Biomass Energy in Humboldt County

350 Humboldt

Introduction

350 Humboldt advocates for a transition to 100% clean, renewable electricity in Humboldt County by 2025 in order to cut greenhouse gas (GHG) emissions and curb climate change. Because most electricity in the County is provided by the Redwood Coast Energy Authority's Community Choice Energy (CCE) program, this 100% clean energy goal can be achieved by changing the CCE's grid mix.

The Redwood Coast Energy Authority (RCEA) currently purchases power from two local biomass plants. Whether energy from these plants, as well as biomass energy from other sources, should be considered clean and renewable has been a matter of significant debate in the community as well as within 350 Humboldt. Issues of concern include the effects of biomass energy production on forest health, climate change, and air quality, as well as the potential for the above-market cost of energy from the biomass plants to divert funds away from wind, wave, and solar projects.

This document is intended to address these concerns by providing background information and laying out 350 Humboldt's official position on biomass energy and whether - or under what conditions - it should be considered clean and renewable. In preparing this background document, we researched:

- local grid constraints,
- land use,
- greenhouse gas emissions, and
- positions taken on biomass by other environmental and health groups.

As we conducted our research, we sought out various experts in forestry, life-cycle assessment, and biomass conversion technologies. We also did our best to listen to people who held a broad range of opinions on this issue. We are indebted to Matthew Marshall, Yana Valachovic, Charles Chamberlin, Han-Sup Han, Angie Lottes, Tom Wheeler, Rob DiPerna, Bob Marino, John Anderson, and Kevin Fingerman for generously sharing their time and knowledge. Thanks also to 350 Humboldt members Colin Fiske, Greg Gaiera and especially Katy Gurin for their work on this document.

Background

Local Power

The RCEA currently purchases electricity from Humboldt Redwood Company's biomass plant, which is located in Scotia (this plant is also referred to as "the Scotia plant"), as well as the DG Fairhaven LLC biomass-fueled generator in Samoa. HRC's Scotia plant burns waste from an adjacent sawmill and planer mill, also owned by HRC. The HRC plant is rated at 32.5 MW of electricity, employs approximately 20 people[1] and uses waste from the adjacent mill.[2] In addition to generating power, HRC captures waste heat and uses it to dry lumber.

The DG Fairhaven plant is rated at 17.25 MW and employed 22 people in 2017.[3] DG Fairhaven primarily, but not exclusively, burns mill waste—some years, mill waste comprises 100% of the plant's feedstock.[4] The plant manager, Bob Marino, also procures some whole logs that are "sub-merchantable"; these whole logs are dried and used in the winter to control moisture levels. Waste logs from thinning on public land have been burned at DG Fairhaven in the past. For instance, trees killed by sudden oak death have been incinerated there.

Were all three of Humboldt's biomass plants (HRC, DG Fairhaven, and Blue Lake) to come online at full capacity, Marino predicts that mill waste would become scarce enough to force DG Fairhaven to start using logging harvest residues that would normally be pile-burned or left to decompose in the field.[5] Approximately 400,000 bone dry tons of mill waste are generated every year in Humboldt County; RCEA staff estimates that at least 200,000 tons of mill waste are either burned in biomass plants, recycled, or otherwise disposed of. Processing that quantity of wood waste requires about 25 MW of power plant capacity.[6] Most mill waste produced in the county which is not currently burned for power production is believed to be used for paper products and animal bedding.

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[1] Bulwinkle, Mary. 2015. Scotia Power Plant Coming Back Online. Humboldt Beacon. http://www.humboldtbeacon.com/article/NL/20151104/NEWS/151109999

[2] Humboldt Redwoods Company, 2016. *RCEA 2016 Biomass Request for Offers Questionnaire.* http://www.redwoodenergy.org/images/PDFs/Bid_Documents/HRC_RCEA_2016_Biomass_RFO_Questionnaire.pdf

[3] DG Fairhaven, 2016. RCEA 2016 *Biomass Request for Offers Questionnaire.* http://www.redwoodenergy.org/images/PDFs/Bid_Documents/DGF_RCEA_2016_Biomass_RFO_Questionnaire.pdf

[4] Marino, B. 2017. Personal communication (phone call) on 7/11/2017

[5] Marino, B. 2017. Personal communication (phone call) on 7/11/2017

[6] Dr. Han-Sup Han, quoted by the Redwood Coast Energy Authority. 2017. *June Board Packet.* http://www.redwoodenergy.org/images/PDFs/Board_Meetings/2017/RCEA-3-20-17-Board-Meeting-Packet-FULL-REDACTED.pdf

Power purchased from the HRC and DG Fairhaven plants is substantially more expensive than solar and wind energy from out of the county. An RCEA staff report in the March 2017 RCEA Board Packet[7] estimates that costs above imported solar and wind amount to $3-4 million per year for the HRC purchase alone. From page 71 of the packet: "The cost of power procured through the two PPAs totals approximately $45 million over 5 years. The $83/MWh price results in an above market expenditure of approximately $3-4 million/year during the 51-month PPA term. The market value of energy is likely in the range of $50/MWh, totaling $20-30 million over 5 years, and is a cost that RCEA would incur as the result of procuring power from other sources outside the community, if not procured locally."

In January 2018, the RCEA entered into a one-year contract to purchase energy from the DG Fairhaven biomass plant in Samoa for $65/MWh.[8] Although not as high as the rate paid for HRC biomass energy, the rate specified in this contract is also above-market and adds to the yearly above-market expenditures of the CCE for biomass energy.

