Examining the Feasibility and Implications of US Energy Independence

When state-of-the-art technologies meet ancient rock formations, the results can be transformational.

An advanced ventilation system allowed the Holland Tunnel to be built on the bedrock of the Hudson River, connecting the island of Manhattan to the mainland. The construction of Hoover Dam across the Black Canyon harnessed the power of the Colorado River, thanks to innovative construction techniques that mitigated the intense heat generated by the curing concrete.

And today, advanced drilling and production technologies are unlocking energy reserves from deep beneath the Gulf of Mexico, and from previously impenetrable shale formations across the Lower 48 states. These advancements – and others – could transform the import-dependent United States into a more self-sufficient energy producer. In turn, greater US energy independence could significantly alter long-standing global relationships between the US and its historical energy suppliers.

Savvy investors across the world are looking ahead to the potential opportunities that could accompany a transformational change in the dynamics of US energy supply and demand. This paper will describe the feasibility of greater US energy independence and the implications for the economy. It will also highlight potential areas of opportunity for stock, bond and real estate investors to invest directly and indirectly in these trends.

Part 1: Setting the Stage
Part 2: Investment Opportunities
Part 1: Setting the Stage

The US energy industry is on the path to self-sufficiency. To reach full energy independence would require further technological innovation, a constructive regulatory environment, and major infrastructure investments. But even a partial move toward energy independence would supply a clear economic boost to the US.

How reliant is the US on energy imports today versus the past?

Shaia Hosseinzadeh: First, let’s look at natural gas. From the 1970s to the early part of this decade, US natural gas imports quintupled because US reserves were not being replenished at a sustainable rate while our consumption grew steadily. However, recent advancements in horizontal drilling and hydraulic fracturing have now commercialized an enormous source of oil and gas trapped in shale rocks.

To be sure, the US has gone from a position of resource constraint to one of great abundance. Shale gas production has increased a staggering 45% annually since 2007 and currently accounts for over one-third of total production in the US. By the end of this decade, the US Energy Information Administration (EIA) estimates that the US will derive more than half of its natural gas production from domestic shale formations.

Already, shale has had a dramatic impact on US gas supply, and the US is no longer reliant on imports of natural gas. In fact, most of our import terminals are in the process of being reconfigured for export capability, and the US is well on its way to becoming a net exporter of natural gas.

Shale has also impacted US oil supply. Since the onset of the shale revolution, the US and Canada together are now estimated to control the third-largest oil reserves in the world.

It seems clear that the US is becoming more energy self-sufficient than it’s been in the past. But is it feasible that the US could become completely energy independent in the foreseeable future?

Shaia Hosseinzadeh: The commercialization of tight oil in the US, together with the proliferation of Canadian oil sands production, has had the effect of significantly increasing the overall production of crude oil in North America. According to the EIA, the US is now the second-largest oil producer just behind Saudi Arabia.
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The US is Gradually Closing the Gap Between Oil Consumption and Production

US total oil consumption and production, 1980-2012

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption (Low)</th>
<th>Consumption (High)</th>
<th>Production (Low)</th>
<th>Production (High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>15,231</td>
<td>11,192</td>
<td>11,124</td>
<td>8,317</td>
</tr>
<tr>
<td>1984</td>
<td>20,802</td>
<td>11,192</td>
<td>18,555</td>
<td>11,124</td>
</tr>
<tr>
<td>1988</td>
<td>20,802</td>
<td>11,192</td>
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<td>1992</td>
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<td>18,555</td>
<td>11,124</td>
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<tr>
<td>1996</td>
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<tr>
<td>2000</td>
<td>20,802</td>
<td>11,192</td>
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<tr>
<td>2004</td>
<td>20,802</td>
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<td>18,555</td>
<td>11,124</td>
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<td>2008</td>
<td>20,802</td>
<td>11,192</td>
<td>18,555</td>
<td>11,124</td>
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<tr>
<td>2012</td>
<td>20,802</td>
<td>11,192</td>
<td>18,555</td>
<td>11,124</td>
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</tbody>
</table>

