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# The US Energy Revolution: Frequently Asked Questions

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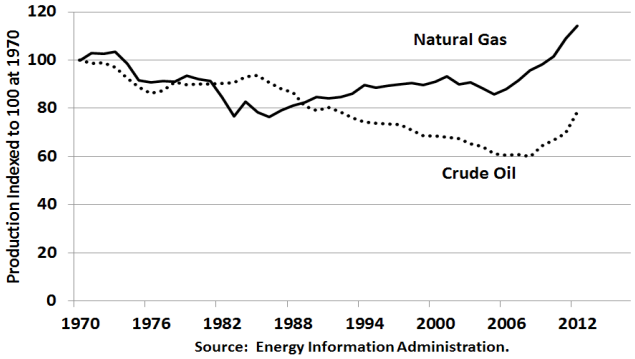
The substantial increase in the supply of energy from the United States is both creating new dynamics in world energy markets as well as providing the US with an economic growth dividend. Since 2005, which we use as our base year since it roughly represents the year before the energy revolution in the US started, crude oil production in the US has increased 29% and natural gas production has grown 33%. The numbers are impressive and they continue to grow.

**Figure 1: US Crude Oil and Natural Gas Production**




Source: Energy Information Administration.

In this report, CME's economists address some of the frequently asked questions (FAQ) regarding the U.S energy renaissance, the macroeconomic impact of abundant energy, as well as global energy market implications.

## Frequently Asked Questions

1. **Is it possible to quantify the growth dividend for the U.S economy from the energy production boom?**

As is the often the case with economic impacts, the indirect effects can be much larger and more powerful over time than the direct effects. This makes quantifying the growth benefits to the US economy of the energy supply boom more of an art than a science. We are seeing new infrastructure being built to move oil and gas production to users. Shifting relative prices have encouraged substitution of one form of energy for another and have stimulated construction, including new industrial plants near the sources of the new supplies, especially natural gas. Natural gas has not generally been considered a transportation fuel, yet its abundance and lower price per BTU is generating greater interest to power bus fleets as well as train locomotives.

Taking a very broad view of the indirect stimulus coming from the new oil and natural gas production, the incremental advantage to the US is probably between 0.5% and 1% of extra real GDP per year, and this energy

growth dividend may last for the next five years or more as production continues to increase, as the distribution infrastructure is built, and as industrial users make new investments and build new plants to take advantage of the energy boom.

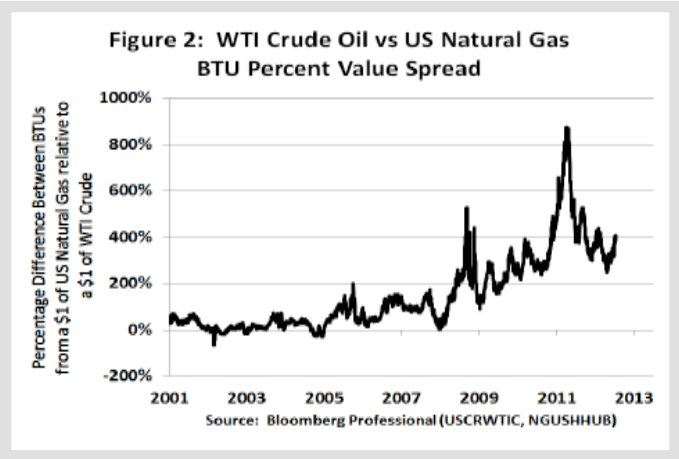
As noted, our energy growth dividend assessment is more of a back of the envelope calculation than a detailed quantification. Some energy analysts would go with a higher impact, while some traditional macroeconomists are on the lower side. No one, however, is downplaying the long-term importance to the US economy.