To put the cost of above-market biomass energy in perspective, the RCEA hopes to build a CCE rate stabilization/reserve/contingency fund of $10-35 million after five years, with one million per year spent on all community programs, including solar and energy storage technical assistance, electric vehicle charging infrastructure, energy efficiency and conservation, and matching for state, federal, and foundation grants.[9] That means that the annual, above-market spending on just the biomass contract with HRC is 3-4 times what the CCE allocates community programs. (RCEA spends approximately an additional $1.9 million per year on community programs from funds generated outside the CCE, such as government grants.[10])

Locally generated power has an important role to play in the CCE's energy mix. This is because the CCE expects a peak load of 140 MW in 2017,[11] while the transmission system to the county can only handle about 70 MW.[12] That leaves about half of peak (70 MW) that must be generated locally in order to manage the grid.

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[7]Redwood Coast Energy Authority. 2017. *March Board Packet.*
http://www.redwoodenergy.org/images/PDFs/Board_Meetings/2017/RCEA-3-20-17-Board-Meeting-Packet-FULL-REDACTED.pdf

[8] Redwood Coast Energy Authority. 2018. *February Board Packet.*
https://redwoodenergy.org/wp-content/uploads/2018/02/February-26-2018-Board-Agenda-Packet-Audit-Rpt.pdf.

[9] RCEA, 2016. Guidelines for the Redwood Coast Energy Authority Community Energy Program Launch Period Strategy and Targets.
http://www.redwoodenergy.org/images/PDFs/CCA/RCEA-Community_Energy_Program_Guidelines.pdf

[10] Redwood Coast Energy Authority. 2017. *June Board Packet.*
https://redwoodenergy.org/wp-content/uploads/2017/08/RCEA-June-19-2017-Board-Packet.pdf

[11] Matthew Marshall, June 7, 2017 personal communication (email)

[12] RePower Humboldt, 2013. *Repower Humboldt Strategic Plan.*
http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf

The RCEA can and does purchase over 50% of the CCE's grid mix from electricity generators located outside the county; this is because the system that accounts for purchasing of electricity is different from the system that accounts for how the grid is managed. At this point, the two major local sources of electricity are 1) biomass, including DG Fairhaven and Scotia, and 2) the Humboldt Bay Generating Station (HBGS), which is fueled by natural gas. If the RCEA were to purchase 100% of the CCE's electricity from elsewhere, the HBGS or a biomass plant would still need to be dispatched in order to balance the grid. As the RCEA's executive director, Matthew Marshall, put it: "We happen to be able to directly influence to some extent a fossil fuel generation source outside of our operational control by virtue of the fact we can displace the extent it is dispatched through CAISO [the California Independent System Operator, which manages the grid] for the purpose of overall grid reliability by increasing local renewable generation.[13]"

The RePower Humboldt Study was developed by the Schatz Energy Research Center (SERC) for the RCEA in 2013.[14] RePower is a plan to develop local energy resources, and it included an expansion of existing biomass electricity generation to as much as 160 MW.[15] Biomass was considered to be an important resource because of its abundance and that fact that, unlike solar or wind, electricity from biomass can be generated on demand.

Since the publication of the RePower Study, energy technologies and markets have shifted and developed. For instance, the price of solar has dropped considerably,[16] and large battery banks have become more common, allowing for some degree of reliability even with intermittent energy sources like wind and solar power. Battery storage facilities are being built in Southern California with up to 30 MW/120MWh of capacity.[17]

Another recent development is the maturation of floating wind turbines technology. As of 2018, California's offshore wind resource is for the first time being considered a feasible source of substantial renewable energy, and the North Coast has the best offshore wind resource in the state.[18] As of April 2018, RCEA is negotiating a contract with a consortium of companies to develop wind energy off the Humboldt County coast.[19]

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[13] Matthew Marshall, June 7, 2017. personal communication (email)
[14] SERC. 2013. RePower Humboldt. http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf
[15] SERC. 2013. RePower Humboldt. http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf
[16] Matthew Marshall, 2017. Personal communication.
[17] Daniel Cusick, 2017. *Battery Storage Poised to Expand Rapidly.* E&E News. Republished in Scientific American. https://www.scientificamerican.com/article/battery-storage-poised-to-expand-rapidly/
[18] See for example http://www.energy.ca.gov/renewables/offshore_energy/.
[19] RCEA. 2018. *April Board Packet*. https://redwoodenergy.org/wp-content/uploads/2018/04/April-16-2018-Agenda-and-Packet.pdf.

