomes the massive, custom engineering and construction challenges that typically drive the cost of a site-built nuclear plant to more than $6 billion, and the time required for completion to several years. One modular unit from Babcock & Wilcox could be installed in relatively short order, and could power a single large industrial complex or a few thousand homes. Several of these small, low-cost units could be combined at one site to create power stations of enough overall capacity to power a small city. The air-cooled design is described as passively safe. The firm already has a lengthy history in the nuclear field, as it builds reactors for the U.S. Navy.

Several other firms are pursuing the mini-reactor business, including Westinghouse and NuScale Power. Gen4Energy, formerly Hyperion Power Generation, hopes to be able to sell a small reactor, suitable to power about 20,000 American homes, for only $50 million. Gen4Energy is utilizing technology that originated more than 50 years ago at the nearby Los Alamos Labs. Competitor Toshiba has its own small unit, the "4S" (super safe, small and simple).

Yet another alternative to traditional nuclear reactors is thorium liquid fuel reactors, which are fueled by molten fluoride salt containing thorium. Thorium is far more abundant than uranium and it creates uranium 223 continuously, resulting in approximately 90 times as much energy from the same quantity of uranium. In addition, it generates less waste, which itself has a much shorter half-life than uranium. India has significant reserves of thorium (about 319,999 tons or 13% of the world's total), and has been working on the technology since the 1950s. Since then, about one ton of thorium oxide fuel has been irradiated experimentally in pressurized heavy water reactors and has been reprocessed, according to the Bhabha Atomic Research Centre (BARC). A reprocessing center for thorium fuels is being built at Kalpakkam. In November 2011, India announced plans to build a prototype thorium-fueled advanced heavy water reactor that will generate 300 megawatts of electricity.

SPOTLIGHT: Fusion Power

As opposed to nuclear fission, nuclear fusion is the reaction when two light atomic nuclei fuse together, forming a heavier nucleus. That nucleus releases energy. So far, fusion power generators burn more energy than they create. However, that may change with the construction of the International Thermonuclear Experimental Reactor (ITER) in Southern France (www.iter.org). To be completed in 2016 at a cost of about $11.7 billion, the reactor is a pilot project to demonstrate the feasibility of full-scale fusion power.

The Middle East, where industrial and residential need for electricity is set to soar, is a ripe area for nuclear power plant development. Saudi Arabia plans to build 16 new nuclear plants by 2030, at a cost of more than $100 billion. Nearby in the UAE, the government has awarded a South Korean consortium with a contract for the construction of four new nuclear plants at a cost of $20.4 billion.

SPOTLIGHT: Gen4Energy

Startup Gen4Energy, formerly Hyperion Power Generation (www.gen4energy.com) is working on utilizing technology from Los Alamos National Laboratory for a nuclear battery. The unit, which is a little less than five feet wide and called the Gen4 Module, can produce more than 25 megawatts for five years, or enough to power about 25,000 homes. The battery runs on uranium hydride which, in addition to providing fuel, regulates power output so the possibility of a meltdown is almost nil. There are no moving parts, and the unit can be buried underground for additional safety. The company claims that the cost of each unit will be far less than the price for building and operating a natural gas plant with the same capacity.

18) Ethanol Production Soared, But U.S. Federal Subsidy Expires

High gasoline prices, effective lobbying by agricultural and industrial interests and a growing interest in cutting reliance on imported oil put a high national focus on bioethanol in America in recent years. Corn and other organic materials, including agricultural waste, can be converted into ethanol through the use of engineered bacteria and superenzymes manufactured by biotechnology firms. This trend has given a boost to the biotech, agriculture and alternative energy sectors. At present, corn is almost the exclusive source for bioethanol in America, and ethanol plants burn approximately 40% of U.S. corn output as of 2012. This is a shift of a crop from use in the food chain to use in the energy chain that is unprecedented in all of agricultural history—a shift that is having profound effects on prices for consumers, livestock growers (where corn has long been a traditional animal feed) and food processors.

In addition to the use of ethanol in cars and trucks, the chemicals industry, faced with daunting increases in petrochemicals costs, has a new appetite for bioethanol. In fact, bioethanol can be used to create plastics—an area that consumes vast quantities of oil in America and around the globe. Archer Daniels Midland has a plant in Clinton, Iowa that produces 110 million pounds of plastic per year through the use of biotechnology to convert corn into polymers.

Ethanol is an alcohol produced by a distilling process similar to that used to produce liquors. A small amount of ethanol is added to much of the gasoline sold in America, and most U.S. autos are capable of burning "E10," a gasoline blend that contains 10% ethanol. E85 is an 85% ethanol blend that may grow in popularity due to a shift in automotive manufacturing. Although only about 2,893 of the 170,000 U.S. service stations sold E85 as of the beginning of 2012, there may be an increase in demand for ethanol in the U.S. due to mandates by the U.S. government calling for reduced dependence on oil.

Yet, despite the millions of vehicles on the road that can run on E85 and billions of dollars in federal subsidies to participating refiners, many oil companies seem unenthusiastic about the adoption of the higher ethanol mix. E85 requires separate gasoline pumps, trucks and storage tanks, as well as substantial cost to the oil companies (the pumps alone cost about $200,000 per gas station to install). The plants needed to create ethanol cost $500 million or more to build. Many drivers who have tried filling up with E85 once revert to regular unleaded when they find as much as a 25% loss in fuel economy when burning the blend.

Ethanol is a very popular fuel source in Brazil, and is typically made from sugarcane. In fact, Brazil is one of the world's largest producers of ethanol, which provides a significant amount of the fuel used in Brazil's cars. This is due to a concerted effort by the government to reduce dependency on petroleum product imports. After getting an initial boost due to government subsidies and fuel tax strategies beginning in 1975, Brazilian producers developed

methods that enable them to produce ethanol at moderate cost. The fact that Brazil's climate is ideally suited for sugarcane is a great asset. Also, sugar cane can be converted with one less step than corn, which is the primary source for American ethanol. Brazilian automobiles are typically equipped with engines that can burn pure ethanol or a blend of gasoline and ethanol. Brazilian car manufacturing plants operated by Ford, GM and Volkswagen all make such cars.

In June 2011, Royal Dutch Shell, a global energy giant, and Cosan Industria e Comerica SA of Brazil announced a new joint venture to be one of the world's largest producers of ethanol. Based in Brazil, their firm, known as Raizen, will eventually have sugarcane crushing capacity of 100 million tons yearly. Elsewhere in Brazil, oil giant Petroleo Brasileiro ("Petrobras") recently invested about $1 billion to purchase a 46% interest in Guarani, one of Brazil's largest sugar millers. In 2011, Brazil crushed 555 million tons of sugarcane, which left 150 million tons of mill capacity unused. As of the end of 2011, American import tariffs and tax credits were dropped, opening the U.S. market to Brazilian ethanol. Look for increased sugarcane production, new mills and possibly the construction of a pipeline between Brazil's central and southern agricultural regions and the port of Santos.

In America, partly in response to the energy crisis of the 1970s, Congress instituted federal ethanol production subsidies in 1979. Corn-based grain ethanol production picked up quickly, and federal subsidies have amounted to several billion dollars. The size of these subsidies and environmental concerns about the production of grain ethanol produced a steady howl of protest from observers through the years. Nonetheless, the Clean Air Act of 1990 further boosted ethanol production by increasing the use of ethanol as an additive to gasoline. Meanwhile, the largest producers of ethanol, such as Archer Daniels Midland (ADM), have reaped significant subsidies from Washington for their output. Between 2005 and 2009, the federal government spent $17 billion in tax credits. In 2010 and 2011, the subsidies amounted to between $5 billion and $6 billion yearly.

With the U.S. government's budget deficit mounting to more than $1 trillion as of 2012, many lawmakers are looking for ways to cut government spending. Many politicians had been calling for a reduction or even the phasing out of government subsidies for ethanol production. Congress allowed the subsidy to expire on December 31, 2011.

The U.S. Energy Act of 2005 specifically required that oil refiners mix 7.5 billion gallons of renewable fuels such as ethanol in the nation's gasoline supply by 2012. Ethanol production in the U.S. reached 13.23 billion gallons in 2010, up from 10.75 billion gallons in 2009, according to the U.S. Energy Information Administration (EIA). Iowa, Illinois, Nebraska, Minnesota and South Dakota are the biggest producers, in that order. Although grain farmers and ethanol producers enjoyed high prices at the onset, a glut of ethanol supply eventually caused market prices to plummet. Next, the Energy Independence and Security Act of 2007 called for even more ethanol production, with a goal of 36 billion gallons per year by 2022 including 21 billion gallons to come from cellulosic and advanced biofuel sources. (Later, in 2010, the goal was reduced to 16 billion gallons from ethanol.) However, environmental concerns, the sizeable investments needed to construct ethanol refineries and questions about the advisability of using a food grain as a source for fuel made these goals unattainable using existing technologies.

Until recently, some of the largest ethanol production companies have suffered severe financial problems. Notably, VeraSun filed for bankruptcy protection in late 2008, citing high corn prices and difficulty in obtaining trade credit. The 2008-09 plummet in the price of crude oil made ethanol look much less attractive from a cost point-of-view. However, as of 2012, with oil prices hovering close to $100 per barrel and therefore making ethanol prices more attractive, most major ethanol producers such as Valero Energy, POET and Archer Daniels Midland are in the black.

Traditional grain ethanol is typically made from corn or sugarcane. In contrast to grain ethanol, "cellulosic" ethanol is typically made from agricultural waste like corncobs, wheat husks, stems, stalks and leaves, which are treated with specially engineered enzymes to break the waste down into its component sugars. The sugars (or sucrose) are used to make ethanol. Since agricultural waste is plentiful, turning it into energy seems a good strategy. Cellulosic ethanol can also be made from certain types of plants and grasses.

The trick to cellulosic ethanol production is the creation of efficient enzymes to treat the agricultural waste. The U.S. Department of Energy is investing heavily in research, along with major companies such as Dow Chemical, DuPont and Cargill. Another challenge lies in efficient collection and delivery of cellulosic material to the refinery. It may be more

costly to make cellulosic ethanol than to make it from corn. In any event, the U.S. remains far behind Brazil in cost-efficiency, as Brazil's use of sugar cane refined in smaller, nearby biorefineries creates ethanol at much lower costs per gallon.

Iogen, a Canadian biotechnology company, makes just such an enzyme and has been operating a test plant to determine how economical the process may be. The company hopes to construct a $300 million, large-scale biorefinery with a potential output of 50 million gallons per year. Its pilot plant in Ottawa utilizes wheat straw and corn stalks. In mid-2009, a Shell gasoline station in Ottawa, Canada became the first retail outlet in that nation to sell a blend of gasoline that features 10% cellulosic ethanol.

In the U.S., the Department of Energy has selected six proposed new cellulosic ethanol refineries to receive a total of $385 million in federal funding. If completed, these six refineries are expected to produce 130 million gallons of ethanol yearly. Iogen's technology will be used in one of the refineries, to be located in Shelley, Idaho. Partners in the refinery include Royal Dutch Shell. Cellulosic ethanol proponent Novozymes and its partner Poet LLC were promised $105 million in government funding in mid-2011 to build a new plant, called Project Liberty, with a goal of starting operations in 2013.

Meanwhile, the Canadian government plans to support the Canadian biofuel industry with up to 500 million Canadian dollars for construction of next-generation plants. In 2012, the province of Edmonton committed $444 million over three years for renewable energy development.

Biotech Breakthrough Modifies Corn for Faster Conversion to Ethanol

In February 2011, the U.S. Department of Agriculture approved commercial planting for a revolutionary, genetically modified corn seed developed by Syngenta. The modification causes the corn to produce an enzyme that breaks down corn starch into sugar, thus taking the first step needed to produce ethanol within the corn itself, instead of within a refinery.

Other companies, such as Syngenta, DuPont and Ceres, are genetically engineering crops so that they can be more easily converted to ethanol or other energy producing products. Syngenta, for example, is testing a bio-engineered corn that contains the enzyme amylase. Amylase breaks down the corn's starch into sugar, which is then fermented into ethanol. The refining methods currently used with traditional corn crops add amylase to begin the process.

Environmentalists are concerned that genetically engineering crops for use in energy-related yields will endanger the food supply through cross-pollination with traditional plants. Monsanto is focusing on conventional breeding of plants with naturally higher fermentable starch content as an alternative to genetic engineering.

Global warming concerns were heightened in 2009 by a report by the International Council for Science (ICSU) that concluded that the production of biofuels, including ethanol, has hurt rather than helped the fight against climate change. The report cites findings by a scientist at the Max Planck Institute for Chemistry in Germany that biofuels expand the harmful effects of a gas called nitrous oxide, which may be 300 times worse for global warming than carbon dioxide. The amounts of nitrous oxide released when farming biofuel crops such as corn may negate any advantage gained by reduced carbon dioxide emissions.

In addition, ethanol production requires enormous amounts of water. To produce one gallon of ethanol, up to four gallons of water are consumed by ethanol refineries. Add in the water needed to grow the corn in the first place, and the number grows to as much as 1,700 gallons of water for each gallon of ethanol.

Other concerns regarding the use of corn to manufacture ethanol include the fact that a great deal of energy is consumed in planting, reaping and transporting the corn in trucks. Also, high demand for corn for use in biorefineries has, from time-to-time, dramatically driven up the cost per bushel, creating burdens on consumers.

POET is a South Dakota-based producer of ethanol from corn that operates 27 plants in seven U.S. states. It hopes to construct a plant in Emmetsburg, Iowa that will be one of the first in the U.S. to produce cellulosic ethanol on a large scale, using non-food sources such as corn cobs, leaves, husks and stalk (as opposed to corn kernels).

Novozymes, a Danish bioindustrial product manufacturer, has developed an enzyme blend containing an agent called GH-61 that has the potential to speed chemical reactions. Enzymes containing GH-61 may reduce production costs to the extent that producing ethanol can be competitive on a price basis with fossil fuels. Novozymes says that the cost of the enzyme, called Cellic, is about 50

cents per gallon, or less than a third of the projected $1.90 per gallon total cost (naturally, the retail price per gallon would be higher). Poet's Emmetsburg plant will utilize the substance in its ethanol production. In the U.S., Novozymes opened a Blair, Nebraska enzymes plant in May 2012, at a cost of $200 million.

U.S. ethanol production slowed dramatically in mid-2012 due to rising corn prices and falling demand for gasoline. In addition, the inventory of ethanol was high. As most of the Midwest suffered from drought conditions in 2012, the corn crop will likely be poor causing a spike in prices. A number of ethanol plants were slowing or idling production. Valero Energy Corp., Abengoa Bioenergy US Holding, Inc. and Nedak Ethanol LLC temporarily stopped production as of June 2012, while Archer Daniels Midland announced that its operating profit margins had fallen by more than 20 cents per gallon. Christianson & Associates surveyed a number of ethanol producers, finding that the most efficient 25% of plants profited 11 cents per gallon in the first quarter of 2012, down from 31 cents per gallon for the same period in 2011.

SPOTLIGHT: Biofuels

Corn and sugar cane are not the only sources for creating biofuels.

Municipal/Agricultural Waste: Might be cheaply produced, but could be in limited supply compared to the billions of gallons of fuel needed in the market place.

Wood: Easily harvested and in somewhat healthy supply; however, cellulose can be more difficult to extract from wood than from other biosources.

Algae: The slimy green stuff does have the potential for high yields per acre, but the process for distilling its cellulose is complex, requiring a source of carbon dioxide to permeate the algae.

Grasses/Wheat: Including switchgrass, miscanthus and wheat straw, the supply could be almost limitless. The challenge here is creating efficient methods for harvesting and infrastructure for delivering it to biorefineries.

Vegetable Oils: Including soybean, canola, sunflower, rapeseed, palm or hemp. It is difficult to keep production costs of these oils low.

SPOTLIGHT: Algae Draws Major Investment

Algae's potential as a source of biofuel got a big boost from an unlikely source in 2009. ExxonMobil announced plans to invest $300 million or more in San Diego, California-based Synthetic Genomics, a company headed by genome pioneer Craig Venter. Dr. Venter is studying ways in which an ideal species of algae can be developed for a unique culturing process. This process induces algae to release their oil (naturally stored as a foodstuff for the organisms), which can then be manipulated so that the oxygen molecules in the oil are disposed of, leaving a pure hydrocarbon suitable for use as biofuel. Another plus to Venter's process is that carbon dioxide claimed from industrial plant exhaust is used in the culturing process and then released in the atmosphere. This does not make algae biofuel production carbon neutral, but it does utilize carbon dioxide twice before it's released. Should the study go well, ExxonMobil has pledged an additional $300 million in funding to further develop the process to an industrial scale. An organism called blue-green algae (although technically it is a kind of bacteria and not an algae) can produce fuel using photosynthesis. Found in non-potable standing water and in barren fields, the bacterium secretes a class of hydrocarbon molecules called alkanes that are chemical doppelgangers for hydrocarbons. Joule Unlimited, Inc., a Cambridge, Massachusetts-based biotech company, holds a patent on the process that uses the bacterium to create ingredients for diesel fuel. The firm plans to build a commercial plant slated for completion in 2012.

19) New Refineries and Petrochemicals Plants Add to Capacity/Take Advantage of Cheap Natural Gas on the Gulf Coast

The last time a new refinery was opened in America was 1976. That's not to say that refining capacity hasn't changed—in fact, while many refineries have closed, the 148 remaining operable refineries have added significant capacity. Meanwhile, the U.S. has an emergency Strategic Petroleum Reserve of about 700 million barrels, but that reserve holds crude—there is no emergency reserve of refined fuels such as gasoline.

There are many difficult challenges to developing new plants in the U.S. The first is the "not in my backyard" factor. Consumers want a reliable supply of refined oil, but they don't want a refinery in the neighborhood.

The next problem is investment. To build a refinery requires a massive investment of capital. In the past, refinery profits have been sporadic and profit margins have often been low. The prospect of low or no profits doesn't encourage investment. However, profitability of any kind is compromised when some refiners don't produce enough of their own crude oil to refine and must buy it at widely fluctuating prices.

A third problem lies in environmental concerns. U.S. environmental standards require that refineries produce a dizzying variety of refined gasoline to meet emissions standards that are set for certain locations and certain times of year. This complicates both refinery design and operation. Meanwhile, vast regulatory barriers have been erected that make it all but impossible to pass the environmental impact tests necessary to build a new refinery. One stalwart firm, Arizona Clean Fuels Yuma, has been trying for years to build a new refinery in Arizona. The company submitted its initial permit application in 1999, only to spend the next decade embroiled in permit negotiations, financing hurdles and legal disputes with a nearby Native American tribe with ancestral ties to the originally proposed refinery site. Existing plants have invested very heavily in order to meet increasingly complex environmental regulations.

Finally, there is the varying nature of crude itself. American oil fields luckily tend to contain light sweet crude. Such crude is light in viscosity and low in sulfur, making it is relatively easy to refine. Sweet crude is the most desirable type of raw oil and thus is the highest priced. It is scarce in quantity on the market. What is available in abundance is heavy sour crude. Heavy crude is thicker and lower in desirability. It sells for considerably less per barrel than sweet crude—as much as a 30% discount is not uncommon. Heavy crude is produced in vast quantity in Mexico, Saudi Arabia and elsewhere. Heavy crude contains high quantities of sulfur that must be dealt with in an environmentally acceptable manner. Consequently, refining heavy crude is more complex and more costly.

Saudi Aramco and Royal Dutch Shell recently spent about $7 billion to double the size of the Motiva refinery in Port Arthur, Texas, capable of refining heavy crude. The expanded section opened in May 2012. The refinery is now expected to have a 600,000 barrel per day capacity, making it one of the largest refineries in America. The new production capacity will enable the refinery to produce 23 million gallons daily of gasoline, diesel and aviation fuel.

To paint a broader picture of the American refining situation, a little history is in order. In 1981, there were 325 refineries in the U.S., with a combined capacity of 18.6 million barrels per day. More than one-half of these refineries have been closed due to historically low profit margins and the vast investments that would have been needed for them to meet evolving environmental standards. While the number of refineries has dwindled, the capacity of remaining refineries has been steadily enhanced at great investment.

By 1992, America's refining capacity had declined to about 15 million barrels per day. As of mid-2011, plant expansion had pushed U.S. refining capacity to about 17.7 million barrels per day.

Today, two dramatic developments are having a major impact on America's refineries and petrochemical plants: To begin with, America's crude oil production is soaring. This is largely thanks to the Baaken Shale oil field in North Dakota and Montana. This is enabling U.S. refiners to access an ever-growing and reliable domestic supply of crude.

At the same time, natural gas production from shale is likewise rocketing ahead. Ethylene, a derivative of ethane liquid that can be stripped from natural gas or obtained through olefins associated with crude oil, is the basic feedstock used in many petrochemicals plants. Petrochemicals plants convert ethylene into an astonishing array of products, including trash bags and myriad other basic household items; building materials such as windows, pipe, carpeting and siding; tires; and food and beverage packaging and bottles. One observer said that ethylene is to the chemicals business as flour is to bakeries.

Other oil and/or natural gas-derived chemical feedstocks include propylene and pygas, and "aromatics" including benzene, toluene and xylene. In other words, oil and gas are the basic foundation of the organic chemicals industry. America's immense increase in oil and gas output is fueling a huge boom in new chemicals plant construction, particularly on the Gulf Coast.

Meanwhile, massive investments are being made in new petrochemical and refinery plants in China, the Middle East and India. Saudi Arabia is vastly increasing the size of its petrochemicals facilities, often in partnership with leading global oil companies. Reliance Industries Ltd., invested $6 billion to double its Jamnagar refinery near the Pakistani border, which is now producing at full capacity of 580,000 barrels per day. A significant share of new refinery construction is in Asia and the

Middle East, in nations such as China, India, Saudi Arabia, Vietnam, Indonesia, Singapore, Qatar and Kuwait. One of the leaders in the investment in new refineries is Saudi Aramco.

As new refineries come on line, capacity will increase significantly. According to BP, worldwide capacity was 93.1 million barrels per day as of the end of 2011, an increase of 1.5% over 2010.

20) Energy Intensity is a Prime Focus in China/U.S. Achieves Dramatic Energy Intensity Results

In a global sense, energy efficiency may advance at the creeping pace of a turtle, but over the years the compounding results are exceptional. "Energy intensity" refers to the amount of energy required for a nation to produce a unit of GDP (gross domestic product—a basic measure of economic output). A nation's goal should be to make intensity as low as possible. In constant dollars (adjusted for inflation and expressed as year 2005 dollars), the U.S. economy grew from $1.84 trillion in GDP in 1949 to $13.3 trillion in 2008—an increase of 623%. During the same period, America's annual energy consumption rose from 31.98 quadrillion BTU to 99.4 quadrillion BTU—an increase of only 210%. Energy consumption per dollar of GDP (on the same constant, year 2005 dollar basis) dropped from 17.34 thousand BTU to 7.47 thousand BTU.

In other words, after removing any distortion caused by inflation, America required only 43.5% as much energy to create a dollar of economic output in 2008 as it required shortly after the close of World War II, while America's energy intensity improved by a factor of 2.29 times. A table of this progress, as published by the U.S. Energy Information Administration (EIA), shows steady improvements in energy intensity, year by year, for the past 60 years.

This drop in energy used per unit of economic output is not limited to America by any means, but is more of a global phenomenon. China, the world's largest consumer of energy and a major concern in terms of pollution and emissions, is showing steady improvement, cutting its energy intensity by about 50% from 1980 through 2004. Its five-year plan for 2011 through 2015 calls for a 16% improvement in energy intensity.

In recent years, annual growth in energy usage has slowed in developed nations such as those in the EU, along with Canada, Australia, The U.S. and others, while efficiency has soared. The challenge is to make efficient technologies inexpensive, widespread and readily adoptable in emerging nations. This is especially important in light of the fact that there will be big increases in the total demand for energy as the world's middle classes grow and emerging nations become more industrial. The EIA projects global demand for energy to balloon from 508 quadrillion BTU in 2008 to 678 quadrillion BTU in 2030. This is a 33% increase, a mere fraction of the expected increase in global economic activity. Most of the increased energy use will occur in emerging nations, particularly India and China. Accelerating improvements in energy and conservation technologies will be at work to an increasing degree, reducing total demand, lessening the impact of emissions and greatly boosting efficiency. This is a massive market opportunity for innovative firms that develop significant technologies and services in this regard.

21) America on Track to Lead the World in Oil Production by 2017

The IEA forecast in late 2012 that the United States will become almost self-sufficient in energy by 2035, on a net basis accounting for imports and exports. This is due largely to growing oil and gas output, but also to increasing efficiency and conservation as well as renewables. The IEA further forecast that the U.S. would be the world's leading oil producer by 2017, overtaking Saudi Arabia (11,161 thousand barrels per day in 2011) and Russia (10,280 thousand barrels per day). America's production in 2011 was 7,841 thousand barrels daily. By 2030, America might even be a net oil exporter, provided Congress allows it. This trend is accelerated by the boom in oil shale fields such as the Eagle Ford in Texas and the Baaken in the North Dakota/Montana area.

This will broadly affect U.S. industry, consumer budgets, economic policy and foreign policy, and it may affect military policy as well. Domestic oil security has been an oft-stated, but elusive, American goal for decades. The U.S. was so dependent on imported oil from the Persian Gulf that much of its foreign and military policy has been centered on maintaining oil flow from that region. For example, the U.S. Navy's Fifth Fleet ships are a constant presence in that region, with a mission to keep sea lanes open for supertankers while maintaining some level of deterrence of war between neighboring states.

U.S. oil imports have already dropped to 19,550,654 billion Btus in 2011 from 22,090,819 in 2005. Crude production in America jumped from 4,950 thousand barrels daily in 2008 to 5,662 in

2011. Drilling activity is so high that production will continue to accelerate rapidly.

Chapter 2

ENERGY INDUSTRY STATISTICS

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I. Overview of the Energy Industry

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Global Energy Overview: 2010-2011

(Latest Years Available)

	North America	S. & Cent. America	Europe & Eurasia	Middle East	Africa	Asia Pacific	Total World
Petroleum							
Production (thousand barrels daily)							
2010	13,880	7,293	17,629	25,314	10,114	8,251	82,480
2011	14,301	7,381	17,314	27,690	8,804	8,086	83,576
Consumption (thousand barrels daily)							
2010	23,491	6,079	19,039	7,890	3,377	27,563	87,439
2011	23,156	6,241	18,924	8,076	3,336	28,301	88,034
Proved Reserves (thousand million barrels)							
2010	217.8	324.7	139.5	765.6	132.7	41.7	1,622.1
2011	217.5	325.4	141.1	795.0	132.4	41.3	1,652.6
Natural Gas							
Production (billions of cubic meters)							
2010	819.1	162.8	1,026.9	472.3	213.6	483.6	3,178.2
2011	864.2	167.7	1,036.4	526.1	202.7	479.1	3,276.2
Consumption (billions of cubic meters)							
2010	836.2	150.2	1,124.6	377.3	106.9	557.9	3,153.1
2011	863.8	154.5	1,101.1	403.1	109.8	590.6	3,222.9
Proved Reserves (trillion cubic meters)							
2010	10.3	7.5	68.0	79.4	14.5	16.5	196.1
2011	10.8	7.6	78.7	80.0	14.5	16.8	208.4
Coal							
Production (million tonnes oil equivalent)							
2010	592.7	57.2	437.3	0.7	146.1	2,492.7	3,726.7
2011	600.0	64.8	457.1	0.7	146.6	2,686.3	3,955.5
Consumption (million tonnes oil equivalent)							
2010	559.5	28.2	483.3	8.5	98.1	2,354.4	3,532.0
2011	533.7	29.8	499.2	8.7	99.8	2,553.2	3,724.3
Proved Reserves (million tonnes)							
2011	245,088	12,508	304,604	1,203	32,895	265,843	860,938
Nuclear							
Consumption (million tonnes oil equivalent)							
2010	213.8	4.9	272.9	0.0	3.1	131.7	626.3
2011	211.9	4.9	271.5	<.05	2.9	108.0	599.3
Hydro-Electric							
Consumption (million tonnes oil equivalent)							
2010	147.2	158.6	196.4	4.1	23.0	249.7	778.9
2011	167.6	168.2	179.1	5.0	23.5	248.1	791.5
Other Renewables*							
Consumption (million tonnes oil equivalent)							
2010	44.4	11.1	70.8	0.1	1.2	37.9	165.5
2011	51.4	11.3	84.3	0.1	1.3	46.4	194.8

Note: Proved reserves of oil are generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions.

* Based on gross generation from renewable sources including wind, geothermal, solar, biomass and waste.

Source: BP, *Statistical Review of World Energy*, June 2012

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U.S. Energy Industry Overview

Energy Production	78,095,827	Bil. Btu*	2011	DOE
By Fossil Fuels	60,600,703	Bil. Btu*	2011	DOE
By Renewable Energy Power Sources	9,235,692	Bil. Btu*	2011	DOE
By Nuclear	8,259,432	Bil. Btu*	2011	DOE
U.S. Energy Consumption	97,301,269	Bil. Btu*	2011	DOE
U.S. Energy Consumption per Person	312	Mil. Btu*	2011	DOE
Share of U.S. Oil Consumption for Transportation	70	%	2011	DOE
Energy Imports	28,587,117	Bil. Btu*	2011	DOE
Energy Exports	10,355,611	Bil. Btu*	2011	DOE
Crude Oil Production	5,662	Mbbl/d	2011	DOE
Number of Operable Refineries	148		2011	DOE
Number of Oil Wells	536,000		2011	DOE
Average Oil Well Productivity	10.6	Bbl/Well/Day	2011	DOE
U.S. Strategic Petroleum Reserve Size	695.951 Million	Barrels	2011	DOE
Dry Natural Gas Production	23,000,177	Mcf	2011	DOE
Coal Production	1,094,335,567	Short Tons	2011	DOE
Electricity Net Generation	4,105.7	Bil. KWh	2011	DOE
From Coal (42.24%)	1,734.3	Bil. KWh	2011	DOE
From Petroleum (.69%)	28.2	Bil. KWh	2011	DOE
From Gas (25.03%)	1,027.9	Bil. KWh	2011	DOE
From Nuclear (19.25%)	790.2	Bil. KWh	2011	DOE
From Hydro-Electric (7.92%)	325.1	Bil. KWh	2011	DOE
From Other Renewables (4.75%)	195.0	Bil. KWh	2011	DOE
Average U.S. Retail Price of Electricity, All Sectors	9.99	Cents/KWh	2011	DOE
U.S. Share of the World's Total Petroleum Consumption	20.5	%	2011	BP
U.S. Share of the World's Coal Reserves	27.6	%	2011	BP
U.S. Share of the World's Natural Gas Reserves	4.1	%	2011	BP
U.S. Share of the World's Petroleum Reserves	1.9	%	2011	BP
Primary Energy Consumption by Source				
Petroleum	36.3	%	2011	DOE
Natural Gas	25.5	%	2011	DOE
Coal	20.3	%	2011	DOE
Renewable Energy	9.4	%	2011	DOE
Nuclear Electric Power	8.5	%	2011	DOE

*Reserves that can be commercially recovered.

DOE = U.S. Department of Energy

BP = BP Statistical Review of World Energy

Btu = British Thermal Unit = 0.252 kilocalories

Mbbl/d = thousands of barrels per day

Bbl = barrel = 42 U.S. gallons

Mcf = million cubic feet

KWh = Kilowatt-Hour = 860 kilocalories

Source: Plunkett Research, Ltd. Copyright© 2012, All Rights Reserved
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U.S. Energy Overview: Selected Years, 1970-2011

(In Billions of Btus; Latest Year Available)

	1970	1980	1990	2000	2009	2010	2011
Production							
Fossil Fuels Production[1]	59,186,071	59,007,873	58,559,602	57,366,024	56,685,210	58,235,197	60,600,703
Nuclear Energy Consumed by the Electric Power Sector	239,347	2,739,169	6,104,350	7,862,349	8,356,019	8,434,433	8,259,432
Renewable Energy Production[2]	4,070,021	5,428,343	6,040,675	6,103,785	7,615,742	8,136,463	9,235,692
Total Energy Production	63,495,439	67,175,384	70,704,628	71,332,159	72,656,971	74,806,092	78,095,827
Imports							
Petroleum Imports[3]	7,469,646	14,658,259	17,117,225	24,531,416	25,081,641	25,370,727	24,491,000
Total Energy Imports[4]	8,341,615	15,796,247	18,817,264	28,972,779	29,705,660	29,877,112	28,587,117
Exports							
Coal Exports	1,935,500	2,420,518	2,772,273	1,527,552	1,514,832	2,101,155	2,750,646
Total Energy Exports[5]	2,632,135	3,694,770	4,752,479	4,005,875	6,964,591	8,233,777	10,355,611
Consumption							
Fossil Fuels Consumption[6]	63,522,269	69,827,771	72,332,212	84,730,559	78,487,598	81,109,073	79,779,295
Nuclear Energy Consumed by the Electric Power Sector	239,347	2,739,169	6,104,350	7,862,349	8,356,019	8,434,433	8,259,432
Renewable Energy Consumption[2]	4,070,021	5,428,343	6,040,675	6,106,352	7,599,603	8,089,914	9,135,400
Total Energy Consumption[7]	67,838,325	78,066,681	84,485,125	98,814,459	94,559,407	97,722,053	97,301,269

Note: Totals may not equal sum of components due to independent rounding. 2011 data is preliminary.

[1] Coal, natural gas (dry), crude oil and natural gas plant liquids.

[2] End-use consumption, electric utility and non-utility electricity net generation.

[3] Crude oil and petroleum products. Includes imports into the Strategic Petroleum Reserve.

[4] Also includes natural gas, coal, coal coke, fuel ethanol and electricity.

[5] Also includes natural gas, petroleum, coal coke, and electricity.

[6] Coal, coal coke net imports, natural gas and petroleum.

[7] Also includes electricity net imports.

Source: U.S. Department of Energy, Energy Information Administration

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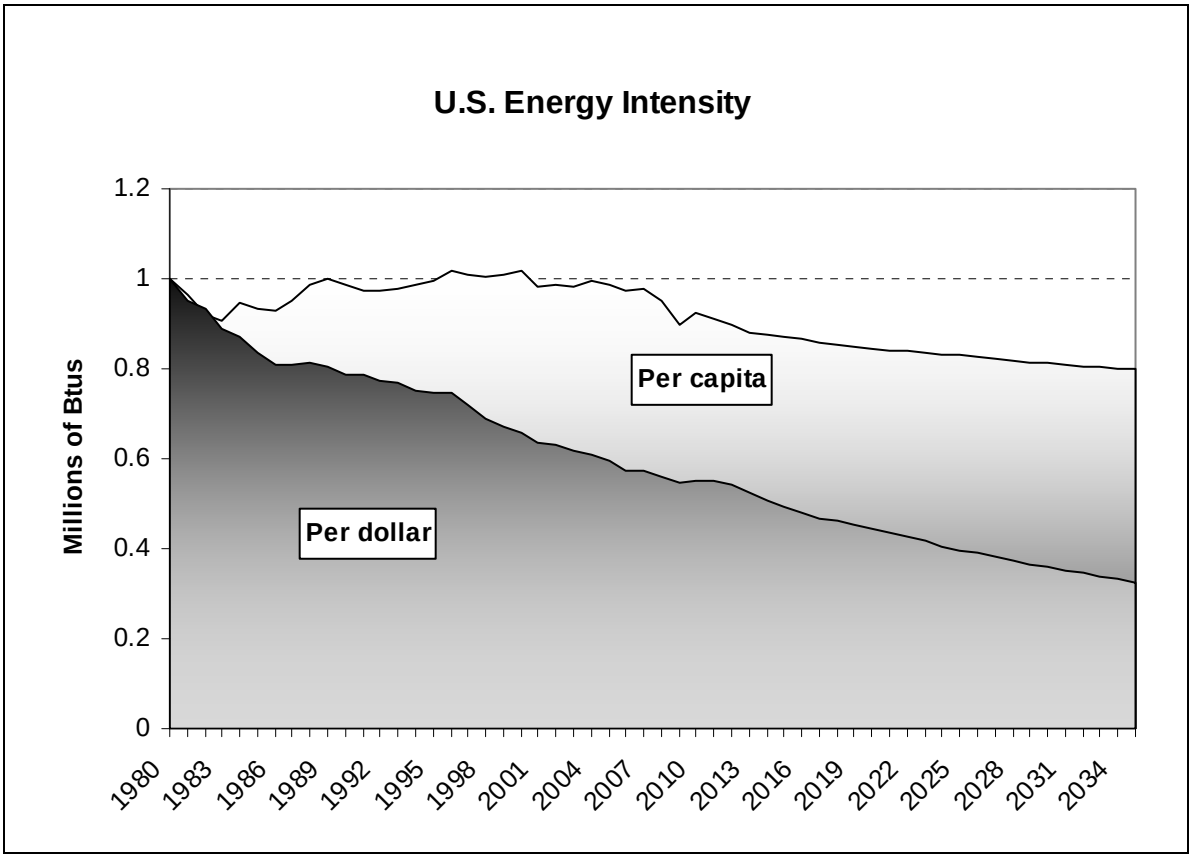
U.S. Energy Intensity 1980-2035

(Energy Consumption in Millions of Btus per Capita and per Dollar of GDP)



Source: U.S. Department of Energy, U.S. Energy Information Administration

Plunkett Research, Ltd.

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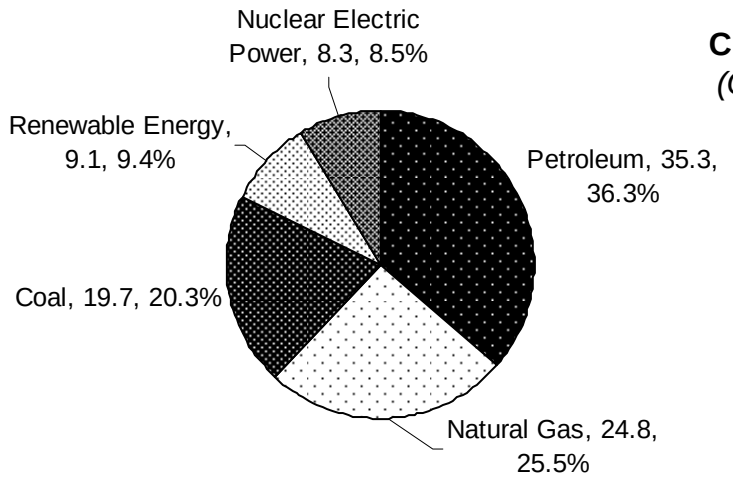
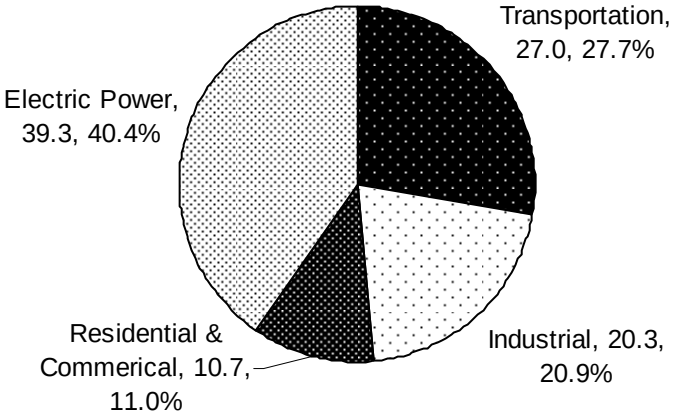
Primary Energy Flow by Source & Sector, U.S.: 2011

(Latest Year Available; Total Energy: 97.3 Quadrillion Btu)

Consumption by Source
(Qradrillion Btu, Percent)



Consumption by Sector
(Qradrillion Btu, Percent)



Notes: Sum of components may not equal 100 percent due to independent rounding.

Petroleum: Does not include biofuels that have been blended with petroleum, which are included in "Renewable Energy."

Natural Gas: Excludes supplemental gaseous fuels.

Coal: Includes less than 0.1 quadrillion Btu of coal coke net exports.

Renewable Energy: Includes conventional hydroelectric power, geothermal, solar/PV, wind, and biomass.

Industrial: Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

Residential & Commercial: Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

Electric Power: Includes electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public.

Source: U.S. Department of Energy, U.S. Energy Information Administration

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Energy Consumption by Source & Sector, U.S.: 2011

(By Percent; Latest Year Available; Total Energy: 97.3 Quadrillion Btu)

Sector, by Source		Source, by Sector	
Petroleum[1]: 35.3 Quad. Btu		**Transportation: 27.0 Quad. Btu**	
Transportation	71	Petroleum	93
Industrial	23	Natural Gas	3
Residential & Commercial	5	Renewable Energy	4
Electric Power	1	**Industrial[5]: 20.3 Quad. Btu**	
Natural Gas[2]: 24.8 Quad. Btu		Petroleum	40
Transportation	3	Natural Gas	41
Industrial	33	Coal	8
Residential & Commercial	32	Renewable Energy	11
Electric Power	31	**Residential & Commercial[6]: 10.7 Quad. Btu**	
Coal[3]: 19.7 Quad. Btu		Petroleum	17
Industrial	8	Natural Gas	75
Residential & Commercial	< 1	Coal	1
Electric Power	92	Renewable Energy	7
Renewable Energy[4]: 9.1 Quad. Btu		**Electric Power[7]: 39.3 Quad. Btu**	
Transportation	13	Petroleum	1
Industrial	25	Natural Gas	20
Residential & Commercial	8	Coal	46
Electric Power	54	Renewable Energy	13
Nuclear Electric Power: 8.3 Quad. Btu		Nuclear Electric Power	21
Electric Power	100		

Note: Sum of components may not equal 100 percent due to independent rounding.

[1] Does not include biofuels that have been blended with petroleum, which are included in "Renewable Energy."

[2] Excludes supplemental gaseous fuels.

[3] Includes less than 0.1 quadrillion Btu of coal coke net exports.

[4] Conventional hydroelectric power, geothermal, solar/PV, wind, and biomass.

[5] Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

[6] Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

[7] Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public.

Source: U.S. Department of Energy, U.S. Energy Information Administration

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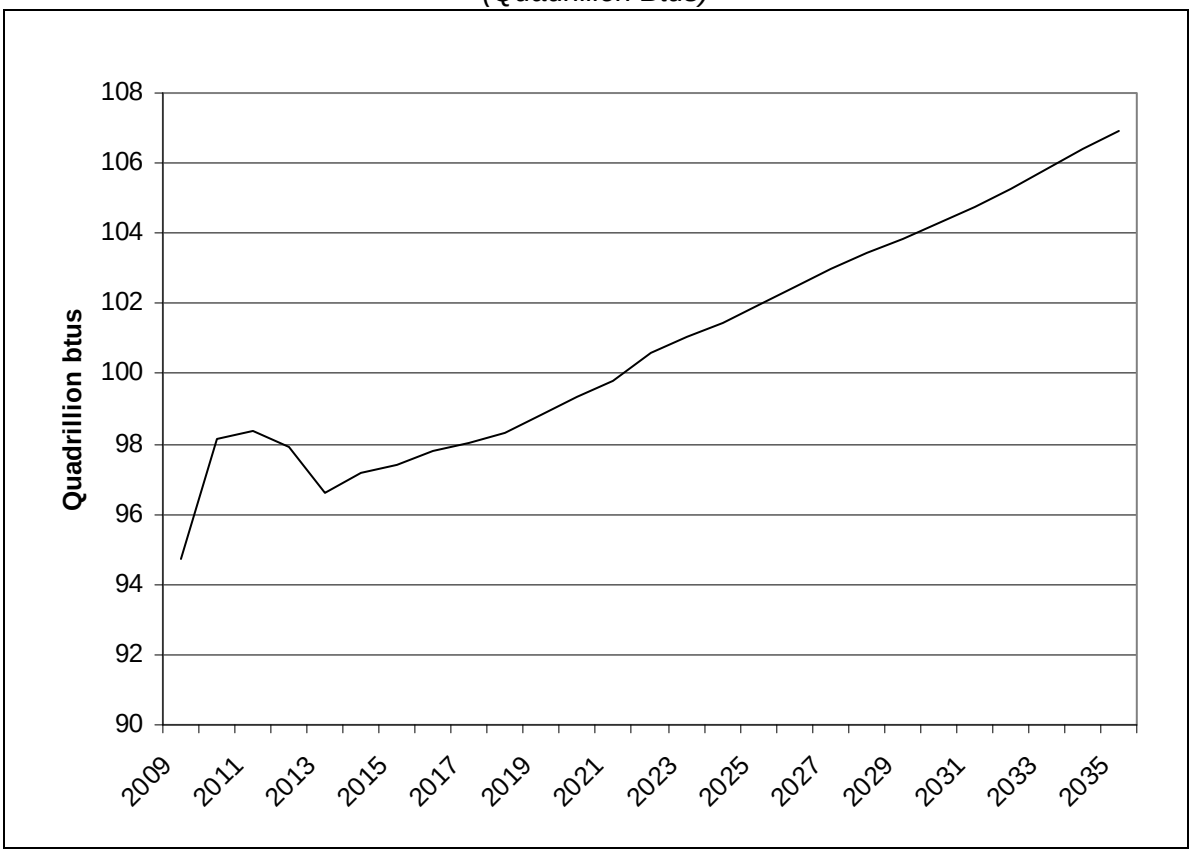
Total U.S. Energy Consumption 2009-2035

(Quadrillion Btus)



Source: U.S. Department of Energy, U.S. Energy Information Administration

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Energy Consumption & Expenditures Indicators, U.S.: Selected Years, 1950-2011

(Latest Year Available)

Year	Energy Consumption	Energy Consum-ption per Person	Energy Expenditures	Energy Expenditures per Person	Gross Domestic Product (GDP)	Energy Expenditures as Share of GDP	Gross Domestic Product (GDP)	Energy Consumption per Dollar of GDP
	Quadrillion Btu	*Mil. Btu*	*Mil. Nominal US$*	*Nominal US$*	*Bil. Nominal US$*	*Percent*	*Bil. Chained (2005) US$*	*Thousand Btu per Chained (2005) US$*
1950	34.62	227	NA	NA	293.7	NA	2,006.0	17.27
1955	40.21	242	NA	NA	414.7	NA	2,500.3	16.09
1960	45.09	250	NA	NA	526.4	NA	2,830.9	15.94
1965	54.02	278	NA	NA	719.1	NA	3,610.1	14.98
1970	67.84	331	82,860	404	1,038.3	8.0	4,269.9	15.90
1975	71.97	333	171,837	796	1,637.7	10.5	4,879.5	14.76
1980	78.07	344	374,347	1,647	2,788.1	13.4	5,839.0	13.38
1985	76.39	321	438,347	1,842	4,217.5	10.4	6,849.3	11.16
1990	84.49	338	472,653	1,893	5,800.5	8.1	8,033.9	10.52
1991	84.44	334	470,668	1,860	5,992.1	7.9	8,015.1	10.54
1992	85.78	334	475,644	1,854	6,342.3	7.5	8,287.1	10.36
1993	87.42	336	491,231	1,890	6,667.4	7.4	8,523.4	10.27
1994	89.09	339	504,073	1,916	7,085.2	7.1	8,870.7	10.05
1995	91.03	342	513,947	1,930	7,414.7	6.9	9,093.7	10.02
1996	94.02	349	559,890	2,078	7,838.5	7.1	9,433.9	9.97
1997	94.60	347	566,714	2,079	8,332.4	6.8	9,854.3	9.61
1998	95.02	344	525,515	1,905	8,793.5	6.0	10,283.5	9.25
1999	96.65	346	556,379	1,994	9,353.5	5.9	10,779.8	8.97
2000	98.81	350	685,902	2,431	9,951.5	6.9	11,226.0	8.81
2001	96.17	337	694,484	2,437	10,286.2	6.8	11,347.2	8.48
2002	97.65	339	662,414	2,303	10,642.3	6.2	11,553.0	8.46
2003	97.98	338	754,708	2,601	11,142.3	6.8	11,840.7	8.28
2004	100.16	342	871,097	2,975	11,853.3	7.3	12,263.8	8.18
2005	100.28	339	1,046,897	3,543	12,623.0	8.3	12,638.4	7.94
2006	99.63	334	1,159,687	3,887	13,377.2	8.7	12,976.2	7.69
2007	101.30	336	1,234,242	4,097	14,028.7	8.8	13,228.9	7.67
2008	99.28	326	1,408,845	4,633	14,291.5	9.9	13,228.8	7.54
2009	94.56	308	1,061,220	3,459	13,939.0	7.6	12,880.6	7.44
2010	97.72	316	1,204,827	3,895	14,526.5	8.3	13,088.0	7.47
2011	97.30	312	NA	NA	15,094.0	NA	13,315.1	7.31

Note: Expenditures include taxes where data are available. 2011 data are preliminary.

NA = Not available.

Source: U.S. Department of Energy, Energy Information Administration

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Energy Imports, U.S.: Selected Years, 1950-2011

(In Billions of Btus; Latest Year Available)

Year	Coal	Coal Coke	Natural Gas	Petroleum			Bio-fuels[3]	Elec-tricity	Total
				Crude Oil[1]	Petroleum Products[2]	Total			
1950	9,132	10,862	0	1,056,154	830,142	1,886,296	NA	6,596	1,912,887
1955	8,425	3,125	11,269	1,690,834	1,060,671	2,751,505	NA	15,583	2,789,908
1960	6,551	3,125	161,094	2,196,380	1,802,314	3,998,694	NA	18,163	4,187,626
1965	4,600	2,232	470,999	2,654,379	2,747,586	5,401,965	NA	12,140	5,891,935
1970	900	3,794	846,224	2,813,732	4,655,914	7,469,646	NA	21,051	8,341,615
1975	23,500	45,111	977,786	8,720,912	4,226,634	12,947,546	NA	38,446	14,032,389
1980	29,840	16,343	1,006,432	11,194,854	3,463,406	14,658,259	NA	85,373	15,796,247
1985	48,810	14,334	951,614	6,813,508	3,795,708	10,609,216	NA	156,595	11,780,570
1990	67,485	18,972	1,550,646	12,766,330	4,350,895	17,117,225	NA	62,936	18,817,264
1991	84,745	29,338	1,798,139	12,553,444	3,794,330	16,347,774	NA	74,829	18,334,826
1992	95,069	52,030	2,161,017	13,253,408	3,714,306	16,967,714	NA	96,377	19,372,208
1993	204,524	53,444	2,397,117	14,749,427	3,760,193	18,509,620	846	106,992	21,272,544
1994	221,746	82,782	2,681,563	15,339,528	3,903,541	19,243,069	968	159,795	22,389,924
1995	236,828	94,736	2,900,710	15,669,254	3,211,383	18,880,637	1,342	146,216	22,260,469
1996	202,882	63,042	3,002,036	16,341,399	3,942,923	20,284,321	1,086	148,410	23,701,776
1997	187,169	77,847	3,063,039	17,875,688	3,864,489	21,740,177	295	146,823	25,215,350
1998	218,092	95,083	3,224,555	18,916,158	3,991,739	22,907,897	229	134,820	26,580,676
1999	227,233	79,955	3,664,386	18,935,152	4,197,780	23,132,932	302	147,449	27,252,257
2000	312,816	93,769	3,868,580	19,782,784	4,748,632	24,531,416	402	165,797	28,972,779
2001	494,682	62,633	4,068,409	20,347,647	5,050,795	25,398,442	1,512	131,363	30,157,041
2002	421,886	80,395	4,103,803	19,920,301	4,754,189	24,674,490	2,084	125,490	29,408,149
2003	626,099	68,415	4,042,343	21,060,345	5,158,589	26,218,934	1,515	103,706	31,061,012
2004	682,000	170,463	4,365,022	22,082,229	6,114,465	28,196,694	12,806	116,725	33,543,709
2005	761,509	87,526	4,449,560	22,090,819	7,157,370	29,248,189	12,324	149887	34,708,994
2006	906,149	100,876	4,290,938	22,084,624	7,084,371	29,168,995	66,105	145,663	34,678,725
2007	908,671	60,998	4,722,771	21,913,503	6,867,538	28,781,041	54,177	175,362	34,703,020
2008	855,192	89,354	4,083,704	21,448,357	6,236,843	27,685,201	83,935	194550	32,991,936
2009	565,963	8,598	3,845,144	19,698,574	5,383,067	25,081,641	26,240	178074	29,705,660
2010	483,817	30,107	3,834,276	20,140,145	5,230,583	25,370,727	4,361	153,824	29,877,112
2011[P]	327,190	35,162	3,539,778	19,560,654	4,930,346	24,491,000	15,537	178,449	28,587,117

NA = Not Available. P = Preliminary.

[1] Crude oil and lease condensate. Includes imports into the Strategic Petroleum Reserve, which began in 1977.

[2] Petroleum products, unfinished oils, pentanes plus, and gasoline blending components. Does not include biofuels.

[3] Fuel ethanol (including denaturant) and biodiesel.

Source: U.S. Energy Information Administration

Plunkett Research, Ltd.

www.plunkettresearch.com

Energy Exports, U.S.: Selected Years, 1950-2011

(In Billions of Btus; Latest Year Available)

Year	Coal	Coal Coke	Natural Gas	Petroleum			Biofuels[3]	Electricity	Total
				Crude Oil[1]	Petroleum Products[2]	Total			
1950	786,496	9,870	26,627	201,973	439,854	641,827	NA	501	1,465,322
1955	1,464,521	13,169	32,115	67,112	706,887	773,999	NA	1,705	2,285,508
1960	1,023,170	8,754	11,729	17,905	413,229	431,133	NA	2,689	1,477,475
1965	1,376,486	20,683	26,968	6,363	385,811	392,173	NA	12,622	1,828,933
1970	1,935,500	61,454	71,977	28,948	519,893	548,841	NA	14,363	2,632,135
1975	1,761,300	31,570	73,692	12,447	426,899	439,345	NA	17,344	2,323,252
1980	2,420,518	51,361	49,365	608,623	550,929	1,159,552	NA	13,974	3,694,770
1985	2,438,129	27,826	55,876	432,175	1,225,220	1,657,395	NA	16,940	4,196,166
1990	2,772,273	14,186	87,105	229,987	1,593,879	1,823,866	NA	55,048	4,752,479
1991	2,853,670	19,642	132,087	245,833	1,881,865	2,127,698	NA	7,863	5,140,959
1992	2,681,926	17,410	220,175	188,343	1,819,439	2,007,783	NA	9,644	4,936,938
1993	1,962,467	26,338	142,426	207,837	1,907,219	2,115,056	NA	12,082	4,258,368
1994	1,878,801	24,453	163,517	208,916	1,778,600	1,987,516	NA	6,858	4,061,144
1995	2,318,168	33,678	155,814	200,152	1,790,696	1,990,849	NA	12,361	4,510,870
1996	2,368,031	40,226	155,080	233,224	1,825,433	2,058,657	NA	11,266	4,633,260
1997	2,193,135	31,397	158,733	227,986	1,872,116	2,100,102	NA	30,619	4,513,987
1998	2,091,677	27,999	160,756	232,592	1,739,580	1,972,172	NA	46,596	4,299,200
1999	1,525,108	22,270	164,395	249,580	1,705,120	1,954,700	NA	48,525	3,714,999
2000	1,527,552	28,421	245,178	106,442	2,047,685	2,154,127	NA	50,598	4,005,875
2001	1,265,220	33,373	377,011	42,839	1,995,787	2,038,626	211	56,207	3,770,647
2002	1,032,088	19,637	520,363	19,117	2,023,327	2,042,443	298	53,895	3,668,724
2003	1,117,147	17,900	686,042	26,320	2,124,406	2,150,726	588	81,802	4,054,205
2004	1,253,129	32,701	861,825	56,741	2,150,776	2,207,518	662	78,128	4,433,962
2005	1,273,227	43,335	735,158	67,390	2,374,311	2,441,701	1,103	65,343	4,559,866
2006	1,263,672	40,089	730,474	52,194	2,698,749	2,750,944	4,435	82,814	4,872,427
2007	1,506,648	35,807	829,856	58,034	2,948,508	3,006,543	34,710	68,730	5,482,293
2008	2,070,504	48,582	971,932	60,691	3,739,122	3,799,814	86,430	82,564	7,059,825
2009	1,514,832	32,409	1,082,008	92,711	4,146,810	4,239,521	33,934	61,887	6,964,591
2010	2,101,155	36,278	1,147,020	88,151	4,749,678	4,837,828	46,305	65,190	8,233,777
2011[P]	2,750,646	24,058	1,520,695	99,515	5,801,367	5,900,882	108,022	51,308	10,355,611

NA = Not Available. P = Preliminary

[1] Crude oil and lease condensate.

[2] Petroleum products, unfinished oils, pentanes plus, and gasoline blending components. Does not include biofuels.

[3] Biodiesel only.

Source: U.S. Energy Information Administration

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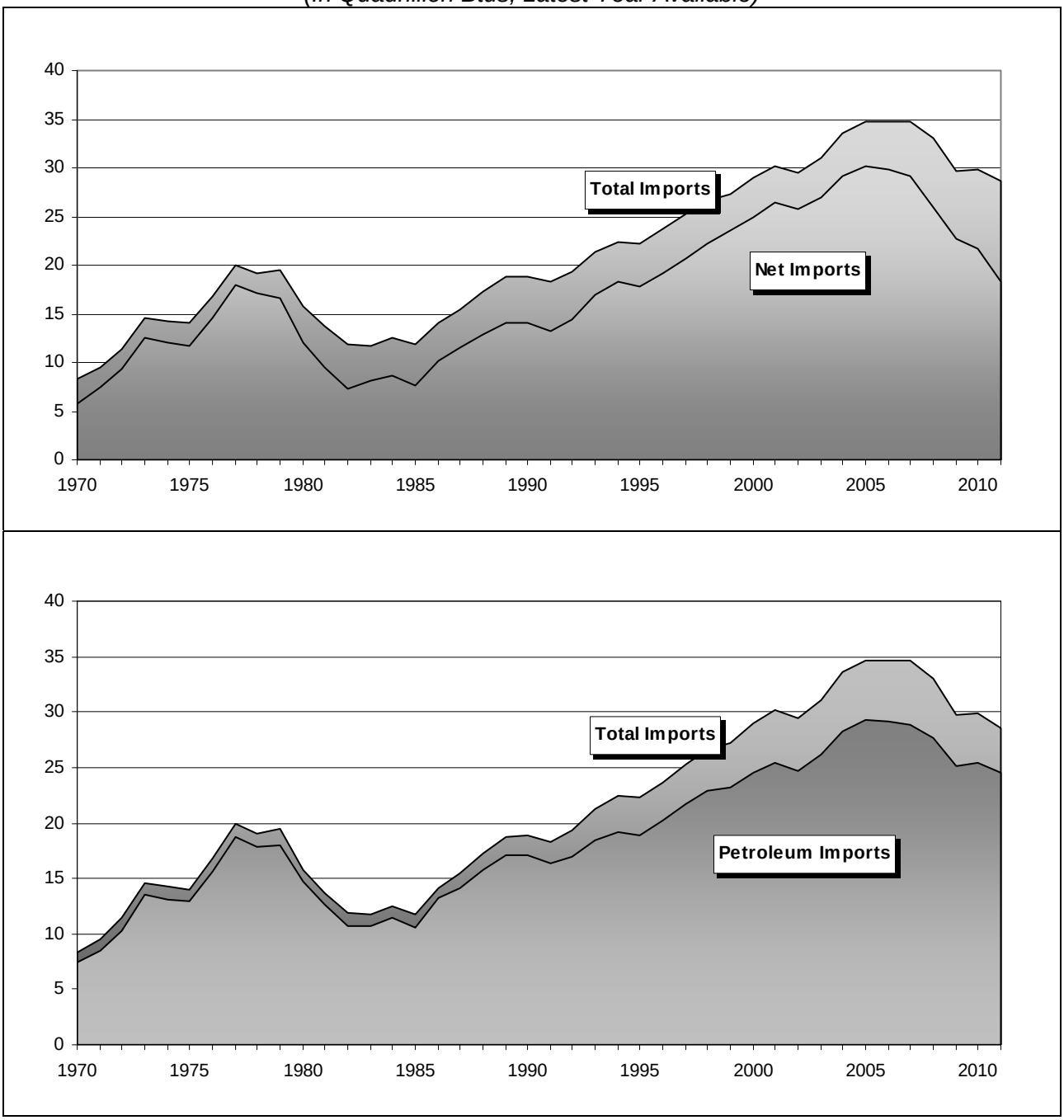
Total Energy Imports, Net Energy Imports & Petroleum Imports, U.S.: 1970-2011

(In Quadrillion Btus; Latest Year Available)



Note: Net imports equal imports minus exports. Negative numbers would indicate exports greater than imports.