Source: EIA, May 2013

However, our primary dependence on imports today is on foreign oil. The question of whether – or more importantly when – the US becomes energy independent depends largely on how quickly the mix of fossil fuel consumption in the US evolves to align with the production mix. Because of the shales, for the first time in history the US has over 100 years of clean, reliable low-cost natural gas supply. By comparison, natural gas accounts for only one-third of total US fossil fuel consumption, with coal and oil making up most of the difference. Yet, gas is a good substitute for both in a number of applications, ranging from power production to transportation. If the first chapter in the shale story was about supply growth, the next chapter will be about consumption rebalancing. That rebalancing is now underway with the construction of gas-fired power plants, the retirement of older coal plants and the conversion of trucking fleets and eventually the railroads to run on natural gas.

This is an area where policy can play a constructive role – by creating monetary or other fiscal incentives that encourage the consumption of one fuel over another. Roughly 70% of the oil consumed domestically is used in transportation. Meanwhile fewer than 1% of all vehicles in the US run on natural gas.

Top Petroleum Importers to the United States: 2012

The US imported petroleum from about 80 countries in 2012

<table>
<thead>
<tr>
<th>Country</th>
<th>% Share of US Net Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>34%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>18%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>12%</td>
</tr>
<tr>
<td>Russia</td>
<td>10%</td>
</tr>
<tr>
<td>Mexico</td>
<td>6%</td>
</tr>
</tbody>
</table>

Source: EIA, June 2013. Includes crude oil, refined petroleum products like gasoline, and biofuels like ethanol and biodiesel.

Norman MacDonald: The US looks to be on a path toward energy independence, but one must be cautious on the growth expectations.

The unconventional onshore shale plays that are providing this growth will not continue at the rapid pace we have seen the past few years, and the infrastructure within the US will also be challenged from the liquids side to keep up with the pace of growth in the associated gas.

One wild card that may provide for improved energy efficiency may be found in the deepwater Gulf of Mexico, but this may require a longer cycle time to turn these reserves into production. Needless to say, the march toward relying less and less on foreign oil is getting easier.
The production drivers that will lead to increased energy independence include:

- Improved technology focusing on increased recovery of hydrocarbons.
- Good operating procedures to manage environmental concerns around fracking.
- Cooperation of capital markets, because the extraction of oil and gas is very capital intensive.
- A pragmatic government policy that doesn’t kill the goose that lays the golden egg and overtax or overregulate the opportunity.

What role are energy-efficient technologies playing in the marketplace?

**Shaia Hosseinizadeh:** Energy efficiency has played an important role in attenuating demand growth in the US, particularly during periods of high commodity prices. As gross domestic product (GDP) grows, and equally importantly, as the energy intensity of GDP shifts toward sectors like manufacturing, steel production, data servers and so on, our consumption of energy is unlikely to decrease with time in an absolute sense. The EIA projects that domestic energy consumption in British thermal unit (Btu) terms is expected to grow at an average rate of 0.6% through the end of the decade.

Nonetheless, federal and state policy can play an important role in helping to reduce the energy input content per unit of GDP output. A good example is in electricity generation, where new legislation is inducing utilities to switch from operating coal-fired generators to gas-fired generators. When you switch to a new combined cycle gas turbine that produces the same amount of electricity as a coal generator with 30% less fuel, you get a great deal of efficiency pick-up across grid with significantly less pollution, too.

**Norman MacDonald:** There is a lot of attention given to hybrid technologies. But before we think of hybrid engines replacing conventional engines, there is room for technology innovation of diesel engines and efficiency improvements in power train technology, which still bodes well for gasoline consumption at the right price. That said, there will be a substitution effect if the US cannot think of a way to get gasoline and diesel prices down to a level that the average consumer would equate to an “energy renaissance.” This will require a significant investment in downstream infrastructure so that refining capacity is added to increase gasoline and diesel yields.

Let’s explore the issue of infrastructure a bit further. What will it take to monetize new US energy supply?

**Norman MacDonald:** To make this push toward energy self-sufficiency would require a massive infrastructure investment. It would mean improving the design of pipelines and gathering systems, and additional refining capacity would have to be built for the long run. It will also require a big investment by the chemical companies to increase their capacity to turn natural gas liquids into petrochemical feedstock.

