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Why Pipeline Natural Gas and Compressed Natural Gas (CNG) are not and will not be an Option for Millions of Homes and Businesses if Premium Wood Pellet Fuel is Available

By Dr. William Strauss, President, FutureMetrics - March, 2014

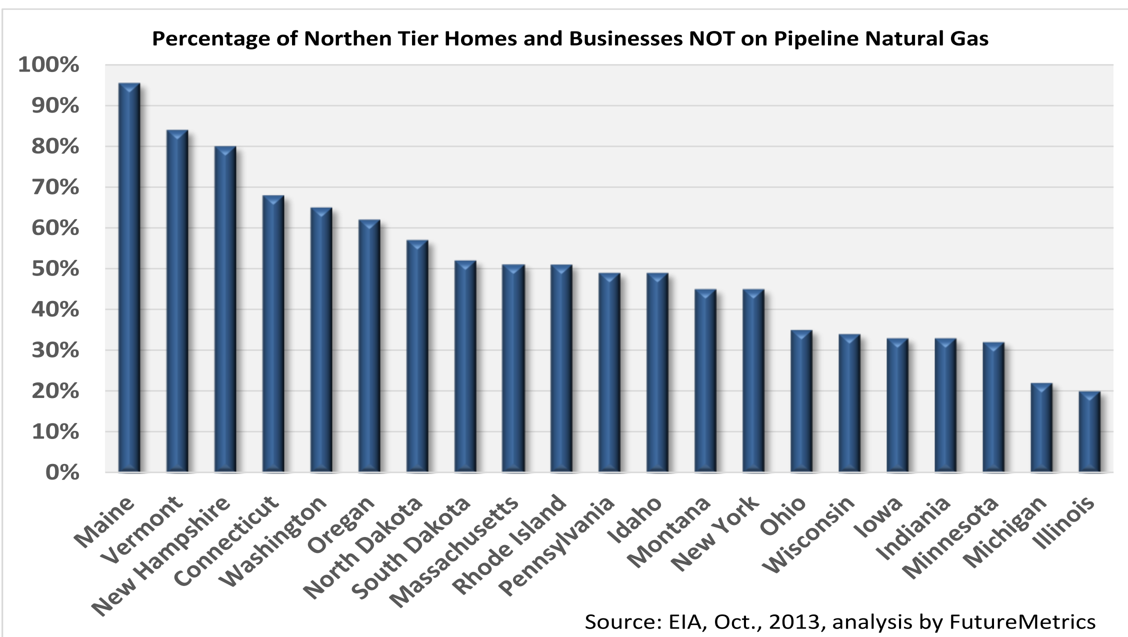
Over 4.3 million northern tier homes that are dependent on heating oil or propane do not have and will likely never have pipeline natural gas or home delivered compressed natural gas (CNG).

CNG is an option for very large commercial and industrial users not on a natural gas pipeline. But those large energy users would not use pellets. They would choose wood chips over pellets if they converted to biomass fuel.