Source: U.S. Energy Information Administration
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Federal Research & Development (R&D) & R&D Plant Funding for Energy, U.S.: Fiscal Years 2010-2012

(In Millions of US$)

Funding Category and Agency	2010 Actual	2011 Prelim.	2012 Proposed	% Change (2011-12)
Total	2,570	2,219	3,654	64.6%
Department of Energy	2,443	2,088	3,518	68.5%
Energy programs	2,443	1,915	2,898	51.4%
Energy efficiency and renewable energy	1,163	813	1,850	127.4%
Electricity delivery and energy reliability	122	113	194	72.1%
Fossil energy	531	397	326	-17.8%
Nuclear energy	627	592	528	-10.8%
ARPA-E	0	173	620	258.6%
Nuclear Regulatory Commission	81	84	78	-7.0%
Tennessee Valley Authority	18	18	18	0.2%
U.S. Department of Agriculture (Biomass R&D)	28	30	40	33.3%

ARPA-E = Advanced Research Projects Agency-Energy. NA = Not Available.

Note: Detail may not add to total because of rounding. Percentage change calculated on unrounded data.

Source: U.S. National Science Foundation

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U.S. Department of Energy
Funding for Scientific Research: 2011-2013

(In Thousands of US$)

Area of Scientific Research	2011 Current Appropriation	2012 Enacted Appropriation	2013 Congressional Request
Energy Programs	**9,362,851**	**9,413,687**	**10,175,731**
Energy Efficiency & Renewable Energy	1,771,721	1,809,638	2,337,000
Hydrogen and Fuel Cell Technologies	95847	103,624	80,000
Biomass & Biorefinery Systems R&D	179,979	199,276	270,000
Solar Energy	259,556	288,951	310,000
Wind Energy	78,834	93,254	95,000
Geothermal Technology	36,992	37,862	65,000
Water Power	29,201	58,787	20,000
Vehicle Technologies	293,151	328,807	420,000
Building Technologies	207,310	219,204	310,000
Industrial Technologies	105,899	115,580	--
Advanced Manufacturing	--	--	290,000
Federal Energy Management Program	30,402	29,891	32,000
Electricity Delivery & Energy Reliability	138,170	139,103	143,015
Nuclear Energy	717,817	765,391	770,445
Fuel Cycle R&D	182,428	186,250	175,438
Fossil Energy Programs	**572,525**	**564,435**	**650,792**
Fossil Energy Research & Development	434,052	346,703	420,575
Coal	389,688	368,395	275,869
Fuels & Power Systems	389,688	--	--
CCS & Power Systems	--	368,395	275,869
Carbon Capture	--	68,898	60,438
Carbon Storage	--	115,410	95,477
Advance Energy Systems	--	99,942	55,193
Cross Cutting Research	--	49,134	29,750
NETL Coal R&D	--	35,011	35,011
Natural Gas Technologies	--	14,991	17,000
Unconventional Fossil Energy Technologies	--	4,997	--
Naval Petroleum & Oil Shale Reserves	20,854	14,909	14,909
Strategic Petroleum Reserve	123,141	192,704	195,609
Northeast Home Heating Oil Reserve	10,978	10,119	4,119
Science	4,897,283	4,873,634	4,992,052
High Energy Physics	775,578	790,860	776,521
Advanced Scientific Computing Research	410,317	440,868	455,593
Fusion Energy Sciences Program	367,257	400,996	398,324
Nuclear Physics	527,684	547,387	526,938
Biological & Environmental Research	595,246	609,557	625,347
Basic Energy Sciences	1,638,511	1,688,093	1,799,592
Other			
Uranium Enrichment D&D Fund	497,084	472,180	442,493
Energy Information Administration	95,009	105,000	116,365
Non-Defense Environmental Cleanup	225,106	235,306	198,506

Source: U.S. Department of Energy, Office of Science

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Approximate Energy Unit Conversion Factors

Crude oil[1]

From	To convert into: tonnes[2] (Multiply by:)	kilolitres	barrels	US gallons	tonnes/year
Tonnes[2]	1	1.165	7.33	307.86	–
Kilolitres	0.8581	1	6.2898	264.17	–
Barrels	0.1364	0.159	1	42	–
US gallons	0.00325	0.0038	0.0238	1	–
Barrels per day	–	–	–	–	49.8

[1] Based on worldwide average gravity. [2] tonnes = metric tons

Products

From	To convert: barrels to tonnes (Multiply by:)	tonnes to barrels	kilolitres to tonnes	tonnes to kilolitres
Liquefied Petroleum Gas (LPG)	0.086	11.6	0.542	1.844
Gasoline	0.118	8.5	0.740	1.351
Kerosene	0.128	7.8	0.806	1.240
Gas oil/diesel	0.133	7.5	0.839	1.192
Fuel oil	0.149	6.7	0.939	1.065

Natural Gas (NG) and Liquefied Natural Gas (LNG)

From	To convert to: billion cubic meters NG (Multiply by:)	billion cubic feet NG	million tonnes oil equivalent	million tonnes LNG	trillion British thermal units	million barrels oil equivalent
1 billion cubic meters NG	1	35.3	0.90	0.74	35.7	6.60
1 billion cubic feet NG	0.028	1	0.025	0.021	1.01	0.19
1 million tonnes oil equivalent	1.11	39.2	1	0.82	39.7	7.33
1 million tonnes LNG	1.36	48.0	1.22	1	48.6	8.97
1 trillion British thermal units	0.028	0.99	0.025	0.021	1	0.18
1 million barrels oil equivalent	0.15	5.35	0.14	0.11	5.41	1

Units

1 metric tonne = 2204.62 lb.
1 metric tonne = 1.1023 short tons
1 kilolitre = 6.2898 barrels
1 kilolitre = 1 cubic meter
1 kilocalorie (kcal) = 4.187 kJ = 3.968 Btu
1 kilojoule (kJ) = 0.239 kcal = 0.948 Btu
1 British thermal unit (Btu) = 0.252 kcal = 1.055 kJ
1 kilowatt-hour (kWh) = 860 kcal = 3600 kJ = 3412 Btu

Calorific equivalents:

One tonne of oil equivalent equals approximately:

Heat units	10 million kilocalories	**Solid fuels**	1.5 tonnes of hard coal
	42 gigajoules		3 tonnes of lignite
	40 million Btu	**Gaseous fuels**	See Natural gas and LNG table
		Electricity	12 megawatt-hours

Note: One million tonnes of oil or oil equivalent produces about 4,400 gigawatt-hours (= 4.4 terawatt-hours) of electricity in a modern power station.

Source: BP, *Statistical Review of Energy,* June 2012
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II. Electricity

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Electricity Overview, U.S.: Selected Years, 1950-2011

(In Billions of Kilowatt-Hours; Latest Year Available)

Year	Net Generation				Imports[1]	Exports[1]	T & D[5] Losses & Unaccoun-ted For[6]	End Use		
	Electric Power Sector[2]	Comme-rcial Sector[3]	Industrial Sector[4]	Total				Retail Sales[7]	Direct Use[8]	Total
1950	329	NA	5	334	2	(S)	44	291	NA	291
1955	547	NA	3	550	5	(S)	58	497	NA	497
1960	756	NA	4	759	5	1	76	688	NA	688
1965	1,055	NA	3	1,058	4	4	104	954	NA	954
1970	1,532	NA	3	1,535	6	4	145	1,392	NA	1,392
1975	1,918	NA	3	1,921	11	5	180	1,747	NA	1,747
1980	2,286	NA	3	2,290	25	4	216	2,094	NA	2,094
1985	2,470	NA	3	2,473	46	5	190	2,324	NA	2,324
1990	2,901	6	131	3,038	18	16	203	2,713	125	2,837
1995	3,194	8	151	3,353	43	4	229	3,013	151	3,164
2000	3,638	8	157	3,802	49	15	244	3,421	171	3,592
2001	3,580	7	149	3,737	39	16	202	3,394	163	3,557
2002	3,698	7	153	3,858	37	16	248	3,465	166	3,632
2003	3,721	7	155	3,883	30	24	228	3,494	168	3,662
2004	3,808	8	154	3,971	34	23	266	3,547	168	3,716
2005	3,902	8	145	4,055	44	19	269	3,661	150	3,811
2006	3,908	8	148	4,065	43	24	266	3,670	147	3,817
2007	4,005	8	143	4,157	51	20	298	3,765	126	3,890
2008	3,974	8	137	4,119	57	24	287	3,733	132	3,865
2009	3,810	8	132	3,950	52	18	261	3,597	127	3,724
2010	3,972	9	144	4,125	45	19	265	3,754	132	3,886
2011[P]	3,955	8	142	4,106	52	15	287	3,726	130	3,856

NA = Not Available. P = Preliminary. S = Less than 0.5 billion kilowatt hours.

[1] Electricity transmitted across U.S. borders.

[2] Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

[3] Commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

[4] Industrial combined-heat-and-power (CHP) and industrial electricity-only plants. Through 1988, data are for industrial hydroelectric power only.

[5] Transmission and distribution losses (electricity losses that occur between the point of generation and delivery to the customer).

[6] Data collection frame differences and nonsampling error.

[7] Electricity retail sales to ultimate customers by electric utilities and, beginning in 1996, other energy service providers.

[8] Use of electricity that is 1) self-generated, 2) produced by either the same entity that consumes the power or an affiliate, and 3) used in direct support of a service or industrial process located within the same facility or group of facilities that house the generating equipment. Direct use is exclusive of station use.

Source: U.S. Department of Energy, Energy Information Administration

Plunkett Research, Ltd.

www.plunkettresearch.com

Total Electrical Power Generation by Fuel Type, U.S.: 1981-1st 7 Months of 2012

(Thousands of Megawatt Hours; Latest Year Available)

Year	Coal[1]	Petroleum[2]	Natural Gas	Other Gases[3]	Nuclear Energy	Conventional Hydroelectric	Other Re-newables[4]	Other[5]	Total
1981	1,203,203	206,421	345,777	NA	272,674	263,845	5,686	NA	2,297,973
1982	1,192,004	146,797	305,260	NA	282,773	312,374	4,843	NA	2,244,372
1983	1,259,424	144,499	274,098	NA	293,677	335,291	6,075	NA	2,313,446
1984	1,341,681	119,808	297,394	NA	327,634	324,311	7,741	NA	2,419,465
1985	1,402,128	100,202	291,946	NA	383,691	284,311	9,325	NA	2,473,002
1986	1,385,831	136,585	248,508	NA	414,038	294,005	10,308	NA	2,490,471
1987	1,463,781	118,493	272,621	NA	455,270	252,856	10,775	NA	2,575,288
1988	1,540,653	148,900	252,801	NA	526,973	226,101	10,300	NA	2,707,411
1989	1,583,779	164,518	352,629	7,862	529,355	271,977	14,593	3,830	2,967,306
1990	1,594,011	126,621	372,765	10,383	576,862	292,866	15,434	3,616	3,037,988
1991	1,590,623	119,752	381,553	11,336	612,565	288,994	15,966	4,739	3,073,799
1992	1,621,206	100,154	404,074	13,270	618,776	253,088	16,138	3,720	3,083,882
1993	1,690,070	112,788	414,927	12,956	610,291	280,494	16,789	3,487	3,197,191
1994	1,690,694	105,901	460,219	13,319	640,440	260,126	15,535	3,667	3,247,522
1995	1,709,426	74,554	496,058	13,870	673,402	310,833	73,965	4,104	3,353,487
1996	1,795,196	81,411	455,056	14,356	674,729	347,162	75,796	3,571	3,444,188
1997	1,845,016	92,555	479,399	13,351	628,644	356,453	77,183	3,612	3,492,172
1998	1,873,516	128,800	531,257	13,492	673,702	323,336	77,088	3,571	3,620,295
1999	1,881,087	118,061	556,396	14,126	728,254	319,536	79,423	4,024	3,694,810
2000	1,966,265	111,221	601,038	13,955	753,893	275,573	80,906	4,794	3,802,105
2001	1,903,956	124,880	639,129	9,039	768,826	216,961	70,769	11,906	3,736,644
2002	1,933,130	94,567	691,006	11,463	780,064	264,329	79,109	13,527	3,858,452
2003	1,973,737	119,406	649,908	15,600	763,733	275,806	79,487	14,045	3,883,185
2004	1,978,301	121,145	710,100	15,252	788,528	268,417	83,067	14,232	3,970,555
2005	2,012,873	122,225	760,960	13,464	781,986	270,321	87,329	12,821	4,055,423
2006	1,990,511	64,166	816,441	14,177	787,219	289,246	96,525	12,974	4,064,702
2007	2,016,456	65,739	896,590	13,453	806,425	247,510	105,238	12,231	4,156,745
2008	1,985,801	46,242	882,981	11,707	806,208	254,831	126,101	11,804	4,119,388
2009	1,755,904	38,936	920,979	10,632	798,855	273,445	144,279	11,928	3,950,331
2010	1,847,290	37,061	987,697	11,313	806,968	260,203	167,173	12,855	4,125,060
2011	1,734,265	28,162	1,016,595	11,269	790,225	325,074	194,993	11,064	4,105,734
2012*	854,145	12,868	734,973	7,431	450,184	180,928	128,067	6,450	2,372,562

* Year to date, through July. NA = Not available.

[1] Anthracite, bituminous, subbituminous, lignite, waste coal, and coal synfuel.

[2] Petroleum liquids including distillate fuel oil, residual fuel oil, jet fuel, kerosene, and waste oil; and petroleum coke.

[3] Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

[4] Includes wind; solar thermal and photovoltaic; wood and wood-derived fuels; geothermal; and other biomass. Category realignments are responsible for the dramatic increase in 1995.

[5] Non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuel, and miscellaneous technologies.

Source: U.S. Department of Energy, Energy Information Administration
Plunkett Research, Ltd.
www.plunkettresearch.com

Average Retail Prices of Electricity Sold by U.S. Electric Utilities: Selected Years, 1960-2011

(In Cents per Kilowatt-Hour; Latest Year Available)

Year	Residential		Commercial[1]		Industrial[2]		Other/ Transportation[3]		Total Average	
	Nominal[4]	Real[5]	Nominal[4]	Real[5]	Nominal[4]	Real[5]	Nominal[4]	Real[5]	Nominal[4]	Real[5]
1960	2.60	14.00	2.40	12.90	1.10	5.90	1.90	10.20	1.80	9.70
1970	2.20	9.00	2.10	8.60	1.00	4.10	1.80	7.40	1.70	7.00
1980	5.40	11.30	5.50	11.50	3.70	7.70	4.80	10.00	4.70	9.80
1990	7.83	10.84	7.34	10.16	4.74	6.56	6.40	8.86	6.57	9.09
2000	8.24	9.29	7.43	8.37	4.64	5.23	6.56	7.39	6.81	7.68
2001	8.58	9.46	7.92	8.73	5.05	5.57	7.20	7.94	7.29	8.04
2002	8.44	9.15	7.89	8.56	4.88	5.29	6.75	7.32	7.20	7.81
2003	8.72	9.26	8.03	8.53	5.11	5.43	7.54	8.01	7.44	7.90
2004	8.95	9.25	8.17	8.44	5.25	5.42	7.18	7.42	7.61	7.86
2005	9.45	9.45	8.67	8.67	5.73	5.73	8.57	8.57	8.14	8.14
2006	10.40	10.07	9.46	9.16	6.16	5.97	9.54	9.24	8.90	8.62
2007	10.65	10.03	9.65	9.08	6.39	6.02	9.70	9.13	9.13	8.59
2008	11.26	10.37	10.36	9.54	6.83	6.29	10.74	9.89	9.74	8.97
2009	11.51	10.49	10.17	9.27	6.81	6.21	10.65	9.71	9.82	8.95
2010	11.54	10.40	10.19	9.18	6.77	6.10	10.57	9.52	9.83	8.86
2011	11.80	10.41	10.32	9.10	6.89	6.08	10.58	9.33	9.99	8.81

Notes: Data represent revenue from electricity retail sales divided by electricity retail sales. Through 1979, data are for Classes A and B privately owned electric utilities only. For 1980-1982, data are for selected Class A utilities whose electric operating revenues were $100 million or more during the previous year. For 1983, data are for a selected sample of electric utilities. Beginning in 1984, data are for a census of electric utilities. Beginning in 1996, data also include energy service providers selling to retail customers.

[1] Commercial sector. For 1960-2002, prices exclude public street and highway lighting, interdepartmental sales, and other sales to public authorities.

[2] Industrial sector. For 1960-2002, prices exclude agriculture and irrigation.

[3] The category "Other" was changed to "Transportation" in 2003. It reflects sales to public street and highway lighting, other sales to public authorities, sales to railroads and railways, and interdepartmental sales.

[4] In dollars not adjusted for inflation.

[5] In chained (2005) dollars, calculated by using gross domestic product implicit price deflators.

Source: U.S. Department of Energy, Energy Information Administration

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III. Fossil Fuels & Nuclear Energy

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Energy Production by Fossil Fuels & Nuclear Power, U.S.: Selected Years, 1950-2011

(In Billions of Btu; Latest Year Available)

Year	Fossil Fuels					Nuclear Electric Power	Total[2]
	Coal	Natural Gas (Dry)	Crude Oil[1]	Natural Gas Plant Liquids	Total		
1950	14,060,135	6,232,975	11,446,729	822,828	32,562,667	0	35,540,385
1955	12,369,608	9,344,668	14,409,682	1,239,721	37,363,680	0	40,147,667
1960	10,817,398	12,656,133	14,934,611	1,460,974	39,869,117	6,026	42,803,347
1965	13,055,285	15,775,441	16,521,381	1,882,795	47,234,902	43,164	50,673,882
1970	14,607,064	21,665,670	20,401,210	2,512,128	59,186,071	239,347	63,495,439
1975	14,989,315	19,640,343	17,729,318	2,374,297	54,733,273	1,899,798	61,320,192
1980	18,597,726	19,907,600	18,248,917	2,253,630	59,007,873	2,739,169	67,175,384
1985	19,325,166	16,980,380	18,992,407	2,240,771	57,538,724	4,075,563	67,698,304
1990	22,487,548	18,326,155	15,571,185	2,174,714	58,559,602	6,104,350	70,704,628
1991	21,636,424	18,228,736	15,700,826	2,305,740	57,871,727	6,422,132	70,362,376
1992	21,694,132	18,375,100	15,222,863	2,362,961	57,655,057	6,479,206	69,955,615
1993	20,335,654	18,584,037	14,494,390	2,408,002	55,822,083	6,410,499	68,315,361
1994	22,202,083	19,348,014	14,102,563	2,390,979	58,043,639	6,693,877	70,725,634
1995	22,129,550	19,082,245	13,886,757	2,441,583	57,540,135	7,075,436	71,173,994
1996	22,790,148	19,344,269	13,722,899	2,529,910	58,387,226	7,086,674	72,486,072
1997	23,309,614	19,393,851	13,658,020	2,495,207	58,856,692	6,596,992	72,471,914
1998	24,045,199	19,613,294	13,235,130	2,420,459	59,314,083	7,067,809	72,876,229
1999	23,295,084	19,340,702	12,451,046	2,527,649	57,614,481	7,610,256	71,742,196
2000	22,735,478	19,661,530	12,358,101	2,610,916	57,366,024	7,862,349	71,332,159
2001	23,547,080	20,165,568	12,281,564	2,547,136	58,541,347	8,028,853	71,734,563
2002	22,732,237	19,382,055	12,163,319	2,559,168	56,836,779	8,145,429	70,716,137
2003	22,093,652	19,633,304	12,026,028	2,346,260	56,099,244	7,958,858	70,039,770
2004	22,852,099	19,074,254	11,503,140	2,465,850	55,895,343	8,221,985	70,187,684
2005	23,185,189	18,556,015	10,962,615	2,333,842	55,037,660	8,160,810	69,427,669
2006	23,789,510	19,021,706	10,801,102	2,355,836	55,968,154	8,215,414	70,782,157
2007	23,492,742	19,786,209	10,721,012	2,408,589	56,408,552	8,455,364	71,373,190
2008	23,851,368	20,702,884	10,508,538	2,419,358	57,482,148	8,427,297	73,111,145
2009	21,623,721	21,139,450	11,348,257	2,573,782	56,685,210	8,356,019	72,656,971
2010	22,038,226	21,823,065	11,592,618	2,781,288	58,235,197	8,434,433	74,806,092
2011[P]	22,180,926	23,506,181	11,985,743	2,927,854	60,600,703	8,259,432	78,095,827

Note: Totals may not equal sum of components due to independent rounding. [P] Preliminary data.

[1] Includes lease condensate.

[2] This total includes generation from renewable sources such as hydro-electric, geothermal, solar, wind and biomass.

Source: U.S. Department of Energy, Energy Information Administration

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Petroleum Overview, U.S.: Selected Years, 1950-2011

(In Thousands of Barrels per Day; Latest Year Available)

Year	Field Production[1]			Trade			Stock Change[2]	Adjust-ments[3]	Petroleum Products Supplied
	Crude Oil	Natural Gas Plant Liquids	Total	Imports[4]	Exports	Net Imports			
1950	5,407	499	5,906	850	305	545	-56	-51	6,458
1955	6,807	771	7,578	1,248	368	880	<1	-37	8,455
1960	7,035	929	7,965	1,815	202	1,613	-83	-8	9,797
1965	7,804	1,210	9,014	2,468	187	2,281	-8	-10	11,512
1970	9,637	1,660	11,297	3,419	259	3,161	103	-16	14,697
1975	8,375	1,633	10,007	6,056	209	5,846	32	41	16,322
1980	8,597	1,573	10,170	6,909	544	6,365	140	64	17,056
1985	8,971	1,609	10,581	5,067	781	4,286	-103	200	15,726
1990	7,355	1,559	8,914	8,018	857	7,161	107	338	16,988
1991	7,417	1,659	9,076	7,627	1,001	6,626	-10	287	16,714
1992	7,171	1,697	8,868	7,888	950	6,938	-68	386	17,033
1993	6,847	1,736	8,582	8,620	1,003	7,618	151	422	17,237
1994	6,662	1,727	8,388	8,996	942	8,054	15	523	17,718
1995	6,560	1,762	8,322	8,835	949	7,886	-246	496	17,725
1996	6,465	1,830	8,295	9,478	981	8,498	-151	528	18,309
1997	6,452	1,817	8,269	10,162	1,003	9,158	143	487	18,620
1998	6,252	1,759	8,011	10,708	945	9,764	239	495	18,917
1999	5,881	1,850	7,731	10,852	940	9,912	-422	567	19,519
2000	5,822	1,911	7,733	11,459	1,040	10,419	-69	532	19,701
2001	5,801	1,868	7,670	11,871	971	10,900	325	501	19,649
2002	5,746	1,880	7,626	11,530	984	10,546	-105	527	19,761
2003	5,681	1,719	7,400	12,264	1,027	11,238	56	478	20,034
2004	5,419	1,809	7,228	13,145	1,048	12,097	209	564	20,731
2005	5,178	1,717	6,895	13,714	1,165	12,549	145	513	20,802
2006	5,102	1,739	6,841	13,707	1,317	12,390	60	522	20,687
2007	5,064	1,783	6,847	13,468	1,433	12,036	-148	653	20,680
2008	4,950	1,784	6,734	12,915	1,802	11,114	195	852	19,498
2009	5,361	1,910	7,270	11,691	2,024	9,667	109	218	18,771
2010	5,476	2,074	7,550	11,793	2,353	9,441	49	264	19,180
2011	5,662	2,183	7,844	11,360	2,924	8,436	-115	402	18,835

[1] Crude oil production on leases, and natural gas plant liquids (liquefied petroleum gases, pentanes plus, and a small amount of finished petroleum products) production at natural gas processing plants. Excludes what was previously classified as "Field Production" of finished motor gasoline, motor gasoline blending components, and other hydrocarbons and oxygenates; these are now included in "Adjustments."

[2] A negative number indicates a decrease in stocks and a positive number indicates an increase. Includes crude oil stocks in the Strategic Petroleum Reserve, but excludes distillate fuel oil stocks in the Northeast Heating Oil Reserve.

[3] An adjustment for crude oil, finished motor gasoline, motor gasoline blending components, fuel ethanol, and distillate fuel oil.

[4] Includes crude oil imports for the Strategic Petroleum Reserve, which began in 1977.

Source: U.S. Department of Energy, Energy Information Administration

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Crude Oil Production & Oil Well Productivity, U.S.: Selected Years, 1955-2011

(In Thousands of Barrels per Day Unless Otherwise Noted; Latest Year Available)

	Geographic Location		Site			Oil Well Productivity	
	48 States[1]	Alaska	Onshore	Offshore	Total Crude Oil Production	Producing Wells[2] *(thous.)*	Average Daily Productivity[3] *(barrels per well)*
1955	6,807	0	6,645	162	6,807	524	13.0
1960	7,034	2	6,716	319	7,035	591	11.9
1965	7,774	30	7,140	665	7,804	589	13.2
1970	9,408	229	8,060	1,577	9,637	531	18.1
1975	8,183	191	7,012	1,362	8,375	500	16.8
1980	6,980	1,617	7,562	1,034	8,597	548	15.7
1985	7,146	1,825	7,722	1,250	8,971	647	13.9
1986	6,814	1,867	7,426	1,254	8,680	623	13.9
1987	6,387	1,962	7,153	1,196	8,349	620	13.5
1988	6,123	2,017	6,949	1,191	8,140	612	13.3
1989	5,739	1,874	6,486	1,127	7,613	603	12.6
1990	5,582	1,773	6,273	1,082	7,355	602	12.2
1991	5,618	1,798	6,245	1,172	7,417	614	12.1
1992	5,457	1,714	5,953	1,218	7,171	594	12.1
1993	5,264	1,582	5,596	1,250	6,847	584	11.7
1994	5,103	1,559	5,291	1,370	6,662	582	11.4
1995	5,076	1,484	5,035	1,525	6,560	574	11.4
1996	5,071	1,393	4,902	1,562	6,465	574	11.3
1997	5,156	1,296	4,803	1,648	6,452	573	11.3
1998	5,077	1,175	4,560	1,692	6,252	562	11.1
1999	4,832	1,050	4,132	1,750	5,881	546	10.8
2000	4,851	970	4,049	1,773	5,822	534	10.9
2001	4,839	963	3,879	1,923	5,801	530	10.9
2002	4,761	984	3,743	2,003	5,746	529	10.9
2003	4,706	974	3,668	2,012	5,681	513	11.1
2004	4,510	908	3,536	1,883	5,419	510	10.6
2005	4,314	864	3,466	1,712	5,178	498	10.4
2006	4,361	741	3,401	1,701	5,102	497	10.3
2007	4,342	722	3,407	1,657	5,064	500	10.1
2008	4,268	683	3,452	1,498	4,950	526	9.4
2009	4,715	645	3,622	1,738	5,361	526	10.2
2010	4,874	601	3,744[E]	1,732[E]	5,476	520	10.5
2011	5,090[E]	572[E]	4,178[E]	1,484[E]	5,662[E]	536[P]	10.6[E]

Note: Totals may not equal sum of components due to independent rounding. [P] Preliminary data. [E] Estimate.

[1] United States excluding Alaska and Hawaii. Includes State onshore, State offshore, and Federal offshore production.

[2] As of December 31.

[3] Through 1976, average productivity is based on the average number of producing wells. Beginning in 1977, average productivity is based on the number of wells producing at end of year.

Source: U.S. Department of Energy, Energy Information Administration

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Crude Oil Domestic First Purchase Prices, U.S.: Selected Years, 1960-2011

(In US$ per Barrel; Latest Year Available)

	Alaska North Slope		California		Texas		U.S. Average	
	Nominal[1]	Real[2]	Nominal[1]	Real[2]	Nominal[1]	Real[2]	Nominal[1]	Real[2]
1960	—	—	—	—	—	—	2.88	15.47
1970	—	—	—	—	—	—	3.18	13.07
1980	16.87	35.30	23.87	49.95	21.84	45.70	21.59	45.18
1981	23.23	44.44	26.80	51.27	35.06	67.07	31.77	60.78
1982	19.92	35.92	24.58	44.32	31.77	57.29	28.52	51.43
1983	17.69	30.68	22.61	39.22	29.35	50.91	26.19	45.43
1984	17.91	29.94	22.09	36.93	28.87	48.26	25.88	43.27
1985	16.98	27.55	22.14	35.93	26.80	43.49	24.09	39.09
1986	6.45	10.24	11.90	18.89	14.73	23.38	12.51	19.86
1987	10.83	16.71	13.92	21.48	17.55	27.08	15.40	23.76
1988	8.43	12.57	10.97	16.36	14.71	21.94	12.58	18.76
1989	12.00	17.25	14.06	20.21	17.81	25.60	15.86	22.79
1990	15.23	21.08	17.81	24.65	22.37	30.96	20.03	27.72
1991	11.57	15.46	13.72	18.34	19.04	25.45	16.54	22.11
1992	11.73	15.31	13.55	17.69	18.32	23.92	15.99	20.88
1993	10.84	13.85	12.11	15.47	16.19	20.68	14.25	18.20
1994	9.77	12.22	12.12	15.16	14.98	18.74	13.19	16.50
1995	11.12	13.63	14.00	17.16	16.38	20.07	14.62	17.92
1996	15.32	18.42	16.72	20.11	20.31	24.42	18.46	22.20
1997	14.84	17.54	15.78	18.65	18.66	22.05	17.23	20.36
1998	8.47	9.90	9.55	11.16	12.28	14.35	10.87	12.70
1999	12.46	14.35	14.08	16.21	17.29	19.91	15.56	17.92
2000	23.62	26.62	24.82	27.97	28.60	32.24	26.72	30.12
2001	18.18	20.04	20.11	22.17	23.41	25.80	21.84	24.07
2002	19.37	21.01	21.87	23.72	23.77	25.78	22.51	24.42
2003	23.78	25.26	26.43	28.08	29.13	30.94	27.56	29.28
2004	33.03	34.13	34.47	35.61	38.79	40.08	36.77	37.99
2005	47.05	47.05	47.08	47.08	52.61	52.61	50.28	50.28
2006	56.86	55.08	57.34	55.55	61.31	59.39	59.69	57.82
2007	63.69	59.96	65.07	61.26	68.30	64.30	66.52	62.62
2008	90.10	82.98	90.47	83.32	96.85	89.20	94.04	86.61
2009	54.41	49.59	56.11	51.14	57.40	52.31	56.35	51.35
2010	72.33	65.17	74.51	67.13	76.23	68.68	74.71	67.31
2011	98.79	87.15	102.50	90.42	91.99	81.15	95.73	84.45

Note: Prices are for the marketed first sales price of domestic crude oil.

[1] In dollars not adjusted for inflation.

[2] In chained (2005) dollars, calculated by using gross domestic product implicit price deflators.

Source: U.S. Department of Energy, Energy Information Administration

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Landed Costs of U.S. Crude Oil Imports from Selected Countries: Selected Years, 1975-2011

(In Nominal US$ per Barrel; Latest Year Available)

	Persian Gulf	Selected OPEC[2] Countries					Selected Non-OPEC Countries						Avg. Imports
	Persian Gulf Nations[1]	Kuwait	Nigeria	Saudi Arabia	Vene-zuela	Total OPEC[2]	Canada	Colo-mbia	Mexico	Norway	U.K.	Total Non-OPEC	
1975	12.64	W	12.70	12.50	12.36	12.70	12.84	NA	12.61	12.80	NA	12.70	12.70
1980	30.59	W	37.15	29.80	25.92	33.56	30.11	W	31.77	36.82	35.68	33.99	33.67
1985	22.50	NA	28.96	24.72	24.43	26.86	25.71	NA	25.63	28.32	28.36	26.53	26.67
1990	20.55	17.01	23.33	21.82	20.31	21.23	20.48	22.34	19.64	21.11	22.65	20.98	21.13
1991	17.34	18.48	21.39	17.22	15.92	18.08	17.16	19.55	15.89	21.44	21.37	17.93	18.02
1992	17.58	16.99	20.78	17.48	15.13	17.81	17.04	18.46	15.60	20.90	20.63	17.67	17.75
1993	15.26	14.23	18.73	15.40	13.39	15.68	15.27	16.54	14.11	18.99	17.92	15.78	15.72
1994	15.00	14.49	17.21	15.11	13.12	15.08	14.83	15.80	14.09	17.09	16.64	15.29	15.18
1995	16.78	16.47	18.25	16.84	14.81	16.61	16.65	17.45	16.19	18.06	17.91	16.95	16.78
1996	20.45	20.32	21.95	20.49	18.59	20.14	19.94	22.02	19.64	21.34	20.88	20.47	20.31
1997	17.44	17.03	20.64	17.52	16.35	17.73	17.63	19.71	17.30	20.26	20.64	18.45	18.11
1998	11.18	11.00	14.14	11.16	10.16	11.46	11.62	13.26	11.04	13.83	13.55	12.22	11.84
1999	17.37	16.77	17.63	17.48	15.58	16.94	17.54	18.09	16.12	19.06	18.26	17.51	17.23
2000	26.77	26.28	30.04	26.58	26.05	27.29	26.69	29.68	26.03	30.13	29.26	27.80	27.53
2001	20.73	19.66	26.55	20.98	19.81	21.52	20.72	25.88	19.37	25.77	25.32	22.17	21.82
2002	24.13	23.04	26.45	24.77	21.93	23.83	22.98	25.28	22.09	26.60	26.35	23.97	23.91
2003	27.54	26.82	31.07	27.50	25.70	27.70	26.76	30.55	25.48	30.51	30.62	27.68	27.69
2004	36.53	35.89	40.95	37.11	33.79	36.84	34.51	39.03	32.25	39.92	39.28	35.29	36.07
2005	49.68	48.36	57.55	50.31	47.87	51.36	44.73	53.42	43.47	56.23	55.28	47.31	49.29
2006	58.92	57.64	68.26	59.19	57.37	61.21	53.90	62.13	53.76	64.39	67.44	57.14	59.11
2007	69.83	66.01	78.01	70.78	66.13	71.14	60.38	70.91	62.31	71.66	72.47	63.96	67.97
2008	93.59	86.35	104.83	94.75	90.76	95.49	90.00	93.43	85.97	104.13	96.95	90.59	93.33
2009	62.15	61.12	68.01	62.14	57.78	61.90	57.60	58.50	57.35	59.80	63.87	58.58	60.23
2010	78.58	75.91	83.15	79.25	72.43	78.27	72.80	74.25	72.86	82.20	80.12	74.67	76.49
2011	108.10	106.33	116.40	108.74	100.14	107.83	90.03	102.53	101.22	118.09	118.35	98.76	102.98

Notes: This table reports landed costs of crude oil imports only; it does not account for refined petroleum products imported into the United States. Totals may not equal sum of components due to independent rounding. 2011 data are preliminary.

W = Data withheld to avoid disclosure of individual company data. NA = Not available, or no data reported.

[1] Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates and the Neutral Zone (between Kuwait and Saudi Arabia).

[2] OPEC = Organization of Petroleum Exporting Countries. On this table, "Total OPEC" for all years includes Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela; for 1973-2008, also includes Indonesia; for 1973-1992 and beginning in 2008, also includes Ecuador; for 1974-1995, also includes Gabon; and beginning in 2007, also includes Angola. Data for all countries not included in "Total OPEC" are included in "Total Non-OPEC."

Source: U.S. Department of Energy, Energy Information Administration

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Value of U.S. Crude Oil Imports from Selected Countries: Selected Years, 1980-2011

(In Thousands of Nominal US$; Latest Year Available)

	1980	1990	2000	2005	2008	2009	2010	2011
Persian Gulf Nations[1]	**16,878,614**	**13,505,727**	**23,604,207**	**40,024,841**	**80,143,831**	**37,577,257**	**48,599,373**	**72,900,701**
Total OPEC[2] Countries	**47,458,069**	**27,226,010**	**45,387,718**	**90,276,191**	**189,234,920**	**98,391,598**	**130,063,372**	**165,109,188**
Kuwait	W	492,303	2,532,525	4,000,823	6,506,732	4,013,934	5,410,485	7,394,401
Nigeria	11,436,256	6,675,320	9,616,915	22,619,337	35,365,344	19,253,019	29,844,531	32,596,074
Saudi Arabia	13,638,596	9,517,731	14,820,184	26,527,809	52,138,651	22,238,290	31,301,135	47,083,876
Venezuela	1,476,144	4,933,502	11,663,523	21,680,993	34,526,828	20,066,127	24,113,830	31,728,257
Total Non-OPEC	**17,395,806**	**18,232,797**	**46,006,816**	**91,898,220**	**144,951,251**	**99,745,528**	**127,161,483**	**170,225,616**
Canada	2,198,090	4,802,888	13,165,003	26,667,266	64,438,380	40,844,506	52,355,940	72,524,117
Colombia	0	1,140,256	3,452,110	3,045,047	6,080,051	5,357,079	9,171,731	14,472,520
Mexico	5,894,638	4,936,416	12,506,608	24,689,004	37,340,210	22,855,351	30,642,512	40,642,259
Norway	1,941,408	736,275	3,333,975	2,443,418	1,134,913	1,275,295	756,322	2,299,212
United Kingdom	2,264,217	1,279,657	3,111,274	4,512,009	2,762,881	2,390,399	3,515,105	1,575,949
Total Crude Oil Imports	**64,853,875**	**45,458,807**	**91,394,534**	**182,174,411**	**334,186,171**	**198,137,125**	**257,224,855**	**335,334,804**

Notes: Crude oil import volumes used to calculate values in this table are for the 50 States and the District of Columbia. Totals may not equal sum of components due to independent rounding.

W = Data withheld to avoid disclosure of individual company data.

[1] Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates and the Neutral Zone (between Kuwait and Saudi Arabia).

[2] OPEC = Organization of Petroleum Exporting Countries. On this table, "Total OPEC" for all years includes Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela; for 1973-2008, also includes Indonesia; for 1973-1992 and beginning in 2008, also includes Ecuador; for 1974-1995, also includes Gabon; and beginning in 2007, also includes Angola. Data for all countries not included in "Total OPEC" are included in "Total Non-OPEC."

Source: U.S. Department of Energy, Energy Information Administration

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Petroleum Imports by Country of Origin, U.S.: Selected Years, 1960-2011

(In Thousands of Barrels; Latest Year Available)

	1960	1970	1980	1990	2000	2008	2009	2010	2011
Total Petroleum Imports	664,111	1,248,062	2,528,703	2,926,395	4,194,086	4,726,994	4,267,110	4,304,533	4,146,266
From Selected OPEC[1] Countries									
Total Persian Gulf Nations[2]	**NA**	**44,083**	**555,922**	**717,425**	**910,598**	**867,559**	**616,371**	**624,638**	**679,649**
Persian Gulf Nations as Share of Total Imports (%)	NA	3.5	22.0	24.5	21.7	18.4	14.4	14.5	16.4
Total OPEC[3]	**451,342**	**472,250**	**1,573,815**	**1,568,093**	**1,904,188**	**2,179,305**	**1,743,143**	**1,790,811**	**1,654,959**
OPEC as Share of Total Imports (%)	68.0	37.8	62.2	53.6	45.4	46.1	40.9	41.6	39.9
Iraq	7,927	0	10,328	189,105	226,804	229,300	164,357	151,619	167,905
Nigeria	NA	NA	313,816	291,959	328,079	361,659	295,310	373,297	298,153
Saudi Arabia	30,786	10,858	461,365	488,818	575,274	559,750	366,605	400,127	436,051
Venezuela	333,589	361,155	176,135	373,989	565,865	435,029	387,856	360,526	344,685
From Selected Non-OPEC Countries									
Total Non-OPEC Countries	**212,769**	**775,812**	**954,888**	**1,358,302**	**2,289,898**	**2,547,689**	**2,523,967**	**2,513,722**	**2,491,307**
Brazil	416	909	1,187	17,874	18,840	94,519	112,689	99,257	90,797
Canada	44,076	279,733	166,361	340,858	661,351	912,263	904,914	925,428	987,736
Mexico	5,808	15,439	195,103	275,594	502,509	476,366	441,648	468,830	439,753
Russia[5]	0	1,081	260	16,411	26,382	170,264	205,525	223,370	226,675
United Kingdom	6	3,951	64,271	69,021	133,799	86,512	89,332	93,413	57,640

Notes: The country of origin for refined petroleum products may not be the country of origin for the crude oil from which the refined products were produced. For example, refined products imported from refineries in the Caribbean may have been produced from Middle East crude oil. Data include any imports for the Strategic Petroleum Reserve, which began in 1977. Totals may not equal sum of components due to independent rounding.

[1] OPEC = Organization of Petroleum Exporting Countries.

[2] Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, the UAE, and the Neutral Zone (between Kuwait and Saudi Arabia).

[3] On this table, "Total OPEC" for all years includes Iran, Iraq, Kuwait, Saudi Arabia and Venezuela; beginning in 1961, also includes Qatar; beginning in 1962, also includes Libya; for 1962-2008, also includes Indonesia; beginning in 1967, also includes United Arab Emirates; beginning in 1969, also includes Algeria; beginning in 1971, also includes Nigeria; for 1973-1992 and beginning in 2008, also includes Ecuador; for 1975-1994, also includes Gabon; and beginning in 2007, also includes Angola. Data for all countries not included in "Total OPEC" are included in "Total Non-OPEC."

[4] Nigeria joined OPEC in 1971. Prior to that year, Nigeria is included in "Total Non-OPEC."

[5] Through 1992, may include imports from republics other than Russia in the former U.S.S.R.

Source: U.S. Department of Energy, Energy Information Administration

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Refinery Capacity & Utilization in the U.S.: Selected Years, 1960-2011

(Latest Year Available)

	1960	1970	1980	1990	2000	2006	2007	2008	2009	2010	2011
Number of Operable Refineries	309	276	319	205	158	149	149	150	150	148	148
Crude Oil Refining Capacity on Jan. 1st *(in thousands of barrels per day)*	9,843	12,021	17,988	15,572	16,512	17,339	17,443	17,594	17,672	17,584	17,736
Crude Oil Gross Input to Distillation Units *(in thousands of barrels per day)*	8,439	11,517	13,796	13,610	15,299	15,602	15,450	15,027	14,659	15,177	15,283
Operable Refineries Utilization Percent *(%)*[1]	85.1	92.6	75.4	87.1	92.6	89.7	88.5	85.3	82.9	86.4	86.2

[1]Through 1980, utilization is calculated by dividing gross input to distillation units by one-half of the current year January 1 capacity and the following year January 1 capacity. Beginning in 1981, utilization is calculated by dividing gross input to distillation units by the annual average capacity.

Source: U.S. Department of Energy, Energy Information Administration

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Refinery Sales Prices & Refinery Profit Margins for Selected Petroleum Products, U.S.: Selected Years, 1995-2011

(In Nominal US$ per Gallon, Excluding Taxes; Latest Year Available)

Product	1995	2000	2005	2006	2007	2008	2009	2010	2011
Sales Prices to Resellers[1]									
Aviation Gasoline	0.975	1.330	2.076	2.490	2.758	3.342	2.480	2.874	3.739
Motor Gasoline	0.626	0.963	1.670	1.969	2.182	2.586	1.767	2.165	2.867
Unleaded Regular	0.593	0.942	1.654	1.950	2.161	2.570	1.747	2.146	2.847
Unleaded Midgrade	0.670	1.013	1.708	2.016	2.245	2.610	1.784	2.185	2.893
Unleaded Premium	0.722	1.055	1.789	2.117	2.357	2.746	1.958	2.346	3.049
Kerosene	0.580	0.969	1.757	2.007	2.249	2.851	1.844	2.299	3.065
Jet Fuel, Kerosene-Type	0.539	0.880	1.723	1.961	2.171	3.020	1.719	2.185	3.014
No. 1 Distillate	0.625	1.019	1.801	2.044	2.430	2.712	2.050	2.573	3.223
No. 2 Distillate	0.530	0.896	1.720	1.991	2.190	2.970	1.707	2.208	3.025
No. 2 Fuel Oil	0.511	0.886	1.623	1.834	2.072	2.745	1.657	2.147	2.907
No. 2 Diesel Fuel	0.538	0.898	1.737	2.012	2.203	2.994	1.713	2.214	3.034
No. 4 Fuel [2]	0.463	0.778	1.377	1.395	1.551	2.157	1.561	W	2.801
Residual Fuel Oil	0.363	0.566	0.971	1.136	1.350	1.866	1.342	1.697	2.336
Sulfur ≤ 1%[3]	0.383	0.627	1.115	1.202	1.406	1.918	1.337	1.756	2.389
Sulfur > 1%	0.338	0.512	0.842	1.085	1.314	1.843	1.344	1.679	2.316
Propane (Consumer Grade)	0.344	0.595	0.933	1.031	1.194	1.437	0.921	1.212	1.467
Sales Prices to End Users[1]									
Aviation Gasoline	1.005	1.306	2.231	2.682	2.849	3.273	2.442	3.028	3.803
Motor Gasoline	0.765	1.106	1.829	2.128	2.345	2.775	1.888	2.301	3.050
Unleaded Regular	0.717	1.073	1.802	2.099	2.315	2.748	1.856	2.270	3.021
Unleaded Midgrade	0.808	1.168	1.893	2.213	2.438	2.879	1.997	2.416	3.165
Unleaded Premium	0.890	1.242	1.992	2.320	2.552	2.965	2.122	2.536	3.283
Kerosene	0.589	1.123	1.957	2.244	2.263	3.283	2.675	3.063	3.616
Jet Fuel, Kerosene-Type	0.540	0.899	1.735	1.998	2.165	3.052	1.704	2.201	3.054
No. 1 Distillate	0.620	0.988	1.832	2.137	2.286	2.983	2.141	2.705	3.467
No. 2 Distillate	0.560	0.934	1.777	2.091	2.266	3.143	1.840	2.318	3.119
No. 2 Fuel Oil	0.562	0.927	1.705	1.982	2.241	2.986	1.962	2.462	3.193
No. 2 Diesel Fuel	0.560	0.935	1.786	2.096	2.267	3.150	1.834	2.314	3.117
No. 4 Fuel[2]	0.505	0.769	W	W	W	W	W	W	W
Residual Fuel Oil	0.392	0.602	1.048	1.218	1.374	1.964	1.341	1.713	2.401
Sulfur ≤ 1%[3]	0.436	0.708	1.168	1.342	1.436	2.144	1.413	1.920	2.736
Sulfur > 1%	0.377	0.566	0.974	1.173	1.350	1.889	1.306	1.619	2.257
Propane (Consumer Grade)	0.492	0.603	1.089	1.358	1.489	1.892	1.220	1.481	1.709
Refiner Margins[4]									
Motor Gasoline	0.216	0.290	0.474	0.535	0.564	0.330	0.355	0.339	0.440
Jet Fuel, Kerosene-Type	0.129	0.207	0.527	0.527	0.553	0.764	0.307	0.359	0.587
No. 2 Distillate	0.120	0.223	0.524	0.557	0.572	0.714	0.295	0.382	0.598
Residual Fuel Oil	-0.048	-0.107	-0.225	-0.298	-0.268	-0.390	-0.070	-0.129	-0.091
Composite	0.181	0.261	0.484	0.530	0.553	0.453	0.328	0.344	0.481

W = Value withheld to avoid disclosure of individual company data.

[1] Sales for resale (wholesale sales) are those made to purchasers who are other than ultimate consumers. Sales to end users are those made directly to the ultimate consumer, including bulk customers, such as agriculture, industry, and utilities, as well as residential and commercial customers.

[2] Includes No. 4 fuel oil and No. 4 diesel fuel.

[3] Sulfur content by weight.

[4] In this table, refiner margin is the difference between the composite refiner acquisition price of crude oil and the price to resellers.

Source: U.S. Department of Energy, Energy Information Administration
Plunkett Research, Ltd.
www.plunkettresearch.com

Petroleum Consumption by the Transportation Sector, U.S.: Selected Years, 1950-2011

(In Thousands of Barrels per Day; Latest Year Available)

Year	Aviation Gasoline	Distillate Fuel Oil	Jet Fuel[1]		Liquefied Petroleum Gases	Lubricants	Motor Gasoline[2]	Residual Fuel Oil	Total
			KT	Total					
1950	108	226	0	[1]	2	64	2,433	524	3,356
1955	192	372	0	154	9	70	3,221	440	4,458
1960	161	418	91	371	13	68	3,736	367	5,135
1965	120	514	334	602	23	67	4,374	336	6,036
1970	55	738	718	967	32	66	5,589	332	7,778
1975	39	998	782	992	31	70	6,512	310	8,951
1980	35	1,311	845	1,062	13	77	6,441	608	9,546
1985	27	1,491	1,005	1,218	21	71	6,667	342	9,838
1990	24	1,722	1,340	1,522	16	80	7,080	443	10,888
1991	23	1,694	1,296	1,471	15	71	7,042	447	10,763
1992	22	1,728	1,310	1,454	14	72	7,125	465	10,881
1993	21	1,785	1,357	1,469	14	74	7,367	393	11,124
1994	21	1,896	1,480	1,527	24	77	7,487	385	11,417
1995	21	1,973	1,497	1,514	13	76	7,674	397	11,668
1996	20	2,096	1,575	1,578	11	73	7,772	370	11,921
1997	22	2,198	1,598	1,599	10	78	7,883	310	12,099
1998	19	2,263	1,623	1,622	13	81	8,128	294	12,420
1999	21	2,352	1,675	1,673	10	82	8,336	290	12,765
2000	20	2,422	1,725	1,725	8	81	8,370	386	13,012
2001	19	2,489	1,656	1,655	10	74	8,435	255	12,938
2002	18	2,536	1,621	1,614	10	73	8,662	295	13,208
2003	16	2,665	1,578	1,578	12	68	8,733	249	13,321
2004	17	2,783	1,630	1,630	14	69	8,887	321	13,720
2005	19	2,858	1,679	1,679	20	68	8,948	365	13,957
2006	18	3,017	1,633	1,633	20	67	9,029	395	14,178
2007	17	3,037	1,622	1,622	16	69	9,093	433	14,287
2008	15	2,824	1,539	1,539	29	64	8,834	400	13,704
2009	14	2,600	1,393	1,393	20	57	8,840	353	13,279
2010	15	2,737	1,432	1,432	21	64	8,816	382	13,466
2011[P]	15	2,779	1,425	1,425	21	60	8,585	359	13,223

[1] Through 1951, naphtha-type jet fuel is included in the products from which jet fuel was blended: in 1952, 71 percent gasoline, 17 percent kerosene, and 12 percent distillate fuel oil. Beginning in 1952, includes naphtha-type jet fuel. Beginning in 1957, also includes kerosene-type jet fuel. Beginning in 2005, includes kerosene-type jet fuel only. KT = Kerosene Type.

[2] Finished motor gasoline. Through 1963, also includes special naphthas. Beginning in 1993, also includes ethanol blended into motor gasoline.

[P] Preliminary Data

Source: U.S. Department of Energy, Energy Information Administration

Plunkett Research, Ltd.

www.plunkettresearch.com

Retail Motor Gasoline & On-Highway Diesel Fuel Prices, U.S.: Selected Years, 1950-2011

(In Dollars per Gallon; Latest Year Available)

Year	Motor Gasoline by Grade								Regular Motor Gasoline by Area Type (Nominal)			On-Highway Diesel Fuel (Nominal)
	Leaded Regular		Unleaded Regular		Unleaded Premium		All Grades		Conventional Gasoline Areas[1]	Reformulated Gasoline Areas[2]	All Areas	
	Nominal	Real[3]	Nominal	Real[3]	Nominal	Real[3]	Nominal	Real[3]				
1950	0.27	1.83	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1955	0.29	1.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1960	0.31	1.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1965	0.31	1.57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1970	0.36	1.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1975	0.57	1.69	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1980	1.19	2.49	1.25	2.61	NA	NA	1.22	2.56	NA	NA	NA	NA
1985	1.12	1.81	1.20	1.95	1.34	2.17	1.20	1.94	NA	NA	NA	NA
1990	1.15	1.59	1.16	1.61	1.35	1.87	1.22	1.68	NA	NA	NA	NA
1995	NA	NA	1.15	1.41	1.34	1.64	1.21	1.48	1.10	1.16	1.11	1.11
1996	NA	NA	1.23	1.48	1.41	1.70	1.29	1.55	1.19	1.24	1.19	1.24
1997	NA	NA	1.23	1.46	1.42	1.67	1.29	1.53	1.19	1.25	1.20	1.20
1998	NA	NA	1.06	1.24	1.25	1.46	1.12	1.30	1.02	1.08	1.03	1.04
1999	NA	NA	1.17	1.34	1.36	1.56	1.22	1.41	1.12	1.20	1.14	1.12
2000	NA	NA	1.51	1.70	1.69	1.91	1.56	1.76	1.46	1.54	1.48	1.49
2001	NA	NA	1.46	1.61	1.68	1.83	1.53	1.69	1.38	1.50	1.42	1.40
2002	NA	NA	1.36	1.47	1.56	1.69	1.44	1.56	1.31	1.41	1.35	1.32
2003	NA	NA	1.59	1.69	1.78	1.89	1.64	1.74	1.52	1.66	1.56	1.51
2004	NA	NA	1.88	1.94	2.07	2.14	1.92	1.99	1.81	1.94	1.85	1.81
2005	NA	NA	2.30	2.30	2.49	2.49	2.34	2.34	2.24	2.34	2.27	2.40
2006	NA	NA	2.59	2.51	2.81	2.72	2.64	2.55	2.53	2.65	2.57	2.71
2007	NA	NA	2.80	2.64	3.03	2.86	2.85	2.68	2.77	2.86	2.80	2.89
2008	NA	NA	3.27	3.01	3.52	3.24	3.32	3.06	3.21	3.31	3.25	3.80
2009	NA	NA	2.35	2.14	2.61	2.38	2.40	2.19	2.32	2.43	2.35	2.47
2010	NA	NA	2.78	2.51	3.05	2.75	2.84	2.56	2.74	2.86	2.78	2.99
2011	NA	NA	3.53	3.11	3.79	3.35	3.58	3.16	3.48	3.62	3.52	3.84

NA = Not Available. Nominal = Not adjusted for inflation.

[1] Any area that does not require the sale of reformulated gasoline. For 1993-2000, includes data collected for oxygenated areas.

[2] "Reformulated Gasoline Areas" are ozone nonattainment areas designated by the Environmental Protection Agency that require the use of reformulated gasoline. For 1995-2000, includes data collected for combined oxygenated and reformulated areas.

[3] In chained (2005) dollars, calculated by using gross domestic product implicit price deflators.

Source: U.S. Department of Energy, Energy Information Administration

Plunkett Research, Ltd.

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Top World Oil Reserves by Country: 2011

(End of Period; Latest Year Available)

Rank	Country	Proven Reserves (in Billions of Barrels)	Share of Total
1	Venezuela	296.5	17.9%
2	Saudi Arabia	265.4	16.1%
3	Canada	175.2	10.6%
4	Iran	151.2	9.1%
5	Iraq	143.1	8.7%
6	Kuwait	101.5	6.1%
7	United Arab Emirates	97.8	5.9%
8	Russian Federation	88.2	5.3%
9	Libya	47.1	2.9%
10	Nigeria	37.2	2.3%
11	US	30.9	1.9%
12	Kazakhstan	30.0	1.8%
13	Qatar	24.7	1.5%
14	Brazil	15.1	0.9%
15	China	14.7	0.9%
16	Angola	13.5	0.8%
17	Algeria	12.2	0.7%
18	Mexico	11.4	0.7%
19	Azerbaijan	7.0	0.4%
20	Norway	6.9	0.4%
World Total		**1,652.6**	**100.0%**

Note: Proved reserves of oil are generally taken to be those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reservoirs under existing economic and operating conditions.

Source: BP, *Statistical Review of World Energy*, June 2012

Plunkett Research, Ltd.

www.plunkettresearch.com

Top World Oil Producers: 2011

(In Thousands of Barrels per Day; Latest Year Available)

Rank	Country	Production
1	Saudi Arabia	11,161
2	Russian Federation	10,280
3	United States	7,841
4	Iran	4,321
5	China	4,090
6	Canada	3,522
7	United Arab Emirates	3,322
8	Mexico	2,938
9	Kuwait	2,865
10	Iraq	2,798
11	Venezuela	2,720
12	Nigeria	2,457
13	Brazil	2,193
14	Norway	2,039
15	Kazakhstan	1,841
World Total		**83,576**

Note: Includes crude oil, shale oil, oil sands and NGLs (the liquid content of natural gas where this is recovered separately). Excludes liquid fuels from other sources such as biomass and coal derivatives.

Source: BP, *Statistical Review of Energy*, June 2012

Plunkett Research, Ltd.

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Top World Oil Net Importers: 2011

(In Thousands of Barrels per Day; Latest Year Available)

Rank	Country	Net Imports
1	US	8,694
2	China	5,551
3	Japan	4,329
4	India	2,483
5	Germany	2,235
6	South Korea	2,170
7	France	1,697
8	Spain	1,346
9	Italy	1,292
10	Netherlands	948
11	Taiwan	902
12	Singapore	885
13	Turkey	650
14	Belgium	634
15	Thailand	549

Source: U.S. Department of Energy, U.S. Energy Information Administration
Plunkett Research, Ltd.
www.plunkettresearch.com

Top World Oil Net Exporters: 2011

(In Thousands of Barrels per Day; Latest Year Available)

Rank	Country	Net Exports
1	Saudi Arabia	8,167
2	Russian Federation	7,504
3	United Arab Emirates	2,609
4	Kuwait	2,343
5	Nigeria	2,242
6	Iran	2,206
7	Iraq	1,817
8	Norway	1,752
9	Angola	1,752
10	Venezuela	1,490
11	Algeria	1,482
12	Qatar	1,455
13	Kazakhstan	1,377
14	Canada	1,341
15	Mexico	827

Source: U.S. Department of Energy, U.S. Energy Information Administration
Plunkett Research, Ltd.
www.plunkettresearch.com

Top World Oil Consumers: 2011

(In Thousands of Barrels per Day; Latest Year Available)

Rank	Country	Consumption
1	United States	18,835
2	China	9,758
3	Japan	4,418
4	India	3,473
5	Russian Federation	2,961
6	Saudi Arabia	2,856
7	Brazil	2,653
8	South Korea	2,397
9	Germany	2,362
10	Canada	2,293
11	Mexico	2,027
12	Iran	1,824
13	France	1,724
14	United Kingdom	1,542
15	Italy	1,486
World Total		**88,034**

Note: Includes inland demand plus international aviation and marine bunkers and refinery fuel and loss. Consumption of fuel ethanol and biodiesel is also included.

Source: BP, *Statistical Review of Energy*, June 2012

Plunkett Research, Ltd.

www.plunkettresearch.com

Coal Overview, U.S.: Selected Years, 1950-2011

(In Millions of Short Tons; Latest Year Available)

Year	Production[1]	Waste Coal[2]	Imports	Exports	Stock Change[3]	Losses and Unaccounted For[4]	Consumption
1950	560.4	NA	0.4	29.4	(5)	37.3	494.1
1955	490.8	NA	0.3	54.4	(5)	-10.3	447.0
1960	434.3	NA	0.3	38.0	(5)	-1.5	398.1
1965	527.0	NA	0.2	51.0	(5)	4.1	472.0
1970	612.7	NA	0.03	71.7	(5)	17.7	523.2
1975	654.6	NA	0.9	66.3	32.2	-5.5	562.6
1980	829.7	NA	1.2	91.7	25.6	10.8	702.7
1985	883.6	NA	2.0	92.7	-27.9	2.8	818.0
1990	1,029.1	3.3	2.7	105.8	26.5	-1.7	904.5
1991	996.0	4.0	3.4	109.0	-0.9	-3.9	899.2
1992	997.5	6.3	3.8	102.5	-3.0	0.5	907.7
1993	945.4	8.1	8.2	74.5	-51.9	-4.9	944.1
1994	1,033.5	8.2	8.9	71.4	23.6	4.3	951.3
1995	1,033.0	8.6	9.5	88.5	-0.3	0.6	962.1
1996	1,063.9	8.8	8.1	90.5	-17.5	1.4	1,006.3
1997	1,089.9	8.1	7.5	83.5	-11.3	3.7	1,029.5
1998	1,117.5	8.7	8.7	78.0	24.2	-4.4	1,037.1
1999	1,100.4	8.7	9.1	58.5	24.0	-2.9	1,038.6
2000	1,073.6	9.1	12.5	58.5	-48.3	0.9	1,084.1
2001	1,127.7	10.1	19.8	48.7	41.6	7.1	1,060.1
2002	1,094.3	9.1	16.9	39.6	10.2	4.0	1,066.4
2003	1,071.8	10.0	25.0	43.0	-26.7	-4.4	1,094.9
2004	1,112.1	11.3	27.3	48.0	-11.5	6.9	1,107.3
2005	1,131.5	13.4	30.5	49.9	-9.7	9.1	1,126.0
2006	1,162.7	14.4	36.2	49.6	42.6	8.8	1,112.3
2007	1,146.6	14.1	36.3	59.2	5.8	4.1	1,128.0
2008	1,171.8	14.1	34.2	81.5	12.4	5.7	1,120.5
2009	1,074.9	13.7	22.6	59.1	39.7	15.0	997.5
2010	1,084.4	13.7	19.4	81.7	-11.2	-4.4	1,051.3
2011[P]	1,094.3	12.5	13.1	107.3	-7.3	17.0	1,003.1

NA = Not available. [P] Preliminary data.

