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California Air Resources Board and the Board of Forestry:

The draft AB 32 scoping plan section for sustainable forests (p. 27) identifies two goals – **carbon storage and energy substitution** - that must be addressed to produce cost-effective climate benefits and requests the Board of Forestry and Fire Protection (BOF) to take the lead on this sector. However, the exact wording – "*Preserve forest sequestration and encourage the use of forest biomass for sustainable energy generation*" - could be interpreted in a manner that could lead to unintended negative consequences in terms of climate benefits for a number of reasons. First, private forest lands that are managed for sustainable timber production depend on the financial returns from timber revenues to reduce the financial incentive of converting forests into to the more lucrative market for residential and recreational lots. Reducing the net revenues to sustainable timber management will probably increase the forest conversion rate for some landowners – the opposite trend that is proposed in the Scoping Plan. In addition to providing revenue, wood products also provide carbon sequestration while they are in use, again if they are recycled, and finally when they are stored in an engineered landfill. Wood products also have significant life-cycle benefits in terms of reduced energy use compared to other products such as cement and steel. While those benefits will be accounted for in the much larger building sector energy use, they should be tracked and considered in forest policies designed by the BOF. Another potential negative consequence of focusing only on forest sequestration - rather than carbon sequestration in both the forests and in products - is that climate change will probably increase risk factors such as fires, insect attacks, and droughts that can wipe out considerable quantities of forest sequestration. As the current fire season is demonstrating, forest sequestration can go up in smoke fairly rapidly.

A more accurate one sentence mission could be:
"*Promote carbon storage in resilient and productive forests and wood products and encourage the use of forest biomass for sustainable energy generation*."

The addition of a consideration of the climate benefits of wood products as well as the risk factors affecting the loss of climate benefits in the forest should change the BOF reporting focus regarding climate benefits. Focusing on how permitted projects may change the remaining forest carbon inventory measures only one type of climate benefits. Unless all the benefits are correctly assessed, it would be very possible to maximize forest sequestration while reducing total climate benefits. This is the exactly the outcome that was documented in a series of peer reviewed technical papers co-authored by Sandra Brown who was the lead author on the benchmark technical report used by CARB to estimate the current CO2 flux of California's forests – **http://www.energy.ca.gov/pier/project_reports/500-04-069.html** .

In 2006 Brent Sohngen and Sandra Brown published "The influence of conversion of forest types on carbon sequestration and other ecosystem services in the South Central United States" in Ecological Economics (57:4) 2006 . After other researchers commented on the model, they responded in 2008 with a reply that was also published in Ecological Economics. The following sentence from their 2008 reply illustrates a case where the scenario with the higher amount of forest sequestration had less total carbon storage than the one involving the pine plantations with shorter rotations. They also pointed out that the pine plantation scenario could also provide even more climate benefits if the renewable energy was produced with the biomass. "In conclusion, we agree with South and Radcliffe that our model suggests a change in management of forests in this region. The differences we project are losses of hardwood and natural pine stands and conversion to planted pine stands, and consequently a movement from an older forest on average to a younger forest on average. Our results do show that this means less aboveground carbon over the next 30 years, but more total carbon when product storage is considered, and even more if energy produced as biomass residuals is considered." (Brent Sohngen and Sandra Brown, "Response to South and Radcliffe comments on paper" Ecological Economics (66:2-3) 2008)

While this example is not from California, it shows the high likelihood of getting the wrong answer if only some types of climate benefits are considered. California is not the only government that is focusing on increasing climate benefits from forests and forest products. Sweden and Finland are both meeting many of their Kyoto commitments with renewable energy produced from wood chips. The New Zealand government has introduced legislation that would allow owners of forest plantations to sell carbon offsets as long as they keep their land in forest use. Within the Western Climate Initiative (WCI) the leading timber producer in is British Columbia. They are looking at the full range of climate benefits - http://www.bcclimatechange.ca/ - and will be promoting this perspective in the WCI. The more California works with these countries that are pioneering approaches towards full accounting of climate benefits associated with forests and forest products, the easier it will be to coordinate with them.

California has an extremely efficient forest sector in terms of producing climate benefits from 'seedling to landfill' when 1) forest landowners have positive net revenues and 2) the seedlings outgrow the shrubs. The BOF will need to develop policies that accurately account for two very different types of benefits – visible trees and avoided fossil fuel emissions. The simple comparison table below is a schematic of three possible approaches to forest management.

