Public Comment

for September 19, 2016
RCEA Board of Directors Meeting

Written Comments Submitted by Jacob Pounds (9/15/16):

I support the shift to renewable energy use in Humboldt County, and believe it is imperative to do so in a wise manner. Prioritizing a distributed and/or community-supported model should be made a priority over large utility-scale style projects.

I can see a nexus of where it may be appropriate for large-scale utilities and Tribal/City/County government, public schools and private businesses should collaborate to create space for clean energy to be created without the ecological and economic costs of converting raw landscapes into utilities. For example, creating a partnership with PG and E to cover all the city-owned buildings and parking lots within the incorporated cities of Humboldt County with solar panels. This could be negotiated to not incur a large investment on behalf of the cities, and would open up avenues for PG and E to meet renewable energy goals without investing lots of money in acquiring land and associated environmental documents to bring renewable energy projects to fruition with alacrity. Place a ballot measure before voters to create an additional sales tax that would provide a "match" to show that there is vast community support for wise development of existing infrastructure as a base for renewable energy development. There are plenty of existing developed spaces near essential energy infrastructure that can help keep project implementation costs low, while producing clean, local power. The next issue to address would then be how to store the energy created during daylight hours for demand that occurs in the dark.

Where I urge extreme caution in 'renewable' energy development is where it crosses into a grey area concerning management or development of undeveloped places in the landscape, and how impacts from the creation of different types of energy like biomass or wave energy can affect the overall health of people and place. It's no secret that the biomass facility in Blue Lake has been notorious for egregious pollution for decades. When the plant was built, it had a noble purpose: converting sawmill waste to local electricity. Over time, the operation slipped from mill waste to chipping whole "waste" trees that were extracted from surrounding landscapes. And it has always ran dirty when burning biomass for power. The only time the plant's emissions meet air quality standards are when it burns straight natural gas for power. There is really nothing renewable about that. We do not need more similar developments such as Blue Lake Power.

However, promising advances in small-scale biomass gasification could be an answer to neighborhoods in the ever-popular Wildland-urban interface, so people living in these places have good incentive to manage their lands and properties in a firewise manner while producing energy to meet demand.

Public comment submitted by Walt Paniak

9/19/2016
RCEA Board
Thank you for the opportunity for me to express by explicit biases in terms biomass and how that were represented by the UC Biomass Utilization Resources Group.
In May RCEA participated in a program that appears to show that biomass burning is climate change beneficial. This program was presented by various biomass proponents one of which was the UC Extension Biomass Utilization Resources Group. (I've been waiting about 12 weeks for my Freedom of Information request concerning a list of their funders for the last 3 fiscal years.)One presenter made it appear that the black carbon from burning forest residue in place was very bad. However, he left out that most black particles from forest burning fall out of the air within hours to a week or so and the fact that controlled burning is scheduled by weather conditions and the sites are usually somewhat remote. He did not address black carbon from biomass energy combustion. I'm assuming that industrial biomass burning is filtering the large particulates. However, the fine particles may be the most problematic. see comments from American Lung Association. Stanford Study , Lowell Mass)

I would like to prevent long term contracts with the 3 biomass plants for several reasons:

1. Even though biomass is considered renewable and perhaps carbon neutral over years for grasses, and years for hybrid poplar and decades for wood in our climate and up to a century in other climate zones. I don't think that we have the luxury of time. Biomass investors say that it is climate neutral; however, there are western timber scientists that show decades of carbon debt in their modeling. (Oregon State model with various degrees of thinning) There are also many concerned scientists that says that the nationwide race to build biomass plants and sell <u>wood residue across the world i</u>s misguided and places the pace of climate change in the positive feedback loop to catastrophe. (see Woods Hole Research letter to Senate, Partnership for Policy Integrity How Biomass Because the new coal Center and Biological Diversity summary of carbon accounting.

2. Health issues for the people in close proximity to the biomass plants are not addressed. Some amounts of pollution 24/7 is not beneficial. By virtue of being under Title V the power plant produce measureable pollution. <u>There should be a footnote in the clean energy description with words to the effect that biomass plants and in compliance with EPA title V.</u>

3. I don't think that the biomass plants are a good long term investments or the following reasons:
a. They are old and complicated and difficult to maintain. Would you invest for the long term in decades old technology? See California Energy list of new biomass plants and total biomass plants which includes methane from landfills versus new solar and wind in 2015.

b. Biomass plants have received direct financial assistance in the past. I don’t think that there is still a tax credit for biomass producers. New state mandates ,if the governor signs a law, require utilities to purchase a specific amount of power from biomass plants and to pay the added cost created and pass on the cost to rate payers. (There are a few areas in California where the US

Department of Agriculture under the title of BCAP Biomass Crop Assistance Program is paying a significant amount of the cost for up to 5 years for farmers to grow plants to supply biomass energy). There is a separate program and market for renewable energy when the REC Renewable Energy Credits are traded. Unbundled RECs can come from any source and can be traded in the energy market.
Ex: Marin Clean Energy can sell you 100% Wind Power energy at a currently slightly higher price. The reality is that Marin Clean Energy can purchase Wind energy credits from sources in California and the West and use these credits to apply against the use of natural gas at night, in the winter, etc. They really can't do otherwise until there are systems for utility level energy storage. Is this really a 100% wind power?
Ex: Using an outrageous but plausible example: Trinity River water supported by taxpayers can be allocated to a Kern county hybrid poplar grower who receives taxpayer money from the US Department of Agriculture BCAP program to grow their poplar which they sell to a biomass plant and the excess cost of burning the biomass which products more of every pollution component and is less efficient versus burning clean and low cost natural gas must be paid by utility rate payers according to state mandate.
c. The short term goal is local jobs. But because of the hidden cost and mandated subsidies there are things that are controlled by outsiders; long term finances may be problematic. Margaret Thatcher said something like "Socialism works until you run out of other people's money." Wind, solar and water have no fuel cost and product no GHG. I would prefer only short term biomass utilization until utility level storage for wind and solar is available. Rate payers should not have to pay higher prices for somewhat "brown" green energy. There will be more technical storage jobs if there is money to invest. There are grid batteries already in place for the large investor owned utilities. These are used to replace Peaker gas plants. They are less expensive than adding a new plant and much easier to approved. The duration is about 4 hours 100 MW by 400 MV with current technology.

d. Burning biomass from logging to reduce fire risk is one of the reasons for this program. This is supported by both the timber industry and Cal Fire. Some fire scientists emphasize climate conditions as the main source of forest and wild fires. Ironically, when I was looking at the website for The Mendocino Redwood Company and Humboldt Redwood Company they had several official comments about the recently passed Mendocino county Measure V. One of the provisions of this measure was for the company to remove the tan oaks that they poison because the dead oaks create added fire danger. That website provided information using Cal Fire Maps where they show that there was **no correlation** <u>between the most intensely burned areas and areas where they had used herbicide to kill tan oaks.</u> The Redwood company further stated that the are exempt from Measure V because of California agricultural nuisance exemption rules.
Should rate payers pay for a marginal benefit without full knowledge of the cost structure and where others might see a cost shift where there is a private benefit paid by a public? Why is power subsidizing timber? Shouldn't timber pricing pay for thinning?
Ex: Could the Scotia power plant sell all their energy to RCEA and purchase lower cost energy from PG&E for their wood drying and local power need?

Finally, all power sources receive some sort of subsidy. When I was looking up the oil depletion allowance, too strange to believe I found IRS form T(Timber) This is the form where you compute your timber deletion allowance for your renewable produce.

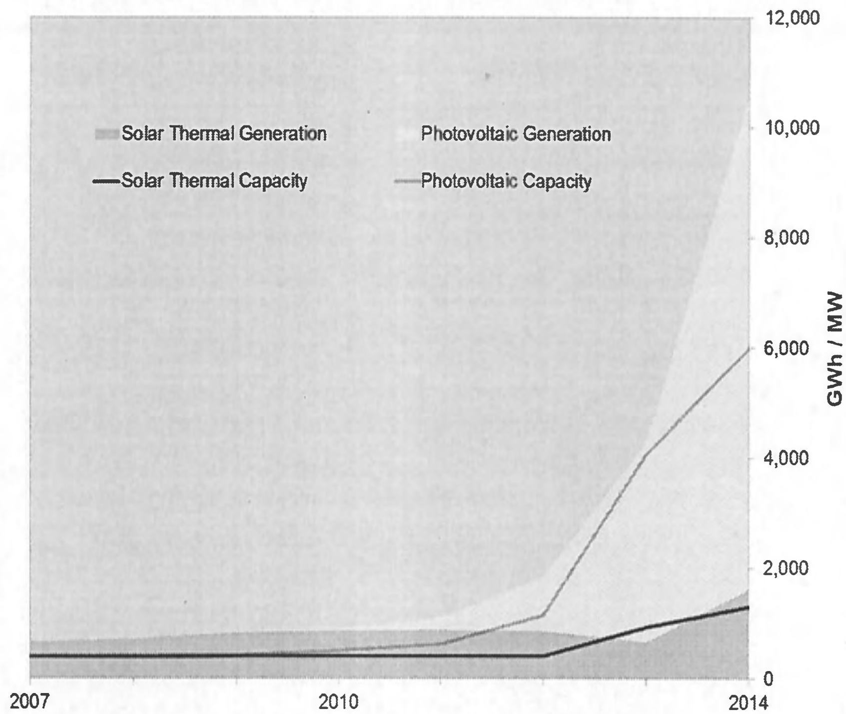
Additional attachments with manual notes.

Walt Paniak

Arcata Ca.

Figure 10 takes a closer look at the solar capacity and generation additions between 2007 and 2014. It does not include self-generation solar capacity. As shown in the figure, both solar thermal and PV capacity increased in 2014 by 150 percent.

Figure 10: California Solar Generation and Capacity Additions From 2007 Through 2014



Source: Energy Commission staff based on sources [1] through [7] listed near the end of this document. Updated –June 30, 2015

The Energy Commission estimates that as of October 31, 2015, 680 MW of new renewable capacity began operating in 2015. **Table 2** summarizes capacity additions in 2015 as of October 31, 2015, by resource and technology type.

Table 2: New Renewable Capacity Added in 2015

Resource/Technology	Operating MW
Solar PV	560
Solar Thermal	0
Wind	100
Geothermal	0
Biomass	20
Total	**680**

Source: Energy Commission staff. Totals may not sum due to rounding. Updated October 31, 2015.

Table 3 on the following page shows the capacity of renewable energy facilities on-line as of October 31, 2015, by county, excluding self-generation. The table provides data on the number of facilities and MW by fuel type.

Table 3: Summary of In-State Renewable Projects On-Line as of October 31, 2015

County	Biomass		Geothermal		Small Hydro		Solar PV		Solar Thermal		Wind		Total	
	Count	MW	Count	MW	Count	MW	Count	MW	Count	MW	Count	MW	Count	MW
Alameda	5	30					5	8			17	460	27	499
Amador	1	23			2	14	1	2					4	39
Butte	2	21			10	70	2	2					14	93
Calaveras					7	33	1	2					8	35
Colusa	1	29											1	29
Contra Costa	2	7					4	6			1	38	7	51
El Dorado					8	68							8	68
Fresno	2	56			2	44	22	288					26	388
Glenn					1	5							1	5
Humboldt	3	61			2	2							5	64
Imperial			20	705	8	93	10	889			1	265	39	1,951
Inyo			3	302	11	81							14	383
Kern	3	114			5	75	35	1121			53	3,292	96	4,419
Kings							11	193					11	193
Lake			6	418	2	6							8	423
Lassen	2	47			1	30							3	77
Los Angeles	10	157			19	198	49	455	1	8			78	814
Madera	2	38			7	61							9	99
Marin	1	0					1	2					2	2
Mariposa					1	9							1	9
Mendocino					4	13							4	13
Merced	2	13			5	39	4	25			1	19	12	96
Mono			5	62	5	96							10	158
Monterey	3	8									2	2	5	10
Napa	2	3											2	3
Nevada					12	82							12	82
Orange	6	82			3	12							9	94
Placer	3	52			9	89	3	5					15	146
Plumas	2	40			4	28							6	67
Riverside	3	59			6	50	17	618	1	250	33	713	59	1,683
Sacramento	1	9			1	14	28	114					30	137
San Benito							2	3					2	3
San Bernardino	3	6			11	38	46	251	13	1,042	3	7	74	1,318
San Diego	12	44			4	13	11	60			2	51	29	168
San Francisco	1	2					6	12					7	14
San Joaquin	5	83			1	11	3	6			2	4	11	103
San Luis Obispo	2	3			1	4	6	806					9	813
San Mateo	1	11											1	11
Santa Barbara	2	4											2	4
Santa Clara	1	2			1	0	10	19					12	21
Santa Cruz	2	5					2	3					4	8
Shasta	5	129			25	88	3	6			1	101	34	324
Sierra					4	19							4	19
Siskiyou	1	13			5	72							6	86
Solano	1	2					6	10			13	1,032	20	1,044
Sonoma	3	9	12	1,238	1	3	7	10					23	1,260
Stanislaus	2	26			6	21	3	28					11	74
Sutter							1	1					1	1
Tehama					4	21	2	3			1	1	7	25
Trinity					5	9							5	9
Tulare	2	13			7	38	29	184					38	235
Tuolumne	2	33			7	75	1	2					10	110
Ventura	2	6			2	2							4	8
Yolo	2	32			1	12	2	5			1	1	6	49
Yuba	1	3			2	1							3	4
Total	106	1,300	46	2,700	222	1,600	333	5,100	15	1,300	131	6,000	849	18,100

PFPI
driven by data

The Role of Biomass Energy in EPA's Greenhouse Gas Rule

Partnership for Policy Integrity

August 7, 2014 v.3

This is a working document and subject to change. We appreciate the helpful input to this document so far.

Contents

A good news/bad news story about bioenergy and the greenhouse gas rule

The EPA's recently published Existing Source Performance Standards for greenhouse gas emissions (GHG), intended to address emissions from large fossil-fuel fired existing power plants, relies on four main "building blocks" as the Best System of Emissions Reduction ("BSER") from which the Agency then calculates target 2020 and 2030 state specific emissions rates for carbon dioxide emissions from the power sector. The proposed rule allows states to achieve their 2020 and 2030 target emissions rates (expressed as pounds of CO_2 per megawatt-hour of electricity generated) in a variety of ways, provided they can be linked to reductions in existing power sector. One of the BSER building blocks is increased efficiency at existing coal plants, to reduce emissions of CO_2 per unit energy generated. Another is increased use of "low" or "zero" emissions renewable energy. EPA seeks comment both on the way it has developed the target state specific emissions rates, and the way in which states may meet the rates.

Biomass energy – the combustion of wood and other biological materials in power plants – has been promoted extensively at the state level as renewable energy. However, it is well-known that per megawatt-hour (MWh), biomass power plants emit more CO_2 than coal plants, and that co-firing biomass at coal plants increases CO_2 emissions and decreases facility efficiency (see Appendix 2 for more details). Given these facts, it is important to determine how the EPA counts bioenergy emissions under the existing source GHG rule, and what role EPA envisions for biomass power in helping states meet target emissions rates.

EPA's rule treats biomass and waste-burning as having zero CO_2 emissions

The short answer is that despite all the time and energy that EPA and others have devoted to developing a biogenic carbon accounting framework, EPA's estimates of current power sector emissions, the 2012 baseline, treats standalone biomass power plants as having zero carbon emissions, although emissions from biomass co-fired at coal plants are counted in state-level totals. Looking forward, the equation that EPA has developed to calculate state-level power-sector emissions rate goals, in which CO_2 emissions are summed in the numerator, and power generation (as MWh) is summed in the denominator, treats standalone biomass power plants as contributing to power generation, but again, not to CO_2 emissions (although the CO_2 emitted by biomass co-fired at coal plants is counted), and again, biogenic municipal waste combustion is treated as having zero CO_2 emissions.

The one place where biomass (but not waste) emissions are counted is in EPA's going forward modeling, the model runs that the Agency conducted to determine a least-cost pathway for states to achieve their emissions goals. There, emissions from standalone biomass plants are counted, along with emissions from biomass that is co-fired at fossil fueled plants.[1] Table 1 summarizes how biomass and waste emissions are treated in these three areas of the rule.

[1] A previous version of this summary incorrectly stated that EPA's IPM modeling treated biomass as having zero emissions, due to the incorrect assumption that EPA calculated 2012 rates and future goal rates using the same equation and assumptions. We regret the error.

Are CO_2 emissions counted?	2012 estimate of current emissions	Goal emissions rate equation	Modeling in support of goal rates
Biomass co-firing at coal plants	yes	yes	yes
Biomass standalone facilities	no	no	yes
Biogenic municipal waste	no	no	no

Table 1. Summary of how the GHG rule treats CO_2 emissions from biomass and municipal waste.

The following report explores these findings in more depth, and contemplates what they may mean for the role of biomass in the ESPS rule.

Bioenergy does not directly provide "mitigation" of emissions in the GHG rule

The objective of both the New Source Performance Standards (NSPS) and the Existing Source Performance Standards (ESPS, here also referred to as the "greenhouse gas rule" or "GHG rule") is to reduce CO_2 emissions from certain fossil fueled plants in the power sector. While the Agency's NSPS rule governs emissions from new coal and natural gas combined cycle power plants, the ESPS creates target emissions rates for the existing fleet. These rates, expressed for the power sector as a whole, are to be achieved not only by improving facility efficiency and taking other measures to control CO_2 emissions at individual existing plants, but also by replacing existing coal-fired generation with lower-emitting existing natural gas plants[2] and low- or zero-emissions renewable energy and nuclear power, and/or by reducing electricity demand.

Importantly, neither the NSPS nor the ESPS explicitly offers biomass co-firing as a means to "reduce" emissions at coal plants. Most significantly, *all* emissions from fossil-fueled plants – even emissions from co-fired biomass – are counted in EPA's 2012 baseline emissions rates, in the equation that develops the goal emissions rates, and in EPA's forward-looking modeling of how states can achieve the goal rates. This produces the counterintuitive result that emissions from biomass burned in conjunction with coal in the same boiler are counted under the rule, but emissions from a standalone wood-fired boiler sitting next to a coal-fired boiler will not be counted.

