September 9, 2020

RAJINDER SAHOTA
CHIEF, INDUSTRIAL STRATEGIES DIVISION
CALIFORNIA AIR RESOURCES BOARD
1001 I STREET
SACRAMENTO, CA 95814

SUBJECT: ACHIEVING CARBON NEUTRALITY IN CALIFORNIA

Dear Ms. Sahota,

Thank you for the opportunity to provide comments on E3's recent carbon neutrality study. AJW is proud to represent the carbon reduction technologies of all our clients, and we are technology optimists. Reports like the E3 document that forecast potential futures are of great interest to our clients and their breakthrough technologies. We recognize that a forecasting exercise like this Carbon Neutrality study is contains a healthy degree of assumptions and guesses. However, we believe there are additional considerations and technologies that are worthy of inclusion within the modeling project.

As an aspirational document, the study does well to aim high and showcase some of the technologies that may be possible to meet California's targets by 2045. However, as a technical and economic report, the document seems to be somewhat perhaps overly optimistic regarding the pace of some technological advancements, while overlooking important carbon reduction strategies building on technologies increasingly in use today. Achieving our climate goals requires achieving dramatic reductions as rapidly as possible. This study demonstrates an appropriate interest in stretch technology goals but seems needlessly dismissive of maximizing more reachable technologies in combination with those ambitions.

We believe the best policies incentivize the market to fully deploy all cost-effective solutions. Placing too much faith in the availability – and affordability – of as yet undemonstrated technologies is a mistake and an unnecessary risk for the future of our climate. Our hope is that CARB will put this report in the appropriate perspective for both its value and its limitations as a guide for policymaking.

AJW would like to provide the following specific comments on the analysis:

RISK ASSESSMENT

CARB has an established track record of success designing and implementing technology-neutral emission reduction strategies. Such programs enable discovery – often surprising – as to how technologies, markets, and consumers will interact to meet ambitious targets. Because technology neutrality empowers private sector competition and consumer choice, such approaches tend to minimize the risks of government over-reliance on speculative projections of technology development and adoption rates.

E3's study seems to promote the "balanced" strategy of relying on a portfolio approach consistent with, for example, CARB's approach to decarbonizing transportation fuels. We encourage CARB to continue to adopt strategies that avoid over-reliance on any single technology – especially those that are not yet in commercial use or even demonstrated at a commercial scale and operating conditions.

The E3 study makes some assertions regarding the benefits and timing of key technologies, yet it is not entirely clear what assumptions are used to underpin these assertions. For example, the treatment of technology costs in discussing the technology scenarios is not fully explained. It seems that some technologies with high potential costs, significant cost uncertainties, and limited demonstration are included as essential in the Balanced and ZCE scenario. Meanwhile, other technologies with lower anticipated costs based on greater levels of technology demonstration are dismissed as of limited value. It is unclear if costs have been factored into technology adoption rates or market penetration levels. It is further unclear if the total costs of the various scenarios have been compared and factored into the assessments.

Cost is an important component of technology adoption, and therefore essential to understanding how E3 assessed various scenarios. The report's risk assessment identifies as "uncertain" the cost difference between scenarios (slide 17 of presentation). By contrast, the Intergovernmental Panel on Climate Change's (IPCC) study of technologies needed to address decarbonization contains extensive and transparent cost considerations and sensitivity analysis for each technology in the portfolio scenarios it analyzed. While we recognize the budget and resources available for the E3 study are a fraction of those at the disposal of the IPCC, it is unsatisfying that their report should differ substantially from IPCC recommendations while not providing transparent discussion of the cost assumptions connected to its own recommendations.

It would be more appropriate to account for technology cost as a fourth consideration in the risk overview, apart from the technology adoption and implementation risks. As Slide 17 of the E3 presentation shows, the potential costs of the ZCE scenario are large, while policy support for the development and deployment of these technologies at a commercial scale is currently limited or insufficient. Technology development requires either public or private resources – and often both. Understanding the scale of needed resources is essential to understanding and assessing the risks associated with a given technology. Balancing the risk assessment to capture the potential cost implications of the technologies needed for this scenario would better allow stakeholders to assess the tradeoffs of the scenarios.

As an illustration, the ZCE scenario depends on electric aviation and other technologies that are at the earliest stages of development, and so, carry significant cost and adoption uncertainties. Evaluating the potential for such early stage technologies is a worthwhile exercise in future scenario planning. However, policies crafted to depend on the deployment of unproven technologies are blind to the risk that such technologies may not materialize as timely and cost-effective solutions. Ignoring such realities introduces policy risks that could undermine the effort to achieve the zero-carbon goal. We would prefer to see the inclusion of at least one scenario based more heavily on the assumption of continued use and evolution of technologies in use today, even if they are less politically popular. This may be a more balanced and less risky way for California to meet its zero-carbon energy goals. At a minimum, it would provide a useful and grounded way to assess more technologically risky strategies for decarbonization.

