*FutureMetrics™ LLC*
8 Airport Road
Bethel, ME 04217, USA

# Wind power generation, solar PV generation, and energy storage are combining forces.

## What about the wood pellet sector?

# Why wind, solar, and pellet-based generation should collaborate.

July 26, 2021

Authors: Annette Bossler and William Strauss, FutureMetrics

The associations that represent the industrial wood pellet[1] sector, the major producers of industrial pellet fuel, and traders in industrial pellet fuel have successfully championed the growth of the industry over the past 15 plus years. Industrial pellet fuel has become an important component in the move to renewable power generation in the UK, western Europe, Japan, and South Korea (see figure 1 below).

However, under current policies, growth in the industry from 2023 forward is relatively flat. Finding policy pathways that support growth in demand in existing markets is becoming more challenging. Furthermore, US policy that would support industrial pellet demand is nowhere to be seen.

This white paper's thesis is that the likelihood of evolving policy that supports continued growth (see figure 2 below) might be significantly increased by focused efforts on cooperation between the pellet sector and the consortiums that advocate for wind power, solar power, and energy storage.

### Pellet Fuel Not Included…

In September 2020, the American Wind Energy Association (AWEA) announced a merger into a new clean energy industry organization: the American Clean Power Association (ACPA). Members of this organization are some of America's largest utilities as well as project developers and suppliers to the wind, solar, storage, and power grid sectors. On July 22, 2021, the ACPA met with President Biden at the White House[2]. Industrial pellet fuel? Not included but should be.

In June 2021, Bloomberg New Energy Finance released their latest New Energy Outlook (NEO). As in previous editions, the latest NEO covers wind power, solar PV, battery storage, and green hydrogen. Industrial pellet fuel? Not included but should be.

[1] "Industrial" pellet fuel is primarily used to replace coal in large utility pulverized coal power stations
[2] See HERE.

*FutureMetrics™ LLC*
8 Airport Road
Bethel, ME 04217, USA

In February 2021, Japan's Ministry of Economy, Trade and Industry (METI) established a committee to formulate basic policies for the budget for the Green Growth Strategy, which was announced in December 2020. Industrial pellet fuel? So far, not included, but should be.

These examples highlight how the renewable power generation sector is evolving: major players in wind and solar are forging alliances and are successfully gaining access and traction with lawmakers, regulators, ENGO's, and influential media.

This powerful consortium has a strong influence in how policy is formulated. As a result, policies are focused on wind, solar, and energy storage.

Even though using pellet fuel in power stations has become a mainstay in some nations, it still does not rise to the top in policy discussions and is often depicted negatively in influential media.

A few examples of policy not properly recognizing the contribution to the fight against climate change that the industrial pellet sector offers are as follows.

In July 2021, the EU updated its climate and energy laws and published an amendment to the REDII climate goals. The EU puts more emphasis on wind, solar and hydrogen compared to biomass[3]. Hydrogen and ammonia produced from wind and solar as a form or energy storage are explicitly targeted and may get 10-year tax breaks. In contrast, while the efficacy of using biomass is not disputed, the proposed rules will remove all subsidies for pellet fuel by 2027[4]. Unless there is a high price on $CO_2$ emissions, the economics of substituting pellet fuel for coal will be challenged[5].

In December 2020, the Japanese government announced the "Green Growth Strategy" which includes focus and major investments in the following sectors: offshore wind, fuel ammonia, hydrogen, and small nuclear reactors[6].

In March 2021, the Biden Administration announced a new offshore wind target of 30GW by 2030[7]. To date, there has been no high-level policy discussion of using pellets in power stations in the US.

The industrial pellet sector has been active over the past 15+ years in certain jurisdictions and certainly pays careful attention to policy formation. Through its trade associations and its major producers, it has worked hard to gain policy traction.

[3] See HERE.
[4] See HERE and HERE and a summary by the Wood Pellet Association of Canada's Executive Director Gord Murray HERE.
[5] A FutureMetrics dashboard allows calculation of the needed carbon tax. Direct link is HERE.
[6] See HERE.
[7] See HERE.

In general, those past efforts have been successful. Policies in the countries shown in the figure 1 below have supported growth in pellet demand. Demand has increased by about 1.8 million metric tonnes per year from 2010 to 2022. But under current policy, that growth flattens to only about 300,000 tonnes per year from 2023 to 2027.