To promote biomass co-firing would be counter to the first goal of the GHG rule, increased efficiency at coal plants, since co-firing biomass at a coal plant actually decreases facility efficiency and increases CO_2 emissions per megawatt-hour. Indeed, an increased facility heat rate (the amount of energy required to produce electrical energy) was recently cited by Georgia Power as one reason to *not* convert its Plant Mitchell from coal to biomass.[3] Likewise, EPA notes in a technical document[4] for the GHG rule that, regarding co-firing,

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[2] As the rule does not take into account methane leakage from natural gas, many are questioning whether the increased deployment of natural gas under the rule might actually increase greenhouse gas emissions.

[3] Georgia Public Service Commission. Georgia Power Plant Mitchell Unit 3 Biomass Conversion Cancellation: Decision Review Findings. June 5, 2014.

[4] U.S. Environmental Protection Agency. Documentation for EPA Base Case v.5.13 Using the Integrated Planning Model. Page 5-9.

"logistics and boiler engineering considerations place limits on the extent of biomass that can be fired. The logistic considerations arise because it is only economic to transport biomass a limited distance from where it is grown given the low energy density of the fuel. In addition, the extent of storage that can be devoted at a power plant to this relatively low density fuel is another limiting factor. ***Boiler efficiency and other engineering considerations, largely due to the relatively higher moisture content and lower heat content of biomass compared to fossil fuel,*** *also plays a role in limiting the level of co-firing."* (emphasis added)

Biomass co-firing is also costly. EPA provides a detailed treatment of the costs and logistics of biomass co-firing at coal plants, finding that even if biogenic CO_2 emissions are treated as zero, the "reductions" in fossil fuel CO_2 emissions at coal plants co-firing 10% biomass ranges from \$30 - \$80 per ton of CO_2. EPA concludes:

"Replacing some coal with low levels of biomass co-firing may result in stack CO_2 increases. ***Even if biogenic CO_2 emissions are not counted as part of stack emissions, biomass co-firing is a relatively costly approach to CO_2 reductions at existing coal steam boilers when compared to other measures*** *such as heat rate improvements and re-dispatch of generation supply to other existing capacity with lower CO_2 emissions rates."*[5]

While EPA has not offered biomass co-firing as means of reducing greenhouse gas emissions at coal plants, the Agency has stopped short of taking a firm position on bioenergy emissions, and the GHG rule, as currently formulated, treats biomass and biogenic waste burned at standalone plants as having zero carbon emissions. The consequences of this are explored in more depth below.

EPA's biogenic carbon accounting approach is likely to be science-based

Three years on since EPA's deferral of regulation of bioenergy CO_2, and nearly two years since the Science Advisory Board (SAB) panel issued its report, EPA does not appear to be very close to issuing a carbon accounting framework for bioenergy. As explained in this report, the ESPS, especially, suffers from the absence of clear guidance on biomass.

However, there are hints that EPA is headed toward a science-based carbon accounting framework for biomass energy. For instance, the January 2014 draft of the NSPS acknowledges,

"In general, the overall net atmospheric loading of CO_2 resulting from the use of a biogenic feedstock by a stationary source will ultimately depend on the stationary source process and the type of feedstock used, as well as the conditions under which that feedstock is grown and harvested."

And,

"In its Advisory, the SAB recommended revisions to the EPA's proposed accounting approach, and also noted that biomass cannot be considered carbon neutral a priori, without an evaluation of the carbon cycle effects related to the use of the type of biomass being considered."[6]

[5] U.S. Environmental Protection Agency. Technical Support Document for Carbon Pollution Guidelines for Existing Power Plants. GHG Abatement Masures, page 6-16.
[6] Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 1,430 (proposed Jan. 8, 2014) ("Proposed Rule"), page 1446.

These same statements occurred in the September 2013 version of the NSPS, but the June 2014 ESPS indicates that EPA is still studying the issue:[7]

"*The EPA is in the process of revising the draft framework and considering next steps, taking into account both the comments provided by the SAB and feedback from stakeholders. The EPA's biogenic CO_2 accounting framework is expected to provide important information regarding the scientific basis for assessing these biomass-derived fuels and their net atmospheric contribution of CO_2 related to the growth, harvest and use of these fuels. This information should assist both states and the EPA in assessing the impact of the use of biomass fuels in reaching emission reduction goals in the energy sector under state plans to comply with the requirements in the emission guidelines.*"

Despite these statements, however, the ESPS as currently formulated does contain the default assumption that biomass is carbon neutral – in contradiction from the SAB report's clear conclusion, that

"*Carbon neutrality cannot be assumed for all biomass energy a priori. There are circumstances in which biomass is grown, harvested and combusted in a carbon neutral fashion but carbon neutrality is not an appropriate a priori assumption; it is a conclusion that should be reached only after considering a particular feedstock's production and consumption cycle*" [8]

What are the consequences of treating biomass and waste burning as having zero emissions?

By lumping bioenergy with all other renewables, and biomass and waste-burning as if they reduce emissions as effectively as wind and solar, EPA may be inadvertently promoting these technologies as mitigation measures in the GHG rule. Further, counting these emissions as zero can also introduce significant errors into the estimate of present day power sector CO_2 emissions and target emissions rates, which are likely to be carried forward as states attempt to meet target emissions goals. This problem is most apparent for those states where bioenergy and waste-burning contribute a significant share of total CO_2 emissions.

To explore this further, we used the same data as EPA, from the Agency's Emissions and Generation Resource Integrated Database (eGRID), to estimate what proportion of state-level GHG emissions were not being included in EPA's official totals. For the initial estimation of 2012 baseline power sector rates, EPA only considers power generation and emissions from a segment of the total power sector, excluding facility emissions from contributing to calculated 2012 state-level emissions rates on various grounds. Standalone biomass plants and municipal waste combustors are excluded because they are "non fossil fuel" units, burning less than 10% fossil fuels. EPA also excludes industrial/commercial power generators that are not connected to the grid,[9] a set of facilities that includes a substantial number of biomass-burning units. Simple cycle turbine plants less than 25 MW and steam turbine plants less than 25 MW/250 MMBtu are also excluded.[10]

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[7] Environmental Protection Agency. 40 CFR Part 60: Carbon pollution emission guidelines for existing stationary sources: electric generating units; proposed rule. Federal Register Vol. 79 No. 117, June 18 2014, page 34925

[8] United States Environmental Protection Agency. SAB review of EPA's Accounting Framework for Biogenic CO_2 Emissions From Stationary Sources. EPA-SAB-12-011. September 28, 2012. Washington, DC. (http://yosemite.epa.gov/sab/SABPRODUCT.NSF/57B7A4F1987D7F7385257A87007977F6/$File/EPA-SAB-12-011-unsigned.pdf).

[9] http://www2.epa.gov/sites/production/files/2014-06/documents/20140602-description-egrid-methodology.pdf

[10] EPA makes the decision about whether a boiler's emissions are regulated under the rule at the individual unit level, rather than the facility level, allowing multiple boilers at a single facility to be excluded using different justifications. For instance, in Maine, Verso Paper was burning natural gas in 2012 at four burners of 15 MW, 24 MW, 72 MW, and 186.8 MW. Although

Table 2 provides a state-level summary of emissions from biomass- or waste-burning facilities that were excluded from state totals on the basis of being non-fossil fueled (states with low amounts of biomass/waste in this category may nonetheless have biomass/waste burning units that were excluded on the basis of not being connected to the grid).

State	Biomass and waste emissions excluded on basis of being non-fossil fuels (tons CO_2)	Total included emissions (tons CO_2)	% increase if biomass and waste burning emissions were included in total
VT	519,266	2,319	22390.8%
ME	2,877,303	3,108,203	92.6%
NH	1,906,859	4,642,898	41.1%
WA	2,660,941	7,439,852	35.8%
CT	2,419,315	6,769,291	35.7%
MA	3,412,335	13,201,015	25.8%
HI	1,425,872	6,316,936	22.6%
ID	157,733	789,232	20.0%
OR	1,359,558	7,679,058	17.7%
CA	8,642,415	50,538,538	17.1%
MN	4,214,848	28,710,984	14.7%
NJ	1,801,946	13,938,132	12.9%
VA	3,447,003	28,425,400	12.1%
FL	13,226,624	121,388,920	10.9%
NY	3,774,380	36,128,451	10.4%
MD	1,565,937	20,592,993	7.6%
SC	2,825,130	37,792,258	7.5%
AL	4,188,420	75,901,923	5.5%
NC	3,126,428	61,711,952	5.1%
LA	2,253,311	49,513,590	4.6%
MI	3,102,176	71,060,733	4.4%
PA	3,576,247	116,966,573	3.1%
WI	1,191,782	43,037,386	2.8%
GA	1,176,147	65,130,319	1.8%
IN	812,960	101,827,187	0.8%
AR	278,014	40,137,961	0.7%
AZ	258,677	40,903,915	0.6%
OK	327,289	52,998,373	0.6%
UT	138,469	31,178,820	0.4%
OH	386,369	103,281,832	0.4%
TX	704,448	247,589,234	0.3%
ND	88,159	33,370,886	0.3%
KY	78,641	93,176,101	0.1%

Table 2. Emissions from biomass and waste burning, versus fossil fuel emissions included by EPA in state-level totals for 2012.

these boilers are located at the same facility, the first two are excluded from regulation under the GHG rule on the basis of being less than 25 MW; the second two are exempted on the basis of being commercial/industrial units.

Florida is the state with the most bioenergy/waste emissions excluded from its 2012 emissions total (13.2 million tons). In terms of how CO_2 from biomass and waste burning compares to reported CO_2 from fossil fuels on a percentage basis, Vermont is the leader, but in fact biomass energy does not actually provide a high percentage of the power generated in that state, due to the presence of the 543 MW Vermont Yankee nuclear plant.

Maine is the state where biomass makes the largest percentage contribution to both in-state power generation and power sector CO_2 emissions. Figure 1 shows Maine's 2012 emissions as reported in eGRID. "Included" emissions contribute to EPA's baseline estimate of power sector emissions; "excluded" categories are reported by e-GRID, but are not included in EPA's summed total.

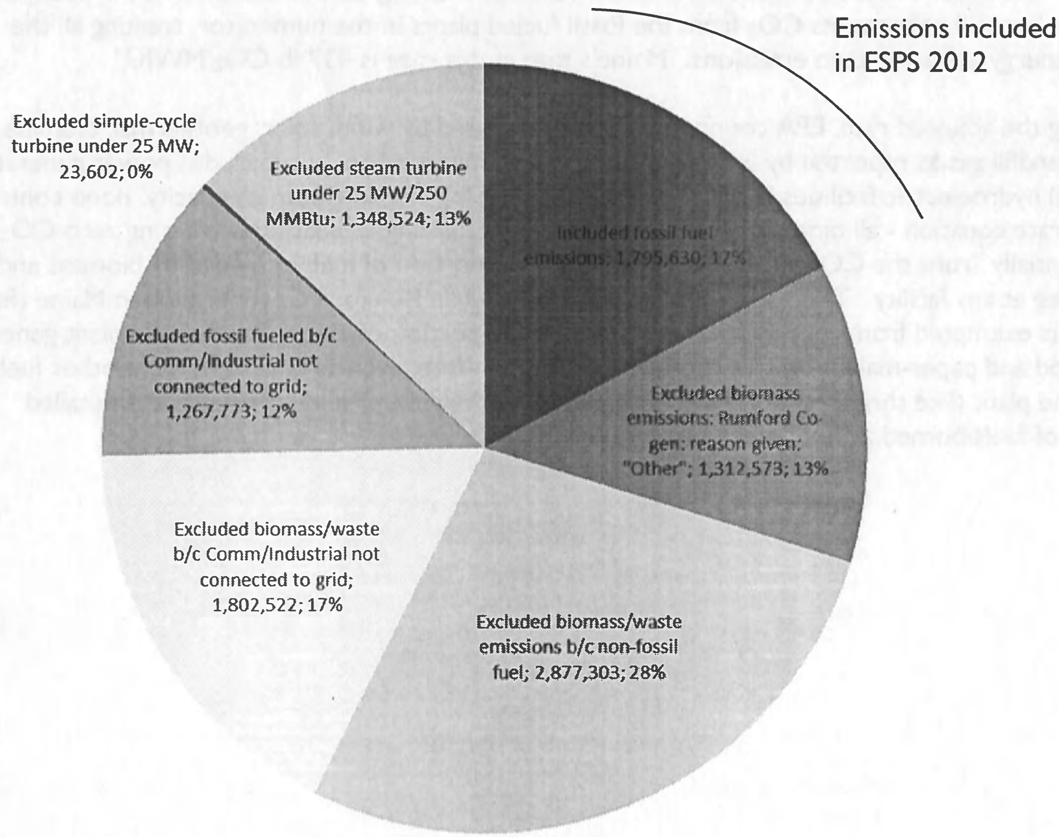

Figure 1. eGRID data on 2012 CO_2 emissions from the Maine power sector (tons, and percent contribution, corresponding to size of pie wedge).

In Maine, four fossil-fueled plants contribute the 17% of emissions initially regulated by the GHG rule. Of the excluded emissions, Rumford Cogeneration (a biomass-burning plant owned by NewPage Corporation), contributes 1.3 million tons of CO_2, 13% of eGRID's reported emissions for the state. Another 28% of reported emissions are contributed by facilities burning biomass and waste where emissions have not been included in the total because they occur at facilities burning less than 10% fossil fuels (these are the "standalone" biomass and waste-burning plants). Biomass/waste burners that are not connected to the grid, and are therefore not included in the EPA total, contribute a further 17% of emissions; similarly, 12% of emissions come from fossil-fueled plants not connected to the grid. Another 25% of emissions come from fossil-fueled facilities excluded because they are less than 25 MW in size. Not reported at all to eGRID are those facilities that burn fuels solely for thermal energy.

EPA's baseline and goal rates are skewed by the assumption that biomass is carbon neutral

To develop goal emissions rates for states, EPA first determines each state's baseline emissions rate from 2012 power sector data on emissions and generation. The "goal computation" technical support document actually presents two rates. First is the emissions rate from just the fossil fueled plants that are initially regulated under the rule, which in the case of Maine is derived from only four plants and is 873 lb CO_2/MWh. The second rate adds generation from renewable energy to the denominator of fossil-fueled rate (MWh), but still only counts CO_2 from the fossil fueled plants in the numerator, treating all the renewable energy as having zero emissions. Maine's rate in this case is 437 lb CO_2/MWh.[11]

In calculating the adjusted rate, EPA counts electricity generated by wind, solar, geothermal, biomass, waste, and landfill gas as reported by Energy Information Administration, but excludes power generated at conventional hydroelectric facilities.[12] While all these technologies contribute electricity, none contribute CO_2 in the rate equation - all biomass, waste, and landfill gas burning is treated as emitting zero CO_2. The system essentially "runs the CO_2 meter backwards" for the portion of fuels provided by biomass and waste-burning at any facility. This means, for instance, that while Rumford Cogeneration in Maine (featured in Figure 1) is exempted from regulation under the rule, the portion of electricity that the plant generates burning wood and paper-making wastes is credited as carbon-free, even as emissions from other fuels burned at the plant (like shredded tires) are unregulated by the rule. Table 3 presents the detailed breakdown of fuels burned at Rumford Cogeneration in 2012.

[11] U.S Environmental Protection Agency. Goal Computation Technical Support Document for the CAA Section 111(d) Emission Guidelines for Existing Power Plants Docket ID No. EPA-HQ-OAR-2013-0602. June, 2014. Page 25. http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents

[12] U.S Environmental Protection Agency. Alternative RE Approach Technical Support Document. http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule-technical-documents. Table 1.3 on page 11 is the version of the renewable energy generation totals where conventional hydroelectric power is excluded. Plugging these numbers in to the emissions calculation produces an emissions rate that matches the rate presented in the Goal Computation Document on page 25.

Reported Fuel Type	Physical Unit Label	Total Fuel Consumption Quantity	Electric Fuel Consumption Quantity	Total Fuel Consumption MMBtu	Elec Fuel Consumption MMBtu	Net Generation (Megawatthours)	Percent of Total
Bituminous Coal	short tons	31,769	6,032	810,183	153,809	30,392	5%
Black Liquor	**short tons**	**715,330**	**137,114**	**8,208,219**	**1,573,399**	**311,103**	**50%**
Distillate Fuel Oil (Diesel, No. 1, No. 2, and No. 4 Fuel Oils)	barrels	0	0	0	0	0	0%
Residual Fuel Oil (No. 5, No. 6 Fuel Oils, and Bunker C Fuel Oil)	barrels	25,954	4,621	162,215	28,871	5,703	1%
Sludge Waste	**short tons**	**41,295**	**7,825**	**465,439**	**88,211**	**17,420**	**3%**
Tire-derived Fuels	short tons	126,205	24,182	3,912,355	749,646	148,234	24%
Wood/Wood Waste Solids (paper pellets, railroad ties, utility poles, wood chips, bark, and other wood waste solids)	**short tons**	**337,412**	**64,945**	**2,868,002**	**552,024**	**109,176**	**18%**

Table 3. Energy Information Administration data on fuels burned at NewPage Corporation's Rumford Cogeneration plant in 2012. Electricity generated by burning the fuels highlighted in grey is credited as carbon-free in calculating the 2012 baseline power sector emissions rate for Maine. EPA reports total emissions from the plant as over 1.3 million tons in 2012.

What is the role for bioenergy under the greenhouse gas rule?

States have a great deal of flexibility under the GHG rule as to how they meet emissions reduction goals. EPA's approach is to offer states a menu of options for reducing greenhouse gas emissions, which in addition to the building blocks of increased efficiency at coal plants and new renewable energy, also includes greater dispatch of natural gas plants and increased demand side efficiency. EPA models and projects potential outcomes of the rule using the Integrated Planning Model (IPM) which is designed to seek optimal, least cost scenarios for power sector development, given initial sets of constraints. EPA used IPM to model a "Base Case," representing development of the power sector if the GHG rule is *not* adopted,[13] and scenarios representing implementation of the rule with state versus regional goals and goal implementation over differing timeframes.

