NEXTGEN CLIMATE AMERICA

3 June, 2016

Dear Chair Nichols,

Thank you for the opportunity to participate in the May 18th workshop and comment on the three studies on emissions leakage from the cap-and-trade program. Climate change is a critical threat facing the world and California's leadership is critical to addressing this problem. The California Air Resources Board has established policies to minimize regulatory costs and ensure that there are incentives for progress on emissions reduction that more than offset these costs to business and consumers. The studies being discussed are intended to help develop the next iteration of policies to minimize the risk of production and emissions leakage from California businesses. We applaud the Board for advancing the state of research into this subject, and the authors of these studies for their contributions to a highly relevant area of policy.

The studies each evaluate a different scale of potential leakage: international, domestic and within the food processing industry. Each highlights different and valuable considerations when evaluating the effects of climate change policy, however there are several findings common to each. We will present some comments that apply to all three studies, then comments specific to each study in turn.

It is important to note, however, that all of these studies are by their own admission, limited quantitative examinations of one variable - production leakage - in a large and complex system. To isolate this variable, they use statistical methodology to exclude the effects of many factors which would clearly affect the system under study, including the policies explicitly enacted to prevent such leakage. They are not estimates of actual leakage under the cap-and-trade program and should not be presented as such. This fact should be made clear in forthcoming reports and communication on this subject. Decisions about the future of California's climate policy must be based on the total suite of benefits and costs, over a broad geographic and temporal scale.

The critical policy question these studies address is how much leakage would occur under a hypothetical scenario in which California's climate action was, globally, the only policy force acting on energy prices and there were no policies to prevent leakage. In many ways, this represents a worst-case-scenario from a leakage standpoint. Many of the assumptions and fundamental methodological choices employed by the authors lead the results to error on the side of overestimation of potential leakage effects. Overestimation may be a desired outcome, in order to provide a margin of error in future policy making, however it is important that the quantitative estimates developed under these research assumptions be clearly identified as intentional overestimates, out of healthy caution, not actual estimates of real-world effect.

While caution is a reasonable motivation when making policy, we feel that accurate reflection of real-world conditions is equally, if not more important when developing quantitative estimates of policy effect and would offer some suggestions about this work.

Comments in Response to All Studies

The exclusive focus on leakage of productivity and jobs, absent the broader context of global climate policy, can lead to misleading and poorly-supported conclusions. It is important to consider several critical issues of broader context when interpreting the results of the three studies being discussed here.

The most glaring flaw, shared by all three studies is that they assume California's climate policy acts in a vacuum and that the rest of the world maintains the *status quo* of uncontrolled emissions, stable energy prices and no impact on economic activity from climate change. These assumptions to some degree reflect the inherent limitations of econometric modeling: one approach to establishing a causal relationship between a factor and an outcome (e.g. energy prices and production loss) is to hold all other variable fixed and examine only the effects of variation in the variable of interest.

Unfortunately, this approach necessarily divorces itself from reality. There is no conceivable future of the world in which California's emissions control programs occur in the context of a stable world. This is particularly troubling in the context of regression analysis since many of these effects would also correlate with energy prices, the primary explanatory variable in these studies. This correlation opens these studies to errors from omitted variable bias, and in the context of these studies, would generally bias the results toward an overestimation of the effect from California's policy actions. Specifically:

The Studies Overlook Similar Policy Actions Outside of California

In particular, there are climate change and renewable energy policies either in place, or in development in almost every possible jurisdiction that California production could leak to. Within the U.S., the Clean Power Plan will transform the U.S. energy generation fleet, pushing out coal power and dramatically increasing the prevalence of renewable sources. Many states are considering a market-based emissions permit trading system, very similar to California's cap-and-trade system, as their compliance mechanism for the Clean Power Plan and states that comprise the Regional Greenhouse Gas Initiative (RGGI) already have such a program in place. Additionally, 28 states *besides California* have Renewable Portfolio Standards, which require electricity grids to increase the fraction of energy from renewable sources. Internationally, 177 countries agreed to the Paris climate accords and submitted Individually-Determined National Contributions, which pledge these states towards reducing their GHG emissions. All of these measures may impose policy-related costs on the energy supply system similar to those in California. The presence of sustainable energy policy could correlate with increased energy prices in other jurisdictions, leading to omitted variable bias.

