Objections to CARB Staff's Reasons for Proposal on Land Use Change[1]

April 15, 2009, William J. Hudson (see endnote)

General Objections

Using the Purdue GTAP, a Computable General Equilibrium Model whose baseline is the year 2001[2], CARB staff calculated that devoting 30 percent of America's available corn acreage to the production of about 13 billion gallons per year of ethanol would lead to the conversion of approximately 2 million acres of forest land and 7.5 million acres of pasture land in the world to row crops, which would result in an "indirect" carbon emission cost of 30 gCO2e / MJ for mid-western corn ethanol, to be allocated each year over the coming decade. When this indirect cost is added to the estimated direct cost for ethanol, the total is 99.40 gCO2e / MJ, slightly higher than the estimated 95.86 figure for CARBOB.

The CARB staff offered the following statement concerning the nature of "indirect land use change," apparently to simplify the mathematical structure of GTAP2001:

"An indirect land use change impact is initially triggered when an increase in the demand for a crop-based biofuel begins to drive up prices for the necessary feedstock crop. This price increase causes farmers to devote a larger proportion of their cultivated acreage to that feedstock crop. Supplies of the displaced food and feed commodities subsequently decline, leading to higher prices for those commodities. The lowest-cost way for many farmers to take advantage of these higher commodity prices is to bring non-agricultural lands into production. These land use conversions release the carbon sequestered in

[1] Citations of CARB Staff are from Executive Summary and Section IV of "Proposed Regulation to Implement the Low Carbon Fuel Standard, Volume I, Staff Report: Initial Statement of Reasons."
[2] According to page IV-20, "GTAP employs the 2001 world economic database as the analytical baseline. This is the most recent year for which a complete global land use database exists.

soils and vegetation. The resulting carbon emissions constitute the 'indirect' land use change impact of increased biofuel." (Page ES-28)

This statement of sequential causality is hypothetical. This statement, along with the economic data sampled in GTAP2001, does not, in the strictest sense, constitute an empirical test of what may or may not happen to world land use with the advent of the US Renewable Fuel Standard (RFS) enacted in the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 (EISA), as promulgated in regulations by the US EPA.[3]

For one thing, no such policy on the scale of the 2005 or the 2007 RFS had been invoked during or before 2001. From an empirical standpoint, therefore, and as will be indicated below from current USDA data, the 2001 data used in GTAP are essentially mute on what land use effects might be triggered by such a new policy. In other words, CARB staff does not demonstrate that GTAP elasticities derived from land use changes due to annual and smaller market changes might not be completely misleading with respect to the elasticities induced by large, long-term policy changes.

To gage the hypothetical nature of CARB staff's use of GTAP 2001, consider the following questions:

- Would a complete but static economic database for the year 1941 be expected to accurately model land use changes during World War Two, 1942-45, and during the Marshall Plan re-construction and Soviet Iron Curtain conditions which followed the war?
- Would similar static economic data for the year 1961 be expected to model land use changes in Central Asia undertaken by Soviet-era agricultural planners?
- Would static economic data for 1981 be expected to model land use changes in the United States promulgated by Congress and USDA in Acreage Reduction Programs (ARPs) of tens of millions of acres, and in the Conservation Reserve Program (CRP), which grew to over 30 million acres?

[3] See Appendix for further comments on "Why the so-called "Thought Experiment on Land Use Change" is invalid.

- Thus, would static economic data for 2001 (and / or before) be expected to model land use changes following in the wake of the terrorist attack on the Twin Towers, the invasion of Afghanistan and Iraq, the emergence of China and other parts of Asia as fully industrialized and rapidly growing economies, the quadrupling of crude oil price, the investment bubble in US real estate (including farmland), the creation of tens of trillions of dollars of new financial derivatives, and the subsequent collapse of the world economy?

A reasonable answer to all of these questions would be "No." The proposition that the world economy today can be treated by a static "General *Equilibrium* Model" is questionable. It s not completely clear that the world economy today is actually in "equilibrium,"[4] and certainly not on the same terms as it might have been in 2001.