TRANSPORTATION

BIOMASS

By using a fixed amount of biomass from the Department of Energy's (DOE) 2016 biomass study, an important market development is overlooked for many promising technologies. Based on market demand, there is significant work underway to produce more efficient energy crops and utilize biomass sources that previously were cost prohibitive. Furthermore, biomass is currently not fully utilized by all regions and while California is developing its carbon reduction technologies, it is reasonable to expect that California may pull a greater proportion of biomass demand in initial years while feedstocks are further developed. "Unlocking" some of the biomass would provide significant carbon reduction strategies to alleviate the reliance on less-proven technologies. The evidence from the state's Low Carbon Fuel Standard (LCFS) bears out this case – we are using ethanol, biodiesel,

and renewable diesel to fulfill our carbon reduction goals while the state's fleet undergoes a slower-than-hoped transition to electric technologies. As ZEVs increase their market penetration, use of these liquid fuels may shift to other needs. For example, GE has already constructed and demonstrated a commercial scale ethanol powered turbine for industrial heat and power applications.

AVIATION

In our work with sustainable aviation fuel (SAF) centric clients, we have had the pleasure of working with many leaders across the aviation industry. Electric aviation has been a source of inquiry for some time now, but its development has stagnated around the issue of battery weight. At this stage, the weight of any battery powerful enough for a flight would unfortunately be too heavy to actually be transported with the plane. There is still a need for significant development and lightweighting of batteries initially, and then subsequent years of testing, improvement, and eventual market introduction. A 30-year timeline for half of the state's aviation to be electric powered seems overly ambitious, and we wonder if that power from the grid could otherwise be put to better use in the ZCE scenario. In its stead, we suggest that SAF be more heavily relied upon by utilizing biomass sources that are currently being explored and developed.

RAIL

The scenario assumptions for rail may benefit from considering other fuels like renewable natural gas and ammonia. These low carbon alternative fuels may offer more flexibility than overloading electricity demand and have lower cost implications.

HEAVY-DUTY

The analysis shows that a significant portion of the heavy-duty sector switches over to ZEVs by 2035. For this level of penetration, the study could consider deploying more hydrogen production. Increasing the scope of technologies considered would further de-risk the analysis' reliance on a chosen technology that may or may not be adopted at the rates suggested in the analysis. However, green hydrogen is a gradual development that will be reached through incremental investments in grey or blue hydrogen and renewable natural gas (RNG). RNG is an important bridge technology towards green hydrogen. Not all RNG will be phased out by 2035, and it would be appropriate for a balanced scenario to take this into account. Given the low carbon values of RNG, it will still make valuable contributions towards our carbon targets. Furthermore, CARB's newly adopted Advanced Clean Truck (ACT) rule state's that "by 2035, zero-emission truck/chassis sales would need to by 55% of Class 2b – 3 trucks, 75% of Class 4 – 8 straight truck sales, and 40% of truck tractor sales."[1] Based on these sales requirements, the Balanced and ZCE scenario's assumptions of 93% and 100% HDV ZEV sales by 2035, respectively, appear out of alignment with CARB's previous expectations from automotive manufacturers by 2035.

ADDITIONAL TECHNOLOGIES TO CONSIDER

In addition to the technologies that we've outlined above, there are a few that could benefit the analysis by playing a more prominent role. Overall, we see greater potential for the growth and maturity of low-carbon liquid fuels in the California marketplace. These fuels can be deployed in engines today without waiting for fleet turnover, providing valuable carbon reduction benefits

[1] https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet

immediately. This includes the role of ethanol, which has improved its carbon intensity by more than 30% since the inception of the LCFS. Going forward, the ethanol industry is focused on further reducing its carbon impact to remain competitive in California. When coupled with carbon capture and storage (CCS), ethanol has the opportunity to provide a zero-carbon fuel. Integrating CCS, alongside the expansion of ethanol via E85 and E15, within the analysis would provide large carbon benefits to the transportation sector. Our analysis suggests that pairing low carbon E85 with hybrid vehicles would double the decarbonization benefit achieved from using those vehicles.

Renewable diesel (RD) will also provide carbon reduction opportunities. With the recent announcements by oil majors of converting their facilities to renewable diesel, we can expect RD to play an increasing role. This investment by large producers is further evidence of the development that will transpire for low carbon biomass sources. California's original renewable diesel producer, World Energy in Paramount, has also announced the complete conversion of its assets to be capable of supplying 10 percent of California's diesel demand with RD. We can anticipate that the carbon intensity of RD will improve with time as well, as it has the opportunity to become carbon neutral by utilizing green hydrogen for its production process.

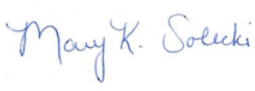
With companies like Carbon Engineering pursuing Direct Air Capture in collaboration with oil majors like Occidental Petroleum, and CCS now being deployed around the world, the analysis could have a greater degree of confidence about the early and ongoing contributions that these technologies can make towards our carbon goals. If the grid does indeed achieve 100 percent zero carbon energy as most of the scenarios contemplate, then the use of CDR would be of greater carbon benefit. Coupled with the addition of the technologies outlined in this letter, the CDR scenario could offset some of its reliance on CDR, and instead become a scenario that continues and expands technologies that are in use today.

CONCLUSION

We offer these comments in the spirit of our strong commitment to building and promoting policies and technologies that will help California achieve its carbon neutrality goals. Our overriding desire is to work with CARB to build illustrative scenarios that can be living blueprints for the state to chart its way towards carbon neutrality and reflect the abundance of technologies that will likely play a role in our economy and environment. All illustrative scenarios will have some guesswork and have varying degrees of eventual accuracy. We believe that incorporating more of the fuels and technologies in use today will bolster the assessment's validity farther into the future.

We appreciate your time and consideration of our perspectives.

Sincerely,



Mary K. Solecki

Partner, AJW, Inc.
msolecki@ajw-inc.com