The Studies Assume Zero Cost From Climate Change

All three studies compare a jurisdiction assumed to have a policy-driven cost on energy supply - California - against jurisdictions without such cost. This overlooks the fact that in absence of effective climate policy - of which, California' leadership is crucial - climate change will impose devastating costs. California is particularly vulnerable to climate change because of our long coastline, substantial agricultural sector, outdoor tourism industry and stressed water supply. The authors assume that not having a climate policy leads to business as usual over the foreseeable future, and essentially zero costs to industry. There is an extensive body of literature which indicates substantial economic risk to California industries from climate change [1,2,3,4], this is especially true in relation to the food-processing industries discussed in the sector-specific study. In reality, inaction on climate would subject the businesses discussed in this report to billions of dollars in additional costs and could easily reduce production by far more than the relatively small increments discussed in this paper.

The Studies Ignore the Economic Benefits of Renewable Energy and Climate Investments

The studies evaluate the loss of production and jobs from leakage, but separating the revenue-generating element of California's cap and trade program - the permit price - from the benefits gained from spending the revenue is an arbitrary distinction which does not illuminate the broader impacts of the plan.

Sustainability policies in general, and the cap-and-trade program in particular, have prompted the development of a massive new clean energy industry in California. From 2010-2014, state policy incentives led to over $20 billion in renewable energy, energy efficiency and clean transportation projects in-state. The revenue from the cap-and-trade program, coupled with the policy incentives created by the broader suite of AB-32 authorized policies, will inject billions of dollars of state funding, which will leverage billions more in private investment, into sustainable energy investments, which create good-paying jobs and expand the economy.

Insofar as the studies attempt to predict corporate behavior by examining response to prices, omitting the benefits of renewable energy investments paints an incomplete picture and again limits the accuracy of quantitative estimates of leakage effects. The models assume that the permit and energy prices borne by industries is the only price signal they receive from sustainable energy policies, however the investments made can function as a countervailing price signal, which the study does not consider. This again, tends to bias the studies towards overestimation of leakage effects.

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[1] http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf
[2] http://link.springer.com/article/10.1007/s10584-011-0322-3
[3] http://link.springer.com/article/10.1007/s10584-011-0314-3
[4] http://riskybusiness.org/site/assets/uploads/2015/09/California-Report-WEB-3-30-15.pdf

The Studies Generally Assume That Compliance Costs Are Equal to Permit Costs

Permit costs represent an upper bound on compliance costs, with many industries choosing to find lower-cost compliance options through internal efficiencies. Better insulation of heated vessels, cogeneration and energy recovery from waste biomass are technically feasible and cost effective ways to reduce emissions within the food processing sector. GGRF funding can, and has, been used to help facilitate these efficiency improvements in industry. With actual compliance costs potentially lower than those assumed by the study, the resulting leakage estimates are biased towards over-estimation.

The Studies Do Not Sufficiently Examine Alternative Causes For Changes in Production

Least-squares regression functions by drawing the line of best fit through a group of points and determining how well it matches the given data. This is one of the most fundamental, and well-studied econometric tools, however it is limited by the data available and assumptions about the nature of the system under study. In particular, when only one explanatory variable is considered in studies of complex systems - and the economic behavior of modern economies certainly qualifies as complex -there is a risk that the model will over-ascribe causality for the observed behavior to the explanatory variable included in the study. That is to say, if you only include one possible cause of an effect in your least-squares regression study, the model will err on the side of finding more causality than there actually is.

The studies under discussion do not consider alternative causes for geographic shifts in production, such as broader market behavior, weather, trade disruptions, labor price, consumer trends, etc. Several of these effects could correlate with energy prices and therefore lead to omitted variable bias.

The Assumption of Full Cost Pass-Through is Incorrect

The studies all base their estimates of the price effect on manufacturers on the price of emission permits and the price increase in energy to reflect utilites' need to obtain permits. They assume that these costs from utilities are fully passed through. Recent research has indicated that within the manufacturing sector, this is not the case[5]. This implies that for the industries affected, the impact of cap-and-trade related price effects on competition cannot be modeled so simply as is done in these studies.