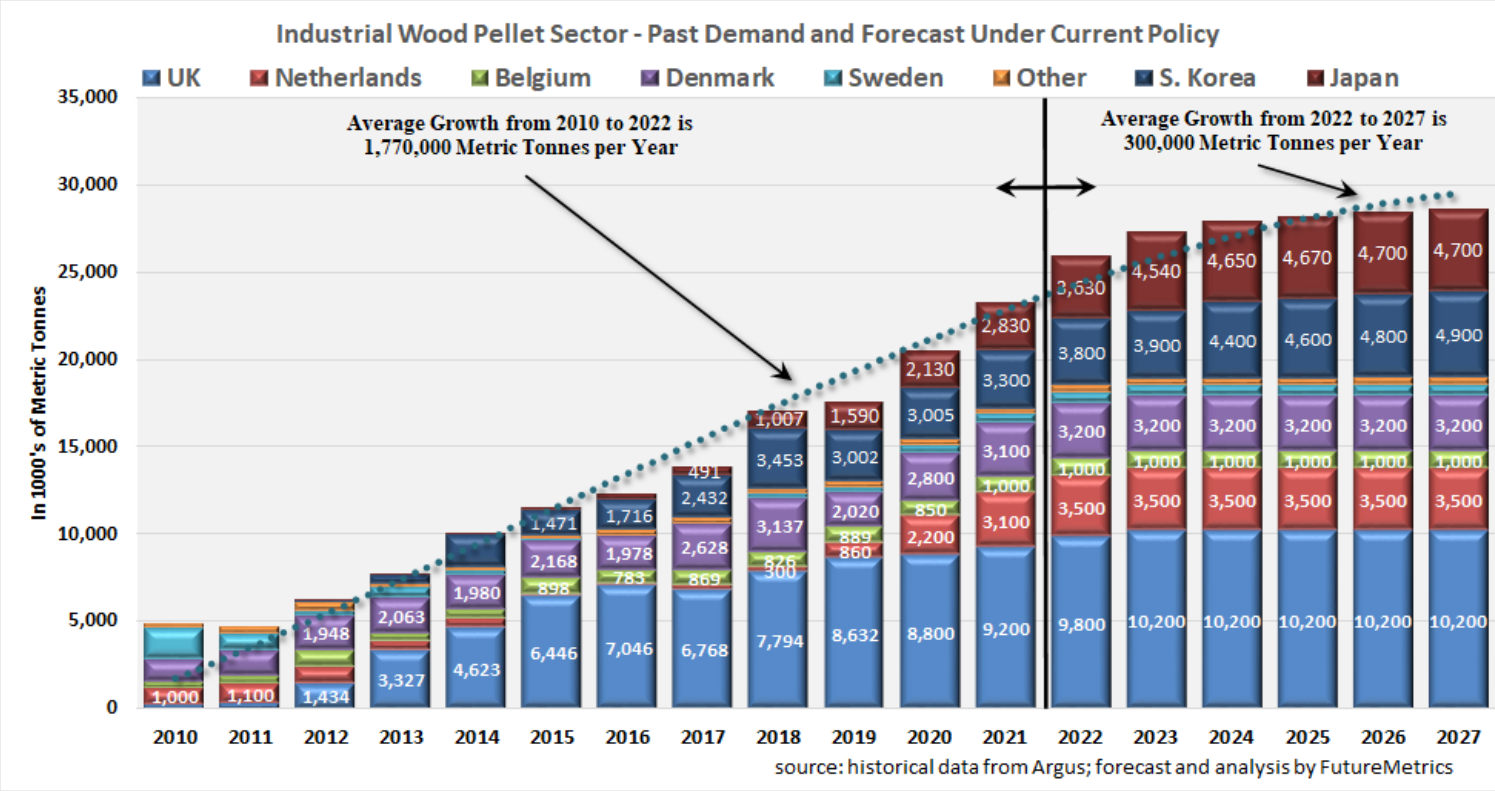


*Figure 1- Industrial Pellet Demand under Current Policy*

That growth trajectory could be significantly altered if policies evolve. North America, Japan, Western Europe, SE Asia, South America, Oceania, India, and perhaps China would benefit from evolving policies that support the transition strategy of using pellet fuel to replace coal in power stations.

The chart below shows a scenario for new growth in just north America and Japan. The assumption is that by 2027 about 2,000 MW's of coal fueled generation has been converted to pellet fueled generation in the US, about 750 MW's in Canada, and about 1,200 MW's in Japan.

A total of 2,000 MW's of pellet fueled generation in the US is less than the Drax power station in the UK[8].

