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### **Opponents of the Clean Power Plan Should Read this White Paper**

***Our future energy mix will be based increasingly on continuously renewing carbohydrate based fuels and less on non-renewable hydrocarbons.***

***This paper describes a low cost, low carbon emitting, and job creating way to generate electricity that should be part of the US's strategy for our future.***

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(Significantly updated from an earlier paper)

By William Strauss, PhD, President, FutureMetrics

**This white paper will first review the impacts of increased concentration of CO<sub>2</sub> in the atmosphere. The paper will offer some thoughts on carbon policy and why some influential leaders oppose action on mitigating CO<sub>2</sub> emissions. This paper will then discuss why the Clean Power Plan, as we have coined in an earlier paper, is part of a rational and pragmatic off-ramp towards a more decarbonized future and why those in opposition should reconsider.**

#### **Anthropomorphic Carbon Dioxide (CO<sub>2</sub>) – The consequence of a fossil fuel dependent global economy**

Over the last 150 years the global economy has transformed. That transformation has been made possible by innovation and by the increasing supply and use of concentrated energy in efficiently transportable fuels. Coal, then petroleum and, more recently, natural gas are the primary energy inputs into a system that supports billions of people. Growth, underpinned by our energy infrastructure, has been the foundation of increasing standards of living for most of the world's population. What we have today and how we experience our daily lives depends on fossil fuels.

But there are consequences. As we have increased our use of fossil fuel, we have also increased the by-products of the combustion of those fuels. The highly concentrated energy in fossil fuels is based on the carbon and hydrogen molecules that make up the fuels: hydrocarbons. When oxidized with air, one of the by-products of combustion is carbon dioxide. Because the use of fossil fuels has grown so dramatically over the past 150 years, the release of CO<sub>2</sub> from fossil fuel combustion far exceeds the ability for plant life to recapture the gas, create carbohydrates, and release oxygen. That CO<sub>2</sub> accumulates in the atmosphere and in the oceans<sup>1</sup>.

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<sup>1</sup> This paper will focus on atmospheric CO<sub>2</sub>. However, an estimated 30% to 40% of CO<sub>2</sub> from fossil fuel combustion ends up in the oceans. That CO<sub>2</sub> forms carbonic acid. Ocean acidity is increasing rapidly with observable impacts on marine life.

Carbon dioxide concentrations in the atmosphere determine the degree to which the “greenhouse effect” captures solar energy on earth. The science that describes the so-called greenhouse effect is clear and unambiguous; as CO<sub>2</sub> concentrations in the atmosphere increase, the greenhouse effect also increases.

An actual greenhouse with a glass or plastic roof allows solar energy into the greenhouse. Some of that radiant energy is absorbed by the objects and air inside the greenhouse and they heat up. Some is reflected by the objects inside the greenhouse. But the glass roof prevents the reflected radiant energy from escaping. It is reflected off of the inside of the glass roof and again onto the solid objects and air inside the house which heats up even more. The captured energy causes greenhouses to get very hot inside when in direct sunlight.

The atmospheric greenhouse effect is the same but on a global level. Radiant energy from the sun enters the atmosphere and some is absorbed by objects on the earth’s surface, by the oceans, and by the atmosphere. But some is also reflected. Most of that reflected energy returns to space and does not heat the earth’s surface. However, as CO<sub>2</sub> concentrations in the atmosphere increase, more of that reflected energy is again reflected back toward the earth’s surface. The energy captured by the greenhouse effect turns into heat just like in the greenhouse at the garden shop.

That heat builds up over time. There is no denying that this process is unfolding without ignoring facts and basic science. The impacts on sea level and surface ice levels are already measurable. The warmer atmosphere, surface, and oceans will have long-term impacts on weather. Modeling those climate impacts is complex but the consensus suggests that the changes will be highly disruptive<sup>2</sup>.