Land Use

Concerns about forest health impacts from biomass have proven to be well-founded in other areas,[20] and it is a common practice to use BioMAT guidelines (Initial Fuel Attestation form; b. Guidance Docs/3. Fuel Attestation Form/)[21] in power purchase agreements to ensure that forests are not cut unsustainably to make electricity.[22] However, as mentioned previously, all of the material burned in HRC's Scotia mill is mill waste,[23] and much of the material used in the DG Fairhaven Plant is mill or harvest waste.[24] Because DG Fairhaven and Scotia burn waste, it is likely that renewal of biomass contracts will have little effect on harvest rates or other land use practices (unless, of course, local logging companies go out of business as a result of increased waste management costs).[25]

John Anderson, who is the forest policy director for HRC/Mendocino Redwood Company, told 350 Humboldt that no trees were being cut for the purpose of making electricity; furthermore, Anderson said that "no forest management practices changed whatsoever after the purchase of biomass plant" (Scotia)[26] According to Tom Wheeler, the Executive Director of the Environmental Protection Information Center (EPIC), "HRC and Green Diamond are generally limited by their lack of merchantable timber and the general demand to have a sustained rate of timber harvest: they can't increase their rate of harvest because there generally isn't much more that they could cut."[27]

350 Humboldt found little evidence that the presence of the HRC/Scotia and DG Fairhaven plants aids in wildfire prevention efforts, or in restoration thinnings (one notable exception is the incineration of logs killed by sudden oak death at DG Fairhaven mentioned earlier). According to forest advisor Yana Valachovic,[28] the Blue Lake Power plant is the only local plant to utilize

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[20]Manomet, 2010. Biomass Sustainability and Carbon Policy Study. https://www.manomet.org/sites/default/files/publications_and_tools/Manomet_Biomass_Report_Full_June2010.pdf

[21] PG&E, BioMAT. 2015. *Initial Fuel Attestation Form.* https://pgebiomat.accionpower.com/biomat/documents.asp?Col=DateDown&strFolder=b.%20Guidance%20Docs/3.%20Fuel%20Attestation%20Form/&filedown=&HideFiles=

[22] Lottes, Angela. 2017. Personal Communication

[23] Humboldt Redwoods Company, 2016. *RCEA 2016 Biomass Request for Offers Questionnaire.* http://www.redwoodenergy.org/images/PDFs/Bid_Documents/HRC_RCEA_2016_Biomass_RFO_Questionnaire.pdf

[24]DG Fairhaven, 2016. RCEA 2016 *Biomass Request for Offers Questionnaire.* http://www.redwoodenergy.org/images/PDFs/Bid_Documents/DGF_RCEA_2016_Biomass_RFO_Questionnaire.pdf

[25] DiPerna, Rob and Tom Wheeler. June 20, 2017. Personal Communication with EPIC staff re. Biomass via email

[26] John Anderson, phone call on 7/25/2017.

[27] Tom Wheeler. June 20, 2017. Personal Communication with EPIC staff re. Biomass via email

[28] Valachovic, Yana. Personal communication, June 29, 2017

restoration thinnings, and the RCEA is not considering a contract with Blue Lake Power at this time.

Carbon Neutrality

The authors of Repower Humboldt pointed out several key issues that would need to be addressed prior to an expansion of biomass infrastructure. One of these issues was the assumption that biomass is "carbon neutral":

> "In general, biomass has been treated as a carbon neutral resource as long as the harvest rate does not exceed the rate of new growth. However, this premise is currently being scrutinized and regulatory treatment of biomass could change. (...) These emissions can be assessed in a life cycle analysis. This study treated biomass as a carbon neutral resource. It is recommended that this assumption be further evaluated as a topic of future research[29]."

A life cycle assessment (LCA) is an evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. There must be a causal link between the presence of a biomass plant and land management actions that increases carbon sequestration[30] in order to account for carbon sequestration in the life cycle assessment for the plant's GHG emissions. According to biomass researcher Kevin Fingerman, an assumption of carbon neutrality tends to make sense with short lifecycle biofuel feedstocks such as algae and annual grasses. This assumption is not always applicable with forest-derived feedstocks.

In 2014, Angela Lottes performed a life cycle assessment comparing raw biomass incineration at the Fairhaven plant with torrefaction, a process where biomass is heated in a low-oxygen environment. Lottes did not include carbon sequestration in accounting for greenhouse gas emissions, because the biomass feedstock is a waste: "Emissions sequestration and release during the growth and harvest of timber are allocated to timber products, according to market value allocation. There is no economic value of timber harvest waste, in fact there is a disposal cost to the landowner. Timber provides 100% of the economic value of products from the timber harvest process, so 100% of the emissions from timber harvest are allocated to timber and therefore are not considered in the biomass power pathways analysis.[31]"

According to Forest Policy director John Anderson, HRC and Mendocino Redwoods Company increase carbon sequestration on their land by 1) growing more biomass than they harvest, and 2)

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[29] SERC. 2013. RePower Humboldt. http://www.schatzlab.org/docs/RePower_Humboldt_Strategic_Plan.pdf
[30] Fingerman, K. 2017. Personal communication
[31] Lottes, A. 2014. Supply Chain and Process Emissions Impact of Torrefaction to Enable Biomass Use in Large Power Plants Versus Raw Biomass Use in Small Power Plants

restoring land that has become hardwood-dominated back to a conifer-dominated vegetation type.[32] However, as mentioned previously, these land management practices did not change with HRC's purchase of the Eel River Plant in Scotia, and they would likely continue if the Scotia plant was not operating.

Although carbon sequestration is not really relevant to our discussion about wood waste management, the authors found it helpful to consider possible impacts of the timber industry in order to place the debate over biomass in context. To our knowledge, there has not been any investigation into how much carbon could be sequestered by Humboldt County's forests under ideal management conditions. Although this review is not extensive enough to elucidate this matter in full, we did find research suggesting that timber harvest doesn't always increase sequestration. A 2011 study of carbon sequestration patterns on two ownership classes (public and private) in the Pacific Northwest after the implementation of the Northwest Forest Plan (NWFP) found that a decrease in harvest removals on public land significantly impacted the regional carbon balance[33]:

> "In the late 1980s, forestland in both ownership classes was subject to high rates of harvesting, and consequently the land was a carbon source (...). After the policy driven reduction in the harvest level, public forest land became a large carbon sink (...) whereas private forest lands were close to carbon neutral. In the 2003-2007 period, the trend towards carbon accumulation on public lands continued despite a moderate increase in the extent of wildfire. The NWFP was originally implemented in the context of biodiversity conservation, but its consequences in terms of carbon sequestration are also of societal interest."

