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ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

November 4, 2014

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Note*: Musings from the Oil Patch reflects an eclectic collection of stories and analyses dealing with issues and developments within the energy industry that I feel have potentially significant implications for executives operating and planning for the future. The newsletter is published every two weeks, but periodically events and travel may alter that schedule. As always, I welcome your comments and observations.* Allen Brooks

Being Late For Closing Barn Doors Makes Forecasting Hard

Many of the companies significantly damaged price-wise were perceived as prime beneficiaries from continued high oil prices

The carnage from falling global oil prices is felt throughout the stock market. Energy producers have suffered the brunt of the damage inflicted by the 20+% drop in Brent and West Texas Intermediate (WTI) oil prices since last June, but other energy subsectors have been hurt, too. Many of the companies significantly damaged price-wise were perceived as prime beneficiaries from continued high oil prices such as renewable energy companies, offshore drillers and energy equipment suppliers. The near-term beneficiaries from falling oil prices have been those companies who are big consumers of energy such as airlines or users of petroleum products in their manufacturing processes such as chemical companies and plastics manufacturers.

Without a healthy Europe, Saudi Arabia and its fellow Middle East OPEC partners, face a tougher time holding on to their share of global export volumes

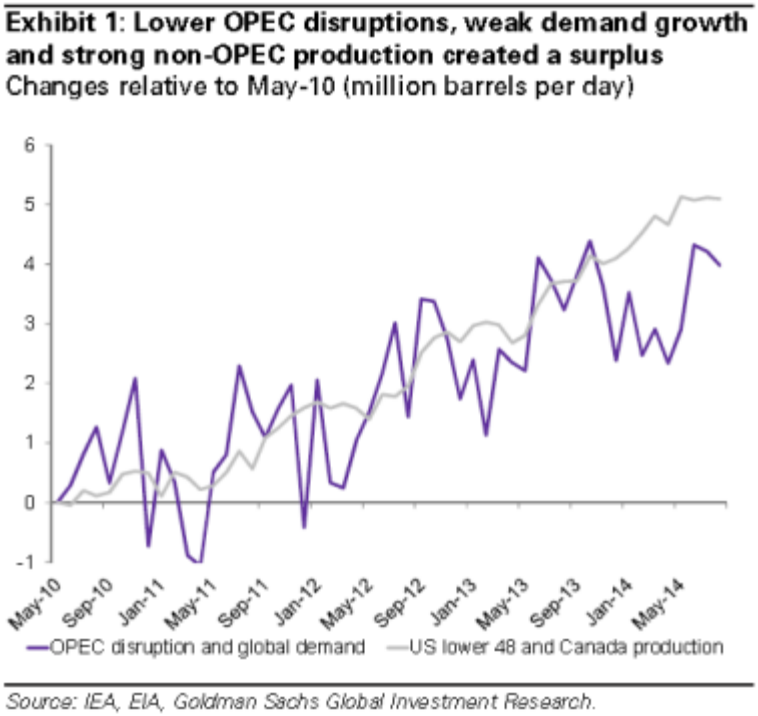
In our last *Musings*, we wrote about the challenge of falling oil prices that appeared to be driven by the desire of Saudi Arabia to shut down the growth in non-OPEC oil supply to improve the competitive position of OPEC's output. In the geopolitical arena of what lies behind Saudi Arabia's motivation to cut its export price for a barrel of crude oil rather than to strike a deal with its fellow OPEC members to cut the group's output to support high prices, we explored a half dozen theories. The one we settled on as having the greatest credibility, in our mind, was the idea that Saudi Arabia has become quite concerned about the weakening economic landscape of Europe, a major export market for OPEC crude oil. Without a healthy Europe, Saudi Arabia and its fellow Middle East OPEC partners, face a tougher time holding on to their share of global export volumes. In the U.S., Saudi Arabia is competing against the growing volume of tight and shale oil output, while in Asia, the demand depends on the fortunes of China that has been buying not only for current consumption, but also to fill its strategic storage reserve. The problem is that with shrinking U.S. and European oil

markets for Saudi exports, Asia is rapidly becoming overly competitive forcing the Kingdom to increasingly compete on price.

The other factor that played into this assessment was the timing of the Saudi Arabia announcement, which came almost immediately after the decision by the EU to not classify Canada's oil sands output as "dirty" oil

What we perceived to be behind Saudi Arabia's price cutting actions and its subsequent announcement that it was prepared to accept lower prices, potentially in the $80 to $90 per barrel range, for up to two years was our belief that it might take up to two years of low oil prices to eventually restore Europe to an economic growth path that would lead to higher oil consumption, and correspondingly greater imports. The other factor that played into this assessment was the timing of the Saudi Arabia announcement, which came almost immediately after the decision by the European Union (EU) to not classify Canada's oil sands output as "dirty" oil. That classification would have limited oil sands' ability to gain access to the European market. We saw these two items as closely aligned. Without resurgent European oil demand and a favorable classification for oil sands bitumen, the cheaper Canadian oil would take market share from OPEC, and especially Saudi Arabia, unless their high oil price umbrella was lowered below the marginal cost of oil sands output.

Exhibit 1. Supply And Demand Going In Opposite Directions



Source: Goldman Sachs

Last week, the venerable investment bank and commodity trading firm, Goldman Sachs (GS-NYSE), announced it was reducing its 2015 crude oil price forecast due to a reassessment of the fundamentals underlying the global oil market. The firm is now

Goldman believes that the weakest period will be the second quarter of 2015 when it sees WTI averaging only $70 a barrel

calling for WTI to average $75 a barrel in the first quarter of 2015 and during the second half of 2015. This price is down from their previous estimate of $90 a barrel. Importantly, Goldman believes that the weakest period will be the second quarter of 2015, the traditional shoulder months when winter demand ends and before the driving season boosts oil consumption, when it sees WTI averaging only $70 a barrel. Part of Goldman's thesis for 2015 is that 2015's second quarter will represent the period when the global oil over-supply will be the greatest. Goldman anticipates that by 2016 the slowdown in U.S. shale oil production growth will be apparent and that there will be moderate cuts to OPEC production, presumably in late 2015. If these two events transpire, oil prices should begin climbing. Those two conditions represent big "Ifs" and certainly are not bankable events.

The Goldman oil price outlook is predicated on changes to the global oil market that it claims forces a re-examination of the dynamics underlying the market. These changes include:

- "We have greater confidence in the scale and sustainability of US shale oil production. This implies that the global cost curve has shifted lower and that cost deflation is sustainable.
- "We forecast that accelerating non-OPEC production growth outside North America will outpace demand growth, leaving the global oil market oversupplied.
- "We believe that OPEC will no longer act as the first-mover swing producer and that U.S. shale oil output will be called upon to fill this role."

