Global Development And Environment Institute
Tufts University

A Critical Look at Forest Bioenergy:

Exposing a high carbon "climate solution"

Jamie Fanous and William R. Moomaw*

Nations have launched into action to fight climate change after ratifying the 2015 Paris Agreement to limit temperature rise to no more than 2°C above pre-industrial levels. To reach strict climate goals, many countries have turned to burning wood (forest biomass) as a form of renewable energy.

The Argument for Forest Bioenergy

Supporters point to the renewable nature of wood, arguing that biomass is carbon neutral because plants and trees absorb carbon as they grow, and when they die, they release carbon. Thus, when they are used as a fuel, the carbon released during combustion is reabsorbed when new trees grow to replace them.[1] Additionally, the Forest Solutions Group has argued that since global net forest growth exceeds emissions from biomass burning, bioenergy is carbon neutral.[2] These arguments are faulty and omit major components of the bioenergy life cycle.

The biomass industry also argues that wood pellet manufacturers are not using whole trees and only using wood waste products including sawdust, wood thinning, and residues.[3] This argument has been debunked by local environmental organizations, such as the Dogwood Alliance, which has documented companies harvesting whole hardwood trees.[4]

The Science Against Forest Bioenergy

These nations fail to recognize the intensity of CO_2 emissions linked to the burning of biomass. The chemical energy stored in wood is converted into heat or electricity by way of combustion and is sometimes used for combined heat and power cogeneration.

** Jamie Fanous is a M.S./M.A candidate in the Agriculture, Food, and the Environment and Urban and Environmental Policy & Planning programs at Tufts University. Dr. William Moomaw is the co-director of GDAE and lead author or coordinating lead author of multiple IPCC reports. Your comments may be sent to gdae@tufts.edu.*

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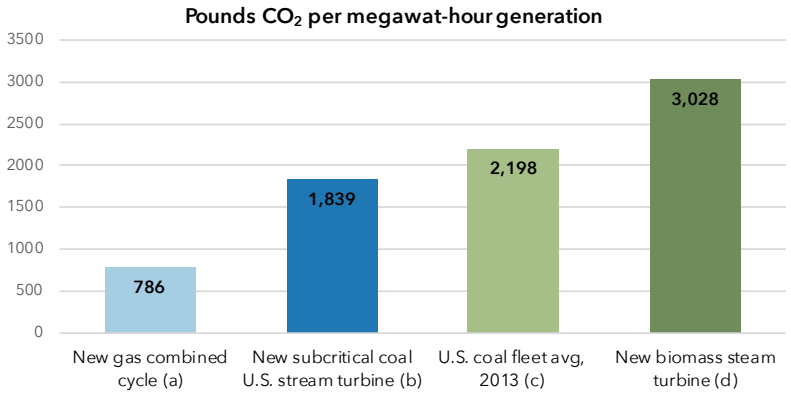
Figure 1: Comparison of power plant emissions



See *Appendix A* for sources

At the point of combustion, biomass emits more carbon per unit of heat than most fossil fuels. Due to the inefficiencies of biomass energy, bioenergy power plants emit approximately 65 percent more CO_2, per MWH than modern coal plants, and approximately 285 percent more than natural gas combined cycle plants.[5] Furthermore, the Intergovernmental Panel on Climate Change (IPCC) states that combustion of biomass generates gross greenhouse gas (GHG) emissions roughly equivalent to the combustion of fossil fuels. In the case of forest timber turned into wood pellets for bioenergy use, the IPCC further indicates that the process produces higher CO_2 emissions than fossil fuels for decades to centuries.[6] The U.S. Environmental Protection Agency states that biomass energy cannot be assumed to be carbon neutral *a priori* because of the heterogeneity in feedstock types, sources, and production methods.[7]

The scientific community along with many international environmental organizations are working to illustrate the environmental damage tied to bioenergy. They are primarily studying the timescale and geographic scale of bioenergy.[8] The burning of wood pellets emits much higher levels of carbon than if the wood was left to decay in the forest because the harvesting, transport, processing, and burning of wood all emit carbon dioxide.

Deforestation and Land Use Change

Although the global rates of deforestation have slowed in the past two decades, between 2005 and 2014 global deforestation accounts for approximately 31 percent of carbon emissions, while reforestation helped sequester approximately 20 percent of emissions.[9]

The rapidly growing demand for bioenergy puts additional pressure on land use. It is estimated that over 500 million hectares, or 1.3 times the current amount of agricultural land area in the U.S., would be needed to produce nearly the total annual U.S. energy consumption or approximately100 EJ[10] of bioenergy. [11] [12]

In 2015, North American wood pellet exports reached a record high of 6.1 million tons, equivalent to removing all the trees on approximately 60,000 hectares of forested land, representing a 2 percent increase from 2014, and 4-times the 2010 amount. This has had severe impacts on U.S. forests, with the greatest impact in the Southeast-

ern region of the U.S. Bioenergy companies such as Enviva have clear-cut thousands of acres of forestland to produce bioenergy, while insisting that their forestry management is sustainable.[13]

Additionally, there is no assurance that a forest can regrow on the harvested land. It takes decades to centuries for a mature forest to return to its prior carbon stock. Globally, most hardwood forests do not fully grow back after a clear-cut. For example, between 2000 and 2013 the Oregon forest aggregate rate of loss reached 45 percent, meaning the forest loss due to clear-cutting (which requires replanting) exceeded regrowth by nearly half.[14]

