# BIOMASS AT BOARDMAN

## PGE's Proposal to Convert Oregon's Only Coal Plant into America's Largest Biomass Facility

## INTRODUCTION

Before the year's end, Portland General Electric (PGE) will conduct a full day of testing in its coal plant located a few hours east of Portland in Boardman, Oregon, burning wood and energy crops instead of coal. Oregon's largest utility decided to close the Boardman plant when continued operation conflicted with Oregon's shift toward a clean energy future. If the biomass test burn is successful, PGE will consider a full transformation of our state's only coal plant into the largest biomass project in the country.

Figure 1

**Facts About Current Facility**

-600 megawatt capacity

-Built in 1977, closing in 2020

-Oregon's only coal plant

-Oregon largest $CO_2$ emitter

**Facts About Biomass Proposal**

-8,000 tons of torrefied biomass/day

-Full capacity for 5 months/year

-Test burn with 100% biomass before year's end. If successful, PGE will explore permanent substitution.

-This biomass facility would be largest in the Unites States and the largest torrefaction operation in the world.

The term "biomass" can apply to a variety of feedstocks such as forest thinnings, logging waste, mill residue, or short-rotation energy crops. Given the sheer diversity of feedstocks used, any analysis of a biomass facility's environmental impact must consider the specific variables associated with the feedstock it will burn. Therefore, in order to determine the consequences of the unprecedented proposal in Boardman this report includes a careful analysis of the feedstock's life cycle, which considers how the feedstock is grown, harvested, transported, treated, and burned. This analysis finds that PGE's proposal may pose major implications for local air quality, forest health, and carbon reduction goals.

***Our key findings include:***

-PGE will require about 3.8 million green tons of biomass every year, the majority of which would be sourced from trees on National Forest land.

-Despite claims by biomass advocates, the annual level of wood waste generated by Oregon's timber industry is negligible compared to the feedstock needs of a growing biomass industry.

-Transporting this massive amount of material will require 800 trucks every day, which will not only be logistically complex but will also pose consequences for traffic and carbon emissions.

-An average biomass power plant emits 40-60% more $CO_2$ than an average coal plant and almost 300% more $CO_2$ than a new natural gas plant per unit of energy produced.

# I. SOURCE OF FEEDSTOCK

Portland General Electric estimates that the 600 megawatt (MW) power plant will require ***8,000 tons of torrefied biomass every day***.[i] Since the treatment, or "torrefaction," of the material will result in a significant loss in mass, PGE will actually need over 12,800 tons of dry material each day. Currently, their proposed plan is to power the facility at full capacity for 5 months every year, which means the plant will need roughly 1.9 million dry tons of unprocessed material each year (or about 3.8 million green tons).[ii]

This tremendous amount of wood and plant-based material will be sourced from a variety of feedstocks in order to maintain a reliable supply chain. Through review of the available literature, interviews, and calculations, it can be concluded that the following feedstocks will provide some percentage of the required fuel for this proposal:

### 1. Logging Residue and Mill Waste

Proponents of biomass argue that deriving energy from tree and plant-based material holds great potential because the energy sector could utilize timber industry waste that would otherwise remain unused. They claim that large amounts of wood waste are either left on forest floors to rot after logging operations or simply burned off in mills; however, government data shows that the annual amount of unused logging waste and mill residue generated by Oregon's timber industry is negligible when compared to the demand of a growing biomass industry.

***Logging residue***, also known as "slash", is the un-used woody material left in the forest after a commercial timber operation. Research conducted by the University of Montana conservatively estimates that, on average, about 2.07 green tons of logging residue are generated per one thousand board feet of timber harvested in Oregon.[iii] According to a Forest Service report released in November of 2016, Oregon's timber harvest for 2013 was about 4.2 billion board feet, which means roughly 8.8 million green tons (4.4 million dry tons) of logging residue were generated from commercial timber operations.[iv]

This is not an estimate of logistically or financially available residue, but rather an estimate of the gross amount of residue generated. A host of variables must be considered to ascertain how much of this slash is actually available for Boardman to use as feedstock. About 30-50% of slash must be left onsite for ecological benefits[v] and about half of the left over material is actually not collectable due to logistical complexities.[vi] In addition to these constraints, Boardman's feedstock must be sourced within a 45-100 mile radius and within Oregon borders in order to be economical.[vii] Forests west of the Cascades, where 90% of Oregon's slash is produced[viii] are far beyond this boundary, and the radius itself is cut in half because Boardman is on the Oregon-Washington border. When these factors are considered, it is estimated that ***logging residue could only provide about 6 - 8% (or 110,000 - 154,000 dry tons) of the feedstock the facility will require each year***.