According to the Goldman report, average wells in the Eagle Ford, Bakken and Permian Basin shales may attain an estimated 11% internal rate of return on investment at WTI prices of $70-$80 a barrel

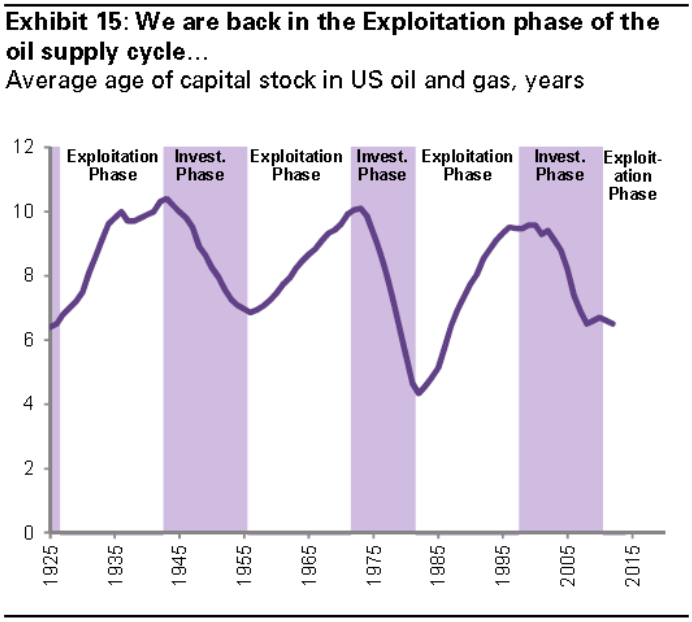
Goldman believes that the oil price needs to decline to a level that will significantly slow the growth in oil shale production, and for them that price is $75. According to the Goldman report, average wells in the Eagle Ford, Bakken and Permian Basin shales may attain an estimated 11% internal rate of return on investment at WTI prices of $70-$80 a barrel. Possibly more significant, the Goldman oil analysts believe that the industry will face a funding gap at WTI prices below $80 a barrel. That point goes to the debate over whether shale exploration and production companies are profitable while still being capable of growing their production. For Goldman, it would seem their analysts believe that companies will neither be able to grow production nor sustain current output volumes. Therefore, with WTI oil prices falling to $75 a barrel, domestic oil output will start falling short of the estimated growth projections of 1.0-1.1 million barrels per day, the pace of supply growth in recent years. Goldman believes that within 4-6 months after drilling rigs are laid down, shale production will be falling and that output decline will eventually contribute to balancing the global oil market supply and demand parameters. In Goldman's view, American shale oil has

now become the global marginal barrel, taking over that global pricing lever from OPEC. One wonders whether that means we return to an oil-pricing dynamic that existed in the 1960s before U.S. production peaked and global oil pricing power was transferred to OPEC.

For analysts, the game changed quickly from: at what oil price does the decline stop, to now guessing what the damage from the oil fall will be

The Goldman view is similar to a recent item from energy investment banker Tudor Pickering & Holt (TPH) where their analysts have begun running models of shale drilling economics and production outlooks in an attempt to identify when and how many drilling rigs will be let go with falling oil prices and what that means to future oil production growth estimates. According to their analysis, "our macro model called for a 2015E 850-900 mbopd [thousands of barrels of oil per day] of oil growth. TPH['s] full year production impact of these ~190 "rigs at risk" is ~215 mbopd oil, ~500 mmcfe/d gas [millions of cubic feet equivalent per day], and ~52 mbopd of NGL associated production are quantified as at risk." For analysts, the game changed quickly from: at what oil price does the decline stop, to now guessing what the damage from the oil fall will be.

Exhibit 2. New Industry Phase Signals Spending Changes



Source: Goldman Sachs

Suggesting that oil was "going the way of whale oil"

We are not sure that the game has changed as much as Denis Gartman of the *Gartman Letter*, a commodity trading advisory service, suggested. He was interviewed on CNBC a week ago last Monday afternoon suggesting that oil was "going the way of whale oil" and that the price decline would be "demonstratively" lower than most expected. It seems that during his vetting by the show's producer, he told the producer that the price of oil could fall to $10 a

Mr. Gartman's comments confirm that the energy industry analysis business has now officially entered the "silly season"

barrel, a level he refused to restate on the air when challenged to "go on the record" by the anchor. Mr. Gartman's comments confirm that the energy industry analysis business has now officially entered the "silly season" where claims and forecasts become more outrageous in order to generate attention for the speaker. The Goldman report came out the same day Mr. Gartman was on the air. As several old, experienced energy analysts we were dining with that night suggested, "Goldman always gets it wrong." We are not sure we can substantiate that claim, but since we aren't making it we don't need to prove or disprove it.

We are surprised the E&P companies would move quite as quickly on the cost side, but that may be a confirmation of the financial stress the shale revolution has created for producers

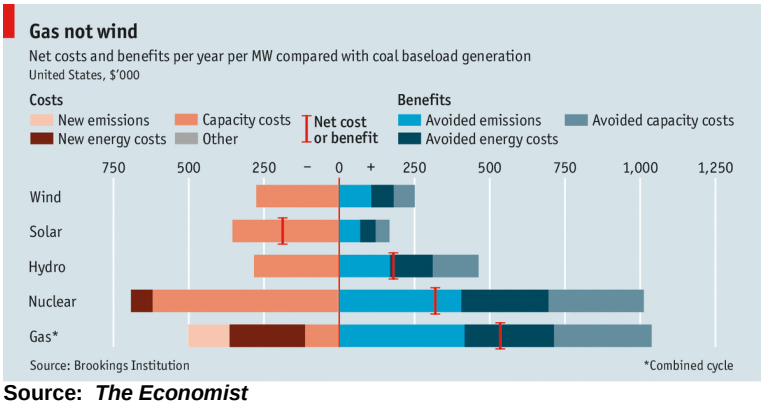
Goldman's report suggests that the oil industry is undergoing a fundamental transition with major implications and potential unintended consequences for it and the global economy. We don't disagree that there will be changes to the oil industry, which are largely tied to the maturing of the great American shale revolution. Trying to understand these changes and their future implications now becomes very important. According to THP, E&P companies are supposedly sending letters to their service company providers seeking price relief to help offset the WTI oil price decline. We are surprised the E&P companies would move quite as quickly on the cost side, but that may be a confirmation of the financial stress the shale revolution has created for producers, especially for those companies that have had to borrow substantial sums to exploit their acreage holdings. If the industry was as profitable as many analysts suggest, then we would have anticipated them waiting to see whether the oil price stayed down for an extended period before calling for service company price reductions. If this information is right, then one has to wonder whether the petroleum industry believes it is on the brink of a greater oil price decline than currently anticipated, or they expect this current decline to last much longer than generally anticipated. Then again, maybe managers are just scared. Remember, there are many new CEOs in the corner offices of energy companies, so do they have to make their own mistakes and misjudgments as their predecessors did early in their careers?

