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Cheap Natural Gas will be Good for the Wood-to-Energy Sector!

January 13, 2013

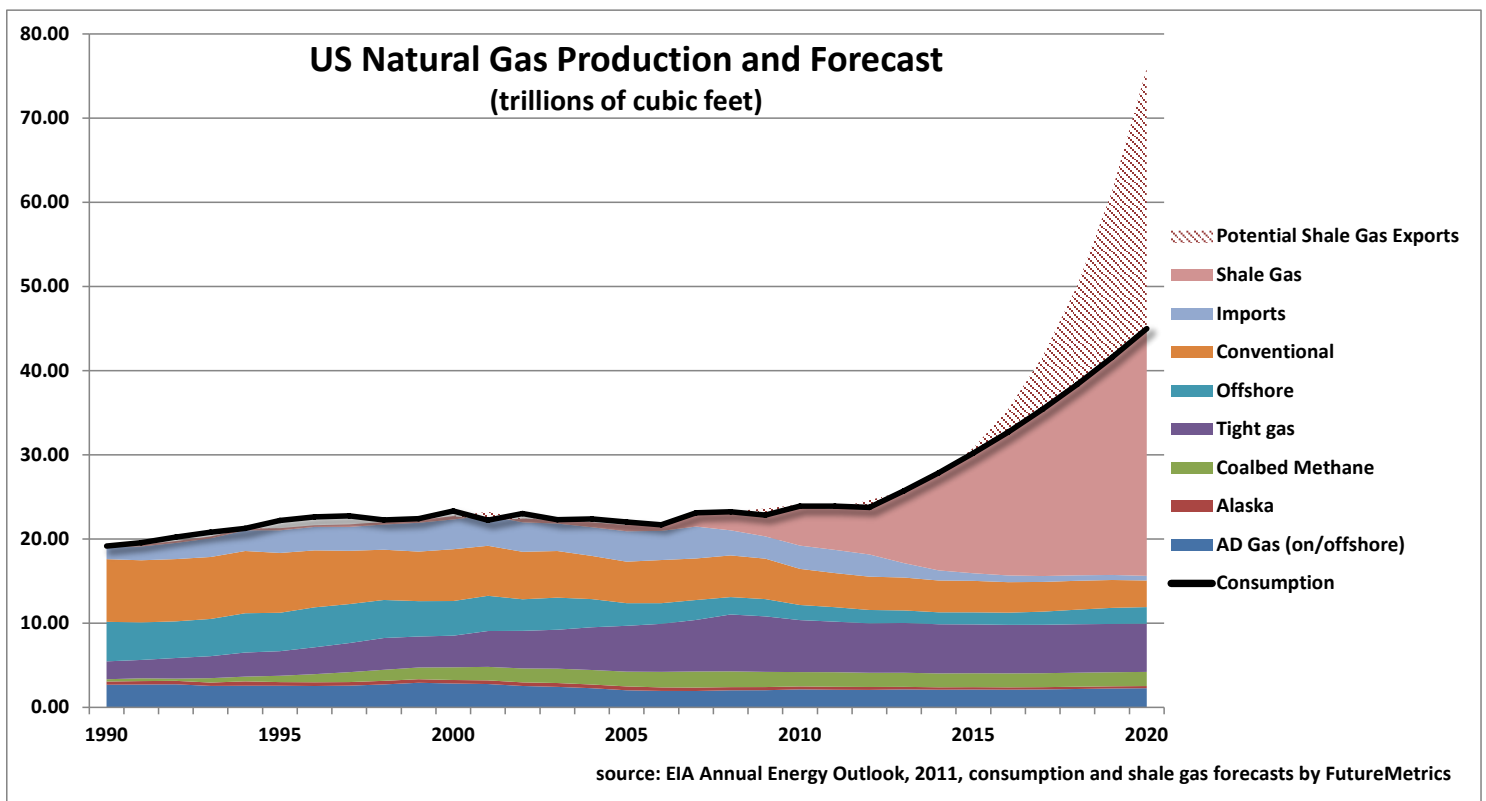
By Dr. William Strauss, FutureMetrics

It is not uncommon to hear that low cost natural gas is a challenge to the growth of the biomass thermal sector. There is no question that cheap natural gas has changed the landscape and has, in a number of locations, caused projects that were considering biomass fuel to go with natural gas.