***Mill waste*** is the material left over after a mill processes roundwood into products such as lumber or veneer. Currently, ***over 99% percent of mill waste is already utilized*** at the source by the pulp and paper industry or by mills that burn left-over material to generate modest amounts of electricity for their own facility (usually between 5 and 50 MW).[ix] The scale of demand for mill waste to fuel a stand-alone, utility-scale power plant like Boardman is enormous when compared to the effective integration of these waste streams to power the operations of existing forest-product facilities. Consequently, it is unlikely that mill waste could serve as a viable feedstock source for the Boardman proposal.

The size and scope of the Boardman proposal is unprecedented in the United States and due to the insufficient levels of logging residue and mill waste generated by Oregon's timber industry, PGE will need to find alternative forms of feedstock.

## 2. Restoration Thinnings

To solve this feedstock problem, PGE has proposed sourcing the majority of the feedstock it will need from standing trees on public land.[x] According to Bruce Daucsavage, the president of Ochoco Lumber Company, if the Boardman proposal works out, "We can take more material out of the woods,"[xi] which raises concerns that ***energy needs might motivate increased forest harvest from public lands***. Ochoco Lumber is a partner in the public-private entity known as Oregon Torrefaction, which is responsible for helping provide feedstock for the Boardman proposal. Oregon Torrefaction's own website confirms Ochoco's plans by stating, "Oregon Torrefaction intends to source most of the biomass needs from forest restoration treatments."[xii]

The average amount of residue generated from thinning projects on public land each year is complicated to assess because each assessment must consider the specific needs for the treatment and the particular details of the site. For this reason, most assessments estimate the amount of material available based on the dollar value associated with each ton of residue produced. In other words, if the market places a higher value on these thinnings, more wood could be extracted from the forest.

In the past few decades, thinning restoration projects have become a source of political contention. Since European settlement, poor land management practices have suppressed wildfires in western forests beyond healthy balances, which means when fires do break out they are more severe and volatile. Many assume that the solution to this problem is to more aggressively thin forests; however, these projects face serious funding problems which has caused advocates for more aggressive thinning to urge forest management to be tied to the demand for biomass feedstock. Biomass advocates argue that the thinning-biomass approach alleviates economic limitations for more aggressive restoration while simultaneously providing fuel for the biomass industry.

While this may seem like a win-win scenario, managing our forests to meet energy needs may pose dangerous implications for Oregon's public forests. The argument to tie forest management to energy production is founded on the assumption that fires in the west are increasing and therefore thinning must increase to mitigate risk of fire; however, a recent report by the Geos Institute finds that wildfires are not increasing compared to historical periods. The report also highlights that ***thinned areas and fire outbreaks are unlikely to overlap***, stating that "Because fires in any single location are extremely rare, the chance of thinned areas, even over large landscapes, encountering fire within the timeframe that thinning is most effective is very low."[xiii]

Ultimately, forest management must be conducted to enhance ecological values and restore forest health, not to provide fuel for the energy sector. In drier parts of the state, the objective is often to restore the land "within the range of natural variation" – which means reducing the stocking density of the forest through tree thinning and other removals. What actually constitutes the historical "range of natural variation," however, is widely contested. Aggressive restoration focused on the treatment of a particular stand with insufficient attention to broader forest health can have adverse cumulative ecological impacts at the forest biome level.