A second important issue overlooked by CARB staff in its hypothetical statement of serial causality is the complex structure of the federal RFS. Certainly, the RFS does not occur "all at once in a given year," as modeled by CARB staff, nor is the Standard a simple set of immutable, annual biofuel volumes linked to fixed numbers of corn bushels and acreages. Congress specified instead that the annual volumes of biofuels be promulgated by EPA in the form of a percentage inclusion rate of ethanol derived by EPA in November of the previous year based on the estimated annual consumption of motor fuel in the coming year, as given in the Department of Energy's Short-term Energy Outlook for October (of the preceding year). If such estimate is above or below the actual motor fuel usage in the coming year, then the usage of ethanol will also be up or down from the so-called "mandate," depending on the share of total motor fuel supplied by Small Refiners (who are not obligated parties until after 2010).

Congress further specified that the RFS be administered with a credit trading system (now called by EPA the "RINs system"), in which obligated parties (refiners, not farmers) have considerable freedom in meeting the

[4] See the book by Princeton economist Harold James, *The End of Globalization; Lessons from the Great Depression* (Cambridge, MA, Harvard University Press, 2001) for an introduction to the "alternative paths to the autodestruction of the globalized economy" which researchers have identified in the past decade. (Page 2.)

Required Volumes in any given calendar year, by means of either deferring the obligation until the next year or by means of trading electronic certificates, including the carryover of up to 20 percent of the obligation into the next calendar year. This flexible structure, which depends on economic conditions and trading, does not conform to a modeling procedure based on a "one-time shock" to a static equilibrium condition. Modeling the RFS (or any other form of generally increasing demand for ethanol) requires a dynamic approach, including an analysis of changing independent variables and their interaction over time.

In addition, coming back to the structure of the RFS, the legislation was enacted with a set of potential waivers, depending on the impact of the RFS under unforeseen conditions. The Administrator of EPA, for instance, can legally waive part or all of the RFS if EPA determines that the RFS will cause serious economic harm to a region or the country. In 2008, the Governor of Texas petitioned EPA for such a waiver, alleging that the RFS had driven up corn price and seriously harmed the state's cattle feeders. On August 7, 2008, EPA denied the Texas waiver request, and on August 11, 2008, EPA published a 26-page economic analysis of its reasons in the Federal Register.[5]

The ethanol corn dry mill expansion and the actual volume of corn ethanol production in this country during the period 2005-2008 was annually in excess of the RFS annual targets—indicating that other economic forces were strongly at work besides federal policy. The US EPA's finding in the Texas Waiver Request that the dramatic rise in corn price during the period 2002-2008 (a doubling in the corn farm price) was *not* caused by the federal RFS should be taken by CARB staff as a benchmark case, questioning the validity of the CARB staff's hypothesis of serial causality leading to land use change as modeled from GTAP2001. The

[5] See http://www.epa.gov/EPA-AIR/2008/August/Day-13/a18738.htm. The EPA analysis says, "We believe that implementation of the RFS would not have a significant impact on expected ethanol production in 2008/2009, with the most likely result being no impact on ethanol production. We have analyzed the impacts of waiving the mandate under a wide variety of scenarios, ranging from worst case scenarios to the more likely situations. Based on the ISU modeling results, the average expected impact of waiving the mandate over all the potential outcomes, both those binding and those non-binding, would be a decrease in the price of corn by $0.07/bushel."

March 5, 2009, CARB report does not examine the EPA's August 7, 2008, finding in detail.

Finally, the federal RFS is in an important sense "legally incomplete." In calling for a biofuel volume of 36 billion gallons in the year 2022, the RFS implies a general ethanol inclusion rate (from the combination of Conventional and Advanced sources) in the nation's total motor fuel (in the range of 130-150 billion gallons) well above the legal level today of E-10. Debate among interested parties on this issue is rampant, and it is unclear whether and to what degree either the EPA or legislators will act[6]. This situation should indicate to CARB staff a greater degree of caution in their modeling, especially (as already mentioned) from the static conditions of 2001, and the appeal of more dynamic approaches to the prospective future of California.