But, as this brief white paper will show, the wood-to-energy sector will significantly benefit from low cost natural gas.

The pathway is through compressed natural gas (CNG) as a transportation fuel. As this paper will show, we expect a relatively rapid transition into CNG fueled vehicles of all types. The impact of significantly lower operating costs, from harvest to highway transport, on the cost of wood will make biomass fuels cheaper and cost competitive with pipeline natural gas and CNG.

In an earlier FutureMetrics white paper, we forecast natural gas production in the US. The chart below is from that paper. The rapid rise in domestic consumption is in part due to the rapid shift in transportation fuel from gasoline and diesel to CNG.



The cost for CNG as a transportation fuel has to include the costs associated with the filling infrastructure. The cost of CNG at a fast filling location or from a truck-to-site system depends on a number of variables¹.

We estimate the all-in cost at today's natural gas rates is about \$1.61 per diesel gallon equivalent.

	Unit	Price	BTU/Unit	\$/MMBTU	CAPEX Amortization and other Costs ¹ (\$/MMBTU)	Total Cost per MMBTU	\$/Diesel Gallon Equivalent
Natural Gas	MMBTU	\$5.50	1,000,000	\$5.50	\$6.10	\$11.60	\$1.61
Diesel	Gallon	\$4.00	139,200	\$28.74		\$28.74	\$4.00

source: EIA data, 2013, analysis by FutureMetrics

The cost for new natural gas fueled engines and vehicles is only marginally higher than traditional diesel fueled vehicles and that cost difference will quickly disappear as production volumes increase.

Therefore, our forecast is that CNG fueled vehicles will become the dominant transportation solution in the near future (3 to 7 years). The only bottleneck is filling station infrastructure and that will change rapidly as the market wakes up to the operating cost benefits of CNG over gasoline and diesel fuel.

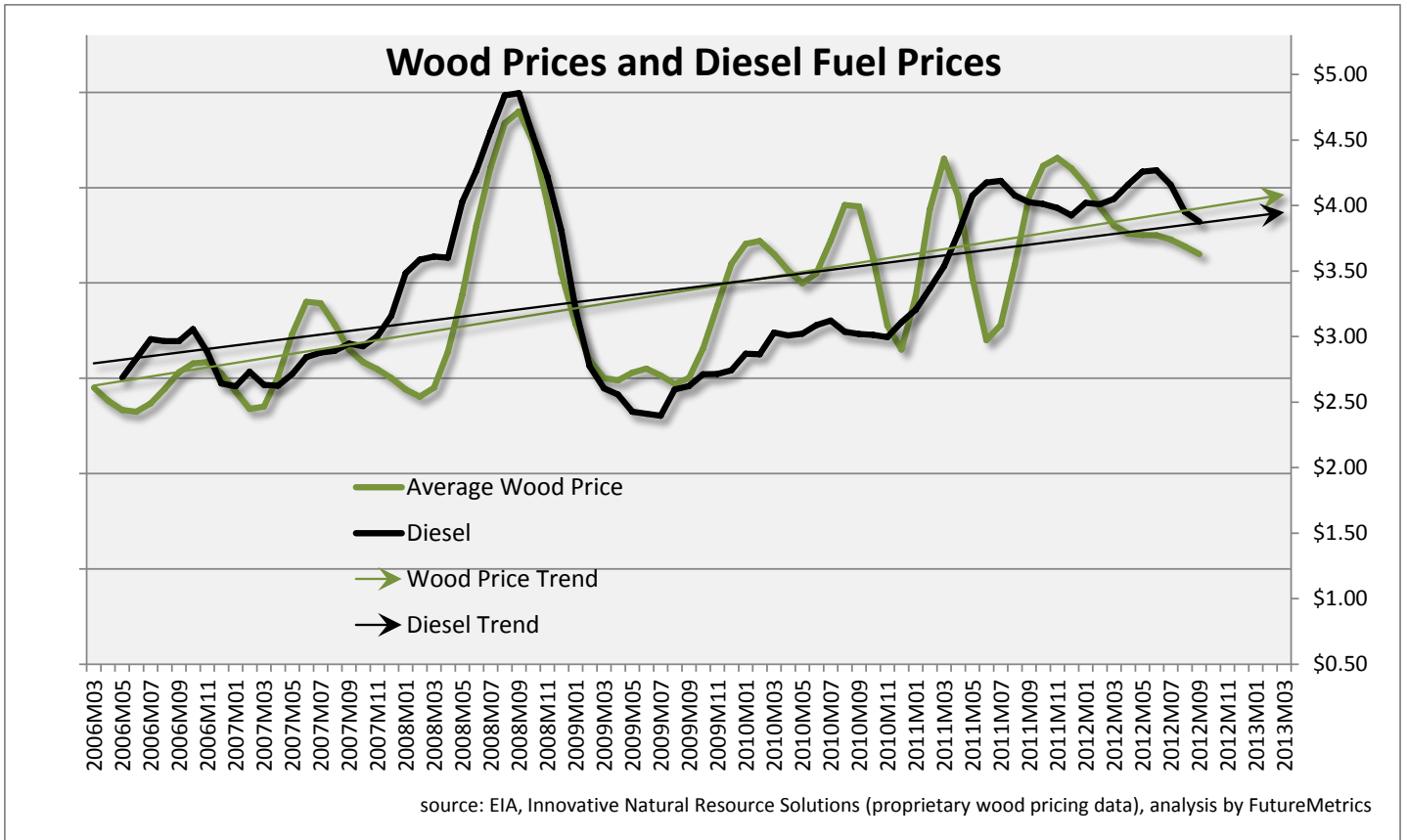
The ease of moving CNG on highway tankers will also transform the in-woods logging industry over the same period.

