Response to Kevin Bundy (CBD)
June 3, 2013 PPt. @ CEC Bioenergy Workshop

Mr. Kevin Bundy, Senior Attorney, Center for Biological Diversity gave a presentation on June 3, 2013 at the CEC Staff Workshop on Status of Bio-energy Development in California. The title of his presentation was "Reexamining the benefits of Forest Bio-energy". Mr. Bundy's presentation provided a brief statement identifying commonly assumed benefits of biomass based bio-energy. Beyond that brief statement Mr. Bundy dedicated his presentation to identifying what he felt were "commonly over looked costs" of biomass based bio-energy. Mr. Bundy provided at least one reference in support of the each of the costs he identified. The points stressed by Mr. Bundy were:

1. Increased GHG emissions over significant time scales ("carbon debt")
2. Downsides of forest thinning for wildfire control are:
    a. Reduced forest carbon stocks
    b. Forgone ecological benefits
3. Serious "sustainability" questions
4. Air quality and public health impacts
5. Water use and wastewater disposal

The points raised by Mr. Bundy are in areas where there continues to be debate about the effects of harvesting biomass to produce energy (electricity, biogas, or liquid fuels). A number of “scientific" publications with findings exist for each of the listed topics. There is variation in the findings of these publications in part due to the basic temporal and spatial assumptions used in each of the studies. In short, the support provided by Mr. Bundy in his presentation is only part of the story.

We offer some additional information on points 1 - 3 of the areas of cost identified by Mr. Bundy:

<u>1. Increased GHG emission over significant time scales ("carbon debt")</u>

The presentation offers that Co2 stack emissions are greater for biomass than equivalent Mwh's produced from coal or gas. We agree with this statement as biomass has a lower btu content per weight than do fossil based fuels. Mr. Bundy follows this with statements that biomass produced energy is not by definition "carbon neutral". He continues that the use of biomass for energy can produce a carbon debt for decades. The presentation relies mostly on the "Manomet study"[1] from Massachusetts and the recent Hudiburg (Hudiburg et. al., 2011)[2] study for these statements.

In the case of the Manomet study the carbon debt results from spatial and temporal limitations used in the research. The carbon balance evaluation was limited to the small area actually

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[1] Manomet Center for Conservation Sciences, 2010, Massacheusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources Walker, T. (Ed) Contributors: Cardellichio, Pl Colnes, A.k Gunn,J., Kittler, B., Perschedl, R.k Recchia, C.k Saah, D., and Walker, T. Natural Capital Initiative Report NCI-2010-03, Brunswick, Maine.

[2] Nature Climate Change, 23 October, 2011, Regional Carbon Dioxide Implications of Forest Bioenergy Production, Contributors: Hudiburg, Tara W., Law, Beverly, E., Wirth, Christian, Luyssaert, Sebastiaan.

harvested and the time for new forest regeneration to replace the carbon value of biomass harvested where all biomass was harvested. This report does not consider carbon accounting at the forest or landscape level where biomass removed is less than the growth of the larger assessment area.

Hudiburg et. al. (2011) looked at the strategy for reducing carbon dioxide emission by utilizing biomass as a substitution for fossil fuel produced energy for 19 Eco regions in the U.S. west coast. The evaluation was based on the USFS Forest Inventory data. Biomass supply was sourced from thinning to reduce wildfire disturbance and wide scale biomass harvest. In 16 of the 19 Eco regions a carbon debt was incurred with this analysis, but in 3 of the Eco regions, even with the projected intense harvesting, there was a carbon benefit. The bottom line of the study was that biomass policies should consider current forest carbon balance (growth v. mortality + disturbance losses), local forest conditions and ecosystem sustainability in establishing actions used to decrease emissions. This study is not a final conclusion that biomass harvesting will by nature result in a carbon debt, but rather a caution that managers need to balance removals plus mortality plus loss to disturbance with growth. Carbon neutrality does occur under some forest conditions and not in others.

Mr. Bundy is relying on two papers where carbon neutrality is either debunked or questioned. There are also number papers that reach more positive conclusions with regards to the carbon outcome of utilizing forest biomass. For example the Journal of Forestry Special Issue, October 2011 states, "A more correct characterization of the effects of harvesting biofuel uses a landscape level analysis to determine whether the harvest needed to sustain processing facilities within an economic haul distance increases or decreases average carbon stores on the land. If harvesting results in a stable average of carbon across the total forest through time (Figure 5-3b), the forest itself is carbon- cycle neutral".

Bruce Lippke et. al[3] in "Life Cycle Impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns", 2011 in the executive summary offer that, “Life cycle research demonstrates that the emissions from sustainability produced products or biomass for energy are being offset by the forest carbon removed from the atmosphere". This paper also cautions that managers need to assure forest removals plus mortality cannot exceed growth for the assessment area.

