SIGNATUREFD

HARNESSING THE POWER OF NATURAL GAS

A SIGNATUREFD WHITEPAPER

abstract

Recent developments in the natural gas industry in the U.S., particularly the increase in hydraulic fracturing (or "fracking") have created both opportunity and controversy. We believe newly discovered natural gas reserves in the U.S. can help reduce our country's dependence on foreign oil, lower energy prices for consumers and businesses, and create jobs. At the same time, we must use caution and common sense as we pursue these new energy resources, balancing our need for additional fossil fuels with appropriate regulation and a long-term focus on developing cleaner energy solutions.

For at least a decade, SignatureFD has been an active investor in the real asset markets, which generally include commodities, real estate and energy. Client portfolios have consistently had a meaningful allocation to this asset class with a focus on both the public and private markets. The dramatic developments over the past several years mean that it is now a very interesting time to share the current state of the U.S. natural gas market. Consider the following energy market dynamics:

- The U.S. currently has 92 years of natural gas based on current consumption rates.[1]
- Oil, which traded at 6 to 12 times natural gas for most of the 1990s and 2000s, was trading in excess of 50 times the price of natural gas this past April.[2]
- Nuclear remains an option in the U.S., yet natural gas trades for $2.77/MMBtu as of September 1, 2012.[3]

THE NATURAL RESOURCES (BOTH FOSSIL FUELS AND CLEAN WATER) WE POSSESS ARE GAME CHANGERS THAT MAY ULTIMATELY IMPROVE AMERICAN LIVES AND CREATE ABUNDANT OPPORTUNITIES FOR INVESTORS.

- Japan is seeking to eliminate nuclear power by 2030, which has driven the cost of natural gas to $17/MMBtu.[4] Double-digit prices for natural gas are fairly common elsewhere around the globe.
- Of all electricity sources, natural gas accounted for 40% of net capacity additions during the past five years for which data are available (2006–2010). Notably, wind generated half of the new capacity.[5]

What the above figures all have in common is that they show the profound impact natural gas is having throughout the energy markets. We expect far-reaching implications for numerous groups including investors, consumers and regulators. This report will explain the recent developments in natural gas within the United States, describe the impacts of these developments and touch on our outlook for shale gas outside the United States. The U.S. has an abundance of natural gas and is the leader in oil and gas technology. We must be good stewards of our fossil fuel assets as well as our country's environmental assets. The natural resources (both fossil fuels and clean water) we possess are game changers that may ultimately improve American lives and create abundant opportunities for investors.

NATURAL GAS BASICS AND RECENT DEVELOPMENTS

Before going into the developments in natural gas outlined above, we must understand some basic information about the resource. "Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane… Natural gas is found in deep underground natural rock formations or associated with other hydrocarbon reservoirs."[6] Compared to other fossil fuels its "clean burning properties have contributed to an increase in natural gas use for electricity generation and as a transportation fuel for fleet vehicles in the United States," according to U.S. Energy Information Agency (EIA).[3] The EIA also notes that natural gas:

