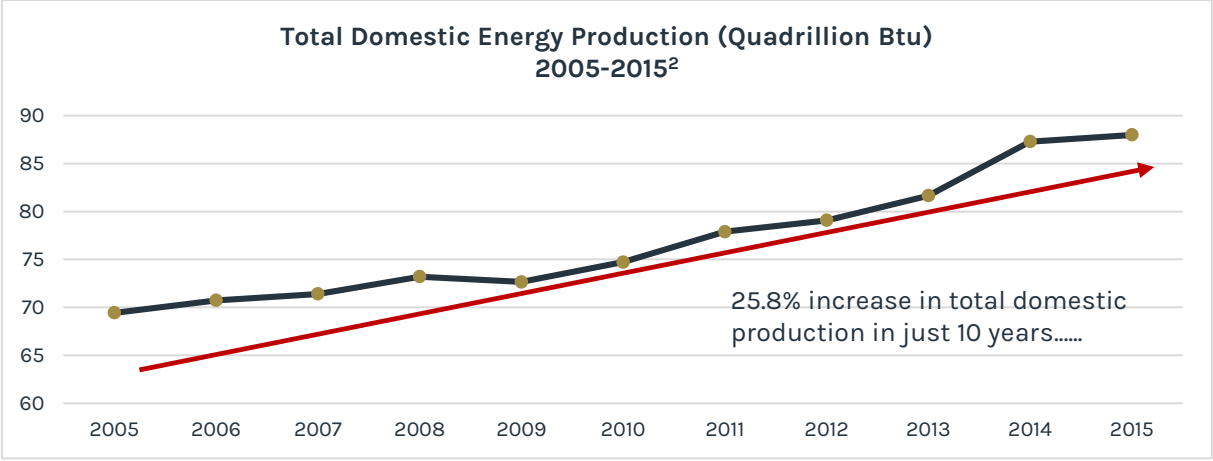
## Volume #4: Lower Domestic Energy Prices

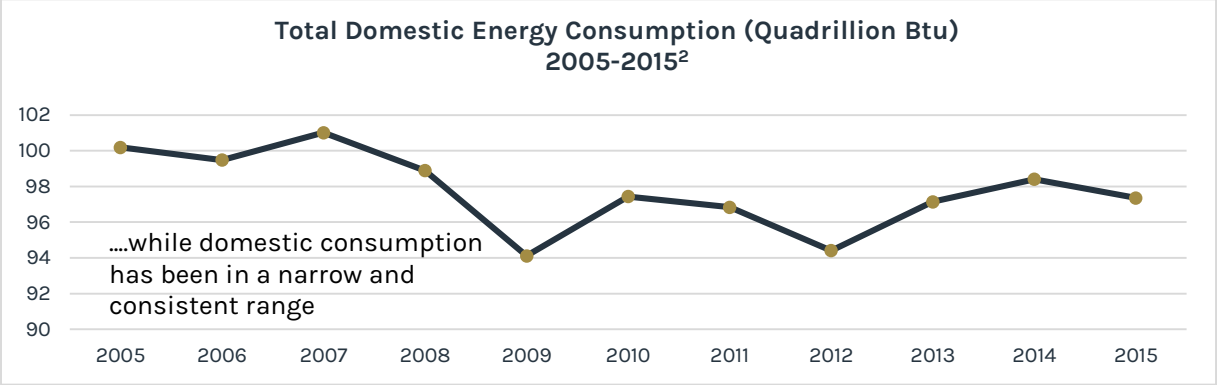
**Summary of Key Findings:**

- Overall U.S. demand for energy is growing slightly, but regional demand around "Mega Cities" is booming[1].
- While still dominant in terms of market share, coal is declining in relative growth. Natural gas will replace coal as the man source of electricity in the U.S. by 2035[2].
- U.S. production of natural gas will displace development of renewable and nuclear energy in the short term.
- In response to lower oil prices, U.S. oilfield services companies have reduced their prices, which will spur production[2].
- Development of renewable energy in the U.S will be led by wind and solar, which combined will account for more than half of renewable energy production by 2025[2].
- New nuclear capacity is unlikely to be installed in the short term due to regulatory complexity and competition from cheap oil and natural gas[3].