The California Energy Commission published a paper in 2010 titled "Biomass to Energy: Forest Management for Wildfire Reduction, Energy Production and Other Benefits"[4]. Appendix 9 of the paper by Dr. Gregg Morris, Future Resources Associates addresses the long term carbon effects of using biomass from fuels treatments in a 2.7 million acre beta landscape within the Plumas Co. forest area. The paper was a life-cycle assessment evaluating the implications of various forest treatment regimes for atmospheric GHG levels. Fuels treatment, fire impacts, and energy production carbon balances were parts of the paper. In the conclusion the paper states that if carefully planned forest treatment operation are conducted there will be carbon benefits.

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[3] Carbon Management (2011) 2(3), 303-333, Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns, Contributors: Lippke, Bruce, Oneil, Elaine, Skog, Kenneth, Gustavsson, Leif and Sathre, Roger

[4] CEC-500-2009-0800-AP9, January 2010, Biomass To Energy: Forest Management for Wildfire Reduction, Energy Production and Other Benefits, Author: Morris, Gregg, Future Resources Associates

Net benefits of enhanced carbon sequestration incur across the landscape due to forest treatment and those have to be balanced against the release of the biogenic carbon releases from power plants. With an ongoing program of forest treatment across the landscape the net effect on biogenic greenhouse gas level associated with the landscape is an increase for the first several decades, followed eventually by a long-term decrease in atmospheric GHGs. That is in addition to the avoidance of fossil carbon emissions due to the production of energy from the un-merchantable forest biomass removals. Strictly from the application of fuels treatment impacts, the treated acreage itself becomes neutral with respect to associated biogenic GHGs in approximately eight years, and positive in subsequent years.

The Department agrees with a broad overview of the body of current research points to a conclusion that carbon neutrality is a function of the management principles applied to forested areas at the landscape level. Management should constrain harvest (energy, wood products) to a level where it plus mortality and disturbance losses are in balance with forest growth. This approach to management will approximate a carbon neutral or carbon positive landscape.

2. Downsides of forest thinning for wildfire control are: a) reduced carbon stocks, b) foregone ecological benefits.

Mr. Bundy refers to two studies that question the effects of fuels treatments on carbon stocks: 1) Campbel et. al. 2011 and 2) Hudiburg et al. 2011. Both studies contain statements that intensive fuels treatments are not likely to result in increased carbon storage. Hudiburg was discussed in the answers to the previous discussion on biomass and carbon neutrality. Campbell does conclude that it is not likely that fuels treatment will have the effect of increased carbon stocks. As with most studies there are allowances for other outcomes. When decomposition is included in the analysis a conclusion is that net environmental productivity may end up the same for treated areas where fire effects are lessened and areas where high intensity wildfires have occurred. The potential for fuels treatments to result in an increase in carbon stocks is dependent on the treatments having other ecological benefits such as reducing natural mortality and a more resilient forest health condition.

Hurteau and North, 2009[5] state that wildfire effects on forest conditions and C emissions will vary across a burn landscape in response to local fuel conditions and the interaction of fire behavior and weather. They further state it is unclear, however, how to manage forests with frequent fire regimes to maximize C storage while reducing C emissions from prescribed burns or wildfire. The study modeled the effects of eight different fuel treatments on tree-based C storage and release over a century, with and without wildfire. Model runs show that, after a century of growth without wildfire, the control stored the most C. However, when wildfire was included in the model, the control had the largest total C emission and largest reduction in live-tree-based C stocks. In model runs including wildfire, the final amount of tree-based C sequestered was most affected by the stand structure initially produced by the different fuel treatments. In wildfire-prone forests, tree-based C stocks were best protected by fuel treatments that produced a low-density stand structure dominated by large, fire-resistant pines.

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[5] Frontiers in Ecology and the Environment, Fuels treatment effects on tree-based forest carbon storage and emissions under modeled wildfire scenarios, Front Ecol Environ 2009, Hurteau, Matthew, and North, Malcom

It is also noted that current carbon accounting methods need modification to properly reflect the relationships among fuels treatments, wildfire, and long term carbon stock assessments.