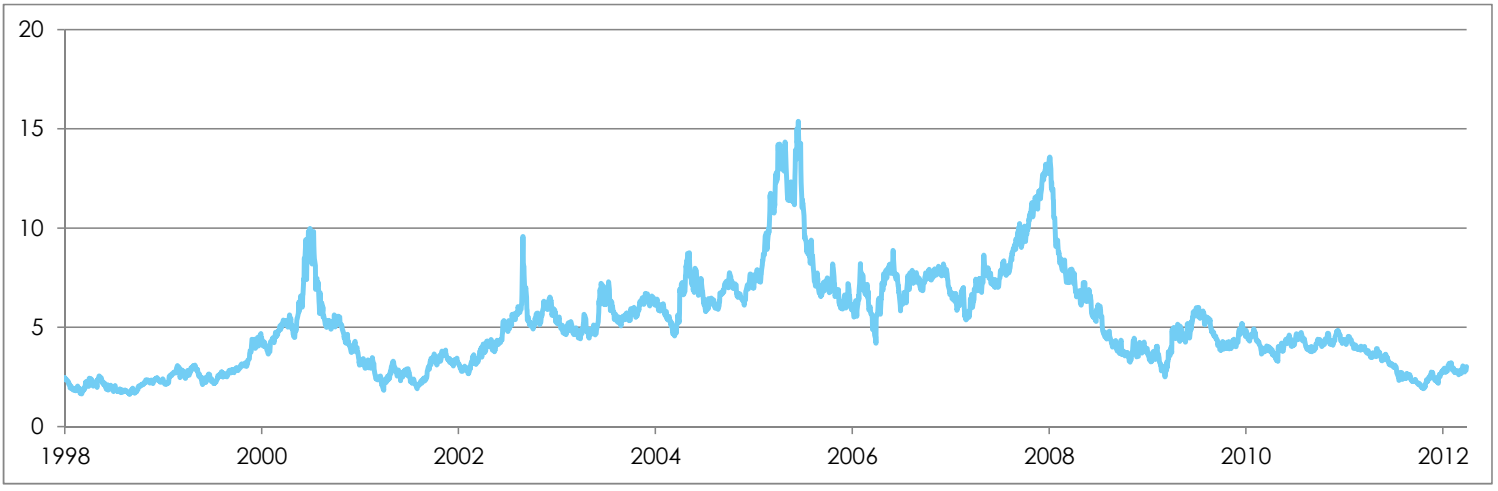
- Produced about a quarter of the energy used in the United States in 2011
- Heats slightly more than half the homes in the United States
- Is used to produce steel, glass, paper, clothing, brick and electricity
- Is an essential raw material for paints, fertilizers, plastics, antifreeze, dyes, photographic film, medicines and explosives

A RECENT HISTORY OF NATURAL GAS

In the early part of this century, natural gas was expensive because of significant supply constraints. In 2001, the situation became so dire that the U.S. government began forgiving royalty payments to encourage exploration in less competitive areas, such as deep wells in the Gulf of Mexico.[7] As shown in the chart below, starting in 2002 already volatile natural gas prices generally increased until 2009. The following quote from a *Wall Street Journal* story in 2004 was fairly typical at that time: "After decades of being cheap and plentiful…U.S. natural gas is the most expensive in the industrialized world, averaging $5.50 per million BTUs for the past year."[8] That all changed in the middle part of last decade as shale gas emerged and prices started to fall.[3]

Henry Hub Gulf Coast Natural Gas Spot Price

Dollars/Mil. BTUs

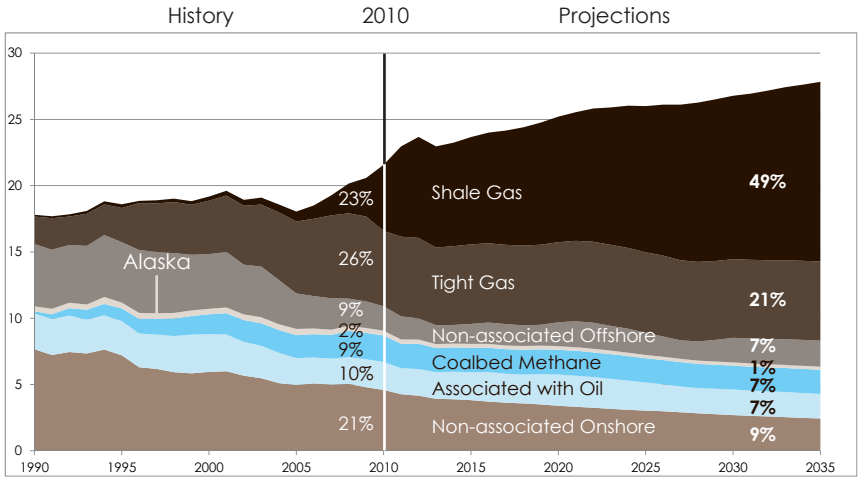


THE SHALE GALE

The key reason that natural gas prices rose in the middle of last decade and then fell can be seen in the figure below, which illustrates natural gas reserves in the United States. If you exclude shale gas (dark brown), it is evident that our supplies of natural gas would decline. If not for shale gas discoveries and our ability to access them (the "shale gale"), we would likely import significant amounts of natural gas from elsewhere in the world.