EPA's modeling shows almost no new biomass power development by 2030

EPA's modeling is not prescriptive in any sense, but it does map out optimal, least cost pathways that states could follow. It is thus interesting that the IPM scenarios of modeling implementation of the greenhouse gas rule actually show very *low* levels of biopower sector development. This is because while EPA models

[13] http://www.epa.gov/airmarkets/powersectormodeling/cleanpowerplan.html

existing biomass energy facilities as continuing to operate, the model excludes development of new biomass burning facilities as states seek to achieve emissions reductions goals. A technical document explains:[14]

"1.3. RE Target Generation Methodology by Technology Type
This section describes the methodology employed to produce target generation levels for each state by technology type. The RE technology types that contribute to each state's target generation level are utility-scale solar, onshore wind, conventional geothermal (hydrothermal), hydropower, and select ***existing*** *biopower capacity types."*

Bioenergy development under EPA's modeling for GHG rule implementation is indeed essentially flat. As shown in Figure 2, biopower buildout under both the State Option 1 modeling scenario (under which GHG reduction targets are achieved by 2030) and State Option 2 runs (under which GHG reductions are slightly less aggressive than under Option 1 by the year 2020[15]), are both lower than for the Base Case, under which the GHG rule is not implemented.

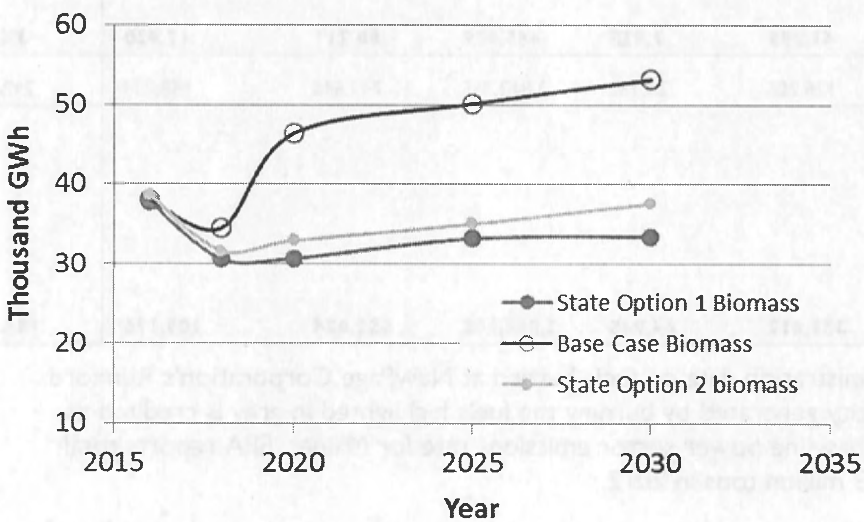

Figure 2. Biopower development under the Base Case (no GHG rule) and two GHG rule implementation scenarios, as predicted using EPA's IPM model.

Data from the Energy Information Administration (EIA) reveal that the whole bioenergy industry in the U.S. generated about 37.8 thousand gigawatt-hours (GWh) of electricity in 2012.[16] Under the IPM scenarios for State Option 1 and State Option 2, bioenergy generation in 2030 decreases to 33 and 37 thousand GWh, respectively, while the Base Case generation is 53 thousand GWh in 2030.[17]

Figure 3 demonstrates that EPA's projections of biomass buildout, even under the Base Case, are also low relative to projections from the Energy Information Administration's modeling. The EIA uses the National

[14] U.S. Environmental Protection Agency. Alternative Renewable Energy Approach Technical Support Document. Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Docket ID No. EPA-HQ-OAR-2013-0602, June 2014.
[15] Environmental Protection Agency. 40 CFR Part 60: Carbon pollution emission guidelines for existing stationary sources: electric generating units; proposed rule. Federal Register Vol. 79 No. 117, June 18 2014, page 34931
[16] Energy Information Administration. Annual Generation. State Historical Tables for 2013, December 2013.
[17] These numbers are obtained by summing the "biomass" and "biomass co-firing" values on the "summary" tab of the "ssr" spreadsheets provided by EPA for each scenario. These are available for download at http://www.epa.gov/airmarkets/powersectormodeling/cleanpowerplan.html

Energy Modeling System (NEMS) to develop its Annual Energy Outlook (AEO). Each year, the AEO "reference case" modeling shows actual energy sector development for the preceding two years, then forecasts future development. Forecasts can vary widely year to year. Comparing the EPA's IPM projections for the GHG rule (which start in 2016) to EIA's AEO forecasts, it can be seen that the EPA's Base Case projection tracks EIA's 2012 reference case scenario until about 2025, but shows lower capacity thereafter. The State Option 1 scenario is lower after about 2018 than all of EIA's recent AEO projections.

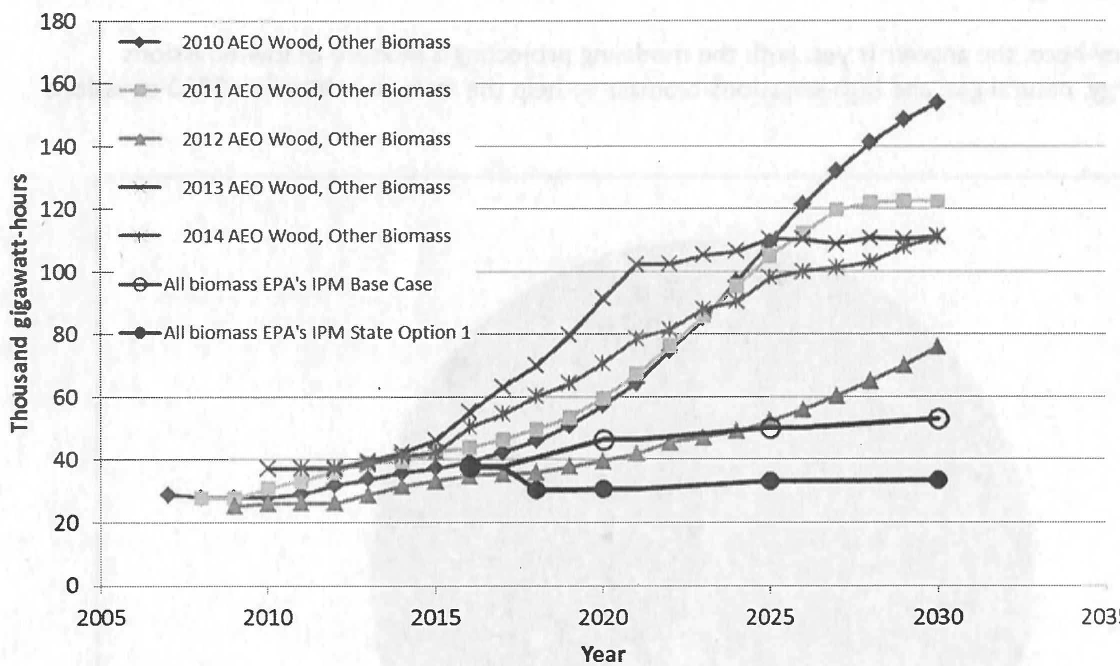

Figure 3. EPA's predictions for bioenergy development contrasted with EIA's predictions.

Why doesn't EPA's modeling show more biomass power development?

EPA's decision to exclude new biomass power development from its forward-looking modeling is obviously not prescriptive, but it does reflect some realities about costs and impacts of biomass energy.

EPA's modeling counts biomass energy emissions

First, EPA has counted actual stack emissions from bioenergy in its forward-looking modeling, which probably explains in part why little new bioenergy capacity is included, since growing the industry is counterproductive to reducing emissions. The modeling treats biomass but as a high-carbon fuel with emissions of 195 lb CO2/MMBtu,[18] a rate that translates approximately one ton of forest wood emitting

[18] EPA's Integrated Planning Model (IPM) modeling files in support of the ESPS rule are available at http://www.epa.gov/airmarkets/powersectormodeling/cleanpowerplan.html. The "State Option 1" zipped directory contains the "Proposed Clean Power Plan_Option1 State_rpe file.xls" file, which contains the CO_2 emission factors (in lb/MMBtu) assigned to each fuel type by the model. Biomass is assigned an emissions factor of 195 lb/MMBtu, whereas municipal waste (and landfill gas) are assigned an emissions factor of zero.

one ton of CO2 when burned.[19] (The modeling still treats biogenic waste burning as having zero emissions.) Under this scheme, any net reductions in lifecycle CO_2 emissions that do occur over time (see Appendix 2) are a "bonus" – but the model doesn't depend on them occurring in its determination of how states can meet their target goals. This is a sound modeling decision, for while it means that the modeling does not match EPA's equation for determining state-level goal emissions rates, it is useful because it answers the questions, "What happens if under EPA's carbon accounting framework, or due to legal reasons, all bioenergy emissions must be counted? Can states still achieve their renewable energy goals with minimal bioenergy?"

In Maine, as elsewhere, the answer is yes, with the modeling projecting a mixture of low-emissions renewable energy, natural gas, and high-emissions biomass to help the state to achieve its 2030 emissions goal (Figure 4).

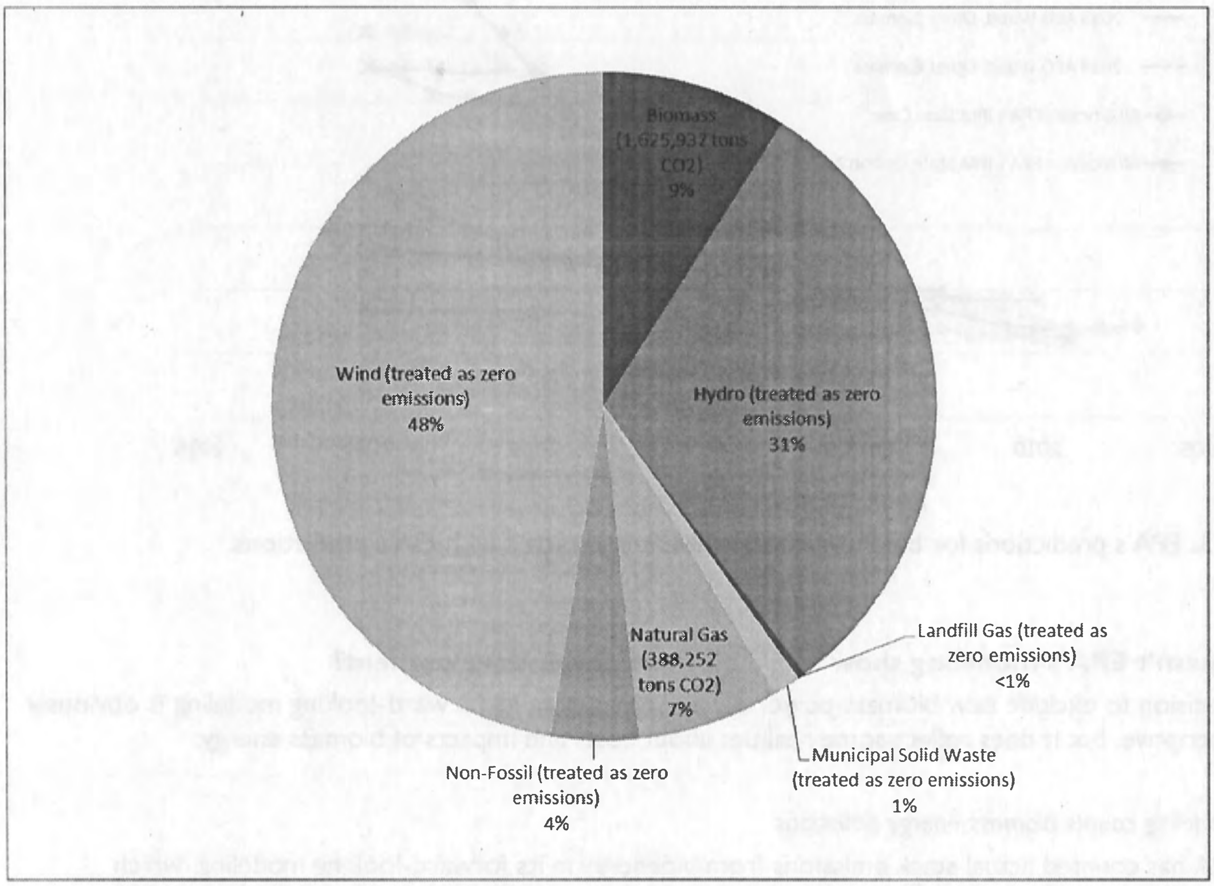

Figure 4. EPA's optimal, least-cost projection for Maine's power sector in 2030. The percentages (and size of pie wedges) refer to the proportion of power generated.

Under the modeling scenario for Maine, biomass provides the majority of the state's power sector CO_2 emissions in 2030 (while the modeling treats biogenic municipal waste burning as zero emissions, the

[19] A previous version of this summary incorrectly stated that EPA's IPM modeling treated biomass as having zero emissions, due to the incorrect assumption that EPA calculated 2012 rates and future goal rates using the same equation and assumptions. We regret the error.

contribution of waste burning to the total mix is low). The modeling does contain some flawed assumptions, and only covers a relatively small portion of the state's power sector. However, the fact that bioenergy-heavy Maine can achieve the emissions goals even while constraining new bioenergy development and counting full stack emissions from existing plants is a rebuttal to biomass industry arguments that new bioenergy buildout is necessary for achieving renewable energy goals.

At the same time, the large percentage of biomass burners that is excluded from regulation (Figure 1) shows how little the existing industry has to fear from the GHG rule, at least in Maine. The biomass industry has always been careful to avoid the 250 MMBtu fossil-fuel limit, to avoid regulation as fossil-fueled plants under other EPA rules. These include the NSPS set for particulate matter emissions at fossil-fueled electric utility boilers, and the triggering provisions for Prevention of Significant Deterioration permitting (whereby if a boiler receives more than 250 MMBtu heat input from fossil fuels, it is regulated as a fossil-fueled unit where PSD permitting is triggered by emissions of 100 tons of a criteria pollutant, rather than the 250 tons of emissions that trigger PSD permitting at biomass-fueled boilers).[20] Similarly, most biomass-burning plants are exempted from regulation under the GHG rule because they don't receive more than 250 MMBtu heat input from fossil fuels, or because they are commercial/industrial units that are not connected to the grid. Giving the existing biomass industry even less cause for concern about the rule, EPA's modeling demonstrates that even biomass-heavy Maine can achieve its emissions reduction target while counting emissions from ongoing operation of existing biomass facilities.

Biomass availability is limited

Besides the decision to count stack emissions, there are a number of other factors that may inherently limit deployment of new bioenergy capacity in the modeling for the GHG rule, among them fuel availability. EPA based their initial estimates of renewable energy capacity on a "renewable energy potential" study by the National Renewable Energy Laboratory (NREL).[21] Table 4, taken from that report, shows the technical potential for different forms of renewable energy, with technical potential meaning that almost all constraints are removed – for instance, under this analysis, a given area of land is considered "available" for all uses simultaneously. The estimate for biopower capacity is notably low, compared to other technologies, and even so, it's probably a significant overestimate, because not only does NREL's estimate include all forms of biopower (including methane collection from human and animal waste) but it considers that *all* biomass is available to generate combustion-biopower, rather than being collected for use as ethanol feedstock. Even with these assumptions, biopower is considered to have only 1.5% the generation potential of onshore wind (500 TWh versus 32,700 TWh).

[20] See http://www.pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf for a summary of some of the ways that biomass facilities are regulated differently from fossil-fueled boilers.

[21] Lopez, A. et al. U.S. renewable energy technical potentials: a GIS-based analysis. National Renewable Energy Laboratory Technical Report NREL/TP-6A20-51946. July, 2012.

Table ES-1. Total Estimated U.S. Technical Potential Generation and Capacity by Technology

Technology	Generation Potential (TWh)[a]	Capacity Potential (GW)[a]
Urban utility-scale PV	2,200	1,200
Rural utility-scale PV	280,600	153,000
Rooftop PV	800	664
Concentrating solar power	116,100	38,000
Onshore wind power	32,700	11,000
Offshore wind power	17,000	4,200
Biopower[b]	500	62
Hydrothermal power systems	300	38
Enhanced geothermal systems	31,300	4,000
Hydropower	300	60

[a] Non-excluded land was assumed to be available to support development of more than one technology.
[b] All biomass feedstock resources considered were assumed to be available for biopower use; competing uses, such as biofuels production, were not considered.

Table 4. NREL's technical analysis for renewable energy capacity in the United States.

Further, the NREL technical potential estimates are unrealistic for yet another reason – they are based on an NREL study of biomass availability in the United States that assumes that crop residues are a likely fuel,[22] although these materials are notoriously problematic as fuel for combustion biopower. The study assessed potential biomass availability in each state, examining the categories of crop residues, forestry residues, "urban" wood, and mill residues. Crop residues make up the bulk of the biomass considered to be potentially available for biomass power generation in the study, outweighing forestry residues[23] by a factor of 2.8 and urban wood by a factor of 5.1. This is why, in NREL's assessment of technical potential for biomass power generation, the states of Ilinois, Indiana, Iowa, Missouri, Nebraska, and Ohio – not exactly known for their forestry resources – provide a combined total of 16 GW of the potential overall biopower capacity of 62 GW (26%).[24] The problem with all this supposedly available crop-based biomass and the biopower capacity it potentially supports is that very few biomass plants or coal plants can actually burn crop residues for fuel, as is shown by the fact that almost every one of the biomass power plants currently being proposed and built around the country plans to burn wood as fuel.[25] Crop residues are dirty and contain relatively high amounts of potassium and other elements that foul emissions controls. Collection, processing, and storage of these materials is expensive, a fact that EPA acknowledges in its IPM modeling by

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[22] Milbrandt, A. A geographic perspective on the current biomass resource availability in the United States. National Renewable Energy Laboratory, Technical Report NREL/TP-560-39181. December, 2005.

[23] The category of "forest residues" in the Milbrandt report unequivocally includes whole tree harvesting. It includes "logging residues and other removals. Logging residues are the unused portions of trees cut, or killed by logging, and left in the woods. Other removals are considered trees cut or otherwise killed by cultural operations (e.g. pre-commercial thinning, weeding, etc.) or land clearings and forest uses that are not directly associated with round wood product harvests." (Milbrandt, 2005, page 18).

[24] Lopez, A. et al. U.S. renewable energy technical potentials: a GIS-based analysis. National Renewable Energy Laboratory Technical Report NREL/TP-6A20-51946. July, 2012. Data from Table 8, page 16.