Hudiberg et al (2009) estimated live and dead biomass stores, net primary productivity (NPP), and mortality in western forests[34], and found that, theoretically, carbon storage in western forests could be increased by 46% if forests were managed for maximum carbon storage. The authors argue that this limit is probably unattainable given disturbance by fire and a timber-based economy in many regions; however, there was "potential to significantly increase the land-based carbon storage by increasing rotation age and reducing harvest rates." According to Hudiberg et al, private lands in the Coast Range, West Cascades, and Klamath Mountains "have, on average, less live biomass per unit area than do public lands because the typical harvest rotation (80 years) is much less than the age at which maximum biomass is reached (300 years)." Although this

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[32] Anderson, John. 2017. Personal communication on 7/25/2017

[33] Turner, D.P. 2011. Decadal Trends in Net Ecosystem and Net Ecosystem Carbon Balance for a Regional Sociological System. Forest Ecology and Management.

[34] Hudiberg, et al. 2009. Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. Ecological Applications. 19(1), 2009, pp. 163–180

analysis took a regional approach, the authors suggest that the Coast Range is an area that is "more likely to reach the theoretical levels" of sequestration than other areas in the west. Indeed, redwood forests create more biomass than any other forest type on earth.[35]

Although Hudiberg et al (2009) did not perform a full lifecycle analysis on wood products from timber harvests, the impact of storage in wood products was discussed:

> "Some carbon can be sequestered in wood products derived from harvesting. However, due to manufacturing losses, only about 60% of the carbon harvested enters the products pool (Harmon et al. 1996) and there are significant emissions from older products decomposing in landfills that tend to offset this carbon sink. Furthermore, with full carbon accounting there is a large carbon cost to the initial conversion of a landscape dominated by old forests to one dominated by young forests (Harmon et al. 1990)[36]."

However, the question of timber harvest impacts on carbon sequestration should have little bearing on wood waste management decisions: even if current land management practices on lumber company land did result in excess carbon sequestration rates equalling or exceeding the emissions from raw biomass incineration, it would still be better from a climate standpoint to keep emissions low. Given that concentrations of atmospheric carbon have exceeded 400 ppm, we should be creating sinks that sequester atmospheric carbon; per AB and SB 32, California is hoping to achieve net sequestration for forests.[37]

Woody Waste Management & Associated Emissions

Given that sequestration and electricity generation from waste are essentially separate issues, one can get a general sense of the greenhouse gas impacts of raw biomass incineration (such as occurs at DG Fairhaven and Scotia plants) by comparing emissions from the biomass plants to emissions from other types of waste disposal. Because the biomass plants currently offset burning of natural gas at the HBGS, emissions from the HBGS should be subtracted from the biomass plant emissions as well. The HRC plant in Scotia also uses captured waste heat in drying kilns which might otherwise be powered by natural gas.

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[35] Van Pelt, et al. 2016. Emergent crowns and light-use complementarity lead to global maximum biomass and leaf area in Sequoia sempervirens forests. Forest Ecology and Management. https://www.savetheredwoods.org/wp-content/uploads/VanPelt-et-al-2016-Maximum-biomass-and-leaf-area-in-Sequoia-sempervirens-forests.pdf

[36] Hudiberg, et al. 2009. Carbon dynamics of Oregon and Northern California forests and potential land-based carbon storage. Ecological Applications. 19(1), 2009, pp. 163–180

[37] California Air Resources Board, 2017. The 2017 Climate Change Scoping Plan Update.

Raw biomass incineration, the process performed at local biomass plants, emits more climate pollution than burning of natural gas does (table 1):

Environmental Impact

Air Emissions	Coal Fueled Boiler (lb/Million Btu)	Biomass Fueled Boiler (lb/Million Btu)	Natural Gas Boiler (lb/Million Btu)
CO	0.02 – 0.67	0.60	0.058
CO_2 fossil	178 - 231	0	117.6
CO_2 non fossil	0	195.0	0
NO_x	0.27 – 1.15	0.22 – 0.49	0.031 – 0.27
SO_x	1.3	0.025	0.0005
VOC	0.002 – 0.048	0.017	0.005
Methane	0.002	0.021	0.002
Particulates	0.37 – 2.4	0.05 – 0.56	0.007

Source: US EPA. AP42, Fifth Edition, Volume 1, Chapter 1

Wood waste will emit greenhouse gases under any management scenario; the question is whether some sequestration of carbon is possible over a significant period of time.

Other types of waste management include:

- landfilling,
- composting,
- gasification,
- biochar production, and
- reuse.

Raw biomass incineration, gasification, and pyrolysis

Wood waste can be burned, pyrolyzed, or gasified to generate electricity. Burning (combustion or incineration) takes place in a high-oxygen environment. Waste from biomass combustion is typically conveyed to a combustion chamber, and heat from combustion is used to create steam; it is this steam that turns turbines and creates electricity. At HRC's biomass plant, steam is also used elsewhere in the mill.