Renewables Subsidy Battle Restarts; Economics Still Muddy

The result of Dr. Frank's work was that renewables were judged to be much more expensive than fossil fuel-generated electricity, even after their full environmental benefits are included

Last summer, *The Economist* published an article discussing the economics of various energy sources that stirred up a controversy. The article, "Sun, wind and drain," focused on an analysis of several forms of energy that were ranked based on a cost-benefit analysis that attempted to take into account all the costs and benefits of each source of power. The report was prepared by Dr. Charles Frank of the Brookings Institute and was based on previous work by Dr. Paul Joskow of the Massachusetts Institute of Technology who criticized the traditional way in which power sources are judged, which is their levelized cost. The result of Dr. Frank's work was that renewables were judged to be much more expensive than fossil fuel-generated electricity, even after their full environmental benefits are included.

Exhibit 3. Natural Gas Wins Over Renewables



Source: ***The Economist***

Important shortcomings with the levelized cost analysis, in particular with the failure to account for the costs associated with "intermittency" when dealing with renewables such as solar and wind

The use of levelized cost as a method for comparing the cost of electricity over time is a convenient way in which power providers can assess which energy source to employ when they are considering building new power plants. The concept of levelized cost is to calculate the net present value of all costs – capital and operating – for a generating unit over its lifetime, divided by the number of megawatt-hours of electricity expected to be generated during the life-cycle. According to Dr. Joskow, there are some important shortcomings with the levelized cost analysis, in particular with the failure to account for the costs associated with "intermittency" when dealing with renewables such as solar and wind. The cost of building, operating and maintaining backup conventional power plants to provide power during the periods of renewable-intermittency is not included in the calculation of the levelized cost for renewable power.

This hourly-variability is extremely important when considering the value of the electricity generated by wind and solar power units

As Dr. Joskow points out, electricity demand varies by the hour during the day, which makes the ability to deliver electricity when it is in high demand that much more valuable than an hour of power when demand is low. This hourly-variability is extremely important when considering the value of the electricity generated by wind and solar power units. So even if renewables and traditional fossil fuel power have similar levelized costs, the value of the power may be quite different.

In certain sunny locations, such as the desert Southwest, solar power is providing electricity to the power grid as cheaply as conventional coal- or gas-fired power plants

The Economist article focused on the fact that renewable power costs have been falling in recent years, in particular solar power. As the article stated, the cost of photovoltaic panels have fallen in half since 2008 and the capital cost of solar-power plants, of which panels represent about half the cost, are down 22% in 2010-2013. We know that in certain sunny locations, such as the desert Southwest, solar power is providing electricity to the power grid as cheaply as conventional coal- or gas-fired power plants. Of course, the tax subsidy for these renewable power plants is an important consideration in their economics. As a result, policy makers are beginning to ask the question of whether renewables should

continue to be subsidized or whether these energy sources have reached the point at which they can compete on their own economics.

A nuclear power plant that operates at about 90% of capacity utilization will avoid nearly four times as much carbon dioxide per unit of capacity as do wind turbines that run at about 25-30% of capacity, and nearly six-times as much as a solar plant

Dr. Frank used his cost-benefits analysis approach to rank the cost of four zero-carbon energy sources (solar, wind, hydroelectric and nuclear) plus a low-carbon fossil fuel (natural gas combined-cycle power) against various sorts of traditional fossil fuel-powered plants. One measure of the competitive cost-benefits of these power sources is environmental. Obviously, low- and no-carbon power plants do not avoid emissions when they are not working, though they do incur some operating costs. A nuclear power plant that operates at about 90% of capacity utilization will avoid nearly four times as much carbon dioxide per unit of capacity as do wind turbines that run at about 25-30% of capacity, and nearly six-times as much as a solar plant. If, as Dr. Frank assumed, a ton of carbon was priced at $50, (this is well above the price of carbon in the nescient cap-an-trade markets) then a nuclear plant would avoid about $400,000-worth of carbon emissions per megawatt (MW) of capacity versus about $70,000 for solar and $107,000 for wind. Of course, nuclear power plants are very expensive to build, but they do operate at such a high capacity rate, which makes them only about 75% more expensive to build and operate per MW of capacity than a solar-power plant.

A 1MW wind farm running at 25% of capacity can replace only about 0.23MW of a coal plant operating at 90% of capacity

One of Dr. Frank's key assumptions is that the analysis needs to account for what he calls "avoided capacity costs," which are the costs for keeping fossil-fuel plants that have to be maintained for those times when solar and wind plants remain idle and would not have been incurred had the green-energy plants not been built. He calculates that a 1MW wind farm running at 25% of capacity can replace only about 0.23MW of a coal plant operating at 90% of capacity. As solar farms operate at only about 15% of capacity, they will displace even less of a traditional power plant. In Dr. Frank's analysis, seven solar plants or four wind farms would be needed to produce the same amount of electricity over time as a similar-sized coal-fired power plant. This means we need to build much greater wind and solar power capacity in order to meet the power output from a traditional power plant, and that extra green-energy capacity has a significant cost associated with it.

They claimed that he used outdated data in his calculations that skewed the results in favor of traditional energy

Dr. Frank's cost estimates for renewables drew considerable criticism from proponents of green-energy. They claimed that he used outdated data in his calculations that skewed the results in favor of traditional energy. One of the more prominent critics of the analysis and of *The Economist* for publishing an article about Dr. Frank's study was Dr. Amory Lovins, the chairman and chief scientist of the Rocky Mountain Institute, a non-profit organization in Colorado.

Dr. Lovins' central criticism of Dr. Frank's study was that the capital cost estimates for solar and wind power are really about half of the costs he used

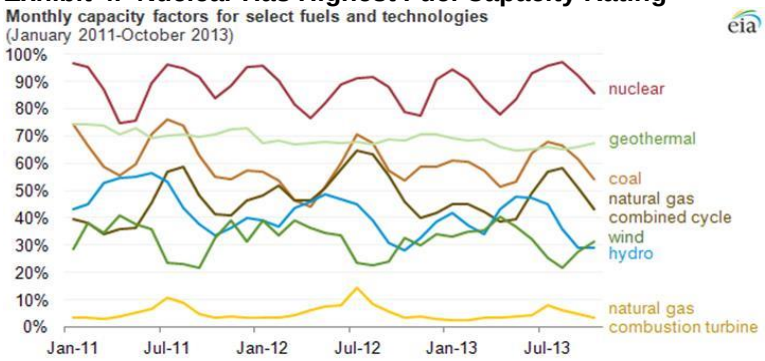
Dr. Lovins' central criticism of Dr. Frank's study was that the capital cost estimates for solar and wind power are really about half of the costs he used. By using these lower capital cost figures, it would make solar and wind power look more efficient than other technologies, not less as suggested by Dr. Frank's study. Dr. Lovins cited figures for the capital cost of solar that came from the U.S. Department of Energy (DOE). These figures show that the weighted average capital cost of 113 utility-scale solar projects completed in 2012 was $3,900 per kilowatt (KW). It turns out that Dr. Frank used an estimated cost figure provided by the Energy Information Administration (EIA), an arm of the DOE, of $3,873 per KW.

With respect to the estimated capital cost for wind power, Dr. Lovins also cited the DOE and its *Wind Technologies Market Report*, which calculated the weighted average capital cost of 118 wind projects in 2012 to be $1,940 per KW. Again, Dr. Frank relied on EIA's estimate that the figure was $2,213 per KW, some 14% higher but not the 100% higher that Dr. Lovins suggested in his criticism.