[25] Forisk Wood Energy US database, May 6, 2014.

attaching not only a $12/dry ton surcharge on all types of biomass for transport, but also a $20/ton surcharge for storage of crop residue-derived biomass fuels, since they can only be collected at certain times of the year and must be stored in quantity until they are needed.[26]

Even if treated as carbon neutral, bioenergy is a costly way to "reduce" CO_2 emissions

In addition to biomass fuel costs, which are perpetual (in contrast to the "fuels" of wind and solar energy, which are perpetually free) biomass power plants are expensive to build and require substantial and ongoing infrastructure investments. EPA's IPM documentation document contains the data reproduced in Table 5,[27] which shows the costs of building new infrastructure. Bioenergy is substantially more expensive than onshore wind, per kilowatt-year, including both the initial infrastructure investment and ongoing "fixed" costs (the annual expense of maintaining a unit) and "variable" costs (expenses associated with operating units, including for pollution controls).

Table 4-16 Performance and Unit Cost Assumptions for Potential (New) Renewable and Non-Conventional Technology Capacity in EPA Base Case v.5.13

	Biomass-Bubbling Fluidized Bed (BFB)	Geothermal	Landfill Gas LGHI	Landfill Gas LGLo	Landfill Gas LGVLo	Fuel Cells	Solar Photovoltaic	Solar Thermal	Onshore Wind	Offshore Wind
Size (MW)	50	50	50			10	150	100	100	400
First Run Year Available	2018	2018	2016			2016	2016	2016	2016	2018
Lead Time (Years)	4	4	3			3	2	3	3	4
Availability	83%	87%	90%			87%	90%	90%	95%	95%
Generation Capability	Economic Dispatch	Economic Dispatch	Economic Dispatch			Economic Dispatch	Generation Profile	Generation Profile	Generation Profile	Generation Profile
	Vintage #1 (2016-2054)					Vintage #1 (2016)				
Heat Rate (Btu/kWh)	13,500	30,000	13,648	13,648	13,648	9,246	9,756	9,756	9,756	9,756
Capital (2011$/kW)	4,041	1,187 - 15,752	8,408	10,594	16,312	7,117	3,364	4,690	2,258	6,298
Fixed O&M (2011$/kW/yr)	103.79	50 - 541	381.74	381.74	381.74	357.47	21.37	66.09	38.86	72.71
Variable O&M (2011$/MWh)	5.17	0.00	8.51	8.51	8.51	0.0	0.0	0.0	0.0	0.0

Table 5. EPA's IPM model assumptions for the costs of building new renewable energy infrastructure. Biomass energy costs substantially exceed those of onshore wind.

As explained above, biomass co-firing is also costly. EPA provides a detailed treatment of the costs and logistics of biomass co-firing at coal plants, finding that even if biogenic CO_2 emissions are treated as zero, the "reductions" in fossil fuel CO_2 emissions at coal plants co-firing 10% biomass ranges from $30 - $80 per ton of CO_2, concluding

"*Replacing some coal with low levels of biomass co-firing may result in stack CO_2 increases.* ***Even if biogenic CO_2 emissions are not counted as part of stack emissions, biomass co-firing is a relatively costly approach to CO_2 reductions at existing coal steam boilers when compared to other measures*** *such as heat rate improvements and re-dispatch of generation supply to other existing capacity with lower CO_2 emissions rates.*"[28]

Combined, fuel costs, infrastructure costs, and maintenance costs can quickly drive bioenergy costs to an uneconomic level where the IPM model is likely to "choose" lower cost renewable energy options over bioenergy.

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[26] U.S. Environmental Protection Agency. Documentation for EPA Base Case v.5.13 Using the Integrated Planning Model. Page 11-2.
[27] Ibid, page 4-32.
[28] U.S. Environmental Protection Agency. Technical Support Document for Carbon Pollution Guidelines for Existing Power Plants. GHG Abatement Masures, page 6-16.

EPA isn't giving up on bioenergy

While the IPM modeling does not project development of new biomass capacity, EPA suggests that the biomass energy industry can still be developed by the states as they seek to meet emissions reduction goals - (emphasis added) –

"*EPA notes that RE target generation levels are used solely to inform each state's goal calculation and are not prescriptive of any RE compliance outcome – either in sum or by technology type. Consequently, whether or not any particular RE technology is considered in this Alternative RE Approach* ***does not have any bearing on what types of RE generation a state may consider in developing its state plan for complying with its state goal***"[29]

A footnote to this section additionally emphasizes,

"*Existing dedicated biomass and landfill gas facilities contribute to RE target generation levels. The analysis in this TSD does not consider biomass renewables in its evaluation of renewable development potential for BSER,* ***but the preamble discusses the possibility of a path for states to consider it in their plans***."

Thus, while EPA's own modeling does not plan for development in the bioenergy power sector, the rule leaves the door open for states to continue developing biomass power. But how will states account for emissions?

Future regulation of biogenic CO_2 emissions

However, EPA has indicated both in the NSPS and the ESPS rules that the Agency recognizes the importance of devising a carbon accounting framework for bioenergy that will properly account for lifecycle greenhouse gas emissions from burning biomass, especially wood. In the meantime, indications are that EPA supports the concept that burning waste wood and forestry residues has a lower lifecycle greenhouse gas impact than burning trees that are harvested for fuel. This direction is indicated in the Region 9 EPA response to comments on the recently issued PSD permit for the Sierra Pacific Anderson biomass facility in California. The document, issued in April 2014, states that EPA is still working on an accounting framework for bioenergy:

"*As previously stated, EPA is not currently prepared to classify any particular biomass feedstocks as a "clean fuel" or "inherently lower emitting" or to engage in a quantitative ranking and comparison of the net atmospheric contribution of such fuels*"[30]

but then goes on to say that fuels will be restricted at the plant to those with lower net emissions impacts (emphasis added):

"*The revision is intended to clarify that SPI will be limited to the following types of biomass fuels: mill residues; untreated wood debris from urban areas (e.g., pallets and crates); agricultural crops and residues; forest residues;*

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[29] U.S. Environmental Protection Agency. Alternative Renewable Energy Approach Technical Support Document. Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Docket ID No. EPA-HQ-OAR-2013-0602, June 2014.

[30] U.S. Environmental Protection Agency, Region 9. Responses to Public Comments on the Proposed Prevention of Significant Deterioration Permit Major Modification for Sierra Pacific Industries - Anderson Division. April, 2014. Page 10 (http://www.epa.gov/region9/air/permit/pdf/spi-anderson/spi-anderson-final-permit-public-comment-response-2014-04-25.pdf)

and non-merchantable forest biomass. ***EPA believes*** *that these revisions to Permit Condition X.G. will limit the facility to the types of biomass fuels that are* ***generally considered to have lower net atmospheric contributions when combusted****. In addition, the record reflects that SPI's proposed cogeneration project is not intended to use timber harvested solely for the purpose of biomass combustion. See Second Recirculated Draft EIR, February 2012, at 2.0-20. Nevertheless, in response to the commenter's concerns, EPA's revisions to Permit Condition X.G.* ***are intended to preclude the use of this type of feedstock.***"[31]

This decision suggests that EPA's thinking on the topic of bioenergy emissions is evolving in the direction laid out by the most current science, which recognizes that burning trees in power plants is highly counterproductive if the goal is to reduce energy sector greenhouse gas emissions.

Matters of practical implementation remain, however. Modeling shows that net CO_2 emissions from residues can be significant (the SAB report states that burning "residues" and waste wood can have a significant carbon impact;[32] for an explanation of why this is the case, see Appendix 2). Further, existing and proposed biomass plants currently do not just burn waste wood and "residues," [33] and there is a real danger that if wood waste is treated as having zero or negligible emissions, then *everything* will be defined as "waste." For instance, Dominion Energy in Virginia is converting three coal-fired power plants to burn wood, with total forest wood consumption around 2 million tons of forest wood per year (translating to just over 2 million tons of CO_2 emitted per year). A letter from Dominion to EPA's Science Advisory Board on biogenic carbon states that waste wood "*to us means forest materials including residues (tree tops, non-merchantable sections of stem, branches, and bark),* ***small trees*** *and other low value materials*"[34] (emphasis added). Covanta Energy, another operator of wood-fired biomass power plants (as well as municipal waste incinerators) distinguishes residues from whole tree chips but nonetheless treats whole tree chips as waste wood, stating that their Burney Mountain Power facility in California burns "waste" comprised of "forest residue, mill residue and **whole tree chips**."[35] Their website additionally states that they use "**logs from forest thinning**" for fuel.[36]

Could the GHG rule increase forest harvesting for biomass energy?

As demonstrated above, EPA has left the door open for states to propose bioenergy as a means to increase renewable energy capacity. The Agency is soliciting comment on deployment of bioenergy at the state level:

"*Beyond the types of state plan measures already discussed in this section of the preamble, the agency has identified a number of other measures that could also lead to CO_2 emission reductions from EGUs. These include, for*

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[31] Ibid, page 11

[32] The report states, "For logging residues and other feedstocks that decay over longer periods, decomposition cannot be assumed to be instantaneous… For residues, consider alternate fates (e.g., some forest residues may be burned if not used for bioenergy) and information about decay. An appropriate analysis using decay functions would yield information on the storage of ecosystem carbon in forest residues."

[33] Forest wood use for biomass fuel is growing so fast, and in so many categories, that the bioenergy tracking service Forisk has recently partitioned energy wood use into categories of "softwood pulpwood,", "hardwood pulpwood," "logging resdues/dirty chips," "urban wood," and "mill residues." Forisk Wood Energy US database, May 6, 2014.

[34] Pamela F. Faggert, Dominion Resources Services, Inc. Comments to the Science Advisory Board biogenic carbon emissions panel on its draft advisory report regarding EPA's accounting framework for biogenic CO_2 emissions from stationary sources. March 16, 2012.

[35] Other Renewable Energy Projects, Covanta website, (http://www.covantaenergy.com/what-we-do/our-services/other-renewable-energy.aspx).

[36] http://www.covantaenergy.com/what-we-do/our-services/other-renewable-energy.aspx

example, electricity transmission and distribution efficiency improvements, retrofitting affected EGUs with partial CCS, ***the use of biomass-derived fuels at affected EGUs,*** *and use of new NGCC units. Although the emission reduction methods discussed in this section are not proposed to be part of BSER, the agency anticipates that some states may be interested using these approaches in their state plans.* ***The agency solicits comment on whether these measures are appropriate to include in a state plan to achieve CO_2 emission reductions from affected EGUs.***"[37] (emphasis added)

Given that the EPA itself is supposed to be coming up with a framework for carbon accounting, and given that EPA solicited, and received, abundant comments on greenhouse gas emissions from bioenergy when it issued the biogenic C deferral, to say nothing of the extensive input during the US Court of Appeals case on the deferral and the expert input provided by the Science Advisory Board, for EPA to be soliciting *additional* comment on whether burning biomass can "reduce" greenhouse gas emissions seems somewhat superfluous. The Agency should have more than enough information now to produce a science-based carbon accounting framework.

Further, the lack of enforceable language in the GHG rule suggests that even if EPA does develop a carbon accounting framework for bioenergy, it could be difficult to get states to use it. The ESPS suggests it's likely that the states will deploy bioenergy:

"*Because of the positive attributes of certain biomass-derived fuels, the EPA also recognizes that biomass-derived fuels can play an important role in CO_2 emission reduction strategies. We anticipate that states likely will consider biomass-derived fuels in energy production as a way to mitigate the CO_2 emissions attributed to the energy sector and include them as part of their plans to meet the emission reduction requirements of this rule and we think it is important to define a clear path for states to do so.*"[38]

If EPA came out with a strong and decisive carbon accounting framework that acknowledged the true emissions from burning biomass, states that were serious about reducing emissions would eliminate large-scale bioenergy from their list of options, as Massachusetts has done and as Vermont is starting to do.[39] However, there is no indication in the rule that EPA has any means of enforcing a science-based carbon accounting framework at the state level. Indeed, the language around deployment of the carbon accounting framework is notably weak:

"*The EPA* ***expects*** *that the framework, when finalized, will be a resource that* ***could*** *help inform states in the development of their CAA section 111(d) plans.*"[40] (emphasis added)

Unfortunately, some of the states that are now experiencing the highest bioenergy development are also those states that are targeted by the rule to show the greatest reductions in power sector emissions rates. Ranked in descending order of the percent reduction required, Washington, South Carolina, Oregon, New Hampshire, and Georgia are all states that have entertained proposals or actually built large, low-efficiency, wood-burning power plants (see Appendix 1 for full list of states, EPA's current emission rate estimates, and target emission rates). These states, and the bioenergy developers therein, will no doubt pressure EPA to allow bioenergy as a means of "mitigating" power sector carbon emissions. Unless there is strong implementation of a carbon accounting framework, and rigorous oversight to ensure that only fuels with

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[37] Environmental Protection Agency. 40 CFR Part 60: Carbon pollution emission guidelines for existing stationary sources: electric generating units; proposed rule. Federal Register Vol. 79 No. 117, June 18 2014, page 34923
[38] Ibid, page 34924
[39] See http://www.pfpi.net/vermont-biomass-power-plant-denied-approval-on-basis-of-greenhouse-gas-emissions
[40] Ibid, page 34927

very low lifecycle greenhouse gas emissions are burned (thereby severely limiting development of the biomass industry) there is a real possibility that the GHG rule could actually increase forest harvesting for bioenergy, and commensurately, greenhouse gas emissions. This is especially true if states displace actual no-emissions renewable energy that would be built with biomass power. Meanwhile, the treatment of bioenergy as having zero carbon emissions in the GHG rule goal rate equation continues to promote the erroneous concept that burning biomass has no greenhouse gas impacts.

Is "beyond the fenceline" carbon offsetting for bioenergy allowable under the GHG rule?

Certain to become an issue of contention in the proposed greenhouse gas rule is the extensive use of "beyond the fenceline" mitigation measures for reducing greenhouse gas emissions, as EPA has recognized in its request for comments.[41] While the NSPS rule treats an individual power plant as the entity of concern, setting a fixed emissions standard that applies at the facility, the ESPS seeks a "best system of emission reduction" (BSER) for entities where the boundaries are less clear. Does increased use of low- or zero-emissions renewable energy (EPA's terms) somewhere in a state constitute a "reduction" in greenhouse gas emissions from that state's coal-fired plants? Can increased demand-side efficiency likewise constitute a reduction? These questions will no doubt be extensively argued and likely litigated as well.

Meanwhile, it is important to recognize that most claims for bioenergy as having "low" or "zero" carbon emissions *also* rely on "beyond the fenceline" mitigation. Biomass can't play a role in reducing greenhouse gas emissions at the time it is burned, because essentially all biomass fuels emit more CO_2 per unit energy generated than all fossil fuels. Thus, any claim that bioenergy emits less CO_2 than fossil fuels relies on calculation of net CO_2 emissions over time. Lifecycle GHG accounting can show lower net emissions for biomass than for fossil fuels, based on either the idea that fuels are waste that would decompose and inevitably emit CO_2 anyway, or that fuels are sourced from forests or crops that can regow and sequester an equivalent amount of CO_2 as emitted by burning. However, as neither process is instantaneous, no biomass energy can be instantaneously carbon neutral.

In fact, both justifications for eventual carbon neutrality of biomass energy are essentially **carbon offset schemes**, in that they assume that a process occurring in some other place, and at some future time, compensates for CO_2 emissions from burning biomass now (see Appendix 2 for modeling of typical time periods required for bioenergy CO_2 emissions to be offset). Can the GHG rule accommodate a scenario whereby it is acceptable to increase powerplant or grid-wide emissions by substituting biomass for fossil fuels, based on the idea that emissions will eventually be offset? Does EPA have the jurisdiction under the GHG rule to discriminate between stack emissions at the present time – which for every biomass fuel are greater than emissions from coal, per megawatt-hour – and "net" emissions in the future, which are calculated assuming that emissions are offset?

In a narrower context, but also pertaining to Clean Air Act implementation, the US Court of Appeals has already weighed in on the question of whether offsetting of bioenergy greenhouse gas emissions constitutes a reduction. Much of the court's reasoning for ruling against EPA's deferral of biogenic CO_2 regulation turned on the plain meaning of the word "emit," and the fact that the Clean Air Act regulates stack emissions of power plants and other stationary sources. However, a concurrent opinion issued with the main ruling also explained that the Clean Air Act *forecloses* any "offsetting" approach – i.e., taking off-site carbon sequestration into account as a compensating factor that can mitigate a power plant's emissions –

[41] Environmental Protection Agency. 40 CFR Part 60: Carbon pollution emission guidelines for existing stationary sources: electric generating units; proposed rule. Federal Register Vol. 79 No. 117, June 18 2014, page 34888

because " *The statute does not allow EPA to exempt those sources' emissions of a covered air pollutant just because the effects of those sources' emissions on the atmosphere might be offset in some other way.*"[42]

The EPA may have already internalized this lesson with regard to the ability of states to use actual carbon offsets as a means of mitigating power sector emissions under the GHG rule, whereby, for instance, a forest and its carbon sequestration capacity is preserved to compensate for a fossil fuel plant's CO_2 emissions. The ESPS rule is initially somewhat ambiguous as to whether the GHG rule allows offsets, but, an assessment included in a technical support document seems to clearly prohibit use of offsets for mitigation:

"*For emission budget trading programs that regulate EGUs and include offsets, which we define here as emissions reductions from sources not regulated by the trading program,* ***emissions reductions from offsets would not be counted*** *when evaluating CO_2 emission performance of affected EGUs, because those reductions would not come from those affected EGUs*"[43]

The prohibition on use of offsets may provide some guidance for the parallel issue of bioenergy emissions offsetting. If EPA does not intend to allow actual offsets under the rule, then it is hard to see how biomass emissions that rely on offsite regrowth of fuels can be allowable, especially when most power plant operators do not own or otherwise control the forest lands where future carbon sequestration is ostensibly to occur.

The situation with regard to "waste" materials that would decompose anyway may be more ambiguous. The offsetting of emissions from burning true wastes simply relies on time, and the assumption that decomposition would be emitting greenhouse gases anyway if the material were not burned for fuel. In this case, as decomposition can take years to decades, and net emissions from biomass burning will almost always exceed "anyway" emissions from decomposition over multiple years (see Appendix 2), the question is simply whether the ESPS rule can count hypothetical reductions in emissions that will occur at some future time as a real reduction in emissions now.

