

BAD BUSINESS\$

**The Economic Case Against
Woody Biomass
as Renewable Energy**

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The Rachel Carson Council, founded in 1965, is the national environmental organization envisioned by Rachel Carson to carry on her work. We promote Carson's ecological ethic that combines scientific concern for the environment and human health with a sense of wonder to build a more sustainable, just, and peaceful future.

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LETTER FROM THE PRESIDENT

Bad Business is the fifth comprehensive report from the Rachel Carson Council. It is, in effect, a sequel to our last report, *Clear Cut*, that laid out the devastating consequences for the environment, for climate change, and for citizens and workers of clear-cutting forests and producing wood pellets at industrial scale to be shipped overseas to produce electricity in coal-fired utilities. These reports constitute a series around a common theme central to the work of the Rachel Carson Council and to the ecological ethic of Rachel Carson — **climate justice**. Carson is best known for the exposé in her 1962 classic, *Silent Spring*, of the harmful effects of pesticides like DDT on wildlife and on human beings alike. But Carson's larger, more enduring contribution — in her writing and in her environmental and political advocacy — is the combination of reverence, awe, and wonder for all living things, their interdependence, and their beauty, along with stark warnings of the destructive nature of human arrogance in attempting to control and dominate nature in the interests of efficiency, profit and greed. Rachel Carson puts it eloquently and bluntly, "The modern world worships the gods of speed and quantity, and of the quick and easy profit, and out of this idolatry monstrous evils have arisen."

Bad Business is designed to reach out widely to those who may not identify as environmentalists, but who will recognize a failing business enterprise that needlessly soaks up precious tax dollars from Americans. **Bad Business** focuses on the "quick and easy profit" of the wood pellet industry by examining the economics of biomass production that is profitable in the short-term only because its shaky business model teeters atop a tower of taxpayer-supported subsidies, credits and bailouts. The industry is further propped up by false claims that it is renewable and reduces carbon in the atmosphere. Forests that are clear-cut to produce wood pellets will not grow to maturity again, if ever, in the dwindling time left for the drastic action needed to prevent climate catastrophe.

Rachel Carson's brilliant nineteenth-century foremother, Susan Fenimore Cooper, warned in *Rural Hours* (1850) of the greed and long-range damage of the clear-cutting then ravaging the ancient forests of New York as "civilization" marched forward. "It is not surprising, perhaps, that a man whose chief object in life is to make money should turn his timber into bank-notes with all possible speed." Cooper noted, too, the inordinate time it would take to replace a mature forest. "It needs but a few short minutes to bring one of these [ancient] trees to the ground. The rudest boor... may easily do the deed; but how many years must pass ere its equal stand on the same spot! Let us pause to count the days, the months, the years; let us number the generations that must come and go... ere the seed sown from this year's cones shall produce a wood like that before us."

Bad Business puts such heedless loss in economic terms as it places a price on the benefits of forests — wildlife, biodiversity, clean air, clean water, the absorption of CO₂, and the mitigation of storm damage and flooding from climate change — that are eliminated to produce wood pellets. That the wood pellet industry is a poor financial investment is further demonstrated



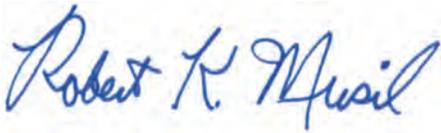
Photo credit: Edwin Gray

Rachel Carson at Woods Hole, MA, 1951.

in *Bad Business* by the far more cost-competitive and truly renewable energy sources of wind and solar power. There is no need to underwrite the biomass industry, if there ever was, when cheaper, carbon neutral alternatives exist.

Rachel Carson's environmental ethic also calls for action in the face of such environmental destruction. Carson had fought actively to protect and preserve a coastal forest in Maine near her summer cottage in Southport. Her description of what she called "The Lost Woods" captures the beauty of what would have been lost there and, increasingly, will be lost unless wood pellet production is finally halted. "It is a living museum of mosses and lichens, which in some places form a carpet many inches deep. Rocks jut out here and there, as a flat floor where only lichens may grow, or rising in shadowed walls. For the most part the woods are dark and silent, but here and there one comes out into open areas of sunshine filled with the wood's smells. It is a treasure of a place to which I have lost my heart, completely... and this past fall as I walked there the feeling became overwhelming that something must be done."

Bad Business concludes with a series of detailed economic and policy alternatives that we hope citizens, investors, and policy makers alike will act upon. Both liberals and conservatives can agree, we believe, that the economically unsustainable business model of the biomass industry should no longer claim our support, or our dollars.



Robert K. Musil, Ph.D., M.P.H., President & CEO



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FOREWORD

False solutions to the climate crisis are worse than no solutions at all. They divert critical resources and undermine efforts to truly address the problem. That the industrial use of woody biomass, or wood pellets, is based on false claims was made clear in the Rachel Carson Council's report, *Clear Cut*. This so-called "new" technology is merely an update on the ancient source of fire, trees. But now, it plays a direct role in the destruction of our critical forests. Science has repeatedly proven that forests are better left standing in the fight against increasing carbon emissions. As of today, they are the best, cheapest and easiest solution to draw down large amounts of carbon from the atmosphere to mitigate or reverse climate change. Nevertheless, wood pellet manufacturers continue to devastate this vital resource in an ever-expanding search for profit.

While wood pellet manufacturers tout their operations as carbon neutral, claiming that the trees cut down will grow back, this is not the full story. First, there are no requirements for the industry to ensure that forests chopped down for fuel are ever replaced. Often, if forests are regrown on the land, those that take their place are sterile pine monocultures. Such plantations lack the rich biodiversity of older growth, naturally-occurring forests. Second, the climate crisis is happening **now**. Scientists say we have mere decades to address it before unmitigated disasters become unavoidable. Trees need decades to regrow, so even if fully biodiverse forests were planted to replace those clear-cut by the wood pellet industry, we would not see the carbon offset of the burned trees within a time scale necessary to meet critical climate goals. Finally, carbon neutrality cannot be the only measure of an energy source's efficacy. Forests and trees play an invaluable role in natural systems by cleaning the air and water while mitigating natural disasters such as heavy wind and flooding. When all these aspects are considered, it becomes clear - **wood pellets are bad for the environment and bad for business.**

Since the publication in 2019 of the Rachel Carson Council's (RCC) report, *Clear Cut*, that details the heavy environmental injustice of the wood pellet industry in early 2019, we have witnessed the uncontrolled growth of wood pellet facilities throughout the US, especially in Southeastern states. In 2019 alone, the RCC attended over four expansion hearings for plants in North Carolina and Virginia to speak out against them. The industry has also been approved to create two of the world's largest production facilities in Alabama and Mississippi. Each time, however, community members, environmentalists, and activists have been there to ensure that the truth is known about the adverse impact of these plants.

As a result, there have already been wins. Clean Air Carolina, The Southern Environmental Law Center and concerned citizens settled a legal case in North Carolina with Enviva, the world's largest producer of wood pellets, to require they install better air quality measures on their North Carolina plants. Until that time, Enviva



Alexandra Wisner, Associate Director, testifying in Virginia against the Southampton Plant expansion.

had been breaking Clean Air Act regulations and polluting the air around their plants to an unknown extent. In North Carolina, the state soon to become the world's largest producer of wood pellets, the Governor's Clean Energy Plan has made it clear that woody biomass will not be included in the state's transition to cleaner energy.* Even on Capitol Hill, offices are now listening and learning about the negative consequences of wood pellet production. Critically, Senator Ed Markey, the key Senate sponsor of the Green New Deal, has stated that woody biomass will not be included because the industry does not meet the goal of zero carbon emissions.

Progress is being made. Citizens and policy makers are waking up to the fact that the wood pellet industry, created in the early 2000's by an unfortunate loophole in international climate agreements, is entirely unnecessary. It is, in fact, hurting our ability to achieve carbon neutrality.

Clear Cut, The Rachel Carson Council's last report, made a compelling case against further support of this destructive industry in terms of public health and environmental justice. *Bad Business* expands on these findings through additional economic perspectives designed to reach a larger audience of those who favor using fiscal concerns and the viability of business models in judging whether an industry is worth investment. Through heavy subsidization, exaggerated rural job creation claims, and turning a blind eye to the negative externalities of forest destruction and carbon emissions, the wood pellet industry has been able to grow. There are other, more economically sound, options, however. *Bad Business* examines what those may be for forest owners, the energy sector, community members, workers and taxpayers throughout the United States.

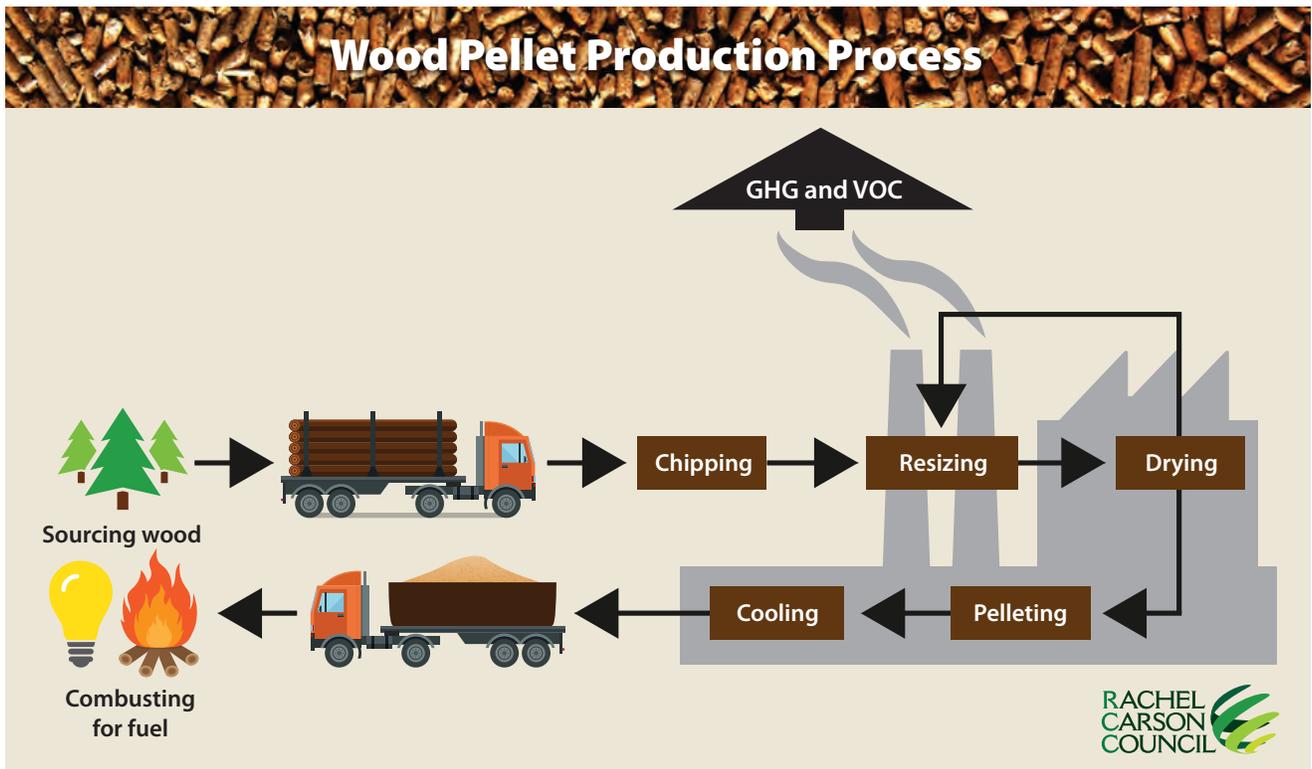
*Cantanoso, Justin. 2020. "Slow Burn Part 2: From Poland to NC, activists plea for reduced carbon dioxide" *The News and Observer.* <https://www.newsobserver.com/news/business/article238396613.html>

INTRODUCTION

Wood pellets, or woody biomass, are an energy source that burns processed, dried wood to create electricity. This intensely extractive industry relies on wood by-products, such as stems, branches and treetops, as well as whole trees from clear-cutting operations. Pellets can be used to power anything from small household stoves to massive coal-fired power plants. In recent years, the global community, particularly the European Union, as well as the United States, has begun to expand its industrial usage of pellets in biomass power plants and coal-fired power plants under the guise of meeting their carbon neutrality agreements.

It all began because of a loophole in carbon accounting in international climate agreements. In the International Panel on Climate Change (IPCC) climate assessment of 1990, the two categories for counting greenhouse gas (GHG) emissions were energy use and land use.

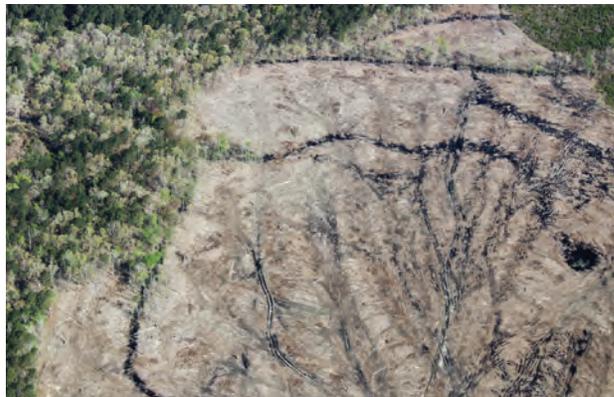
“To avoid double counting the carbon emitted from using forests for energy, the emission numbers were only counted in the land-use section of the report.¹ The intent was not to suggest that these emissions were carbon neutral, but this oversight opened the way for the thriving wood pellet industry we see today.”²



Eventually this flawed accounting was adapted into other climate deals, including the E.U. Renewable Energy Directives of 2005, which allowed biomass energy to be considered carbon neutral³. This accounting error allowed the United Kingdom to invest heavily in biomass energy in order to reach their renewable energy goals, even though it goes directly against a growing body of evidence, including a study by the Natural Resource Defense Council (NRDC), a respected environmental non-profit, which **finds that per unit of energy burning wood pellets produces as many, or more, carbon emissions as coal.**⁴

Such pellets are supplied primarily by the Southeastern United States where whole forests are being cut down to meet ever-increasing demand. This process cumulatively produces massive carbon emissions, damages the environment, and threatens the livelihood of surrounding communities.

Nevertheless, despite problematic carbon accounting and a host of environmental and public health concerns, the wood pellet industry, in both production and consumption, is still heavily subsidized by federal and state governments. Enviva, the largest producer of wood pellets globally, receives millions from the government in order to remain profitable. U.S. biomass power plants, which use a combination of biomass sources like wood, garbage and crop residue,



Dogwood Alliance, Clear Cut of Forests for Enviva products. <https://www.dogwoodalliance.org/2019/06/caught-in-the-act/>

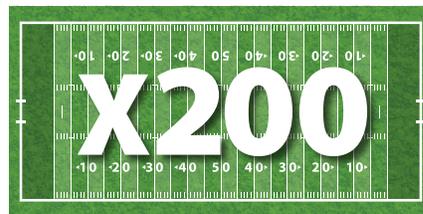
are also propped up by the government, having received billions in order to remain in operation. With the uptick in production of wood pellets, they are becoming attractive sources of fuel for U.S. biomass plants as well. Converted coal-fired power plants, like Drax in the United Kingdom, have for years been receiving heavy subsidization to transition to wood pellets as a source of fuel for “renewable energy.”

However, as *Bad Business* lays out, woody biomass and biomass power plants continue to be far more expensive than other renewable forms of energy such as wind and solar. As the costs of cleaner sources of energy continue to decline, states are forced to give millions to biomass power plants, passing the burden on to ratepayers to keep these polluting facilities from shutting down, as they have started to do across the United States.