Forest management practices motivated to meet energy needs sets a dangerous precedent for our public forests, especially when continuous large volumes are needed in the supply chain as is the case with the Boardman proposal. In the American South, forests are regularly clearcut to produce wood pellets for

Britain's booming biomass industry, which demonstrates what can happen when forest management is motivated by energy needs.[xiv]

### 3. Arundo Donax

PGE is also considering an energy crop called *Arundo donax* (giant cane) as a possible source of fuel due to its rapid growth and high energy content. Arundo can grow 5-10 cm per day[xv] and each year the energy crop is estimated to yield between 20-33 tons per acre.[xvi] [xvii] If the Boardman facility were to only burn Arundo, PGE would need 1.2 million tons of torrefied Arundo, or about 2,173,600 dry tons of untorrefied Arundo on the front end.[xviii] Depending on the tons produced per acre, this amount of Arundo would require between 67,000 - 111,500 acres (for reference: 92,800 acres is the size of Portland city limits).

Unfortunately, the same characteristics that make Arundo such a high producing energy crop also make it a ***highly invasive plant***. Since its introduction to the North American continent in the 19th century, Arundo has taken over river banks in California, Texas, and elsewhere, causing major damage to ecosystems and watersheds.[xix] In a 2012 letter to the EPA, dozens of environmental groups from around the country spoke out against Arundo donax being treated as a viable energy solution. The letter stated, "Given the difficulty of eradicating Arundo donax and the extent of potential environmental damages, it is highly unlikely that the benefits would clearly outweigh the costs."[xx] The Native Plant Society of Oregon echoed these concerns when they expressed caution over PGE's plans, saying "No regulations can be strong enough to prevent this plant from escaping cultivation when it is planted on a large scale for biofuel production."[xxi]

## II. TRANSPORTATION

Transporting 3.5 - 4 million green tons of wood, energy crops, and other biomass feedstock to rural Northern Oregon will be a major logistical feat. For the test burn alone, about one third of the torrefied material needed will be transported across the country from a plant in Mississippi (see Figure 2). Transportation logistics are complicated by the fact that most of this material will be sourced from disparate locations such as logging sites and restoration treatments in Oregon's backwoods. Location is a fundamental component in determining the accessibility and economic viability of a biomass source, even when subsidies are considered. The further biomass must be transported, the higher the cost both financially[xxii] and environmentally.[xxiii] For example, increasing truck traffic on forest roads results in up to 4 times as much erosion as low traffic, erosion that negatively impacts Oregon's watersheds.[xxiv]

Figure 2

**Sourcing from Mississippi**

PGE plans to source roughly one third of the torrefied feedstock needed for this month's test burn (2,000 - 3,000 tons) from a torrefaction plant in Quitman, Mississippi. If 2,500 tons of material are transported by truck, roughly 250 trucks would have to drive a combined total of 575,000 miles.

Based on average fuel efficiency for trucks and EPA data on diesel carbon emissions/gallon, this trip across the country would emit about one thousand tons of $CO_2$. In other words, ***transporting just 1/3 of Boardman's feedstock for a single day will emit the same amount of $CO_2$ that 191 passenger cars emit on average each year.***

Once the wood and logging waste emerges from the forest roads, it would need to be transported to a torrefaction facility either in Grant County or the Port of Morrow. Once processed, 8,000 tons of torrefied material would then need to be trucked to the Boardman facility itself, ***requiring 800 trucks every day***.[xxv] Currently, coal supporting Boardman arrives by train, but since biomass would be trucked, local traffic will inevitably increase. Trucks increase traffic at a rate more than double than passenger cars[xxvi] and emit almost five times as much carbon as rail.[xxvii] Increased traffic has a negative impact on property values[xxviii] and intensifies required road maintenance for local communities.[xxix] All told, the external costs of freight trucking (considering accidents, air pollution, greenhouse gasses, and noise) comes to .86 cents per ton-mile, versus .24 cents a mile for freight trains.[xxx]

# III. TORREFACTION

Torrefaction is a process in which biomass is roasted at 200-350°C in an airless environment, removing moisture and breaking down volatile substances.[xxxi] This treatment technique improves the energy density of biomass and makes it easier to store; however, torrefaction is energy intensive and may result in the loss of up to half of the original mass of the feedstock. According to PGE, wood has a mass retention rate of about 65% during the torrefaction process[xxxii] and it is estimated that Arundo donax has a 56% mass retention rate.[xxxiii]

