

Horizontal Drilling and Hydraulic Fracturing – Is This the Cure to our Energy Dependency?

By Ryan M. Hanna, Vice President and Investment Officer, 617-441-1497

Technological advancements are dramatically altering the energy industry. The deployment of hydraulic fracturing (fracking) and horizontal drilling has resulted in an increase in domestic energy production since 2005 and has the potential to provide ongoing long-term economic and geopolitical benefits for the U. S. over the next decade and beyond. These benefits include a resurgence in U.S. manufacturing activity and the creation of hundreds of thousands of new jobs across a wide range of economic sectors. In addition there is the potential for lower energy and power prices, less dependency on foreign sources of oil, and a subsequent reduction in our country's trade deficit as we import less crude oil and petroleum products in the future. As the U.S. power industry converts coal power generation plants to cleaner burning natural gas plants, carbon dioxide emissions will be reduced. Notwithstanding these benefits, the industry and the regulators will need to address environmental concerns, such as the proximity of drinking water supplies, the consumption of water in the fracking process and the disposal of spent fluids.

As discussed in the March 2011 Cambridge Trust Company publication titled "Unrest in the Middle East and Factors Impacting Investment Strategy," our domestic economy and the global economy have been pressured from an escalation in oil prices because of factors mainly outside of our control. Elevated oil prices have been driven by ongoing political concerns in the Middle East, limited spare capacity from

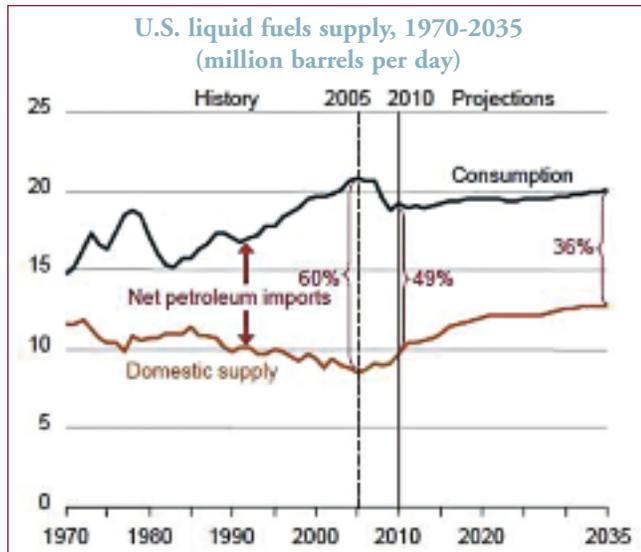
OPEC nations (except Saudi Arabia), and growing demand from emerging economies like China and India. In 2011 during the uprising in the Middle East and the fall of Muammar el-Qaddafi in Libya, approximately 1.4 million barrels of oil (1-2% of global supply) were removed from the global market causing oil prices to rise, and illustrating that our domestic energy markets remain tied to events halfway across the globe. These ever present factors, combined with Iranian threats to block oil shipments from flowing through the Strait of Hormuz, where almost 30% of globally traded oil traverses on a daily basis, have all contributed to the recent rise in West Texas Intermediate (WTI) oil prices approaching \$110 per barrel and Brent oil prices nearing \$125 per barrel. These issues prove that the United States needs to reduce its dependence on foreign sources of energy.

The United States is at a critical juncture in its quest towards energy independence. The last time the U.S. achieved energy independence was in 1952. While it still imported some petroleum that year, the country's energy exports, including coal, more than offset its imports. For the past fifty years, dating back to the days of the Nixon Administration, there have been calls to reduce America's dependency on foreign oil and the unstable and sometimes unfriendly governments that provide this energy. As indicated in **Figure 1**, net imports of crude oil peaked in 2005 at slightly more than 12.5 million barrels per day. This figure represents approximately 60% of total petroleum

