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Why the Clean Power Plan is NOT a "War on Coal"

How following a well proven strategy can support the need for coal

By William Strauss, PhD

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Some members of congress have gained strong press lately by saying that the Clean Power Plan will close hundreds of coal fired power plants and that the plan is a "war on coal". In fact, if the coal industry and the power stations that use coal follow a strategy that is proven successful in Europe and South Korea, coal plants will not close and coal producers may see their margins improve. Furthermore the strategy will increase the number of jobs in the power industry and its supply chains at an almost insignificant cost per kilowatt-hour (kWh).

The key points of this white paper are as follows:

- All power grids need baseload and peaking[1] generation capacity. Every megawatt (MW) of wind and solar capacity needs a matching MW of conventional generation capacity (hydro, natural gas turbine, and thermal/steam turbine) to balance grid demand when the sun is not shinning and the wind is not blowing. The existing fleet of coal plants, particularly in those regions highly dependent on coal generation, cannot be closed and replaced with intermittent wind and solar power.
- Part of the reduction in CO_2 can be achieved by co-firing refined industrial wood pellets in existing pulverized coal power plants. Those plants can be either baseload or peaking.
- The generation company (genco) that co-fires wood pellets with coal to achieve a 10% reduction in CO_2 will increase its cost of production by about $0.008/kWh (that is less than one penny per kWh). This is significantly less than the current cost of wind or solar power for achieving the same reduction.
- The supply of wood pellet fuel to the power plants requires more US workers per megawatt-hour than the supply of coal. The co-firing solution is job creating. Wind and solar require zero workers to supply fuel.
- The US is already a major producer of power plant wood pellet fuel. The US has the capacity now to produce 8 million tons per year of industrial pellets and has the sustainable wood supply to expand that capacity many times over. Most of that capacity is currently shipped to the UK and EU. A 325 MW pulverized coal plant co-firing pellets for a 10% reduction in CO_2 (about 11% pellets and 89% coal) would consume 145,000 tons per year of pellets.
- Some US coal producers are already considering investment in the industrial pellet production sector through partnership with experienced US industrial pellet production companies. The objective would be to be suppliers of pulverizable power plant fuel in the form of coal and pellets. Coal producers can benefit from Clean Power Plan if they engage with the pellet producing sector.

[1] Baseload power plants are expected to generate all the time. Peaking plants are expected to generate on-demand when demand is peaking or intermittent generation is not producing.

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Misconceptions about how we can lower carbon emissions

Many in the policymaking arena think that for the US power industry to reach a 30% reduction in CO_2 emissions by 2030 that coal plants will have to close and be replaced with power plants using wind and solar energy. That is not possible is many locations. Wind and solar are intermittent low-capacity factor[2] generators. Maintaining grid reliability requires baseload and on-demand power generation that can keep the supply of power balanced with the demand for power even when the wind is not blowing and the sun is not shining. The potential for grid-scale battery storage of intermittent wind and solar power is not technically feasible now and may never be. The concept of a "smart grid" of connected electric cars is decades away.

But more importantly, a significant proportion of the US power is now generated from coal. It is not possible in 5 to 15 years to replace all that capacity in areas that have a concentrated dependence on coal for both generation and for jobs in the coal supply chain. Many of those locations are also not favorable to wind power generation. Practical and technological constraints require the use of the existing coal generation fleet. The strategy described in this white paper is a bridge that will maintain grid reliability and lower CO_2. The strategy depends on using existing coal plants.

[2] Capacity factor is a measure of the actual total electricity output versus the nameplate output of the generator. For example, a windfarm with 100 megawatts of installed generating capacity will on average produce 27 megawatts because the wind does not always blow and often, when it does, it is below the velocity needed for full output. Thus the capacity factor for a typical land based wind farm is 27%.