This infrastructure spend is a new phenomenon in the US since the country has been so used to gearing its pipeline and refining footprint based on importing crude and crude products into the country. The infrastructure boom should benefit the refining and pipeline companies initially, but longer term, the real prize in my eyes is the resurgence of a mini manufacturing boom for the chemical companies that can use low-cost ethylene and turn this into derivative plastic products. This would mean increased jobs and a better balance of payments on the margin for the government. That is the key: There would be a direct net benefit to the companies that spend this capital because it would guarantee low-cost feedstock for their manufacturing capabilities, which means this will not need to be government subsidized.

**Shaia Hosseinizadeh:** The shale revolution has not only changed the production of energy, but it also has profound effects on the transportation and distribution of that energy. In contrast to the past, the shale supply sources are not all located in the traditional energy hubs, nor are they all in close proximity to consuming markets. Therefore, hundreds of billions of dollars per year will be required to develop a new distribution network to process and transport that energy from the new producing hubs into the consuming hubs.
Secondarily, most of the oil production coming out of the Bakken and Eagle Ford shales is light, sweet crude. This creates its own set of challenges in terms of ensuring that our refinery infrastructure is adequately equipped to process that quality of crude.

Major Shale Plays in the Lower 48
This map illustrates the plays mentioned in this paper. It is not a comprehensive list of shale plays.

What about energy sources beyond oil and gas? Will solar, wind and other alternative sources play a larger role in the future?

Norman MacDonald: A lot of these technologies have their own unique challenges. One common challenge they all share is the reliance on government subsidies to justify continued investment, which may be threatened as government budgets continually tighten rather than expand. For example, I cannot see a circumstance where the government of California opens its purse strings more to the wind power companies.

<table>
<thead>
<tr>
<th>Renewables Comprise Less Than 10% of Total US Energy Usage</th>
<th>Consumption in quadrillion Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012</td>
</tr>
<tr>
<td>Hydroelectric Power</td>
<td>2.687</td>
</tr>
<tr>
<td>Wood Biomass</td>
<td>1.938</td>
</tr>
<tr>
<td>Wind</td>
<td>1.360</td>
</tr>
<tr>
<td>Ethanol</td>
<td>1.097</td>
</tr>
<tr>
<td>Waste Biomass</td>
<td>0.468</td>
</tr>
<tr>
<td>Solar</td>
<td>0.235</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0.227</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>0.115</td>
</tr>
<tr>
<td><strong>Total Renewable Consumption</strong></td>
<td><strong>8.13</strong></td>
</tr>
<tr>
<td><strong>Total Energy Consumption</strong></td>
<td><strong>95.10</strong></td>
</tr>
</tbody>
</table>

Source: EIA Short-Term Energy Outlook - October 2013
Shaia Hosseinzadeh: Between solar and wind, we feel that solar holds the greatest promise. In the past, the main problem with solar has been the prohibitively high initial cost of purchasing and installing the panels, which is typically borne by the consumer. Fortunately, as is the case with any technology-intensive process, the cost of producing the solar panels has been falling considerably, while the efficacy has increased. At the same time, several companies have begun to revolutionize the value proposition for customers by developing innovative ways to finance the upfront cost of purchasing and installing the panels.

What are the economic impacts of the US energy resurgence?
Shaia Hosseinzadeh: It’s been forecast that the US could produce 4 million more barrels of oil per day next year than it did in 2011. At a price of $100 per barrel, this would result in a roughly 1% boost to GDP. In addition, consumers’ discretionary income could increase as they pay less for energy to heat their homes, power their lights and run their cars. This extra spending power could boost the US economy by another 1%. And, finally, the increased sale of petroleum products and chemicals in the US and abroad would add to GDP as well. All together, these factors could result in an extra full year’s economic growth over the next few years – with no government expenditures or increased tax revenues.

Part 2: Investment Opportunities
When the energy industry is booming, it can affect everything from stocks to bonds to real estate demand. Where are the opportunities – and risks – for investors?

