# America’s New Energy Future:

The Unconventional Oil and Gas Revolution and the US Economy

## Volume 3: A Manufacturing Renaissance

*Appendix A. Impact on the US Power Sector and Other Key US Manufacturing Sectors*

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# Appendix A. Impact on the US Power Sector and Other Key US Manufacturing Sectors

## Implications of the Unconventional Revolution for the US Power Sector

In the past two decades, natural gas has been the only fossil fuel with an increasing market share in US power generation. The share of power generated by natural gas nearly doubled from 1991 through 2011, while market share for both coal and oil declined. Low cost and abundant shale gas reinforces this trend. The implications are game-changing for the power sector, shale gas is resetting the cost and environmental benchmarks for future additions to generation capacity and further increasing market share for existing natural gas-fired generators. In the near-term, coal-fired and natural gas-fired generators will jockey between themselves for market share—gas and coal typically compete at the margins in several US power markets when the price spread between them tightens. But by the middle of this decade, as coal-fired power generators are retired, natural gas generators stand to benefit. In the longer term, the favorable economics of natural gas relative to other generation alternatives will make it the fuel of choice as power markets begin to add capacity to service growing domestic electricity demand.

The advance of gas-fired power generation in the United States has been driven by three related market factors:

- First, lower natural gas prices ushered in by the revolution in unconventional oil and natural gas production have increased the direct competition between existing coal-fired and gas-fired generation assets. During the recent period of very low gas prices, the variable costs of many gas-fired power generators were below the costs of their coal-fired competitors, and gas-fired generators were able to increase their production and grab market share. This price competition is the principal driver of the coal-to-gas displacement that will be discussed in more detail below.
- Second, existing coal-fired assets are facing substantial environmental retrofit costs to comply with new environmental regulations. Owners of these older, less efficient plants, which have less remaining economic life, are finding asset retirement to be the better economic decision, and much of that lost energy generation is expected to be replaced by gas-fired generation.
- Third, the development of new coal-fired generation assets is being hindered by both economic and environmental regulatory forces. The higher capital costs for new coal-fired generation (compared to gas-fired generation), in combination with the narrowing of the price advantage for coal, has made natural gas an overwhelming economic choice for new generation resource development. Anticipated environmental regulations that are also limiting carbon dioxide (CO2) emissions provide a further regulatory hindrance to new coal asset construction.

### *Coal-to-Gas Displacement*

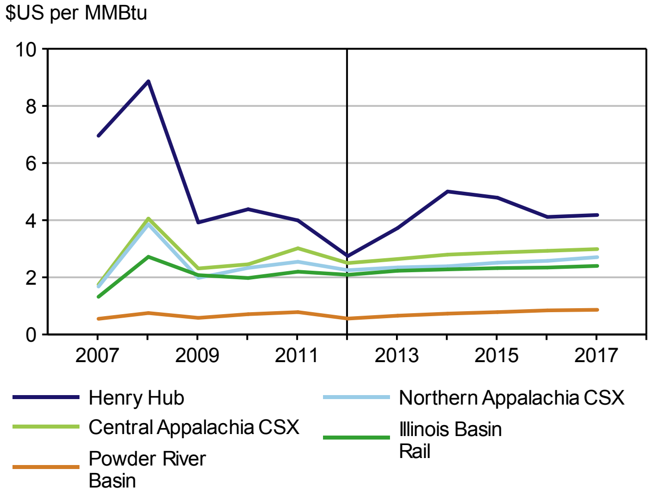
In the past three years, power-sector demand for natural gas has grown significantly as low gas prices have greatly reduced the spread between gas and coal prices, making gas-fired generation increasingly competitive for electric dispatch. IHS estimates that between 2008 and 2011, gas demand for power generation increased by 3.8 billion cubic feet (Bcf) per day as a result of this coal-to-gas displacement.[1] Natural gas prices in 2012 averaged a cyclical low of $2.75 per million British thermal units (Btu) for the year, the result of an abnormally warm winter, high production, and higher than normal natural gas storage inventories. This further tightened the spread between coal and natural gas prices, precipitating a more than doubling of coal displacement to an average 8.4 Bcf per day in incremental natural gas

1 We benchmark against 2008 because high natural gas prices kept coal-to-gas displacement at a minimum for that year.

demand for 2012 compared with 2008. IHS estimates that the displacement of coal-fired generation also resulted in the power sector's greenhouse gas (GHG) emissions falling in 2011 and 2012 to about 11% and 17% below 2005 levels, respectively.[2]