A Science Synthesis developed by the US Forest Service[6] in 2013 indicates that the carbon results of fuels treatments varies with the existing forest conditions and the frequency of high intensity fires.   However, the report continues that recent research has proposed the idea of carbon carrying capacity (Keith et al. 2009). In the absence of disturbance, a forest may 'pack' on more carbon as the density and size of trees increase. This additional biomass, however, makes the forest prone to disturbances, such as drought stress, pests, pathogens, and higher-severity wildfire, which increase tree mortality. This mortality reduces carbon stocks as dead trees decompose and through efflux, much of the carbon returns to the atmosphere. Carbon carrying capacity, therefore, is lower than the maximum storage potential of a forest, but represents the biomass that can be maintained given disturbance and mortality agents endogenous to the ecosystem. In frequent-fire forests such as Sierra Nevada mixed conifer, the carbon carrying capacity is the amount that a forest can store and still be resilient (i.e., have low levels of mortality) to fire, drought, and bark beetle disturbances. One factor that would change this long-term balance is if management led to increased carbon storage by altering the amount and longevity of sequestered carbon. In Sierra Nevada mixed-conifer forests, two studies that examined historical forest conditions have suggested that this might be possible. Although historical forests were less dense due to frequent fire, they may have stored more carbon because the number and size of large trees was greater (Fellows and Golden 2008, North et al. 2009a) than in current forests that have fewer large trees, possibly due to increased mortality rates from increased stand density (Smith et al. 2005). Carbon stores are calculated from total tree biomass (a three dimensional measure) and will be much higher in a stand with a few large trees compared with a stand with many small trees, even if both stands have similar basal area (a two dimensional measure). Other studies (Hurteau et al. 2010, Scholl and Taylor 2010), however, have found higher carbon storage in modern fire-suppressed forests than in historical active-fire forests, suggesting that there may be considerable variability between different locations and levels of productivity. In general, forests managed so that growth and carbon accumulation are concentrated in large trees will also have longer, more secure carbon storage than in stands where growth is concentrated in a high density of small trees prone to pest, pathogen, and fire mortality.

3. "Sustainability" questions

Mr. Bundy expressed several concerns about the ability of the California Forest Practice Act and the Rules to provide for overall forest and ecosystem "sustainability" if biomass harvesting intensifies with a more favorable market.

The state established an Interagency Forest Workgroup (IFWG) in 2009 to assist in meeting the AB 32 goals as they pertain to the management of California Forests. Two of the charges for IFWG were to assess the ability of the Forest Practice Act and Rules to meet the goals of the

[6] Science Synthesis to Promote Resilience of Social-ecological Systems in the Sierra Nevada and Southern Cascades, Pacific Southwest Research Station, U.S. Forest Service, January 2013, Contributors: Jonathan Long, Carl Skinner, Malcolm North, Pat Winter, Bill Sielinski, Carolyn Hunsaker, Brandon Collins, John Keane, Frank Lake, Jessica Wright, Emily Moghaddas, Angelan Jardine, Ken Hubbert, Karen Pope, Andrzej Bytnerowicz, Mark Fenn, Matt Busse, Susan Charnley, Trista Patterson, Lenya Quinn-Davidson, and Hugh Safford.

Climate Change Scoping Plan (task#2) and to define forest "sustainability" for the Low Carbon Fuel Standard and the Alternative and Renewable Fuel Technology program (AB 118 – task#3). The Board has completed the Task #2[7] report, but the task #3 report is yet to be completed. Because of the overlap of the two tasks the Task #2 report addresses a number of the concerns raised by Mr. Bundy.

The first question of sustainability would be assurances that under an aggressive biomass market forest growth would be required to exceed harvest (biomass plus solid wood products). The Forest Practice Act (FPA) has been amended since the adoption of AB 32 to require that the Rules of Board of Forestry and Fire Protection (Board) address carbon storage in a way to achieve the AB 32 Scoping Plan carbon sequestration target. In addition to the changes in the FPA the California Environmental Quality Act (CEQA) has been amended to require all projects to assess their potential greenhouse gas (GHG) effects and to mitigate negative impacts to the extent feasible.

IFWG reviewed the best available information on the current trends of carbon sequestration on California forestlands and determined that carbon sequestration will increase on both private and public lands through the mid-century (2050) and then will decline, possibly to the condition where forests produce net emissions instead being a carbon sink. Currently private lands are sequestering approximately 5 mmt of Co2e annually while the public lands are sequestering approximately 25 mmt of Co2e annually[8]. These are net sequestration numbers over and above harvest, natural mortality, and losses due to wildfire. The predicted future decline in sequestration is expected to be the result of increased natural mortality from overstocked forest stands (reaction to climate change) and increased losses from disturbances (primarily wildfire).

IFWG and the Board noted that there may be some gaps in the current FPA that will need to be addressed with regard to ecosystem sustainability. Two primary areas are forest land that is not under the authority of the FPA and potential increases in development located in rural areas. There may also be some minor adjustments needed in the Board rules affecting water quality and wildlife issues. These are to be identified through current Board monitoring efforts and rule adjustments developed, adopted by the Board and implement by the Department in response to the monitoring results.

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[7] Interagency Forest Workgroup, The Effects of the California Forest and Rangeland Regulations and Program on Greenhouse Gas Goals, Board of Forestry and Fire Protection, 2009, http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/current_projects/ifwg_task_2_final_3_20_12.pdf

[8] Fire and Resource Assessment Program, California's Forests and Rangelands: 2010 Assessment, California Department of Forestry and Fire Protection, http://frap.fire.ca.gov/assessment2010.html