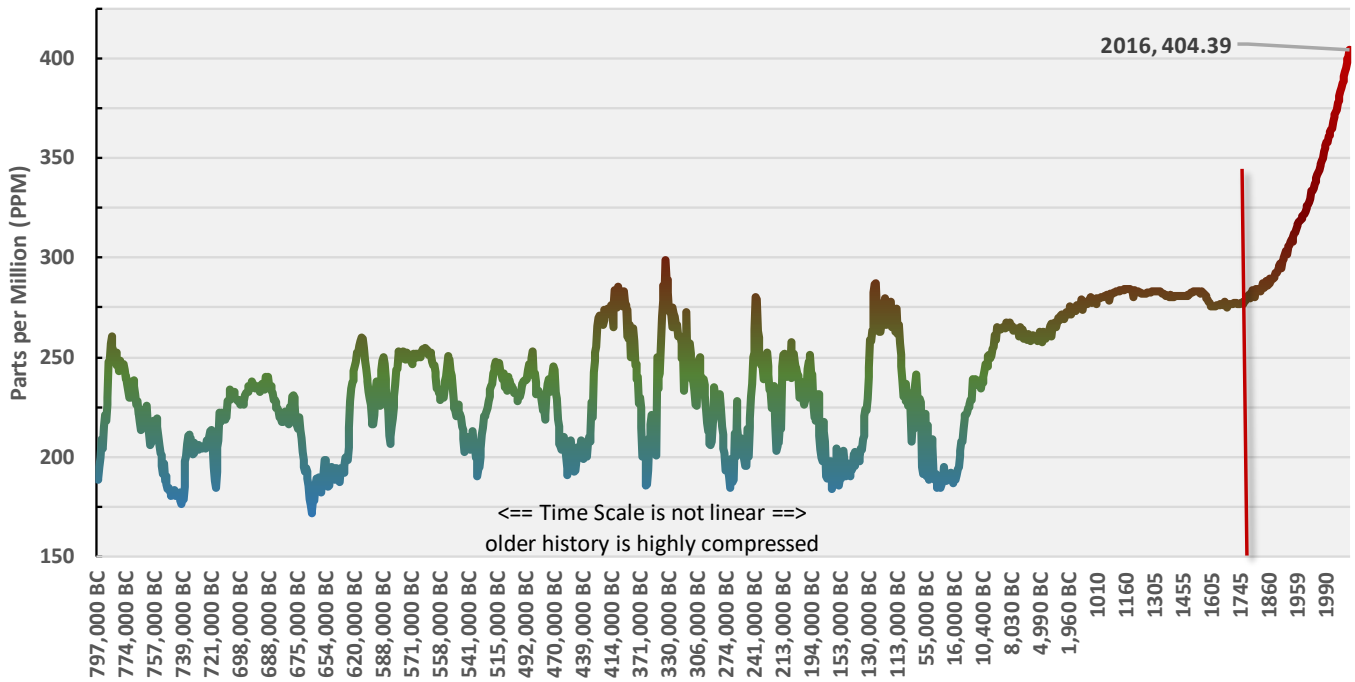
What is most troubling is the rate at which these changes are occurring.

CO<sub>2</sub> levels in the atmosphere have varied over time due to natural geologic and ecologic cycles. But the increase in CO<sub>2</sub> concentrations in recent decades is unprecedented in measurable geologic history. The charts below show CO<sub>2</sub> concentration in the atmosphere over the last 800,000 years and the last 2,000 years. The increase from about 275 parts per million (ppm) beginning in the early 1800’s to now is dramatic in both magnitude and in the rate of increase; particularly since the 1950’s.

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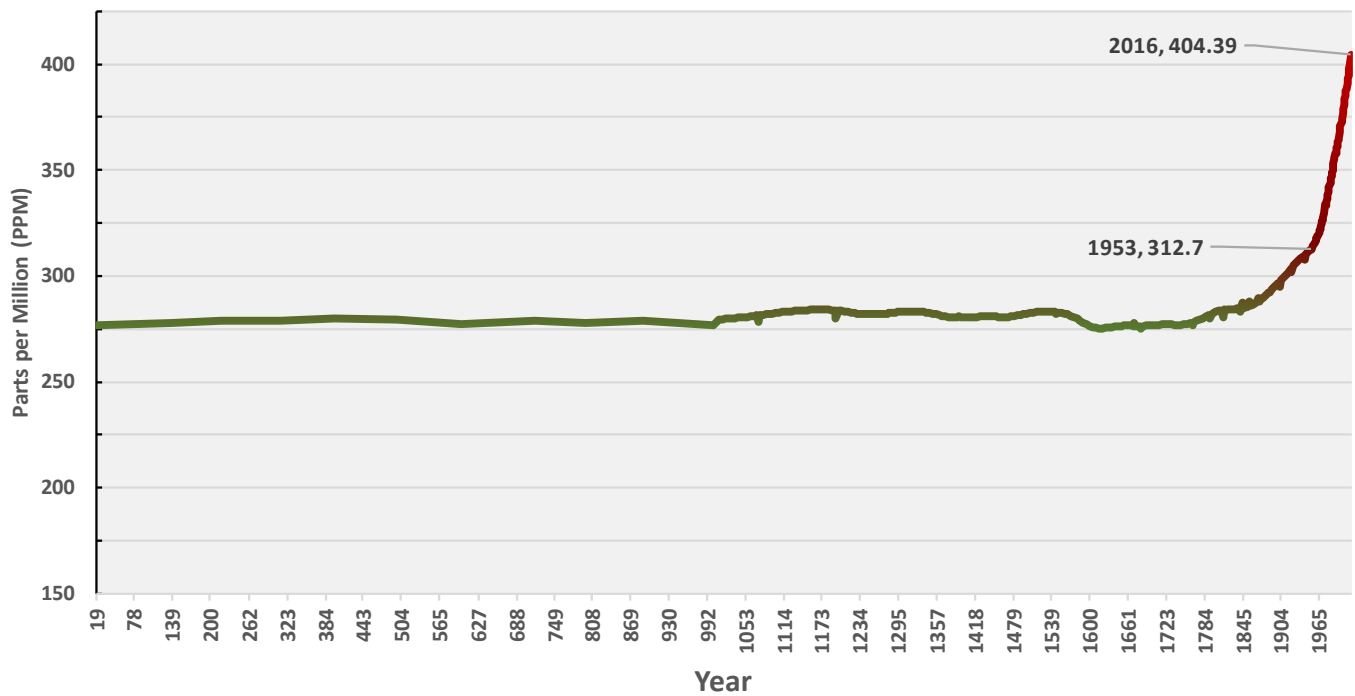
<sup>2</sup> Rising temperatures and rising sea level will have direct impacts on agriculture, coastal cities and their populations, storm intensity and damage, drought and fire risk, disease patterns, and extinction rates.

