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Department of Energy Resources
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Comments from the National Biodiesel Board on the Massachusetts Alternative Energy Portfolio Standard and Guideline on Biomass, Biogas, and Biofuels for Eligible Renewable Thermal Generation Units

We commend the Commonwealth of Massachusetts and the Department of Energy Resources for promulgating and implementing the Alternative Energy Portfolio Standard (APS) which will address a serious need to reduce harmful emissions from power generation and thermal energy use. The United States has a long history of successful energy policy that has not only provided for the energy needs of its citizens, but has also provided the power needed to propel industry and grow the economy. In developing the APS, the commonwealth recognizes that decades-old energy policy can be improved in order to continue meeting those needs for energy and economic growth, and that utilizing domestically produced renewable fuels will reduce harmful emissions and provide even greater economic benefits.

It is imperative that policy for clean fuels be supported by sound science. Massachusetts should take pride in recognizing the need to curb emissions of greenhouse gases. It is highly unfortunate that this topic has become politically controversial in other jurisdictions. Special interests have gone beyond misinterpreting the science of climate change to declaring war on science itself. While this disturbing trend is delaying critical progress that needs to be made nationally and internationally, we can be confident that science will eventually prove itself. No policy that is built on false information can truly serve its citizens. Nor is that policy likely to stand the test of time.

The National Biodiesel Board was founded to offer a healthier, homegrown fuel, invigorate economies throughout the US, and increase energy independence. The National Biodiesel Board is dedicated to inclusiveness and integrity and was the first national association of fuel producers to adopt a set of sustainability principles. Significant among the principles adopted by our membership is that biodiesel shall contribute to climate change mitigation by significantly reducing lifecycle greenhouse gas (GHG) emissions as compared to fossil fuels. While this principle was crafted by our own members, we consistently rely on knowledgeable third parties to quantify the GHG performance of biodiesel.

The stated goal within the APS to reduce GHG emissions by a minimum of 50% through the use of biofuel and the displacement of some portion of fossil fuel is consistent with NBB principles to significantly reduce lifecycle GHG emissions. The relative comparison to the conventional fuel being displaced is also consistent with ASTM E3066, which is the Standard Practice for

Evaluating Relative Sustainability Involving Energy or Chemicals from Biomass. More importantly a minimum 50% reduction is appropriately consistent with the definition of biomass based diesel and advanced biofuel under the federal Renewable Fuel Standard. This has been stated clearly in section 5.C) of the Guideline on Biomass, Biogas, and Biofuels for Eligible Renewable Thermal Generation Units. We support this language. However, it becomes less clear in section 11 of the guideline document when it states only organic "waste" derived liquid biofuels will be considered Eligible Liquid Biofuel. We note the term "waste" also appears in 225 CMR 16.02 where it states such wastes shall not be limited to waste vegetable oils, waste animal fats, or grease trap waste.

We are concerned that the undefined term "waste" could unnecessarily limit the feedstocks otherwise found by respected government and academic institutions to meet the 50% GHG threshold. On one hand Massachusetts has defined a threshold for GHG reduction that is quantifiable through accepted science and entirely consistent with federal regulations. On the other hand, the undefined term "waste" could be open to subjective interpretation without clear reason why it belongs in the regulation.

Defining a "waste" is a problem that has confounded many organizations. We have participated in depth with standard setting bodies such as the Roundtable on Sustainable Biomaterials and ASTM International, and others that have wrestled this topic. After considering such definitions, other regulating authorities (including USEPA and the California Air Resources Board) base eligibility on quantifiable criteria (primarily GHG score), and not the condition of being a waste. The US Energy Information Administration (EIA) tracks feedstocks that are used nationally to produce biodiesel (https://www.eia.gov/biofuels/biodiesel/production/table3.pdf). EIA categorizes feedstocks as "vegetable oils", "animal fats", or "recycled feeds". EIA does not use the term "waste" to describe any of the more than 11 billion pounds of feedstocks used annually to make biodiesel (simultaneously considered advanced biofuel). Nor does USEPA track annual biofuel compliance using the term waste. Their compliance is based entirely on meeting the prescribed GHG thresholds.

It is always better to set quantifiable metrics rather than subjective criteria for determining what is a waste. Even then, it can depend on one's position in the supply chain or point in time relative to policy and markets as to what is considered a waste and what is not. It is a goal of the National Biodiesel Board to eliminate waste. We seek to develop markets for underutilized materials. We seek to convert what was once considered waste into marketable commodities. In an optimized system for producing food and energy, there are no wastes-only coproducts. Every triglyceride or fatty acid molecule contains stored solar energy. For the feedstocks that are used to produce biodiesel in the US, this stored solar energy exists as coproducts of protein production for food. It is our goal to put that energy to use and displace the extraction of fossil carbon.