Similarly, the United Kingdom has begun to remove subsidies from its biomass power plants and transfer the subsidies to more affordable and cleaner energy. This has left the fate of Drax, the United Kingdom’s largest producer of bioenergy, and its biomass power plants in question. Furthermore, the European Union’s treatment of biomass energy as renewable and carbon neutral has recently been called into question by a lawsuit addressing the carbon accounting loophole brought by non-profits and concerned citizens. As a result, the industry’s future is uncertain.

Despite this poor record, American companies like Enviva continue to promote wood pellets as a “green” industry that supports rural economies. In reality, these jobs are on the decline as wood pellet and bioenergy plants are being denied renewal across the world.

Equally problematic, wood pellet production has heavy negative externalities* which place a financial burden on communities forced to bear the brunt of the sourcing, production, transportation and burning of these pellets. The mass deforestation associated with wood pellet operations in the U.S. - conservatively about 220 acres, or 200 football fields a day⁵ - can be linked to increased drinking water costs, excessive heat, climate change, and consequent sea-level rise and forced migration. These externalities severely affect communities in the United States and globally. When properly accounted for, externalities drastically increase the **true cost** of the wood pellet industry. *Bad Business* illustrates that the wood pellet industry is an economic fiasco, undeserving of further subsidization or expansion.



*An externality is a side effect of industrial or business operations that affects outside parties without being properly reflected in the cost of the product or operation.

SUBSIDIES

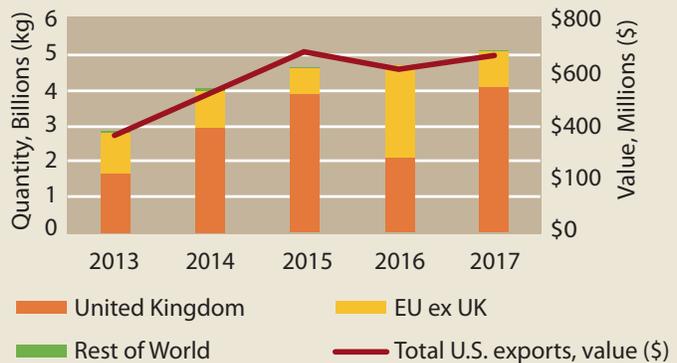
In the push to expand renewable sources of energy and transition our energy grid, wood pellet production facilities and biomass power plants have emerged, and federal, state, and local governments have rushed to funnel billions of dollars' worth of subsidies to prop up the industry. To many, especially those in heavily-forested or forestry-dependent states in the Southeast, Northwest and Northeastern United States, wood pellets are the perfect compromise - they can continue to support the forestry industry while also complying with national and global goals of carbon neutrality and expanded renewable energy sources. Further, wood pellets are attractive because they are easy to transport and can be burned in pre-existing facilities without creating drastically new infrastructure.

Unfortunately, such a narrative fails to recognize that the pellet industry is, in fact, not sustainable; it harms the ability of state, national and international communities to meet climate goals. Further, woody biomass's future is uncertain in the United Kingdom and the rest of the European Union where over 75% of all U.S. wood pellets are shipped.⁶

These billions of dollars of government funding in the U.S. and EU should not be allocated to a falsely-green and unstable industry. Rather, these funds should be redirected towards supporting cleaner, more affordable forms of renewable energy, such as solar and wind. Unlike biomass energy, wind and solar offer a host of economic benefits to communities, reduce carbon emissions, protect our natural resources and communities, and provide relief to ratepayers through less expensive energy bills.

The excessive cost of biomass energy is not new. Unlike other sources of energy where new technologies have helped make production cheaper and the product more efficient, bioenergy has been unable to lower its price. In a study of four biomass power plants in Virginia, Georgia Tech professors found that prices for bioenergy were 40-53% more expensive than wind or solar.⁷ The study found

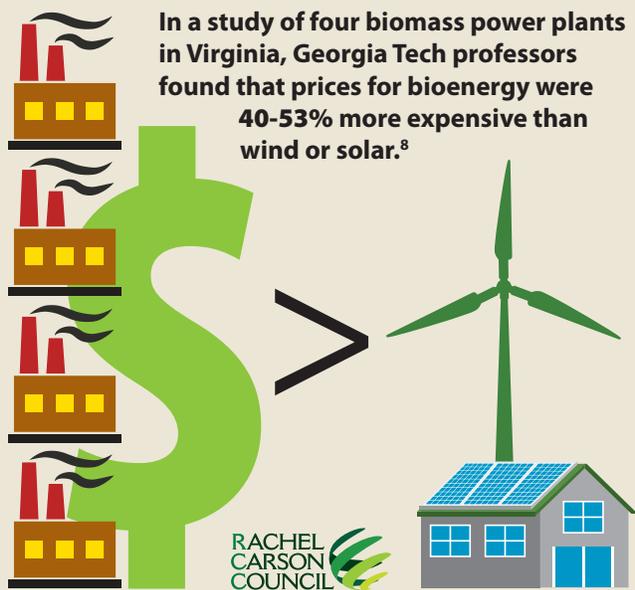
U.S. wood pellet export destinations by quantity (kg) & total exports by value (\$) 2013-2017



Source: U.S. Department of Commerce

https://www.usitc.gov/publications/332/executive_briefings/wood_pellets_ebot_final.pdf

In a study of four biomass power plants in Virginia, Georgia Tech professors found that prices for bioenergy were 40-53% more expensive than wind or solar.⁸



that not only were these plants a bad investment in 2012 when they were turned into biomass facilities, but they make even less sense in today's marketplace.⁸ Due to the rapidly declining cost of wind and solar, as well as the increase in affordable energy efficiency options, the study advised against investing in large biomass facilities which will be unable to produce energy at a price competitive with other rapidly evolving technologies.⁹ Therefore, states must move away from funneling money into expensive bioenergy, and move instead towards supporting clean, affordable energy. Such a switch will provide their communities with more economic opportunity, cleaner air, and lower electricity bills. As other countries are starting to realize, bioenergy makes little economic or environmental sense. The United States must follow their lead.

The Subsidization of Production

National Subsidies for Production

Biomass suppliers like Enviva have been buoyed by the federal government through various departmental grants and programs, federal loan guarantees, rate-payer subsidies and stimulus funding. They have been further bolstered by pro-biomass language in policy and legislation from Congress looking to drastically expand the renewable energy portfolio of the United States.

One critical source of income is the Biomass Crop Assistance Program (BCAP), administered by the U.S. Department of Agriculture. The BCAP is meant to give producers incentives to produce and deliver biomass feedstocks. Though the program was extremely popular with biomass producers, it cost taxpayers \$243 million in 2009 and 2010. While these high levels of spending were eventually reduced, taxpayers still pay up to \$25 million dollars per year to help create energy that produces CO₂ at far higher levels than coal.

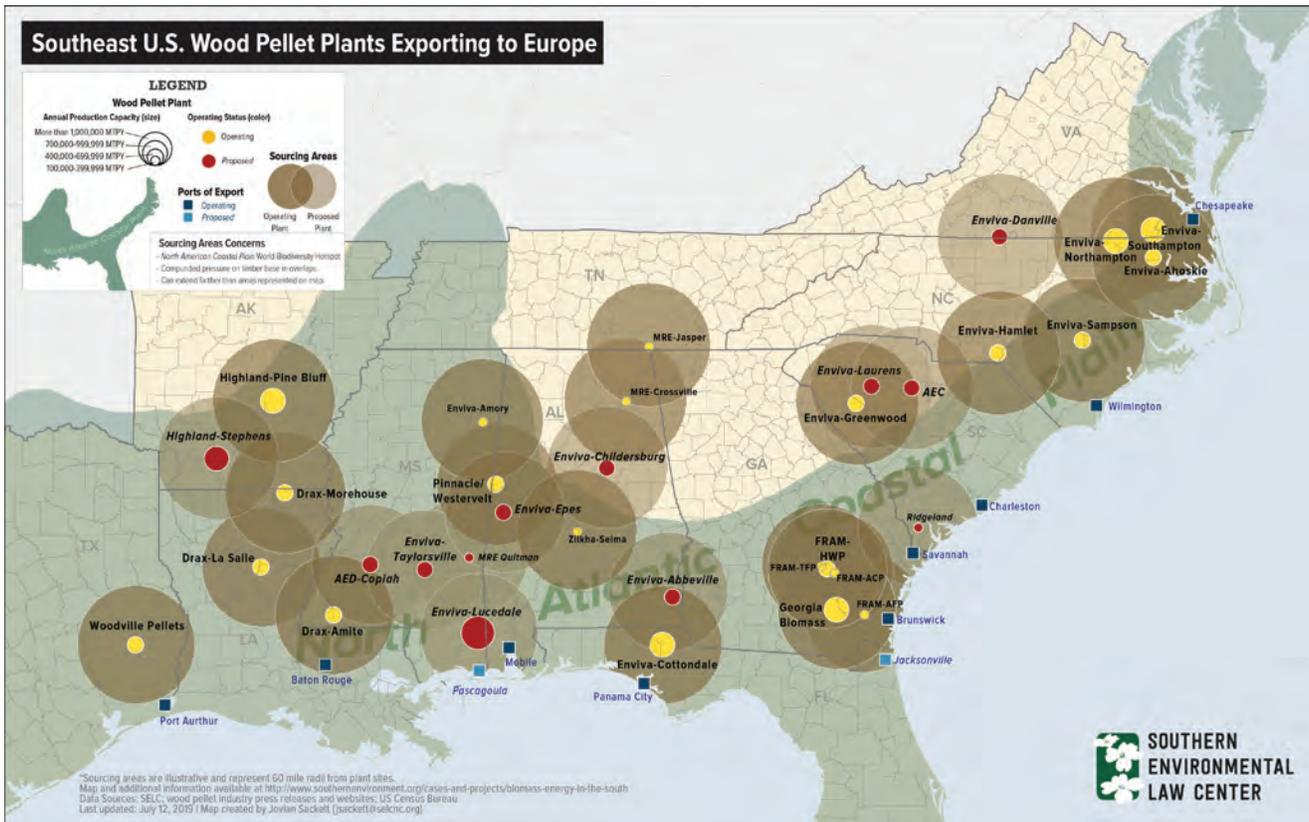
However, such Federal largesse pales compared to the risks posed by Congressional policies designed to drastically overhaul the energy sector in response to the climate crisis. The 2020 Budget includes a rider which would define biomass as carbon neutral.¹⁰ If enacted, this would override scientific findings and direct the departmental policies of the EPA, USDA and more into channeling further funding to wood pellet and biomass projects. This biomass rider was removed by House members in the push to pass a truly "clean" budget. But, unfortunately, the rider has been re-included by the Senate and spearheaded by Senator Susan Collins of Maine. It is supported by Republicans, Independents and Democrats alike.

Another threat is posed by increased Congressional action being taken to introduce climate crisis bills. In order to do so, many members are introducing new Renewable Energy Standard legislation that defines and sets goals for how renewable energy should progress, what can be included, and, ultimately, what would be funded. A prime example is Senator Tom Udall's Renewable Electricity Standard Act of 2019. It sets up some of the most aggressive goals yet to achieve renewability in the energy sector - 50% renewable in just 15 years.¹¹ Unfortunately, it also includes an opening for biomass power and woody biomass to be counted as renewable. Such a rapid transition would require huge investments along with renewable energy credits for biomass power, only bolstering a falsely green industry. Although this legislation, and other bills introduced earlier, is unlikely to become law under the current Republican administration, it sets a precedent for language which can be used in future, more favorable political climates for passage into law.

State Subsidies for Production

Significant funding for wood pellet producers is also being provided by state governments throughout the country to align with renewable energy goals and expand rural job markets.

A clear example can be seen in the relationship between the state of North Carolina and Enviva. North Carolina, as highlighted in RCC's previous report, *Clear Cut*, is one of the top wood-pellet producing states in the U.S. with four, ever-expanding wood pellet plants owned by Enviva, the world's largest producer of wood pellets. These plants are permitted to produce almost 2.5 million tons of wood pellets annually and are requesting to expand even further.¹²



Map of Wood Pellet production facilities, and expected expansions created by SELC in December 2019

Within North Carolina, Enviva has received over six million dollars in federal, state, and local subsidies to establish facilities in the state. In Northampton County, Enviva received subsidies and grants from The Economic Development Agency (\$2 million), The Community Development Block Grant Program administered by the Department of Housing and Urban Development (\$930 thousand), North Carolina Rural Center (\$220 thousand), and from the local county (more than \$31 thousand).¹³ North Carolina also provided Enviva with millions more in tax breaks to build plants in Hampton and Sampson County, on top of generous local subsidies.¹⁴ Under a falsely “sustainable” narrative, Enviva is profiting from the destruction of biodiverse forests in order to produce wood pellets in North Carolina.¹⁵ At a time when credible science points to reforestation as one of the most important and cheapest ways to fight climate change, North Carolina’s government-funded clear-cutting will likely lead to dangerous consequences for the state, as well as the nation.¹⁶ The continued destruction of North Carolina’s forests will have dire ramifications for wildlife habitats, natural disaster prevention, as well as North Carolina’s levels of carbon emissions — all of which adversely affect the state’s tourist, fishing, agricultural and hunting economies.



Peter Stauble, Southwings & Dogwood Alliance flyover of North Carolina Clearcut

Given its relative success in North Carolina, Enviva has been able to expand its production even further into other states.¹⁷ In Mississippi, the largest plant of its kind has just been approved and will receive

larger government subsidies than seen in North Carolina. For the George County plant, the Mississippi Development Authority plans to provide \$4 million to help Enviva with construction.¹⁸ George County, itself, has plans to provide another \$13 million in property tax breaks over the next 10 years, originally offered to entice Enviva to build their plant there.¹⁹ The future plant will eventually employ approximately 90 employees. According to the Mississippi Center for Public Policy, that means that if all the promised employees are eventually hired within Mississippi, the \$17 million dollars of incentives would amount to \$188,888 spent per job.²⁰ On top of this, the Mississippi government also has announced another \$1.4 million given to widen the plant's entrance so that it will be easier for trucks to enter. In enticing this industry to operate in their community, George County is opening itself to a false solution which will affect the health and well-being of its community and environment. A similar story can be seen unfolding in Alabama, where another Enviva plant is proposed.

Instead of creating reliance on an industry supported by substantial subsidies paid for by taxpayers and a false narrative that exists because of a loophole, rural counties in Southeastern and other forested states should look towards truly sustainable sources.

The Subsidization of Consumption

In addition to funding to create and expand wood pellet *production* in the United States, to bolster the industry further, there are also massive subsidies for the *consumption* of biomass at the state, federal and international level.

National Subsidies for Consumption

Unlike solar and wind, burning biomass, like wood pellets, for energy is not competitive in the electricity marketplace. Biomass power plants have taken billions of dollars in subsidies from the federal government. Yet, many plants are still forced to close because the cost of energy they produce is too high. Others are forced to shut down because their adverse environmental effects on the surrounding communities are too severe. These plants burn a medley of biomass sources, such as agricultural wastes, wood and wood byproducts, animal waste, and more in order to produce energy for fuel. Wood pellets are a part of this mix. But they are unique since they can be used in biomass plants as well as co-fired in pre-existing coal plants. Although most industrial wood pellet products from the U.S. are exported, as states, the federal government and Congress continue to look to biomass as a renewable fuel source, wood pellets will become more important in biomass energy mixes. A close examination of current industrial facilities reveals that further dependence and investment in such plants would be fiscally irresponsible.

Through federal grants for renewable energy in the 2009 American Recovery and Reinvestment Act, biomass power plants were given \$1.062 billion for bioenergy projects. The program converted the Investment Tax Credit, which provided up to 30% of the construction cost for certain renewable energy projects, into cash grants. According to the Partnership for Policy Integrity, a leading international expert on biomass, just 25 power plants were given \$856.7 million of these grants. Of those that received the largest federal subsidies, seven were closed or idled by 2018 due to financial losses.²¹ Not even these incredibly costly government grants were enough to make biomass competitive with other sources of electricity generation.