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Figure 1

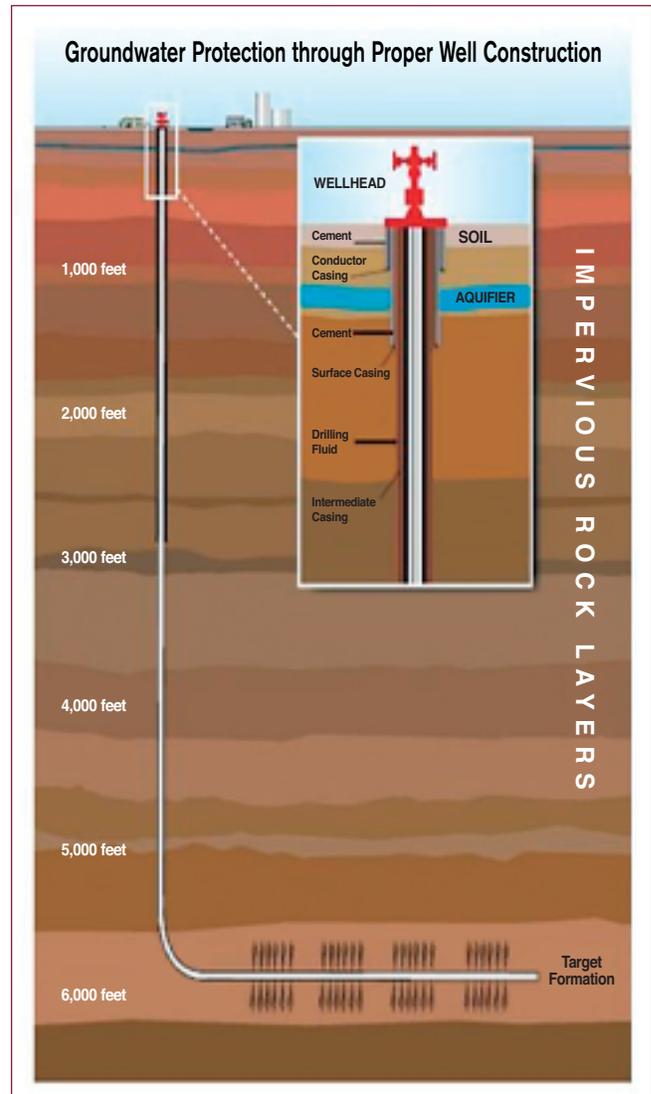


Source: U.S. Energy Information Administration

products consumed in the United States that year; 40.7% of imports came from OPEC nations, of which, 17% came from Persian Gulf countries. Canada and Mexico, combined, represented 30.6% of net imports in 2005.¹

Around 2005 an interesting technology began to develop, one that was put in motion back in the 1980's by an oil tycoon named George P. Mitchell. Mitchell spent most of his post-World War II career as the CEO of Mitchell Energy & Development Corporation, a company that was acquired by Devon Energy in 2001 for \$3.5 billion. Encouraged by a provision inserted in the 1980 Windfall Oil Profits Tax bill to encourage drilling for unconventional natural gas, Mitchell spent more than 15 years experimenting with different drilling techniques and methods before making a major technological breakthrough. This new technology involved the combination of horizontal drilling and hydraulic fracturing, which made it possible to produce gas economically from shale rock formations. Starting in 2005, this transformative method of drilling and well stimulation began to change the landscape of domestic energy production, and potentially, the future of U.S. energy supplies.

Figure 2



Source: www.energytomorrow.org

Horizontal Drilling & Hydraulic Fracturing (Figure 2)

Hydraulic fracturing has been utilized for more than 60 years and more than one million wells have used this technique to effectively drill for natural gas. Fracking is not a new phenomenon.