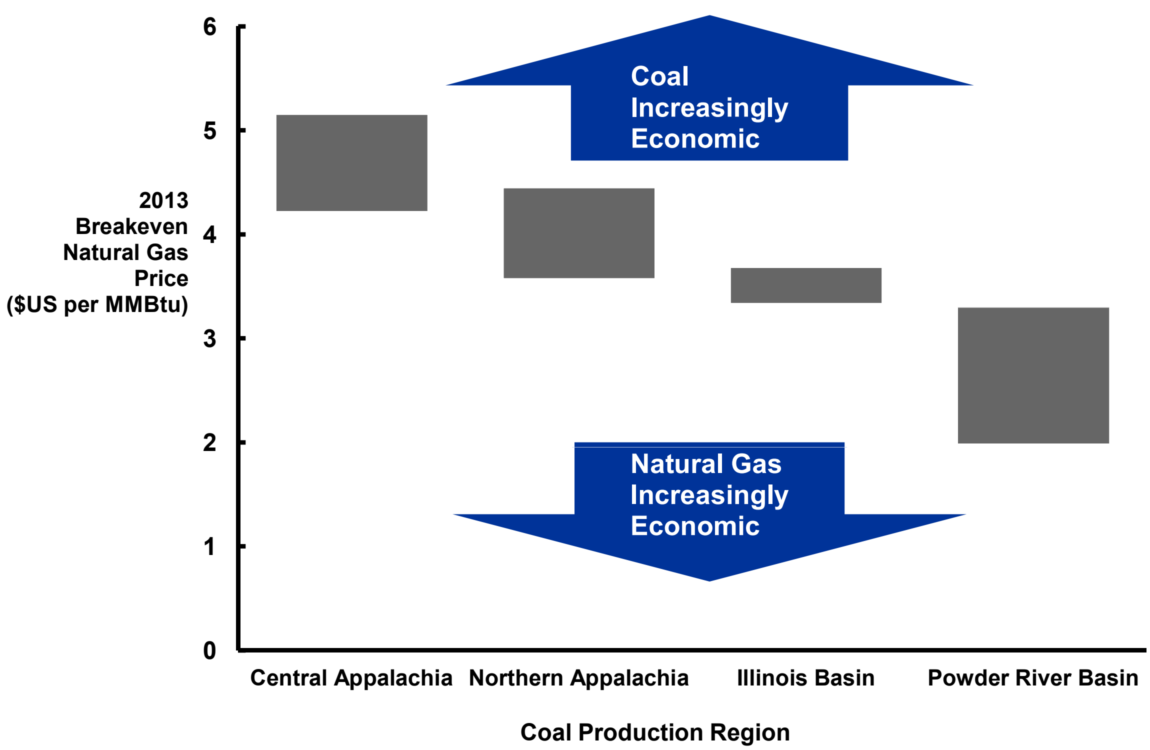
IHS Energy expects this coal displacement to gradually abate during 2013 as rising natural gas prices improve coal's competitive position. With 2013 average Henry Hub pricing for natural gas expected to be at $3.72 per million Btu for the year, we expect coal displacement to revert to close to 2011 levels as gas prices begin to rise. This abatement is expected to be sustained in 2014 and 2015 as gas prices undergo a pricing cycle before settling in at around their full life cycle costs. In the longer-term, however, the power sector's gas demand is expected to continue to grow steadily as existing coal-fired generators are projected to retire, electricity demand increases, and gas-fired generation retains its cost advantage over competing technologies.

**Annual Henry Hub and Spot Coal Prices**




Source: IHS Energy

**Competitive Position of Coal Relative to Natural Gas in US Power Generation**



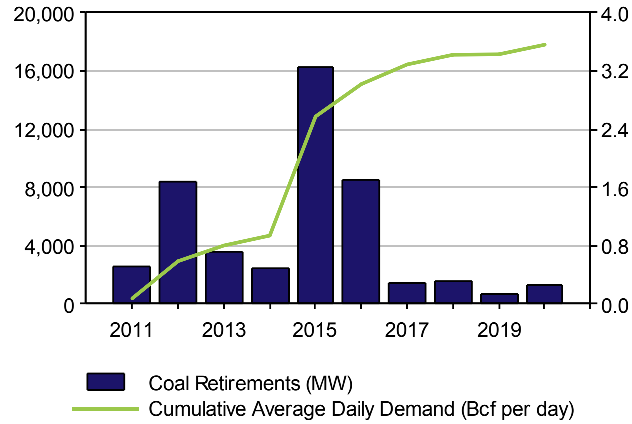

Source: IHS Energy

[2] See the IHS Energy Decision Brief *Coal-to-Gas Displacement Produces a Sharp but Temporary Decline in US Power Sector $CO_2$ Emissions*.

### *Coal-Fired Generation Retirements*

For the existing fleet of coal-fueled generators, more stringent Environmental Protection Agency (EPA) restrictions on conventional air emissions (sulfur dioxide [SO2], nitrogen oxides [NOX], mercury, and other hazardous air pollutants), coal ash disposal, and cooling water use will force many coal plant operators to decide between investing in costly environmental upgrades and retiring coal units over the next few years. Facing these difficult and costly decisions about emission control retrofitting in the wake of cyclical low natural gas prices, many operators will be looking to shelve or completely retire some coal units. IHS estimates that more than 50 gigawatts (GW) of coal-fired generation capacity will be retired between 2011 and 2020. This accounts for roughly one-sixth of the existing coal fleet. These retired plants will generally be the smaller, older, and less efficient units that currently operate at reduced capacity. IHS estimates that, assuming that natural gas generation is replaces power previously generated by these retiring coal-fired units, incremental gas demand will average about 3.5 Bcf per day.