### Atmospheric CO<sub>2</sub> Concentration - 800,000 year history



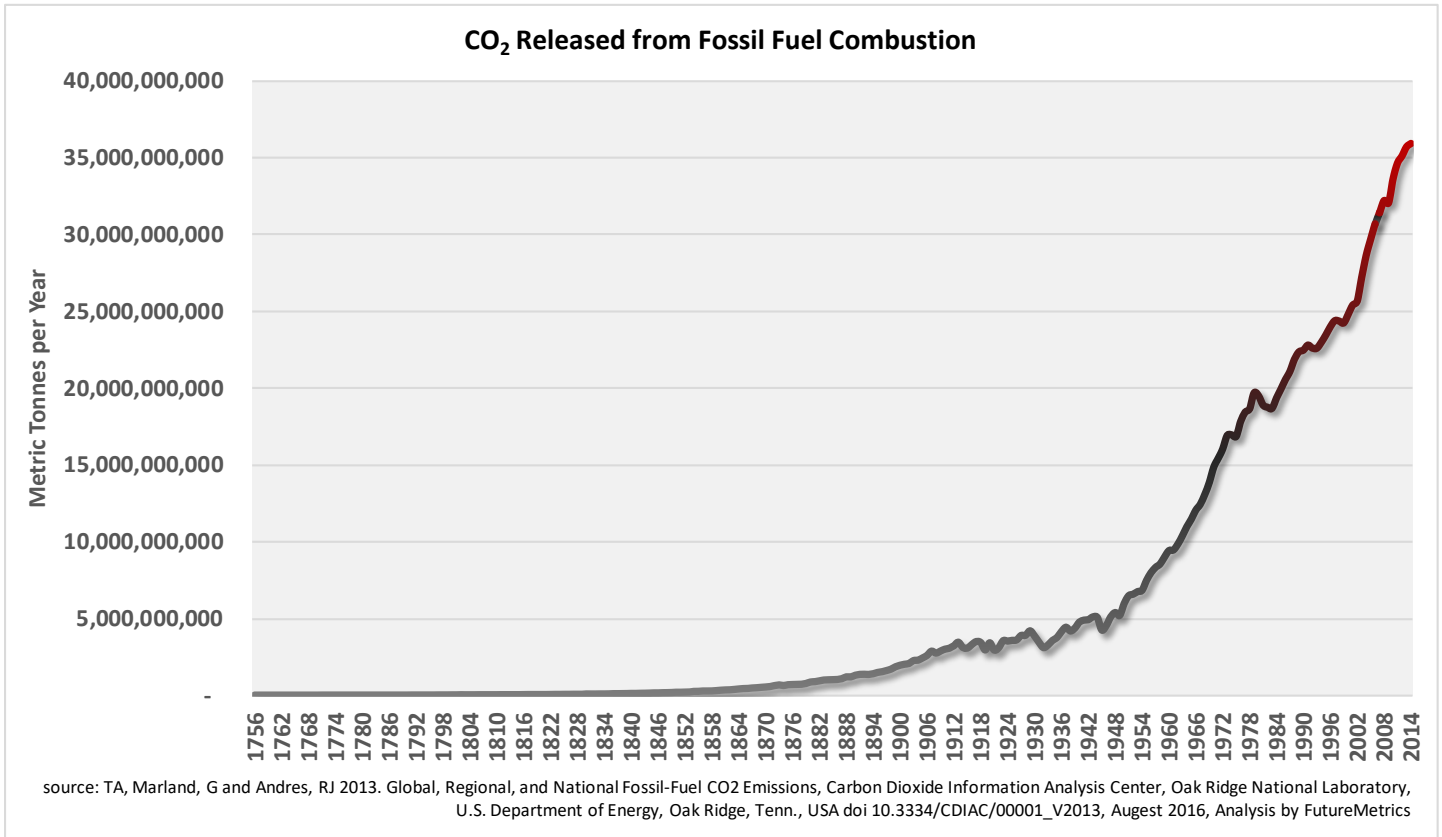
Source: EPA's Climate Change Indicators in the United States: [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators), April, 2016, 2016 data from Mauna Loa July average, analysis by FutureMetrics