The US biodiesel industry first arose out of the need to create new uses for soybean oil. Soybeans had grown in popularity as an efficient crop for producing protein meal. Soybeans are crushed in order to separate the protein meal for livestock feed and to reduce the oil content to a level that can be digested by animals. Protein demand dictates the amount of soybeans crushed in the US each year. The process of crushing soybeans yields an excess of oil that is greater than the amount of oil that can be consumed as food, feed or exported according to the General Agreement on Tariffs and Trade. The success of turning this renewable domestic feedstock into clean burning fuel that displaces fossil carbon led to the pursuit of other feedstocks that could provide similar benefits. Biodiesel is now produced regularly from feedstocks including animal fats, canola oil, used cooking oil, and distillers corn oil. None of these feedstocks are produced in response to biofuels policy, but biofuels policy can achieve economic and environmental benefit by directing these resources to displace fossil fuel.

The primary purpose in writing to you today is to share some of the published science on biodiesel GHG reduction that is standing the test of time. The APS will be strengthened by aligning it not only with existing federal policy on advanced biofuels but also by incorporating the best quantifiable science available on lifecycle GHG emissions. This table summarizes the most credible studies publishing the GHG reduction of biodiesel compared to petroleum diesel.

Year of publication	Authoring Agency	% reduction
1998	NREL	78
2008	Argonne	66-94
2010	USEPA	57
2011	Argonne	73-122
2012	USDA	76
2015	CARB	50
2016	Purdue	60

The landmark scientific publications that prove biodiesel from virtually all commercial US feedstocks meets the 50% GHG threshold are described briefly as follows.

1998 National Renewable Energy Laboratory; NREL/SR-580-24089 UC Category 1503; Life Cycle Inventory of Biodiesel and Petroleum Diesel for use in an Urban Bus; U.S. Department of Agriculture and US Department of Energy; http://www.nrel.gov/docs/legosti/fy98/24089.pdf

Summary: The National Renewable Energy Laboratory published the first comprehensive lifecycle analysis of soy biodiesel comparing it to petroleum diesel and found:

- Biodiesel reduces net emissions of CO_2 by 78.45% compared to petroleum diesel.
- The use of B100 in urban buses results in substantial reductions in life cycle emissions of total particulate matter, carbon monoxide and sulfur oxides (32%, 35% and 8% reductions, respectively, relative to petroleum diesel's life cycle).
- Tailpipe emissions of particulates less than 10 microns in size ($PM_{2.5}$) are 68% lower for buses run on biodiesel (compared to petroleum diesel). In addition, tailpipe emissions of carbon monoxide are 46% lower for buses run on biodiesel (compared to petroleum diesel).
- Biodiesel production results in 79% less wastewater production compared to the petroleum lifecycle.
- Biodiesel production results in 96% less hazardous waste production compared to the petroleum lifecycle.

Note: these comparisons were made before the advent of hydraulic fracturing, which produces much higher volumes of wastewater and hazardous waste.

2008 Argonne National Laboratory; ANL/ESD/08-2; Life-Cycle Assessment of Energy and Greenhouse Gas Effects of Soybean-Derived Biodiesel and Renewable Fuels; https://www.anl.gov/energy-systems/publication/life-cycle-assessment-energy-and-greenhouse-gas-effects-soybean-derived

Summary: Argonne expanded the lifecycle GHGs to include not only CO_2, but N_2O and other GHGs. Argonne also illustrated the impact of different allocation methods presenting a range of results from 66% to 94% GHG reduction for soy biodiesel compared to petroleum diesel.

Note: The lower end of the range is impacted by allocating emissions between soybean oil and soy protein meal according to the energy content of each. This example was given for academic purposes, and is not recommended for policy application, because soybeans are not grown for energy content. Soybean production is driven primarily by protein demand. Soybeans are 80% protein meal and 20% oil, approximately. The fat in soybean oil contains 9 Calories per gram while protein contains only 4 Calories per gram. Allocating according to the high energy content of the fat byproduct distorts the reality that protein is valued more greatly in the food supply, because of its scarcity compared to fat.

The relative scarcity of protein results because the ratio of protein required in the diets of humans and livestock animals is high relative to nutritional requirements for fats and carbohydrates. For comparison, the plants that produce our food are high in carbohydrates and fats while relatively low in protein content. Soy is exceptional as a crop for its high protein content. However, even this high protein crop produces more fat than can be eaten in ratio to its protein output. These factors combine to make protein the limiting factor in our food supply. When we increase population or affluence, we must grow more protein. When we grow protein to feed the world, we harvest more fats and carbohydrates than we can eat.

