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California Air Resources Board
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Dear Ms. Sahota, Dr. Wimberger, and Mr. Zielkiewicz,

Thanks to you and the CARB staff for your work on the 2030 Scoping Plan and for the opportunity to comment on the material presented at the November 7th workshop. The need to continue CARB's leadership and quality work is even greater today than it was on that day.

These types of big picture, long range policy analysis and planning exercises are challenging but worthwhile. Energy innovation staff has significant expertise on the topic, including extensive participation in economic analysis of the original Scoping Plan. For example, Energy Innovation Research Director Chris Busch served as an invited panelist at the Public Meeting to Update the Board on Assembly Bill 32 Economic Analyses in April of 2010.

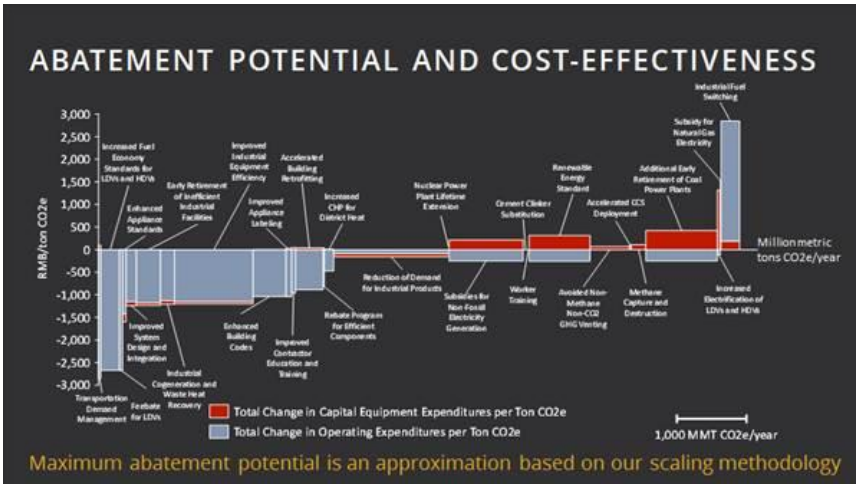
Our overall conclusion is that this work is shaping up to be a well-crafted analysis that makes a strong case that the costs of achieving the 2030 target will be moderate and outweighed by benefits. The state is clearly justified in taking these actions due to the in-state benefits for Californians (air quality, public health, and quality of life), even before factoring in the benefits of avoided climate damage and the advantages of growing clean energy businesses, which are increasingly demanded by the world economy, thereby increasing future opportunities for exporting clean technologies.

At this time, we offer one specific recommendation regarding your existing analytical work. ***Integrate public health benefits with economic analysis.*** At the workshop, CARB indicated measures will be ranked by social cost-effectiveness, as AB 197 requires. In addition to the ranking that is specifically discussed, we urge the integration of social impacts within the other more readily quantified monetary impacts already reflected in the economic analysis. Air quality and related public health impacts at least should be approximated and attributed to the different policy scenarios under consideration. Without this step, there is the risk of an unduly negative frame.

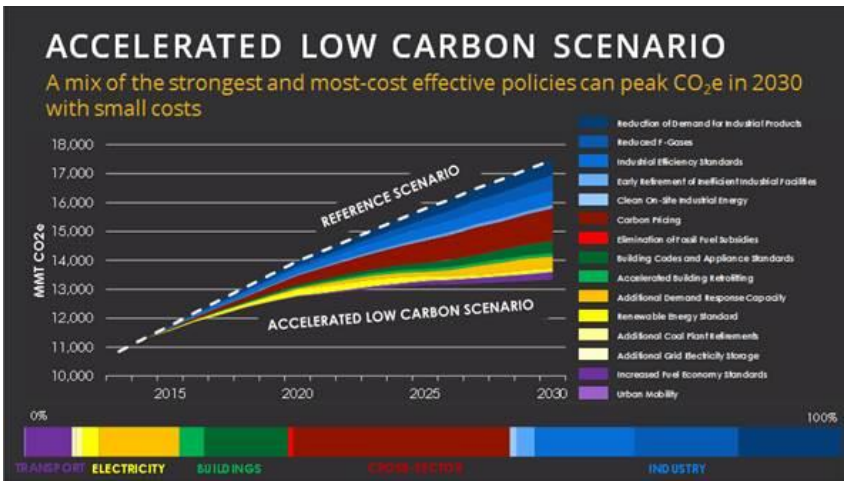
We also ask: ***Why not include a scenario that tests strengthening of some current commitments in combination with the cap-and-trade program?*** The "draft scoping plan scenario" includes current commitments, plus a new rule requiring a 20 percent reduction in refinery emissions by 2030, and cap-and-trade. It would be helpful to understand how and why the various scenarios

have been constructed. In general, more documentation is needed and will facilitate more detailed comment on the Scoping Plan recommendations.