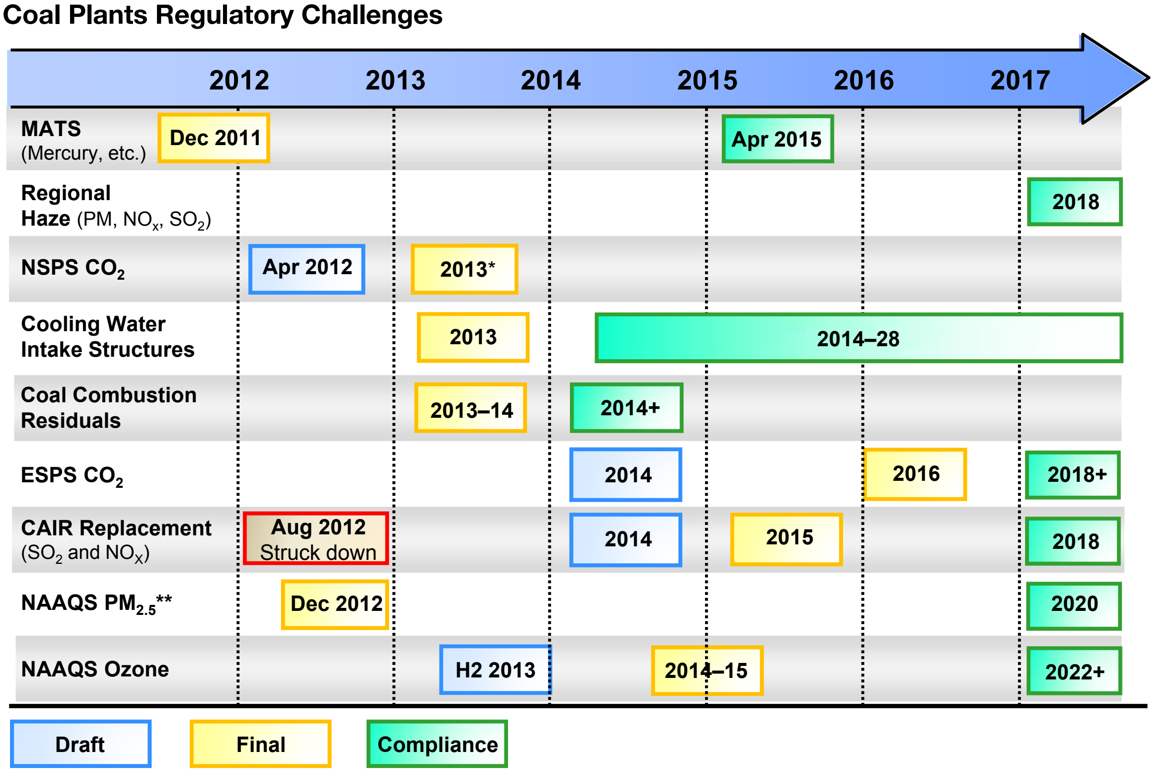
**US Coal Retirements and Implications for Natural Gas Demand**




Note: Gas demand is relative to 2011 coal-fired generation

Source: IHS Energy

**Coal Plants Regulatory Challenges**




NOTES: *EPA's NSPS for $CO_2$ will apply to plants that begin construction 12 months after the proposal was released (i.e., April 2013).
**$PM_{2.5}$ = fine particulate matter (<2.5 microns). 30105-2
Source: IHS Energy

### *Additions of Gas-Fired Generation Capacity*

Natural gas–fired generators have lower capital costs than most other types of new generation units and can often be built much more quickly, particularly when they're compared to new coal and nuclear plants. IHS Energy expects natural gas-fired technologies to make up close to one half of all power generation capacity additions planned over the next decade. Further, the EPA is in the process of finalizing GHG performance standards for new generators. The proposed regulation targeting CO2 emissions from new fossil fuel-fired power plants includes an emission performance standard that effectively blocks the construction of conventional coal generators. However, the emissions limit was set to allow continued construction of natural gas-fired combined cycle generators (CCGT)—current CCGT technology is capable of achieving the performance standard without carbon capture and storage. The stringency level of the performance standard signals an acceptance of an ongoing role for natural gas in the power generation fuel mix and of the pre-commercial status of utility-scale capture and storage.