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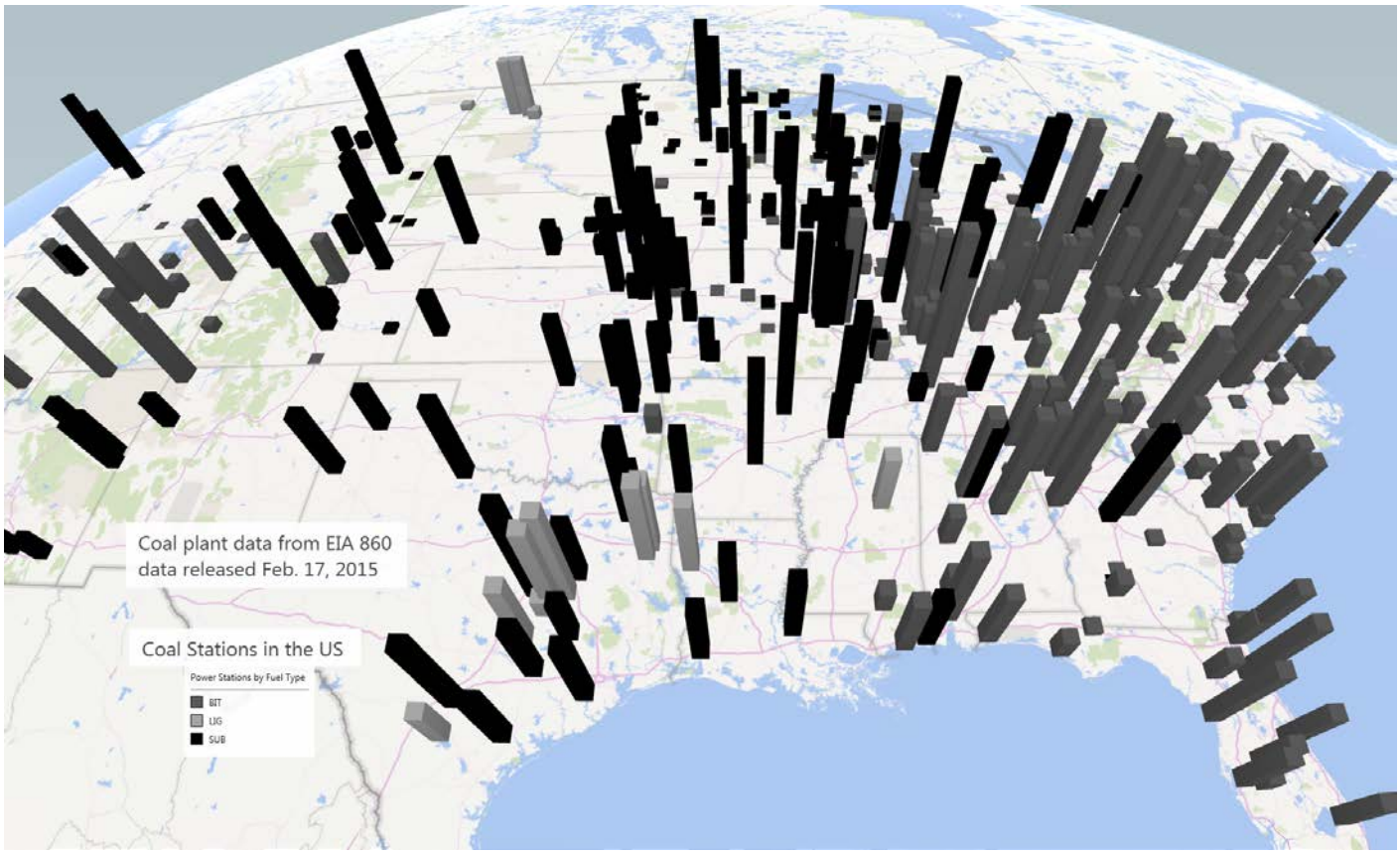

The coal power plant locations in the eastern part of the US are in good proximity to the abundant tree farms of the southeastern states that are currently the major supplier to the world for industrial wood pellets (see map later in this white paper).

To mitigate carbon emissions, completely eliminating the combustion of coal for power generation is not necessary. By blending wood pellets at modest proportions to coal, pulverized coal plants can lower their total CO_2 emissions significantly.

This is possible because wood pellets sourced from sustainable forests are carbon neutral in combustion.

Why pellets are carbon neutral in combustion

Perhaps some people living in urban environments cannot envision the vast forested lands in the US that have for generations been sustainably producing raw material for the wood products industries. These forests are in many stages of growth. There are new young trees replacing a recent harvest, and there are trees of all ages up to mature stands of trees that are ready to provide their benefit to the end users with things that many take for granted such as boards, cardboard boxes, and toilet tissue. Those managed working forests also provide benefit to the landowners, forestry workers, and mill workers as income. Keeping these vast tree farms in business will maintain the stock of trees. Without markets, the incentive will be for landowners to convert forested land to other uses.

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A major emerging market is industrial pellet production. The industrial wood pellet market is driven by the demand for low carbon fuel for power plants in Europe, the UK, and South Korea. The following scenario explains how refined wood pellet fuel is carbon neutral in combustion. Assume that the growth rate for a managed working forest is 4 tons per acre per year. Assume that the landowner has 1.0 million acres under management (that is a small fraction of actual forestland under managed growth). That 1 million acre plot produces 4 million tons per year of new growth. That is 10,950 tons per day of new growth. Suppose the landowner's forester sets the maximum allowable cut at 9,000 tons per day. If 50% of that harvest were to be used for pellet production, that one landowner would supply enough wood fiber to make about 860,000 tons per year of pellets.

If a 325 MW pulverized coal power plant is reducing its CO_2 emission by 10%, it would use about 145,000 tons per year of wood pellets co-fired with the coal. That power plant would consume about 400 tons per day of pellet fuel. That is about 4 rail cars per day. If, as assumed above, 50% of the annual allowable harvest were used for pellets, this one landowner could provide carbon neutral fuel for more than 5 power plants of that size and all of those plants would achieve a 10% CO_2 reduction.