2. **The abundant supplies of shale gas have significantly pushed down the price of natural gas in the US. In fact, the amount of energy content per $1 of WTI crude is significantly less that the amount of energy per $1 of natural gas in British Thermal Units (BTU). How is the BTU pricing gap likely to evolve over time?**

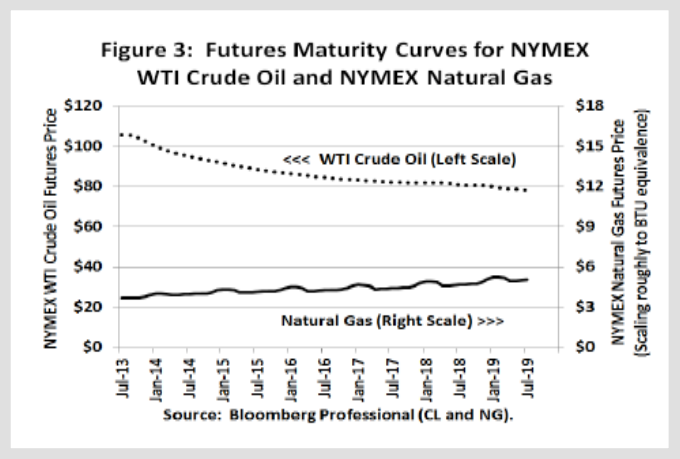
The oil and gas production increases initially far outpaced the ability of the then existing distribution system to move the product to the locations necessary to obtain the most efficient use and higher prices. Thus, crude oil inventories accumulated at storage centers in the Midwest, such as Cushing, Oklahoma, while natural gas prices dropped precipitously to encourage greater consumption closer to the sources of the new production. This opened up the BTU pricing gap. At the low point for natural gas prices in the US in 2011, $1 spent on natural gas could have bought eight times the BTUs of a $1 spent on WTI crude.

Building an expanded distribution infrastructure is expensive and involves extensive planning and environmental approvals, so the process takes years.

Nevertheless, the distribution infrastructure for both oil and gas has made great strides in the last few years, and as noted in the discussion in the previous Q&A, giving the economy a solid boost. The lower section of the Keystone pipeline from Oklahoma to the Gulf Coast is under construction. The Seaway pipeline, which once moved crude oil north from Texas to Cushing, OK, has been reversed and now feeds oil to the Gulf Coast. Other pipelines have been upgraded to expand capacity. Trains now carry a significant amount of oil from the Bakken fields in North Dakota and Montana to refineries on the East and Gulf Coasts. And, more infrastructure upgrades are in the works. As the distribution system has improved, the BTU pricing gap has narrowed, although in the US, a dollar spent on oil still gets only a quarter to a third of the BTUs of a dollar spent on natural gas.

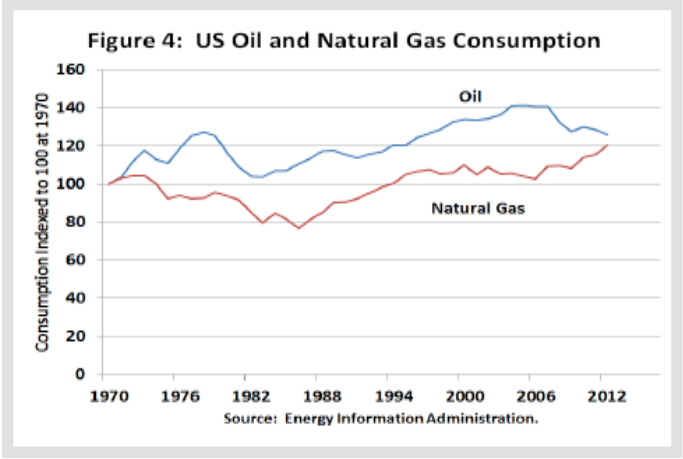



Over time, the BTU pricing gap is likely to narrow further, although it is not so clear which prices will do the adjusting. The NYMEX maturity curve for WTI crude oil futures currently implies a significant drop in the price of oil over the next six years, while the NYMEX maturity curve for natural gas futures implies rising natural gas prices. Even after six years, however, the implied BTU pricing gap would still be quite large.