Where are the equity opportunities in and around the energy space?
Juan Hartsfield: From the perspective of US growth equities, much of the recent excitement in the energy patch has been around breakthroughs achieved in oil resource plays. One example is the Permian Basin, which was discovered in the 1920s and has produced over 29 billion barrels of oil and 75 trillion cubic feet of gas primarily through vertical wells. We’re just now starting to drill horizontal wells there in a meaningful way in 2013. The Permian possesses multi-stack reservoirs with hydrocarbon-bearing potential. However, most companies have only been targeting single reservoirs with horizontal wells. The exciting thing is that recently, there has been drilling of multiple wells in close proximity to one another, with the wells targeting different reservoirs and not experiencing communication between each other. This is significant, because the thought until recently was that wells close to one another would result in cannibalization of reserves instead of the capture of additional reserves. It’s a great opportunity for companies that own the right acreage within a particular play – it opens up decades of reserve potential, and companies can essentially double their money within the same section of land. Many of the stocks have significantly appreciated in value to reflect the optimism, but there’s a lot of opportunity yet to create value in unconventional resource oil plays over a longer-term investment horizon.

The oil that comes from the Permian and other reservoirs in the US is light, sweet crude oil. What’s significant about that is that back in the mid-2000s, North American refiners built coking facilities to refine the heavy, sour crudes that the US imports from abroad. Now, keep in mind that due to the Jones Act, the US cannot export crude (except to Canada) – it can only export refined products. So, unless investments are made to allow refineries to process more light, sweet crude, or unless the federal government passes a law that allows the US to export this crude, we could find ourselves in a situation where US supply is going to outweigh the available refining capacity. If that occurs, you’ll see the differentials start to widen between Brent crude, which comes from the UK’s North Sea, and crude oils that are linked to US prices, such as West Texas Intermediate (WTI). That would create a low input cost for the refiners and a high selling price for the refined products. So that’s potentially a very good position for them to be in. However, as the US builds out its infrastructure to address this situation, the Brent-WTI spread could collapse.
A particular focus area for my large-cap growth colleagues is the large engineering and construction firms that do business around the globe. In recent years, these firms have been more focused on the Middle East and Asia than they have on North America, but we believe that in the next three to four years, there will be a massive increase in capital expenditures in the petrochemical space that will keep these firms busy. While South Korean companies have historically been very aggressive in pricing on international petrochemical projects, we believe that knowledge of local regulations may give North American engineering and construction firms a bit of an advantage.

Other areas we’re watching include the growth of the liquefied natural gas (LNG) market globally. We’re probably two to three years away from the US becoming an LNG exporter, but that will have ramifications all along the value chain, from engineering and construction, to transportation, to trading. That’s a big opportunity there.

Also, deepwater drilling and production is a huge opportunity. The US has a terrific backlog of projects that have been explored and are now in the exploitation phase, so floating rigs are projected to increase over next several years.

**Norman MacDonald:** For my investment strategy that focuses exclusively on the energy space, the opportunity lies within several different subsectors. I own exploration companies in the Eagle Ford, Bakken, Permian and Marcellus, as they are proving to be the most prolific basins in the Lower 48. I also own some of the large, integrated companies that are exploiting big oil resources in the deepwater Gulf of Mexico. I have also taken a large position in the oil and gas service companies that are going to be net beneficiaries of this increased level of spending from the exploration and production companies. I view the service and equipment companies almost like technology and manufacturing stocks versus energy stocks. This theoretical secular theme could lead to a much higher valuation level in the stock market over time.

As energy companies issue debt to finance their projects, where are the fixed income opportunities?

**Scott Roberts:** For the last six years, we’ve helped finance companies that have developed the most prolific shale resources discovered so far. We were very active early on in providing financing for exploration companies in the Marcellus Shale, Haynesville Shale, Bakken and the Permian. We’ve helped service companies buy new drilling rigs, completion rigs, and workover rigs to help boost production. We have also been very active in investing in midstream companies that have been instrumental in helping production companies process their raw natural gas streams.

From the high yield perspective, the areas we find attractive are upstream onshore oil development, certain land-based service providers, and fee-based midstream processors. We generally avoid financing deepwater oil development for smaller operators as they do not have the financial resources to operate in this harsh environment.

Are there real estate opportunities related to the US energy boom?