Pyrolysis and gasification are both processes in which biomass is heated in an enclosed, low-oxygen space. During pyrolysis, gases are released and can be collected to be used as fuel. Pyrolysis also results in a char. Biochar can be used as a soil amendment, a carbon sequestration tool, or as input for other products such as activated charcoal. Gasification, which involves higher temperatures, turns char into ash while also releasing gases for use as fuel.

Torrefaction is a type of pyrolysis that can produce a coal substitute for power plants. Torrefied briquettes only reduce GHG emission by 5% vs. non-torrefied briquettes (made from wood waste), though GHG emissions from both torrefied and non-torrefied briquettes are 90% lower than coal.[38] GHG impacts from torrefaction depend a lot on the energy source used for drying/torrefaction; using captured torgas substantially reduces impacts, but diesel is cheaper and easier.

Potential for carbon sequestration with biochar.

Biochar has been recommended for use in forest thinning and harvesting applications, as it can sequester carbon[39] and improve soil.[40] However, the success of large-scale biochar production likely depends on the market for soil amendments and other products as well as the further development and commercialization of related technologies. Furthermore, according to biomass researcher Charles Chamberlin, only about 10-15% of carbon can be sequestered in biochar.[41] Chamberlin also said that biochar production releases considerable amounts of particulates into the air. The feasibility of biochar creation from local mill waste should be further investigated, including relative effectiveness of carbon sequestration and impacts to public health when compared to other disposal pathways.

Disposal of wood waste

According to the director of forest policy at Mendocino Redwood Co/Humboldt Redwood Co, if local biomass plants were unavailable, HRC would sell most waste as a soil amendment, animal bedding, or similar use.[42] He also stated that landfilling was an option that would be considered. However, according to forestry advisor Yana Valachovic,[43] local mill waste volumes are much too high to be taken to a landfill, and mills would have to consider other options. Also, per SB 1383[44] and AB 1826[45] many organic wastes must be diverted from landfills throughout the state. Landfilling has the potential to create more climate pollution than incineration if large amounts of methane are released into the atmosphere (from decomposition in a low-oxygen environment) without being captured.

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[38] Waste to Wisdom. 2017. Webinar: Lifecycle Assessment and Economics of Torrefied Biomass. http://wastetowisdom.com/webinars/lifecycle-assessment-and-economics-of-torrefied-biomass/

[39] Lehmann, Johannes. 2007. Bio-energy in the black. Frontiers in Ecology and the Enironment.

[40] Deborah S. Page-Dumroese et al, 2017. Methods to Reduce Forest Residue Volume After Timber Harvesting and Produce Black Carbon. Scientifica. https://www.hindawi.com/journals/scientifica/2017/2745764/

[41] Chamberlin, Charles. Personal communication, 8-18-2017

[42] Phone call with John Anderson, 7/25/2017.

[43] Valachovic, Yana. Personal communication, June 29, 2017

[44] Senator Lara. *Bill Text, SB 1383.* http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB1383

[45] Cal Recycle, 2017. Mandatory Commercial Organics Recycling. http://www.calrecycle.ca.gov/recycle/commercial/organics/

Composting of wood waste

Research on industrial-scale composting of wood waste from sawmills is limited. We speculate that this may be in part because producing high-quality compost for agricultural applications from carbon-rich mill waste would likely require the input of other nitrogen-rich materials, which may be difficult to accomplish at scale. One study notes that "known beneficial applications for surplus biomass residues, such as composting, are already flooded with material, even with the existing biomass-energy industry in operation."[46] However, Humboldt County produces significant amounts of nitrogen-rich waste in the form of cow manure from dairies as well as treated solids from wastewater treatment, and it may be that these could be combined with some fraction of the county's mill waste as part of a composting operation.

Composting is a process largely designed to sequester carbon in the soil. Much research exists which compares composting favorably to other biomass disposal fates, but incineration for electricity production is generally not included in these analyses.[47] The only study of which we are aware which has compared the impacts of composting biomass to incineration concluded that composting would produce a greater greenhouse gas burden than incineration for electricity production.[48] However, this study did not examine composting in detail and did not provide support for the model inputs which led to its conclusions about GHG production. Notably, the study assumes only 5% long-term carbon storage from composting, while the USEPA's WARM model assumes approximately 20%.[49]

Reuse.

When the Scotia plant wasn't operating, Forest Policy director John Anderson said that HRC would "scramble" to either sell waste or give it away; during this time, HRC donated chips to local school FFA programs and sold chips for animal bedding, soil amendments, and pellets.[50]

Mill waste can also be used to make durable building materials. Mill waste is often used to make medium-density fiberboard—a process which includes the use of considerable amounts of

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[46] Morris, Gregory. 2008. Bioenergy and greenhouse gases. The Pacific Institute. http://www.usabiomass.org/docs/PRI%20-%20Bioenergy_and_Greenhouse_Gases.pdf

[47] See for example California Air Resource Board. 2017. Method for Estimating Greenhouse Gas Emission Reductions from Diversion of Organic Waste from Landfills to Compost Facilities. https://www.arb.ca.gov/cc/waste/cerffinal.pdf.