For example, the federal stimulus package provided the Deerhaven Renewable Energy Plant in Gainesville, Florida, \$116.8 million dollars in grants.²² However, the plant has been idled for almost the entire period since its construction, as the energy it produces is too costly. Unfortunately, the city entered into a 30-year, \$2.1 billion dollars Power Purchase Agreement (PPA) with the plant.²³ Citizens are effectively paying \$70 million dollars a year through their electricity bill for a power plant that has

not been producing electricity for most of its life.²⁴ In order to get out of this PPA, the City of Gainesville purchased the plant for \$754 million.²⁵ Gainesville will also need to pay another \$400 million in interest for the loans it took out to pay off the plant.²⁶ Since then, the plant has had multiple problems, including three fires that caused it to briefly cease operations. Deerhaven Renewable Energy plant cost federal taxpayers over one hundred million dollars for its construction and local taxpayers over a billion dollars to get out of its PPA. The federal and local Gainesville government have spent these substantial funds on a fiscally irresponsible project that rarely produces electricity. When it does, it raises costs for ratepayers and pollutes the surrounding community.

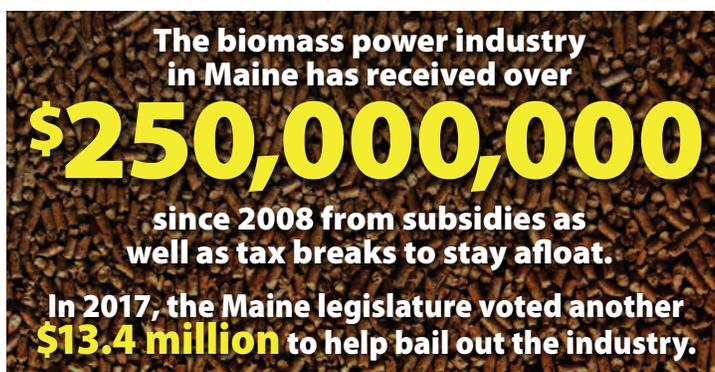
State Subsidies for Consumption

As biomass power plants prove too costly to keep running, state legislatures are also quickly stepping in to save these polluting sources of electricity. In a pattern seen throughout the U.S., state legislatures are forcing ratepayers to pay millions more for their electricity in order to keep their biomass power plants online. Instead of investing in truly clean sources of electricity that are proven to be cost competitive with fossil fuels, these states are throwing millions at an unsustainable industry.

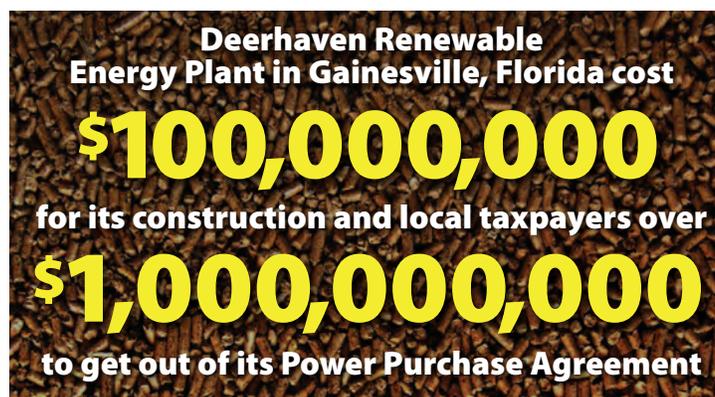
In New Hampshire, Eversource, a utility company, agreed to pay \$100 million over market cost for the bioenergy produced from the state's biomass plants. However, after only five years, Eversource had already exceeded the agreed upon \$100 million. Nevertheless, the New Hampshire legislature passed a law allowing the contract to continue for three years after the limit was breached. Although the bailout was vetoed by Republican Governor Chris Sununu, who is staunchly against ratepayers paying more for a costly and inefficient form of energy, his veto was overridden by the state legislature. The rescue package means that ratepayers, who were already forced to pay \$100 million more for electricity, would now be required to pay three more years of unknown costs to continue using this unsound source of energy.²⁷ This decision has been challenged in court, with the argument that, if the bailout goes through, it will cost ratepayers between \$20 and \$30 million annually in increased electricity costs.²⁸

Meanwhile, as the legal challenge continues, four biomass plants across the state have been forced to close. One received \$153.1 million in loans, grants, and tax credits for its construction.²⁹ Despite these generous subsidies, the plant was still not economically viable. New Hampshire's propping up of its failing biomass plants foreshadows what other states will be forced to do if they continue to invest in bioenergy.

Maine, like New Hampshire, is another state that has seen the dire economic impacts of biomass energy. The biomass power industry in Maine has received over a quarter of a billion dollars since 2008 from subsidies as well as tax breaks to stay afloat.³⁰ Nevertheless, plants continue to fail. In 2017, the Maine legislature voted another \$13.4 million to help bailout the industry.³¹ Maine taxpayers paid over \$30,000 for each of the 77 employees at two of Stored Solar's biomass plants.³² Shortly after the bailout passed, Stored Solar slashed



The biomass power industry in Maine has received over **\$250,000,000** since 2008 from subsidies as well as tax breaks to stay afloat. In 2017, the Maine legislature voted another **\$13.4 million** to help bail out the industry.



Deerhaven Renewable Energy Plant in Gainesville, Florida cost **\$100,000,000** for its construction and local taxpayers over **\$1,000,000,000** to get out of its Power Purchase Agreement.

their employment from 77 to 15 employees. The subsidy effectively cost \$154,000 per job.³³ Despite this massive bailout, both of Stored Solar's plants have spent months out of operation, failing to come even close to generation targets that the subsidy required. Since then, Stored Solar has also come under fire for not fulfilling its contracts to loggers, owing up to \$90,000 in unpaid property taxes, and violating the terms of their bailout.³⁴

The biomass industry in Maine took another hit when Massachusetts and Connecticut decided to no longer grant subsidies to biomass plants in Maine.³⁵ Instead, subsidies in those states have been redirected to clean, economical energy such as wind and solar. Instead of abandoning the industry as it loses critical subsidies from neighboring states, Maine has continued to increase the amount of money wasted on biomass energy, causing increased financial stress for its taxpayers.

International Subsidies & the Trouble on the Horizon

The U.S. depends on overseas sales for its growing supply of wood pellets. However, economic factors indicate an uncertain future for its biggest consumer, the United Kingdom (UK). The UK's recent focus on offshore wind has put the biomass energy industry in a tenuous position. Great Britain says it will be able to provide one-third of its electricity from offshore wind by 2030.³⁶ Thus, the UK has revised its subsidies

to focus on reaching that target, deciding in late 2018 to remove subsidies for most biomass energy plants. At the same time, they implemented much stricter emission limits that, with current technologies, biomass power plants are unable to attain. Recognizing that biomass power plants are releasing dangerous amounts of carbon and other pollutants, the UK has moved towards supporting clean, affordable energy. The UK recently announced that the government and the offshore wind industry set up a £100 million (\$127 million) fund to help local businesses capitalize on manufacturing turbines, laying cables, and maintenance for offshore wind farms.³⁷ The subsidy is meant to ensure that the



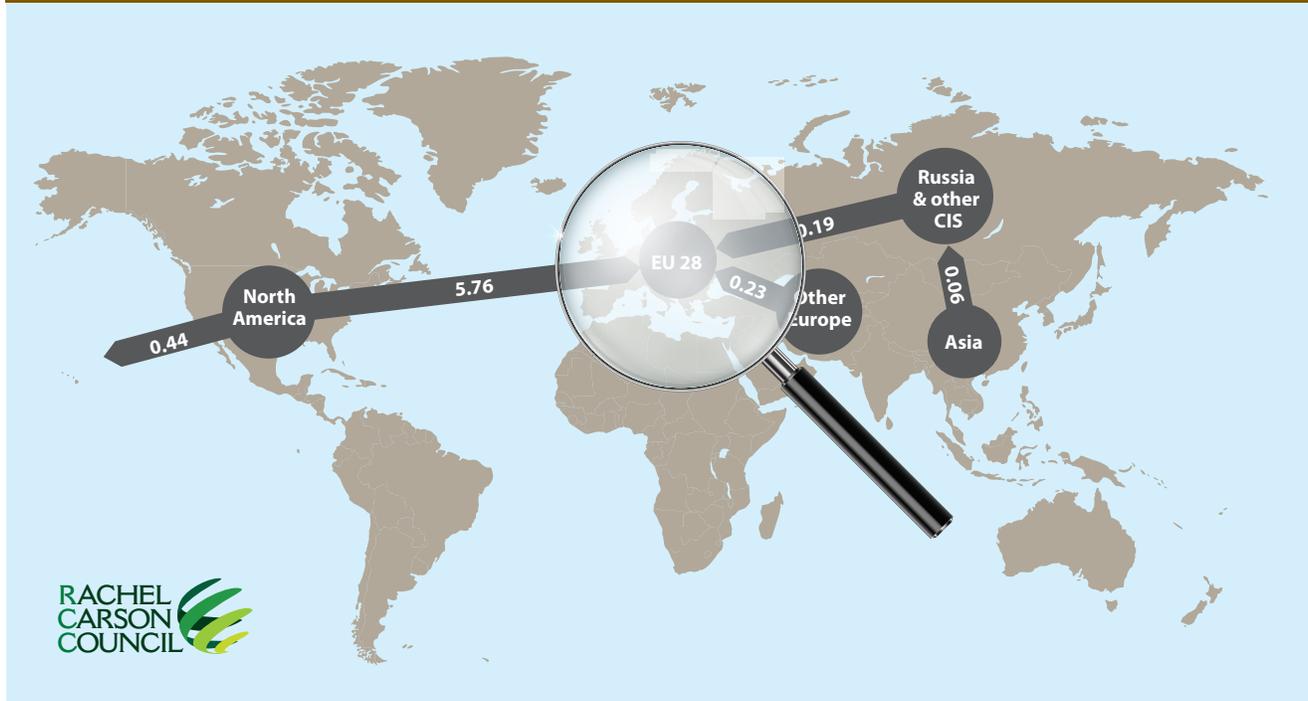
Drax Power Station in the UK by Chris Allen, <https://www.geograph.org.uk/photo/3588534>

United Kingdom can capitalize on this growing industry. Unfortunately for the United States wood pellet industry, that means their biggest customer is looking elsewhere for its energy. Therefore, demand for wood pellets may see a dramatic decrease as bioenergy still fails to compete on the electricity market without millions in subsidies.

As biomass energy continues to be an economic disaster in the United States, the wood pellet industry will have few markets left to send their product. At present, around 73% of wood pellets are exported, while 27% are consumed domestically.³⁸ Of the wood pellets being exported, 80% are being sent to the United Kingdom.³⁹ Therefore, the wood pellet industry's largest market could quickly shrink. With an imminent bust in sight, the United States should not continue to waste billions of dollars on this polluting industry.

In the European Union, which started the push for more biomass energy, its fate is also uncertain. Biomass gained popularity in Europe as a renewable resource when the EU decided all its member states needed to produce 32% of their energy from renewable resources by 2032. However, as NGOs are asking the EU to reconsider their decision, the EU's definition of biomass as renewable is being called into question. In fact, they decided to take the EU to court over the definition. The plaintiffs claim that the EU ignored scientific

Global Demand for Wood Pellets by Geographic Region



evidence and expert advice that biomass energy is not carbon neutral and has a particularly detrimental impact on the climate. They assert that the current treatment of biomass is incompatible with the EU's decision to reduce carbon emissions to 40% below 1990 levels by 2030. If the court sides with the plaintiffs, this would be another major setback for the wood pellet industry. 99.1% of wood pellets that are exported from the U.S. are sent to the European Union. While 80% of these exports are to the United Kingdom, the rest of the EU still plays a significant role in the wood pellet market.⁴⁰

With the United Kingdom eliminating most of its biomass subsidies, with biomass power plants struggling in the United States despite billions in subsidies, and with the European Union's use of biomass in question, the U.S. wood pellet industry likely faces difficult times ahead. It is clear, the industry is bad business for the environment, for public health and for the economy. Industrial wood pellets should not continue to be subsidized, lest more people continue to rely on an entirely unstable industry for energy and jobs.

THE MYTH OF JOB CREATION

Nevertheless, corporate and political rhetoric focuses heavily on the biomass industry's supposed ability to foster good jobs. Yet the wood pellet industry in the US, particularly through its largest private proponent, Enviva, has not delivered on its promises, whether in job creation or worker safety.

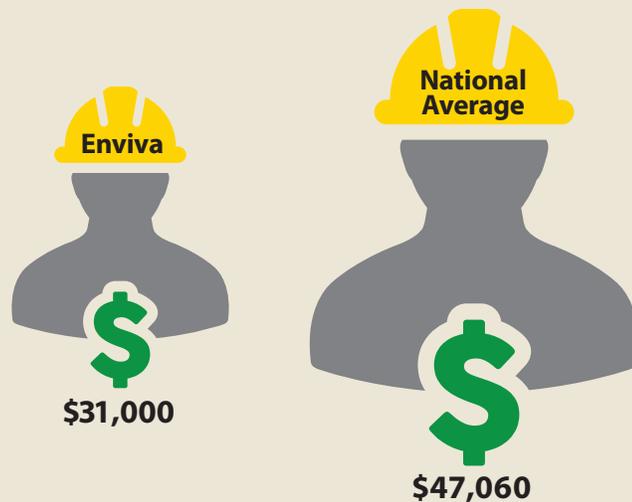
The large number of Enviva facilities in North Carolina are in Hertford, Sampson, Northampton and Richmond Counties. On their website, Enviva claims to be "creating nearly 2,000 new jobs in less than a decade and pumping almost \$1 billion into the Southern economy every year."⁴¹ This is simply false. Enviva was established in 2004. Yet to date, it has generated a mere 250-300 jobs in the state of North Carolina — the company's operations headquarters. Current statistics show a meager 75⁴² jobs in Sampson County, 70⁴³ jobs in Northampton County, 72⁴⁴ jobs in Ahoskie County and 80⁴⁵ jobs promised to Hamlet County. The average salary of lower to mid-level employees at Enviva in Richmond and Sampson counties is about \$31,000⁴⁶, drastically lower than the 2019 national average of \$47,060 according to the Bureau of Labor Statistics.⁴⁷ Despite the \$6 million⁴⁸ in state and local subsidies that allow Enviva to stay profitable, the company fails to provide serious employment, and is a step backward in job creation and prosperity for Southern economies. \$6 million is a high price to pay for so few jobs.

In addition, wood pellet plant jobs come with heavy risks. The bland job description posted for Enviva's Pellet Mill Operators in Ahoskie requires that workers will, "occasionally work in temperatures above 100 degrees and below 32 degrees. Occasionally walk

on slippery or uneven surfaces. Climb ladders and work off elevated surfaces on an occasional basis during each shift." Such a description seriously downplays the dangers of working in Enviva plants.

Enviva also fails to reveal that wood pellets are highly flammable. "Worldwide, at least 76 fires and explosions associated with wood pellets occurred between 2008 and 2012." One of the world's largest wood pellet producers, Enviva has a poor U.S. fire safety record. "Enviva has had news-worthy fires at its Florida facility (Enviva Cottdale near Panama City), two fires at its Virginia facilities near Chesapeake, and a North Carolina facility (Enviva Ahoskie north of Greenville)."

Current statistics show a meager 75 jobs in Sampson County, 70 jobs in Northampton County, 72 jobs in Ahoskie County and 80 jobs promised to Hamlet County.