These latest capacity factors do make wind and solar look better, as suggested by Dr. Lovins, but not that much better than how they fared in Dr. Frank's original study

At the time of Dr. Frank's study, the latest *Annual Power Report,* published by the EIA in December 2013, and upon which he relied, did not give actual capacity factors for wind and solar power. The EIA report only estimated the capacity factor, which Dr. Frank used for his estimates. Since then the EIA has begun publishing monthly capacity factors for wind and solar, along with all other sources of power generation. These latest capacity factors do make wind and solar look better, as suggested by Dr. Lovins, but not that much better than how they fared in Dr. Frank's original study.

Exhibit 4. Nuclear Has Highest Fuel Capacity Rating



Source: EIA

Dr. Frank has redone his analysis using the 2013 actual capacity figures published by the EIA, rather than their estimated numbers. In his original paper, Dr. Frank calculated that the overall costs, offset by the benefits, of solar power were $188,800 per MW per year more than a similar-sized coal plant. Now, by utilizing the updated numbers, Dr. Frank finds solar's net cost to be only $158,800 per MW per year, compared with coal, a $30,000 improvement from his original estimate. It is still a net cost.

While the new figures reduce the benefits of the other technologies and improve the efficiency of renewables, the results do not alter the rankings

In the original study, Dr. Frank estimated that wind energy cost $25,300 per MW per year more than coal. In the new analysis, those net costs become net benefits, to the tune of $31,200 per MW per year cheaper than coal. Even so, wind and solar is still at a disadvantage with the alternatives that Dr. Frank considered. Compared with coal, hydropower is $156,800 per MW per year cheaper using the new numbers, where it had been $180,400 cheaper before. Nuclear power is $261,300 cheaper compared to $318,600 earlier. And natural gas combined-cycle power is $476,600 cheaper, but $59,400 per MW less than the earlier estimate. While the new figures reduce the benefits of the other technologies and improve the efficiency of renewables, the results do not alter the rankings. Natural gas combined-cycle, nuclear and hydropower are still more cost-effective at reducing emissions than wind and solar, and the gap between them remains fairly large.

Another critic of Dr. Frank's study and *The Economist's* article, was Michael Goggin of the American Wind Energy Association (AWEA) who blogs on their web site. He wrote a blog headed: "Fact Check: Wind power is a cost-effective way to reduce emissions." In his opening paragraph, he writes, "the paper [Dr. Frank's study] is plagued by inaccurate data inputs and assumptions that greatly skew the results against wind energy. Once those errors are corrected, the paper shows wind energy to be a highly cost-effective energy source that greatly benefits consumers and the environment." He then proceeds to point out "incorrect" data and assumptions made by Dr. Frank.

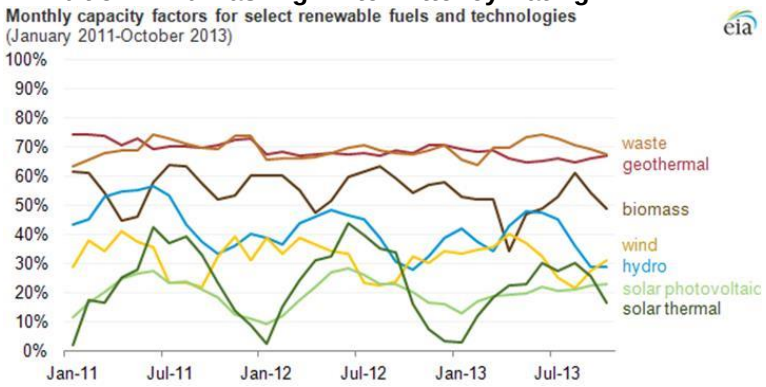
Mr. Goggin points to the DOE's data for the average of 2008-2012 showing wind's capacity factor at 31% and natural gas combined-cycle's at 44.2%

The first statistical assumption he attacks was Dr. Frank's use of a 25.5% capacity factor for wind and a 92% capacity factor for natural gas combined-cycle power. Mr. Goggin points to the DOE's data for the average of 2008-2012 showing wind's capacity factor at 31% and natural gas combined-cycle's at 44.2%. That translates into a 21% under-estimate for wind and a 108% over-estimate for natural gas combined cycle versus Dr. Frank's estimates. Starting in December 2013, the EIA began publishing monthly capacity factors for 16 fossil and non-fossil fuel and technology combinations. We show the latest capacity factor data displayed in EIA charts for a range of fossil and non-fossil fuels (Exhibit 4) and also for renewable energy and technologies (Exhibit 5).

They are designed to run in a base-load mode at 70% or more of their rated capacity

A review of the chart in Exhibit 4 shows an interesting pattern that significantly impacts the average capacity factor for natural gas combined-cycle power plants. We did some research on the expected and actual capacity for these gas-fired plants. They are designed to run in a base-load mode at 70% or more of their rated capacity. However, because these are the most efficient power plants for starting and accelerating to optimum output quickly, they are the preferred utility backup power plant for renewable fuels with their high intermittency factors. If one examines the history from January 2011 through October 2013, natural gas combined-cycle

Exhibit 5. Wind Has High Intermittency Rating



Source: EIA

plants have ranged in capacity from the mid-30% to 65%. There were several times when those plants averaged near or above 60%. What is important to note is that those peak capacity rates were at the exact times when wind capacity was close to 20%, not the 31% citied by Mr. Goggin, showing that combined-cycle plants are really used in tandem with renewables rather than for base-load power.

Those peak capacity rates were at the exact times when wind capacity was close to 20%

Mr. Goggin also challenged Dr. Frank's use of an estimate of $2,213 per KW for installed wind power cost. That estimate was higher than the DOE's 2012 data showing an average cost of $1,940 per KW. It is much higher than a preliminary 2013 DOE estimate Mr. Goggin cited of $1,630 per KW. Mr. Goggin also challenged Dr. Frank's use of only a 20-year life for wind projects when "25 years is the more commonly used standard assumption…" Clearly, Dr. Frank's assumptions would make wind power less competitive. However, in a review of the latest 2013 estimates from the DOE of power plant capital and operating costs, onshore wind is assigned a cost of $2,213 per KW in 2012 dollars.

Mr. Goggin also challenged Dr. Frank's use of only a 20-year life for wind projects when "25 years is the more commonly used standard assumption…"

As for the life of wind turbines, a 2012 study of almost 3,000 onshore wind turbines in the UK, conducted for the Renewable Energy Foundation, an opponent of wind farms, by Professor Gordon Hughes, an economist at Edinburgh University and a former energy advisor to the World Bank, showed them having a life span of 12-15 years as opposed to the wind energy's and UK government policymakers' assumptions of 20-25 year lives. Wind Measurement International says that the lives of wind turbines should be planned for 20 years to ensure that all the components will last and perform for at least two decades. In fact, they state on their web site that "The components of a wind turbine are typically designed to remain operational for twenty years. It would be quite easy, and hardly any more expensive, to design and build some of the components to remain operational for far longer. However, because most of the major components would be very expensive to build for a longer life span, it would be a waste to have a whole turbine standing idle because one part failed years earlier than the rest."