[48] Morris, Gregory. 2008. Bioenergy and greenhouse gases. The Pacific Institute. http://www.usabiomass.org/docs/PRI%20-%20Bioenergy_and_Greenhouse_Gases.pdf

[49] US Environmental Protection Agency. 2012. Composting in WARM. https://www3.epa.gov/warm/pdfs/Composting_Overview.pdf

[50] Phone call with John Anderson, 7/25/2017.

volatile organic compounds.[51] Long-term sequestration of carbon in structural materials would likely result in the greatest amount of carbon sequestration of any wood waste management alternative.[52]

Summary of climate impacts

Raw biomass incineration and gasification release all GHG emissions quickly, with most carbon forming CO2. Gasification can be more efficient than raw incineration, potentially creating more electricity from the same amount of fuel and possibly releasing lower amounts of health-harming air pollutants. Composting and landfilling can sequester some carbon for a period of decades, but considerable amounts of methane can be produced in landfills or in poorly managed composting facilities; as methane is a more potent GHG than CO2, conversion to methane is undesirable from a climate standpoint. In durable building products, it is theoretically possible, albeit unlikely, to sequester most or all of the carbon in wood waste for 100+ years. Biochar production can sequester 10-15% of wood waste carbon for 100-1000 years, and 5-20% of composted material can be sequestered in soil for decades. Reuse, biochar production, and composting or landfilling have the potential to sequester carbon for a few decades or more (Table 1).

Table 1. Carbon sequestration potential for various mill waste management options.

Waste Option	**Potential GHG impacts**	**Time frame for sequestration**	**Other impacts/considerations**
landfilling	Potential for substantial amounts of methane to be released, particularly if gases are not collected[53]	decades[54]	California law may make it difficult to landfill organics.
composting	5-20% of carbon sequestered[55]; potential to release substantial amounts of methane if not	10-20 years[56]	Benefits to soil

[51] USEPA. 2002. Medium-density Fiberboard Production. https://www3.epa.gov/ttnchie1/ap42/ch10/final/c10s0603.pdf
[52] Chamberlin, Charles. Personal communication on 8/18/2017
[53] Chamberlin, Charles. Personal communication, 8-18-2017
[54] US EPA, 2015. Landfilling. https://www3.epa.gov/epawaste/conserve/tools/warm/pdfs/Landfilling.pdf
[55] US Environmental Protection Agency. 2012. Composting in WARM. https://www3.epa.gov/warm/pdfs/Composting_Overview.pdf
[56] US Environmental Protection Agency. 2012. Composting in WARM. https://www3.epa.gov/warm/pdfs/Composting_Overview.pdf

	managed properly		
Raw biomass incineration	Most carbon converted to CO2	Essentially instantaneous	Human health impacts
gasification	Similar GHG emissions as raw biomass incineration [57]	Essentially instantaneous	Typically more efficient than raw biomass incineration; may have lower air quality impacts [58]
biochar production	10-15% of carbon[59]	Potentially 100-1,000 years	Difficult to scale; particulates released during production[60]
reuse	all carbon in waste sequestered (theoretically)	Potentially 100+ years	Potential environmental, health and climate impacts, with manufacture of durable products

This table is meant to give a broad sense of the types of emissions that can be expected from various waste management methods. A lifecycle assessment is necessary to actually quantify total emissions from transportation, offsets from cogeneration, methane from chip storage, etc.

Local biomass research

Authors of the RePower Humboldt Strategic Plan recommended that a biomass energy working group be formed in order to study, among other things, GHG impacts; to our knowledge, this group has not been formed.

A 2014 life cycle analysis (LCA) quantified emissions from raw biomass combustion at the Fairhaven Plant vs torrefaction at a larger plant.[61] The LCA developed for the raw biomass pathway showed net negative emissions when compared to alternative modes of disposal, including pile-burning and in-field decomposition— the analysis did not consider alternate modes of mill waste disposal as outlined here. This research suggests that biomass incineration of harvest waste at the Fairhaven plant is less harmful to the climate than pile burning of waste

[57] Chamberlin, Charles. Personal communication, 8-18-2017
[58] Chamberlin, Charles. Personal communication, 8-18-2017
[59] Chamberlin, Charles. Personal communication, 8-18-2017
[60] Chamberlin, Charles. Personal communication, 8-18-2017
[61] Lottes, A. 2014. Supply Chain and Process Emissions Impact of Torrefaction to Enable Biomass Use in Large Power Plants Versus Raw Biomass Use in Small Power Plants.

or decomposition near the harvest site, even when transportation emissions are taken into account. This is because there are some controls on emissions at the biomass plant, while there are no controls on pile burns. Also, incineration may prevent some of the methane emissions that occur during decomposition.

Research on the climate impacts of biomass at state and regional levels is ongoing. The North Coast Resource Partnership[62] is funding an investigation into forest management and biomass energy.[63] The California Energy Commission recently awarded HSU professor Kevin Fingerman and colleagues a $1 million grant to investigate impacts of biomass energy at the state level.[64] In 2014, HSU and regional partners received a $5.88 million grant from the U.S. Department of Energy to conduct research on logging wastes that are normally left in the field or burned in a pile (as opposed to mill waste, which is what is generally burned at DG Fairhaven and Scotia). Three research areas include feedstock (processed forest residues) supply, mobile conversion technologies, and economic life cycle assessment.