[42] *Center for Biological Diversity v. EPA*, D.C. Cir. No. 11-1101, July 12, 2013; Concurrence page 3.
[43] U.S. EPA. Projecting EGU CO_2 Emission Performance in State Plans. Technical Support Document (TSD) for Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units. Docket ID No. EPA-HQ-OAR-2013-0602, June 2014. Page 37.

Appendix 1: EPA's current and target emissions rates for states ranked by emission reduction required under the GHG rule[44]

	current fossil rate	fossil + nukes + RE	block 1	block 1&2	1&2&3	1&2&3&4	% reduction
Washington	1,379	756	728	444	298	215	72%
Arizona	1,551	1,453	1,394	843	814	702	52%
South Carolina	1,791	1,587	1,506	1,342	866	772	51%
Oregon	1,081	717	701	565	452	372	48%
New Hampshire	1,119	905	887	710	532	486	46%
Georgia	1,598	1,500	1,433	1,216	926	834	44%
Arkansas	1,722	1,634	1,554	1,058	996	910	44%
New York	1,096	978	970	828	652	549	44%
New Jersey	1,035	928	916	811	616	531	43%
Minnesota	2,013	1,470	1,389	999	1,042	873	41%
North Carolina	1,772	1,647	1,560	1,248	1,125	992	40%
Louisiana	1,533	1,455	1,404	1,043	978	883	39%
Tennessee	2,015	1,903	1,797	1,698	1,322	1,163	39%
Texas	1,420	1,284	1,235	979	861	791	38%
Florida	1,238	1,199	1,169	882	812	740	38%
Virginia	1,438	1,302	1,258	1,047	894	810	38%
Massachusetts	1,001	925	915	819	661	576	38%
Mississippi	1,140	1,093	1,071	809	752	692	37%
Maryland	2,029	1,870	1,772	1,722	1,394	1,187	37%
Oklahoma	1,562	1,387	1,334	1,053	964	895	35%
Colorado	1,959	1,714	1,621	1,334	1,222	1,108	35%
South Dakota	2,256	1,135	1,067	732	900	741	35%
Nevada	1,091	988	970	799	720	647	35%
Wisconsin	1,988	1,827	1,728	1,487	1,379	1,203	34%
New Mexico	1,798	1,586	1,513	1,277	1,163	1,048	34%
Illinois	2,189	1,894	1,784	1,614	1,476	1,271	33%
Idaho	858	339	339	339	291	228	33%
Delaware	1,255	1,234	1,211	996	892	841	32%
Michigan	1,814	1,690	1,603	1,408	1,339	1,161	31%
Pennsylvania	1,627	1,531	1,458	1,393	1,157	1,052	31%
Connecticut	844	765	764	733	643	540	29%
Ohio	1,897	1,850	1,751	1,673	1,512	1,338	28%
Utah	1,874	1,813	1,713	1,508	1,454	1,322	27%
Alabama	1,518	1,444	1,385	1,264	1,139	1,059	27%
Nebraska	2,162	2,009	1,889	1,803	1,652	1,479	26%
Alaska	1,368	1,351	1,340	1,237	1,191	1,003	26%
California	900	698	697	662	615	537	23%
Kansas	2,320	1,940	1,828	1,828	1,658	1,499	23%
Missouri	2,010	1,963	1,849	1,742	1,711	1,544	21%
Montana	2,439	2,246	2,114	2,114	1,936	1,771	21%
Indiana	1,991	1,924	1,817	1,772	1,707	1,531	20%
West Virginia	2,056	2,019	1,898	1,898	1,687	1,620	20%
Wyoming	2,331	2,115	1,988	1,957	1,771	1,714	19%
Kentucky	2,166	2,158	2,028	1,978	1,947	1,763	18%
Iowa	2,197	1,552	1,461	1,304	1,472	1,301	16%
Hawaii	1,783	1,540	1,512	1,512	1,485	1,306	15%
Rhode Island	918	907	907	907	867	782	14%
Maine	873	437	437	425	451	378	14%
North Dakota	2,368	1,994	1,875	1,875	1,865	1,783	11%

[44] U.S Environmental Protection Agency. Goal Computation Technical Support Document for the CAA Section 111(d) Emission Guidelines for Existing Power Plants Docket ID No. EPA-HQ-OAR-2013-0602. June, 2014.

Appendix 2: Technical information on CO_2 from biomass energy

Carbon dioxide emissions from power plants

All fuels produce CO_2 when burned. The general assumption is that all carbon in the fuel is converted to CO_2, though in fact, some small fraction is emitted as carbon monoxide (CO) and other carbon-containing compounds such as volatile organics.

CO_2 emissions from power plants are typically expressed in units of pounds of CO_2 per megawatt-hour of electricity produced (lb CO_2/MWh).

How much CO_2 does burning wood emit?

Biomass power plants may burn a variety of fuels, including energy crops, crop residues, wood, and "wood-derived fuels," the residuals from pulp and papermaking.[45] However, the overwhelming majority of new biomass power plants now being proposed burn wood. The rest of this factsheet assumes that wood is the main fuel burned for biomass.

Green wood when it is harvested can be more than 50% water by weight. A typical industry assumption is that wood is 45% water by weight. Of the 55% "bone dry" mass that is left after subtracting water weight, around 50% is carbon.[46] The conversion factor for carbon to CO_2 during combustion is the molecular weight of CO_2 (44) divided by the molecular weight of carbon (12).

The full conversion equation thus reveals that burning one ton of "green" wood at 45% moisture content emits just over one ton of CO_2:

1 ton green wood * 0.55 ton bone dry wood/ton green wood * 0.5 ton carbon/ton bone dry wood *44 tons $CO_2 \div 12$ tons carbon = 1.008 tons CO_2

How much CO_2 does a biomass power plant emit?

To compare the amount of CO_2 emitted by biomass power plants versus a same-sized coal or gas plant, the CO_2 emissions need to be expressed using a common currency, rather than in terms of the pounds or tons of fuel burned.

The CO_2 per megawatt-hour produced at any power plant is a function of two main factors:

- The amount of CO_2 emitted by the fuel when it is burned, relative to its energy content, or "heat content" in million Btu (lb CO_2/MMBtu)
- Facility efficiency (MMBtu output of useful energy divided by MMBtu of fuel input). The lower the efficiency of the facility, the more fuel that has to be burned to produce a given amount of "useful" energy.

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[45] These wastes are high in moisture content and therefore low in energy, but they are an important fuel for the industries where they are generated, and use of them as fuel solves the industry's disposal problems.

[46] The assumption of 50% carbon content is an oversimplification, as species vary in carbon content (http://www.sciencedirect.com/science/article/pii/S0961953403000333; also http://is.muni.cz/el/1423/podzim2013/MEB423/um/Wood_Combustion_Lesson_02.pdf) but it is a representative average that is widely used. See for instance http://www.epa.gov/burnwise/workshop2011/WoodCombustion-Curkeet.pdf

AMERICAN LUNG ASSOCIATION

PUBLIC POLICY POSITION

POSITION TITLE: **Energy**
DATE REVISED: **June 25, 2015**

Policy Principle on Energy

The use of energy is essential to the growth and functioning of the U.S. economy and for the quality of life enjoyed in the United States. However, certain energy practices, fuel sources and technologies place a heavy toll on human health and the environment, impacting the lives of millions of - people, including those who are most vulnerable to harm. The American Lung Association strongly supports measures to prevent lung disease, reduce the incidence and exacerbation of lung disease. The American Lung Association believes that protection of lung health and a sound U.S. energy policy are compatible goals that require an emphasis on energy conservation, energy efficiency, and the use of cleaner energy resources, including a transition from coal and oil to cleaner alternatives. Our overarching principles call for the implementation of effective air quality programs and standards, transitioning to a clean energy future, with a commitment to promote environmental justice.

Promoting Effective Air Quality Programs and Standards

To ensure the protection of human health, the American Lung Association supports the rigorous enforcement of air pollution regulations, and the strengthening of air quality standards and abatement requirements.

The American Lung Association believes that all energy production facilities should use state-of-the-art pollution control technologies to protect public health and the environment. All facilities should meet the same rigorous standards of environmental performance, including both new and existing facilities.

Transitioning to a Clean Energy Future

The American Lung Association supports state and federal policies that will drive the deployment of the cleanest and most fuel-efficient energy resources and technologies. Such policies should promote the use of non-combustion renewable energy, low carbon fuels (measured on a lifecycle basis), expanded transmission and smart grid technologies, alternative forms of transportation, and energy storage. These programs and policies may include financial incentives, funding for research and development, and other measures to accelerate the deployment of alternative energy technologies.

The American Lung Association does not support the construction of new advanced coal-based generating facilities, including carbon capture and sequestration and integrated gasification combined cycle plants.

Natural Gas-based Electricity

The American Lung Association supports public policies requiring the installation and operation of state-of-the-art pollution control systems, including leakage detection and emissions monitoring, at new and existing natural gas-fired power plants. The American Lung Association supports systems, equipment and policies to protect public health and safety, air, water, and other environmental resources during the exploration, extraction (including hydraulic fracturing), production, transmission and use of natural gas.

Nuclear Electricity

Before nuclear generating capacity is expanded, the American Lung Association believes that two key thresholds must be met. First, the expansion of capacity must be economically viable without direct government subsidies. Second, the nuclear industry must demonstrate that it can reduce the continuing risks to safety and the environment. The American Lung Association supports measures to improve the health and safety of uranium mine workers, and the communities where they live, including protection from harmful air pollutants.

Non-Combustion Renewable Electricity

The American Lung Association supports policies and incentives that will encourage the development and deployment of clean, renewable energy resources that are not combustion-based, including, but not limited to, wind, solar and geothermal. The American Lung Association supports reforms to transmission and distribution policies that will encourage the expansion and delivery of clean, renewable, non-combustion energy resources. The American Lung Association supports additional research and development of advanced technologies that facilitate the expanded use of renewable energy, including improvements to energy storage capabilities. The American Lung Association supports improving the efficiency and output of existing hydroelectric power facilities.

Biomass Combustion for Electricity

The American Lung Association does not support biomass combustion for electricity production, a category that includes wood, wood products, agricultural residues or forest wastes, and potentially highly toxic feedstocks, such as construction and demolition waste. If biomass is combusted, state-of-the-art pollution controls must be required.

Electricity from Waste

The American Lung Association does not support incineration of municipal solid waste or other waste for electricity production. The American Lung Association supports programs and policies to reduce the health and environmental impacts associated with refuse disposal by: first, reducing the use of materials in production, packaging and purchasing; second, reusing materials whenever possible; and third, recycling or

Impacts of Thinning on Carbon Stores in the PNW: A Plot Level Analysis

Joshua Clark, John Sessions,
Olga Krankina, Thomas Maness

Final Report

College of Forestry
Oregon State University
25 May 2011

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Executive Summary

This report provides an analysis of forest carbon stores, fluxes and avoided emissions directly related to fuel reduction thinnings for sample plots in eastern and western Oregon.

Primary Goals

- Determine the level of on-site carbon storage under different thinning prescriptions and in different forest types.
- Analyze plot-level forest carbon pools and carbon fluxes over a 50-year period. Compare alternative thinning treatments with a no thinning scenario.
- Estimate the amount of carbon transferred to harvested wood products, carbon emissions of biomass burning for energy production, and avoided carbon emissions from not burning fossil fuels.
- Determine if revenue from harvested wood products from the thinning treatment could pay for the thinning under specified market and harvest unit assumptions for one thinning scenario (the "breakeven" scenario).

Methods

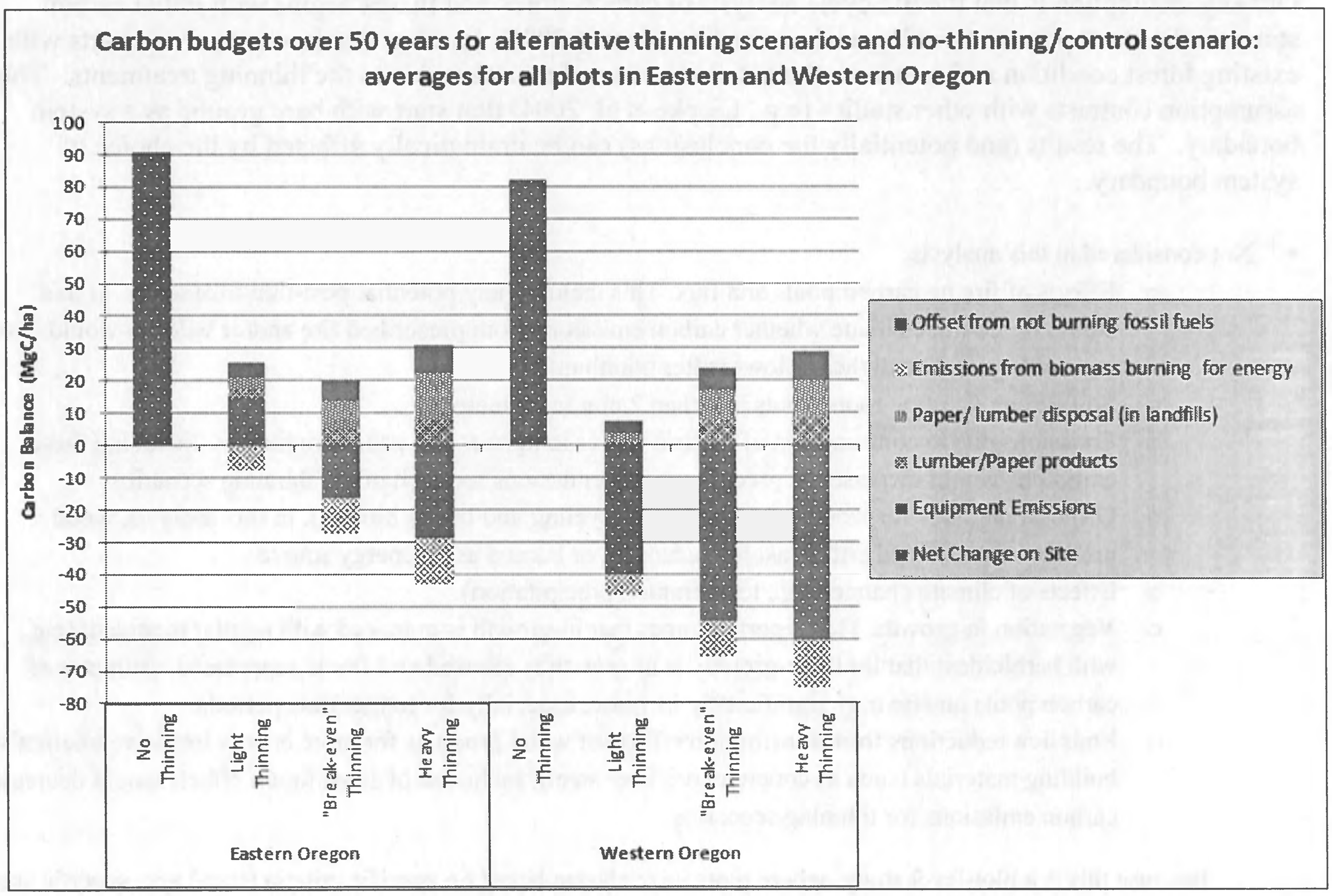
- Plots were chosen from the Forest Inventory and Analysis (FIA) National Program and the Current Vegetation Survey (CVS) to represent a range of common landscape types with stand conditions that show a potential for fuel reduction.
- Plots were all from Oregon, including the Eastern Cascade, Western Cascade, and Blue Mountain regions. A wide range of stand ages was included (21-269 years for Eastern Oregon/Blue Mountains and 10-220 years for Western Oregon).
- Thinning scenarios were developed to meet specified torching and crowning thresholds. All simulated thinnings use a "thin from below" (low thinning) approach. A control (no harvest scenario) is compared to different treatments.
- Carbon pools were estimated using the Fire and Fuels Extension (FFE) of the Forest Vegetation Simulator (FVS) with manual adjustments and additions to address known model limitations.
- Estimated harvest costs were based on the Fuel Reduction Cost Simulator (FRCS-West). Estimated timber revenues were based on ODF data.

Findings

- Forest carbon pools always immediately decreased as a result of a fuel reduction thinning, with larger differences in total carbon pools resulting from heavier thinning treatments.
- After thinning, forest carbon pools (both total and standing live aboveground) remain lower throughout a 50-year period for all simulated plots in eastern and western Oregon. The difference in total carbon pools between a thinned and unthinned plot is dependent on the level of live standing tree inventory reduction. A heavier thin tends to reduce carbon pools more than lighter thins throughout a 50-year simulated period.
- Carbon pool estimates for thinned stands were still lower than unthinned stands even after accounting for carbon transfer to wood products and avoided emissions from fossil fuels for energy production. After simulating growth

in the stands for 50 years the average difference in net carbon balance between unthinned and thinned plots for the three age groups ranged between 73.5– 103.4 MgC/ha in Eastern Oregon to 121.8 – 128.6 MgC/ha in Western Oregon. Carbon losses on site account for the bulk of the effect of thinning on carbon. Carbon retention in wood products and avoided emissions from fossil fuels tend to offset the equipment emissions and emissions from burning biomass for energy, but not the loss of carbon from forest on site.

- The following figure (adapted from Table 15) shows that, regardless of the single-entry thinning regime used, the "No Thinning" scenario resulted in the most carbon remaining on-site following 50 years. The figure accounts for emissions from equipment and emissions from biomass burning, and also accounts for paper/lumber products sequestered after 50 years, and offsets from burning biomass for energy instead of fossil fuels. The "Net Change" in the graph includes all gains and losses in carbon on-site 50 years after either no thinning, or 50 years following a thinning from a single entry.



- For the plots examined, it is generally possible to reach specific fuel reduction goals with revenues exceeding treatment costs. There are notable exceptions in younger plots, particularly in plots with relatively few larger trees (as measured by DBH). If administrative costs are included, treatment costs may exceed harvest revenues on federal lands. Financial viability is significantly affected by many stand-dependent variables, including current stand structure, average distance of wood from roadside, average distance of stand to mill/plant, and current market prices.