Hydraulic fracturing is a well stimulation technique used in tight oil and tight gas bearing formations in order to release and extract hydrocarbons from these low-porosity and low-permeability rocks. The process involves the pressurized injection of fluid, commonly made up of water, sand, and

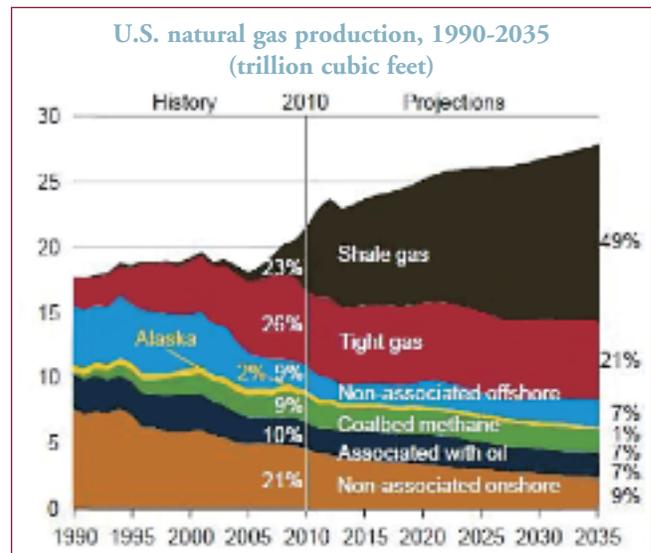
Horizontal Drilling and Hydraulic Fracturing – Is This the Cure to our Energy Dependency? *(continued)*

chemical additives, into a geologic formation. During the drilling process, there are many steps taken prior to the actual fracking of a well. These include the vertical drilling of the well bore, inserting steel tubing down into the well bore and then effectively and safely layering cement to provide barriers that will prevent hydrocarbon from leaking into ground water. Drilling companies use more than three million pounds of steel casing and cement to provide barriers that measure more than ten inches wide, equal to an armored door of a bank vault. This barrier serves to shield underground aquifers and is intended to prevent contamination of any ground water. After the casing is complete, the drilling process continues until approximately 500 feet above the shale rock formation. At this point the drill bit is turned at a 90 degree angle and *horizontal drilling* starts. This directional drilling technique, sometimes extending for a mile or more through the richest layer of rock, allows for greater accessibility to the shale formation. Once the hole is drilled and the steel and cement casings are completed, the fracking process begins. In essence, the pressure from this artificial stimulation exceeds the rock strength and the fluid opens or enlarges fractures in the rock. As the formation is fractured and the fluid is injected, proppants (mainly remnants from the sand injection) serve to hold the fractures in the shale rock open, allowing the hydrocarbons to flow into the well formation. The actual fracturing of the rock takes place 6,000 feet or more below the ground surface, well below most underground aquifers that reside between 500-800 feet below the surface.

The United States has vast reserves of natural gas that are commercially viable as a result of advances in horizontal drilling and hydraulic fracturing, which allow greater access to gas and other liquid shale formations. The Energy Information Association (EIA) estimates 860 trillion cubic feet of “technically recoverable” U.S. shale gas, which would give the U.S. 40 years of gas consumption at current rates.² As seen in **Figure 3**, shale gas production stands to increase from 5.0 trillion cubic feet in 2010 (23% of total U.S. dry gas production) to 13.6 trillion cubic feet in 2035 (49% of total U.S. dry gas production). Consequently, the role of natural gas is likely to expand because the supply is domestic and abundant. Also the increase in production outlook has enhanced the possibilities to substitute natural gas for oil and coal in the electricity, industrial, and transportation sectors.

These dynamics are already beginning to have a positive effect on the U.S. manufacturing sector of the economy. Quoting