[5] http://faculty.haas.berkeley.edu/rwalker/research/GanapatiShapiroWalker-PassThrough.pdf

Specific Comments on the Food Processing Industry Study (Hamilton, et al. 2016)

- The study is based on a fairly simple elasticity-based modeling rather than equilibrium modelling or other econometric techniques. Elasticity based modeling assumes linear response to changes in conditions, which is seldom true at scales considered by this study. For some of the industries under study, there is also very little data on which to base these conclusions. There are four sugar processors in the state and four wet corn processors, of which one wet corn processor controls almost three-quarters of the market. Trying to extrapolate generalized predictions about responses to conditions never before seen in California's economic history from four data points is highly uncertain at best.

- The paper attempts a regression analysis with a very limited data set, in some places as little as two years of California production. The data is largely confidential and therefore not available for review. As the authors note, in many cases, the industry has consolidated to a relatively small number of producers. This means that confounding factors which affect one producer are likely to affect many of them and thereby impart systematic bias. There are also potential problems with collinearity and heteroskedasticity which may not be apparent with such a limited dataset. Ultimately, without a larger and more diverse data set, and the ability to review it for alternative explanations for the observed behavior, the conclusions offered by this report are not well-supported by the data.

- The paper makes the claim, with little evidence to support, that producers using natural gas in-state will shift out-of-state and start using coal. Market and regulatory forces outside California, including the Clean Power Plan, air quality regulation (e.g. the Mercury and Air Toxics rule) and the cascading bankruptcy of the coal industry has dramatically limited the prospects of industries choosing to build new coal-powered facilities.

  The study's own numbers bear this out. They report a nearly equal fraction of production which relocates outside of the state will be powered by electricity as by coal or fuel oil. Electricity is likely to be an environmentally superior option to natural gas, due to the rapid decarbonization of the U.S. power grid and the dispatchability of demand from industrial sources. So, by the most straightforward interpretation of data provided in this paper, as much production will be moving to less-emitting sources of power as will be moving to more.

- The actual production decreases reported in this study are extremely small and difficult to translate to actual production numbers. They rely on the completely linear behavior

of elasticity-based economic models whereas real production decisions and responses to changing economic conditions are often highly non-linear.

For example, the paper predicts a 0.75% marginal cost increase in sugar mills leads to a 1% loss in production. Given that there are 4 sugar mills in operation, what does that mean in real terms? Is there any evidence that production at California sugar mills is so incrementally flexible that you would see a 1% change in production and/or employment? Or are production values set by long term contract, which would imply that a .75% cost increase would be simply absorbed into overhead and either passed on to buyers or reflected in lower profit?

- The wet corn industry in California, by the authors' own admission, is dominated by one producer which represents 72% of total production. The authors first make an error by assuming that the relationship between energy price and output is the same at the smaller facilities as it is at the one several times their size; the large facility is likely to enjoy economies of scale not available to the smaller ones. Second, similar to the questions about sugar production discussed above, interpreting a 2% production cut in a small sector in light of production contracts is problematic. It is almost certain that the actual behavior is non-linear. Third, within California excess corn could easily be shifted to the dairy, beef and poultry industries, which would preserve the market for the agricultural product and could potentially offset production and job losses.

- The methods state that they do not have detailed information about manufacturing processes for out-of-state producers, so they assume identical efficiencies as in California. This assumption may not hold true however. Californian farmers are typically more efficient than those in other areas because of high rates of technological adoption, the relatively higher cost of land and labor, water scarcity and most California industries have higher energy efficiency than competitors in other states due to years of state policy action. So the conclusion that marginal increases in cost will lead to production flight rests on an unsupported assumption.

- The authors use 2010-2012 production and industry survey data, but acknowledge that for the first several compliance periods, the industry will receive all, or a majority of emission permits allocated for free. This means that the data which populate their model do not include a carbon price price, nor the benefits provided from GGRF spending. These conditions do not represent those likely to affect the industry at the times when cap-and-trade will be in effect, nor do they consider the revenue generated in early years of the program from the large allocations of free permits these industries will receive, which could be invested in production improvements or emissions-reducing technology.

Specific Comments on the Domestic Leakage Study (Gray, et al. 2016)

- Natural gas cost shares are based off a 1991 survey of manufacturing energy costs. Industrial energy use has massively changed over the last 25 years, with substantial increases in energy efficiency, which would dramatically shift the cost share of natural gas in a finished product.