[8] The Drax station used to be the largest coal fueled power plant in England. It no longer uses coal. Four 650 MW units are modified to run on 100% pellet fuel.

*FutureMetrics™ LLC*
8 Airport Road
Bethel, ME 04217, USA

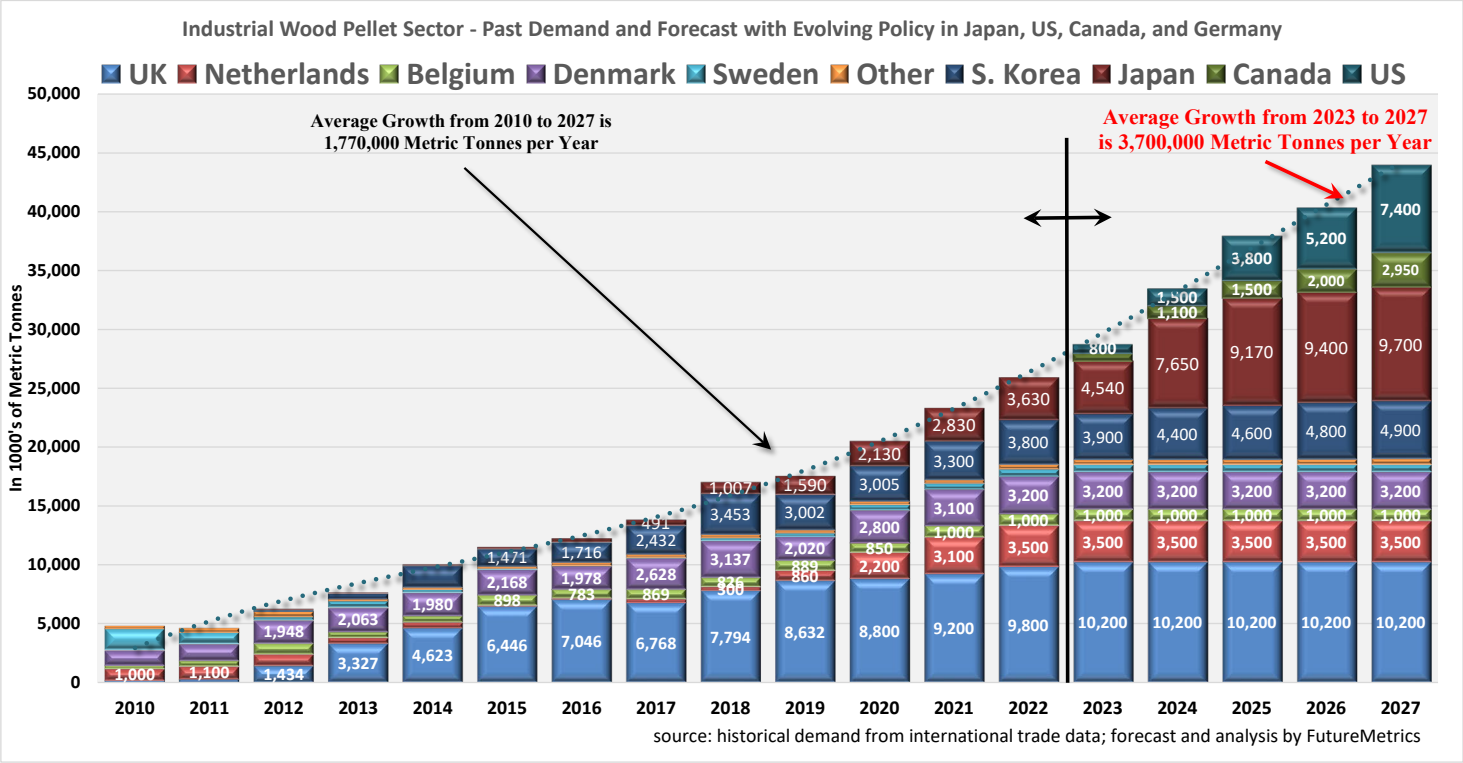


*Figure 2 - Industrial Pellet Demand under Evolving Policy*

Under the assumptions in this forecast for evolving policy, growth in pellet demand over the five years from 2023 to 2027 goes from averaging 300,000 tonnes per year to averaging about 3.7 million tonnes per year. And that is without potential demand growth in other countries.