Figure 3



Source: U.S. Energy Information Administration

an International Strategy & Investment (ISI) presentation titled *Investing in US Manufacturing Renaissance*, “U.S. manufacturing is benefitting from a host of long-term competitive advantages, including: restrained labor costs, big Emerging Market wage increases, low dollar, low natural gas prices, and abundant domestic supply. Among the direct consequences should be stronger capital expenditures and exports, restrained imports, more domestic and foreign investment in the US, and stronger manufacturing employment.”³ This follows another report from PricewaterhouseCoopers that the abundance of shale gas resources may spark a manufacturing renaissance, potentially adding 1 million jobs, an estimated \$11.6 billion in cost savings and greater investment in U.S. plants.⁴ Furthermore, according to a Bloomberg report, “the industrial heartland of America is humming with jobs again as a region once left for dead recovers faster than the rest of the U.S.”⁵ Over the past six months, the list of chemical and manufacturing companies that have announced building new plants or reopening mothballed plants is growing. For example, Potash Corporation of Saskatchewan announced it will be restarting an ammonia plant, which was closed in 2003. Royal Dutch Shell announced a new chemical plant to make ethylene and petrochemicals. Dow Chemical plans to open a new ethylene and propylene plant and restart a Louisiana ethylene cracker that was closed in 2009. Nucor Corporation is building a \$750 million factory to convert natural gas and iron ore

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The New Hampshire Advantage and More

By Susan Martore-Baker, President, Cambridge Trust Company of New Hampshire, 603-369-5101

When people hear about the “New Hampshire Advantage” they might think about asset protection or Dynasty trusts, or the myriad of sweeping trust legislation that has made the Granite State attractive for wealthy families in their trust and estate planning. Much has been written by legal experts and others about these trust laws, and the benefits of establishing or moving a trust to New Hampshire. As introduced in the Winter 2011 TrustLetter, this article will highlight and briefly review just a few of the advantages New Hampshire and Cambridge Trust Company of New Hampshire have to offer.

The benefits of New Hampshire’s laws are available to both residents and non-residents. As one of the leading states in which to administer and manage trusts, New Hampshire enables a donor or settlor (that is, the person who creates a trust) greater flexibility in creating a trust that suits his or her particular goals and wishes. In addition, those laws often make New Hampshire an attractive state into which to move an existing trust. Some of the key aspects of New Hampshire’s trust laws include:

- **Directed Trusts.** New Hampshire law allows for investment and administrative responsibilities to be divided between trustees. For example, the trust can provide for one trustee to have the exclusive duty to invest the trust assets while another trustee is responsible for other aspects of trust administration, such as distributing income or making discretionary decisions.
- **Dynasty Trusts.** New Hampshire law allows an individual to create a trust that continues in perpetuity. Thus, an individual may create a multi-generational trust or a trust for a particular purpose and the trust need not terminate within a specific time frame or someone’s lifetime. This is not the situation in most states which require that a trust terminate within a specific number of years or a life in being, known as the rule against perpetuities.
- **Wealth Preservation Trusts.** New Hampshire law allows for the creation of wealth preservation trusts (also called asset protection trusts), which provide significant protections of trust assets against a settlor’s creditors. The creation of this type of trust involves careful planning to meet the requirements set forth in the law.
- **Trust Protectors and Trust Advisors.** New Hampshire law recognizes trust protectors and trust advisors who can

oversee or advise the trustees or investment managers. These added personal advocates can provide significant assistance to a financial advisor.

- **Decanting.** New Hampshire law allows decanting, a process by which a trustee creates a new trust and transfers assets from the old trust to the new trust. Most typically, a trustee would exercise the power to decant for purposes of improving the administrative provisions governing the trust. For example, by today’s standards, some older trusts have inflexible, restrictive, or ambiguous provisions governing investments, distributions, or trustee succession, which can make decanting an attractive option in an otherwise irrevocable trust. A trustee is not required to seek a court’s approval to decant a trust since this is a statutory power.
- **Efficient Administration.** New Hampshire’s laws facilitate the efficient administration of trusts. Through concepts like virtual representation, which allow certain beneficiaries to represent the interests of other beneficiaries, and non-judicial settlement agreements, trustees often can resolve administrative issues—such as the interpretation of ambiguous trust provisions or confirming the scope or propriety of the trustee’s actions—without having to seek court involvement. Non-judicial settlement agreements can save time and legal expense.
- **State Tax Advantages.** New Hampshire does not impose any capital gains or other income tax on trusts where the beneficiaries are not New Hampshire residents. These tax savings can be tremendously beneficial. For non-New Hampshire residents a New Hampshire trustee, whether individual or corporate, is required.