**Paul Curbo:** Growing strength in the oil and gas industry may have positive implications for real estate markets that are in close proximity to energy centers. In energy hubs like Houston, which has long been home to major oil and gas companies, and Pittsburg, which is a newer energy center thanks to the nearby Marcellus Shale play, the local real estate markets are linked to the health of the energy sector. Housing in select North Dakota communities is in high demand with very little supply, and apartments and hotels are at peak capacity due to the influx of workers who are developing the Bakken Shale play. The markets with growing oil and gas infrastructure requirements will likely have long-term lasting positive impacts on communities as well as real estate values. Infrastructure projects can last several years, requiring growth in construction employment that can have a positive spillover effect to the broader economy.

As always, investors should remain mindful of increasing new commercial real estate construction, as this may tend to moderate the positive impact to local markets from increased energy demand and new energy infrastructure projects. While strong economic growth can be a positive for real estate fundamentals, creative real estate
developers will likely begin to increase construction to meet this demand. Careful monitoring of supply and demand conditions remains critical to understanding the pace of improvement in future real estate fundamentals in these energy markets.

A growing number of energy businesses are forming master limited partnerships (MLPs). Why is this structure appealing for these companies, and where are the opportunities and risks for investors?

Darin Turner: With a total market capitalization of approximately $450 billion, publicly traded energy MLPs have seen tremendous growth since first being defined by Congress in 1987. Due to the partnership structure, MLPs generally do not pay entity-level income taxes, and therefore provide a competitive advantage relative to a C Corporation (C-Corp) considering their tax-advantaged status. Recently, many energy companies have utilized MLPs for qualifying assets to capture the valuation difference between the two structures. Although the asset class has approximately doubled in size over the past three years, energy MLPs are still relatively underowned compared with more traditional investments. For investors, MLPs can offer many attractive characteristics including the potential for a competitive total return, a relatively high dividend yield, a possible hedge against inflation, and portfolio diversification. As with any industry that continues to grow and increase its overall profile, MLPs could become susceptible to higher correlations with the broader equity markets in addition to extra scrutiny from legislators.

The dynamics of energy supply and demand are global. What are some key examples of the ways that growing US energy production might affect global markets?

Joseph Tang: Assuming the US becomes energy independent, there would be two main impacts on economies in Asia. First, Japan and China are net importers of natural gas – usually from Australia, Southeast Asia and Middle Asia – and natural gas prices in Asia are much higher than in the US. If US can export LNG at a lower price, it will boost the gas consumption in countries like China, which is thirsty for clean energy. Second, with the rapid pickup in shale gas supply in the US dragging down US natural gas prices meaningfully, we see Asian oil-based chemical producers moving up the cost curve, while US gas-based producers are sliding down. Therefore, the US gas-based chemical producers may regain competitiveness in the global market. In terms of investment opportunities in Asia, we are positive on gas-related investment ideas in China, such as LNG tanker manufacturers, gas distributors, gas-based chemical producers, gas drilling service providers and fracturing equipment manufacturers.

Dean Newman: If the shale boom causes US gas prices to remain low, then rising US production could significantly impact the Mexican economy. There are a number of projects underway to improve the gas pipeline infrastructure between US and Mexico that should give Mexico greater access to the US gas supply. This could well mean cheaper electricity prices and also bring a positive stimulus for investment in the petrochemical industry in Mexico. Some people have estimated that if Mexico has reasonably open access to US gas, that could in the long run add two percentage points to Mexico’s GDP growth rate. It could also be a positive for companies that are involved in the construction and operation of these pipelines.

In a way, it’s rather an irony that Mexico might benefit from this oil and gas boom in the US when in reality, from a geological perspective, Mexico itself has significant potential reserves of shale gas and gas liquids. If there were an energy renaissance in Mexico, exploitation of those reserves could progress with the type of technology that’s fueling the boom in the US. But for that to happen, private capital needs to be allowed into the oil and gas sector through government reforms. That would be good for growth and investment, and could bring opportunities for companies involved in the petrochemical sector.
The potential growth scenarios in the US energy space look impressive. What are some of the risks?