## Cooperation not Competition between Wind and Solar Advocates and the Industrial Wood Pellet Sector

Too often, strategic decision making is distilled into binary forks. If one pathway is chosen, the other pathway defined as suboptimal. This tendency engenders competitiveness. Advocates of pathway (A) may focus attention on the shortcomings of pathway (B), and vice versa. Some opponents to the various renewable energy generation pathways utilize this fragmented approach. For example, anti-pellet-industry NGO's often promote wind and solar as the only options for power sector decarbonization.

But oftentimes there is complementarity that can strengthen the desirability of both pathway (A) and (B).

The strategy for decarbonizing the electricity generating sector is dominated by wind and solar; and for good reason. Wind and solar both have zero fuel cost, and they produce no emissions when

generating power. They hold the promise of a future powered by sunshine and wind with zero $CO_2$ emissions from generation[9] and at competitive costs.

The advocates for wind and solar have traditionally had a number of separate trade associations vying for attention as the preferred pathway. As noted in the opening paragraph of this white paper, in February of 2021[10], numerous entities aligned into the American Clean Power Association (ACPA). On July 23, 2021 the ACPA and the Energy Storage Association (ESA), announced that they will merge (pending final approval of ESA members)[11]. The ACPA advocates for developers, equipment suppliers, and the operators of wind farms, solar farms, transmission systems, and now energy storage solutions.

The complex dynamics of generating from variable and geographically diverse wind and solar inputs, and thus the required infrastructure needed to maintain a reliable power grid, make it a "no-brainer" that the ACPA has been formed. Wind and solar in conjunction with storage are seen as compliments in the pathway to full decarbonization of the power grid.

There is further complementarity that is missing from the ACPA's mission.

**Why is there Complementarity?**

As FutureMetrics has shown in previous white papers[12], the transition to a future that is primarily energized by wind and solar generation will take decades. It is not just the build out of wind and solar farms: The energy storage requirements needed to buffer the intermittency and variability of wind and solar power while maintaining grid reliability are massive.

> To support the growth of variable and intermittent generation (wind and solar) that outpaces the growth of grid-level energy storage, on-demand and easily variable renewable power that can meet needed load demand should be not only desired but should be seen as a strong complement to the wind and solar industries.

The idea of burning fuel for power generation may seem primitive. In several decades that may be the case for most power generation[13]. But in this interim period, during the transition to a grid

[9] It should be noted that there are $CO_2$ emissions associated with wind and solar. There are $CO_2$ emissions produced in raw materials extraction and refining, manufacturing, transportation, and recycling of wear parts (like turbine blades and degraded solar panels). This "supply chain" and O&M carbon footprint is not unique to wind and solar.
[10] See HERE.
[11] See HERE.
[12] All are free to download from the FutureMetrics website. For a paper specific to the challenges facing the transition to a grid primarily energized by wind and solar, see HERE.
[13] As bioenergy carbon capture and storage (BECCS) become mainstream, power stations that have been modified to use pellet fuel in place of coal will be significantly carbon negative. Those stations will have long lives as they subtract

primarily energized by non-$CO_2$ emitting wind, solar, hydro, and nuclear generation, using non-$CO_2$ emitting pellet fuel[14] to replace coal in existing utility power stations is a pathway that makes very good sense.

Nuclear power is non-carbon emitting. But nuclear power stations cannot rapidly respond to variations in demand. Plus, their business models require that they generate at full capacity most of the time. They are baseload systems that generate with little variation in output. Plus, permitting and commissioning of new nuclear plants can take more than a decade.

Hydro power is also non-carbon emitting, and it can vary with fluctuations in demand. But in many jurisdictions including the US, Canada, Europe, Japan, South Korea, and South America, most potential hydro supply has already been exploited. In many locations, hydro output is also at risk from climate change as increasingly prolonged draughts are depleting reservoirs and slowing flow rates where run-of-river generation is used.

**The only other non-carbon emitting option that is utility scale, on-demand, able to follow the load, come online as needed, is already fully interconnected into the grid, and is quick to deploy, is to use existing power stations that were built to be operated on coal and have been or can be modified to use wood pellet fuel in place of the coal.**

**Having renewable carbon neutral power balancing the grid to offset intermittent wind and solar output perfectly complements the build out of the wind and solar industry.**

Of course, the marginal cost of a MWh from thermal generation is higher than that from wind and solar[15]. That is because there are no fuel supply chain costs and no delivered fuel cost with wind and solar[16].

---

$CO_2$ from the atmosphere while generating power. See pages 16 and 17 of Canadian Biomass Magazine for an article by Dr. Strauss on this topic HERE.