The average salary of lower to mid-level employees at Enviva in Richmond and Sampson counties is about \$31,000, drastically lower than the 2019 national average of \$47,060 according to the Bureau of Labor Statistics⁴⁷



The large number of fires in the plants of wood pellet manufacturing companies has resulted in expensive remodeling and legal fees, as well as a negative effect on insurance prospects. "An analysis by the Environmental Integrity Project found that at least eight of the 15 largest U.S. wood pellet facilities have had fires or explosions since 2014." While the response to fire was fairly quick, several questions were raised about the ability of wood pellet companies to meet shipping requirements after a fire, raising doubts regarding future investments. Dealing with such a dangerous business is seriously high risk in terms of investment and insurance, even before acknowledging the danger to human life.

Excessive costs, the need for subsidies and the danger of wood pellet production prove, once again, that it is a poor investment. The future of the industry is not clear, nor is how long wood pellet jobs will be around. Enviva itself boasts wood pellets will be a "bridge-fuel" to a more sustainable future. But bridge fuels are intended to be phased out as more sustainable energy sources are expanded and created. William Schlesinger, a biogeochemist and member of the U.S. Environmental Protection Agency advisory board, was quoted in *The Guardian* calling wood pellets a potential bridge fuel as the solar and wind industries expand.⁵⁰ This clearly indicates that wood pellets are not truly sustainable in the long term from either an environmental or an economic standpoint. The termination of the wood pellet industry in the foreseeable future raises serious questions about long-term job security for individuals working in biomass, particularly those at companies like Enviva. While such companies strive to convince communities that wood pellet factories and deforestation operations are helping them because of job creation, it is worth questioning the value of such temporary jobs that are supported by a transitional, boom and bust industry. With more stable job alternatives available in the wind and solar industries, there is scant justification for people to endanger their own environment and health, as well as that of their communities, in return for temporary jobs that fail even to reach the average living wage.⁵¹

KEEP THE FORESTS GROWING: THE NEGATIVE EXTERNALITIES OF BIOMASS

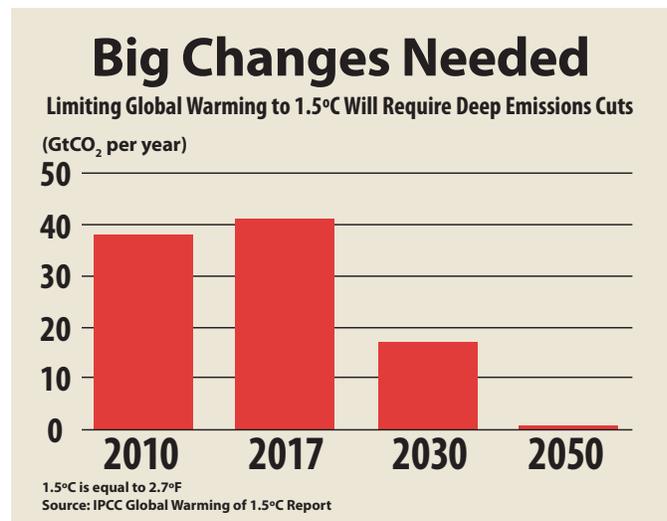
So long as state, national and international actors continue to invest in biomass energy and wood pellet fuel combustion, the industry will continue to profit while the environment and communities suffer. The wood pellet industry is high-risk with a host of negative externalities that need to be appropriately accounted for in its overall cost and its claims to be a sustainable fuel source. At the same time, the destruction of forests for biomass energy eliminates, at a significant cost to society, the positive externalities, or beneficial services, of mature forests.

One of the largest adverse effects of mass-producing wood pellets is enormous deforestation. While wood pellet companies claim to collect forest waste and engage in wildfire preventive logging to make their product, they also engage in extensive clear-cutting of forests. Forests are natural carbon sinks for the planet, absorbing vast amounts of carbon dioxide. They prevent sea-level rise by mitigating soil erosion, and moderate local temperatures countering excessive daily heat. To use these critical ecosystems for a fuel source that does not actually help the fight against climate change is perverse. Aside from the sheer environmental degradation caused by deforestation, there is a host of economic reasons to preserve woodlands and forests.

Forests provide critical ecosystem services which directly benefit communities and lower the cost of healthy living. They are critical for carbon sequestration, naturally clean the air and water and help mitigate natural disasters. All of these are invaluable to healthy, stable communities. Better forest management that excludes harvesting for wood pellets is crucial to reducing carbon emissions and providing countless other benefits to the United States' economy.

Forest Carbon Sequestration

In an era where carbon concentration in the atmosphere has reached a danger point and climate change has been declared a crisis, natural systems that can slow and reverse the amount of carbon in our atmosphere are essential. A prime reason to move away from dangerous wood pellet production is that trees are currently the cheapest and most effective form of carbon sequestration; we should work to protect them rather than burn them for fuel. Instead, many lawmakers are looking to develop a largely unproven and expensive technology called Direct Air Capture (DAC), as they continue to allow extreme deforestation in our country.



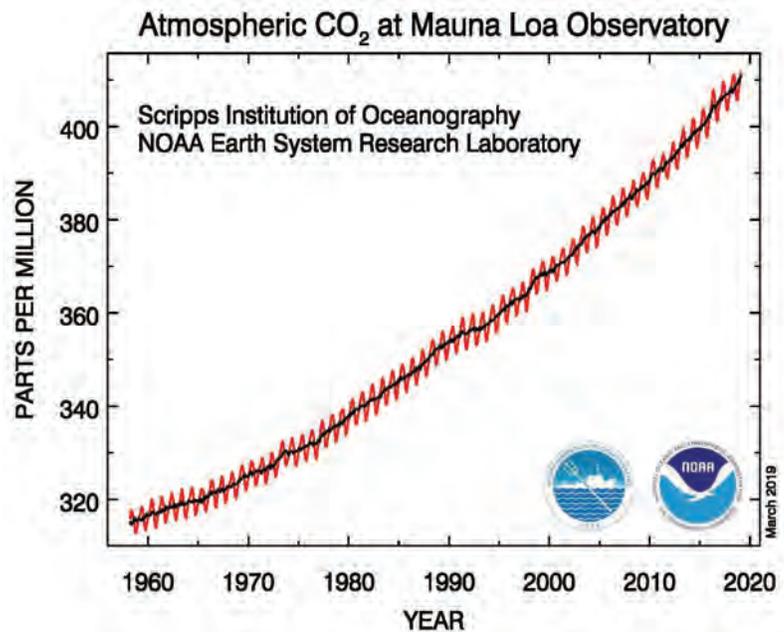
Credit: Climate Central
<https://www.climatecentral.org/gallery/graphics/limiting-global-warming-require-deep-emissions-cuts>

DAC technology is being developed with the goal of being able to pull carbon dioxide from the air, store it in the ground or transform it into fuel. DAC has been hailed by some as a “silver bullet” in the fight against climate change.⁵² However, not only is this technology in the earliest stages of development, it is also incredibly costly.⁵³ The most optimistic estimate puts the cost of carbon sequestration from Direct Air Capture facilities at \$94 per ton. Others suggest the cost is closer to \$232 per ton.⁵⁴ Yet, these costs do not even include the price of first building DAC plants.

Currently, there is no market to make Direct Air Capture profitable, and the cost proposed simply for research on these plants will require at least \$245 million per year in subsidies.⁵⁵ This proposal also calls for a federal mandate to buy fuels created from DAC plants that would still emit large amounts of carbon, keeping us within an unsustainable, consumptive system. The tax on carbon of at least \$94 to create a sustainable market for DAC in the United States is also far greater than Europe’s current levels of around \$20 per ton.⁵⁶ While DAC technologies may one day play a role as part of the United States’ fight against climate change, they do not come close to the benefits or the affordability of today’s forests.

Each year, forests in Oregon alone withdraw 23 million to 63 million tons of carbon from the atmosphere at no cost. If reliant on DAC plants to sequester that much carbon, Oregon would need to spend between \$2.162 and \$5.922 billion annually.⁵⁷ Oregon’s trees also have stored in them an estimated 11 billion tons of carbon.⁵⁸ Despite these benefits and Oregon’s seeking to pass one of the nation’s most aggressive bills to tackle climate change, logging in the state contributes an average of 33 million tons of CO₂ to the atmosphere each year.⁵⁹ While Oregon’s steps to protect the climate should be applauded, they also ignore one of its largest annual contributors of carbon emissions. In fact, according to a study by Oregon State University and the University of Idaho, as well as two studies by the Center for a Sustainable Economy, deforestation is Oregon’s leading cause of carbon emissions. Logging accounts for 10 million more tons of carbon emissions than the entire transportation sector in Oregon, the state’s second largest contributor.⁶⁰

In order to truly address our changing climate, Oregon and others must find a way to protect forests from continued deforestation. Many of the trees in the Pacific Northwest, such as Douglas firs, cedars, and hemlocks, sequester twice as much carbon per acre than trees do in the much heralded Amazon.⁶¹ Redwood trees in Northern California sequester almost seven times as much.⁶² Since older trees sequester carbon at a higher rate than younger ones, protecting our forests provides an important and inexpensive way for the United States to fight climate change.⁶³ Forests are a critical component in protecting habitats, safeguarding against floods, cooling temperatures, and creating clean water. Each of these functions creates a low-cost way to improve local economies by driving tourism and helping to reduce the impact of natural disasters. It is crucial to protect forests against increased logging from the harmful industrial production of wood pellets. Bioenergy is a polluting, dangerous, and inefficient form of energy that is devastating our cheapest and most effective protection against rising levels of CO₂ in the atmosphere.



Credit: NOAA. <https://climate.nasa.gov/news/2915/the-atmosphere-getting-a-handle-on-carbon-dioxide/>

Water Treatment

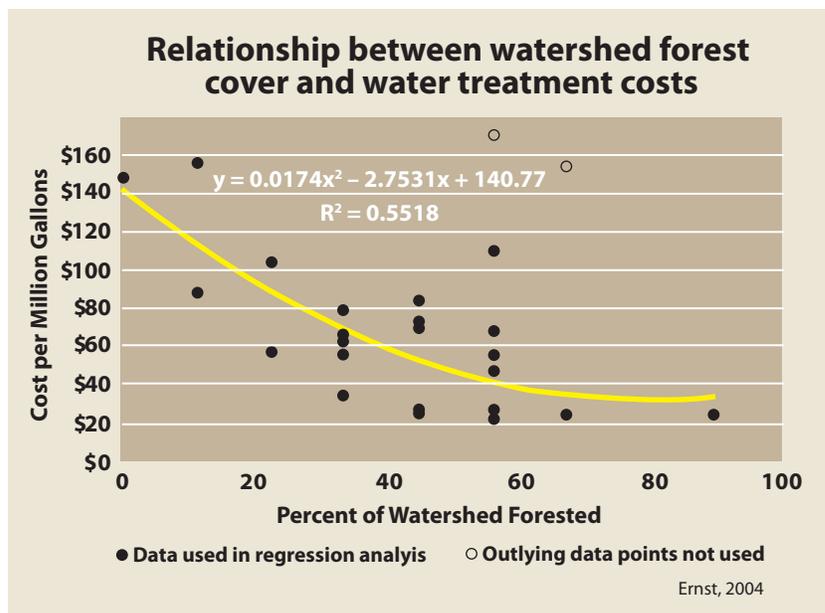
Forests are also proven natural water filtration systems. The filtration they provide lowers the cost of treating drinking water since it reduces the need to artificially purify water. North Carolina is a good example. According to the National Conference of State Legislatures, “North Carolina forests filter, store, and deliver fresh drinking water.”⁶⁴ More than half the state’s population directly depends on groundwater for its water supply.⁶⁵ About 98 percent of all public supply systems also rely on groundwater.⁶⁶ This means that North Carolina residents have directly benefited from the natural filtration system that forests provide.”⁶⁷

Such natural water filtration systems save consumers an enormous amount of money. “For every 10 percent increase in forest cover in the source area, treatment and chemical costs decreased approximately 20 percent”⁶⁸ for up to approximately 60 percent forest cover. Although anything beyond 60 percent forest cover has a negligible cost difference in water treatment, the clear-cutting resulting from the wood-pellet industry drops vastly below the 60 percent mark, and closer to more expensive water treatment costs.

The diagram on the right illustrates the increasing cost of water treatment per million gallons at different percentages of forestation. Carolyn Ernst, a researcher at Johns Hopkins University, discovered that, “For every 4 percent increase in raw water turbidity, treatment costs increase 1 percent.”⁶⁹ Increased turbidity is caused by both pollution emitted directly because of increased development and mining, and indirectly from soil erosion that allows sediments to enter bodies of water because of poor forestry and deforestation that loosen the soil. “Wetlands and forested land, if left undeveloped, can help slow and filter water before it gets to lakes, rivers, and aquifers, keeping these drinking water sources cleaner and making treatment cheaper.”⁷⁰

When extrapolated, average annual water treatment costs due to the lack of natural purification systems result in between \$300,000 and one million dollars that consumers would have to spend for drinking water.

With the mass deforestation needed to match the wood pellet demands of Europe and expanding markets in the U.S. and Japan, the U.S. is losing its natural, low-cost water treatment systems. Forested



WATERSHED FORESTED	TREATMENT AND CHEMICAL COSTS PER MG	CHANGE IN COSTS	AVERAGE TREATMENT COSTS PER DAY	AVERAGE TREATMENT COSTS PER YEAR
10%	\$115	19%	\$2,530	\$923,450
20%	\$93	20%	\$2,046	\$746,790
30%	\$73	21%	\$1,606	\$586,190
40%	\$58	21%	\$1,276	\$465,740
50%	\$46	21%	\$1,012	\$369,380
50%	\$37	19%	\$814	\$297,110

watersheds require less water treatment, and are therefore lower cost, as visible in the graphic above. “This study found that there were significant relationships among source water quality, percent land cover, and drinking water treatment cost ... Decreased forest land cover was significantly related to decreased water quality. Further, low water quality was related to higher treatment cost. High percent land cover by non-forest vegetation was significantly related to low treatment cost, while high percent land cover by urban area was related to high treatment cost.”⁷²

Forests & Disaster Mitigation

The Costs of Sea-Level Rise & Flooding

While drinking water scarcity and high water treatment costs are imminent with current climate change trends, one of the most terrifying realities of climate change is sea-level rise.

Forests protect coastal areas from flooding by preventing soil erosion. They are also natural carbon sinks that help to absorb carbon dioxide emissions and moderate temperatures — ultimately mitigating ice melt and consequent sea-level rise.

The deforestation caused by the wood pellet industry reduces the Earth’s carbon sinks, exacerbating global warming and climate change. Even though some reports consider wood pellets to be a renewable source of energy because companies claim trees will be replanted, this weak argument does not hold up to scrutiny. The time it will take new saplings to grow and have the same carbon sink efficiency as current, mature trees is, at best, decades-long. In the meantime, the number of natural disasters due to climate change will continue to increase; natural disaster management is an extremely expensive, time-sensitive endeavor.

One of the most common disasters resulting from deforestation is flooding, which, at the current rate of rising temperatures, is becoming chronic. “The United States faces more than \$400 billion in costs over the next 20 years, much of it sooner, to defend coastal communities from inevitable sea level rise.”⁷³ The two most common ways to defend areas against sea-level rise are seawall fortification and migration, both of which are extremely expensive.

The cost of seawalls — approximately 50,145 miles of seawall worth \$416 billion by 2040⁷⁴ — illustrates merely the cost of immediate disaster relief in the US. It is further important to note that the \$400 billion bill to defend coastal communities will, ironically, be footed disproportionately by Republican states, simply because they are located in more vulnerable areas. Although Republicans usually take a hardline stance

against addressing climate change, or ignore it altogether, their constituencies have been and will continue to be the first to feel its wrath. Florida, Louisiana, and North Carolina are projected to be the top three most affected states in the US, with the longest and most vulnerable coastlines that will require seawalls.⁷⁵ “Overall, Republican congressional districts will incur \$224 billion in seawall costs, while Democratic congressional districts will incur \$192 billion. Republicans, however, represent a disproportionate number of districts facing the highest costs. Of the 71 districts facing more than \$1 billion in seawall expenses by 2040, seven of the top 10 and 24 of the top 40 are Republican.”⁷⁶ This means that though 100 of 137 affected congressional districts are represented by Democrats, those represented by Republicans are more likely to incur over a billion dollars in seawall expenses.