U.S. Natural Gas Production, 1990-2035

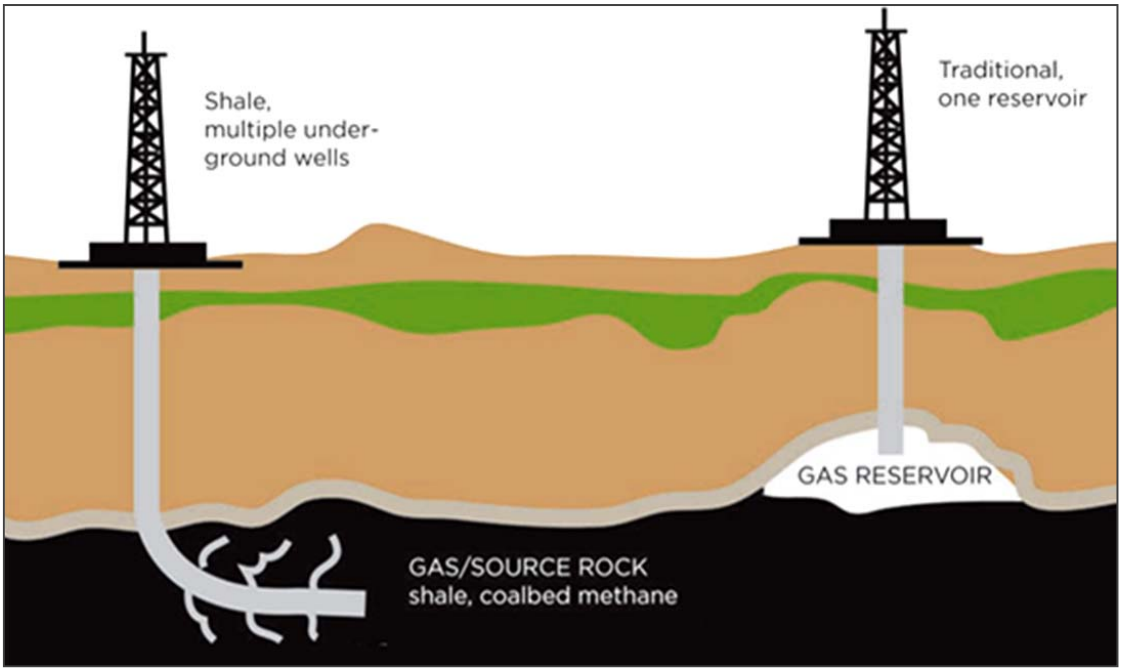
trillion cubic feet



Source: U.S. Energy Information Administration, AEO2012 Early Release Overview, January 23, 2012.

SHALE GALE AND HORIZONTAL FRACTURING BASICS

Before moving on to the impacts of shale gas, we want to review the processes used in horizontal drilling and hydraulic fracturing (also known as fracking). The diagram below shows the difference between traditional drilling and horizontal fracking.



Source: Fairway Annual Investor Report 2010

In basic terms, fracking involves pumping fluids deep into the earth to cause oil and gas to rise to the surface. Technology has advanced to the point where multiple horizontal holes can be drilled thousands of feet beneath the surface. Once the holes are drilled horizontally, water, sand and chemicals can be pumped through cemented pipes at high pressure into the shale. This process creates fissures in the rock formation that enable natural gas to flow to the surface. For a general overview of the process, please see the following video: Hydraulic Fracturing. Fracking creates environmental and regulatory concerns that we will cover later.

HISTORY OF FRACKING

After being discovered early last century, conventional fracking oil and gas wells grew in the late 1940s, according to a report from the Energy Institute at the University of Texas. The report indicates that, "since its initiation, hydraulic fracturing has been used to stimulate approximately a million oil and gas wells."[9] Devon Energy was a pioneer in the actual technique of horizontal fracking. In *The Quest*, a comprehensive book on energy-related topics, Pulitzer Prize-winning author Daniel Yergin reviews fracking's history. He notes that Devon benefitted from the strategic acquisition of Mitchell Energy, a company it purchased for $3.5 billion in 2001. Yergin describes how Devon combined its horizontal drilling expertise with the fracking expertise of Mitchell Energy. Prior to its sale to Devon, Mitchell had spent two decades working on fracking shale

SURPLUS GAS IS CURRENTLY BEING BURNED OR "FLARED" AS THERE IS NO DEMAND FOR IT AND NO PLACE TO STORE IT.

formations for natural gas and "absolutely no one believed that shale drilling worked other than Mitchell and us," according to Devon's CEO Larry Nichols.[10]

SHALE GAS IMPACTS

Now that we have reviewed natural gas and touched on how fracking works, we want to share our thoughts on the implications of America's newfound natural gas abundance.