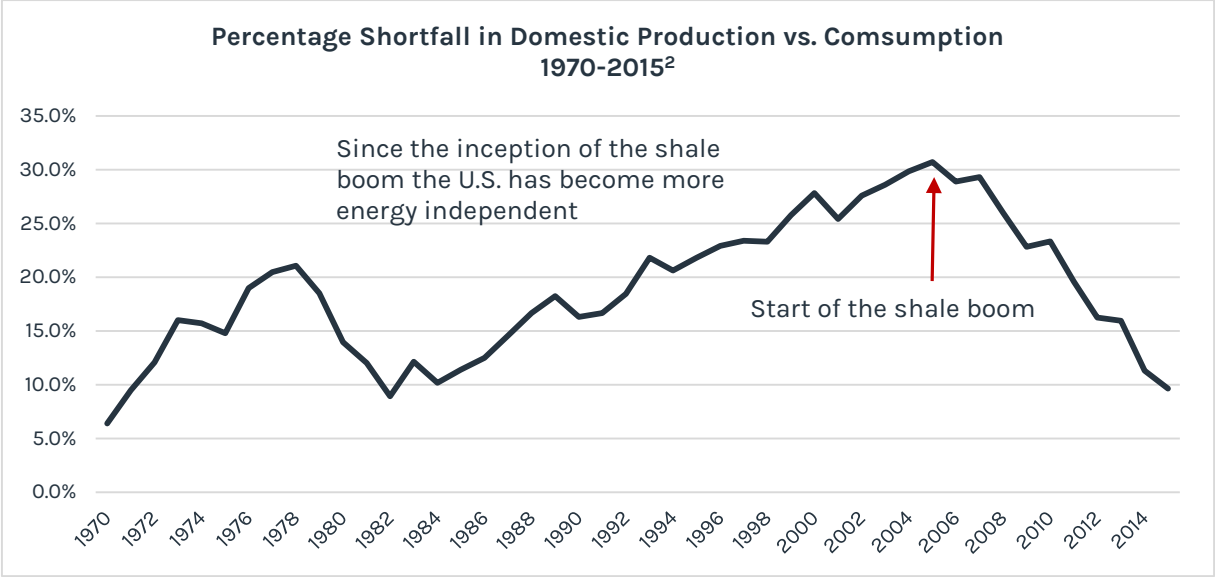
As discussed in our first report, a major economic factor that 3 Rivers Capital believes will influence our investment strategy is the trend of lower energy prices. While we do believe that we will continue to see fluctuations in energy pricing ongoing, in general we believe energy prices could remain in a narrow range with a trend towards lower pricing for the next 10 years.

To understand pricing one first has to understand the supply and demand dynamics. As the shale boom swept across the United States over the past decade, domestic energy production nearly doubled (see production chart below), while energy consumption trended in a narrow range (see consumption chart below).




This major infusion of domestic supply coupled with the more consistent consumption of energy has created the narrowest spread between domestic consumption and production since 1982.




As mentioned, the major driver of increased domestic production has been the shale boom which has sharply increased natural gas production. Considering its low end user cost and smaller environmental emissions footprint, natural gas is an attractive alternative to foreign oil imports and less environmentally friendly coal based energy production. When added to Canada's tar sands production and Russia's natural gas and oil production, OPEC's ability to set prices for oil has been diminished. OPEC's response was to continue production at high levels to drive higher cost producers out of the market so that they could maintain market share.

This increased pricing pressure has forced domestic producers to further drive technological advancements and lower costs of production. While U.S. domestic production has slowed over the last two years, leveraged energy companies continued to produce to maintain bank covenants as they played a game of chicken with OPEC, who continued to maintain their high production levels. Recently, OPEC relented it policies and decided to cut crude output to rein in a global glut of supply that has weighed on prices for more than two years[4]. While this has helped to push oil prices back over $50 per barrel, further production cuts from OPEC are unlikely in the near term. The current level of supply coupled with more efficient use of energy will likely ensure perpetual pressure on energy prices over the next decade. In addition, the International Energy Agency (IEA) predicts that 45% of all global energy production will be created through nuclear and renewable sources by 2030. It is also estimated that new fuel efficiency standards for cars and trucks could cut oil demand by as much as 4 million barrels per day. Given these contributing factors, we believe that energy prices will remain far lower than the historical norm in real terms, which will manifest into compelling investment opportunities throughout the economy.