### Atmospheric CO<sub>2</sub> Concentration - Last two millennia



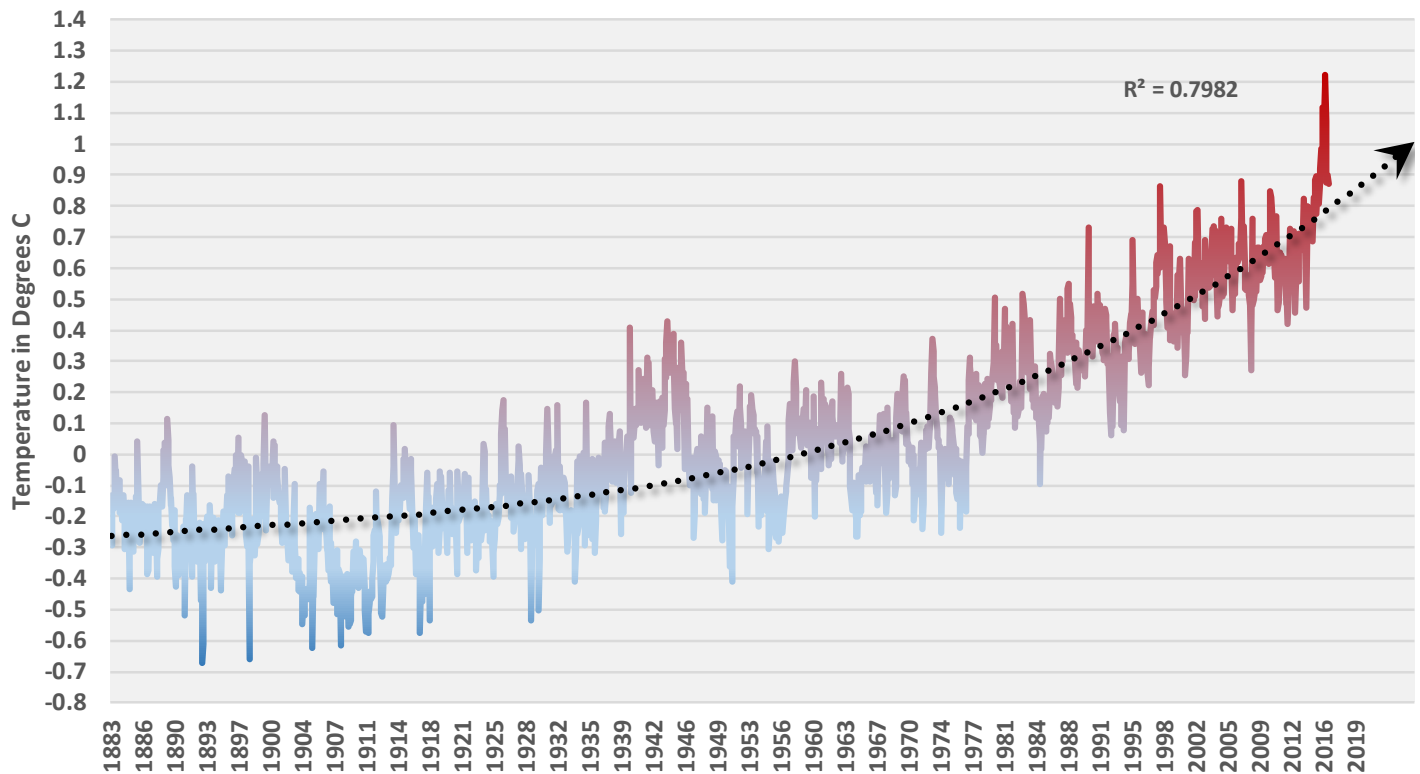
Source: EPA's Climate Change Indicators in the United States: [www.epa.gov/climate-indicators](http://www.epa.gov/climate-indicators), April, 2016, 2016 data from Mauna Loa July average, analysis by FutureMetrics

The rapidly increasing concentrations of CO<sub>2</sub> in the atmosphere are the result of the rapid increase in the use of fossil fuels. The increase since about 1950 is dramatic.



Is this causing a greenhouse effect? The next chart suggests that since the 1950's, when the increase on CO<sub>2</sub> emissions from fossil fuels takes off, the land and ocean temperatures have been increasing. And the rate of increase appears to be accelerating.