Wind Measurement International says that the lives of wind turbines should be planned for 20 years to ensure that all the components will last and perform for at least two decades

Older wind turbines are being replaced before they achieve their target life span

Other studies we consulted suggest that given the evolution of technology and the push to increase the size of wind turbines to reach more stable wind flows at higher elevations in order to improve the turbines' cost per KW and reduce the physical size of wind farms, older wind turbines are being replaced before they achieve their target life span. That boosts the lifetime capital cost of wind farms well beyond what was originally projected.

Wind has a levelized cost of electricity of $80.3 per KW compared to natural gas conventional combined-cycle's cost of $66.3

While everyone acknowledges that renewables have lowered their costs in recent years, their levelized costs remain well above those of other fuels. If we compare the most recent cost estimates employed in the EIA's *Annual Energy Outlook* studies, we see this improvement, but also the competitive fuel challenges. In Exhibit 6, we show the table of levelized cost of electricity assumptions utilized by the EIA in preparation of the AEO report for 2014. These assumptions are for the estimated costs for energy sources and electricity technologies in 2013 for plants that will go into service in 2019, all based on 2012 dollars. We find it interesting that the EIA puts the capacity factor for natural gas combined-cycle plants at 87%, the third highest capacity factor behind geothermal (92%) and advanced nuclear (90%). Wind has a capacity factor of 35% assigned to it. As a result of the capacity factors along with the estimated capital, repair and maintenance, and transmission costs, wind has a levelized cost of electricity of $80.3 per KW compared to natural gas conventional combined-cycle's cost of $66.3 and advanced combined-cycle's cost of $64.4. Solar photovoltaic has a projected levelized cost of $130.0 as hydro is at $84.5. Geothermal has the lowest estimated levelized cost of electricity at $47.9.

Exhibit 6. Wind Remains High Cost Vs. Natural Gas

Table 1. Estimated levelized cost of electricity (LCOE) for new generation resources, 2019

	U.S. Average LCOE (2012 $/MWh) for Plants Entering Service in 2019							
Plant Type	Capacity Factor (%)	Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System LCOE	Subsidy[1]	Total LCOE including Subsidy
Dispatchable Technologies								
Conventional Coal	85	60.0	4.2	30.3	1.2	95.6		
Integrated Coal-Gasification Combined Cycle (IGCC)	85	76.1	6.9	31.7	1.2	115.9		
IGCC with CCS	85	97.8	9.8	38.6	1.2	147.4		
Natural Gas-fired								
Conventional combined Cycle	87	14.3	1.7	49.1	1.2	66.3		
Advanced Combined Cycle	87	15.7	2.0	45.5	1.2	64.4		
Advanced CC with CCS	87	30.3	4.2	55.6	1.2	91.3		
Conventional Combustion Turbine	30	40.2	2.8	82.0	3.4	128.4		
Advanced Combustion Turbine	30	27.3	2.7	70.3	3.4	103.8		
Advanced Nuclear	90	71.4	11.8	11.8	1.1	96.1	-10.0	86.1
Geothermal	92	34.2	12.2	0.0	1.4	47.9	-3.4	44.5
Biomass	83	47.4	14.5	39.5	1.2	102.6		
Non-Dispatchable Technologies								
Wind	35	64.1	13.0	0.0	3.2	80.3		
Wind – Offshore	37	175.4	22.8	0.0	5.8	204.1		
Solar PV[2]	25	114.5	11.4	0.0	4.1	130.0	-11.5	118.6
Solar Thermal	20	195.0	42.1	0.0	6.0	243.1	-19.5	223.6
Hydroelectric[3]	53	72.0	4.1	6.4	2.0	84.5		

[1]The subsidy component is based on targeted tax credits such as the production or investment tax credit available for some technologies. It only reflects subsidies available in 2013, which include a permanent 10% investment tax credit for geothermal and solar technologies, and the $18.0/MWh production tax credit for up to 6 GW of advanced nuclear plants, based on the Energy Policy Acts of 1992 and 2005. EIA models tax credit expiration as in current laws and regulations: new solar thermal and PV plants are eligible to receive a 30% investment tax credit on capital expenditures if placed in service before the end of 2016, and 10% thereafter. New wind, geothermal, biomass, hydroelectric, and landfill gas plants are eligible to receive either: (1) a $21.5/MWh ($10.7/MWh for technologies other than wind, geothermal and closed-loop biomass) inflation-adjusted production tax credit over the plant's first ten years of service or (2) a 30% investment tax credit, if they are under construction before the end of 2013.

[2]Costs are expressed in terms of net AC power available to the grid for the installed capacity.

[3]As modeled, hydroelectric is assumed to have seasonal storage so that it can be dispatched within a season, but overall operation is limited by resources available by site and season.

Source: U.S. Energy Information Administration, Annual Energy Outlook 2014 Early Release, December 2013, DOE/EIA-0383ER(2014).

Source: EIA

Between the 2013 and 2014 Annual Energy Outlooks, the levelized cost of electricity from wind fell from $86.6 to $80.3, while solar photovoltaic dropped to $130.0 from $144.3

What gives renewables hope that their green-energy sources will soon reach competitive parity with natural gas is the progress they have made in reducing their levelized cost of generating electricity. Between the 2013 and 2014 *Annual Energy Outlooks*, the levelized cost of electricity from wind fell from $86.6 to $80.3, while solar photovoltaic dropped to $130.0 from $144.3. At the same time, natural gas conventional combined-cycle power's cost declined marginally from $67.1 to $66.3. If natural gas prices increase in the future, that may help close the gap with renewables. However, one also has to wonder at what point the move down the cost curve due to efficiencies of larger suppliers and technological improvements stop contributing to significant reductions in the cost of renewables.

Mr. Buffett, and Greg Abel have made no secret of the fact that their renewables investments have been driven by the tax credits that come along with them

What was most telling about the outlook for renewable fuels and their profitability was a recent article in *The Wall Street Journal* discussing the bet being made by Warren Buffett's Berkshire Hathaway (BRK.A-NYSE) in its 2000 purchase of Mid-American Energy Holdings Co., since renamed Berkshire Hathaway Energy. So far, Mr. Buffett has invested $15 billion in renewable energy projects to supply clean energy to his customers. But Mr. Buffett, and Greg Abel, who runs the energy company and who is considered a leading candidate to replace Mr. Buffett, have made no secret of the fact that their renewables investments have been driven by the tax credits that come along with them. Since those credits can be used to reduce Berkshire Hathaway's overall tax bill, the credits have significant value. The expiration of the wind production tax credit and possible expiration of the solar tax credit in 2016 have driven Messrs. Buffett and Abel to seek other utility acquisitions rather than chase new wind and solar investments.