[14] The carbon neutrality of the combustion of wood pellets is well documented. Simply put, as long as the mass of carbon sequestered in the forest landscape that is supplying the feedstock for pellet production is not depleting, then no net new $CO_2$ is added to the atmosphere. The efficacy of modifying pulverized coal (PC) power stations so that they can use pellet fuel is well-proven. About 23 million metric tonnes of pellet fuel will be used in ex-PC power stations in 2021.

[15] While the actual cost of generation is low for wind and solar, it does not capture the cost of having capacity available to fill the constantly varying gap between total demand and the supply from wind and solar. The cost of on-demand generation that is forced to run at varying capacity factors and thus has a higher cost of generation is integrated into the final rates paid by consumers, but it is not explicit to the cost of wind and solar generation.

[16] As a consequence, there are zero jobs created for fuel supply for wind and solar. For example, the fuel supply chain jobs for a 550 MW power plant are 2,300 for coal, 3,300 for pellet fuel, 290 for a natural gas, and of course zero for wind and solar. Data on coal employment from "U.S. Coal Exports: National and State Economic Contributions", Ernst & Young, May 2013. NG jobs based on percentage of NG that goes to the power sector and data from employment in

When, not if, there is a sufficient price on carbon (which should be sooner than later), then filling that power grid's demand gap with fossil fueled generation (natural gas[17] or coal) may be more costly than generating with pellet fuel.

And, as a recent FutureMetrics white paper and dashboard have shown, combined with carbon capture and storage, using industrial pellet fuel in a modified pulverized coal power station is the only pathway to negative carbon emissions while generating electricity. The technology for carbon capture and storage will be mainstream and economical (assuming a price on carbon emissions) within the next five years.

In the **United States**, the ACPA should recognize the significant value to their mission if they included this strategy. It would allow the build out of solar and wind generation to outpace the growth of energy storage while still producing zero net emissions of $CO_2$. The industrial pellet fuel sector should consider reaching out to the ACPA, perhaps joining, and certainly meeting with and educating their board and executive leadership.

### What about Japan?

Japan may be even better suited for cooperation between their wind and solar associations and the Japan Biomass Power Association (BPA), and other trade associations advocating for the use of industrial pellets as a substitute for coal.

Since the Great Eastern Japan Earthquake, the resulting tsunami, and the Fukushima catastrophe, Japan has been supporting renewable energy via feed-in-tariffs. Biomass, as part of the category "combustible renewables", delivered 27,322 GWh's in 2020; up from 15,174 GWh's in 2010 (this includes pellet fuel, palm kernel shells, wood chips, and some other biomass[18]). Solar PV has been the clear leader in renewable power. Solar delivered 81,318 GWh's in 2020. To date, "combustible renewables" in Japan have produced more power than wind. Wind supplied 14,117 GWh's in 2020.

But that is going to change: Japan has a 15 GW+ project pipeline for offshore wind. Roughly 8GW of capacity is to be built and commissioned between 2026 and 2030. An offshore wind target of 10

NG extraction and transport. Total jobs include direct, indirect, and induced jobs calculated by FutureMetrics with IMPLAN.

[17] FutureMetrics has shown that the lowest cost per avoided tonne of $CO_2$ emissions is not by building a new natural gas combined cycle plant but is by converting an existing pulverized coal station to use pellet fuel. See the FutureMetrics white paper and dashboard on this topic.

[18] To date, most of the biomass used for power generation is Japan is used in relatively small independent power plants that use fluidized bed (FB) boiler technology. FB boilers, unlike large scale PC boilers, do not pulverize the fuel and thus can accept a wide variety of fuel types. PC boilers have been preferred at utility scale for their load following ability, their reliability, and their higher efficiency.

GW by 2030 is likely to be met. The 30 GW to 45 GW target by 2040 is achievable given the offshore wind resources in Japan's territorial waters (within 12 nautical miles from the coast). The combination of offshore wind with hydrogen production is included in many of these plans that are in the pipeline.

Why should industrial pellet producers care?

The use of pellets as a coal replacement in Japan's large utility power stations competes with other generation sources as pathways to comply with Japan's targets for renewable energy. And so far, Japan's Green Growth Initiative and its respective budget planning does not include industrial pellet fuel. Instead, the focus is on offshore wind, hydrogen, ammonia fuel, and small nuclear reactors.[19] These are the sectors that the Japanese government will actively promote.