CO_2 is reduced because every day the 10,900 tons of new growth on the 1.0 million acres of forestland will absorb all, and more, of the carbon released in the combustion of those pellets. As long as the harvest and consumption of wood to make pellet fuel does not exceed the growth rate, there is no new net carbon added to the atmosphere. In fact, since the forester in our example set a significant buffer between the actual growth rate and the harvest rate, the forest is guaranteed to be a carbon sink. Most environmental NGOs will recognize that benefit[3].

All fuels accrue a carbon footprint from the use of fossil fuels in extraction, refining, and transport. The chart below shows an estimate of the carbon footprint accumulated by the supply chain for pellets going from the southeast US to the UK's Drax power station. The Drax station currently uses 100% pellets in two of its six lines. The other four lines use coal. The analysis in the chart is based on the UK's Department of Energy and Climate Change (DECC) calculator.

[3] Greenpeace has praised the Dutch sustainability and carbon accounting criteria passed in March, 2015 that will support the co-firing of about 3.5 million tonnes per year of wood pellets in Dutch coal fired power stations.

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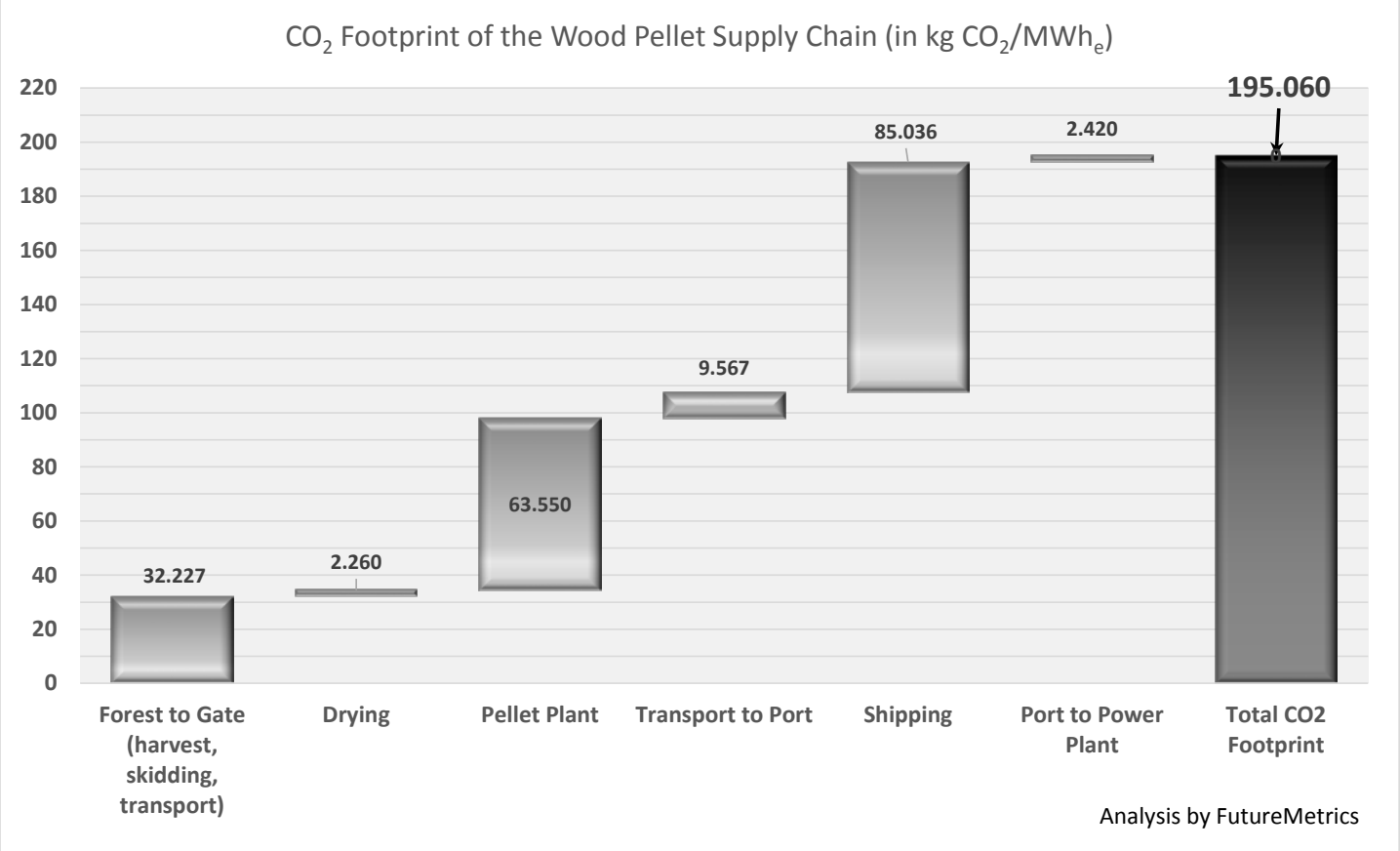


A similar analysis for the coal supply chain, from mining and extraction, to milling, to shipping, and to delivery to the Drax power station, would result in about 150 kg of CO_2 per MWh of electricity generated. Pellets produce about 45 kg/MWh_e more CO_2 in this supply chain example. If those pellets were delivered to a US power station, the major part of the footprint, shipping, would be eliminated. If the power station is close to the pellet production facility, the supply chain carbon footprint for pellets could be lower than that of coal.