[1] Beginning in 2001 includes a small amount of refuse recovery (coal recaptured from a refuse mine and cleaned to reduce the concentration of noncombustible materials).

[2] Waste coal (including fine coal, coal obtained from a refuse bank or slurry dam, anthracite culm, bituminous gob, and lignite waste) consumed by the electric power and industrial sectors. Beginning in 1989, waste coal supplied is counted as a supply-side item to balance the same amount of waste coal included in "Consumption."

[3] A negative value indicates a decrease in stocks; a positive value indicates an increase.

[4] "Losses and Unaccounted For" is calculated as the sum of production, imports, and waste coal supplied, minus exports, stock change and consumption.

[5] Through 1973, stock change is included in "Losses and Unaccounted For."

Source: U.S. Department of Energy, Energy Information Administration
Plunkett Research, Ltd.
www.plunkettresearch.com

Natural Gas Production, U.S.: Selected Years, 1950-2011

(In Billions of Cubic Feet; Latest Year Available)

Year	Gross Withdrawals					Re-pressuring	NH[1] Gases Removed	Vented & Flared	Marketed Production	Extraction Loss[2]	Dry Gas Production
	From Gas Wells	From Oil Wells	Coal-bed Wells	Shale Gas Wells	Total						
1950	5,603	2,876	NA	NA	8,480	1,397	NA	801	6,282	260	6,022
1955	7,842	3,878	NA	NA	11,720	1,541	NA	774	9,405	377	9,029
1960	10,853	4,234	NA	NA	15,088	1,754	NA	563	12,771	543	12,228
1965	13,524	4,440	NA	NA	17,963	1,604	NA	319	16,040	753	15,286
1970	18,595	5,192	NA	NA	23,786	1,376	NA	489	21,921	906	21,014
1975	17,380	3,723	NA	NA	21,104	861	NA	134	20,109	872	19,236
1980	17,573	4,297	NA	NA	21,870	1,365	199	125	20,180	777	19,403
1985	14,535	5,071	NA	NA	19,607	1,915	326	95	17,270	816	16,454
1990	16,054	5,469	NA	NA	21,523	2,489	289	150	18,594	784	17,810
1991	16,018	5,732	NA	NA	21,750	2,772	276	170	18,532	835	17,698
1992	16,165	5,967	NA	NA	22,132	2,973	280	168	18,712	872	17,840
1993	16,691	6,035	NA	NA	22,726	3,103	414	227	18,982	886	18,095
1994	17,351	6,230	NA	NA	23,581	3,231	412	228	19,710	889	18,821
1995	17,282	6,462	NA	NA	23,744	3,565	388	284	19,506	908	18,599
1996	17,737	6,376	NA	NA	24,114	3,511	518	272	19,812	958	18,854
1997	17,844	6,369	NA	NA	24,213	3,492	599	256	19,866	964	18,902
1998	17,729	6,380	NA	NA	24,108	3,427	617	103	19,961	938	19,024
1999	17,590	6,233	NA	NA	23,823	3,293	615	110	19,805	973	18,832
2000	17,726	6,448	NA	NA	24,174	3,380	505	91	20,198	1,016	19,182
2001	18,129	6,371	NA	NA	24,501	3,371	463	97	20,570	954	19,616
2002	17,795	6,146	NA	NA	23,941	3,455	502	99	19,885	957	18,928
2003	17,882	6,237	NA	NA	24,119	3,548	499	98	19,974	876	19,099
2004	17,885	6,084	NA	NA	23,970	3,702	654	96	19,517	927	18,591
2005	17,472	5,985	NA	NA	23,457	3,700	711	119	18,927	876	18,051
2006	17,996	5,539	NA	NA	23,535	3,265	731	129	19,410	906	18,504
2007	17,065	5,818	1,780	NA	24,664	3,663	661	143	20,196	930	19,266
2008	15,618	5,747	1,986	2,284	25,636	3,639	719	167	21,112	953	20,159
2009	14,885	5,812	1,977	3,384	26,057	3,522	722	165	21,648	1,024	20,624
2010	20,841	5,995	(3)	(3)	26,836	3,432	837	166	22,402	1,070	21,332
2011	22,378	6,199	(3)	(3)	28,576	3,410	831	165	24,170	1,169	23,000

NA = Not available

Notes: Beginning with 1965 data, all volumes are shown on a pressure base of 14.73 p.s.i.a. at 60° F. For prior years, the pressure base was 14.65 p.s.i.a. at 60° F. Totals may not equal sum of components due to independent rounding.

[1] NH Gases = Non-hydrocarbon Gases.

[2] Volume reduction resulting from the removal of natural gas plant liquids, which are transferred to petroleum supply.

[3] Beginning in 2010, natural gas gross withdrawals from coalbed wells and shale gas wells are included in "Gas Wells."

Source: U.S. Department of Energy, Energy Information Administration

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Natural Gas Prices Paid, by Sector, U.S.: Selected Years, 1970-2011

(In US$ per Thousand Cubic Feet; Latest Year Available)

Year	Residential			Commercial[1]			Industrial[2]			Vehicle Fuel[3]		Electric Power[4]		
	Prices		% of Sector[7]	Prices		% of Sector[7]	Prices		% of Sector[7]	Prices		Prices		% of Sector[7]
	Nominal[5]	Real[6]		Nominal[5]	Real[6]		Nominal[5]	Real[6]		Nominal[5]	Real[6]	Nominal[5]	Real[6]	
1970	1.09	4.48	NA	0.77	3.16	NA	0.37	1.52	NA	NA	NA	0.29	1.19	NA
1975	1.71	5.09	NA	1.35	4.02	NA	0.96	2.86	NA	NA	NA	0.77	2.29	96.1
1980	3.68	7.70	NA	3.39	7.09	NA	2.56	5.36	NA	NA	NA	2.27	4.75	96.9
1985	6.12	9.93	NA	5.50	8.92	NA	3.95	6.41	68.8	NA	NA	3.55	5.76	94.0
1990	5.80	8.03	99.2	4.83	6.68	86.6	2.93	4.05	35.2	3.39	4.69	2.38	3.29	76.8
1991	5.82	7.78	99.2	4.81	6.43	85.1	2.69	3.60	32.7	3.96	5.29	2.18	2.91	79.3
1992	5.89	7.69	99.1	4.88	6.37	83.2	2.84	3.71	30.3	4.05	5.29	2.36	3.08	76.5
1993	6.16	7.87	99.1	5.22	6.67	83.9	3.07	3.92	29.7	4.27	5.45	2.61	3.33	74.1
1994	6.41	8.02	99.1	5.44	6.81	79.3	3.05	3.82	25.5	4.11	5.14	2.28	2.85	73.4
1995	6.06	7.43	99.0	5.05	6.19	76.7	2.71	3.32	24.5	3.98	4.88	2.02	2.48	71.4
1996	6.34	7.62	99.0	5.40	6.49	77.6	3.42	4.11	19.4	4.34	5.22	2.69	3.23	68.4
1997	6.94	8.20	98.8	5.80	6.85	70.8	3.59	4.24	18.1	4.44	5.25	2.78	3.28	68.0
1998	6.82	7.97	97.7	5.48	6.40	67.0	3.14	3.67	16.1	4.59	5.36	2.40	2.80	63.7
1999	6.69	7.70	95.2	5.33	6.14	66.1	3.12	3.59	18.8	4.34	5.00	2.62	3.02	58.3
2000	7.76	8.75	92.6	6.59	7.43	63.9	4.45	5.02	19.8	5.54	6.24	4.38	4.94	50.5
2001	9.63	10.61	92.4	8.43	9.29	66.0	5.24	5.78	20.8	6.60	7.27	4.61	5.08	40.2
2002	7.89	8.56	97.9	6.63	7.19	77.4	4.02	4.36	22.7	5.10	5.53	3.68	3.99	83.9
2003	9.63	10.23	97.5	8.40	8.92	78.2	5.89	6.26	22.1	6.19	6.57	5.57	5.92	91.2
2004	10.75	11.11	97.7	9.43	9.74	78.0	6.53	6.75	23.6	7.16	7.40	6.11	6.31	89.8
2005	12.70	12.70	98.1	11.34	11.34	82.1	8.56	8.56	24.0	9.14	9.14	8.47	8.47	91.3
2006	13.73	13.30	98.1	12.00	11.62	80.8	7.87	7.62	23.4	8.72	8.45	7.11	6.89	93.4
2007	13.08	12.31	98.0	11.34	10.68	80.4	7.68	7.23	22.2	8.50	8.01	7.31	6.88	92.2
2008	13.89	12.79	97.5	12.23	11.26	79.9	9.65	8.89	20.5	11.75	10.82	9.26	8.53	101.1
2009	12.14	11.06	97.4	10.06	9.17	77.8	5.33	4.86	18.8	8.13	7.41	4.93	4.49	101.1
2010	11.39	10.26	97.4	9.47	8.53	77.5	5.49	4.95	18.0	6.25	5.63	5.27	4.75	100.8
2011	10.80	9.53	95.7	8.86	7.82	62.3	5.02	4.43	16.0	NA	NA	4.87	4.30	101.2

Note: 2011 data are preliminary.

[1] Commercial sector, including commercial combined-heat-and-power (CHP) and commercial electricity-only plants.
[2] Industrial sector, including industrial combined-heat-and-power (CHP) and industrial electricity-only plants.
[3] Much of the natural gas delivered for vehicle fuel represents deliveries to fueling stations that are used primarily or exclusively by fleet vehicles. Thus, the prices are often those associated with the operation of fleet vehicles.
[4] Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 2001, data are for electric utilities only; beginning in 2002, data are for electric utilities and independent power producers.
[5] In dollars not adjusted for inflation.
[6] In chained (2005) dollars, calculated by using gross domestic product implicit price deflators.
[7] The percentage of the sector's consumption for which price data are available.

Source: U.S. Department of Energy, Energy Information Administration

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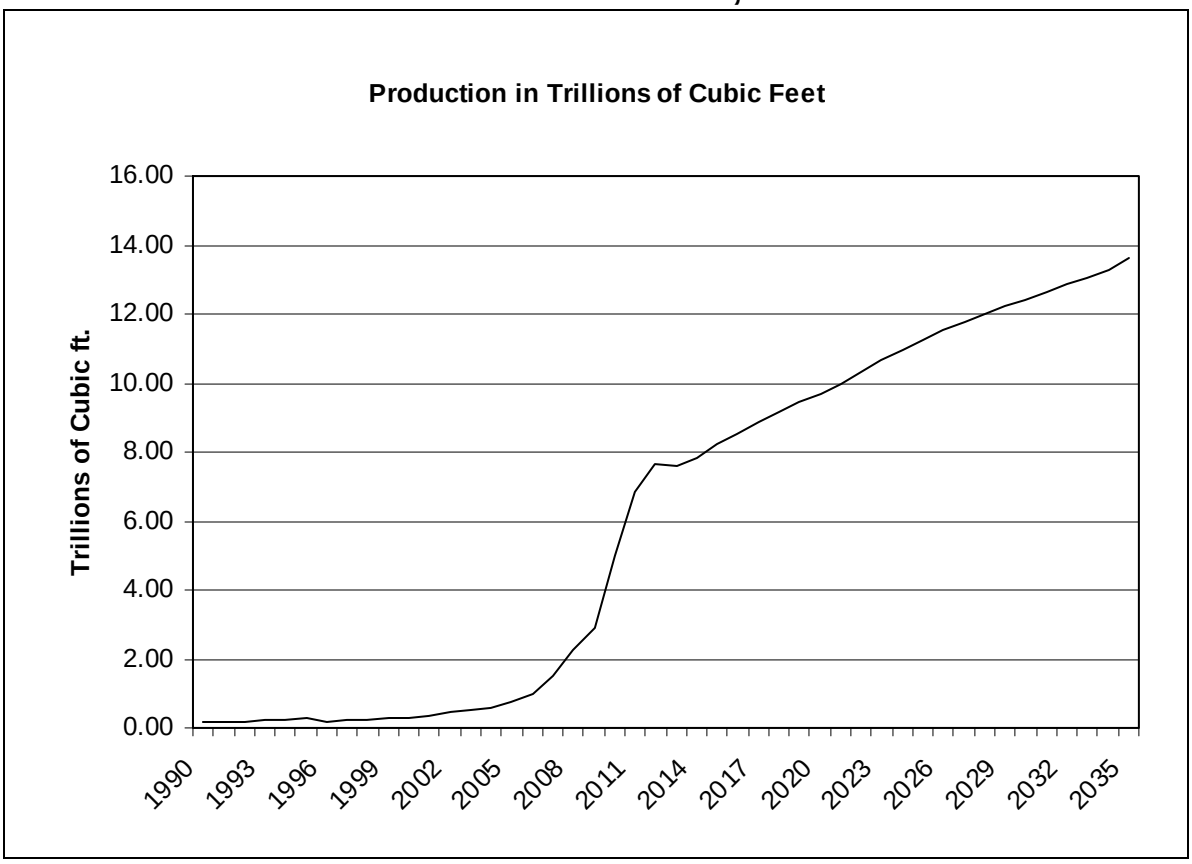
U.S. Shale Gas Production, 1990-2035



Source: U.S. Department of Energy, U.S. Energy Information Administration

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The 15 Largest Nuclear Reactors in the U.S.

	Name of Reactor	State	Operating Utility	Capacity[1] (Net MW)	Capacity Factor[2]	1st Year Operative
1	Palo Verde-3	AZ	Arizona Public Service Co.	1,317	89%	1987
2	Palo Verde-2	AZ	Arizona Public Service Co.	1,314	101%	1986
3	Palo Verde-1	AZ	Arizona Public Service Co.	1,311	81%	1985
4	South Texas Project-1	TX	STP Nuclear Operating Co.	1,280	101%	1988
5	South Texas Project-2	TX	STP Nuclear Operating Co.	1,280	88%	1989
6	Grand Gulf-1	MS	Entergy Nuclear Operations, Inc.	1,251	88%	1984
7	Seabrook-1	NH	NextEra Energy Seabrook, LLC	1,247	100%	1990
8	Perry-1	OH	FirstEnergy Nuclear Operating Co.	1,240	98%	1986
9	Millstone-3	CT	Dominion Nuclear Connecticut	1,233	86%	1986
10	Comanche Peak-1	TX	Luminant Generation Co.	1,209	91%	1990
11	Callaway-1	MO	Union Electric Co.	1,190	86%	1984
12	Susquehanna-2	PA	PPL Susquehanna, LLC	1,190	98%	1984
13	Susquehanna-1	PA	PPL Susquehanna, LLC	1,185	80%	1982
14	Braidwood-1	IL	Exelon Generation Co., LLC	1,178	89%	1987
15	Salem-1	NJ	PSEG Nuclear, LLC	1,174	85%	1976

MW = Megawatts.

[1] Summer Capacity (Net): The maximum output, excluding electricity used for station's internal operations, expressed in Megawatts (electricity). Note that nuclear power can also be expressed in Megawatts (thermal).

[2] Capacity Factor: The ratio of power actually generated to the maximum potential generation, expressed as a percent. The factor is calculated by multiplying the summer capacity by the number of hours in a day (24) by the number of days in a year (365 or 366). That total is then divided into the amount of actual generation and multiplied by 100 to get a percent.

Source: U.S. Department of Energy, Energy Information Administration & U.S. Nuclear Regulatory Commission

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IV. Renewable Energy

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Energy Production by Renewable Energy, U.S.: Selected Years, 1950-2011

(In Billions of Btus; Latest Year Available)

Year	Renewable Energy						Total, Renewable & Non-Renewable
	Conventional Hydroelectric Power	Geothermal	Solar/PV	Wind	Biomass	Total Renewable	
1950	1,415,411	NA	NA	NA	1,562,307	2,977,718	35,540,384
1955	1,359,844	NA	NA	NA	1,424,143	2,783,987	40,147,667
1960	1,607,975	359	NA	NA	1,319,870	2,928,204	42,803,347
1965	2,059,077	1,978	NA	NA	1,334,761	3,395,816	50,673,882
1970	2,633,547	5,511	NA	NA	1,430,962	4,070,021	63,495,439
1975	3,154,607	33,780	NA	NA	1,498,734	4,687,120	61,320,192
1980	2,900,144	52,699	NA	NA	2,475,500	5,428,343	67,175,384
1985	2,970,192	97,421	111	60	3,016,233	6,084,017	67,698,304
1990	3,046,391	170,747	59,420	29,007	2,735,110	6,040,675	70,704,627
1991	3,015,943	177,626	62,354	30,796	2,781,798	6,068,516	70,362,376
1992	2,617,436	178,699	63,676	29,863	2,931,678	5,821,352	69,955,615
1993	2,891,613	185,673	66,060	30,987	2,908,446	6,082,779	68,315,361
1994	2,683,457	173,464	68,102	35,560	3,027,535	5,988,118	70,725,634
1995	3,205,307	152,057	69,347	32,630	3,099,082	6,558,423	71,173,994
1996	3,589,656	163,359	70,418	33,440	3,155,301	7,012,173	72,486,072
1997	3,640,458	166,698	69,586	33,581	3,107,908	7,018,230	72,471,914
1998	3,297,054	168,450	69,053	30,853	2,928,929	6,494,338	72,876,229
1999	3,267,575	170,921	67,937	45,894	2,965,132	6,517,460	71,742,196
2000	2,811,116	164,364	65,587	57,057	3,005,661	6,103,785	71,332,159
2001	2,241,858	164,461	64,267	69,617	2,624,160	5,164,363	71,734,563
2002	2,689,017	171,164	63,006	105,334	2,705,408	5,733,929	70,716,137
2003	2,824,533	175,119	62,010	114,571	2,805,435	5,981,667	70,039,770
2004	2,690,078	178,236	62,688	141,749	2,997,605	6,070,356	70,187,684
2005	2,702,942	180,703	63,446	178,088	3,104,021	6,229,199	69,427,669
2006	2,869,035	181,200	68,441	263,738	3,216,176	6,598,590	70,782,157
2007	2,446,389	185,774	75,657	340,503	3,460,951	6,509,274	71,373,190
2008	2,511,108	192,433	88,767	545,548	3,863,844	7,201,700	73,111,145
2009	2,668,824	200,185	97,766	721,129	3,927,839	7,615,742	72,656,971
2010	2,538,541	207,979	125,901	923,427	4,340,615	8,136,463	74,806,092
2011	3,171,422	226,421	158,145	1,168,247	4,511,456	9,235,692	78,095,827

NA = Not available

Note: Most data are estimates. Totals may not equal sum of components due to independent rounding.

Source: U.S. Department of Energy, Energy Information Administration

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Renewable Energy Consumption by Source, U.S.: Selected Years, 1950-2011

(In Billions of Btus; Latest Year Available)

Year	Hydroelectric Power[1]	Biomass[2]	Geothermal[3]	Solar[4]	Wind[5]	Total
1950	1,415,411	1,562,307	NA	NA	NA	2,977,718
1960	1,607,975	1,319,870	359	NA	NA	2,928,204
1970	2,633,547	1,430,962	5,511	NA	NA	4,070,021
1980	2,900,144	2,475,500	52,699	NA	NA	5,428,343
1990	3,046,391	2,735,110	170,747	59,420	29,007	6,040,675
1995	3,205,307	3,101,142	152,057	69,347	32,630	6,560,483
1996	3,589,656	3,156,806	163,359	70,418	33,440	7,013,678
1997	3,640,458	3,105,220	166,698	69,586	33,581	7,015,542
1998	3,297,054	2,927,489	168,450	69,053	30,853	6,492,898
1999	3,267,575	2,963,291	170,921	67,937	45,894	6,515,618
2000	2,811,116	3,008,228	164,364	65,587	57,057	6,106,352
2001	2,241,858	2,622,347	164,461	64,267	69,617	5,162,550
2002	2,689,017	2,700,598	171,164	63,006	105,334	5,729,119
2003	2,824,533	2,807,132	175,119	62,010	114,571	5,983,364
2004	2,690,078	3,009,666	178,236	62,688	141,749	6,082,416
2005	2,702,942	3,116,765	180,703	63,446	178,088	6,241,943
2006	2,869,035	3,266,757	181,200	68,441	263,738	6,649,171
2007	2,446,389	3,474,262	185,774	75,657	340,503	6,522,585
2008	2,511,108	3,848,548	192,433	88,767	545,548	7,186,404
2009	2,668,824	3,911,700	200,185	97,766	721,129	7,599,603
2010	2,538,541	4,294,066	207,979	125,901	923,427	8,089,914
2011	3,171,422	4,411,164	226,421	158,145	1,168,247	9,135,400

[1] Conventional hydroelectric net generation (converted to Btu using the fossil-fueled plants heat rate).

[2] Includes energy from wood and wood-derived fuels; municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts and other biomass (through 2000, also includes non-renewable waste such as municipal solid waste from non-

[3] Geothermal electricity net generation (converted to Btu using the geothermal energy plants heat rate), and geothermal heat pump and direct use energy.

[4] Solar thermal and photovoltaic electricity net generation (converted to Btu using the fossil-fueled plants heat-rate), and solar thermal direct use energy.

[5] Wind electricity net generation (converted to Btu using the fossil-fueled plants heat rate).

Source: U.S. Department of Energy, Energy Information Administration

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Renewable Energy Consumption in the Residential, Commercial & Industrial Sectors, U.S.: 2005-2011

(In Billions of Btus; Latest Year Available)

	2005	2006	2007	2008	2009	2010	2011
Residential Sector							
Biomass (Wood[1])	430,000	380,000	410,000	450,000	430,000	420,000	430,000
Geothermal[2]	15,900	18,300	22,000	26,400	32,800	36,800	39,600
Solar[3]	57,943	63,405	69,610	80,250	89,068	114,075	140,448
Total	503,843	461,705	501,610	556,650	551,868	570,875	610,048
Commercial Sector[4]							
Hydroelectric[5]	860	927	764	591	692	785	928
Biomass	105,134	102,675	102,712	109,253	111,666	110,919	109,838
Wood[1]	70,006	65,114	69,785	72,909	72,481	71,526	70,520
Waste[6]	34,249	36,309	30,960	34,214	36,355	35,959	35,877
Fuel Ethanol[7]	879	1,251	1,966	2,130	2,829	3,435	3,440
Geothermal[2]	13,600	14,000	14,400	14,800	16,700	18,500	19,700
Total	119,594	117,601	117,876	124,644	129,060	130,407	130,874
Industrial Sector							
Hydroelectric[5]	31,951	28,756	15,715	16,514	18,235	16,270	17,933
Biomass	1,836,920	1,896,649	1,935,613	2,027,883	1,993,634	2,229,866	2,272,984
Wood[1]	1,451,729	1,472,389	1,404,720	1,340,084	1,208,437	1,300,823	1,311,393
Waste[6]	148,248	129,573	144,360	144,112	155,369	169,240	172,382
Fuel Ethanol[7]	6,843	9,668	9,840	11,645	12,968	17,412	17,440
Geothermal[2]	4,300	4,400	4,700	5,000	4,200	4,200	4,200
Total	1,873,172	1,929,805	1,956,029	2,049,398	2,016,069	2,250,353	2,295,306

Notes: All values are estimated, except for commercial sector hydroelectric power and waste. Totals may not equal sum of components due to independent rounding.

[1] Wood and wood-derived fuels.

[2] Geothermal heat pump and direct use energy.

[3] Solar thermal direct use energy and photovoltaic electricity net generation (converted to Btu using the fossil-fueled plants heat rate). Includes a small amount of commercial sector use.

[4] Including commercial/industrial combined-heat-and-power (CHP) and commercial/industrial electricity-only plants.

[5] Conventional hydroelectricity net generation (converted to BTU using the fossil-fueled plants heat rate).

[6] Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

[7] The fuel ethanol (minus denaturant) portion of motor fuels, such as E10, consumer by these sectors.

Source: U.S. Department of Energy, Energy Information Administration

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Renewable Energy Consumption in the Transportation & Electric Power Sectors, U.S.: 2005-2011

(In Billions of Btus; Latest Year Available)

	2005	2006	2007	2008	2009	2010	2011
Transportation Sector							
Fuel Ethanol[1]	327,426	441,702	556,791	785,844	893,863	1,040,378	1,042,024
Biodiesel[2]	11,589	33,249	45,699	40,294	41,533	33,539	112,085
Total	339,015	474,951	602,490	826,138	935,396	1,073,917	1,154,109
Electric Power Sector[3]							
Hydroelectric[4]	2,670,131	2,839,353	2,429,909	2,494,003	2,649,898	2,521,486	3,152,561
Biomass	405,695	412,482	423,447	435,274	441,011	459,372	444,235
Wood[5]	184,973	181,815	185,956	177,348	180,046	195,597	175,253
Waste[6]	220,722	230,667	237,492	257,926	260,966	263,775	268,982
Geothermal[7]	146,903	144,500	144,674	146,233	146,485	148,479	162,921
Solar[8]	5,502	5,036	6,047	8,516	8,697	11,762	17,514
Wind[9]	178,088	263,738	340,503	545,548	721,127	923,271	1,167,832
Total	3,406,319	3,665,109	3,344,581	3,629,575	3,967,218	4,064,369	4,945,064

[1] The ethanol portion of motor fuels (such as E10 and E85) consumed by the transportation sector.

[2] Either a diesel fuel substitute or diesel fuel additive or extender.

[3] The electric power sector comprises electricity only and combined heat and power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public.

[4] Conventional hydroelectricity net generation (converted to Btu using the fossil-fueled plants heat rate).

[5] Wood and wood-derived fuels.

[6] Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

[7] Geothermal electricity net generation (converted to Btu using the geothermal energy plants heat rate).

[8] Solar thermal and photovoltaic electricity net generation (converted to Btu using the fossil-fueled plants heat rate).

[9] Wind electricity net generation (converted to Btu using the fossil-fueled plants heat rate).

Source: U.S. Department of Energy, Energy Information Administration

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Chapter 3

IMPORTANT ENERGY INDUSTRY CONTACTS

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XLVIII. Risk Professionals Associations
XLIX. Robotics Associations
L. Science & Technology Resources
LI. Smart Meter Industry Associations
LII. Stocks & Financial Markets Data
LIII. Technology Transfer Associations
LIV. Trade Associations-General
LV. Trade Associations-Global
LVI. Trade Resources
LVII. U.S. Government Agencies
LVIII. Water Technologies & Resources
LIX. Weather Risk Management Associations

I. Accountants & CPAs Associations

Council of Petroleum Accountants Societies, Inc. (COPAS)
3900 E. Mexico Ave., Ste. 602
Denver, CO 80210 US
Phone: 303-300-1131
Fax: 303-300-3733
Toll Free: 877-992-6727
E-mail Address: *Execdir@copas.org*
Web Address: www.copas.org
The Council of Petroleum Accountants Societies, Inc. (COPAS) provides a forum for discussing and solving the variety of problems related to accounting for oil and gas. COPAS also provides valuable educational materials related to oil and gas accounting.

II. Agriculture Industry Associations

Brazilian Sugarcane Industry Association
Av. Brigadeiro Faria Lima, 2179, Fl. 9
Sao Paulo, SP 01452-000 Brazil
Phone: 55-11-3093-4949
Fax: 55-11-3812-1416
E-mail Address: *unica@unica.com.br*
Web Address: unica.com.br
The Brazilian Sugarcane Industry Association (Uniao da Industria de Cana-de-Acucar, or UNICA), created in 1997, is the country's largest trade association representing producers of sugar, ethanol and bioelectricity. Its member companies are responsible for approximately 50% of Brazil's ethanol production and 60% of the country's sugar production. UNICA maintains a number of international offices, including one in Washington D.C.

III. Alternative Energy-Biomass

Centre for the Development of Renewable Energy Sources (CEDER)
Autovia de Navarra A15
Salida 56
Lubia, 42290 Spain
Phone: 34-975-281-013
Fax: 34-975-281-051
E-mail Address: *ceder@ciemat.es*
Web Address: www.ceder.es
The Centre for the Development of Renewable Energy Sources (CEDER) is a unit of Spain's CIEMAT (Research Centre for Energy, Environment and Technology). CEDER focuses on biomass energy, wind energy and energy efficiency.

IV. Alternative Energy-Ethanol

Renewable Fuels Association (RFA)
425 3rd St. SW, Ste. 1150
Washington, DC 20024 US
Phone: 202-289-3835
Fax: 202-289-7519
Web Address: www.ethanolrfa.org
The Renewable Fuels Association (RFA) is a trade organization representing the ethanol industry. It publishes a wealth of useful information, including a listing of biorefineries and monthly U.S. fuel ethanol production and demand.

V. Alternative Energy-Fuel Cells

Fuel Cell and Hydrogen Energy Association (FCHEA)
1211 Connecticut Ave. NW, Ste. 600
Washington, DC 20036 US
Phone: 202-261-1331
E-mail Address: *mmarkowitz@fchea.org*
Web Address: www.fchea.org
The Fuel Cell and Hydrogen Energy Association (FCHEA) is an industry association dedicated to fostering the commercialization of fuel cells and hydrogen energy technologies in the U.S.

Fuel Cell Today
Gate 2, Orchard Rd.
Royston, Herts SG8 5HE UK
Phone: 44-1763-256326
E-mail Address: *info@fuelcelltoday.com*
Web Address: www.fuelcelltoday.com
Fuel Cell Today is an Internet portal that provides news, commentary and information on the fuel cell industry.

Fuel Cells 2000
1100 H St. NW, Ste. 800
Washington, DC 20005 US
Phone: 202-785-4222
Fax: 202-785-4313
E-mail Address: *info@fuelcells.org*
Web Address: www.fuelcells.org
Fuel Cells 2000, run by the Breakthrough Technologies Institute (BTI), is a site devoted to preparing and disseminating information on fuel cells and the fuel cell industry.

VI. Alternative Energy-General

Alliance to Save Energy (ASE)
1850 M St. NW, Ste. 600
Washington, DC 20036 US
Phone: 202-857-0666
Fax: 202-331-9588
E-mail Address: *info@ase.org*
Web Address: www.ase.org
The Alliance to Save Energy (ASE) promotes energy-efficiency worldwide to achieve a healthier economy, a cleaner environment and energy security.

American Council for an Energy-Efficient Economy (ACEEE)
529 14th St. NW, Ste. 600
Washington, DC 20045-1000 US
Phone: 202-507-4000
Fax: 202-429-2248
E-mail Address: *mannelin@aceee.org*
Web Address: www.aceee.org
The American Council for an Energy-Efficient Economy (ACEEE) is a nonprofit organization dedicated to advancing energy-efficiency as a means of promoting both economic prosperity and environmental protection.

American Council on Renewable Energy (ACORE)
1600 K St., Ste. 650
Washington, DC 20006 US
Phone: 202-393-0001
Fax: 202-393-0606
E-mail Address: *houston@acore.org*
Web Address: www.acore.org
The American Council On Renewable Energy (ACORE) is a nonprofit organization focused on accelerating the adoption of renewable energy technologies into the mainstream of American society. With an interest in trade, finance and policy, ACORE promotes all renewable energy options for the production of electricity, hydrogen, fuels and end-use energy.

Business Council for Sustainable Energy (BCSE)
1629 I St. NW, Ste. 501
Washington, DC 20006 US
Phone: 202-785-0507
Fax: 202-785-0514
E-mail Address: *bcse@bcse.org*
Web Address: www.bcse.org
The Business Council for Sustainable Energy (BCSE) strives to realize goals for the nation's economic, environmental and national security. The Council focuses on the promotion of clean energy technologies as solutions to certain environmental challenges.

Center for Energy Efficiency and Renewable Technologies (CEERT)
1100 11th St., Ste. 311
Sacramento, CA 95814 US
Phone: 916-442-7785
Fax: 916-447-2940
Toll Free: 877-758-4462
E-mail Address: *info@ceert.org*
Web Address: www.ceert.org
The Center for Energy Efficiency and Renewable Technologies (CEERT) provides technical support to environmental advocates and clean technology developers.

Chinese Renewable Energy Industries Association (CREIA)
Street A4
No. A2106 Wuhua Plaza, CheGongZhuang
Beijing, 100044 China
Phone: 86-10-68002617-18
Fax: 86-10-68002674
E-mail Address: *creia@creia.net*
Web Address: www.creia.net
The Chinese Renewable Energy Industries Association (CREIA) was established in 2000 under official government sanction to promote the use of renewable energy sources within China.

Interstate Renewable Energy Council
P.O. Box 1156
Latham, NY 12110-1156 US
Phone: 518-458-6059
E-mail Address: *info@irecusa.org*
Web Address: www.irecusa.org
Interstate Renewable Energy Council (IREC), formed in 1982 as a nonprofit organization, supports market-oriented services promoting renewable energy, aimed at education, coordination, procurement, the adoption and implementation of uniform guidelines and standards, workforce development, and consumer protection.

Renewable Energy & Energy Efficiency Partnership (REEEP)
Wagramerstrasse 5
Vienna Int'l Ctr.
Vienna, A-1400 Austria
Phone: 43 1 26026-3425

Fax: 43 1 21346-3425
E-mail Address: *info@reeep.org*
Web Address: www.reeep.org
The Renewable Energy and Energy Efficiency Partnership (REEEP) is a global, public-private partnership that structures policy and regulatory initiatives for clean energy, and facilitates financing for energy projects. Backed by more than 200 national governments, businesses, development banks and NGOs, REEEP hopes to contribute to international, national and regional policy dialogues. Its aim is to accelerate the integration of renewables into the energy mix and to advocate energy efficiency as a path to improved energy security and reduced carbon emissions, ensuring socio-economic benefits.

Renewable Energy Policy Project (REPP)
1612 K St. NW, Ste. 202
Washington, DC 20006 US
Phone: 202-293-2898
Fax: 202-293-5857
E-mail Address: *gsterzinger@repp.org*
Web Address: www.repp.org
The Renewable Energy Policy Project (REPP) is devoted to creating policy tools and disseminating information on public policy about alternative energy.

Sustainable Energy Association of Singapore (SEAS)
1 Cleantech Loop
02-16 Cleantech One
637141 Singapore
Phone: 65-6338-8578
E-mail Address: *info@seas.com*
Web Address: www.seas.com
The Sustainable Energy Association of Singapore (SEAS) represents the interests of companies in renewable energy, carbon trading, energy efficiency, clean development mechanism projects and their financial institutions.

VII. Alternative Energy-Geothermal

GeoExchange Heat Pump Consortium (GHPC)
1050 Connecticut Ave. NW, Ste. 1000
Washington, DC 20036 US
Fax: 202-558-6759
Toll Free: 1-888-255-4436
Web Address: www.geoexchange.org
GeoExchange Heat Pump Consortium (GHPC) offers information on how geothermal heating and cooling can provide energy efficiency and reliability in the field of interior climate control.

Geothermal Resources Council (GRC)
2001 2nd St., Ste. 5
Davis, CA 95617 US
Phone: 530-758-2360
Fax: 530-758-2839
E-mail Address: *grc@geothermal.org*
Web Address: www.geothermal.org
The Geothermal Resources Council (GRC) is an association that encourages the development of geothermal resources and provides information on geothermal energy.

VIII. Alternative Energy-Hydroelectric

International Journal on Hydropower & Dams
P.O. Box 285
Little Woodcote Estate
Wallingtin, Surrey SM6 6AN UK
Phone: 44-2087737240
E-mail Address: *edit@hydropower-dams.com*
Web Address: www.hydropower-dams.com
The International Journal on Hydropower & Dams is an online journal with detailed information about the hydropower segment of the energy industry.

National Hydropower Association (NHA)
25 Massachusetts Ave. NW, Ste. 450
Washington, DC 20001 US
Phone: 202-682-1700
Fax: 202-682-9478
E-mail Address: *help@hydro.org*
Web Address: www.hydro.org
The National Hydropower Association (NHA) is the only national trade association dedicated exclusively to representing the interests of the hydropower industry. Its members span the breadth of the industry and all related fields.

IX. Alternative Energy-Solar

American Solar Energy Society (ASES)
4760 Walnut St., Ste. 106
Boulder, CO 80301 US
Phone: 303-443-3130
Fax: 303-443-3212
E-mail Address: *ases@ases.org*
Web Address: www.ases.org
The American Solar Energy Society (ASES) is a nonprofit association committed to advancing the use

of solar energy to benefit citizens and the global environment, promoting widespread solar energy use in the near future and long-term.

International Solar Energy Society (ISES)
Wiesentalstr. 50
Villa Tannheim
Freiburg, 79115 Germany
Phone: 49-761-459-060
Fax: 49-761-459-0699
E-mail Address: *public.relations@ises.org*
Web Address: www.ises.org
The International Solar Energy Society (ISES) is an international nonprofit group promoting the advancement of renewable energy technology, implementation and education worldwide. ISES maintains a presence in over 50 countries worldwide.

Solar Electric Power Association (SEPA)
1220 19th St. NW, Ste. 800
Washington, DC 20036-2405 US
Phone: 202-857-0898
Fax: 202-559-2035
E-mail Address: *info@solarelectricpower.org*
Web Address: www.solarelectricpower.org
The Solar Electric Power Association (SEPA) is a nonprofit organization consisting of more than 100 companies and associations in eight countries. It aims to help energy utilities add solar energy to their generation portfolios.

Solar Energy Industries Association (SEIA)
575 7th St. NW, Ste. 400
Washington, DC 20004 US
Phone: 202-682-0556
E-mail Address: *info@seia.org*
Web Address: www.seia.org
Established in 1974, the Solar Energy Industries Association is the American trade association of the solar energy industry. Among its operations is a web site that provides news for the solar energy industry, links to related products and companies and solar energy statistics.

Solar Platform of Almeria (PSA)
Carretera de Senes, km. 4.5
Paraje Los Retamares
Tabernas, Almeria 04200 Spain
E-mail Address: *info@psa.es*
Web Address: www.psa.es
The Solar Platform of Almeria (Plataforma Solar de Almería), a dependency of Spain's Center for Energy, Environment and Technological Research (CIEMAT), is the largest center for research, development and testing of concentrating solar power (CSP) technologies in Europe. PSA activities form an integral part of the CIEMAT Department of Renewable Energies as one of its lines of R&D.

X. Alternative Energy-Storage

Electricity Storage Association
1155 15th St. NW, Ste. 500
Washington, DC 20005 US
Phone: 202-293-0537
E-mail Address: *info@electricitystorage.org*
Web Address: www.electricitystorage.org
The Electricity Storage Association promotes the development and commercialization of improved energy storage delivery systems for use by electricity suppliers and their customers. Its web site provides information on advanced storage technologies such as flywheels, pumped hydro storage, flow cell batteries and compressed air energy storage.

XI. Alternative Energy-Wind

American Wind Energy Association (AWEA)
1501 M St. NW, Ste. 1000
Washington, DC 20005 US
Phone: 202-383-2500
Fax: 202-383-2505
E-mail Address: *windmail@awea.org*
Web Address: www.awea.org
The American Wind Energy Association (AWEA) promotes wind energy as a clean source of electricity worldwide. Its website provides excellent resources for research, including an online library, discussions of legislation, and descriptions of wind technologies.

Canadian Wind Energy Association (CanWEA)
1600 Carling Ave., Ste. 710
Ottawa, ON K1Z 1G3 Canada
Phone: 613-234-8716
Fax: 613-234-5642
Toll Free: 800-922-6932
E-mail Address: *info@canwea.ca*
Web Address: www.canwea.ca
The Canadian Wind Energy Association (CanWEA) is a nonprofit trade association that promotes the development of wind energy.

European Wind Energy Association (EWEA)
80 Rue d'Arlon
Brussels, B-1040 Belgium

Phone: 32-2-213-1811
Fax: 32-2-213-1890
E-mail Address: *ewea@ewea.org*
Web Address: www.ewea.org
The European Wind Energy Association (EWEA) co-ordinates international policy, communications, research and analysis from its headquarters in Brussels. EWEA manages European programs, hosts events and supports the needs of its members.

Indian Wind Energy Association
Opp. Asian Games Village, August Kranti Marg
PHD House, 3rd Fl.
New Delhi, 110 016 India
Phone: 91-11-26523042
E-mail Address: *manish@inwea.org*
Web Address: www.inwea.org
The Indian Wind Energy Association was organized to promote and develop wind power in India.

XII. Automotive Industry Resources

DieselNet
Ecopoint Inc.
P.O. Box 47055
Mississauga, ON L5K 2R2 Canada
Phone: 905-990-0775
Fax: 905-990-0776
E-mail Address: *consult@dieselnet.com*
Web Address: www.dieselnet.com
DieselNet is an online information service on diesel emissions, emission control, diesel engines, fuels and more. Ecopoint Inc. owns and publishes the site.

XIII. Canadian Government Agencies-Energy

Canadian Nuclear Safety Commission (CNSC)
280 Slater St., Ste. B
Ottawa, ON K1P 5S9 Canada
Phone: 613-995-5894
Fax: 613-995-5086
Toll Free: 800-668-5284
E-mail Address: *info@cnsc-ccsn.gc.ca*
Web Address: www.nuclearsafety.gc.ca
The Canadian Nuclear Safety Commission (CNSC) regulates nuclear power plants, nuclear research facilities and the use of nuclear materials in Canada.

National Energy Board (NEB)
444 7th Ave. SW
Calgary, AB T2P 0X8 Canada
Phone: 403-292-4800
Fax: 403-292-5503
Toll Free: 800-899-1265
E-mail Address: *info@neb-one.gc.ca*
Web Address: www.neb-one.gc.ca
The National Energy Board (NEB) is the Canadian government body responsible for the regulation of oil and natural gas pipeline traffic and construction, international power line construction and the export of oil, electricity and gas, as well as oil and gas activities within the country.

XIV. Canadian Government Agencies-General

Canadian Polar Commission
360 Albert St., Consitution Sq., Ste. 1710
Ottawa, ON K1R 7X7 Canada
Phone: 613-943-8605
Fax: 613-943-8607
Toll Free: 888-765-2701
E-mail Address: *mail@polarcom.gc.ca*
Web Address: www.polarcom.gc.ca
The Canadian Polar Commission promotes and distributes research in the Polar regions.

XV. Careers-First Time Jobs/New Grads

Black Collegian Online (The)
140 Carondelet St.
New Orleans, LA 70130 US
Phone: 504-523-0154
Web Address: www.blackcollegian.com
The Black Collegian Online features listings for job and internship opportunities, as well as other tools for students of color; it is the web site of The Black Collegian Magazine, published by IMDiversity, Inc. The site includes a list of the top 100 minority corporate employers and an assessment of job opportunities.

CollegeGrad.com, Inc.
234 E. College Ave., Ste. 200
State College, PA 16801 US
Phone: 262-375-6700
Toll Free: 1-800-991-4642
Web Address: www.collegegrad.com
CollegeGrad.com, Inc. offers in-depth resources for college students and recent grads seeking entry-level jobs.

Job Web
62 Highland Ave.
Bethlehem, PA 18017-9085 US
Phone: 610-868-1421
Fax: 610-868-0208
Toll Free: 800-544-5272
E-mail Address: *callen@naceweb.org*
Web Address: www.jobweb.com
Job Web, owned and sponsored by National Association of Colleges and Employers (NACE), displays job openings and employer descriptions for college students and recent graduates. The site also offers a database of career fairs, searchable by state or keyword; sample resumes; and other career related information.

MBAjobs.net
Web Address: www.mbajobs.net
MBAjobs.net is an international service for MBA students and graduates, employers, recruiters and business schools. It aims to match MBA graduates with employers and provides links to online MBA programs.

MonsterCollege
799 Market St., Ste. 500
San Francisco, CA 94103 US
Toll Free: 800-999-8725
E-mail Address: *info@college.monster.com*
Web Address: www.college.monster.com
MonsterCollege provides information about internships and entry-level jobs, as well as career advice and resume tips, to recent college graduates.

National Association of Colleges and Employers (NACE)
62 Highland Ave.
Bethlehem, PA 18017-9085 US
Phone: 610-868-1421
Fax: 610-868-0208
Toll Free: 800-544-5272
E-mail Address: *customer_service@naceweb.org*
Web Address: www.naceweb.org
The National Association of Colleges and Employers (NACE) is a premier U.S. organization representing college placement offices and corporate recruiters who focus on hiring new grads.

XVI. Careers-General Job Listings

Career Exposure, Inc.
3934 SW Corbett Ave.
Portland, OR 97239 US
Phone: 503-221-7779
E-mail Address: *pr@careerexposure.com*
Web Address: www.careerexposure.com
Career Exposure, Inc. is an online career center and job placement service, with resources for employers, recruiters and job seekers.

CareerBuilder, Inc.
200 N. LaSalle St., Ste. 1100
Chicago, IL 60601 US
Phone: 773-527-3600
Fax: 773-399-6313
Toll Free: 866-438-1485
E-mail Address: *jennifer.grasz@careerbuilder.com*
Web Address: www.careerbuilder.com
CareerBuilder, Inc. focuses on the needs of companies and also provides a database of job openings. The site has over 1 million jobs posted by 300,000 employers, and receives an average 23 million unique visitors monthly. The company also operates online career centers for 140 newspapers and 9,000 online partners. Resumes are sent directly to the company, and applicants can set up a special e-mail account for job-seeking purposes.
CareerBuilder is primarily a joint venture between three newspaper giants: The McClatchy Company, Gannett Co., Inc. and Tribune Company.

CareerOneStop
Toll Free: 877-348-0502
E-mail Address: *info@careeronestop.org*
Web Address: www.careeronestop.org
CareerOneStop is operated by the employment commissions of various state agencies. It contains job listings in both the private and government sectors, as well as a wide variety of useful career resources and workforce information.
CareerOneStop is sponsored by the U.S. Department of Labor.

JobCentral
9002 N. Purdue Rd., Ste. 100
Indianapolis, IN 46268 US
Phone: 317-874-9000
Fax: 317-874-9100
Toll Free: 866-268-6206
E-mail Address: *info@us.jobs*
Web Address: www.jobcentral.com
JobCentral, operated by the nonprofit DirectEmployers Association, Inc., links users directly to job opportunities posted on the sites of participating employers, thus bypassing the usual job

search sites. This saves employers money and allows job seekers to access many more job opportunities.

LaborMarketInfo (LMI)
P.O. Box 826880, MIC 57
c/o Employment Dev. Dept., Labor Market Info. Div.
Sacramento, CA 94280-0001 US
Phone: 916-262-2162
Fax: 916-262-2352
Toll Free: 800-480-3287
Web Address: www.labormarketinfo.edd.ca.gov
LaborMarketInfo (LMI) provides job seekers and employers a wide range of resources, namely the ability to find, access and use labor market information and services. It provides statistics for employment demographics on both a local and regional level, as well as career searching tools for California residents. The web site is sponsored by California's Employment Development Office.

Recruiters Online Network
3599 E. Normandy Park Dr.
Medina, OH 44256 US
E-mail Address: *recruitersonline@earthlink.net*
Web Address: www.recruitersonline.com
The Recruiters Online Network provides job postings from thousands of recruiters, Careers Online Magazine, a resume database, as well as other career resources.

USAJOBS
1900 E St. NW
Washington, DC 20415 US
Phone: 202-606-1800
Web Address: www.usajobs.gov
USAJOBS, a program of the U.S. Office of Personnel Management, is the official job site for the U.S. Federal Government. It provides a comprehensive list of U.S. government jobs, allowing users to search for employment by location; agency; type of work; or by senior executive positions. It also has special employment sections for individuals with disabilities, veterans and recent college graduates; an information center, offering resume and interview tips and other information; and allows users to create a profile and post a resume.

XVII. Careers-Job Reference Tools

Vault.com, Inc.
132 W. 31st St., Fl. 17
New York, NY 10001 US
Phone: 212-366-4212
Fax: 212-366-6117
E-mail Address: *jminners@vault.com*
Web Address: www.vault.com
Vault.com, Inc. is a comprehensive career web site for employers and employees, with job postings and valuable information on a wide variety of industries. Its features and content are largely geared toward MBA degree holders.

XVIII. Chemicals Industry Associations

American Chemical Society (ACS)
1155 16th St. NW
Washington, DC 20036 US
Phone: 202-872-4600
Toll Free: 800-227-5558
E-mail Address: *help@acs.org*
Web Address: www.acs.org
The American Chemical Society (ACS) is a nonprofit organization aimed at promoting the understanding of chemistry and chemical sciences. It represents a wide range of disciplines including chemistry, chemical engineering and other technical fields.

Association of Chemical Industry of Texas (ACIT)
1402 Nueces St.
Austin, TX 78701-1586 US
Phone: 512-646-6400
Fax: 512-646-6420
E-mail Address: *rivero@acit.org*
Web Address: www.acit.org
The Association of Chemical Industry of Texas (ACIT) represents chemical companies and those affiliated with the industry in Texas.

Brazilian Chemical Industry Association
Av. Chedid Jafet, 222, Bloco C, Fl. 4
Sao Paulo, SP 04551-065 Brazil
Phone: 55-11-2148-4700
Fax: 55-11-2148-4760
E-mail Address: *abiquim@abiquim.com.br*
Web Address: www.abiquim.org.br
The Brazilian Chemical Industry Association (Associacao Brasileira da Industria Quimica, ABIQUIM) represents Brazilian manufacturers of chemical products and assists with a variety of issues related to the industry, including product quality; environmental and safety issues; human resource development; product advocacy; tariff negotiations; and trade agreements. ABIQUIM runs a 24-hour

hotline for chemical transportation safety issues, and is also involved with plastics recycling efforts.

ChemAlliance
1850 M St. NW, Ste. 700
Washington, DC 20036-5810 US
Phone: 202-721-4100
Fax: 202-296-8120
E-mail Address: *chemalliance@socma.com*
Web Address: www.chemalliance.org
ChemAlliance, operated by the Society of Chemical Manufacturers and Affiliates (SOCMA), provides up-to-date information concerning the environmental regulations affecting the chemical industry.

Chemical Industries Association (CIA)
Kings Bldg.
Smith Sq.
London, SW1P 3JJ UK
Phone: 44-20-7834-3399
Fax: 44-20-7834-4469
E-mail Address: *enquiries@cia.org.uk*
Web Address: www.cia.org.uk
The Chemical Industries Association (CIA) is the UK's leading trade association for the chemical and chemistry-related industries, representing members both nationally and internationally.

Chemistry Industry Association of Canada
350 Sparks St., Ste. 805
Ottawa, ON K1R 7S8 Canada
Phone: 613-237-6215
Fax: 613-237-4061
Web Address: www.canadianchemistry.ca
The Chemistry Industry Association of Canada, formerly Canada's Chemical Producers' Association (CCPA), is a trade association that represents over 50 companies active in Canada's chemistry sector.

China Petroleum & Chemical Industry Federation (CPCIF)
Anhuili Asian Games Village
Bldg. 16 Qu 4 Anhuili
Beijing, 100723 China
Phone: 86-10-8488-5415
Fax: 86-10-8488-5087
Web Address: www.cpcia.org
The China Petroleum & Chemical Industry Federation (CPCIF) is a non-government and nonprofit association composed of regional and local associations including the China Polyurethane Industry Association.

Council for Chemical Research (CCR)
1550 M St. NW, Ste. 300
Washington, DC 20005 US
Phone: 202-429-3971
Fax: 202-429-3976
E-mail Address: *pmendez@ccrhq.org*
Web Address: www.ccrhq.org
The Council for Chemical Research (CCR) represents industry, academia and government members involved in the chemical sciences and engineering.

International Council of Chemical Associations (ICCA)
Ave. E. Van Nieuwenhuyse 4, Box 1
Brussels, B-1160 Belgium
Phone: 32-2-676-74-15
E-mail Address: *rba@cefic.be*
Web Address: www.icca-chem.org
The International Council of Chemical Associations (ICCA) represents chemical manufacturers and producers all over the world.

International Union of Pure and Applied Chemistry (IUPAC)
104 T.W. Alexander Dr., Bldg. 19
Research Triangle Park, NC 27709 US
Phone: 919-485-8700
Fax: 919-485-8706
E-mail Address: *secretariat@iupac.org*
Web Address: www.iupac.org
The International Union of Pure and Applied Chemistry (IUPAC) is a world authority on chemical nomenclature, terminology, standardized methods for measurement, atomic weights and other critically evaluated data.

Korea Petrochemical Industry Association (KPIA)
Yeonji-Dong, Jongno-Gu
Fl. 6, Yeojundo-Bldg., 1-1
Seoul, 110-738 Korea
Phone: 82-2-3668-6100
Fax: 82-2-743-1887
E-mail Address: *kpia@kpia.or.kr*
Web Address: www.kpia.or.kr
The Korea Petrochemical Industry Association (KPIA) is a leading Korean association focused on the petrochemicals sector. It is especially dedicated to developing safe practices, promoting international cooperation and general research and development in the industry.

Louisiana Chemical Association (LCA)
One American Pl., Ste. 2040
Baton Rouge, LA 70825 US
Phone: 225-344-2609
Fax: 225-343-1007
Web Address: www.lca.org
The Louisiana Chemical Association (LCA) promotes the chemical industry in Louisiana and the growth of chemical manufacturers.

Singapore Chemical Industry Council (SCIC)
8 Jurong Town Hall
#25-04,The JTC Summit
609434 Singapore
Phone: 65-6267-8891
E-mail Address: *secretariat@scic.sg*
Web Address: www.scic.sg
The Singapore Chemical Industry Council (SCIC) is the official body representing the chemical industry of Singapore in the private sector. Its membership comprises key companies, logistics service providers and traders.

Society of Chemical Industry (SCI)
14/15 Belgrave Sq.
London, SW1X 8PS UK
Phone: 44-20-7598-1500
Fax: 44-20-7598-1545
E-mail Address: *secretariat@soci.org*
Web Address: www.soci.org
The Society of Chemical Industry (SCI) is a professional association for networking and problem solving in the international chemical industry. Established in 1881, SCI has members in over 70 countries. Its international headquarters are in London, with additional offices in the U.S., Canada, Continental Europe, India and Australia.

UIC (Union des Industries Chimiques)
Le Diamant A
14 Rue de la Republique
Paris, 92909 France
Phone: 33-1-46-53-11-00
Web Address: www.uic.fr
UIC, the Union des Industries Chimiques (Union of French Chemical Industries), represents chemicals manufacturers in France, including basic, fine, specialty and pharmaceuticals. It provides support to its members in six areas: technical, economic, social, innovation, communication and legal.

XIX. Chemicals Industry Resources

Chemical Cluster Singapore
Phone: 65-6872-0865
Fax: 65-6872-5655
E-mail Address: *support@chemindustry.org.sg*
Web Address: www.chemindustry.org.sg
The Singapore Chemical Industry Council (SCIC) hosts the Chemical Cluster Singapore web site, which provides press releases; environment and safety information; directories; and links to tenders, buyers and sellers.

ICIS.com
Quadrant House
The Quadrant
Sutton, Surrey SM2 5AS UK
Phone: 44-20-8652-3335
Toll Free: 888-525-3255
E-mail Address: *csc@icis.com*
Web Address: www.icis.com
ICIS.com is an online portal for news and market research regarding the global chemical and energy industries. It also publishes the weekly magazine ICIS Chemical Business.

XX. Construction Resources-Energy Efficient Buildings

Energy Efficiency Programme Office (E2PO)
40 Scotts Rd.
Environmental Bldg. #13-00
Singapore, 228231 Singapore
Fax: 65-6235-2611
Toll Free: 800-2255-632
E-mail Address: *contact_NEA@nea.gov.sg*
Web Address: www.e2singapore.gov.sg
To drive energy efficiency improvement in Singapore, the Energy Efficiency Programme Office (E2PO) has been established. The website includes information about energy programs, publications, incentives and development opportunities for power generation, industry, transport, green buildings and the public sector of Singapore.

XXI. Corporate Information Resources

bizjournals.com
120 W. Morehead St., Ste. 400
Charlotte, NC 28202 US
Web Address: www.bizjournals.com

Bizjournals.com is the online media division of American City Business Journals, the publisher of dozens of leading city business journals nationwide. It provides access to research into the latest news regarding companies both small and large. The organization maintains 42 websites and 64 print publications and sponsors over 700 annual industry events.

Business Wire
44 Montgomery St., Fl. 39
San Francisco, CA 94104 US
Phone: 415-986-4422
Fax: 415-788-5335
Toll Free: 800-227-0845
E-mail Address:
Thomas.Becktold@businesswire.com
Web Address: www.businesswire.com
Business Wire offers news releases, industry- and company-specific news, top headlines, conference calls, IPOs on the Internet, media services and access to tradeshownews.com and BW Connect On-line through its informative and continuously updated web site.

Edgar Online, Inc.
11200 Rockville Pike, Ste. 310
Rockville, MD 20852 US
Phone: 301-287-0300
Fax: 301-287-0390
Toll Free: 888-870-2316
Web Address: www.edgar-online.com
Edgar Online, Inc. is a gateway and search tool for viewing corporate documents, such as annual reports on Form 10-K, filed with the U.S. Securities and Exchange Commission.

PR Newswire Association LLC
350 Hudson St., Ste. 300
New York, NY 10014 US
Fax: 800-793-9313
Toll Free: 800-776-8090
E-mail Address: *rachel.meranus@prnewswire.com*
Web Address: www.prnewswire.com
PR Newswire Association LLC provides comprehensive communications services for public relations and investor relations professionals, ranging from information distribution and market intelligence to the creation of online multimedia content and investor relations web sites. Users can also view recent corporate press releases from companies across the globe. The Association is owned by United Business Media plc.

Silicon Investor
E-mail Address: *silicon.admin@gmail.com*
Web Address: www.siliconinvestor.com
Silicon Investor is focused on providing information about technology companies. Its web site serves as a financial discussion forum and offers quotes, profiles and charts.

XXII. Economic Data & Research

Centre for European Economic Research (The, ZEW)
P.O. Box 103443
Mannheim, 68034 Germany
Phone: 49-621-1235-01
Fax: 49-621-1235-224
E-mail Address: *info@zew.de*
Web Address: www.zew.de/en
Zentrum fur Europaische Wirtschaftsforschung, The Centre for European Economic Research (ZEW), distinguishes itself in the analysis of internationally comparative data in a European context and in the creation of databases that serve as a basis for scientific research. The institute maintains a special library relevant to economic research and provides external parties with selected data for the purpose of scientific research. ZEW also offers public events and seminars concentrating on banking, business and other economic-political topics.

Economic and Social Research Council (ESRC)
Polaris House
North Star Ave.
Swindon, SN2 1UJ UK
Phone: 01793 413000
Fax: 01793 413001
E-mail Address: *comms@esrc.ac.uk*
Web Address: www.esrc.ac.uk
The Economic and Social Research Council (ESRC) funds research and training in social and economic issues. It is an independent organization, established by Royal Charter. Current research areas include the global economy; social diversity; environment and energy; human behavior; and health and well-being.

Eurostat
5 Rue Alphonse Weicker
Joseph Bech Bldg.
Luxembourg, L-2721 Luxembourg
Phone: 44-20-300-63103
E-mail Address: *eurostat-pressoffice@ec.europa.eu*
Web Address: www.epp.eurostat.ec.europa.eu

Eurostat is the European Union's service that publishes a wide variety of comprehensive statistics on European industries, populations, trade, agriculture, technology, environment and other matters.

Federal Statistical Office of Germany
Gustav-Stresemann-Ring 11
Wiesbaden, D-65189 Germany
Phone: 49-0-611-75-2405
Fax: 49-0-611-75-3976
Web Address: www.destatis.de
Federal Statistical Office of Germany publishes a wide variety of nation and regional economic data of interest to anyone who is studying Germany, one of the world's leading economies. Data available includes population, consumer prices, labor markets, health care, industries and output.

India Brand Equity Foundation (IBEF)
249-F Sector 18
Udyog Vihar Phase IV
Gurgaon, Haryana 122015 India
Phone: 91-124-401-4060-67
Fax: 91-124-401-3873
E-mail Address: *ceo@ibef.org*
Web Address: www.ibef.org
India Brand Equity Foundation (IBEF) is a public-private partnership between the Ministry of Commerce and Industry, the Government of India and the Confederation of Indian Industry. The foundation's primary objective is to build positive economic perceptions of India globally. It aims to effectively present the India business perspective and leverage business partnerships in a globalizing marketplace.

National Bureau of Statistics (China)
57, Yuetan Nanjie, Sanlihe
Xicheng District
Beijing, 100826 China
Phone: 86-10-6852-0066
Fax: 86-10-6878-2000
E-mail Address: *info@gj.stats.cn*
Web Address: www.stats.gov.cn/english
The National Bureau of Statistics (China) provides statistics and economic data regarding China's economy and society.

Organization for Economic Co-operation and Development (OECD)
2 rue André Pascal
Cedex 16
Paris, F-75775 France
Phone: 33-1-45-24-82-00
Fax: 33-1-45-24-85-00
E-mail Address: *webmaster@oecd.org*
Web Address: www.oecd.org
The Organization for Economic Co-operation and Development (OECD) publishes detailed economic, government, population, social and trade statistics on a country-by-country basis for over 30 nations representing the world's largest economies. Sectors covered range from industry, labor, technology and patents, to health care, environment and globalization.