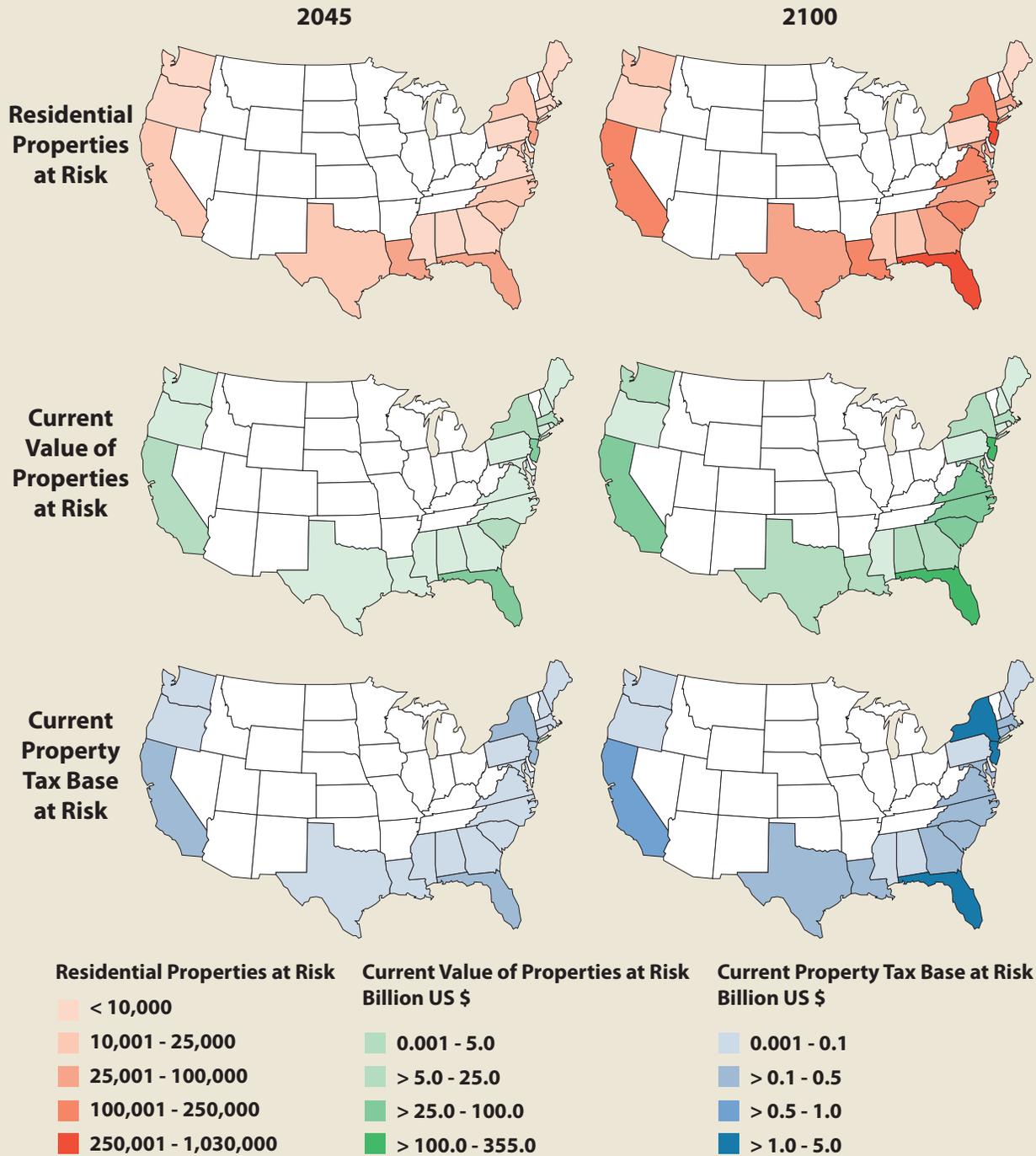
Residential properties and property value are also at direct risk as shown by the infographic on page 19.⁷⁷ By 2045, 310,000 existing homes in the contiguous United States will be at risk from flooding and, between the years 2045 and 2100, will have drastically diminished value. Particularly on the coasts, the value of properties at risk range from \$25 - \$355 billion. Similarly, the property tax base at risk on the East Coast, as well as in California and several southern states, is expected to face a steep rise in risk and risk-related costs well into the billions of dollars.

Furthermore, forests are natural barriers against more than sea-level rise. “Strong forests protect North Carolinians from extreme weather events such as costly hurricanes. In 2016, Hurricane Matthew caused \$4.8 billion in damage, affected 98,000 homes and nearly 20,000 businesses across North Carolina.⁷⁸ While the federal government initially committed \$1.2 billion toward the recovery, this was still insufficient to properly address housing and infrastructure needs.⁷⁹ Cutting down trees for wood pellets further weakens North Carolina’s natural defenses against such severe weather events.”⁸⁰ Two years later, Hurricane Florence outdid Hurricane Matthew, inflicting nearly \$17 billion in “damage to homes, businesses, farms and governments in North Carolina, and that as much as half of that may not be covered by private insurance or government aid.”⁸¹ In 2018 Hurricane Florence surpassed the combined magnitude of hurricanes Matthew and 1999’s Floyd that was equal to Matthew’s severity. This trend paints a terrifying picture — not only is the severity of hurricanes in the U.S. increasing, but also the intervals between hurricanes are shortening, meaning more frequent and deadly hurricanes than ever before.

The National Oceanic and Atmospheric Administration reported \$91 billion in natural disaster costs in the United States in 2018. “The economic losses in 2018 were due to 14 different natural disasters, ranging from hurricanes to wildfires to winter storms. Eighty percent, or \$73 billion, of the total loss was attributable to just three events: Hurricane Michael in Florida, Hurricane Florence in the Carolinas, and wildfires in the West, including California.”⁸² In each of these cases, healthy forests could have played a critical role in lessening the damages.

Nor is 2018 an anomaly. According to a Rhodium Group⁸³ analysis of extreme weather events in 2014, “the average damage from hurricanes and nor’easters, to the East and Gulf coasts in particular, should be \$3 billion to \$7.3 billion higher each year. That is if climate change continues unabated.”⁸⁴ While 2018 saw an increase in “natural” disasters compared to previous years, there has been an upward trend of billions of dollars in property damage and restoration, as well as in the loss of life. These natural disasters can no longer be dismissed as beyond human control. Our actions are creating an extremely expensive, life-threatening problem.

Residential Properties and Property Value at Direct Risk



These maps, from the Union of Concerned Scientists, show the states most threatened from property inundation from rising sea levels. In the lower 48 of the United States, it totals 2.4 million homes by the end of the century. Data provided by third parties through Zillow Transaction and Assessment Dataset (ZTRAX).

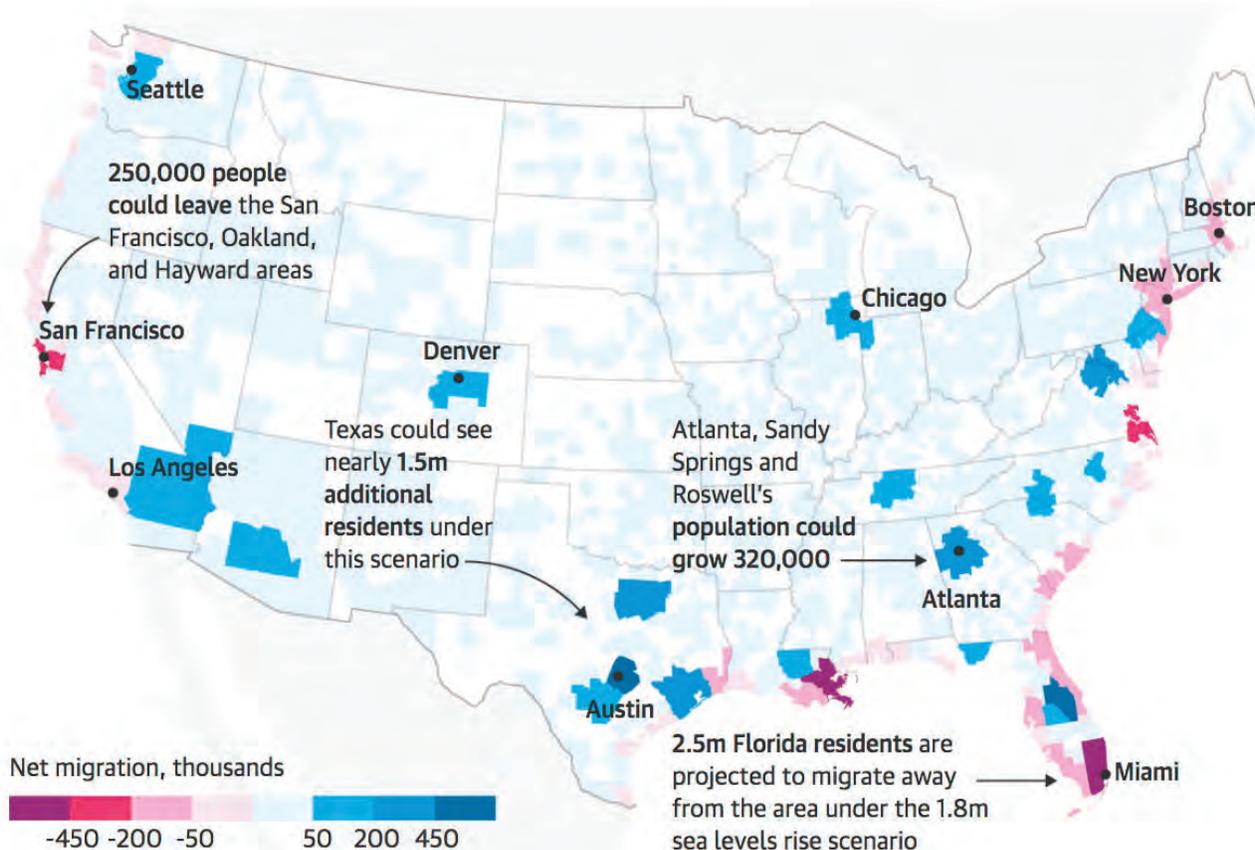
Climate Refugees

With the increase in global warming and climate change, the number of people losing their homes will rise; international pressure for the U.S. to admit external climate refugees will also increase. Such an influx will have serious effects on the U.S. job market and economy.

Burning wood pellets as fuel has two consequences that exacerbate the refugee problem. First, their combustion releases carbon emissions and, second, the clear-cutting involved in the production of wood pellets destroys a carbon sink that would have previously drawn carbon from the atmosphere. These processes warm the climate which leads to sea-level rise induced migration away from coastal communities. Critically, forests that are left standing mitigate such impacts and can lessen the displacement of climate-change refugees.

The Intergovernmental Panel on Climate Change estimates that there will be 200 million climate refugees⁸⁵ in the world by the year 2050. Of these 200 million, a good portion will be Americans. Coastal regions in the U.S. like New Jersey, South Carolina, North Carolina, Florida, Texas, Georgia, and Alaska, among others, are predicted to be some of the first areas to experience more regular, dangerous floods as a result of sea-level rise by 2060.⁸⁶ Homes, offices, and property will be destroyed. Americans, while not necessarily refugees, will most likely be classified as migrants or internally-displaced people within the U.S. who need to relocate to safer areas for refuge.

Relocating U.S. residents is expensive. The situation in Isle De Jean Charles — a particularly vulnerable area in Louisiana — is a perfect example. “The Office of Community Development has been the lead player on the project since 2016, when it won a \$48.3 million grant from the federal Department of Housing and



Guardian graphic. Source: Nature climate change, Mathew E. Hauer

Urban Development, which would put the relocation cost per family at \$2.5 million."⁸⁷ Relocation requires an enormous amount of taxpayer money to move just one community. It costs millions of dollars to uproot and provide a stable living environment in a different location for even a single family.

Considering how expensive it is to relocate a single family, moving approximately 13 million migrants nation-wide is absolutely daunting. "Estimates range from \$200,000 to \$1 million per person to undertake a relocation. If 13 million people do have to move, it seems fantastical to imagine \$13 trillion, or even a significant fraction of this amount, being spent by governments to ease the way."⁸⁸

In the end, it is essential to continue to invest in our forests, our pre-existing, natural infrastructure, to help mitigate the effect of climate change, floods, and natural disasters. We should not be investing in the wood pellet industry which directly threatens our ability to meet climate goals while destroying the very forests that are protecting us.

ALTERNATIVE SOLUTIONS?

Alternative Energy Sources are Cheaper and More Stable

Currently, biomass energy is created through co-firing wood pellets at coal plants. However, neither this nor any part of the biomass industry is profitable. 42% of global coal capacity is currently unprofitable, and the United States could save \$78 billion⁸⁹ by closing coal-fired power plants — many of which also burn biomass.

It seems to be common sense to invest in wind and solar energy, which are cheaper, safer, more reliable components of the energy sector that create more jobs annually than the wood pellet industry ever has.

Wind and solar energy are without a doubt the cheapest source of energy in the U.S., and they are only getting cheaper. “LCOE (Levelized Cost of Energy) analysis reported new onshore wind costs \$29-\$56 per megawatt hour (MWh) to build without subsidies and \$14-\$47/MWh to build with subsidies. New utility solar PV costs \$36-\$44/MWh to build without subsidies and \$32-\$41/MWh to build with subsidies. Comparatively, the cost to operate existing plants are \$27-\$45/MWh for coal and \$24-\$31/MWh for nuclear”⁹⁰ **The building costs alone for solar and wind are competitive with the costs of running existing coal and nuclear plants without subsidies.** Generating solar and wind



energy, once built, is even cheaper. Solar panel prices have dropped by 99% in the last 40 years, and prices are expected to continue to plummet.⁹¹ While critics of the solar industry believe that the continuing decline in prices is a deterrent to investment, the stability solar technology offers is unparalleled in the biomass industry.

Wind-generated power is currently the cheapest and most stable form of electricity generation in the United States. “Because the electricity from wind farms is sold at a fixed price over a long period of time (e.g. 20+ years) and its fuel is free, wind energy mitigates the price uncertainty that fuel costs add to traditional sources of energy.”⁹²

Additionally, the wind industry is acclaimed for creating sizable quantities of employment across the country, contributing a total of \$20 billion⁹³ annually to the U.S. economy. “The U.S. wind sector employed more than 100,000 workers in 2016, and wind turbine technician is one of the fastest-growing American jobs of the decade. According to the Wind Vision Report, wind has the potential to support more than 600,000 jobs in manufacturing, installation, maintenance, and supporting services by 2050.”⁹⁴

This widespread employment is not concentrated in already prosperous parts of the nation. Wind energy generates revenue in rural areas, particularly amongst agricultural communities that tend to have the best sites for wind infrastructure. “Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land, providing landowners with additional income.”⁹⁵

The United States is extremely interested in energy independence from other nations, and wind power is a realistic and sustainable way for the U.S. to attain it. “The nation’s wind supply is abundant and inexhaustible”⁹⁶ unlike forests, and by extension wood pellets. Forests are an extremely precious and exhaustible resource that take decades if not centuries to regenerate. “None of the companies can guarantee they can regrow untouched forest to capture the same amount of carbon released.”⁹⁷ Wind energy, on the other hand is truly renewable. Additionally, “over the past 10 years, cumulative wind power capacity in the United States increased an average of 30% per year, and wind now has the largest renewable generation capacity of all renewables in the United States.”⁹⁸



The United States needs to pick up the economic warning signals against biomass, warnings that have flared internationally, particularly in the UK — a chief importer of U.S. wood-pellets. The UK is already transitioning to subsidy-free renewable energy generation. “Wind power is expected to account for half of the 18GW of subsidy-free renewables to be built in the UK between now and 2030, according to a new Aurora Energy Research report.”⁹⁹ As noted elsewhere in *Bad Business*, Great Britain has ended its subsidies for biomass, thus proving that wood pellets and the biomass industry will no longer be viable. Similarly, wood pellet plants in the Republic of Ireland are shutting down operations instead of burning biomass. The Electricity Supply Board was denied permission by An Bord Pleanála, a national court with local oversight in Ireland, to extend biomass burning operations until 2027. Instead, it will be shutting plants down in 2020.¹⁰⁰

U.S. companies have also started to move away from biomass production. In May 2019, Pine Tree Power — a Bethlehem, New Hampshire based wood-burning “biomass” power company — was forced to shut its plants when the governor vetoed a bill which would have dispensed subsidies that were critical for its continued operation.