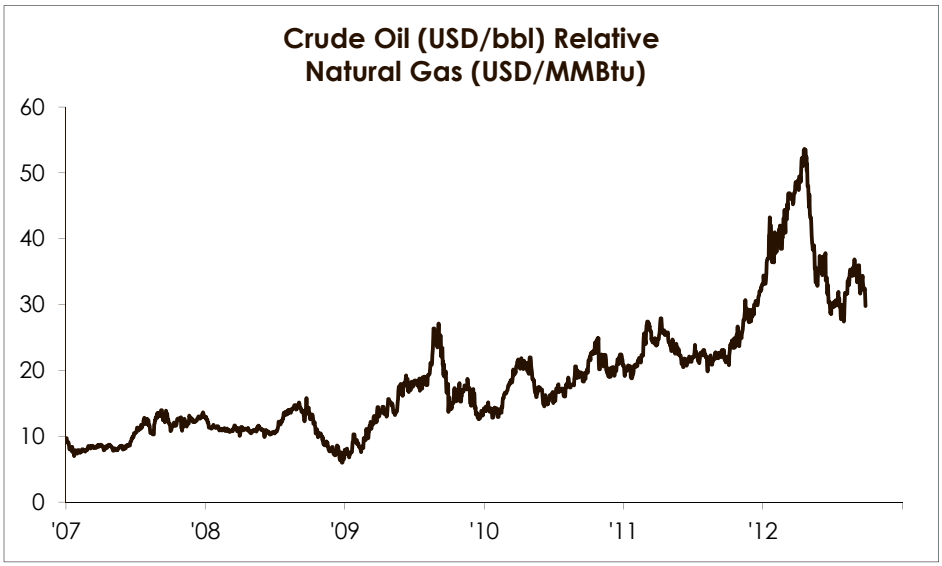
SHALE GAS IMPACT: EXCESS SUPPLY

Between 2000 and 2010, shale gas went from being an insignificant natural gas source to 23% of our reserves. By 2035, shale gas is expected to represent 49% of our reserves. The proliferation of drilling techniques is transforming the country from an importer into a potential exporter of natural gas. Many in the industry are projecting the U.S. will export natural gas by converting to liquid and shipping it around the world. The pipelines and liquefied natural gas (LNG) infrastructure necessary to export natural gas will take years to complete. In the meantime, we have an unexpected gas surplus. As such, inventory (i.e., supply) at the end of March 2012 was by far the highest on record for that time of year.[11] In the near term, we do not have enough storage for our natural gas, and in states like North Dakota we lack the pipelines to move the gas to where it is needed. As a result, surplus gas is currently being burned or "flared" as there is no demand for it and no place to store it.

SHALE GAS IMPACT: LOW PRICES

A logical impact of excess natural gas, of which only a finite amount can be stored, is lower prices. As we saw earlier, natural gas prices recently reached decade lows. Meanwhile, many other energy sources, including oil, have experienced dramatic price spikes. As shown by the blue line in the table on the following page, the historic link between oil and natural gas prices is separating. It was not uncommon during most of the 1990s for nine units of

natural gas to equal one unit of oil. This created a historic gas to oil ratio of 9:1. That ratio increased during the past five years and peaked at over 50:1. As oil prices have fallen and natural gas prices have crept up, that ratio has since retreated to roughly 30: 1, which is still abnormally higher than the trend. We believe this gap will remain persistently high for several years. We have been looking to identify investment opportunities where the market does not appreciate the shift from oil to gas. The continuing low prices for natural gas leads to key implications we describe next.



Source: Strategas

IMPLICATIONS OF SHALE GAS FOR THE U.S.

In the prior section, we reviewed the impact of excess natural gas supply, which has largely increased demand and lower prices. In this section, we will cover the implications for the United States. At the most basic level, an excess supply of natural gas leading to prolonged low prices generates positive tailwinds for U.S. citizens, companies and the federal government in terms of improved manufacturing competitiveness, energy security and employment. Below, we outline the potential implications of shale gas in the U.S.