Comparing Climate Benefits from One Acre @ 1mbf/ac/yr Under Three Scenarios
Growth Rate = 1MBF/ac/yr or 8 Green tons of biomass (6 to mill, 2 tops and limbs)
Conversion Factors: 1 Green Ton = 0.5 Bone Dry Ton = 0.25 Carbon Ton = 0.92 CO_2 Ton

Theme	Carbon Storage	Energy Substitution	Balanced Harvest = Growth	'Half' Harvest (Partial Harvest)	Let Grow (No Harvest)
Additional Annual Growth in Forest Inventory	100 year minus the risk of loss to fires, drought, insects, etc. (p(Fire, etc))		0 – p_1(Fire, etc)	4 – p_2(Fire, etc)	8 – p_3(Fire, etc)
Timber	Long-lived products -> landfill (nearly permanent)	AND energy substitution (E) by replacing cement and steel in buildings	4+ EE	2 + E	0
Clean chips (produced in the mill)	Short-lived products -> landfill (nearly permanent)	OR Cogeneration heat and electricity	2 (=1 CO2 ton displaced for energy option)	1 (=0.5 CO2 ton displaced for energy option)	0
Dirty chips (collected at the harvest site)		Cogeneration heat and electricity	2 (=1 CO2 ton displaced)	1 (=0.5 CO2 ton displaced)	0
Total CO_2 ton benefits E = energy benefits of wood over cement			6 + EE – p_1(Fire, etc)	7 + E – p_2(Fire, etc)	8 – p_3(Fire, etc)
Revenues CO_2 storage ($10/ton) Lumber ($40/ton) Chips ($20/ton) TOTAL Revenue			 $0 $160 $40 $200	 $40 $80 $20 $140	 $80 $ 0 $ 0 $80

Although the majority of forest articles in Science and other journals focus the importance of maintaining tropical forests so that climate benefits are not lost, California's working forests are quite different. The key difference is that the various streams of harvested forest biomass can produce climate benefits and the harvested forests can continue high biomass growth rates. In the preceding example, simply increasing forest sequestration by reducing harvest levels may produce no new climate benefits and will usually reduce total net revenues to forest landowners at the current prices for different outputs. The probable benefits from any strategy depends on rates of change that occur over decades – the rate of forest biomass growth (timber volume plus other biomass); the loss of biomass to fires, droughts, and insects (p1, p2, p3) ; the comparative energy substitution benefits compared to other products (E) ; and the long term performance of engineered landfills. The 'best' strategy for

California will depend on the availability of forest management and processing infrastructure (including fire protection) as well as on the relative prices of different products. Most of these variables are controlled by private parties and prices in various commodity markets. The overall climate benefits also depend on decisions made after the harvest and replanting operations such as what type of products are produced, where they are used, and how effective recycling and landfill programs actually are. The carbon stored in forest inventory always has a risk of loss to fires, drought, and insects that is difficult to calculate but affects all approaches.

Some studies in Scandinavia and the United States have calculated that the energy substitution benefits of wood building products over their lifetime will be even greater than their carbon storage benefits. Whatever the value of 'E' (the fossil fuel emission offset of using lumber, not cement) here in California, the immediate and lifetime energy substitution benefits are of similar magnitude to the carbon storage benefits in the forest in or use as long as a viable forest products industry exists.

The real opportunity for significant new benefits is to identify and improve forest growth on less productive lands by replacing shrub fields with forests, reforesting new and old burns, and improving forest growth via better forest stewardship. This requires working with many landowners who have not made these investments and commitments to date. The financial challenge of valuing these types of reforestation efforts is that the carbon storage and energy substitution benefits will be decades out into the future. For example, with a 4% discount rate, 100 CO2 tons twenty years from now are only equal to 46 CO2 tons now. Carbon offset markets where the timing of future forestry benefits is not transparent are very hard to evaluate. The discount rate is used is the single most important factor in valuing future forest climate benefits.

The Air Resources Board has made an excellent decision to have the BOF provide leadership and clarity in terms of the potential climate benefit roles of sustainable forests. California's historic investment in policies that established an extensive network of producers of wood-chip based energy as well as engineered landfills that capture most carbon stored in wood products after their useful lifespan has the net result of significantly increasing the climate benefits of our forest sector compared to those in other states. Using a full accounting approach similar to that proposed by British Columbia will provide a more accurate measure of overall climate benefits. Additional policies that promote more investment into the forest sector could lead to even more cost-effective climate benefits. Counting only a select sub-set of benefits, however, could lead to a decline in total benefits.

Sincerely,

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