Objections based on Current USDA Data

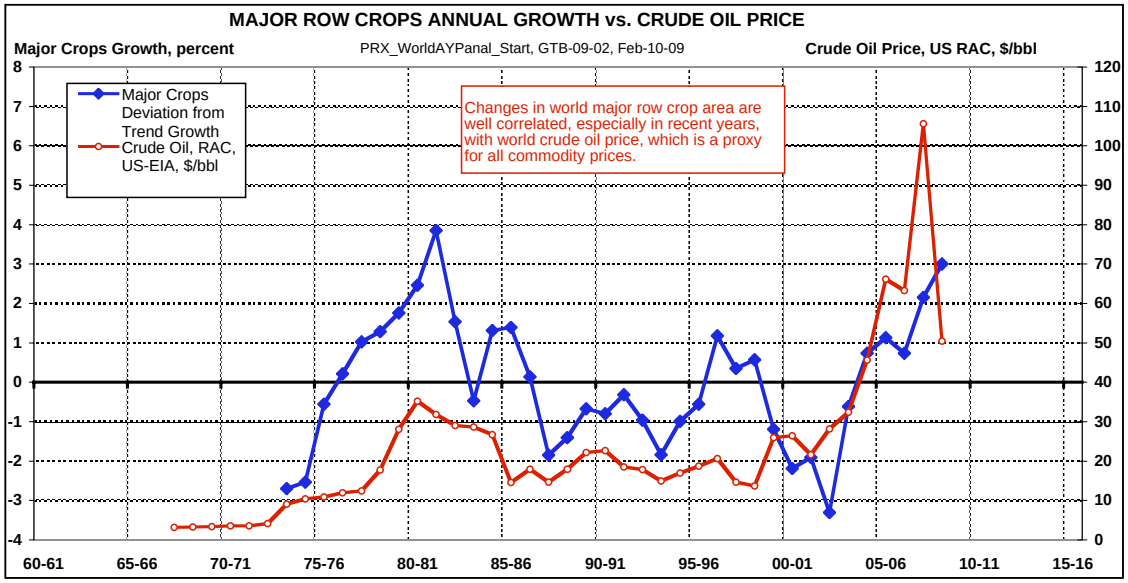
The USDA Foreign Agricultural Service (USDA-FAS) maintains and updates monthly a world-region-country database of Harvested Area for the major crops of the world. This database may be accessed at **http://www.fas.usda.gov/psdonline/psdhome.aspx**. This database does not include *all* classes of land use, as in GTAP2001, but the conclusions about land use change of the Major Row Crops (the major feedgrains, the major oilseeds, plus wheat, rice, and cotton) are striking.

As shown by the table of USDA-FAS data below, the world area of the Major 10 Row Crops in crop year 01-02 was 1926 million acres, and the area of the same crops in 08-09 was 2068 million acres—an *increase of 142 million acres*. If such a change in row crops is reflective of changes in forest and pasture, then the actual change since 2001 is about one order of magnitude greater than indicated in the CARB staff's modeling based on static elasticities.

[6] According to the EIA's Annual Energy Outlook for 2009 (released Dec-08), the E-10 "problem" would only become real if Advanced Biofuels (such as cellulosic ethanol) actually became available in volume. The EIA AEO2009 estimates that such Advanced Biofuels will not become available in volume, that such fuels will only reach about 100 million gallons in 2011 and about 500 million gallons in 2017.

WORLD & US HARVESTED AREA OF TEN MAJOR ROW CROPS, 2000-2008
Crop data source: USDA-FAS, http://www.fas.usda.gov/psdonline/psdhome.aspx, Feb-09