“According to biomass plant owners, getting assistance is a matter of now or never. ‘Without this legislation, the Bethlehem and Tamworth plants will close,’ [Mark] Driscoll [multi-plant manager at ENGIE North America] said..”¹⁰¹

Michael O’Leary, the asset manager at Bridgewater Power Company in Plymouth, gave several examples of measures employed by Pine Tree Power to cut costs such as cancelled raises or bonuses for employees (since 2017), deferred maintenance, and no capital investments in the plant. However, none of these measures has made a difference. Similarly, plants in Bethlehem and Tamworth are shuttered with no certainty when they will be back in operation, underscoring the unreliability of wood pellets for investment.¹⁰²

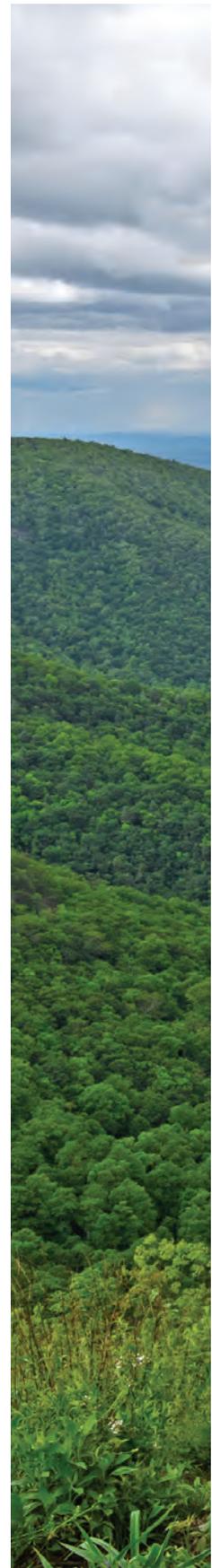
Marc Brown, director of government affairs at the New Hampshire Ratepayers Association, said about the biomass plants, “This isn’t a three-year fix; this is going to be forever for these plants,” he said. “They’re never going to be economic. They never really have been.”¹⁰³

These examples make it clear that not only is the biomass industry unprofitable, but it also creates a myriad of externalities by generating millions in current and impending subsidy costs that offset what little revenue is garnered. Wind and solar energy are more cost-effective, sustainable, and profitable alternatives that are already outperforming wood-pellets in every desirable parameter.

Policy Solutions

Given the dangers and poor business prospects of the biomass utility, significant policy changes are needed to move to a truly economical and carbon-free economy. Below is a list of responsive policies that are critical for Congress, states and the next President to address in order to achieve critical forest protection and remove wood pellets from the renewable energy future of the US. These options were compiled in coalition by the Rachel Carson Council, the Forest Carbon Coalition, the Partnership for Policy Integrity and The John Muir Project to send to the House Committee on the Climate Crisis to help inform the creation of sweeping climate policy reform in 2020. The following recommendations are supported by over 40 nationwide organizations representing tens of thousands of members.

- 1. End the commercial logging program on public lands.**¹⁰⁴ The economic value of public forestlands for carbon storage and other ecosystem services, including biodiversity protection, far exceeds that of the production of timber and other extractive resources. When forests are logged, local economies and the climate suffer economic damage. In Oregon, climate-related damage from logging on public forests is at least 10 times and perhaps more than 80 times revenues earned from timber sales.¹⁰⁵ The commercial logging program should be defunded and otherwise phased out on all Forest Service and BLM lands. Additional protected federal public forestlands should be acquired from willing sellers, especially in regions with few federal public lands, like the southeastern US. States can adopt similar policies for state and county owned forests.¹⁰⁶
- 2. Establish forest-carbon reserves.**¹⁰⁷ Establish forest carbon reserves as a requirement for all public forestlands. Such reserves should be off limits to logging or other extractive uses and should be drawn around all remaining tracts of native (unlogged) forestlands since these represent the last vestiges of high-density forest carbon stocks in the nation. The reserves should also encompass high productivity lands that may have been logged previously but can be managed through proforestation to achieve high carbon densities over time.
- 3. Define meaningful carbon-storage targets.**¹⁰⁸ Establish forest carbon-storage targets for each national forest or BLM district. These should reflect the carbon-density representative of unlogged native, old-growth forest. Management activities would be required to move towards, and not away from such targets.
- 4. Decouple agency funding from logging.**¹⁰⁹ Until the federal logging program can be phased out, decouple funding for line items described as forest and watershed restoration, fire risk reduction and forest health from the revenue streams generated by timber sales. Congress should fund these activities directly instead of allowing the Forest Service and BLM to retain timber sale revenues and recycle them into these programs. This would eliminate the perverse incentive to contaminate legitimate restoration activities with commercially valuable timber of interest to purchasers.
- 5. Enact the next generation of corporate farming and forestry laws.**¹¹⁰ Corporate farming laws are on the books in nine states that restrict ownership or management of prime farmlands by large, foreign, and investor-driven corporations.¹¹¹ A next generation of these laws should be adopted nationwide to include productive



forest lands as well. This would stimulate a transfer of US forestlands out of absentee corporate ownership and back into the hands of family foresters and smaller scale, sustainable businesses who have the capacity and long-term commitments needed to safeguard the nation's food, water, and fiber security through climate smart practices as climate change unfolds. This transition will also boost jobs and strengthen rural communities.

6. **Adopt a no-net-loss policy (NNL) for private forestlands.**¹¹² Similar to the nation's wetlands mitigation program goals, NNL here would require the federal government and states to ensure that any forestland converted to other uses or degraded by clear-cut logging be offset by an ecologically equivalent set aside of land that can be restored to its natural forested condition and not managed as a timber plantation.
7. **Reform climate-harmful subsidies.**¹¹³ All forms of federal, state, and local government financial assistance to forestland owners should be conditioned upon landowner commitments—through approved management plans—to climate-smart practices such as long rotations, alternatives to clear-cutting, and re-establishment of natural forests where timber plantations now exist. In addition, governments should stop financial support—in the form of tax credits, low interest loans, industrial development bonds, and other expenditures—for new mills and biomass facilities that stimulate the wasteful consumption of carbon-intensive wood products. Finally, consumption subsidies for paper and wood products should be shifted to non-wood substitutes whenever possible, such as through changes in public procurement expenditures.
8. **Add emissions from logging and wood products to GHG inventories.**¹¹⁴ When GHG inventory methods were first developed, the timber industry was given the leading role in shaping accounting rules for the logging and wood products sector. The result—described by international monitors at the time—were rules “written by loggers for loggers.”¹¹⁵ Unlike agriculture, these rules excluded the logging and wood products sector entirely. Methods and sources of information are readily available to supplement national and state-level GHG inventories with estimates of emissions from this sector.¹¹⁶
9. **Incorporate a climate test in NEPA analysis.**¹¹⁷ All forest management plans and projects on federal public lands should be subject to a strict climate test that ensures that selected alternatives (1) lead to a reduction in atmospheric greenhouse-gas concentrations; (2) increase carbon sequestration capacity; (3) rebuild forest carbon stocks, (4) protect forest soils, and (5) improve the ability of U.S. forestlands to withstand predicted increases in drought, wildfires, storms, floods, harmful algae blooms, and outbreaks of insects and disease. National Environmental Policy Act (NEPA) procedures should be updated to require this. Some states have state environmental policy acts (SEPA) that can be similarly updated.
10. **Develop a tax-and-reward program for forest carbon.**¹¹⁸ Carbon taxes work most effectively if technologies to reduce emissions are ready to deploy at scale but need financial incentives for more ubiquitous uptake. This is the case with U.S. forests. Alternatives to carbon-intensive forest practices exist (i.e. variable density thinning and other selective harvest methods) and provide an economically feasible option for forestland owners with long term commitments to the land. A forest carbon tax-



and-reward program would incentivize these practices by levying a tax on logging-related emissions associated with conventional, industrial forest practices and using proceeds to help small landowners reduce the costs of implementing climate-smart alternatives that boost the storage of forest carbon.¹¹⁹ Proceeds would also be used to acquire forestlands to be put in the public domain and managed for long-term carbon storage.

- 11. Modernize state forest-practices laws.**¹²⁰ State forest-practices laws need to be modernized to make climate-smart forestry the law and not the exception.¹²¹ Key elements should include requirements for forest-management plans and carbon-storage targets for large corporate owners, science-based buffers for aquatic ecosystems, set-asides for developing carbon rich mature and old growth forests, and mechanisms for public participation.
- 12. End carbon-neutrality designations for forestry biomass energy.**¹²² Burning woody biomass is not instantaneously carbon neutral under any scenario.¹²³ Bioenergy emissions must be accounted for in federal greenhouse gas reduction policies, including carbon pricing legislation. Congress cannot legislate the science and should remove the legacy rider that pro-biomass industry advocates have inserted in the federal budget for the past several years that falsely assumes the carbon neutrality of forest biomass.¹²⁴ Woody-biomass emissions can take decades to more than a century for new tree growth to offset, assuming regrowth of harvested forests actually occurs.¹²⁵ This is well beyond the timescale relevant for climate action.
- 13. Eliminate renewable energy subsidies for forest biomass energy.**¹²⁶ The U.S. biomass industry has been heavily subsidized through state and federal renewable energy (RE) programs, including direct grants, stimulus funding, production and investment tax credits, federal loan guarantees, and rate-payer subsidies. Across the country, tens of millions of dollars in federal stimulus funds went to biomass power plants that have been plagued with cost overruns, air and water violations, lawsuits, and early closures.¹²⁷ With certain exceptions, such as in Massachusetts and the District of Columbia, biomass power plants do not have to meet any emissions or efficiency criteria to be eligible for renewable energy credits (RECs).^{128, 129} Therefore, they compete directly for the same resources with zero-emission renewable energy technologies such as solar and wind, with negative outcomes for ratepayers, the environment, and communities where these facilities are located. Forest biomass energy – whether for electricity, heat, or transportation - should not be incentivized through state or federal renewable energy programs.
- 14. Close international biomass loopholes.**¹³⁰ The massive increase in industrial-scale wood pellet production, particularly in the U.S. Southeast, for export to Europe and other overseas markets is tied directly to international policies that fail to account for bioenergy emissions as well as generous renewable energy subsidies for bioenergy.^{131, 132} Forests in the southeastern states are being massively exploited to meet international demand for woody biomass fuel to burn in industrial-scale power plants as so-called “carbon neutral” and “renewable” energy. The harvesting, production, and transport of industrial wood pellets devastates critical forestland, harms the health of communities and the environment, and compounds environmental injustices in poor, rural communities of color.¹³³ The U.S. and Congress



must act as global leaders in closing these loopholes in the United States and thus set an example for other countries.

15. Carbon removal and negative emissions.¹³⁴ We need to grow our trees, not burn them. The IPCC has concluded that limiting dangerous temperature rise will require both deep GHG emissions reductions and carbon dioxide removal (CDR) to compensate for residual emissions and for delays in implementing emissions reductions. Protecting existing forests to maximize their carbon storage and ecological potential – known as proforestation¹³⁵ – is the most effective and low-cost approach to achieve this goal and can be put to work immediately across all forest types. Ecologically appropriate forest restoration and afforestation¹³⁶ also offer tremendous carbon sequestration potential.¹³⁷ While many climate models have advanced bioenergy with carbon capture and storage (BECCS) as a means to achieve “negative emissions,” this is based on the false premise that bioenergy is carbon neutral.¹³⁸ These models do not take into account the progressive loss of forest carbon sequestration and storage potential with every additional rotation of logging. The IPCC report includes a pathway for limiting temperature rise to 1.5 degrees Celsius without relying on BECCS.¹³⁹ In order to maximize nature-based solutions such as reforestation and protection of standing forests, this model requires scaling back bioenergy to 2010 levels. We must immediately begin to shift away from logging for bioenergy, just as we are working to move beyond fossil fuel consumption. We must not defer action by relying on the hypothetical future deployment of unproven, unscalable, and environmentally-risky solutions such as BECCS.

A Transition for Employees of the Wood Pellet Industry & Forest Owners

Along with new policies, it is critical to remember the workers and landowners that have come to rely on the wood pellet industry. The wood pellet industry is not a sustainable option for either workers or companies to invest in. It is well documented that deforestation and clear-cutting to fuel the forest, paper, and packing industry are among the chief reasons for elevated carbon levels in the environment, and, thus, a leading cause of global warming and climate change. The International Labour Organisation (ILO), the United Nations’ agency for the global workforce, estimates that action to meet the Paris goals would create 24 million jobs in clean energy generation, electric vehicles and energy efficiency with job losses of only around 6 million, a net gain of 18 million jobs. The latest report from the New Climate Economy (NCE) concludes that ambitious climate action would result in a net employment gain of 37 million jobs across the global economy by 2030.¹⁴⁰ However, it would be unjust to place a universal ban on forestry, or suddenly close all wood pellet production facilities, thus ending the jobs that depend on them.

What is needed is a just transition. A just transition is a fair and equitable evolution from an extractive to a regenerative economy.¹⁴¹ It aims to address and correct for past harms faced by disadvantaged groups to prevent further cycles of poverty and violence. On the ground, this means providing workers employed in extractive, unsustainable industries opportunities to transition to sustainable and profitable industries while uplifting those who have been historically disenfranchised in order to level the playing field. In forestry, it also includes providing financial remediation for forest landowners.



How?

- **Step 1** Enroll workers in vocational training programs and other educational programs to transition into the real green sector.
 - Renewable energy jobs are abundant in the wind and solar energy generation installation sector, as well as in a proposed tree planting initiative that could employ millions of people to help the environment.
 - As we have seen, the wind industry creates sizable quantities of employment across the country, with more than 100,000 workers in 2016 and the potential to support more than 600,000 jobs in manufacturing, installation, maintenance, and supporting services by 2050.¹⁴² It is important to note that this employment is not concentrated in already prosperous parts of the nation. Wind energy also generates revenue in rural communities in agricultural communities that tend to have the best sites for wind infrastructure. "Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land, providing landowners with additional income."¹⁴³
 - Similarly, the solar installation industry is enormous and prosperous, with operational prices comparable if not better than the fossil fuel industry. In 2016, the U.S. Department of Energy "showed that solar energy was responsible for a much larger share of employment in the electric power sector (43%) than the whole of the fossil fuel industry combined (22%)". However, in the two years since then, the Trump administration has imposed tariffs on solar panels creating a dip in the solar employment market. If such anti-renewable legislation were lifted, the solar industry would be as successful as wind energy.
 - Aside from renewable energy installation, the Green New Deal also suggests creating employment out of common-sense environmental solutions, like planting trees. This idea is based on the success of Franklin D. Roosevelt's Civilian Conservation Corps that employed 3 million people after the Great Depression as tree planters and infrastructure builders. Within a few years, they had planted 3 billion trees.
- **Step 2** During education and training for sustainable jobs, we must also provide funding to sustain families during the transition. This is possible if government agencies stop investing in and giving subsidies and grants to logging and biofuel initiatives which are unsuitable alternatives to coal and petroleum, as well as overspending on military budgets. **Such subsidies and grants should first begin rebate programs and grants to incentivize workers to train for truly green jobs and provide funding for forest owners to keep their forest land forested.** Second, further subsidies should be provided to wind and solar programs to fund research that minimizes cost and ascertains the efficiency and storage of truly renewable energy.
- **Step 3** Decentralize electricity grids with feed-in tariffs, citizens' energy and local energy cooperatives. "Residential energy storage is already attractive to 20 percent of U.S. households, and the market for these systems is expected to expand significantly in the next few years".