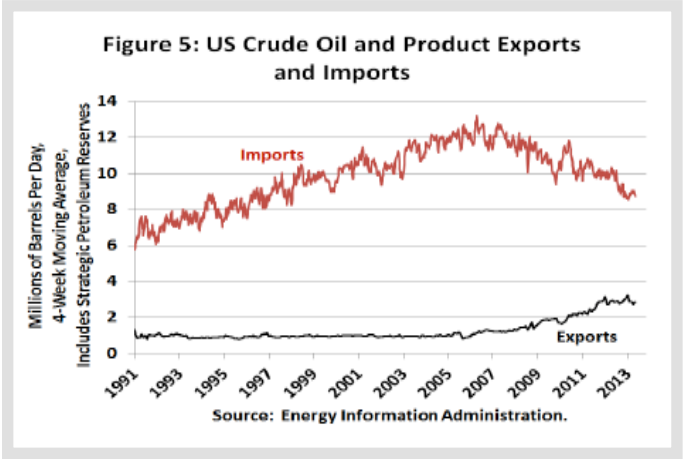

### 3. How has the US energy production boom impacted trends in consumption?

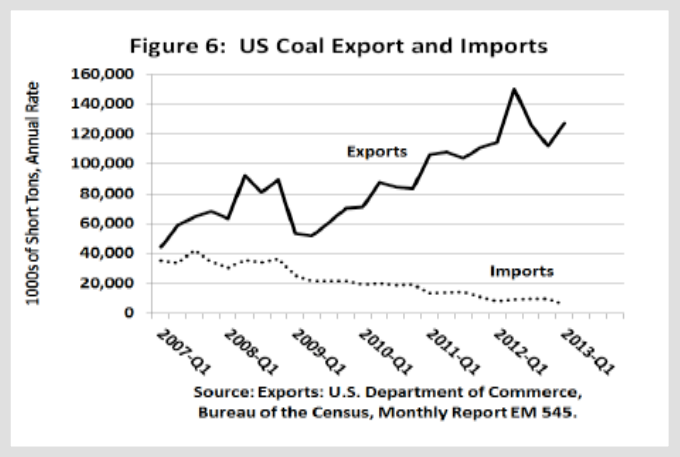
Consumption trends have been quite interesting. US oil consumption has actually been declining during the last five or six years just as oil production has increased. The opposite pattern has occurred with natural gas, with consumption rising more or less in tandem with increased production. The reasons have to do with relative prices and environmental issues. As noted in the previous Q&A, compared to crude oil, natural gas is now much cheaper in terms of a BTU of energy. Natural gas is also a cleaner burning fuel than coal. Because of the relative price difference in favor of natural gas, there has been a tendency to consume the additional natural gas domestically, at the expense of crude oil where possible. In the electrical power generation industry, cleaner burning natural gas has been aggressively substituted for coal.




### 4. How has the increased US energy production affected trade patterns?

As might be expected, the primary initial impact of rising US energy production on import and exports was to lower crude oil imports into the US. Since the additional natural gas production has largely been consumed domestically, partly at the expense of coal consumption for electrical power generation, exports of coal also have increased rather sharply. Indeed, coal exports were up over 100% in 2012 compared to 2007.






### 5. What are the prospects for US energy independence and how do regulatory issues impact the discussion?

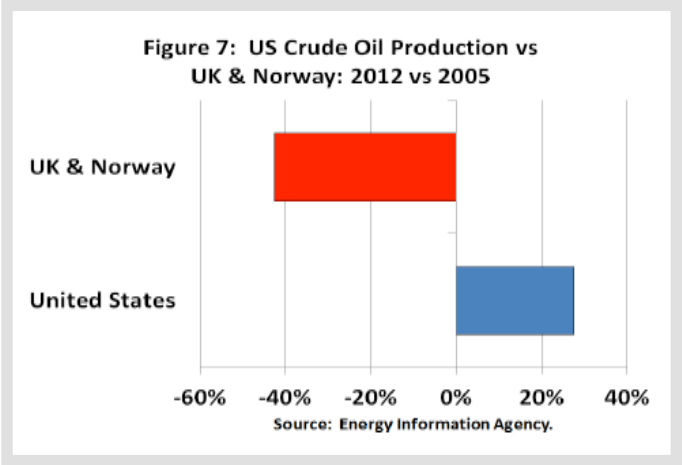
US energy independence may be a fun political topic, but energy independence is not particularly close at hand. And, since it will be much more efficient to continue to import certain energy supplies, what is at stake is the US energy import/export gap, which certainly has narrowed considerably. Moreover, for geo-politics, it is the crude oil import-export balance that matters most. In terms of oil, the US is nowhere near the point where exports would equal imports. Domestic production would have to nearly double to achieve net import/export neutrality, and that assumes continued declines in domestic oil consumption.