Overview of the Market

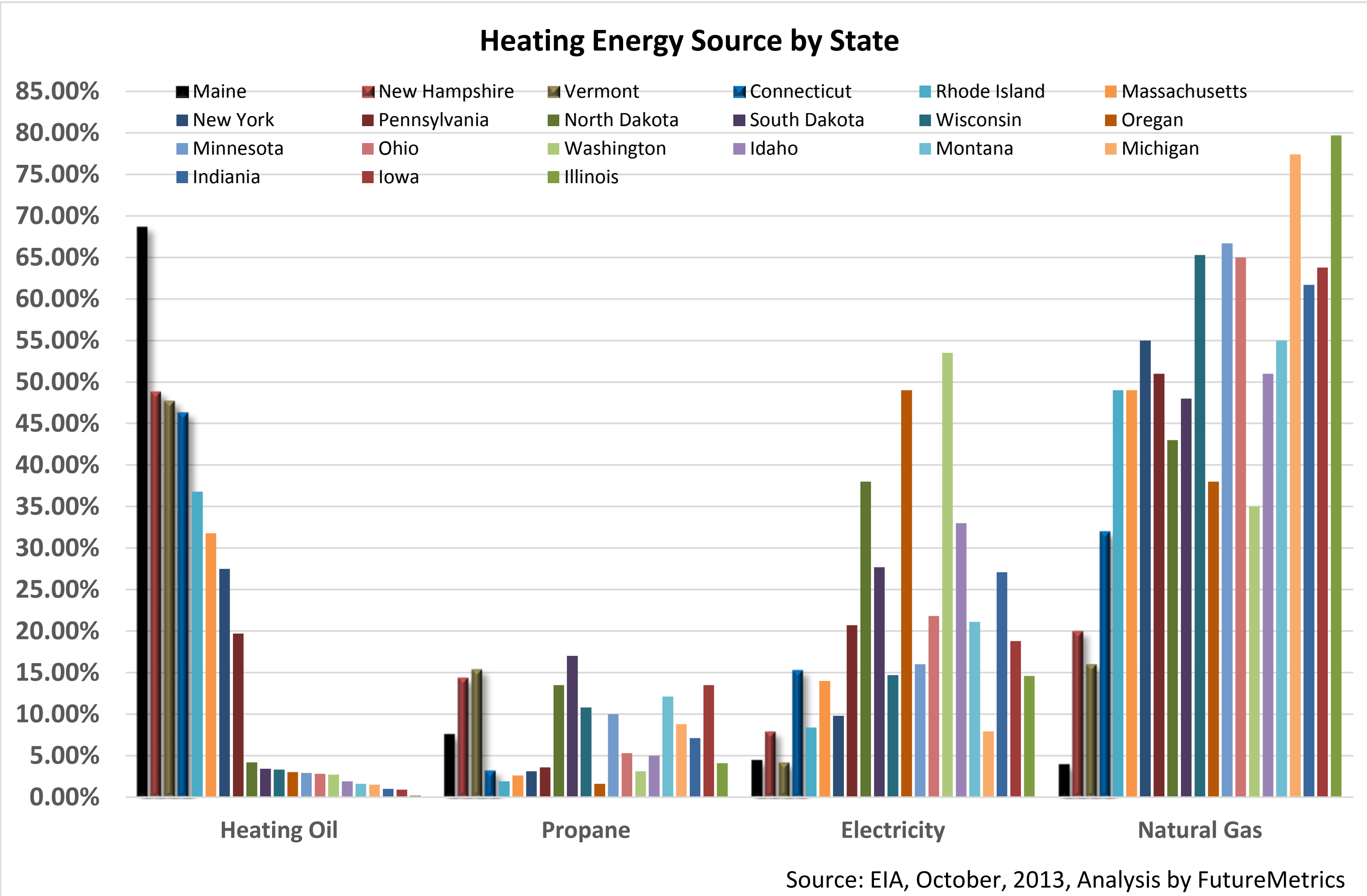
The most common fuel used for heating varies by state. In some states natural gas dominates. In some states heating oil dominates. For example, 68.7% of Maine's homes and business use heating oil and only 5.0% are connected to pipeline natural gas. In Illinois 79.7% are on natural gas[1].

The states that benefit the most from a conversion to premium wood pellet fuel for heat[2] are those with the higher use of heating oil and propane and the lack of natural gas pipeline infrastructure. The charts below show that in general the Northeastern states and a few in the Pacific Northeast will benefit the most.



[1] EIA state data, 2013. The northwestern states have low cost renewable hydro-electric power which makes electric resistance heating competitive with fossil fueled combustion boilers and furnaces. The Midwest and Northeast states not on natural gas depend primarily on heating oil or propane.

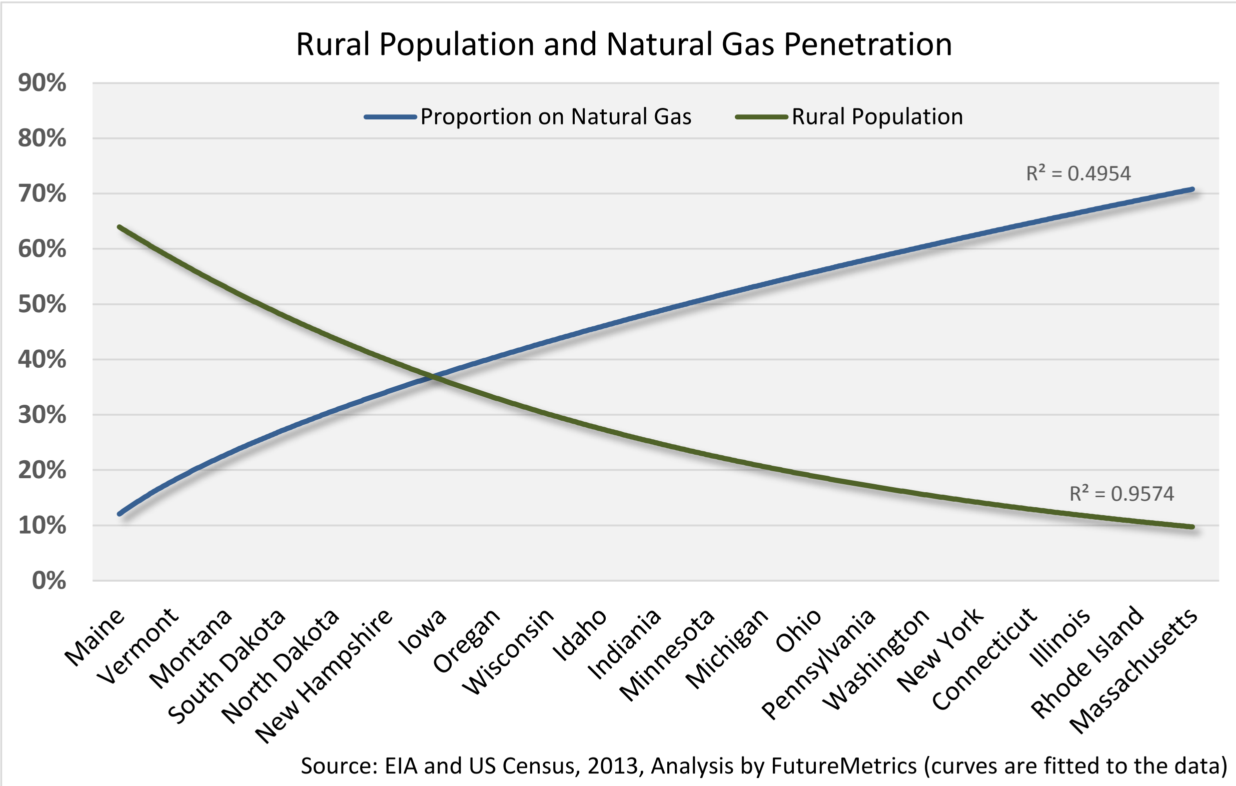
[2] Fully automatic high efficiency wood pellet boilers are common in Europe. They are beginning to penetrate the markets in the US. For an example of that see Maine Energy Systems at www.MaineEnergySystems.com. There are already hundreds of thousands of pellet stoves in the northern states.