Reg-	Row Crop	Northern Hemisphere Crop Years									08-09 minus
		00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	01-02
		mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac	mil ac
WORLD											
	Barley	133	139	139	148	143	139	142	143	137	-2
	Corn	339	341	341	351	359	362	370	397	389	48
	Sorghum	97	101	95	103	93	98	97	101	99	-2
	Major Feedgrains	569	581	575	602	595	599	610	641	625	44
	Wheat	538	532	532	519	538	541	526	540	554	22
	Peanuts	56	57	53	56	54	54	50	52	53	-3
	Rapeseed	61	58	55	63	66	67	66	70	76	19
	Soybeans	186	196	203	218	230	230	233	224	239	42
	Sunflower	49	47	50	58	53	57	59	54	58	12
	Major Oilseeds	353	357	360	395	403	408	408	400	426	69
	Rice	375	373	361	367	373	378	380	381	385	13
	Cotton	79	83	76	80	88	86	86	82	77	-7
	Major 10 Row Crops	1914	1926	1904	1964	1997	2011	2010	2044	2068	142
UNITED STATES											
	Barley	5.2	4.3	4.1	4.7	4.0	3.3	3.0	3.5	3.8	-0.5
	Corn	72.4	68.8	69.3	70.9	73.6	75.1	70.6	86.5	78.6	9.9
	Sorghum	7.7	8.6	7.1	7.8	6.5	5.7	4.9	6.8	7.3	-1.3
	Major Feedgrains	85.4	81.6	80.6	83.5	84.2	84.1	78.5	96.8	89.7	8.1
	Wheat	53.1	48.5	45.8	53.1	50.0	50.1	46.8	51.0	55.7	7.2
	Peanuts	1.3	1.4	1.3	1.3	1.4	1.6	1.2	1.2	1.5	0.1
	Rapeseed	1.5	1.5	1.3	1.1	0.8	1.1	1.0	1.2	1.0	-0.5
	Soybeans	72.4	73.0	72.5	72.5	74.0	71.3	74.6	64.1	74.6	1.7
	Sunflower	2.6	2.6	2.2	2.2	1.7	2.6	1.8	2.0	2.4	-0.2
	Major Oilseeds	147.7	148.8	147.6	147.3	150.1	145.2	151.4	130.6	151.8	3.0
	Rice	3.0	3.3	3.2	3.0	3.3	3.4	2.8	2.7	3.0	-0.3
	Cotton	13.1	13.8	12.4	12.0	13.1	13.8	12.7	10.5	7.7	-6.1
	Major 10 Row Crops	232.4	225.6	219.3	228.6	228.4	228.0	219.5	229.6	235.6	10.0
CROP PRICES (US Farm Price, USDA WASDE, Mar-09)											
		dol/bu	dol/bu	dol/bu	dol/bu	dol/bu	dol/bu	dol/bu	dol/bu	dol/bu	dol/bu
	Corn	1.85	1.97	2.32	2.42	2.05	2.00	3.04	4.20	4.10	2.25
	Wheat	2.62	2.62	3.56	3.40	3.40	3.42	4.26	6.48	6.80	4.18
	Soybeans	4.54	4.38	5.53	7.34	5.74	5.66	6.43	10.10	9.35	4.81
CRUDE OIL PRICE (WTI, EIA STEO, Mar-09))											
		dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl	dol/bbl
	Crude oil, WTI	26	22	28	32	46	66	63	106	50	24



Note from the table as well that for the United States in 01-02 the Major 10 Row Crops were 225.6 million acres, and the area of the same crops in 08-09 came to 235.6 million acres—an increase of 10 million acres. (The change would

be even less if 00-01 were taken as the base year.) Such a small change in the US major row crops seems unlikely to be the driver of such a large change worldwide. How could a 10 million acre change in this country produce a 142 million acre change in the world? The answer is that the change in US acres was not a major driver of the change in world acres. The concept of "land use change" in which "land use change drives land use change" is deeply flawed.

As shown by the chart below the table, the annual deviations in the world's major ten crops' area are generally correlated with the changes in the price of crude oil—which might be taken as a proxy for the changes in the prices of all commodities, especially of crops. If this is true, then the main driver of land use change is not so much an alternative energy policy in itself but rather the overall change in the world economy and energy price, as represented by crude oil. Thus, under this understanding, the CARB staff should consider applying a measure of grams of CO2e / MJ to gasoline itself (to CARBOB), or to the growth of domestic GDP of the State of California, to represent the large indirect impact on land use change coming from the petroleum sector and the general economy.

At various places in the March 5 text, the CARB staff acknowledges the degree of difficulty in the approach it has taken to modeling land use change. For instance, on page ES-29, the CARB staff says, "Because food prices are determined by multiple factors—including fuel prices—estimating the incremental impact of ethanol production is difficult." But the CARB staff ultimately recommends the proposal as described in the first paragraph of this commentary, namely a specific figure of 30 grams CO2e / MJ due to indirect land use change for corn ethanol. In view of the incommensurability of the actual land use changes from 2001 to 2008 described in the above table with CARB staff's model, such a recommendation should be reconsidered.