In the future, massive batteries or perhaps ammonia and/or hydrogen storage may be used by Japan for buffering intermittency, for load following to compensate for variability, and for peaking generation. Eventually, that future will likely arrive and the need for on-demand generation from burning even a non-carbon emitting fuel will be mostly eliminated.

However, that future is decades away.

In the meantime, it makes very good sense for some of the existing PC coal stations to be modified to use pellet fuel.

Japan plans to exit coal fired power generation by 2030. In response to this, the Japan Biomass Power Association is advocating for the conversion of roughly 9.8GW of the pulverized coal (PC) plant fleet from coal to pellet fuel.[20] This effort is pragmatic for many reasons. And it is very important vis-à-vis the build out of the wind and solar sectors for the reasons already discussed above: PC power stations using carbon neutral fuel will allow wind and solar capacity to get ahead of the grid-level energy storage capacity needed for reliability of supply.

Japan's offshore wind project pipeline and the fact that most of Japan's utility coal power stations are located along the coastline (to easily receive imported coal) suggests that, in addition to the grid balancing and grid reliability roles, a secondary complimentary condition arises.

[19] "Green Growth Strategy" action plan announced in December 2020 targets 14 key fields, including offshore wind and green hydrogen – English publication in January 2021 (see HERE).
[20] See HERE.

Offshore power will have to come ashore and interconnect with the grid. As is shown in the grid upgrade scenario published by the Japanese Government in May 2021[21], extensive grid upgrades will be required.

Meanwhile, all of the existing coal fired power stations along the coast already have the grid interconnection infrastructure in place. The fuel change from coal to industrial pellet fuel does not require any grid upgrades or new transmission wires.

Furthermore, for those offshore projects near existing generating stations, the existing interconnect infrastructure can be shared with the coal stations; some of which could be using pellet fuel in place of coal.

Power generation using pellet fuel can complement intermittent offshore wind as part of a carbon neutral solution. If BECCs is added, the synergies are amplified as the solution permanently subtracts $CO_2$ from the atmosphere while generating power.

FutureMetrics has created an online interactive map showing the locations of the approximately 150 utility power stations in Japan that use imported coal, as well as the locations of planned offshore wind power generation. The user can zoom in on the satellite view of any station. Clicking on the coal power plant icon will bring up information about the power plant.

The map illustrates the potential synergy in Japan between the offshore wind industry and the use of industrial pellet fuel in coastal PC power stations. This synergy will become even more important if the Energy Mix 2030 is revised as expected.

METI is currently reviewing the Energy Mix 2030[22]. The revised energy mix will be:

- Renewables between 36% and 38%, replacing the 22% and 24% target which is currently in effect.
- Fossil fuel power will be 40%, replacing 56% which is currently in effect (26% coal + 27% LNG + 3% oil).
- Nuclear will remain at the current level of between 20% and 22%

It is worth noting that only pellet fuel can substitute for coal on PC power stations. Palm kernel shells (PKS) and wood chips are suitable for fluidized bed boilers; but they do not pulverize and thus are not suitable for use in large utility power boilers that pulverize the fuel to a very fine particle size prior to combustion.

## Conclusion – Cooperation not Competition

[21] See HERE.
[22] See HERE (actual information In Japanese) and HERE for English summary by Reuters.

Until energy storge is many orders of magnitude greater than it is today, wind and solar power's build out is limited by its inherent unpredictable constant fluctuations in output which can sometimes go to zero. Sufficient energy storage for a grid entirely reliant on wind and solar is decades away. Wind and solar needs reliable and robust load following generation to expand.

This is well-understood in the wind and solar space. Balancing wind power with load following hydro generation is seen as a model for a carbon free grid. But as noted above, expanding hydro capacity in most locations is not feasible. And in many existing locations, climate change will have negative long-term impacts on river flows.

Repurposing some of the existing coal generation assets that risk being stranded by low-cost natural gas and the general phase out of coal generation is pragmatic and rational; and it allows the wind and solar industry to expand more rapidly well before utility scale energy storage is actualized.

The wind and solar industry should welcome the addition of this pragmatic and rational carbon neutral (or negative with BECCS!) reliable load following addition to the decarbonization strategy.

**Should the industrial pellet sector be working with wind, solar, transmission, and energy storage sectors as an ally in the common goal of decarbonizing the power sector?**

**This white paper clearly suggests that the answer to that question should be "yes".**

Cooperation in strategy and communications may yield a future in which government strategies and influential reporting will have a more complete view of how to get from today to a fully decarbonized power sector.