How far can pipeline natural gas penetrate into the heating market?

An optimistic scenario might suggest that by 2020 most urban centers will have natural gas pipeline connections. But that will leave a lot of rural homes and businesses on heating oil or propane. The chart below shows the relationship between pipeline natural gas penetration and the proportion of the population that lives in rural areas[3].

[3] Defined by the US Census as towns with populations of less than 2500 or people not living in a town.



Most of those households will never see a natural gas connection. Running natural gas pipes to low density rural populations is highly unlikely. There is no business case for spending millions on pipelines for a few homes per square mile. Furthermore, low NG prices also means smaller absolute profit margins which makes the returns on investment even lower that they would otherwise be.

The next chart shows the number of households (not including businesses) in the northern tier states that are in rural areas that are not on natural gas. The chart assumes that 80% of rural areas will not be connected to natural gas. It also excludes those already using electricity.

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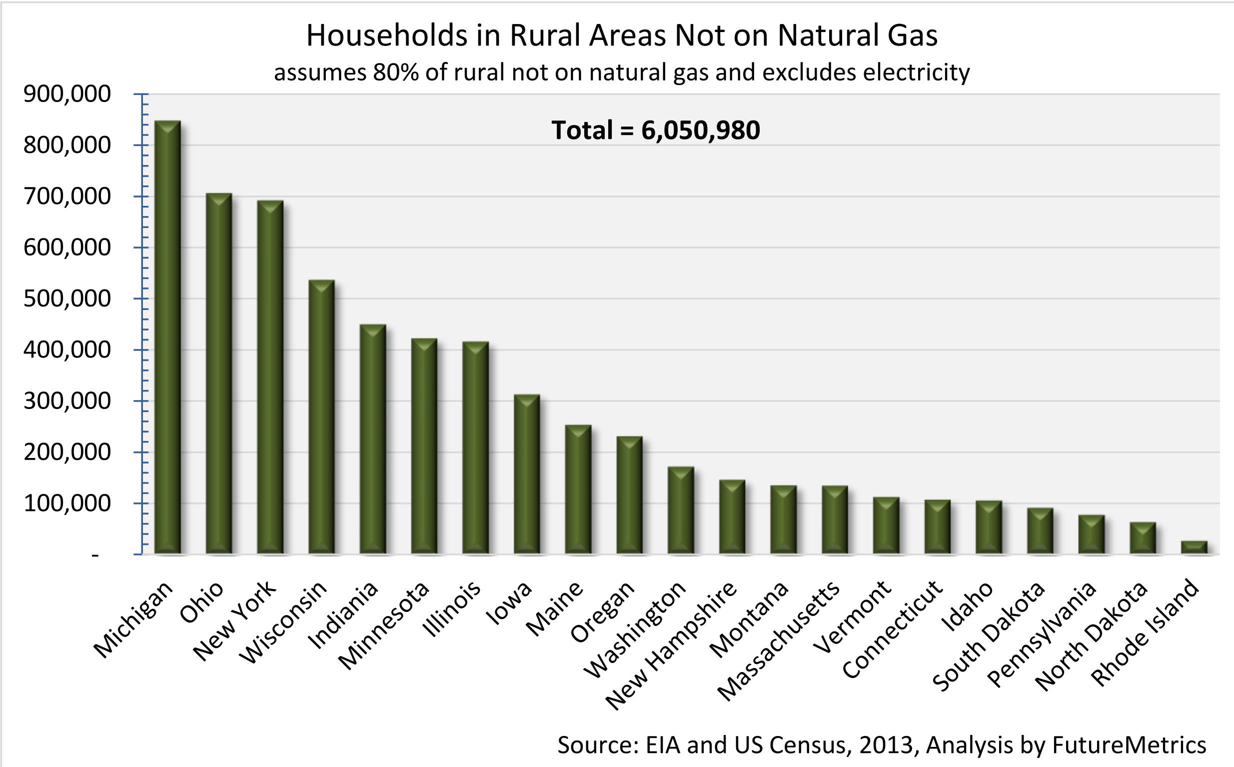
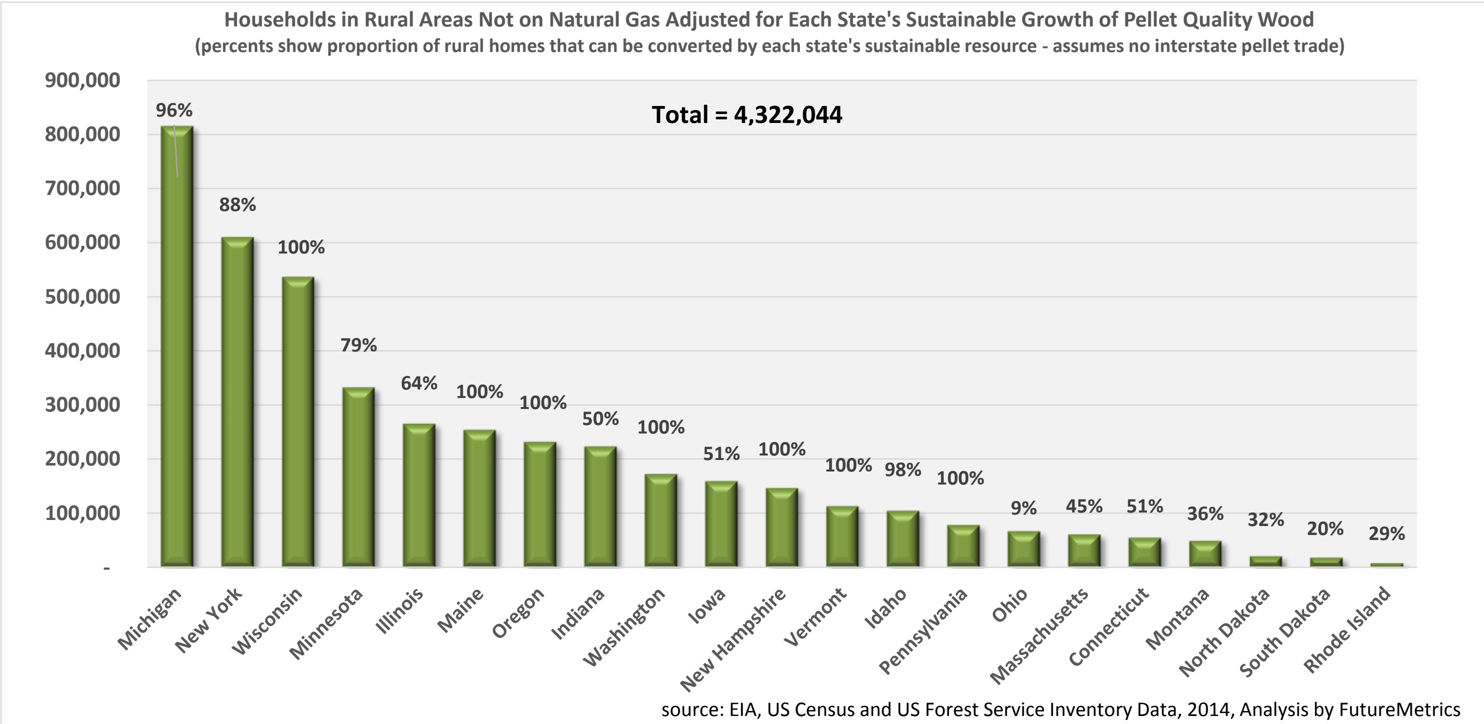


Some of the states in the chart above do not have a robust forest products industry for making pellets. But those in the Northeast, the Pacific Northwest, and the upper Midwest do.

The next chart shows the number of homes in rural areas not on natural gas but with the totals adjusted to recognize the sustainable pellet quality forest resources in each state. This conservative analysis assumes no interstate transport of wood pellets. If there were interstate trade in pellets, those states that show that 100% of the homes in rural areas not on pipeline gas can be supplied with wood pellets from that state's resource would likely export the surplus to those states with insufficient sustainable wood supplies.



What about CNG (compressed natural gas)?

The economics of CNG production and distribution limits the economical distribution of CNG to large users of energy. CNG requires costly compression stations, is costly to compress, and requires specialized trucks and storage tanks. The typical threshold for a CNG provider to consider a site for conversion is 100,000 MMBTU per year. Some providers in areas with lower cost natural gas will consider customers at 15,000 MMBTU/year (for example schools, hospitals, and large poultry or dairy farms). The typical home will use about 110 MMBTU/year.