Mobile conversion technologies that are being investigated include biochar production, torrefied pellet production, and briquetting of logging waste.[65]

Positions taken by environmental & health groups

Several environmental and health groups oppose biomass because they are concerned about forest health, air pollution, and climate pollution. The following health organizations are opposed to biomass energy under any circumstances:

- the American Academy of Pediatrics,
- the American Lung Association,
- the American Public Health Association,
- The Asthma and Allergy Foundation of America,
- The National Association of County & City Health Officials,
- the National Environmental Health Association,
- the Trust for America's Health, and
- The Children's Environmental Health Network.

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[62] North Coast Resource Partnership. http://www.northcoastresourcepartnership.org/app_pages/view/7983
[63] Matthew Marshall, 2017. Personal communication via email. June 7.
[64] HSU Marketing and Communications. 2017. Evaluating the Climate and Environmental Impacts of Biomass Energy Systems in California. Humboldt NOW. http://now.humboldt.edu/news/evaluating-the-climate-and-environmental-impacts-of-biomass-energy-systems-/
[65] HSU Marketing and Communications. 2017. HSU Receives $5.8 Million Federal Grant for Innovative Biomass Research. Humboldt NOW. http://now.humboldt.edu/news/hsu-receives-58-million-federal-grant-for-innovative-biomass-research1/

The California Air Pollution Control Officers Association supports biomass, particularly as a way to dispose of waste without open-pile burning, which is much more harmful to air quality.[66]

The Natural Resource Defense Council (NRDC) and the Sierra Club find biomass acceptable provided that certain feedstock requirement are met. NRDC advocates to quickly transition to clean, renewable energy; however, biomass is not a part of the energy portfolio that the NRDC advocates for, especially when power companies are using standing timber to power their generators. According to the NRDC: "Biomass energy is dirty and destructive, and can be highly inefficient. Trees are approximately half water by weight so to generate the same amount of electricity from trees as from fossil fuels, many more trees have to be burned, resulting in roughly 40% more carbon dioxide emissions at the smoke stack per unit of energy generated."[67] The NRDC also points out that cut trees will be unable to sequester carbon, and that burning most types of forest biomass will increase carbon emissions for up to 100 years.

Although the NRDC is opposed to the burning of whole trees for energy, they do not oppose the use of other biomass fuels in all circumstances: "Wood or agricultural materials that would otherwise end up in a landfill or burned are the preferred alternatives. In addition, the use of sustainably grown agricultural crops or the limited use of the tops and limbs of trees might represent better options for reducing carbon emissions than using whole trees. However, the use of these sources can result in significant, negative environmental impacts unless strict sustainability standards are adopted. It is important to recognize that most of these alternative sources of biomass are limited. Therefore, utilities should increase their focus on energy efficiency and the development of alternative energy sources such as solar, wind and geothermal."[68]

While the Sierra Club believes that using biomass as an energy source can be sustainable, it contends that that most projects currently operating are not. Forest health is of primary concern. Any biomass projects that rely on logging activities that "jeopardize fully functioning forest ecosystems" are opposed[69]. Additionally, supporting projects based on "clean" construction waste is difficult for the Sierra Club because there is a strong incentive for biomass plant operators to use contaminated or unsustainably harvested fuel if the supply runs short.

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[66] California Air Pollution Control Officers Association. 2016. CAPCOA Policy Statement on Biomass Power Plants. http://www.capcoa.org/wp-content/uploads/2016/12/CAPCOA_Biomass_Policy_Dec_2016.pdf
[67] Stashwick, S. 2016. Uncertainty for the Biomass Industry Grows. NRDC Expert Blog. https://www.nrdc.org/experts/sasha-stashwick/uncertainty-biomass-industry-grows
[68] NRDC, 2016. Are Forests Aren't Fuel. https://www.nrdc.org/resources/our-forests-arent-fuel
[69] Sierra Club. Biomass Guidance. http://www.sierraclub.org/policy/energy/biomass-guidance Accessed 7/11/2017

Research Conclusions

We investigated the potential impacts associated with the operation and funding of local biomass plants, focusing on forest health and climate change. We found that electricity from local biomass is expensive; however, we do believe that the RCEA is committed to investing in the development of wind and solar projects. Climate impacts are less clear, largely because GHG emissions associated with mill waste management have not been fully assessed. Our research suggests that alternative methods of mill waste management may result in lower GHG emissions; however, it remains to be seen whether these reductions would be significant, or whether these options are otherwise feasible. We did not find any evidence to suggest that local forests are being positively or negatively impacted by the presence of the biomass plants.

Many health organizations have opposed raw biomass incineration for electricity, and we believe this issue deserves consideration from local governments and agencies. For more information on health impacts, please review Dr. Wendy Ring's report on biomass and public health in Humboldt County here.

350 Humboldt's Position

350 Humboldt advocates for a transition to 100% clean, renewable electricity in Humboldt County by 2025. In order for local biomass energy to qualify as clean and renewable, we believe it must (1) be a carbon neutral source of energy; (2) be a carbon-neutral investment for RCEA; (3) have no effect, or a net positive effect, on forest health; and (4) have no effect, or a net positive effect, on human health. As our research has revealed, there is not currently enough information to fully assess local biomass energy production by these three criteria. Therefore, we call on RCEA to investigate these potential impacts more fully prior to renewing its contracts or signing new contracts for local biomass energy purchases.