Statistics Bureau, Director-General for Policy Planning (Japan)
19-1 Wakamatsu-cho
Shinjuku-ku
Tokyo, 162-8668 Japan
Phone: 81-3-5273-2020
E-mail Address: *stat_webmaster@soumu.go.jp*
Web Address: www.stat.go.jp/english
The Statistics Bureau, Director-General for Policy Planning (Japan) and Statistical Research and Training Institute, a part of the Japanese Ministry of Internal Affairs and Communications, plays the central role of producing and disseminating basic official statistics and coordinating statistical work under the Statistics Act and other legislation.

Statistics Canada
150 Tunney's Pasture Driveway
Ottawa, ON K1A 0T6 Canada
Phone: 613-951-8116
Fax: 877-287-4369
Toll Free: 800-263-1136
E-mail Address: *infostats@statcan.gc.ca*
Web Address: www.statcan.gc.ca
Statistics Canada provides a complete portal to Canadian economic data and statistics. Its conducts Canada's official census every five years, as well as hundreds of surveys covering numerous aspects of Canadian life.

XXIII. Emissions Cap & Trade Associations

International Emissions Trading Association (IETA)
24, Rue Merle d'Aubigne
Geneva, 1207 Switzerland
Phone: 41 22 737 05 00

Fax: 41 22 737 05 08
E-mail Address: *secretariat@ieta.org*
Web Address: www.ieta.org
IETA is a leading association in the carbon emissions cap and trade industry. It sponsors research, publications and conferences on a worldwide basis.

UK Emissions Trading Group (ETG)
8 Duncannon St.
Golden Cross House
London, WC2N 4JF UK
Phone: 020 7484 5274
E-mail Address: *John.Craven@etg.uk.com*
Web Address: www.uketg.com
The business-led UK Emissions Trading Group (ETG) offers a forum for discussion and resolution of all aspects of emissions trading and enables communication to take place between commerce and industry, and the UK Government.

XXIV. Energy Associations-China, General

China Energy Association (CEA)
7th of Nanlishi St., Toutiao
Xicheng District
Beijing, 100045 China
Phone: 86-010-68051807
Fax: 86-010-68051799
E-mail Address: *hzt1008@hotmail.com*
Web Address: www.zhnx.org.cn
The China Energy Association (CEA) is a membership organization that represents the energy sources sector and energy industry. The organization publishes the Energy Resource World magazine.

XXV. Energy Associations-Coal

American Coal Foundation
101 Constitution Ave. NW, Ste. 525 E.
Washington, DC 20001-2133 US
Phone: 202-463-9785
Fax: 202-463-9786
E-mail Address: *info@teachcoal.org*
Web Address: www.teachcoal.org
The American Coal Foundation was created to develop, produce and disseminate coal-related educational materials and programs designed for teachers and students.

Coal Association of Canada
205-9th Ave. SE, Ste. 150
Calgary, AB T2G 0R3 Canada
Phone: 403-262-1544
Fax: 403-265-7604
Toll Free: 800-910-2625
E-mail Address: *info@coal.ca*
Web Address: www.coal.ca
The Coal Association of Canada represents members of the Canadian coal industry.

Kentucky Coal Association
2800 Palumbo Dr., Ste. 200
Lexington, KY 40509 US
Phone: 859-233-4743
Fax: 859-233-4745
E-mail Address: *kca@kentuckycoal.com*
Web Address: www.kentuckycoal.org
The Kentucky Coal Association represents members of the coal industry in Kentucky.

West Virginia Coal Association
P.O. Box 3923
Charleston, WV 25309 US
Phone: 304-342-4153
E-mail Address: *braney@wvcoal.com*
Web Address: www.wvcoal.com
The West Virginia Coal Association represents members of the coal industry in West Virginia.

Wyoming Coal division of the Wyoming Mining Association
206 Central
Cheyenne, WY 82007 US
Phone: 307-635-0331
Fax: 307-778-6240
E-mail Address: *wma@vcn.com*
Web Address: www.wma-minelife.com
The Wyoming Mining Association operates web pages dedicated to the state's extensive coal production industry.

XXVI. Energy Associations-Electric Power

American Public Power Association (APPA)
1875 Connecticut Ave. NW, Ste. 1200
Washington, DC 20009-5715 US
Phone: 202-467-2900
Fax: 202-467-2910
Toll Free: 800-515-2772
E-mail Address: *info@PublicPower.org*
Web Address: /www.publicpower.org

The American Public Power Association (APPA) is a nonprofit service organization for the country's community-owned electric utilities, dedicated to advancing the public policy interests of its members and their consumers.

Edison Electric Institute (EEI)
701 Pennsylvania Ave. NW
Washington, DC 20004-2696 US
Phone: 202-508-5000
E-mail Address: *feedback@eei.org*
Web Address: www.eei.org
The Edison Electric Institute (EEI) is an association of U.S. shareholder-owned electric companies as well as worldwide affiliates and industry associates. Its web site provides energy news and a link to Electric Perspectives magazine.

Electric Power Research Institute (EPRI)
3420 Hillview Ave.
Palo Alto, CA 94304 US
Phone: 650-855-2121
Fax: 704-595-2871
Toll Free: 800-313-3774
E-mail Address: *askepri@epri.com*
Web Address: my.epri.com
Electric Power Research Institute (EPRI) is a leader in creating technology and solving tough environmental problems.

Electric Power Service Provider Association
1401 New York Ave. NW, Fl. 11
Washington, DC 20005-2110 US
Phone: 202-628-8200
Fax: 202-628-8260
E-mail Address: *info@matrixgroup.net*
Web Address: www.epsa.org
The Electric Power Service Provider Association promotes the interests of the electric power generation and distribution industry.

Institute of Public Utilities
Michigan State University
W157 Owen Graduate Hall
East Lansing, MI 48825-1109 US
Phone: 517-355-1876
Fax: 517-355-1854
E-mail Address: *ipu@msu.edu*
Web Address: www.ipu.msu.edu
The Institute of Public Utilities is committed to a mission of supporting informed, effective and efficient utility regulation by providing educational programs and applied research to the regulatory policy community.

National Rural Electric Cooperative Association (NRECA)
4301 Wilson Blvd.
Arlington, VA 22203-1860 US
Phone: 703-907-5500
E-mail Address: *Patrick.lavigne@nreca.coop*
Web Address: www.nreca.coop
The National Rural Electric Cooperative Association (NRECA) is the national service organization dedicated to representing the interests of consumer-owned cooperative electric utilities and the consumers they serve.

Public Utility Research Center (PURC)
University of Florida, 205 Matherly Hall
P.O. Box 117142
Gainesville, FL 32611-7142 US
Phone: 352-392-6148
Fax: 352-392-7796
E-mail Address: *purcecon@warrington.ufl.edu*
Web Address: warrington.ufl.edu/purc/
Public Utility Research Center (PURC) provides international training and strategic research in public utility regulation, market rules, and infrastructure management in the energy, telecommunications, and water industries.

Western Energy Institute (WEI)
827 NE Oregon St., Ste. 200
Portland, OR 97232-2172 US
Phone: 503-231-1994
Fax: 503-231-2595
E-mail Address: *himes@westernenergy.org*
Web Address: www.westernenergy.org
The Western Energy Institute (WEI) serves the electric and gas industries throughout the western U.S. and Canada.

Women's International Network of Utility Professionals (WINUP)
P.O. Box 817
Fergus Falls, MN 56538-0817 US
Phone: 218-731-1659
E-mail Address: *tdrexler@otpco.com*
Web Address: www.winup.org
The Women's International Network of Utility Professionals (WINUP) provides networking and support for women in the utility industry.

XXVII. Energy Associations-International

International Association for Energy Economics (IAEE)
28790 Chagrin Blvd., Ste. 350
Cleveland, OH 44122 US
Phone: 216-464-5365
Fax: 216-464-2737
E-mail Address: *iaee@iaee.org*
Web Address: www.iaee.org
The International Association for Energy Economics (IAEE) provides members with an opportunity to exchange ideas and information relevant to professionals involved in energy economics.

International Energy Agency (IEA)
9 rue de la Federation
Paris Cedex 15, 75739 France
Phone: 33-1-40-57-65-00
Fax: 33-1-40-57-65-09
E-mail Address: *info@iea.org*
Web Address: www.iea.org
The International Energy Agency (IEA) is the energy forum for its members' countries and is committed to taking joint measures to meet oil supply emergencies. It shares energy information, coordinates energy policies and helps in the development of national energy programs. The agency publishes a wealth of information each year, including statistics of fuel usage and emissions.

XXVIII. Energy Associations-Natural Gas

American Gas Association (AGA)
400 N. Capitol St. NW, Ste. 450
Washington, DC 20001 US
Phone: 202-824-7000
E-mail Address: *lmeigs@aga.org*
Web Address: www.aga.org
The American Gas Association (AGA) represents a large number of natural gas providers, advocating for these companies and providing a broad range of programs and services for members.

Canadian Gas Association (CGA)
350 Sparks St., Ste. 809
Ottawa, ON K1R 7S8 Canada
Phone: 613-748-0057
Fax: 613-748-9078
E-mail Address: *info@cga.ca*
Web Address: www.cga.ca
The Canadian Gas Association (CGA) is a trade organization representing natural gas distribution companies, transmission companies and related equipment manufacturers and service providers in Canada and the U.S.

Canadian Propane Association (CPA)
800, 717-7th Ave. SW
Calgary, AB T2P 0Z3 Canada
Phone: 403-543-6500
Fax: 403-543-6508
Toll Free: 877-784-4636
E-mail Address: *training@propane.ca*
Web Address: www.propane.ca
The Canadian Propane Association (CPA), formerly the Propane Gas Association of Canada, is a nonprofit organization dedicated to the development of a safe and environmentally-friendly propane industry in Canada.

GAS Association of Singapore
24A Senoko Ave.
758314 Singapore
Phone: 65-6567-7601
Fax: 65-6823-8699
E-mail Address: *info@gas.org.sg*
Web Address: www.gas.org.sg
The Gas Association of Singapore represents professionals in the natural gas and gas related industries in Singapore.

Gas Processing Association Canada (GPAC)
1040-7th Ave. SW, Ste. 400
Calgary, AB T2P 3G9 Canada
Phone: 403-244-4487
Fax: 403-244-2340
E-mail Address: *info@gpacanada.com*
Web Address: www.gpacanada.com
The Gas Processing Association Canada (GPAC), formed by the merger of the Canadian Gas Processing Association and the Canadian Gas Processing Suppliers Association, aims to serve the needs of natural gas processors, suppliers and relevant industry associations and entities affected by the hydrocarbon processing industry.

Gas Processors Association (GPA)
6526 E. 60th St.
Tulsa, OK 74145 US
Phone: 918-493-3872
Fax: 918-493-3875
Web Address: www.GPAglobal.org

The Gas Processors Association (GPA) is an organization of companies involved in the natural gas processing industry. The association sets product standards, publishes industry statistics and is an educational resource.

Gas Technology Institute (GTI)
1700 S. Mount Prospect Rd.
Des Plaines, IL 60018-1804 US
Phone: 847-768-0500
Fax: 847-768-0501
E-mail Address: *businessdevelopmentinfo@gastechnology.org*
Web Address: www.gastechnology.org
The Gas Technology Institute (GTI) is a not-for-profit research and development organization, and works to develop and deploy technologies related to affordable energy production, sustainable energy development and the efficient use of energy resources. Its network of partners, investors and clients includes state and federal government agencies; natural gas utilities and pipeline companies; industrial companies; electric utilities; independent power producers; technology developers; and national laboratories. In addition to its Illinois headquarters (which houses 28 specialized laboratories working on various advanced energy technologies), GTI also maintains smaller offices and facilities in locations including Houston, Texas; Sacramento, California; and Washington D.C.

Interstate Natural Gas Association of America (INGAA)
20 F St. NW, Ste. 450
Washington, DC 20001 US
Phone: 202-216-5900
Fax: 202-216-0870
E-mail Address: *webinfo@ingaa.org*
Web Address: www.ingaa.org
The Interstate Natural Gas Association of America (INGAA) represents interstate and interprovincial natural gas pipeline companies as a voice on important issues concerning natural gas pipeline companies. It also provides expertise and information services.

National Propane Gas Association (NPGA)
1899 L St. NW, Ste. 350
Washington, DC 20036 US
Phone: 202-466-7200
Fax: 202-466-7205
E-mail Address: *info@npga.org*
Web Address: www.npga.org
The National Propane Gas Association (NPGA) is a national trade association that strives for safe and increased use of propane and for a more positive environment for propane production.

Natural Gas Supply Association (NGSA)
1620 Eye St. NW, Ste. 700
Washington, DC 20006 US
Phone: 202-326-9300
Web Address: www.ngsa.org
The Natural Gas Supply Association (NGSA) represents domestic producers and marketers of natural gas.

XXIX. Energy Associations-Nuclear

Canadian Nuclear Association
130 Albert St., Ste. 1610
Ottawa, ON K1P 5G4 Canada
Phone: 613-237-4262
Fax: 613-237-0989
E-mail Address: *olsonk@cna.ca*
Web Address: www.cna.ca
The Canadian Nuclear Association is a nonprofit organization that promotes nuclear power in Canada.

China Atomic Energy Authority
China Atomic Energy Authority
Beijing, 100037 China
E-mail Address: *webmaster@caea.gov.cn*
Web Address: www.caea.gov.cn
The China Atomic Energy Authority is involved in developing policies and regulations and the development programming, planning and industrial standards for peaceful uses of nuclear energy.

European Nuclear Society
Rue Belliard 65
Brussels, B-1040 Belgium
Phone: 32-2-505-30-50
Fax: 32-2-502-39-02
E-mail Address: *info@euronuclear.org*
Web Address: www.euronuclear.org
The European Nuclear Society promotes the science and application of nuclear technology in Europe.

International Atomic Energy Agency (IAEA)
P.O. Box 100
Vienna Int'l Ctr.
Vienna, A-1400 Austria
Phone: 431-2600-0
Fax: 431-2600-7
E-mail Address: *official.mail@iaea.org*

Web Address: www.iaea.org
The International Atomic Energy Agency (IAEA) focuses on global nuclear energy developments.

Japan Atomic Industrial Forum
1-2-8 Toranomon, Minato-ku
Kotohira Twr., Fl. 9
Tokyo, 105-8605 Japan
Phone: 81-3-6812-7100
Fax: 81-3-6812-7110
E-mail Address: *information@jaif.or.jp*
Web Address: www.jaif.or.jp/english
The Japan Atomic Industrial Forum, Inc. is a nonprofit industry organization that promotes the use of safe nuclear power.

Nuclear Energy Institute (NEI)
1776 I St. NW, Ste. 400
Washington, DC 20006-3708 US
Phone: 202-739-8000
Fax: 202-785-4019
E-mail Address: *webmasterp@nei.org*
Web Address: www.nei.org
The Nuclear Energy Institute (NEI) is a policy organization for the national nuclear technologies industry.

Societe Francaise D'Energie Nucleaire (SFEN)
5 rue des Morillons
Paris, 75015 France
Phone: 33-01-53-58-32-10
Fax: 33-01-53-58-32-11
E-mail Address: *sfen@sfen.fr*
Web Address: www.sfen.org
The Societe Francaise D'Energie Nucleaire (SFEN) promotes nuclear power and provides information to the public.

United Kingdom Atomic Energy Association (UKAEA)
Culham Science Ctr.
Abingdon
Oxfordshire, OX14 3DB UK
Phone: 44-1235-52882
E-mail Address: *Cashmore@ccfe.ac.uk.*
Web Address: www.uk-atomic-energy.org.uk
The United Kingdom Atomic Energy Association (UKAEA) is is a researcher in the field of fusion technologies and is responsible for the decommissioning of nuclear reactors in the United Kingdom.

World Council of Nuclear Workers (WONUC)
49 rue Lauriston
Paris, 75116 France
Phone: 33-0-6-08-21-32-87
E-mail Address: *wonuc.secretary@orange.fr*
Web Address: www.wonuc.org
The World Council of Nuclear Workers (WONUC) is a nonprofit trade union for workers in the nuclear industry.

World Nuclear Association
22a St. James Sq.
London, SW1Y 4JH UK
Phone: 44-20-7451-1520
Fax: 44-20-7839-1501
E-mail Address: *wna@world-nuclear.org*
Web Address: www.world-nuclear.org
The World Nuclear Association promotes the peaceful worldwide use of nuclear power as a sustainable energy resource.

World Nuclear Transport Institute
310-312 Regent St.
Remo House
London, W1B 3 AX UK
Phone: 44-207-580-1144
Fax: 44-207-580-5365
E-mail Address: *wnti@wnti.co.uk*
Web Address: www.wnti.co.uk
The World Nuclear Transport Institute is dedicated to the safe and efficient transportation of nuclear materials.

XXX. Energy Associations-Oil Field Services/Drilling

Association of Well Head Equipment Manufacturers
P.O. Box 1166
Bellaire, TX 77402 US
E-mail Address: *pres@awhem.org*
Web Address: www.awhem.org
The Association of Well Head Equipment Manufacturers provides technical consulting to national and international standards bodies and serves to influence value-added standardization of well head and related equipment in a positive manner.

Canadian Association of Oilwell Drilling Contractors (CAODC)
800, 540-5 Ave. SW
Calgary, AB T2P 0M2 Canada

Phone: 403-264-4311
Fax: 403-263-3796
E-mail Address: *info@caodc.ca*
Web Address: www.caodc.ca
The Canadian Association of Oilwell Drilling Contractors (CAODC) is a trade association that represents drilling and rig services contractors throughout Canada. The web site provides members with the latest information in the Canadian oil and gas exploration industry.

International Association of Geophysical Contractors (IAGC)
1225 N. Loop W., Ste. 220
Houston, TX 77008 US
Phone: 713-957-8080
Fax: 713-957-0008
Toll Free: 866-558-1756
E-mail Address: *iagc@iagc.org*
Web Address: www.iagc.org
The International Association of Geophysical Contractors (IAGC) is the international trade association representing the industry that provides geophysical services to the oil and gas industry.

National Association of Energy Service Companies (NAESCO)
1615 M St. NW, Ste. 800
Washington, DC 20036 US
Phone: 202-822-0950
Fax: 202-822-0955
E-mail Address: *info@naesco.org*
Web Address: www.naesco.org
The National Association of Energy Service Companies (NAESCO) provides an opportunity for energy service companies to meet with industry peers to discuss issues relative to the energy services industry's growth and future direction.

National Association of Steel Pipe Distributors (NASPD)
1501 E. Mockingbird Ln., Ste. 307
Victoria, TX 77904 US
Phone: 361-574-7878
Fax: 832-201-9479
E-mail Address: *info@naspd.com*
Web Address: www.naspd.com
The National Association of Steel Pipe Distributors (NASPD) represents the steel pipe and tubular products distribution industry.

Petroleum Equipment Suppliers Association (PESA)
1240 Blalock Rd., Ste. 110
Houston, TX 77055 US
Phone: 713-932-0168
Fax: 713-932-0497
E-mail Address: *info@pesa.org*
Web Address: www.pesa.org
The Petroleum Equipment Suppliers Association (PESA) is an organization of equipment manufacturers, well site service providers and supply companies serving the drilling and production segments of the petroleum industry.

XXXI. Energy Associations-Oil Sands

Oil Sands Developers Group
617 - 8600 Franklin Ave.
Fort McMurray, ALB T9H 4GB Canada
Phone: 780-790-1999
Fax: 780-790-1971
E-mail Address:
carol.christian@oilsandsdevelopers.ca
Web Address: www.oilsandsdevelopers.ca
On behalf of its members, the group works closely with oil sands operators and developers, related industries, governments, Aboriginal peoples, and other organizations active in the Athabasca oil sands deposit region to define and address regional issues related to oil sands development.

XXXII. Energy Associations-Other

Alliance for Energy & Economic Growth
Phone: 202-463-5452
E-mail Address: *rbillings@uschamber.com*
Web Address: www.yourenergyfuture.org
The Alliance for Energy & Economic Growth is a broad alliance of interests that develop, deliver and consume energy from all sources. The alliance strives to help build an agreement for a strategy that balances supply and demand so that America's economy is fueled and the quality of life is supported.

American Association of Blacks in Energy
1625 K St. NW, Ste. 450
Washington, DC 20006 US
Phone: 202-371-9530
Fax: 202-371-9218
E-mail Address: *info@aabe.org*
Web Address: www.aabe.org

The American Association of Blacks in Energy is dedicated to ensuring the input of African Americans and other minorities in discussions and developments of energy policies, regulations, research and development technologies and environmental issues.

International Coiled Tubing Association (ICoTA)
P.O. Box 1082
Montgomery, TX 77356 US
Phone: 936-520-1549
Fax: 832-201-9977
E-mail Address: *ababin@icota.com*
Web Address: www.icota.com
The International Coiled Tubing Association (ICoTA) is a nonprofit, member organization that works to improve communication and promotion of technical awareness within the coiled tubing industry.

National Association of State Energy Officials (NASEO)
2107 Wilson Blvd., Ste. 850
Arlington, VA 22201 US
Phone: 703-299-8800
Fax: 703-299-6208
E-mail Address: *energy@naseo.org*
Web Address: www.naseo.org
The National Association of State Energy Officials (NASEO) provides a forum for energy officials, policymakers and others to trade information and discuss issues with regional and national implications.

New England Fuel Institute (NEFI)
303 Wyman St., Ste. 210
Waltham, MA 02451 US
Phone: 617-924-1000
Fax: 617-924-5962
Web Address: www.nefi.com
The New England Fuel Institute (NEFI) provides information about the fuel oil business in New England.

NORA
5965 Amber Ridge Rd.
Haymarket, VA 20169 US
Phone: 703-753-4277
Fax: 703-753-2445
E-mail Address: *sparker@noranews.org*
Web Address: www.noranews.org
NORA, formerly the National Oil Recyclers Association, represents nearly 200 companies involved in the liquid recycling industry. The organization promotes proper recycling of used oil, oil filters, antifreeze, waste water, chemicals and other industrial liquids.

Society of Energy Professionals International
300-425 Bloor St. E
Toronto, ON M4W 3R4 Canada
Phone: 416-979-2709
Fax: 416-979-5794
Toll Free: 866-288-1788
E-mail Address: *society@thesociety.ca*
Web Address: www.thesociety.ca
The Society of Energy Professionals International is an independent trade union representing professionals in the energy industry within Ontario, Canada.

U.S. Energy Association (USEA)
1300 Pennsylvania Ave. NW
Ste. 550, Mailbox 142
Washington, DC 20004-3022 US
Phone: 202-312-1230
Fax: 202-682-1682
E-mail Address: *reply@usea.org*
Web Address: www.usea.org
The U.S. Energy Association (USEA) represents the interests of the U.S. energy sector by increasing understanding in domestic and international energy issues. USEA is the U.S. member committee of the World Energy Counsel (WEC).

Women's Council on Energy and the Environment (WCEE)
816 Connecticut Ave. NW, Ste. 200
Washington, DC 20006 US
Phone: 202-997-4512
Fax: 202-478-2098
Web Address: www.wcee.org
The Women's Council on Energy and the Environment (WCEE) is dedicated to promoting professional and educational opportunities for women in the fields of energy and environment in the Washington, D.C. area.

XXXIII. Energy Associations-Petroleum, Exploration, Production, etc.

Alaska Oil & Gas Association (AOGA)
121 W. Fireweed Ln., Ste. 207
Anchorage, AK 99503 US
Phone: 907-272-1481
Fax: 907-279-8114
E-mail Address: *info@aoga.org*

Web Address: www.aoga.org
The Alaska Oil & Gas Association (AOGA) is a trade association that provides a forum for communication regarding oil and gas issues in Alaska.

American Association of Professional Landmen (AAPL)
4100 Fossil Creek Blvd.
Fort Worth, TX 76137 US
Phone: 817-847-7700
Fax: 817-847-7704
E-mail Address: *aapl@landman.org*
Web Address: www.landman.org
The American Association of Professional Landmen (AAPL) promotes the highest standards of performance for all land professionals and seeks to advance their stature and to encourage sound stewardship of energy and mineral resources.

American Exploration & Production Council (AXPC)
1350 Eye St. NW, Ste. 510
Washington, DC 20005 US
Phone: 202-652-2359
E-mail Address: *info@axpc.us*
Web Address: www.axpc.us
The American Exploration & Production Council (AXPC), formerly the Domestic Petroleum Council (DPC), is a representative for large U.S. independent natural gas and crude oil exploration and production companies. It strives for more responsible exploration, development and production to better meet the needs of consumers and to fuel the economy.

American Petroleum Institute (API)
1220 L St. NW
Washington, DC 20005-4070 US
Phone: 202-682-8000
E-mail Address: *fangs@api.org*
Web Address: www.api.org
American Petroleum Institute (API) represents U.S. oil and gas industries and its web site includes in-depth sections for energy consumers and energy professionals.

American Petroleum Institute-Delta API Chapter
P.O. Box 50110
New Orleans, LA 70150 US
E-mail Address: *bwaring@ocsbbs.com*
Web Address: www.api-delta.org
The American Petroleum Institute-Delta API Chapter acts as an umbrella organization to serve all aspects of the oil and gas industry. It actively supports the community and surrounding area of New Orleans.

American Petroleum Institute-Houston API Chapter
P.O. Box 219276
Houston, TX 77218 US
Phone: 281-492-6000
Fax: 281-310-5087
E-mail Address: *api@apihouston.org*
Web Address: www.api-houston.org
The American Petroleum Institute-Houston API Chapter is a nonprofit organization that provides a forum for discussion of energy-related matters and promotes education and personal interaction to improve the energy industry.

Association of the German Petroleum Industry (MWV)
Georgenstrasse 25
Berlin, 10117 Germany
Phone: 49-30-202-205-30
Fax: 49-30-202-205-55
Web Address: www.mwv.de
Association of the German Petroleum Industry (MWV) promotes the interests of its member companies as well as collects and publishes statistics regarding the industry.

Australian Institute of Petroleum
24 Marcus Clarke St., Level 2
Canberra City, ACT 2601 Australia
Phone: 02-6247-3044
Fax: 02-6247-3844
E-mail Address: *aip@aip.com.au*
Web Address: www.aip.com.au
The Australian Institute of Petroleum, a globally recognized representative of Australia's petroleum industry, strives to develop a better Australian petroleum industry and provides responsible, professional and principled representation of the industry.

Canadian Association of Petroleum Producers (CAPP)
350 7th Ave. SW, Ste. 2100
Calgary, AB T2P 3N9 Canada
Phone: 403-267-1100
Fax: 403-261-4622
E-mail Address: *communication@capp.ca*
Web Address: www.capp.ca
Canadian Association of Petroleum Producers (CAPP) is committed to improving the economic

well-being and sustainability of the Canadian upstream petroleum industry.

Independent Petroleum Association of America (IPAA)
1201 15th St. NW, Ste. 300
Washington, DC 20005 US
Phone: 202-857-4722
Fax: 202-857-4799
E-mail Address: *Webmaster@ipaa.org*
Web Address: www.ipaa.org
The Independent Petroleum Association of America (IPAA) provides a forum for the exploration and production segment of the independent oil and natural gas business. It also provides information on the domestic exploration and production industry.

International Association of Drilling Contractors (IADC)
10370 Richmond Ave., Ste. 760
Houston, TX 77042 US
Phone: 713-292-1945
Fax: 713-292-1946
E-mail Address: *info@iadc.org*
Web Address: www.iadc.org
The International Association of Drilling Contractors (IADC) represents the worldwide oil and gas drilling industry and promotes commitment to safety, preservation of the environment and advances in drilling technology.

International Association of Oil & Gas Producers (OGP)
209-215 Blackfriars Rd.
London, SEI 8NL UK
Phone: 44-20-7633-0272
Fax: 44-20-7633-2350
E-mail Address: *reception@ogp.org.uk*
Web Address: www.ogp.org.uk
The International Association of Oil & Gas Producers (OGP) provides engineering, environmental, health, safety and personal competence and communications support for the international oil and gas industry in the areas of exploration and production.

International Petroleum Industry Environmental Conservation Association (IPIECA)
209-215 Blackfriars Rd., Fl. 5
London, SE1 8NL UK
Phone: 44-20-7633-2388
Fax: 44-20-7633-2389
E-mail Address: *info@ipieca.org*
Web Address: www.ipieca.org
The International Petroleum Industry Environmental Conservation Association (IPIECA) works for the petroleum industry by developing and promoting solutions to global environmental issues.

Louisiana Mid-Continent Oil & Gas Association (LMOGA)
730 N. Blvd.
Baton Rouge, LA 70802 US
Phone: 225-387-3205
Fax: 225-344-5502
E-mail Address: *ashley@lmoga.com*
Web Address: www.lmoga.com
The Louisiana Mid-Continent Oil & Gas Association (LMOGA) represents all sectors of the oil and gas industry in Louisiana and the Gulf of Mexico.

Mid-Continent Oil & Gas Association of Oklahoma
6701 N. Broadway, Ste. 300
Oklahoma, OK 73116 US
Phone: 405-843-5741
Web Address: www.okmoga.com
The Mid-Continent Oil & Gas Association of Oklahoma strives to solve problems and provide a unified voice for the advancement and improvement of the oil and gas industry.

National Association of Royalty Owners (NARO)
15 W. 6th St., Ste. 2626
Tulsa, OK 74119 US
Phone: 918-794-1660
Fax: 918-794-1662
Toll Free: 800-558-0557
E-mail Address: *NARO@NARO-us.org*
Web Address: www.naro-us.org
The National Association of Royalty Owners (NARO) remains the only national organization promoting the rights, responsibilities and definitions of citizens that own the natural resources in our country.

National Ocean Industries Association (NOIA)
1120 G St. NW, Ste. 900
Washington, DC 20005 US
Phone: 202-347-6900
Fax: 202-347-8650
E-mail Address: *nicolette@noia.org*
Web Address: www.noia.org
The National Ocean Industries Association (NOIA) represents all facets of America's domestic offshore petroleum industry.

National Petroleum Council (NPC)
1625 K St. NW, Ste. 600
Washington, DC 20006 US
Phone: 202-393-6100
Fax: 202-331-8539
E-mail Address: *info@npc.org*
Web Address: www.npc.org
The National Petroleum Council (NPC) web site offers a comprehensive look at the federally charted, privately funded advisory committee and its operations.

New Mexico Oil & Gas Association (NMOGA)
203 E. Santa Fe Ave.
Santa Fe, NM 87505 US
Phone: 505-982-2568
Web Address: www.nmoga.org
The New Mexico Oil & Gas Association (NMOGA) is a private, nonprofit organization dedicated to promoting the welfare of the oil and gas industry of New Mexico and the conservation and environmentally responsible development of oil and gas resources within the state.

North Dakota Petroleum Council
120 N. 3rd St., Ste. 200
Bismarck, ND 58501 US
Phone: 701-223-6380
Fax: 701-222-0006
E-mail Address: *ndpc@ndoil.org*
Web Address: www.ndoil.org
The North Dakota Petroleum Council provides a voice for the oil industry in North Dakota.

Oil and Gas UK
Portland House, Fl.6 E.
Bressenden Place
London, SW1E 5BH UK
Phone: 44-020-7802-2400
E-mail Address: *info@oilandgasuk.co.uk*
Web Address: www.oilandgas.org.uk
The United Kingdom Offshore Operators Association (UKOOA) is the representative organization for the U.K. offshore oil and gas industry.

Permian Basin Petroleum Association (PBPA)
415 W. Wall
Midland, TX 79702 US
Phone: 432-684-6345
Fax: 432-684-7836
E-mail Address: *nicole@pbpa.info*
Web Address: www.pbpa.info
The Permian Basin Petroleum Association (PBPA) is the voice of the Permian Basin oil and gas community, serving the Permian Basin of Texas and New Mexico.

Petroleum Association of Wyoming (PAW)
951 Werner Ct., Ste. 100
Casper, WY 82601 US
Phone: 307-234-5333
Fax: 307-266-2189
E-mail Address: *paw@pawyo.org*
Web Address: www.pawyo.org
The Petroleum Association of Wyoming (PAW) strives to better Wyoming's oil and gas industry and public welfare.

Petroleum Equipment Institute (PEI)
6514 E. 69 St.
Tulsa, OK 74133-1729 US
Phone: 918-494-9696
Fax: 918-491-9895
E-mail Address: *jrbrown@pei.org*
Web Address: www.pei.org
The Petroleum Equipment Institute (PEI) is the leading authority and information source for the petroleum marketing and liquid handling equipment industry.

Petroleum Services Association of Canada (PSAC)
800 6th Ave. SW, Ste. 1150
Calgary, AB T2P 3G3 Canada
Phone: 403-264-4195
Fax: 403-263-7174
E-mail Address: *info@psac.ca*
Web Address: www.psac.ca
The Petroleum Services Association of Canada (PSAC) is the national association of Canadian oil field service, supply and manufacturing companies.

Texas Independent Producers and Royalty Owners Association (TIPRO)
919 Congress Ave., Ste. 1000
Austin, TX 78701 US
Phone: 512-477-4452
Fax: 512-476-8070
E-mail Address: *info@tipro.org*
Web Address: www.tipro.org
The Texas Independent Producers and Royalty Owners Association (TIPRO) provides legislative and public representation, important information and opportunities to develop business relationships for independent oil and gas operators, working interest owners and other businesses in the energy industry.

Texas Oil & Gas Association (TXOGA)
304 W. 13th St.
Austin, TX 78701 US
Phone: 512-478-6631
Fax: 512-472-3859
Web Address: www.txoga.org
The Texas Oil & Gas Association (TXOGA) is a petroleum trade association for oil and gas industry professionals in Texas.

Western States Petroleum Association (WSPA)
1415 L St., Ste. 600
Sacramento, CA 95814 US
Phone: 916-498-7750
Fax: 916-444-5745
Web Address: www.wspa.org
The Western States Petroleum Association (WSPA) strives to supply precise information about industry issues and to provide a discussion for different ideas on petroleum matters.

World Petroleum Council (WPC)
1 Duchess St.
Fl. 4, Ste. 1
London, W1W 6AN UK
Phone: 44-20-7637-4958
E-mail Address: *info@world-petroleum.org*
Web Address: www.world-petroleum.org
The World Petroleum Council (WPC) sponsors the World Petroleum Congress, which provides an opportunity for discussions of the issues facing the worldwide oil industry.

XXXIV. Energy Associations-Pipelines

Association of Oil Pipe Lines
1808 I St. NW, Ster. 300
Washington, DC 20006 US
Phone: 202-408-7970
Fax: 202-280-1949
E-mail Address: *atzamaras@aopl.org*
Web Address: www.aopl.org
The Association of Oil Pipe Lines is an information source for the public, the media and the pipeline industry. It represents common carrier crude and product petroleum pipelines before Congress and regulatory agencies and in the federal courts.

Canadian Energy Pipeline Association (CEPA)
505-3rd St. SW, Ste. 200
Calgary, AB T2P 3E6 Canada
Phone: 403-221-8777
Fax: 403-221-8760
E-mail Address: *info@cepa.com*
Web Address: www.cepa.com
The Canadian Energy Pipeline Association (CEPA) is the trade association representing the Canadian transmission pipeline industry.

XXXV. Energy Associations-Refining

American Fuel & Petrochemical Manufacturers (AFPM)
1667 K St. NW, Ste. 700
Washington, DC 20006 US
Phone: 202-457-0480
Fax: 202-457-0486
E-mail Address: *info@afpm.org*
Web Address: www.afpm.org
The American Fuel & Petrochemical Manufacturers (AFPM), formerly the National Petrochemical & Refiners Association, gathers and distributes information and statistics regarding the petroleum refining and petrochemical manufacturing industries.

Canadian Petroleum Products Institute (CPPI)
1000-275 Slater
Ottawa, ON K1P 5H9 Canada
Phone: 613-232-3709
Fax: 613-236-4280
Web Address: www.cppi.ca
The Canadian Petroleum Products Institute (CPPI) is an association of Canadian companies involved in the refining, distribution and marketing of petroleum products. The Institute represents the views of its members on business, environmental, health and safety issues.

European Petroleum Industry Association (Europia)
Blvd. du Souverain 165, Fl. 3
Brussels, B-1160 Belgium
Phone: 32-2-566-91-00
Fax: 32-2-566-91-11
E-mail Address: *info@europia.com*
Web Address: www.europia.com
The European Petroleum Industry Association (Europia) is the European government affairs organization of the oil refining and marketing industry, representing the problems of its members for institutions of the European Union and other European industrial and commercial organizations.

Independent Lubricant Manufacturers Association (ILMA)
400 N. Columbus St., Ste. 201

Alexandria, VA 22314 US
Phone: 703-684-5574
Fax: 703-836-8503
E-mail Address: *ilma@ilma.org*
Web Address: www.ilma.org
The Independent Lubricant Manufacturers Association (ILMA) strives to improve the role of independent lubricant manufacturers in a universal, competitive marketplace.

XXXVI. Energy Education Resources

Arctic National Wildlife Refuge (ANWR)
425 8th St. NW, Ste. 540
Washington, DC 20004 US
Phone: 202-248-4468
Fax: 202-248-6123
Web Address: www.anwr.org
Arctic National Wildlife Refuge (ANWR), located in the Coastal Plain, is believed to have the potential to hold billions of recoverable barrels of oil and gas. This web site is promotes the authorization to lease and develop this area.

California Energy Commission-Energy Quest
1516 9th St., MS-29
Sacramento, CA 95814 US
Phone: 916-654-4989
E-mail Address: *mediaoffice@energy.state.ca.us*
Web Address: www.energyquest.ca.gov
Energy Quest is an educational web site that teaches children about energy.

Canadian Centre for Energy Information
800-6 Ave. SW, Ste. 1600
Calgary, AB T2P 3G3 Canada
Phone: 403-263-7722
Fax: 403-237-6286
Toll Free: 877-606-4636
Web Address: www.centreforenergy.com
The Canadian Centre for Energy Information provides conferences, workshops and other activities, as well as informational publications designed to inform the public about issues affecting the Canadian energy industry.

Chevron Carsville
Web Address: www.chevroncarsville.com
Chevron's Energy Information for Kids is a web site providing energy information geared for children.

National Energy Education Development (NEED)
8408 Kao Cir.
Manassas, VA 20110 US
Phone: 703-257-1117
Fax: 703-257-0037
Toll Free: 800-875-5029
E-mail Address: *info@need.org*
Web Address: www.need.org
National Energy Education Development (NEED) is devoted to developing and disseminating hands-on energy education programs to schools nationwide.

National Ocean Industries Association-About Offshore Oil & Gas
1120 G St. NW, Ste. 900
Washington, DC 20005 US
Phone: 202-347-6900
Fax: 202-347-8650
E-mail Address: *nicolette@noia.org*
Web Address: www.noia.org
The National Ocean Industries Association provides information about offshore oil and gas, petroleum and natural gas through this web page.

XXXVII. Energy Industry Resources

Baker Hughes Incorporated
2929 Allen Pkwy., Ste. 2100
Houston, TX 77019-2118 US
Phone: 713-439-8600
Toll Free: 800-229-7447
E-mail Address: *info@bakerhughes.com*
Web Address: www.bakerhughes.com
Baker Hughes' web site is the home of the firm's famous drilling rig count. Their site includes historical and global data concerning drilling, formation evaluation, completion and production products and services.

BP Statistical Review of World Energy
1 St. James Sq.
London, SW1Y 4PD UK
Phone: 44-20-7496-4000
Fax: 44-20-7496-4630
E-mail Address: *sr@bp.com*
Web Address: www.bp.com/statisticalreview
BP Statistical Review of World Energy, a publication of BP p.l.c., is an excellent source of the worlds current and historical energy trends.

Canadian Energy Research Institute (CERI)
3512-33 St. NW, Ste. 150
Calgary, AB T2L 2A6 Canada
Phone: 403-282-1231
Fax: 403-284-4181

E-mail Address: *info@ceri.ca*
Web Address: www.ceri.ca
The Canadian Energy Research Institute (CERI) represents various Canadian governmental departments, the University of Calgary and over 100 private sector energy-related companies. It seeks to provide analysis of energy economics and related government issues in the fields of energy production, transportation and consumption.

DLA Energy
Phone: 703-767-4357
E-mail Address: *hqhelpdesk@dla.mil*
Web Address: www.dla.mil
DLA Energy, formerly the Defense Energy Support Center (DESC), is focused on designing an energy program that moves the Department of Defense out of the management of energy infrastructure and into the management of energy products. DLA Energy also grants electricity services contracts to the DoD and the Federal Civilian Agency.

Earth Sciences and Resources Institute
1233 Washington St., Ste. 300
Columbia, SC 29208 US
Phone: 803-978-7550
Fax: 803-978-7528
E-mail Address: *info@esri.sc.edu*
Web Address: www.esri.sc.edu
The Earth Sciences and Resources Institute is a free-standing environmental and petroleum geology research institute operating out of the University of South Carolina.

ElectricNet
5340 Fryling Rd., Ste. 101
Erie, PA 19510 US
E-mail Address: *info@vertmarkets.com*
Web Address: www.electricnet.com
ElectricNet is a gateway to valuable industry information pertinent to those who design, manufacture, construct, startup, test, repair, service, calibrate, maintain or sell electrical equipment, power apparatus, plant electrical facilities or generation, transmission or distribution equipment or systems.

Enerdata
47 av. Alsace Lorraine
Grenoble, 38000 FR
Phone: 33-4-76-42-25-46
Fax: 33-4-76-51-61-45
E-mail Address: *info@enerdata.net*
Web Address: www.enerdata.net
Enerdata publishes an annual, online Global Energy Statistical Yearbook. It is an excellent way to study energy consumption and production, as well as emissions and other factors.

Energy Central
2821 S. Parker Rd., Ste. 1105
Aurora, CO 80014 US
Phone: 303-782-5510
Toll Free: 800-459-2233
E-mail Address: *service@energycentral.com*
Web Address: www.energycentral.com
Energy Central provides a large number of news releases related to the energy industry as well as other industry information.

Energy Charter Secretariat
Boulevard de la Woluwe, 56
Brussels, B-1200 Belgium
Phone: 32 2 775 98 00
Fax: 32 2 775 98 01
E-mail Address: *info@encharter.org*
Web Address: www.encharter.org
The Energy Charter Treaty, an international agreement, plays an important role as part of an effort to build a legal foundation for energy security, based on the principles of open, competitive markets and sustainable development. The group holds conferences and publishes excellent reports on such topics as LNG, renewable energy and investments. More than 50 nations are members.

Energy Market Authority (EMA)
991G Alexandra Rd.
01-29
119975 Singapore
Phone: 65-6835-8000
Fax: 65-6835-8020
Web Address: www.ema.gov.sg
The Energy Market Authority (EMA) promotes competition in the electricity and piped gas industry and maintains the security and reliability of the power system. EMA is a statutory board under the Ministry of Trade and Industry that regulates the electricity and gas industry and district cooling services in designated areas of Singapore.

Energy Policy Research Foundation Inc. (EPRINC)
1031 31st St. NW
Washington, DC 20007-4401 US
Phone: 202-944-3339
Fax: 202-944-9830

E-mail Address: *yulang@eprinc.org*
Web Address: www.eprinc.org
The Energy Policy Research Foundation, Inc. (EPRINC), formerly PIRINC was incorporated in 1944 and is a not-for-profit organization that studies energy economics with special emphasis on oil. It is known internationally for providing objective analysis of energy issues. Its website offers a wealth of up-to-the-minute white papers on energy production and energy issues.

Energy Security Analysis, Inc. (ESAI)
401 Edgewater Pl., Ste. 640
Wakefield, MA 01880 US
Phone: 781-245-2036
Fax: 781-245-8706
E-mail Address: *admin@esai.com*
Web Address: www.esai.com
Energy Security Analysis, Inc. (ESAI) has a site that provides full-service energy research and analysis on both regional and global energy markets.

Hydrocarbon Online
5340 Fryling Rd., Ste. 101
Erie, PA 16510 US
Phone: 215-675-1800
E-mail Address: *info@vertmarkets.com*
Web Address: www.hydrocarbononline.com
Hydrocarbon Online is a site offering news and information on oil refining and hydrocarbon processing, including a careers page, breaking news in the petroleum and chemicals industries, product news and more.

India Energy Portal (IEP)
Lodhi Rd.
Darbari Seth Block, IHC Complex
New Delhi, 110 003 India
Phone: 91-11-2468-2100
Fax: 91-11-2468-2144
E-mail Address: *mailbox@teri.res.in*
Web Address: www.indiaenergyportal.org
The India Energy Portal (IEP), built upon public-private partnership, provides access to information and knowledge on various aspects of energy.

ODS-Petrodata
3200 Wilcrest Dr., Ste. 170
Houston, TX 77042 US
Phone: 832-463-3000
Fax: 832-463-3100
E-mail Address: *tmarsh@ods-petrodata.com*
Web Address: www.ihs.com/info/en/a/ods-petrodata/index.aspx
ODS-Petrodata provides users with data, information and market intelligence on the upstream oil and marine construction industries.

Offshore Technology
John Carpenter St.
John Carpenter House
London, EC4Y 0AN UK
Phone: 44-207-936-6400
E-mail Address: *offshore@spgmedia.com*
Web Address: www.offshore-technology.com
Offshore Technology produces online and print resources with latest news, detailed information and breakdown of products and services available to professionals in the offshore oil and gas industry.

Oil & Gas Journal Online
1455 West Loop S, Ste. 400
Houston, TX 77027 US
Phone: 713-621-9720
E-mail Address: *ogjsub@pennwell.com*
Web Address: www.ogj.com/index.html
Oil & Gas Journal Online, produced by PennWell Petroleum Group, is an online portal containing useful global energy news and information.

OilOnline
1635 W. Alabama
Houston, TX 77006 US
Phone: 713-529-1616
Fax: 713-523-2339
E-mail Address: *jamess@oilonline.com*
Web Address: www.oilonline.com
OilOnline provides online exploration and production information for the oil industry.

Petro Pages
1100 NASA Rd. One
Houston, TX 77058 US
Phone: 281-957-0048
Fax: 866-430-0239
Toll Free: 800-369-2815
Web Address: www.petropages.com
Petro Pages offers information about jobs, products, services and suppliers for the petroleum and process industries.

Petroleum Place, Inc.
1670 Broadway, Ste. 2900
Denver, CO 80202 US
Phone: 303-292-0990

Fax: 303-292-1812
Web Address: www.petroleumplace.com
Petroleum Place, Inc. provides acquisition and divestiture services, as well as operations software and geospatial data solutions to the upstream oil and gas industry through The Oil & Gas Asset Clearinghouse, P2 Energy Solutions and Tobin Data.

Power Online
5340 Fryling Rd., Ste. 101
Erie, PA 16510 US
E-mail Address: *info@vertmarkets.com*
Web Address: www.poweronline.com
Power Online is an energy industry web site offering a global newswire and energy job postings, as well as a Web Resource Center link.

Refining Online
P.O. Box 218275
Houston, TX 77218 US
Phone: 281-589-6600
Fax: 281-589-7335
E-mail Address: *info@refiningonline.com*
Web Address: www.refiningonline.com
Refining Online, a service of Astron International, Inc., is an online refining resource that provides information, a knowledge base and various software tools for professionals in the refining industry.

Rigzone
5870 Hwy 6 N., Ste. 107
Houston, TX 77084 US
Phone: 281-345-4040
Fax: 281-345-4848
E-mail Address: *media@rigzone.com*
Web Address: www.rigzone.com
Rigzone provides oil and gas industry news, events and information, offshore reports, rig updates, a company and products database and directory, careers, a classifieds marketplace, and more.

WorldOil.com
2 Greenway Plz., Ste. 1020
Houston, TX 77046 US
Phone: 713-529-4301
Fax: 713-520-4433
E-mail Address: *nell.lukosavich@worldoil.com*
Web Address: www.worldoil.com
Worldoil.com is an Internet business that serves the oil field services industry. The web site includes a catalog of products and services, a magazine, an information center of breaking industry news and an industry directory.

XXXVIII. Engineering Indices

Cornell Engineering Library (The)
Engineering Library Cornell University
Carpenter Hall, Fl. 1
Ithaca, NY 14853 US
Phone: 607-254-6261
E-mail Address: *engranswers@cornell.edu*
Web Address: engineering.library.cornell.edu
Cornell University's Engineering Library web site has a number of resources concerning engineering research, as well as links to other engineering industry information sources. Its physical location on Cornell's campus possesses over 400,000 print volumes and more than 2 million micro-forms.

XXXIX. Engineering, Research & Scientific Associations

American Association for the Advancement of Science (AAAS)
1200 New York Ave. NW
Washington, DC 20005 US
Phone: 202-326-6400
E-mail Address: *webmaster@aaas.org*
Web Address: www.aaas.org
The American Association for the Advancement of Science (AAAS) is the world's largest scientific society and the publisher of Science magazine. It is an international nonprofit organization dedicated to advancing science around the globe.

American Association of Petroleum Geologists (AAPG)
1444 S. Boulder Ave.
Tulsa, OK 74119 US
Phone: 918-584-2555
Fax: 918-560-2665
Toll Free: 800-364-2274
Web Address: www.aapg.org
The American Association of Petroleum Geologists (AAPG) is an international geological organization that supports educational and scientific programs and projects related to geosciences.

American Geophysical Union (AGU)
2000 Florida Ave. NW
Washington, DC 20009-1277 US
Phone: 202-462-6900
Fax: 202-328-0566
Toll Free: 800-966-2481
E-mail Address: *service@agu.org*

Web Address: www.agu.org
The American Geophysical Union (AGU) is an international scientific community that performs research and provides information about the interdisciplinary field of geophysics.

American Institute of Chemical Engineers (AIChE)
3 Park Ave.
New York, NY 10016-5991 US
Phone: 203-702-7660
Fax: 203-775-5177
Toll Free: 800-242-4363
E-mail Address: *steps@aiche.org*
Web Address: www.aiche.org
The American Institute of Chemical Engineers (AIChE) provides leadership in advancing the chemical engineering profession. The organization, which is comprised of more than 40,000 members from over 90 countries, provides informational resources to chemical engineers.

American Institute of Mining, Metallurgical and Petroleum Engineers (AIME)
12999 E. Adam Aircraft Cir.
Englewood, CO 80127 US
Phone: 303-325-5185
Fax: 888-702-0049
E-mail Address: *aime@aimehq.org*
Web Address: www.aimehq.org
The American Institute of Mining, Metallurgical and Petroleum Engineers (AIME) is a trade association devoted to the science of the production and use of minerals, metals, energy sources and materials.

American National Standards Institute (ANSI)
1899 L St. NW, Fl. 11
Washington, DC 20036 US
Phone: 202-293-8020
Fax: 202-293-9287
E-mail Address: *info@ansi.org*
Web Address: www.ansi.org
The American National Standards Institute (ANSI) is a private, nonprofit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. Its mission is to enhance both the global competitiveness of U.S. business and the quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems and safeguarding their integrity.

American Nuclear Society (ANS)
555 N. Kensington Ave.
La Grange Park, IL 60526 US
Phone: 708-352-6611
Fax: 708-352-0499
Toll Free: 800-323-3044
Web Address: www.ans.org
The American Nuclear Society (ANS) is a nonprofit organization unifying professional activities within the nuclear science and technology fields. ANS seeks to promote the awareness and understanding of the application of nuclear science and technology.

American Society of Civil Engineers (ASCE)
1801 Alexander Bell Dr.
Reston, VA 20191-4400 US
Phone: 703-295-6300
Fax: 703-295-6222
Toll Free: 800-548-2723
E-mail Address: *member@asce.org*
Web Address: www.asce.org
The American Society of Civil Engineers (ASCE) is a leading professional organization serving civil engineers. It ensures safer buildings, water systems and other civil engineering works by developing technical codes and standards.

Association of Consulting Chemists and Chemical Engineers (ACC&CE)
P.O. Box 902
Murray Hill, NJ 07974-0902 US
Phone: 908-464-3182
Fax: 908-464-3182
E-mail Address: *acccce@chemconsult.org*
Web Address: www.chemconsult.org
The Association of Consulting Chemists and Chemical Engineers (ACC&CE) was established to advance the practices of consulting chemists and chemical engineers.

ASTM International
100 Barr Harbor Dr.
P.O. Box C700
West Conshohocken, PA 19428-2959 US
Phone: 610-832-9500
Fax: 610-832-9555
E-mail Address: *jthomas@astm.org*
Web Address: www.astm.org
ASTM International, formerly the American Society for Testing & Materials, provides and develops voluntary consensus standards and related technical information that promote public health and safety. It

also contributes to the reliability of materials for industries worldwide.

Chinese Hydraulic Engineering Society (CHES)
2-2 BaiGuang Rd.
Beijing, 100053 China
Phone: 86-1063202163
Fax: 86-1063202154
E-mail Address: *Ches@mwr.gov.cn*
Web Address: www.ches.org.cn
The Chinese Hydraulic Engineering Society (CHES) aims to promote hydraulic engineering professionals and the water resources sciences and technologies. CHES has 31 regional socieites in China.

CIEMAT
Avda. Complutense 22
Madrid, 28040 Spain
Phone: 91-346-60-00
Fax: 91-346-60-05
E-mail Address: *contacto@ciemat.es*
Web Address: www.ciemat.es
The CIEMAT, a unit of Spain's Ministry of Education and Science, is a public research agency. Its areas of focus include solar energy, biomass energy, wind energy, environment, basic research, fusion by magnetic confinement, nuclear safety, and technology transfer. Primary operations include PSA, the Solar Platform of Almeria, where concentrating solar power (CSP) is researched; CEDER, the Centre for the Development of Renewable Energy Sources; and CETA-CIEMAT, a center for information technology research.

European Association of Geoscientists & Engineers (EAGE)
De Molen 42
Db Houten, 3990 The Netherlands
Phone: 31-88-995-5055
Fax: 31-30-6343524
E-mail Address: *eage@eage.org*
Web Address: www.eage.org
EAGE is a professional association for geoscientists and engineers. It is a European-based organization with a worldwide membership providing a global network of commercial and academic professionals to all members. The association is truly multi-disciplinary and international in form and pursuits.

IEEE Oceanic Engineering Society (OES)
445 Hoes Ln.
P.O. Box 1331
Piscataway, NJ 08855-1331 US
Phone: 601-798-0277
Toll Free: 800-678-4333
E-mail Address: *sholt@ieee.org*
Web Address: www.oceanicengineering.org
The IEEE Oceanic Engineering Society (OES) is the division of the IEEE that deals with electrical engineering at sea, including unmanned submarines and offshore oil platforms.

Industrial Research Institute (IRI)
2200 Clarendon Blvd., Ste. 1102
Arlington, VA 22201 US
Phone: 703-647-2580
Fax: 703-647-2581
E-mail Address: *taussig@iriweb.org*
Web Address: www.iriweb.org
The Industrial Research Institute (IRI) is a nonprofit organization of over 200 leading industrial companies, representing industries such as aerospace, automotive, chemical, computers and electronics, which carry out industrial research efforts in the U.S. manufacturing sector. IRI helps members improve research and development capabilities.

Institute of Electrical and Electronics Engineers (IEEE)
3 Park Ave., Fl. 17
New York, NY 10016-5997 US
Phone: 212-419-7900
Fax: 212-752-4929
Toll Free: 800-678-4333
E-mail Address: *ieeeusa@ieee.org*
Web Address: www.ieee.org
The Institute of Electrical and Electronics Engineers (IEEE) is a nonprofit, technical professional association of more than 375,000 individual members in approximately 160 countries. The IEEE sets global technical standards and acts as an authority in technical areas ranging from computer engineering, biomedical technology and telecommunications, to electric power, aerospace and consumer electronics.

Institute of Industrial Engineers (IIE)
3577 Parkway Ln., Ste. 200
Norcross, GA 30092 US
Phone: 770-449-0460
Fax: 770-441-3295
Toll Free: 800-494-0460
E-mail Address: *editor@iienet.org*
Web Address: www.iienet2.org
The Institute of Industrial Engineers (IIE) is dedicated to the professional needs of industrial engineers.

Institute of Marine Engineering, Science and Technology (IMarEST)
Aldgate House
33 Aldgate High St.
London, EC3N 1EN UK
Phone: 44-20-7382-2636
Fax: 44-20-7382-2674
E-mail Address: *marketing@imarest.org*
Web Address: www.imarest.org
The Institute of Marine Engineering, Science and Technology (IMarEST) works to promote the development of marine engineering, science and technology.

Institution of Mechanical Engineers-UK
1 Birdcage Walk
Westminster
London, SW1H 9JJ UK
Phone: 44-20-7222-7899
Fax: 44-20-7222-4557
E-mail Address: *enquiries@imeche.org*
Web Address: www.imeche.org
Institution of Mechanical Engineers represents the mechanical engineering profession in UK. The UK has the sixth largest manufacturing industry in the world and this association recognizes engineering professionals in this field. In addition, its other major themes are the energy, environment and transport industries as well as hosting educational opportunities for engineers.

International Petroleum Technology Institute (IPTI)
11757 Katy Fwy., Ste. 865
Houston, TX 77079 US
Phone: 281-493-3491
Fax: 281-493-3493
E-mail Address: *ipti@asme.org*
Web Address: www.asme-ipti.org
The International Petroleum Technology Institute (IPTI) is the division of ASME (the American Society of Mechanical Engineers) concerned with the special engineering needs of the petroleum industry.

International Society for Measurement and Control (ISA)
67 T.W. Alexander Dr.
Research Triangle Park, NC 27709 US
Phone: 919-549-8411
Fax: 919-549-8288
E-mail Address: *info@isa.org*
Web Address: www.isa.org
The International Society for Measurement and Control (ISA) is a nonprofit organization that serves the professional development and credential needs of control system engineers, instrument technicians and others within the field of measurement and control.

International Standards Organization (ISO)
1 ch. de la Voie-Creuse
Case Postale 56
Geneva 20, CH-1211 Switzerland
Phone: 41-22-749-01-11
Fax: 41-22-733-34-30
E-mail Address: *central@iso.org*
Web Address: www.iso.org
The International Standards Organization (ISO) is a global consortium of national standards institutes from 162 countries. The established International Standards are designed to make products and services more efficient, safe and clean.

Marine Technology Society (MTS)
1100 H St. NW, Ste. LL-100
Washington, DC 20005 US
Phone: 202-717-8705
Fax: 202-347-4302
E-mail Address: *membership@mtsociety.org*
Web Address: www.mtsociety.org
The Marine Technology Society (MTS) is an organization devoted to marine science and technical knowledge.

Minerals, Metals & Materials Society (The) (TMS)
184 Thorn Hill Rd.
Warrendale, PA 15086-7514 US
Phone: 724-776-9000
Fax: 724-776-3770
Toll Free: 800-759-4867
E-mail Address: *webmaster@tms.org*
Web Address: www.tms.org
The Minerals Metals & Materials Society (TMS) is an organization of professionals and students involved in metallurgy and material engineering, promoting the exchange of information, education and technology.

Research in Germany, German Academic Exchange Service (DAAD)
Kennedyallee 50
Bonn, 53175 Germany
Phone: 49-228-882-743
Fax: 49-228-882-9743
Web Address: www.research-in-germany.de

The Research in Germany portal, German Academic Exchange Service (DAAD),
is an information platform and contact point for those looking to find out more about Germany's research landscape and its latest research achievements. The portal is an initiative of the Federal Ministry of Education and Research.

Royal Society (The)
6-9 Carlton House Ter.
London, SW1Y 5AG UK
Phone: 44-20-7451-2500
E-mail Address: *communications@royalsociety.org*
Web Address: www.royalsoc.ac.uk
The Royal Society, originally founded in 1660, is the UK's leading scientific organization and the oldest scientific community in continuous existence. It operates as a national academy of science, supporting scientists, engineers, technologists and researchers. Its web site contains a wealth of data about the research and development initiatives of its fellows and foreign members.

Society of Exploration Geophysicists (SEG)
8801 S. Yale, Ste. 500
Tulsa, OK 74137-3575 US
Phone: 918-497-5500
Fax: 918-497-5557
E-mail Address: *membership_online@seg.org*
Web Address: www.seg.org
The Society of Exploration Geophysicists (SEG) promotes the science of geophysics. The website provides access to their foundation, online publications and employment and education services.

Society of Manufacturing Engineers (SME)
One SME Dr.
Dearborn, MI 48121 US
Phone: 313-425-3000
Fax: 313-425-3400
Toll Free: 800-733-4763
E-mail Address: *communications@sme.org*
Web Address: www.sme.org
The Society of Manufacturing Engineers (SME) is a leading professional organization serving engineers in the manufacturing industries.

Society of Naval Architects and Marine Engineers (SNAME)
601 Pavonia Ave.
Jersey City, NJ 07306 US
Phone: 201-798-4800
Fax: 201-798-4975
Toll Free: 800-798-2188
E-mail Address: *ldavis@sname.org*
Web Address: www.sname.org
The Society of Naval Architects and Marine Engineers (SNAME) is an internationally recognized nonprofit, professional society of members serving the maritime and offshore industries and their suppliers.

Society of Petroleum Engineers (SPE)
830 S. Greenville Ave.
Allen, TX 75002 US
Phone: 972-952-9393
Fax: 972-952-9435
Toll Free: 800-456-6863
E-mail Address: *spedal@spe.org*
Web Address: www.spe.org
The Society of Petroleum Engineers (SPE) helps connect engineers in the oil and gas industry with ideas, answers, resources and technological information.