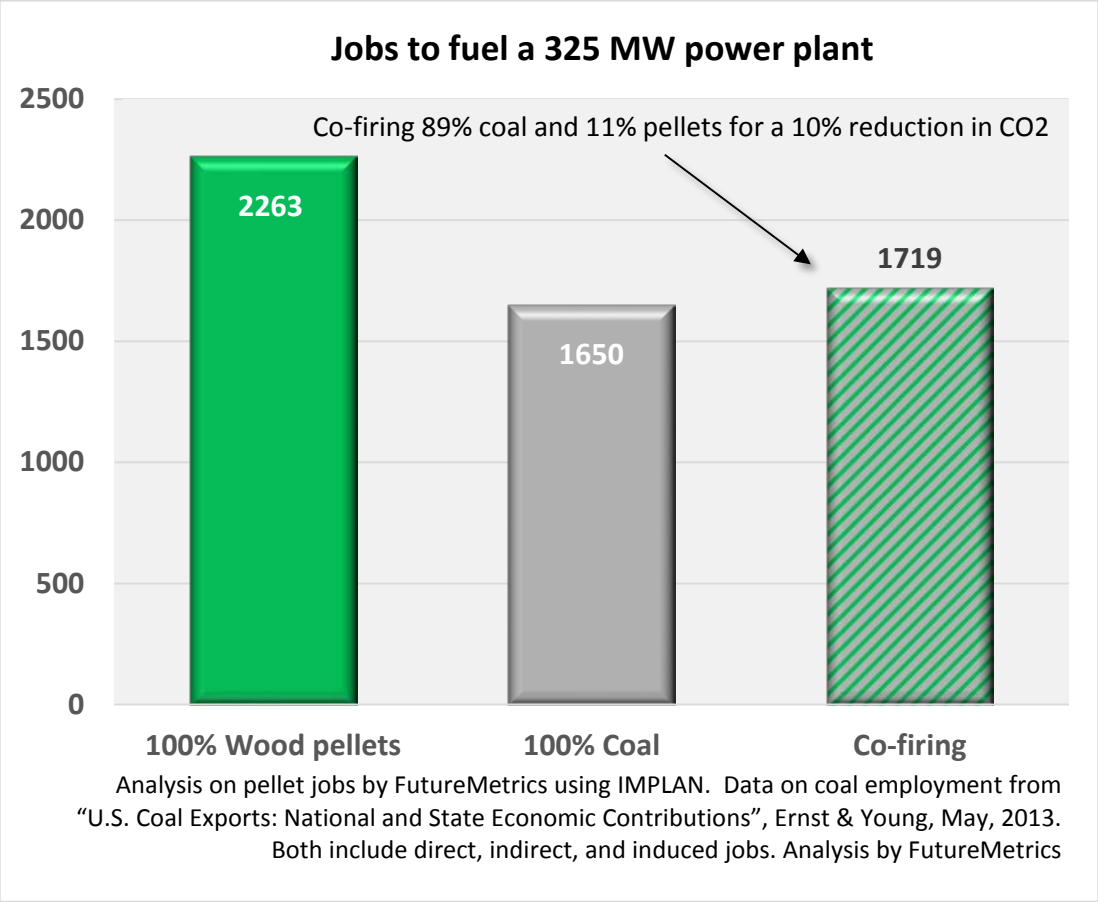
The reason why blending pellets with coal lowers the CO_2 emission is that, as shown above, pellets that are sourced from forests that are managed so that the growth rate equals or exceeds the harvest rate are carbon neutral in combustion. Each MWh of electricity generated by a power station from coal produces almost 1000 kg of new atmospheric CO_2. Including the supply chain carbon footprints of coal and pellets, that is 7 to 9 times more CO_2 from coal than from pellets for the same power output.

For the 10% CO_2 emissions reduction in our 325 MW power plant example above, the plant would use about 11% pellets and 89% coal.

Why co-firing pellet with coal is job creating

The supply chain for wood pellets requires more workers per unit of energy for the fuel delivered to the power plant. The process of harvesting, transporting, converting from wood to refined pellet fuel, and then transport to the power plant requires a higher labor intensity per unit of energy than the supply

chain for coal. The chart below shows the number of jobs needed to bring fuel into our example 325 MW pulverized coal plant.