The purpose of the “Trust Modernization and Competitiveness Act of 2006” was “to establish New Hampshire as the best and most attractive legal environment in the nation for trust and trust services.”¹ The legislation provided the framework to put New Hampshire on the trust map, but its uniqueness as a state makes its attractiveness as a trust situs even more powerful. According to studies by Ross Gittell, at the University of New Hampshire Whittemore School of Business and Economics, New Hampshire boasts one of the strongest state economies in the nation. It has a skilled workforce and is attractive to well educated workers,

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The New Hampshire Advantage and More *(continued)*

families, entrepreneurs, and tourists.² New Hampshire is the second healthiest state³ as well as the most livable state⁴ with access to highly-ranked medical facilities and the arts. The data is irrefutable when it comes to New Hampshire's advantage as it pertains to a quality of life.

Cambridge Trust Company of New Hampshire proactively supports clients with their trust administration and estate planning issues. The commitment to work with clients face-to-face and keep their best interests as our priority surpasses the mere financial benefits of creating a trust in New Hampshire or moving a trust to New Hampshire. For more

than a century, Cambridge Trust has been helping individuals and families with their trust needs. For more than a decade we have been working in New Hampshire to expand that expertise in the Granite State. Cambridge Trust Company of New Hampshire formed Cambridge Trust Company of New Hampshire, Inc., which is a New Hampshire non-depository trust company. Through this subsidiary Cambridge Trust Company is qualified to serve as trustee to meet our clients' needs and take advantage of New Hampshire's beneficial trust and tax laws.

The New Hampshire Advantage- it is all of this and more.

¹ TMCA, §1, II.

² Ross Gittell, James R Carter Professor, UNH, *New Hampshire Outlook for Estate Planning*, May 2011 presentation to the NH Estate Planning Council.

³ United Health Foundation

⁴ CQ Press

Todd Mayo *Advantages of New Hampshire Trusts, Specialty Trusts for the Well-Rounded Practitioner*, New Hampshire Bar Association May 20, 2011
Joseph F. McDonald, III, *Migrating Trusts to New Hampshire: The "Why" and "How,"* New Hampshire Bar Journal, Winter 2010

Cambridge Trust Profile

Susan Martore-Baker

President, Cambridge Trust Company of New Hampshire

Wealth Management recently welcomed Susan Martore-Baker as President of Cambridge Trust Company of New Hampshire and Senior Vice President of Cambridge Trust Company in Cambridge, Massachusetts. Susan directs business development and leads our wealth management efforts in New Hampshire.

With more than thirty years of trust and investment experience, Susan is recognized throughout New Hampshire for her work with individuals, corporations, charitable organizations, and municipalities. Prior to joining Cambridge Trust Company of New Hampshire, she was a Senior Vice President at Citizens Bank where she managed the New Hampshire market and provided comprehensive wealth management solutions to high net worth individuals and families. She previously held positions at Shawmut Bank, First NH Investment Services, U.S. Trust (formerly State Street Global Advisors), and CFX Bank.

Active in the New Hampshire community, Susan serves as Vice President of the Nashua Symphony Orchestra, is a member of the American Lung Association Advisory Board in New Hampshire, the New Hampshire Bankers Trust Committee and the Manchester Region Advisory Board of the New Hampshire Charitable Foundation.

Susan earned a BA in Business from Furman University in Greenville, South Carolina and her MBA from Southern New Hampshire University. She currently resides in Bedford, New Hampshire with her husband, Steven, and has two children.



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pellets into iron in Louisiana. Methanex Corp., the world's largest methanol maker, is dismantling a factory in Chile and will reassemble it in Louisiana to take advantage of low natural gas prices.

