March 31, 2022
To: CARB
From: Muriel Strand, P.E.
Re: 2022 Scoping Plan Update Modeling Scenarios Workshop

"All Models Are Wrong; Some Are Useful." – George Box

Thus, the question becomes in what ways this or that model and its predictions can be useful, and conversely, which may be misleading or harmful.

With respect to the trade-off between CO2 and CH4, it seems that basically:
Anaerobic biological processes produce methane and not CO2
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Aerobic biological processes can occur underwater if the dissolved oxygen is more than about 1 mg/L

Thus, we can displace some methane emissions by substituting aerobic processes for anaerobic ones whenever possible. For example, CAFOs can be replaced by natural grazing for ruminants. How does one cornfed steer's methane emissions, enteric plus CAFO poop, compare to the enteric methane of a grass-fed one? Can models assess the benefits of the autonomous self-manufacturing, seeding, mowing, irrigating, fertilizing, food-producing machines called ruminants?

Model algorithms are vulnerable to analytical bias in ways described by researchers such as Cathy O'Neil in her book, "Weapons of Math Destruction." Specifically, she reports a common tendency to predict the future by extrapolating from the past, to repeat implicit human biases unnoticed in the input data. As O'Neil notes, too often legal protections for "proprietary information" cover up algorithms that lack feedback and re/calibration. Software code and documentation for models used for public purposes should be transparent.

Economic & Energy Modeling
Thus, models like PATHWAYS and IMPLAN almost certainly use input data, assumptions and processes based on current economic activities, and on extrapolation of recent trends of energy demand as well as trends of production of standard goods and services in the usual ways. But modeling the same business-as-usual (BAU) jobs, commutes, stores, shopping, construction, manufacturing, supply chains, travel, etc., and just replacing fossil fuels with electricity, does not strike me as the easiest and simplest way to really zero out net carbon.

Rather, data about those predicted energy and economic trends are usually nonvariable assumptions in typical energy and economic models, thus reproducing a version of BAU that's grafted onto different energy sources, namely the usual nonrenewable harvesters of renewable energy.

Could this be why, as I gather, that VMT reductions to date have not lived up to previous predictions and expectations? The plan to graft our fossil fuel lifestyles onto PVs, windmills and batteries, without first adjusting attitudes, allows most people to expect little change

aside from buying some new appliances. When energy prices are so much cheaper than human muscles, they are unlikely to really move the market.

Can PATHWAYS or another existing model estimate the effects of triple-pricing retail goods and services with embedded kwhr and GHG 'prices,' as well as dollars? What good and services would be simplest for estimating such parallel prices, and which triple prices would best induce behavior change and emissions reductions?

Really transcending BAU and avoiding the sort of bias that O'Neil describes may require a different model with different lifestyle assumptions and parameters. Ideally, a detailed and realistic model could offer a motivating vision for change. Specifically, one could be developed from the kind of model I have sketched out in this paper: https://www.researchgate.net/publication/333581837_Is_it_true_that_'Small_Is_Beautiful'

I am convinced that planning would be greatly improved by creating this kind of back-to-basics model. While development of such a model may not be feasible this year, and its results thus not available for the scoping plan, there is good reason to include prompt development of such a model in the scoping plan for the near-term.

Taken as a whole, my scoping plan comments are my best efforts to outline a vision that has no model (beyond my super-simple spreadsheet) but it overlaps quite a bit with what the EJAC seems to be asking for—an affordable alternative model that puts conservation, thrift and frugality first, ahead of new high-tech equipment. People such as the homeless, and small family farmers who reap the smallest fraction of the revenue from our food dollars, need such alternatives.

Such a model could address questions such as:
* What are the jobs that directly and collectively provide for basic human physical needs, using only natural materials and renewable energy flows?
* What is the smallest collective community that could achieve that goal in relationship with a suitable parcel of land guaranteed in perpetuity?
* What education and training is needed for efficacy and success in performing those various jobs in that particular place?