1. **Carbon neutral energy.** To be considered both "clean" and "renewable," biomass energy production at local plants must be carbon neutral. There is currently not enough information to determine whether local biomass energy production should qualify as carbon neutral. A full calculation of carbon cycle impacts must take into account avoided emissions from natural gas burning at the Humboldt Bay Generating Station as well as a comparison with the impacts of alternative disposal methods for wood waste (including landfilling, composting, gasification, biochar production, and reuse). Our research suggests that other alternatives for mill waste disposal may theoretically cause less climate pollution than raw biomass incineration; however, it will be difficult for us to make recommendations without a full life-cycle assessment/feasibility study. RCEA

should support ongoing research into the full life-cycle carbon impacts of local biomass power production and fund its own research if necessary. If other feasible modes of mill waste management show substantial greenhouse gas emissions savings over raw biomass incineration, or if research reveals other significant GHG impacts of local biomass power production, RCEA should phase out biomass from the CCE grid mix.

2. **Carbon neutral investment.** To be considered a "clean" and "renewable" part of the CCE grid mix, local biomass energy should not divert RCEA's limited funds away from purchasing or developing other demonstrably cleaner and more renewable forms of energy. An economic analysis is necessary to determine the carbon "opportunity cost" of local biomass power procurement by RCEA when compared to investment in purchasing out-of-county renewable energy or development of other local renewable energy sources. If research shows that RCEA could generate significantly greater GHG savings through alternatives to paying above-market rates for biomass power, RCEA should lower the price it is willing to pay for local biomass power or phase it out of the CCE grid mix.

3. **No effect on forest health, or net positive effect.** To be considered "renewable," biomass power must not contribute to any degradation of forest health. Our research suggests that current biomass power operations are not affecting local forest practices. However, in order to ensure that unsustainable forestry practices aren't employed in order to create fuel for electricity generation, RCEA should include the BioMAT guidelines (Initial Fuel Attestation form; b. Guidance Docs/3. Fuel Attestation Form/)[70] or similar requirements in any future power purchase agreements.

4. **No negative human health effects, or net positive effects.** To be considered "clean," local biomass power production must not contribute to any degradation of air quality that negatively impacts local public health. The research of Dr. Wendy Ring and others suggests that this is a major concern. However, it is possible that local biomass energy could be considered to have a net positive impact on public health under some circumstances. For example, the electricity produced in well-regulated plants could be used to offset or replace other local sources of emissions, such as individual wood stoves used for heating. Prior to renewing or signing any new power purchase agreement, RCEA should require biomass power plant operators to demonstrate a reduction in health-harming emissions from other sources equal to or greater than the expected emissions from the plant, or require them to fund outside programs to accomplish such a reduction.

[70] PG&E, BioMAT. 2015. *Initial Fuel Attestation Form.* https://pgebiomat.accionpower.com/biomat/documents.asp?Col=DateDown&strFolder=b.%20Guidance%20Docs/3.%20Fuel%20Attestation%20Form/&filedown=&HideFiles=

Just transition

The concept of "just transition" has been widely promoted in recent years by labor and environmental groups in recognition of the fact that any economic shift affects the jobs of people employed in status-quo industries. In the words of the labor leader who coined the term, no worker should have to "pay a disproportionate tax - in the form of losing his or her job" to fund environmental progress; rather, "these costs should be fairly distributed across society."[71]

What does this look like at a community scale? In"Jobs Beyond Coal: A Manual for Communities, Workers, and Environmentalists,"[72] the Labor Network for Sustainability recommends the following measures that coal-retirement campaigns can demand from coal power plant employers and public officials and agencies who negotiate with them:

- Negotiate a jobs agreement with unions representing affected workers.
- Find jobs for affected workers who want them.
- Ensure job retraining for those who need it to fill new jobs.
- Provide decent pensions with healthcare for workers who are not provided other jobs and who do not opt for retraining.
- Create jobs restoring the site.
- Reutilize facilities to replace losses in tax base.
- Fund job-creating community economic development.

The Labor Network for Sustainability report also specifies that protections should apply to all affected workers, including those in supply and transportation.

350 Humboldt fully supports the concept of just transition. As described above, a total of approximately 40 workers are believed to be employed at the two biomass plants from which RCEA currently procures power. To ensure that workers in the timber industry do not bear disproportionate costs in a possible transition in mill waste disposal pathways, we suggest that the RCEA and member governments create and fully fund a program with the following purposes: (1) funding research into the technical and economic feasibility of lower-GHG mill waste disposal pathways; (2) supporting the development of the necessary infrastructure and systems to transition to lower-GHG mill waste disposal pathways if necessary; (3) if any workers

[71] Labor Network for Sustainability. "Just Transition" - Just What Is It?" http://www.labor4sustainability.org/uncategorized/just-transition-just-what-is-it/

[72] Brecher, Jeremy. 2012. "Jobs Beyond Coal." Labor Network for Sustainability. http://report.labor4sustainability.org/. Cited in "Just Transition" - Just What Is It?" http://www.labor4sustainability.org/uncategorized/just-transition-just-what-is-it/

are displaced in the process, providing them with re-training and job placement assistance. If current efforts to develop Humboldt County's substantial offshore wind resource are successful, we believe it may be desirable for displaced biomass energy workers to find work in that industry.

RCEA should also consider the applicability of the other considerations recommended by the Labor Network for Sustainability.

Attachments

Ring, Wendy. 2016. Biomass Energy and Health in Humboldt County.
Lottes, Angela. 2014. Supply Chain and Process Emissions Impact of Torrefaction to Enable Biomass use in Large Power Plants versus Raw Biomass Use in Small Power Plants.