**NRG Considering Three New Natural Gas-fired Power Plants in New York State**

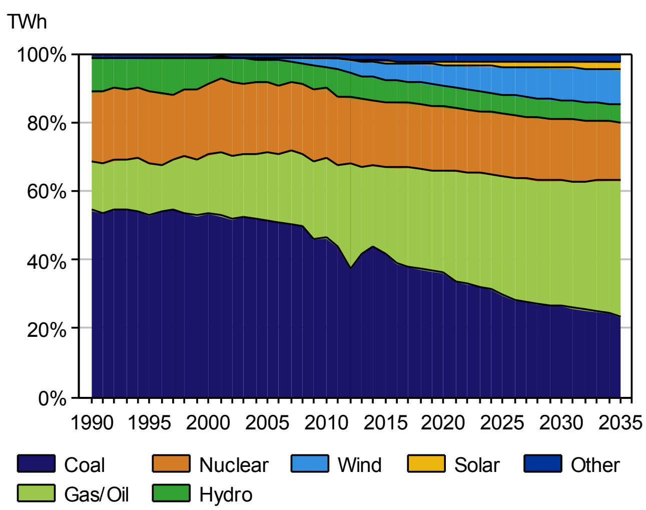
NRG Energy, a Fortune 500 company headquartered near Princeton, New Jersey, announced plans in April 2013 to construct at least one, and potentially two, new natural gas-fired electric generating plants to replace capacity if the Indian Point Nuclear power plant is retired.

NRG is expected to propose the construction of a combined cycle natural gas-fired plant that would replace oil and gas-fired units at its 580 megawatt (MW) Astoria plant in New York City. The proposed plant would cost up to $1.5 billion and would produce between 520 MW and 1,040 MW of electric power. NRG is also considering adding a 775 MW combined cycle natural gas-fired unit at its existing 1,139 MW Bowline oil and gas plant on the Hudson River, about five miles south of Indian Point. This facility would cost around $1 billion. Another facility under consideration would be a new natural gas-fired plant located at the site of the closed Lovett coal-fired plant on the Hudson River, also south of Indian Point.

These expectations of abundant long-term supplies of competitively priced natural gas from the Marcellus shale formation is the primary reason for NRG's construction activity. NRG is also considering the three new plants in response to The New York Power Authority's efforts to seek proposals for new power sources because of the potential shut down of the Indian Point nuclear power facility, located near New York City. The 2,037 MW Indian Point plant currently provides about 25 percent of the city's energy supply.

Natural gas-fired generators provide a flexible power source that can adapt to fluctuating power demand, maintain power system reliability, and back up the growing amount of generation available from intermittent renewable power resources. In addition, natural gas-fired combined cycle plants emit less than half the GHG emissions of coal-fired generators. IHS expects that gas-fired power plants will gradually erode coal's share of the electricity generation mix. But despite the cumulative costs to the US coal fleet of meeting increasingly stringent environmental restrictions, most coal-fired plants will remain economic over the next two decades and in 2035 they will constitute about 23% of the

**US Power Generation Fuel Mix**




Source: IHS Energy

US generation market. At the same time, utilities will be investing heavily in more combined-cycle gas turbines, and compared with current demand gas demand from the power sector is expected to double by 2035 in the US Lower 48 states. Power-sector gas consumption by itself will constitute about 47% of total US Lower 48 natural gas demand.

## Other Energy Intensive Industries

The following subsection presents IHS's analysis of the effect on selected energy-intensive industries where, directly or indirectly, natural gas prices influence the cost structure of the production process. Electricity represents a significant portion of the cost structure of industries like aluminum, steel and cement. However, in the case of fertilizer production, since natural gas is used as a feedstock, natural gas prices directly affect input costs for the fertilizer industry. [3]

### *Non-Durable Manufacturing*

#### Fertilizers

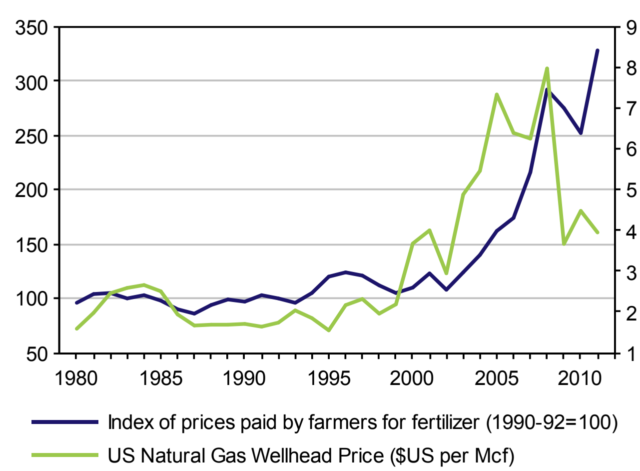
Around 80% of the cost of producing nitrogen-based fertilizers is associated with natural gas. It is predominantly used as a feedstock, but natural gas is also the common fuel source for manufacturing nitrogen-based fertilizers. Nitrogen is a plant nutrient, with the exception of some legumes that have the ability to fix nitrogen from the atmosphere and use it for plant growth. As part of the rapid expansion in food production capacity in the United States and around the world, the production of synthetic nitrogen has been essential to advancing crop yields and production.

The fertilizer manufacturing process is energy intensive and highly susceptible to changes in natural gas prices. The higher level of natural gas prices prior to the wide-spread development of shale gas considerably deteriorated the profitability of this industry.

Economies of scale inherent in the manufacturing process played an important role in the evolution of the competitive landscape in the United States, which promoted a consolidation process that resulted in considerable reductions in installed production capacity by 2006. Unable to compete with international prices, many small US-based producers shut down their operations or combined into larger manufacturing facilities. This caused a significant increase in market concentration, leaving a few players with control of most of the production.