As the analysis below shows, the business model for CNG to residences does not hold up against pellet fuel.

The table below shows the cost build up for a residential buyer for CNG. The first column shows the incremental costs. The second column is the cumulative costs. The columns to the right show the equivalent cost in heating oil per gallon and pellet fuel per ton.

The current retail price for pellet fuel in the New England area is between $200 and $250 per ton. As the far right column shows, **CNG is not competitive with pellet fuel at a delivered price equivalent to $376/ton of pellet fuel.**

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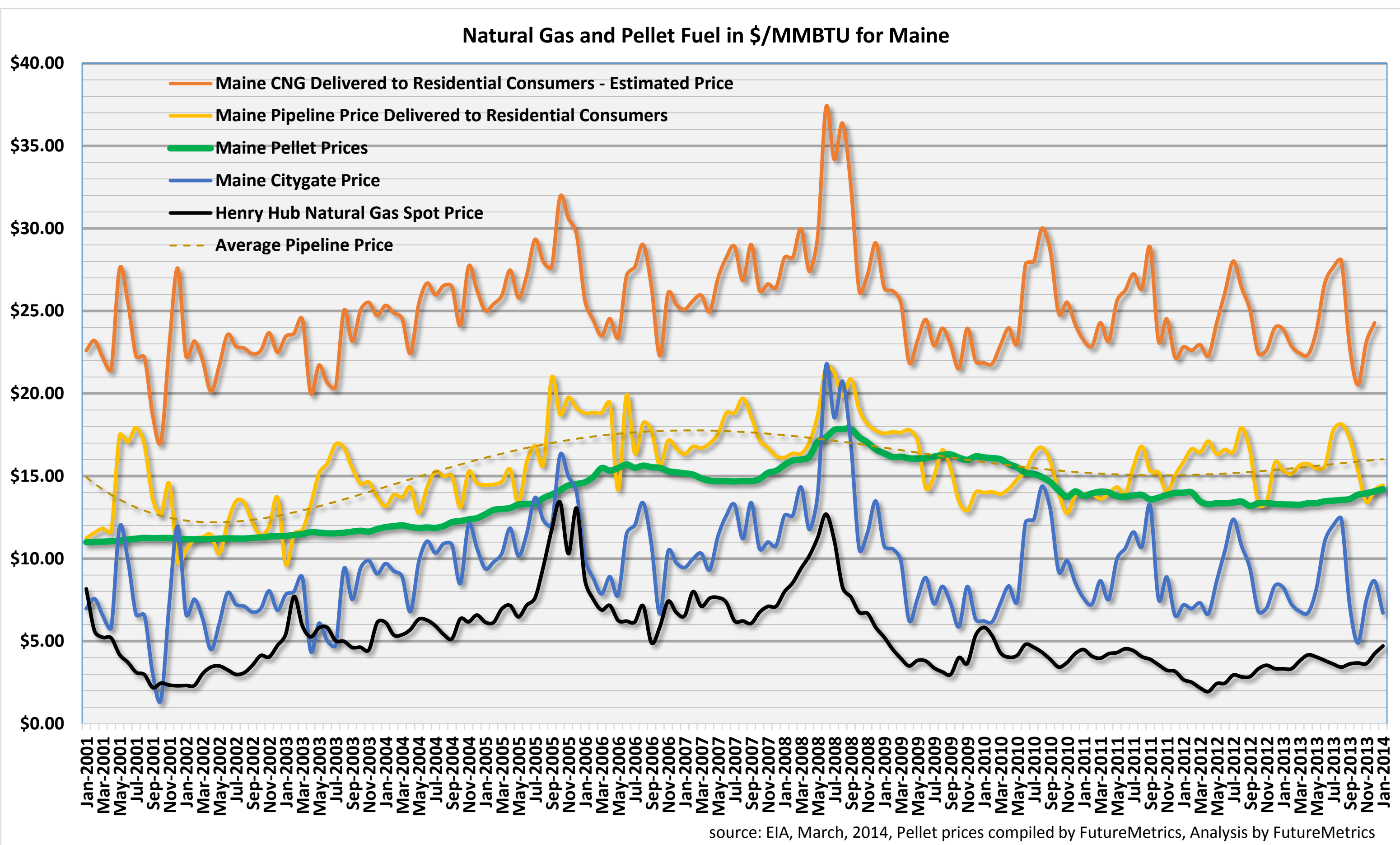
Cost of CNG	Incremental Cost measured in MMBTU equivalent	Cumulative Cost in MMBTU		Cost in Heating Oil Equivalent per Gallon	Cost in Pellet Fuel Equivalent per Ton
Gas at the Pipeline Gate	$6.50	$6.50		$ 0.90	$ 110.50
Gas at the Compressor Station	$2.00	$8.50		$ 1.18	$ 144.50
Electricity for Compression	$1.20	$9.70		$ 1.35	$ 164.90
O&M costs (labor, truck fuel and maintenance)	$4.75	$14.45		$ 2.01	$ 245.65
Amortized CAPEX for Station and Two Trucks	$1.10	$15.55		$ 2.16	$ 264.35
Amortized CAPEX for End User Hardware and Installation	$3.70	$19.25		$ 2.68	$ 327.25
Profit at 15% Margin	$2.89	$22.14		$ 3.08	$ 376.34
Price to Residential User ==>		**$22.14**		**$ 3.08**	**$ 376.34**