Expansion of Biofuel Use

The rapid adoption of such a dubious *renewable* energy source raises concerns – primarily that governments and organizations assume bioenergy is sustainable and a carbon neutral form of energy. The term *renewable* encourages governing bodies such as the European Union (EU) to promote the use of wood burning for electricity and heat. Nearly two-thirds of the EU's rapidly growing renewable energy sector consists of bioenergy, which they consider as zero carbon emissions.[15]

Of the many global climate leaders, the UK has been the most aggressive adopter of modern bioenergy. This pressure is in response to the country's climate goals to derive 20 percent of all energy from renewable sources. The government has awarded generous subsidies, converted several coal power plants to burn wooden pellets, and imported millions of tons of wooden pellets annually. Currently, *Drax* (a major UK power plant) produces 70 percent of its electricity from biomass which is enough to power four major cities in the UK (Leeds, Manchester, Sheffield, and Liverpool). This amount of electricity requires over 18 million tons of wooden pellets annually, equivalent to approximately 174,824 hectares of forest land.[16] [17]

Local governments, such as the state of Massachusetts, have proposed subsidizing bioenergy for building heat without accounting for the additional emissions as described in the 2017 Massachusetts Department of Energy Resources.[18] Proposals such as the establishment of The Mohawk Trail Woodlands Partnership is pending legislation, and while it claims to support forest conservation, one of its original goals was to harvest wood from Massachusetts forests for the production of bioenergy.[19]

If modern bioenergy continues to be labeled as carbon neutral, more industrial countries will adopt its use, and sourcing is likely to spread to developing countries. In Europe, biomass is predicted to supply 42 percent of the 2020 energy target, requiring greater imports and pressure on global forest resources.[20] Both the Renewable Energy Policy Network for the 21st Century and the International Energy Agency Bioenergy note that bioenergy production grew over the last decade and that growth is predicted to continue.[21] [22]

Faulty Incentives and Accounting

The persistence of government subsidies for bioenergy and a lack of clear regulations on the wood-pellet industry in terms of land use change, allows for a continuation of clear-cutting forests without any repercussions.[23] International accounting rules require that wood harvested for bioenergy be counted as a land use change, rather than include all the emissions tied to the energy source, which also includes production and burning of wood. Currently the emissions associated with wood harvested in the U.S. for bioenergy is counted under Land Use, Land-Use Change and Forestry (LULUCF), however the combustion of pellets from that same wood is never counted under EU emissions when burned in the UK. Since the wood is harvested in the United States, and burned for energy in Europe, the emissions from burning the pellets are left uncounted by both parties. It is estimated that globally approximately 0.5 GtC per year is emitted annually for electricity production through these bioenergy schemes that fail to account for their emissions, which amounts to 1.5 percent of total annual global emissions.[24]

However, developing countries in tropical and subtropical regions such as Brazil and Indonesia have starkly different accounting rules. The global community created the Forest Carbon Partnership Facility to Reduce Emissions from Deforestation and Forest Degradation (REDD+) for developing nations. This effort works to create regulations to limit deforestation in developing countries. Yet, no such strict accounting rules exist to control the extreme of deforestation rates in the U.S. This stark contrast allows developed countries to continue destroying forests with no consequences while holding developing countries to higher environmental standards.

Opportunities to Correct Policy

Despite efforts by lead scientists and activists to contest decisions made by the EU, biomass is still expanding rapidly. The most recent EU parliamentary agreement encourages the doubling of forest bioenergy use by 2030. This parliamentary support allows forest bioenergy to be eligible for the same energy subsidies as carbon-neutral renewable sources, such as wind and solar. Continuing biomass energy to be unequivocally treated as carbon neutral makes it impossible to achieve emissions targets set by the Paris Agreement.

In response to this latest EU decision, 796 lead scientists from around the world, including two Nobel Laureates, wrote detailed letters to the EU Parliament condemning the recent decision regarding forest biomass.[25] The letters strongly urged the EU parliament to restrict biomass production to only forest residues and forest production. However, it is yet to be determined if the EU will reconsider the January 2018 decision.

Appendix A

References for power plant emissions figure: [26]

CO_2 per MMBtu

a,b,c: from EIA at http://www.eia.gov/environment/emissions/co2_vol_mass.cfm. Value for coal is for "all types." Different types of coal emit slightly more or less.

d: Assumes power plant burning wood with higher heating value of 8,600 MMBtu/lb (bone dry - Biomass Energy Data Book v. 4; Oak Ridge National Laboratory, 2011. http://cta.ornl.gov/bedb.) and that wood is 50% carbon.

Efficiency

a: DOE National Energy Technology Laboratory: Natural Gas Combined Cycle Plant F-Class (http://www.netl.doe.gov/KMD/cds/disk50/NGCC%20Plant%20Case_FClass_051607.pdf)

b: International Energy Agency. Power Generation from Coal: Measuring and Reporting Efficiency Performance and CO2 Emissions. https://www.iea.org/ciab/papers/power_generation_from_coal.pdf

c. EIA data show the averaged efficiency for the U.S. coal fleet in 2013 was 32.6% (http://www.eia.gov/electricity/annual/html/epa_08_01.html)

d: ORNL's Biomass Energy Data Book (http://cta.ornl.gov/bedb; page 83) states that actual efficiencies for biomass steam turbines are "in the low 20's"; PFPI's review of a number of air permits for recently proposed biopower plants reveals a common assumption of 24% efficiency.

Endnotes

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Tufts University's Global Development And Environment Institute (GDAE) offers a series of climate policy briefs covering the Paris agreement, the role of forests and soils, and current policies on biomass and forests.