**Current Energy Outlook is Highly Vulnerable to Game Changing Disruptions:**

If any one of four major disruptions occurs, the energy landscape by 2025 will look very different from current projections. Advancements in grid technology will transform the grid from hub-and-spoke to a point-to-point model[1]. This makes renewable energy more economically attractive and likely will lead to a greater portion of the country's energy coming from non-carbon based fuels. A next generation, lower cost, fast-breeding uranium or thorium reactor would fundamentally alter energy economics and revitalize U.S. nuclear investment[3]. Economically viable energy storage solutions will change utility cost structure and dramatically alter the way that electricity is generated and sold[5]. Lastly, harnessing the wasted energy in other processes would make energy a by-product of other activities and could make some energy free.

The surprising presidential election results likely will lead to less regulatory pressures, thus creating a less encumbered environment for drilling as well. The result of this alleviated regulatory environment will likely result in natural gas gaining market share. Coal will be the hardest hit, as natural gas is the lower-cost, slightly greener alternative. Implications will manifest in lower natural gas pricing as the shale boom enters its second

chapter. If the drop in pricing from the shale boom continues (natural gas pricing is down 57% since 2005 – the start of the boom) we can assume continued pricing pressures to persist.

**The Era of Coal's Dominance Will Come to an End**

Growth in the coal business has been muted by competition from domestic O&G production, which has only exacerbated the problems for a coal industry that has already been in decline. Additional regulation by the EPA has further reduced the profitability of coal-fired power plants. As of March 2015, operators of coal burning plants must submit quarterly and annual reports to the EPA, with complete emissions data, including a number of metrics on air toxins and carbon emissions generated by their operations[6]. This data is intended to inform future regulations around carbon caps for coal-fired generation plants.

The combination of existing regulation with the domestic competition with O&G producers will likely lead to a reduction in coal-fueled generating capacity by as much as 15% by the year 2025[2]. While this is not good news for coal producers, it will help to stabilize the prices for O&G by helping to set a floor on supply of available energy in the market.

**Energy Harvesting Holds Great Promise for Cheap Energy**

Generating electricity passively from solar, wind, thermal, kinetic/piezoelectric, or electromagnetic sources, coupled with new energy harvesting technologies would be disruptive to the supply/demand balance for energy[1]. There is enough energy emitted by the human body to power one person's consumer and medical devices daily. In power plants and industrial processes, an estimated 66% of total energy is lost between vibration, movement, sound and heat[5]. The energy harvesting market is expected to increase from $1.0 billion to $7.1 billion by the year 2025[5], driven by technologies that will include:

*Vehicle Efficiency*[1]

Electric vehicles extended range using wireless charging built into roads. Electric buses will collect energy from induction coils buried in the road surface, dramatically increasing the range of the vehicle and reducing the downtime spent refueling.

*Device Charging*[1]

Consumer devices will charge through motion, or through thermal or solar power. Laboratories are developing technologies to harvest energy from body motion and heat to power consumer and medical electronics.

*Remote Operations*[1]

In inaccessible or hazardous locations, devices will be able to charge themselves. The market is currently developing a sensor that harvests energy from background radio and TV waves to power devices in high-up, or hard to reach places.

*Signage Power*[1]

A/V displays will harvest ambient energy and require no added power. Texas Instruments is developing a technology to replace batteries and wired energy feeds to digital signage, dramatically improving the economics of operations.

Opportunities in this burgeoning market could be plentiful but likely early movers will capture the majority of the upside.

**Solar Energy Storage is Key to the Growth of Renewables**

A utility-level energy storage technology will be the key to growth for renewable energy sources. Electricity is fleeting. Almost all electricity is used within a fraction of a second from when it is generated. Thus an increase in demand necessitates an immediate and proportional increase in power generation. Augmentation is not the answer. Current technologies that can quickly augment capacity are expensive to operate and use a lot of fossil fuels. Energy storage solutions would provide the ability to generate energy when it is plentiful and cheap and store it for use later when generation would be difficult or costly. Energy storage would reduce the cost of electricity to the end user, as well as make generation cheaper for producers. Emerging energy storage technologies that may lead the way include:

*Chemical*[5]

Hydrogen or methane is extracted from other molecules via renewable, or variable, energy sources and stored for use in vehicles and fuel cells.

*Air*[5]

Air is compressed to very high densities sometimes liquefied and stored during periods of high generation then released during period of low generation.