CONCLUSION

The use of wood pellets must be ended. As our previous report demonstrated, their environmental and community impact is substantial, and although woody biomass is promoted as a green source of energy, it is not. Still, some argue that the industry holds a critical role in stimulating rural economies, a priority in many regions where there are simply not enough jobs. *Bad Business* debunks this myth as well. The wood pellet and, by extension, the biomass industry is neither lucrative nor a reliable investment.

While biomass is currently making profits, these rewards are built upon taxpayer-sponsored subsidies and the extraordinary work of mid-level workers earning below average salaries. Companies like Enviva have overpromised the number of jobs they provide local economies, and these jobs do not pay well. Furthermore, government grants like the Economic Development Agency and the Community Development Block Program, among many others, add up to millions of dollars in subsidies for wood pellets. These funds are being paid even as wood pellet plants are closing across Ireland, and biomass burning power plants are shutting down in the UK and the U.S. These realities are a testimony to the fragility and instability of this falsely renewable industry which not only puts our environment at risk, but also critical local and rural economies that have allowed the industry into their locales.

As we have seen, there are million-, and billion-dollar externalities that result from subsidizing the wood pellet industry to continue operations. Forests are natural deterrents that reduce cooling costs, protectors from soil erosion that aid in natural water purification, and carbon sinks that mitigate climate change and its related disasters such as sea-level rise and forced migration. Climate change disasters — Hurricane Florence, and, most recently, Hurricane Barry, for example — cost governments billions of dollars in damages. These costs are preventable if we halt deforestation and instead promote protection and reforestation of forested land. **These externalities must be included when analyzing the costs and benefits of wood pellets and biomass.**

Finally, when we consider that the solar and wind industries are already cost competitive and responsible for employing far greater numbers of people each year than the wood pellet industry has in a decade — it is necessary to invest in truly renewable energy instead of the environmentally harmful and bad business of biomass.

ENDNOTES

1. J.T. Houghton, G.J. Jenkins and J.J. Ephraums (eds.). Cambridge University Press, Cambridge, Great Britain, New York, NY, USA and Melbourne, Australia 410 pp.
2. Wisner, Alexandra, et al. *Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice*. Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Pg 4
3. "Opinion of the EEA Scientific Committee on Greenhouse Gas Accounting in Relation to Bioenergy," European Environment Agency Scientific Committee, September 15, 2011, <https://www.eea.europa.eu/about-us/governance/scientific-committee/sc-opinions/opinions-on-scientific-issues/sc-opinion-on-greenhouse-gas/view>.
4. "Think Wood Pellets Are Green? Think Again." NRDC Issue Brief. May 2015. <https://www.nrdc.org/sites/default/files/bioenergy-modelling-IB.pdf>.
5. Dogwood Alliance. 2019. <https://www.dogwoodalliance.org/wp-content/uploads/2017/08/Acres-of-Pellets-Fact-Sheet.pdf>.
6. Ireland, Robert. Sep 2018. "International Trade in Wood Pellets: Current Trends and Future Prospects." The U.S. International Trade Commission. https://www.usitc.gov/publications/332/executive_briefings/wood_pellets_ebot_final.pdf.
7. Mark Lisher, "City of Austin one of many sucked into biomass money pit," *The Texas Monitor*, May 7, 2018, <https://texasmonitor.org/city-of-austin-one-of-many-sucked-into-biomass-plant-money-pit/>.
8. Mark Lisher, "City of Austin one of many sucked into biomass money pit," *The Texas Monitor*, May 7, 2018, <https://texasmonitor.org/city-of-austin-one-of-many-sucked-into-biomass-plant-money-pit/>.
9. Mark Lisher, "City of Austin one of many sucked into biomass money pit," *The Texas Monitor*, May 7, 2018, <https://texasmonitor.org/city-of-austin-one-of-many-sucked-into-biomass-plant-money-pit/>.
10. U.S. Senate. 16 December 2019. "Rule Committee Print 116-44 Text of the House Amendment to the Senate Amendment to H.R. 1865." https://www.appropriations.senate.gov/imo/media/doc/H1865PLT_44.PDF.
11. Tom Udall. 2019. "Press Release: Udall, Senators Introduce Renewable Electricity Standard Legislation". <https://www.tomudall.senate.gov/news/press-releases/udall-senators-introduce-renewable-electricity-standard-legislation>.
12. Dogwood Alliance. 2019. "Destroying Southern Forests for International Export." <https://www.dogwoodalliance.org/wp-content/uploads/2017/08/Acres-of-Pellets-Fact-Sheet.pdf>.
13. Della Rose, "Northampton County impact through pellets: Governor, Enviva CEO celebrate Garysburg plant's ribbon cutting, contribution," *The Daily Herald (Roanoke Rapids)*, May 21, 2013, http://www.rrdailyherald.com/news/northampton-county-impact-through-pellets/article_ed925a72-c22a-11e2-adbf-001a4bcf887a.html.
14. Bruce Siceloff, "NC tax breaks support wood pellets in Sampson, Richmond counties," *News & Observer*, September 9, 2014, <https://www.newsobserver.com/news/politics-government/state-politics/article10055087.html>.
15. Dogwood Alliance, "Destroying Southern Forests for International Exports," <https://www.dogwoodalliance.org/wp-content/uploads/2017/08/Acres-of-Pellets-Fact-Sheet.pdf>.
16. Umair Irfan, "Americans are worried about climate change- but don't want to pay much to fix it," *Vox*, January 28, 2019, <https://www.vox.com/2019/1/28/18197262/climate-change-poll-public-opinion-carbon-tax>.

17. Market Watch, "Wood Pellet Market Will Grow U.S. \$20 Billion by 2023," May 22, 2018, <https://www.marketwatch.com/press-release/wood-pellets-market-will-grow-us-20-billion-by-2023-2018-05-22>.
18. Mary Perez, "One of the world's largest pellet plants planned in Lucedale. Residents, environmental activists at odds," *Sun Herald*, May 16, 2019, <https://www.sunherald.com/news/local/counties/george-county/article230375599.html>.
19. Mary Perez, "One of the world's largest pellet plants planned in Lucedale. Residents, environmental activists at odds," *Sun Herald*, May 16, 2019, <https://www.sunherald.com/news/local/counties/george-county/article230375599.html>.
20. Steve Wilson, "How much do incentives cost per job?" *Mississippi Center for Public Policy*, February 25, 2019, <https://www.msppolicy.org/how-much-do-incentives-cost-per-job/>.
21. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
22. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
23. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
24. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
25. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
26. Mark Lisher, "City of Austin one of many sucked into biomass money pit," *The Texas Monitor*, May 7, 2018, <https://texasmonitor.org/city-of-austin-one-of-many-sucked-into-biomass-plant-money-pit/>.
27. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
28. John Lipman, "Even after victory in Statehouse biomass battle, Springfield, N.H., power plant goes idle," *Valley News*, May 11, 2019, <https://www.vnews.com/Impasse-shuts-down-Springfield-NH-biomass-plant-25412164>.
29. Mary S. Booth and Brett Leuenberg, "The Bioenergy Boom from the Federal Stimulus: Outcomes and Lessons," *Partnership for Policy Integrity*, October 24, 2018, <http://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bio-energy-and-the-Stimulus-Oct-24.pdf>.
30. Mary S. Booth, "Maine Bioenergy at the Crossroads: Costs of a Failing Industry," *Partnership for Policy Integrity*, April 18, 2017, <http://www.pfpi.net/wp-content/uploads/2017/04/PFPI-Maine-Biomass-Report-4-18-17.pdf>.
31. Darren Fishell, "Biomass power plants backed by tax money haven't run for months," *Bangor Daily News*, August 7, 2018, <https://bangor-dailynews.com/2018/08/07/mainefocus/biomass-power-plants-backed-by-tax-money-havent-run-in-four-months/>.
32. Darren Fishell, "Biomass power plants backed by tax money haven't run for months," *Bangor Daily News*, August 7, 2018, <https://bangor-dailynews.com/2018/08/07/mainefocus/biomass-power-plants-backed-by-tax-money-havent-run-in-four-months/>.

33. Darren Fishell, "Biomass power plants backed by tax money haven't run for months," *Bangor Daily News*, August 7, 2018, <https://bangor-dailynews.com/2018/08/07/mainefocus/biomass-power-plants-backed-by-tax-money-havent-run-in-four-months/>.
34. Steve Mistler, "Maine lawmakers say biomass generator shouldn't have qualified for tax payer subsidy," *Bangor Daily News*, March 1, 2018, <https://bangordailynews.com/2018/03/01/politics/maine-lawmakers-say-biomass-generator-shouldnt-have-qualified-for-taxpayer-subsidy/>.
35. Steve Mistler, "Maine lawmakers say biomass generator shouldn't have qualified for tax payer subsidy," *Bangor Daily News*, March 1, 2018, <https://bangordailynews.com/2018/03/01/politics/maine-lawmakers-say-biomass-generator-shouldnt-have-qualified-for-taxpayer-subsidy/>.
36. BBC News, "Wind Power: £100m fund aims to boost UK companies," June 24, 2019, <https://www.bbc.com/news/business-48740215>
37. BBC News, "Wind Power: £100m fund aims to boost UK companies," June 24, 2019, <https://www.bbc.com/news/business-48740215>
38. Robert Ireland, "International Trade in Wood Pellets: Current Trends and Future Prospects," *U.S. International Trade Commission*, September 2018, https://www.usitc.gov/publications/332/executive_briefings/wood_pellets_ebot_final.pdf.
39. Robert Ireland, "International Trade in Wood Pellets: Current Trends and Future Prospects," *U.S. International Trade Commission*, September 2018, https://www.usitc.gov/publications/332/executive_briefings/wood_pellets_ebot_final.pdf.
40. Robert Ireland, "International Trade in Wood Pellets: Current Trends and Future Prospects," *U.S. International Trade Commission*, September 2018, https://www.usitc.gov/publications/332/executive_briefings/wood_pellets_ebot_final.pdf.
41. N/, A. "Strong Communities." Enviva, 30 July 2019, www.envivabiomass.com/sustainability/strong-communities/.
42. Berendt, Chris. "Wooten Urgesunity in Search for 'Golden Egg'." *Sampson Independent*, 7 Feb. 2019, www.clintonnc.com/news/37079/wooten-urgesunity-in-searchfor-golden-egg.
43. Wisner, Alexandra, et al. *Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice*. Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Pg 21.
44. Bryant, Cal. "Local Timber Helps Meet World's Needs - The Roanoke-Chowan News." *Herald*, 6 May 2013, www.roanoke-chowannews-herald.com/2013/05/06/local-timber-helps-meet-worlds-needs/.
45. Wisner, Alexandra, et al. *Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice*. Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Pg 21.
46. Jacobs, Chick. "Work Begins on Wood Pellet Plant in Sampson County." *The Fayetteville Observer*, *The Fayetteville Observer*, 23 Feb. 2015, www.fayobserver.com/0114d6a2-0746-55e4-b800-1c024fd5ec8f.html.
47. Bureau of Labor Statistics. 2019. "Usual Weekly Earnings of Wage and Salary Workers Third Quarter 2019" <https://www.bls.gov/news.release/pdf/wkyeng.pdf>.
48. Wisner, Alexandra, et al. *Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice*. Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Exec Summary.
49. Enviva. "Enviva - Careers." Enviva - Careers, 25 July 2019, https://rew31.ultipro.com/ENV1001/JobBoard/JobDetails.aspx?ID=*F5BEDD731D7D62B7
50. Dart, Tom, and Oliver Milman. "The Dirty Little Secret behind 'Clean Energy' Wood Pellets." *The Guardian*, *Guardian News and Media*, 30 June 2018, www.theguardian.com/environment/2018/jun/30/wood-pellets-biomass-environmental-impact.

51. Nadeau, Carey Anne, and Dr. Amy K. Glasmeier. "Bare Facts About the Living Wage in America 2017-2018." Living Wage Calculator, Living Wage Calculator, 30 Aug. 2018, livingwage.mit.edu/articles/31-bare-facts-about-the-living-wage-in-america-2017-2018.
52. David Roberts, "Sucking carbon out of the air won't solve climate change," *Vox*, July 16, 2018, <https://www.vox.com/energy-and-environment/2018/6/14/17445622/direct-air-capture-air-to-fuels-carbon-dioxide-engineering>.
53. David Roberts, "Sucking carbon out of the air won't solve climate change," *Vox*, July 16, 2018, <https://www.vox.com/energy-and-environment/2018/6/14/17445622/direct-air-capture-air-to-fuels-carbon-dioxide-engineering>.
54. David Roberts, "Sucking carbon out of the air won't solve climate change," *Vox*, July 16, 2018, <https://www.vox.com/energy-and-environment/2018/6/14/17445622/direct-air-capture-air-to-fuels-carbon-dioxide-engineering>.
55. John Larsen, Whitney Herndon, Mikhail Grant, and Peter Marsters, "Capturing Leadership: Policies for the U.S. to Advance Direct Air Capture Technology," *Rhodium Group*, May 9, 2019, <https://rhg.com/research/capturing-leadership-policies-for-the-us-to-advance-direct-air-capture-technology/>.
56. David Roberts, "Sucking carbon out of the air won't solve climate change," *Vox*, July 16, 2018, <https://www.vox.com/energy-and-environment/2018/6/14/17445622/direct-air-capture-air-to-fuels-carbon-dioxide-engineering>.
57. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
58. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
59. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
60. John Talberth, "OSU Research Confirms that Big Timber is Oregon's Leading Source of GHG Emissions," *Center for Sustainable Economy*, April 30, 2018, <https://sustainable-economy.org/osu-research-confirms-big-timber-leading-source-greenhouse-gas-emissions-oregon/>.
61. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
62. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
63. Paul Koberstein and Jessica Applegate, "Tall and old or dense and young: Which kind of forest is better for the climate?" *Mongabay*, May 23, 2019, <https://news.mongabay.com/2019/05/tall-and-old-or-dense-and-young-which-kind-of-forest-is-better-for-the-climate/>.
64. Sam L. Davis, "Treasures of The South: The True Value of Wetland Forests", Dogwood Alliance, accessed July 15, 2018, <https://www.dogwoodalliance.org/wp-content/uploads/2018/01/Treasures-of-the-South-Web-Report.pdf>.