IMPLICATION OF SHALE GAS: U.S. MANUFACTURING RENAISSANCE

Several trusted research providers are discussing an improved picture for U.S. manufacturing. Various companies are bringing jobs back to the U.S. as the costs of doing business abroad rise, while the benefits of operating in the U.S. have increased. Research firm GaveKal recently noted that the cost of energy had been roughly the same across the globe for the first 60 years after WWII (i.e., until 2005). Ever since 2005, the U.S. has enjoyed a cost advantage due to excess natural gas and GaveKal expects energy costs will continue to diverge. With land and labor relatively stable around the world, energy divergence becomes a key factor. GaveKal sees the U.S. receiving much more capital investment and a stronger dollar.[12]

Here are a few notes on planned expansion based on low natural gas prices and high supply. Shell plans to build a $4 billion facility to refine liquid natural gas into various components including plastics.[13] Chemical companies are in expansion mode. "We have an unprecedented opportunity with shale gas to push the reset button on the U.S. energy economy," said Ken Bromfield, a Dow Chemical Executive. Mr. Bromfield added that the "industry has announced plans to build about $80 billion of projects in the next five years, as a result reasonably priced natural gas. Dow alone has announced $4 billion of new manufacturing projects."[14]

IMPLICATION OF SHALE GAS: ADDITIONAL JOBS

Another one of our trusted research providers, BCA, released a comprehensive report on the implications for shale oil and gas in the United States, and predicted several likely outcomes by the year 2020. As a result of shale, BCA believes the domestic economy should benefit, leading to additional GDP growth of 0.2%–0.3% per year and a stronger currency.[15] Considering that BCA, a Canadian firm with offices in five continents, does not have a U.S. bias, we find these figures and comments especially encouraging. Part of the improving GDP picture comes from more domestic jobs. Energy research firm IHS notes that in 2010, shale gas was responsible for over 600,000 jobs, while in 2011 shale jobs represented 9% of jobs created in the country.[16, 17]

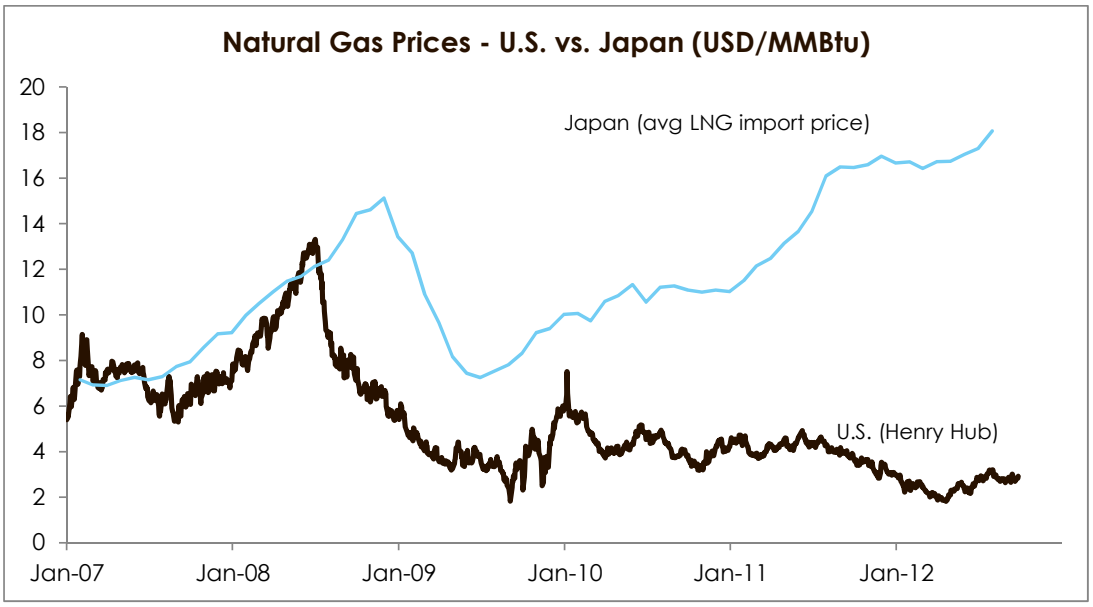
UNLIKE NUCLEAR AND COAL, WHICH HAVE A POOR IMAGE, NATURAL GAS IS SEEN AS A CLEANER ENERGY.