Reductions in local supply, combined with strong demand due to record corn acreage levels and the positive economics of major crop production (corn, wheat, and soybeans), have put significant pressure on fertilizer prices while making the United States a net importer of this commodity. In the absence of sustained, inexpensive sources of feedstock and fuel, the market for fertilizers was characterized by reduced competition and highly volatile prices—a situation evident in the recent increases in prices for nitrogen-based fertilizer. Cheap sources of natural gas provide a competitive advantage to producers located close to the energy source, a condition that will determine the direction of trade as prices of this commodity are set in the international markets.

**Price of Fertilizers vs. Natural Gas**

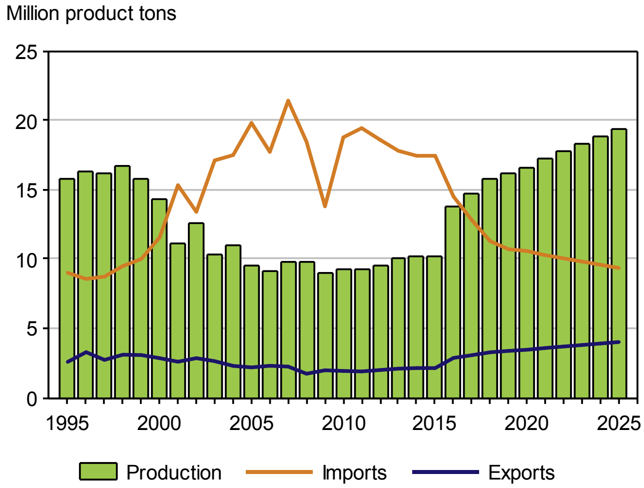



Source: NASS and Bureau of Labor Statistics

[3] This analysis is limited to nitrogen based fertilizers.

Lower price levels for natural gas in the United States, sustained by the development of unconventional sources, have provided increasing profitability to local fertilizer manufacturers. Moreover, rigid production capacity has pushed up market clearing prices for fertilizers as demand expands to keep up with the production of agricultural products, further increasing profitability. Sustainable low natural gas prices in the future will trigger a significant increase of investment in the production capacity of fertilizers as more companies enter the market to take advantage of the increased profitability.

**US Fertilizer Industry: Nitrogen**




Source: IHS Energy

At the end of 2012, 26 companies were either building or expanding new nitrogen-related production capacity, with over 40 projects in different stages of development. This large amount of investment, sustained by abundant low-cost natural gas, will expand production and favor reduced prices and improved trade balances for this commodity—in addition to all of the benefits of increased economic activity and employment generation caused by falling energy prices as a result of the revolution in unconventional energy.

### Major Fertilizer Plant Proposed for Iowa

The Iowa Fertilizer Company, a subsidiary of Egypt-based Orascom Construction Industries, announced plans in March 2013 to spend more than $1.3 billion to construct a nitrogen fertilizer manufacturing plant in Lee County, near the town of Wever, Iowa. According to Iowa Governor Terry Branstad, the proposed plant would be the largest private capital investment project in the history of the state.

The proposed plant will make ammonia and nitrogen fertilizers for sale to farmers located in the Midwestern United States, decreasing their dependence on fertilizer from suppliers located overseas. The economic benefits of the fertilizer plant include 2,000 jobs during the construction phase and 165 permanent jobs once it begins operating.

### Food Processing

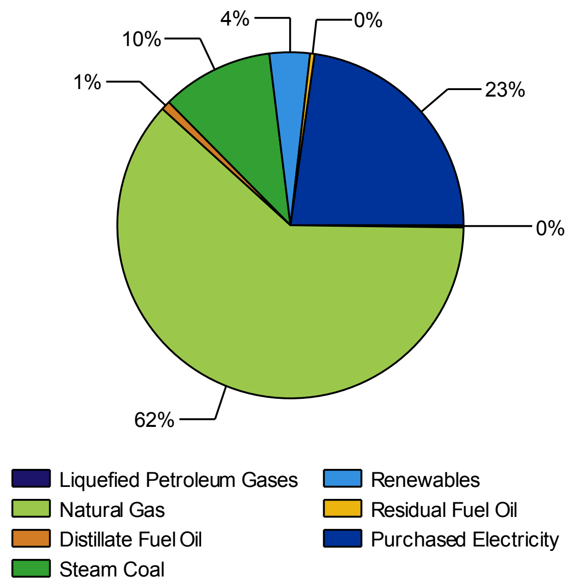
According to the 2010 Annual Survey of Manufactures data published by the US Census Bureau, the food manufacturing sector is one of the largest manufacturing sectors in the United States. The total value of food manufacturing shipments reached $646 billion, or 14.2% of total US manufacturing shipments, in 2010. Employment in the industry accounts for almost 13% of all employment in manufacturing.

Over the years, the US food manufacturing industry has been able to increase output by investing heavily in new technology and further automating its production processes. Between 1995 and 2010, total industrial food production increased by nearly 15% as the industry responded to increasing demand for prepared foods sold in grocery stores and restaurant and take-out food[4].