As this form of combined drilling technology expands from shale gas to tight oil basins, where activity is ramping up in areas like the Bakken Shale in North Dakota and the Eagle Ford Shale in South Texas, we expect natural gas liquids (liquid byproducts from natural gas such as ethane, propane, butane, and isobutane) and petroleum production to continue to increase as well. As noted by the chairman of IHS Cambridge Energy Research Associates, Daniel Yergin, U.S. crude oil output has risen by 18% since 2008 and the reason is the sudden appearance of tight oil. Tight oil represented about 3% of total output in 2000, or 200,000 barrels per day. Today it is about 1 million barrels per day and by the end of the decade it could reach 3 million barrels per day.⁶ Trends are improving as domestic production grows and the need to import oil from OPEC countries will be less (currently supplying 4.2m barrels per day, the lowest levels since 1996). Decreased amounts of imported oil would also have a positive effect on reducing a portion of the United States trade deficit. "With the price of oil at about \$100, a drop of 4 million barrels a day in oil imports would shave \$145 billion off the deficit."⁷ According to the Commerce Department, through November 2011, the trade gap was \$513 billion.

While there are economic benefits to using these drilling and extraction technologies, there are also safety and environmental concerns, which have been the subject of much discussion. Responsible development of America's unconventional resources is essential if natural gas is to play a larger role in our nation's clean energy future. According to a report published by MIT, the environmental impacts of shale developments are challenging but manageable. Research and regulation, both state and Federal, are needed to minimize the environmental consequences.⁸ As a beginning, more transparent disclosure rules of the chemicals that compose the fracking fluid is necessary. Some energy companies are voluntarily disclosing the contents of the fracking fluid, while others have resisted making full disclosure. Range Resources has voluntarily been making this disclosure since 2010. Starting February 1, 2012, drilling operators in Texas began reporting many of the chemicals used in fracking wells.⁹ More regulation will occur in the future.

One of the environmental concerns is the amount of water needed to frack a well because fracking a well requires 1

million to 5 million gallons of water. Mike Hightower, a researcher hired by the U.S. Energy Department for a 2006 study, estimated that water used by energy companies will almost quadruple to as much as 15 billion gallons each day by 2035, from 4.3 billion gallons in 1995.¹⁰ Yet a study prepared for the Texas Water Development Board suggested that less than 1 percent of water used statewide went into fracking, and according to Dan Hardin, the Water Board's Resources Planning Director, water use for fracking was not expected to exceed 2% of the statewide total by 2020.¹¹

Individual states have taken the initiative to institute policies that specifically address the environmental issues of drilling and fracturing. In West Virginia the House of Delegates passed a bill that covers drilling in the Marcellus Shale by a 92-5 vote and the State Senate then passed it unanimously. Specifically, the bill stipulates that new wells must be drilled at least 250 feet from any water well and 300 feet from natural trout streams. Wells must also be kept 625 feet from occupied homes and 1,000 feet from public water supplies. Since 2010, New York State has imposed a moratorium on all drilling. However, Governor Andrew Cuomo's stance has softened recently as more stringent rules, similar to West Virginia, are being drafted. Released for public comments in September, the proposal would prohibit drilling within 2,000 feet of public drinking water supplies or 500 feet of the state's 18 primary aquifers. Joe Martens, the NY Commissioner of Environmental Conservation said "our most conservative estimate is that we could add more than 13,000 jobs, direct and indirect. The higher estimate is nearly 54,000 jobs."¹²

Additional environmental concerns are the disposal and storage of wastewater upon completion of a fracturing job. One method of wastewater disposal is the injection of water into the subsurface which has the potential to activate faults and cause earthquakes. A string of nine earthquakes over an eight month span in Ohio last year brought this potential hazard to light. There have been many acknowledged cases of seismic activity associated with well operations (not just through employing fracking) dating back more than 70 years; earthquakes were reported in the Permian Basin in Texas back in the early 1960's and throughout other active drilling areas in Canada, Oklahoma, Ohio, and New Mexico over many years. When considered in the context of the magnitude of the quakes, this level of seismic activity registers as relatively minor in nature. A research report published by Bernstein, sourcing Caltech and the U.S. Geologic Service, estimates that earthquakes measuring a magnitude of 4-4.9 on the Richter Scale routinely occur once every hour. On a slightly lower level, magnitude 3-3.9 earthquakes happen on a

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frequency of 15 per hour.¹³ Regulatory oversight to ensure that disposal wells are properly sited away from fault lines could potentially reduce the risk of greater magnitude earthquakes as a result of wastewater disposal.