In addition to inherent job creation, BCA research believes that "promoting the natural gas industry may become the next politically acceptable 'stimulus program.'"[15] Both political parties want job creation and these types of jobs also generate additional tax revenue. Moreover, unlike nuclear and coal, which have a poor image, natural gas is seen as a cleaner energy.

IMPLICATION OF SHALE GAS: ENERGY SECURITY

At a time when defense spending is on the chopping block in most budget discussions, a smaller U.S. military presence in the Middle East could ultimately be realized. BCA predicts that the U.S. may significantly reduce oil imports from the Middle East. This would be a major victory as currently the U.S. spends significant defense resources patrolling the Strait of Hormuz, which transports about 20% of the world's oil.[18] The U.S. actually imports more oil from politically risky countries such as Venezuela, Russia, Nigeria, Angola and Ecuador than it does from the Middle East.[15] If the U.S. successfully transitions to importing less fuel from hostile partners, this would be welcome news. Expropriation of energy assets is happening in some of these unstable countries. During a two-week period earlier this year, we saw two Latin American governments nationalize foreign-held subsidiaries. In one case, Red Electrica, a Spanish electricity operator, saw its Bolivian subsidiary seized by armed troops.

While the U.S. is currently a net liquefied natural gas importer, we believe the potential exists to become the world's largest natural gas exporter. Bank Credit Analyst believes, "There is room to accommodate both rising domestic natural gas demand and liquid natural gas exports."[15] Jason Trennert of Strategas Research Partners, who recently visited our office, puts it a little more bluntly: "With natural gas prices hovering around $2 in the U.S. and LNG prices of $17 in the world's third-largest economy, Japan, the market's invisible hand is screaming for domestic production of natural gas for export."[18] The chart on the following page illustrates the price divergence of natural gas between Japan and the U.S.



Source: Strategas

Daniel Yergin notes that, "The major arguments in favor of domestic oil and gas production have mainly been about energy security and balance of payments. But now this surge is recognized as an engine of economic growth."[20] Our next section focuses on the growth manifested through increased demand.

RISING DEMAND

Considering current excess inventories and large supplies of natural gas for decades to come, demand should rise for natural gas in several areas. Some of this excess supply either is or will be soaked up by fleet vehicles, LNG exports, utilities converting from coal to gas power, and increased manufacturing activity in the U.S. LNG export infrastructure is currently being developed. Over a dozen facilities are on the drawing board or are set to expand between now and the end of this decade. These new export facilities would be able to transport 19 billion cubic feet per day of natural gas.[21] In terms of coal to gas conversion, a record 57 coal generators will be turned off this year.[22]

While infrastructure challenges for natural gas-powered vehicles (NGVs) will take time to address, change is happening. For example, 22 states are currently trying to buy compressed natural gas vehicles for their governments.[23] T. Boone Pickens, who is pushing the transition to natural gas vehicles, recently estimated that just switching large trucks to natural gas would reduce our oil imports from OPEC by 70%.[24]

Current statistics show:

- There are about 120,000 NGVs on U.S. roads today and more than 15.2 million worldwide.[25]
- In the U.S. alone, NGVs offset the use of nearly 360 million gallons of gasoline in 2011.[25]
- According to the American Public Transit Association, nearly one-fifth of all transit buses were run by compressed natural gas (CNG) or liquid natural gas (LNG) in 2011.[25]
- The fastest-growing NGV segment is waste collection and transfer vehicles. Almost 40% of the trash trucks purchased in 2011 were natural gas powered.[25]

SHALE'S PROSPECTS OUTSIDE THE UNITED STATES

A fair question to ask when considering the future of natural gas is whether or not countries outside the U.S. can replicate what we are doing. Other countries would likely need to demonstrate the desire, have the right geology and possess

INDUSTRY OFFICIALS NEED TO TAKE THE LEAD ON PROMOTING BEST PRACTICES AS THEY MAY UNDERSTAND SAFETY BETTER THAN THE REGULATING BODIES.

the knowledge similar to that of the U.S. Research firm GaveKal notes that governments around the world have been increasing energy prices by speculating unsuccessfully on nuclear, coal and wind. Meanwhile, the private sector in the U.S. has determined the direction of energy in the U.S. by investing in fracking.