[4] The USDA Economic Research Service in its report, "Energy Use in the US Food System", states that between 1997 and 2002 food processing showed the largest growth in energy as both households and foodservice establishments increasingly outsourced manual food preparation and cleanup activities to the manufacturing sector, which relied on energy using technologies to carry out these processes.

As the food manufacturing industry's reliance on machinery has increased, it has also become more energy intensive. According to the US Energy Information Administration's Annual Energy Outlook 2012, energy demand by the food processing industry is expected to grow at an average annual rate of 1.5% between 2010 and 2035.[5] With the US population growing larger and with more demands on personal time, the demand for greater output of processed foods will push the industry to expand capacity.

**Food Industry Energy Consumption: 2012**




Source: EIA Annual Energy Outlook 2013

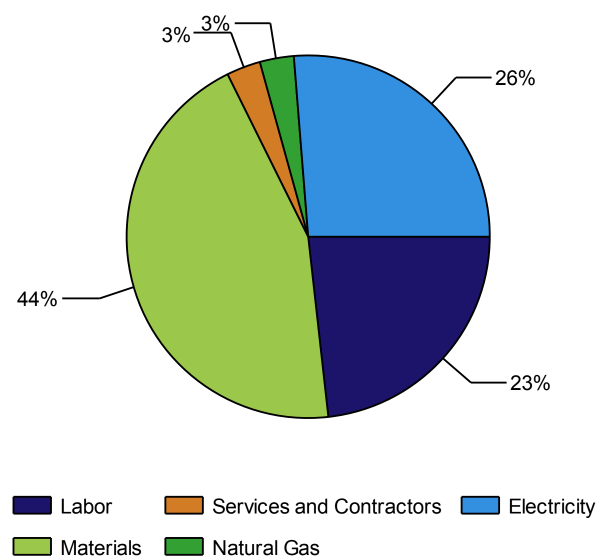
Natural gas is the food manufacturing industry's largest source of energy, accounting for more than half of all of the industry's energy sources. Lower and more stable natural gas prices will help future development of the US food processing industry. Over the decade preceding the boom in unconventional energy production, escalating fossil energy prices created significant concerns for US food manufacturers. However, the advent of hydraulic fracturing technologies has opened up new opportunities for reducing and stabilizing natural gas prices. As the increase in domestic natural gas production continues to reduce US reliance on imported fuels and diminishes the risk of external energy price shocks, the US food manufacturing industry will face lower costs for their input materials and will be more able to expand capacity to meet growing consumer demand.

### *Durable Manufacturing*

#### Aluminum

Aluminum production is electricity-intensive, because electricity is inherent in the chemical process required to produce it. As a result, primary aluminum smelters tend to be situated in countries where electric power is both plentiful and inexpensive, such as the Gulf States, Quebec, Iceland and Norway.[6] Electricity represents 26% of the cost of producing aluminum in the United States, and about 5% of all the electricity generated in this country is consumed by the aluminum industry.

**US Primary Aluminum Current Average Cost Structure**




Source: IHS Energy

There has been a slow decline in US primary aluminum production over the past 30 years. It is conceivable that lower US natural gas prices could potentially slow or even halt this decline. However, given a number of challenges facing the industry, it is unlikely that substantial new upstream investment will be forthcoming and, it is difficult to see more than a check in its long-term decline. There are four reasons for this outlook.

5 http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf (page 71)

6 Saudi Arabia, the United Arab Emirates and Qatar use excess natural gas supplies to fuel power generation while Iceland, Quebec and Norway employ geothermal and hydroelectric energy generation processes, respectively.

First, although lower natural gas prices in North America have helped to change the economics of primary aluminum production, this is not likely to be enough to tip choices for plant locations in the region's favor as it has in other manufacturing industries. Decisions to site new smelting capacity today are made with a global perspective based almost entirely on cost. Even if natural gas prices are so attractive as to become competitive with coal-fired generation, this still indicates an energy cost profile for potential US smelting capacity that is at best on par with potential investments overseas. In most cases, though, electricity prices even from dedicated, lower-cost gas-fired generation are not competitive with hydroelectric generation. Without a compelling cost advantage, the added environmental hurdles that a US project would likely face point to a relatively lackluster climate for new investment.

Second, the breakdown of the aluminum industry's vertically integrated business model works against expansions of primary smelting capacity in the United States. Global mining companies have successfully leveraged the higher value added function of iron ore production to the detriment of basic steel making profitability. This same phenomenon is now pushing aluminum companies toward a horizontal structure, with producers increasingly specializing in either the upstream or downstream segments of the industry. Traditionally, the processing of bauxite ore, alumina refining, primary smelting and even downstream product fabrication were carried out by the same vertically integrated organization[7]. For example, companies often treated bauxite and alumina costs as internal transfer prices. Alumina prices, for instance, were generally set as a function of the price of primary aluminum, which ranged historically between 12% and 16% of prices on the London Metal Exchange (LME).