- Burning biomass from forest fuel reduction thinnings results in avoided carbon emissions from fossil fuels. Due to relatively low energy density, biomass has greater carbon emissions from the boiler per energy unit produced (CO_2 emissions per kWh or BTU produced) when compared to carbon emissions from fossil fuels (coal, natural gas) per energy unit produced.
- All thinning scenarios on all plots without exception resulted in a significant loss of carbon relative to a no-thinning scenario. This suggests that the findings may be applicable to other forest types and thinning prescriptions.

Key Assumptions and Limitations

Our key assumption is that the life cycle analysis of carbon stores and fluxes begins with initial carbon stores in the stand prior to thinning as described by Maness 2009. In other words, our analysis starts with existing forest condition and measures the net change in carbon stores due to the thinning treatments. This assumption contrasts with other studies (e.g., Lippke et al. 2004) that start with bare ground as a system boundary. The results (and potentially the conclusions) can be dramatically affected by the choice of system boundary.

- Not considered in this analysis:
    - Effects of fire on carbon pools and flux. This includes any potential post-thin treatments. In this study, we do not estimate whether carbon emissions from prescribed fire and/or wildfire would (over repeated cycles) be higher or lower after thinning.
    - Soil carbon and fine roots (roots less than 2 mm in diameter).
    - Emissions due to consumption of electric power in lumber and paper production. Including these emissions would increase the greenhouse gas emissions for each of the thinning scenarios.
    - Disposal methods for wood products (e.g., recycling and use as biofuel). In this analysis, wood products are assumed either taken to a landfill or burned as an energy source.
    - Effects of climate change (e.g., temperature, precipitation).
    - Vegetation in-growth. This report assumes that in-growth is managed with regular treatment (e.g., with herbicides) that limits in-growth. If in-growth is allowed and fire is suppressed, estimates of carbon pools on-site may significantly increase, especially for longer time periods.
    - Emission reductions from substitution effects of wood products for more energy intensive alternative building materials (such as concrete, brick, or steel). Inclusion of substitution effects would decrease carbon emissions for thinning scenarios.

Because this is a plot-level study, where plots were chosen based on specific criteria (stand age, specific stand structures, specific dominant species), study results cannot be extrapolated directly to a regional analysis. The analysis assumes that there is no re-entry onto the site in the next 50 years. The stand projection is shown for illustrative purposes only; it is not intended to be a management prescription.

Agricultural burning, like this farmer's burning of rice straw, contributes significantly to climate change and adverse health effects, according to a study by Stanford Professor Mark Z. Jacobson. (Photo: Shutterstock)

Stanford Report, July 31, 2014

Stanford study shows effects of biomass burning on climate, health

Stanford professor's calculations indicate that wildfires and other types of fires involving plant matter play a much bigger role in climate change and human health than previously thought.

BY GLEN MARTIN

Biomass burning – whether accidental wildfires or deliberate burning of forests to create agricultural lands – has long been known to affect both climate change and public health.

But until the release of a new study by Stanford Civil and Environmental Engineering Professor Mark Z. Jacobson, the degree of that contribution had never been comprehensively quantified.

Jacobson's research, detailed in a paper published on July 30 in the *Journal of Geophysical Research: Atmospheres,* is based on a three-dimensional computer model simulation of the impacts of biomass burning. His findings indicate that burning biomass is playing a much bigger role in climate change and human health issues than previously thought.

"We calculate that 5 to 10 percent of worldwide air pollution mortalities are due to biomass burning," he said. "That means that it causes the premature deaths of about 250,000 people each year."

Carbon factor

Carbon, of course, is associated with global warming. Most carbon emissions linked to human activity are in the form of carbon dioxide gas (CO_2). But other forms of carbon include methane and the particles generated by fires – tiny bits of soot, called black carbon, and motes of associated substances, known as brown carbon.

Jacobson explained that total anthropogenic, or human-created, carbon dioxide emissions, excluding biomass burning, now stand at more than 39 billion tons annually. That incorporates everything associated with non-biomass-burning human activity, from coal-fired power plants to automobile emissions, from concrete factories to cattle feedlots.

Jacobson, the director of Stanford's Atmosphere/Energy Program and a senior fellow at the Stanford Woods Institute for the Environment and the Precourt Institute for Energy, said that almost 8.5 billion tons of atmospheric carbon dioxide – or about 18 percent of all anthropogenic carbon dioxide emissions – come from biomass burning.

But Jacobson's research also demonstrates that it isn't just the CO_2 from biomass burning that's a problem. Black carbon and brown carbon maximize the thermal impacts of such fires. They essentially allow biomass burning to cause much more global warming per unit weight than other human-associated carbon sources.

Black and brown carbon particles increase atmospheric warming in three ways. First, they enter the minuscule water droplets that form clouds. At night, that's not an issue. But during the day, sunlight scatters around within clouds, bathing them in luminescence.

When sunlight penetrates a water droplet containing black or brown carbon particles, Jacobson said, the carbon absorbs the light energy, creating heat and accelerating evaporation of the droplet. Carbon particles floating around in the spaces between the droplets also absorb scattered sunlight, converting it to heat.

combusting biomass.

"The direct heat generated by burning biomass is significant, and contributes to cloud evaporation by decreasing relative humidity," Jacobson said. "We've determined that 7 percent of the total net warming caused by biomass burning – that is, 7 percent of the 0.4 degree Celsius net warming gain – can be attributed to the direct heat caused by the fires."

Biomass burning also includes the combustion of agricultural and lumber waste for energy production. Such power generation often is promoted as a "sustainable" alternative to burning fossil fuels. And that's partly true as far as it goes. It is sustainable, in the sense that the fuel can be grown, processed and converted to energy on a cyclic basis. But the thermal and pollution effects of its combustion – in any form – can't be discounted.

"The bottom line is that biomass burning is neither clean nor climate-neutral," Jacobson said. "If you're serious about addressing global warming, you have to deal with biomass burning as well."

Exposure to biomass burning particles is strongly associated with cardiovascular disease, respiratory illness, lung cancer, asthma and low birth weights.

MEDIA CONTACT
Tom Abate, School of Engineering: (650) 736-2245, tabate@stanford.edu

Dan Stober, Stanford News Service, (650) 721-6965, dstober@stanford.edu

org/) WOODS HOLE RESEARCH CENTER

Ranked #1 climate think tank in the world.

Letter to the Senate on carbon neutrality of forest biomass

February 24, 2016

The letter below was sent to 10 U.S. senators who are working on the Energy Policy Modernization Act. The Senate has accepted an amendment to the act which would legally designate forest biomass to be "carbon neutral." This means that U.S. Federal agencies would be required to assume that burning wood (instead of coal) to generate electricity emits no greenhouse gases to the atmosphere, even though this is not the case. As our letter states, it is never good to legislate scientific fact, and especially bad when those facts are wrong.

February 22, 2016

Dear Majority Leader Mitch McConnell, Minority Leader Harry Reid, Chairwoman Lisa Murkowski, and Ranking Member Maria Cantwell:

We are 65 research scientists and practitioners who study energy, soils, forested and wetland ecosystems and climate change. We are writing in our individual capacities to express our concern over the implications of a "forest biomass carbon neutrality" Senate Amendment 3140 to the Energy Policy Modernization Act that was recently accepted by the US Senate.

This well-intentioned legislation, which claims to address climate change, would in fact promote deforestation in the U.S. and elsewhere and make climate change much worse.

The amendment would require all federal departments and agencies to promote consistent policies that "reflect the carbon neutrality of forest bioenergy and recognize biomass as a renewable energy source." Mandating that there are no carbon dioxide emissions from burning wood from forests
to produce energy does not make it so in fact.

The consequence of the amendment is to encourage a shift to forest biofuels in the form of pellets and wood chips to replace coal in the generation of electricity. Wood burning power plants are becoming more numerous in the United States and in the European Union. The US Department of Commerce and the US Forest Service are
promoting expanded export of American wood pellets for this purpose to Europe and to Asia. Burning any carbon containing substance whether biomass or fossil fuels releases carbon dioxide into the atmosphere. Burning forest biomass to make electricity
releases substantially more carbon dioxide per unit of electricity than does coal. Removing the carbon dioxide released from burning wood through new tree growth requires many decades to a century, and not all trees reach maturity because of drought, fire, insects or land use conversion. All the while the added carbon dioxide is in the atmosphere trapping heat. Right now, large areas of American forests including old growth trees are being cleared for pellets that are shipped to Europe and burned to produce electricity that is counted there as zero carbon. There is no requirement in the amendment that trees used for bioenergy be replaced. International obligations require the United States to account for bioenergy emissions from either the energy sector or as land-use change.

While forest biomass energy may be renewable over the long-term, it is not a low-carbon source of energy like solar panels. Using the same amount of land area, solar panels produce up to 80-times as much electricity as wood burning with no emissions at all. Yet with this amendment, both might receive the same subsidy under the Act. Furthermore, fossil fuel emissions associated with producing bioenergy (harvesting, chipping, drying, pelletizing and transporting) are

equivalent to 20-25% of direct emissions, and under this legislation these emissions are unaccounted for.
Forest bioenergy as currently produced also competes with land for other forest products including timber, paper and agriculture. Promoting forest biomass therefore encourages additional deforestation.

Granting carbon amnesty to forest biomass burning for energy could lead to significant depletion of US forests. The potential implications of declaring carbon neutrality for forest biofuels are great because even small quantities of bioenergy require large quantities of wood. The US Energy Information Agency estimates that for each 1% added to current US electricity production from forest biomass an additional 18% increase in US forest harvest is required. This policy would also encourage the destruction of forests in developing countries that would see the US as an export market. This would undermine international attempts to protect tropical forests in these countries through the programs agreed to in Paris.
This amendment puts forest carbon in the atmosphere contributing to climate change instead of keeping it in living, productive forests that provide multiple benefits of water and wetland protection, flood control, soils protection, wildlife habitat, improved air quality and recreational benefits for hunters and all who enjoy being in the great out-of-doors. Legislating scientific facts is never a good idea, but is especially bad when the "facts" are incorrect. We urge you and other members of the Senate to reconsider this well-intentioned legislation and eliminate the misrepresentation that forest bioenergy is carbon-neutral.

We respectfully request an opportunity to inform you and other Senators of the scientific evidence for the appropriate accounting of forest bioenergy emissions. You could perform a great service by proposing and enacting legislation that effectively addresses climate change by enhancing the capacity of forests to reduce the amount of carbon dioxide entering the atmosphere. Any number of us would be willing to testify or to assist you and your staff in meeting the climate challenge with scientifically sound actions.

Sincerely,

Philip B. Duffy, Ph.D. President and Executive Director Woods Hole Research Center pduffy@whrc.org 508-444-1504

Prof. Emeritus William R. Moomaw, Ph.D., Co-Director Global Development and Environment Institute, Tufts University
william.moomaw@tufts.edu 617-335-3994

William Schlesinger, Ph.D., President Emeritus, Cary Institute
schlesingerw@caryinstitute.org

cc Olivia Kurtz, Senator Collins' Energy legislative Council, James Springer, Senator King's Energy legislative Council, Anne Knapke, Senator Klobuchar's Energy legislative Council and Blaise Sheriden, Senator Franken's Legislative Council

Viney P. Aneja, Ph.D.
Professor Air Quality
Professor Environmental Technology
North Carolina State University

Loretta Battaglia, Ph.D.
Secretary General, Society of Wetland Scientists
Associate Professor of Wetland Ecology
Southern Illinois University

Mary S. Booth, Ph.D.
Director
Partnership for Policy Integrity

Jonah Busch, Ph.D.
Senior Fellow, Center for Global Development
Washington, DC.

Ken Caldeira, Ph.D.
Senior Scientist
Department of Global Ecology
Carnegie Institution for Science

Eric Chivian, M.D.
Founder and Former Director
The Center for Health and the Global Environment
Harvard Medical School

James Clark, Ph.D.
Nicholas School of the Environment
Duke University

Jeffrey Corbin, Ph.D.
Associate Professor
Union College

Eric A. Davidson, Ph.D.
Professor and Director Appalachian Laboratory
University of Maryland Center for
Environmental Science

Steven J. Davis, Ph.D.
Assistant Professor
Dept. of Earth System Science
University of California, Irvine

Saara J. DeWalt, Ph.D.
Associate Professor
Clemson University

David Foster, Ph.D.
Director, Harvard Forest
Harvard University

Peter Frumhoff, Ph.D.
Director of Science and Policy
Union of Concerned Scientists

James Galloway, Ph.D.
Sidman P. Poole Professor
Department of Environmental Sciences
University of Virginia

Scott Goetz, Ph.D.
Deputy Director and Senior Scientist
Woods Hole Research Center

Mark E. Harmon, Ph.D.
Richardson Chair and Professor
Oregon State University

Sarah Hobbie, Ph.D.
Professor, Department of Ecology, Evolution and Behavior
University of Minnesota

Richard A. Houghton, Ph.D.
Senior Scientist and George M. Woodwell Chair for Global Ecology
Woods Hole Research Center

Robert M. Hughes,
President, International Fisheries Section
American Fisheries Society

Deborah Lawrence, Ph.D.
Environmental Sciences
University of Virginia

Gene E. Likens, Ph.D.
Distinguished Research Professor
University of Connecticut
Special Advisor to the University President on Environmental Affairs
Cary Institute of Ecosystem Studies
Founding Director and President Emeritus

Richard N. Mack, Ph.D.
Professor Emeritus
School of Biological Sciences
Washington State University

Jerry Melillo, Ph.D.
Distinguished Scientist
The Ecosystems Center
Marine Biological laboratory

Susan Natali, Ph.D.
Associate Scientist
Woods Hole Research Center

James E. Perry, Ph.D., PWS
Immediate Past President, Society of Wetland Scientists
Professor of Marine Science
Virginia Institute of Marine Science
College of William and Mary

Jennifer Powers, Ph.D.
Associate Professor
Dept. of Ecology, Evolution, and Behavior
University of Minnesota

Jonathan Sanderman, Ph.D.
Associate Scientist
Woods Hole Research Center

Herman H. Shugart, Ph.D.
W.W. Corcoran Professor
Department of Environmental Sciences
University of Virginia

James R. Strittholt, Ph.D.
President/Executive Director
Conservation Biology Institute

Richard H. Waring, Ph.D.
O.S.U. Distinguished Professor Emeritus of Forest Ecosystems
Oregon State University

Matt R. Whiles, Ph.D.
Professor of Zoology
President, Society for Freshwater Science
Director, SIU Center for Ecology
Interim Director, Cooperative Wildlife Research Laboratory
Southern Illinois University

George M. Woodwell, Ph.D.
Founder
Woods Hole Research Center

Henry W. Art, Ph.D.
Samuel Fessenden Professor of Biology
Williams College

Matthew Berman, Ph.D.
Professor of Economics
University of Alaska Anchorage

Mark Bradford, Ph.D.
Associate Professor of Terrestrial Ecosystem Ecology
Yale University

Robert Cabin, Ph.D.
Professor of Ecology and Environmental Science
Brevard College

Julia Cherry, Ph.D.
Treasurer, Society of Wetland Scientists
Associate Professor of Interdisciplinary Sciences and Wetland Ecology
University of Alabama

Norm L. Christensen, Ph.D.
Professor Emeritus and Founding Dean
Nicholas School of the Environment
Duke University

Steve Colt, Ph.D.
Professor of Economics
University of Alaska Anchorage

Gretchen C. Daily, Ph.D.
Bing Professor of Environmental Science
Stanford University

Gillian T. Davies, M.E.S., PWS,
Registered Soil Scientist, NHCWS
President Elect, Society of Wetland Scientists

David Dethier, Ph.D.
Edward Brust Professor of Geology and Mineralogy
Department of Geosciences
Williams College

Aaron M. Ellison, Ph.D.
Senior Research Fellow in Ecology, Harvard Forest
Harvard University

Andrew J. Friedland, Ph.D.
Richard and Jane Pearl Professor of Environmental Studies
Adjunct Professor of Biological Sciences and Earth Sciences
Dartmouth College

Paul W. Gabrielson, Ph.D.
President, Phycological Society of America
Adjunct Assistant Professor of Biology
University of North Carolina, Chapel Hill

Andrew George, Ph.D.
Community Engagement Research Associate
University of North Carolina at Chapel Hill

Matthew C. Hansen, Ph.D.
Professor
Department of Geographical Sciences
University of Maryland

John Harte, Ph.D.
Professor of Ecosystem Sciences
ERG/ESPM
University of California at Berkeley

R. Max Holmes, Ph.D.
Senior Scientist
Woods Hole Research Center

Robert W. Howarth, Ph.D.
David R. Atkinson Professor of Ecology and Environmental Biology
Cornell University
Editor-in-Chief, Limnology & Oceanography
Founding Editor, Biogeochemistry

Malcolm L. Hunter, Jr, Ph.D.
Professor of Wildlife Ecology
Libra Professor of Conservation Biology
University of Maine, Orono

John Lichter, Ph.D.
Professor of Biology and Environmental Studies
Bowdoin College

Thomas Lovejoy, Ph.D.
Senior Fellow, United Nations Foundation
Professor, Environmental Science and Policy
George Mason University

James McCarthy, Ph.D.
Alexander Agassiz Professor of Biological Oceanography
Department of Earth and Planetary Sciences and
Department of Organismic and Evolutionary Biology
Harvard University

Jacqueline Mohan, Ph.D.
Associate Professor
Terrestrial Ecosystem Ecology & Biogeochemistry
University of Georgia

Neil Pederson, Ph.D.
Senior Ecologist, Harvard Forest
Harvard University

Kimberli J. Ponzio, M.S., PWS
President, Society of Wetland Scientists

G. Philip Robertson, Ph.D.
University Distinguished Professor
Dept. of Plant, Soil, and Microbial Sciences
Michigan State University

Timothy D. Searchinger, J.D.
Research Scholar
Woodrow Wilson School
Science, Technology and Environmental Program
Princeton University

Miles Silman, Ph.D.
Andrew Sabin Professor of Conservation Biology
Wake Forest University

Richard Thomas, Ph.D.
Professor and Chair of Biology
West Virginia University

Alan S. Weakley, Ph.D.
Adjunct Associate Professor
Director, UNC Herbarium

Herb Wilson, Ph.D.
Arey Professor of the Biosciences
Department of Biology
Colby College

Societies

Phycological Society of America
Paul W. Gabrielson, Ph.D., President

Society of Wetland Scientists,
Kimberli J. Ponzio, M.S., PWS, President

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Our Location

Address 149 Woods Hole Road
Falmouth, MA, 02540-1644

Contact info@whrc.org (mailto:info@whrc.org)
Phone 508-540-9900
Fax 508-540-9700

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Email (mailto:info@whrc.org)

particles are largely deposited in the deep lung (alveolar regions), where they penetrate the blood stream and can have systemic effects.