The state had over 11,000 MWs of wind capacity but ERCOT could only count on 963 MWs of wind generation being available when the state's power demand was the highest

In Texas, Comptroller Susan Combs recently issued a report that urged policymakers and elected officials to discontinue costly subsidies and tax breaks that are driving development of new electricity generation. She would like to see a more market-based approach to the development of the state's power market. In 2005, the Texas Legislature approved Competitive Renewable Energy Zones to carry mostly wind energy generated in West Texas and the Panhandle to high-demand cities. The plan was forecast to cost under $5 billion but has since climbed to more than $6.9 billion. It is estimated that these projects will cost the average Texas homeowner between $70 and $100 annually for 15 to 20 years to pay for them. The power situation in 2014 highlighted the problem with intermittency of renewables. The state had over 11,000 MWs of wind capacity but the Electric Reliability Council of Texas (ERCOT) could only count on 963 MWs of wind generation being available when the state's power demand was the highest. This meant that utilities needed to make sure that there was adequate natural gas power generation capacity available. Comptroller Combs wants to make sure that businesses and homeowners are not being saddled with the cost of retail electricity and the subsidies for wind power generators.

Behind the demand for renewable energy here and in Europe have been clean-power mandates

The combination of Mr. Buffett's view, who after 13 years of owning a utility and investing $15 billion in renewable energy projects, says the expiration of the wind energy tax credit and the upcoming ending of the solar tax subsidy will have a "significant impact" on the economics of investing in renewable power, and ERCOT's need to plan on less than 10% of Texas' wind power during peak demand periods, will force some changes to the renewable energy marketplace. Behind the demand for renewable energy here and in Europe have been clean-power mandates. The rush to transition the power markets of developed countries from low-cost, but greenhouse-gas-creating fossil fuels to high-priced, intermittent power supplies has created more problems sooner than anyone anticipated. A reassessment of this trend is now underway and hopefully it will continue in a way that will ultimately balance the economy and the environment for the betterment of everyone.

Nuclear Power Plants Seeking Approval To Work Longer

Approximately 67% of the electricity generated came from fossil fuels

Nuclear power is an important component of our nation's electricity generating capacity because it offers both a high and consistent level of output, while the power generated lacks carbon pollution. According to government figures, in 2013, the United States generated about 4,058 billion kilowatt-hours (kWh) of electricity. Approximately 67% of the electricity generated came from fossil fuels – coal, natural gas and petroleum – with coal representing 39%. Natural gas was the second most important source of energy at 27%, while nuclear was in third place at 19%. Hydropower accounted for 7% of electricity generated, while renewables represented the balance, or 6%, of which wind was 4.1%.

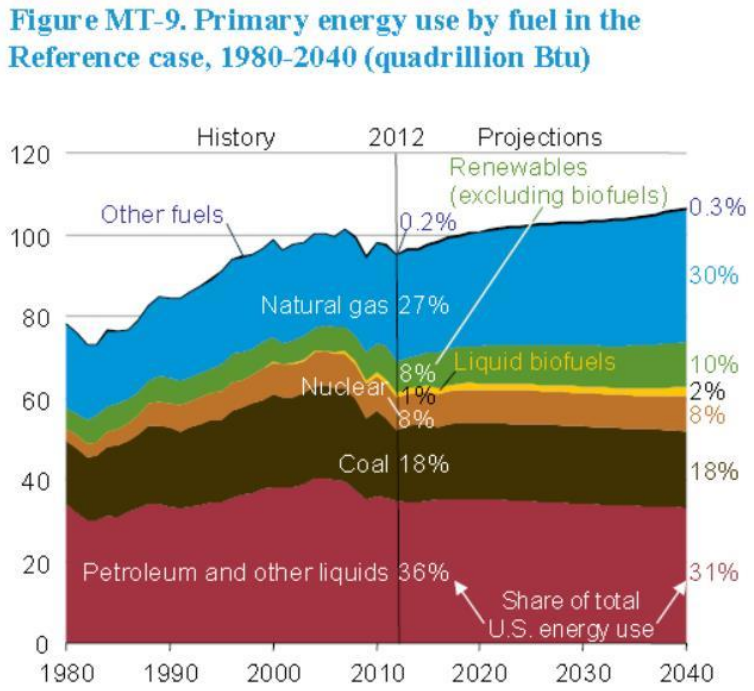
The EIA estimated that nuclear power accounted for 8% of total Btu of electricity generated in 2012

The Energy Information Administration (EIA) measures the contribution of energy sources to the generation of electricity by a different measure – British thermal unit (Btu). The EIA estimated that nuclear power accounted for 8% of total Btu of electricity generated in 2012. In its base case outlook for power generation through 2040, the EIA believes that nuclear power plants will still be generating 8% of the nation's electricity at the end of their forecast.

One year after the earthquake, all but two of Japan's nuclear power plants remained closed

Following the March 11, 2011, magnitude 9.0 Tōhoku earthquake offshore Japan that created a tsunami that swamped the Fukushima I Nuclear Power Plant and caused three of its six nuclear reactors to melt down, the country reacted by shutting down its nuclear power industry out of concern about the safety of the remaining plants. One year after the earthquake, all but two of Japan's nuclear power plants remained closed. The government decided to give the right to decide whether to restart the shutdown plants to the local governments, all of whom decided to leave them shut. As a result, Japan has had to rely on natural gas- and coal-fired power plants to make up the 30% of its electricity generation capacity lost to the meltdown and nuclear shutdown policy. The gas has arrived as

Exhibit 7. Nuclear Power's Significant Electricity Generator



Source: EIA

liquefied natural gas (LNG) volumes and has helped boost LNG to record high prices in the Asian region.

The nuclear power industry operated at 50% of capacity in the early 1970s, rising to 70% by 1991 and then to 90% by 2002

Today, the U.S. nuclear power industry is composed of 100 reactors in 62 power plants located in 31 states and operated by 30 different companies. Thirty-five of these plants have two or more reactors. There are five reactors currently under construction. These power plants have operated in excess of 90% of their rated capacity since 2001. That performance has been remarkable when one considers the nuclear power industry operated at 50% of capacity in the early 1970s, rising to 70% by 1991 and then to 90% by 2002. In 2013, these plants operated at 91% of capacity. As shown in Exhibit 8, the 62 nuclear power plants are scattered across the United States, with heavy concentrations in the Midwest and along the East Coast. Of course that is where the bulk of the nation's population resides, so their location is logical as those regions are where the power demand is concentrated.

The general assumption was that new generation plants would replace the old ones within a few decades

When the nuclear power plants were built in the 1970s and 1980s, they were licensed to operate for 40 years. The general assumption was that new generation plants would replace the old ones within a few decades, which turned out to be wrong, not only for nuclear plants but for coal-fired ones, also. The nuclear power industry says the original 40-year life span was really an early estimate of the plants' economic life and not their physical viability.