The third impact on aluminum manufacturing has been the industry's globalization and commoditization. The broad adoption of the LME aluminum contract in the 1980s, coupled with the entry of Russian producers into the global market in the 1990s, helped commoditize the business of making aluminum and reduced its attractiveness. The final straw was the growth in Chinese alumina imports between 1995 and 2005. This development created a large independent market for alumina outside of the industry's traditional production chain, creating a strong profit motive in the upstream segment of the industry. The end result has been that the price of alumina, as a percentage of the price of primary aluminum, has been moving toward 18%, a change that is eroding the profitability of primary smelting.

Finally, labor costs in the US aluminum industry are too high, relative to other countries. US labor costs are either on par with, or slightly higher than, those in Canada or Europe, 25% higher than in Australia, more than double those in Brazil, four times the level of those in the Middle East, and more than five times greater than they are in China, India, and Africa.

Together, these factors—no clear advantage in electricity prices, the commoditization of primary aluminum, and higher relative alumina and labor costs—make it unlikely that significant investments in domestic primary aluminum production will be forthcoming. No Greenfield capacity has been built in the United States since the early 1970s, and as much as 1 million metric tons of the rated capacity that is currently idle will probably never be restarted.

Brownfield expansions are possible. Here, however, the relatively small size of the US units, in combination with the relatively poor economics of primary smelting, argue for investing in higher value-added downstream markets. These markets, which are closer to end-users where quality is important and allow for product differentiation, can capture more value. The bottom line is that lower natural gas prices can only partially offset the migration of the US primary aluminum industry up the global cost curve. The US is currently not an attractive location for new smelting capacity and it not likely to be even with lower natural gas prices.

7 The production of aluminum metal progresses through several stages beginning with the mining of bauxite. Bauxite is then refined into alumina which is then smelted to produce primary aluminum.

### Cement

Cement production requires large amounts of energy to drive the chemical reactions that occur inside a kiln. The common energy sources in US cement production are coal and electricity. Coal is used to heat the kiln and the feedstock, while electricity powers the stone crushers and grinders, the control systems, and the kiln's motor. According to the 2011 Annual Survey of Manufactures, the combined cost of purchased fuels and electricity accounted for 46% of the total cost of materials used in the cement manufacturing process. The split in the industry's spending on energy is split fairly evenly between fuels and electricity, at 54% and 46%, respectively. Looking at energy's role in the cost of cement production, energy accounts for between 25-30% of total costs. Although cement manufacture is a highly energy-intensive industry, low natural gas prices will have a fairly limited impact on cement production in the coming years. There are two reasons for this.

First, the decision of which fuel to use to heat the kilns is not limited to simply coal versus natural gas. For decades, cement plants have used alternative kiln fuels, which have ranged from industrial waste to tires. In several cases, cement plants are actually paid to incorporate these fuels into their production processes. More often, the plants acquire these waste fuels at little or no cost. This minimal cost profile often offsets the cost of installing the equipment required to handle these alternative fuels. So even though natural gas may be a cheaper energy input than coal, it is competing with other alternative fuels that are even less expensive. This is one reason the use of natural gas in cement plants has remained fairly steady over the last decade. According to the US Geological Survey, the cement industry consumed 14.02 Bcf of natural gas in 2001. By 2011, that had fallen 4%, to 13.45 Bcf. At the same time, the amount of waste fuels consumed has increased considerably. Tire use rose from 300,000 metric tons in 2001 to 320,000 metric tons in 2011. Solid waste fuel use jumped from 320,000 metric tons to 699,000 metric tons during that period. Finally, liquid waste fuel consumption rose 32.7%, from 829,000 liters in 2001 to 1.1 million liters in 2011.

A second consideration is the cost of converting cement kilns so that they are more reliant on natural gas than coal during the calcination process[8]. The combustion of natural gas creates far more gas molecules than are created by coal when trying to achieve the same temperature levels. Since all of the raw materials and combustion gases must be contained within the kiln, relying primarily on natural gas as a kiln fuel requires larger kilns to produce the same tonnage of clinker. Given the fact that a new cement plant can cost upwards of $150 million, with the kiln accounting for a significant fraction of that cost, the energy savings would have to be significant to compel cement manufacturers to absorb these conversion costs if they want to take advantage of lower natural gas prices. The fragile state of nonresidential construction markets in the United States, which has weighed heavily on cement demand in the past five years, makes any large capital expenditure even less appealing.

One way in which lower natural gas prices will benefit cement manufacturers is in the industry's electricity spending. This is where we would expect the impact of the North American natural gas revolution to have its largest impact.

### Flat Glass

Flat glass is a product of the float glass manufacturing process that is commonly used as a construction material and automotive component. The flat glass industry is a highly energy intensive. The materials required to manufacture flat glass include silica, limestone, soda ash, dolomite and glass cullet (recycled glass). These materials are fed into a furnace, which melts them at temperatures of 2,700°F and above. The furnace itself is typically fired with natural gas and superheated air or waste gases. Once the materials have melted, the molten glass leaves the furnace and flows onto a bath of molten tin, where

8 Calcination is the process that occurs within the cement kiln whereby the raw cement mix is heated to a sintering temperature, which initiates a series of chemical reactions that transform the original mix into cement clinker.

it gradually cools and spreads out into a ribbon. Due to the high operating temperatures of the furnace, most float lines run continuously for years on end.