The CARB staff should note as well that if the data regarding the world's major ten row crops is a meaningful proxy for what has actually happened since 2001, compared to what was modeled from GTAP2001, then the fact is that *this land use change has indeed <u>already happened</u>*. It has been driven by crude oil price—or perhaps by the combination of all energy price increases in the context of world economic growth and the recent financial bubble—but it has happened. There is no practical point in assessing a penalty to corn ethanol or any other

biofuel for the veritable "volcano" of land use change in row crops which has already happened. It is a change driven not by the (seemingly modest) RFS policy, but by the throes of the world economy under pressure of increasing energy price and financial instability. The proposed regulations should be based not on a static interpretation of past economic elasticities but on the dynamic prospective interaction of many variables.

The CARB staff should note as well the recent release of a report by the International Energy Agency, "An Examination of the Potential for Improving Carbon / Energy Balance of Bioethanol," Report T39-TR1, 15 February 2009. This report develops direct GHG emissions for corn ethanol substantially lower than the CARB staff with CA-GREET, and looks for greater improvement in the future.

Other Objections to Statements in the CARB Staff Report

1. On page IV-39, the statement is made, "A significant component of the increased demand in China and other rapidly developing countries is a sharp increase in the consumption of meat and soy products in those countries. This has created a demand for imported soybeans and corn, which are used as livestock feed. This demand has helped to increase prices and has kept US exports steady. . . ." If this statement is meant to say that "China's demand for imported corn has increased," then this statement is not factual. China has not imported significant quantities of corn since crop years 1994-95 and 1995-96; furthermore, as recently as crop year 2006-07 China was a net EXPORTER of 5.3 million metric tons of corn. China has indeed become a major importer of soybeans over the past decade, with the meal component of soybeans adding efficiency to livestock rations and with the oil component adding to the increased needs of China for food oil. To say that China has seen a "sharp increase in the consumption of meat" would also be an overstatement. (In passing, we should also note that US corn exports have been "steady" for a

very long time: The record export figure of 2401 million bushels established in 1979-80 held until the recent figure of 2436 million bushels in 2007-08. During this 28-year period of US corn exports holding "steady," world population increased by 2 billion people.)

2. On page IV-41, the statement is made, "If sufficient CRP land is not available to indirectly support an expansion of corn acreage, a large supply of non-CRP pasture land that was formerly in crops could be brought back into production." It is not clear what the term "indirectly support" means; Congress has recently reduced the permitted acreage for enrollment in the CRP. More importantly, the assertion of the existence of "a large supply on non-CRP pasture land that was formerly in crops" is not quantified or supported with USDA or Ag Census data. The CARB staff should note that present pasture land (in its full extent) is used for *pasturing*—that is, for helping to feed ruminant animals such as cattle, dairy, sheep, and horses. If pasture land is removed from pasturing, either for use in row crops or perennial energy crops, then substantially more corn and other feedgrains must be fed to the ruminant animals in question, and alternative ways and means for conducting cow-calf operations on pasture/rangeland must be found. In other words, the present classes of agricultural land are all actively involved in the country's meat and food production system—there is no "large" and unused reserve of pasture available for energy crops, independently of economic interaction with all other types of food and feed cropland..
3. On page IV-29, under "Adjustment of GTAP Model Results," the CARB staff proposes that the main adjustment required in adapting GTAP to the present year (2008) is simply to adjust the corn yield. The preceding comments about the inappropriateness of GTAP2001 will not be repeated, but two smaller questions arise: (a) Why is the US aggregate average corn yield of 138.2 bushel per acre in 2001 used instead of the mid-western cornbelt average (12 main cornbelt states) of 139.9? And (b) Why are the three recent years of 2006, 2007, and

2008 averaged in the proposal looking ahead to 2011-2020, as opposed to extending the corn yield trend, even the well-established trend of 1973-2004? For the three years 2006-2008, the cornbelt average yield would be 154.8 bushels per acre, instead of the US aggregate 151.3 cited by CARB staff. The average of the 1973-2004 yield trend for the cornbelt states during the period 2011-2020 would be 167.5. As previously argued, the CARB staff should consider a dynamic approach to forward regulations, not a static approach.

Final and Supreme Objection:
How Does the Public Verify the Efficacy of Proposed Regulations?