## Global Land and Ocean Temperature Anomalies



Source: NOAA, August, 2016; Analysis and time series trend by FutureMetrics  
<https://www.ncdc.noaa.gov/monitoring-references/faq/anomalies.php>

The data suggests that we are rapidly moving into a period, recently coined the Anthropocene<sup>3</sup>, in which the by-products of our dependence on fossil fuels are causing changes that will be highly disruptive to our future.

As noted above, the ability to transport and use the concentrated energy in coal, crude oil, and natural gas may be the single most important contributor to the advancements that have given us our modern society.

However, we can no longer deny or ignore the consequences of the by-products from using fossil fuels to support our global economy.

### **Policy – Why increasing CO<sub>2</sub> concentrations and the consequences are so hard for policymakers to deal with**

Clearly there is no easy or quick solution. The benefits derived from fossil fuels are deeply ingrained into all of our lives and into the economic well-being of countries, companies, and citizens. But as with any well managed enterprise, strategic planning is essential.

<sup>3</sup> <https://en.wikipedia.org/wiki/Anthropocene>

For a firm, strategic planning means anticipating changes that would threaten the firm's business model and planning tactics to counter those threats. For a country, strategic planning is also important and there should be a role for government to anticipate changes in the external environment that will threaten future economic and social well-being.

Strategic planning becomes more difficult when cooperation is required amongst different entities with potentially competing interests; whether they be companies or countries. This is compounded by short-term growth/profit maximizing views that do not consider the long-term impacts of business-as-usual.

This is the challenge we face with carbon dioxide emissions. There may be justified scientific debate over defining the timing of the impacts of unprecedented levels and rates of growth of CO<sub>2</sub> on oceans and climate; but there is no scientific basis to deny that consequential changes are occurring and will, under business-as-usual, accelerate.

Yet at the political level, particularly in the US, some leaders continue to pretend that there is nothing to worry about, that the facts are manufactured, and that the majority of the scientific community is engaged in fraud. And even if they recognize that there is a problem, they have rational arguments about the higher cost of energy and global competitiveness: Why should we do anything that will negatively effect our business climate in the short-run?

As FutureMetrics has shown in previous white papers, a rational and pragmatic strategy applied to a portion of the power generation sector can provide a gradual glide path from today to a more decarbonized future while creating jobs and building the foundation for a more robust and sustainable economic system.

Unfortunately, the denial of facts and an unwillingness to engage in a fact-based investigation is business-as-usual for some. Most of us have a propensity to see the world in a way that confirms our ideas about what is right and wrong, and we tend to exclude anything that disrupts that world view. But good strategic planning and good leadership requires challenging assumptions and testing their validity. Leaders need to carefully listen to and evaluate differing points of view.

Publicly acknowledging that there is a problem may be a challenge for a cohort of influential individuals. If those influential individuals were to look beyond the short-term view of what they define as "what matters", they would notice that the future of our socio-economic systems are at risk for reasons other than those short-term concerns that dominate a significant part of the political narrative.

The near term risks are real and important: security and access to vital natural resources, including fossil fuels, are necessary to continue hitting the benchmarks of success as defined by our economic system and to maintain social stability. If things go the wrong way in the short-term, then growth, profit metrics, and consumer confidence are quickly impacted. But the medium to long-term risks that are outside the boundary of some policymakers' strategic thought processes, which may not have relatively immediate impacts on growth and profits, are also important.

That is in part why it has been so difficult for some to understand the magnitude of the danger to business-as-usual from using fossil fuels with no restraint now and for planning for restraint in the future. The risks are too far into the future and the changes are relatively gradual.

But the sum of the changes over time add up to a very uncertain future which should alarm all influential leaders. And for most of the world, it does alarm them. Most of the world's larger economic players, including China, have committed to lowering carbon emissions now and over time.

It is extremely difficult to envision a future that is not dependent on solid and liquid hydrocarbon fuels mined from the earth. But we must take the facts about CO<sub>2</sub> concentrations from fossil fuel combustion, the facts about the increasing trapped energy that is heating up the planet, the facts about the increasing acidification of the oceans, and the consensus scientific forecasts regarding the consequences of an increasingly warmer atmosphere and ocean, and we must strategically plan our way to a less risky future.

We would never advocate for any strategy that rapidly eliminates fossil fuels. That is not feasible. But we do advocate for recognizing the problem and then rationally and pragmatically planning for the long gentle off-ramp to a decarbonized future.

### **How the Clean Power Plan provides a Rational and Pragmatic Off-Ramp to a More Decarbonized Future**

FutureMetrics has published a number of papers on this topic. Rather than revisit the logic and conclusions in those papers, the reader is encouraged to download and read them<sup>4</sup>.