The threat of cheap imports coupled with weak nonresidential construction markets have weighed on US flat glass manufacturers for years. Given the important role that natural gas plays in heating the furnace, gas prices should provide some relief to a struggling industry. However, it will not result in a sudden renaissance in US based glass manufacturing.

Fuel and energy costs combined account for around 26% of the total cost of materials consumed by the glass-making industry, and most flat glass facilities are already outfitted to operate on natural gas. Gaining a competitive edge on pricing relative to imports will hopefully lead to an uptick in US based flat glass production, but a lower energy bill will not be enough to incentivize new plant construction.

Although end market demand is expected to gradually improve as the recovery in construction markets slowly spreads to the nonresidential segment, capacity utilization rates for the glass manufacturing industry domestically are well below ideal operating rates. According to the Federal Reserve Board, capacity utilization for the nonmetallic minerals industry—of which glass manufacturing is a major component—stood at 58.9% of total existing capacity in March 2013. In our opinion, lower natural gas prices may give a boost to manufacturers' profits but will not lead to a surge in new capacity additions.

**Steel**

Steel production can be classified by the type of furnace technology and by the mix of input material. In the US, two primary methods are used:

- Basic Oxygen Furnace (BOF): This process uses 5-25% of scrap steel to make new steel, the balance of which is iron ore. The heat source is metallurgical coal. BOFs make up approximately 40% of today's US steelmaking.
- Electric Arc Furnace (EAF): This process uses recycled steel to make new steel. The heat source is electricity. EAFs make up about 60% of today's US steelmaking.

Natural gas has a low impact on the steel industry. Electricity generation makes up a relatively minor share of total production costs for both production methods, so shifts in electricity prices generally have a negligible impact on costs. The area where natural gas prices does hold the promise of lowering the production cost curve is through a shift in the production method toward a third process: greater use of Direct Reduced Iron (DRI). The DRI process involves the production of highly refined iron—typically greater than 90% iron content compared to the typical content of iron ore in the United States used in either BOF or EAF, which is around 40% iron.

Various companies in the United States have announced plans to build DRI plants. If all of these plants are built, they will add 10 million short tons per year of capacity by 2017, and another 10 million by 2020. Nucor's Midrex plant is expected to use 8.9 MMBtu (an MMBtu is equal to 1 million British Thermal Units) of natural gas per ton of DRI. Based on that, Nucor's 20 million additional tons of DRI implies 178 MMBtu of added natural gas demand by 2020.

DRI technology is attractive in any location with low natural gas prices and easy access to iron ore, whether domestic or imported. DRI is important and capacity is likely to grow in Saudi Arabia, Iran, and possibly Venezuela, but no location is as attractive as the United States due to the unique combination of large amounts of cheap natural gas and the world's third-largest steel industry.

Outside of capacity expansions, the US steel industry has been fairly stagnant. The recovery to pre-recession levels of production remains in the distance. Demand from the automotive sector has been the strongest of the major market segments in recent years, but growth rates are slowing. We believe that the construction industry, especially the steel-intensive non-residential construction market—including construction that results from the unconventional oil and gas value chain—will offer tepid growth in the short term and could hold more promise in the long term. Full recovery for the steel industry remains in the distance on a tonnage basis, but the increasing use of natural-gas intensive DRI facilities will lower industry costs and improve long-term competitiveness, providing a long-term opportunity for the industry.

**Tenaris and Borusan-Mannesman to Build Steel Pipe Manufacturing Plants in Texas**

In February 2013, Tenaris, a global manufacturer of steel pipe products used for drilling by the energy industry, announced plans to construct a 1 million square foot steel pipe production facility in Matagorda County, on the Gulf Coast south of Houston. The proposed plant will require a total capital investment of $1.3 billion and is expected to create 600 new permanent jobs once it begins operating. The proposed plant will include a state-of-the-art seamless pipe mill, heat treatment and premium threading facilities. The mill is expected to have an annual capacity of 600,000 tons of pipe.

Borusan Mannesmann Pipe, a Turkish-owned steel pipe maker, will expand its US operations by constructing a steel pipe production facility in Baytown, north of Houston. The proposed plant will require a capital investment of $148 million and is expected to create 250 permanent operating jobs. Borusan Mannesmann's steel pipe is used in oil and gas drilling and transmission, and the company currently produces about 1 million tons of steel pipe products annually. The Baytown facility will produce some 300,000 tons of steel pipe annually, primarily for casings used to secure oil wells and tubing to extract gas and oil from the ground.

In summary, the currently low and stable trajectory of natural gas prices and the associated savings in electricity costs are providing benefits across the manufacturing sector. The opportunity to take advantage of these potential benefits would never have existed without the development of unconventional energy. In addition to the benefits discussed elsewhere in this report for midstream and downstream energy and related chemicals, which are experiencing increased investment and production in the United States, the competiveness of selected domestic manufacturing industries will also be enhanced.