The 94% GHG reduction was obtained by applying the displacement method for coproduct allocation. The displacement method is most often recommended by lifecycle experts as producing the most meaningful results for policy. The displacement method is considered consequential lifecycle analysis, which is more consistent with the application of market mediated effects, such as indirect land use change.

2010 USEPA Regulation of Fuels and Fuel Additives: Changes to the Renewable Fuel Standard Program final rule; Federal Register, March 26, 2010, page 14788-14789, http://www.gpo.gov/fdsys/pkg/FR-2010-03-26/pdf/2010-3851.pdf

Summary: EPA's final rule implementing the Energy Independence and Security Act marked the first comprehensive analysis of international indirect land use change as a result of national-scale biofuels policy. EPA's analysis underwent intense scrutiny, public comment, and expert review. In the federal register, EPA published its finding that soy biodiesel most likely reduces GHGs by 57% compared to average 2005 petroleum. EPA further clarified its findings of eligibility in a fact sheet, clearly stating: "Biodiesel and renewable diesel from soy oil or waste oils, fats, and greases will meet the 50% GHG threshold for biomass-based diesel compared to the 2005 petroleum diesel baseline." That fact sheet is titled EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels; Office of Transportation and Air Quality, EPA-420-F-10-006, February 2010; https://www.epa.gov/sites/production/files/2015-08/documents/420f10006.pdf

Note: EPA later added Canola from the US and Canada as a qualifying feedstock meeting the 50% threshold.

2011 Argonne National Laboratory; Methods of dealing with co-products of biofuels in life-cycle analysis and consequent results within the U.S. context; Energy Policy; October 2011; http://www.sciencedirect.com/science/article/pii/S0301421510002156?via%3Dihub

Summary: Argonne National Laboratory updated lifecycle analysis of soy biodiesel making use of better data available following increased commercialization of biodiesel in the US. Most of the improved data shows increased efficiency in production. Like the 2008 paper, this paper illustrates the large difference in results depending on the allocation methods chosen within the lifecycle analysis.

At a presentation to the Biodiesel Technical Workshop in Kansas City, MO on November 2, 2010, Jeongwoo Han from Argonne National Laboratory presented a range of GHG reduction for soy biodiesel of 73% to 122% compared to petroleum diesel. The results greater than 100% are produced by consequential analysis that probes the question what would be planted to produce protein needed for food when biodiesel is not available to consume the excess fat coproduct of soy. The next most efficient crops for producing protein are less efficient. Therefore, removing biodiesel from the system would result in greater emissions to produce needed protein for the food supply. This consequential analysis is consistent with EPA's analysis that predicted domestic land use change as a result of biodiesel in the RFS as reducing emissions by 19 kg $CO2_{2e}$ /mmBTU.

2012 USDA/University of Idaho; Reassessment of Life Cycle Greenhouse Gas Emissions for Soybean Biodiesel; Transactions of the American Society of Agricultural and Biological Engineers; http://web.cals.uidaho.edu/biodiesel/files/2013/08/Reassessment-of-life-cycle-GHG-emissions-for-soybean-biodiesel.pdf

Summary: This analysis updates the methodology employed by USDA and NREL in the original 1998 lifecycle report. It incorporates current data and a more comprehensive set of emission factors. In doing so, they reported an 81.2% GHG reduction between soy biodiesel and average 2005 petroleum. The authors also proposed a correction to EPA's methodology for ascribing emission from indirect land to change to biodiesel. The result of adding this moderated ILUC penalty to the direct emissions was given as a 76.4% reduction between soy biodiesel and average 2005 petroleum.

2015 California Air Resources Board; CA-GREET 1.8b versus 2.0 CI Comparison Table; https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/040115_pathway_ci_comparison.pdf

Summary: California continued to improve its modeling of indirect land use change (ILUC) from 2009 through 2015. New, reduced values for ILUC were implemented when CARB readopted the Low Carbon Fuel Standard. The improvements stemmed from years of work and lengthy review and input from international experts. CARB adopted ILUC values of 29.1 g/MJ and 14.5 g/MJ for soy and canola biodiesel, respectively. CARB did not credit biodiesel with the positive domestic effects to agriculture as did USEPA and Argonne National Laboratory in their previous work using the consequential displacement method. Instead, CARB added these ILUC penalties on top of the attributional lifecycle scores derived from the attributional accounting of the GREET model (modified for CA). Experts of lifecycle analysis argue that this addition of lifecycle results from two independent, perhaps redundant methods amounts to double counting and produces exaggerated emission estimates for biodiesel. Nevertheless, the conservative carbon intensity scores adopted by CARB are 50% less that average CARB diesel.