In looking at the geology for shale natural gas in Europe, there are structural reasons that those countries are highly unlikely to experience the same benefits. Europe's "geology is less favorable; its shale deposits tend to be deeper underground and harder to extract."[26] In addition, the U.S. has regulatory advantages for developers, wells that are cheaper by a factor of over three, and perhaps most importantly, investors and landowners, not governments that own many of the mineral rights which encourage development. The "not in my back yard" (NIMBY) voices can be loud and take center stage when governments own the mineral rights as in Europe.

While we expect to see other countries, such as China and Poland, expand their use of fracking, the U.S. has a head start, while many other countries lack the infrastructure, technology and gas reserves of the U.S.

CAVEATS AND COMMENTS ON THE REGULATORY CLIMATE AND THE ENVIRONMENT

Before concluding this paper, we would like to introduce caveats to the discussion and share our thoughts on the regulatory landscape while addressing environmental concerns.

The main caveat we would stress is that horizontal fracking and completion technology is still in the early implementation stage. Modern fracking techniques have existed for a number of years but have improved recently. The technology and water advantages enjoyed by the U.S. are significant.

However, technology changes quickly, additional discoveries are made frequently and the environmental impact is an evolving story.

ENVIRONMENTAL CONCERNS

The next topics we want to cover are the regulatory environment and the environmental impact of horizontal drilling and fracturing. A few videos and documentaries have become popular which report that fracking and other natural gas activities are responsible for gas leaking into water wells and waterlines. The EIA's website contains details on the environmental concerns, which can be summarized as follows:

1. The fracturing of wells requires large amounts of water. In some areas of the country, significant use of water for shale gas production may affect the availability of water for other uses and can affect aquatic habitats.[27]
2. Fracturing produces large amounts of wastewater, which may contain dissolved chemicals and other contaminants requiring treatment before disposal or reuse. Because of the quantities of water used and the complexities inherent in treating some of the wastewater components, treatment and disposal is an important and challenging issue.[27]
3. If mismanaged, hydraulic fracturing fluid can be released by spills, leaks, faulty well construction or other exposure pathways. Any such releases can contaminate surrounding areas.[27]
4. According to the United States Geological Survey, hydraulic fracturing causes small earthquakes, though these are almost always too small to be a safety concern.[27]

GREEN TECHNOLOGY HOLDS PROMISE. OVER TIME, WE HOPE IT WILL BECOME ECONOMICALLY VIABLE IN VARIOUS ENERGY SOURCES AND INDUSTRIES.

Here is our assessment of the risks put forth by the EIA.

WATER CONCERNS

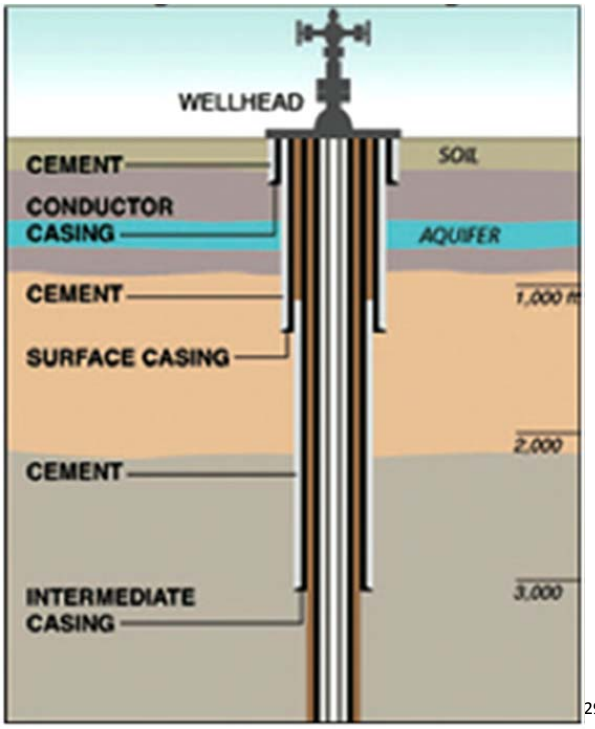
Water use and abuse is an issue and one that may become more important over time, especially if the natural gas industry does not come up with solutions. "The drilling and hydraulic fracturing of a horizontal shale gas well may typically require 2 to 4 million gallons of water, with about 3 million gallons being most common."[28] Many emerging areas for oil and natural gas are scrambling to establish regulations for the new technologies. If natural gas companies ramp up water use and water-saving technologies do not keep pace, water wars are a potential outcome.