We would like to assume that most rational individuals with basic critical thinking skills have to agree that the combustion of fossil fuels is rapidly changing our ecosystems. There may be disagreement on the impacts of those changes. But it is difficult, given the facts about CO<sub>2</sub> concentrations and how that changes the retention of solar energy on the earth, to not conclude that significant changes are occurring and will occur well into the future. The vast majority of peer reviewed scientific forecasts suggest a high likelihood of disruptive tipping point changes if we continue business-as-usual. That is why most nations have agreed to set goals for mitigating carbon emissions and have policies in place now that are already guiding a gradual decarbonization of the power sector.

The US, via the Clean Power Plan (CPP), is joining the global community. The CPP, while setting goals for 2030, provides great flexibility to the states regarding their compliance strategy and the timing of the deployment of those strategies.

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<sup>4</sup> A few of the papers are listed here with direct links. Others can be downloaded from [www.FutureMetrics.com](http://www.FutureMetrics.com).

*"A Rational and Pragmatic Off-Ramp to a Decarbonized Future"* [HERE](#)

*"The Washington Post and 65 "Experts" that Wrote a Letter to Congress are Wrong about Biomass to Energy."* [HERE](#)

*"Why the Clean Power Plan is NOT a war on coal"* [HERE](#)

*"A critique of the recent Climate Central report titled 'Pulp Fiction'"* [HERE](#)

*"Debunking myths about pellets for power"* [HERE](#)

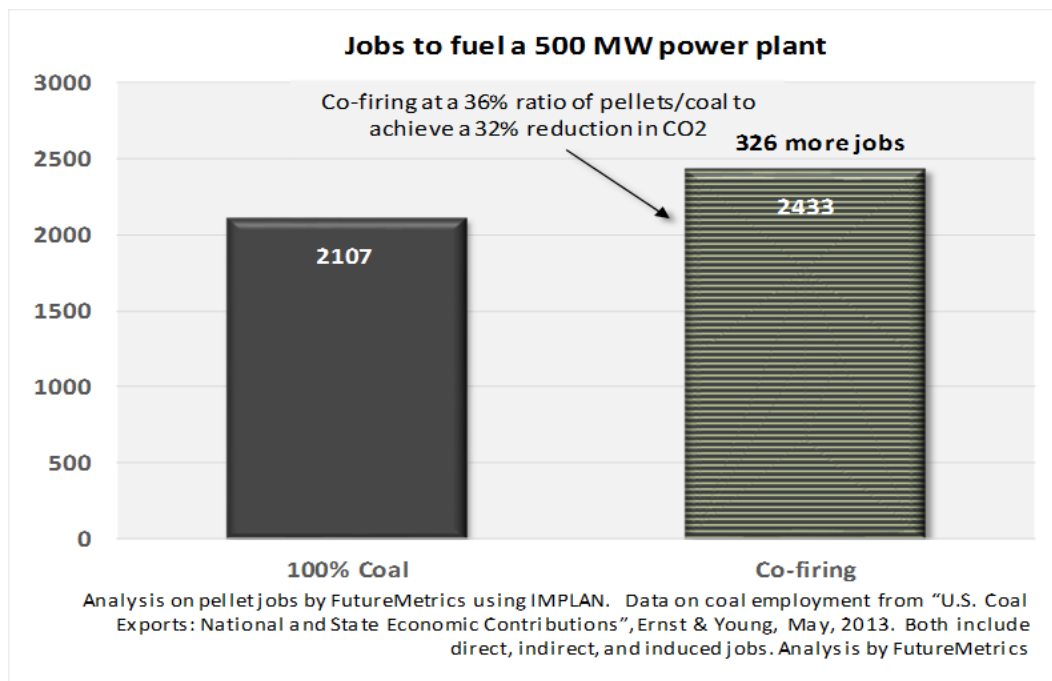
As our white papers have discussed in detail, blending industrial wood pellets with coal is a low cost, easily deployable, dispatchable, and sustainable solution for lowering carbon emissions from coal power plants.

Switching from non-renewing hydrocarbons to continuously renewing biomass sourced carbohydrates for energy stops the release of geologic carbon.

Every ton of wood pellet fuel sourced from sustainable working forests that replaces coal in a power station can lower CO<sub>2</sub> emissions by up to 90%.

And using existing coal power plants as the foundation for a gradual weaning off of fossil fuels for power generation supports jobs.

Creating and delivering refined solid fuel from renewable biomass for power generation requires more labor than mining and delivering coal. The chart below shows the number of jobs sustained or created by fueling a 500 MW power plant with 100% coal and then with a blend of pellets and coal in order to achieve a 32% reduction in CO<sub>2</sub> emissions. Jobs are sustained in the coal industry since 64% of the fuel is coal.