Exhibit 8. Nuclear Power Plants Are Where People Are

Source: World Nuclear Association

The NRC is working on determining the criteria it should establish for extending nuclear power plant licenses for years 61 through 80

As construction of new nuclear power plants tailed off in the late 1980s, the Nuclear Regulatory Commission (NRC) established a procedure in 1991 for 20-year plant license extensions. So far, the NRC has granted 70 such extensions. Now, the NRC is working on determining the criteria it should establish for extending nuclear power plant licenses for years 61 through 80, as it expects utility companies to begin applying for additional 20-year license extensions about 2018. At the present time, it is thought that there are likely seven reactors that are early candidates for seeking these additional operating license extensions. Two of the reactors are located in Pennsylvania, two in Virginia and three in South Carolina.

Metal parts become increasingly more brittle after decades of exposure to radiation

One of the key issues is assessing the safety of nuclear power plants is how their metal parts become increasingly more brittle after decades of exposure to radiation. This means those metal parts are increasingly more likely to break. To measure embrittlement, the plants use extra samples of the metal from which their reactor vessels were made, called coupons that are stored for years in irradiated areas inside the reactors. These coupons have been removed at different times in the past for analysis of their embrittlement in a test that usually destroys them.

To win a license extension, the nuclear power plants do not have to show that they will be safe for 80 years, only that they have monitoring programs in place to promptly detect problems as they emerge

As a few of the nuclear reactors have run out of these coupons, engineers are trying to draw conclusions about their conditions by extrapolating from coupons in other reactors. In other cases, they have moved the coupons closer to the center of the reactor to age them faster so they have an idea of what the vessel's metal will look like in a few years, not just in their current condition. As staff members of the NRC point out, to win a license extension, the nuclear power plants do not have to show that they will be safe for 80 years, only that they have monitoring programs in place to promptly detect problems as they emerge. This is referred to "aging

management." These staff people say that they don't see any cliffs in aging management.

"I mean, will you buy a car that was designed in '64?"

Last May, a then-commissioner of the NRC, George Apostolakis, a risk expert, pointed out that if plants had their licenses extended for 80 years, some of them would be using designs substantially older than that. He said, "I don't know how we would explain to the public that these designs, 90-year old designs, 100-year old designs, are still safe to operate." He went on to say, "I mean, will you buy a car that was designed in '64?"

If you're talking about cars versus transportation, vehicles designed and built in the 1960s are perfectly capable of meeting the mobility needs of people

We're not sure that Mr. Apostolakis really meant what he said about buying a car designed in '64. That was the year Lee Iacocca, the CEO of Ford Motor Company (F-NYSE) introduced the Mustang at the 1964 World's Fair in New York. Today, people such as entertainer Jay Leno are willing to pay millions of dollars for those '64-designed and built cars. If you're talking about cars versus transportation, vehicles designed and built in the 1960s are perfectly capable of meeting the mobility needs of people. Would their ride be different – for example, less smooth? Would that 60's car have fewer safety and creature comforts - no Sirius radio, backup cameras or GPS navigation systems - compared to today's cars? Certainly a 1960s car isn't a 2015 model. But that doesn't mean that an old car couldn't meet the basic transportation needs of people.

It is certainly an interesting fact that a key component of our nation's defense system is our B-52 intercontinental bomber fleet, of which the youngest one has just turned 50 years old

When talking about old technology, it is certainly an interesting fact that a key component of our nation's defense system is our B-52 intercontinental bomber fleet, of which the youngest one has just turned 50 years old. Many of them are 60–65 years old, but no one suggests that they can't do the job they were designed for even after one considers the development of technologies to stop them. The good news for our energy supply outlook is that the nuclear power business continues to move forward with new plants and license applications seeking approval to build others. And yes, when considering which nuclear power plant to build for the future, we aren't likely to select a 1960s model. We are seeing new designs and concepts for nuclear power plants that should be not only safer to operate, but easier and less costly to construct. But shutting down currently operating plants merely because they aren't 2015 models would be a mistake. For the sake of our future energy needs and our desire to improve the environment, nuclear needs to play a significant role in our electricity industry.

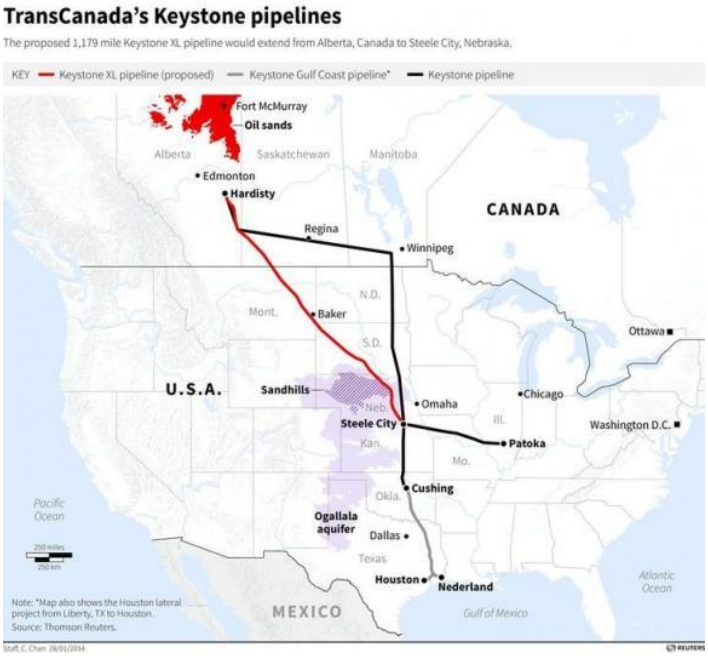
Sec. Of State Kerry Proves He Is Powerless On Keystone XL

Last week, United States Secretary of State John Kerry made his first official visit to Canada since assuming the office 21 months ago. The visit coincided with the funeral of the Canadian soldier killed in a terrorist attack on Parliament Hill in Ottawa, and he was there to declare U.S. solidarity with Canada. During Sec. Kerry's visit, in a joint news conference with Canadian Foreign Minister John Baird,

"I certainly want to do it sooner rather than later but I can't tell you the precise date."

he commented on the status of the 830,000-barrel-a-day Keystone XL pipeline construction permit application. He said, "I certainly want to do it sooner rather than later but I can't tell you the precise date." Was that one of life's great equivocating statements? What was left unstated was probably the following: I'd approve it if I could, but I can't. Moreover, I don't know that I can convince the guy who has to approve it. But trust me when I say, we are sincere in our belief that any decision soon would be better for you than no decision. But boy, by stringing you along my boss and my party have raised a ton of campaign contributions, which is why he's there and I'm here. So thank you for hanging around.

Exhibit 9. Will Keystone XL Ever Be Approved By Obama?



Source: ***Reuters***

The excuse keeping the decision off President Barrack Obama's desk was the unresolved court case in Nebraska challenging the constitutionality of the pipeline route approval process

Whether those thoughts were going through Sec. Kerry's mind or not as he made his equivocating statement we'll never know (until he writes his book), but pressure is building for a decision on the pipeline's future. The excuse keeping the decision off President Barrack Obama's desk was the unresolved court case in Nebraska challenging the constitutionality of the pipeline route approval process. Now that the court hearing for the appeal is over, everyone is waiting for the Nebraska Supreme Court's ruling. It is expected sometime between late November and mid-December. The decision will either give Keystone a green light or send its sponsor, TransCanada Corp. (TRP-NYSE), back to square one needing to start a new route approval application. In the meantime, the battleground has shifted to South Dakota where the permit approval for Keystone's route is up for renewal and is being challenged by environmental groups.