What is the Evidence of the Impact of Fine Particles on Mortality?

In the mid 1970's, Dr. Dockery and colleagues began the Six Cities Study.[18] This study investigated the effects of air pollution on mortality in random sample of people in six cities across the country. The six cities included two "heavily polluted" cities (Steubenville, OH and St. Louis, MO), two "moderately polluted" cities (Watertown, MA and Harriman, TN), and two "clean cities" (Topeka, KS and Portage, WI). Individuals enrolled in the study were asked about their health status, their smoking history, their occupational history as well as a range of other disease risk factors. The study followed participants or their families for 16 years to ascertain survival information. It found that individuals living in the two "heavily polluted" cities were dying at a faster rate (i.e., years earlier) than those in the two "clean cities". Those living in the "moderately polluted" cities died faster than those in the "clean cities," but more slowly than those in the "heavily polluted cities." After adjusting for a range of risk factors (e.g., age, sex, cigarette smoking, occupation, education and obesity), the study found that life expectancy decreases with increasing concentration of $PM_{2.5}$ in ambient air.

National Ambient Air Quality Standards for $PM_{2.5}$

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) is required to: (a) identify air pollutants that are anticipated to endanger health, (b) issue air quality criteria which accurately reflect the latest science on public health impacts, (c) set standards to protect health with adequate margins of safety, and (d) routinely review the data every five years. In 1997, EPA established an annual standard of $PM_{2.5}$ of 15 ug/m^3—roughly the same as the level observed in Watertown, MA, one of the "moderately polluted" cities in which study participants died prematurely relative to those living in "clean" cities in the Six Cities Study.[19] In 2006, the daily $PM_{2.5}$ standard was reduced to 35 ug/m^3.[20]

In a 2010 analysis of $PM_{2.5}$ air quality data, EPA found that 62 counties, home to 26% of the U.S. population, are not in compliance with the $PM_{2.5}$ standards. Nine counties in the Northeast (13% of the U.S. population) are not in compliance.[21] [22] These are primarily in the major metropolitan areas of New York, New Jersey and Pennsylvania where industrial and mobile pollution are the primary sources of

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[18] Dockery DW, Pope CA, Xiping X, et al. An association between air pollution and mortality in six U.S. cities, *N Engl J Med.* 1993;329:1753.

[19] The annual $PM_{2.5}$ standard is met when the annual average of the quarterly mean $PM_{2.5}$ concentrations is less than or equal to 15 μg/m^3 (3-year average).

[20] The 24-hour $PM_{2.5}$ standard is met when the 98th percentile value is less than or equal to 35 μg/m^3 (3-year average)

[21] See: Schmidt M, Hassett-Sipple B, Rajan P. *PM2.5 Air Quality Analyses. Memorandum to PM NAAQS review docket. EPA-HQ-OAR-2007-0492.* July 22, 2010. Available at: http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_2007_td.html. Accessed: September 15, 2012.

[22] In a subsequent 2011 analysis, EPA estimated that all Northeast counties would be in compliance with $PM_{2.5}$ standards. See: Schmidt M. *Air Quality Analyses—Update. Memorandum to PM NAAQS review docket. EPA-HQ-OAR-2007-0492.* April 15, 2011. Available at: http://www.epa.gov/ttnnaaqs/standards/pm/data/Schmidt041511.pdf. Accessed: September 15, 2012.

concern for $PM_{2.5}$ emissions. Residential wood biomass burning plays a large role in other locations that are also out of compliance, such as areas in Montana.

Since $PM_{2.5}$ was first regulated in the U.S. in 1997, ambient levels have steadily decreased in response to increasingly stringent standards under the Clean Air Act. Levels of other criteria air pollutants (PM_{10}, NO_2, SO_2, CO, lead and O_3) have also decreased. Thus, the Clean Air Act has resulted in the majority of U.S. residents being able to breathe air that is substantially cleaner than it was 30 years ago.

Has Cleaner Ambient Air Resulted in Measurable Improvements to Health?

Dr. Dockery and colleagues recently evaluated associations between life expectancy and fine-particulate air pollution in 51 metropolitan areas in the US.[23] They compared data from 1979 to 1982 with matched data for the period 1997 to 2001. Even within the first time period, the study revealed what the earlier Six Cities Study had found: increasing levels of fine particulate air pollution were associated with lower life expectancy. The data two decades later revealed that levels of fine particulate pollution had decreased significantly and that life expectancy had increased across the 51 metropolitan areas.

In addition, the study affirmed the association between lower life expectancy and higher levels of fine particulate air pollution when life expectancy in communities with higher levels of fine particulate pollution was compared with life expectancy in communities with lower levels during the same time period. A decrease of 10 ug/m^3 in the concentration of fine particulate matter was associated with an estimated increase in average life expectancy of 0.6 years. For comparison, life expectancy is estimated to be 6.8 years shorter for the average smoker. If one-fifth of the population are current smokers, the decrease in average life-expectancy would be one-fifth of 6.8 years, or 1.6 years. Compare this to the estimated loss of 0.6 years due to $PM_{2.5}$ air pollution, which affects nearly 100% of the population.

These data suggest that there is no indication of a bright line below which $PM_{2.5}$ concentration will not affect health. The study of the 51 communities suggests that continued improvements in life expectancy are associated with reductions in fine particulate pollution even when they fall below average annual concentrations of 15 ug/m^3. The robustness of the association shows that the corollary is also true: even at levels below 15 ug/m^3, fine particulate pollution is associated with reduced life expectancy.

Consistent with Clean Air Act requirements for regular review of ambient air quality standards to take into account emerging science, EPA has been reviewing new evidence since the annual $PM_{2.5}$ standard was last revised in 2006. Based on this review and recommendation of its Clean Air Science Advisory Committee (CASAC), EPA is expected to lower the current $PM_{2.5}$ standards in 2012. The Agency is considering reducing the annual standard from 15 ug/m^3 to somewhere in the range of 11 - 13 ug/m^3, and reducing the 24-hr standard to 30 ug/m^3.[24]

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[23] Pope III CA, Ezzati M, Dockery DW. Fine-particulate air pollution and life expectancy in the United States, *N Engl J Med* 2009; 360:376-386.

[24] In June 2012, U.S. EPA issued its proposed revisions to the PM2.5 standard. The proposed rule changes the annual standard from 15 ug/m^3 to 12-13 ug/m^3 and keeps the 24-hour standard the same at 35 ug/m^3.

Part II Timber Depletion (see instructions)

1 Name of block and title of account ▶

		(a) Quantity	(b) Cost or other basis
	If you express timber quantity in thousand board feet (MBF), log scale, name the log rule used. If another unit of measure is used, provide details ▶		
2	Estimated quantity of timber and cost or other basis returnable through depletion at end of the preceding tax year		
3	Increase or decrease of quantity of timber required by way of correction		
4a	Addition for growth (number of years covered ▶)		
b	Transfers from premerchantable timber account		
c	Transfers from deferred reforestation account		
5	Timber acquired during tax year		
6	Addition to capital during tax year		
7	Total at end of tax year, before depletion. Add lines 2 through 6		
8	Unit rate returnable through depletion, or basis of sales or losses. Divide line 7, column (b), by line 7, column (a)		
9	Quantity of timber cut during tax year		
10	Depletion for the current tax year. Multiply line 8 by line 9		
11	Quantity of standing timber sold or otherwise disposed of during tax year		
12	Allowable as basis of sale. Multiply line 8 by line 11		
13	Quantity of standing timber lost by fire or other cause during tax year		
14	Allowable basis of loss plus any excess amount where decrease in FMV (before and after the casualty) exceeds the standard depletion amount, but not the block basis (see instructions)		
15	Total reductions during tax year:		
a	In column (a), add lines 9, 11, and 13		
b	In column (b), add lines 10, 12, and 14		
16	Net quantity and value at end of tax year. In column (a), subtract line 15a from line 7. In column (b), subtract line 15b from line 7		

17 Quantity of cut timber that was sold as logs or other rough products

18 **Section 631(a):**

a Are you electing, or have you made an election in a prior tax year that is in effect, to report gains or losses from the cutting of timber under section 631(a)? (see instructions) ☐ Yes ☐ No

b Are you revoking your section 631(a) election (see instructions)? ☐ Yes ☐ No

Effective date ▶

Part III Profit or Loss From Land and Timber Sales (see instructions)

1 Name of block and title of account

2 Location of property (by legal subdivisions or map surveys)

3a Purchaser's name and address | b Date of sale

4 Amount received: a In cash	
b In interest-bearing notes	
c In non-interest-bearing notes	
5a Amount of other consideration	
b Explain the nature of other consideration and how you determined the amount shown on line 5a:	
6 Total amount received for property. Add lines 4a, 4b, 4c, and 5a	

7 Cost or other basis of property:	Unit	Number of units	Cost or other basis per unit	Total cost or other basis
a Forested land	Acre			
b Nonforested land	Acre			
c Improved land (describe) ▶	Acre			
d Merchantable timber. Estimate in detail the quantity of merchantable timber on the date of sale or exchange. Include the quantity of timber in each species of timber by diameter at breast height (DBH) classes. State the log rule used if the unit of measure is thousand board feet (MBF), log scale. If another unit of measure is used, provide details. ▶				
e Premerchantable timber				
f Improvements (list separately)				
g Mineral rights				
h Total cost or other basis. Add lines 7a through 7g				
i Direct sale expenses (cruising, marking, selling)				
8 Profit or loss. Subtract the sum of lines 7h and 7i from line 6				

Frequently Asked Questions About Biomass Energy

Center for Biological Diversity

Q: Doesn't renewable energy, including biomass, reduce fossil fuel emissions?
A: "Renewable" doesn't mean "low-carbon." In fact, burning wood for electricity releases more CO_2 per megawatt of energy than burning coal, and far more CO_2 than burning natural gas. This is because wood is less energy-dense, and contains more moisture, than fossil fuels. Measured at the smokestack, replacing fossil fuels with biomass actually *increases* CO_2 emissions.[1]

Q: But isn't biomass combustion "carbon neutral"?
A: No. The climate can't tell the difference between "biogenic" and fossil CO_2.[2] And CO_2 from combustion of trees remains in the atmosphere—and warms the climate—for decades or even centuries, even if the trees eventually grow back. Multiple studies have shown that it can take a very long time for new biomass growth to recapture the carbon emitted by combustion, even where fossil fuel displacement is assumed, and even where "waste" materials like timber harvest residuals are used for fuel.[3] This is known as the "carbon debt" of bioenergy.

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[1] Typical CO_2 emission rates for facilities:

Gas combined cycle	883 lb CO_2/MWh
Gas steam turbine	1,218 lb CO_2/MWh
Coal steam turbine	2,086 lb/CO_2/MWh
Biomass steam turbine	3,029 lb CO_2/MWh

Sources: EIA, Electric Power Annual, 2009: Carbon Dioxide Uncontrolled Emission Factors. Efficiency values used to calculate emissions from fossil fuel facilities calculated using EIA heat rate data. (http://www.eia.gov/cneaf/electricity/epa/epat5p4.html); biopower efficiency value is 24%, a standard industry value.

[2] *Center for Biological Diversity, et al. v. EPA*, 722 F.3d 401, 406 (D.C. Cir. 2013) ("In layman's terms, the atmosphere makes no distinction between carbon dioxide emitted by biogenic and fossil-fuel sources"); Science Advisory Board Review of EPA's Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources 7 (Sept. 28, 2012) (hereafter "SAB Panel Report").

[3] *See, e.g.*, Stephen R. Mitchell, et al., *Carbon debt and carbon sequestration parity in forest bioenergy production*, Global Change Biology Bioenergy (2012), doi: 10.1111/j.1757-1707.2012.01173.x; Ernst-Detlef Schulze, et al., *Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral*, Global Change Biology Bioenergy (2012), doi: 10.1111/j.1757-1707.2012.01169.x at 1-2; Jon McKechnie, et al., *Forest Bioenergy or Forest Carbon? Assessing Trade-Offs in Greenhouse Gas Mitigation with Wood-Based Fuels*, 45 Environ. Sci. Technol. 789 (2011); Anna Repo, et al., *Indirect Carbon Dioxide Emissions from Producing Bioenergy from Forest Harvest Residues*, Global Change Biology Bioenergy (2010), doi: 10.1111/j.1757-1707.2010.01065.x; Manomet Center for Conservation Sciences, Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources (2010); Giuliana Zanchi et al., The Upfront Carbon Debt of Bioenergy (Joanneum Research May 2010); M.

Climate scientists agree we need to reduce emissions dramatically in the short term and keep them down. Global greenhouse gas emissions must peak within the next few years and drop sharply thereafter in order to preserve a likely chance of keeping aggregate global warming below 2°C—a level at which serious impacts will still occur.[4] Yet the science shows this is precisely the time period during which bioenergy emissions released today may increase atmospheric CO_2 levels.

Policymakers cannot simply assume that "biogenic" CO_2 emissions have no effect on the climate. Rather, a full and scrupulously accurate life-cycle analysis is essential to understanding the greenhouse gas implications of burning biomass for energy.[5]

Q: Isn't biomass combustion carbon neutral so long as growth rates exceed harvest in the forest?

A: No. Some biomass proponents claim that emissions from harvest and combustion of trees are negated if the forest is growing at a faster rate than it is being harvested; put another way, the claim is that emissions need not be counted if the forest serves as a net carbon sink at the landscape level. The claim is inaccurate for two reasons. First, it ignores the effect of present logging on future carbon stocks. Second, any conclusions of carbon neutrality depend entirely—and even arbitrarily—on the forest area selected for analysis.

Harvest of live trees from the forest doesn't just reduce current standing carbon stocks. It also reduces the forest's future rate of carbon sequestration, and its future carbon storage capacity, by removing trees that otherwise would have continued to grow and remove CO_2 from the atmosphere.[6] Even if harvested biomass is substituted for fossil fuels, it can be decades or centuries before the harvested forest achieves the same CO_2 reductions that

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O'Hare et al, *Proper Accounting for Time Increases Crop-Based Biofuels' Greenhouse Gas Deficit Versus Petroleum*, Envtl. Res. Lett. (2009), doi:10.1088/1748-9326/4/2/024001.

[4] Joeri Rogelj, et al., *Emission Pathways Consistent with a 2° Global Temperature Limit*, 1 Nature Climate Change 413 (2011).

[5] *See generally* Timothy D. Searchinger, et al., *Fixing a Critical Climate Accounting Error*, 326 Science 527 (2009); see also Mitchell 2012, supra note 3 at 9 (concluding that management of forests for maximum carbon sequestration provides straightforward and predictable benefits, while managing forests for bioenergy production requires careful consideration to avoid a net release of carbon to the atmosphere).

[6] Bjart Holtsmark, *The outcome is in the assumptions: analyzing the effects on atmospheric CO_2 levels of increased use of bioenergy from forest biomass*, Global Change Biology Bioenergy (2012), doi: 10.1111/gcbb.12015 ("Taking into account that harvest usually takes place in stands that are still growing, the baseline scenario becomes important. . . . [T]he harvest scenario should be measured against a baseline scenario (with no harvest) in which the trees are still growing, thus capturing CO_2 from the atmosphere.").

could be achieved by leaving the forest unharvested (depending on harvest intensity, frequency, and forest characteristics).[7]

Moreover, because this approach depends entirely on the landscape scale chosen for analysis—that is, what forested "region" is assessed to determine whether it is growing more quickly than it is being cut—its results can be arbitrary, misleading, and easily manipulated. EPA proposed using this approach in its recent draft framework for biomass carbon accounting, but EPA's own case studies showed that the exact same biomass facility could be found to have entirely different atmospheric CO_2 impacts solely as a result of differences in the landscape scale chosen for analysis.[8] Recognizing the potential for arbitrary results and the need to evaluate the relationship between biomass facilities and surrounding forest landscapes in a more sophisticated manner, EPA's science advisors criticized this approach as a "central weakness" of the EPA framework—one lacking a sound scientific basis.[9]

Q: Don't the Intergovernmental Panel on Climate Change (IPCC), EPA, and California Air Resources Board all treat biomass as carbon neutral?
A: No. And declaring something neutral doesn't make it so.

Biomass proponents often assert that IPCC carbon accounting rules treat biomass emissions as carbon neutral, and that EPA has adopted this approach. This assertion is founded on a fundamental misinterpretation of IPCC carbon accounting guidelines.[10] The IPCC guidelines are intended to aid countries in preparing overall national emissions inventories. The guidelines divide each nation's economy into sectors, emissions from which are counted and reported accordingly. Unlike other emissions, bioenergy emissions could show up in either or both of two sectors—in the land use and forestry sector, where harvest takes place, or in the energy sector, where combustion takes place. In order to avoid double-counting these emissions, the IPCC guidelines simply assign them to the land use and forestry sector, and do not count them in the energy sector. But this does not

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[7] *See, e.g.*, Mitchell 2012, *supra* note 3; John L. Campbell, et al., *Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?* Front. Ecol. Env't (2011), doi:10.1890/110057; Tara Hudiburg, et al., *Regional carbon dioxide implications of forest bioenergy production*, Nature Climate Change (2011), doi: 10.1038/NCLIMATE1264; Searchinger 2009, *supra* note 5 at 528.
[8] EPA concluded that a wood-fired biomass energy facility in New Hampshire would be found to increase atmospheric CO_2 levels based on an assessment of New Hampshire's forests, but would be found to have no net effect on CO_2 levels based on an assessment of forests throughout the Northeast. U.S. EPA, Accounting Framework for Biogenic CO_2 Emissions from Stationary Sources 75 (Sept. 2011).
[9] *See* SAB Panel Report, supra note 2 at 2, 5-6, 17, 20, 27-29, 40.
[10] The scientific literature has repeatedly identified this error in interpreting IPCC guidance. *See, e.g.*, Miguel Brandão , et al., *Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting*, 18 Int'l J. Life Cycle Assess. 230 (2013), doi:10.1007/s11367-012-0451-6; Repo 2010, *supra* note 3; Searchinger 2009, *supra* note 5.

mean the IPCC regards biomass combustion as carbon neutral. In fact, the IPCC's website specifically explains this is *not* the case.[11]

Nor does EPA share the view that the IPCC guidelines mandate treatment of biomass combustion as carbon neutral. Although statements to this effect appeared in some older versions of EPA's annual greenhouse gas inventory, those statements were removed beginning in 2011. EPA's draft biomass accounting framework, released in September 2011, explains in detail that the IPCC's guidance does not mean that biomass emissions are carbon neutral.[12] EPA's Science Advisory Panel agreed that "[a]pplication of the IPCC accounting approach is not conducive to considering the incremental effect of bioenergy on carbon emissions."[13] And even EPA's recent rule exempting biomass CO_2 emissions from Clean Air Act permitting requirements acknowledges that biogenic CO_2 may not be carbon neutral in all instances.[14] It is, therefore, entirely false to claim that EPA treats biomass as carbon neutral.