The effect of lower operating costs on wood prices

A significant proportion of the cost of wood for end users is from the cost of diesel fuel used in harvest and transport. The chart below shows that relationship for wood priced in a specific woodbasket in the northeast².

¹ The significant inputs are the cost of the natural gas, the cost of electricity for compression, maintenance and repair costs, capital amortization of the equipment, and state and federal motor fuels taxes (or credits).

² The data is from gate prices paid by pulpwood buyers in a closely defined geographical region in the northeast. Each specific location will have different sensitivities to diesel fuel prices.



The correlation between a simple average of wood prices for hardwood and pine and diesel fuel is 0.63. It is obvious from the chart that there are other influences on wood prices.

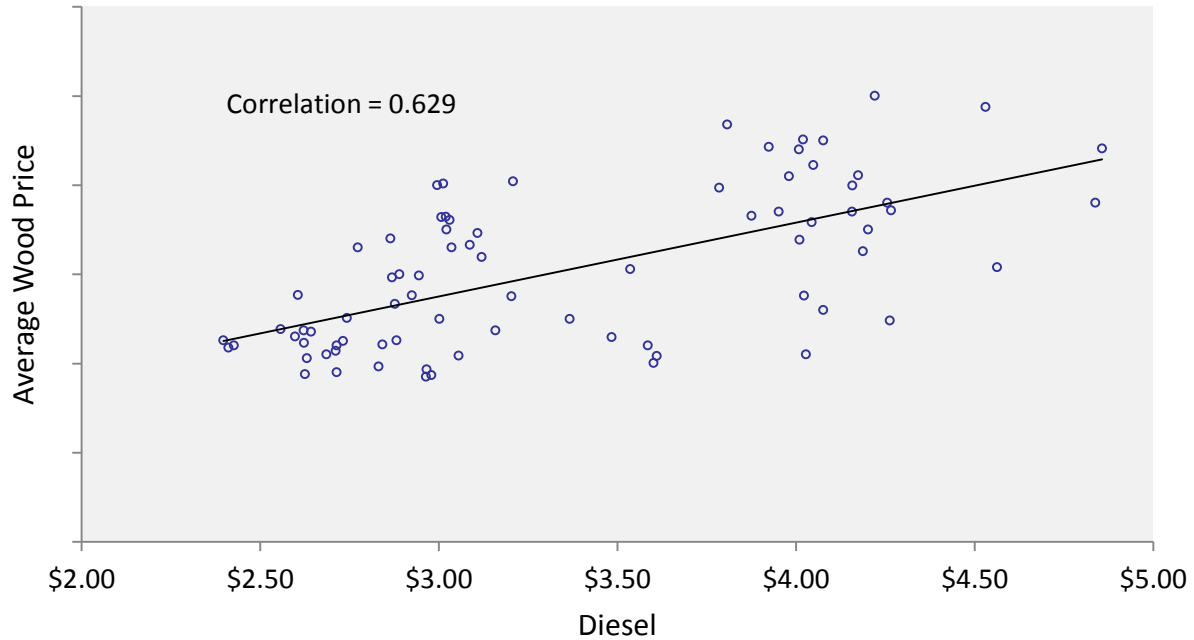
FutureMetrics has worked extensively with Innovative Natural Resource Solutions’ consultant Eric Kingsley on a wood price model. That model explains over 90% of the variation by using independent location specific variables³. However, for this analysis we will focus only on the contribution that the fuel that powers the harvesting and transportation stock has on wood prices⁴.