Moreover, there are three regulatory issues that loom large in the discussion of US energy independence. First, there is the question of whether the section of the Keystone pipeline to bring crude oil from northern Canada to the US and ultimately the Gulf Coast will be approved and built. Second, there are a variety of restrictions on the export of liquefied natural gas (LNG) although some permits are being issued to convert import facilities to export facilities. And third, there is the Jones Act that regulates the use of foreign ships used in exporting domestic products. All of these issues are contentious and complicated. In general the LNG export restrictions and the Jones Act work to limit US exports. This has the potential to make global pricing less efficient while providing some security benefits from lowering the dependence on non-US energy sources. The Keystone pipeline from Canada is a hot button political issue in both the US and Canada. The trade-off is jobs in the US from building the pipeline relative to concerns about the environmental impact from the source of the oil and its production methods in the north of Canada. Canada appears committed to find alternative ways to move its oil to market, should the US not approve the construction of the pipeline, but this is not a given. An alternative pipeline exclusively in Canada would also face environmental opposition. Rail transport is more expensive than pipelines (once they are built), although the relative safety record is up for debate. For the most part, these are long-term issues, and as they play-out we will incorporate them into our analysis.

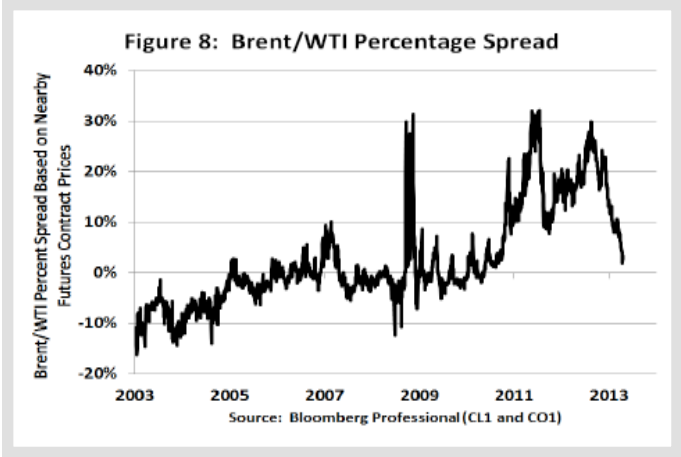
### 6. The WTI-Brent spread receives intense focus in the energy community. How has the US energy boom impacted the Brent-WTI spread?

There are two primary issues for the Brent-WTI spread. First, there is the relative supply issue. US WTI and related crude oil production is increasing. UK and Norwegian crude oil production from the North Sea (Brent) is declining. As earlier, we focus on the period from 2005, which roughly dates when the US energy revolution began. New crude oil supplies in the US, however, did not unambiguously overwhelm the distribution system until early 2011. Also, one cannot forget, as well, that oil production is increasing in

the Middle East (Iraq and Libya are back online), the Russian Federation, and China. Oil is a global market.




These supply shifts are overlaid on the second issue, discussed earlier, of infrastructure and distribution bottlenecks. Effectively, and with the benefit of hindsight, the spread that opened up between Brent and WTI in 2011 and 2012 reflected the inability to get a portion of the increased North American mid-continent crude oil production onto world markets so it could compete with Brent. To equilibrate prices, adjusted for crude oil type, quality, dependability of delivery, etc., all that is needed is that the marginal oil from each source makes it to competitive markets. The amount of marginal oil needed to equilibrate world oil markets is relatively small compared to total oil production. So the key is whether the marginal oil can get to competitive markets, which can choose easily between energy sources. US East Coast refineries, for example, can get their oil by pipelines and trains from the US Midwest, or by ship from the North Sea or Middle East. And oil markets are truly global, so it is not just the points of US competition that are key. China can potentially source oil from the Middle East or from North America. Continental Europe can source its energy needs from the North Sea, the Middle East or the Russian Federation and related republics. Current price trends suggest the Brent-WTI pricing gap has largely, if not completely, been resolved and it is not likely to reappear at the 2011-2012 levels again.