World Federation of Engineering Organizations
Maison de l'UNESCO
1, rue Miollis
Paris, 75015 France
Phone: 33-1-45-68-48-46
Fax: 33-1-45-68-48-65
E-mail Address: *info@wfeo.net*
Web Address: www.wfeo.org
World Federation of Engineering Organizations (WFEO) is an international non-governmental organization that represents major engineering professional societies in over 90 nations. It has several standing committees including engineering and the environment, technology, communications, capacity building, education, energy and women in engineering.

XL. Environmental Industry Associations

Air & Waste Management Association (A&WMA)
420 Fort Duquesne Blvd., Fl. 3
Pittsburgh, PA 15222 US
Phone: 412-232-3444
Fax: 412-232-3450
Toll Free: 800-270-3444
E-mail Address: *info@awma.org*
Web Address: www.awma.org
The Air & Waste Management Association (A&WMA) is a nonprofit professional organization

that provides education and support to more than 8,000 environmental professionals in 65 nations.

Institute of Clean Air Companies (ICAC)
2025 M St. NW, Ste. 800
Washington, DC 20036 US
Phone: 202-367-1114
E-mail Address: *icacinfo@icac.com*
Web Address: www.icac.com
The Institute of Clean Air Companies (ICAC) is a U.S. association of companies that supply air pollution monitoring and control systems, equipment, and services for stationary sources. ICAC has promoted the air pollution control industry and encouraged improvement of engineering and technical standards since 1960. Members are leading manufacturers of equipment to monitor and control emissions of particulate, VOC, SO2, NOx, air toxins and greenhouse gases.

XLI. Environmental Resources

Center for Clean Air Policy (CCAP)
750 First St. NE, Ste. 940
Washington, DC 20002 US
Phone: 202-408-9260
Fax: 202-408-8896
E-mail Address: *sdodd@ccap.org*
Web Address: www.ccap.org
The Center for Clean Air Policy (CCAP) promotes and applies solutions to key environmental and energy problems.

Center for Climate and Energy Solutions (C2ES)
2101 Wilson Blvd., Ste. 550
Arlington, VA 22201 US
Phone: 703-516-4146
Fax: 703-516-9551
Web Address: www.c2es.org
The Center for Climate and Energy Solutions (C2ES), the successor to the Pew Center on Global Climate Change, was established in 2011 as a nonprofit, non-partisan and independent organization. C2ES' mission is to provide credible information, straight answers, and innovative solutions in the effort to address global climate change.

Environment Canada
10 Wellington, Fl. 23
Gatineau, QC K1A 0H3 Canada
Phone: 819-997-2800
Fax: 819-994-1412
Toll Free: 800 668-6767
E-mail Address: *enviroinfo@ec.gc.ca*
Web Address: www.ec.gc.ca
Environment Canada is the Canadian government's natural environment preservation department.

German Federal Environmental Foundation
Deutsche Bundesstiftung Umwelt
An der Bornau 2
Osnabruck, 49090 Germany
Phone: 49-541-9633-0
Fax: 49-541-9633-190
Web Address: www.dbu.de
The German Federal Environmental Foundation's projects and activities concentrate on environmental technology and research, nature conservation, environmental communication and cultural assets. It is an initiative of the German Government.

XLII. Financial Industry Resources

SNL Financial
1 SNL Plz., 212 7th St. NE
Charlottesville, VA 22902 US
Phone: 434-977-1600
Fax: 434-977-4466
Toll Free: 866-296-3743
E-mail Address: *support@snl.com*
Web Address: www.snl.com
SNL Financial provides industry-specific research and statistics in the banking, financial services, insurance, real estate and energy sectors.

XLIII. Gasoline Retailing Associations

Florida Petroleum Marketers Association (FPMA)
209 Office Plaza Dr.
Tallahassee, FL 32301 US
Phone: 850-877-5178
Fax: 850-877-5864
Toll Free: 800-523-9166
Web Address: www.fpma.org
The Florida Petroleum Marketers Association (FPMA) represents the petroleum and convenience store industry in Florida. Its web site includes Internet resources, government news, general industry news and updated information.

Indiana Petroleum Marketers and Convenience Store Association (IPCA)
115 W. Washington St., Ste. 1690
Indianapolis, IN 46204 US
Phone: 317-633-4662

Fax: 317-630-1827
E-mail Address: *brenda@ipca.org*
Web Address: www.ipca.org
The Indiana Petroleum Marketers and Convenience Store Association (IPCA) represents Indiana's petroleum marketers, lube oil dealers and convenience store and truck stop operators.

Kentucky Petroleum Marketers Association (KPMA)
2365 Harrodsburg Rd., Ste. A325
Lexington, KY 40504 US
Phone: 859-226-4374
Fax: 859-226-4404
E-mail Address: *Anne.Hardy@kpma.net*
Web Address: www.kpma.net
The Kentucky Petroleum Marketers Association (KPMA) is a nonprofit trade association providing information relevant to retail petroleum sales for all segments of the petroleum industry in the state of Kentucky.

Louisiana Oil Marketers and Convenience Stores Association (LOMCSA)
2431 S. Acadian Trwy., Ste. 230
Baton Rouge, LA 70808 US
Phone: 225-926-8300
Fax: 225-926-7722
E-mail Address: *lomcsa@lomcsa.com*
Web Address: www.lomcsa.com
The Louisiana Oil Marketers and Convenience Stores Association (LOMCSA) is a nonprofit organization that represents the business interests of independent distributors of petroleum products in Louisiana.

Maine Energy Marketers Association (MEMA)
25 Greenwood Rd.
P.O. Box 249
Brunswick, ME 04011-0249 US
Phone: 207-729-5298
Fax: 207-721-9227
Toll Free: 888-863-3753
E-mail Address: *jamie@maineenergymarketers.com*
Web Address: www.maineenergymarketers.com
The Maine Energy Marketers Association (MEMA), formerly the Maine Oil Dealers Association, is a member organization that represents the petroleum industry and its customers in Maine.

Missouri Petroleum Marketers and Convenience Store Association (MPCA)
205 E. Capitol Ave., Ste. 200
Jefferson City, MO 65101 US
Phone: 573-635-7117
Fax: 573-635-3575
Web Address: www.mpca.org
The Missouri Petroleum Marketers and Convenience Store Association (MPCA) is dedicated to serving the interests of convenience stores across Missouri.

Ohio Petroleum Marketers & Convenience Store Association (OPMCA)
17 S. High St., Ste. 810
Columbus, OH 43215 US
Phone: 614-947-8646
Fax: 614-947-8648
E-mail Address: *info@opmca.org*
Web Address: https://netforum.avectra.com/eWeb/StartPage.aspx?Site=OPMCA
The Ohio Petroleum Marketers & Convenience Store Association (OPMCA) is dedicated to serving the interests of retail petroleum marketers, independent refineries, truck stops, retail chains and convenience stores throughout Ohio.

Petroleum Marketers Association of America (PMAA)
1901 N. Ft. Myer Dr., Ste. 500
Arlington, VA 22209-1604 US
Phone: 703-351-8000
Fax: 703-351-9160
E-mail Address: *info@pmaa.org*
Web Address: www.pmaa.org
The Petroleum Marketers Association of America (PMAA) is a federation of 42 state and regional trade associations.

Society of Independent Gasoline Marketers of America (SIGMA)
3930 Pender Dr., Ste. 340
Fairfax, VA 22030 US
Phone: 703-709-7000
Fax: 703-709-7007
E-mail Address: *scrosby@sigma.org*
Web Address: www.sigma.org
The Society of Independent Gasoline Marketers of America (SIGMA) represents chain retailers and marketers of motor fuel, ensuring a free and unencumbered economic environment.

XLIV. Hybrid & Electric Vehicles

Electric Drive Transportation Association (EDTA)
1250 Eye St. NW, Ste. 902

Washington, DC 20005 US
Phone: 202-408-0774
E-mail Address: *info@electricdrive.org*
Web Address: www.electricdrive.org
The Electric Drive Transportation Association (EDTA) is an industry association working to advance electric vehicle transportation technologies and supporting infrastructure through policy, information and market development initiatives.

XLV. Industry Research/Market Research

Forrester Research
60 Acorn Park Dr.
Cambridge, MA 02140 US
Phone: 617-613-6000
Fax: 617-613-5200
Toll Free: 866-367-7378
Web Address: www.forrester.com
Forrester Research is a publicly traded company that identifies and analyzes emerging trends in technology and their impact on business. Among the firm's specialties are the financial services, retail, health care, entertainment, automotive and information technology industries.

Gartner, Inc.
56 Top Gallant Rd.
Stamford, CT 06902 US
Phone: 203-964-0096
E-mail Address: *inquiry@gartner.com*
Web Address: www.gartner.com
Gartner, Inc. is a publicly traded IT company that provides competitive intelligence and strategic consulting and advisory services to numerous clients worldwide.

MarketResearch.com
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Rockville, MD 20852 US
Phone: 240-747-3000
Fax: 240-747-3004
Toll Free: 800-298-5699
E-mail Address:
customerservice@marketresearch.com
Web Address: www.marketresearch.com
MarketResearch.com is a leading broker for professional market research and industry analysis. Users are able to search the company's database of research publications including data on global industries, companies, products and trends.

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Fax: 713-932-7080
E-mail Address:
customersupport@plunkettresearch.com
Web Address: www.plunkettresearch.com
Plunkett Research, Ltd. is a leading provider of market research, industry trends analysis and business statistics. Since 1985, it has served clients worldwide, including corporations, universities, libraries, consultants and government agencies. At the firm's web site, visitors can view product information and pricing and access a large amount of basic market information on industries such as financial services, InfoTech, e-commerce, health care and biotech.

XLVI. MBA Resources

MBA Depot
Web Address: www.mbadepot.com
MBA Depot is an online community and information portal for MBAs, potential MBA program applicants and business professionals.

XLVII. Research & Development, Laboratories

Advanced Technology Laboratory (ARL)
10000 Burnet Rd.
University of Texas at Austin
Austin, TX 78758 US
Phone: 512-835-3200
Fax: 512-835-3259
E-mail Address: *atl_director@arlut.utexas.edu*
Web Address: www.arlut.utexas.edu
Advanced Technology Laboratory (ARL) at the University of Texas at Austin provides research programs dedicated to improving the military capability of the United States in applications of acoustics, electromagnetic and information technology.

Argonne National Laboratory, Nuclear Engineering Division (ANL)
9700 S. Cass Ave.
Argonne, IL 60439-4814 US
Fax: 630-252-4780
E-mail Address: *neinfo@anl.gov*
Web Address: www.ne.anl.gov

The Argonne National Laboratory-Nuclear Engineering Division (ANL) is engaged in research and development in the area of applied nuclear technologies such as nonproliferation, environmental remediation, fusion power and new initiatives.

Commonwealth Scientific and Industrial Research Organization (CSRIO)
CSIRO Enquiries
Bag 10
Clayton South, Victoria 3169 Australia
Phone: 61-3-9545-2176
Fax: 61-3-9545-2175
Toll Free: 1300-363-400
E-mail Address: *enquiries@csiro.au*
Web Address: www.csiro.au
The Commonwealth Scientific and Industrial Research Organization (CSRIO) is Australia's national science agency and a leading international research agency. CSRIO performs research in Australia over a broad range of areas including agriculture, minerals and energy, manufacturing, communications, construction, health and the environment.

Council of Scientific & Industrial Research (CSIR)
2 Rafi Marg
Anusandhan Bhawan
New Delhi, 110 001 India
Phone: 91-11-2371-0618
Fax: 91-11-2371-3011
E-mail Address: *itweb@csir.res.in*
Web Address: rdpp.csir.res.in/csir_acsir/Home.aspx
The Council of Scientific & Industrial Research (CSIR) is a government-funded organization that promotes research and development initiatives in India. It operates in the fields of energy, biotechnology, space, science and technology.

Fraunhofer-Gesellschaft (FhG) (The)
Fraunhofer-Gesellschaft zur Forderung der angewandten Forschung e.V.
Postfach 20 07 33
Munich, 80007 Germany
Phone: 49-89-1205-0
Fax: 49-89-1205-7531
Web Address: www.fraunhofer.de
The Fraunhofer-Gesellschaft (FhG) institute focuses on research in health, security, energy, communication, the environment and mobility. FhG includes over 80 research units in Germany. Over 70% of its projects are derived from industry contracts.

Hanford Nuclear Site
825 Jadwin Ave., Ste. 1
Richland, WA 99352 US
Phone: 509-376-7411
Toll Free: 800-664-0771
E-mail Address: *Webmaster@rl.gov*
Web Address: www.hanford.gov
The Hanford Nuclear Site is designed to solve critical problems related to the environment, energy production and use, U.S. economic competitiveness and national security.

Helmholtz Association
Anna-Louisa-Karsch-Strasse 2
Berlin, 10178 Germany
Phone: 49-30-206329-42
Fax: 49-30-206329-59
E-mail Address: *eva-jasmin.freyschmidt@helmholtz.de*
Web Address: www.helmholtz.de/en
The Helmholtz Association is a community of 17 scientific-technical and biological-medical research centers. Helmholtz Centers perform top-class research in strategic programs in several core fields: energy, earth and environment, health, key technologies, structure of matter, aeronautics, space and transport.

Idaho National Laboratory (INL)
2525 Fremont Ave.
Idaho Falls, ID 83415 US
Phone: 208-526-0111
Toll Free: 866-495-7440
Web Address: inlportal.inl.gov/portal/server.pt/community/home/255
Idaho National Laboratory (INL) is a multidisciplinary, multiprogram laboratory that specializes in developing nuclear energy with research concerning the environment, energy, science and national defense.

Indira Gandhi Institute of Development Research
Gen. A. K. Vaidya Marg
Goregaon (E)
Mumbai, 400 065 India
Phone: 022-2840-0919
Fax: 022-2840-2752
E-mail Address: *director@igidr.ac.in*
Web Address: www.igidr.ac.in

The Indira Gandhi Institute of Development Research (IGIDR) focuses on research of the economic, technological, social, political and ecological aspects of development and the influence of international trading, financial and economic systems on countries. It also includes an examination of energy, technology and environmental problems in a global setting.

Leibniz Association of German Research Institutes (WGL)
Chaussee Strasse 111
Berlin, D-10115 Germany
Phone: 49-030/20-60-49-0
Fax: 49-030/20-60-49-55
E-mail Address: *mannheim@leibniz-gemeinschaft.de*
Web Address: www.leibniz-gemeinschaft.de
The Leibniz Association of German Research Institutes (WGL) is a research organization that comprises over 85 institutes. WGL works on international interdisciplinary research and acts as a bridge between traditional research and customer oriented applications. The association focuses on scientific excellence and social relevance.

Los Alamos National Laboratory (LANL)
Bikini Atoll Rd., SM 30
P.O. Box 1663
Los Alamos, NM 87545 US
Phone: 505-667-5061
Fax: 505-665-4411
Toll Free: 877-723-4101
E-mail Address: *community@lanl.gov*
Web Address: www.lanl.gov
The Los Alamos National Laboratory (LANL), a national energy lab in New Mexico, was originally built as a work site for the team that designed the first atomic bomb during World War II. Currently, it provides a continual stream of research in physics and energy matters. Much of that research is put to use in the commercial sector.

Max Planck Society (MPG)
Hofgartenstr. 8
Munich, 80539 Germany
Phone: 49-(89)-210-80
Fax: 49-(89)-210-811-11
E-mail Address: *christina.beck@gv.mpg.de*
Web Address: www.mpg.de
The Max Planck Society (MPG) currently maintains 80 institutes, research units and working groups that are devoted to basic research in the natural sciences, life sciences, social sciences, and the humanities. Max Planck Institutes work largely in an interdisciplinary setting and in close cooperation with universities and research institutes in Germany and abroad.

National Renewable Energy Laboratory (NREL)
1617 Cole Blvd.
Golden, CO 80401-3393 US
Phone: 303-275-3000
Web Address: www.nrel.gov
The National Renewable Energy Laboratory (NREL) reduces nuclear danger, transfers applied environmental technology to government and non-government entities and forms economic and industrial alliances.

National Research Council Canada (NRC)
1200 Montreal Rd., Bldg. M-58
Ottawa, ON K1A 0R6 Canada
Phone: 613-993-9101
Fax: 613-952-9907
Toll Free: 877-672-2672
E-mail Address: *info@nrc-cnrc.gc.ca*
Web Address: www.nrc-cnrc.gc.ca
National Research Council Canada (NRC) is comprised of 20 government organization, research institutes and programs that carry out multidisciplinary research. It maintains partnerships with industries and sectors key to Canada's economic development.

Oak Ridge National Laboratory (ORNL)
1 Bethel Valley Rd.
P.O. Box 2008
Oak Ridge, TN 37831 US
Phone: 865-574-4160
Fax: 865-574-0595
E-mail Address: *strohlhf@ornl.gov*
Web Address: www.ornl.gov
The Oak Ridge National Laboratory (ORNL) is a multiprogram science and technology laboratory managed for the U.S. Department of Energy by U.T.-Battelle, LLC. It conducts basic and applied research and development to create scientific knowledge and technological solutions.

Sandia National Laboratories
1515 Eubank SE
Albuquerque, NM 87123 US
Phone: 505-844-8066
E-mail Address: *webmaster@sandia.gov*
Web Address: www.sandia.gov
Sandia National Laboratories is a national security laboratory operated for the U.S. Department of

Energy by the Sandia Corporation. It designs all nuclear components for the nation's nuclear weapons and performs a wide variety of energy research and development projects.

Savannah River Site (SRS)
U.S. Dept. of Energy, P.O. Box A
Savannah River Operations Office
Aiken, SC 29802 US
Phone: 803-952-7697
E-mail Address: *dean.campbell@srs.gov*
Web Address: www.srs.gov
The Savannah River Site (SRS) is a nuclear fuel storage and production site that works to protect the people and the environment of the U.S. through safe, secure, cost-effective management of the country's nuclear weapons stockpile and nuclear materials. While the site is owned by the U.S. Department of Energy, it is operated by the subsidiaries of Washington Savannah River Company, LLC (WSRC), itself a wholly-owned subsidiary of Washington Group International.

SRI International
333 Ravenswood Ave.
Menlo Park, CA 94025-3493 US
Phone: 650-859-2000
E-mail Address: *webmaster@sri.com*
Web Address: www.sri.com
SRI International is a nonprofit research organization that offers contract research services to government agencies, as well as commercial enterprises and other private sector institutions. It is organized into five R&D areas: Physical Sciences; Biosciences; Information and Computing Sciences; Engineering and Systems; and Policy.

XLVIII. Risk Professionals Associations

Global Association of Risk Professionals (GARP)
111 Town Square Pl., Ste. 1215
Jersey City, NJ 07310 US
Phone: 201-719-7210
Fax: 201-222-5022
E-mail Address: *researchcenter@garp.com*
Web Address: www.garp.org
The Global Association of Risk Professionals (GARP) is a not-for-profit organization for risk managers, with a focus on the financial and energy industries. GARP offers the FRM (Financial Risk Manager) and ERP (Energy Risk Professional) certifications, as well as education and training, media, and events. In addition to its U.S. headquarters, it has offices in the UK.

XLIX. Robotics Associations

International Federation of Robotics (IFR)
Lyoner Str. 18
Frankfurt am Main, 60528 Germany
Phone: 49-69-6603-1502
Fax: 49-69-6603-2502
E-mail Address: *gl@ifr.org*
Web Address: www.ifr.org
The International Federation of Robotics (IFR) promotes the robotics industry worldwide, including the fields of industrial robots for manufacturing and other purposes, service robots and robotics research. Among other things, it is focused on research, development, use and international co-operation in the entire field of robotics, and it seeks to act as a focal point for organizations and governmental representatives in activities related to robotics.

L. Science & Technology Resources

Technology Review
1 Main St., Fl. 13
Cambridge, MA 02142 US
Phone: 617-475-8000
Fax: 617-475-8042
Toll Free: 800-877-5230
Web Address: www.technologyreview.com
Technology Review, an MIT enterprise, publishes tech industry news, covers innovation and writes in-depth articles about research, development and cutting-edge technologies.

LI. Smart Meter Industry Associations

Smart Meter Manufacturers Association of America (SMMAA)
Web Address: www.smmaa.org
The Smart Meter Manufacturers Association of America (SMMAA) is a group consisting of smart meter manufacturers, which represent roughly 99% of the installed base of electric meters currently deployed in the U.S.

LII. Stocks & Financial Markets Data

Bloomberg LP
731 Lexington Ave.
New York, NY 10022 US
Phone: 212-318-2000
Fax: 917-369-5000
Web Address: www.bloomberg.com
Bloomberg LP is one of the world's premier providers of financial information and business news.

LIII. Technology Transfer Associations

Association of University Technology Managers (AUTM)
111 Deer Lake Rd., Ste. 100
Deerfield, IL 60015 US
Phone: 847-559-0846
Fax: 847-480-9282
E-mail Address: *info@autm.net*
Web Address: www.autm.net
The Association of University Technology Managers (AUTM) is a nonprofit professional association whose members belong to over 350 research institutions, universities, teaching hospitals, government agencies and corporations from 45 countries. The association's mission is to advance the field of technology transfer and enhance members' ability to bring academic and nonprofit research to people around the world.

Federal Laboratory Consortium for Technology Transfer
950 N. Kings Hwy., Ste. 208
Cherry Hill, NJ 08304 US
Phone: 856-667-7727
Fax: 856-667-8009
E-mail Address: *flcmso@federallabs.org*
Web Address: www.federallabs.org
In keeping with the aims of the Federal Technology Transfer Act of 1986 and other related legislation, the Federal Laboratory Consortium (FLC) works to facilitate the sharing of research results and technology developments between federal laboratories and the mainstream U.S. economy. FLC affiliates include federal laboratories, large and small businesses, academic and research institutions, state and local governments and various federal agencies. The group has regional support offices and local contacts throughout the U.S.

Licensing Executives Society (U.S.A. and Canada), Inc.
1800 Diagonal Rd., Ste. 280
Alexandria, VA 22314 US
Phone: 703-836-3106
Fax: 703-836-3107
E-mail Address: *info@les.org*
Web Address: www.lesusacanada.org
Licensing Executives Society (U.S.A. and Canada), Inc., established in 1965, is a professional association composed of about 5,000 members who work in fields related to the development, use, transfer, manufacture and marketing of intellectual property. Members include executives, lawyers, licensing consultants, engineers, academic researchers, scientists and government officials. The society is part of the larger Licensing Executives Society International, Inc. (same headquarters address), with a worldwide membership of some 12,000 members from approximately 80 countries.

State Science and Technology Institute (SSTI)
5015 Pine Creek Dr.
Westerville, OH 43081 US
Phone: 614-901-1690
Fax: 614-901-1696
Web Address: www.ssti.org
The State Science and Technology Institute (SSTI) is a national nonprofit group that serves as a resource for technology-based economic development. In addition to the information on its web site, the Institute publishes a free weekly digest of news and issues related to technology-based economic development efforts, as well as a members-only publication listing application information, eligibility criteria and submission deadlines for a variety of funding opportunities, federal and otherwise.

LIV. Trade Associations-General

Brazilian Trade & Investment Promotion Agency (Apex-Brasil)
SBN, Quadra 02, Lote 11
Edificio Apex-Brasil
Brasilia, DF 70040-020 Brazil
Phone: 55-61-3426-0202
E-mail Address: *investment@apexbrasil.com.br*
Web Address: www.apexbrasil.com.br
Apex-Brasil works to promote exports of Brazilian products and services, supporting some 70 industry sectors such as agribusiness, technology, civil engineering, entertainment, apparel and industrial equipment.

BUSINESSEUROPE
168 Ave. de Cortenbergh
Brussels, 1000 Belgium
Phone: 32(0)-2-237-65-11
Fax: 32(0)-2-231-14-45
E-mail Address: *main@businesseurope.eu*
Web Address: www.businesseurope.eu
BUSINESSEUROPE is a major European trade federation that operates in a manner similar to a chamber of commerce. Its members are the central national business federations of the 34 countries throughout Europe from which they come. Companies cannot become direct members of BUSINESSEUROPE, though there is a support group which offers the opportunity for firms to encourage BUSINESSEUROPE objectives in various ways.

Canadian Chamber of Commerce
360 Albert St., Ste. 420
Ottawa, ON K1R 7X7 Canada
Phone: 613-238-4000
Fax: 613-238-7643
E-mail Address: *info@chamber.ca*
Web Address: www.chamber.ca
The Canadian Chamber of Commerce is the liaison to the government representing businesses of all types in Canada.

United States Council for International Business (USCIB)
1212 Ave. of the Americas
New York, NY 10036 US
Phone: 212-354-4480
Fax: 212-575-0327
E-mail Address: *membership@uscib.org*
Web Address: www.uscib.org
The United States Council for International Business (USCIB) promotes an open system of world trade and investment through its global network. Standard USCIB members include corporations, law firms, consulting firms and industry associations. Limited membership options are available for chambers of commerce and sole legal practitioners.

LV. Trade Associations-Global

World Trade Organization (WTO)
Centre William Rappard
Rue de Lausanne 154
Geneva 21, CH-1211 Switzerland
Phone: 41-22-739-51-11
Fax: 41-22-731-42-06
E-mail Address: *enquiries@wto.og*
Web Address: www.wto.org
The World Trade Organization (WTO) is a global organization dealing with the rules of trade between nations. To become a member, nations must agree to abide by certain guidelines. Membership increases a nation's ability to import and export efficiently.

LVI. Trade Resources

BrazilBiz
E-mail Address: *BrazilBiz@maxtie.com*
Web Address: www.brazilbiz.com.br
The BrazilBiz web site serves as a clearinghouse of general contact information for Brazilian companies; registration on the site is free, and allows users to search within the BrazilBiz database for firms across a range of industries.

LVII. U.S. Government Agencies

Bureau of Economic Analysis (BEA)
1441 L St. NW
Washington, DC 20230 US
Phone: 202-606-9900
E-mail Address: *customerservice@bea.gov*
Web Address: www.bea.gov
The Bureau of Economic Analysis (BEA), an agency of the U.S. Department of Commerce, is the nation's economic accountant, preparing estimates that illuminate key national, international and regional aspects of the U.S. economy.

Bureau of Labor Statistics (BLS)
2 Massachusetts Ave. NE
Washington, DC 20212-0001 US
Phone: 202-691-5200
Toll Free: 800-877-8339
E-mail Address: *helpdesk@bls.gov*
Web Address: stats.bls.gov
The Bureau of Labor Statistics (BLS) is the principal fact-finding agency for the Federal Government in the field of labor economics and statistics. It is an independent national statistical agency that collects, processes, analyzes and disseminates statistical data to the American public, U.S. Congress, other federal agencies, state and local governments, business and labor. The BLS also serves as a statistical resource to the Department of Labor.

Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)
1849 C St. NW

Washington, DC 20240 US
Phone: 202-208-3985
E-mail Address: *BOEMPublicAffairs@boem.gov*
Web Address: www.boemre.gov
The Department of the Interior's (DOI), Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), is the federal agency responsible for overseeing the development of energy and mineral resources on the outer continental shelf, including offshore oil and gas production. (This bureau replaced the former Minerals Management Service in 2010.)

Energy Information Administration (EIA)
1000 Independence Ave. SW
Washington, DC 20585 US
Phone: 202-586-8800
E-mail Address: *infoctr@eia.doe.gov*
Web Address: www.eia.doe.gov
The Energy Information Administration (EIA) is a vast source of useful information on every branch of the industry. It is operated by the U.S. Department of Energy (DOE). The site includes links to a number of other helpful energy industry web sites.

Federal Energy Regulatory Commission (FERC)
888 First St. NE
Washington, DC 20426 US
Phone: 202-502-6088
Toll Free: 866-208-3372
E-mail Address: *customer@ferc.gov*
Web Address: www.ferc.gov
The Federal Energy Regulatory Commission (FERC) regulates and oversees energy industries in the economic, environmental and safety interests of the American pubic.

National Institute of Standards and Technology (NIST)
100 Bureau Dr., Stop 1070
Gaithersburg, MD 20899-1070 US
Phone: 301-975-6478
Toll Free: 800-877-8339
E-mail Address: *inquiries@nist.gov*
Web Address: www.nist.gov
The National Institute of Standards and Technology (NIST) is an agency of the U.S. Department of Commerce that works with various industries to develop and apply technology, measurements and standards.

National Science Foundation (NSF)
4201 Wilson Blvd.
Arlington, VA 22230 US
Phone: 703-292-5111
Toll Free: 800-877-8339
E-mail Address: *info@nsf.gov*
Web Address: www.nsf.gov
The National Science Foundation (NSF) is an independent U.S. government agency responsible for promoting science and engineering. The foundation provides colleges and universities with grants and funding for research into numerous scientific fields.

Occupational Safety and Health Administration (OSHA)
200 Constitution Ave. NW
Washington, DC 20210 US
Toll Free: 800-321-6742
Web Address: www.osha.gov
The Occupational Safety and Health Administration (OSHA), regulates safety within the workplace. Its web site provides information on laws and regulations, safety and health, statistics, compliance assistance and news. OSHA is a unit of the U.S. Department of Labor.

Office of Fossil Energy
1000 Independence Ave. SW
Washington, DC 20585 US
Phone: 202-586-5000
Fax: 202-586-4403
Toll Free: 800-342-5363
E-mail Address: *The.Secretary@hq.doe.gov*
Web Address: www.fe.doe.gov
The Office of Fossil Energy, an office within the U.S. Department of Energy (DOE), studies and reports on the latest developments in advanced fossil fuel technology.

U.S. Census Bureau
4600 Silver Hill Rd.
Washington, DC 20233-8800 US
Phone: 301-763-4636
Toll Free: 800-923-8282
E-mail Address: *pio@census.gov*
Web Address: www.census.gov
The U.S. Census Bureau is the official collector of data about the people and economy of the U.S. Founded in 1790, it provides official social, demographic and economic information. In addition to the Population & Housing Census, which it conducts every 10 years, the U.S. Census Bureau numerous other surveys annually.

U.S. Department of Commerce (DOC)
1401 Constitution Ave. NW
Washington, DC 20230 US
Phone: 202-482-2000
Fax: 202-482-5168
E-mail Address: *TheSec@doc.gov*
Web Address: www.commerce.gov
The U.S. Department of Commerce (DOC) regulates trade and provides valuable economic analysis of the economy.

U.S. Department of Energy (DOE)
1000 Independence Ave. SW
Washington, DC 20585 US
Phone: 202-586-5000
Fax: 202-586-4403
E-mail Address: *the.secretary@hq.doe.gov*
Web Address: www.energy.gov
U.S. Department of Energy (DOE) web site is the best way to gain information from the U.S. Government regarding its many agencies, bureaus and operations in energy. Through the site, users can gain access to government agencies such as Los Alamos National Laboratory, the strategic oil reserves and the agencies that regulate nuclear, geothermal and other types of power.

U.S. Department of Labor (DOL)
200 Constitution Ave. NW
Frances Pekins Bldg.
Washington, DC 20210 US
Phone: 202-693-6000
Toll Free: 866-487-2365
Web Address: www.dol.gov
The U.S. Department of Labor (DOL) is the government agency responsible for labor regulations.

U.S. Environmental Protection Agency (EPA) On-road Vehicles and Engines
1200 Pennsylvania Ave. NW
Office of Transportation and Air Quality (6401A)
Washington, DC 20460 US
Phone: 202-564-1682
E-mail Address: *otaq@epa.gov*
Web Address: www.epa.gov/otaq/hwy.htm
The U.S. Environmental Protection Agency (EPA) On-road Vehicles and Engines site, part of the EPA's Office of Transportation and Air Quality (OTAQ), provides details about the best and worst cars and trucks in terms of exhaust emissions. Its web site allows people to instantly check the emission rating of any vehicle. The site also contains information about industry emission trends and goals.

U.S. Geological Survey (USGS)
12201 Sunrise Valley Dr.
Reston, VA 20192 US
Phone: 703-648-4000
Toll Free: 888-275-8747
E-mail Address: *ask@usgs.gov*
Web Address: www.usgs.gov
The U.S. Geological Survey (USGS) conducts research on geography, geology, biology and related hazards and benefits in the United States.

U.S. Nuclear Regulatory Commission (NRC)
11555 Rockville Pike
Rockville, MD 20852 US
Phone: 301-415-7000
Fax: 301-415-3716
Toll Free: 800-368-5642
E-mail Address: *OPA.Resource@nrc.gov*
Web Address: www.nrc.gov
The U.S. Nuclear Regulatory Commission (NRC) is an independent agency established by Congress to ensure adequate protection of public health and safety, common defense and security and the environment in use of nuclear materials in the United States.

U.S. Patent and Trademark Office (PTO)
401 Dulany St.
Randolph Bldg.
Alexandria, VA 22314 US
Phone: 571-272-1000
Toll Free: 800-786-9199
E-mail Address: *usptoinfo@uspto.gov*
Web Address: www.uspto.gov
The U.S. Patent and Trademark Office (PTO) administers patent and trademark laws for the U.S. and enables registration of patents and trademarks.

U.S. Securities and Exchange Commission (SEC)
100 F St. NE
Washington, DC 20549 US
Phone: 202-942-8088
E-mail Address: *publicinfo@sec.gov*
Web Address: www.sec.gov
The U.S. Securities and Exchange Commission (SEC) is a nonpartisan, quasi-judicial regulatory agency responsible for administering federal securities laws. These laws are designed to protect investors in securities markets and ensure that they have access to disclosure of all material information concerning publicly traded securities. Visitors to the web site can access the EDGAR database of corporate financial and business information.

U.S. Trade Representative (USTR)
600 17th St. NW
Washington, DC 20508 US
Phone: 202-395-3230
Fax: 202-395-4549
E-mail Address: *contactustr@ustr.eop.gov*
Web Address: www.ustr.gov
The U.S. Trade Representative (USTR) is the nation's chief trade negotiator and the principal trade policy advisor to the President.

LVIII. Water Technologies & Resources

American Water Resources Association (AWRA)
P.O. Box 1626
Middleburg, VA 20118 US
Phone: 540-687-8390
Fax: 540-687-8395
E-mail Address: *info@awra.org*
Web Address: www.awra.org
The American Water Resources Association (AWRA) represents the interests of professionals involved in water resources.

LIX. Weather Risk Management Associations

Weather Risk Management Association (WRMA)
529 14th St. NW, Ste. 750
Washington, DC 20045 US
Phone: 202-289-3800
Fax: 202-223-9741
Web Address: www.wrma.org
WRMA is an organization that servers companies and professionals involved in assessing and hedging against the potential effects of weather events, such as drought, flood or hurricane. Weather risk contracts are regularly traded on futures exchanges.

Chapter 4

THE ENERGY 500: WHO THEY ARE AND HOW THEY WERE CHOSEN

Includes Indexes by Company Name, Industry & Location

The companies chosen to be listed in PLUNKETT'S ENERGY INDUSTRY ALMANAC comprise a unique list. THE ENERGY 500 (the actual count is 498 companies) were chosen specifically for their dominance in the many facets of the energy industry in which they operate. Complete information about each firm can be found in the "Individual Profiles," beginning at the end of this chapter. These profiles are in alphabetical order by company name.

THE ENERGY 500 includes leading companies from all parts of the United States as well as many other nations, and from all energy and related industry segments: exploration, production, distribution, retailing and special services relating to the industry.

Simply stated, the list contains 498 of the largest, most successful, fastest growing firms in the energy and related industries in the world. To be included in our list, the firms had to meet the following criteria:

1) Generally, these are corporations based in the U.S., however, the headquarters of 219 firms are located in other nations.

2) Prominence, or a significant presence, in energy and supporting fields. (See the following Industry Codes section for a complete list of types of businesses that are covered).

3) The companies in THE ENERGY 500 do not have to be exclusively in the energy field.

4) Financial data and vital statistics must have been available to the editors of this book, either directly from the company being written about or from outside sources deemed reliable and accurate by the editors. A small number of companies that we would like to have included are not listed because of a lack of sufficient, objective data.

INDEXES TO THE ENERGY 500, AS FOUND IN THIS CHAPTER AND IN THE BACK OF THE BOOK:

Industry List, With Codes	**p. 135**
Index of Rankings Within Industry Groups	**p. 137**
Alphabetical Index	**p. 149**
Index of Headquarters Location by U.S. State	**p. 152**
Index of Non-U.S. Headquarters Location by Country	**p. 154**
Index by Regions of the U.S. Where the Firms Have Locations	**p. 156**
Index of Firms with International Operations	**p. 162**
Index of Firms Noted as "Hot Spots for Advancement" for Women/Minorities	**p. 664**
Index by Subsidiaries, Brand Names and Selected Affiliations	**p. 666**

INDUSTRY LIST, WITH CODES

This book refers to the following list of unique industry codes, based on the 2007 NAIC code system (NAIC is used by many analysts as a replacement for older SIC codes because NAIC is more specific to today's industry sectors, see www.census.gov/NAICS). Companies profiled in this book are given a primary NAIC code, reflecting the main line of business of each firm.

Energy

Fuel Mining & Extraction

211111 Oil & Natural Gas Exploration & Production
21211 Coal Mining
213111 Drilling Services--Oil & Gas Wells
213112 Oil Field Services

Utilities

221111 Utilities-Hydroelectric
221112 Utilities-Electric & Natural Gas
221113 Utilities-Nuclear Generation
221119 Utilities-Alternative Energy Generation
221121 Utilities-Electric, Wholesale Generation
221122 Utilities-Electric Power Transmission & Distribution
221210 Utilities-Gas

Petroleum-Refining & Manufacturing

324110 Petroleum Refineries
324199 Other Petrochemical & Coal Products Manufacturing
325110 Petrochemicals Manufacturing

Manufacturing

332410 Nuclear Reactor Manufacturing

Wholesaler-Petroleum & Petroleum Products

424720 Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)

Financial Services

Banking, Credit & Finance

522220 Financing--Business

Stocks & Investments

523130 Commodity and Foreign Currency Trading

Insurance

524126 Insurance--Property & Casualty, Specialty, Surety

InfoTech

Computers & Electronics Manufacturing

334210A Computer Networking & Related Equipment, Manufacturing
3345 Instrument Manufacturing, including Measurement, Control, Test & Navigational
334513 Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables

Manufacturing

Chemicals

325188 All Other Basic Inorganic Chemical Manufacturing
325199 Other Basic Organic Chemicals/Biofuels

Primary Minerals

331111 Iron & Steel Mills

Fabricated Metals

331210 Steel Pipe Manufacturing

Machinery & Manufacturing Equipment

33313 Machinery-Mining & Oil & Gas Field, Manufacturing
333132 Oil and Gas Field Machinery and Equipment Manufacturing
333611 Turbine and Turbine Generator Set Units Manufacturing

Electrical Equipment, Appliances, Tools

335311 Power, Distribution, and Specialty Transformer Manufacturing
335313 Electrical Switches, Sensors, Microelectronics, Optomechanicals

Mining

212234 Copper Ore & Nickle Ore Mining
212291 Uranium-Radium-Vanadium Ore Mining

Retailing

Gasoline Stations

447110 Gasoline Stations

Nonstore Retailers

454312 Bottled Gas Dealers, Retail

Services

Construction

236220 Commercial & Institutional Building Construction
237110 Water & Sewer Line and Related Structures Construction
237120 Oil & Gas Pipeline and Related Structures Construction
237130 Construction, Power & Communication Lines and Structures
237990 Other Heavy & Civil Engineering Construction
2389 Construction--Other Special Trade Contractors

Consulting & Professional Services

541330 Engineering Services
541360 Surveying & Mapping--Geophysical
541614 Logistics Outsourcing
541690 Consulting--Scientific & Technical
541712 Research & Development-Physical, Engineering & Life Sciences

Management

551114 Management of Companies & Enterprises

Telecommunications

Telecommunications Equipment

334220 Radio & Wireless Communication, Manufacturing

Transportation

Air

481211 Air Transportation-Charter Services

Ships

483111 Shipping-Deep Sea

Wholesale Distribution-Other

Distribution-Nondurable Goods

424710 Petroleum Bulk Stations & Terminals Distribution
424910 Farm Supplies Merchant Wholesalers
486110 Pipeline Transportation of Crude Oil
486210 Pipeline Transportation of Natural Gas
486910 Pipeline Transportation of Refined Petroleum Products

INDEX OF COMPANIES WITHIN INDUSTRY GROUPS

Company	Industry Code	2011 Sales	2011 Profits
Air Transportation-Charter Services			
Bristow Group Inc	481211	1,232,808,000	132,315,000
CHC Helicopter Corp	481211	1,445,460,000	-65,269,000
PHI Inc	481211	540,169,000	4,852,000
All Other Basic Inorganic Chemical Manufacturing			
USEC Inc	325188	1,671,000,000	-540,000,000
Bottled Gas Dealers, Retail			
AmeriGas Partners LP	454312	2,537,959,000	138,523,000
Blue Rhino LLC	454312		
Ferrellgas Partners LP	454312	2,423,215,000	-43,648,000
Inergy LP	454312	2,153,800,000	17,600,000
UGI Corp	454312	6,091,300,000	308,200,000
Coal Mining			
Alliance Resource Partners LP	21211	1,843,560,000	389,353,000
Alpha Natural Resources Inc	21211	7,109,186,000	-677,390,000
Anglo American plc	21211	30,580,000,000	7,885,000,000
Arch Coal Inc	21211	4,285,895,000	141,683,000
China Shenhua Energy Company Limited	21211	32,711,200,000	7,176,610,000
Cloud Peak Energy Inc	21211	1,553,661,000	189,797,000
CONSOL Energy Inc	21211	6,117,242,000	632,497,000
Drummond Company Inc	21211	3,500,000,000	
Oxbow Corporation	21211	4,000,000,000	
Peabody Energy Corp	21211	7,974,400,000	946,300,000
Rhino Resource Partners LP	21211	339,000,000	38,070,000
UK Coal plc	21211	753,102,000	85,152,100
Westmoreland Coal Co	21211	501,713,000	-33,100,000
Xstrata plc	21211	33,877,000,000	5,713,000,000
Yanzhou Coal Mining Co Ltd	21211	7,394,690,000	1,402,740,000
Commercial & Institutional Building Construction			
Foster Wheeler AG	236220	4,480,729,000	162,383,000
Commodity and Foreign Currency Trading			
Louis Dreyfus SAS	523130		
Computer Networking & Related Equipment, Manufacturing			
Silver Spring Networks	334210A	107,038,000	-41,839,000
Construction, Power & Communication Lines and Structures			
Black & Veatch Holding Company	237130	3,300,000,000	
Reliance Power Limited	237130	391,588,000	155,247,000
Construction--Other Special Trade Contractors			
Subsea 7 SA	2389	5,055,200,000	391,100,000
Consulting--Scientific & Technical			
Ameresco Inc	541690	728,200,000	34,700,000
Copper Ore & Nickle Ore Mining			
JX Nippon Mining & Metals Corporation	212234	11,397,222,000	856,742,000
Drilling Services--Oil & Gas Wells			
Abbot Group Limited	213111		

Company	Industry Code	2011 Sales	2011 Profits
Atwood Oceanics Inc	213111	645,076,000	271,674,000
Baker Hughes Inc	213111	19,831,000,000	1,739,000,000
Diamond Offshore Drilling Inc	213111	3,322,419,000	962,542,000
Ensco plc	213111	2,842,700,000	600,400,000
Ensign Energy Services Inc	213111	1,890,372,000	212,393,000
Hercules Offshore Inc	213111	655,358,000	-76,128,000
Nabors Industries Ltd	213111	6,060,351,000	243,679,000
Noble Corporation	213111	2,695,832,000	422,043,000
Parker Drilling Company	213111	686,650,000	-50,450,000
Patterson-UTI Energy Inc	213111	2,565,943,000	322,413,000
Precision Drilling Corporation	213111	1,916,059,000	190,009,000
Rowan Companies Inc	213111	939,229,000	736,841,000
Seadrill Limited	213111	4,095,000,000	1,401,000,000
Unit Corp	213111	1,208,371,000	195,867,000
Weatherford International Ltd	213111	12,990,000,000	262,000,000
Electrical Switches, Sensors, Microelectronics, Optomechanicals			
ABB (India) Ltd	335313	1,369,260,000	33,848,600
ABB Ltd	335313	37,990,000,000	3,168,000,000
Cooper Industries plc	335313	5,409,400,000	827,600,000
Engineering Services			
Atomic Energy of Canada Ltd	541330	458,000,000	-60,000,000
ENGlobal Corp	541330	312,747,000	-7,076,000
Furmanite Corp	541330	316,207,000	23,970,000
Farm Supplies Merchant Wholesalers			
Transammonia Inc	424910	11,300,000,000	
Financing--Business			
Power Finance Corporation Limited	522220	776,200,000	540,800,000
Gasoline Stations			
Susser Holdings Corporation	447110	5,190,000,000	47,470,000
Instrument Manufacturing, including Measurement, Control, Test & Navigational			
Elster Group SE	3345	1,868,975,000	100,879,000
PowerSecure International Inc	3345	130,015,000	24,050,000
Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables			
Siemens AG	334513	97,931,500,000	8,185,900,000
Insurance--Property & Casualty, Specialty, Surety			
Loews Corporation	524126	14,127,000,000	1,064,000,000
Iron & Steel Mills			
Essar Group Ltd	331111	9,788,516,000	117,162,000
Logistics Outsourcing			
Grupo EBX	541614		
Machinery-Mining & Oil & Gas Field, Manufacturing			
Joy Global Inc	33313	4,403,910,000	609,660,000
NOV Wilson	33313	535,713,000	14,020,300
Management of Companies & Enterprises			
Mitsubishi Corp	551114	67,689,300,000	6,021,400,000
Nuclear Reactor Manufacturing			
AREVA Group	332410	11,833,600,000	-3,233,200,000
Westinghouse Electric Company LLC	332410		

Company	Industry Code	2011 Sales	2011 Profits
Oil & Gas Pipeline and Related Structures Construction			
Chicago Bridge & Iron Company NV	237120	4,550,542,000	255,032,000
Matrix Service Company	237120	627,100,000	19,000,000
Shaw Group Inc (The)	237120	5,937,734,000	-175,016,000
Oil & Natural Gas Exploration & Production			
Abu Dhabi National Oil Company	211111		
Adams Resources & Energy Inc	211111	3,214,399,000	22,931,000
Addax Petroleum Inc	211111		
Aera Energy LLC	211111		
Anadarko Petroleum Corporation	211111	13,882,000,000	-2,649,000,000
Apache Corp	211111	16,888,000,000	4,584,000,000
Apco Oil and Gas International Inc	211111	104,780,000	31,746,000
Barnwell Industries Inc	211111	38,460,000	-109,000
Berry Petroleum Co	211111	919,558,000	-228,063,000
BG Group plc	211111	21,256,000,000	4,315,000,000
BHP Billiton	211111	71,739,000,000	23,946,000,000
Bolt Technology Corp	211111	38,858,000	5,527,000
BP plc	211111	375,517,000,000	34,787,268,000
BreitBurn Energy Partners LP	211111	480,370,000	110,698,000
Cabot Oil & Gas Corp	211111	973,700,000	122,400,000
Callon Petroleum Company	211111	127,644,000	104,149,000
CAMAC International Corp	211111		
Canadian Natural Resources Ltd	211111	13,545,000,000	2,596,000,000
Canadian Oil Sands Ltd	211111	3,857,050,000	1,121,620,000
Carrizo Oil & Gas Inc	211111	202,200,000	36,600,000
Ceylon Petroleum Corp (CPC)	211111		
Cheniere Energy Inc	211111	290,444,000	-198,756,000
Chesapeake Energy Corp	211111	11,635,000,000	1,742,000,000
Chevron Corporation	211111	253,706,000,000	26,895,000,000
China National Petroleum Corp (CNPC)	211111	374,545,000,000	20,528,150,000
China Petroleum & Chemical Corporation (Sinopec)	211111	323,011,000,000	9,442,100,000
Cimarex Energy Co	211111	1,757,889,000	529,932,000
Clayton Williams Energy Inc	211111	410,700,000	93,800,000
CNOOC Limited	211111	38,282,000,000	11,162,000,000
ConocoPhillips Company	211111	244,813,000,000	12,436,000,000
Continental Resources Inc	211111	1,679,838,000	429,072,000
Denbury Resources Inc	211111	2,291,900,000	573,300,000
Devon Energy Corporation	211111	11,454,000,000	4,704,000,000
Dorchester Minerals LP	211111	69,489,000	42,215,000
Ecopetrol SA	211111	33,919,000,000	7,971,000,000
EnCana Corp	211111	8,467,000,000	128,000,000
Eni SpA	211111	147,359,000,000	9,187,800,000
EOG Resources Inc	211111	10,126,115,000	1,091,123,000
EPL Oil & Gas Inc	211111	347,327,000	26,611,000
EQT Corporation	211111	1,639,934,000	479,769,000
EXCO Resources Inc	211111	754,201,000	22,596,000
Exxon Mobil Corporation (ExxonMobil)	211111	486,429,000,000	41,060,000,000
Forest Oil Corporation	211111	704,557,000	142,829,000
Formosa Petrochemical Corp (FPCC)	211111	26,287,300,000	738,931,000

Company	Industry Code	2011 Sales	2011 Profits
GAIL (India) Limited	211111	7,172,300,000	821,500,000
Galp Energia SGPS SA	211111	21,757,400,000	559,375,000
Goodrich Petroleum Corp	211111	201,069,000	-31,758,000
Harvest Natural Resources Inc	211111	6,488,000	53,894,000
Helmerich & Payne Inc	211111	2,543,894,000	434,186,000
Hess Corporation	211111	38,466,000,000	1,703,000,000
Hunt Consolidated Inc	211111	4,000,000,000	
Husky Energy Inc	211111	22,907,000,000	2,180,500,000
Idemitsu Kosan Co Ltd	211111	47,497,700,000	787,700,000
Imperial Oil Limited	211111	30,164,000,000	3,311,000,000
INPEX Corporation	211111	12,231,700,000	1,669,200,000
John Wood Group plc	211111	5,666,000,000	2,302,000,000
JSC Gazprom Neft	211111	44,172,000,000	5,352,000,000
Korea Gas Corporation	211111	24,564,300,000	156,457,000
Kuwait Petroleum Corporation	211111	103,278,666,000	7,123,376,000
Marathon Oil Corp	211111	14,663,000,000	2,946,000,000
McMoRan Exploration Co	211111	555,410,000	-15,970,000
MDU Resources Group Inc	211111	4,050,000,000	213,000,000
Mesa Energy Holdings Inc	211111	6,941,000	4,152,000
Mitsui Oil Exploration Co Ltd (MOECO)	211111	1,268,081,000	-872,816,000
Murphy Oil Corporation	211111	27,745,549,000	872,702,000
Newfield Exploration Co	211111	2,471,000,000	539,000,000
Nexen Inc	211111	6,348,000,000	685,000,000
Nigerian National Petroleum Corporation	211111		
Noble Energy Inc	211111	3,763,000,000	453,000,000
OAO Gazprom	211111	143,903,000,000	40,560,600,000
OAO Lukoil	211111	133,650,000,000	10,357,000,000
OAO Novatek	211111	3,630,860,000	1,768,880,000
OAO Rosneft	211111	83,851,100,000	9,806,420,000
OAO Tatneft	211111	19,112,200,000	1,985,270,000
Occidental Petroleum Corp	211111	23,939,000,000	6,771,000,000
OGX Petroleo e Gas Participacoes SA	211111		-258,196,000
Oil & Natural Gas Corp Ltd	211111	24,028,800,000	4,587,700,000
Oil Search Ltd	211111	732,000,000	202,480,000
OMV AG	211111	44,093,500,000	1,376,430,000
PDC Energy Inc	211111	395,960,000	13,437,000
Penn Virginia Corp	211111	300,050,000	-132,910,000
Penn West Petroleum Ltd	211111	3,006,000,000	638,000,000
Petrobras Argentina SA	211111	3,314,250,000	-190,341,000
PetroChina Company Limited	211111	317,909,700,000	21,094,300,000
Petroleo Brasileiro SA (Petrobras)	211111	131,745,200,000	17,974,000,000
Petroleos de Venezuela SA (Pdvsa)	211111	124,754,000,000	4,496,000,000
Petroleos Mexicanos (Pemex)	211111	111,400,000,000	-6,500,000,000
PETRONAS (Petroliam Nasional Berhad)	211111	75,561,316,000	19,736,280,000
PetroQuest Energy Inc	211111	160,700,000	10,550,000
Pioneer Natural Resources Company	211111	2,294,100,000	834,500,000
Plains Exploration and Production Company	211111	1,964,488,000	84,325,000
Polski Koncern Naftowy Orlen SA (PKN ORLEN Group)	211111	31,201,700,000	689,235,000
Premier Oil plc	211111	826,000,000	171,000,000

Company	Industry Code	2011 Sales	2011 Profits
PrimeEnergy Corporation	211111	119,000,000	4,810,000
PT Pertamina (Persero)	211111		
PTT Exploration and Production pcl	211111	5,354,570,000	1,412,400,000
PTT pcl	211111	76,641,000,000	3,323,500,000
Qatar Petroleum	211111	79,422,983,000	24,405,916,000
Questar Corporation	211111	1,194,000,000	207,000,000
Quicksilver Resources Inc	211111	887,000,000	90,000,000
Range Resources Corp	211111	1,173,000,000	58,000,000
Royal Dutch Shell plc	211111	470,171,000,000	30,918,000,000
SandRidge Energy Inc	211111	1,415,213,000	108,065,000
Santos Ltd	211111	2,477,250,000	766,132,000
Saudi Aramco (Saudi Arabian Oil Co)	211111	260,000,000,000	
Shell Canada Limited	211111		
Shell Oil Co	211111	91,946,000,000	
SM Energy Company	211111	1,381,000,000	215,000,000
Sonatrach	211111		
Southwestern Energy Co	211111	2,952,900,000	637,800,000
Statoil ASA	211111	112,437,500,000	13,721,500,000
Stone Energy Corporation	211111	864,557,000	194,332,000
Suncor Energy Inc	211111	39,077,000,000	4,227,000,000
Surgutneftegas (OJSC)	211111	24,449,400,000	7,378,650,000
Swift Energy Co	211111	599,131,000	98,821,000
Syncrude Canada Ltd	211111		
Talisman Energy Inc	211111	8,194,000,000	776,000,000
Targa Resources Partners LP	211111	6,987,100,000	204,500,000
TNK-BP	211111	60,200,000,000	8,981,000,000
Total SA	211111	221,981,200,000	16,361,700,000
Transocean Ltd	211111	8,335,000,000	-5,632,000,000
Triangle Petroleum Corp	211111	537,000	-20,277,000
Ultra Petroleum Corp	211111	1,101,000,000	453,000,000
VAALCO Energy Inc	211111	210,000,000	34,150,000
W&T Offshore Inc	211111	971,050,000	172,820,000
Williams Companies Inc (The)	211111	7,930,000,000	376,000,000
Wintershall AG	211111		
Woodside Petroleum Ltd	211111	4,802,000,000	1,507,000,000
XTO Energy Inc	211111		
YPF SA	211111	13,160,700,000	1,092,600,000
Oil and Gas Field Machinery and Equipment Manufacturing			
Cameron International Corporation	333132	6,959,000,000	521,900,000
Dril-Quip Inc	333132	601,342,000	95,267,000
Lufkin Industries Inc	333132	932,135,000	65,971,000
National Oilwell Varco Inc	333132	14,658,000,000	1,994,000,000
Tesco Corporation	333132	513,000,000	27,000,000
Oil Field Services			
Arctic Slope Regional Corp	213112		
Basic Energy Services Inc	213112	1,243,255,000	47,163,000
Boots & Coots Inc	213112		
C&J Energy Services Inc	213112	758,454,000	161,979,000
Carbo Ceramics Inc	213112	625,700,000	130,100,000

Company	Industry Code	2011 Sales	2011 Profits
China Oilfield Services Limited	213112	2,895,030,000	634,594,000
Exterran Holdings Inc	213112	2,683,470,000	-340,608,000
Fugro NV	213112	3,336,830,000	371,622,000
Halliburton Company	213112	24,829,000,000	2,839,000,000
Helix Energy Solutions Group Inc.	213112	1,398,607,000	129,979,000
Hunting PLC	213112	939,548,000	122,079,000
Key Energy Services Inc	213112	1,846,883,000	101,461,000
Newpark Resources Inc	213112	958,180,000	80,017,000
Oceaneering International Inc	213112	2,192,663,000	235,658,000
Oil States International Inc	213112	3,479,180,000	322,453,000
RPC Inc	213112	1,809,800,000	296,400,000
Saipem SpA	213112	16,306,000,000	1,192,560,000
Schlumberger Limited	213112	39,540,000,000	4,997,000,000
Superior Energy Services Inc	213112	2,070,166,000	142,554,000
Technip	213112	9,061,000,000	674,700,000
TETRA Technologies Inc	213112	845,275,000	4,147,000
Tidewater Inc	213112	1,055,400,000	105,600,000
URS Flint Energy Services Ltd	213112	1,627,662,000	23,975,000
Other Basic Organic Chemicals/Biofuels			
BASF SE	325199	97,672,400,000	8,223,400,000
Evonik Industries AG	325199	19,353,720,000	1,345,727,000
Other Heavy & Civil Engineering Construction			
Bechtel Group Inc	237990	32,900,000,000	
Fluor Corp	237990	23,381,400,000	698,100,000
KBR Inc	237990	9,261,000,000	480,000,000
McDermott International Inc	237990	3,445,110,000	138,730,000
Willbros Group Inc	237990	1,615,040,000	-292,821,000
Other Petrochemical & Coal Products Manufacturing			
Dakota Gasification Company	324199		
Headwaters Inc	324199	591,954,000	-229,921,000
Petrochemicals Manufacturing			
Braskem SA	325110	17,786,441,000	-277,088,000
LyondellBasell Industries	325110	51,035,000,000	2,147,000,000
Mitsubishi Chemical Holdings Corporation	325110	41,041,400,000	1,083,200,000
Reliance Industries Ltd (Reliance Group)	325110	58,558,100,000	4,245,500,000
Repsol YPF SA	325110	77,849,000,000	2,839,610,000
Sinopec Shanghai Petrochemical Co Ltd	325110	14,063,300,000	150,203,000
Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)			
Aegean Marine Petroleum Network Inc	424720	6,965,465,000	10,228,000
Petroleum Bulk Stations & Terminals Distribution			
Apex Oil Company Inc	424710		
Center Oil Company	424710	4,630,000,000	
Colonial Group Inc	424710	5,460,000,000	
Global Partners LP	424710	14,835,729,000	19,352,000
Gulf Oil Limited Partnership	424710		
NuStar Energy LP	424710	6,575,300,000	221,600,000
PAA Natural Gas Storage LP	424710	339,000,000	59,000,000
Royal Vopak NV	424710	1,516,270,000	517,940,000
SMF Energy Corporation	424710	236,423,000	1,300,000

Company	Industry Code	2011 Sales	2011 Profits
Sunoco Logistics Partners LP	424710	10,918,000,000	259,000,000
Truman Arnold Companies	424710		
Ultrapar Participacoes SA	424710	23,790,800,000	452,132,000
US Venture Inc	424710		
World Fuel Services Corp	424710	34,622,000,000	194,000,000
Petroleum Refineries			
Alon USA Energy Inc	324110	7,186,257,000	47,635,000
Arabian American Development Co	324110	199,517,000	8,430,000
Bangchak Petroleum pcl (The)	324110	5,006,230,000	177,070,000
Bharat Petroleum Corporation Ltd	324110	31,389,700,000	334,000,000
Caltex Australia Limited	324110	22,490,700,000	-725,660,000
CITGO Petroleum Corporation	324110		
Compania Espanola de Petroleos SA (CEPSA)	324110	26,150,200,000	839,600,000
Cosmo Oil Co Ltd	324110	35,946,700,000	375,300,000
Crown Central LLC	324110		
Ergon Inc	324110		
Fortum Company	324110	7,977,570,000	2,290,590,000
GS Caltex Corp	324110	41,334,400,000	717,237,000
GS Holdings Corp	324110	7,322,180,000	666,982,000
Hellenic Petroleum SA	324110	12,051,200,000	147,613,000
Hindustan Petroleum Corporation Ltd	324110	26,306,900,000	348,000,000
HollyFrontier Corporation	324110	15,439,528,000	1,059,704,000
Indian Oil Corp Ltd	324110	57,990,600,000	1,599,800,000
JX Holdings Inc	324110	125,240,368,000	4,050,532,000
Koch Industries Inc	324110	110,000,000,000	
Kochi Refineries Ltd	324110		
Marathon Petroleum Corporation	324110	78,638,000,000	2,389,000,000
Motiva Enterprises LLC	324110		
Pakistan State Oil Co Ltd	324110	9,375,900,000	168,900,000
Petron Corp	324110	6,235,850,000	192,773,000
Showa Shell Sekiyu KK	324110	35,800,100,000	298,526,000
Sinclair Oil Corp	324110	7,000,000,000	
SK Holdings Co Ltd	324110	95,880,600,000	1,442,360,000
S-Oil Corporation	324110	27,512,900,000	1,026,740,000
Sunoco Inc	324110	46,824,000,000	-1,684,000,000
Tesoro Corp	324110	30,303,000,000	546,000,000
Thai Oil pcl	324110	14,084,900,000	468,811,000
TonenGeneral Sekiyu KK	324110	34,582,000,000	1,715,190,000
TOTAL UK Limited	324110		
United Refining Company	324110	3,166,876,000	-7,408,000
United Refining Company (Red Apple)	324110	3,166,876,000	-8,119,000
Valero Energy Corp	324110	125,987,000,000	2,096,000,000
Pipeline Transportation of Crude Oil			
Enbridge Energy Partners LP	486110	9,109,000,000	624,000,000
Enbridge Inc	486110	19,022,500,000	1,300,030,000
Genesis Energy LP	486110	3,089,699,000	51,249,000
Kinder Morgan Inc	486110	8,264,900,000	594,400,000
Plains All American Pipeline LP	486110	34,275,000,000	966,000,000
SHV Holdings NV	486110	22,481,200,000	1,012,570,000