Below is a scatter plot that illustrates the relationship between wood prices (at a specific wood basket in New England) and diesel fuel.

³ See <http://www.palisade.com/cases/futuremetrics.asp> for a case study based on that research.

⁴ The statistical analysis does incorporate one other dominant input to wood price variability in order to isolate the diesel fuel effect.

Scatterplot of Average Wood Price vs Diesel



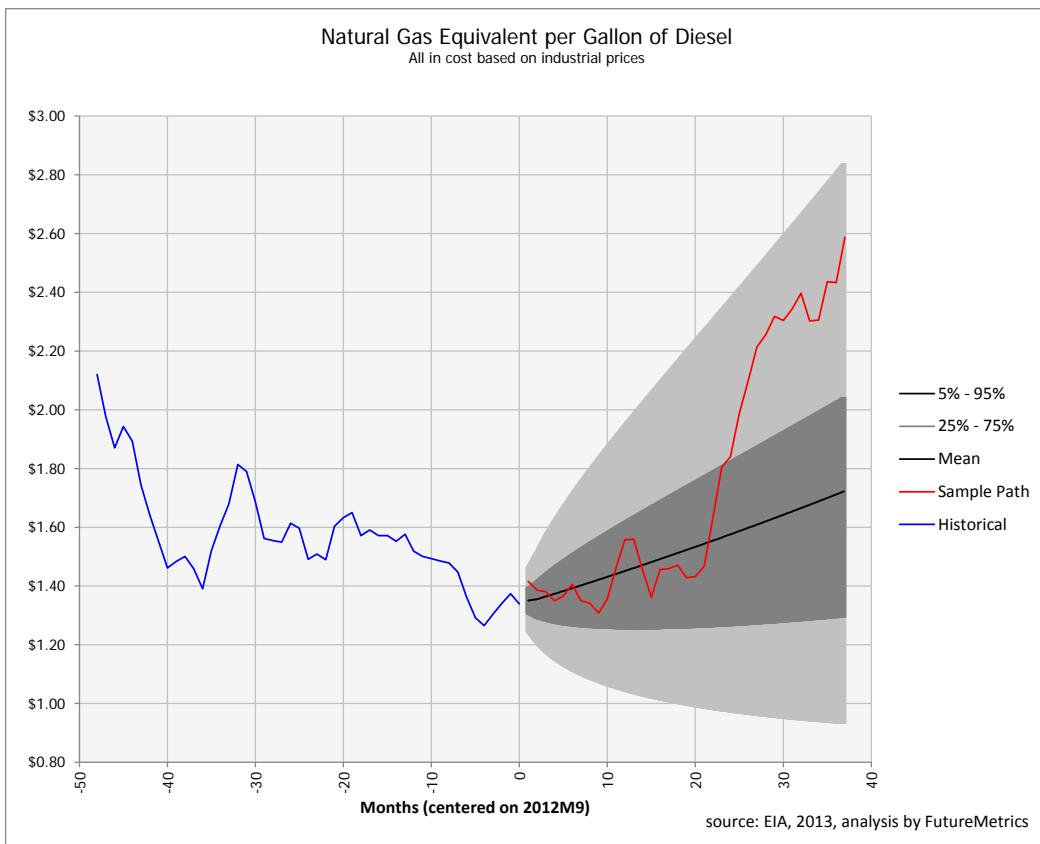
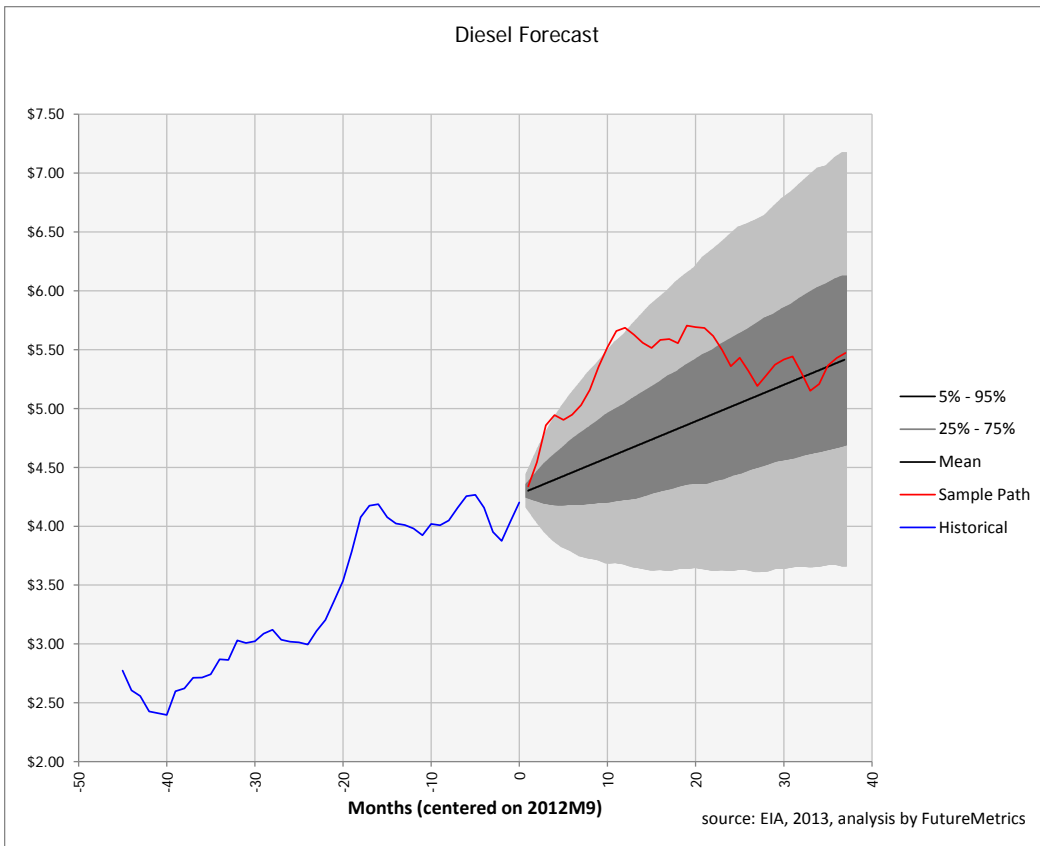
source: wood price data from INRS, EIA 2013, analysis by FutureMetrics

Our analysis has determined the following:

For each \$1.00 increase in diesel, wood price increases by:	
Average	\$4.20
Hardwood	\$4.79
Pine	\$3.60

We have also estimated wood prices in this location using our pricing model. The inputs to the model going forward are based on an estimated stochastic process that is based on the diesel fuel and the other relevant historical data. The charts below show the diesel fuel forecast and the expected prices for CNG at the pump in diesel gallon equivalent. The confidence intervals are shown as shaded areas. The expected price is the dark line. One sample path is shown in red. To calculate future wood prices and the probability distributions for those prices we run a 5000 iteration simulation that randomly selects from possible future price paths of both diesel fuel and natural gas⁵.