Pipeline gas to homes on average costs more than $12/MMBTU and is higher in northern New England. Assuming that the costs in the CNG price build up shown above stay constant, the chart below shows the estimated cost of CNG delivered to homes in Maine (based on a constant spread between the citygate price and the delivered CNG price). Wood pellet fuel, on average, is lower cost in Maine than pipeline natural gas and is about 55% the cost of the same energy delivered to homes as CNG. The price of CNG delivered to residences in Maine is equivalent to $415 per ton of pellets. Pellet fuel prices are also far less volatile.



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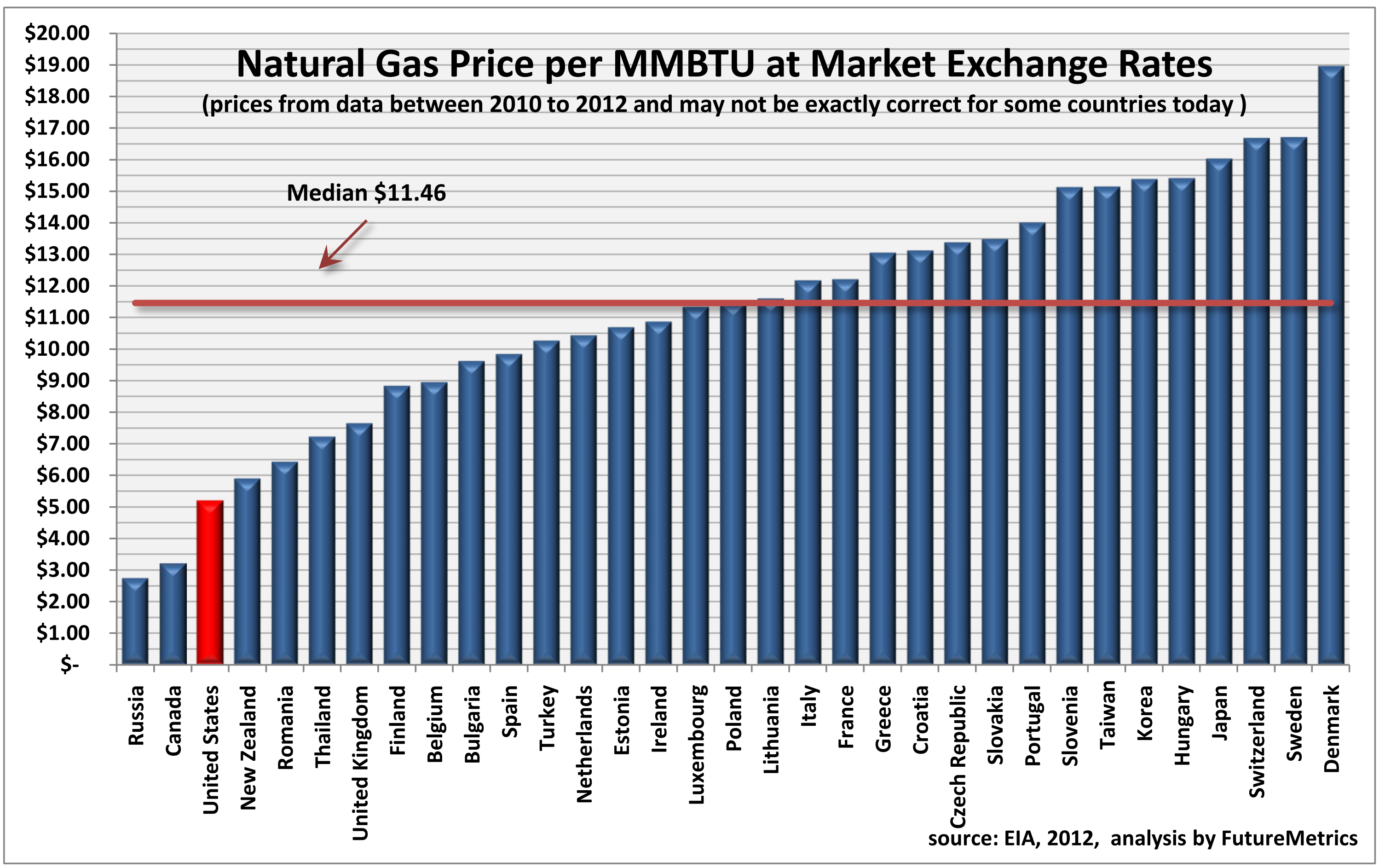
As the table and chart above[4] shows, delivered CNG will always be higher than delivered pipeline NG. The chart also illustrates the large gap between the Henry Hub price and the price paid by residential consumers. When natural gas is discussed as low cost, it is often the Henry Hub price that is quoted. The costs of transmission, pressure reduction (citygate), and distribution system capital and operating costs generate a significant gap between the Henry Hub price and the price to residential consumers.