The vast majority of biomass facilities in the world do not burn torrefied material, making the PGE proposal both unique and unprecedented. PGE is part of a public-private partnership known as Oregon Torrefaction, which is intended to supply torrefied biomass for the Boardman power plant. Currently, the partnership is operating two pilot torrefaction sites at the Port of Morrow and the partnership has plans to build a large torrefaction facility in Grant County.[xxxiv] If the Boardman project goes forward, these plants would need to process 1.9 million tons of dry biomass a year to supply 8,000 tons of torrefied material each day.

# IV. COMBUSTION

## 1. Carbon Consequences

The low energy density of biomass makes it an exceptionally inefficient fuel, which means it emits more $CO_2$ per unit of energy produced when compared to fossil fuels. In fact, ***an average biomass facility emits 40-60% more $CO_2$ than an average coal plant*** and almost 300% more $CO_2$ than a new natural gas plant, simply because so much more material is burned to generate the same amount of power (see Figure 3).[xxxv]

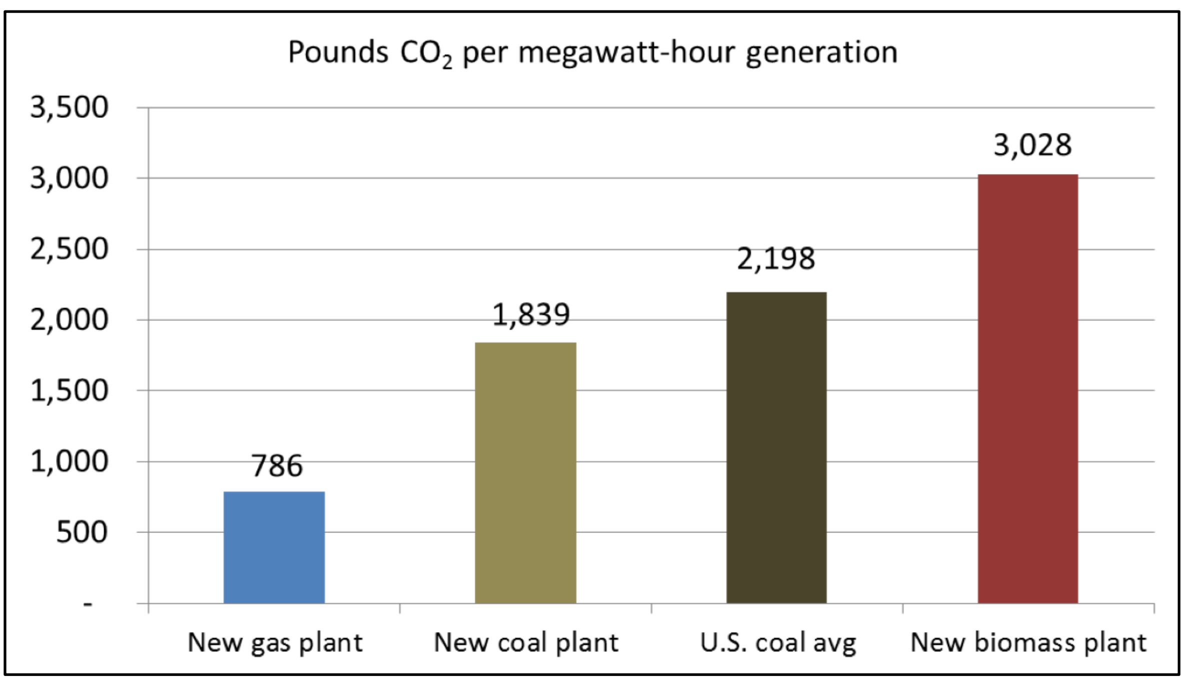


**Figure 3 - Typical $CO_2$ emission rates from power plants burning fossil fuels and biomass.**

Advocates of a growing biomass industry often claim that despite these high smokestack emissions biomass energy production is "carbon-neutral." They argue that when biomass is removed from the forest and combusted for energy, the large amounts of carbon spewed into the atmosphere are eventually re-captured, or "sequestered," by the forest's regrowth; however, these proponents neglect to recognize the timeline: ***a forest takes many decades to regrow whereas biomass power plants emit tremendous amounts of carbon instantaneously***. The moment these biogenic carbon molecules are emitted into the atmosphere they begin to actively trap heat, thus warming our planet. In the atmosphere there is no distinction between carbon molecules derived from biomass or fossil fuels – both kinds prevent energy from escaping to space. A sudden increase in biomass energy would spell a dramatic spike in carbon emissions at a time when we need to reduce carbon levels as soon as possible.

To be sure, PGE's proposal to substitute biomass for coal in their Boardman plant won't necessarily result in 40-60% more carbon emissions because they plan to burn torrefied biomass instead of wood pellets. While torrefied biomass has a higher energy density and emits less carbon at the smokestack, a great deal of energy is needed during the torrefaction process itself, energy that is mostly generated at conventional power plants that burn fossil fuels. In addition, the torrefaction conversion process emits much of the carbon stored in the feedstock, however, the exact amount of carbon emitted during this process varies depending on the type of feedstock being treated.[xxxvi][xxxvii] Since there is little definitive research on a torrefaction operation of this size, the true carbon consequences are unknown. When the carbon emissions and the amount of energy used are factored in, many of the climate benefits often associated with torrefaction may be negated.