2016 Purdue University; An Exploration of Agricultural Land Use Change at the Intensive and Extensive Margins: Implications for Biofuels Induced Land Use Change; Taheripour, Cui, & Tyner; *Bioenergy and Land Use Change*: American Geophysical Union, forthcoming

Summary: The attention devoted to the controversial application of ILUC in biofuels policy has had the positive effect of drawing academic thought and increased scientific research. Tyner and Taheripour, who developed the GTAP-BIO model for use by CARB continued to improve their modeling beyond the work completed by CARB in 2015. Every advance in modeling and data improves confidence in the modeling outcomes. These authors take advantage of new data that was not previously available. By observing actual shifts in global land use change since the advent of the biofuels industry, the authors were able to calibrate GTAP-BIO for more realistic predictions. Their results suggest the 29.1 g/MJ ILUC penalty applied by CARB to soy biodiesel might more realistically be quantified as 18 g/MJ. This would equate to a further 10% increase in carbon benefit relative to baseline CARB diesel and the carbon intensity assigned by CARB in 2015.

Science is continually improving upon itself. Nearly two decades of lifecycle assessment show that the GHG reduction of biodiesel is impacted by the data available as well as the methodology for conducting the assessment. Taken as a collective body of work, these studies conclude without a doubt that biodiesel has significant GHG advantages over fossil fuels. The majority of the studies cited above include consequential lifecycle analysis including international indirect land use change. While the quantification of ILUC is the most highly variable factor in the published literature, biodiesel from all commercial US feedstocks meets the 50% GHG threshold under all circumstances.

The context of evaluating ILUC should also be noted. ILUC is a predicted outcome from large scale, national policy. ILUC cannot be attributed to a single biofuel producer or even the policies of a moderately sized state affecting several producers. The theory of ILUC assumes that policy impacts feedstock volumes great enough to change the global price for that commodity. When CARB modeled the ILUC for biodiesel, it was in fact doing redundant modeling of the national RFS impacting billions of gallons of fuel. The volumes of fuel used under the APS are most likely to be the same volumes that also participate in the RFS. This emphasizes the utility of making the APS consistent with the RFS. It also suggests that Massachusetts needn't exclude any RFS-qualifying advanced biofuels, because the indirect effects of the RFS have already been quantified. The APS will have no additional indirect effect. This would only leave in question any fuel imported from other continents. While the APS will not pull volumes large enough to cause ILUC, the ILUC that has been quantified is that relying on US-produced feedstocks. It may be observed that the European Commission is considering significantly higher ILUC results for soy biodiesel sourced from South America. The model used in Europe has had virtually no scientific peer review to date. Our initial investigations into the model used in Europe suggest several significant flaws. However, it would not be unreasonable to expect different ILUC impacts stemming from European policy that relies on imports from South America or Asia. Potential land use change could be sensitive to the region from where feedstocks are sourced. The US is a natural place for the origin of biofuel feedstock. The US produces a lot of protein, and so we have a lot of fat production in excess of what can be consumed as food or feed. Because we export approximately half of our annual soybean crop as whole beans with both their protein and oil intact, export markets are also saturated. These conditions of protein demand and fat excess require us to develop additional domestic uses for this surplus oil. We can use large quantities of this domestic oil without triggering any additional global price changes or ILUC.

The APS will benefit by including all eligible fuels that meet the 50% threshold and the appropriate standards for fuel quality. Subjective discrimination could sacrifice the integrity of a clean fuels program and give credence to the accusation that carbon policy is not always based entirely on sound science.

We would be happy to convey additional information as needed to fully address the sustainability of agriculture, indirect land use change, and the economic interactions between biodiesel and the food supply. Over a decade of studying these issues intently has led us to discover that the net impacts of biodiesel are positive for the environment and the economy. Beyond reducing GHG emissions relative to extraction of fossil energy, biodiesel provides economic incentive for farming and food production to become more efficient. US farmers are growing more efficient crops to meet the rising demand for protein in the food system. In the course of meeting protein demand with the lowest environmental footprint, farmers need an outlet for the excess fats and oils produced as natural byproducts. These excess vegetable oils are a natural source of stored solar energy. Recycling the carbon bound in these food byproducts is a powerful way to displace fossil fuels while providing energy and economic development to the nation's economy.

Sincerely,

Don Scott, PE
Director of Sustainability
National Biodiesel Board