Juan Hartsfield: Environmental issues are always in the background. Refineries and petrochemical companies must get permits in place for new projects, and so far this hasn't seemed to be an issue, but that doesn't mean it couldn't arise as an issue very quickly.

Also, engineering and construction firms are not talking about whether they'll get contracts or not, they're talking about whether they can find the craft labor to build them. So we're already talking about what the constraints could be and whether they have enough skilled welders, for example. Companies are trying to train people – they're going to high schools and promoting technical schools as a career option. But, if labor becomes a big issue, you could see projects costing twice as much as first thought and taking two years longer.

Finally, commodity price risk is an issue. Production doesn't occur in a vacuum, and if US crude oil production continues to increase at the same pace for the next several years, global supply will exceed demand, and oil prices will decline. Lower oil prices would reduce cash flows to the industry, giving companies less capital to deploy and sustain their growth. Barring external sources of financing, production growth would eventually slow.

Norman MacDonald: Regulation with respect to fracking is a big issue. The backlash against fracking, which initially stemmed from high-pressure lobbying from coal-heavy states such as West Virginia, has quieted down a bit due to a net jobs benefit. However, when you have an industry that can be potentially regulated by so many different government organizations at various levels – the Environmental Protection Agency, the county, the state or potentially even the federal government – it is a risk. When analyzing companies, I look for those using the best safety and environmental practices.

Energy markets are notoriously volatile. How do you navigate this space for your investors?

Shaia Hosseinzadeh: When investing in commodities, it is critical to start with a good understanding of the fundamentals, namely, supply and demand. Our experience shows that if you get the fundamentals correct to begin with, then volatility can be an advantage, providing discrete windows in the marketplace when risk is mispriced. It is often during these periods where one is able to find investments that offer attractive risk-reward.

As a private equity investor, we adhere to three simple rules. First, we look for low-cost producers that can sustain profitable production growth in a variety of commodity price settings. Second, we seek platforms with defensible balance sheets that have staying power through the cycle, or alternatively we seek to restructure the balance sheet with the objective of creating such an outcome. Last but not least, we look for exceptional management teams that are capable of building and growing world-class organizations.

Norman MacDonald: In the short term, the market can grossly underestimate the long-term value of a business – we stick to our discipline and think longer-term. I believe that's the best way to use volatility to our advantage and make good returns for shareholders. In my strategy, we seek companies that we believe have a margin of safety built in – whether it's from their assets or the structure of their balance sheets. I have personally visited all of the companies in my strategy, and believe their good-quality assets and good-quality balance sheets should help them weather whatever storm the financial markets bring.
About the contributors

Shaia D. Hosseinzadeh is a principal of WL Ross & Co. LLC. Mr. Hosseinzadeh is primarily responsible for originating, structuring and executing private equity transactions for WL Ross & Co. LLC. Mr. Hosseinzadeh has more than 13 years of experience in mergers and acquisitions, capital raises, and private equity investments. He has led or participated in more than 45 transactions with a combined aggregate value of over $35 billion.

Prior to joining WL Ross & Co. LLC, Mr. Hosseinzadeh was a principal with Apollo Investment Management, LP. Previously, Mr. Hosseinzadeh spent six years at Credit Suisse in the Investment Banking Division and in the Leveraged Finance Group. Mr. Hosseinzadeh earned his M.Sc. degree in economics and philosophy and his B.Sc. degree in economics from the London School of Economics & Political Science.

Norman MacDonald is a portfolio manager for energy and natural resources sector equity strategies in the US and Canada. Mr. MacDonald joined Invesco in 2008 as a portfolio manager for Invesco's Canadian-distributed sector mutual funds.

Mr. MacDonald began his investment career in 1994 at State Street Bank and Trust as a derivatives analyst. He later moved to Ontario Teachers' Pension Plan Board, where he worked for three years in progressive roles from research assistant to portfolio manager. His next role was as a vice president and partner at Beutel, Goodman & Co. Ltd. Prior to joining Invesco, Mr. MacDonald was a vice president and portfolio manager at Salida Capital Corp.

Mr. MacDonald earned a BComm degree from the University of Windsor and is a CFA charterholder.

Juan Hartsfield is a portfolio manager for Invesco small-cap core and small-cap growth products.