From a climate standpoint, biomass is concerning not only because of the smokestack and torrefaction emissions, but also because providing feedstock requires the removal of standing trees, which diminishes the forest's capacity to mitigate climate change by capturing and safely storing carbon. Excessive thinning projects and the removal of whole trees to fulfill the demand for fuel would be entirely unacceptable, especially as we continue to depend on our forests as carbon sinks. In fact, the country's ability to reach emission reduction goals under the Paris Accord will depend on our forests' ability to sequester the same, if not more, carbon than they have in the past.[xxxviii]

## 2. Carbon Neutrality Loophole

Despite the proven carbon consequences of biomass energy production, industry interests are making a concerted effort to pass legislation in Congress that classifies biomass as "carbon-neutral" nationwide. This classification is concerning for two main reasons, the first of which is that Congress is crafting climate policy with complete disregard to scientific fact, setting a dangerous precedent for how our government responds to the impending climate crisis. While there are climate benefits associated with some forms of biomass energy production (i.e. small-scale generation in mills), these benefits do not universally apply to all scenarios and therefore ***any blanket designation of carbon neutrality is inaccurate***. The EPA acknowledges that accounting for the carbon emitted during the combustion of biomass is an inherently complicated process, and therefore "it is a conclusion that should be reached only after considering a particular feedstock's production and consumption cycle."[xxxix]

The second chief concern of the biomass loophole is that a classification of carbon-neutrality would rapidly grow the industry, posing serious implications for the climate, our forests, and public health. Government data predicts that a carbon-neutrality designation would almost double the size of the biomass industry in just a few years[xl] and that this growth will displace solar production, not coal.[xli] Many industry groups support the loophole because it would classify biomass as a renewable alongside wind and solar while simultaneously facilitating increased harvest from Oregon's forests. Not surprisingly,

***PGE supports the carbon neutrality loophole***, which demonstrates their intent to confront the global climate crisis, at least in part, by burning trees and energy crops.[xlii]

### 3. Air Pollution

Burning biomass also creates dangerous air pollution that can lead to an array of health problems. Biomass facilities emit large amounts of particulate matter (also known as "soot"), which can cause asthma attacks, cardiovascular disease, and even death in some cases. These facilities also threaten public health in adjacent communities by emitting nitrogen oxide, carbon monoxide, and various carcinogens. Earlier this fall, public health groups from around the country signed onto a letter urging Congress "to oppose policies that would encourage or expand the use of biomass for electricity production." Acknowledging the role that a changing climate has on human health, these organizations called for the development of truly clean and truly carbon-neutral forms of energy such as solar and wind energy.[xliii]

