



June 3, 2019

Sen Bob Weickowski  
Asm Laura Friedman  
Sen Bill Monning  
Asm Eduardo Garcia  
Sen Ben Allen

Members of the California State Legislature  
Sacramento, CA

cc: Mary Nichols, Chair, California Air Resources Board  
Jared Blumenfeld, Secretary, California EPA  
Bruce McCarl, Professor, Texas A&M University

Dear Members of the Legislature,

It has recently come to my attention that my research has been cited by parties commenting on the issue of leakage relevant to the forestry protocols for California's cap-and-trade program. Having read the policy brief that cites my research to argue that California substantially underestimates leakage (diverted emissions to other locations) from its current forest protocol, it appears that the policy brief misinterprets my research in making the argument.

The policy brief in question, titled "The California Air Resources Board's U.S. Forest offset protocol underestimates leakage", written by Dr. Barbara Haya, a Research Fellow at UC-Berkeley's Center for Environmental Public Policy cites a 2004 article I co-authored with Dr. David Wear in the *Journal of Environmental Economics and Management* (JEEM) on timber harvest restrictions in the Pacific Northwest.

- Wear, D.N. and B.C. Murray. 2004. "Federal Timber Restrictions, Interregional Spillovers, and the Impact on U.S. Softwood Markets." *Journal of Environmental Economics and Management* 47(2):307-330.

I will confine my comments to the use of my JEEM paper to make their point and not to other evidence presented.

The brief accurately states that that the JEEM article examines timber harvest restrictions on federal lands commencing in the late 1980s and finds that the restrictions effectively diverted harvests to other North American forests and that the volume of diverted harvests was more than 80 percent of the volume of harvests avoided in the Pacific Northwest federal forests. The brief then concludes that the carbon leakage from those diverted forests (the losses in carbon diverted elsewhere) must also be in excess of 80 percent of the carbon savings for projects/programs that protect forests. This interpretation is mistaken for a number of reasons.

First, the flow of timber is not the same as the flow of carbon. Forests in the Northwest are more carbon-dense than forests in the US South, where much of the diversion is found. Thus the diverted carbon is less than the diverted timber. One needs to have a carbon accounting mechanism to estimate these effects. The JEEM paper does not have that.

Second, an accurate estimate of carbon leakage must capture the land use change that is induced by the intervention. Most forest harvesting and management in the US occurs on private lands and the vast majority of private land is used for forestry or agriculture. Therefore, any change that affects markets in the forest sector will affect both the intensity with which forests and agricultural lands are managed (affecting their carbon content) and the allocation of land between forests and agriculture on private lands (in this case, likely affecting the establishment of new forests to make up for the forests “lost” via protection). This must be taken into account. Forest and agricultural markets operate over larger geographic regions than just the location where the forest project intervention occurs so the land use change effects will also be dispersed spatially. The JEEM paper does not capture this.

Third, because of the two factors above, the leakage from any forest carbon project intervention will depend tremendously on where that intervention occurs. Leakage from an avoided deforestation project in the Northwest could be substantially different from a similar project in the South. Yet the JEEM paper only addresses interventions in the Pacific Northwest and, even putting aside the two technical shortcomings referenced above, should not be used to attribute leakage effects for projects in other regions that may be generating offsets for the California market.

Realizing that the JEEM paper on timber markets might be used as a proxy for leakage, I embarked on a body of research with Professor Bruce McCarl of Texas A&M University, who is the developer of the FASOMGHG model of the US forest and agricultural sectors that captures forest and agricultural commodity markets, land use allocation and comprehensive greenhouse gas accounting across all sectoral activities. That work, among other things, estimated the potential for leakage from regional forest carbon activities incorporating the features that I mention above. This work was published in the following outlet:

- Murray, B.C., B.A. McCarl, and H. Lee. 2004. “Estimating Leakage from Forest Carbon Sequestration Programs.” *Land Economics* 80(1):109-124.

I do not know why the policy brief cited the JEEM article rather than the Land Economics article since they were both released at about the same time and the Land Economics piece was far more appropriate sources given that it was actually targeted at carbon leakage, which the JEEM article was not.

This study found wide variation in estimates, but generally lower than would have been implied by JEEM. Indeed the Land Economics paper even used the JEEM article as the point of departure and found leakage from avoided deforestation in the Pacific Northwest is likely much lower (less than 10%) than the JEEM estimates (more than 80%). The leakage effects from avoided deforestation in the South are in the 20-30% range. Avoided deforestation, though could be high in the Lake States in the Midwest or the Northeast if projects originate from there, but I do not know if those are common origins of offsets for California.

Another study that I contributed to at around the same time showed even lower leakage levels than those implied in the Land Economics study, but that study focused on national programs, both forest

and agriculture, not regional ones focused on forests, and thus is not as appropriate a source for the California forest offsets program

- Murray, B.C., B.L. Sohngen, A.J. Sommer, B.M. Depro, K.M. Jones, B.A. McCarl, D. Gillig, B. DeAngelo, and K. Andrasko. 2005. EPA-R-05-006. "*Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture.*" Washington, D.C: U.S. Environmental Protection Agency, Office of Atmospheric Programs.

I believe leakage is an important issue in forest carbon programs and I devoted a substantial amount of my professional effort in the early 2000s exploring its nature and empirical magnitude. I think California is absolutely right to adjust offset quantities to account for leakage as this will give a more proper accounting of the net benefits of the transactions. The empirical work is not easy and I do not pretend that the estimates from my work with others, generated more than ten years ago, focused on hypothetical programs are precise estimates of what happens today with real programs. But to my knowledge, they are the only (or perhaps one of a few) peer-reviewed estimates of carbon leakage in US regional programs out there. As such, I encourage California to fund more work in this area using a range of methods and tapping other researchers to give a more contemporary view and policy guidance for today.

I will also point out that leakage exists in the other sectors affected directly by the California cap and trade program. While the state has taken great efforts to address this in the electric power sector through resource shuffling provisions, and these effects have likely reduced leakage, it has probably not eliminated it. Moreover the program may also be diverting activity and emissions to other states through the interaction of inter-regional and global markets for industrial goods. This is the unfortunate fact of any emissions control program that is regionally confined. This does not mean that the program should not be undertaken, just that it is not as effective as a comprehensive global (or even national) program. California cannot create that outcome but understand the shortcomings of what it does create, a program that will have leakage effects for all sectors, including via forest offsets.

Sincerely,



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Research Professor, Nicholas School of the Environment and Sanford School of Public Policy  
Duke University