A person who lived in Southern California during the 1960s or 1970s may return to the State today and conclude, "The air is (usually or often) better." Objective measurements of the pollutants causing smog will bear this impression out. But how will the public make an objective assessment in 2020 that the State's GHG emissions have or have not been reduced by 10 percent? The quarrel here is not with whether or not CARB can certify that obligated parties have fully *complied* with the proposed regulations, the problem is that the desired reduction of 16 million tons of CO2 (page ES-1) will not ever, under the proposed use of inferential mathematical modeling, be directly measured. From the public's standpoint, the credibility in the efficacy of CARB's rules will rest entirely on the hypothetical verisimilitude of a static historical model with reality—without specific means for objective, empirical verification.

The US EPA announced a "Proposed Mandatory Greenhouse Gas Reporting Rule" (pursuant to the FY2008 Consolidated Appropriations Act of Congress) on March 10, 2009, and hearings on the form of this rule are now underway. CARB staff should consider modifying their proposed methods of March 5, 2009, to take advantage of the future emergence of new, objective GHG metrics, and de-emphasize inferential modeling which will always be contentious and which the public cannot effectively challenge.

Appendix.
Why the GTAP's "Counterfactual" Approach is in fact Counter-factual and should not be adopted, and
Why the So-Called "Thought Experiment on Land Use Change" is invalid

The following paragraphs are in response to an April 13, 2009, letter by Thomas W. Hertel and Wallace E. Tyner of Purdue's GTAP, entitled "Response to William J. Hudson's Discussion of GTAP-based Analysis of Land Use Change from Corn Ethanol Production," based on an earlier draft of my Objections above, in the main body of the present essay.

In paragraph four of the Hertel letter, Hertel acknowledges the brief analysis above of the USDA-FAS data showing that the world's ten major row crops, between 2001 and 2008, increase by some 142 million acres, compared with the GTAP projections of about 10 million acres. In the physical sciences, a model which misses reality by an order of magnitude would be dismissed.

Hertel's response is that instead we must take a "Counterfactual" Approach to Global Economic Policy Analysis. What this means, in his view, is that we must set aside the reality of what actually happened between 2001 and 2008, as a result of multitudinous economic variables, and pretend that we can "tease out" the impact of single variable, such as corn ethanol production. The phrase "to tease out" derives from pulling apart or separating the adhering fibers of wool as in combing or carding. Hertel's application of the phrase is metaphorical. Separating the fibers of wool is a physical process. There is no evidence that a single economic variable can indeed be separated from the whole adhering family of such variables, as is possible in the physical combing or carding of wool. Hertel does not submit a list of "Successful Policies Enabled by GTAP and their Measured Results." Hertel merely avers that there is no other choice.

The so-called "Counterfactual" Approach, particularly with regard to general history, has a checkered reputation. A well-worn example goes as follows, aimed at separating out the role of Adolph Hitler in world affairs. Suppose Hitler had not been born, or had died in 1930. How many Jews would have resettled into the nation now called Israel? And today, in the absence of an "Arab-Israeli" problem, what would be the world price of crude oil, etc., etc.? In

other words, once the tactic is adopted of *pretending* (of being counter-factual), there is no knowing where one should stop. It is easy to wish that ignoring reality would work to solve real problems, but reality has a way of making itself felt in its whole cloth.

Certain statements in Hertel's response make it clear that Hertel himself has difficulties with his own argument. In paragraph three, he says something with which I agree: "The problem is that the world economy is continually changing. It is not possible for us to hold everything else constant and just perturb one element—say trade policy, or biofuel production. And so, when one looks back in time, it is hard to say what has given rise to any particular change in land use or ethanol production." But then, *in seemingly complete contradiction*, Hertel says in paragraph four, ". . . [W]e must adopt the 'counterfactual' approach to global land use impacts of biofuels: Holding all else constant, how would the world have changed if one element of the global economy were different? Thus this is not a forecast of what will happen. Rather it is an analysis of the partial contribution of a given change in policy on key variables of interest."

The key question remains: Why must we adopt a tool, even if it appears to be "the best tool available," if we have no definite evidence that the tool will solve the problem, and if to use the tool we must behave in a counter-factual fashion?

A second major problem is with the "thought experiment" which Hertel proposes, and which constitutes the core of the concept known as "land use change." Here are the words Hertel uses to launch his "thought experiment": "What if the US diverted one acre (net of by-products) of corn land from feed production to the energy system?"