  When asked at the workshop, the authors said that the natural gas cost shares effectively cancel themselves out, however given that they are one of the factors used in the basic model form to determine the elasticity of response to energy prices, it seems likely that the bias from the out-of-date natural gas cost share would be reflected in the elasticity values estimated from the regression, if not in the final aggregate job, productivity and value added loss values. Given that the elasticity values will be used to develop future CARB policy regarding protection for leakage-prone industries, this seems to be a significant flaw[6].

- The study finds that the most significant impacts are predominantly in the short run and in Energy-Intensive Trade-Exposed (EITE) industries. California's cap-and-trade program has several provisions which reduce short-run costs to EITEs, including free allocation of emissions permits to both utilities and EITEs. Entities receiving a free allocation of permits can either use them to substantially reduce compliance costs, possibly to near zero, or sell them to raise revenue, which could be used to fund emission-reducing process enhancements or other business expansion. If a business has any emissions reducing projects with a GHG abatement cost less than the permit price, this leads to a net profit in the short run, which can be reinvested in reducing future emissions.

  The authors explore these effects through rebates of part of the compliance cost, which is reported in Table A-1, which shows that rebating the cost of compliance to these industries dramatically lowers the reduction in value added within each industrial group. The authors did not report similar results for output or employment.

  This brief treatment does not adequately evaluate the effects of free permit allocation on affected industries. By treating free permits as a partial cost rebate, it overlooks two potential outcomes which would ultimately reduce compliance costs even further.

[6] The methodology surrounding this point was unclear and Dr. Morgenstern did not respond to an email asking for further clarification.

  - Industries investing revenue from near-term emission permit sales in projects to reduce GHG emission over the long run, which would reduce compliance costs further below those predicted by the model.
  - Industries with above-average emissions efficiency choosing to remain in California, or relocate here, to take advantage of the benefit that the free allocation of permits provides.

- The study also focuses exclusively on the effects of energy prices and does not attempt to control for, or explore the effects of, alternative causality. While this study does a better job of exploring several dimensions of correlation between energy prices and output indicators than the food processing one, it still does not adequately eliminate other potential causes to clearly establish causality or quantify the magnitude of a causal relationship. Without exploring other plausible causes, such as broader economic activity, changes in trade patterns, changes in input factor costs or availability or labor costs, the strongest claim the study can make is a correlation, not causality and certainly not an accurate quantification of the magnitude of the effect.

- Cap and trade compliance costs in the electricity sector were modeled by assuming a $0.005525 per kWh charge, which was based on the compliance costs for natural gas generation. In 2014, California obtained 45-60% of its power from natural gas sources[7], a figure that is certain to substantially decrease over time due to increases in the state's Renewable Portfolio Standard, as specified by SB 350 (2015, de Leon). Conversely, 34% of its power came from non-emitting sources such as wind, solar, hydro and nuclear, which would pay little or no emission-based GHG charges. The fraction of electricity which is not subject to carbon charges will, by law, increase significantly.. This means that the assessed carbon charge in this study, by applying the rate for natural gas generation to all power in the state, substantially over-estimated the effect of cap-and-trade; an error that would only increase over time.

- In common with the other studies, this paper erroneously assumes that states outside of California will not experience price increases from GHG reduction policies - "In contrast, for a plant located outside California, the energy prices it faces do not change, but the prices faced by its California competitors increase"[8]. As discussed earlier, other states and, in fact, almost every other nation has committed to significant GHG reduction policies, which would imply similar cost effects outside of California. Additionally, coal and natural gas, which predominantly comprise the fuel for electricity generation, are at historical low prices right now, so normal cyclic behavior would suggest that their price will go up. Together, this means that the assumption that energy prices outside the state will remain static is almost certain to be untrue.

[7] http://energyalmanac.ca.gov/electricity/total_system_power.html
[8] Page 4, paragraph 4

- The authors report that over the long run, the results are minimal for most industries, which implies that after the initial adjustment period to the new policy, in-state production will recover.

- Over the long run, the authors find that net output will increase with the carbon cap in place, while employment will slightly decrease. This reflects the broader trend observed in almost every industrialized economy: that output increases but labor requirements decrease due to the effects of automation and other productivity-increasing technology. Since the authors did not present an analysis of business conditions in absence of policy action - they only compared California against neighboring states with the carbon price in place - this study does not present sufficient evidence that the long term trends reflect anything other than normal industrial maturation.