This compliance solution provides insurance to the coal producers that they will be supplying coal to this power station through the 2020's and beyond and, ironically, makes the coal industry a strategic partner in CPP compliance.

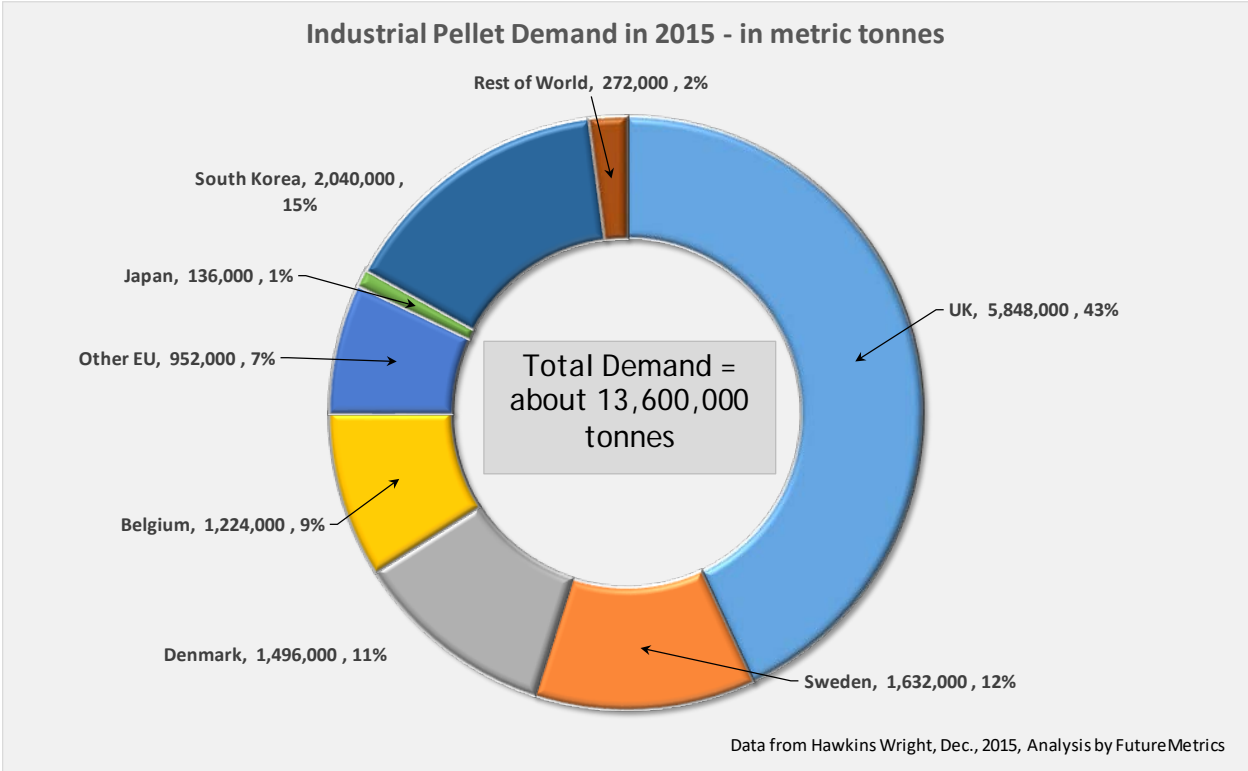
Given the rapid loss of market share to natural gas, we would think that the coal sector would support this strategy.

A co-firing strategy for CO<sub>2</sub> reduction is not new or risky. Power plants that co-fire or even use 100% industrial pellets are just as reliable and produce the same power output as they did with coal (no de-rate).