Company	Industry Code	2011 Sales	2011 Profits
Pipeline Transportation of Natural Gas			
Access Midstream Partners LP	486210	565,929,000	194,337,000
Crosstex Energy LP	486210	2,013,942,000	-2,342,000
DCP Midstream LLC	486210	12,982,000,000	924,000,000
Energy Transfer Partners LP	486210	6,850,440,000	235,826,000
Enogex LLC	486210	1,787,000,000	82,000,000
Enterprise Products Partners LP	486210	44,313,000,000	2,046,900,000
Great Lakes Gas Transmission Company	486210		
Nederlandse Gasunie NV	486210	2,234,910,000	-775,615,000
ONEOK Inc	486210	14,805,000,000	360,000,000
ONEOK Partners LP	486210	11,322,000,000	830,000,000
Snam Rete Gas SpA	486210	4,582,470,000	1,022,930,000
Southern Union Company	486210	2,665,954,000	255,424,000
Spectra Energy Corp	486210	5,351,000,000	1,184,000,000
Texas Gas Transmission LLC	486210		
TransCanada Corp	486210	8,960,240,000	1,550,080,000
Pipeline Transportation of Refined Petroleum Products			
Kinder Morgan Energy Partners LP	486910	8,211,200,000	1,257,800,000
Magellan Midstream Partners LP	486910	1,748,700,000	413,600,000
Petrobras Distribuidora SA	486910		
TransMontaigne Inc	486910	12,000,000,000	
Transportadora de Gas del Sur SA	486910	395,383,000	49,076,100
Power, Distribution, and Specialty Transformer Manufacturing			
Schneider Electric SA	335311	29,768,900,000	2,420,100,000
Radio & Wireless Communication, Manufacturing			
Itron Inc	334220	2,434,124,000	-510,157,000
Research & Development-Physical, Engineering & Life Sciences			
Fuel Tech Inc	541712	93,668,000	6,148,000
Shipping-Deep Sea			
AP Moller-Maersk A/S	483111	60,230,000,000	3,377,000,000
BW Gas Limited	483111		
Frontline Ltd	483111	810,100,000	-529,600,000
GulfMark Offshore Inc	483111	381,870,000	49,934,000
Mitsui OSK Lines Ltd	483111	20,005,800,000	755,300,000
SEACOR Holdings Inc	483111	2,141,942,000	41,056,000
Tsakos Energy Navigation Ltd	483111	395,162,000	-89,496,000
Steel Pipe Manufacturing			
Tenaris SA	331210	9,972,000,000	1,331,000,000
Surveying & Mapping--Geophysical			
CGGVeritas	541360	2,936,720,000	-24,602,200
Dawson Geophysical Company	541360	333,279,000	-3,246,000
Geokinetics Inc	541360	763,729,000	-222,053,000
Petroleum Geo Services ASA	541360	1,253,000,000	33,690,000
Seitel Inc	541360	218,000,000	11,800,000
WesternGeco	541360		
Turbine and Turbine Generator Set Units Manufacturing			
Alstom SA	333611	28,147,300,000	621,500,000
ENERCON GmbH	333611		
GE Energy Infrastructure	333611	43,694,000,000	6,650,000,000

Company	Industry Code	2011 Sales	2011 Profits
Uranium-Radium-Vanadium Ore Mining			
Cameco Corporation	212291	2,384,000,000	450,000,000
Rio Tinto Group	212291	55,171,000,000	14,238,000,000
Utilities-Alternative Energy Generation			
EPCOR Utilities Inc	221119	1,794,000,000	144,000,000
Wisconsin Energy Corp	221119	4,431,000,000	526,000,000
Utilities-Electric & Natural Gas			
Abu Dhabi National Energy Company PJSC (TAQA)	221112	6,584,150,000	202,531,000
AES Corporation (The)	221112	17,274,000,000	1,530,000,000
Alabama Power Company	221112	5,702,000,000	747,000,000
Alliant Energy Corp	221112	3,665,300,000	321,900,000
Ameren Corp	221112	7,531,000,000	519,000,000
Ameren Illinois Company	221112	2,787,000,000	193,000,000
American Electric Power Company Inc (AEP)	221112	15,116,000,000	1,946,000,000
Arizona Public Service Company	221112	3,237,241,000	363,773,000
Atlantic City Electric Company	221112		
Baltimore Gas and Electric Company	221112	2,993,100,000	
Bangor Hydro-Electric Company	221112		
Black Hills Corp	221112	1,272,200,000	49,700,000
CenterPoint Energy Inc	221112	8,450,000,000	1,357,000,000
Centrais Eletricas Brasileiras SA (Electrobras)	221112	18,346,100,000	2,015,220,000
CEZ AS	221112	10,557,800,000	2,051,200,000
CH Energy Group Inc	221112	986,000,000	43,000,000
Cheung Kong Infrastructure Holdings Ltd	221112	449,599,000	996,892,000
Chubu Electric Power Co Inc	221112	36,062,600,000	1,603,300,000
CLP Holdings Limited	221112	11,794,600,000	1,195,500,000
CMS Energy Corporation	221112	6,503,000,000	415,000,000
Commonwealth Edison Company	221112	6,056,000,000	416,000,000
Companhia de Transmissao de Energia Eletrica Paulista (CTEEP)	221112	1,491,120,000	436,461,000
Consolidated Edison Inc	221112	12,938,000,000	1,062,000,000
Constellation Energy Group	221112	13,758,000,000	-340,000,000
Consumers Energy Company	221112	6,253,000,000	467,000,000
CPFL Energia SA	221112	6,843,066,000	27,868,000
Delmarva Power and Light Company	221112		
Direct Energy	221112	9,452,660,000	361,603,000
Dominion Resources Inc	221112	14,379,000,000	1,408,000,000
DPL Inc	221112	1,514,000,000	144,300,000
DTE Energy Company	221112	8,897,000,000	711,000,000
Duke Energy Corp	221112	14,529,000,000	1,706,000,000
Dynegy Inc	221112	1,585,000,000	-1,645,000,000
E.ON AG	221112	146,258,000,000	-2,409,720,000
E.ON UK plc	221112	14,278,700,000	627,396,000
Edison International	221112	12,760,000,000	21,000,000
EDP - Energias de Portugal SA	221112	18,911,300,000	1,455,410,000
Electrabel SA	221112		
Electricity Generating Authority of Thailand	221112	13,207,500,000	1,036,021,000
Eletrobras Participacoes SA	221112		
Eletropaulo Metropolitana Electricidade de Sao Paulo SA	221112	5,268,680,000	842,139,000

Company	Industry Code	2011 Sales	2011 Profits
Endesa SA	221112	41,767,000,000	3,860,380,000
Enel SpA	221112	100,445,000,000	5,371,040,000
Energy Future Holdings Corp	221112	7,040,000,000	-1,913,000,000
Entergy Corp	221112	11,229,073,000	1,367,372,000
FirstEnergy Corp	221112	16,258,000,000	869,000,000
Gas Natural Fenosa	221112	27,290,300,000	1,975,940,000
GDF Suez SA	221112	117,408,000,000	5,183,280,000
GenOn Energy Inc	221112	3,614,000,000	-189,000,000
Georgia Power Company	221112	8,800,000,000	1,162,000,000
Glow Energy pcl	221112	1,273,830,000	110,282,000
Great Plains Energy Inc	221112	2,318,000,000	174,400,000
Hawaiian Electric Industries Inc	221112	3,242,335,000	140,120,000
Iberdrola SA	221112	40,979,400,000	3,630,760,000
Kansai Electric Power Company Inc	221112	35,924,100,000	1,597,200,000
Korea Electric Power Corporation	221112	43,532,302,000	-3,370,464,000
LG&E And KU Energy	221112	2,912,000,000	
Light SA	221112	3,719,730,000	166,060,000
MidAmerican Energy Holdings Co	221112	11,173,000,000	1,331,000,000
National Thermal Power Corp Ltd	221112	11,737,333,000	2,463,627,000
New York State Electric & Gas Corp	221112	1,703,529,000	99,722,000
NextEra Energy Inc	221112	15,341,000,000	1,923,000,000
Niagara Mohawk Power Corporation	221112		
Northeast Utilities	221112	4,465,657,000	394,693,000
NorthWestern Corporation	221112	1,362,500,000	115,200,000
NSTAR	221112	2,930,395,000	271,398,000
NV Energy Inc	221112	2,943,307,000	163,432,000
OGE Energy Corp	221112	3,915,900,000	342,900,000
Oncor Electric Delivery Company	221112	3,118,000,000	367,000,000
Ontario Power Generation Inc	221112	4,962,010,000	407,863,000
PacifiCorp	221112	4,586,000,000	555,000,000
Pepco Holdings Inc	221112	5,920,000,000	257,000,000
Pinnacle West Capital Corporation	221112	3,241,000,000	339,470,000
PNM Resources Inc	221112	1,700,619,000	190,934,000
Power Assets Holdings Ltd	221112	1,313,010,000	1,162,290,000
Power Grid Corporation of India Ltd	221112	1,767,600,000	545,900,000
PPL Corporation	221112	12,737,000,000	1,495,000,000
Public Power Corporation SA	221112	6,316,280,000	-191,638,000
Public Service Enterprise Group Inc (PSEG)	221112	11,079,000,000	1,503,000,000
Puerto Rico Electric Power Authority (PREPA)	221112	4,422,997,000	-39,247,000
Ratchaburi Electricity Generating Holding pcl	221112	1,371,620,000	152,767,000
Reliance Infrastructure Ltd	221112	3,093,000,000	317,000,000
Rochester Gas and Electric Corp	221112		
RWE AG	221112	63,645,800,000	2,338,500,000
RWE npower	221112		
San Diego Gas & Electric Company	221112	3,373,000,000	455,000,000
SCANA Corporation	221112	4,409,000,000	387,000,000
Scottish and Southern Energy plc	221112	43,832,400,000	2,327,400,000
ScottishPower UK plc	221112		
Sembcorp Industries Ltd	221112	7,220,837,000	914,523,000

Company	Industry Code	2011 Sales	2011 Profits
Sempra Energy	221112	10,036,000,000	1,365,000,000
Shikoku Electric Power Company Inc	221112	7,673,900,000	306,500,000
Southern California Edison Company	221112	10,577,000,000	1,144,000,000
Southern Company (The)	221112	17,657,000,000	2,268,000,000
Tampa Electric Company	221112	2,020,600,000	
Tata Power	221112	3,973,800,000	420,800,000
TECO Energy Inc	221112	3,343,000,000	272,000,000
Tenaga Nasional Berhad (TNB)	221112	10,134,400,000	157,023,000
Tenaska Inc	221112	9,339,000,000	
Tennessee Valley Authority (TVA)	221112	11,841,000,000	162,000,000
Tohoku Electric Power Co Inc	221112	22,162,300,000	-437,200,000
Tokyo Electric Power Company Inc (The, TEPCO)	221112	69,844,700,000	-16,228,000,000
TransAlta Corp	221112	2,610,910,000	299,034,000
UIL Holdings Corporation	221112	1,570,447,000	99,710,000
UNS Energy Corp	221112	1,509,515,000	109,975,000
Vattenfall AB	221112	26,164,500,000	1,510,470,000
Westar Energy Inc	221112	2,170,991,000	230,239,000
Xcel Energy Inc	221112	10,654,000,000	841,000,000
Utilities-Electric Power Transmission & Distribution			
National Grid plc	221122	22,419,400,000	3,374,700,000
Utilities-Electric, Wholesale Generation			
Calpine Corporation	221121	6,800,000,000	-190,000,000
Cogentrix Energy LLC	221121		
ITC Holdings Corp	221121	757,397,000	171,685,000
LS Power Associates LP	221121		
NRG Energy Inc	221121	9,079,000,000	197,000,000
Tractebel Energia SA	221121	2,317,330,000	775,123,000
Utilities-Gas			
AGL Resources Inc	221210	2,338,000,000	186,000,000
ATCO Ltd	221210	3,991,000,000	327,000,000
Atmos Energy Corporation	221210	4,347,634,000	207,601,000
Centrica plc	221210	35,270,200,000	1,954,820,000
Gaz Metro	221210		
Hong Kong and China Gas Co Ltd (The)	221210	2,886,540,000	791,464,000
Integrys Energy Group Inc	221210	4,708,700,000	230,500,000
Laclede Group Inc (The)	221210	1,603,307,000	63,825,000
MetroGas SA	221210	269,495,000	-16,945,000
Michigan Consolidated Gas Company	221210		
National Fuel Gas Co	221210	1,778,842,000	258,402,000
National Grid USA	221210	22,475,583,000	3,389,040,000
New Jersey Resources Corporation	221210	3,009,209,000	101,299,000
NiSource Inc	221210	6,019,000,000	299,100,000
Northern Indiana Public Service Company	221210		
Osaka Gas Co Ltd	221210	15,409,100,000	596,700,000
Piedmont Natural Gas Company Inc	221210	1,433,905,000	113,568,000
Southern California Gas Company	221210	3,816,000,000	287,000,000
Southwest Gas Corp	221210	1,887,188,000	111,763,000
Tokyo Gas Co Ltd	221210	19,896,700,000	1,237,300,000

Company	Industry Code	2011 Sales	2011 Profits
Vectren Corporation	221210	2,325,000,000	141,600,000
WGL Holdings Inc	221210	2,751,501,000	118,370,000
Utilities-Hydroelectric			
Avista Corporation	221111	1,619,780,000	103,539,000
British Columbia Hydro and Power Authority	221111	3,438,000,000	589,000,000
Companhia Paranaense de Energia - Copel	221111	4,168,967,000	630,936,000
Emera Inc	221111	1,891,000,000	247,000,000
Hydro One Inc	221111	5,509,797,000	645,523,000
Hydro-Quebec	221111	12,149,600,000	2,559,930,000
Manitoba Hydro-Electric	221111	2,019,000,000	150,000,000
PG&E Corporation	221111	14,956,000,000	844,000,000
Portland General Electric Company	221111	1,813,000,000	147,000,000
Puget Energy Inc	221111	3,318,765,000	123,290,000
Utilities-Nuclear Generation			
British Energy Group plc	221113		
Electricite de France SA (EDF)	221113	84,562,800,000	3,897,500,000
Exelon Corporation	221113	18,924,000,000	2,495,000,000
UniStar Nuclear Energy LLC	221113		
Water & Sewer Line and Related Structures Construction			
Layne Christensen Company	237110	1,025,659,000	29,991,000
Team Inc	237110	508,020,000	26,585,000

ALPHABETICAL INDEX

ABB (India) Ltd
ABB Ltd
Abbot Group Limited
Abu Dhabi National Energy Company PJSC (TAQA)
Abu Dhabi National Oil Company
Access Midstream Partners LP
Adams Resources & Energy Inc
Addax Petroleum Inc
Aegean Marine Petroleum Network Inc
Aera Energy LLC
AES Corporation (The)
AGL Resources Inc
Alabama Power Company
Alliance Resource Partners LP
Alliant Energy Corp
Alon USA Energy Inc
Alpha Natural Resources Inc
Alstom SA
Ameren Corp
Ameren Illinois Company
Ameresco Inc
American Electric Power Company Inc (AEP)
AmeriGas Partners LP
Anadarko Petroleum Corporation
Anglo American plc
AP Moller-Maersk A/S
Apache Corp
Apco Oil and Gas International Inc
Apex Oil Company Inc
Arabian American Development Co
Arch Coal Inc
Arctic Slope Regional Corp
AREVA Group
Arizona Public Service Company
ATCO Ltd
Atlantic City Electric Company
Atmos Energy Corporation
Atomic Energy of Canada Ltd
Atwood Oceanics Inc
Avista Corporation
Baker Hughes Inc
Baltimore Gas and Electric Company
Bangchak Petroleum pcl (The)
Bangor Hydro-Electric Company
Barnwell Industries Inc
BASF SE
Basic Energy Services Inc
Bechtel Group Inc
Berry Petroleum Co
BG Group plc
Bharat Petroleum Corporation Ltd
BHP Billiton
Black & Veatch Holding Company
Black Hills Corp
Blue Rhino LLC
Bolt Technology Corp
Boots & Coots Inc
BP plc
Braskem SA
BreitBurn Energy Partners LP
Bristow Group Inc
British Columbia Hydro and Power Authority
British Energy Group plc
BW Gas Limited
C&J Energy Services Inc
Cabot Oil & Gas Corp
Callon Petroleum Company
Calpine Corporation
Caltex Australia Limited
CAMAC International Corp
Cameco Corporation
Cameron International Corporation
Canadian Natural Resources Ltd
Canadian Oil Sands Ltd
Carbo Ceramics Inc
Carrizo Oil & Gas Inc
Center Oil Company
CenterPoint Energy Inc
Centrais Eletricas Brasileiras SA (Electrobras)
Centrica plc
Ceylon Petroleum Corp (CPC)
CEZ AS
CGGVeritas
CH Energy Group Inc
CHC Helicopter Corp
Cheniere Energy Inc
Chesapeake Energy Corp
Cheung Kong Infrastructure Holdings Ltd
Chevron Corporation
Chicago Bridge & Iron Company NV
China National Petroleum Corp (CNPC)
China Oilfield Services Limited
China Petroleum & Chemical Corporation (Sinopec)
China Shenhua Energy Company Limited
Chubu Electric Power Co Inc
Cimarex Energy Co
CITGO Petroleum Corporation
Clayton Williams Energy Inc
Cloud Peak Energy Inc
CLP Holdings Limited
CMS Energy Corporation
CNOOC Limited
Cogentrix Energy LLC
Colonial Group Inc
Commonwealth Edison Company
Companhia de Transmissao de Energia Eletrica Paulista (CTEEP)
Companhia Paranaense de Energia - Copel
Compania Espanola de Petroleos SA (CEPSA)
ConocoPhillips Company
CONSOL Energy Inc
Consolidated Edison Inc
Constellation Energy Group
Consumers Energy Company
Continental Resources Inc
Cooper Industries plc
Cosmo Oil Co Ltd
CPFL Energia SA
Crosstex Energy LP
Crown Central LLC
Dakota Gasification Company
Dawson Geophysical Company
DCP Midstream LLC
Delmarva Power and Light Company
Denbury Resources Inc
Devon Energy Corporation
Diamond Offshore Drilling Inc
Direct Energy
Dominion Resources Inc
Dorchester Minerals LP
DPL Inc
Dril-Quip Inc
Drummond Company Inc
DTE Energy Company
Duke Energy Corp
Dynegy Inc
E.ON AG
E.ON UK plc
Ecopetrol SA
Edison International
EDP - Energias de Portugal SA
Electrabel SA
Electricite de France SA (EDF)
Electricity Generating Authority of Thailand
Eletrobras Participacoes SA
Eletropaulo Metropolitana Electricidade de Sao Paulo SA
Elster Group SE
Emera Inc
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Endesa SA
Enel SpA
ENERCON GmbH
Energy Future Holdings Corp
Energy Transfer Partners LP
ENGlobal Corp
Eni SpA
Enogex LLC
Ensco plc
Ensign Energy Services Inc
Entergy Corp
Enterprise Products Partners LP
EOG Resources Inc
EPCOR Utilities Inc
EPL Oil & Gas Inc
EQT Corporation
Ergon Inc
Essar Group Ltd
Evonik Industries AG
EXCO Resources Inc
Exelon Corporation
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
FirstEnergy Corp
Fluor Corp
Forest Oil Corporation
Formosa Petrochemical Corp (FPCC)
Fortum Company

Foster Wheeler AG
Frontline Ltd
Fuel Tech Inc
Fugro NV
Furmanite Corp
GAIL (India) Limited
Galp Energia SGPS SA
Gas Natural Fenosa
Gaz Metro
GDF Suez SA
GE Energy Infrastructure
Genesis Energy LP
GenOn Energy Inc
Geokinetics Inc
Georgia Power Company
Global Partners LP
Glow Energy pcl
Goodrich Petroleum Corp
Great Lakes Gas Transmission Company
Great Plains Energy Inc
Grupo EBX
GS Caltex Corp
GS Holdings Corp
Gulf Oil Limited Partnership
GulfMark Offshore Inc
Halliburton Company
Harvest Natural Resources Inc
Hawaiian Electric Industries Inc
Headwaters Inc
Helix Energy Solutions Group Inc.
Hellenic Petroleum SA
Helmerich & Payne Inc
Hercules Offshore Inc
Hess Corporation
Hindustan Petroleum Corporation Ltd
HollyFrontier Corporation
Hong Kong and China Gas Co Ltd (The)
Hunt Consolidated Inc
Hunting PLC
Husky Energy Inc
Hydro One Inc
Hydro-Quebec
Iberdrola SA
Idemitsu Kosan Co Ltd
Imperial Oil Limited
Indian Oil Corp Ltd
Inergy LP
INPEX Corporation
Integrys Energy Group Inc
ITC Holdings Corp
Itron Inc
John Wood Group plc
Joy Global Inc
JSC Gazprom Neft
JX Holdings Inc
JX Nippon Mining & Metals Corporation
Kansai Electric Power Company Inc
KBR Inc
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Kinder Morgan Inc
Koch Industries Inc
Kochi Refineries Ltd
Korea Electric Power Corporation
Korea Gas Corporation
Kuwait Petroleum Corporation
Laclede Group Inc (The)
Layne Christensen Company
LG&E And KU Energy
Light SA
Loews Corporation
Louis Dreyfus SAS
LS Power Associates LP
Lufkin Industries Inc
LyondellBasell Industries
Magellan Midstream Partners LP
Manitoba Hydro-Electric
Marathon Oil Corp
Marathon Petroleum Corporation
Matrix Service Company
McDermott International Inc
McMoRan Exploration Co
MDU Resources Group Inc
Mesa Energy Holdings Inc
MetroGas SA
Michigan Consolidated Gas Company
MidAmerican Energy Holdings Co
Mitsubishi Chemical Holdings Corporation
Mitsubishi Corp
Mitsui Oil Exploration Co Ltd (MOECO)
Mitsui OSK Lines Ltd
Motiva Enterprises LLC
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Grid plc
National Grid USA
National Oilwell Varco Inc
National Thermal Power Corp Ltd
Nederlandse Gasunie NV
New Jersey Resources Corporation
New York State Electric & Gas Corp
Newfield Exploration Co
Newpark Resources Inc
Nexen Inc
NextEra Energy Inc
Niagara Mohawk Power Corporation
Nigerian National Petroleum Corporation
NiSource Inc
Noble Corporation
Noble Energy Inc
Northeast Utilities
Northern Indiana Public Service Company
NorthWestern Corporation
NOV Wilson
NRG Energy Inc
NSTAR
NuStar Energy LP
NV Energy Inc
OAO Gazprom
OAO Lukoil
OAO Novatek
OAO Rosneft
OAO Tatneft
Occidental Petroleum Corp
Oceaneering International Inc
OGE Energy Corp
OGX Petroleo e Gas Participacoes SA
Oil & Natural Gas Corp Ltd
Oil Search Ltd
Oil States International Inc
OMV AG
Oncor Electric Delivery Company
ONEOK Inc
ONEOK Partners LP
Ontario Power Generation Inc
Osaka Gas Co Ltd
Oxbow Corporation
PAA Natural Gas Storage LP
PacifiCorp
Pakistan State Oil Co Ltd
Parker Drilling Company
Patterson-UTI Energy Inc
PDC Energy Inc
Peabody Energy Corp
Penn Virginia Corp
Penn West Petroleum Ltd
Pepco Holdings Inc
Petrobras Argentina SA
Petrobras Distribuidora SA
PetroChina Company Limited
Petroleo Brasileiro SA (Petrobras)
Petroleos de Venezuela SA (Pdvsa)
Petroleos Mexicanos (Pemex)
Petroleum Geo Services ASA
Petron Corp
PETRONAS (Petroliam Nasional Berhad)
PetroQuest Energy Inc
PG&E Corporation
PHI Inc
Piedmont Natural Gas Company Inc
Pinnacle West Capital Corporation
Pioneer Natural Resources Company
Plains All American Pipeline LP
Plains Exploration and Production Company
PNM Resources Inc
Polski Koncern Naftowy Orlen SA (PKN ORLEN Group)
Portland General Electric Company
Power Assets Holdings Ltd
Power Finance Corporation Limited
Power Grid Corporation of India Ltd
PowerSecure International Inc
PPL Corporation
Precision Drilling Corporation
Premier Oil plc
PrimeEnergy Corporation
PT Pertamina (Persero)
PTT Exploration and Production pcl
PTT pcl
Public Power Corporation SA
Public Service Enterprise Group Inc (PSEG)
Puerto Rico Electric Power Authority (PREPA)
Puget Energy Inc
Qatar Petroleum
Questar Corporation
Quicksilver Resources Inc
Range Resources Corp
Ratchaburi Electricity Generating Holding pcl
Reliance Industries Ltd (Reliance Group)

Reliance Infrastructure Ltd
Reliance Power Limited
Repsol YPF SA
Rhino Resource Partners LP
Rio Tinto Group
Rochester Gas and Electric Corp
Rowan Companies Inc
Royal Dutch Shell plc
Royal Vopak NV
RPC Inc
RWE AG
RWE npower
Saipem SpA
San Diego Gas & Electric Company
SandRidge Energy Inc
Santos Ltd
Saudi Aramco (Saudi Arabian Oil Co)
SCANA Corporation
Schlumberger Limited
Schneider Electric SA
Scottish and Southern Energy plc
ScottishPower UK plc
SEACOR Holdings Inc
Seadrill Limited
Seitel Inc
Sembcorp Industries Ltd
Sempra Energy
Shaw Group Inc (The)
Shell Canada Limited
Shell Oil Co
Shikoku Electric Power Company Inc
Showa Shell Sekiyu KK
SHV Holdings NV
Siemens AG
Silver Spring Networks
Sinclair Oil Corp
Sinopec Shanghai Petrochemical Co Ltd
SK Holdings Co Ltd
SM Energy Company
SMF Energy Corporation
Snam Rete Gas SpA
S-Oil Corporation
Sonatrach
Southern California Edison Company
Southern California Gas Company
Southern Company (The)
Southern Union Company
Southwest Gas Corp
Southwestern Energy Co
Spectra Energy Corp
Statoil ASA
Stone Energy Corporation
Subsea 7 SA
Suncor Energy Inc
Sunoco Inc
Sunoco Logistics Partners LP
Superior Energy Services Inc
Surgutneftegas (OJSC)
Susser Holdings Corporation
Swift Energy Co
Syncrude Canada Ltd
Talisman Energy Inc
Tampa Electric Company
Targa Resources Partners LP
Tata Power
Team Inc
Technip
TECO Energy Inc
Tenaga Nasional Berhad (TNB)
Tenaris SA
Tenaska Inc
Tennessee Valley Authority (TVA)
Tesco Corporation
Tesoro Corp
TETRA Technologies Inc
Texas Gas Transmission LLC
Thai Oil pcl
Tidewater Inc
TNK-BP
Tohoku Electric Power Co Inc
Tokyo Electric Power Company Inc (The, TEPCO)
Tokyo Gas Co Ltd
TonenGeneral Sekiyu KK
Total SA
TOTAL UK Limited
Tractebel Energia SA
TransAlta Corp
Transammonia Inc
TransCanada Corp
TransMontaigne Inc
Transocean Ltd
Transportadora de Gas del Sur SA
Triangle Petroleum Corp
Truman Arnold Companies
Tsakos Energy Navigation Ltd
UGI Corp
UIL Holdings Corporation
UK Coal plc
Ultra Petroleum Corp
Ultrapar Participacoes SA
UniStar Nuclear Energy LLC
Unit Corp
United Refining Company
United Refining Company (Red Apple)
UNS Energy Corp
URS Flint Energy Services Ltd
US Venture Inc
USEC Inc
VAALCO Energy Inc
Valero Energy Corp
Vattenfall AB
Vectren Corporation
W&T Offshore Inc
Weatherford International Ltd
Westar Energy Inc
WesternGeco
Westinghouse Electric Company LLC
Westmoreland Coal Co
WGL Holdings Inc
Willbros Group Inc
Williams Companies Inc (The)
Wintershall AG
Wisconsin Energy Corp
Woodside Petroleum Ltd
World Fuel Services Corp
Xcel Energy Inc
Xstrata plc
XTO Energy Inc
Yanzhou Coal Mining Co Ltd
YPF SA

INDEX OF U.S. HEADQUARTERS LOCATION BY STATE

ALABAMA
Alabama Power Company; Birmingham
Drummond Company Inc; Birmingham

ALASKA
Arctic Slope Regional Corp; Anchorage

ARIZONA
Arizona Public Service Company; Phoenix
Pinnacle West Capital Corporation; Phoenix
UNS Energy Corp; Tucson

ARKANSAS
Murphy Oil Corporation; El Dorado

CALIFORNIA
Aera Energy LLC; Bakersfield
Bechtel Group Inc; San Francisco
BreitBurn Energy Partners LP; Los Angeles
Chevron Corporation; San Ramon
Edison International; Rosemead
Occidental Petroleum Corp; Los Angeles
PG&E Corporation; San Francisco
San Diego Gas & Electric Company; San Diego
Sempra Energy; San Diego
Silver Spring Networks; Redwood City
Southern California Edison Company; Rosemead
Southern California Gas Company; Los Angeles

COLORADO
Berry Petroleum Co; Denver
Cimarex Energy Co; Denver
DCP Midstream LLC; Denver
Forest Oil Corporation; Denver
PDC Energy Inc; Denver
SM Energy Company; Denver
TransMontaigne Inc; Denver
Triangle Petroleum Corp; Denver
Westmoreland Coal Co; Englewood

CONNECTICUT
Bolt Technology Corp; Norwalk
UIL Holdings Corporation; New Haven

DELAWARE
Delmarva Power and Light Company; Wilmington

DISTRICT OF COLUMBIA
Pepco Holdings Inc; Washington
WGL Holdings Inc; Washington

FLORIDA
NextEra Energy Inc; Juno Beach
Oxbow Corporation; West Palm Beach
SEACOR Holdings Inc; Ft. Lauderdale
SMF Energy Corporation; Fort Lauderdale
Tampa Electric Company; Tampa
TECO Energy Inc; Tampa
World Fuel Services Corp; Miami

GEORGIA
AGL Resources Inc; Atlanta
Colonial Group Inc; Savannah
GE Energy Infrastructure; Atlanta
Georgia Power Company; Atlanta
RPC Inc; Atlanta
Southern Company (The); Atlanta

HAWAII
Barnwell Industries Inc; Honolulu
Hawaiian Electric Industries Inc; Honolulu

ILLINOIS
Ameren Illinois Company; Peoria
Commonwealth Edison Company; Chicago
Exelon Corporation; Chicago
Fuel Tech Inc; Warrenville
Integrys Energy Group Inc; Chicago

INDIANA
NiSource Inc; Merrillville
Northern Indiana Public Service Company; Merrillville
Vectren Corporation; Evansville

IOWA
MidAmerican Energy Holdings Co; Des Moines

KANSAS
Black & Veatch Holding Company; Overland Park
Ferrellgas Partners LP; Overland Park
Koch Industries Inc; Wichita
Layne Christensen Company; Mission Woods
Westar Energy Inc; Topeka

KENTUCKY
LG&E And KU Energy; Louisville
Rhino Resource Partners LP; Lexington
Texas Gas Transmission LLC; Owensboro

LOUISIANA
Entergy Corp; New Orleans
EPL Oil & Gas Inc; New Orleans
McMoRan Exploration Co; New Orleans
PetroQuest Energy Inc; Lafayette
PHI Inc; Lafayette
Shaw Group Inc (The); Baton Rouge
Stone Energy Corporation; Lafayette
Superior Energy Services Inc; New Orleans
Tidewater Inc; New Orleans

MAINE
Bangor Hydro-Electric Company; Bangor

MARYLAND
Baltimore Gas and Electric Company; Baltimore
Constellation Energy Group; Baltimore
Crown Central LLC; Baltimore
UniStar Nuclear Energy LLC; Baltimore
USEC Inc; Bethesda

MASSACHUSETTS
Ameresco Inc; Framingham
Global Partners LP; Waltham
Gulf Oil Limited Partnership; Framingham
National Grid USA; Waltham
Northeast Utilities; Springfield
NSTAR; Boston

MICHIGAN
CMS Energy Corporation; Jackson
Consumers Energy Company; Jackson
DTE Energy Company; Detroit
ITC Holdings Corp; Novi
Michigan Consolidated Gas Company; Detroit

MINNESOTA
Xcel Energy Inc; Minneapolis

MISSISSIPPI
Callon Petroleum Company; Natchez
Ergon Inc; Jackson

MISSOURI
Ameren Corp; St. Louis
Apex Oil Company Inc; Clayton
Arch Coal Inc; St. Louis
Center Oil Company; St. Louis
Great Plains Energy Inc; Kansas City
Inergy LP; Kansas City
Laclede Group Inc (The); St. Louis
Peabody Energy Corp; St. Louis

NEBRASKA
Tenaska Inc; Omaha

NEVADA
NV Energy Inc; Las Vegas
Southwest Gas Corp; Las Vegas

NEW JERSEY
Atlantic City Electric Company; Mays Landing
New Jersey Resources Corporation; Wall
NRG Energy Inc; Princeton

Public Service Enterprise Group Inc (PSEG); Newark

NEW MEXICO
PNM Resources Inc; Albuquerque

NEW YORK
CH Energy Group Inc; Poughkeepsie
Consolidated Edison Inc; New York
Hess Corporation; New York
Loews Corporation; New York
LS Power Associates LP; New York
National Fuel Gas Co; Williamsville
New York State Electric & Gas Corp; Binghamton
Niagara Mohawk Power Corporation; Syracuse
Rochester Gas and Electric Corp; Rochester
Transammonia Inc; New York
United Refining Company (Red Apple); New York

NORTH CAROLINA
Blue Rhino LLC; Winston-Salem
Cogentrix Energy LLC; Charlotte
Duke Energy Corp; Charlotte
Piedmont Natural Gas Company Inc; Charlotte
PowerSecure International Inc; Wake Forest

NORTH DAKOTA
Dakota Gasification Company; Bismarck
MDU Resources Group Inc; Bismarck

OHIO
American Electric Power Company Inc (AEP); Columbus
DPL Inc; Dayton
FirstEnergy Corp; Akron
Marathon Petroleum Corporation; Findlay

OKLAHOMA
Access Midstream Partners LP; Oklahoma City
Alliance Resource Partners LP; Tulsa
Apco Oil and Gas International Inc; Tulsa
Chesapeake Energy Corp; Oklahoma City
Continental Resources Inc; Oklahoma City
Devon Energy Corporation; Oklahoma City
Enogex LLC; Oklahoma City
Helmerich & Payne Inc; Tulsa
Magellan Midstream Partners LP; Tulsa
Matrix Service Company; Tulsa
OGE Energy Corp; Oklahoma City
ONEOK Inc; Tulsa
ONEOK Partners LP; Tulsa
SandRidge Energy Inc; Oklahoma City
Unit Corp; Tulsa
Williams Companies Inc (The); Tulsa

OREGON
PacifiCorp; Portland
Portland General Electric Company; Portland

PENNSYLVANIA
AmeriGas Partners LP; King of Prussia
CONSOL Energy Inc; Canonsburg
EQT Corporation; Pittsburgh
Penn Virginia Corp; Radnor
PPL Corporation; Allentown
Sunoco Inc; Philadelphia
Sunoco Logistics Partners LP; Philadelphia
UGI Corp; King of Prussia
United Refining Company; Warren
Westinghouse Electric Company LLC; Monroeville

SOUTH CAROLINA
SCANA Corporation; Cayce

SOUTH DAKOTA
Black Hills Corp; Rapid City
NorthWestern Corporation; Sioux Falls

TENNESSEE
Tennessee Valley Authority (TVA); Knoxville

TEXAS
Adams Resources & Energy Inc; Houston
Alon USA Energy Inc; Dallas
Anadarko Petroleum Corporation; The Woodlands
Apache Corp; Houston
Arabian American Development Co; Sugarland
Atmos Energy Corporation; Dallas
Atwood Oceanics Inc; Houston
Baker Hughes Inc; Houston
Basic Energy Services Inc; Midland
Boots & Coots Inc; Houston
Bristow Group Inc; Houston
C&J Energy Services Inc; Houston
Cabot Oil & Gas Corp; Houston
Calpine Corporation; Houston
CAMAC International Corp; Houston
Cameron International Corporation; Houston
Carbo Ceramics Inc; Houston
Carrizo Oil & Gas Inc; Houston
CenterPoint Energy Inc; Houston
Cheniere Energy Inc; Houston
CITGO Petroleum Corporation; Houston
Clayton Williams Energy Inc; Midland
ConocoPhillips Company; Houston
Crosstex Energy LP; Dallas
Dawson Geophysical Company; Midland
Denbury Resources Inc; Plano
Diamond Offshore Drilling Inc; Houston
Dorchester Minerals LP; Dallas
Dril-Quip Inc; Houston
Dynegy Inc; Houston
Enbridge Energy Partners LP; Houston
Energy Future Holdings Corp; Dallas
Energy Transfer Partners LP; Dallas
ENGlobal Corp; Houston
Enterprise Products Partners LP; Houston
EOG Resources Inc; Houston
EXCO Resources Inc; Dallas
Exterran Holdings Inc; Houston
Exxon Mobil Corporation (ExxonMobil); Irving
Fluor Corp; Irving
Furmanite Corp; Richardson
Genesis Energy LP; Houston
GenOn Energy Inc; Houston
Geokinetics Inc; Houston
Goodrich Petroleum Corp; Houston
Great Lakes Gas Transmission Company; Houston
GulfMark Offshore Inc; Houston
Halliburton Company; Houston
Harvest Natural Resources Inc; Houston
Helix Energy Solutions Group Inc.; Houston
Hercules Offshore Inc; Houston
HollyFrontier Corporation; Dallas
Hunt Consolidated Inc; Dallas
Hunting PLC; Houston
KBR Inc; Houston
Key Energy Services Inc; Houston
Kinder Morgan Energy Partners LP; Houston
Kinder Morgan Inc; Houston
Lufkin Industries Inc; Lufkin
Marathon Oil Corp; Houston
McDermott International Inc; Houston
Mesa Energy Holdings Inc; Dallas
Motiva Enterprises LLC; Houston
National Oilwell Varco Inc; Houston
Newfield Exploration Co; The Woodlands
Newpark Resources Inc; The Woodlands
Noble Energy Inc; Houston
NuStar Energy LP; San Antonio
Oceaneering International Inc; Houston
Oil States International Inc; Houston
Oncor Electric Delivery Company; Dallas
PAA Natural Gas Storage LP; Houston
Parker Drilling Company; Houston
Patterson-UTI Energy Inc; Houston
Pioneer Natural Resources Company; Irving
Plains All American Pipeline LP; Houston
Plains Exploration and Production Company; Houston
PrimeEnergy Corporation; Houston
Quicksilver Resources Inc; Fort Worth
Range Resources Corp; Fort Worth
Rowan Companies Inc; Houston
Schlumberger Limited; Houston
Seitel Inc; Houston
Shell Oil Co; Houston
Southern Union Company; Houston
Southwestern Energy Co; Houston
Spectra Energy Corp; Houston

Susser Holdings Corporation; Corpus Christi
Swift Energy Co; Houston
Targa Resources Partners LP; Houston
Team Inc; Alvin
Tesco Corporation; Houston
Tesoro Corp; San Antonio
TETRA Technologies Inc; The Woodlands
Truman Arnold Companies; Texarkana
Ultra Petroleum Corp; Houston
VAALCO Energy Inc; Houston
Valero Energy Corp; San Antonio
W&T Offshore Inc; Houston
Willbros Group Inc; Houston
XTO Energy Inc; Fort Worth

UTAH
Headwaters Inc; South Jordan
Questar Corporation; Salt Lake City
Sinclair Oil Corp; Salt Lake City

VIRGINIA
AES Corporation (The); Arlington
Alpha Natural Resources Inc; Abingdon
Dominion Resources Inc; Richmond

WASHINGTON
Avista Corporation; Spokane
Itron Inc; Liberty Lake
Puget Energy Inc; Bellevue

WISCONSIN
Alliant Energy Corp; Madison
Joy Global Inc; Milwaukee
US Venture Inc; Appleton
Wisconsin Energy Corp; Milwaukee

WYOMING
Cloud Peak Energy Inc; Gillette

INDEX OF NON-U.S. HEADQUARTERS LOCATION BY COUNTRY

ALGERIA
Sonatrach; Algiers

ARGENTINA
MetroGas SA; Buenos Aires
Petrobras Argentina SA; Buenos Aires
Transportadora de Gas del Sur SA; Buenos Aires
YPF SA; Buenos Aires

AUSTRALIA
Caltex Australia Limited; Sydney
Santos Ltd; Adelaide
Woodside Petroleum Ltd; Perth

AUSTRIA
OMV AG; Vienna

BELGIUM
Electrabel SA; Brussels

BERMUDA
Frontline Ltd; Hamilton
Nabors Industries Ltd; Hamilton
Seadrill Limited; Hamilton

BRAZIL
Braskem SA; Sao Paulo
Centrais Eletricas Brasileiras SA (Electrobras); Rio de Janeiro
Companhia de Transmissao de Energia Eletrica Paulista (CTEEP); Sao Paulo
Companhia Paranaense de Energia - Copel; Curitiba
CPFL Energia SA; Sao Paulo
Eletrobras Participacoes SA; Rio De Janeiro
Eletropaulo Metropolitana Electricidade de Sao Paulo SA; Sao Paulo
Grupo EBX; Rio de Janeiro
Light SA; Rio de Janeiro
OGX Petroleo e Gas Participacoes SA; Rio de Janeiro
Petrobras Distribuidora SA; Rio de Janeiro
Petroleo Brasileiro SA (Petrobras); Rio de Janeiro
Tractebel Energia SA; Florianopolis
Ultrapar Participacoes SA; Sao Paulo

CANADA
ATCO Ltd; Calgary
Atomic Energy of Canada Ltd; Chalk River
British Columbia Hydro and Power Authority; Vancouver
Cameco Corporation; Saskatoon
Canadian Natural Resources Ltd; Calgary
Canadian Oil Sands Ltd; Calgary
CHC Helicopter Corp; Richmond
Direct Energy; Toronto
Emera Inc; Halifax
Enbridge Inc; Calgary
EnCana Corp; Calgary
Ensign Energy Services Inc; Calgary
EPCOR Utilities Inc; Edmonton
Gaz Metro; Montreal
Husky Energy Inc; Calgary
Hydro One Inc; Toronto
Hydro-Quebec; Montreal
Imperial Oil Limited; Calgary
Manitoba Hydro-Electric; Winnipeg
Nexen Inc; Calgary
NOV Wilson; Calgary
Ontario Power Generation Inc; Toronto
Penn West Petroleum Ltd; Calgary
Precision Drilling Corporation; Calgary
Shell Canada Limited; Calgary
Suncor Energy Inc; Calgary
Syncrude Canada Ltd; Fort McMurray
Talisman Energy Inc; Calgary
TransAlta Corp; Calgary
TransCanada Corp; Calgary
URS Flint Energy Services Ltd; Calgary

CHINA
Cheung Kong Infrastructure Holdings Ltd; Hong Kong
China National Petroleum Corp (CNPC); Beijing
China Oilfield Services Limited; Beijing
China Petroleum & Chemical Corporation (Sinopec); Beijing
China Shenhua Energy Company Limited; Beijing
CLP Holdings Limited; Hong Kong
CNOOC Limited; Hong Kong
Hong Kong and China Gas Co Ltd (The); Hong Kong
PetroChina Company Limited; Beijing
Power Assets Holdings Ltd; Hong Kong
Sinopec Shanghai Petrochemical Co Ltd; Shanghai
Yanzhou Coal Mining Co Ltd; Zoucheng

COLOMBIA
Ecopetrol SA; Bogota

CZECH REPUBLIC
CEZ AS; Prague

DENMARK
AP Moller-Maersk A/S; Copenhagen

FINLAND
Fortum Company; Espoo

FRANCE
Alstom SA; Levallois-Perret
AREVA Group; Paris
CGGVeritas; Paris

Electricite de France SA (EDF); Paris
GDF Suez SA; Paris
Louis Dreyfus SAS; Paris
Schneider Electric SA; Rueil-Malmaison
Technip; Paris
Total SA; Courbevoie

GERMANY
BASF SE; Ludwigshafen
E.ON AG; Dusseldorf
Elster Group SE; Essen
ENERCON GmbH; Aurich
Evonik Industries AG; Essen
RWE AG; Essen
Siemens AG; Munich
Wintershall AG; Kassel

GREECE
Aegean Marine Petroleum Network Inc; Athens
Hellenic Petroleum SA; Maroussi
Public Power Corporation SA; Athens
Tsakos Energy Navigation Ltd; Athens

INDIA
ABB (India) Ltd; Bangalore
Bharat Petroleum Corporation Ltd; Mumbai
Essar Group Ltd; Mumbai
GAIL (India) Limited; New Delhi
Hindustan Petroleum Corporation Ltd; Mumbai
Indian Oil Corp Ltd; Mumbai
Kochi Refineries Ltd; Kochi
National Thermal Power Corp Ltd; New Delhi
Oil & Natural Gas Corp Ltd; Dehradun
Power Finance Corporation Limited; New Delhi
Power Grid Corporation of India Ltd; Gurgaon
Reliance Industries Ltd (Reliance Group); Mumbai
Reliance Infrastructure Ltd; Thane
Reliance Power Limited; Navi Mumbai
Tata Power; Mumbai

INDONESIA
PT Pertamina (Persero); Jakarta

IRELAND
Cooper Industries plc; Dublin

ITALY
Enel SpA; Rome
Eni SpA; Rome
Saipem SpA; Milan
Snam Rete Gas SpA; Milan

JAPAN
Chubu Electric Power Co Inc; Nagoya
Cosmo Oil Co Ltd; Tokyo
Idemitsu Kosan Co Ltd; Tokyo
INPEX Corporation; Tokyo
JX Holdings Inc; Tokyo
JX Nippon Mining & Metals Corporation; Tokyo
Kansai Electric Power Company Inc; Osaka
Mitsubishi Chemical Holdings Corporation; Tokyo
Mitsubishi Corp; Tokyo
Mitsui Oil Exploration Co Ltd (MOECO); Tokyo
Mitsui OSK Lines Ltd; Tokyo
Osaka Gas Co Ltd; Osaka
Shikoku Electric Power Company Inc; Takamatsu
Showa Shell Sekiyu KK; Tokyo
Tohoku Electric Power Co Inc; Miyagi
Tokyo Electric Power Company Inc (The, TEPCO); Tokyo
Tokyo Gas Co Ltd; Tokyo
TonenGeneral Sekiyu KK; Tokyo

KOREA
GS Caltex Corp; Seoul
GS Holdings Corp; Seoul
Korea Electric Power Corporation; Seoul
Korea Gas Corporation; Gyeonggi-do
SK Holdings Co Ltd; Seoul
S-Oil Corporation; Seoul

KUWAIT
Kuwait Petroleum Corporation; Safat

LUXEMBOURG
Tenaris SA; Luxembourg

MALAYSIA
PETRONAS (Petroliam Nasional Berhad); Kuala Lumpur
Tenaga Nasional Berhad (TNB); Kuala Lumpur

MEXICO
Petroleos Mexicanos (Pemex); Mexico City

NIGERIA
Nigerian National Petroleum Corporation; Garki Abuja

NORWAY
BW Gas Limited; Oslo
Petroleum Geo Services ASA; Lysaker
Statoil ASA; Stavanger

PAKISTAN
Pakistan State Oil Co Ltd; Karachi

PAPUA NEW GUINEA
Oil Search Ltd; Port Moresby

PHILIPPINES
Petron Corp; Manila

POLAND
Polski Koncern Naftowy Orlen SA (PKN ORLEN Group); Plock

PORTUGAL
EDP - Energias de Portugal SA; Lisbon
Galp Energia SGPS SA; Lisbon

PUERTO RICO
Puerto Rico Electric Power Authority (PREPA); San Juan

QATAR
Qatar Petroleum; Doha

RUSSIA
JSC Gazprom Neft; St. Petersburg
OAO Gazprom; Moscow
OAO Lukoil; Moscow
OAO Novatek; Moscow
OAO Rosneft; Moscow
OAO Tatneft; Tatarstan
Surgutneftegas (OJSC); Surgut
TNK-BP; Moscow

SAUDI ARABIA
Saudi Aramco (Saudi Arabian Oil Co); Dhahran

SINGAPORE
Sembcorp Industries Ltd; Singapore

SPAIN
Compania Espanola de Petroleos SA (CEPSA); Madrid
Endesa SA; Madrid
Gas Natural Fenosa; Barcelona
Iberdrola SA; Bilbao
Repsol YPF SA; Madrid
ScottishPower UK plc; Bilbao

SRI LANKA
Ceylon Petroleum Corp (CPC); Colombo

SWEDEN
Vattenfall AB; Stockholm

SWITZERLAND
ABB Ltd; Zurich
Addax Petroleum Inc; Geneva
Foster Wheeler AG; Geneva
Noble Corporation; Baar
Transocean Ltd; Vernier
Weatherford International Ltd; Geneva
Xstrata plc; Zug

TAIWAN
Formosa Petrochemical Corp (FPCC); Taipei

THAILAND
Bangchak Petroleum pcl (The); Bangkok
Electricity Generating Authority of Thailand; Bang Kruai
Glow Energy pcl; Bangkok
PTT Exploration and Production pcl; Bangkok
PTT pcl; Bangkok
Ratchaburi Electricity Generating Holding pcl; Bangkok
Thai Oil pcl; Bangkok

THE NETHERLANDS
Chicago Bridge & Iron Company NV; The Hague
Fugro NV; Leidschendam
LyondellBasell Industries; Rotterdam
Nederlandse Gasunie NV; Groningen
Royal Dutch Shell plc; The Hague
Royal Vopak NV; Rotterdam
SHV Holdings NV; Utrecht

UNITED ARAB EMIRATES
Abu Dhabi National Energy Company PJSC (TAQA); Abu Dhabi
Abu Dhabi National Oil Company; Abu Dhabi

UNITED KINGDOM
Abbot Group Limited; Aberdeen
Anglo American plc; London
BG Group plc; Reading
BHP Billiton; London
BP plc; London
British Energy Group plc; East Kilbride
Centrica plc; Windsor
E.ON UK plc; Coventry
Ensco plc; London
John Wood Group plc; Aberdeen
National Grid plc; London
Premier Oil plc; London
Rio Tinto Group; London
RWE npower; Swindon
Scottish and Southern Energy plc; Perth
Subsea 7 SA; London
TOTAL UK Limited; Watford
UK Coal plc; Doncaster
WesternGeco; Gatwick Airport

VENEZUELA
Petroleos de Venezuela SA (Pdvsa); Caracas

INDEX BY REGIONS OF THE U.S. WHERE THE FIRMS HAVE LOCATIONS

WEST
Access Midstream Partners LP
Aera Energy LLC
AES Corporation (The)
Alliance Resource Partners LP
Alon USA Energy Inc
Alpha Natural Resources Inc
Ameresco Inc
AmeriGas Partners LP
Anadarko Petroleum Corporation
AP Moller-Maersk A/S
Apache Corp
Apex Oil Company Inc
Arch Coal Inc
Arctic Slope Regional Corp
Atmos Energy Corporation
Avista Corporation
Baker Hughes Inc
Barnwell Industries Inc
BASF SE
Basic Energy Services Inc
Bechtel Group Inc
Berry Petroleum Co
Black & Veatch Holding Company
Black Hills Corp
Blue Rhino LLC
Bolt Technology Corp
Boots & Coots Inc
BP plc
BreitBurn Energy Partners LP
C&J Energy Services Inc
Calpine Corporation
Cameco Corporation
Cameron International Corporation
Carrizo Oil & Gas Inc
Chevron Corporation
Chicago Bridge & Iron Company NV
Cimarex Energy Co
CITGO Petroleum Corporation
Clayton Williams Energy Inc
Cloud Peak Energy Inc
CMS Energy Corporation
Cogentrix Energy LLC
ConocoPhillips Company
CONSOL Energy Inc
Constellation Energy Group
Continental Resources Inc
Cooper Industries plc
Cosmo Oil Co Ltd
Dawson Geophysical Company
DCP Midstream LLC
Denbury Resources Inc
Devon Energy Corporation
Drummond Company Inc
Duke Energy Corp
Dynegy Inc
Edison International
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Energy Transfer Partners LP
ENGlobal Corp
Eni SpA
Ensign Energy Services Inc
Entergy Corp
Enterprise Products Partners LP
EOG Resources Inc
EPCOR Utilities Inc
Ergon Inc
Exelon Corporation
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
FirstEnergy Corp
Fluor Corp
Forest Oil Corporation
Foster Wheeler AG
Fugro NV
Furmanite Corp
GE Energy Infrastructure
Genesis Energy LP
GenOn Energy Inc
GS Holdings Corp
Halliburton Company
Hawaiian Electric Industries Inc
Headwaters Inc
Helmerich & Payne Inc
Hess Corporation
HollyFrontier Corporation
Idemitsu Kosan Co Ltd
Integrys Energy Group Inc
Itron Inc
John Wood Group plc
JX Nippon Mining & Metals Corporation
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Koch Industries Inc
Layne Christensen Company
Loews Corporation
LS Power Associates LP
Magellan Midstream Partners LP
Marathon Oil Corp
Matrix Service Company
MDU Resources Group Inc
MidAmerican Energy Holdings Co
Mitsui OSK Lines Ltd
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Oilwell Varco Inc
Newpark Resources Inc
NextEra Energy Inc
NiSource Inc
Noble Corporation
Noble Energy Inc
NorthWestern Corporation
NRG Energy Inc
NuStar Energy LP
NV Energy Inc
Occidental Petroleum Corp
Oceaneering International Inc
Oil States International Inc
ONEOK Partners LP
Oxbow Corporation

PacifiCorp
Parker Drilling Company
Patterson-UTI Energy Inc
PDC Energy Inc
Peabody Energy Corp
PG&E Corporation
PHI Inc
Pinnacle West Capital Corporation
Pioneer Natural Resources Company
Plains All American Pipeline LP
Plains Exploration and Production Company
Portland General Electric Company
PPL Corporation
Puget Energy Inc
Questar Corporation
Quicksilver Resources Inc
Rhino Resource Partners LP
Rio Tinto Group
Rowan Companies Inc
Royal Dutch Shell plc
Royal Vopak NV
RPC Inc
San Diego Gas & Electric Company
Schlumberger Limited
SEACOR Holdings Inc
Seitel Inc
Sempra Energy
Shaw Group Inc (The)
Shell Oil Co
Siemens AG
Silver Spring Networks
Sinclair Oil Corp
SM Energy Company
SMF Energy Corporation
Southern California Edison Company
Southern California Gas Company
Southern Company (The)
Southern Union Company
Southwest Gas Corp
Spectra Energy Corp
Stone Energy Corporation
Suncor Energy Inc
Sunoco Inc
Superior Energy Services Inc
Swift Energy Co
Talisman Energy Inc
Targa Resources Partners LP
Team Inc
Technip
Tenaris SA
Tenaska Inc
Tesoro Corp
TETRA Technologies Inc
Tidewater Inc
Tokyo Electric Power Company Inc (The, TEPCO)
Total SA
TransAlta Corp
TransCanada Corp
TransMontaigne Inc
Triangle Petroleum Corp
Truman Arnold Companies
UGI Corp
Ultra Petroleum Corp
Unit Corp
URS Flint Energy Services Ltd
Valero Energy Corp
Weatherford International Ltd
Westinghouse Electric Company LLC
Westmoreland Coal Co
Willbros Group Inc
Williams Companies Inc (The)
World Fuel Services Corp
Xcel Energy Inc
Xstrata plc
XTO Energy Inc

SOUTHWEST

Abbot Group Limited
Access Midstream Partners LP
Adams Resources & Energy Inc
AES Corporation (The)
AGL Resources Inc
Alliance Resource Partners LP
Alon USA Energy Inc
Alstom SA
Ameresco Inc
American Electric Power Company Inc (AEP)
AmeriGas Partners LP
Anadarko Petroleum Corporation
AP Moller-Maersk A/S
Apache Corp
Apco Oil and Gas International Inc
Apex Oil Company Inc
Arabian American Development Co
Arch Coal Inc
Arctic Slope Regional Corp
Arizona Public Service Company
Atmos Energy Corporation
Atwood Oceanics Inc
Baker Hughes Inc
BASF SE
Basic Energy Services Inc
Bechtel Group Inc
Berry Petroleum Co
BG Group plc
BHP Billiton
Black & Veatch Holding Company
Black Hills Corp
Blue Rhino LLC
Bolt Technology Corp
Boots & Coots Inc
BP plc
Braskem SA
BreitBurn Energy Partners LP
Bristow Group Inc
C&J Energy Services Inc
Cabot Oil & Gas Corp
Callon Petroleum Company
Calpine Corporation
CAMAC International Corp
Cameron International Corporation
Carbo Ceramics Inc
Carrizo Oil & Gas Inc
CenterPoint Energy Inc
Centrica plc
CGGVeritas
Cheniere Energy Inc
Chesapeake Energy Corp
Chevron Corporation
Chicago Bridge & Iron Company NV
Cimarex Energy Co
CITGO Petroleum Corporation
Clayton Williams Energy Inc
Colonial Group Inc
ConocoPhillips Company
Constellation Energy Group
Continental Resources Inc
Cooper Industries plc
Crosstex Energy LP
Dawson Geophysical Company
DCP Midstream LLC
Denbury Resources Inc
Devon Energy Corporation
Diamond Offshore Drilling Inc
Direct Energy
Dominion Resources Inc
Dorchester Minerals LP
Dril-Quip Inc
DTE Energy Company
Duke Energy Corp
Dynegy Inc
Edison International
Elster Group SE
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Energy Future Holdings Corp
Energy Transfer Partners LP
ENGlobal Corp
Eni SpA
Enogex LLC
Ensco plc
Ensign Energy Services Inc
Entergy Corp
Enterprise Products Partners LP
EOG Resources Inc
EPL Oil & Gas Inc
Ergon Inc
Essar Group Ltd
EXCO Resources Inc
Exelon Corporation
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
Fluor Corp
Forest Oil Corporation
Foster Wheeler AG
Fugro NV
Furmanite Corp
GDF Suez SA
GE Energy Infrastructure
Genesis Energy LP
GenOn Energy Inc
Geokinetics Inc
Goodrich Petroleum Corp
GulfMark Offshore Inc
Halliburton Company
Harvest Natural Resources Inc
Headwaters Inc
Helix Energy Solutions Group Inc.
Helmerich & Payne Inc
Hercules Offshore Inc