Analysis on pellet jobs by FutureMetrics using IMPLAN. Data on coal employment from "U.S. Coal Exports: National and State Economic Contributions", Ernst & Young, May, 2013. Both include direct, indirect, and induced jobs. Analysis by FutureMetrics

Contrary to the fears that the Clean Power Plan will kill jobs, if this strategy is followed, it will create jobs.

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Why co-firing will not significantly increase the cost of power

The cost of refined wood pellet fuel suitable for use in pulverized coal plants is higher than coal. So any blend of coal and pellets will marginally increase the cost of generation. However, as the analysis below shows, the increase is very low.

Most coal fired power stations are "pulverized" coal plants. Those plants convey coal into pulverizing machines that crush the coal into a fine powder. That powder is pneumatically conveyed from the pulverizers to the burners. The burners are mounted in the sidewalls of the power boiler. The coal dust is blown into the burners and combusts very rapidly; almost like a liquid fuel. Industrial wood pellets pulverize just like coal. At modest levels of co-firing no modification to the pulverizers and burners is required. At modest co-firing levels, pellets can simply be metered into the coal prior to the pulverizers.

The assumptions used to estimate the increased cost per kWh are: The average current price for industrial wood pellets at the gate of a pellet mill, a transportation strategy (and the costs) that includes trucking and barging of the pellets to the power plant over pathways and distances associated with a plant somewhat proximate to the rich wood baskets of the southeastern US, and the average current price of steam coal delivered to a power station. The analysis also assumes that the coal plant will have to upgrade its pollution control equipment to meet the standards for emissions for coal power plants and that cost is included in the calculations. Wood pellets do not contain the pollutants that need to be scrubbed from coal plant emissions so the operating costs of the pollution control systems are lower when co-firing.

Using these inputs, at a co-firing rate that reduces CO_2 emissions by 10%, the cost increase over 100% coal is <u>less than one penny</u> per kilowatt-hour (about $0.008/kWh).

Estimates for the current cost of power from wind and solar are many times higher. Plus, as noted above, load centers in the east often have poor wind resources that preclude that generation pathway.

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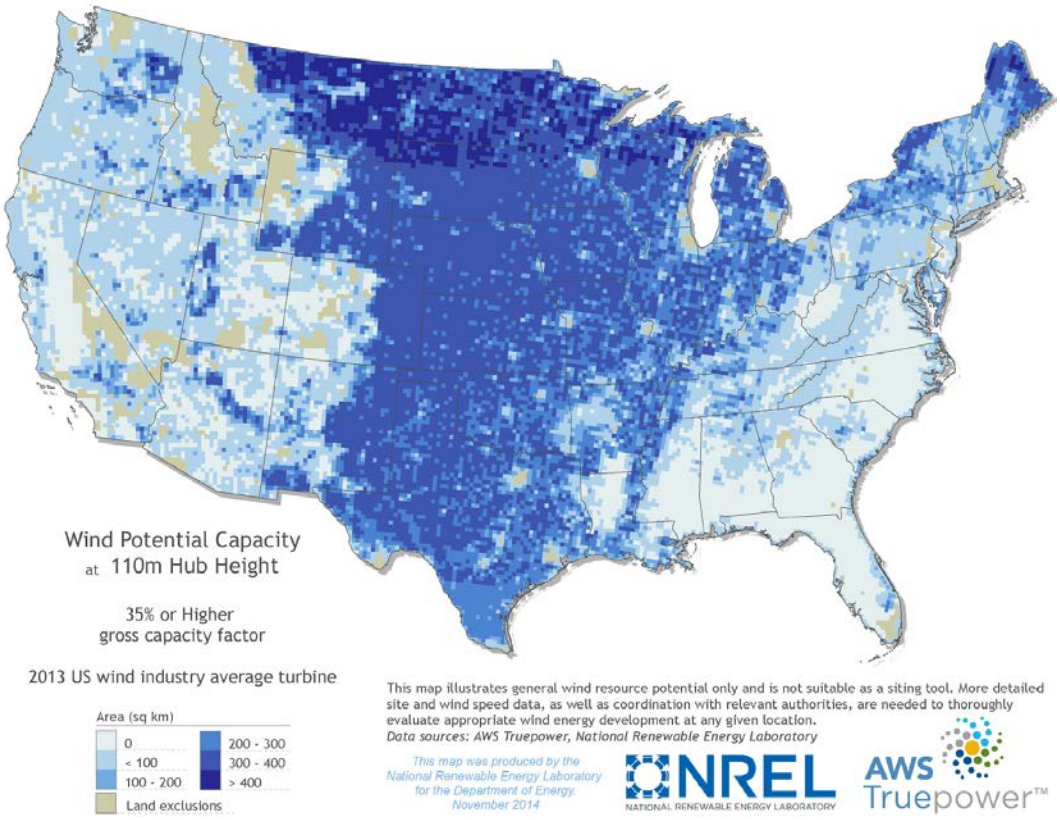

While a low cost solution to CO_2 mitigation is an important characteristic of this strategy, perhaps most important to the economic well-being of the nation and the states is that this strategy actually increases the need for workers to supply fuel.