Okay, think about this, and try to compare the sentence with reality. The actor in Hertel's sentence is "the US." In reality, the actor will be the aggregate of all American farmland owners—responding to a host of economic, policy-based, agronomic, climatic, and other signals—who change the total acreage devoted to corn. The proper starting point in thought is not with a single acre that the "country" changes, as if in a single moment of time for one clear reason; this is an abstraction which leads us away from reality. The better starting point for realistic thought is with the ever-present multiple signals (mainly price signals)

acting on millions of farmland owners, over weeks and months, who then make individual decisions. The aggregate of these decisions are then sampled in official economic data.

In reality, therefore, a change in a single acre is never really an independent driver of price—causing the kind of chain reaction of land use change around the world as supposed by Hertel. Changes in land use do occur, of course, but the forces which lead to the changes are always multiple, they are always over and above what takes place on any given acre, and they can not be reliably "teased out" as separate forces. What takes place on an acre is more an *effect* of large independent variables (such as oil price and economic growth) than a direct cause in itself of other land uses.

Using Hertel's approach, the CARB staff "shocks" the static 2001 database as though "the US" (as a single entity, suddenly and without reference to the multiple number of major independent variables at work in the 2001 world economy) devotes enough corn land for 13.2 billion gallons of ethanol in one year. The magnitude of this induced change is outside the historical range of the GTAP database and model. Nonetheless, the CARB staff, following the ill-conceived thought experiment described above (that "land use change" causes "land use change," as opposed to being the effect of an ever-present family of large independent variables), determines "counterfactually" that specific amounts of CO-2e can be attributed to a completely hypothetical event enacted on a mathematical model.

My commercial view is that a family of multiple, large independent variables drives land use change. Indeed, the coming and perhaps imminent depletion of fossil fuels amounts to a massive, general signal for developing alternative fuels and thus for land use change around the world. I return to my observations from current USDA-FAS data that the actual change in the 10 major row crops of the world during the period 2001-2008 is an order of magnitude greater than suggested by GTAP. As previously mentioned, in the physical sciences a theoretical model which misses reality by such an extent is quickly dismissed. Hertel uses the word "science" to describe GTAP's mathematical economics, but this in my view is not a deserved application of the word. The human world economy is not obliged to behave "scientifically" nor to be fully

representable in computer models. The current world financial crisis provides more evidence than any of us should need for a more humble approach to the role of models.

My supreme objection to all of this is that the CARB staff, with the blessing of Hertel and other Purdue academics, endorses the promulgation of the proposed CARB policy without providing any way of checking whether it works! As I pointed out in my Final and Supreme Objection above, "from the public's standpoint, the credibility in the efficacy of CARB's rules will rest entirely on the hypothetical verisimilitude of a static historical model with reality—without specific means for objective, empirical verification. However, the US EPA announced a "Proposed Mandatory Greenhouse Gas Reporting Rule" (pursuant to the FY2008 Consolidated Appropriations Act of Congress) on March 10, 2009, and hearings on the form of this rule are now underway. CARB staff should consider modifying their proposed methods of March 5, 2009, to take advantage of the future emergence of new, objective GHG metrics, and de-emphasize inferential modeling which the public cannot effectively challenge."

Endnote on the author of these remarks. **William J. Hudson** is founder of The ProExporter Network®, a consulting company to US and world agribusinesses, including some 150 grain companies, railroads, processors, seed companies, fertilizer companies, agricultural banks, and commodity associations. Mr. Hudson began his career with the Sandia National Laboratories before moving to agriculture in the 1970s, where he became Senior Vice President of The Andersons of Ohio in the 1980s. Mr. Hudson served on various national panels, including the USDA's Users Advisory Board for Research and Extension and the DOE's 1981 Biomass Energy Panel chaired by David Pimentel of Cornell. Mr. Hudson has written several books on the commercial aspects of agricultural economics and forecasting, and has also contributed numerous scholarly articles on global food and population trends for books edited by David Pimentel, Julian Simon, and others. In 2001, the National Grain and Feed Association called on Mr. Hudson to present extended evidence on the role of world trade in American agriculture to the staffs of the House and Senate Agriculture Committees. Mr. Hudson also consulted directly to the Chief Economist of USDA (Keith Collins) on publications concerning the structure of world agriculture and the influence of the World Trade Organization, and he also consulted to NASA's Space Remote Sensing Center on the development of a satellite-based Geographical Information System for analyzing details of agricultural land use and grain origination areas for commercial agribusinesses such as elevators and processors.