The California Air Resources Board ("CARB") has exempted emitters of biogenic CO_2 from compliance obligations under the state's cap-and-trade program for greenhouse gases.[15] CARB's rationale for the exemption seems to have been a preconceived notion—unsupported by any actual analysis—that biomass combustion is preferable to fossil fuels combustion.[16] If CARB does in fact believe that biomass combustion is automatically carbon neutral, its belief contradicts the published scientific literature, the IPCC's guidance, and current thinking at the EPA.

Q: Don't bioenergy power plants reduce greenhouse gases by displacing fossil-fired power plants?

A: Not necessarily. Policymakers often assume "renewable" energy facilities displace fossil fuel facilities on a one-to-one basis. However, studies show this isn't always the case. New "renewable" facilities often just add capacity to the system rather than displacing fossil-fired generation.[17] And although there's some debate in the scientific

[11] IPCC, Frequently Asked Questions Q1-4-5 and Q2-10, at http://www.ipcc-nggip.iges.or.jp/faq/faq.html (last visited June 12, 2015).

[12] U.S. EPA 2011, *supra* note 8 at 11-12 ("The IPCC also eschewed any statements indicating that its decision to account for biomass CO_2 emissions in the Land-Use Sector rather than the Energy Sector was intended to signal that bioenergy truly has no impact on atmospheric CO_2 concentrations.")

[13] SAB Panel Report, *supra* note 9 at 3; see also id. at 4.

[14] Deferral for CO_2 Emissions from Bioenergy and Other Biogenic Sources Under the Prevention of Significant Deterioration (PSD) and Title V Programs, 76 Fed. Reg. 43,490, 43,498 (July 20, 2011).

[15] Cal. Code Regs., tit. 17, § 95852.2(a).

[16] Cal. Air Res. Bd., California's Cap-and-Trade Program: Final Statement of Reasons 416 (Oct. 2011).

[17] Richard York, *Do alternative energy sources displace fossil fuels?* 2 Nature Climate Change 441 (2012) (finding that non-hydropower renewables, including biomass, typically add capacity rather than displace fossil fuels).

literature about the appropriate "displacement factor" to use in evaluating bioenergy greenhouse gas emissions, an assumption of one-to-one displacement is most likely inaccurate.[18]

Q: What about burning waste wood for energy? Isn't that carbon neutral?
A: No. Calling wood "waste" doesn't tell you what effect burning it has on the atmosphere. "Waste" has no stable definition, and in practice is used to mean anything from slash left over from logging operations, to wood from urban demolition projects, to live, growing trees someone decided should be cut down for some reason.

Determining the atmospheric effect of burning any woody material—including so-called "waste"—requires figuring out what would have happened to the material otherwise. For example, slash and residual wood left over from a logging operation will eventually decompose, releasing at least some of the stored carbon to the atmosphere (though some fraction of the carbon may remain stored for a longer period in the forest soil). Different sizes and kinds of wood decompose at different rates; while smaller branches and stems may decompose in a few years, stumps and other large pieces of wood can take decades to break down.[19] Bioenergy production, in contrast, results in an immediate emission of CO_2 to the atmosphere. Accordingly, even burning this "waste" material incurs a carbon debt for at least the period of time that would have been required for the material to decompose naturally.[20] Recent studies also have shown that intensified removal of logging residues for bioenergy can release vast amounts of carbon stored in forest soils and damage future forest productivity.[21]

Q: Doesn't forest thinning reduce greenhouse gas emissions by preventing catastrophic forest fires, especially when the thinnings are burned for energy?
A: No. Two recently published studies of forests in the western United States suggest that emissions from removal and combustion of forest fuels may exceed emissions from even high-intensity fires, at least for some period of time.

The first study, led by John L. Campbell of Oregon State University, found "little credible evidence" that fuel reduction projects increased forest carbon stock.[22] Campbell identified several reasons for this. For example, the amount of carbon lost through fuels

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[18] Kim Pingoud, et al., *Global warming potential factors and warming payback time as climate indicators of forest biomass use,* Mitig. Adapt. Strateg. Glob. Change (2011), doi:0.1007/s11027-011-9331-9.
[19] Repo 2010, supra note 3.
[20] The SAB Panel Report highlighted the need for consideration of this delay in natural decomposition when accounting for emissions from burning forest-derived "waste" materials. SAB Panel Report, supra note 9 at 5.
[21] David L. Achat, et al., *Forest soil carbon is threatened by intensive biomass harvesting*, SCIENTIFIC REPORTS 5:15991 (2015), doi:10.1038/srep15991; D.L. Achat, et al., *Quantifying consequences of removing harvesting residues on forest soils and tree growth – A meta-analysis*, 348 FOREST ECOLOGY & MGMT. 124 (2015).
[22] Campbell 2011, supra note 7.

reduction projects tends to exceed the amount of carbon those fuel removal projects prevent from being emitted during a fire. This is partly because most fire-related emissions are associated with combustion of fine materials like branches and needles; because these materials tend to burn no matter how hot the fire, the difference in emissions between a high-intensity fire in an untreated stand and a low-intensity fire in a treated stand is not that great. It is not practical to "thin" branches and needles without also removing the trees to which they are attached. Campbell thus concluded that even in a fire-suppressed ponderosa pine forest, protecting one unit of carbon from combustion in a fire required removing three units of carbon in fuels. Moreover, because the probability of a fire on any given acre of forest is relatively low, forest managers must treat many more acres than will actually burn in order to get much of a benefit—again resulting in an increase in carbon removed relative to avoided combustion. Campbell also found that over a succession of disturbance cycles, models predicting forest growth, mortality, decomposition and combustion showed more carbon storage in a low-frequency, high-intensity fire regime than in a high-frequency, low-intensity fire regime. Only where disturbances caused a permanent change in forest productivity did Campbell find fuel treatments to have a profound influence on carbon storage.

Another Oregon State University researcher, Tara Hudiburg, led an investigation of forest carbon responses to three different levels of fuel reduction treatments in 19 West Coast ecoregions containing 80 different forest types and different fire regimes.[23] Hudiburg found that in nearly all forest types, intensive harvest for bioenergy production resulted in net carbon emissions to the atmosphere, at least over the 20-year time frame of the study. Only in forest ecoregions currently functioning as net carbon sources did bioenergy production result in decreased emissions. The positive carbon emissions of bioenergy persisted even in a lighter-touch fire prevention scenario in most ecoregions. The study acknowledged that if forests currently serving as carbon sinks were to become sources in the future, the effect of bioenergy production might be different—but at present, across a wide range of ecosystems, forest bioenergy increases carbon dioxide concentrations, at least in the short term.

Both papers recognize that forest managers may have important reasons for wanting to do certain thinning projects. Both papers also make clear, however, that these projects—whatever their merits from a forest management perspective—may have climatic consequences that should be taken into account.

For more information contact:
Kevin Bundy, Senior Attorney
Center for Biological Diversity
1212 Broadway, Suite 800
Oakland, CA 94612
(510) 844-7100 x313
kbundy@biologicaldiversity.org

[23] Hudiburg 2011, supra note 7.

BIOMASS ACCOUNTABILITY PROJECT • CENTER FOR BIOLOGICAL DIVERSITY • ENERGY JUSTICE NETWORK • GLOBAL ALLIANCE FOR INCINERATOR ALTERNATIVES • GREEN BERKSHIRES • MASSACHUSETTS FOREST WATCH

April 14, 2010

Via email: hockstad.leif@epa.gov and regulations.gov

Leif Hockstad
Environmental Protection Agency
Climate Change Division (6207J)
1200 Pennsylvania Ave., NW
Washington, DC 20460

Re: Inventory of U.S. Greenhouse Gas Emissions and Sinks

Dear Mr. Hockstad:

The undersigned organizations respectfully submit the following comments on the United States Environmental Protection Agency's ("EPA") Inventory of U.S. Greenhouse Gas Emissions and Sinks (the "Inventory").

EPA's inventory document repeats a pernicious assumption that has profound consequences for both the climate and the nation's forests: the assumption that biomass combustion is "carbon neutral." EPA recognizes, as it must, that the combustion of biomass and biofuels produces CO_2 and other greenhouse gases. Yet EPA declines to include these emissions in national totals "because biomass fuels are of biogenic origin."[1] According to EPA, "[i]t is *assumed* that the carbon (C) released during the consumption of biomass is recycled as U.S. forests and crops regenerate, causing no net addition of CO_2 to the atmosphere."[2]

As described in detail below, scientists have concluded that this assumption represents a critical error in EPA's climate accounting methodology. This error pervades all of EPA's biomass calculations, but it is especially glaring as applied to facilities that burn woody biomass from tree plantations, forest thinning projects, or fire salvage projects. Promotion of new and expanded biomass energy facilities predicated on this assumption is beginning to threaten both the ecology of the nation's forests and the stability of the world's climate. EPA thus should revise the Inventory to eliminate reliance on the "carbon neutrality" assumption and should adopt accounting methods that

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[1] U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2008; Public Review Draft (March 9, 2010), Ch. 3 (Energy) at 1.
[2] *Id.* (emphasis added).

II. The Carbon Neutrality Assumption Ignores the Critical Time Lapse Between Present Carbon Dioxide Emissions and Future Carbon Sequestration.

The claim that biomass combustion is "carbon neutral" because biomass is "biogenic" is both false and dangerous, primarily because it ignores the fact that carbon emitted during biomass combustion may remain in the atmosphere for decades or centuries before being resequestered. The claim thus ignores the critical temporal relationships between present carbon emissions and the future effects of global warming and climate change. In other words, because meeting (or exceeding) atmospheric CO_2 targets has a strong temporal element, the time that it takes for CO_2 released into the atmosphere today to be reabsorbed is of critical importance in assessing the climate impacts of carbon emissions, regardless of their "biogenic" origin.

Scientists agree that "[t]he amount of carbon sequestered by forest ecosystems plays an important role in regulating atmospheric levels of carbon dioxide."[7] The removal and processing of forest biomass reduces storage in forest carbon pools and results in short-term emissions of greenhouse gases, even when some of that biomass remains sequestered for a period of time in commercial forest products.[8] According to recent studies, "[t]ypically 30–50% of the harvested C is lost in manufacturing and initial use, a loss that is larger than could be expected from even the most extreme forest fire."[9] Where harvested biomass is combusted for energy, rather than processed into wood products, short-term emissions are necessarily far greater, and long-term sequestration in forest products is eliminated altogether.

Thinning and post-fire salvage operations reduce the future carbon sequestration potential of a given forest stand by removing trees that otherwise would have continued to draw CO_2 from the atmosphere.[10] This is true even for projects that are intended to reduce fuel loads in order to lessen the potential severity of future wildfires. One recent study concluded that "fuel removal almost always reduces C storage more than the additional C that a stand is able to store when made more resistant to wildfire. . . . [I]t is inefficient to remove large amounts of biomass to reduce the fraction by which other

[7] Tara Hudiburg, et al., *Carbon Dynamics of Oregon and Northern California Forests and Potential Land-Based Carbon Storage*, 19 ECOLOGICAL APPLICATIONS 163, 163 (2009).
[8] *See id.* at 176-77 (discussing carbon storage reductions associated with shorter rotations and emissions caused by logging); *see also* Mark E. Harmon, et al., *Modeling Carbon Stores in Oregon and Washington Forest Products: 1900-1992*, 33 CLIMATIC CHANGE 521 (1996) (concluding that harvesting for sawtimber results in sequestration of only about 60% of carbon previously stored in forest pools).
[9] Mark E. Harmon, et al., *Effects of Partial Harvest on the Carbon Stores in Douglas-fir/Western Hemlock Forests: A Simulation Study*, 12 ECOSYSTEMS 777, 778 (2009).
[10] *See* Brooks M. Depro, et al., *Public Land, Timber Harvests, and Climate Mitigation: Quantifying Carbon Sequestration Potential on U.S. Public Timberlands*, 255 FOREST ECOLOGY & MGMT. 1122 (2008) (concluding that eliminating timber harvest on public lands would increase forest carbon storage capacity by roughly 40-50% over "business as usual").

likely catastrophic climate changes. The probability of overshooting 2°C is as follows according to Hare and Meinshausen (2006)[19]:

85% (68-99%) at 550 ppm CO_2 eq (= 475 ppm CO_2)
47% (26-76%) at 450 ppm CO_2 eq (=400 ppm CO_2)
27% (2-57%) at 400 ppm CO_2 eq (= 350 ppm CO_2)
8% (0-31%) at 350 ppm CO_2 eq

According to these scientists, "[o]nly scenarios that aim at stabilization levels at or below 400 ppm CO_2 equivalence (~350 ppm CO_2) can limit the probability of exceeding 2°C to reasonable levels."[20] But in order to achieve stabilization levels that avert the worst impacts of climate change, emissions must peak by about 2015, and must decline very rapidly thereafter.[21]

In short, minimizing CO_2 emissions in the *next few years* is critically important to meeting climate targets, even if some of all of that CO_2 might in theory be reabsorbed from the atmosphere in the decades or centuries to come. The science makes clear that the time frame for resequestration of CO_2 emitted from forest biomass combustion is on the order of decades or centuries, not years. Indeed, in evaluating carbon emissions from other biofuels, independent scientists have begun to develop strategies for evaluating the carbon impacts of biofuels in relation to the high social and environmental cost of short-term emissions.[22] Even EPA has begun to recognize the importance of this temporal analysis in other contexts.[23] Short-term CO_2 emissions from woody biomass combustion are thus *significant*—not "neutral"—in the context of efforts to avoid the worst impacts of climate change, and should be treated as such in both environmental analysis and air permitting decisions. EPA's failure to acknowledge this fact in the context of the annual emissions inventory is arbitrary and unsupportable.

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[19] B. Hare & M. Meinshausen, *How Much Warming Are We Committed To and How Much Can Be Avoided?*, 75 CLIMATIC CHANGE 111 (2006).
[20] *Id.* at 137.
[21] *See* IAN ALLISON, ET AL., THE COPENHAGEN DIAGNOSIS: UPDATING THE WORLD ON THE LATEST CLIMATE SCIENCE 9 (2009); *see also* M. den Elzen & N. Höhne, *Reductions of greenhouse gas emissions in Annex I and non-Annex I countries for meeting concentration stabilisation targets*, 91 CLIMATIC CHANGE 249 (2008).
[22] *See* M. O'Hare et al., *Proper Accounting for Time Increases Crop-Based Biofuels' Greenhouse Gas Deficit Versus Petroleum*, 4 ENVTL. RESEARCH LETT. 024001 (2009) (applying discount rate to account for importance of early emissions).
[23] *See* U.S. EPA, *EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels* (2009) ("[T]he time horizon over which emissions are analyzed and the application of a discount rate to value near-term versus longer-term emissions are critical factors").

even a high-intensity fire, and decays slowly into the atmosphere even as new plant growth recolonizes a burned area. The eventuality of forest fire cannot be used as an excuse for wholesale logging and burning of forests to create energy.

Finally, the demand for wood created by large-scale construction of biomass energy facilities is likely to be more than our forests can sustain, and thus may have very significant cumulative impacts on biodiversity, water quality, and forest health.[28] In addition, if each of these facilities were to claim "carbon neutrality," in the absence of any evidence or analysis, the result could be a dramatic and uncontrolled overall increase in near-term CO_2 emissions during precisely the time period when emissions most need to be curtailed.

IV. Conclusion

The "carbon neutrality" assumption is just that—an assumption, not a fact. "Carbon neutrality," if it exists at all, must be demonstrated on a project-specific basis, taking into account all emissions from biomass production, transport, processing, and combustion, all emissions and lost sequestration capacity associated with forest thinning and clearing operations, and actual analysis of fossil fuel displacement. In the absence of such a demonstration, the actual emissions from biomass combustion must be counted in EPA's annual emissions inventory. EPA must revise the Inventory to eliminate reliance on the "carbon neutrality" myth, and must replace it with an accurate and comprehensive accounting methodology for biomass emissions.

Thank you for your consideration of our comments. Please feel free to contact Kevin Bundy at (415) 462-9683 x313 with any questions.

Sincerely,

Kevin P. Bundy
Senior Attorney
Center for Biological Diversity

Margaret E. Sheehan, Esq.
Director
The Biomass Accountability Project, Inc.

Mike Ewall
Founder and Director
Energy Justice Network

Ananda Lee Tan
North American Program Coordinator
Global Alliance for Incinerator Alternatives

Eleanor Tillinghast
President
Green Berkshires, Inc.

Chris Matera
Founder
Massachusetts Forest Watch

[28] *See, e.g.*, V.A. Sample, *Summary/synthesis: What Role Will Forests Play in America's Long-Term Energy Future?* (2009) at 16-17.

V.A. Sample, *Summary/synthesis: What Role Will Forests Play in America's Long-Term Energy Future?* (2009).

Timothy Searchinger, et al., *Fixing a Critical Climate Accounting Error*, 326 SCIENCE 527 (2009).

U.S. EPA, *EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels* (2009).