Prior to joining Invesco in 2004, Mr. Hartsfield was a portfolio manager with JPMorgan Fleming Asset Management, where he was involved with the management of various small-cap portfolios. Prior to joining JPMorgan, Mr. Hartsfield served as an associate with Booz Allen & Hamilton.

Mr. Hartsfield earned a BS degree in petroleum engineering from The University of Texas at Austin and an MBA from the University of Michigan. He is a CFA charterholder.

Scott Roberts is co-head of the High Yield team for Invesco Fixed Income. He is also a senior portfolio manager on the team and has analytical responsibilities for the chemicals, energy and utility areas.

Mr. Roberts joined Invesco in 2000 as a high yield analyst and was named portfolio manager in 2009. Previously, he was a high yield analyst and trader with Van Kampen Investment Advisory Corp. He entered the industry in 1995.

Mr. Roberts earned a BBA degree in finance from the University of Houston. He is a CFA charterholder.
Paul Curbo is a portfolio manager and member of the Real Estate Securities Portfolio Management and Research team with Invesco Real Estate.

Mr. Curbo entered the industry in 1993 and joined Invesco in 1998. Prior to assuming his current position, Mr. Curbo served as a senior research analyst in the real estate research group. He led one of Invesco's regional teams and directed the firm's research and strategy efforts in the western region of the US. Before joining Invesco, Mr. Curbo was a senior research associate with Security Capital Group, where he was responsible for analyzing multifamily, industrial and office real estate markets. He produced research on economic, demographic and real estate market information for Security Capital's affiliate companies. Mr. Curbo previously held a position with Texas Commerce Bank.

Mr. Curbo earned a BBA degree in finance from The University of Texas at Austin and has completed graduate coursework in economic theory and econometrics at The University of Texas at Dallas. He is a CFA charterholder.

Darin Turner is a portfolio manager and member of the Real Estate Securities Portfolio Management and Research team with Invesco Real Estate. His current duties involve evaluating structured real estate securities with a focus on fixed income instruments such as commercial mortgage-backed securities, corporate debt and corporate preferred stock. He also provides tenant and credit-quality analysis, capital-structure analysis and debt-pricing analysis for equity portfolios.

Mr. Turner joined Invesco in 2005 as an acquisitions analyst for direct property investments, and later served as an associate portfolio manager for Invesco Real Estate. He has been in the industry since 2003 and previously was a financial analyst in the corporate finance group at ORIX Capital Markets.

Mr. Turner earned a BBA in finance from Baylor University, an MS degree in real estate from the University of Texas at Arlington and an MBA specializing in investments from Southern Methodist University.

Joseph Tang is an investment director for Invesco Hong Kong and a portfolio manager for Invesco Chinese equity products. He has been specializing in the China A-shares market since he joined Invesco Great Wall, Invesco's China joint venture, as head of investments in September 2006. In August 2007, he joined Invesco Hong Kong to manage QFII portfolios investing in China A-shares.

Prior to joining Invesco, Mr. Tang was a vice president and greater China equity strategist at Credit Suisse Private Bank from December 2004 to August 2006. He was the head of research at Sun Hung Kai Securities from September 2000 to November 2004. Prior to that, he spent six years in Asia ex-Japan fund management, managing portfolios at Daiwa Investment Advisors (HK) Ltd., East Asia Hamon and BZW Investment Management (HK) Ltd.

Mr. Tang earned his MS degree in finance from the University of Lancaster, UK.

Dean Newman is head of emerging markets equities at Invesco Perpetual, with responsibility for the management of global emerging markets and Latin American equity portfolios.


He earned a BA degree with honors in economics and politics from Durham University.
About risk
Investments in energy companies may be adversely affected by foreign, federal or state regulations governing energy production, distribution and sale as well as supply-and-demand for energy resources. Although individual security selection drives the performance of an energy strategy, short-term fluctuations in energy prices may cause price fluctuations in its shares.

Foreign investments may be affected by changes in a foreign country's exchange rates, political and social instability, changes in economic or taxation policies, difficulties when enforcing obligations, decreased liquidity, and increased volatility. Foreign companies may be subject to less regulation resulting in less publicly available information about the companies.