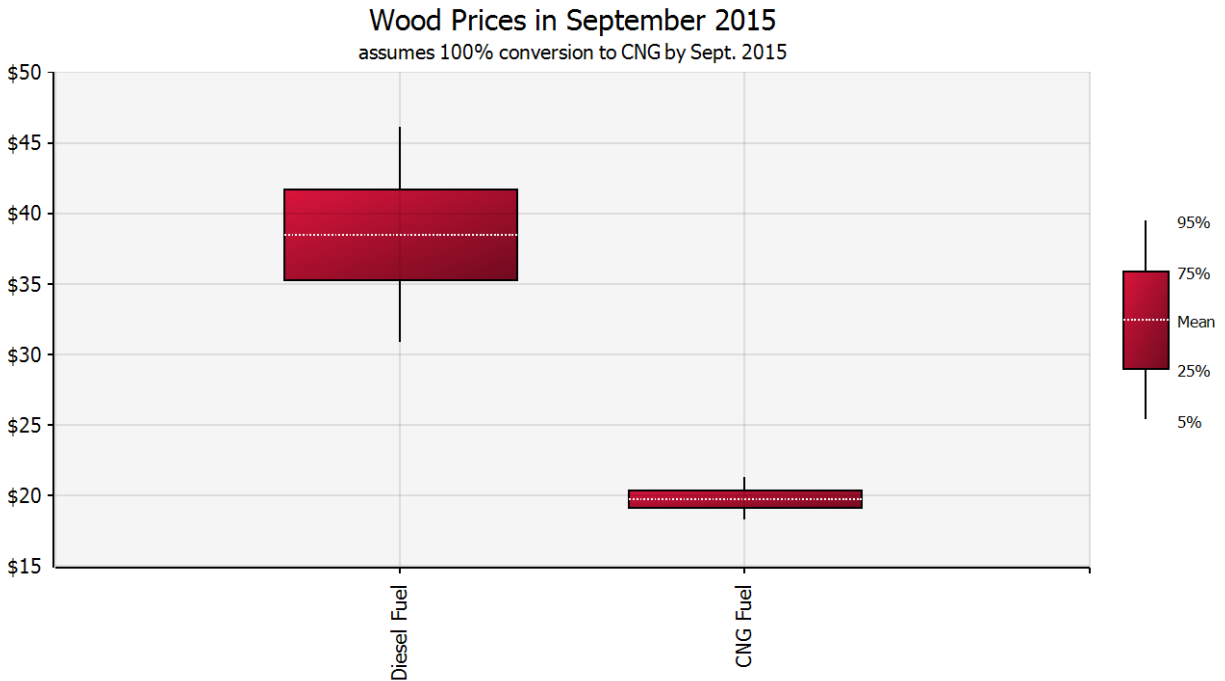
⁵ FutureMetrics uses Palisade Corporation's Decision Tools Suite and in particular @RISK for running simulations.



What follows is based on a hypothetical scenario in which over the next three years (the same 36 months as the forecasts in the charts) transportation fuel converts from 100% diesel to 100% natural gas (CNG). Of course, that scenario is highly unlikely. However, it will demonstrate the potential effect on wood prices.

Because natural gas converts to a diesel fuel equivalent that is about 40% the cost of diesel at today's prices, the impact on wood prices will be significant. Furthermore, even if the industrial price of natural gas increases, the fixed cost component of the all-in CNG cost will remain relatively constant. In 36 months we forecast that CNG fuel will be 31.8% the cost of diesel on a per gallon equivalent⁶.

We also would expect that CNG pricing would be less volatile than diesel fuel since it is not exposed to geopolitical risk. The chart below shows the outcome of our simulation.



The significant drop in operating costs translates, in this woodbasket, into a 49% decrease in wood costs at the gate. In dollar terms, wood would be expected to be about \$18.50/green ton less than it would be if diesel is at \$5.39/gallon at the end of 2015 (assuming industrial priced natural gas at about \$4.60/MMBTU in September, 2015).

The Pellet Export Sector

What would this mean for a pellet export project? The matrix below is based on a detailed capital cost and operating cost model that FutureMetrics has developed for analyzing pellet manufacturing business models.

⁶ That includes an assumption of some price appreciation for natural gas as demand for transportation fuel increases.