Hess Corporation
HollyFrontier Corporation
Hunt Consolidated Inc
Hunting PLC
Iberdrola SA
Inergy LP
INPEX Corporation
Integrys Energy Group Inc
John Wood Group plc
KBR Inc
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Kinder Morgan Inc
Koch Industries Inc
Kuwait Petroleum Corporation
Laclede Group Inc (The)
Layne Christensen Company
Loews Corporation
LS Power Associates LP
Lufkin Industries Inc
LyondellBasell Industries
Magellan Midstream Partners LP
Marathon Oil Corp
Marathon Petroleum Corporation
Matrix Service Company
McDermott International Inc
McMoRan Exploration Co
MDU Resources Group Inc
Mesa Energy Holdings Inc
MidAmerican Energy Holdings Co
Mitsui Oil Exploration Co Ltd (MOECO)
Mitsui OSK Lines Ltd
Motiva Enterprises LLC
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Oilwell Varco Inc
New Jersey Resources Corporation
Newfield Exploration Co
Newpark Resources Inc
Nexen Inc
NextEra Energy Inc
NiSource Inc
Noble Corporation
Noble Energy Inc
NRG Energy Inc
NuStar Energy LP
Occidental Petroleum Corp
Oceaneering International Inc
OGE Energy Corp
Oil States International Inc
Oncor Electric Delivery Company
ONEOK Inc
ONEOK Partners LP
Oxbow Corporation
PAA Natural Gas Storage LP
Parker Drilling Company
Patterson-UTI Energy Inc
Penn Virginia Corp
Petroleo Brasileiro SA (Petrobras)
Petroleos de Venezuela SA (Pdvsa)
Petroleos Mexicanos (Pemex)
Petroleum Geo Services ASA
PetroQuest Energy Inc
PHI Inc
Pinnacle West Capital Corporation
Pioneer Natural Resources Company
Plains All American Pipeline LP
Plains Exploration and Production Company
PNM Resources Inc
PowerSecure International Inc
Precision Drilling Corporation
PrimeEnergy Corporation
Questar Corporation
Quicksilver Resources Inc
Range Resources Corp
Rowan Companies Inc
Royal Dutch Shell plc
Royal Vopak NV
RPC Inc
Saipem SpA
SandRidge Energy Inc
Saudi Aramco (Saudi Arabian Oil Co)
Schlumberger Limited
SEACOR Holdings Inc
Seadrill Limited
Seitel Inc
Sempra Energy
Shaw Group Inc (The)
Shell Oil Co
Siemens AG
Sinclair Oil Corp
SK Holdings Co Ltd
SM Energy Company
SMF Energy Corporation
Southern California Edison Company
Southern Union Company
Southwest Gas Corp
Southwestern Energy Co
Spectra Energy Corp
Statoil ASA
Stone Energy Corporation
Subsea 7 SA
Sunoco Inc
Sunoco Logistics Partners LP
Superior Energy Services Inc
Susser Holdings Corporation
Swift Energy Co
Talisman Energy Inc
Targa Resources Partners LP
Team Inc
Technip
Tenaris SA
Tenaska Inc
Tesco Corporation
Tesoro Corp
TETRA Technologies Inc
Texas Gas Transmission LLC
Tidewater Inc
Total SA
TransAlta Corp
Transammonia Inc
TransCanada Corp
TransMontaigne Inc
Transocean Ltd
Truman Arnold Companies
UGI Corp
Ultra Petroleum Corp
Ultrapar Participacoes SA
Unit Corp
UNS Energy Corp
URS Flint Energy Services Ltd
VAALCO Energy Inc
Valero Energy Corp
W&T Offshore Inc
Weatherford International Ltd
Westar Energy Inc
WesternGeco
Westinghouse Electric Company LLC
Westmoreland Coal Co
Willbros Group Inc
Williams Companies Inc (The)
Woodside Petroleum Ltd
World Fuel Services Corp
Xcel Energy Inc
XTO Energy Inc
YPF SA

MIDWEST

Abu Dhabi National Energy Company PJSC (TAQA)
Access Midstream Partners LP
AES Corporation (The)
AGL Resources Inc
Alliance Resource Partners LP
Alliant Energy Corp
Alpha Natural Resources Inc
Ameren Corp
Ameren Illinois Company
Ameresco Inc
American Electric Power Company Inc (AEP)
AmeriGas Partners LP
AP Moller-Maersk A/S
Apex Oil Company Inc
Arch Coal Inc
Arctic Slope Regional Corp
Atmos Energy Corporation
Baker Hughes Inc
BASF SE
Basic Energy Services Inc
Bechtel Group Inc
Black & Veatch Holding Company
Black Hills Corp
Blue Rhino LLC
BP plc
BreitBurn Energy Partners LP
C&J Energy Services Inc
Calpine Corporation
Cameco Corporation
Cameron International Corporation
Carbo Ceramics Inc
Center Oil Company
CenterPoint Energy Inc
Chesapeake Energy Corp
Chevron Corporation
Chicago Bridge & Iron Company NV
Cimarex Energy Co
CITGO Petroleum Corporation
CMS Energy Corporation
Cogentrix Energy LLC
Commonwealth Edison Company
ConocoPhillips Company
Constellation Energy Group

Consumers Energy Company
Continental Resources Inc
Cooper Industries plc
Dakota Gasification Company
DCP Midstream LLC
Direct Energy
Dominion Resources Inc
DPL Inc
DTE Energy Company
Duke Energy Corp
Dynegy Inc
E.ON AG
Edison International
EDP - Energias de Portugal SA
Elster Group SE
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Energy Transfer Partners LP
ENGlobal Corp
Enterprise Products Partners LP
EOG Resources Inc
EQT Corporation
Ergon Inc
Exelon Corporation
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
FirstEnergy Corp
Foster Wheeler AG
Fuel Tech Inc
Fugro NV
Furmanite Corp
GE Energy Infrastructure
GenOn Energy Inc
Great Lakes Gas Transmission Company
Great Plains Energy Inc
Headwaters Inc
Helmerich & Payne Inc
Hess Corporation
HollyFrontier Corporation
Idemitsu Kosan Co Ltd
Inergy LP
Integrys Energy Group Inc
ITC Holdings Corp
Itron Inc
John Wood Group plc
Joy Global Inc
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Koch Industries Inc
Laclede Group Inc (The)
Layne Christensen Company
Loews Corporation
LS Power Associates LP
LyondellBasell Industries
Magellan Midstream Partners LP
Marathon Oil Corp
Marathon Petroleum Corporation
Matrix Service Company
MDU Resources Group Inc
Michigan Consolidated Gas Company
MidAmerican Energy Holdings Co
Mitsui OSK Lines Ltd
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Oilwell Varco Inc
Newpark Resources Inc
NextEra Energy Inc
NiSource Inc
Noble Energy Inc
Northern Indiana Public Service Company
NorthWestern Corporation
NRG Energy Inc
NuStar Energy LP
Occidental Petroleum Corp
Oil States International Inc
ONEOK Inc
ONEOK Partners LP
Oxbow Corporation
PAA Natural Gas Storage LP
Patterson-UTI Energy Inc
Peabody Energy Corp
Petroleos de Venezuela SA (Pdvsa)
PHI Inc
Pioneer Natural Resources Company
Plains All American Pipeline LP
PPL Corporation
Questar Corporation
Rhino Resource Partners LP
Royal Dutch Shell plc
SandRidge Energy Inc
Schlumberger Limited
SEACOR Holdings Inc
Shaw Group Inc (The)
Shell Oil Co
Siemens AG
Sinclair Oil Corp
Southern Union Company
Spectra Energy Corp
Sunoco Inc
Sunoco Logistics Partners LP
Targa Resources Partners LP
Team Inc
TECO Energy Inc
Tenaris SA
Tenaska Inc
Tesoro Corp
Texas Gas Transmission LLC
TransAlta Corp
Transammonia Inc
TransCanada Corp
TransMontaigne Inc
Truman Arnold Companies
UGI Corp
Unit Corp
United Refining Company
URS Flint Energy Services Ltd
US Venture Inc
USEC Inc
Valero Energy Corp
Vectren Corporation
Weatherford International Ltd
Westar Energy Inc
Westinghouse Electric Company LLC
Westmoreland Coal Co
Willbros Group Inc
Williams Companies Inc (The)
Wisconsin Energy Corp
World Fuel Services Corp
Xcel Energy Inc
XTO Energy Inc

SOUTHEAST

Access Midstream Partners LP
Adams Resources & Energy Inc
AES Corporation (The)
AGL Resources Inc
Alabama Power Company
Alon USA Energy Inc
Ameresco Inc
American Electric Power Company Inc (AEP)
AmeriGas Partners LP
Anadarko Petroleum Corporation
AP Moller-Maersk A/S
Apache Corp
Apex Oil Company Inc
Arctic Slope Regional Corp
Atmos Energy Corporation
Baker Hughes Inc
BASF SE
Basic Energy Services Inc
Bechtel Group Inc
BG Group plc
Black & Veatch Holding Company
Black Hills Corp
Blue Rhino LLC
Boots & Coots Inc
BP plc
BreitBurn Energy Partners LP
Bristow Group Inc
C&J Energy Services Inc
Callon Petroleum Company
Calpine Corporation
Cameron International Corporation
Carbo Ceramics Inc
Carrizo Oil & Gas Inc
CenterPoint Energy Inc
Centrica plc
Cheniere Energy Inc
Chesapeake Energy Corp
Chevron Corporation
Chicago Bridge & Iron Company NV
Cimarex Energy Co
CITGO Petroleum Corporation
Clayton Williams Energy Inc
Cogentrix Energy LLC
Colonial Group Inc
ConocoPhillips Company
Constellation Energy Group
Continental Resources Inc
Cooper Industries plc
Crown Central LLC
DCP Midstream LLC
Denbury Resources Inc
Diamond Offshore Drilling Inc
Direct Energy
Dominion Resources Inc
Dril-Quip Inc
Drummond Company Inc
DTE Energy Company
Duke Energy Corp
Dynegy Inc

Edison International
Elster Group SE
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Energy Transfer Partners LP
ENGlobal Corp
Ensco plc
Entergy Corp
Enterprise Products Partners LP
EOG Resources Inc
EPL Oil & Gas Inc
EQT Corporation
Ergon Inc
EXCO Resources Inc
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
Fluor Corp
Forest Oil Corporation
Foster Wheeler AG
Fugro NV
Furmanite Corp
GE Energy Infrastructure
Genesis Energy LP
GenOn Energy Inc
Georgia Power Company
Goodrich Petroleum Corp
GulfMark Offshore Inc
Halliburton Company
Headwaters Inc
Helix Energy Solutions Group Inc.
Helmerich & Payne Inc
Hercules Offshore Inc
Hess Corporation
Hunt Consolidated Inc
Inergy LP
Integrys Energy Group Inc
John Wood Group plc
KBR Inc
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Koch Industries Inc
Layne Christensen Company
Loews Corporation
LS Power Associates LP
Lufkin Industries Inc
LyondellBasell Industries
Magellan Midstream Partners LP
Marathon Oil Corp
Marathon Petroleum Corporation
Matrix Service Company
McDermott International Inc
McMoRan Exploration Co
MDU Resources Group Inc
Mesa Energy Holdings Inc
MidAmerican Energy Holdings Co
Mitsui OSK Lines Ltd
Motiva Enterprises LLC
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Oilwell Varco Inc
Newpark Resources Inc
NextEra Energy Inc
NiSource Inc
NRG Energy Inc
NuStar Energy LP
Occidental Petroleum Corp
Oceaneering International Inc
OGE Energy Corp
Oil States International Inc
Oxbow Corporation
PAA Natural Gas Storage LP
Parker Drilling Company
Patterson-UTI Energy Inc
Penn Virginia Corp
Petroleos de Venezuela SA (Pdvsa)
PetroQuest Energy Inc
PHI Inc
Piedmont Natural Gas Company Inc
Plains All American Pipeline LP
Plains Exploration and Production Company
PowerSecure International Inc
Questar Corporation
Range Resources Corp
Rowan Companies Inc
Royal Dutch Shell plc
Royal Vopak NV
RPC Inc
SCANA Corporation
SEACOR Holdings Inc
Seitel Inc
Sempra Energy
Shaw Group Inc (The)
Shell Oil Co
SHV Holdings NV
Siemens AG
SM Energy Company
SMF Energy Corporation
Southern Company (The)
Southern Union Company
Southwestern Energy Co
Spectra Energy Corp
Stone Energy Corporation
Sunoco Inc
Superior Energy Services Inc
Swift Energy Co
Tampa Electric Company
Targa Resources Partners LP
Team Inc
Technip
TECO Energy Inc
Tenaris SA
Tennessee Valley Authority (TVA)
TETRA Technologies Inc
Texas Gas Transmission LLC
Tidewater Inc
Transammonia Inc
TransCanada Corp
TransMontaigne Inc
Truman Arnold Companies
UGI Corp
Unit Corp
United Refining Company
USEC Inc
Valero Energy Corp
W&T Offshore Inc
Weatherford International Ltd
Westinghouse Electric Company LLC
Willbros Group Inc
Williams Companies Inc (The)
Woodside Petroleum Ltd
World Fuel Services Corp
XTO Energy Inc

NORTHEAST

ABB Ltd
Access Midstream Partners LP
Aegean Marine Petroleum Network Inc
AES Corporation (The)
AGL Resources Inc
Alliance Resource Partners LP
Alpha Natural Resources Inc
Alstom SA
Ameresco Inc
American Electric Power Company Inc (AEP)
AmeriGas Partners LP
AP Moller-Maersk A/S
Apex Oil Company Inc
Arch Coal Inc
Arctic Slope Regional Corp
AREVA Group
Atlantic City Electric Company
Atmos Energy Corporation
Baker Hughes Inc
Baltimore Gas and Electric Company
Bangor Hydro-Electric Company
Barnwell Industries Inc
BASF SE
Bechtel Group Inc
BG Group plc
BHP Billiton
Black & Veatch Holding Company
Blue Rhino LLC
Bolt Technology Corp
BP plc
Braskem SA
C&J Energy Services Inc
Cabot Oil & Gas Corp
Calpine Corporation
Cameron International Corporation
Carrizo Oil & Gas Inc
Center Oil Company
Centrica plc
CH Energy Group Inc
Chesapeake Energy Corp
Chevron Corporation
Chicago Bridge & Iron Company NV
China Petroleum & Chemical Corporation (Sinopec)
Chubu Electric Power Co Inc
CITGO Petroleum Corporation
CMS Energy Corporation
Cogentrix Energy LLC
Colonial Group Inc
ConocoPhillips Company
CONSOL Energy Inc
Consolidated Edison Inc
Constellation Energy Group
Cooper Industries plc
Crown Central LLC
Dawson Geophysical Company

DCP Midstream LLC
Delmarva Power and Light Company
Direct Energy
Dominion Resources Inc
DPL Inc
DTE Energy Company
Duke Energy Corp
Dynegy Inc
Edison International
Electricite de France SA (EDF)
Elster Group SE
Emera Inc
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Energy Transfer Partners LP
ENGlobal Corp
Eni SpA
EOG Resources Inc
EPCOR Utilities Inc
EQT Corporation
Ergon Inc
Essar Group Ltd
EXCO Resources Inc
Exelon Corporation
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
FirstEnergy Corp
Fluor Corp
Foster Wheeler AG
Fuel Tech Inc
Fugro NV
Furmanite Corp
Gaz Metro
GDF Suez SA
GE Energy Infrastructure
GenOn Energy Inc
Global Partners LP
Grupo EBX
GS Holdings Corp
Gulf Oil Limited Partnership
Headwaters Inc
Helmerich & Payne Inc
Hess Corporation
Hunt Consolidated Inc
Husky Energy Inc
Hydro-Quebec
Iberdrola SA
Idemitsu Kosan Co Ltd
Inergy LP
Integrys Energy Group Inc
Itron Inc
John Wood Group plc
KBR Inc
Key Energy Services Inc
Kinder Morgan Energy Partners LP
Koch Industries Inc
Layne Christensen Company
LG&E And KU Energy
Loews Corporation
Louis Dreyfus SAS
LS Power Associates LP
Lufkin Industries Inc
LyondellBasell Industries
Magellan Midstream Partners LP
Marathon Oil Corp
Marathon Petroleum Corporation
Matrix Service Company
MDU Resources Group Inc
Mesa Energy Holdings Inc
MidAmerican Energy Holdings Co
Mitsubishi Chemical Holdings Corporation
Mitsubishi Corp
Mitsui Oil Exploration Co Ltd (MOECO)
Mitsui OSK Lines Ltd
Motiva Enterprises LLC
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Grid plc
National Grid USA
National Oilwell Varco Inc
New Jersey Resources Corporation
New York State Electric & Gas Corp
Newpark Resources Inc
NextEra Energy Inc
Niagara Mohawk Power Corporation
NiSource Inc
Northeast Utilities
NRG Energy Inc
NSTAR
NuStar Energy LP
OAO Lukoil
Occidental Petroleum Corp
Oceaneering International Inc
Oxbow Corporation
Patterson-UTI Energy Inc
PDC Energy Inc
Penn Virginia Corp
Pepco Holdings Inc
Petroleo Brasileiro SA (Petrobras)
Petroleos de Venezuela SA (Pdvsa)
PG&E Corporation
PHI Inc
Piedmont Natural Gas Company Inc
Plains All American Pipeline LP
PowerSecure International Inc
PPL Corporation
PrimeEnergy Corporation
Public Service Enterprise Group Inc (PSEG)
Range Resources Corp
Rhino Resource Partners LP
Rochester Gas and Electric Corp
Royal Dutch Shell plc
Royal Vopak NV
RPC Inc
Saudi Aramco (Saudi Arabian Oil Co)
SCANA Corporation
Schlumberger Limited
SEACOR Holdings Inc
Shaw Group Inc (The)
Shell Oil Co
SHV Holdings NV
Siemens AG
SK Holdings Co Ltd
SMF Energy Corporation
Sonatrach
Southern Union Company
Southwestern Energy Co
Spectra Energy Corp
Statoil ASA
Stone Energy Corporation
Sunoco Inc
Sunoco Logistics Partners LP
Superior Energy Services Inc
Talisman Energy Inc
Targa Resources Partners LP
Team Inc
TECO Energy Inc
Tenaris SA
Tennessee Valley Authority (TVA)
TETRA Technologies Inc
Tokyo Electric Power Company Inc (The, TEPCO)
TransAlta Corp
Transammonia Inc
TransCanada Corp
TransMontaigne Inc
Truman Arnold Companies
UGI Corp
UIL Holdings Corporation
Ultra Petroleum Corp
UniStar Nuclear Energy LLC
United Refining Company
United Refining Company (Red Apple)
URS Flint Energy Services Ltd
USEC Inc
Valero Energy Corp
Weatherford International Ltd
Westinghouse Electric Company LLC
Westmoreland Coal Co
WGL Holdings Inc
Willbros Group Inc
Williams Companies Inc (The)
World Fuel Services Corp
XTO Energy Inc

INDEX OF FIRMS WITH INTERNATIONAL OPERATIONS

ABB (India) Ltd
ABB Ltd
Abbot Group Limited
Abu Dhabi National Energy Company PJSC (TAQA)
Abu Dhabi National Oil Company
Addax Petroleum Inc
Aegean Marine Petroleum Network Inc
AES Corporation (The)
Alstom SA
Ameresco Inc
Anadarko Petroleum Corporation
Anglo American plc
AP Moller-Maersk A/S
Apache Corp
Apco Oil and Gas International Inc
Apex Oil Company Inc
Arabian American Development Co
Arch Coal Inc
Arctic Slope Regional Corp
AREVA Group
ATCO Ltd
Atomic Energy of Canada Ltd
Atwood Oceanics Inc
Baker Hughes Inc
Bangchak Petroleum pcl (The)
Barnwell Industries Inc
BASF SE
Bechtel Group Inc
BG Group plc
Bharat Petroleum Corporation Ltd
BHP Billiton
Black & Veatch Holding Company
Blue Rhino LLC
Boots & Coots Inc
BP plc
Braskem SA
Bristow Group Inc
British Columbia Hydro and Power Authority
British Energy Group plc
BW Gas Limited
C&J Energy Services Inc
Calpine Corporation
Caltex Australia Limited
CAMAC International Corp
Cameco Corporation
Cameron International Corporation
Canadian Natural Resources Ltd
Canadian Oil Sands Ltd
Carbo Ceramics Inc
Carrizo Oil & Gas Inc
Centrais Eletricas Brasileiras SA (Electrobras)
Centrica plc
Ceylon Petroleum Corp (CPC)
CEZ AS
CGGVeritas
CHC Helicopter Corp
Cheniere Energy Inc
Cheung Kong Infrastructure Holdings Ltd
Chevron Corporation
Chicago Bridge & Iron Company NV
China National Petroleum Corp (CNPC)
China Oilfield Services Limited
China Petroleum & Chemical Corporation (Sinopec)
China Shenhua Energy Company Limited
Chubu Electric Power Co Inc
CITGO Petroleum Corporation
CLP Holdings Limited
CMS Energy Corporation
CNOOC Limited
Cogentrix Energy LLC
Colonial Group Inc
Companhia de Transmissao de Energia Eletrica Paulista (CTEEP)
Companhia Paranaense de Energia - Copel
Compania Espanola de Petroleos SA (CEPSA)
ConocoPhillips Company
CONSOL Energy Inc
Constellation Energy Group
Cooper Industries plc
Cosmo Oil Co Ltd
CPFL Energia SA
DCP Midstream LLC
Devon Energy Corporation
Diamond Offshore Drilling Inc
Direct Energy
Dominion Resources Inc
Dril-Quip Inc
Drummond Company Inc
Duke Energy Corp
Dynegy Inc
E.ON AG
E.ON UK plc
Ecopetrol SA
Edison International
EDP - Energias de Portugal SA
Electrabel SA
Electricite de France SA (EDF)
Electricity Generating Authority of Thailand
Eletrobras Participacoes SA
Eletropaulo Metropolitana Electricidade de Sao Paulo SA
Elster Group SE
Emera Inc
Enbridge Energy Partners LP
Enbridge Inc
EnCana Corp
Endesa SA
Enel SpA
ENERCON GmbH
ENGlobal Corp
Eni SpA
Ensco plc
Ensign Energy Services Inc
EOG Resources Inc
EPCOR Utilities Inc
Ergon Inc
Essar Group Ltd
Evonik Industries AG
Exterran Holdings Inc
Exxon Mobil Corporation (ExxonMobil)
Ferrellgas Partners LP
Fluor Corp
Forest Oil Corporation
Formosa Petrochemical Corp (FPCC)
Fortum Company
Foster Wheeler AG
Frontline Ltd
Fuel Tech Inc
Fugro NV
Furmanite Corp
GAIL (India) Limited
Galp Energia SGPS SA
Gas Natural Fenosa
Gaz Metro
GDF Suez SA
GE Energy Infrastructure
Geokinetics Inc
Glow Energy pcl
Great Lakes Gas Transmission Company
Grupo EBX
GS Caltex Corp
GS Holdings Corp
GulfMark Offshore Inc
Halliburton Company
Harvest Natural Resources Inc
Headwaters Inc
Helix Energy Solutions Group Inc.
Hellenic Petroleum SA
Helmerich & Payne Inc
Hercules Offshore Inc
Hess Corporation
Hindustan Petroleum Corporation Ltd
Hong Kong and China Gas Co Ltd (The)
Hunt Consolidated Inc
Hunting PLC
Husky Energy Inc
Hydro One Inc
Hydro-Quebec
Iberdrola SA
Idemitsu Kosan Co Ltd
Imperial Oil Limited
Indian Oil Corp Ltd
INPEX Corporation
Integrys Energy Group Inc
Itron Inc
John Wood Group plc
Joy Global Inc
JSC Gazprom Neft
JX Holdings Inc
JX Nippon Mining & Metals Corporation
Kansai Electric Power Company Inc
KBR Inc
Koch Industries Inc
Kochi Refineries Ltd
Korea Electric Power Corporation
Korea Gas Corporation
Kuwait Petroleum Corporation
Layne Christensen Company
Light SA
Loews Corporation
Louis Dreyfus SAS
Lufkin Industries Inc
LyondellBasell Industries

Manitoba Hydro-Electric
Marathon Oil Corp
Matrix Service Company
McDermott International Inc
MDU Resources Group Inc
MetroGas SA
MidAmerican Energy Holdings Co
Mitsubishi Chemical Holdings Corporation
Mitsubishi Corp
Mitsui Oil Exploration Co Ltd (MOECO)
Mitsui OSK Lines Ltd
Murphy Oil Corporation
Nabors Industries Ltd
National Fuel Gas Co
National Grid plc
National Oilwell Varco Inc
National Thermal Power Corp Ltd
Nederlandse Gasunie NV
Newpark Resources Inc
Nexen Inc
NextEra Energy Inc
Nigerian National Petroleum Corporation
Noble Corporation
Noble Energy Inc
NOV Wilson
NRG Energy Inc
NuStar Energy LP
OAO Gazprom
OAO Lukoil
OAO Novatek
OAO Rosneft
OAO Tatneft
Occidental Petroleum Corp
Oceaneering International Inc
OGX Petroleo e Gas Participacoes SA
Oil & Natural Gas Corp Ltd
Oil Search Ltd
Oil States International Inc
OMV AG
ONEOK Partners LP
Ontario Power Generation Inc
Osaka Gas Co Ltd
Oxbow Corporation
Pakistan State Oil Co Ltd
Parker Drilling Company
Patterson-UTI Energy Inc
Peabody Energy Corp
Penn West Petroleum Ltd
Petrobras Argentina SA
Petrobras Distribuidora SA
PetroChina Company Limited
Petroleo Brasileiro SA (Petrobras)
Petroleos de Venezuela SA (Pdvsa)
Petroleos Mexicanos (Pemex)
Petroleum Geo Services ASA
Petron Corp
PETRONAS (Petroliam Nasional Berhad)
Plains All American Pipeline LP
Polski Koncern Naftowy Orlen SA (PKN ORLEN Group)
Power Assets Holdings Ltd
Power Finance Corporation Limited
Power Grid Corporation of India Ltd
PPL Corporation
Precision Drilling Corporation
Premier Oil plc
PT Pertamina (Persero)
PTT Exploration and Production pcl
PTT pcl
Public Power Corporation SA
Puerto Rico Electric Power Authority (PREPA)
Qatar Petroleum
Quicksilver Resources Inc
Ratchaburi Electricity Generating Holding pcl
Reliance Industries Ltd (Reliance Group)
Reliance Infrastructure Ltd
Reliance Power Limited
Repsol YPF SA
Rio Tinto Group
Rowan Companies Inc
Royal Dutch Shell plc
Royal Vopak NV
RWE AG
RWE npower
Saipem SpA
Santos Ltd
Saudi Aramco (Saudi Arabian Oil Co)
Schlumberger Limited
Schneider Electric SA
Scottish and Southern Energy plc
ScottishPower UK plc
SEACOR Holdings Inc
Seadrill Limited
Seitel Inc
Sembcorp Industries Ltd
Sempra Energy
Shaw Group Inc (The)
Shell Canada Limited
Shell Oil Co
Shikoku Electric Power Company Inc
Showa Shell Sekiyu KK
SHV Holdings NV
Siemens AG
Silver Spring Networks
Sinclair Oil Corp
Sinopec Shanghai Petrochemical Co Ltd
SK Holdings Co Ltd
Snam Rete Gas SpA
S-Oil Corporation
Sonatrach
Spectra Energy Corp
Statoil ASA
Subsea 7 SA
Suncor Energy Inc
Sunoco Inc
Superior Energy Services Inc
Surgutneftegas (OJSC)
Syncrude Canada Ltd
Talisman Energy Inc
Targa Resources Partners LP
Tata Power
Team Inc
Technip
Tenaga Nasional Berhad (TNB)
Tenaris SA
Tenaska Inc
Tesco Corporation
Tesoro Corp
TETRA Technologies Inc
Thai Oil pcl
Tidewater Inc
TNK-BP
Tohoku Electric Power Co Inc
Tokyo Electric Power Company Inc (The, TEPCO)
Tokyo Gas Co Ltd
TonenGeneral Sekiyu KK
Total SA
TOTAL UK Limited
Tractebel Energia SA
TransAlta Corp
Transammonia Inc
TransCanada Corp
Transocean Ltd
Transportadora de Gas del Sur SA
Tsakos Energy Navigation Ltd
UGI Corp
UK Coal plc
Ultrapar Participacoes SA
United Refining Company
United Refining Company (Red Apple)
URS Flint Energy Services Ltd
VAALCO Energy Inc
Valero Energy Corp
Vattenfall AB
Weatherford International Ltd
WesternGeco
Westinghouse Electric Company LLC
Willbros Group Inc
Williams Companies Inc (The)
Wintershall AG
Woodside Petroleum Ltd
World Fuel Services Corp
Xstrata plc
XTO Energy Inc
Yanzhou Coal Mining Co Ltd
YPF SA

Individual Profiles On Each Of THE ENERGY 500

(SAMPLE)

Exxon Mobil Corporation (ExxonMobil)

www.exxonmobil.com

NAIC Code: 211111

TYPES OF BUSINESS:

Oil & Gas Exploration & Production
Gas Refining & Supply
Fuel Marketing
Power Generation
Chemicals
Petroleum Products
Convenience Stores

BRANDS/DIVISIONS/AFFILIATES:

ExxonMobil
Esso
Exxon
Mobil

CONTACTS: *Note: Officers with more than one job title may be intentionally listed here more than once.*

Rex W. Tillerson, CEO
M. A. Farrant, VP-Human Resources
S. Jack Balagia, General Counsel/VP
W.M. Colton, VP-Corp. Strategic Planning
K.P. Cohen, VP-Public & Gov't Affairs
D. S. Rosentha, VP-Investor Rel./Sec.
P. T. Mulva, Controller/VP
R. S. Franklin, Pres., Upstream Ventures/VP
J.J. Woodbury, VP-Safety, Security, Health & Environment
T. M. Fariello, VP-Washington Office
R. N. Schleckser, Treas./VP
Rex W. Tillerson, Chmn.

GROWTH PLANS/SPECIAL FEATURES:

Exxon Mobil Corporation (ExxonMobil) is one of the largest international petroleum and natural gas exploration and production companies in the world. Its principal business is energy, involving exploration for and production of crude oil and natural gas; the manufacture of petroleum products; and the transportation and sale of crude oil, natural gas and petroleum products. The company has hundreds of affiliates, many with names that include ExxonMobil, Esso, Exxon or Mobil. Overall, the firm divides its business units into three areas: Upstream, Downstream and Chemical. The Upstream business focuses on conventional oil, heavy oil, shale gas, deepwater, liquefied natural gas (LNG), Arctic and sour gas projects. The Downstream business is concerned with refining crude oil and other feedstocks into fuels, lubricants and other chemicals and delivering it to customers through a global distributor network. The Downstream unit also markets its products through about 25,000 retail service stations. The Chemical business is focused on the production of olefins, such as ethylene and propylene, and polyolefins, such as polyethylene and polypropylene. In addition, it manufactures specialty chemicals for use in water treatment, coatings, lubricants and oil drilling fluids. In 2011, the company operated 37,692 gross and 31,683 net operating wells. In 2011, ExxonMobil sold its Downstream business operations in Paraguay, Central America, Argentina, Uruguay and Switzerland. Additionally, the company constructed new units at its Thailand refinery and announced plans for the construction of a new diesel hydrotreater at its Singapore facility. The same year, the firm formed a joint exploration agreement with Rosneft in the development of hydrocarbon resources in the Arctic and Black Sea regions. The two firms will create an Arctic Research and Design Center for Offshore Developments in St. Petersburg, Russia.

U.S. employee benefits include health, dental and vision coverage; life insurance; education assistance; childcare, elder care and adoption assistance; and spousal relocation assistance.

FINANCIAL DATA: *Note: Data for latest year may not have been available at press time.*

In U.S. $	2012	2011	2010	2009	2008	2007
Revenue		486,429,000,000	383,221,000,000	310,586,000,000	477,359,000,000	404,552,000,000
R&D Expense						
Operating Income		73,257,000,000	52,959,000,000	34,777,000,000	118,578,000,000	103,607,000,000
Operating Margin %		15.06%	13.81%	11.19%	24.84%	25.61%
SGA Expense		14,983,000,000	14,683,000,000	14,735,000,000	15,873,000,000	14,890,000,000
Net Income		41,060,000,000	30,460,000,000	19,280,000,000	45,220,000,000	40,610,000,000
Operating Cash Flow		55,345,000,000	48,413,000,000	28,438,000,000	59,725,000,000	52,002,000,000
Capital Expenditure		30,975,000,000	26,871,000,000	22,491,000,000	19,318,000,000	15,387,000,000
EBITDA		89,087,000,000	67,978,000,000	47,242,000,000	94,802,000,000	83,124,000,000
Return on Assets %		12.96%	11.36%	8.35	19.23%	17.61%
Return on Equity %		27.26%	23.66%	17.25%	38.52%	34.47%
Debt to Equity		0.2	0.08	0.06	0.06	0.05

CONTACT INFORMATION:

Phone: 972-444-1000 Fax: 972-444-1350
Toll-Free:
Address: 5959 Las Colinas Blvd., Irving, TX 75039 United States

STOCK TICKER/OTHER:

Stock Ticker: XOM Exchange: NYS
Employees: 82,100 Fiscal Year Ends: 31-Dec
Parent Company:

SALARIES/BONUSES:

Top Exec. Salary: $2,387,000 Bonus: $4,368,000
Second Exec. Salary: $1,170,000 Bonus: $2,994,000

OTHER THOUGHTS:

Estimated Female Officers or Directors: 2
Hot Spot for Advancement for Women/Minorities: Y

Sales, profits and employees may be estimates. Financial information, benefits and other data can change quickly and may vary from those stated here.

ADDITIONAL INDEXES

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INDEX OF FIRMS NOTED AS HOT SPOTS FOR ADVANCEMENT FOR WOMEN & MINORITIES

ABB Ltd
AES Corporation (The)
AGL Resources Inc
Alliant Energy Corp
Alstom SA
Ameresco Inc
American Electric Power Company Inc (AEP)
Anadarko Petroleum Corporation
Anglo American plc
Apache Corp
Apex Oil Company Inc
Arch Coal Inc
Arctic Slope Regional Corp
AREVA Group
Arizona Public Service Company
ATCO Ltd
Atmos Energy Corporation
Atomic Energy of Canada Ltd
Avista Corporation
Baker Hughes Inc
Baltimore Gas and Electric Company
Bangchak Petroleum pcl (The)
Bangor Hydro-Electric Company
Barnwell Industries Inc
BASF SE
Bechtel Group Inc
Bharat Petroleum Corporation Ltd
BHP Billiton
Black & Veatch Holding Company
Black Hills Corp
BP plc
Bristow Group Inc
British Columbia Hydro and Power Authority
Calpine Corporation
Caltex Australia Limited
Cameco Corporation
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Corner Store; **Valero Energy Corp**
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Coronis; **Elster Group SE**
COSL Chemicals Tianjin Co Ltd; **China Oilfield Services Limited**
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Cougar Helicopters Inc; **Bristow Group Inc**
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Country Fair; **United Refining Company (Red Apple)**
Country Fair; **United Refining Company**
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CPFL Jaquari; **CPFL Energia SA**
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CPFL Meridional; **CPFL Energia SA**
CPFL Piratininga; **CPFL Energia SA**
CPFL Santa Cruz; **CPFL Energia SA**
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EDP Distribuicao-Energia SA; **EDP - Energias de Portugal SA**
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EDP Renewables; **EDP - Energias de Portugal SA**
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FBS Limited; **Bristow Group Inc**
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Ferrellgas LP; **Ferrellgas Partners LP**
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Ferrellgas Receivables LLC; **Ferrellgas Partners LP**
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Foster Wheeler Power Systems Inc; **Foster Wheeler AG**
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TXU Energy; **Energy Future Holdings Corp**
Ubon Bio Petroleum Company Ltd; **Bangchak Petroleum pcl (The)**
UGI Penn Natural Gas Inc; **UGI Corp**
UGI Utilities Inc; **UGI Corp**
Ultracargo; **Ultrapar Participacoes SA**
Ultragaz; **Ultrapar Participacoes SA**
Ultramar; **Valero Energy Corp**
Unified Gas Supply System; **OAO Gazprom**
Uniflame; **Blue Rhino LLC**
Union Fenosa SA; **Gas Natural Fenosa**
Union Gas Limited; **Spectra Energy Corp**
UniSource Energy Corporation; **UNS Energy Corp**
UniSource Energy Development Co; **UNS Energy Corp**
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Unit Drilling Co; **Unit Corp**
Unit Petroleum Company; **Unit Corp**
United Petroleum Development Co Ltd; **Cosmo Oil Co Ltd**
United Refining Energy Corp; **United Refining Company (Red Apple)**
Universal Compression Holdings Inc; **Exterran Holdings Inc**
Universiti Tenaga Nasional (UNITEN); **Tenaga Nasional Berhad (TNB)**
UNS Electric Inc; **UNS Energy Corp**
UNS Gas Inc; **UNS Energy Corp**
Upper Peninsula Power Co; **Integrys Energy Group Inc**
URS Corporation; **URS Flint Energy Services Ltd**
US AutoForce; **US Venture Inc**
US Lubricants; **US Venture Inc**
US Oil; **US Venture Inc**
US Petroleum Equipment; **US Venture Inc**
US Salt LLC; **Inergy LP**
USA Gasoline; **Tesoro Corp**
Usinas Siderurgicas de Minas Gerais SA; **Tenaris SA**
U-Tech Engineering Company Ltd; **Hong Kong and China Gas Co Ltd (The)**
Utility Integration Solutions Inc; **Alstom SA**
Utility Powertech Limited; **National Thermal Power Corp Ltd**
UtilityIQ; **Silver Spring Networks**
VAALCO Angola (Kwanza) Inc; **VAALCO Energy Inc**
VAALCO Energy (USA) Inc; **VAALCO Energy Inc**
VAALCO Gabon (Etame) Inc; **VAALCO Energy Inc**
VAALCO International Inc; **VAALCO Energy Inc**
VAALCO Production (Gabon) Inc; **VAALCO Energy Inc**
VAALCO UK (North Sea) Limited; **VAALCO Energy Inc**
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Value Act Capital Master Fund LP; **Seitel Inc**
Varia Perdana Bhd; **Seadrill Limited**
Veba Combi Cracker; **KBR Inc**
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Vectren Fuels Inc; **Vectren Corporation**
Vectren Source; **Direct Energy**
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Vermont Gas Systems Inc; **Gaz Metro**
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Viking Gas Transmission Company; **ONEOK Partners LP**
Vimal; **Reliance Industries Ltd (Reliance Group)**
Virginia Electric and Power Company; **Dominion Resources Inc**
Vista Del Verde; **Aera Energy LLC**
Voest-Alpine Tubulars; **National Oilwell Varco Inc**
W L Doffing LP; **Hunting PLC**
W&T Energy VI LLC; **W&T Offshore Inc**
W&T Energy VII LLC; **W&T Offshore Inc**
Wales & West Utilities; **Cheung Kong Infrastructure Holdings Ltd**
Warri Refining & Petrochemical Co. Ltd.; **Nigerian National Petroleum Corporation**
Warrior Energy Services; **Superior Energy Services Inc**
Washington Gas Credit Corp; **WGL Holdings Inc**
Washington Gas Energy Services Inc; **WGL Holdings Inc**
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WBI Holdings Inc; **MDU Resources Group Inc**
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WE Power LLC; **Wisconsin Energy Corp**
Well Control School; **RPC Inc**
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White Shoal Pipeline Corporation; **W&T Offshore Inc**
Whiteshell Laboratories; **Atomic Energy of Canada Ltd**
Wild Bean Café; **BP plc**
Willbros Canada; **Willbros Group Inc**
Williams Bulk Transfer; **Alliant Energy Corp**
Williams Field Services Group LLC; **Williams Companies Inc (The)**
Williams Gas Pipeline Co LLC; **Williams Companies Inc (The)**
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Wisconsin Public Service Corp; **Integrys Energy Group Inc**
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A Short Energy Industry Glossary

10-K: An annual report filed by publicly held companies. It provides a comprehensive overview of the company's business and its finances. By law, it must contain specific information and follow a given form, the "Annual Report on Form 10-K." The U.S. Securities and Exchange Commission requires that it be filed within 90 days after fiscal year end. However, these reports are often filed late due to extenuating circumstances. Variations of a 10-K are often filed to indicate amendments and changes. Most publicly held companies also publish an "annual report" that is not on Form 10-K. These annual reports are more informal and are frequently used by a company to enhance its image with customers, investors and industry peers.

3-D Seismic Surveying: An enhancement of seismic imaging from the standard two-dimensional view to a three-dimensional view. Three-dimensional seismic images have greater resolution and help delineate oil and gas reservoirs hidden by complex faulting. Also see "Seismic."

4-D Seismic Surveying: Adds the dimension of time to 3-D seismic surveying. Also see "Seismic."

Alcohol: The family name of a group of organic chemical compounds composed of carbon, hydrogen and oxygen. The series of molecules vary in chain length and are composed of a hydrocarbon plus a hydroxyl group. Alcohols include methanol and ethanol. Alcohol is frequently used in fuel, organic solvents, anti-freeze and beverages. Also see "Ethanol."

Alternating Current (AC): An electric current that reverses its direction at regularly recurring intervals, usually 50 or 60 times per second.

American Petroleum Institute (API): A trade association for the petrochemical industry.

Amorphous Silicon: An alloy of silica and hydrogen, with a disordered, noncrystalline internal atomic arrangement, that can be deposited in thin layers (a few micrometers in thickness) by a number of deposition methods to produce thin-film photovoltaic cells on glass, metal or plastic substrates.

Anthracite Coal: Anthracite, or hard coal, is the highest rank of economically usable coal. It is jet black with a high luster. The moisture content is generally less than 15%. It usually has a high fixed carbon and ash content and is low in volatile matter. It is a non-coking coal.

APAC: Asia Pacific Advisory Committee. A multi-country committee representing the Asia and Pacific region.

Applied Research: The application of compounds, processes, materials or other items discovered during basic research to practical uses. The goal is to move discoveries along to the final development phase.

ASEAN: Association of Southeast Asian Nations. A regional economic development association established in 1967 by five original member countries: Indonesia, Malaysia, Philippines, Singapore, and Thailand. Brunei joined on 8 January 1984, Vietnam on 28 July 1995, Laos and Myanmar on 23 July 1997, and Cambodia on 30 April 1999.

Asphalt (Natural): A natural mineral pitch, tar or bitumen composed principally of hydrocarbons; a natural bituminous rock that is dark colored, comparatively hard and nonvolatile. Does not include asphalt, bitumen, tar or other substances, derived from petroleum processing.

Authority for Expenditure (AFE): A standard industry procedure in which a formal written estimate is generated outlining in advance the cost of drilling a given well, both as a dry hole and as a completed well.

Barrel (Petroleum): A unit of volume equal to 42 U.S. gallons.

Barrels of Oil Equivalent (BOE): A measure of the energy of non-oil fuels. For example, a BOE of natural gas is roughly 6,000 cubic feet. The measure is derived by assessing the amount of a fuel required to generate the same heat content as a typical barrel of oil.

Barrels of Oil per Day (BOPD): A standard measurement for volume of oil production.

Basic Research: Attempts to discover compounds, materials, processes or other items that may be largely or entirely new and/or unique. Basic research may start with a theoretical concept that has yet to be proven. The goal is to create discoveries that can be moved along to applied research. Basic research is sometimes referred to as "blue sky" research.

Bbl: See "Barrel (Petroleum)."

Bcf: One billion cubic feet.

Bcfe: One billion cubic feet of natural gas equivalent.

Benchmark Crude Oil: An established variety of crude oil used by a country as the standard of comparison in documenting the properties of other oils and in setting prices. West Texas Intermediate is the U.S. benchmark. Brent is the benchmark in the U.K.

Binary Cycle Generation: A method of geothermal electricity generation where lower-temperature geothermal

sources are tapped. The geothermal steam source is used to heat another liquid that has a lower boiling point, which then drives the turbine. Also see "Flash Steam Generation."

Biodiesel: A fuel derived when glycerin is separated from vegetable oils or animal fats. The resulting byproducts are methyl esters (the chemical name for biodiesel) and glycerin which can be used in soaps and cleaning products. It has lower emissions than petroleum diesel and is currently used as an additive to that fuel since it helps with lubricity.

Bioenergy: Useful, renewable energy produced from organic matter, which may either be used directly as a fuel or processed into liquids and gases. See "Biomass."

Bioethanol: A fuel produced by the fermentation of plant matter such as corn. Fermentation is enhanced through the use of enzymes that are created through biotechnology. Also, see "Ethanol."

Biomass: Organic, non-fossil material of biological origin constituting a renewable energy source. The biomass can be burnt as fuel in a system that creates steam to turn a turbine, generating electricity. For example, biomass can include wood chips and agricultural crops.

Biorefinery: A refinery that produces fuels from biomass. These fuels may include bioethanol (produced from corn or other plant matter) or biodiesel (produced from plant or animal matter).

Bit (Drill Bit): The cutting device connected to the bottom end of a drill, used to bore through rock formations in drilling.

Bitumen: A naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulfur compounds. Also, see "Tar Sands (Oil Sands)."

Bituminous Coal: The most common coal, bituminous coal is dense and black, often with well-defined bands of bright and dull materials. Its moisture content is usually less than 20%. It is used for generating electricity, making coke and space heating.

Black Liquor: A byproduct of the paper production process that can be used as a source of energy.

Black Oil: Oil containing relatively high percentages of long, heavy and nonvolatile hydrocarbons.

Blowout: A sudden, uncontrolled flow of fluid from a well.

Blowout Preventer (BOP): A safety device installed to allow closure of a well should it begin a blowout, and to control escape of pressurized fluids during drilling and related operations. A blowout preventer stack is mounted on top of a well and consists of a series of rams and spools for closing down a wellhead.

Borehole: A hole resulting from the drilling (boring) of a well.

Borehole Compensated Sonic Log (BHCS): A borehole compensated sonic log is generated using two sets of alternately pulsed transmitters, with measurements then averaged in order to compensate for erroneous results due to irregularities in borehole size and tilting of the measuring device.

Bottomhole Assembly: The drill collars, sub pipe and adapters and bit installed at the bottom of a drill.

BPL: See "Broadband Over Power Lines (BPL)."

BPO: See "Business Process Outsourcing (BPO)."

Branding: A marketing strategy that places a focus on the brand name of a product, service or firm in order to increase the brand's market share, increase sales, establish credibility, improve satisfaction, raise the profile of the firm and increase profits.

Breeder Reactor: A breeder reactor is a nuclear plant that produces more fissile material (such as U-235 or plutonium) that it actually consumes. A Fast Breeder Reactor (FBR), once initially started, can utilize depleted uranium from traditional reactors as fuel, thus helping to alleviate the problem of storing spent nuclear fuel rods. This method is used in many nations, but not in the U.S. America does not use FBRs because they create as a byproduct weapons-grade plutonium. A Thermal Breeder Reactor (TBR), once started with enriched uranium or other fissile material, can then be kept running with thorium (a chemical element that is radioactive and found in abundance in nature). Some researchers consider a TBR to be the ultimate, safest, most efficient type of nuclear reactor, due to its use of low-cost thorium as fuel.

Brent: A light, sweet crude oil against which other crude oils (such as West Texas Intermediate and Dubai) are priced. Brent crude is a blend of the UK's two North Sea oils, specifically Brent-field crude produced by Shell Oil Company and Ninian-field crude produced by British Petroleum (BP).

British Thermal Unit (Btu): The quantity of heat needed to raise the temperature of 1 pound of water by 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit.

Broadband Over Power Lines (BPL): Refers to the use of standard electric power lines to provide fast Internet service. Internet data is converted into radio frequency

signals, which are not affected by electricity. Subscribers utilize special modems.

B-to-B, or B2B: See "Business-to-Business."

B-to-C, or B2C: See "Business-to-Consumer."

Btu: See "British Thermal Unit (Btu)."

Bulk Terminal: A facility, used primarily for the storage and/or marketing of petroleum products, which has a total bulk storage capacity of 50,000 barrels or more and/or receives petroleum products by tanker, barge or pipeline.

Business Process Outsourcing (BPO): The process of hiring another company to handle business activities. BPO is one of the fastest-growing segments in the offshoring sector. Services include human resources management, billing and purchasing and call centers, as well as many types of customer service or marketing activities, depending on the industry involved. Also, see "Knowledge Process Outsourcing (KPO)."

Business-to-Business: An organization focused on selling products, services or data to commercial customers rather than individual consumers. Also known as B2B.

Business-to-Consumer: An organization focused on selling products, services or data to individual consumers rather than commercial customers. Also known as B2C.

Butane: A normally gaseous straight-chain or branch-chain hydrocarbon (C4H10), extracted from natural gas or refinery gas streams. It includes isobutane and normal butane.

Butanol (Biobutanol): Butyl alcohol, sometimes used as a solvent. In the form of biobutanol, it is an ethanol substitute, generally derived from sugar beets to be used as a fuel additive.

CAES: Compressed Air Energy Storage.

CAFTA-DR: See "Central American-Dominican Republic Free Trade Agreement (CAFTA-DR)."

CANDU Reactor: A pressurized heavy-water, natural-uranium power reactor designed by a consortium of Canadian government and private industry participants. CANDU utilizes natural, unenriched uranium oxide as fuel. Because unenriched uranium is cheaper, this kind of reactor is attractive to developing countries. The fuel is contained in hundreds of tubes that are pressure resistant. This means that a tube can be refueled while the reactor is operating. CANDU is a registered trademark of the CANDU consortium.

Cap and Trade: A system in which governments attempt to reduce carbon emissions by major industry. First, an overall "cap" is placed, by government regulation, on total carbon emissions for particular companies and/or their industries. The "trade" part of cap and trade allows companies that operate efficiently on a carbon basis, and thereby emit a lower amount of carbon than law allows, to sell or trade the unused part of their carbon allowances to firms that are less efficient.

Capacity Factor: The ratio of the electrical energy produced by a generating unit for a certain period of time to the electrical energy that could have been produced at continuous full-power operation during the same period.

Capex: Capital expenditures.

Carbon Capture and Storage: See "Carbon Sequestration."

Carbon Intensity: The amount of carbon dioxide that a nation emits, on average, in order to create a unit of GDP (gross domestic product, a measure of economic output).

Carbon Sequestration: The absorption and storage of CO2 from the atmosphere by the roots and leaves of plants; the carbon builds up as organic matter in the soil. In the energy industry, carbon sequestration refers to the process of isolating and storing carbon dioxide (a so-called greenhouse gas). One use is to avoid releasing carbon dioxide into the air when burning coal at a coal-fired power plant. Instead, the carbon dioxide is stored in the ground or otherwise stored in a permanent or semi-permanent fashion. Other uses include the return to the ground of carbon dioxide that is produced at natural gas wells, and the introduction of carbon dioxide into oil wells in order to increase internal pressure and production. This process is also known as carbon capture and storage (CCS).

Cased Hole Log: A wireline logging device installed in a well that has been successfully cased. Cased hole logs enable engineers to analyze and monitor the characteristics and movements of a given well.

Casing: A steel pipe with a large diameter that supports the walls or sides of the borehole to prevent them from caving in.

Casinghead: A fitting attached to the top of the casing in an oil or gas well that regulates the flow of oil or gas, allowing the pumping of oil from the well.

Cast Silicon: Crystalline silicon obtained by pouring pure molten silicon into a vertical mold and adjusting the temperature gradient along the mold volume during cooling to obtain slow, vertically advancing crystallization of the silicon. The polycrystalline ingot thus formed is

composed of large, relatively parallel, interlocking crystals. The cast ingots are sawed into wafers for further fabrication into photovoltaic cells. Cast-silicon wafers and ribbon-silicon sheets fabricated into cells are usually referred to as polycrystalline photovoltaic cells.

CCS: See "Carbon Sequestration."

Cement: A mineral growth that bonds the surfaces of elastic sediments, or a composite powder that hardens when mixed with water used to bind casing to the walls of a well.

Central American-Dominican Republic Free Trade Agreement (CAFTA-DR): A trade agreement signed into law in 2005 that aimed to open up the Central American and Dominican Republic markets to American goods. Member nations include Guatemala, Nicaragua, Costa Rica, El Salvador, Honduras and the Dominican Republic. Before the law was signed, products from those countries could enter the U.S. almost tariff-free, while American goods heading into those countries faced stiff tariffs. The goal of this agreement was to create U.S. jobs while at the same time offering the non-U.S. member citizens a chance for a better quality of life through access to U.S.-made goods.

CHP: See "Combined Cycle."

Christmas Tree: An intricate assemblage of pipe connections, gauges, fittings and valves/controls located at the top of a casing of a flowing oil well. The Christmas tree controls the flow of the well.

Climate Change (Greenhouse Effect): A theory that assumes an increasing mean global surface temperature of the Earth caused by gases (sometimes referred to as greenhouse gases) in the atmosphere (including carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons). The greenhouse effect allows solar radiation to penetrate the Earth's atmosphere but absorbs the infrared radiation returning to space.

Coal: A black or brownish-black solid, combustible substance formed by the partial decomposition of vegetable matter without access to air. The ranks of coal, which include anthracite, sub-anthracite, bituminous, sub-bituminous and lignite, are based on fixed carbon, volatile matter, coking and coking properties, and heating value. Coal rank includes the progressive alteration, or coalification, from lignite to anthracite.

Coalbed Methane (CBM): A natural gas that is found in coal seams, while traditional natural gas deposits are trapped in porous rock formations. CBM is produced commercially in many areas, including the Rocky Mountains and other coal-rich areas throughout the U.S., in Australia and in other nations.

Cogeneration: See "Combined Heat and Power (CHP) Plant."

Coiled Tubing Unit: An industrial device that feeds flexible steel tubing from a reel, enabling technicians to run equipment down a well. The tubing, typically measuring 1¼ inches in diameter, is passed through a pipe straightener before it enters the well.

Coke (Coal): In general, coke is made from bituminous coal (or blends of bituminous coals) from which the volatile constituents are driven off by baking in an oven at temperatures as high as 2,000 degrees Fahrenheit, so that the fixed carbon and ash are fused together. Coke is hard and porous, has a gray submetallic luster and is strong enough to support a load of iron ore in a blast furnace. It is used both as a fuel and as a reducing agent in smelting iron ore in a blast furnace.

Combined Cycle: An electric generating technology in which electricity is produced from waste heat that would otherwise be lost when exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to a heat recovery steam generator for utilization by a steam turbine in the production of electricity. Such designs increase the efficiency of the electric generating unit. This process is also known as cogeneration or "combined heat and power" (CHP). One novel approach, know as ISCC or integrated solar combined cycle, adds the use of concentrated solar power (CSP) from mirrors, focused on a tower in order to generate additional steam, which is fed into the system. (See "Concentrated Solar Power (CSP).")

Combined Heat and Power (CHP) Plant: A facility that generates power via combined cycle technology. See "Combined Cycle."

Compressor: A device to increase gas pressure capable of causing the flow of gas.

Concentrating Photovoltaic Power (CPV): An enhanced solar energy generating plant that relies on photovoltaic technology, but uses an advanced optical system to focus a large area of sunlight onto each cell for maximum efficiency. CPV panels are mounted on trackers (heliostats) to keep the focal point on the cell as the sun moves across the sky.

Concentrating Solar Power (CSP): The use of solar thermal collectors to absorb solar heat and then heat water, oil or other substances with that energy. CSP technologies include the use of large numbers of mirrors that reflect and concentrate sunlight upon "solar towers." As heat accumulates in the solar towers, it produces steam that is used to drive turbines and generate electricity. In the latest systems, CSP utilizes heliostats, or motor-driven mirrors,

to track the sun through the sky during the day. (See "Heliostat.")

Concession Agreement: A contractual arrangement between a company and a government, in which the company receives exclusive rights to explore, drill and produce energy resources, at its own expense, within an agreed area of the country, in exchange for payment of negotiated bonuses, royalties and taxes to the government.

Condensate (Lease): A liquid recovered from natural gas at the well or at small gas/oil separators in the field. Consists primarily of pentanes and heavier hydrocarbons. Also called field condensate. Does not include plant condensate.

Condensate (Plant-Petroleum): A light hydrocarbon liquid, consisting mostly of pentanes and heavier hydrocarbons, recovered by condensation of hydrocarbon vapors at natural gas liquids processing plants.

Contango: A condition in futures markets where future contracts, generally for a commodity, trade at higher prices than the current spot month price.

Continental Shelf: The shallow transitional boundary running from the ocean's shore to a depth of roughly 450 feet, after which an abrupt change occurs in slope and depth. Continental shelf environments are the most typical sites of offshore drilling and production.

Continental Slope: The area between the continental shelf and the deep ocean floor, which has become increasingly targeted for oil and gas exploration using various deepwater techniques and devices.

Conventional Thermal Electricity Generation: Electricity generated by an electric power plant using coal, petroleum or gas as its source of energy.

CPV: See "Concentrating Photovoltaic Power (CPV)."

CRM: See "Customer Relationship Management (CRM)."

Crude Oil: A mixture of hydrocarbons that exists in liquid form at atmospheric pressure after passing through surface separating facilities. Included are lease condensate and liquid hydrocarbons produced from tar sands, Gilsonite and oil shale. Drip gases are also included, but topped crude oil (residual) and other unfinished oils are excluded. Liquids produced at natural gas processing plants and mixed with crude oil are likewise excluded where identifiable.

CSP: See "Concentrating Solar Power (CSP)."

Cushing: A town in the U.S. state of Oklahoma that is a major crude oil pipeline and storage site.

Customer Relationship Management (CRM): Refers to the automation, via sophisticated software, of business processes involving existing and prospective customers. CRM may cover aspects such as sales (contact management and contact history), marketing (campaign management and telemarketing) and customer service (call center history and field service history). Well known providers of CRM software include Salesforce, which delivers via a Software as a Service model (see "Software as a Service (Saas)"), Microsoft and Oracle.

Decline Curve: A graphic representation of projected oil production over time.

Deepwater Well: An offshore well drilled in more than 1,000 feet of water depth.

Demand Chain: A similar concept to a supply chain, but with an emphasis on the end user.

Depletion (Economic): The reduction in value of a mineral deposit as it is depleted through production.

Depletion (Physical): The consumption of a mineral deposit by production of the mineral to the point that its deposits are no longer available.

Deregulation: See "Regulated Business (Utility Companies)."

Development: The phase of research and development (R&D) in which researchers attempt to create new products from the results of discoveries and applications created during basic and applied research.

Direct Current (DC): An electric current that flows in a constant direction. The magnitude of the current does not vary or has a slight variation.

Directional Drilling: Involves the intentional inclination of a well away from vertical in order to optimize production and enable drilling in challenging environments. Sometimes referred to as slant drilling, the process has generated public controversy over related attempts to extract oil from under the Great Lakes and was cited by Iraq as one of its grievances with the emirs of Kuwait, leading to its invasion of the country in the early 1990s. Also called deviation drilling.

Distributed Power Generation: A method of generating electricity at or near the site where it will be consumed, such as the use of small, local generators, solar cells or fuel cells to power individual buildings, homes or neighborhoods. Such a system may also include storage batteries. Distributed power is thought by many analysts to offer distinct advantages. For example, electricity generated in this manner is not reliant upon the grid for distribution to the end user.

Distribution System: The portion of an electric system that is dedicated to delivering electric energy to an end user.

Distributor: An individual or business involved in marketing, warehousing and/or shipping of products manufactured by others to a specific group of end users. Distributors do not sell to the general public. In order to develop a competitive advantage, distributors often focus on serving one industry or one set of niche clients. For example, within the medical industry, there are major distributors that focus on providing pharmaceuticals, surgical supplies or dental supplies to clinics and hospitals.

Division Orders: A standard form used to assign distribution of production-related revenues and to assess costs to royalty and working-interest owners.

Downstream: That segment of the oil and gas industry focused on the final phases of the use of production from wells. Downstream includes refining, distributing and retailing of products that include gasoline, diesel, LPG and petrochemicals. Downstream is one of the three major segments of this industry: upstream, midstream and downstream.

Drilling Line: Also known as the hoisting line, this wire rope is composed of braided steel cable wound around a fiber or steel core and is used to position equipment on a drilling rig.

Drilling Mud: See "Mud (Drilling Mud)."

Dry Hole: Any well that fails to produce oil or gas in commercially viable quantities. A dry hole might flow water, gas or oil, but at levels insufficient to justify production. Sometimes referred to as a duster.

Electric Power Industry: The privately, publicly, federally and cooperatively owned electric utilities of the United States taken as a whole. Does not include special-purpose electric facilities.

Electric Power System: An individual electric power entity.

Electric Utility: A corporation, person, agency, authority or other legal entity or instrumentality that owns and/or operates facilities within the United States for the generation, transmission, distribution or sale of electric energy primarily for use by the public.

Electronic Data Interchange (EDI): An accepted standard format for the exchange of data between various companies' networks. EDI allows for the transfer of e-mail as well as orders, invoices and other files from one company to another.

EMEA: The region comprised of Europe, the Middle East and Africa.

Emission: The release or discharge of a substance into the environment. Generally refers to the release of gases or particulates into the air.

Energy: The capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Most of the world's convertible energy comes from fossil fuels that are burned to produce heat that is then used as a transfer medium to mechanical or other means in order to accomplish tasks.

Energy Information Administration (EIA): An independent agency within the U.S. Department of Energy, the Energy Information Administration (EIA) develops surveys, collects energy data and does analytical and modeling analyses of energy issues.

Energy Intensity: The amount of energy needed for a nation to produce a unit of GDP (gross domestic product, a measure of economic output).

Enhanced Oil Recovery (EOR): Any enhancement of oil recovery methods, most typically involving flooding depleted reservoirs with water or gas in order to recover any remaining oil.

ERP: See "Enterprise Resource Planning (ERP)."

Ethanol: A clear, colorless, flammable, oxygenated hydrocarbon, also called ethyl alcohol. In the U.S., it is used as a gasoline octane enhancer and oxygenate in a 10% blend called E10. Ethanol can be used in higher concentrations (such as an 85% blend called E85) in vehicles designed for its use. It is typically produced chemically from ethylene or biologically from fermentation of various sugars from carbohydrates found in agricultural crops and cellulose residues from crops or wood. Grain ethanol production is typically based on corn or sugarcane. Cellulosic ethanol production is based on agricultural waste, such as wheat stalks, that has been treated with enzymes to break the waste down into component sugars.