In addition, ***we invite CARB's participation or guidance in our development of a California Energy Policy Simulator.*** Energy Innovation has developed a policy optimization tool known as the Energy Policy Simulator (EPS). My colleagues Hal Harvey, Jeffrey Rissman, Sonia Aggarwal, and Robbie Orvis have developed this tool, and applied it in China, Mexico, Poland, and at the U.S. national level. We are confident that the EPS can be an important tool in contributing to the development of a successful policy package that achieve SB 32's mandated 2030 emission limit and to carry out the social cost analysis called for under AB 197. Without getting into measure-detail, the following graph shows the policy-by-policy analysis we did for China.



The foregoing shows cost-effectiveness based on direct economic impacts, but it will be straightforward to extend such graphs to social cost. As another sample graphic, see the following wedge analysis, which shows how the simulator produces a package of policies to achieve China's goal of peaking emissions before 2030.



In recent years, the UC Davis Policy Institute for Energy, Environment, and the Economy has convened a climate policy modeling dialogue, bringing together researchers and policymakers.

Our Energy Policy Simulator pushes the state of the art for climate policy modeling in exactly the ways identified as priorities through this process:

> "Policymakers involved asked for more modeling of: (1) individual policies (i.e., rather than generic climate policies) in order to better understand the spatial, temporal, and socio-economic effects of regulations, (2) interactive effects between two or more policies, (3) non-emission impacts like water, land-use, and economic equity, and (4) the optimal sequencing (i.e., timing) and prioritization of policies and technology deployment." Quote from "Comparison of Low Carbon Pathways for California" in the journal *Climatic Change, 2015, v.131 (4)*

The EPS directly innovates on points one and two. It offers more measure specific policy features that are structurally represented, and it offers more systematic endogenous policy interaction than any other policy analysis tool.

We invite CARB to participate in the shaping of this tool so that it will be of maximum usefulness. As CARB did in the collaborative modeling exercise of 2010, which included industry funded modelers, we would urge you to work with any modeling group willing to engage in good faith analysis.

We are flexible about the form of CARB's participation; options include: sending an analyst to spend 8-10 working days with us to build and calibrate the California model and serve as an internal resource to use the tool on an ongoing basis for CARB projects, or providing periodic high-level input on things like the list of policies we should be sure to include as levers, some of the key modeling assumptions, the policy packages highlighted, etc. We are happy to discuss other modes of engagement as useful.

Energy Policy Simulator Capabilities. The Energy Policy Simulator is capable of estimating the combined effects of more than 50 different energy and environmental policies. Its outputs include the emissions of 12 different pollutants, direct economic impacts, and estimates monetized health benefits from reduced pollution, as well as human lives saved through avoided particulate emissions. The structure, parameters, and data sources of the Energy Policy Simulator are entirely transparent. Moreover, this is an open source, free tool that we will make available via an easy-to-use online interface like this one.

Energy Innovation has also developed a comprehensive website for the four currently-available country versions of the EPS, with full documentation and an option to download the model code and software. A notable feature of the website is its web interface that allows users to test policy scenarios without the need to download the model or understand its intricacies. The EPS also boasts impressive graphic capabilities, and results are producible in real time.

The EPS model is a system dynamics model, a new approach to policy analysis that has been advanced by MIT Professor John Sterman. The systems dynamic modeling approach has been deployed fruitfully in the realm of climate change by Climate Interactive, which runs an energy and emissions model of climate change that was one of the main models used to test the impact of pledges made at COP21 in Paris last year (press coverage). Climate Interactive's model analyzes energy use, emissions, and global temperature impacts. However, the Climate Interactive model does not capture the effects of individual policies, policy interactions, or their cost and health impacts, as ours does.

Reflections on economic analysis of original scoping plan. As I see it, the main lesson from the collaborative modeling exercise that CARB orchestrated with UC Berkeley's BEAR model and Charles River Associates MRN model was this: The optimal policy package depends on the scope of market failures beyond the lack of a price on carbon. Modeling results essentially boiled down to disagreements – reflected in the structure and assumptions of the methodologies – regarding the prevalence of market failures. This suggests there is value to evaluating carbon price responsiveness (or lack thereof) as an input to policy. Better understanding the prevalence and size of market failures beyond the carbon externality can help CARB steer resources in the future.

Thank you! Thank you for your consideration of our comments. Thanks again for your diligent and hard work. As Californians, we stand ready to help our state achieve its important climate goals. Please let us know however we might be most helpful.

Chris Busch
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