- There is a lack of transparency about the cleanup techniques applied to the CMF and ASM datasets prior to analysis. We understand that in any large-scale dataset of this type, there will be a need to eliminate duplicate or erroneous values, however the authors did not report what fraction of the dataset was removed by these clean-up techniques or whether the removed values differed significantly from those that remained.

- The labor cost index includes only the pay per worker and does not take into account varying levels of labor productivity by state. California's labor productivity is significantly above the national average[9], which would indicate that a simple pay-per-worker approach would not adequately consider the true costs and value of California labor relative to neighboring states.

- Their costs estimates of electricity supply include only utility-operated plants, not plants operated by the industrial user themselves. This ignores obvious opportunites for co-generation of power and heat at industrial facilities, as well as other opportunities for distributed renewable energy. This is especially problematic, considering the existence of the Self-Generation Incentive Program (SGIP), which has led to $1.5 billion in industrial power generation projects which supplied a total of 1,046 GWh of power in 2013[10].

- The authors use 2009 as the baseline year for their analysis, which was near the worst part of the recession. While their analysis does take the effect of the recession on other states into account, it does not account for the fact that California has recovered from the recession at a rate above that of the national trend. Since this recovery could also affect energy prices, there is a significant risk of omitted variable bias.

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9 https://www.clevelandfed.org/en/newsroom-and-events/publications/discontinued-publications/policy-discussion-papers/pdp-0616-estimating-gsp-and-labor.aspx

10 http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=7909

Specific Comments on the International Leakage Study (Fowlie, et al. 2016)

- The authors do a good job discussing the potential errors and uncertainty in their work. The authors themselves acknowledge that "*In those sectors where California producers comprise the vast majority of domestic market (e.g., tomato processing), our estimates are directly relevant to the California case. In other cases, our estimates likely overstate the impacts of a California Cap-and-Trade Program.*"[11]

  This is particularly important because there are very few industrial sectors that are simultaneously highly energy-intensive and also nationally dominated by Californian production. The EITEs identified by the three studies discussed in this letter are primarily manufacturing of chemical or consumer products, including fertilizer, industrial gases, glass, paper and metal products. While California has a robust presence in these, it hardly dominates national production. So, by the author's own admission, their methodology "likely overstate[s]" the actual leakage. "*The imprecision of our estimates makes it difficult to estimate leakage potential for any particular industry with any degree of precision."*[12]

- Similarly to the other studies, the authors do not consider the impact of international GHG reduction policies, such as the Intended Nationally-Determined Contributions (INDCs) agreed to by 177 nations. The effect of the INDCs will, in many cases, be to promote renewable energy policy similar to that of California, in the countries which would theoretically be competing against our industries for market share. As these policies take effect, the difference between in-state and international energy prices will decline significantly, thereby reducing the effect felt by CA industries. Since clean energy policies can affect energy prices, there is a risk of omitted variable bias.

- Similarly to the domestic leakage study, this study does not adequately model the impact of allowances distributed for free to EITEs. The effect of these free allocations would likely reduce costs to industries and long-run emissions intensity in a similar fashion to that described above:
  - Industries investing revenue from near-term emission permit sales in projects to reduce GHG emission over the long run, which would reduce compliance costs further below those predicted by the model.
  - Industries with above-average emissions efficiency choosing to remain in California, or relocate here, to take advantage of the benefit that the free allocation of permits provides.

[11] (Page 29, paragraph 5)
[12] Page 41, last paragraph.

Conclusion

We applaud the Air Resources Board for examining this issue in a thorough and quantitative way. We agree with the general principle that a rigorous, science-based approach is needed to fully understand the risks of leakage and design appropriate policies in response. The studies presented at the May 18th workshop are a valuable step toward sound policy design. They are not, however, accurate quantification of real-world leakage and should not be presented as such. Within their more narrow, and more appropriate scope, there are some methodological and problem-framing decisions which tend towards overstating the actual leakage risk. This tendency must be considered when developing policies to shield EITEs from potential leakage risk. We urge the Air Resources Board, the Legislature and all stakeholders to consider the costs imposed by the cap-and-trade program in the context of broader economic and policy benefits when modifying this vital and extremely successful policy..

We appreciate the opportunity to comment on these studies and will remain engaged in the process of improving and building upon the success of California's climate change policy. We are happy to offer any additional clarification or explanation on the matters contained in this letter.

Sincerely,

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