A related concern is the amount of wastewater created during the fracturing process. Much of the water used in fracking appears to be plentiful in the United States, especially where it is needed. While the U.S. appears to have more available water than other countries, we have a responsibility to use all resources wisely. Fortunately, we are also seeing the growing use of recycled water and efforts to reduce overall water use.

FRACKING FLUID ENVIRONMENTAL CONCERNS

The safe use of fracking fluid, like water, is a real issue and one that many states are addressing. Fracking fluid is the liquid that goes through the pipes, often containing chemicals, sand and water. A few states are playing catch up as they write regulations from scratch, having had no prior oil and gas activity. Other states have banned fracking. We think the oil and gas industry could do more to police themselves and take the lead on improving regulations. Initially, companies refused to publicly release information about the chemicals being pumped underground, insisting that the chemical compositions were a trade secret. Since then, the mindset has changed and publishing fluid content on the Internet is becoming commonplace.

Future areas we would like industry officials to address are poor well casing and ground water contamination. The illustration below demonstrates how wells should be constructed when traveling through aquifers.



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In the process of inserting and cementing pipes through aquifers, the potential exists for cracks to develop, which can allow leaks into the water table. We believe one case of this happening is one too many. Industry officials need to take the lead on promoting best practices as they may understand safety better than the regulating bodies.

An additional concern is surface water contamination that occurs from spilling fracking fluid on the ground. As part of our oversight process of existing investments, we have visited fracking sites in Texas and Ohio. The procedures and safeguards have been impressive. However, the reality is that when proper industry and regulatory procedures are not followed, accidents can occur. We feel that stiff penalties need to be imposed in the rare occasion when an accident happens.

EARTHQUAKE CONCERNS

In terms of earthquakes, Bill Ellsworth, the Lead Geologist of the U.S. Geological Survey said, "We don't see any connection

between fracking and earthquakes of any concern to society."[30] Mr. Ellsworth conceded that a link exists between the "disposal of waste water and earthquakes,"[30] but he adds, "There are straightforward fixes to the problems when earthquakes begin to occur."[30] Our research indicates that others are reaching the same conclusion. Well-respected news organiziations such as *The Economist* have published numerous articles that touch on earthquakes. Research is ongoing but thus far, the articles have not expressed any meaningful concern about the danger the earthquakes pose.

THE FUTURE OF GREEN TECHNOLOGY

As we consider where we go from here, moving to green technology should be our long-term goal. With wind as the number-one source for new energy in the past five years, evidence exists that renewables can be the solution. However, the shift to green energy will not happen overnight. We think the auto industry holds some interesting lessons on the time it takes for green technology to develop and the important role of fossil fuels. Toyota's Prius is now profitable but according to a recent article, "GM is still losing as much as $49,000"[31] for every Chevy Volt it builds. Other pure-electric cars have posted disappointing sales figures as well. For example, the Nissan Leaf and the Mitsubishi i have sold 4,228 and 403 cars, respectively in 2012. The point here is that the Prius has taken years to catch on and it still uses fossil fuels. The Chevy Volt and other electric cars are years from profitability and are simply not in demand at this point.

Green technology holds promise. Over time, we hope it will become economically viable in various energy sources and industries. In the interim, however, fossil fuels are a bridge we can use. Among the fossil fuel choices, natural gas is generally cleaner, more abundant and less expensive than other options, such as coal. The potential rewards from natural gas appear to justify the apparent risks if proper industry and regulatory producers are implemented. The U.S. has a tremendous amount of natural gas and the technical expertise to extract it. If we use this natural surplus properly, the key implications for our country are job creation, inexpensive energy and less foreign debt.

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