This strategy provides a ready-to-deploy bridge from today's generation mix to the generation mix of the future. This strategy requires coal plants and coal. Natural gas combined cycle plants cannot use wood pellets.

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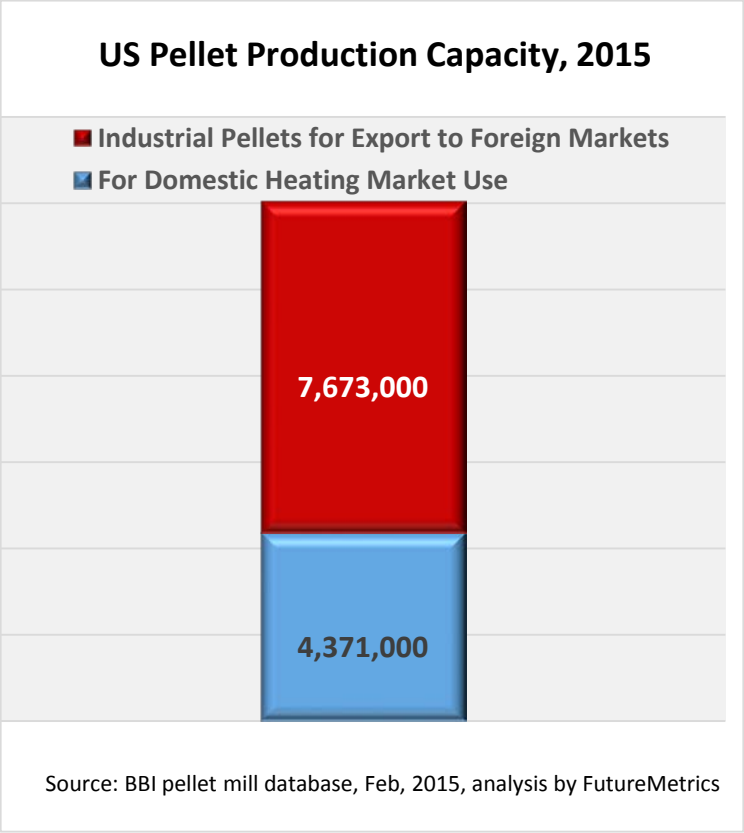
What about Industrial Pellet Fuel Prices and Pellet Fuel Security for Power Plants?

The US currently has the capacity to produce almost 8 million tons per year of industrial grade (pulverizable power plant ready) wood pellets.



Almost all of that capacity for producing industrial wood pellets is located in the US southeast. Currently almost all of the US production of industrial wood pellets is exported in bulk carrier ships to Europe, the UK, and in lesser volumes to South Korea. The tonnage capacities shown in the chart below are both for industrial pellets and premium wood pellets for heating (used in pellet stoves and boilers in the colder northern states).