There is another natural gas market trend that will support pellets remaining cost competitive for heating. As the US exports more natural gas, prices will be set by global rather than domestic markets.

The pricing dynamics are already in place to motivate the US to export natural gas and many LNG export terminals are in development (see the last page of this white paper). The most recent data on world natural gas prices from the EIA (see chart below) shows a median price for wholesale natural gas that is $11.46 per MMBTU. Japan is willing to pay more than $16/MMBTU at current exchange rates. These rates are CIF (cost plus insurance plus freight) at the unloading facility for the shipped liquefied natural gas (LNG). The rates to the end users are substantially higher.



[4] The tables at the end of this white paper show the assumptions used in the cost build up analysis.

Large users of natural gas in the US are lobbying to stop the permitting of LNG export terminals. But a number of major oil and gas companies are moving ahead with plans (see the map at the end of this report).

Just as Saudi Arabia has a strong interest in seeing shiploads of petroleum transit the Atlantic, domestic producers of natural gas have a very strong interest in opening up to the world market and seeing shiploads of LNG heading to higher paying markets. Exporting LNG will remove the constraint by which production has to more or less match the domestic demand on the pipeline; and it will allow producers to seek the best (and higher) price for their product. That will make prices in the US higher.

As LNG export capacity grows, domestic gas will become exposed to world prices and a supply and demand price equilibrium will be reached that will be somewhere between today's prices and the current world prices.

Finally, as CNG fueled trucks become more common, the cost of transporting wood will decrease significantly. This will lower the cost of wood at the pellet mill gate and will thus lower the cost of production. If the pellet market is competitive (sufficient supply to meet demand) this will lower pellet prices.

In summation, CNG is not and will not be a competitor to the residential pellet heating markets in the rural non-natural gas served regions.

But consumers need to understand the real prices of the delivered energy.

And high efficiency fully automatic pellet fueled boilers and the bulk pellet fuel delivery trucks to serve them need to become more commonplace in the US just as they already have in many European countries and some areas in the US northeast like Maine and New Hampshire.

It is "buy local" for heat that significantly lowers the consumer's heat and hot water energy bill, keeps money spent on heating fuel from leaving the states' economies, and has the potential to creates hundreds of thousands of jobs.

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Assumptions in the CNG cost build up analysis

Station and Trucks		
Station CAPEX	$600,000	
2 Trucks CAPEX	$550,000	
	$1,150,000	
Cost of Capital	10%	
Term (years)	7	
Annual flow for 2,000 homes	220,800	MMBTU
Cost per home of CAPEX	$1.10	/MMBTU
End User Tanks, Pressure Reducers, Install		
Number of Homes serviced by two trucks	2000	
Cost per Home (hardware and installation)	$2,500	
Total Cost for End Users	$5,000,000	
Cost of Capital	10%	
Term (years)	10	
Annual flow for 2,000 homes	220,800	MMBTU
Cost per home of CAPEX	$3.70	/MMBTU

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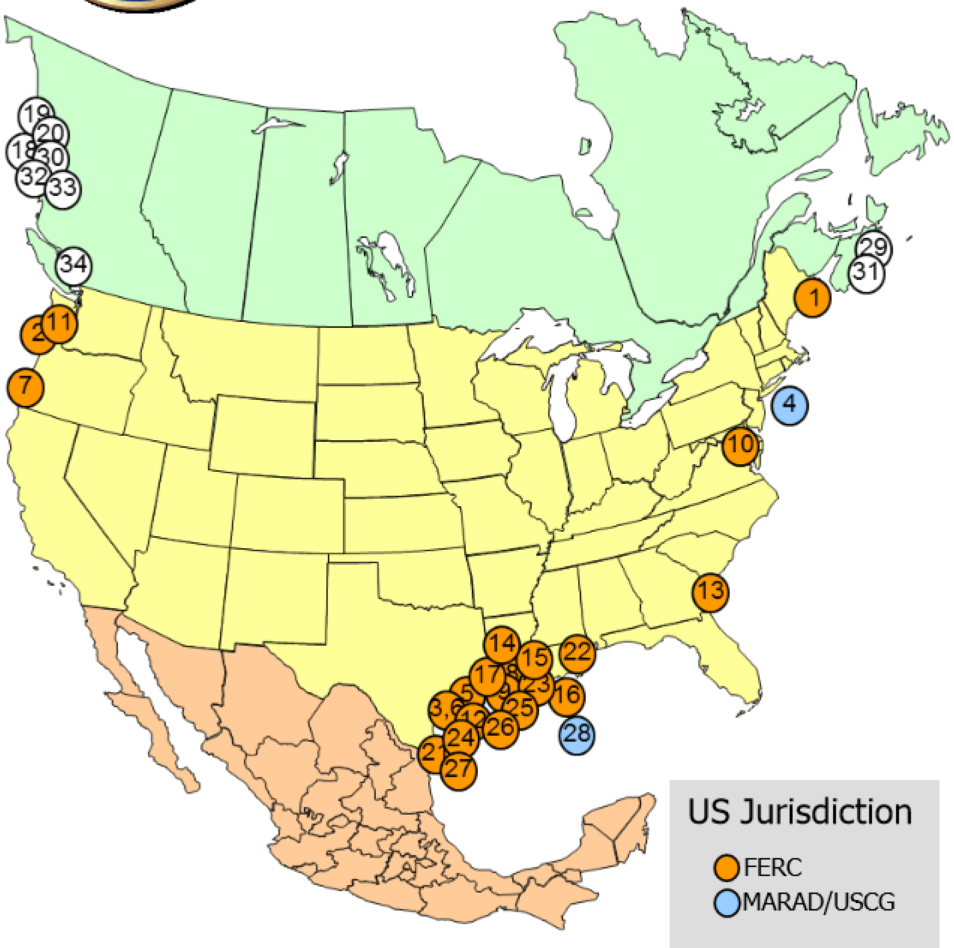
North American LNG Import/Export Terminals