The results of such a model should be applicable on a small, local scale, thus supporting implementation in ways that could seed more such local projects that could be networked regionally. We can build a reliable sustainable future by nurturing such local alternatives, placed here and there amid current infrastructure, which could steadily multiply and replace our existing high-tech fossil fuel systems with minimal pain and chaos. Such a model could start out by using this kind of small project for calibration, since it's best to start with a simple system to get a complex one that works. Ideally, such a detailed and realistic model would offer a motivating vision for change.

Eventually, a back-to-basics model's results could be reconciled with the results of standard models like PATHWAYS, somewhat as emissions inventories are reconciled with ambient air pollution data. Charting a path from where we are to a viable and persuasive future will create another path that people can understand and follow.

Natural and Working Lands Modeling
Adam Moreno noted that in the case of the NWL suite of models, "the science isn't there yet" to model some aspects of regenerative agriculture. I take this to mean that there is as yet no peer-reviewed literature quantifying how much carbon sequestration can be expected from measures such as conversion of this or that acre to organic agriculture or amendment with biochar. It may be that modeling carbon stocks and flows could be facilitated by using the same sort of 'delta' approach typical of entropy calculations in physics and engineering, where absolute entropy need not be calculated but only the difference between 2 thermodynamic states. Sidestepping the need for precision in terms of total amounts by leveraging better information about flows and changes in stocks may help. Supplementing this with general information about the proportions of total carbon in various sectors of NWL might also facilitate some work-arounds.

I very much support staff's stated intention to supplement model results with qualitative descriptions of new and rediscovered traditional methods of regenerative agriculture, agroecology, organic agriculture, climate smart agriculture, etc. I note that these concepts include various specific methods and processes that can be implemented and thus (eventually) modeled individually. But we need not wait for quantitative verification to be certain that such implementation will have positive and likely synergistic climate results.

Happily, it appears to me that there is great interest and ongoing exploration in the field, by both farmers and agronomists, as every season and year seems to bring more climate-healing information and encouraging research results. And there is no shortage of skilled practitioners and devoted researchers to consult, via organizations such as:

The Occidental Arts & Ecology Center - https://oaec.org/
The California Climate Action Network - https://calclimateag.org/
California Alliance with Family Farmers - https://caff.org/
The Organic Consumers Association - https://www.organicconsumers.org/
The Ecological Farming Association - https://eco-farm.org/
Permaculture Artisans - https://www.permaculture artisans.com/
Armed to Farm - https://www.ncat.org/applications-open-for-armed-to-farm-california-training/
and the Rudolf Steiner College in Fair Oaks - http://steinercollege.edu/

Ditching all pesticides is guaranteed to increase the carbon sequestration capacity of any and all unpaved land. One reads that urban pesticide use by residents and local governments is a basically unregulated source of the poisons that kill and/or suppress various elements of the soil microbiota that produce the most nutritious food. As well, standard ionic NPK fertilizers offer the microbiota a junk-food diet at best. Fortuitously, healthy soil provides the nutritional support for most plants to withstand most insect predators.

While the role of forest thinning and fuel reduction is still uncertain, it seems that most such work is expected to be done with fossil fuel machines. But as a general rule, anything that can be done with human muscles should be, rather than with engines or motors. Now it's not news that humanpower is way more expensive at current prices—but the real question is how we can afford ourselves collectively.

How much forest could be restored by a 21st century Civilian Conservation Corps using hand tools? Is it possible that Castor Canadensis, nature's engineers and a keystone species, can play a role in fuel reduction? Although most of the matchstick trees needing thinning are probably not appetizing to beavers, many of those trees can be used for pole-frame buildings. (I hear there's a housing shortage.) Meanwhile, beavers' well-understood role in water retention and infiltration has substantial potential for restoration with well-planned rehoming. And like many natural ecological strategies, they're cheap.

"Live Simply, That Others* May Simply Live." – Mahatma Gandhi

* including all the other species that we absolutely depend on.

Thank you for the opportunity to comment.