## CONCLUSION

After considering how Boardman's biomass feedstock would be grown, harvested, transported, treated, and burned it can be concluded that the current proposal would have dangerous consequences for national forests, climate change, and public health. Due to insufficient levels of wood waste generated by Oregon's timber industry, PGE will have to rely on the cutting of whole trees from public lands to feed their old coal plant in Boardman. As PGE proceeds with this proposal, it is incumbent upon the utility to conduct a thorough analysis of their supply chain to ensure that the 3.8 million green tons of biomass needed each year is sustainably sourced, transported, and treated.

This inquiry also found that burning biomass at Boardman could likely exacerbate climate change by facilitating the release of $CO_2$ that would otherwise remain sequestered in the forest. In order to meaningfully respond to the current climate crisis, our government and utilities must respect the scientific process and take its findings seriously. This means acknowledging that large-scale biomass energy production poses major carbon consequences and therefore cannot be treated as a renewable resource alongside solar and wind. The closing of the Boardman coal plant gives Oregon a unique opportunity to replace coal with truly renewable forms of energy. Therefore, we urge PGE to work with community partners to quicken a full transition to truly renewable forms of energy in the coming decade. Just as oil, coal, and gas must be kept in the ground if we are to avoid catastrophic climate change, so too must trees be kept in the forest.

[i] Portland General Electric. "Integrated resource planning: preparing for Oregon's energy future." (2016): 205.
[ii] Calculations:

**Wood**

- est. 75% of feedstock = 912,000 torrefied tons/year
- 65% mass retention rate
- 1,403,000 dry tons

**Arundo**

- est. 25% of feedstock = 304,000 torrefied tons/year
- 56% mass retention rate
- 543,400 dry tons

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Figure 1

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Figure 2

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Figure 3

***$CO_2$ emissions per MMBtu heat input:***

a, b, c : from EIA at http://www.eia.gov/environment/emissions/co2_vol_mass.cfm. Value for coal is for "all types." Different types of coal emit slightly more or less.
d: Assumes HHV of 8,600 MMBtu/lb for bone dry wood (Biomass Energy Data Book v. 4; Oak Ridge National Laboratory, 2011) and that wood is 50% carbon.

***Efficiency of power plants:***

a: DOE National Energy Technology Laboratory: Natural Gas Combined Cycle Plant F-Class (http://www.netl.doe.gov/KMD/cds/disk50/NGCC%20Plant%20Case_FClass_051607.pdf)
b: International Energy Agency. Power Generation from Coal: Measuring and Reporting Efficiency Performance and CO 2 Emissions. https://www.iea.org/ciab/papers/power_generation_from_coal.pdf
c. EIA data show the averaged efficiency for the U.S. coal fleet in 2013 was 32.6% (http://www.eia.gov/electricity/annual/html/epa_08_01.html)
d: The Biomass Energy Data Book from Oak Ridge National Laboratory (http://cta.ornl.gov/bedb; page 83) states that actual efficiencies for biomass steam turbines are "in the low 20's"; PFPI's review of a number of air permits for recently proposed biopower plants reveals a common assumption of 24% efficiency.

a: DOE National Energy Technology Laboratory: Natural Gas Combined Cycle Plant F-Class (http://www.netl.doe.gov/KMD/cds/disk50/NGCC%20Plant%20Case_FClass_051607.pdf)
b: International Energy Agency. Power Generation from Coal: Measuring and Reporting Efficiency Performance and CO 2 Emissions. https://www.iea.org/ciab/papers/power_generation_from_coal.pdf
c. EIA data show the averaged efficiency for the U.S. coal fleet in 2013 was 32.6% (http://www.eia.gov/electricity/annual/html/epa_08_01.html)
d: The Biomass Energy Data Book from Oak Ridge National Laboratory (http://cta.ornl.gov/bedb; page 83) states that actual efficiencies for biomass steam turbines are "in the low 20's"; PFPI's review of a number of air permits for recently proposed biopower plants reveals a common assumption of 24% efficiency.