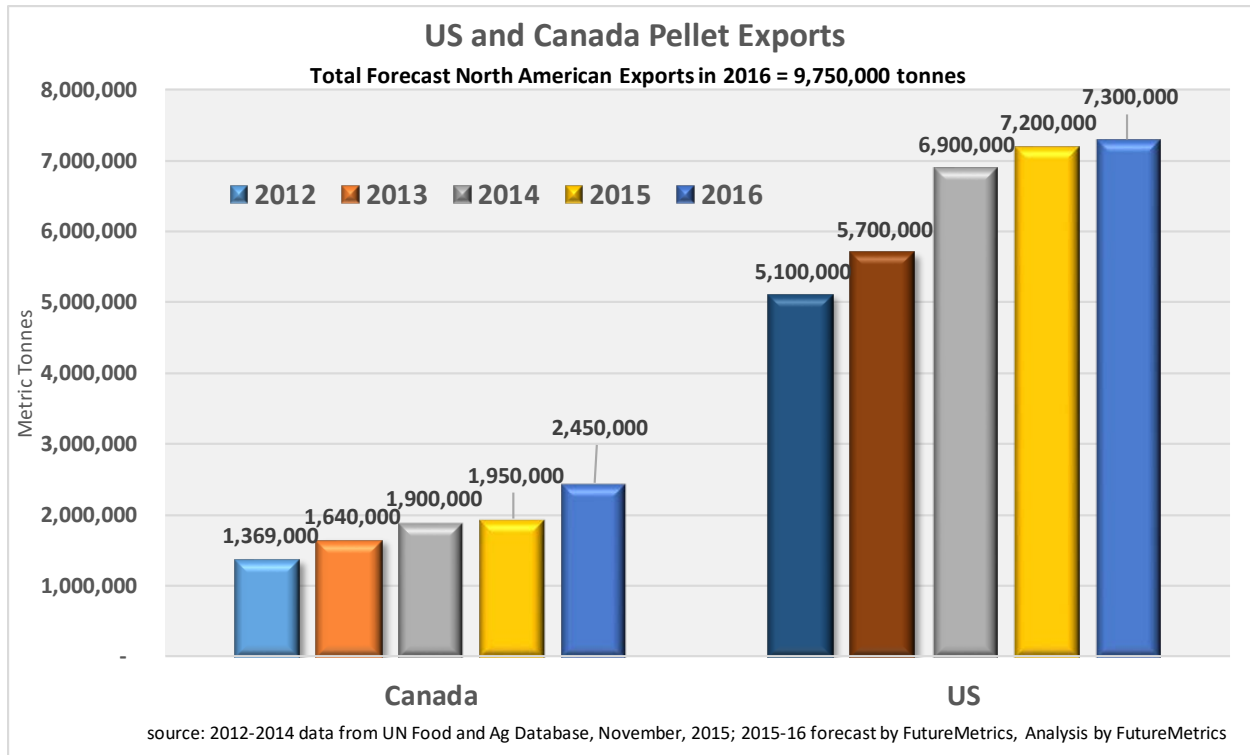


The rigorous certification and auditing schemes for proving CO<sub>2</sub> reduction by using continuously renewing biomass feedstocks are well established.

Because co-firing is well established as a CO<sub>2</sub> reduction strategy, the rest of the world already uses millions of metric tonnes per year of industrial pellets in power plants. The chart below shows the most recent data.



The US and Canada are major exporters of industrial wood pellets. North America is the leading global supplier of industrial wood pellets that are certified to be produced from sustainable renewing sources.



The US is already a major producer for the industrial wood pellet sector. But every ton of certified industrial wood pellet fuel produced in the US is shipped overseas. The US could very easily supply its own coal power stations with the same renewable solid fuel as it supplies to Europe and England.

### **The Clean Power Plan should be implemented**

With all the data and analysis telling us about the risks from fossil fuel combustion, the US should set reasonable goals with a gradual pathway from now to a more decarbonized future and join the rest of the developed nations in caring about the world that future generations will try to live in, and join the rest of the developed nations in doing something about it.

Even those that are skeptics of the science should assess the risk of doing nothing just in case they are wrong.

The consequences of being wrong when denying how our actions are impacting our planet is a future that could make our planet unable to sustain our way of life. We should join the rest of the developed nations of the world and pay a little now for the insurance that mitigates catastrophic loss.

Everyone has homeowner's insurance just in case the house burns down. The probability of that happening is low, but the magnitude of the consequences of that low probability event are high. That is why we are willing to pay for insurance. In the case of the impacts of rapidly increasing CO<sub>2</sub> concentrations in the atmosphere, whatever probability assigned to the risk of a significant negative outcome (and that probability is high based on most of the research), the magnitude of what could happen if business-as-usual

is maintained is so large and disruptive that it seems most rational and pragmatic to formulate a strategy to change our actions over time in a way that lowers the likelihood of significant negative consequences.

The Clean Power Plan is the foundation for that. But can the US as a nation actually have a strategic plan for environmental stewardship?

We hope that this paper has made the case that the opponents of the CPP should step back and reevaluate their opposition. The CPP has been crafted for maximum flexibility while setting goals that will get the US to levels of CO<sub>2</sub> from power generation that will make a difference for our children and grandchildren and so on.

Leaders of companies that fail to apply facts, analysis, and critical thinking to strategically planning for a sustainable future lose their jobs or the companies fail. It is time for the leaders of this country to apply facts, analysis, and critical thinking skills to the task of dealing with the consequences of using fossil fuels.

We have shown in our white papers that a strategy of co-firing industrial pellets with coal to lower carbon emissions from power plants is not only viable but is a preferred pathway in many countries because it uses existing power plants, is easy to implement, is very low cost compared to other renewable generation pathways, can deliver baseload or peaking power to compliment intermittent solar and wind generation, and, for the country that produces the fuel, will have a net positive job impact.

The Clean Power Plan can enable this rational and pragmatic (and job creating) off-ramp to a more decarbonized future.