EU: See "European Union (EU)."

EU Competence: The jurisdiction in which the European Union (EU) can take legal action.

European Community (EC): See "European Union (EU)."

European Union (EU): A consolidation of European countries (member states) functioning as one body to facilitate trade. Previously known as the European

Community (EC). The EU has a unified currency, the Euro. See europa.eu.int.

Exempt Wholesale Generator (EWG): A non-utility electricity generator that is not a qualifying facility under the Public Utility Regulatory Policies Act of 1978.

Expansion-Gas Drive: A reservoir drive mechanism, also known as a volumetric drive, in which the initial production of a reservoir triggers a related reduction in pressure that, in turn, enables the gas to expand and produce energy sufficient to force the gas through surrounding rocks.

Exploration and Production (E&P): See "Upstream."

Exploratory Well: A well drilled to find and produce oil and gas in an area previously considered unproductive, to find a new reservoir in a known field (i.e., one previously producing oil or gas in another reservoir) or to extend the limit of a known oil or gas reservoir.

FASB: See "Financial Accounting Standards Board (FASB)."

Fast Breeder Reactor: See "Breeder Reactor."

Fast Neutron Reactor (FNR): A fast reactor is a type of nuclear plant that uses uranium-238 as a fuel, in addition to the U-235 isotope used in traditional reactors. Variances in design determine the actual designation of a reactor. Reactors that produce more "fissile material" (plutonium, U-235, etc.) than they consume are referred to as Breeder Reactors, or Fast Breeder Reactors (FBR). On the other hand if they are net consumers of fissile material, they are Fast Neutron Reactors (FNR). (Also, see "Breeder Reactor.")

Fast Reactor: An advanced technology nuclear reactor that uses a fast fission process utilizing fast neutrons that would split some of the U-258 atoms as well as transuranic isotopes. The goal is to use nuclear material more efficiently and safely in the production of nuclear energy.

Federal Energy Regulatory Commission (FERC): A quasi-independent regulatory agency within the Department of Energy having jurisdiction over interstate electricity sales, wholesale electricity rates, hydro-electric licensing, natural gas pricing, oil pipeline rates and gas pipeline certification.

Federal Power Act: Regulates licensing of non-federal hydroelectric projects, as well as the interstate transmission of electrical energy and rates for its sale at wholesale in interstate commerce. It was enacted in 1920 and amended in 1935.

Federal Power Commission: The predecessor agency of the FERC, abolished when the Department of Energy was created.

Feed-in Tariff (FIT): Guaranteed prices for output from electric generation, typically offered in long-term contracts to firms that operate renewable electric generating plants based on solar, wind or wave technology. The prices are typically much higher than those paid for electricity from conventional power plants, because most renewable sources operate at lower efficiency and higher cost per KWH. The intent is to encourage investment in renewable plants by guaranteeing a price for output that will create a positive return on investment.

FERC: See "Federal Energy Regulatory Commission (FERC)."

Financial Accounting Standards Board (FASB): An independent organization that establishes the Generally Accepted Accounting Principles (GAAP).

Fishing: The process of retrieving a foreign object (such as a tool or pipe) from a well in order to restore normal functionality.

Fishing String: A length of connected hollow tubes used to lower an attached fishing tool to the bottom of a well.

Fissile Material: Generally, fissile material is material than can be used as nuclear fuel in a reactor, such as Uranium-233, Uranium-235, Plutonium-239 and Plutonium-241.

Flash Steam Generation: The most common type of hydroelectric power generation technique. Flash steam describes a system where a high temperature geothermal steam source can be used to directly drive a turbine. Also see "Binary Cycle Generation."

Flat Plate Pumped: A medium-temperature solar thermal collector that typically consists of a metal frame, glazing, absorbers (usually metal) and insulation and that uses a pump liquid as the heat-transfer medium. Its predominant use is in water heating applications.

Float Collar: A special one-way coupling device inserted just above the bottom of the casing. The collar contains a check valve that permits fluid to flow downward but not return upward, preventing drilling mud from entering the casing and avoiding backflow of cement.

Flow Cell Battery: A massive electricity storage device based on a series of modules. Each module contains a large number of fuel cells. The flow cell battery technology receives electricity from a generating or transmission source, conditions it into appropriate format via transformers and stores it in the fuel cell modules using

sophisticated technology. On a large scale, a flow cell battery has the ability to store enough electricity to power a small city.

FOB (Free On Board) Price: The price actually charged at the producing country's port of loading. The reported price includes deductions for any rebates and discounts or additions of premiums where applicable and should be the actual price paid with no adjustment for credit terms.

Formation Density Compensated Log (FDC): A standard porosity tool that uses gamma rays to log the characteristics of a typically uncased hole, composed of two sets of detectors to compensate for the presence of mud and borehole irregularities. Also called a gamma-gamma log.

Fossil Fuel: Any naturally occurring organic fuel, such as petroleum, coal or natural gas.

Frac: See "Fracking."

Fracking: A hydraulic fracturing method that uses injected fluids to break open reservoir rock and stimulate flow. The fluid carries suspended propping agents or "proppants" (such as sand grains, aluminum pellet and glass beads) in order to keep the newly formed pathways open and permeable.

Fractionating: Separation of crude oil into various products by means of controlled heating and evaporation, according to the characteristic boiling point of each component.

Fuel Cell: An environmentally friendly electrochemical engine that generates electricity using hydrogen and oxygen as fuel, emitting only heat and water as byproducts.

Fumarole: A vent from which steam or gases issue; a geyser or spring that emits gases.

Fusion: See "Nuclear Fusion."

Futures Contract: An agreement to buy or sell a specified number of shares of a particular stock or commodity in a designated future month, at a price agreed upon by both buyer and seller. Futures contracts are frequently traded on the futures market. They differ from options in that options offer the right to buy or sell, while futures contracts bind the buyer and seller to an actual transaction.

GAAP: See "Generally Accepted Accounting Principles (GAAP)."

Gas Hydrates: Gas hydrates are solid particles of methane (which is normally found in gas form) and water molecules in a crystalline form. They are widely found in many parts of the world, including the U.S., South Korea, India and China, often offshore. Gas hydrates have immense potential as a source of energy and may possibly exist in much larger quantities than all other known forms of fossil fuels. Unfortunately, they are not stable except under high pressure. Gas hydrate reserves could be very expensive and difficult to develop as a commercial source of energy. Nonetheless, today's very high prices for oil and gas may eventually make them a viable energy source.

Gas Injection: A production enhancement technique in which natural gas is injected into oil reservoirs, thereby maintaining reservoir pressure and continuing the flow of oil to operating wells.

Gas Turbine: Typically consists of an axial-flow air compressor and one or more combustion chambers where liquid or gaseous fuel is burned. The hot gases are passed to the turbine, in which they expand to drive the generator and are then used to run the compressor.

Gas Turbine Plant: A plant in which the prime mover is a gas turbine.

Gas Well: A well completed for the production of natural gas from one or more gas zones or reservoirs. (Wells producing both crude oil and natural gas are classified as oil wells.)

Gasification: Any chemical or heat process used to convert a feedstock to a gaseous fuel.

Gasohol: A blend of finished motor gasoline containing alcohol (generally ethanol but sometimes methanol) at a concentration of 10% or less by volume. Data on gasohol that has at least 2.7% oxygen, by weight, and is intended for sale inside carbon monoxide non-attainment areas are included in data on oxygenated gasoline.

Gas-to-Liquids (GTL): A special process that converts natural gas into liquids that can be burnt as fuel. Major investments by ExxonMobil and others in the nation of Qatar, which contains massive natural gas reserves, will create an immense GTL plant capable of making up to 750,000 of GTL daily. The product will be GTL diesel, a very low emission alternative to standard diesel fuel.

GDP: See "Gross Domestic Product (GDP)."

Generally Accepted Accounting Principles (GAAP): A set of accounting standards administered by the Financial Accounting Standards Board (FASB) and enforced by the U.S. Security and Exchange Commission (SEC). GAAP is primarily used in the U.S.

Generating Unit: Any combination of physically connected generators, reactors, boilers, combustion

turbines or other prime movers operated together to produce electric power.

Generation (Electricity): The process of producing electric energy; also, the amount of electric energy produced, expressed in watt-hours (Wh).

Geophysicist: A professional who applies the principles of physics to the field of geology. Geophysicists are involved in exploration for oil, gas, coal, geothermal and other underground energy sources. Also, see "Geoscience."

Geoscience: Geoscience is practiced by geologists, as well as certain engineers and scientists from other disciplines, including geophysicists. Geoscientists may collect data derived from measurements or observations of air, soil or water. They may then study the data via software and other methods, and make recommendataionis for future action. In particular, in the oil and gas industry, geoscientists study subsurface structures via seismic and other tools in order to determine the existence of oil and gas deposits.

Geothermal Electric Power Generation: An electric generation plant which is typically powered by a steam turbine. In order to generate steam, long shafts are drilled below the Earth's surface in order to reach hot spots. Water is piped down the shafts where it is heated to a relatively high temperature. The hot water is returned to the surface where it is used to generate steam that turns a turbine. California is a leading producer of geothermal energy.Also see “Flash Steam Generation,” “Binary Cycle Generation” and “Hot Dry Rock Geothermal Energy Technology (HDR).”

GHG: See “Greenhouse Gas (GHG).”

Gigawatt: Equal to one billion watts of power. It is also equal to one million kilowatts or 1,000 megawatts.

Global Warming: An increase in the near-surface temperature of the Earth. Global warming has occurred in the distant past as the result of natural influences, but the term is most often used to refer to a theory that warming occurs as a result of increased use of hydrocarbon fuels by man. See “Climate Change (Greenhouse Effect).”

Globalization: The increased mobility of goods, services, labor, technology and capital throughout the world. Although globalization is not a new development, its pace has increased with the advent of new technologies.

Green Pricing: In the case of renewable electricity, green pricing represents a market solution to the various problems associated with regulatory valuation of the non-market benefits of renewables. Green pricing programs allow electricity customers to express their willingness to pay for renewable energy development through direct payments on their monthly utility bills.

Greenhouse Gas (GHG): See “Climate Change (Greenhouse Effect).”

Grid (The): In the U.S., the networks of local electric lines that businesses and consumers depend on every day are connected with and interdependent upon a national series of major lines collectively called “the grid.” The grid is divided into three major regions: the East, West and Texas regions. The regions are also known as “interconnects.” In total, the grid consists of about 200,000 miles of high-voltage backbone lines and millions of miles of smaller local lines.

Gross Domestic Product (GDP): The total value of a nation's output, income and expenditures produced with a nation's physical borders.

Gross National Product (GNP): A country's total output of goods and services from all forms of economic activity measured at market prices for one calendar year. It differs from Gross Domestic Product (GDP) in that GNP includes income from investments made in foreign nations.

Group of Eight (G8): The eight major industrial countries, including the United States, Japan, Germany, France, the United Kingdom, Italy, Russia and Canada, whose leaders meet at annual economic summits to coordinate economic policies. The group was formerly known as the G7, before Russia was admitted in June 2002.

Heat Pump: A year-round heating and air-conditioning system employing a refrigeration cycle.

Heavy Crude: Crude oil that has a higher relative density and requires higher temperatures to distill into usable products. Heavier crude results in lower value products and requires more energy to refine, and thus is less desirable.

Heliostat: A motor-driven mirror which is used in concentrating solar power and in concentrating photovoltaic power. The mirror is engineered so that it tracks the sun's movement through the sky during the day, thus capturing the maximum amount of solar output. (See “Concentrating Solar Power (CSP)” and "Concentrating Photovoltaic Power (CPV).")

Henry Hub: Originally a U.S. distribution hub for natural gas located in Erath, Louisiana. The name also refers to the pricing point for natural gas futures contracts traded on the New York Mercantile Exchange (NYMEX), as well as over the counter (OTC) swaps traded on the IntercontinentalExchange (ICE).

High-Temperature Collector: A solar thermal collector designed to operate at a temperature of 180 degrees Fahrenheit or higher.

Hot Dry Rock Geothermal Energy Technology (HDR): A technique that drills holes into the ground until rock of a suitably high temperature is reached. Pipes are then installed in a closed loop. Water is pumped down one pipe, where it is heated to extraordinarily high temperatures, and then is pumped up the other pipes as steam. The resulting steam shoots up to the surface, which drives a turbine to power an electric generating plant. As the steam cools, it returns to a liquid state which is then is pumped back into the ground. The technology was developed by the Los Alamos National labs in New Mexico.

HTS: High Temperature Superconductor wire. See "Superconductivity."

Hydraulic Fracturing: See "Fracking." Sometimes called hydrofracture.

Hydraulic Pump: An artificial lift method used to raise oil to the surface once reservoir pressure has diminished to the point where the well no longer produces by means of natural energy. This system employs a surface pump to inject power oil into the well, which in turn drives a pump connected to a sucker-rod pump at the bottom of the well.

Hydrocarbons: Organic compounds of hydrogen and carbon. Mixtures including various hydrocarbons include crude oil, natural gas, natural gas condensate and methane.

Hydroelectric Energy: The production of electricity from kinetic energy in flowing water.

Hydroelectric Plant: An electric generating plant in which the turbine generators are driven by falling water, typically located at a dam or major waterfall.

Hydroelectric Power Generation: Electricity generated by an electric power plant whose turbines are driven by falling water. It includes electric utility and industrial generation of hydroelectricity, unless otherwise specified. Generation is reported on a net basis, i.e., on the amount of electric energy generated after deducting the energy consumed by station auxiliaries and the losses in the transformers that are considered integral parts of the station.

ICE: Intercontinental Exchange (NYSE: ICE) operates leading regulated exchanges, trading platforms and clearing houses serving global markets for agricultural, credit, currency, emissions, energy and equity index markets. ICE operates three futures exchanges including London-based ICE Futures Europe, which hosts trading in half of the world's crude and refined oil futures contracts traded each day. ICE Futures U.S. and ICE Futures Canada list agricultural, currency and Russell Index futures and options markets. ICE also provides trade execution, processing and clearing services for the over-the-counter (OTC) energy and credit derivatives markets. ICE serves customers in more than 55 countries and is headquartered in Atlanta, with offices in New York, London, Chicago, Winnipeg, Calgary, Houston and Singapore.

IEEE: See "Institute of Electrical and Electronic Engineers (IEEE)."

IFRS: See "International Financials Reporting Standards (IFRS)."

Improved Oil Recovery: Any of the conventional methods of secondary recovery (in which water is injected into a reservoir in order to move remaining oil toward producing wells) or enhanced oil recovery methods that are used to optimize production from increasingly depleted reservoirs.

Independent (Oil Company): Any domestic oil company that is not one of the major international oil companies such as BP, ExxonMobil or Royal Dutch/Shell. It also refers to any U.S. oil company that is not part of the 18 to 20 largest integrated oil companies in the United States.

Independent Power Producer: A corporation, person, agency, authority or other legal entity or instrumentality that owns electric generating capacity and is a wholesale electric producer without a designated franchised service area.

Independent System Operator (ISO): One of many independent, nonprofit organizations created by many states in the U.S. during the deregulation of the electricity industry. Its function is to ensure that electric generating companies have equal access to the power grid. It may be replaced by larger Regional Transmission Organizations (RTOs), which would each cover a major area of the U.S.

Induction Log: Measures conductivity or resistivity by generating magnetic fields that in turn cause receiver coils to induce signals at low conductivities proportional to the surrounding formation. Induction logging is often combined with other measuring devices, and can safely be used in nonconductive borehole fluids that preclude the use of other logging techniques. It is utilized in uncased drilling sites.

Industry Code: A descriptive code assigned to any company in order to group it with firms that operate in similar businesses. Common industry codes include the NAICS (North American Industrial Classification System) and the SIC (Standard Industrial Classification), both of which are standards widely used in America, as well as the International Standard Industrial Classification of all Economic Activities (ISIC), the Standard International Trade Classification established by the United Nations (SITC) and the General Industrial Classification of Economic Activities within the European Communities (NACE).

Infrastructure: 1) The equipment that comprises a system. 2) Public-use assets such as roads, bridges, water systems, sewers and other assets necessary for public accommodation and utilities. 3) The underlying base of a system or network. 4) Transportation and shipping support systems such as ports, airports and railways.

Initial Public Offering (IPO): A company's first effort to sell its stock to investors (the public). Investors in an up-trending market eagerly seek stocks offered in many IPOs because the stocks of newly public companies that seem to have great promise may appreciate very rapidly in price, reaping great profits for those who were able to get the stock at the first offering. In the United States, IPOs are regulated by the SEC (U.S. Securities Exchange Commission) and by the state-level regulatory agencies of the states in which the IPO shares are offered.

Institute of Electrical and Electronic Engineers (IEEE): An organization that sets global technical standards and acts as an authority in technical areas including computer engineering, biomedical technology, telecommunications, electric power, aerospace and consumer electronics, among others. www.ieee.org.

Intellectual Property (IP): The exclusive ownership of original concepts, ideas, designs, engineering plans or other assets that are protected by law. Examples include items covered by trademarks, copyrights and patents. Items such as software, engineering plans, fashion designs and architectural designs, as well as games, books, songs and other entertainment items are among the many things that may be considered to be intellectual property. (Also, see "Patent.")

Interconnects: See "Grid (The)."

International Financials Reporting Standards (IFRS): A set of accounting standards established by the International Accounting Standards Board (IASB) for the preparation of public financial statements. IFRS has been adopted by much of the world, including the European Union, Russia and Singapore.

Investor-Owned Electric Utility: A class of utility that is investor-owned and organized as a tax-paying business.

IP: See "Intellectual Property (IP)."

ISO: See "Independent System Operator (ISO)."

ISO 9000, 9001, 9002, 9003: Standards set by the International Organization for Standardization. ISO 9000, 9001, 9002 and 9003 are the highest quality certifications awarded to organizations that meet exacting standards in their operating practices and procedures.

IT-Enabled Services (ITES): The portion of the Information Technology industry focused on providing business services, such as call centers, insurance claims processing and medical records transcription, by utilizing the power of IT, especially the Internet. Most ITES functions are considered to be back-office procedures. Also, see "Business Process Outsourcing (BPO)."

ITES: See "IT-Enabled Services (ITES)."

Jack-Up Rig: A mobile, self-elevating drilling platform that can be used in water depths of 20 to 250 feet.

Jet Fuel (Kerosene-Type): A quality kerosene product with an average gravity of 40.7 degrees API, and a 10% distillation temperature of 400 degrees Fahrenheit. A relatively low freezing-point distillate of the kerosene type, it is used primarily for commercial turbojet and turboprop aircraft engines.

Jet Fuel (Naphtha-Type): A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 20 to 90% distillation temperatures of 290 degrees to 470 degrees Fahrenheit. This type of fuel is used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ram-jet and petroleum rocket fuels.

Joule: The meter-kilogram-second unit of work or energy, equal to the work done by a force of one Newton when its point of application moves through a distance of one meter in the direction of the force; equivalent to 107 ergs and one watt-second.

Just-in-Time (JIT) Delivery: Refers to a supply chain practice whereby manufacturers receive components on or just before the time that they are needed on the assembly line, rather than bearing the cost of maintaining several days' or weeks' supply in a warehouse. This adds greatly to the cost-effectiveness of a manufacturing plant and puts the burden of warehousing and timely delivery on the supplier of the components.

Kerogen: See "Oil Shale."

Kerosene: Light hydrocarbon distillates in the distillation range of 150 degrees to 280 degrees Centigrade (300 degrees to 550 degrees Fahrenheit). Includes vaporizing oil for use in reciprocating engines (primarily tractors), lamp oil, kerosene and heating oil.

Kilowatt (kW): One thousand watts.

Kilowatthour (kWh): One thousand watt-hours.

Knowledge Process Outsourcing (KPO): The use of outsourced and/or offshore workers to perform business tasks that require judgment and analysis. Examples include such professional tasks as patent research, legal research,

architecture, design, engineering, market research, scientific research, accounting and tax return preparation. Also, see "Business Process Outsourcing (BPO)."

LAC: An acronym for Latin America and the Caribbean.

Landed Cost: Represents the dollar-per-barrel price of crude oil at the port of discharge. Includes charges associated with the purchase, transporting and insuring of cargo from the purchase point to the port of discharge. Does not include charges incurred at the discharge port (e.g., import tariffs or fees, wharfage charges and demurrage).

Landman: A person who negotiates the purchase of leases, generally an agent or an employee of an oil company.

LDCs: See "Least Developed Countries (LDCs)."

Lease (Oil and Gas): The exclusive contractual rights to explore for and develop minerals on a property owned by a mineral rights owner.

Least Developed Countries (LDCs): Nations determined by the U.N. Economic and Social Council to be the poorest and weakest members of the international community. There are currently 50 LDCs, of which 34 are in Africa, 15 are in Asia Pacific and the remaining one (Haiti) is in Latin America. The top 10 on the LDC list, in descending order from top to 10th, are Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde and the Central African Republic. Sixteen of the LDCs are also Landlocked Least Developed Countries (LLDCs) which present them with additional difficulties often due to the high cost of transporting trade goods. Eleven of the LDCs are Small Island Developing States (SIDS), which are often at risk of extreme weather phenomenon (hurricanes, typhoons, Tsunami); have fragile ecosystems; are often dependent on foreign energy sources; can have high disease rates for HIV/AIDS and malaria; and can have poor market access and trade terms.

Levelized Cost: The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. Costs are levelized in real dollars (i.e., adjusted to remove the impact of inflation).

Lifting Costs: Expenses related to lifting oil from a producing reservoir in a well up to the surface.

Light Crude: Crude oil that has a lower relative density and requires lower temperatures to distill into usable products. Lighter crude generally yields more gasoline and diesel products and is less expensive to refine, thus making it more desirable.

Lignite: The lowest rank of coal. Lignite is a young coal that is brownish-black in color and has high moisture content, sometimes as high as 45%, and a high ash content. It tends to disintegrate when exposed to the weather. The heat content of lignite is usually less than 5700 Kcal/kg.

Liquefied Natural Gas (LNG): Natural gas that is liquefied by reducing its temperature to -260 degrees Fahrenheit at atmospheric pressure. The volume of the LNG is 1/600 that of the gas in its vapor state. LNG requires special processing and transportation. First, the natural gas must be chilled in order for it to change into a liquid state. Next, the LNG is put on specially designed ships where extensive insulation and refrigeration maintain the cold temperature. Finally, it is offloaded at special receiving facilities where it is converted, via regasification, into a state suitable for distribution via pipelines.

Liquefied Petroleum Gases (LPG): See "Liquefied Refinery Gases (LRG)."

Liquefied Refinery Gases (LRG): Liquefied petroleum fractionated from refinery or still gases. Through compression and/or refrigeration, they are retained in the liquid state. The reported categories are ethane/ethylene, propane/propylene, normal butane/butylene and isobutene. Excludes still gas used for chemical or rubber manufacture, which is reported as petrochemical feedstock, as well as liquefied petroleum gases intended for blending into gasoline, which are reported as gasoline blending components.

Liquid Collector: A medium-temperature solar thermal collector, employed predominantly in water heating, which uses pumped liquid as the heat-transfer medium.

LNG: See "Liquefied Natural Gas (LNG)."

Load (Electric): The amount of electric power delivered or required at any specific point or points on a system. The requirement originates at the energy-consuming equipment of the consumers.

Log (Petroleum): A record of the activities related to the drilling and completion of oil and gas wells.

Logging (Wireline): The lowering of a sensing device into the borehole on the end of an electric cable, which then logs information about the borehole.

LOHAS: Lifestyles of Health and Sustainability. A marketing term that refers to consumers who choose to purchase and/or live with items that are natural, organic, less polluting, etc. Such consumers may also prefer products powered by alternative energy, such as hybrid cars.

Low-Temperature Collectors: Metallic or nonmetallic solar thermal collectors that generally operate at temperatures below 110 degrees Fahrenheit and use pumped liquid or air as the heat-transfer medium. They usually contain no glazing and no insulation, and they are often made of plastic or rubber, although some are made of metal.

Lubricants (Greases): Mixtures of lubricating oils that contain substances that reduce their ability to flow.

Lubricants (Lubricating Oils): Substances used to reduce friction between bearing surfaces. Petroleum lubricants may be produced either from distillates or residues. Other substances may be added to impart or improve certain required properties. Lubricants include all grades of lubricating oils from spindle oil to cylinder oil and those used in greases.

M3 (Measurement): Cubic meters.

Major Oil Company: Traditionally refers to the large integrated international companies such as British Petroleum (BP), ExxonMobil, Chevron and ConocoPhillips.

Marginal Cost: The change in cost associated with a unit change in quantity supplied or produced.

Mbbl: One thousand barrels.

Mcf: One thousand cubic feet.

Mcfe: One thousand cubic feet of natural gas equivalent, using the ratio of six Mcf of natural gas to one Bbl of crude oil, condensate and natural gas liquids.

Medium-Temperature Collectors: Solar thermal collectors designed to operate in the temperature range of 140 degrees to 180 degrees Fahrenheit, but that can also operate at a temperature as low as 110 degrees Fahrenheit. The collector typically consists of a metal frame, metal absorption panels with integral flow channels (attached tubing for liquid collectors or integral ducting for air collectors) and glazing and insulation on the sides and back.

Megawatt (MW): One million watts.

Megawatthour (MWh): One million watt-hours.

Metallurgical Coke: A strong, hard coke produced mainly for use in the iron and steel industry, where it serves as a chemical agent and source of energy. It is used mainly in blast furnaces to absorb the oxygen contained in iron oxides and provide energy for smelting. A portion of its potential energy is captured in the gases generated in the smelting process, then recycled in the form of blast furnace gas to provide additional energy inside or outside the smelting process. Metallurgical coke is also used to some extent as a domestic fuel and as raw material for the manufacture of gas.

Methane: A colorless, odorless, flammable hydrocarbon gas (CH4); the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Also, see “Coalbed Methane (CBN).”

Methane Hydrate: Natural gas (methane) which is trapped in a lattice of ice. Underground or seabed gas can migrate towards the surface, but become trapped under high pressure and combine with water, at low temperature, to form methane hydrate. It has the potential to be a massive source of energy, but producing it commercially is not yet feasible.

Methanol: A light, volatile alcohol (CH3OH) eligible for motor gasoline blending. It is also used as a feedstock for synthetic textiles, plastics, paints, adhesives, foam, medicines and more.

Microbial Enhanced Oil Recovery (MEOR): An oil field recovery technology that creates microbes that biologically generate CO2 and chemicals with cleaning agents that help flush oil out of rock.

Microgrid: See "Distributed Power Generation."

Microturbine: A small, scaled-down turbine engine that may be fueled by natural gas, methane or other types of gas.

Midstream: That part of the oil and gas industry focused on gathering, processing, storing and transporting oil, gas and gas liquids. Midstream is one of the three major segments of this industry: upstream, midstream and downstream.

Mineral Interests: The rights of ownership to gas, oil or other minerals as they naturally occur at or below a tract of land. Also known as “mineral rights.”

Mineral Rights: See “Mineral Interests.”

Mmbtu: One million British thermal units.

Mmcf: One million cubic feet.

Mmcfe: One million cubic feet of natural gas equivalent.

MOX Fuel (Mixed Oxide Fuel): A method of reprocessing spent nuclear material. Surplus plutonium is mixed with uranium to fabricate MOX fuel for use in a commercial nuclear power plant. Traditionally, fuel for commercial nuclear power plants is made of low-enriched uranium. MOX fuel contains 5 percent plutonium.

European countries such as the United Kingdom, Germany, Belgium and France have been fabricating MOX fuel for many years. Commercial MOX-fueled light water reactors are used in France, the United Kingdom, Germany, Switzerland, and Belgium. In the U.S., MOX fuel was fabricated and used in several commercial reactors in the 1970's as part of a development program.

Mud (Drilling Mud): A mixture of one or two liquid phases (water, oil and related emulsions) with clay that circulates during drilling in order to cool and lubricate the bit, remove material from the borehole and bring traces of fluids to the surface. The characteristic qualities of the drilling mud can be engineered to provide specific indicators to surface workers.

NAFTA: See “North American Free Trade Agreement (NAFTA).”

NAICS: North American Industrial Classification System. See “Industry Code.”

Nanotechnology: The science of designing, building or utilizing unique structures that are smaller than 100 nanometers (a nanometer is one billionth of a meter). This involves microscopic structures that are no larger than the width of some cell membranes.

Natural Gas: A mixture of hydrocarbon compounds, primarily methane and small quantities of various nonhydrocarbons, existing in a gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

Natural Gas Field Facility: A field facility designed to process natural gas produced from more than one lease for the purpose of recovering condensate from a stream of natural gas. Some field facilities are designed to recover propane, normal butane, pentanes plus, etc., and to control the quality of natural gas to be marketed.

Natural Gas Liquids: Those hydrocarbons in natural gas that are separated from the gas as liquids through the process of absorption, condensation or other methods in gas processing or cycling plants. Generally such liquids consist of propane and heavier hydrocarbons and are commonly referred to as lease condensate, natural gasoline and liquefied petroleum gases. Natural gas liquids include natural gas plant liquids (primarily ethane, propane, butane and isobutane) and lease condensate (primarily pentanes produced from natural gas at lease separators and field facilities). See “Condensate (Lease).”

Net Generation: Gross generation minus plant use from all electric utility-owned plants. The energy required for pumping at a pumped-storage plant is regarded as plant use and must be deducted from the gross generation.

Net Summer Capability: The steady hourly output that generating equipment is expected to supply to system load exclusive of auxiliary power, as demonstrated by tests at the time of summer peak demand.

NGL: Natural Gas Liquids.

Non-Regulated Business: See “Regulated Business (Utility Companies).”

Nonutility Power Producer: A corporation, person, agency, authority or other legal entity or instrumentality that owns electric generating capacity and is not an electric utility.

North American Free Trade Agreement (NAFTA): A trade agreement signed in December 1992 by U.S. President George H. W. Bush, Canadian Prime Minister Brian Mulroney and Mexican President Carlos Salinas de Gortari. The agreement eliminates tariffs on most goods originating in and traveling between the three member countries. It was approved by the legislatures of the three countries and had entered into force by January 1994. When it was created, NAFTA formed one of the largest free-trade areas of its kind in the world.

Nuclear Electric Power Generation: Electricity generated by nuclear reactors of various types, such as heavy water, light water and boiling water. Generation is reported on a net basis and excludes energy that is used by the electric power plant for its own operating purposes and not for commercial use.

Nuclear Fuel: Fissionable materials that have been enriched to such a composition that, when placed in a nuclear reactor, they will support a self-sustaining fission chain reaction, producing heat in a controlled manner for process use.

Nuclear Fusion: An atomic energy-releasing process in which light weight atomic nuclei, which might be hydrogen or deuterium, combine to form heavier nuclei, such as helium. The result is the release of a tremendous amount of energy in the form of heat. This is potentially an endless supply of energy for mankind, somewhat similar to the power of the Sun. Fusion is undergoing significant research efforts, including a multinational research consortium named ITER. In one approach, magnetic fusion, plasma heated to 100 million-degrees Celsius creates multiple fusion bursts controlled by powerful magnets. Under a different research approach, massive lasers bombard a frozen pellet of fuel creating a brief, intense fusion.

Nuclear Power Plant: A facility in which heat produced in a reactor by the fission of nuclear fuel is used to drive a steam turbine, which in turn powers electric generation equipment. This method is sometimes described as "atomic

power." There are several different types of nuclear power plants. The newest models incorporate advanced safety and disaster recovery features that are vastly superior to early models.

Nuclear Reactor: An apparatus in which the nuclear fission chain can be initiated, maintained and controlled so that energy is released at a specific rate.

NYMEX: New York Mercantile Exchange, Inc. (NYMEX Exchange). The company is a major provider of financial services to the energy and metals industries including the trading of energy futures and options contracts. It is owned by the CME Group.

Octane Rating: A number used to indicate motor gasoline's antiknock performance in motor vehicle engines. The two recognized laboratory engine test methods for determining the antiknock rating, or octane rating, of gasoline are the research method and the motor method. To provide a single number as guidance to the customer, the antiknock index (R + M)/2, which is the average of the research and motor octane numbers, was developed.

OECD: See "Organisation for Economic Co-operation and Development (OECD)."

Ohm: The unit of measurement of electrical resistance; the resistance of a circuit in which a potential difference of one volt produces a current of one ampere.

Oil Sands: See "Tar Sands."

Oil Shale: Sedimentary rock that contains kerogen, a solid, waxy mixture of hydrocarbon compounds. Heating the rock to very high temperatures will convert the kerogen to a vapor, which can then be condensed to form a slow flowing heavy oil that can later be refined or used for commercial purposes. The United States contains vast amounts of oil shale deposits, but so far it has been considered not economically feasible to produce from them on a large scale. (Not to be confused with crude oil that is produced from shale formulations.)

Onshoring: The opposite of "offshoring." Providing or maintaining manufacturing or services within or nearby a company's domestic location. Sometimes referred to as reshoring.

OPEC: Organization of Petroleum Exporting Countries. Current members are Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela. (Ecuador withdrew from OPEC on December 31, 1992, and Gabon withdrew on December 31, 1994.)

Operation and Maintenance (O&M) Cost: Expenses associated with operating a facility (e.g., supervising and engineering expenses) and maintaining it, including labor, materials and other direct and indirect expenses incurred for preserving the operating efficiency or physical condition of utility plants that are used for power production, transmission and distribution of energy.

Organisation for Economic Co-operation and Development (OECD): A group of more than 30 nations that are strongly committed to the market economy and democracy. Some of the OECD members include Japan, the U.S., Spain, Germany, Australia, Korea, the U.K., Canada and Mexico. Although not members, Estonia, Israel and Russia are invited to member talks; and Brazil, China, India, Indonesia and South Africa have enhanced engagement policies with the OECD. The Organisation provides statistics, as well as social and economic data; and researches social changes, including patterns in evolving fiscal policy, agriculture, technology, trade, the environment and other areas. It publishes over 250 titles annually; publishes a corporate magazine, the OECD Observer; has radio and TV studios; and has centers in Tokyo, Washington, D.C., Berlin and Mexico City that distributed the Organisation's work and organizes events.

Ozone: A molecule made up of three atoms of oxygen. It occurs naturally in the stratosphere and provides a protective layer shielding the Earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant, a greenhouse gas and a major component of photochemical smog.

Ozone-Depleting Substances: Gases containing chlorine that are being controlled because they deplete ozone. They are thought to have some indeterminate impact on greenhouse gases.

Packer: A rubber-like cylinder that is used to seal a well at a given level. A packer is often equipped with a flowmeter, forcing the flow of fluid through a monitoring device providing data to the surface.

Paraffin (Oil): A light-colored, wax-free oil obtained by pressing paraffin distillate.

Paraffin-Base Crude Oil: Crude oil containing little or no asphalt, yielding at the refinery a high percentage of paraffin, lubricating oil and kerosene.

Passive Solar: A system in which solar energy (heat from sunlight) alone is used for the transfer of thermal energy. Heat transfer devices that depend on energy other than solar are not used. A good example is a passive solar water heater on the roof of a building.

Patent: An intellectual property right granted by a national government to an inventor to exclude others from making, using, offering for sale, or selling the invention throughout that nation or importing the invention into the nation for a limited time in exchange for public disclosure of the invention when the patent is granted. In addition to national patenting agencies, such as the United States Patent and Trademark Office, and regional organizations such as the European Patent Office, there is a cooperative international patent organization, the World Intellectual Property Organization, or WIPO, established by the United Nations.

Pay: The part of a formation producing or capable of producing oil, gas or another viable product. See "Pay Zone."

Pay Sand: A sandstone formation that produces gas or oil.

Pay Zone: A vertical measure denoting the portion of a well producing gas or oil.

Peak Watt: A manufacturer's unit indicating the amount of power a photovoltaic cell or module will produce at standard test conditions (normally 1,000 watts per square meter and 25 degrees Celsius).

Pebble-Bed Modular Reactor (PBMR): A nuclear reactor technology that utilizes tiny silicon carbide-coated uranium oxide granules sealed in "pebbles" about the size of oranges, made of graphite. Helium is used as the coolant and energy transfer medium. This containment of the radioactive material in small quantities has the potential to achieve an unprecedented level of safety. This technology may become popular in the development of new nuclear power plants.

Persian Gulf: The countries that comprise the Persian Gulf region are: Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates.

Petrochemical Feedstocks: Products from petroleum refineries and natural gas liquids processing plants to be processed further at a petrochemical plant. Includes products primarily in the naphtha range, still gas (refinery gas) and liquefied gases for petrochemical use.

Petroleum: A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oils, refined petroleum products, natural gas plants and liquids, and nonhydrocarbon compounds blended into finished petroleum products.

Petroleum Geologist: A geologist specializing in research and analysis that supports the exploration and production of petroleum resources.

Petroleum Products: Products obtained from the processing of crude oil, unfinished oils, natural gas liquids and other miscellaneous hydrocarbon compounds. Includes aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, ethane, liquefied petroleum gases, petrochemical feedstocks, special naphthas, lubricants, paraffin wax, petroleum coke, asphalt and road oil, still gas and other products.

Petroleum Stocks: Primary stocks of crude oil and petroleum products held in storage at (or in) leases, refineries, natural gas processing plants, pipelines, tankfarms and bulk terminals that can store at least 50,000 barrels of petroleum products or that can receive petroleum products by tanker, barge or pipeline.

Photovoltaic (PV) Cell: An electronic device consisting of layers of semiconductor materials fabricated to form a junction (adjacent layers of materials with different electronic characteristics) and electrical contacts, capable of converting incident light directly into electricity (direct current). Photovoltaic technology works by harnessing the movement of electrons between the layers of a solar cell when the sun strikes the material.

Photovoltaic (PV) Module: An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environment degradation and suited for incorporation in photovoltaic power systems.

Pipeline (Natural Gas): A continuous pipe conduit, complete with such equipment as valves, compressor stations, communications systems and meters, for transporting natural gas and/or supplemental gaseous fuels from one point to another, usually from a point in or beyond the producing field or processing plant to another pipeline or to points of utilization.

Pipeline (Petroleum): Crude oil and product pipelines (including interstate, intrastate and intracompany pipelines) used to transport crude oil and petroleum products, respectively.

Plugged and Abandoned (P&A): A term describing a dry hole or depleted site that has been fitted with a cement plug to close the well.

Porosimeter: A device used to measure porosity.

Porosity: Percentage of rock or soil that is void of solid material.

Power (Electrical): The rate at which energy is transferred. A volt ampere, an electric measurement unit of power, is equal to the product of one volt and one ampere.

This is equivalent to one watt for a direct current system. A unit of apparent power is separated into real and reactive power. Real power is the work-producing part of apparent power that measures the rate of supply of energy and is denoted in kilowatts.

Primary Energy Consumption: The consumption of unprocessed, unrefined fuels including coal, natural gas and crude oil. Since uranium is a raw fuel, it may also be included. Analysis of primary energy consumption may sometimes include renewable power sources, such as hydroelectric, geothermal or even solar and wind. Primary energy analysis is focused on raw fuels, prior to their use in generating electricity and other purposes. Also, see "Secondary Energy Consumption."

Primary Recovery: The production of oil from a reservoir into the well under natural occurrences. Oil flows from a reservoir into the well under natural conditions (the first phase in oil production).

Prime Mover: The motive force that drives an electric generator.

Producing Gas-Oil Ratio: A ratio derived from the cubic foot measure of natural gas produced by a well relative to each barrel of oil produced.

Production Casing: The last section of casing to be set in a well, the production casing is the smallest diameter and longest string of tubulars to be installed.

Propane: A normally gaseous straight-chain hydrocarbon (C_3H_8). Propane is a colorless paraffinic gas that boils at a temperature of –43.67 degrees Fahrenheit. It is extracted from natural gas or refinery gas streams.

Proppant: Sand, ceramics or other materials used during fraccing to help stabilize a pay zone. See "Fracing (Fraccing)."

Prospect: The hypothetical location of naturally occurring, commercially exploitable oil and gas at a clearly defined underground location.

Proved Reserves (Crude Oil, Natural Gas or Coal): The estimated quantities of all crude oil, natural gas or coal which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs or seams under existing economic and operating conditions.

Public Utility: An enterprise providing essential public services, such as electric, gas, telephone, water and sewer services, under legally established monopoly conditions.

Public Utility District (PUD): A municipal corporation organized to provide electric service to both incorporated cities and towns and unincorporated rural areas. Public utility districts operate in six states.

Public Utility Regulatory Policies Act of 1978 (PURPA): A part of the National Energy Act. PURPA contains measures designed to encourage the conservation of energy, more efficient use of resources and equitable rates. Principal among these were suggested retail rate reforms and new incentives for production of electricity by cogenerators and users of renewable resources.

Publicly Owned Electric Utility: A class of ownership found in the electric power industry. This group includes those utilities operated by municipalities and state and federal power agencies.

Pumped-Storage Hydroelectric Plant: A plant that usually generates electric energy during peak load periods by using water previously pumped into an elevated storage reservoir during off-peak periods, when excess generating capacity is available to do so. When additional generating capacity is needed, the water can be released from the reservoir through a conduit to turbine generators located in a power plant at a lower level.

PV: See "Photovoltaic (PV) Cell."

Qualifying Facility (QF): A cogeneration or small power production facility that meets certain ownership, operating and efficiency criteria established by the Federal Energy Regulatory Commission (FERC) pursuant to the Public Utility Regulatory Policies Act of 1978 (PURPA).

R&D: Research and development. Also see "Applied Research" and "Basic Research."

Rate Base: The value of property upon which a utility is permitted to earn a specified rate of return as established by a regulatory authority. The rate base generally represents the value of property used by the utility in providing service.

Ratemaking Authority: A utility commission's legal authority to fix, modify, approve or disapprove rates, as determined by the powers given to the commission by a state or federal legislature.

Refiner: A firm or the part of a firm that refines products or blends and substantially changes products; refines liquid hydrocarbons from oil and gas field gases; or recovers liquefied petroleum gases incident to petroleum refining and sells those products to resellers, retailers or ultimate consumers. Includes gas plant operators.

Refinery: An installation that manufactures finished petroleum products from crude oil, unfinished oils, natural gas liquids, other hydrocarbons and alcohol.

Refuse-Derived Fuel (RDF): Fuel processed from municipal solid waste that can be in shredded, fluff or dense pellet forms.

Regional Transmission Organization (RTO): See "Independent System Operator (ISO)."

Regulated Business (Utility Companies): The business of providing natural gas or electric service to customers under regulations and at prices set by government regulatory agencies. Generally, utilities have been required to operate at set prices and profit ratios because they have been granted monopoly or near-monopoly status to serve a given geographic market. Under deregulation, utility companies are being granted greater flexibility to set prices and to enter new geographic markets. At the same time, consumers gain the right to choose among several different utilities providers.

Renewable Energy Resources: Energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action and tidal action.

Reseller: A firm (other than a refiner) that carries on the trade or business of purchasing refined petroleum products and reselling them to purchasers other than ultimate consumers.

Reserves (Oil, Gas or Coal): Recoverable, unproduced resources contained in a given formation. Reserves are categorized as developed or undeveloped, and as proved, unproved, probable or possible. Also see "Proved Reserves (Crude Oil, Natural Gas or Coal)."

Reservoir: A subsurface deposit of gas, oil or condensate, typically contained in a porous rock formation of limestone, dolomite or sandstone.

Resistivity (R): Measures a material's characteristic resistance to the flow of electrical current. Resistivity is the reciprocal of conductivity. It is denoted by the symbol R.

Royalty and Royalty Interest (Oil and Gas): A specified percentage of the oil and gas produced at a property to which the royalty owner is entitled without bearing an investment in exploration or the costs of such production. The ownership of a "royalty interest" entitles the owner to receive royalty payments.

RTO: See "Regional Transmission Organization (RTO)."

Rural Electrification Administration (REA): A lending agency of the U.S. Department of Agriculture. It makes self-liquidation loans to qualified borrowers to finance electric and telephone service to rural areas. The REA also finances the construction and operation of generating plants, electric transmission and distribution lines, or systems for the furnishing of initial and continued adequate electric services to persons in rural areas not receiving central station service.

Saas: See "Software as a Service (Saas)."

Salt Dome: A common type of rock formation, in which a dome is formed by the intrusion of salt into overlying sediments.

SeaBed Logging (SBL): Controlled source electromagnetic sounding that can improve the accuracy in detecting and characterizing hydrocarbon reservoirs in deepwater areas.

Secondary Energy Consumption: The consumption of electricity, petroleum, and other refined, processed or generated energy supplies. Also, see "Primary Energy Consumption."

Secondary Recovery: The second phase of oil production. Involves activities to waterflood or re-pressurize the reservoir to recover more of the remaining oil. (Additional phases include primary recovery and tertiary recovery. See "Tertiary Recovery.")

Seismic: In oil and gas exploration, seismic data acquisition is the basis for surveying and related analysis to identify oil or gas traps in subsurface, including subsea, formations. Seismic acquisition involves the positioning of a large number of "geophones" on the ground or ocean floor. These receiving devices may also be suspended in the ocean or lowered down a well hole. A vibration wave is then generated in a central location, via dynamite, a massive vibrator, an air gun or other methods. The vibrations travel into the Earth, react to different types of geological strata, and then bounce back to the geophones in order to be recorded as seismic data. Today, the most valuable seismic acquisition projects capture 3-D images of the subsurface. Geologists and geophysicists analyze the data to locate potential oil and gas pay zones.

Semi-Submersible Rig: An offshore drilling rig that floats with its lower hull between 55 and 90 feet below the surface. It is held in position by anchors or by a computer-controlled thruster system.

Shale (Shale Gas, Shale Oil): A rock deposited in dense layers with a consistency somewhat like clay. It is widely dispersed throughout much of the world (including much of Europe, China, Africa, North America and South America.) It often traps crude oil and natural gas in large quantities. Until recently, this type of oil and gas was considered too difficult to produce because the hydrocarbons do not flow naturally, as they are held in

"tight" formations of shale rock. By the late 1990s and early 2000s, however, the oil and gas industry perfected a method of drilling a traditional bore hold to a depth of about 5,000 to 10,000 feet, and then turning that bore horizontally for a length of one mile or more, through the shale rock layer. Then, the horizontal hole is fractured in order to open up cracks through which oil or gas readily flow to the surface. Also, see "Fracking."

Shot Hole: Drilling through surface sediments to form a shallow hole in hard sedimentary rocks creates a shot hole, in which explosives can be detonated as part of a related seismic survey.

SIC: Standard Industrial Classification. See "Industry Code."

Silicon: A semiconductor material made from silica, purified for photovoltaic applications.

Single-Crystal Silicon (Czochralski): An extremely pure form of crystalline silicon produced by the Czochralski method of dipping a single crystal seed into a pool of molten silicon under high-vacuum conditions and slowly withdrawing a solidifying single-crystal boule rod of silicon. The boule is sawed into thin wafers and fabricated into single-crystal photovoltaic cells.

Small Power Producer: A producer that generates electricity by using renewable energy (wood, waste, conventional hydroelectric, wind, solar or geothermal) as a primary energy source. Fossil fuels can be used, but renewable resources must provide at least 75% of the total energy input. It is part of the Public Utility Regulatory Policies Act, a small power producer.

Smart Buildings: Buildings or homes that have been designed with interconnected electronic sensors and electrical systems which can be controlled by computers. Advantages include the ability to turn appliances and systems on or off remotely or on a set schedule, leading to greatly enhanced energy efficiency.

Smart Grid: The use of computers to monitor and improve the efficiency of distribution systems for electricity. Components may include remote sensors, automated controls and integrated communications between various parties on the grid. The intent is to eliminate brown outs and better anticipate and deliver power.

Smart Meter: High-tech electric meters that relay information to electricity providers on a continual basis, showing the amount of power being used by a consumer or business. The intent is to better inform consumers about their usage, while enabling electricity providers to charge higher fees during times of the day when usage is higher across its entire distribution network. The theory is that higher fees during peak times and better informed consumers will lead to lower peak loads.

Software as a Service (SaaS): Refers to the practice of providing users with software applications that are hosted on remote servers and accessed via the Internet. Excellent examples include the CRM (Customer Relationship Management) software provided in SaaS format by Salesforce. An earlier technology that operated in a similar, but less sophisticated, manner was called ASP or Application Service Provider.

Solar Energy: Energy produced from the sun's radiation for the purposes of heating or electric generation. Also, see "Photovoltaic (PV) Cell," "Concentrated Solar Power (CSP)" and "Passive Solar."

Solar Thermal Collector: A device designed to receive solar radiation and convert it into thermal energy. Normally, a solar thermal collector includes a frame, glazing and an absorber, together with the appropriate insulation. The heat collected by the solar thermal collector may be used immediately or stored for later use. Typical use is in solar hot water heating systems. Also, see "Passive Solar" and "Concentrated Solar Power (CSP)."

Solar Tower: See "Concentrated Solar Power (CSP)."

Sonic Amplitude Log: A well log that uses sound attenuation to detect fractures in a formation.

Sonic Log: A sonic, or acoustic, log records the travel time of a compression wave through a well and surrounding formation, providing data useful in calculating porosity and aiding lithology-related analysis.

Sour Crude: Crude oil that has more than 0.5% sulfur content. Sour crude is more expensive to refine, thus making it less desirable.

Spot Price: The price for a one-time market transaction for immediate delivery to the specific location where the commodity is purchased "on the spot," at current market rates.

Standard Cubic Foot (SCF): A regulated measure of natural gas volumes, based on a standardized surface temperature of 60 degrees Fahrenheit and surface pressure of 14.65 psi.

Steam-Electric Plant (Conventional): A plant in which the prime mover is a steam turbine. The steam used to drive the turbine is produced in a boiler where fossil fuels are burned.

Stratigraphic Column: Shows the vertical composition of successive strata, or rock layers, in a given formation.

Stripper Oil Well: A well that produces no more than 10 barrels of oil per day, making it barely profitable.

Structural Map: A contour map detailing elevations of sub-surface rock layers, calibrated either in linear measure of feet or meters, or in time measure based on seismic surveys.

Subsea Completion: A finished well, including casing and wellhead components, in which the wellhead equipment is installed on the bottom of the ocean.

Subsidiary, Wholly-Owned: A company that is wholly controlled by another company through stock ownership.

Substation: Facility equipment that switches, changes or regulates electric voltage.

Sucker-Rod Pumping System: An artificial lift method in which a surface pump drives a sucker-rod pump at the bottom of the well in order to recover additional oil. See "Hydraulic Pump."

Superconductivity: The ability of a material to act as a conductor for electricity without the gradual loss of electricity over distance (due to resistance) that is normally associated with electric transmission. There are two types of superconductivity. "Low-temperature" superconductivity (LTS) requires that transmission cable be cooled to -418 degrees Fahrenheit. Newer technologies are creating a so-called "high-temperature" superconductivity (HTS) that requires cooling to a much warmer -351 degrees Fahrenheit.

Supply Chain: The complete set of suppliers of goods and services required for a company to operate its business. For example, a manufacturer's supply chain may include providers of raw materials, components, custom-made parts and packaging materials.

Sweet Crude: Crude oil that has less than 0.5% sulfur content. Sweet crude is less expensive to refine, thus making it more desirable.

Switching Station: Facility equipment used to tie together two or more electric circuits through switches. The switches are selectively arranged to permit a circuit to be disconnected, or to change the electric connection between the circuits.

Syngas: The synthetic creation of gas to be used as a fuel, typically from coal. See "Gasification."

System (Electric): See "Transmission System (Electric)."

Take-or-Pay Contract: An agreement, generally long-term, whereby a gas purchaser (such as a pipeline transmission company) agrees to purchase a minimum annual amount of gas from the producer or pays the producer for the minimum amount, even if no gas is physically transferred.

Tank Farm: An installation used by gathering and trunk pipeline companies, crude oil producers and terminal operators to store crude oil.

Tar Sands: Sands that contain bitumen, which is a tar-like oil substance that can be processed and refined into a synthetic light oil. Typically, tar sands are mined from vast open pits where deposits are softened with blasts of steam. They are produced by injecting steam in the wells and then pumping out melted bitumen. The Athabasca sands in Alberta, Canada and the Orinoco sands in Venezuela contain vast amounts of tar sands. The Athabasca sands are now producing commercially in high volume. Also known as oil sands.

Tax Royalty Participation Contract: See "Concession Agreement."

Tertiary Recovery: Methods used to increase production from oil fields. Tertiary methods may include the injection of CO2, steam injection, or the use of special chemicals. Often, such methods are used in existing fields where production has started to decline under normal production. Other recovery stages are defined as "primary" which is a field that flows normally with little additional effort, and "secondary" which often involves waterflooding.

Thermal Breeder Reactor (TBR): See "Breeder Reactor."

Thorium: See "Breeder Reactor."

Time Slice: A flat section generated from a 3-D seismic survey, establishing the relative position of various seismic reflectors at a specific time.

Time to Depth Conversion: A translation process to recalibrate seismic records from time measures in millisecond units to linear measures of depth in feet or meters.

Tokamak: A reactor used in nuclear fusion in which a spiral magnetic field inside doughnut-shaped tube is used to confine high temperature plasma produced during fusion. See "Nuclear Fusion."

Toluene: A basic aromatic compound derived from petroleum. It is the most common hydrocarbon purchased for use in increasing octane. Toluene is also used to produce phenol and TNT.

Train: A gasification plant for liquid natural gas (LNG).

Transformer: An electrical device for changing the voltage of an alternating current.

Transmission (Electricity): The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers or delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.

Transmission System (Electric): An interconnected group of electric transmission lines and associated equipment for moving or transferring electric energy in bulk between points of supply and points at which it is transformed for delivery to consumers or delivered to other electric systems.

True Vertical Depth (TVD): The depth of a given point in a well when measured straight down from horizontal, disregarding inclination of the borehole.

Tubing Head: A flanged fitting made of forged or cast steel set at the top of the wellhead to support the tubing string in the well and to seal off pressure between the exterior casing and the interior tubing.

Tubing Packer: A piece of equipment that temporarily seals off the space between the casing and tubing inside an oil or gas well.

Turbine: A machine for generating rotary mechanical power from the energy of a stream of fluid (such as water, steam or hot gas). Turbines convert the kinetic energy of fluids to mechanical energy through the principles of impulse and reaction or a mixture of the two.

Ultimate Oil Recovery: The total amount of oil that can be recovered from a reservoir using primary, secondary (including waterflood) and tertiary enhanced recovery techniques.

Ultradeepwater Well: An offshore well drilled in more than 5,000 feet of water depth.

Unfinished Oils: All oils that require further processing, except those requiring only mechanical blending.

Upstream: The segment of the oil and gas industry focused on the initial phases of production (i.e., finding a prospect, drilling, producing and maintaining the well). Upstream is one of the three major segments of this industry: upstream, midstream and downstream.

Uranium: A heavy, naturally radioactive, metallic element (atomic number 92). Its two principally occurring isotopes are uranium-235 and uranium-238. Uranium-235 is indispensable to the nuclear industry, because it is the only isotope existing in nature to any appreciable extent that is fissionable by thermal neutrons. Uranium-238 is also important, because it absorbs neutrons to produce a radioactive isotope that subsequently decays to plutonium-239, another isotope that is fissionable by thermal neutrons.

Value Added Tax (VAT): A tax that imposes a levy on businesses at every stage of manufacturing based on the value it adds to a product. Each business in the supply chain pays its own VAT and is subsequently repaid by the next link down the chain; hence, a VAT is ultimately paid by the consumer, being the last link in the supply chain, making it comparable to a sales tax. Generally, VAT only applies to goods bought for consumption within a given country; export goods are exempt from VAT, and purchasers from other countries taking goods back home may apply for a VAT refund.

Velocity Analysis: The coordinated measurement of seismic data from one source with multiple receivers at varied distances in order to compute seismic velocity through different portions of a formation.

Vertical Integration: A business model in which one company owns many (or all) of the means of production of the many goods that comprise its product line. For example, founder Henry Ford designed Ford Motor Company's early River Rogue plant so that coal, iron ore and other needed raw materials arrived at one end of the plant and were processed into steel, which was then converted on-site into finished components. At the final stage of the plant, completed automobiles were assembled.

Vertical Seismic Profiling (VSP): A method used to measure seismic velocities of various strata in a well. It utilizes a seismic source positioned at the surface and a borehole instrument that records measurements at specific depths. Also see "Seismic."

VSC: Voltage Source Converters.

Waste Energy (Waste-to-Energy): The use of garbage, biogases, industrial steam, sewerage gas or industrial, agricultural and urban refuse (“biomass”) as a fuel or power source used in turning turbines to generate electricity or as a method of providing heat.

Waterflood: Techniques that involve the injection of water into an underproducing or depleted reservoir in order to move oil toward producing wells.

Watt (Electric): The electrical unit of power equal to the power dissipated by a current of one ampere flowing across a resistance of one ohm.

Watt (Thermal): A unit of power in the metric system, expressed in terms of energy per second, equal to the work done at a rate of one joule per second.

Watthour (Wh): An electrical energy unit equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour.

Well: A hole drilled in the Earth for the purpose of finding or producing crude oil or natural gas or for providing services related to the production of crude oil or natural gas. Wells are classified as oil wells, gas wells, dry holes, stratigraphic test wells or service wells. The latter two types of wells are counted for Federal Reporting System data reporting. Oil wells, gas wells and dry holes are classified as exploratory wells or development wells. Exploratory wells are subclassified as new-pool wildcats, deeper-pool tests, shallow-pool tests and outpost (extension) tests. Well classifications reflect the status of wells after drilling has been completed.

Well Log: An individual or composite record of survey activity relating to a given well. See "Logging (Wireline)."

Well Servicing Unit: Truck-mounted equipment generally used for downhole services after a well is drilled. Services include well completions and recompletions, maintenance, repairs, workovers and well plugging and abandonments. Jobs range from minor operations, such as pulling the rods and rod pumps out of an oil well, to major workovers, such as milling out and repairing collapsed casing. Well depth and characteristics determine the type of equipment used.

Well Shooting: A method of depth measurement in which a sensor is propelled down a well to transmit seismic waves back to the surface.

Well Stimulation: Methods, such as hydraulic fracturing, which increase permeability of a reservoir and increase flow to producing wells.

Wellhead: The point at which the crude oil (and/or natural gas) exits the ground. Following historical precedent, the volume and price for crude oil production are labeled as wellhead, even though the cost and volume are now generally measured at the lease boundary. In the context of domestic crude price data, the term wellhead is the generic term used to reference the production site or lease property.

West Texas Intermediate (WTI): A light, sweet crude oil against which other crude oils (such as Brent and Dubai) are priced.

Wheeling Service: The movement of electricity from one system to another over transmission facilities of intervening systems. Wheeling service contracts can be established between two or more systems.

Wide Angle Azimuth (WAZ): A method of seismic data acquisition that utilizes a large range of short to long seismic source positions. It is often used in conjunction with 3D and subsea seismic projects. Also see "Seismic."

Wildcat: An exploration well, usually drilled to a reservoir from which no oil or gas has been produced previously.

Wind Energy: Energy present in wind motion that can be converted to mechanical energy for driving pumps, mills and electric power generators. Wind pushes against sails, vanes or blades radiating from a central rotating shaft.

Wind Turbine: A system in which blades (windmills) collect wind power to propel a turbine that generates electricity.

Wireless Sensor Network (WSN): Consists of a grouping of remote sensors that transmit data wirelessly to a receiver that is collecting data into a database. Special controls may alert the network's manager to changes in the environment, traffic or hazardous conditions. Long-term collection of data from remote sensors can be used to establish patterns and make predictions. The use of WSNs is growing rapidly, in such applications as environmental monitoring, agriculture, military intelligence, surveillance, factory automation, home automation and traffic control.

Wireline (in oil field services): See "Logging (Wireline)."

Working Interest (WI): An interest resulting from an oil and gas lease, by which the working-interest owner is entitled to a certain percentage of revenues from production. For example, a 100% working interest entitles the working-interest owner to exclusively explore for oil and gas in a tract of land, while also paying 100% of the cost of oil or gas production.

World Trade Organization (WTO): One of the only globally active international organizations dealing with the trade rules between nations. Its goal is to assist the free flow of trade goods, ensuring a smooth, predictable supply of goods to help raise the quality of life of member citizens. Members form consensus decisions that are then ratified by their respective parliaments. The WTO's conflict resolution process generally emphasizes interpreting existing commitments and agreements, and discovers how to ensure trade policies to conform to those agreements, with the ultimate aim of avoiding military or political conflict.

WTI: See "West Texas Intermediate (WTI)."

WTO: See "World Trade Organization (WTO)."

Xylene: An aromatic hydrocarbon commonly used as an industrial solvent. It is also used in producing aviation fuel, resins, and dyes.

ZigBee: May become the ultimate wireless control system for home and office lighting and entertainment systems. The ZigBee Alliance is an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked monitoring and control products based on an open global standard, 802.15.4 entertainment systems.

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