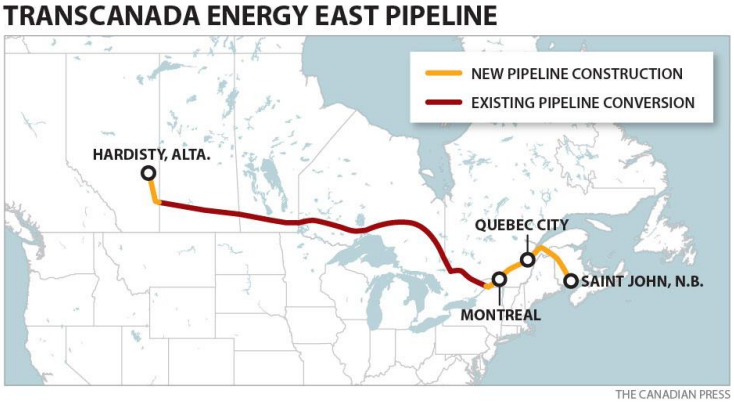
The NRDC is arguing to the White House that the decline in global oil prices has made new oil sands developments uneconomic

Two new factors are coming into play with Keystone. First is the drop in global oil prices. Throughout virtually all of the time the pipeline project has been seeking approval, oil prices have been meaningfully higher than now. Those high prices provided a healthy profit margin for Canada's oil sands producers, but their profit margin is being squeezed by the high cost of the output and the discounted price received for the Canadian bitumen. The Natural Resources Defense Council, which is fighting the approval of the Keystone permit, is arguing to the White House that the decline in global oil prices has made new oil sands developments uneconomic, and they point to various announcements over the past few months of operators in the play pulling back on new investments.

Russ Gerling said he was less inclined than he was earlier this year to build a "rail bridge" across the US/Canadian border to link up with the southern end of the Keystone pipeline

The alternative to pipeline transport is rail, but that is a more expensive mode of transportation. When oil prices were high, the extra cost of rail transport didn't dissuade producers from shipping their output by rail car. Now the situation has changed. In fact, Russ Gerling, TransCanada's CEO, in a recent interview, said he was less inclined than he was earlier this year to build a "rail bridge" across the US/Canadian border to link up with the southern end of the Keystone pipeline already in operation. But he also said he was not about to give up on Keystone, and in fact, he said they have more customers lined up to use the pipeline.

Exhibit 10. Energy East: The New Oil Sands Outlet



Source: ***Warrior Publications***

TransCanada formally submitted its 30,000-page application for the 1.1 million-barrel-a-day project, labeled Energy East, to Canada's regulator

The other factor in play now is TransCanada's plan to ship Canadian oil sands output east from Alberta to the Irving Company refinery and its oil export port in Saint John, New Brunswick. TransCanada formally submitted its 30,000-page application for the 1.1 million-barrel-a-day project, labeled Energy East, to Canada's regulator, National Energy Board. Once in place, oil sands output could move from Alberta to the East Coast and then be loaded on ships and transported to the U.S. Gulf Coast refining complex for only a couple of dollars more than the proposed tariff to ship it to Texas on Keystone. In a low oil price environment, that cost might be considered an impediment to oil sands export, but it doesn't appear

Energy East requires no U.S. approvals, although it does need Canadian federal government ok and approvals from various provinces

to represent a significant economic hurdle. As a result, the environmental movement's argument that by preventing Keystone from being built would prevent Canada from expanding its oil sands business and stepping up its exports would be severely weakened. Energy East requires no U.S. approvals, although it does need Canadian federal government ok and approvals from various provinces. Our understanding is that TransCanada has worked hard to win over those people with rational objections to the pipeline route by relocating the route and adding spurs to refineries in the provinces and export ports. We anticipate Energy East having an easier time winning approval than Keystone has experienced.

The spills strengthened the hand of the environmentalists battling Keystone and the images of black oil oozing through people's backyards, neighborhood streets and bubbling streams is a powerful weapon against the energy business

We have learned several things from watching the battle over Keystone. The view that environmental politics overwhelms energy economics when the country is governed by the left was reinforced. Additionally, while pipelines represent the safest mode of oil transportation, the recent string of oil leaks from old pipelines has battered that safety image. The spills strengthened the hand of the environmentalists battling Keystone and the images of black oil oozing through people's backyards, neighborhood streets and bubbling streams is a powerful weapon against the energy business, and the energy companies have not been proactive in trying to change their image. The environmentalists have demonstrated that they have learned how to fight energy projects more effectively through the regulatory and legal systems. Lastly, low oil prices, should they continue for any duration, will disrupt the pace of development of the oil sands – just how much and exactly when remain uncertain – and possibly change the impetus for either or both Keystone and Energy East. In the end, oil sands output will reach markets, but where those markets are may be different by the end of this decade than where we think they are today.

Random Thoughts About Energy Trends

Chevy Volt will sport a bigger battery pack, a larger engine and reduced vehicle weight

Electric Vehicles: General Motors (GM-NYSE) announced that the second generation Chevy Volt, the automakers' battery-powered car, will sport a bigger battery pack, a larger engine and reduced vehicle weight, all designed to deliver more power (faster acceleration) and greater range on an electric charge. Details will not be announced until the car is introduced at the Detroit Auto Show in January and cars won't be available for sale until mid-year 2015. The most interesting detail (to us) that GM released was that based on Volt owner data from 2011-2013, it found they charged the car 1.4 times a day rather than the one extended overnight charge anticipated. Is that a function of "range anxiety?"

Activist Investors: A survey by Deutsche Bank shows that activist funds' assets under management swelled to a record $111 billion at the end of the second quarter, nearly five times their amount in 2008. The bank attributes the growth to the success of activist investors – some of which have been energy companies – and the

Institutions are jumping on board activism investing

shifting attitude of more staid institutional investors. Those institutions are jumping on board because activist investing has been one of the most successful investment themes of the past five years. Should poor performing energy companies be worried beyond weak oil and gas prices?

In a January poll that Pew conducted, the issue of climate change was listed second from the bottom of the public's list of concerns

Climate Change Message: Some politicians campaigning this fall tell their audiences that climate change is the greatest concern they have. A poll by the Pew Research Center for the People and the Press conducted September 30 to October 4 found that 65% of the public view climate change as "very serious" or "somewhat serious," which certainly would seem to support their claim. However, the same organization reports that in 2007 that concern was at 77% of the public. Additionally, a summer poll by Pew found that fewer Americans cited climate change as their top threat than financial instability, Islamic extremism, Iran's nuclear weapons program and North Korea's nuclear program. In a January poll that Pew conducted, the issue of climate change was listed second from the bottom of the public's list of concerns. Somewhere there is a disconnection between the message about climate change and the public's concern. Is it time to change the message?

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