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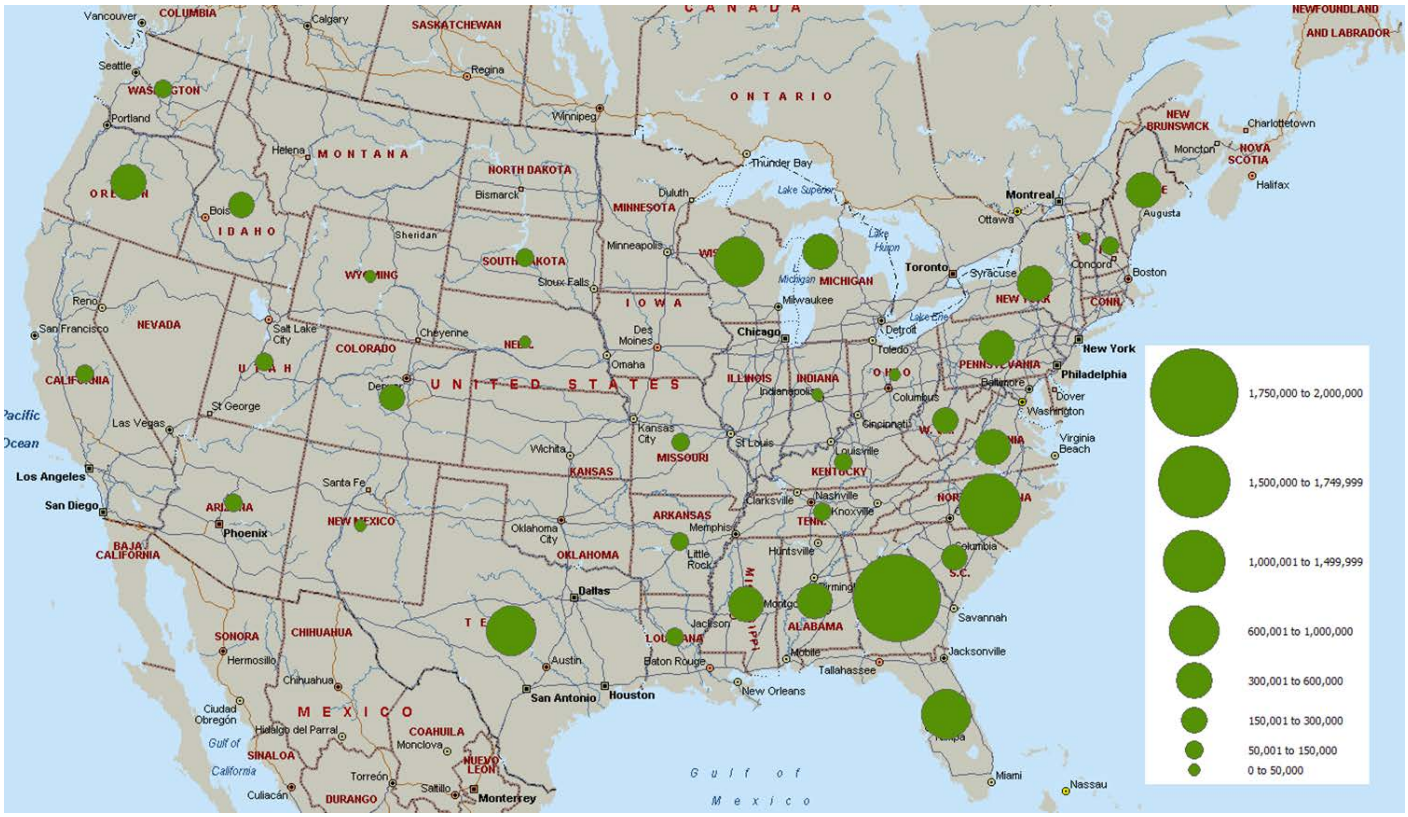

The rich and sustainable wood baskets of the southeastern states have the potential to produce many times over the current rates while staying within the sustainability constraints discussed earlier in this white paper.

One of the major buyers of southeastern US wood fiber has been the pulp and paper industry. That industry is in slow decline for a number of reasons including a global decline in demand for many grades of paper and foreign competition. The industrial pellet sector can not only save many of the production jobs lost by that decline, but also can maintain a market for the landowners who planted their tree farms with the expectation of selling wood fiber into the pulp and paper sector.

The feedstock for pellet making is from continuously and forever renewing managed forests. For the US power plant that co-fires wood pellets with coal, long-term agreements with major industrial pellet producers, some with a number of pellet production facilities, can guarantee the supply of wood pellet fuel. There is a large portfolio of production facilities across the region. As the US demand for industrial wood pellets grows, the robustness of supply will also increase.

Prices in long-term agreements for fuel supply can be negotiated in advance. The dominant price adjuster for wood pellet fuel is for the cost of transportation fuel (typically diesel). Those same adjusters would move coal prices as well. The chart below shows historical pricing for an average price delivered for various grades of steam coal and for industrial wood pellets.

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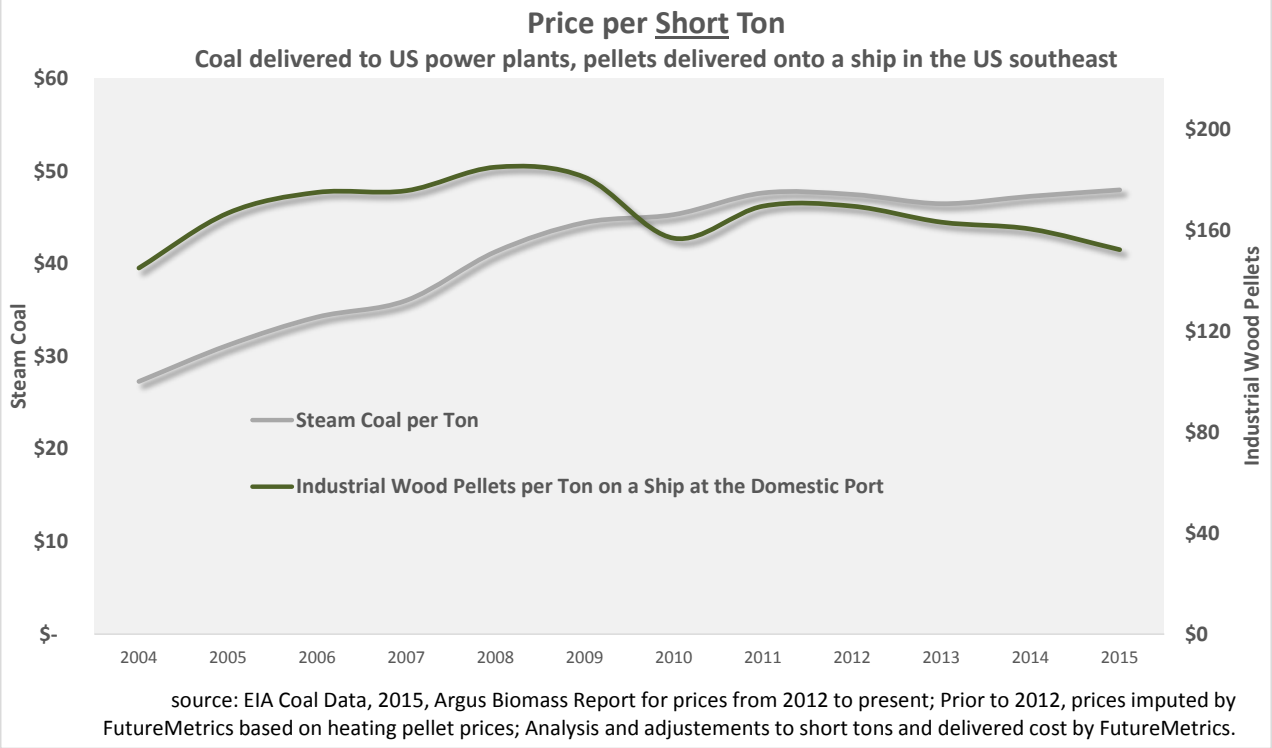