Wastewater storage from fracturing is also a concern. Poorly managed wastewater “pits” have the potential to contaminate drinking-water supplies if not properly designed and monitored. These pits store the flowback water until it is recycled, disposed, or re-injected into the ground. In December, the Environmental Protection Agency issued a draft report that found chemicals in gas wells may have contaminated a shallow water aquifer in Pavillion, Wyoming. The report cites “at least 33 surface pits previously used for storage/disposal of drilling wastes” had contaminated nearby groundwater.¹⁴ Greater regulation regarding the design and location of these disposal sites, combined with ongoing oversight may have prevented these poorly designed storage sites from contaminating drinking water aquifers.

Over the past fifty years there has not been any significant and meaningful energy policy from Washington, D.C. leaving the United States with little clarity to meet the nation’s long-term energy needs. This lack of policies has made the U.S. and the economy vulnerable to higher and more volatile oil prices as the U. S. has remained dependent on imports of almost 8.5 million barrels of oil per day (most

recessions over the past 40 years have been preceded by a spike in oil prices). As noted by President Barack Obama in his most recent State of the Union address, an “all-of-the-above” strategy that develops every available source of American energy should be considered, including deepwater, tight oil and gas reserves. This strategy, combined with ongoing investments in renewable fuel sources such as wind, solar and nuclear energy, may help with a long-term solution. Alternative energy sources carry risks as well. Following the nuclear disaster at the Fukushima Power Plant in Japan last year, the world was reminded of the significant risks associated with nuclear power. German Chancellor Angela Merkel subsequently endorsed a plan to end all nuclear power generation in Germany by the year 2022. It would stand to reason that the reduction of nuclear power in these two major economies will need to be replaced by other sources, placing an additional burden on an already stretched oil market. It is not unreasonable to think that within the next 5-10 years, the United States could be operating from a position of greater economic strength as a result of a reduction in dependence on energy imports and a revival in manufacturing. As with any transformative technology, there are risks associated with hydraulic fracturing, but the rewards appear to be even more significant.

¹ U.S. Energy Information Administration/Monthly Energy Review February 2012, Petroleum Trade: Overview

² “Prepare for a golden age of gas”, [The Financial Times](#) February 21, 2012

³ “Investing in US Manufacturing Renaissance”, ISI – International Strategy & Investment March 5, 2012

⁴ “Abundance of shale gas resources may spark manufacturing renaissance in US” PricewaterhouseCoopers, December 15, 2011

⁵ “U.S. Midwest Jobs Return as Applesauce Joins Cars to Life Obama”, [Bloomberg](#) January 30, 2012

⁶ “America’s New Energy Security”, [Wall Street Journal](#) December 12, 2011

⁷ “Americans Gaining Energy Independence with U.S. as Top Producer”, [Bloomberg](#) February 6, 2012

⁸ MIT Study, “The Future of Natural Gas,” Abstract, June 9, 2011, <http://web.mit.edu/mitei/research/studies/natural-gas-2011.shtm/#introduction>

⁹ “Unlocking the Secrets Behind Hydraulic Fracturing” [The New York Times](#) January 14, 2012

¹⁰ “Dark Side of Fracking Makes Heckmann Bid Target for Oil Services” [Bloomberg](#) December 13, 2011

¹¹ “Unlocking the Secrets Behind Hydraulic Fracturing” [The New York Times](#) January 14, 2012

¹² “Shale-Gas Reserves Have Potential to Reignite U.S. Economy” [Bloomberg](#) November 3, 2011

¹³ “Bernstein Commodities & Power: Frack-Induced Earthquakes – A Tale of Shaking and Fury, Signifying Nothing”, Bernstein Research; January 6, 2012

¹⁴ “Phony fracking fears for NY” [New York Post](#) December 14, 2011

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