250,000 Metric Ton per Year Pellet Export Plant

Sensitivity of Annual After Tax Earnings to Wood Price and Pellet Price (wood price in \$/MT, pellet FOB price in \$/MT)

	\$145	\$150	\$155	\$160	\$165	\$170	\$175	\$180	\$185
\$15	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$16	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$17	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$18	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$19	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$8,850,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$20	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$21	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$22	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$23	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$24	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$25	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$26	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$27	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$28	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$29	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$30	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$31	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$32	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$33	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$34	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$35	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$36	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$37	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$38	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000	\$2,820,000
\$39	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$40	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$41	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$42	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$43	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$44	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$45	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$46	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000
\$47	\$1,200,000	\$1,300,000	\$1,400,000	\$1,500,000	\$1,600,000	\$1,700,000	\$1,800,000	\$1,900,000	\$2,000,000

analysis by FutureMetrics

A 50% reduction in wood costs results in 314% increase in the annual after tax cash flow. Furthermore, it takes the project far away from the negative danger zone in the bottom left of the sensitivity matrix.

As wood harvest and transport operating costs fall, there is a likelihood that margins for the various entities along the supply chain will broaden and therefore the ultimate feedstock price drop may not be as dramatic as this model suggests.

However, in a competitive market, the impact of low cost domestically produced natural gas and therefore low cost transportation fuel will have a dramatic positive impact on the US's competitiveness in the global wood pellet export markets. As low cost producers such as Brazil come into the markets, the ability to price compete and maintain reasonable margins will be very important. The lower carbon output of CNG versus diesel fuel will also enhance the low carbon footprint of wood pellets and add to their value.

The Domestic Wood Pellet Boiler Sector

The impacts of low cost CNG in the domestic pellet boiler sector are more complex to model. Low cost CNG will compete for market share in the home and commercial heating markets. However, the ability for domestic pellet producers to operate with a lower feedstock cost will allow lower priced pellets. In many locations, even with CNG, pellets will be the lowest cost fuel.

At a wood cost of \$38/green ton, a modestly sized domestic pellet mill (80,000 tons per year) can break even⁷ with a gate price of about \$165/ton (short ton). With transportation costs from the mill, bulk delivery with a fully pneumatic delivery trucks, and modest margins for the fuel delivery firms, the price of fuel to owners of wood pellet fueled central heating systems is expected to be about \$220/ton. The table below shows this relationship with natural gas delivered to heating customers as CNG and using the same cost per MMBTU as used above for transportation fuel (also heating oil is shown at the same price as diesel fuel which is consistent with the price histories of those fuels).

	Unit	BTU per Unit	Price per Unit	Efficiency	Price per MM BTU (adjusted for efficiency)
Heating Oil	Gallon	138,000	\$ 5.25	87%	\$33.10
Propane	Gallon	91,000	\$ 3.00	93%	\$30.66
Natural Gas as CNG	MMBTU	1,000,000	\$ 11.60	93%	\$10.79
Wood Pellets	Ton	16,800,000	\$ 220.00	87%	\$11.39
Electricity	kWh	3,412	\$ 0.1208	100%	\$35.40

analysis by FutureMetrics

If wood costs drop as shown above and the pellet delivery trucks run on CNG, the cost to the end user is expected to be as follows (break even for the pellet mill drops to about \$132/ton).

	Unit	BTU per Unit	Price per Unit	Efficiency	Price per MM BTU (adjusted for efficiency)
Wood Pellets	Ton	16,800,000	\$ 185.00	87%	\$9.58

Pellets will thus remain price competitive with CNG and very competitive with other heating fuels. The primary target markets for domestic pellet boiler systems will continue to be those areas that are not connected to pipeline natural gas infrastructure.

Conclusion

Natural gas will remain very low cost in the US relative to diesel and heating oil. In many locations, it will win the battle for domestic market share over wood pellets. This analysis did not look at larger scale wood chip boilers. However, lower wood costs will benefit all systems that use wood chips or wood pellets.

Low cost domestically produced abundant natural gas will provide the foundation for a much more competitive industrial pellet export sector and for lower cost domestic pellet manufacturing. As CNG replaces diesel, end user wood costs will fall dramatically and the cost of production for both domestic and export pellets will, as this white paper has shown, fall dramatically.

⁷ We assume break even to be an 8% return on investment.