source: EIA Coal Data, 2015, Argus Biomass Report for prices from 2012 to present; Prior to 2012, prices imputed by FutureMetrics based on heating pellet prices; Analysis and adjustements to short tons and delivered cost by FutureMetrics.

Why Coal Producers should Support this Strategy

Coal demand is already under pressure because of increasing generating capacity that uses natural gas[4]. Some environmental groups support natural gas as a "bridge fuel" due to lower CO_2 emissions for the same energy as coal.

The co-firing strategy described in this white paper is a better "bridge". It takes advantage of existing generation assets. It requires very low capital investment. It achieves CO_2 reduction for a low cost per MWh. It creates rather than destroys jobs. It provides reliable power using proven co-firing techniques. And it requires that the coal supply chain remain operating.

The co-firing strategy is already being executed in other countries. European nations, England, South Korea, Japan, and China all have strategic plans for lowering carbon emissions by co-firing coal and wood pellets. Power plants in most of those countries are doing it now. Most are using US manufactured industrial wood pellets.

The Clean Power Plan is the US prescription for mitigating CO_2 emissions.

[4] Many incorrectly say that natural gas is a lower cost fuel for generation. Using heat rates from relatively new plants, at $5.50/MMBTU for gas and $55/ton for coal, the fuel cost per megawatt-hour is $24 for coal and $37 for gas. Natural gas does lower CO_2 output. Ignoring methane leakage issues, natural gas does emit less CO_2 per MWh than coal. Co-firing coal and wood pellets for a 10% reduction in CO_2 results in a lower cost per MWh than NG at current prices.

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If the Clean Power Plan's state implementation plans (SIPs) show a 5% reduction as the first phase in 2020 and perhaps 10% early in the 2020's, and much of that is through co-firing pellets with coal, it preserves the need for existing coal fired power stations and their demand for coal. As the 2030 date approaches, co-firing could increase to a level that mitigates CO_2 by 30%. Based on the same assumptions used earlier in this paper that would increase the cost of generation by about 2.5 cents/kWh. That is still much less than the current cost of wind or solar generated power. And the co-firing strategy is dispatchable or baseload and it creates jobs.

It would seem strategically enlightened for the coal producers to consider a play in the pellet production sector. The power plants need pulverizable fuel in ratios of coal to pellets that, if the full 30% CO_2 reduction is met via co-firing, will be around 66%/34%. Rather than forgo that market share, the current coal producers could engage with experienced industrial pellet producers and play a part in supplying all of the fuel: coal and pellets.

Conclusion

Contrary to what some in the US congress are saying, the Clean Power Plan is not a "war on coal".

This white paper has presented a strategy for compliance with the Clean Power Plan that is friendly to coal. Over the next decades, this strategy provides a highly supportive bridge to the future.

What this white paper has presented is a viable, ready-to-deploy, and proven strategy for compliance with the Clean Power Plan. The strategy of co-firing industrial wood pellets with coal does not require some hoped for technological breakthrough. The strategy is already deployed and is successful in many power plants around the world.

The strategy requires the operation of existing pulverized coal power plants. It supports that entire infrastructure. The co-firing strategy is job creating and the incremental cost of the co-firing strategy is very low. For less than a penny per kilowatt-hour the power plant can lower its CO_2 emissions by 10%.

There is potentially a play for US coal producers to be part of this strategy.

Shown in this light, the Clean Power Plan is just the opposite of a war on coal.