Proposed/Potential



Import Terminal

PROPOSED TO FERC

1. **Robbinston, ME:** 0.5 Bcfd (Kestrel Energy - Downeast LNG)
2. **Astoria, OR:** 0.5 Bcfd (Oregon LNG)
3. **Corpus Christi, TX:** 0.4 Bcfd (Cheniere – Corpus Christi LNG)

POTENTIAL U.S. SITES IDENTIFIED BY PROJECT SPONSORS

4. **Offshore New York:** 0.4 Bcfd (Liberty Natural – Port Ambrose)

Export Terminal

PROPOSED TO FERC

5. **Freeport, TX:** 1.8 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction)*
6. **Corpus Christi, TX:** 2.1 Bcfd (Cheniere – Corpus Christi LNG)*
7. **Coos Bay, OR:** 0.9 Bcfd (Jordan Cove Energy Project)*
8. **Lake Charles, LA:** 2.4 Bcfd (Southern Union - Trunkline LNG)
9. **Hackberry, LA:** 1.7 Bcfd (Sempra – Cameron LNG)*
10. **Cove Point, MD:** 0.82 Bcfd (Dominion – Cove Point LNG)*
11. **Astoria, OR:** 1.25 Bcfd (Oregon LNG)*
12. **Lavaca Bay, TX:** 1.38 Bcfd (Excelerate Liquefaction)
13. **Elba Island, GA:** 0.35 Bcfd (Southern LNG Company)
14. **Sabine Pass; LA:** 1.3 Bcfd (Sabine Pass Liquefaction)
15. **Lake Charles, LA:** 1.07 Bcfd (Magnolia LNG)
16. **Plaquemines Parish, LA:** 1.07 Bcfd (CE FLNG)
17. **Sabine Pass, TX:** 2.1 Bcfd (ExxonMobil – Golden Pass)

PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

18. **Kitimat, BC:** 0.7 Bcfd (Apache Canada Ltd.)
19. **Douglas Island, BC:** 0.25 Bcfd (BC LNG Export Cooperative)
20. **Kitimat, BC:** 3.23 Bcfd (LNG Canada)

POTENTIAL U.S. SITES IDENTIFIED BY PROJECT SPONSORS

21. **Brownsville, TX:** 2.8 Bcfd (Gulf Coast LNG Export)
22. **Pascagoula, MS:** 1.5 Bcfd (Gulf LNG Liquefaction)
23. **Cameron Parish, LA:** 0.16 Bcfd (Waller LNG Services)
24. **Ingleside, TX:** 1.09 Bcfd (Pangea LNG (North America))
25. **Cameron Parish, LA:** 0.20 Bcfd (Gasfin Development)
26. **Cameron Parish, LA:** 0.67 Bcfd (Venture Global)
27. **Brownsville, TX:** 3.2 Bcfd (Eos LNG & Barca LNG)
28. **Gulf of Mexico:** 3.22 Bcfd (Main Pass - Freeport-McMoRan)

POTENTIAL CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

29. **Goldboro, NS:** 0.67 Bcfd (Pieridae Energy Canada)
30. **Prince Rupert Island, BC:** 4.2 Bcfd (BG Group)
31. **Melford, NS:** 1.8 Bcfd (H-Energy)
32. **Prince Rupert Island, BC:** 2.5 Bcfd (Pacific Northwest LNG)
33. **Prince Rupert Island, BC:** 3.8 Bcfd (ExxonMobil – Imperial)
34. **Squamish, BC:** 0.27 Bcfd (Woodfibre LNG Export)

As of September 12, 2013

** Filed Certificate Application*