65. North Carolina: Assessing the Costs of Climate Change," National Conference of State Legislatures, 2008, <http://www.ncsl.org/print/environ/ClimateChangeNC.pdf>.
66. North Carolina: Assessing the Costs of Climate Change," National Conference of State Legislatures, 2008, <http://www.ncsl.org/print/environ/ClimateChangeNC.pdf>.
67. North Carolina: Assessing the Costs of Climate Change," National Conference of State Legislatures, 2008, <http://www.ncsl.org/print/environ/ClimateChangeNC.pdf>.
68. Ernst, Caryn. "Protecting the Source." Edited by Kim Hopper and David Summers, The Trust for Public Land, The Trust for Public Land and American Water Works Association, 2004, www.tpl.org/sites/default/files/cloud.tpl.org/pubs/water-protecting_the_source_final.pdf.
69. Warziniack, Travis, et al. "Effect of Forest Cover on Drinking Water Treatment Costs." Ww.fs.fed.us, American Water Works Association and U.S. Endowment for Forestry and Communities, 2016, www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_warziniack_t001.pdf.
70. Warziniack, Travis, et al. "Effect of Forest Cover on Drinking Water Treatment Costs." Ww.fs.fed.us, American Water Works Association and U.S. Endowment for Forestry and Communities, 2016, www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_warziniack_t001.pdf.
71. Ernst, Caryn. "Protecting the Source." Edited by Kim Hopper and David Summers, The Trust for Public Land, The Trust for Public Land and American Water Works Association, 2004, www.tpl.org/sites/default/files/cloud.tpl.org/pubs/water-protecting_the_source_final.pdf.
72. Freeman, J., Madsen, R., and K. Hart. 2008. Statistical Analysis of Drinking Water Treatment Plant Costs, Source Water Quality, and Land Cover Characteristics. Trust for Public Land white paper. <https://www.sciencebase.gov/catalog/item/52fe6b7fe4b0354fef6de496>
73. LeRoy, Sverre, and Richard Wiles. "High Tide Tax." climatecosts2040.Org, The Center for Climate Integrity Resilient Analytics, June 2019, www.climatecosts2040.org/files/ClimateCosts2040_Report-v5.pdf.
74. LeRoy, Sverre, and Richard Wiles. "High Tide Tax." climatecosts2040.Org, The Center for Climate Integrity Resilient Analytics, June 2019, www.climatecosts2040.org/files/ClimateCosts2040_Report-v5.pdf.
75. LeRoy, Sverre, and Richard Wiles. "High Tide Tax." climatecosts2040.Org, The Center for Climate Integrity Resilient Analytics, June 2019, www.climatecosts2040.org/files/ClimateCosts2040_Report-v5.pdf.
76. LeRoy, Sverre, and Richard Wiles. "High Tide Tax." climatecosts2040.Org, The Center for Climate Integrity Resilient Analytics, June 2019, www.climatecosts2040.org/files/ClimateCosts2040_Report-v5.pdf.
77. Union of , Concerned Scientists. "Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate." Ucsusa.org, June 2018, www.ucsus.org/sites/default/files/attach/2018/06/underwater-analysis-full-report.pdf.
78. Wisner, Alexandra, et al. "Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice." Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Pg 21
79. Jess Bidgood, "North Carolina, Still Reeling From Hurricane Matthew, Stares at Irma", The New York Times, September 8, 2017, <https://www.nytimes.com/2017/09/08/us/north-carolina-hurricanerebuild.html>.
80. Wisner, Alexandra, et al. "Clear Cut: Wood Pellet Production, the Destruction of Forests, and the Case for Environmental Justice." Rachel Carson Council, Rachel Carson Council, 7 Jan. 2019, rachelcarsoncouncil.org/publications/. Pg 21
81. Stradling, Richard, and Abbie Bennett. "'Historic' Hurricane Florence Caused More Damage than Matthew and Floyd Combined, Governor Says." Newsobserver, Raleigh News & Observer, 1 Nov. 2018, www.newsobserver.com/news/local/article220890905.html.

82. Chappell, Carmin. "Natural Disasters Cost \$91 Billion in 2018, According to Federal Report." CNBC, CNBC, 6 Feb. 2019, www.cnbc.com/2019/02/06/natural-disasters-cost-91-billion-in-2018-federal-report.html.
83. Independent economic, policy, and global trends research provider. <https://rhg.com/>.
84. Dennis, Brady, and Chris Mooney. "Wildfires, Hurricanes and Other Extreme Weather Cost the Nation 247 Lives, Nearly \$100 Billion in Damage during 2018." The Washington Post, WP Company, 6 Feb. 2019, www.washingtonpost.com/climate-environment/2019/02/06/wildfires-hurricanes-other-extreme-weather-cost-nation-lives-nearly-billion-damage-during/?utm_term=.75dd9fe579f8.
85. Migration, and Climate Change. "Migration and Climate Change." International Organization for Migration, Department of Migration Management, 3 Dec. 2015, www.iom.int/migration-and-climate-change-0.
86. Frohlich, Thomas C, and Michael B. Sauter. "30 U.S. Cities That Could Be Underwater by 2060." Business Insider, Business Insider, 3 Oct. 2018, www.businessinsider.com/30-us-cities-that-could-be-underwater-soon-2018-10#1-miami-beach-florida-30.
87. Varney, James. "Residents of Disappearing Louisiana Isle Refuse \$50 Million Relocation Plan: 'This Is My Paradise.'" The Washington Times, The Washington Times, 16 Apr. 2019, www.washingtontimes.com/news/2019/apr/16/isle-de-jean-charles-louisiana-families-refuse-rel/.
88. Milman, Oliver. "'We're Moving to Higher Ground': America's Era of Climate Mass Migration Is Here." The Guardian, Guardian News and Media, 24 Sept. 2018, www.theguardian.com/environment/2018/sep/24/americas-era-of-climate-mass-migration-is-here.
89. Ambrogi, Stefano. "42% Of Global Coal Power Plants Run at a Loss, Finds World-First Study." Carbon Tracker Initiative, 30 Nov. 2018, www.carbontracker.org/42-of-global-coal-power-plants-run-at-a-loss-finds-world-first-study/.
90. Mahajan, Megan. "Plunging Prices Mean Building New Renewable Energy Is Cheaper Than Running Existing Coal." Forbes, Forbes Magazine, 3 Dec. 2018, www.forbes.com/sites/energyinnovation/2018/12/03/plunging-prices-mean-building-new-renewable-energy-is-cheaper-than-running-existing-coal/#580b388231f3.
91. Chandler, David L. "Explaining the Plummeting Cost of Solar Power." MIT News, 20 Nov. 2018, <http://news.mit.edu/2018/explaining-dropping-solar-cost-1120>.
92. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.
93. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.
94. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.
95. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.
96. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.
97. Dart, Tom, and Oliver Milman. "The Dirty Little Secret behind 'Clean Energy' Wood Pellets." The Guardian, Guardian News and Media, 30 June 2018, www.theguardian.com/environment/2018/jun/30/wood-pellets-biomass-environmental-impact.
98. Office of, Energy and Efficiency. "Advantages and Challenges of Wind Energy." Energy.gov, U.S. Department of Energy, OAD, www.energy.gov/eere/wind/advantages-and-challenges-wind-energy.

- energy.gov/eere/wind/advantages-and-challenges-wind-energy.
99. Vaughan, Adam. "Subsidy-Free Renewable Energy Projects Set to Soar in UK, Analysts Say." *The Guardian*, Guardian News and Media, 20 Mar. 2018, www.theguardian.com/business/2018/mar/20/uk-subsidy-free-renewable-energy-projects-set-soar-aurora-energy-research-analysts.
 100. Quaranda, Scott. "Victory for Forests in the Southern U.S. & Climate in Ireland." Dogwood Alliance, 24 July 2019, www.dogwoodalliance.org/2019/07/statement-victory-for-forests-in-the-southern-u-s-climate-in-ireland/.
 101. DeWitt, Ethan. "Capital Beat: After Regulatory Challenge, Senators Try Again on Biomass Subsidies." *Concord Monitor*, Concord Monitor, 11 May 2019, www.concordmonitor.com/After-regulatory-challenge-New-Hampshire-senators-try-again-on-biomass-subsidies-25387217.
 102. DeWitt, Ethan. "Capital Beat: After Regulatory Challenge, Senators Try Again on Biomass Subsidies." *Concord Monitor*, Concord Monitor, 11 May 2019, www.concordmonitor.com/After-regulatory-challenge-New-Hampshire-senators-try-again-on-biomass-subsidies-25387217.
 103. DeWitt, Ethan. "Capital Beat: After Regulatory Challenge, Senators Try Again on Biomass Subsidies." *Concord Monitor*, Concord Monitor, 11 May 2019, www.concordmonitor.com/After-regulatory-challenge-New-Hampshire-senators-try-again-on-biomass-subsidies-25387217.
 104. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 105. Niemi, Ernie. 3 November 2019. "Climate Costs and Risks of Logging on State Lands." *Natural Resource Economics*. <https://forestcarboncoalition.org/wp-content/uploads/2019/11/BoF-L-2019-1104.pdf>
 106. Fritz, Anita. 23 April 2019. "Bill Aims to Fight Climate Change, Save Forests." *Greenfield Recorder*. <https://www.recorder.com/Climate-change-bills-25053078>
 107. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 108. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 109. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 110. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 111. The National Agricultural Law Center. 2019. *University of Arkansas System: Division of Agriculture*. <https://nationalaglawcenter.org/research-by-topic/corporate-farming-laws/>
 112. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 113. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 114. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
 115. Wetlands International. "Deconstructing LULUCF and its Perversities." <https://www.wetlands.org/>

- wetlands.org/publications/de-constructing-lulucf-and-its-perversities/.
116. Harris, N.L., S.C. Hagen, S.S. Saatchi, et.al. 2016. *Carbon Balance and Management*. "Attribution of net carbon change by disturbance type across forest lands of the conterminous United States." <https://cbmjournal.biomedcentral.com/articles/10.1186/s13021-016-0066-5>.
 117. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 118. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 119. Talberth, John, PhD. 16 February 2017. *Center for Sustainable Economy*. "Forest Carbon Tax and Reward: Creating More Jobs and Carbon in the Woods." <https://sustainable-economy.org/forest-carbon-tax-reward-creating-jobs-carbon-woods/>.
 120. Talberth, John, PhD. 2019. *Forest Carbon Coalition*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 121. Talberth, John, PhD and Heller, Greg. 2017. *Center for Sustainable Economy & Pacific Rivers*. "Modernizing Oregon's Forest Practices Act." <https://sustainable-economy.org/wp-content/uploads/2018/07/OFPA-Detail-Flyer.pdf>.
 122. Wisner, Alexandra and Laura Haight. 2019. *The Rachel Carson Council & PFPI*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 123. Booth, Mary. 21 February 2018. *Environmental Research Letters*. "Not Carbon Neutral: Assessing the net emissions impact of residues burned for bioenergy." <https://iopscience.iop.org/article/10.1088/1748-9326/aaac88>.
 124. Yassa, Sami. 4 November 2019. *NRDC*. "Joint Letter Opposing Forest Biomass Carbon Rider." <https://www.nrdc.org/resources/joint-letter-opposing-forest-biomass-carbon-rider>.
 125. Ter-Mikaelian, Michael T., Colombo, Stephen J., and Chen, Jiaxin. Jan 2015. *Journal of Forestry*. "The Burning Question: Does forest bioenergy reduce carbon emissions? A review of common misconceptions about forest carbon accounting." PP 57-68. <https://academic.oup.com/jof/article/113/1/57/4599732>.
 126. Wisner, Alexandra and Laura Haight. 2019. *The Rachel Carson Council & PFPI*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 127. Booth, Mary and Leuenberger, Brett. Oct 2018. *PFPI*. "The bioenergy boom from the Federal stimulus: Outcomes & Lessons." <https://www.pfpi.net/wp-content/uploads/2018/10/PFPI-Bioenergy-and-the-Stimulus-Oct-24.pdf>.
 128. MA Department of Energy Resources. 2017. "Renewable Energy Portfolio Standard-Class 1." <https://www.mass.gov/files/documents/2017/10/02/225cmr14.pdf>.
 129. The District of Columbia. 2019. "Chapter 14A. Renewable Energy Portfolio Standards." <https://code.dccouncil.us/dc/council/code/titles/34/chapters/14A/>.
 130. Wisner, Alexandra and Laura Haight. 2019. *The Rachel Carson Council & PFPI*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committe-on-the-Climate-Crisis-Comments.pdf>.
 131. Searchinger, Timothy, et.al. 23 Oct 2009. *Science*. "Fixing a Critical Climate Accounting Error." <https://science.sciencemag.org/content/326/5952/527>.
 132. "EU Biomass Legal Case: Save Forests, Save the Climate." 2019. <http://eubiomasscase.org/>.
 133. Wisner, Alexandra, et.al. 2019. *The Rachel Carson Council*. "Clear Cut." <https://rachelcarsoncouncil.org/wp-content/uploads/2019/01/Clear-Cut-web.pdf>.

134. Wisner, Alexandra and Laura Haight. 2019. *The Rachel Carson Council & PFPI*. <https://rachelcarsoncouncil.org/wp-content/uploads/2019/11/House-Select-Committee-on-the-Climate-Crisis-Comments.pdf>.
135. Moomaw, William R, et.al. 11 June 2019. *Frontiers in Forests and Global Change*. "Intact forests in the US: Proforestation mitigates climate change and serves the greatest good." <https://www.frontiersin.org/articles/10.3389/ffgc.2019.00027/full>.
136. Afforestation is the act of replanting forests on barren land.
137. Bastin, Jean-Francois, et.al. 05 Jul 2019. *Science*. "The global tree restoration potential." <https://science.sciencemag.org/content/365/6448/76?hwshib2=authn%3A1562396078%3A20190704%253Ac3ad5971-c185-4942-9acd-92aa24c51c06%3A0%3A0%3A0%3AS1lvoYPtq07c7tMzRommqA%3D%3D>.
138. Booth, Mary. 14 Oct 2019. *NYR Daily*. "The Great Biomass Boondoggle." <https://www.nybooks.com/daily/2019/10/14/the-great-biomass-boondoggle/>.
139. IPCC. "Special Report: Global Warming of 1.5 C." <https://www.ipcc.ch/sr15/chapter/spm/>.
140. OECD. 2017. *OECD*. "Taking action on climate change will boost economic growth." <https://www.oecd.org/environment/taking-action-on-climate-change-will-boost-economic-growth.htm>.
141. Just Transition Alliance. "What do we mean by a just transition?" <https://climatejusticealliance.org/just-transition/>.
142. Energy.Gov. "Advantages and challenges of wind energy." *Wind Energy Technologies Office*. <https://www.energy.gov/eere/wind/advantages-and-challenges-wind-energy>.
143. Energy.Gov. "Advantages and challenges of wind energy." *Wind Energy Technologies Office*. <https://www.energy.gov/eere/wind/advantages-and-challenges-wind-energy>.
144. McCarthy, Niall. 25 Jan 2017. *Forbes*. "Solar Employs More People in U.S. Electricity Generation than Oil, Coal, and Gas Combined." <https://www.forbes.com/sites/niallmccarthy/2017/01/25/u-s-solar-energy-employs-more-people-than-oil-coal-and-gas-combined-infographic/#60a6ed952800>.
145. Ellsmoor, James. 24 Feb 2019. *Forbes*. "Under Trump's Tariffs, the U.S. Lost 20,000 Solar Energy Jobs." <https://www.forbes.com/sites/jamesellsmoor/2019/02/24/under-trumps-tariffs-the-us-lost-20000-solar-energy-jobs/#58dfdf2e76ba>.
146. D'Angelo, Chris. 11 Feb 2019. *HuffPost*. "Success on a Green New Deal Runs Through Public Lands." https://www.huffpost.com/entry/green-new-deal-public-lands-ocasio-cortez_n_5c61de18e4b028d54316c422.
147. McKinsey & Company. 16 April 2019. *McKinsey: Electric Power & Natural Gas*. "How residential energy storage can support the grid." <https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-power-and-gas-blog/how-residential-energy-storage-can-support-the-grid>.

The Rachel Carson Council is the national environmental organization envisioned by Rachel Carson and founded in 1965 to carry on her work after her death. We promote Carson's ecological ethic that combines scientific concern for the environment and human health with a sense of wonder and reverence for all forms of life in order to build a sustainable, just, and peaceful future.

The Rachel Carson Campus Network (RCCN) links students, faculty, staff, and administrators at campuses nationwide to the Rachel Carson Council to provide and share information and resources, recruit environmental leaders, and work on and off campus to create lasting changes in policy and practice for a sustainable future.



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