*Magnetic*[5]

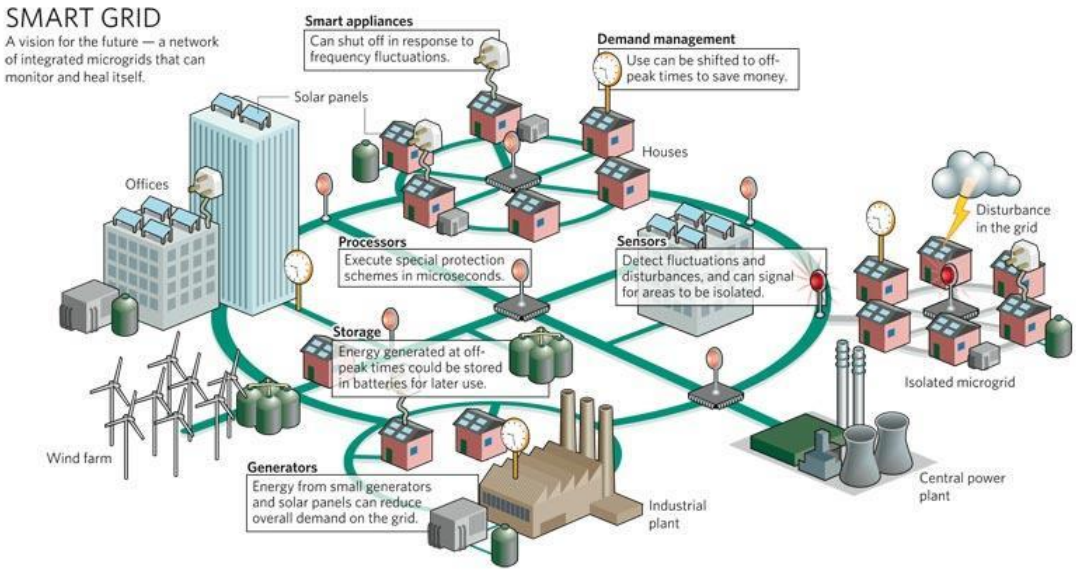
A combined superconducting coil, power system, and ultra-high power refrigerator store energy in a magnetic field at extremely low temperatures.

*Battery and Capacitor*[5]

Flow batteries, solid state batteries and super-capacitors would be useful during dynamic shifts in power to match supply and demand during periods where there are dramatic spikes in demand.

**Distribution Generation is Going Smart**[1]

Enabling on-site generation of electricity improves grid resiliency, efficiency, sustainability, and cost-effectiveness. By changing the energy generation model from a central plant, hub-and-spoke model to a distributed, mesh-network model, local disasters or equipment failures will have a dramatically reduced impact on the system as a whole. Reducing the distance that electricity needs to travel before it can be used reduces the power lost in transmission, and thereby reduces the total needed for generation. By using local generation through sustainable sources in attractive regimes, a greater percentage of electricity can come from renewable sources. In a hub-and-spoke model, peak demand is managed by costly "fast start" supplemental power plants. In a distributed model, peak demand is managed through localized energy trading and peak-demand renewable generation.




**Initial Energy Implications and Predictions**

Fracking and horizontal drilling have propelled the U.S. to the forefront of global natural gas production. Under the new administration, regulatory pressures may be lifted thus unencumbering growth. Renewables will likely continue to gain market share, despite receiving far less government funding and support than fossil fuel industries with which they directly compete.

Aggregate energy demand will not grow significantly through 2025 in the U.S., but demand in regional markets will shift towards new population centers and growing Mega cities. The need for greater generation capacity in

small geographies within the U.S. creates the need for not only more capacity but also more efficient transmission technologies to link demand centers to attractive solar and wind regimes.

The current hub-and-spoke model, wherein energy is generated in a central plant and transported to consumers, cannot manage the capabilities of distributed generation or energy storage. Advances in the latter technologies will force utilities to adapt. The distributed model has the advantage of being more efficient, reliable, and sustainable than the 20th century model, necessitating a complete revision of the energy utility business model.

So what does this all mean for 3 Rivers Capital Investors? Acquisition opportunities in smart grid infrastructure and energy storage will be given a greater focus. Opportunities could arise in many forms, however, especially in areas of the market that we have expertise. While consumption patterns may change rapidly and on occasion cause dramatic shifts in pricing, the general direction of energy pricing should be muted by the increase in supply and more efficient use of energy through more effective transmission. We will follow up on these topics early next year as we delve further into the manifestations that will drive our sourcing efforts. Next month we will delve into the last major factor of influence shaping our sourcing and management efforts, the Modernization of Things.

**SOURCES:**

1- *Frost & Sullivan*
2- *Energy Information Administration*
3- *U.S. Nuclear Regulatory Committee*
4- *Reuters*
5- *U.S. Department of Energy*
6- *Federal Energy Regulatory Commission*