### 7. How is the natural gas production boom in the US likely to impact natural gas prices around the world?

Natural gas is typically distributed by pipelines or liquefied and transported by very large ships. The dominance of pipelines in the distribution system makes it hard for the global supply of natural gas to equilibrate as well as it does with crude oil. For example, the US uses pipelines to import natural gas from western Canada, and other pipelines to export natural gas to eastern Canada and to export gas from Texas to Mexico. Russia moves its gas to Europe through pipelines. Increased natural gas production from the Middle East is more likely to be liquefied and shipped.

Eventually, the local nature of natural gas pricing may give way to a more global market, but big price differences currently prevail. Natural gas is four times more expensive in Europe than in the US, and even more expensive in Japan. Also, as noted in the section above on US energy independence and regulatory issues, the

US has a number of important constraints preventing large scale exports of natural gas from the US.

In Europe, there is a pricing battle that is developing, more from non-US sources. Russia's Gazprom typically prices natural gas as a spread to Brent in its long-term contracts. Norway's Statoil is experimenting with more flexible natural gas contracts not tied to Brent. As sources from all over the world compete to provide liquefied natural gas to Europe (i.e., from the Middle East, increased gas production from Norway, as well as US), the Europe-US natural gas price gap should narrow. The Russian government gets a huge percentage of its revenue from energy taxes and fees, so it is intricately involved in the natural gas pricing debate. The process of getting the marginal natural gas to competitive market points, however, will take decades rather than years, until liquefied natural gas becomes a viable option in a number of local markets, making the whole pricing process more globally integrated.

**8. With more energy production in North America, is it possible that the market impact of geo-political disruptions become less important?**

One of the hard to quantify implications of the US and Canadian energy boom is whether it makes global oil markets less susceptible to large price shocks from geo-political events. Our perspective is that an increased supply from sources that are considered more stable should lessen the shock effect from a geo-political disturbance, say, emanating from the Middle East. We do not want, however, to overstate this case. As we have argued in previous Q&A, what matters in terms of setting global market prices are the competition points for the marginal supply and demand of oil. A disturbance in Egypt, which is not a major producer of oil, is not going to have the impact of a disturbance in Iraq or Iran. Indeed, the continued ability of Saudi Arabia to serve as a buffer producer probably will have more long-term impact on the impact of geo-politics on global oil pricing than the increased US supply. And, in the long-run, the shifts in demand, with China drawing ever more heavily on Middle East oil, while the US becomes less reliant on this source, may well have political dimensions that are at this stage very hard to decipher.

**9. Has there been an impact on US inflation from the energy boom?**

The increased production of both crude oil and natural gas in the US probably has contributed to the subdued inflation rates of the past few years, although the depth of the financial recession was far and away a more important factor. For our analysis, we need to go back to the discussion of the BTU pricing gap, the Brent-WTI spread, and the building out of the US distribution infrastructure. To the extent that energy sources are not priced on world markets, then US inflation has been slowed due to the increased supplies to a greater extent than might otherwise have been the case. As the Brent-WTI spread disappears and the BTU pricing gap between natural gas and oil narrows, the inflation benefit is reduced, and it was probably relatively small to begin with in terms of the whole of the US economy.

One area, though, where natural gas has impacted specific prices, if not general inflation is in the electrical power sector. Natural gas is generally used by many electrical power producers as the marginal fuel. Our analysis has found that the relationship between natural gas prices and power prices has been changing since approximately 2008. Gas prices have been having increasing influence on power prices, and this trend is

only getting stronger. Hence, fluctuations in natural gas prices can impact electrical power rates to consumers, with a lag and with considerable slippage given the regulatory processes that help to set electricity rates. Keep in mind, though, that power production in the U.S is extremely regional – with different load profiles, seasonal trends and generation capacity in different regions (or ISO – Independent System Operator) of the country.